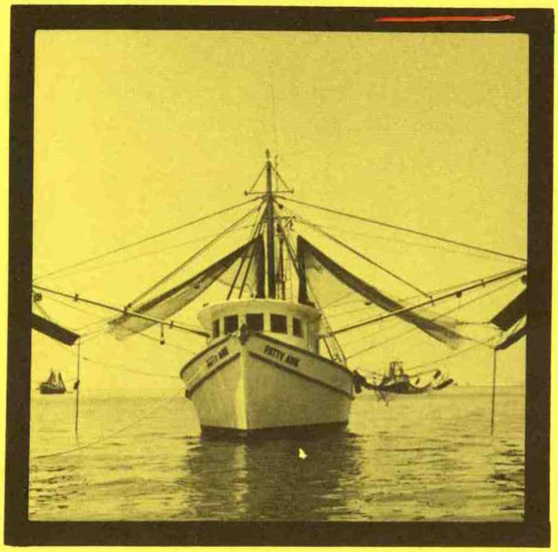
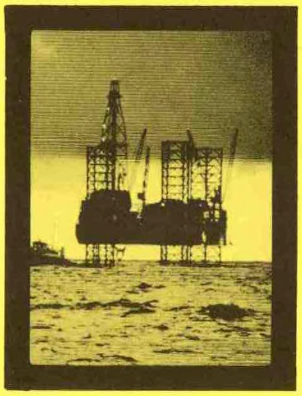
Marine Environmental Assessment

GULF OF MEXICO

ANNUAL SUMMARY 1984





U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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CLIMATE IMPACT ASSESSMENT
UNITED STATES

The AISC/Marine Environmental Assessment Division (MEAD), Marine Assessment Branch (MAB), produces periodic assessments of weather impacts on economic sectors of marine environmental activity. From September 1981 through March 1982, MAB issued monthy assessments of Chesapeake Bay in the economic sectors of fisheries, recreation, and transportation. The Chesapeake Bay region served as a model for assessment development. We now issue quarterly assessments in order to extend the service to other marine areas within existing resource limitations. As a reflection of this effort, we produced a prototypic assessment of the Gulf of Mexico for 1982 and an operational assessment for 1983.

Please send any comments or subscription queries to the Chief, Marine Assessment Branch, Marine Environmental Assessment Division, NOAA/NESDIS/AISC, E/AI32, 3300 Whitehaven Street, NW, Washington, DC 20235, or call (202) 634-7379.

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October 1985

Marine Environmental Assessment

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by Karl Beck Pechmann
Robert E. Dennis
John O. Ellis
Fred G. Everdale
Sylvia Z. Green
Isobel C. Sheifer

Marine Assessment Branch
Marine Environmental Assessment Division

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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration
Anthony J. Calio, Administrator

National Environmental Satellite, Data, and Information Service
William P. Bishop, Acting Assistant Administrator

Assessment and Information Services Center
Joan C. Hock, Director

GULF OF MEXICO MARINE ENVIRONMENT
1984 ANNUAL SUMMARY

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SECTION 1

INTRODUCTION

The Gulf of Mexico 1984 Annual Assessment presents a synoptic view of several economic sectors and their direct and indirect relations to the physical and biological marine and atmospheric environment. We attempt to bring into a single focus the numerous commercial, social, and scientific activities in the Gulf relative to environmental conditions, especially weather and oceanographic events or trends. Using research results in the fields of physical oceanography, marine biology, meteorology, political science, and economics, we have developed a multi-disciplinary view of the Gulf during a single calendar year.

Assessment of the economic impacts of weather and environment is important to planners, engineers, scientists, and commercial interests because of heavy multiple-use requirements for the coastal zone. Our population relies on the nearshore estuarine and coastal shelf environment for food, recreation, energy, transportation, and industrial and societal waste disposal. Most uses conflict at some level of activity. Furthermore, the relative impacts and conflicts are sensitive to weather and climate in many areas. Impacts or conflicts can be minimized if timely information on impacts is available.

The measurement of impacts is imprecise. Specification of relationships between exogenous variables (weather, oceanography, catch statistics) and economic sector variables (transportation, pollution costs, fishery market dynamics) requires further investigation. In this publication we bring together data from several economic sectors and four environmental disciplines for a single viewing. No attempt is made to limit data to specific models or preconceived ideas of causal relationships. Only confirmable relationships are presented as definite connections. Where direct relationships are unclear, the presentation of data from several scientific and economic areas has value by displaying the multiple use of the Gulf coastal environment.

By presenting this collection of data, we intend to stimulate further investigation by scientists and to provide information to those persons responsible for usage regulations of the Gulf and its estuaries.

1.1 Organization of the Report

The report comprises six sections. In the introductory section we delineate the concept of marine environmental assessment embodied in this report, specify the coverage of the present report, and suggest extensions and future development for the assessment function.

In Section 2 we present a summary of impacts identified for 1984. Only confirmed relationships appear as impacts.

Sections 3 through 6 contain details of the weather and oceanography, fisheries, recreation, transportation safety, and pollution events of the Gulf of Mexico marine environment for 1984. Discussions in these sections cover all information available to the Marine Assessment Branch at this time, but are neither exhaustive nor definitive. The review gives a limited synoptic view of several sectors and their relationships for a single year.

1.2 Scope of the Report

The geographical area considered is that part of the Gulf of Mexico which lies north of an imaginary line extending from Brownsville, Texas, to Key West, Florida.

We present a summary of weather and oceanographic events during 1984 over the region. Coverage is only for calendar year 1984, though environmental cycles vary in different regions of the Gulf. Discussion will indicate where such environmental variability is important. The calendar year serves the assessment function in tracking economic variables. Where discussion of environmental patterns or events requires reference to 1983 or to 1985, we extend coverage.

Four economic sectors appear in this report: fisheries, recreation, transportation, and industry. The fisheries section covers finfish and shellfish. Distribution and abundance of species are influenced by local and regional salinity and temperature regimes.

These changing regimes of salinity and water temperature in turn are related to precipitation, air temperature, and general coastal conditions over a broad span of space and time. Harvest of commercial species varies with climate conditions, fishing effort, and market conditions. Pollution and tranportation sectors affect distribution of the fisheries species as well as harvest activity.

Recreation includes park usage, boating, and recreational accident statistics. The recreational sector responds quickly to weather variations and correlates with pollution incidents and the presence of annoying or dangerous organisms in the water. The Gulf Coast is used heavily for recreation including swimming, boating, fishing, and tourism.

Transportation includes shipping, pollution events, and related shore activity. Through most months of the year shipping and related shore activities remain unaffected by climate and weather. Only tropical storms or severe cyclones interrupt normal marine transportation.

Industry in this report appears only as specific events such as spills of oil and hazardous substances. Tributaries of the Gulf form a large resource for waste disposal for surrounding industry and populations. Heavy use of the Gulf and its tributaries for transportation leads to spills of cargo substances, some harmless, others potentially harmful.

1.3 Future Work

The Assessment and Information Services Center, Marine Environmental Assessment Division recognizes the need for extension of this assessment to other sectors and more detailed and rigorous analyses in those sectors already discussed. The industrial complex surrounding the Gulf includes heavy manufacturing (steel, automobiles), food processing (spices, sugar), refining, shipbuilding, and chemical production. The use of water in each of these industries contributes to the quality of water entering the Gulf coast estuaries.

The fisheries assessment may ultimately treat species-specific problems. The analysis can assess the sensitivity of life stages of individual species to changes in environmental conditions.

Future work in the recreation sector may include assessment of sport fishing, marina usage, tourism, and sales of recreational equipment.

In transportation a study of the detailed distribution of Search and Rescue (SAR) in categories of damage, injury, cost, and geography may enhance the usefulness of the assessment. The costs related to maintenance of navigational aids may be of interest to port authorities and the shipping industry.

The discharge of heated water from electric power generating plants contaminates estuarine systems with waste energy. While local changes to each system can be measured at present, the cumulative impact of heat loading on the integrated ecosystems needs to be assessed.

Finally, the Gulf of Mexico assessment will increase in convenience to each user, if sensitivity scales for impacts can be derived. For each sector or resource factor (e.g., streamflow, salinity change, temperature anomaly, wave height, number of rain days) the assessor needs to know not only if the impact is positive or negative, but the degree of impact.

Table 2-1.--Summary of storm events and impacts, Gulf of Mexico, 1984.

Date	Storm Event	Impacts
February 27	Tornadoes (GA, FL)	Block and mobile homes destroyed and damaged (south GA, north FL) ($0.5 million)
March 5	Tornado (AL)	Property damage (Dale Co.) (>$5.0 million)
March 24	Tornado (AL)	Property damage (Clark Co.) (>$0.5 million)
April 21	Tornadoes (MS)	Deaths, injuries and property damage (northern MS) (16 killed, >$5.0 million)
May 2, 3	Tornadoes (LA, AL)	Property damage (north LA, central AL) (>$10.0 million)
June 7	Heavy rain (LA)	Flash floods causing property damage (central LA) (>$0.5 million)
August 2	Heavy rain (LA)	Flooding causing property damage (southern LA) (>$0.5 million)
September 16-20	Heavy rain (TX)	Flooding caused property damage (coastal southern TX) (>$30.0 million)
October 19-26	(19, 20) Heavy rains (TX)	Flash floods, floods, wind, and lightning caused injuries and property damage (Odem, TX, 25" in 3.5 hrs.) (>$5.0 million)
	(21) Hail (TX)	Property damage (windows, autos near Austin) (>$15.0 million)
	(21, 22) Heavy rains (TX)	Property damage (SW of Galveston) (>$0.5 million)
	(22) Tornado, hail (TX)	Property and crop damage (south Houston, Pasadena, TX) (>$0.5 million (property), >$0.1 million (crop))
	(22, 23) Heavy rain (LA)	Flash flooding caused property damage (south central LA) (>$6.0 million) (non-crop only)
	(25) Heavy rains (TX)	Property damage (north of Houston) (>$4.0 million)
November 22-24	Wind, heavy rain (FL)	Shore erosion (east coast FL) and flooding (south and central FL) (>$5.0 million)
December 31	Tornado (TX)	Injuries and property damage (near Houston) (>$10.0 million).

Source: Storm data, January through December 1984. U.S. Department of Commerce, NOAA, National Climatic Data Center.

SECTION 2

IMPACT SUMMARY

Weather and Oceanography

There were two major storm systems in the Gulf of Mexico in 1984. Each of these storms, both in the autumn, caused more than $30 million damage to property and crops. In other weather-related events, tornadoes in May in Mississippi and in December in Texas resulted in 16 deaths and damage exceeding $15 million. Table 2-1 gives a chronological list of weather events and impacts for 1984.

Air temperatures were nearly normal throughout the year around the Gulf. Although precipitation levels were generally below normal, streamflow was above normal at 75 percent of the stations cited in this report.

The sea surface salinity patterns at the National Ocean Service stations sampled around the Gulf followed the long-term seasonal trends in 1984. When deviations occurred, they generally were negative anomalies or slightly positive ones. In 1984 the sea surface temperatures also closely followed the long-term normals.

Environmental Quality

A major pollution event occurred as the British tanker, Alvenus, ran aground south of Cameron, LA, in July. One of the main storage tanks ruptured, spilling 2.3 million gallons of Venezuelan crude oil into the Gulf. The spill tracked westward through the Gulf and impacted on Galveston in early August. The resulting cleanup costs were projected to be more than $13 million, but it may take several years to determine the actual figure. This is not a direct loss to the local economy, as the definitive impacts of an oil spill on an economy have not yet been determined.

The Department of Energy, under congressional mandate of the Energy Policy and Conservation Act of 1975, implemented the Strategic Petroleum Reserve in 1976 to establish a reserve of crude oil to be used in the event of a national energy emergency caused by foreign oil embargoes or disruptions in the international oil trade. Current plans call for a reserve of at least 500 million barrels of crude oil. Storage space for the crude oil is being created by leaching salt domes in coastal Texas and Louisiana.

The brine resulting from the leaching operations is disposed in the near offshore environment of the Gulf of Mexico. The brine has salinities of 250-260 parts per thousand and a chemical composition and ionic proportions different from that of the receiving waters. Disposal from the Bryan Mound, TX, site began in March 1980 and from the West Hackberry, LA, site in May 1981. Discharge rates at each site approach 1.1 million barrels of brine per day.

Results of extensive environmental impact assessment programs designed to monitor the ecology, water quality, sediment chemistry, physical oceanography, and meteorology at the disposal sites indicate that brine discharge has produced no significant environmental alterations at either site.

Fisheries

The Gulf of Mexico fishery yielded the nation's largest harvest by weight for the second year in a row. Over 2.6 billion pounds of finfish and shellfish, worth more than $655 million, were harvested. These landings exceeded 1983's catch by 200 million pounds and $40 million. Only the combined Pacific coast and Alaska fishery exceeded the dollar value of these landings, although the volume of landings was 35 percent lower. The Gulf region accounted for 41.1 percent by weight and 27.9 percent by value of the United States total landings. Louisiana, Texas, and Florida all ranked in the top five nationally in value of landings per state.

Flood control procedures for the Mississippi River caused large volumes of fresh water to be dumped into Mississippi Sound, destroying the oyster beds in that region. Consequently, 1984 oyster landings in Mississippi were reduced to 20 percent of the level of the 1983 harvest. The value of the 1984 landings was $1.1 million, a decrease of $3.1 million from 1983.

Texas oyster landings were also down in 1984. The landings were down nearly 3.0 million pounds from the record harvest of the previous year. The value of the oyster meats in 1984 was $7.0 million, a $2.5 million decline from 1983. Biologists thought the record harvest of 1983 reduced the oyster bars to one-half the 1983 levels and, in order to prevent total destruction of the beds, delayed the opening of the oyster season. The reduction in number of oysters and the delay in the opening of the season contributed to the decline in the landings.

Recreation

Below-normal precipitation and near-normal air temperatures around the Gulf in 1984 contributed to the increase in overall visits to both national and state parks. The World's Fair in New Orleans bolstered the Louisiana visitation figures. According to Galveston residents, the Alvenus oil spill in July and August 1984, which ultimately hit the Galveston area, cost them over $1 million per day in tourist trade.

A prolonged freeze in the western Gulf in December 1983 dropped water temperatures in shallow bays and inland waterways below 40°F, the critical survival temperature for the species that normally inhabit coastal waters. This killed an estimated 15 million fish, shrimp, and crabs along the Texas coast. Spotted seatrout, sand seatrout, and black drum, prized recreational species, suffered considerable losses.

Transportation

Foreign import waterborne commerce rose in 1984 from 1983 with respect to total tonnage and value. Although export waterborne commerce tonnage was up from 1983, value was down for the fourth consecutive year. The total number of spills of pollutants into the Gulf of Mexico was up for the second straight year. The 2133 spills reported by the Coast Guard in 1984 represented a 14 percent increase in spills over 1983.

SECTION 3

WEATHER AND OCEANOGRAPHY

Weather systems were not as severe or extreme in 1984 as in 1983. Two storm systems - one in mid-September and the other in late October - each caused more than $30 million in damages. Tornadoes in northern Mississippi in April, in Louisiana and Alabama in May, and in Texas in December resulted in 16 deaths and damage exceeding $25 million.

The weather was abnormally cool over the Gulf states for the first 9 months of 1984. January and September temperatures averaged about 5°F and 3°F below normal, respectively. However, October and December were warm, with October temperatures close to 6°F above normal, and December temperatures from 3°F to almost 10°F above normal. The yearly average temperature was close to normal for all stations; only Orlando and Mobile showed more than 1°F departure from normal.

Low precipitation levels were prevalent in central Texas from February through September and in some Florida areas from May through December. The central Gulf region from Mobile westward and most of Texas received rains in October. December was dry throughout most of the area.

3.1 Review of Weather Events

As in January 1983, a series of low pressure systems developed in the Gulf of Mexico in January 1984 bringing precipitation to the coastal areas. During the third week, an extremely cold high pressure area pushed through the Gulf coastal area giving cold temperatures to most of the area. This left the Gulf area with temperatures ranging from -0.1°F to -5.8°F below normal for the month. Precipitation for the month was generally below normal in the eastern part of the area and above normal in Louisiana and Texas. It was over 3 1/2 times normal in coastal south Texas.

A series of low pressure areas tracked across the central United States in February. Along with the subsequent high pressure areas behind them, these lows resulted in near-normal temperatures over the Gulf coastal areas. With a series of frontal passages, precipitation totals were geographically inconsistent, ranging from one-half to about 2 times normal. South and east Texas were generally below normal, Louisiana and coastal Mississippi were above normal, Alabama and the western panhandle of Florida were below normal, and the rest of western coastal Florida was above normal. One of the cold frontal systems on the 12th and 13th set off severe thunderstorms and spawned tornadoes across Louisiana, Mississippi, and Alabama. At the end of February a squall line associated with a cold front from a large low pressure system set off thunderstorms and six tornadoes in Georgia and Florida.

A series of lows with their associated cold fronts moved across the central United States during the first half of March. Lows formed farther south during the latter part of the month and moved across the southern states. These produced squall lines and thunderstorms, causing wind and flood damage in Alabama early in the month and in Texas and southern Louisiana later in the month. A

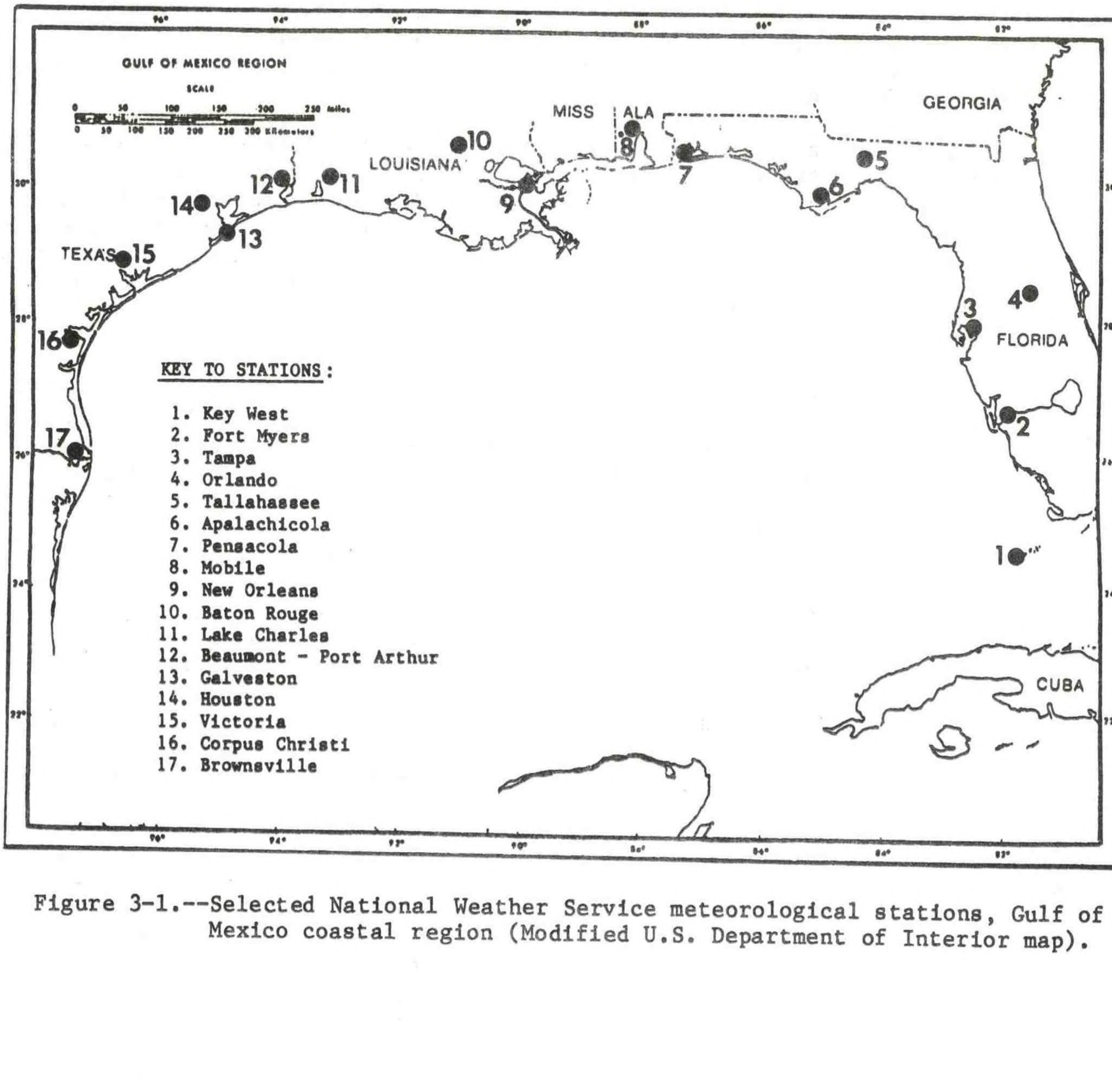


Figure 3-1.--Selected National Weather Service meteorological stations, Gulf of Mexico coastal region (Modified U.S. Department of Interior map).

cold high pressure system in the early part of the month brought damaging freezing temperatures to Georgia and the northern one-third of Florida. Overall, temperatures were slightly above normal in the western Gulf and below normal from Louisiana through Florida. Precipitation was above normal in south Florida and the Florida panhandle and generally below normal in the rest of the Gulf coastal areas. Again, these conditions were caused by a large low pressure area which developed in the Texas panhandle.

In April several large lows, developed east of the Rockies in Colorado and Texas and then tracked east or northeast. The precipitation associated with these storms was above normal over the Florida panhandle and northeastward. Drier, below-normal conditions existed elsewhere in the Gulf coast with areas from Galveston southwestward experiencing little or no rain. Some severe weather was associated with the cold fronts in the weather systems. Overall, temperatures were below normal from eastern Louisiana through Florida, and warmer than normal in areas west of Louisiana.

The circulation had a more southerly component to it after the first one-third of May. Early in the month a storm system tracked across the northern Gulf states setting off thunderstorms and tornadoes. This circulation brought much-needed rains to central and southern Texas. The early-month meridional (north to south) circulation shifted to zonal (west to east) the second week, meridional the third, and back to zonal the fourth. Overall, this left the temperatures slightly below normal over the coastal areas, except for the central Florida coast. Precipitation, because it was a more showery type, was above normal in south Florida, below normal from central Florida west through central Louisiana, above normal in west Louisiana and northeast Texas, below normal in central coastal Texas, and above normal in south Texas.

The Bermuda High influenced the region during part of June. Only two low pressure systems developed to provide organized precipitation-producing circulation. Two easterly trough waves occurred in the latter part of the month causing some precipitation in north central Florida and in the Alabama and Mississippi coastal areas. For the month, temperatures were below normal over the whole coastal area - with highest values along the central Florida coast. Precipitation was generally below normal - particularly in Texas - but was above normal inland in Louisiana and the Mississippi River delta areas.

Only once in the first 10 days of July and twice in the last 10 days did fronts penetrate to the Gulf to set off showers and thunderstorms, primarily in the eastern part of the Gulf. For the month, precipitation was generally above normal in coastal Florida. Westward from Florida precipitation was normal or below except for small areas in coastal to central Louisiana and coastal northeast Texas.

The Bermuda high, dominated the weather in the Gulf states for most of August. However, at the beginning of the month, the onshore flow in the mid-coastal Gulf coupled with the upper air flow to bring heavy rains in this area. After that the Bermuda High circulation prevailed until near the end of the month, when continental frontal systems pushed it far south again. Precipitation (for the month) was above normal only in the central Gulf--eastern Louisiana, Alabama, Mississippi, and far western Florida panhandle. Other coastal areas had below normal precipitation. Temperatures were slightly above normal in the Florida peninsula and Texas and slightly below normal in the rest of the coastal area.

Continental high pressure cells and two tropical storms or their remnants dominated the Gulf area in September. The presence of the highs kept the precipitation concentrated in Florida and Texas and also kept temperatures below normal over most of the area. Shortly after mid-month the remnants of tropical storm Edward influenced weather in south Texas. The tropical disturbance dumped excessive rains (21 inches at Port Isabel) in the area causing flooding. In Florida tropical storm Isidore tracked over peninsular Florida on the 26th to 28th causing some rain. However, neither of these systems extended far enough inland to alleviate the dry conditions in south central Texas or along the northern Gulf states (particularly Georgia, Alabama, and Mississippi). Temperatures were 2° to 3°F below normal over most of the Gulf coastal region in September.

By mid-October the circulation in the Gulf area had settled into a pattern having storm systems forming in Colorado with trailing cold fronts moving south to bring precipitation in the western Gulf area. From the 19th to the 26th a front stalled in eastern Texas and caused showers, thunderstorms, and a tornado. The associated hail, winds, and flooding caused considerable damage (see Events; Table 2-1 and Figure 3-2). This front produced rain amounts from 2 to 5 1/2 times normal from Mobile to Corpus Christi. Florida, however, had below normal precipitation. Temperatures were above normal over the entire area with 4°F and 5°F anomalies in the central part of the coastal region.

Circulation in the first two-thirds of November was mainly zonal with only two incursions of fronts and low systems through the Gulf states. The latter part of the month saw much more meridional upper air flow with its attendant lows developing further south. For the month as a whole, precipitation was generally below normal in the immediate coastal areas but somewhat above normal inland. Temperatures were slightly above normal in some parts of Texas but normal to slightly below normal in the rest of the area.

December circulation looked more winter-like with Colorado lows developing and cold air masses moving south. One frontal system on the 31st caused floods, flash floods, and wind damage and spawned several tornadoes. However, for the whole month, weather over all of the Gulf area was warm (close to 10°F above normal) and dry over the eastern half of the area. Most of Florida had less than 10 percent of normal precipitation, but southern Texas had 1 1/2 times normal.

3.2 Precipitation

January precipitation varied from very dry in south Florida (less than 10 percent of normal) to quite wet in southern Texas. About half of the precipitation for the month in Texas and western Louisiana came from a Gulf low that developed during the second week. The area from central peninsular Florida to south Texas had varied amounts ranging from about 60 percent of normal to 150 percent of normal. The 1984 precipitation values, the 1951-1980 normals, and the percent of normal are given in Table 3-1.

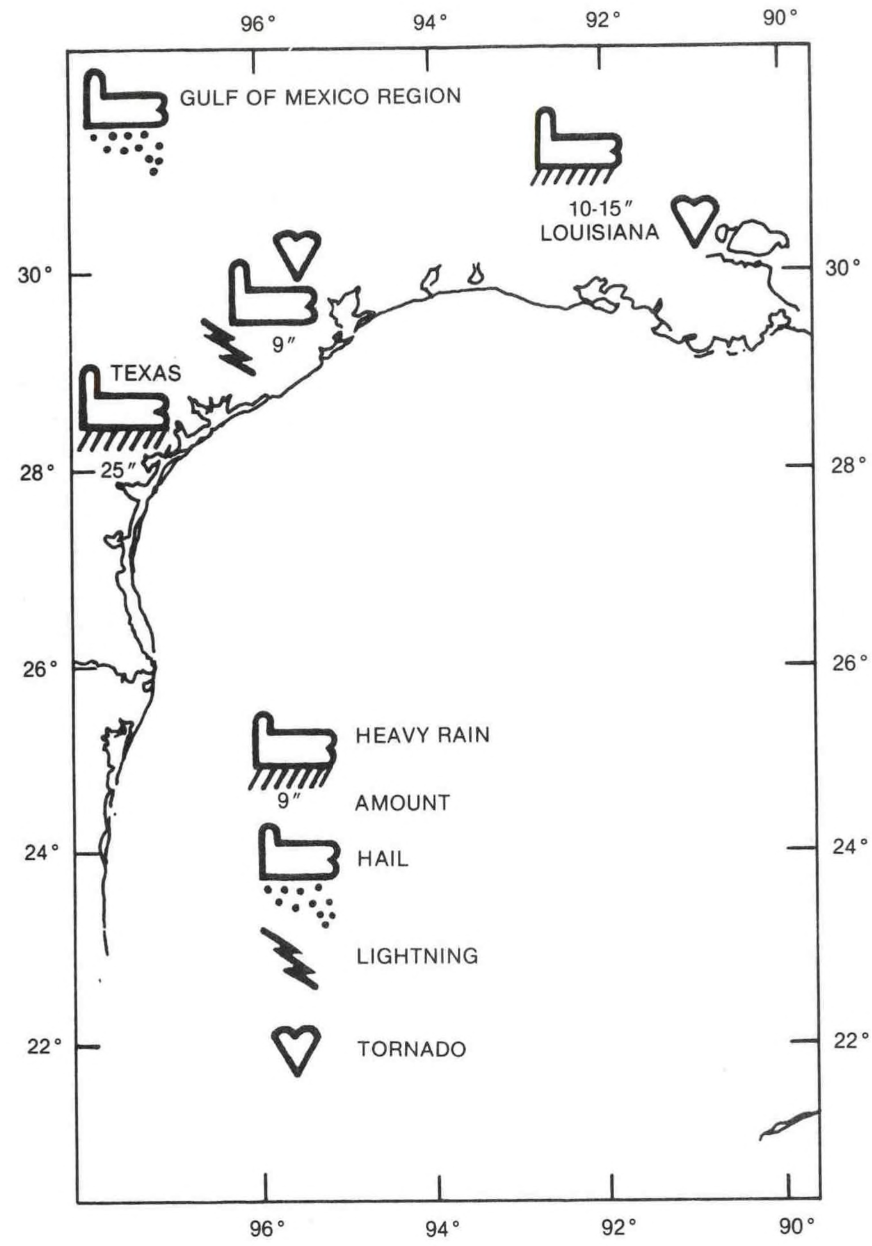


Figure 3-2.--Damaging weather events of October 1984, western Gulf of Mexico region.

Table 3-1.--Normal monthly total precipitation (1951-1980) and percentage of normal, selected stations, Gulf of Mexico, 1984.

A. Normal monthly total precipitation (inches)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
						Month							
Key West, Florida	1.74	1.92	1.31	1.49	3.22	5.04	3.68	4.80	6.50	4.76	3.23	1.73	39.42
Fort Myers, Florida	1.89	2.06	2.85	1.52	4.11	8.72	8.52	8.58	8.56	3.86	1.35	1.57	53.64
Tampa, Florida	2.17	3.04	3.46	1.82	3.38	5.29	7.35	7.64	6.23	2.34	1.87	2.14	46.73
Orlando, Florida	2.10	2.83	3.20	2.19	3.96	7.39	7.78	6.32	5.62	2.82	1.78	1.83	47.83
Tallahassee, Florida	4.66	5.00	5.60	4.13	5.16	6.55	8.75	7.30	6.45	3.10	3.31	4.58	64.59
Apalachicola, Florida	3.51	3.64	4.04	3.25	2.94	4.81	7.09	7.53	8.66	3.19	2.82	3.50	54.98
Pensacola, Florida	4.47	4.90	5.66	4.45	3.87	5.75	7.18	7.04	6.75	3.52	3.42	4.15	61.16
Mobile, Alabama	4.59	4.91	6.48	5.35	5.46	5.07	7.74	6.75	6.56	2.62	3.67	5.44	64.64
New Orleans, Louisiana	4.97	5.23	4.73	4.50	5.07	4.63	6.73	6.02	5.87	2.66	4.06	5.27	59.74
Baton Rouge, Louisiana	4.58	4.97	4.59	5.59	4.82	3.11	7.07	5.05	4.42	2.63	3.95	4.99	55.77
Lake Charles, Louisiana	4.25	3.88	3.05	4.06	5.14	4.19	5.55	5.39	5.21	3.47	3.76	5.08	53.03
Beaumont-Port Arthur, Texas	4.18	3.71	2.93	4.05	4.50	3.96	5.37	5.45	6.13	3.63	4.33	4.55	52.79
Galveston, Texas	2.96	2.34	2.10	2.62	3.30	3.48	3.77	4.40	5.82	2.60	3.23	3.62	40.24
Houston, Texas	3.21	3.25	2.68	4.24	4.69	4.06	3.33	3.66	4.93	3.67	3.38	3.66	44.77
Victoria, Texas	1.87	2.24	1.34	2.61	4.47	4.53	2.58	3.33	6.24	3.31	2.24	2.14	36.90
Corpus Christi, Texas	1.63	1.55	0.84	1.99	3.05	3.36	1.96	3.51	6.15	3.19	1.55	1.40	30.18
Brownsville, Texas	1.25	1.55	0.50	1.57	2.15	2.70	1.51	2.83	5.24	3.54	1.44	1.16	25.44

Table 3-1.--(Continued). Normal monthly total precipitation (1951-1980) and percentage of normal, selected stations, Gulf of Mexico, 1984.

B. Percentage of normal precipitation, 1984.

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Total
						Month							
Key West, Florida	6	212	166	279	180	141	89	54	125	28	36	6	101
Fort Myers, Florida	8	154	224	72	68	99	105	64	92	17	53	1	86
Tampa, Florida	75	109	38	83	94	61	97	74	68	12	38	3	69
Orlando, Florida	96	104	58	284	81	72	80	125	110	20	118	10	93
Tallahassee, Florida	77	131	127	182	123	51	112	59	39	46	62	31	87
Apalachicola, Florida	135	108	151	282	11	70	255	63	14	56	77	26	103
Pensacola, Florida	95	79	95	107	32	77	130	175	6	50	77	33	84
Mobile, Alabama	134	98	127	66	78	41	30	225	11	236	45	39	83
New Orleans, Louisiana	82	101	104	38	70	156	57	158	65	107	69	48	87
Baton Rouge, Louisiana	60	133	26	32	79	96	70	78	54	551	69	75	92
Lake Charles, Louisiana	107	140	62	46	160	92	97	90	131	352	74	81	117
Beaumont-Port Arthur, Texas	160	115	44	25	232	32	71	72	68	412	51	45	114
Galveston, Texas	108	51	65	0	154	25	48	70	85	345	75	75	89
Houston, Texas	124	134	90	13	67	49	103	96	78	437	67	71	108
Victoria, Texas	162	60	130	3	90	45	40	125	30	257	96	184	92
Corpus Christi, Texas	363	25	23	0	73	7	13	26	49	203	110	66	74
Brownsville, Texas	383	27	26	0	287	90	105	64	385	26	1	159	159

February precipitation varied from 25 percent of normal (Corpus Christi and Brownsville) to about twice normal (Key West). From one-fourth to one-third of the monthly total in the central Gulf states came from the Colorado low system that developed on the 25th and 26th and moved across those states.

Rain had become more showery in March, yet one-third to one-half of the total in the central Gulf came from two systems that moved through the area. Over half of the month's rain in south Florida came from a tropical (easterly) trough that moved through that area late in the month. The precipitation was below normal in the immediate coastal area from the Florida panhandle west through Texas, with a few areas in peninsular Florida, Alabama, and southern Louisiana with above-normal precipitation. Precipitation varied from 25 percent of normal in Texas and parts of Louisiana to twice normal in the central Florida peninsula.

A series of fronts in April set off showers in the eastern portion of the Gulf area, giving above normal precipitation to peninsular Florida. To the west, especially in south Texas, it was dry for the third consecutive month. Galveston, Corpus Christi, and Brownsville had only a trace of precipitation for the month. Stations in Florida's upper peninsula recorded levels nearly 3 times normal.

May had a showery, spotty precipitation record for the Gulf. The range was from 10 percent of normal (Appalachicola) to almost 3 times normal (Brownsville). North coastal and southern Texas got some much-needed rain.

The June circulation around the Bermuda High brought warm moist air into the area. Precipitation came mainly from scattered showers. An exception to this was heavy rain on the 7th that dumped 11 to 15 inches of rain over two parishes (counties) in central Louisiana. Otherwise, the precipitation in the area varied from 7 percent of normal (Corpus Christi) to about 1 1/2 times normal (at Key West and New Orleans) and generally was below normal at most of the stations.

Conditions in July were generally wet in the eastern section of the Gulf and dry in the west. The precipitation was mostly of the air-mass shower type with only three weak frontal systems moving toward or through the eastern part of the area. The precipitation for the month varied from about 15 percent of normal (Corpus Christi) to about 2 1/2 times normal (Apalachicola).

Precipitation in August was below normal for much of the Gulf coastal area, except for an area in central and coastal Alabama and an area in south central Louisiana. In these areas about 40 percent of the month's total fell in a few days at the beginning of the month. South central Louisiana had 10 to 12 inches on the night of the 2nd. Mobile, Pensacola, and New Orleans had 1 1/2 to 2 1/4 times normal precipitation. South Texas, on the other hand, had only 25 percent of normal (Corpus Christi).

September precipitation was below normal over the Gulf area with some stations in Florida reporting less than 10 percent of normal. An easterly wave moved into the western Gulf, stalled, and dumped up to 20 inches of rain on the Brownsville area from the 16th to 19th. This gave Brownsville almost 4 times its normal rainfall. At the end of September tropical storm Isidore tracked over the Florida peninsula causing some heavy rain. It gave Tampa over 60 percent of its September total in one day.

Low systems developed in October, and their associated cold fronts initiated heavy rains and severe weather in central Louisiana and coastal eastern Texas (see Events, Table 2-1, and Figure 3-2). Odem, TX, reported an unofficial 25 inches of rain in 3 1/2 hours. However, the eastern Gulf, particularly Florida, had little precipitation, 10 to 20 percent of normal (Tampa, Fort Myers). Stations to the west had up to 5 1/2 times normal (Baton Rouge). Brownsville ended with 25 percent of normal.

November, despite a number of cold fronts which moved through the Gulf area, had few unusual precipitation events. At Mobile and Baton Rouge one storm system late in the month produced more than half their monthly totals. South and central Florida had some heavy rains (up to 7 inches in two days) and strong winds. The western half of Florida and most of the rest of the Gulf coastal areas had below normal precipitation, with Brownsville receiving 1 percent of normal.

Some rain occurred in the eastern Gulf the first week of December. Precipitation was sporadic for the remainder of the month. From Port Arthur eastward, rainfall was generally less than 50 percent of normal with Orlando, Tampa, Fort Myers, and Key West receiving less than 10 percent of normal. Only central coastal Louisiana and southern Texas had above-normal precipitation.

3.3 Air Temperatures

Temperatures over the entire region were below normal in January - in Louisiana as much as 5°F along the coast and more than that inland. Table 3-2 gives the 1984 temperatures, the 1951-1980 normals, and the departures from normal.

The February monthly temperatures were all close to normal with all stations having less than a 2°F departure.

March temperatures were slightly below normal in the eastern half of the Gulf area and above normal in the western half (Louisiana through Texas). On the 27th, Brownsville had an all-time record of monthly maximum temperature of 106°F. Corpus Christi and Victoria, TX, had monthly records of 101°F and 95°F, respectively.

April temperatures somewhat followed the precipitation pattern, with cool, moist air in the eastern Gulf and warm, dry air in the western area. Some stations were close to 4°F below normal. Corpus Christi and Brownsville temperatures of 102°F on April 26th and 27th, respectively, were monthly records for both stations.

May temperatures were close to normal over the entire region. Departures from normal ranged from -2.3°F at Mobile to +1.0°F at Corpus Christi.

June temperatures were slightly below normal over the area, except for southern Texas. The largest deviations were about 2.5°F below normal in central peninsular Florida and extended into northeast Texas. Stations from Fort Myers

Table 3-2.--Normal monthly mean air temperature (1951-1980) and departure from normal, selected stations, Gulf of Mexico, 1984.

A. Normal monthly air temperature (Degrees F)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Average
Key West, Florida	68.7	70.1	74.1	77.7	80.6	82.9	84.5	84.3	82.6	80.1	75.5	71.0	77.7
Fort Myers, Florida	63.4	64.1	68.8	73.1	77.9	81.1	82.6	82.8	81.7	76.5	69.8	64.7	73.9
Tampa, Florida	59.8	60.8	66.2	71.6	77.1	80.9	82.2	82.2	80.9	74.5	66.7	61.3	72.0
Orlando, Florida	60.5	61.5	66.8	72.0	77.3	80.9	82.4	82.5	81.1	74.9	67.5	62.0	72.4
Tallahassee, Florida	51.6	53.6	60.2	67.1	74.0	79.5	81.2	81.1	78.3	68.4	58.8	53.0	67.2
Apalachicola, Florida	52.8	54.7	60.7	67.9	74.5	79.8	81.5	81.4	78.9	70.2	61.0	55.0	68.2
Pensacola, Florida	51.7	54.2	60.4	68.0	75.0	80.6	82.3	81.8	78.7	69.4	59.7	53.8	68.0
Mobile, Alabama	50.8	53.6	60.1	68.0	74.9	80.5	82.2	81.8	78.2	68.5	58.6	53.1	67.5
New Orleans, Louisiana	52.4	54.7	61.4	68.7	74.9	80.3	82.1	81.7	78.5	69.2	60.0	54.6	68.2
Baton Rouge, Louisiana	50.8	53.6	60.5	68.4	74.8	80.3	82.1	81.4	77.9	68.2	58.7	53.1	67.5
Lake Charles, Louisiana	51.5	54.3	60.7	68.4	74.9	80.4	82.3	81.8	78.2	69.3	59.7	53.9	68.0
Beaumont-Port Arthur, Texas	51.9	54.9	61.4	69.0	75.6	81.2	83.1	82.8	79.2	70.2	60.6	54.7	68.7
Galveston, Texas	53.6	55.6	61.4	69.1	75.7	81.2	83.2	83.2	80.0	72.7	63.0	56.8	69.6
Houston, Texas	51.4	54.5	61.0	68.7	74.9	80.6	83.1	82.6	78.4	69.7	60.1	54.0	68.3
Victoria, Texas	53.4	56.6	63.3	70.9	76.7	82.0	84.5	84.2	80.1	71.9	62.3	56.1	70.1
Corpus Christi, Texas	56.3	59.3	65.9	73.0	78.1	82.7	84.9	85.0	81.5	74.0	65.0	59.1	72.1
Brownsville, Texas	60.3	62.8	68.6	74.9	79.2	82.6	84.1	84.1	81.4	75.3	67.7	62.3	73.6

Table 3-2.--(Continued). Normal monthly mean air temperature (1951-1980) and departure from normal, selected stations, Gulf of Mexico, 1984.

B. Departure from normal, 1984 (Degrees F)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Average
Key West, Florida	-0.1/	+0.7	-1.4	-1.3	+0.2	-1.7	-1.6	-0.8	-1.1	0.0	-0.8	+3.1	-0.4
Fort Myers, Florida	-1.3	+0.8	-1.4	-1.0	+0.9	+0.4	-0.2	+1.0	-0.6	+1.3	0.0	+4.7	+0.4
Tampa, Florida	-1.8	+1.9	-0.2	-0.5	+0.8	-0.5	-0.7	+0.1	-0.9	+1.3	-1.8	+6.0	+0.3
Orlando, Florida	-2.7	-0.3	-2.1	-2.8	-1.7	-2.5	-1.6	-1.0	-2.2	+0.5	-1.7	+4.0	-1.1
Tallahassee, Florida	-1.9	+0.4	-1.4	-1.8	-0.5	-1.6	-1.5	0.0	-1.4	+5.1	-0.7	+9.9	+0.6
Apalachicola, Florida	-2.7	-1.3	-2.9	-3.0	-1.7	-2.5	-3.0	-0.7	-1.9	+2.6	-2.1	+7.8	-1.0
Pensacola, Florida	-3.8	-0.8	-1.0	-3.7	-0.9	-0.6	-1.7	-1.1	-0.5	+5.8	-0.8	+8.1	+0.1
Mobile, Alabama	-4.7	-1.1	-1.4	-2.3	-2.3	-2.4	-2.3	-3.0	-2.6	+4.2	-2.3	+7.4	-1.1
New Orleans, Louisiana	-5.8	-0.8	-2.1	-1.2	-1.2	-2.8	-3.3	-2.5	-2.2	+4.3	-1.2	+7.8	-0.9
Baton Rouge, Louisiana	-5.4	-0.2	-0.6	-0.3	-1.0	-1.4	-1.8	-1.6	-1.9	+5.3	-1.4	+8.3	-0.2
Lake Charles, Louisiana	-3.4	+1.7	+1.8	+1.4	+0.8	-0.9	-1.4	-0.9	-2.3	+4.4	-1.6	+8.6	+0.7
Beaumont-Port Arthur, Texas	-3.2	+1.1	+0.8	-0.4	-0.9	-1.5	-1.9	-1.1	-2.2	+4.6	+0.2	+9.0	+0.4
Galveston, Texas	-4.2	+1.7	0.0	-0.3	-0.1	-0.1	+1.3	+0.9	-3.2	+2.4	+0.2	+5.6	+0.2
Houston, Texas	-4.4	-0.5	+0.9	-0.9	0.0	-2.0	-1.3	+0.3	-1.0	+4.5	-0.1	+9.4	+0.5
Victoria, Texas	-3.1	+0.9	+1.6	+0.8	-0.2	+0.2	+0.7	0.0	-1.8	+3.4	+0.4	+9.0	+1.0
Corpus Christi, Texas	-4.9	-0.1	+0.5	+0.2	+1.0	-1.1	-1.6	-1.3	-3.2	+2.5	-0.1	+7.3	-0.2
Brownsville, Texas	-4.4	-0.4	+1.2	+1.4	+0.1	+0.2	+0.1	+0.4	-2.1	+4.0	+1.1	+8.0	+0.8

westward to Port Arthur had record minimum temperatures - mostly in the 50's - in June. July temperatures in the Gulf area were below normal, except for southern Texas. In the northern mid-Gulf area temperatures were 2° to 3°F below normal (3°F below normal at Apalachicola and 3.3°F below normal at New Orleans). August temperatures were close to normal over the area with the greatest deviation being 3°F below normal at Mobile. Temperature readings were slightly above normal in Florida and Texas and below normal in the rest of the area.

September temperatures were below normal over the whole area. For the central coastal Gulf this was the ninth straight month in 1984 and eleventh straight month from November 1983 that the monthly mean air temperatures did not reach normal. For Mobile, only one month in the last 20 has had a positive temperature departure. Departures were 3.2°F in Galveston and Corpus Christi.

Temperature anomalies in October were the most extreme of the year - close to 6.0°F above normal (5.8°F at Pensacola). Departures for the northern Gulf coastal area were all more than 4.0°F, and the entire area was normal (Key West) or above.

November temperatures were slightly below normal from Louisiana eastward and slightly above normal in Texas. Northerly or easterly winds which dominated the eastern half of the Gulf region in November correlated with the below-normal temperatures.

Extremely warm temperatures were the main climatic factor in December. Departures were almost 10°F (9.9°F at Tallahassee) with many stations 8°F above normal from the Florida panhandle to Texas. Though the first one-third of the month was cool, the blocking ridge over the southeast contributed to the high temperatures the last two-thirds. This was in sharp contrast to December 1983, which was cold in most of the area, having set record monthly minimums particularly in the central and western Gulf.

3.4 Streamflow

Streamflow entering the Gulf of Mexico affects the Gulf region's fisheries, recreation, ecology, and water quality. The Gulf coast rivers drain more than 50 percent of the land area of the 48 contiguous United States. This large area and the subsequent large number of rivers prevent analysis of total streamflow for the Gulf as a whole. Each river, however, is susceptible to both local and large-scale weather patterns. These patterns directly affect the rate and quantity of streamflow entering individual estuaries of the Gulf of Mexico.

Twelve major rivers and the locations of the corresponding streamflow monitoring stations are shown in Figure 3-3. Streamflow among the stations averaged 125 percent of normal in 1984. Two of the twelve statons (Alabama River and Tombigbee River) have data only through September 1984. The remaining rivers, with the exception of the Brazos and the Rio Grande, showed cumulative streamflow excesses for calendar year 1984.

Most of the rivers had streamflows greater than their long-term normals for the months of January, March, and August. Fifty percent of the months of available data showed excesses for the year.

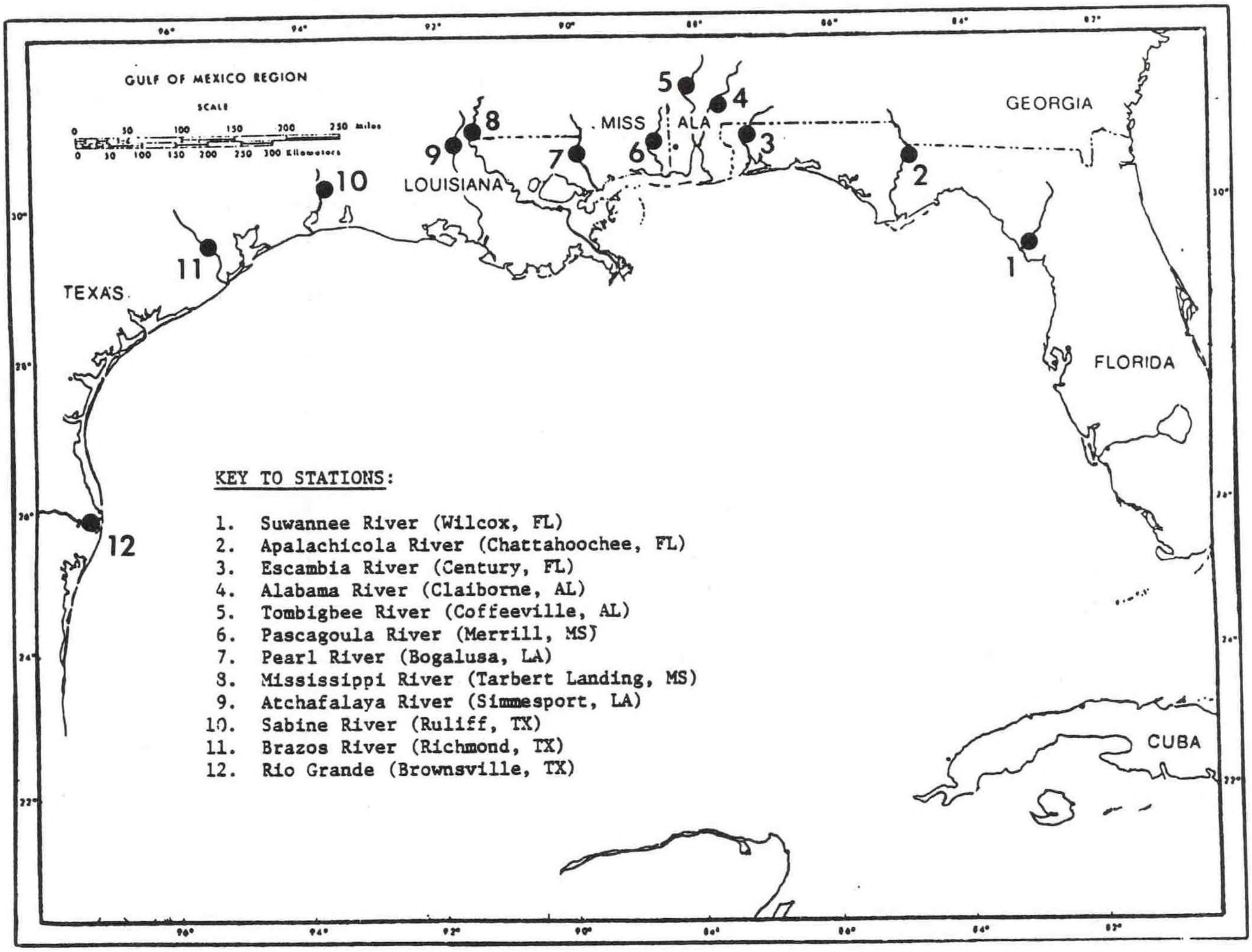


Figure 3-3.--Streamflow monitoring stations on major river systems entering the Gulf of Mexico (Modified U.S. Department of Interior map).

Monthly data from the twelve selected stations are plotted in Figures 3-4a and 3-4b. Annual mean streamflow in 1983 and 1984 as percent of normal for each station is listed in Table 3-3.

Table 3-3.--Annual mean streamflow as percent of normal, selected stations, Gulf of Mexico, 1983-1984.

River	Normal Flow (CFS)	1983-1984 Flow (Percent of Normal)	
		1983	1984
Suwannee	10,207	139	165
Apalachicola	22,509	135	118
Escambia	6,159	153	101
Alabama	37,647	132	101*
Tombigbee	31,457	197	94*
Pascagoula	9,847	185	113
Pearl	9,764	219	112
Mississippi	477,917	143	129
Atchafalaya	199,500	147	132
Sabine	7,268	154	100
Brazos	6,680	78	49
Rio Grande	1,727	23	13

*Data are from January through September, only.

Data from U.S. Geological Survey, U.S Army Corps of Engineers, and International Boundary and Water Commission

Suwannee River

The Suwannee River flows into an area of the Gulf known as Suwannee Sound. The station located near Wilcox, FL, showed streamflow excesses for the first nine months of the year. All the months of 1984 had streamflow greater than 80 percent of the 1951-1980 monthly normals. March through May exhibited the most abnormal streamflows ranging from 196 to 204 percent of normal. The May streamflow of 41,650 cubic feet per second was a new maximum for that month for the period of record. Although October through December had flows that were less than normal, the high flow rates for the first three-quarters of the year enabled the river to show a cumulative streamflow excess for the year of 1570 billion gallons.

Apalachicola River

The Apalachicola River flows into Apalachicola Bay. In 1984 the monitoring station at Chatahoochee, FL, measured streamflow for this river that was similar to that of the Suwannee: the first nine months had flows that were normal, and the last three months had flows that were considerably below normal. Streamflow in August was a record maximum of 30,150 cubic feet per second pushing the cumulative streamflow excess to 1130 billion gallons. The below-normal flows of October through December depressed this excess to 990 billion gallons for the year.

Escambia River

Streamflow for the Escambia River, which flows into Pensacola Bay, is measured near Century, FL. Flows for five of the first eight months of 1984 were above normal, and flows for the last four months were below normal. The river averaged 101 percent of normal flow for the year-reflecting a cumulative streamflow excess of 27 billion gallons.

Alabama River

The Alabama River flows into Mobile Bay, and streamflow is monitored at Claiborne Lock and Dam. Data are available only for the months of January through September. Following record streamflow in December 1983, January's mean flow was a new maximum for the month of 77,190 cubic feet per second. Five of the nine months had flows greater than normal. Record August streamflow of 384 percent of normal and above-normal streamflows in July and September allowed the cumulative streamflow excess to reach 99 billion gallons by the end of September.

Tombigbee River

The Tombigbee River flows into Mobile Bay with streamflow monitored at Coffeeville Lock and Dam. As with the Alabama River, data are available only for the months of January through September. Six of the nine months of available data reflected streamflows well below normal. January, May, and August were the only three months having flow rates above normal. The September rate, which was a new minimum of 37 percent of normal, brought the cumulative streamflow deficit for the first nine months of 1984 to 3800 billion gallons.

Pascagoula River

The Pascagoula River flows into an area of the Gulf known as the Mississippi Sound. Although the monitoring station at Merrill, MS, showed streamflow excesses for only five months of the year, with the months of April through July well below normal, flows 150 percent of normal in August and November and record flow in October of 804 percent of normal boosted the cumulative streamflow excess for 1984 to 305 billion gallons.

Pearl River

The Pearl River, monitored near Bogalusa, LA, empties into Lake Borgne. Seven of the months of 1984 had streamflows greater than 120 percent of normal, with the remaining months exhibiting flows of 85 percent of normal or less. Although below-normal flows from April through July created a cumulative streamflow deficit, flows that were well above normal from October through December brought the cumulative streamflow anomaly to an excess of 280 billion gallons for the year.

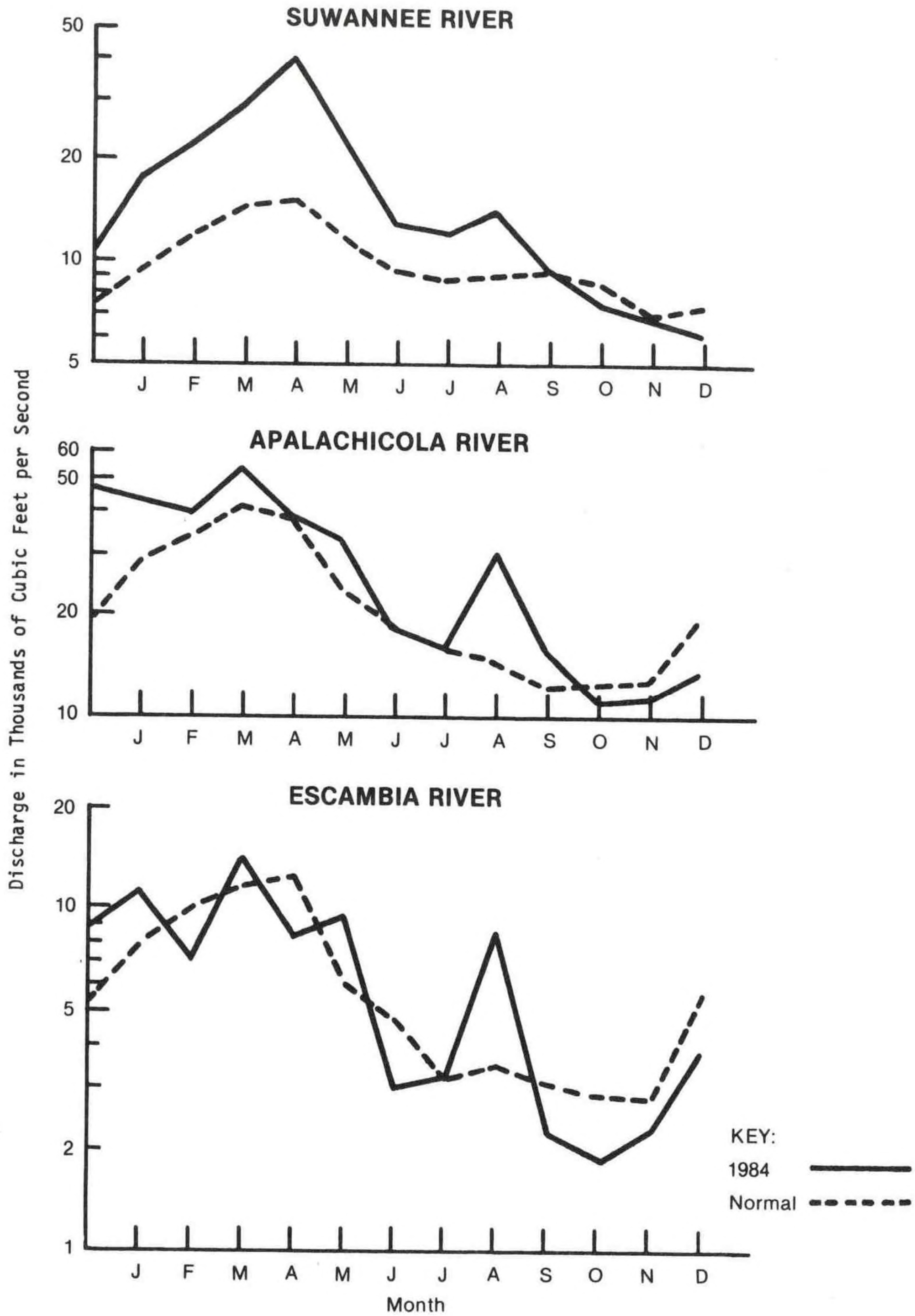


Figure 3-4a.--Monthly streamflow from major river systems entering the Gulf of Mexico during 1984 and average monthly streamflow. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and the International Boundary and Water Commission.

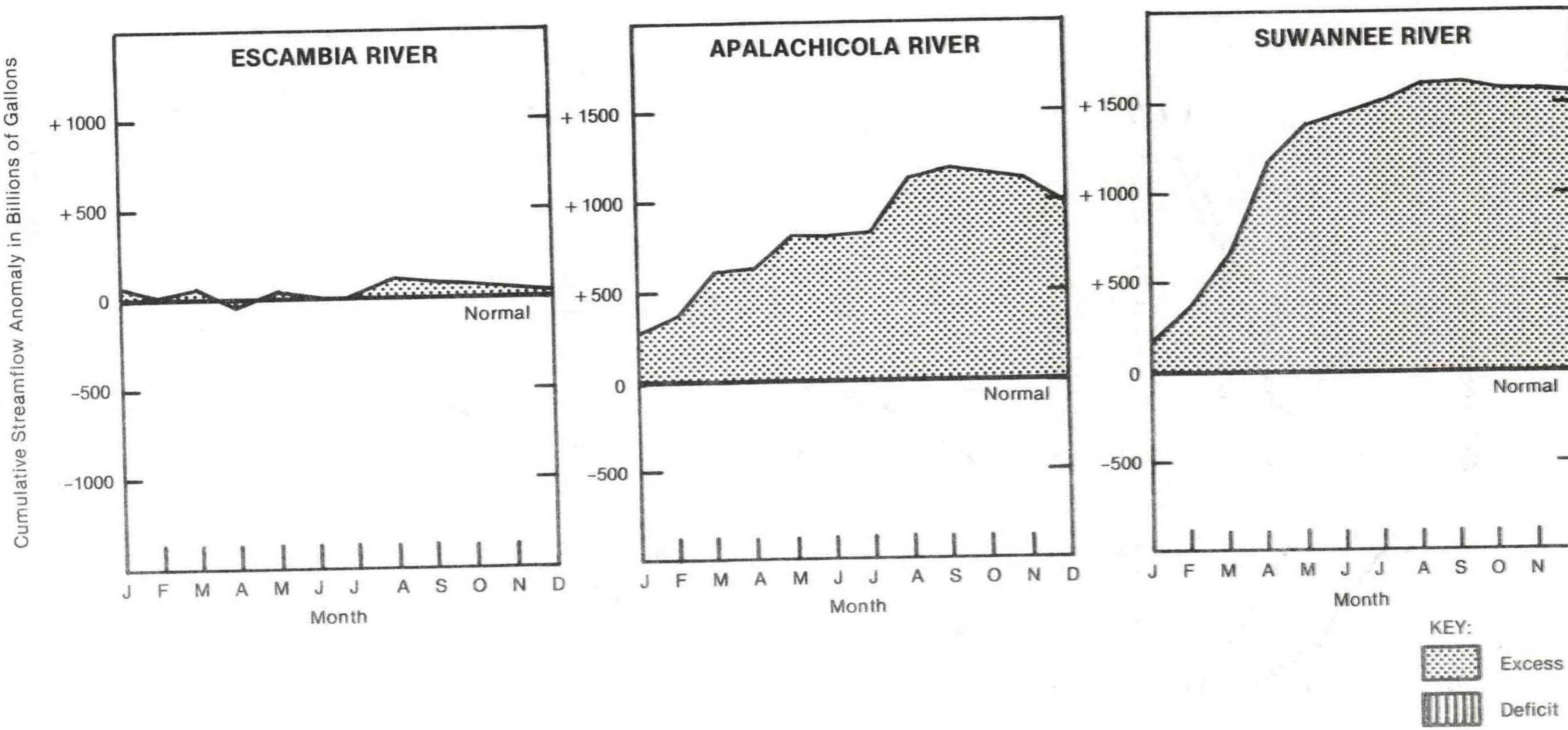


Figure 3-4b.--Cumulative monthly streamflow anomaly, major river systems entering the Gulf of Mexico, 1984. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and International Boundary and Water Commission.

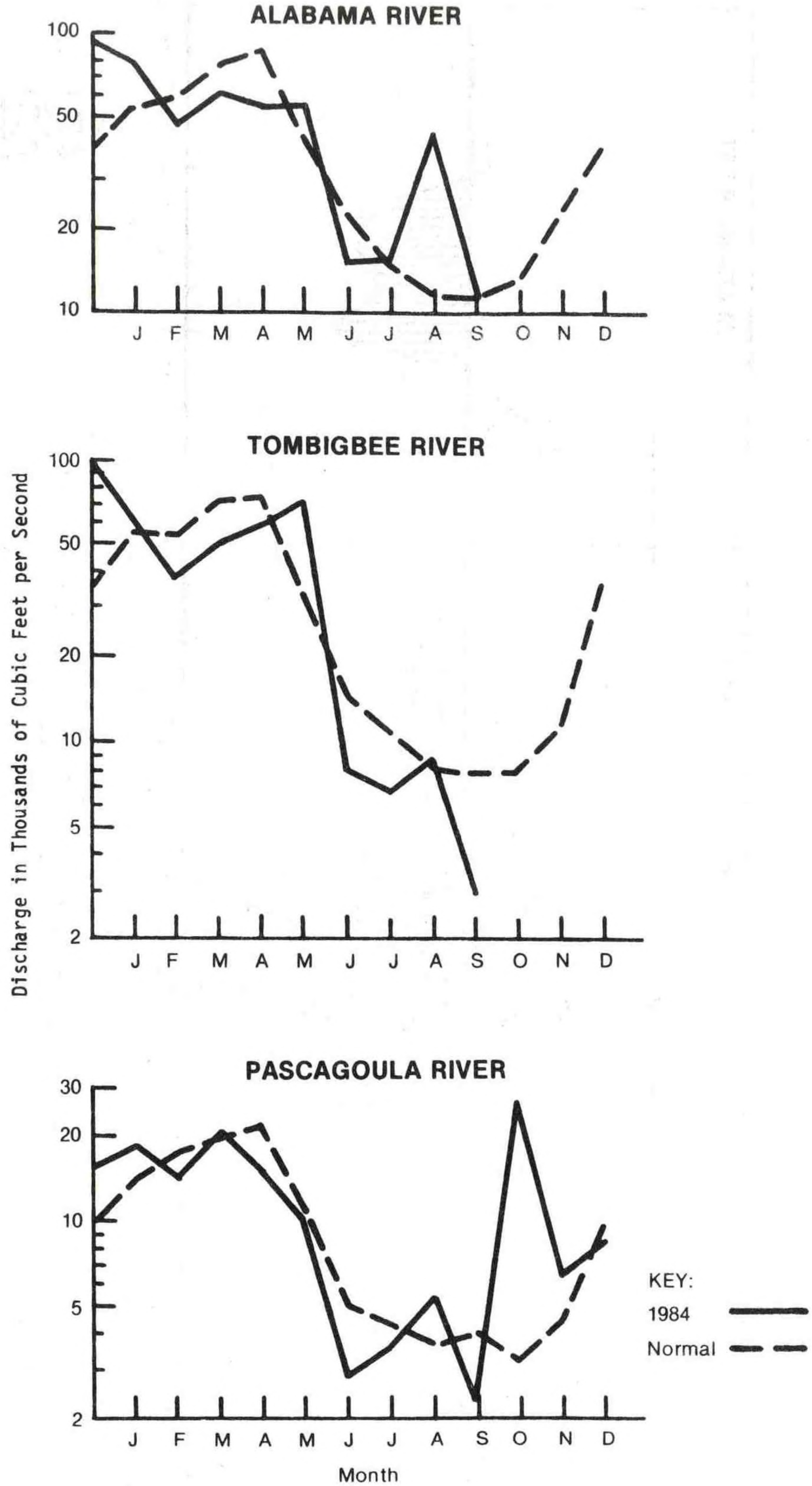


Figure 3-4a (Continued).--Monthly streamflow from major river systems entering the Gulf of Mexico during 1984 and average monthly streamflow. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and the International Boundary and Water Commission.

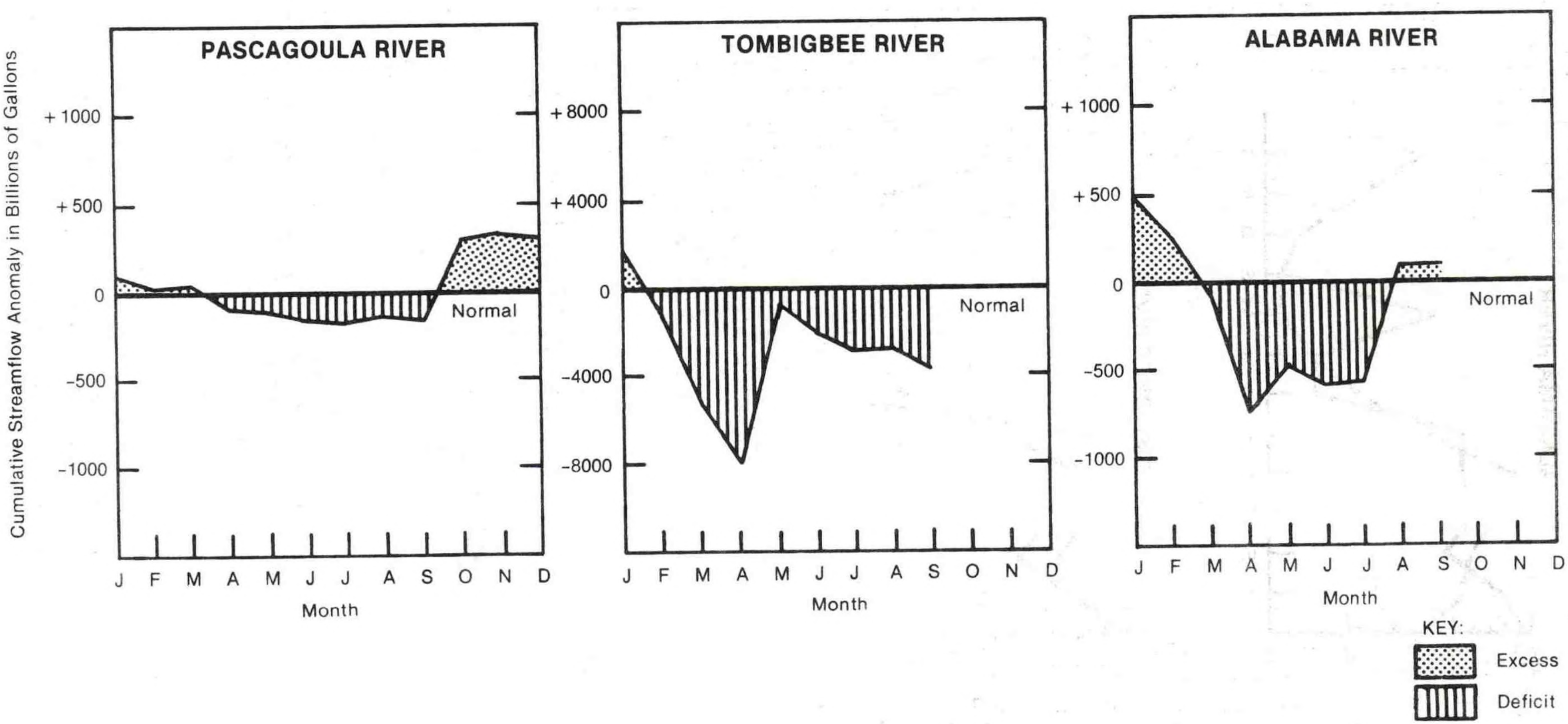


Figure 3-4b (Continued).--Cumulative monthly streamflow anomaly, major river systems entering the Gulf of Mexico, 1984. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and International Boundary and Water Commission.

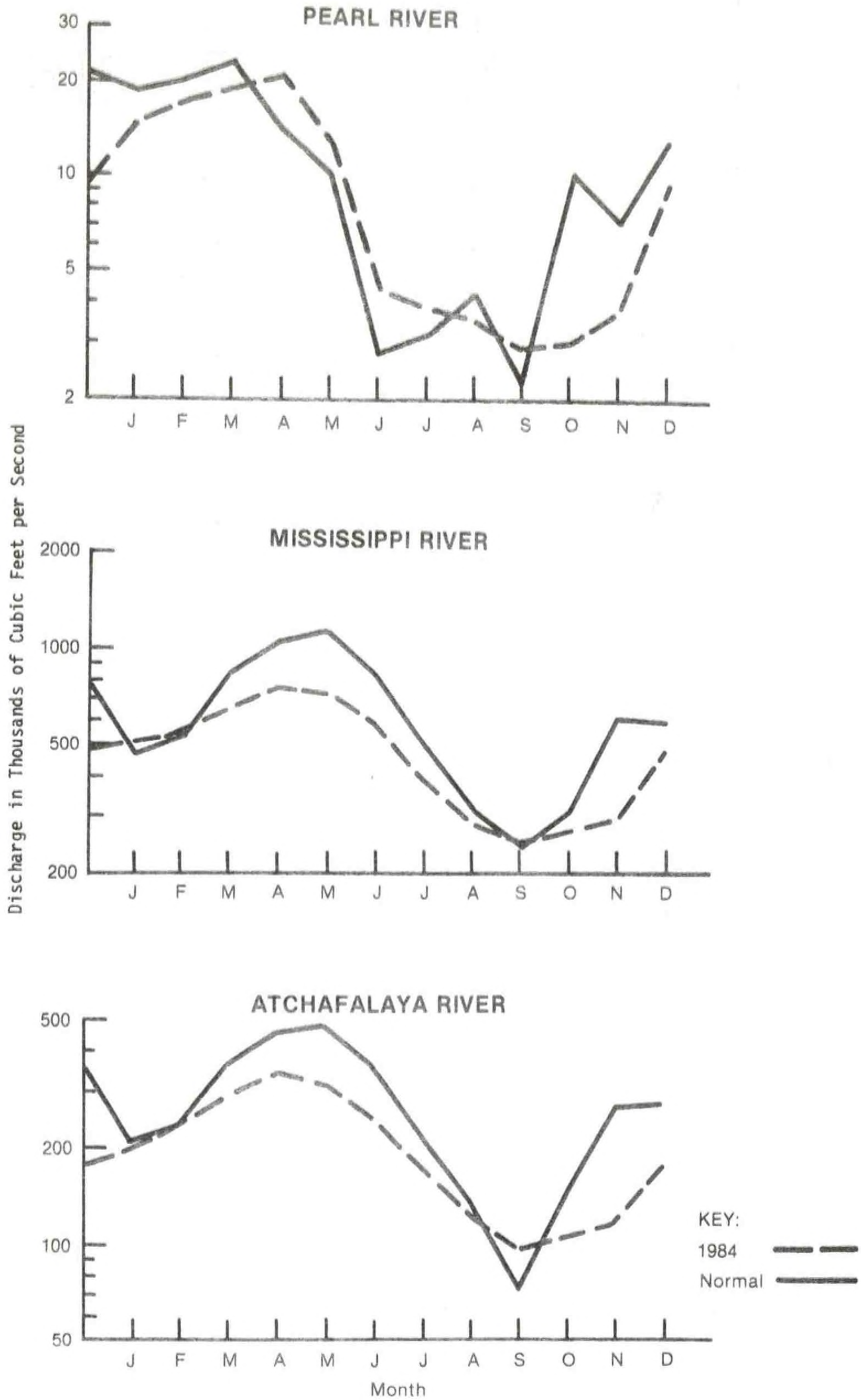


Figure 3-4a (Continued).--Monthly streamflow from major river systems entering the Gulf of Mexico during 1984 and average monthly streamflow. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and the International Boundary and Water Commission.

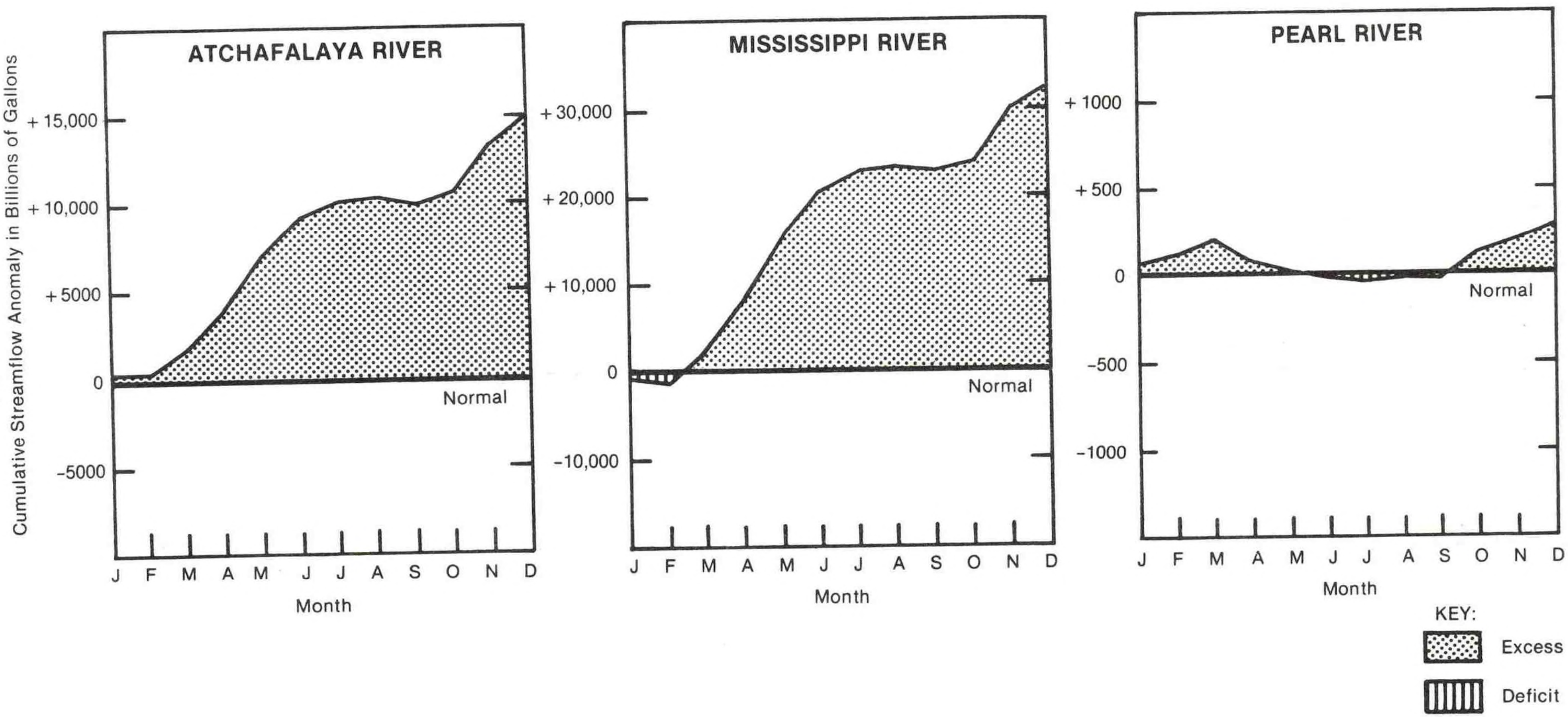


Figure 3-4b (Continued).--Cumulative monthly streamflow anomaly, major river systems entering the Gulf of Mexico, 1984. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and International Boundary and Water Commission.

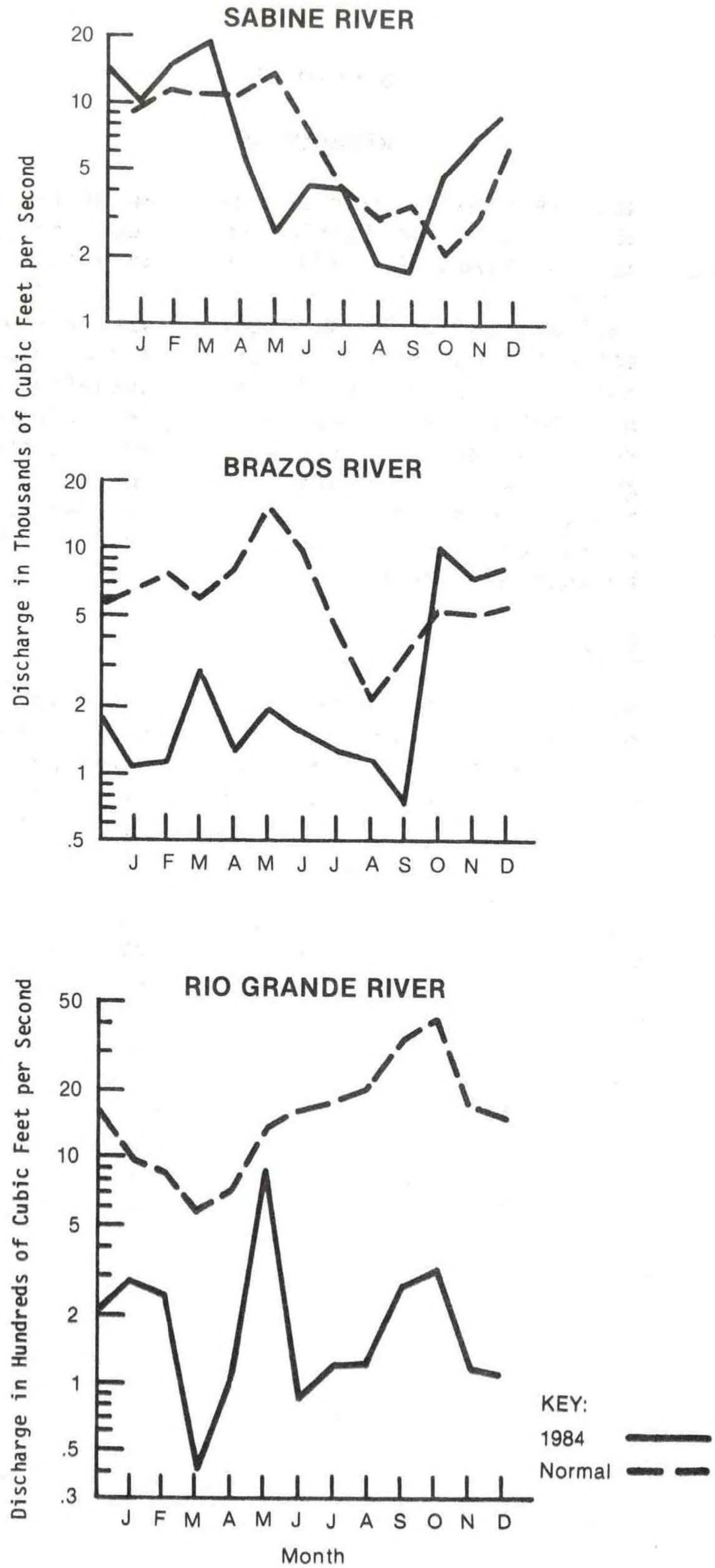


Figure 3-4a (Continued).--Monthly streamflow from major river systems entering the Gulf of Mexico during 1984 and average monthly streamflow. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and the International Boundary and Water Commission.

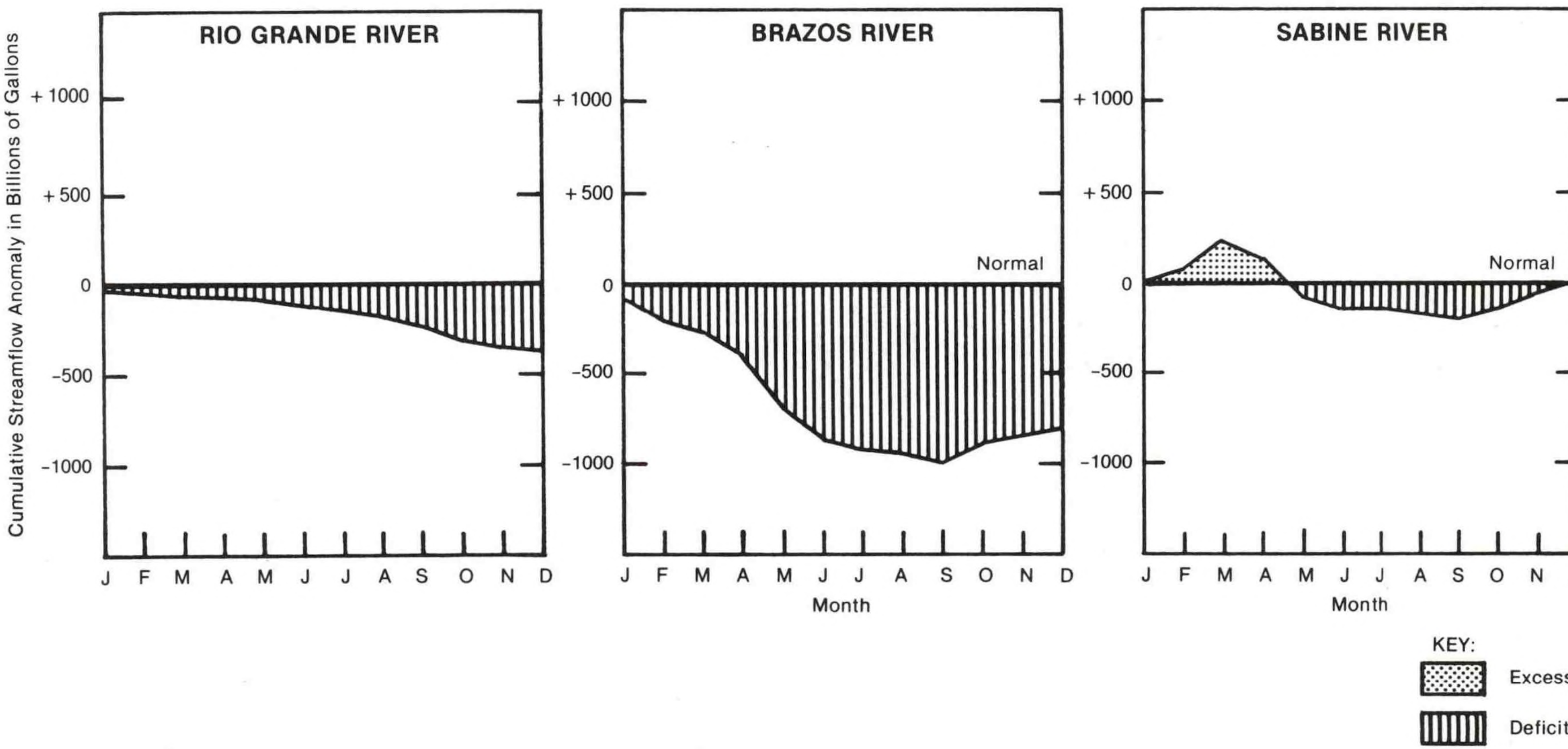


Figure 3-4b (Continued).--Cumulative monthly streamflow anomaly, major river systems entering the Gulf of Mexico, 1984. Data from U.S. Geological Survey, U.S. Army Corps of Engineers, and International Boundary and Water Commission.

Mississippi River

The Mississippi River monitoring station at Tarbert Landing, MS, measured streamflow excesses for nine months of 1984 with no month's having less than 90 percent of normal flow during the year. The months of January, February, and September experienced below-normal flows. Flows in the remaining months were at least 110 percent of normal, and record flow in November of 205 percent of normal enabled the river to finish the year with a cumulative streamflow excess of 32,600 billion gallons.

Atchafalaya River

The Atchafalaya River flows into Atchafalaya Bay and is monitored at Simmesport, LA. Only September flow, which was 75 percent of normal, was below normal for 1984. Like the Mississippi River, the Atchafalaya experienced record flow in November of 265,000 cubic feet per second, or 225 percent of normal. This record flow, along with the above-normal flows in ten of the other months, accounted for a cumulative streamflow excess for 1984 of 15,220 billion gallons.

Sabine River

The Sabine River, monitored near Ruliff, TX, flows into Sabine Lake. Streamflow for 1984 was just above normal, as seven months of the year exhibited flows greater than normal. The months of April through June and August and September had below-normal flows with May's flow only 18 percent of normal. This produced a cumulative streamflow deficit of 200 billion gallons by the end of September. However, high flows in October (241 percent of normal), November (246 percent of normal), and December (144 percent of normal) brought the cumulative streamflow anomaly to 0 for the year.

Brazos River

The Brazos River flows directly into the Gulf of Mexico. The station at Richmond, TX, had only three months, October through December, with streamflows above normal. Although the flows in these months ranged from 144 percent to 194 percent of normal, flows as low as 15 percent of normal in 1984 during months of normally high flow made the cumulative streamflow anomaly a deficit of 790 billion gallons at year's end.

Rio Grande River

The Rio Grande River flows directly into the Gulf of Mexico and is monitored near Brownsville, TX. Streamflow was below normal for each month of the year with the highest flow, 870 cubic feet per second, and highest percent of normal, 65 percent, occurring in May. The cumulative streamflow anomaly was a deficit of 300 billion gallons for 1984.

3.5 Surface Water Salinity and Temperature

Surface water salinity and temperature were evaluated for the selected National Ocean Service (NOS) stations depicted in Figure 3-5. Tables 3-4 and 3-5 give the long-term mean salinities and temperatures and the 1984 departures from these normal values.

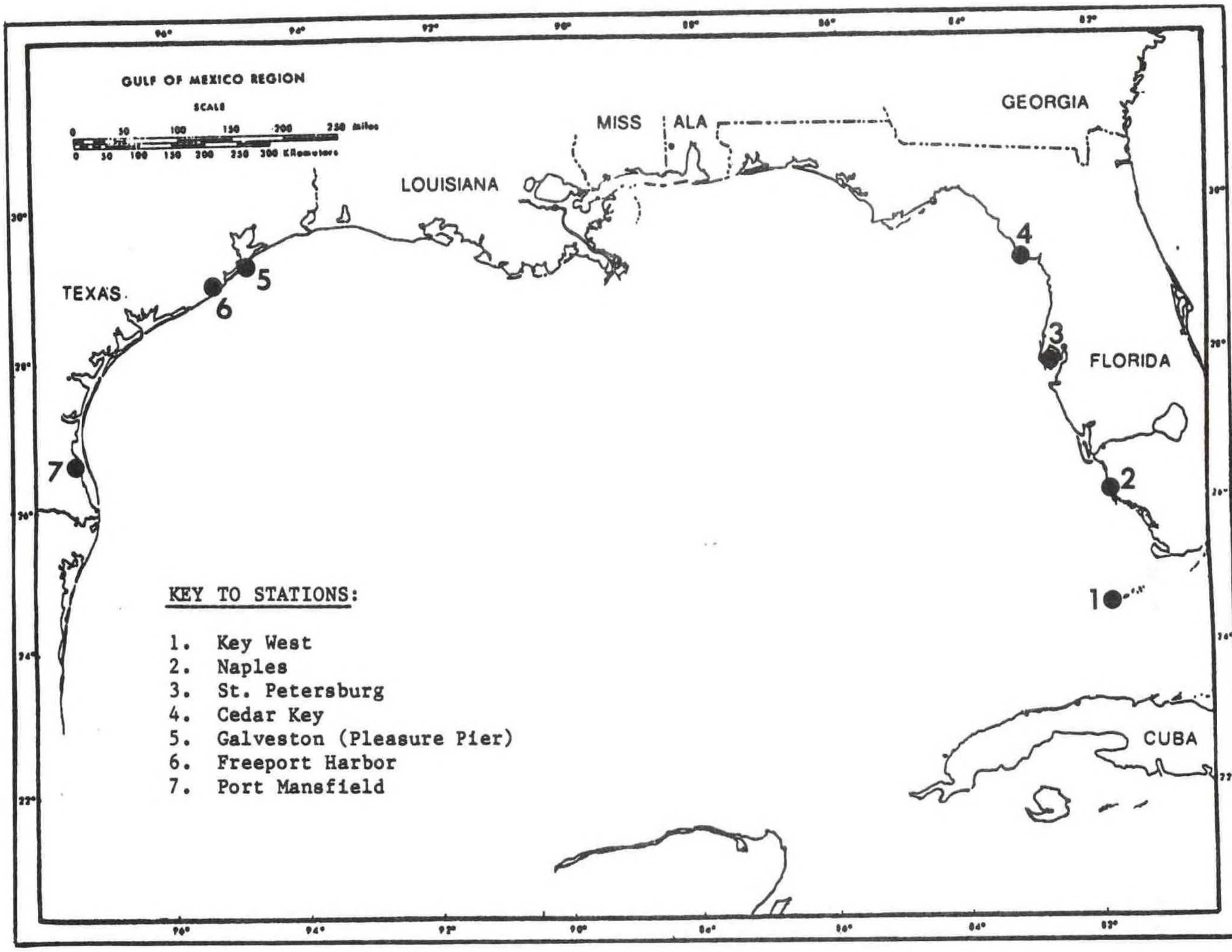


Figure 3-5.--Selected National Ocean Service temperature and density stations, Gulf of Mexico.

Table 3-4.--Monthly long-term average surface salinity and departure from normal, selected stations, Gulf of Mexico, 1984.

A. Monthly long-term average (ppt)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
	Month												
Key West	36.0	36.2	36.4	36.7	37.0	36.6	36.7	36.7	36.2	35.8	36.3	36.2	36.4
Naples	35.7	35.7	36.2	35.3	36.0	35.8	35.3	34.5	33.7	34.2	34.8	35.0	35.2
St. Petersburg	26.8	26.7	26.4	26.5	27.8	28.8	28.0	25.4	23.4	23.9	25.6	26.5	26.3
Cedar Key	27.1	26.0	24.7	24.7	26.0	27.5	27.1	25.9	25.6	26.1	27.5	27.3	26.3
Galveston (Pleasure Pier)	29.1	29.1	28.4	26.1	24.8	28.2	31.8	33.3	28.6	28.5	29.7	29.5	28.9
Freeport Harbor	24.7	24.1	25.8	25.2	23.3	26.0	30.4	33.1	28.4	25.1	25.9	25.1	26.4
Port Mansfield	34.8	35.0	35.3	35.4	33.6	33.3	36.4	40.3	39.8	37.6	38.6	37.1	36.4

Table 3-4.--(Continued). Monthly long-term average surface salinity and departure from normal, selected stations, Gulf of Mexico, 1984.

B. Departure from normal, 1984 (ppt)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Month											
Key West	0.4	-0.3	0.1	0.0	0.0	0.1	0.5	0.6	0.4	0.7	*	1.1
Naples	-1.0	-0.5	-0.2	0.7	1.9	1.7	1.9	2.7	4.1	3.6	3.0	2.0
St. Petersburg	-2.2	-1.4	-1.3	-1.1	-1.2	-1.0	0.6	2.0	3.4	4.1	2.7	2.0
Cedar Key	-1.2	-2.9	-4.8	-8.5	-3.8	-2.6	-1.6	-0.5	1.8	1.5	-1.4	2.9
Galveston (Pleasure Pier)	-4.1	-3.3	-1.5	1.9	0.2	-7.2	0.7	-4.4	-0.4	-4.3	-17.8	-17.3
Freeport Harbor	-2.9	1.3	2.1	4.8	1.9	-2.8	3.2	-2.2	1.5	**	-5.8	-2.6
Port Mansfield	-2.0	-9.0	-9.7	-4.9	-1.4	-0.4	-0.3	-1.6	-9.2	-19.9	-17.1	-12.6

* Data unavailable.

** Insufficient number of days of data to generate a monthly mean.

Table 3-5.--Monthly long-term average surface water temperature and departure from normal, selected stations, Gulf of Mexico, 1984.

A. Monthly long-term average (Degrees C)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
	Month												
Key West	21.7	22.1	23.7	25.8	27.9	29.6	30.4	30.6	29.7	27.6	24.4	22.3	26.3
Naples	18.1	18.1	19.9	24.8	27.5	29.8	30.7	30.6	29.4	27.6	22.2	19.9	24.9
St. Petersburg	16.7	17.6	19.7	23.1	26.4	28.8	29.7	29.7	28.7	25.4	21.0	17.6	23.7
Cedar Key	14.4	15.7	18.4	22.9	26.4	29.1	29.8	29.8	28.3	24.2	19.0	15.4	22.8
Galveston	11.9	12.8	15.7	21.4	25.4	28.3	29.7	30.0	28.3	24.4	19.3	14.9	21.8
Freeport Harbor	11.9	13.5	16.2	21.4	25.1	27.7	28.7	29.3	27.9	23.8	18.9	14.9	21.6
Port Mansfield	14.6	16.1	18.6	23.8	26.1	28.3	29.2	29.2	28.3	24.6	20.7	16.7	23.0

Table 3-5.--(Continued). Monthly long-term average surface water temperature and departure from normal, selected stations, Gulf of Mexico, 1984.

B. Departure from normal, 1984 (Degrees C)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Month											
Key West	-2.0	-0.7	-0.8	-1.0	0.0	-1.3	-0.3	0.1	-0.8	-0.1	*	0.6
Naples	-0.4	0.7	0.7	-1.0	0.4	-1.4	-0.4	0.4	-0.3	-1.2	-0.1	0.5
St. Petersburg	-1.5	1.5	0.6	-0.6	0.8	-0.1	0.6	0.9	0.2	0.9	0.5	2.4
Cedar Key	-2.5	0.6	0.0	-1.2	0.7	0.1	-0.2	0.6	-0.5	1.4	-2.1	3.3
Galveston	-2.1	-0.1	0.2	-1.2	0.2	-0.4	-0.9	-0.9	-0.6	0.4	0.7	1.3
Freeport Harbor	-2.3	3.8	1.1	-0.8	0.5	1.0	0.5	0.8	-0.7	**	0.7	2.5
Port Mansfield	-4.5	0.0	1.1	-1.5	-1.0	-0.7	-0.5	-0.4	-1.2	-0.5	-0.7	3.1

* Data unavailable.

** Insufficient number of days of data to generate a monthly mean.

Salinity

Salinities at the NOS stations around the Gulf of Mexico (Figure 3-5) followed the general long-term seasonal patterns in 1984, with some local anomalies. Stations between Naples and Cedar Key normally experience salinity maxima in May or June and minima in September. Secondary maxima occur in late fall or winter with secondary minima in early spring. Stations north and west from Cedar Key to Grand Isle normally experience salinity maxima in November and minima in spring. Stations farther west experience salinity minima later than stations in the eastern Gulf. Secondary maxima and minima occur at these west Gulf stations in the summer months of some years. From Galveston to Port Mansfield the salinity patterns normally show maxima in August and minima in May with secondary maxima in November following slight secondary minima in October.

Salinity at Key West was near normal throughout 1984, but showed a consistently higher-than-normal bias from July onward. At Naples salinity values were normal through April then jumped to around two parts per thousand (ppt) higher than normal and remained there for the remainder of the year. Maximum positive anomalies occurred in September, when salinity was nearly four ppt above normal. Salinities at St. Petersburg followed a pattern similar to that at Naples with slighlty lower-than-normal values during the first six months and higher-than-normal values for the last half of the year. Maximum positive excursion was in September with anomalies of four ppt.

At Cedar Key the salinity regime was marked by an extreme negative anomaly in April when values averaged as low as 16 ppt, almost 9 ppt lower than normal for the spring. The values recovered and were near normal from July through November. In December the monthly mean was over 30 ppt, about 3 ppt above the normal December value.

Salinity values at Galveston followed the normal seasonal pattern but with extreme values in several months. In June the seasonal minimum went as low as 21 ppt, at least 4 ppt lower than the values normally are at this time of year. After a fairly normal July, August, and September, the values again plunged in October to four ppt below normal. But the really extreme drop was in November when the monthly mean dropped to less than 12 ppt, a value more than 17 ppt below normal. The salinity remained this low through December. We have no explanation at this time for this extreme salinity regime at Galveston. The values are probably not erroneous, however, because the extreme anomalies occur also at Port Mansfield (-20 ppt anomaly in October) and to a lesser degree at Freeport. At year's end all the western Gulf of Mexico stations still showed showed strongly negative salinity anomalies.

Temperature

No distinctive temperature anomalies appear in the monthly means for the Gulf stations during 1984.

3.6 Wind-Induced Mass Transport

The Assessment and Information Services Center has computed wind-driven mass transport estimates based upon the National Weather Service Limited-area, Fine-mesh Model (LFM) - II dataset. The transport values are not intended as a measure of the absolute magnitudes of the transport, but as relative magnitudes and directions of the wind-induced surface layer transport. Since commercial species in the Gulf such as menhaden and shrimp spawn offshore and rely on wind-driven transport to convey larvae into estuarine nursery areas, the patterns of transport at the critical times are important for estimating survival of year classes.

Figure 3-6 shows the mean monthly transports computed for 1984 and for the seven-year period 1977-83. The units are expressed as cubic meters per second per meter of baseline length normal to the wind vector so as to be comparable to previous similar computations in the literature.

The wind-induced circulation in the Gulf is divided geographically into five areas for this discussion: west Florida Shelf, northeast Gulf, northwest Gulf, southeast Texas coast, and the Mexican coast. The following discussion will address the regional transports and their comparison to the monthly 1977-83 normals on a monthly basis for calendar year 1984.

Campeche Bay and the Caribbean LFM - II dataset was initially stored starting in June 1982. Thus, any comparisons of the Campeche Bay 1984 data to the monthly mean must be considered limited due to the lack of a climatological mean for this area.

Monthly Mass Transports

Offshore flows larger than the mean were predicted for January for the Florida Shelf as were greater alongshore flows to the west-southwest for the northeastern and northwestern Gulf areas. This west-southwest surface flow began to rotate counterclockwise from a large onshore to alongshore flow as the southeast Texas and Mexican coast was approached.

Directions of flow for the majority of the Gulf for January 1984 compared favorably to the mean, while magnitudes were consistently larger - up to 3 or 4 times greater - than the mean. The western Gulf experienced the greatest directional differences with flows to the left, more southward than normal along the coast, while in Campeche Bay and to the north of Yucatan rotations of approximately 45 degrees to the right were noted.

February saw a reduction compared to January of the offshore flow off the Florida Shelf, while the magnitude and direction were comparable to the 1977-83 mean. The northeastern and northwestern Gulf continued to experience flow that was alongshore but reduced in magnitude to the west and west-southwest. Alongshore flow to the south is depicted for the southeast Texas coast. Almost negligible and variable flow was present along the Mexican coast.

The expected onshore flow along the Texas and Mexican coast was not predicted for 1984.

Magnitudes and directions for the majority of the Gulf were similar to the mean, although the southeastern Texas and Mexican coasts and Campeche Bay had relatively large departures from the mean directions.

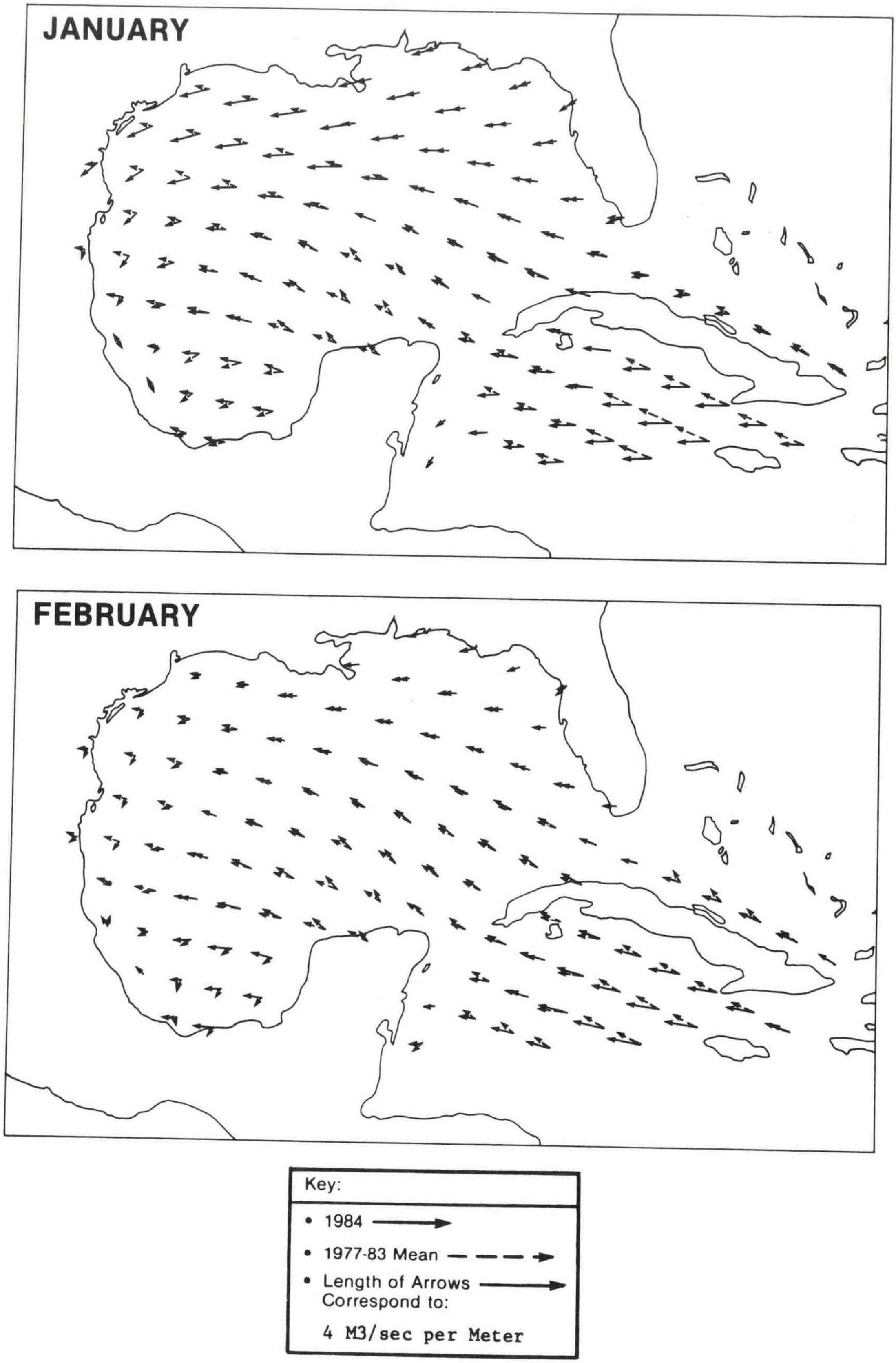


Figure 3-6.--Mean monthly mass transport, 1984, and 1977-83.

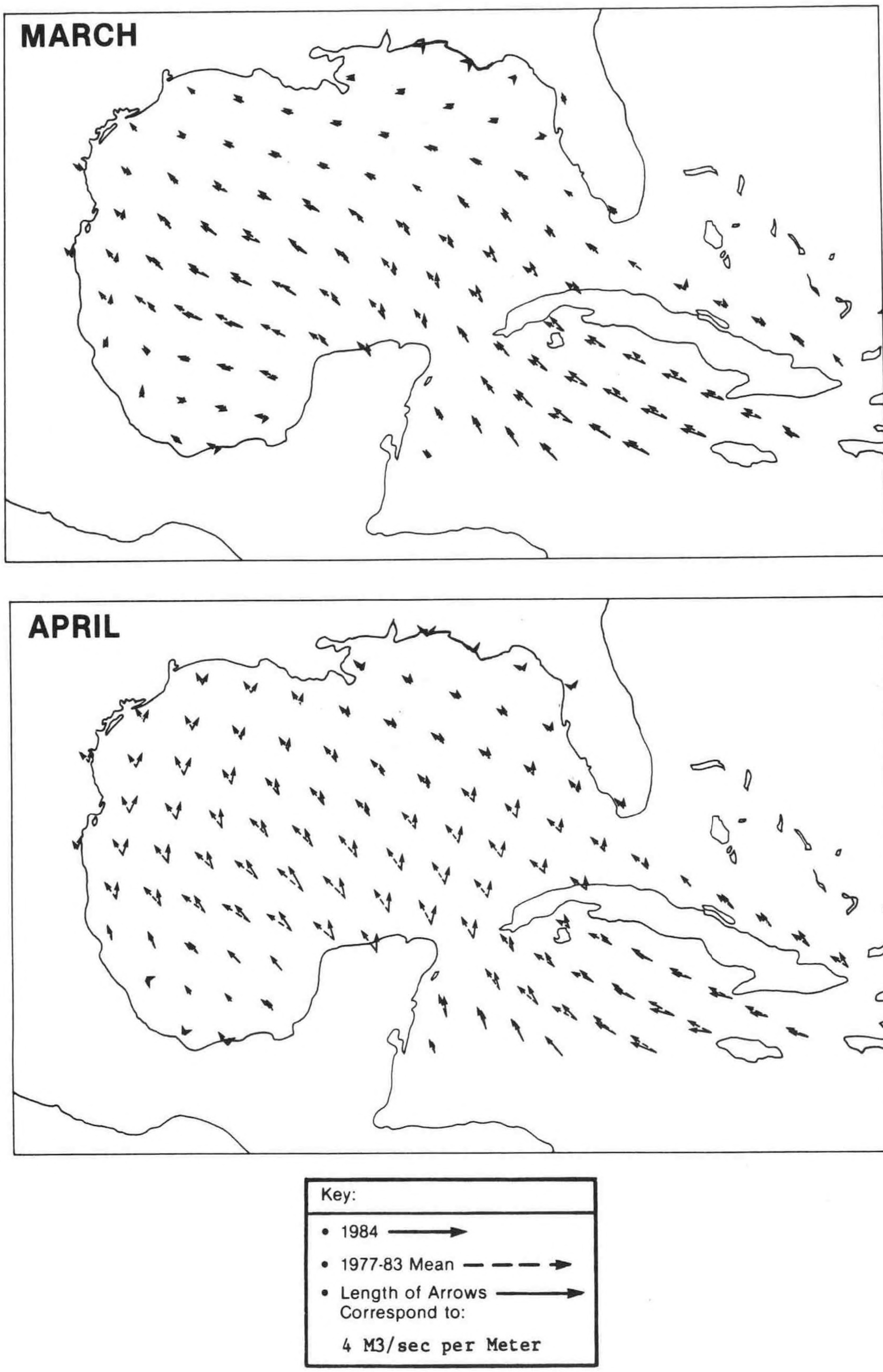


Figure 3-6 (Continued).--Mean monthly mass transport, 1984, and 1977-83.

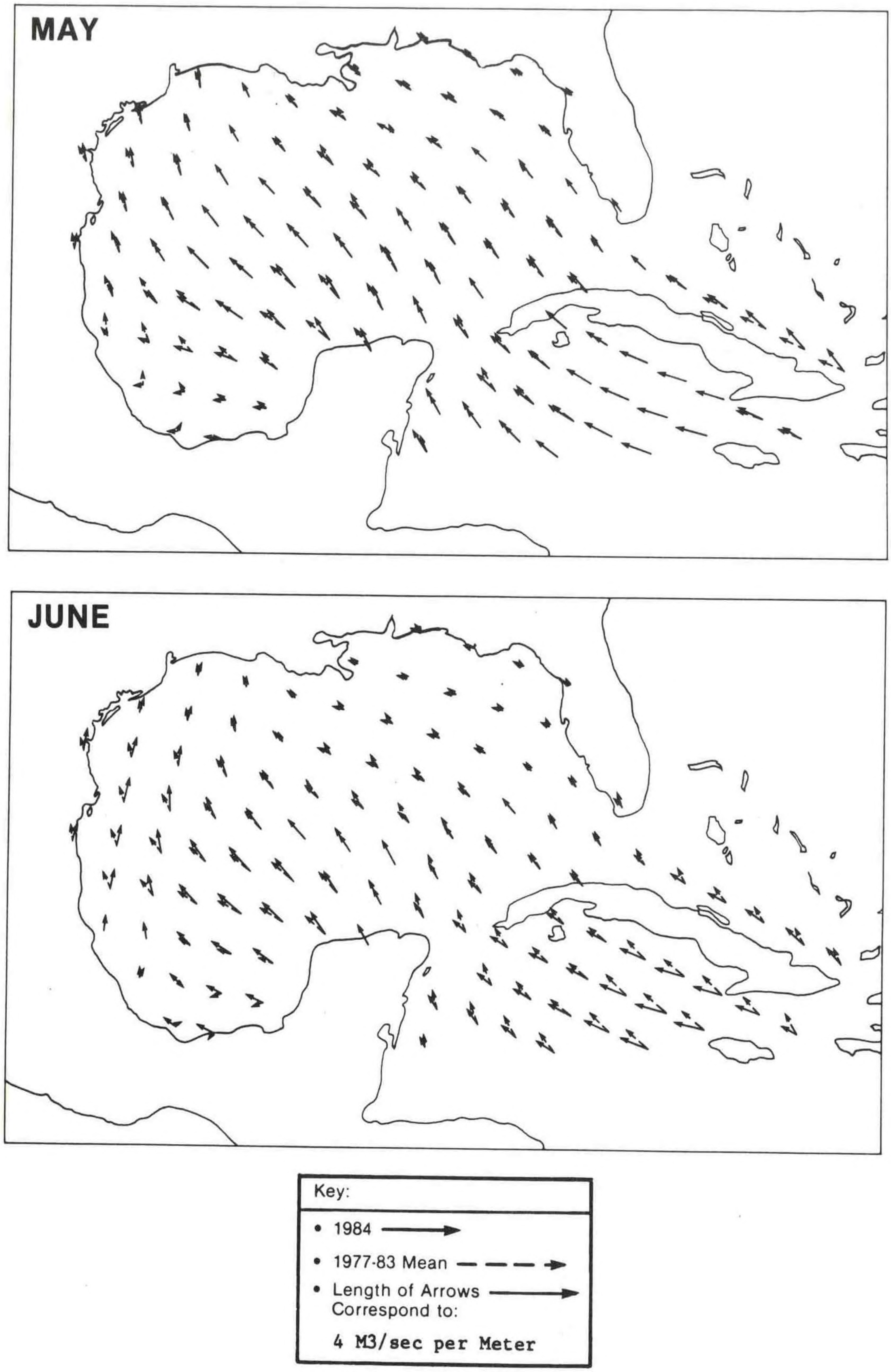


Figure 3-6 (Continued).--Mean monthly mass transport, 1984, and 1977-83.

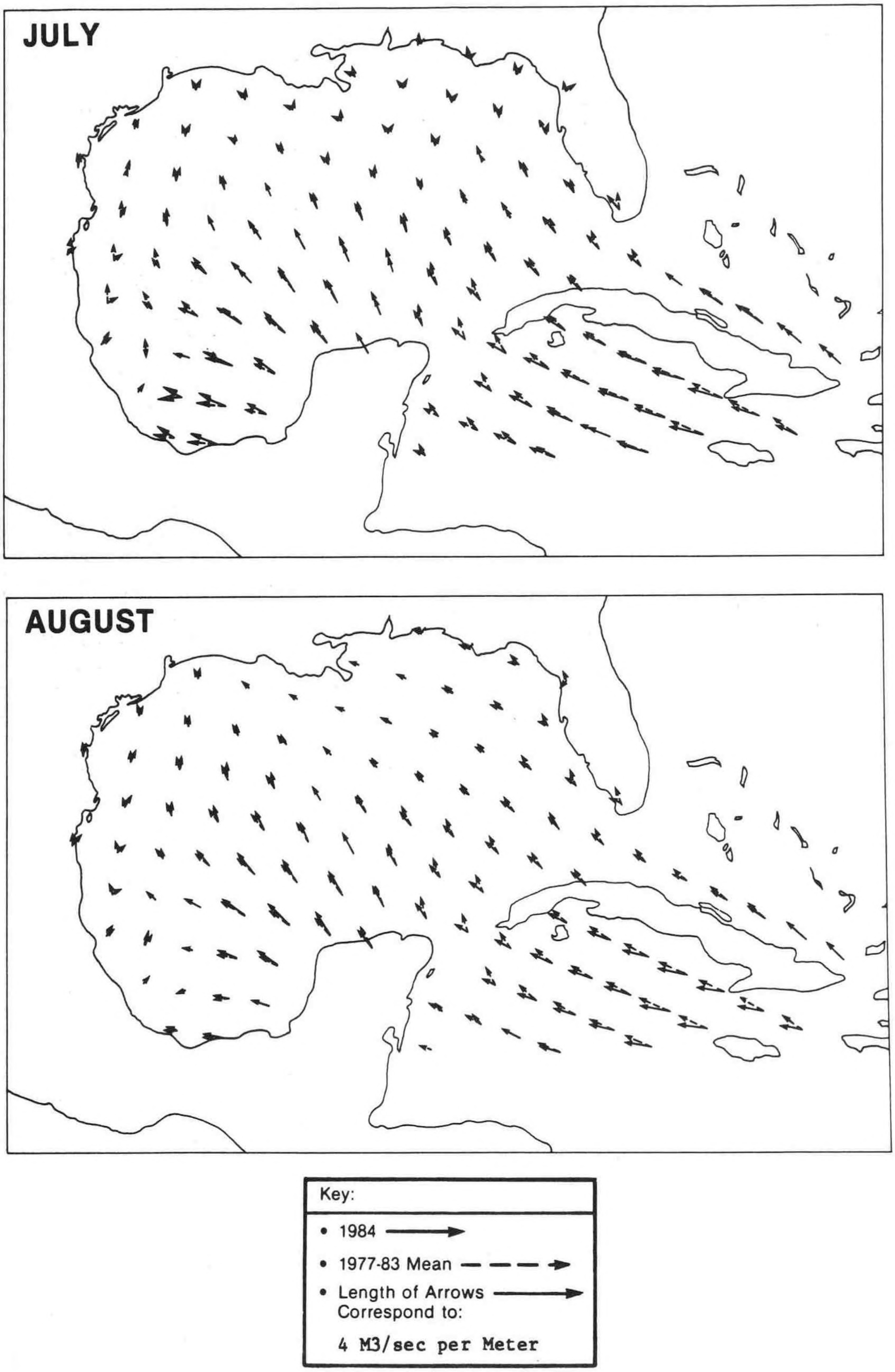
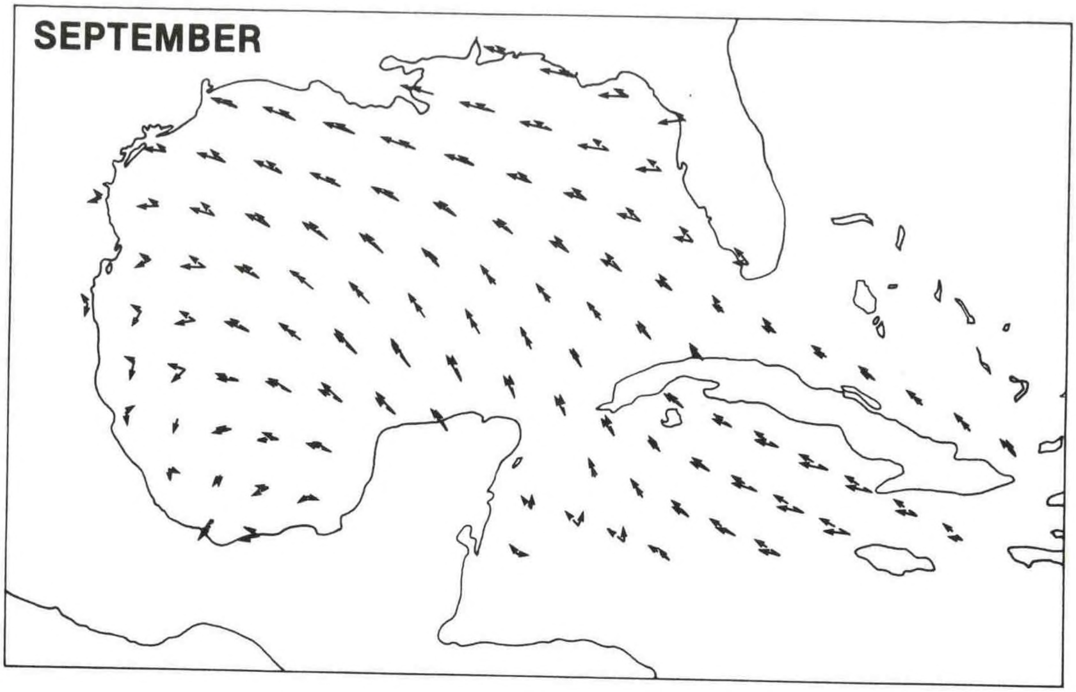
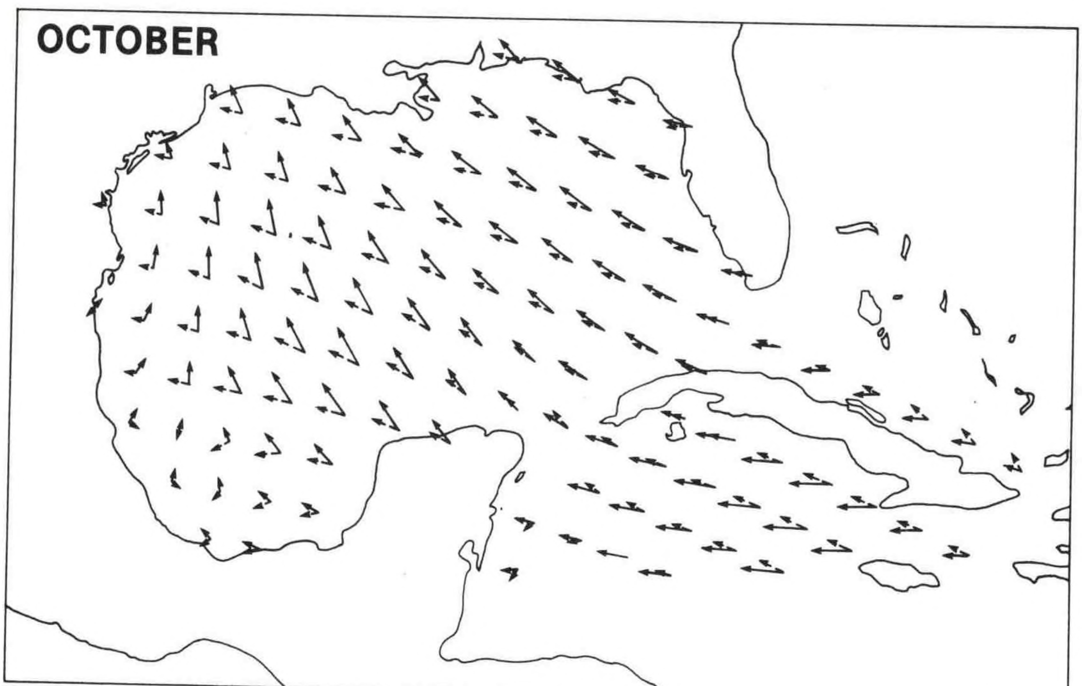


Figure 3-6 (Continued).--Mean monthly mass transport, 1984, and 1977-83.





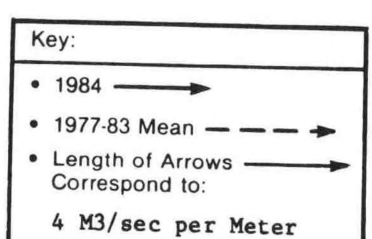


Figure 3-6 (Continued).--Mean monthly mass transport, 1984, and 1977-83.

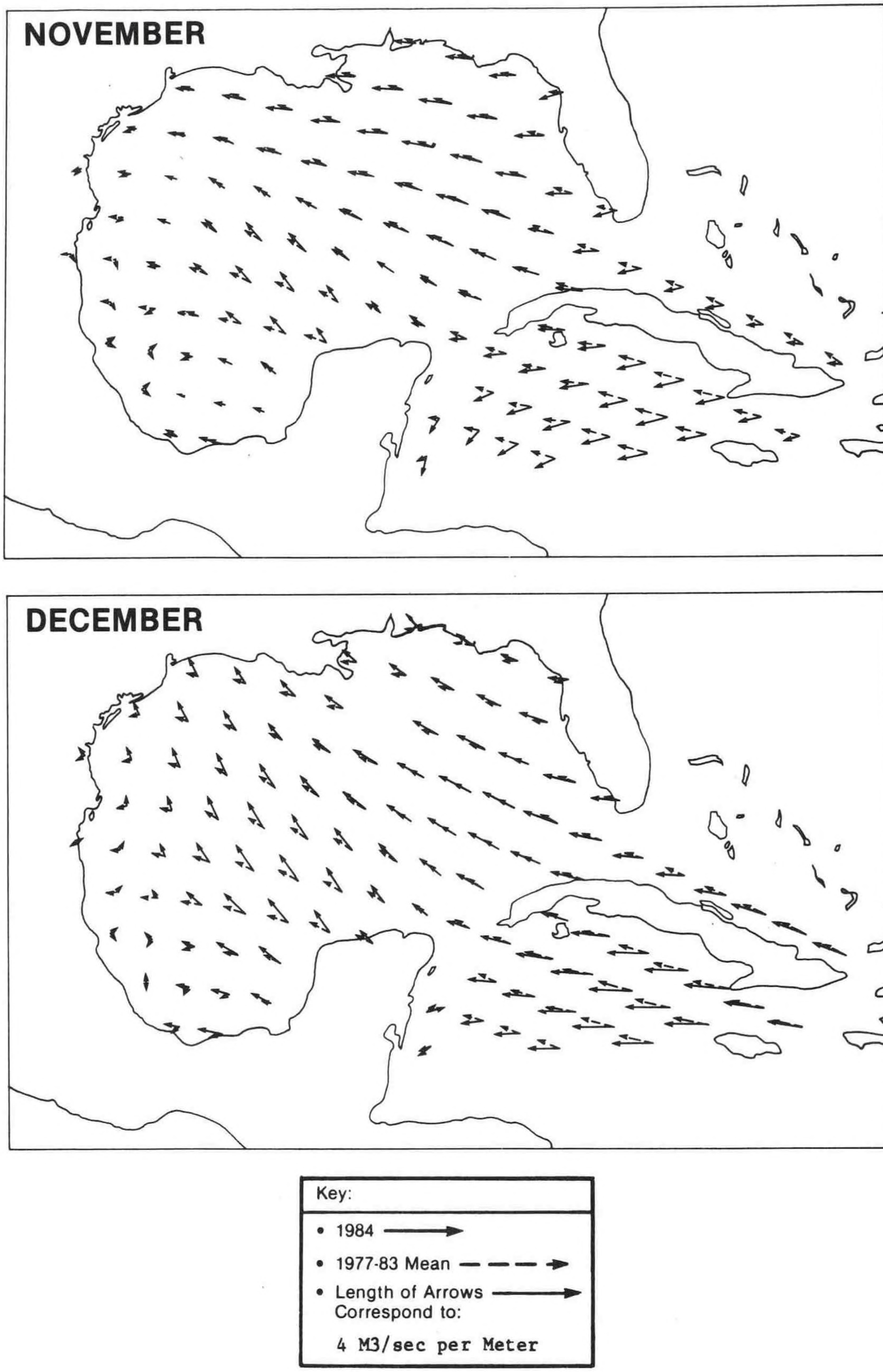


Figure 3-6 (Continued).--Mean monthly mass transport, 1984, and 1977-83.

During January and February there was a westward flow of the surface waters for the Gulf, while for March a northward component appeared in the majority of the predicted mass transport vectors. Offshore flow to the northwest off the south Florida shelf, which was reduced and rotated to the west off Tampa, was predicted for March 1984. This compared favorably to the 1977-83 mean. Slight offshore flow to the south-southwest was predicted for the Florida panhandle, while westward flow returned off the Mississippi Delta. West-northwest flow along the northwest Gulf pushed the surface waters onshore not alongshore as in the previous two months. Reduced alongshore flow to the north was predicted for the entire Mexican and southeast Texas coast not the expected northwest, onshore flows. Directions for the Gulf as a whole compared favorably to the mean, while the majority of the magnitudes were reduced compared to the mean. Compared to both the mean for April and the March 1984 vectors, April saw an additional increase in the northward component of all mass transport vectors, except for Campeche Bay. Alongshore flow for the southern Florida Shelf rotated clockwise to become northeastward to the north of Tampa. Onshore, northeastward flow was predicted along the entire northern Gulf of Mexico. Northward, alongshore flow along Texas and Mexico was predicted. Most mass transport vectors were rotated up to 45 degrees to the right and reduced in magnitude in comparison to the 1977-83 mean vectors.

This may indicate that surface waters were piling up along the northern Gulf of Mexico coastline which might have resulted in increased monthly mean sea level for that area.

The usual north-northwestward flow of the surface waters within the Gulf returned in May. North-northwestward offshore flow along the Florida Shelf became onshore flow for the northeastern Gulf of Mexico. The north-northwestward flow off the Mississippi Delta became more northward as the southeast Texas coast was approached. Alongshore northward flow was predicted for the Mexican and southeast Texas coast. The mass transport vectors were again comparable in directions and magnitudes for the entire Gulf except for Campeche Bay. This disparity in direction for Campeche Bay may be the result of the limited time history (June 1982 through December 1984) of data used in producing the means for this area.

Northwest to north-northwestward flows were predicted for the entire eastern Gulf of Mexico, while north-northwest rotating to north-northeast flows were expected in the western Gulf in June. Alongshore flows were predicted for the Florida Shelf changing to onshore and alongshore flows for the northeastern Gulf. Onshore flows from the Mississippi Delta westward to Matagorda Bay, TX, were depicted. Strong alongshore, north-northeast flows were depicted for the southeast Texas coast south to Campeche Bay. June 1984 magnitudes and directions were very similar to the 1977-83 mean conditions for the entire Gulf.

Stronger-than-normal north-northwestward flow was predicted for the Florida Shelf in July. This transport was different from the more northward and north-northeast, onshore flows of the mean vectors. Northward, onshore, and stronger flows than the slight onshore mean flows were predicted for the northeastern Gulf. Northwestward flows, not northward mean flows, from the Mississippi Delta to Galveston were predicted, while the magnitudes were somewhat similar. Alongshore, northward flow similar to the mean was shown for the southeast Texas coast, while the slight offshore, northeast flows for the Mexican coast did not resemble the 1977-83 alongshore mean flow. Thus, a divergence in surface flow was predicted for the waters offshore Brownsville, TX. The United States and adjacent Mexican coastal waters of the Gulf showed the largest departures from the mean, while the remainder of the July mass transport vectors compared favorably to the mean.

Northwest, offshore flows along the Florida Shelf for August became onshore flows for the northeastern Gulf coastal region. Northwest rotating to northward flows were predicted for the Mississippi Delta to Matagorda Bay region. Alongshore, north-northeastward flows along the southeast Texas coast are depicted in this month's figure. Strongly offshore, northeastward flow was predicted for the Mexican coastal water adjacent to Texas compared to the expected alongshore slightly onshore, north-northwest flow of the 1977-83 mean. The coastal waters of Florida and Mexico showed the largest departures in direction for this month compared to the mean, while magnitudes were similar throughout the Gulf.

Strong west-northwest to north-northwest flow dominated the Gulf of Mexico except for Campeche Bay in September. The strong offshore surface transport which was predicted for the Florida Shelf became alongshore and onshore flow for the northeast Gulf. Strong onshore flow was predicted for the Galveston Bay area and west and south to Brownsville, TX, while alongshore, northwest flow from the Mississippi Delta to Galveston was predicted for September 1984. The first substantial southward flows of the year were depicted for the Mexican coast adjacent to Texas. This was significantly different from the expected northwestward mean flow.

Two different flow patterns appeared to be active in the Gulf during September. The stronger-than-normal Florida and northeastern Gulf flows appeared to originate from an atmospheric high located to the north of the Gulf, while the remainder of the Gulf was dominated by a low centered in Campeche Bay. Thus, a line of convergence crossed the Gulf from southern Florida northwest to Galveston, TX.

Stronger-than-normal west-northwest to northwest flows dominated the Florida Shelf and northeast Gulf of Mexico in October. Offshore flows that were stronger than the mean were predicted for the Florida Shelf, but the direction of flow was similar to the mean. Intense onshore, northwest flow for the northeastern Gulf was significantly different from the mean west-northwest, alongshore flow. Onshore, north-northwest flow which was stonger and rotated up to 45 degrees to the right of the 1977-83 mean direction was depicted for the northwestern Gulf. Alongshore to offshore flow, not the mean onshore flow, dominated the Texas and adjacent Mexican coastal waters.

Directions of flow for October were similar to the mean in the eastern Gulf but became increasingly dissimilar when moving from east to west. Magnitudes of flow were significantly larger for all vectors. A convergence zone having a northerly trend (Veracruz, Mexico to Sabine Pass, TX) is in evidence in the western Gulf.

Mass transport vectors for the Florida Shelf presented an image of stronger-than-normal offshore, westward flow for the month of November. This westward flow became alongshore with a slight onshore component for the northeast and northwest Gulf coastal waters. Magnitudes were still larger than normal for the northern Gulf. Onshore, but with southerly components, west-southwest flows were were predicted for the southeast Texas region. Slight southwest rotating to east-southeast flows were depicted for the Mexican coast. Campeche Bay continued to be an area of rotation with adjacent vectors directed at each other. other. Overall the flow for November was similar in direction to the mean but of increased magnitude.

December directions of flow were similar to the mean in the eastern Gulf but became increasingly dissimilar as the Texas and Mexican coast was approached. Magnitudes were consistently larger for the entire Gulf than the predicted mean vectors. Strong offshore, west-northwest flow of surface waters for the Florida Shelf became more northwestward, onshore flows for the entire northern Gulf. Onshore and alongshore, north-northwest flows were predicted for the Texas coast, while north-northeast to northeast, offshore flows were forecast for the adjacent Mexican coast.

3.7 Loop Current Activities

The circulation in the Eastern Gulf of Mexico is dominated by the Loop Current. This current is a continuation of the Caribbean Current which enters the Gulf between the Yucatan Peninsula and Cuba (Figure 3-7). The following discussion of the 1984 monthly pattern of the Loop Current and warm core eddies within the Gulf of Mexico was derived from the Oceanographic Monthly Summary published by NOAA/NWS/NESDIS. Figure 3-8 is a series of line drawings of the monthly northern limit of the Loop Current.

The Loop Current appears to follow a cyclic pattern. This pattern can be idealized as an intrusion of warm water into the Gulf that extends to some maximum northern limit. Then an anticyclonic eddy (or eddies) is spun off. This eddy can move slowly in a westerly to southwesterly direction into the Western Gulf or be reabsorbed into the Loop Current only to be spun off again later. After the eddy is spun off, the Loop Current retreats to its southern limit (minimum intrusion into the Gulf) which can be as far south as Cuba. This idealized cycle can have a repeat period from less than one year to almost two years.

This cyclic pattern of maximum intrusion of the Loop Current and the eddies and filaments which are produced by this current dominate the circulation in the Eastern Gulf of Mexico and the Florida Shelf. The eddy which becomes detached from the Loop Current slowly migrates westward, affecting the circulation and water mass properties within the Western Gulf. Its ultimate fate is unknown and under investigation. One hypothesis is that the eddy continues its westward movement and bounces off the Mexican coast, where it slowly decays. Two other eddy-like features are observed in the Western Gulf. An anticyclonic eddy-like feature south of Galveston, TX, and a cyclonic feature in Campeche Bay have been observed.

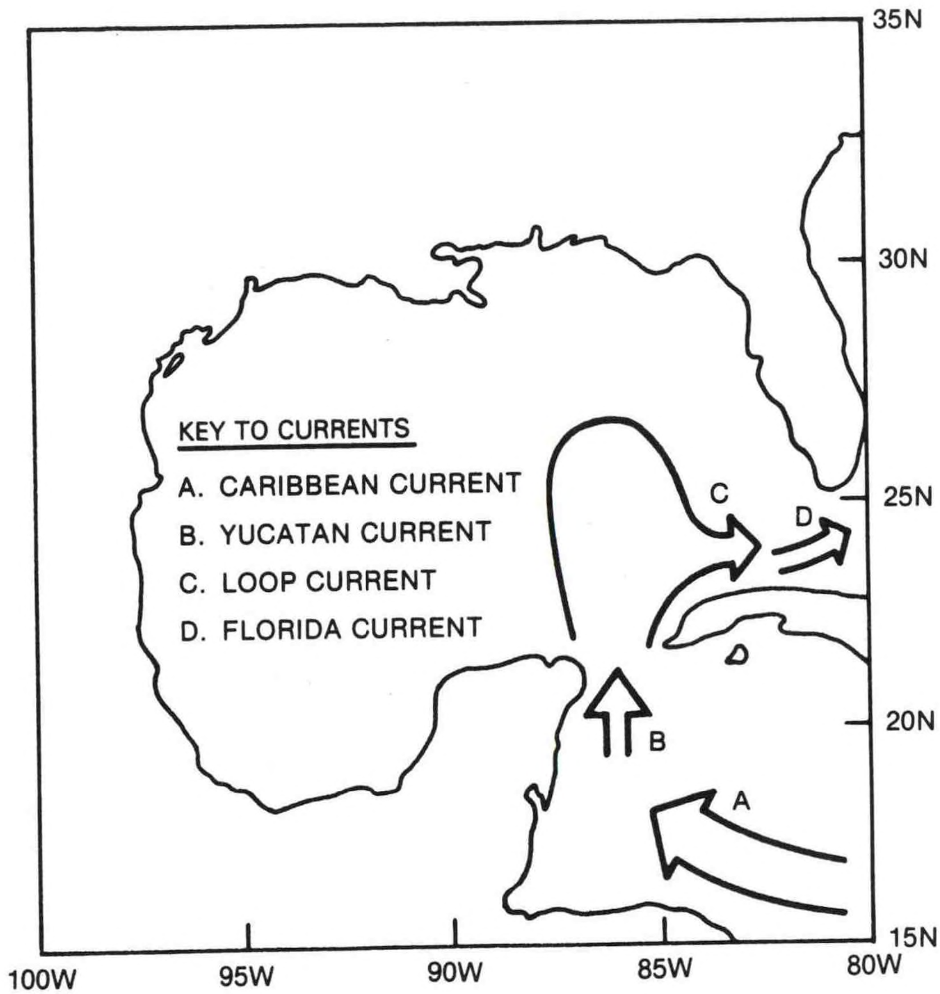


Figure 3-7.--Schematic of major density-driven mass transport in the Gulf of Mexico.

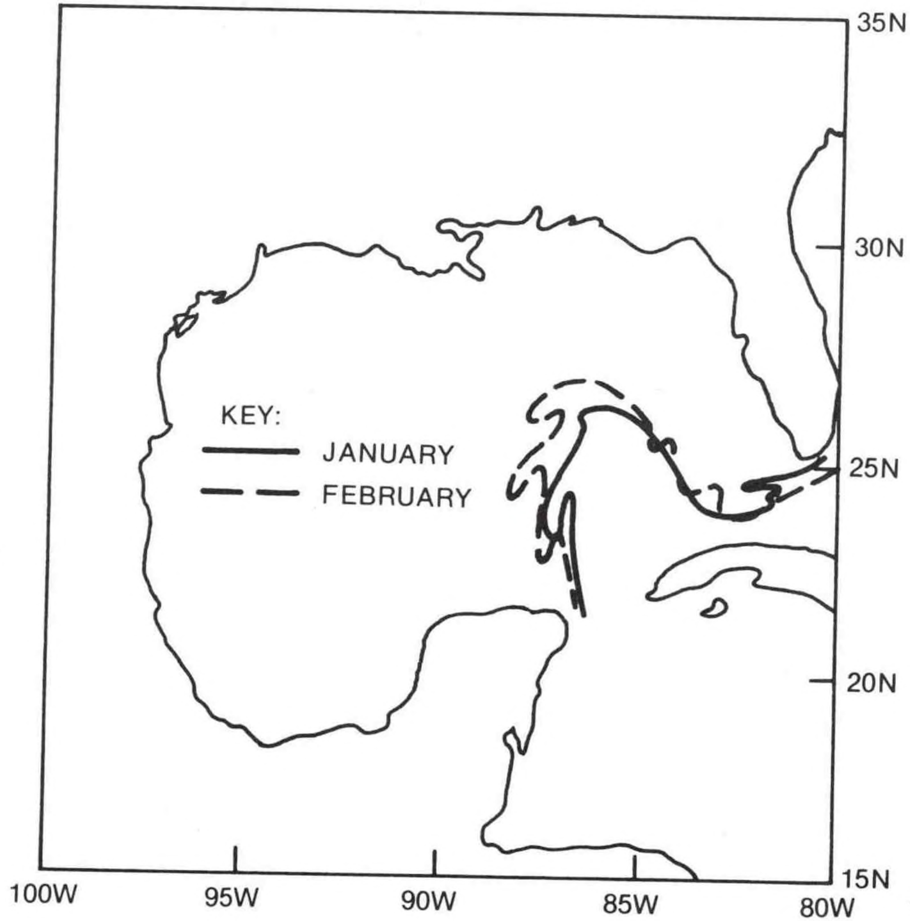


Figure 3-8.--Northern extent of the Loop Current. Figure drawn from material in Oceanographic Monthly Summary: January and February, 1984.

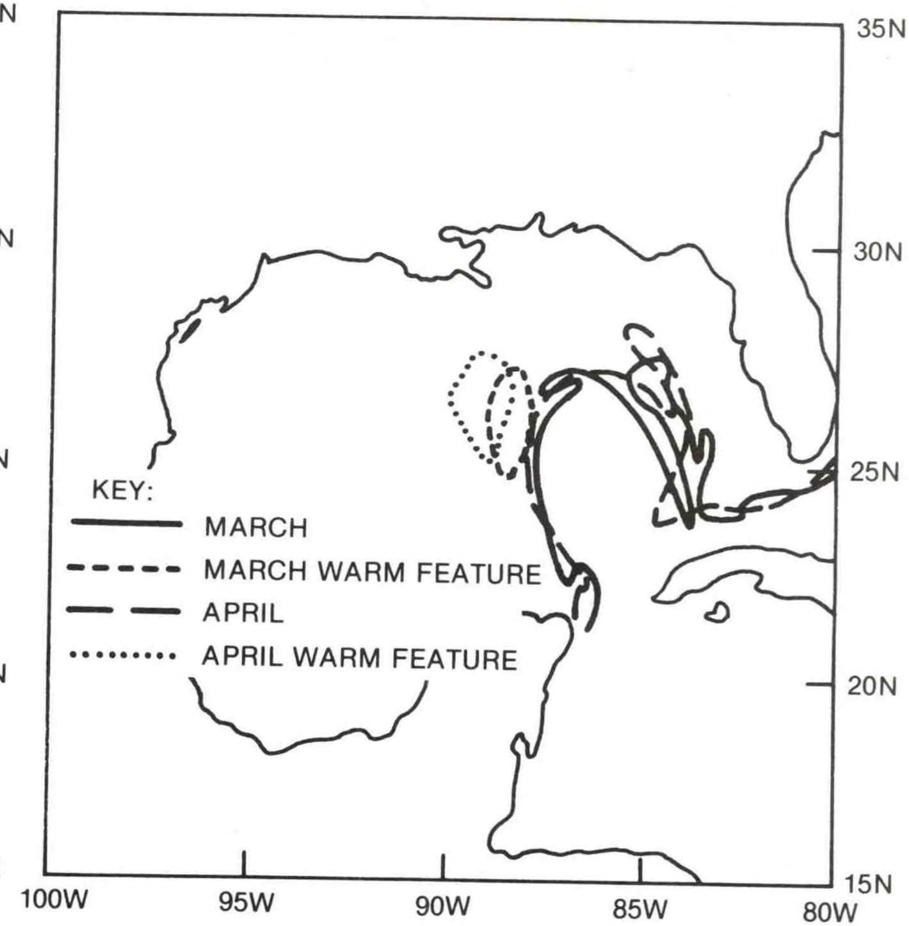


Figure 3-8 (Continued).--Northern extent of the Loop Current. Figure drawn from material in Oceanographic Monthly Summary: March and April, 1984.

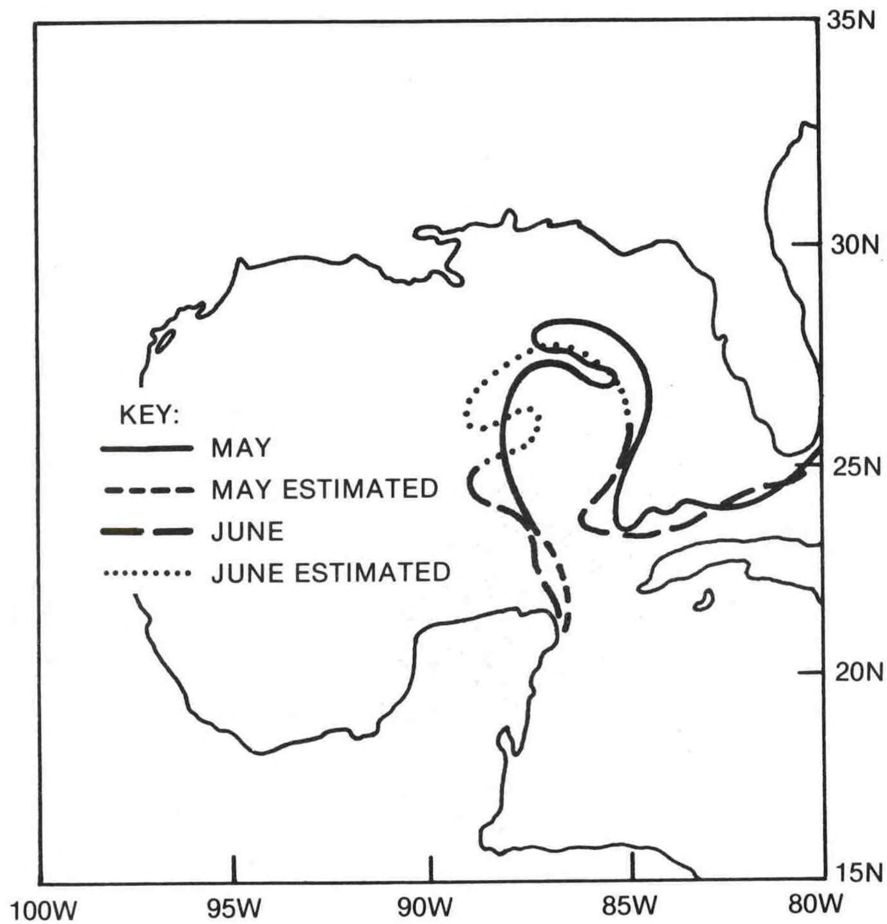


Figure 3-8 (Continued).--Northern extent of the Loop Current. Figure drawn from material in Oceanographic Monthly Summary: May and June, 1984.

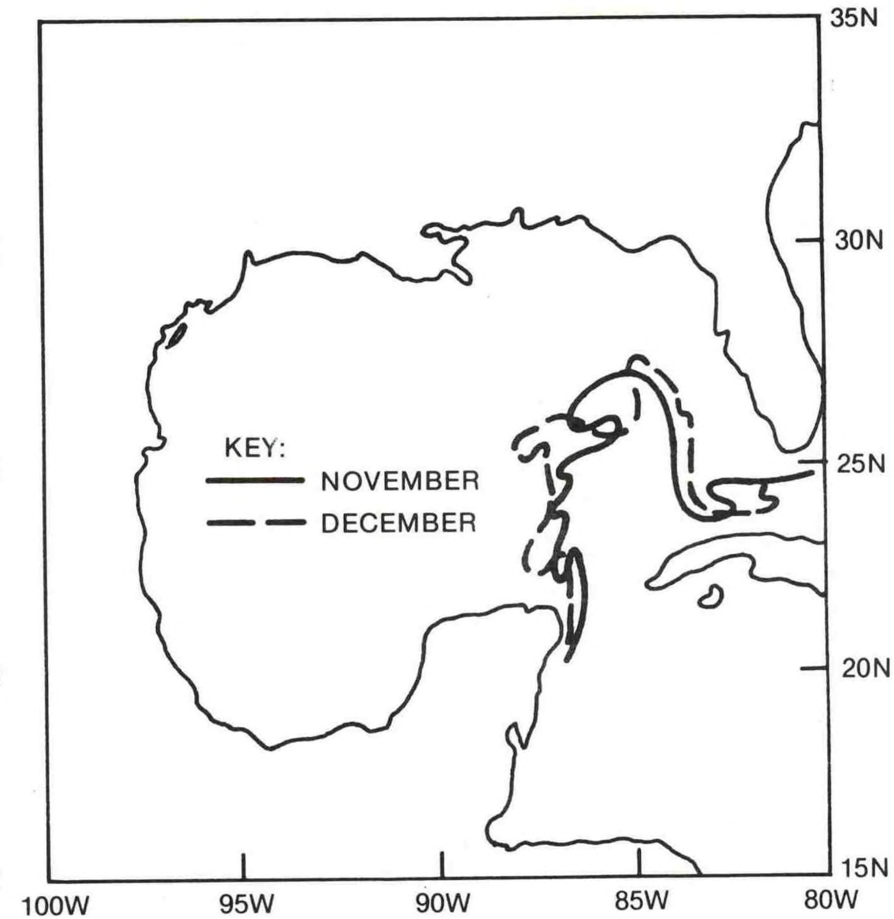


Figure 3-8 (Continued).--Northern extent of the Loop Current. Figure drawn from material in Oceanographic Monthly Summary: November and December, 1984.

Figure 3-9 is a representative image of the satellite-derived sea surface temperature field for the Gulf of Mexico for May 6, 1984. Land and thick clouds are blackened out. The Yucatan Peninsula is at the center bottom of the image and Florida is on the extreme upper right-hand side. Spring warming of the Gulf is depicted with the warmest surface water temperatures along the Mexican coast in Campeche Bay and the cooler waters along the American coast. There is extensive cloud cover and cloud contamination of the coastal waters of Texas and Louisiana. The Loop Current, with waters of 27°C is seen north of the clouds which cover the Yucatan Straits and western Cuba. A warm feature (26°C) is seen to the west of the northern portion of the Loop Current. The 26°C waters appear to be interacting with the waters of the west Florida shelf in this image.

January 1984 started with a large westward expansion of the Loop Current centered at 26°N 87.5°W. The northern limit was approximately 27.5°N. This configuration resulted from the absorption of eddy j by the Loop Current during the last week of December 1983. By the end of the month a warm core eddy (probably modified eddy j) labelled k detached from the Loop Current. The northern limit of the current retreated to approximately 26°N. Eddy i in the western Gulf moved 35 kilometers southeast from its December 1983 location.

The Loop Current's northern limit increased by the end of February to approximately 27°N. Several filaments were seen both on the western and eastern (Florida Shelf) side of the Loop Current. Eddy k remained near the Loop Current on its western side and moved in a southwesterly direction 195 kilometers. Eddy i in the western Gulf translated 65 kilometers to the southwest.

A long (3.5 degree in latitude) warm filament of the Loop Current was located off the West Florida Shelf from the third week of March. The northern limit of the Loop Current had not changed appreciably since February. A warm feature measuring 2 degrees in latitude and 1 degree in longitude and centered centered at 26°N 88.5°W was observed to the west of the Loop Current. Eddy k moved northwestward approximately 55 kilometers, while eddy i in the western Gulf translated in a west-northwesterly direction 75 kilometers.

Northerly increases in the Loop Current of half a degree in latitude and an approximately 1 degree northerly translation of the entire warm filament off the West Florida Shelf were noted for April. The warm filament off the Florida Shelf also moved further offshore by about half a degree of longitude during this month. The warm feature off the western side of the Loop Current remained near the current and translated only half a degree northward. Three warm eddies existed in the western Gulf at the time. Eddy i moved 185 kilometers northeast, while eddy k traveled to the west-southwest about 90 kilometers. A new eddy l was observed on April 10 and translated 125 kilometers to the southwest by the end of the month.

The northern limit of the Loop Current moved 55 kilometers to the north, as the warm filament rotated counterclockwise from a 3 o'clock position relative to the Loop Current in April to a 2 o'clock position in May. This warm filament appeared to be shorter in length, but wider and totally off the Florida Shelf (beyond the 200 meter isobath) in May compared to April. The only eddy detected this month was eddy k, whose surface thermal expression contracted in size and moved 25 kilometers to the west-southwest of its end-of-April position. The seasonal cloudiness of the Gulf prevented the observation of eddies i and l.

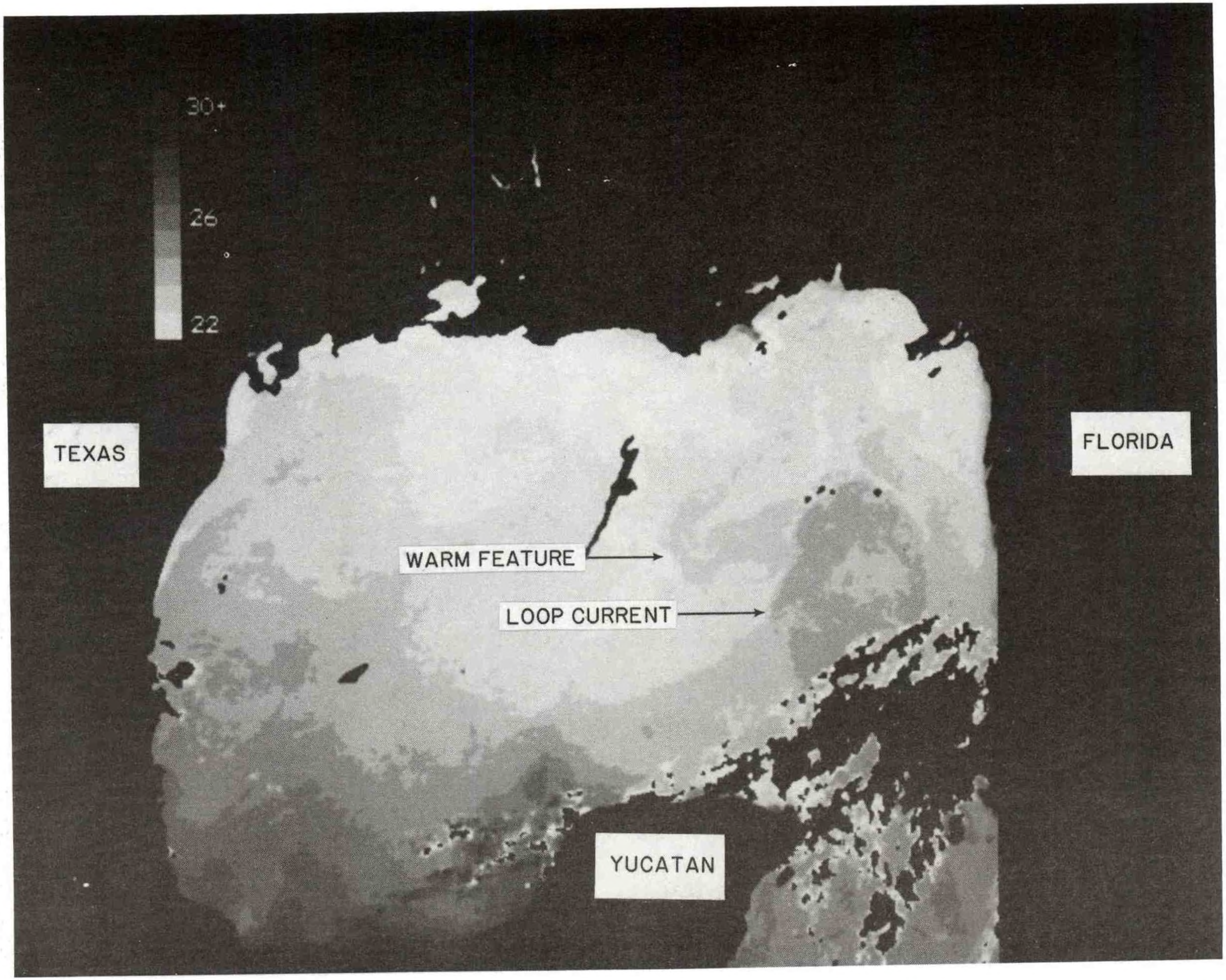


Figure 3-9.--Enhanced satellite-derived sea surface temperature image of the Gulf of Mexico depicting the Loop Current and an associated warm feature, May 6, 1984.

Seasonal cloudiness and isothermal sea surface temperatures precluded the observation of all the western eddies in June. A slight increase of the northern limit of the Loop Current was observed by the end of June.

Observations of the Loop Current and any eddies present within the Gulf of Mexico were not possible for the months of July through October. Seasonal heating of the sea surface and the resulting cloudiness made it impossible to delineate these oceanographic thermal features.

With the coming of fall and the cooling of the air and the water, the Loop Current was observed again in November. A multi-fingered Loop Current with a northern limit at approximately 27°N was observed during the last week of the month. Four filaments (fingers), all curving in a counter-clockwise direction, were observed along the western side of the Loop Current.

December saw a reduction in the number of filaments to three and a slight decrease in the northern limit of the Loop Current. One of the filaments was located astride the 200 meter isobath off the West Florida Shelf and extended from 26°N to 27.5°N.

SECTION 4

FISHERIES

In 1984 the Gulf of Mexico region yielded the nation's largest commercial fishery by weight for the second consecutive year. The Gulf fisheries landings were more than 40 percent of the national total by weight. Fishermen harvested more than 2.6 billion pounds of finfish and shellfish worth over $655 million (Table 4.1). These landings exceeded 1983's catch by 200 million pounds valued at $40 million. The Gulf of Mexico fishery accounted for 41.1 percent by weight and 27.9 percent by value of the national totals. Louisiana and Mississippi each set state landing records by weight in 1984 leading to national rankings of first and fourth, respectively. The Louisiana catch was valued at $263 million, second in the United States. Texas and Florida followed in fourth and fifth places nationally.

4.1 Summary of Commercial Fishing

Combined shellfish and finfish landings in the Gulf of Mexico exceeded 2.6 million pounds and were worth $655.6 million dollars (Table 4-1). Of the landings of the major components of the Gulf fishery - blue crabs, shrimp, oysters, and menhaden - only oyster landings were down in 1984. The total value for each of these fisheries increased from 1983. The record menhaden catch increased the combined fishery landings by 2.2 billion pounds and $85.2 million and enabled Louisiana and Mississippi to dominate these combined fishery landing weights (Figure 4-1). The low commercial value of menhaden ($0.04/pound) resulted in a more uniform market distribution of the landings by value among the states (Figure 4-2).

The commercial fishing industry of the Gulf of Mexico is an important part of the regional economy. A ten year summary (Figure 4-3) of landings by weight and value indicates a relatively steady growth in dollar value despite large fluctuations in landing volumes. The four top ports in the United States in landings by weight in 1984 were in the Gulf of Mexico (Table 4-2). These ports accounted for 28 percent by weight and 10 percent by value of 1984 United States commercial landings.

4.2 Finfish

Total finfish landings (Table 4-1) were nearly 2.3 billion pounds valued at $140 million. These were increases of 6 percent in weight and 4 percent in value from the previous year. Based on the total finfish catch by weight the Gulf region rankings are as follow: Louisiana, Mississippi, Florida (west coast), Alabama, and Texas (Figure 4-4a). Excluding menhaden, the rankings change dramatically. Florida becomes the leader, while Louisiana falls to a distant third (Figure 4-4b).

Menhaden, which is used primarily in the production of meal and oils, is the dominant fishery by weight in the Gulf, contributing 94 percent of the total Gulf landings in 1984. Menhaden landings decreased nationally by 2 percent in 1984, but attained record levels in the Gulf for the third consecutive year. The catch of 2.2 billion pounds, valued at $85.2 million, was up six percent from 1983. For the second year in a row scientists in the National Marine

Table 4-1.--Commercial landings of finfish and shellfish, by state in 1984 for the Gulf of Mexico.

State	Finfish (pounds x 10^3)	Shellfish (pounds x 10^3)	Total Weight (pounds x 10^3)	Total Value ($ x 10^3)
Texas	1,956	102,126	104,082	190,276
Louisiana	1,774,317	149,734	1,924,051	263,251
Mississippi	461,627	15,263	476,890	46,619
Alabama	3,243	23,162	26,405	43,788
Florida (west coast)	57,997	54,039	112,036	111,694
Total	2,299,140	344,324	2,643,464	655,628

All data are preliminary from National Marine Fisheries Service. Catch from high seas or off foreign shores is not included.

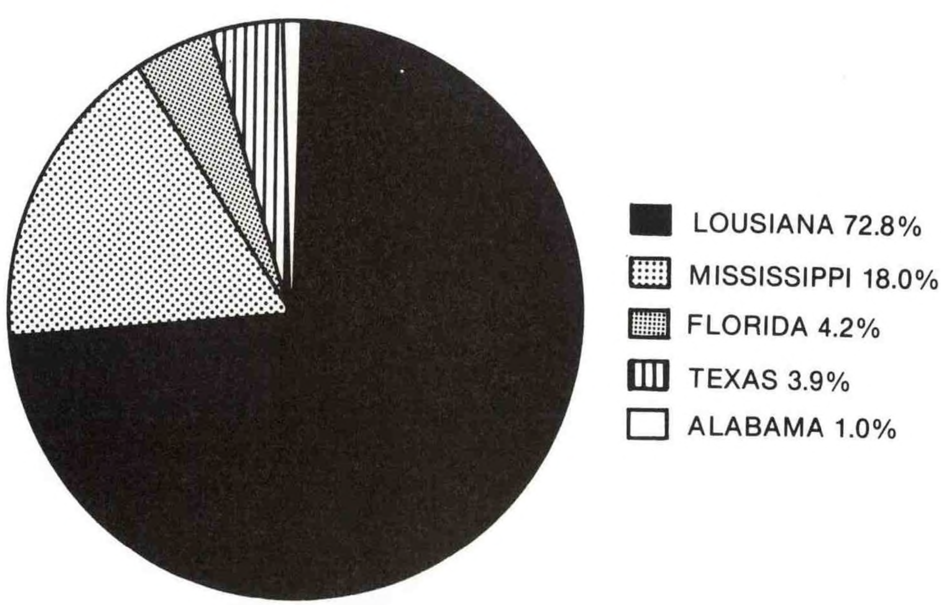


Figure 4-1.--Gulf of Mexico 1984 total finfish and shellfish landings: percent by weight by state.

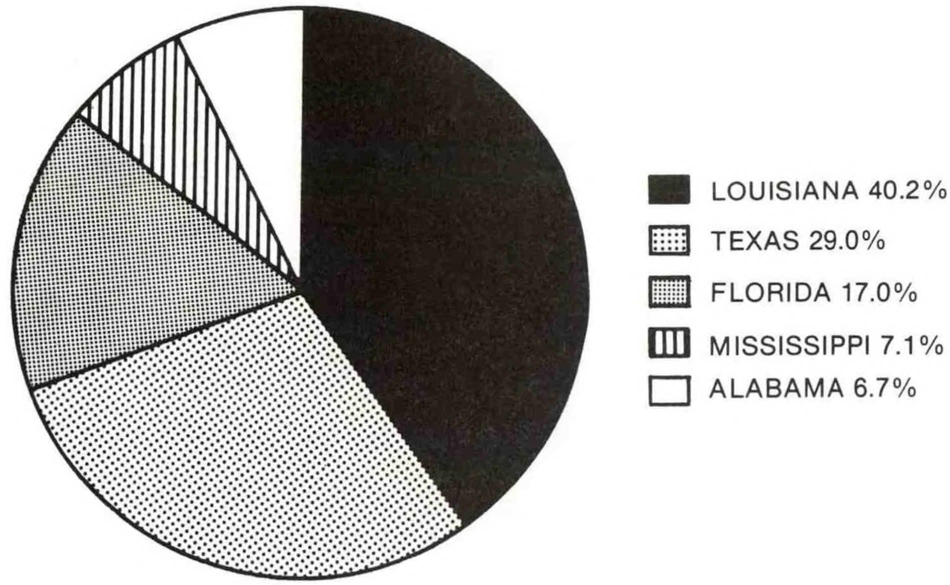


Figure 4-2.--Gulf of Mexico 1984 total finfish and shellfish value: percent of total dollar value by state.

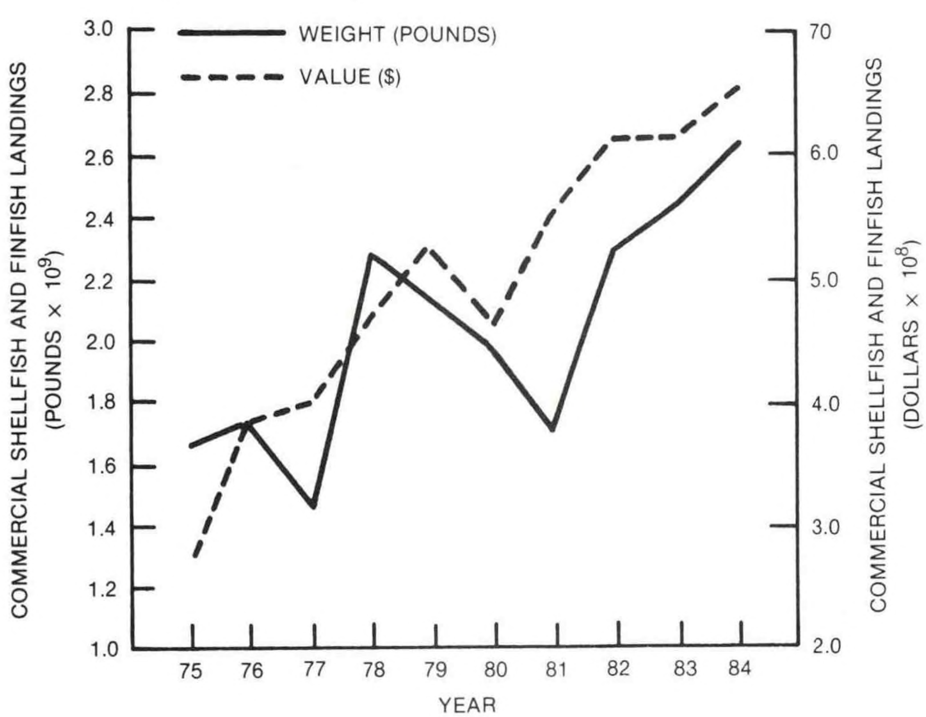


Figure 4-3.--Gulf of Mexico shellfish and finfish landings, 1975-1984.

Table 4-2.--Commercial fishery landings and value at major Gulf of Mexico ports, 1981 through 1984.

Port	Quantity (Million Pounds) 1981	1982	1983	1984	Value (Million Dollars) 1981	1982	1983	1984
Cameron, LA	447.6	714.7	743.9	679.2	29.9	40.4	39.5	38.2
Pascagoula-Moss Point, MS	220.5	331.6	380.2	425.3	16.8	18.5	23.2	25.0
Empire-Venice, LA	221.5	267.3	281.9	383.5	30.5	36.4	31.8	41.6
Dulac-Chauvin, LA	203.9	265.6	269.2	327.2	51.5	51.7	47.7	59.7
Aransas Pass-Rockport, TX	24.4	18.0	21.0	25.2	41.0	41.0	50.0	51.1
Brownsville-Port Isabel, TX	28.9	19.0	21.0	23.0	48.4	52.0	55.0	51.0
Bayou La Batre, LA	25.1	17.8	13.6	18.2	31.4	33.8	28.5	31.5
Key West, FL	18.0	10.0	11.7	17.7	27.0	19.0	18.6	21.8
Golden Meadow-Leeville, AL	18.5	14.2	9.3	16.2	19.9	21.5	15.2	23.6
Lafitte-Barataria, LA	14.7	11.9	9.4	12.5	20.8	21.9	16.5	24.1
Galveston, TX	8.1	7.0	12.0	11.9	13.3	15.0	16.0	20.1
Apalachicola, FL	12.0	9.0	10.8	10.8	12.3	10.2	14.1	13.2
Delacroix-Yscloskey, LA	--	10.6	6.0	10.8	--	9.8	9.0	10.8
Grande Isle, LA	7.1	5.6	6.4	9.2	7.8	5.7	7.7	11.0
Freeport, TX	14.9	9.0	6.0	9.0	26.8	26.0	17.0	19.1
Delcambre, LA	11.0	10.4	--	8.6	18.8	17.6	6.2	14.9
Fort Myers, FL	15.0	9.2	7.3	8.2	18.0	11.9	8.6	13.9
Bon Secour-Gulf Shores, AL	7.0	5.9	--	--	11.6	12.4	11.8	11.5

Data from National Marine Fisheries Service. Blank entries indicate data unavailable. To avoid disclosure of private enterprise the following ports were not included: Intracoastal City, LA; Morgan City, LA; and Biloxi, MS.

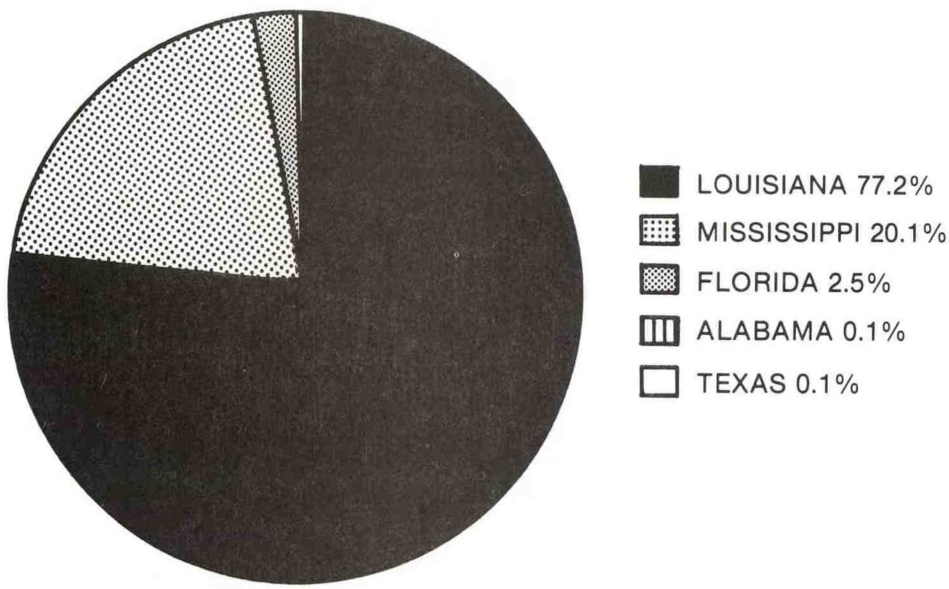


Figure 4-4a.--Gulf of Mexico 1984 total finfish landings: percent by weight by state.

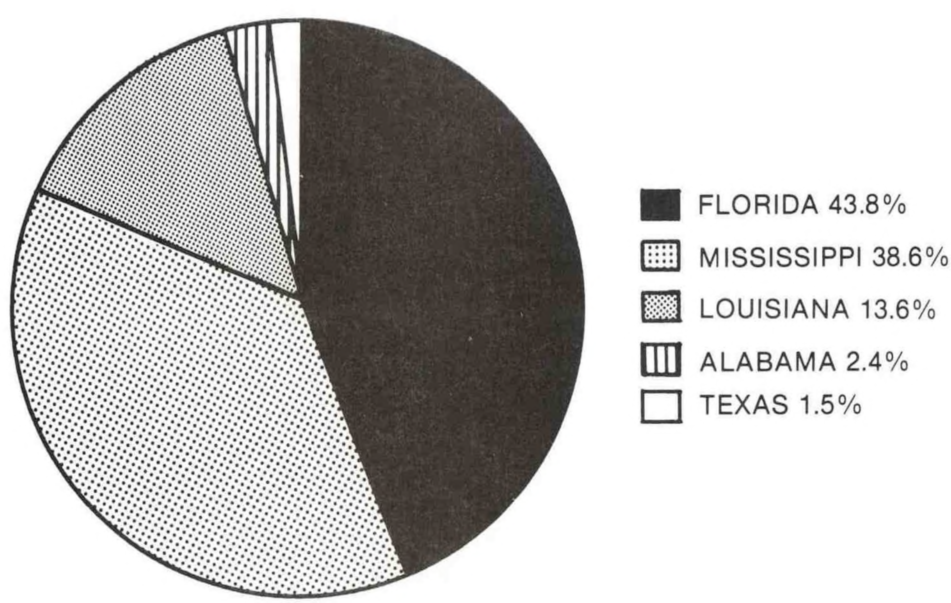


Figure 4-4b.--Gulf of Mexico 1984 finfish landings (excluding menhaden): percent by weight by state.

Fisheries Service project that menhaden stocks cannot sustain the record harvests of recent years.

Other leading fisheries in the Gulf of Mexico are mullet, grouper, and snapper (Table 4-3). Excluding the menhaden landings, finfish landings decreased over 3 million pounds in 1984. However, the value of these landings increased $3 million.

4.3 Shellfish

The Gulf of Mexico shellfish fishery is dominated by three shrimp species: the brown, white, and pink shrimp. These three species are aggregated in the landings data (Table 4-4). Other important species in the Gulf shellfish fishery are blue crabs and oysters. Florida has major spiny lobster and stone crab fisheries.

Louisiana, with 38.9 percent, and Texas, with 31.5 percent, led the Gulf in shellfish landings by weight in 1984 (Figure 4-5). These percentages were bolstered by large shrimp catches in both states. Shellfish landings were 344.3 million pounds valued at $513.6 million in 1984 (Table 4-4). These figures represent increases of 27 percent and 7 percent in weight and value, respectively, from 1983. The shrimp fishery made a recovery after two consecutive years of declining landings. Shrimp landings rose from 198.5 million pounds in 1983 to 254.2 million pounds in 1984. The value of these landings was $439.7 million, an increase of $22.8 million over 1983. Louisiana led the nation in shrimp landings with 35 percent of the total United States catch. Texas followed closely with 30 percent of the total landings.

Hard blue crab landings were at record levels in the United States in 1984. By region the largest gain was in the Gulf of Mexico which had increased landings of 14.8 million pounds and increased value of $3.4 million. Louisiana accounted for one-half of the 51.0 million pounds of blue crabs landed in the Gulf in 1984.

The 1984 Gulf oyster landings mirrored the downward trend of the landings of oysters of the rest of the country, although the region led the nation with 24.4 million pounds, 51 percent of the total United States landings. The Gulf landings were down 3.3 million pounds from 1983. As the supply dropped, the demand rose, and prices went up. The average ex-vessel price per pound of meats (the price received by the harvester) in the Gulf in 1984 was $1.47 compared to $1.20 in 1983. The 1984 landings, valued at $36.0 million, represented an increase of $2.8 million over 1983. Louisiana led the region with 51 percent of the landings. Florida was second with 27 percent of the region's landings.

Although 1984 oyster landings in Louisiana and Florida were above 1983 levels, those in Mississippi and Texas were notably lower than the previous year. Mississippi's catch was 80 percent below 1983 landings at 900,000 pounds. This was due to the destruction of the oyster beds in Mississippi Sound, the primary site of oyster beds in the state, by a large flux of fresh water that reduced the salinity to 0 parts per thousand for several weeks in the spring of 1983. This large volume of water was a result of flood control procedures in Louisiana which relieve excess river flow from the Mississippi River through Lake Pontchartrain into the Mississippi Sound. The oyster reefs did not recover sufficiently from this event to support 1984's harvesting activities.

Table 4-3.--Total finfish landings by species for the Gulf of Mexico Region, 1984.

Species	Distance from U.S. Shores: From 0 to 3 miles Thousand pounds	From 0 to 3 miles Thousand Dollars	Between 3 and 200 miles Thousand Pounds	Between 3 and 200 miles Thousand Dollars	Total Thousand Pounds	Total Thousand Dollars
Alewives	231	38	0	0	231	38
Bluefish	689	120	1	(1)	690	120
Bonito	0	0	175	14	175	14
Croaker	295	135	142	60	437	195
Flounders	643	464	324	154	967	618
Groupers	175	252	9,618	13,610	9,793	13,862
Mackerel, (King/Cero)	100	51	1,690	955	1,790	1,006
Mackerel, Span	1,116	313	1,110	311	2,226	624
Menhaden	2,166,863	85,243	0	0	2,166,863	85,243
Mullet	18,778	4,494	12	3	18,790	4,497
Scup or Porgy	90	43	134	64	224	107
Sea Trout, Spot	2,798	2,725	0	0	2,798	2,725
Sea Trout, White	181	65	205	54	386	119
Sharks, Unc.	51	20	541	217	592	237
Snapper, Red	50	38	5,344	9,336	5,394	9,374
Snapper, Other	587	839	1,763	2,522	2,350	3,361
Swordfish	8	42	665	2,060	673	2,102
Tilefish	0	0	271	243	271	243
Tunas	0	0	1,011	1,583	1,011	1,583
Fish, Other	45,881	11,723	37,598	4,228	83,479	15,951
Total Fish	2,238,536	106,605	60,604	35,414	2,299,140	142,019

All data are preliminary from National Marine Fisheries Service. Catch from high seas or off foreign shores is excluded.

(1) Less than $500.

Table 4-4.--Total shellfish landings for the Gulf of Mexico Region, 1984.

Species	Distance from U.S. Shores				Total	
	From 0 to 3 miles		Between 3 and 200 miles			
	Thousand Pounds	Thousand Dollars	Thousand Pounds	Thousand Dollars	Thousand Pounds	Thousand Dollars
Shrimp	127,942	170,280	126,312	269,447	254,254	439,727
Oyster Meat	24,410	35,979	0	0	24,410	35,979
Crabs, Blue	50,982	15,004	0	0	50,982	15,004
Lobster, Spiny	2,010	5,326	3,014	7,988	5,024	13,314
Crab, Other	586	1,080	3,283	6,074	3,869	7,154
Shellfish, Other	5,649	2,261	1	1	5,650	2,262
Clam, Hard	64	149	0	0	64	149
Squid	24	8	47	12	71	20
Total Shellfish	211,667	230,087	132,657	283,522	344,324	513,609

All data are preliminary from National Marine Fisheries Service. Catch from high seas or off foreign shores is not included.

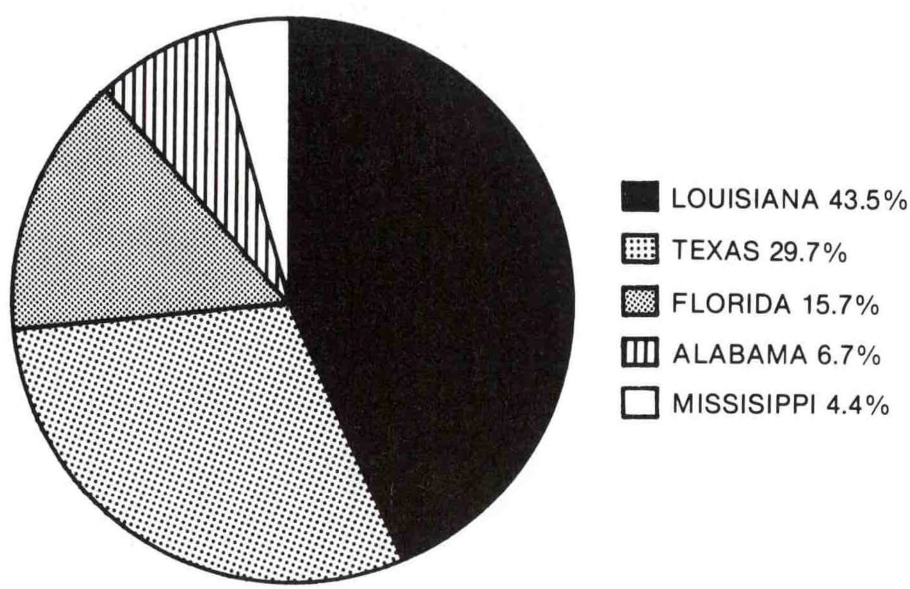


Figure 4-5.--Gulf of Mexico 1984 shellfish landings: percent by weight by state.

The Texas landings were off 41 percent from 1983 levels at 4.2 million pounds. The Texas Parks and Wildlife Department determined that the opening of the oyster season should be delayed in Galveston Bay, which contains the state's leading oyster-producing beds. Department biologists thought the record harvest in 1983 reduced the 1984 oyster bars to one-half of those in 1983. Poor spat set, along with this reduction in the population, led to the delay in the opening.

SECTION 5

RECREATION

The Gulf of Mexico is a major recreational area of the United States, particularly for boating, saltwater fishing (bay, surf, and pier), and beach activities. The coasts of Texas, Louisiana, Mississippi, Alabama, and Florida display a diversity of natural landscapes. Barrier islands, coastal beaches, bays, sounds, river deltas, and marshes, together with a subtropical climate, provide an ideal setting for outdoor recreation and tourism. Tourism within the Gulf region encompasses such activities as sightseeing, swimming, sunbathing, bird watching, hiking, boating, amusement parks, conventions, sports, and festivals. Activities are widespread over the region and contribute to its economic well-being. Although the exact relationship between the weather and the economy associated with recreation is not clear, prolonged periods of inclement weather (i.e., rain and cold) and episodes of severe weather (tornadoes, hurricanes, etc.) will impact the regional economy.

5.1 National Park Visits

The National Park Service of the Department of the Interior manages a number of national parks, national historical parks, national monuments, wildlife and wilderness areas, and national seashores in the states surrounding the Gulf of Mexico. Only those coastal sites for which data are available have been chosen for analysis. Four parks are located along the coast of Florida, and there is one park in each of the other Gulf states, except Alabama (Table 5-1).

Visits to national park sites in the Gulf region increased by 35 percent in 1984 from 6,034,000 visits in 1983 to 8,129,000. The leading site gainers in terms of percentage increase were Jean Lafitte National Historic Park with a gain of nearly 59 percent and Gulf Islands National Seashore in Florida and Mississippi with increases of approximately 43 percent. The 1984 World's Fair in New Orleans unquestionably brought an increase in attendance to Jean Lafitte, which is within the city. Gulf Islands National Seashore continued to increase in popularity with both resident and tourist visitors. A major expansion of the commercial facilities outside the park has made the area even more attractive to tourists. The only Gulf region national park to have a decrease in attendance in 1984 was Padre Island National Seashore with a decline of nearly 3 percent. However, this was far less than the 16 percent decline in park attendance between 1982 and 1983 reported in the 1983 Gulf of Mexico Annual Summary. Texas residents continue to show a preference for new beach facilities at local parks. Despite the decline at Padre Island, total Texas national park attendance rose about 5 percent.

The national parks in the Gulf region have individual monthly attendance patterns which are usually dependent on temperature or season, but which may be altered due to unseasonable weather or special events (Table 5-2). For example, Jean Lafitte National Historic Park, which had peak attendance months in 1983 in April, May, and June, experienced high visitations in 1984 from May through September, the peak being in July with 117,000 visits. This surge in summer tourism to the park was undoubtedly stimulated by the New Orleans World's Fair. Everglades National Park, which is a favorite attraction to the winter season tourist trade in the Miami, FL, area, experiences its highest attendance

Table 5-1.--National park visits (in thousands) to Gulf sites, 1982-1984.[1]

	1982	1983	1984
FLORIDA (state total)	6030	6608	8615
De Soto National Memorial	197	221	222
Everglades National Park	550	577	629
Fort Jefferson National Monument	10	11	12
Gulf Islands National Seashore	2806	3248	4643
Total (Florida Gulf)	3563	4057	5506
LOUISIANA (state total)	377	535	849
Jean Lafitte National Historic Park and Preserve	377	535	849
MISSISSIPPI (state total)	10159	12331	12995
Gulf Islands National Seashore	701	812	1161
TEXAS (state total)	4747	4561	4802
Padre Island National Seashore	731	630	613
Total in Gulf region national parks	5372	6034	8129

[1]No Gulf coastal national park site is located in Alabama.

Data from National Park Service, Denver Service Center, Statistics Office.

Table 5-2.--Monthly national park visits (in thousands), Gulf sites, 1984.[1]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
FLORIDA												
De Soto National Memorial	20.7	26.4	30.1	31.4	15.5	14.0	12.6	12.1	11.6	15.0	15.4	16.5
Everglades National Park	78.2	93.0	98.0	71.6	36.8	22.9	26.9	28.3	26.5	33.7	47.2	65.6
Fort Jefferson National Monument	.5	.7	1.2	1.4	1.8	1.2	1.1	.9	.6	.8	.6	1.0
Gulf Islands National Seashore	149.2	173.0	317.7	479.1	443.4	616.6	565.4	485.6	489.1	382.7	310.6	230.3
Total Florida Gulf	248.6	293.1	447.0	583.5	497.5	654.7	606.0	526.9	527.8	432.2	373.8	313.4
LOUISIANA												
Jean Lafitte National Historic Park and Preserve	49.8	37.3	60.2	68.6	98.6	91.8	117.0	94.8	65.1	74.0	51.1	40.8
MISSISSIPPI												
Gulf Islands National Seashore	37.3	43.2	79.4	119.8	110.8	154.1	141.4	121.4	122.3	95.7	77.7	57.6
TEXAS												
Padre Island National Seashore	18.8	27.0	51.7	47.6	75.6	94.9	100.2	72.8	43.8	28.5	25.8	26.3
Total Gulf Sites	354.5	400.6	638.3	819.5	782.5	995.5	964.6	815.9	759.0	630.4	528.4	438.1

[1]No Gulf coastal national park site is located in Alabama.

Data from National Park Service, Denver Service Center, Statistics Office.

months in January, February, and March. Peak attendance at Everglades was reached in March in both 1983 and 1984. Temperatures at Gulf Islands National Seashore in Florida and Mississippi are warm enough for beach activities much of the year, but the cool temperatures that prevail in December, January, and February keep attendance down in these months. Beginning in March attendance rises significantly and peaks in May through September. The peak month in attendance in 1984 was June with 616,000 visitors to the park in Florida and 154,100 visitors to the park in Mississippi. In 1983 the peak month was July for both. At Padre Island National Seashore, the peak months were June and July in both 1983 and 1984.

5.2 State Park Visits

In 1984 state park attendance in the Gulf region displayed varied attendance patterns based on local conditions. Most parks showed increases in visits. The only state showing a decline in state park attendance in 1984 was Florida, and this decline was due to a special circumstance. Attendance actually rose at most Florida state parks (Table 5-3), but at Honeymoon Island the drop from 1983, the first full year of operation, was 457,200 and was the major factor in the overall decline in Florida figures.

Among the states with substantial park attendance gains in 1984 were Alabama, Mississippi, and Louisiana. Gulf State Park in Alabama had an increase in attendance of about 27 percent from 1983 to 1984, continuing its resurgence after the destruction of Hurricane Frederic in 1979 (Table 5-4). Mississippi's and Louisiana's strong gains in state park visitations were attributable to the World's Fair. Mississippi's Gulf park with a campground, Buccaneer, which is about 50 miles from New Orleans, showed a gain of 162 percent in attendance from 1983 to 1984 (Table 5-5). The leading gainers among state parks in Louisiana (Table 5-6) were those in the vicinity of New Orleans: Fountainbleau with a gain of 131 percent from 1983 to 1984; Fort Pike with an increase of 112 percent; and Fairview-Riverside with a gain of nearly 50 percent. Fountainbleau and Fairview-Riverside both have campgrounds. Fort Pike is a historical area.

Texas state park attendance in 1984 was impacted by effects of a weather event which occurred in 1983 and by the Alvenus oil spill. Table 5-7 shows that park attendance in Texas in 1984 had a modest rise. This rise took place despite a 50 percent decrease in attendance at Galveston Island Park from 688,000 people in 1983 to 342,500 people in 1984. This sharp drop in attendance was due partially to a long period of recovery from Hurricane Alicia which struck Galveston on August 17-18, 1983. The state park was damaged and the facilities were partially closed for approximately eight months. Another cause of the decline in park attendance was damage from an oil spill from the tanker Alvenus. The impacts from this spill are described in detail in order to show not only how park visitors were affected but also to demonstrate the effects of competing uses of the Gulf.

Alvenus Oil Spill

On July 30, 1984 the British tanker, Alvenus, loaded with 14.7 million gallons of Venezuelan crude oil and headed for a refinery in Lake Charles, LA, ran aground near the Calcasieu Channel, approximately 11 miles south of Cameron,

Table 5-3.--Florida (Gulf coast) state park visits (in thousands), 1982-1984.*

	1982	1983	1984
Big Lagoon**	33.7	67.3	86.9
Calodesi Island**	132.5	125.3	125.2
Grayton Beach**	40.2	43.3	49.5
Honeymoon Island	957.1[1]	2225.0	1767.8
Rocky Bayou**	40.8	43.5	51.3
St. Andrews	553.6	550.5	569.5
St. George Island**	75.4	91.2	107.6
St. Joseph Peninsula**	91.6	99.8	94.6
Scherer, Oscar	90.9	100.2	99.2
Wiggins Pass	462.2	411.7	429.7
Total Florida Gulf parks	2478.0	3757.8	3381.3

*For FY ending June 30.

**Estimated attendance (based on automobile traffic or seasonal sample counts).

[1]Opening year.

Data from Florida Department of Natural Resources, Division of Recreation and Parks.

Table 5-4.--Alabama (Gulf coast) state park visits (in thousands), 1982-1984.

	1982	1983	1984
Gulf State Park	1516	1798	2281

Data from Alabama Department of Conservation, Parks Division.

Table 5-5.--Mississippi (Gulf coast) state park visits (in thousands), 1982-1984.

	1982	1983	1984
Gulf Marine	176.3	170.1	167.6
Buccaneer	209.5	232.3	609.0
Total Gulf coast sites	385.8	402.4	776.6

Data from Mississippi Department of Natural Resources.

Table 5-6.--Louisiana (coastal parishes) state park visits (in thousands), 1982-1984.

	1982	1983	1984
Cypremort Point	149.0	103.1	117.7
E.D. White	1.3	.7	1.3
Fairview-Riverside	275.2	151.3	226.5
Fontainebleau	210.4	251.8	582.0
Fort Pike	78.0	184.6	392.1
Grand Isle	225.8	193.7	*
Longfellow-Evangeline	335.9	202.2	181.9
Old Arsenal	67.5	64.4	55.6
Plaquemine Locks	.6[1]	1.4	3.1**
Port Hudson	*	63.7	86.2
Sam Houston Jones	386.0	328.2	380.1
St. Bernard	83.1	80.6	143.1
Total (All Louisiana state parks)	3187.2	2751.2	3565.3
(Gulf coast parks only)	1812.8	1625.7	2169.6

* Closed the entire year.

** Closed part of the year.

[1] Opening year.

Data from Louisiana Department of Culture, Recreation, and Tourism, Office of Tourism.

Table 5-7.--Texas state park (parks fronting saltwater) visits (in thousands), 1982-1984.*

	1982	1983	1984
Bryan Beach	15.2	17.6	16.8
Copano Bay St. Park	52.2	37.8	27.4
Galveston Island	724.8	688.8	342.5
Goose Island	319.4	410.3	432.7
Mustang Island	764.3	1068.3	1247.6
Port Isabel	35.6	30.3	20.3
Port Lavaca Causeway	15.2	10.2	23.6
Queen Isabella Fish Pier	134.2	131.4	115.4
Sabine Pass Battleground	165.2	123.4	186.0
San Jacinto Battleground	1530.7	1321.3	1355.4
Sea Rim	227.9	201.2	224.3
Total (All Texas state parks)	17035.2	18310.3	18617.5
(Gulf parks only)	3984.7	4040.6	3992.0

*FY ending August 31.

Data from Texas Parks and Wildlife Department.

LA, (Figure 5-1). Over the next four days about 2.3 million gallons of this thick crude oil were spilled. The oil swept westward along a path roughly parallel to the coast. Tar balls and oil patches began washing ashore on August 3 along the Bolivar Peninsula, just north of the entrance of Galveston Bay, and began to impact the beaches of Galveston Island. On August 5 the New York Times reported a beach scene very unlike the one seen usually. Sunbathers and beach umbrellas had been replaced by road graders and other earth-moving equipment. For miles, puddles of oil dotted the beaches. A sheet of smelly black slime about 30 feet wide was observed to have covered an area of Jamaica Beach. The Galveston beach clean-up cost was estimated at around $13 million. A picture of the event appears as Figure 5-2.

Fortunately, the oyster beds and marshes of Galveston Bay escaped the oil. Environmentalists and marine biologists were pleased by this, because marshes are sensitive areas not easily restored after spills.

The worst was over on August 5. On August 6 the Washington Post reported that Galveston Island "breathed a sigh of relief" as experts predicted no more oil would wash ashore. While some people visited the Island during the worst of the spill out of curiosity, a drop in tourist trade was reported during the period it took to clean up the spill.

5.3 Boating Registrations

The total numbered boats in the Gulf region registered under the approved Coast Guard numbering system rose by a modest 0.3 percent in 1984 which was less than the 2.8 percent growth nationally (Table 5-8). Florida and Mississippi had modest declines in the number of registered boats with Florida's drop being about 1.7 percent. Yearly variations by state are sometimes misleading. A large gain in one year may be followed by a small decline in the next. In 1983, for example, Florida registrations increased by 8.8 percent.

5.4 Search and Rescue Operations

The Search and Rescue (SAR) operations of the U.S. Coast Guard involve a number of types of incidents related to boat failure. Of the responses of the Coast Guard to recreational boat incidents, only about 3 percent involve matters like fires and collisions. About 69 percent of the recreational cases nationwide are boats which are disabled or adrift, and another 9 percent are boats aground.

In both 1983 and 1984, total SAR caseload dropped in the Gulf of Mexico. The decline from 1982 to 1983 was about 15 percent. Of this decline, there was a 21 percent drop in recreational cases and a 4 percent drop in nonrecreational cases. In 1984 the SAR caseload in the Gulf dropped by an estimated 7 percent (Tables 5-9a and b). Of the explanations that have been advanced concerning the decline, improved boating safety has been prominent.

5.5 Recreational Fishing in the Gulf

The National Marine Fisheries Service (NMFS) collects data on recreational fishing in the Gulf through intercept surveys and telephone surveys conducted in each state. NMFS statistics indicate that the total estimated number of fish caught in the region declined in 1984 from 1983 (Table 5-10). In both 1983

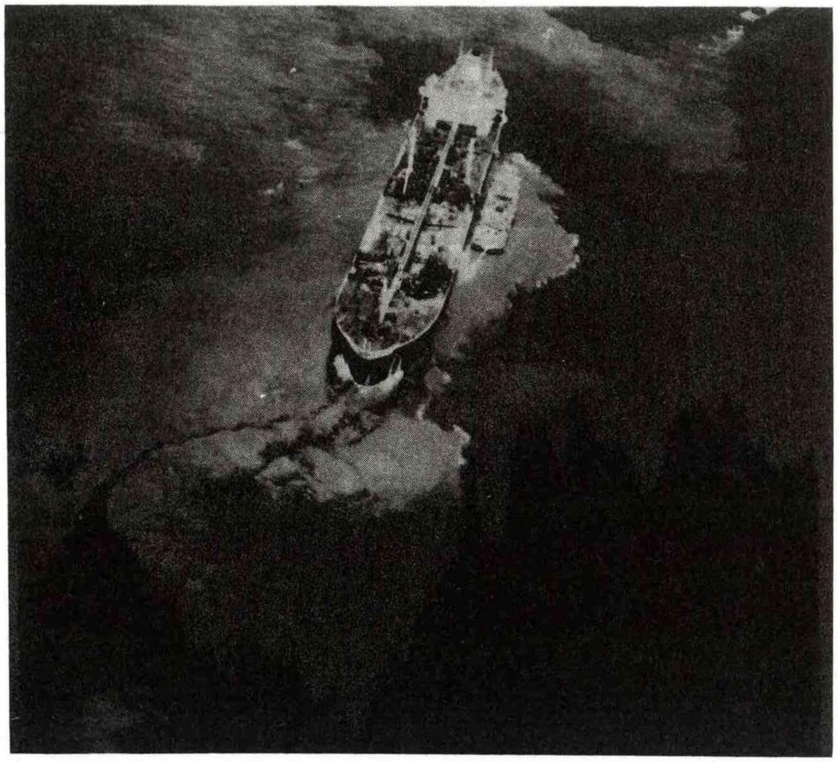


Figure 5-1.--The British tanker Alvenus aground and leaking oil 11 miles south of Cameron, LA, July 30, 1984. U.S. Coast Guard photo.

Figure 5-2.--A road grader scaping oil from Galveston, TX, beach, August 4, 1984. AP/WIDE WORLD PHOTOS.

Table 5-8.--Boating registrations (in thousands), Gulf of Mexico states, 1982-1984.

	1982	1983	1984
ALABAMA	227.3	227.6	229.9
FLORIDA	483.7	526.5	517.4
LOUISIANA	333.8	303.0	312.1
MISSISSIPPI	117.4	123.2	122.2
TEXAS	581.9	594.9	599.6
TOTAL GULF	1744.1	1775.2	1781.2
TOTAL U.S.	9074.0	9165.1	9420.0

Data from U.S. Coast Guard.

Table 5-9a.--Recreational Search and Rescue caseload, U.S. Coast Guard, Gulf of Mexico, 1982-1984.

	1982	1983	1984
January	311	272	161
February	338	224	223
March	426	324	296
April	525	481	399
May	810	569	519
June	839	604	590
July	830	739	634
August	705	510	538
September	470	395	466
October	367	351	N/A
November	318	242	N/A
December	229	186	N/A
Totals	6168	4897	

N/A - not available.

Data from U.S. Coast Guard.

Table 5-9b.--Total Search and Rescue operations, U.S. Coast Guard, Gulf of Mexico, 1982-1984.

	1982	1983	1984
Total Gulf Search and Rescue Operations	9303	7900	7352*

* Estimate based on reported caseload for January - September 1984 divided by 81.5; October - December usually represent 18.5 percent of SAR caseload in the Gulf.

Data from U.S. Coast Guard.

and 1984, Texas catch taken by boat modes (private and charter/party) were not included in these statistics because of data collection problems. The estimated number of trips made by recreational fishermen and the estimated number of participants in Gulf recreational fishing in 1984 also declined from the 1983 level (Table 5-11). The decline in fish catch from 1983 to 1984 was almost 19 percent, and the decreases in participation and fishing trips were 20 percent. However these declines did not extend to all of the states of the region. Florida experienced an upturn in catch of 39 percent and in trips of 12 percent.

Among the factors which may have contributed to the apparent decline in recreational fishing in the Gulf in 1984 were longer-term impacts on fish stocks from a freeze which occurred in late December 1983 in the nearshore waters of Texas (see 1983 Gulf of Mexico Annual Summary). The Texas Parks and Wildlife Magazine reported in March 1984 that 15.2 million fish, shrimp, and crabs along the Texas coast perished in the freeze. About 52 percent of the 14.4 million fish killed were forage species. The gamefish species of spotted seatrout lost an estimated 567,000 juveniles and adults. Black drum and sand seatrout also took considerable losses. A fish kill was also reported by Louisana, but it was less substantial than the one in Texas.

By spring 1984, Texas biologists were noting adverse impacts on fish stocks from the freeze event. The May issue of Texas Parks and Wildlife reported that the sport catch of seatrout in 1984 was less than 50 percent of the average catch during comparable periods from 1976 to 1983. The number of spotted seatrout caught in survey gill nets in 1984 was only 38 percent of the average catch during the 1976-83 period. As a result of these findings, emergency bag, size, and possession limits for redfish and spotted seatrout imposed in Texas after the 1983 freeze were made permanent and extend to this writing.

In Louisiana, similar longer-range impacts on fish stocks from the late 1983 cold snap were also observed by fisheries biologists. Additionally, Louisiana marine fishing suffered in the spring of 1984 from a large amount of freshwater runoff which kept estuarine species from finding their preferred salinities in the nearshore waters.

Despite these declines in catch in 1984, saltwater catfish and that spotted seatrout maintained their position of leadership as the two most frequently caught recreational fishes in the Gulf (Table 5-10).

Declines in recreational fishing in the Gulf have important impacts on state and local economies. Fewer fishermen taking part in the recreation mean less bait and tackle sold and less travel to go fishing. Since many fishermen fish from private recreational boats, similar impacts are felt on the boating industry, gasoline sales, motels, restaurants, and stores in areas from which boats leave.

Table 5-10.--Estimated total number (in thousands) of fish caught in the Gulf of Mexico by marine recreational fishermen by species group, 1983-84.

SPECIES GROUP	1983	1984	SPECIES GROUP	1983	1984
Amberjack	281	117	Mackerel, King	248	283
Barracudas	138	171	Mackerel, Spanish	2,843	972
Bass, Black Sea	1,096	516	Mullets	3,307	4,993
Basses, Sea	2,326	1,722	Perch, Silver	962	634
Bluefish	1,529	432	Pigfish	1,174	1,157
Blue Runner	2,235	501	Pinfish	11,481	8,480
Catfishes, Freshwater	688	188	Pompano, Florida	109	47
Catfishes, Saltwater	20,435	12,347	Porgies	1,742	951
Croaker, Atlantic	11,559	7,978	Porgy, Red	119	106
Dolphins	213	361	Puffers	328	226
Drum, Black	1,461	785	Searobins	125	39
Drum, Red	4,677	3,816	Seatrout, Sand	4,973	6,311
Drums	1,875	2,735	Seatrout, Spotted	14,061	9,352
Eels	156	269	Sharks	308	454
Flounder, Gulf	358	783	Sheepshead	3,356	2,087
Flounder, Southern	1,942	504	Skates and Rays	251	775
Flounders	2,095	483	Snapper, Gray	2,959	3,012
Groupers	2,216	2,651	Snapper, Lane	336	800
Grunt, White	2,782	3,575	Snapper, Red	3,672	1,307
Grunts	2,624	8,461	Snapper, Vermillion	250	420
Herrings	8,205	2,924	Snapper, Yellowtail	930	2,119
Jack Crevalle	1,006	567	Snappers	281	1,201
Jacks	1,804	1,693	Spot	425	--
Kingfishes	2,056	2,809	Toadfishes	186	89
Little Tunny	439	151	Triggerfishes/Filefishes	794	367
			Tunas/Mackerels	86	366
			Other Fish	5,632	6,658
			TOTALS:	135,134	109,745

-- Less than 30,000 reported.

Data from Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1983-84, (NOAA, National Marine Fisheries Service, 1985).

Table 5-11.--Summary of marine recreational fishery statistics, Gulf of Mexico, 1979-1984.

Year	Estimated Number of Fish Caught (in thousands)	Estimated Number of Coastal and Non-coastal Participants (in thousands)	Estimated Number of Fishing Trips (in thousands)
1979	162,279	3,460	21,273
1980	154,176	4,035	24,471
1981	131,407*	2,212*	19,089*
1982	154,405**	2,404	20,520
1983	135,134**	2,838	20,500
1984	109,745**	2,272	16,397

* No survey conducted during January-February 1981.

** Does not include catch by Texas boat modes.

Data from Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1979 (Revised)-1980; 1981-82; 1983-84 (NOAA, National Marine Fisheries Service, 1984-85).

SECTION 6

TRANSPORTATION

The Gulf of Mexico is used heavily for transportation. Goods are moved by barges through the Intracoastal Waterway along the coast and through rivers in each Gulf state. United States Department of Interior studies show that grain and other products of the Mississippi Basin are shipped to the Gulf, while foreign goods and products from other parts of the country are moved back up the river and along the coast.

There are seven major ports (Table 6-1) in the Gulf of Mexico region based on U.S. Department of Commerce, Bureau of Census data. Houston and New Orleans, two of the largest ports in the United States, ship large amounts of oil.

In addition to the intracoastal and international shipping in the Gulf of Mexico, the transportation sector also includes pipelines and related shore facilities such as refineries.

The Gulf of Mexico is among the most seriously polluted major bodies of water in the world with respect to floating tar. Oil pollution is strongly influenced by mean Gulf circulation patterns and is found to be heaviest in the eastern Gulf.

Most Gulf spills are small. United States Department of Interior studies show about 99 percent are less than 50 barrels, and 85 percent are less than one barrel. Studies done over several years show that most of the volume of oil spilled is contributed by a few large spills, although major spills (1,000 barrels or more) are few in number.

6.1 Shipping and Related Shore Activity

Foreign import waterborne commerce in the leading Gulf seaports during 1984 was up 16.2 million tons from 59.7 million tons in 1983, an increase of 27.1 percent (Table 6-1). Dollar value for foreign imports increased 22.1 percent over last year. General import cargo tonnage for the year almost doubled in quantity. Foreign exports also increased to 102 million tons in 1984 from 97 million tons in 1983, an increase of 5.2 percent (Table 6-2). Dollar value for foreign exports has declined since 1981 export cargo tonnage also increased in quantity.

6.2 Accidental Spills of Oil and Hazardous Substances

During 1984 a total of 2133 spills of various pollutants entered the Gulf and its tributaries (Tables 6-3 to 6-6). The sources included onshore plants, refineries, offshore facilities, pipelines, tugboats, and tankships. Table 6-3 lists the spills by material and month. July had the largest number of spills of oil (220). February had the most spills of hazardous substances (10), and January had the greatest number of spills that were not oil or hazardous substances (15). Spills of hazardous substances, natural substances, and other materials occur frequently within the Gulf region (Table 6-4). A dump of caustic soda totalled 37,000 pounds on February 12, and a perchloroethylene spill on May 6 amounted to 20,000 gallons in the Gulf region. These were the

Table 6-1.--Foreign imports waterborne commerce, leading Gulf of Mexico seaports, 1982 to 1984.

SHORT TONS (Thousands)

Ports	1982	1983	1984	% Change (1983-1984)
Houston,Tx	22,257	18,497	22,846	+23.5
New Orleans, LA	18,303	11,979	15,267	+27.5
Corpus Christi, TX	15,716	14,175	19,556	+38.0
Baton Rouge, LA	8,207	6,202	7,060	+13.8
Mobile, AL	4,072	3,148	4,742	+50.6
Tampa, FL	3,450	4,356	5,298	+21.6
Galveston, TX	2,003	1,308	1,082	-17.3
Totals	74,008	59,665	75,851	+27.1

DOLLAR VALUE (Millions)

Ports	1982	1983	1984	% Change (1983-1984)
Houston, TX	10,603	7,652	9,690	+26.6
New Orleans, LA	6,000	4,651	5,731	+23.2
Corpus Christi, TX	2,903	2,572	3,079	+19.7
Baton Rouge, LA	1,239	772	809	+4.8
Mobile, AL	554	670	726	+8.4
Tampa, FL	655	678	948	+39.8
Galveston, TX	997	722	641	-11.2
Totals	22,951	17,717	21,624	+22.1

Source: Foreign Commerce Statistical Report 1984, Maryland Department of Transportation. Data from U.S. Department of Commerce, Bureau of the Census.

Table 6-2.--Foreign export waterborne commerce, leading Gulf of Mexico seaports 1982 to 1984.

SHORT TONS (Thousands)

Ports	1982	1983	1984	% Change (1983-1984)
New Orleans, LA	28,850	24,593	25,072	+1.9
Houston,TX	25,909	22,295	24,356	+9.2
Baton Rouge,LA	14,986	13,403	12,594	-6.0
Tampa, FL	13,512	16,354	16,576	+1.4
Mobile, AL	11,969	10,215	10,956	+7.3
Galveston, TX	5,596	7,142	8,715	+22.0
Corpus Christi, TX	3,066	3,036	3,837	+26.4
Totals	103,888	97,038	102,106	+5.2

DOLLAR VALUE (Millions)

Ports	1982	1983	1984	% Change (1983-1984)
New Orleans, LA	7,793	6,541	6,319	-3.4
Houston, TX	13,358	10,301	10,162	-1.3
Baton Rouge, LA	2,345	1,993	2,035	+2.1
Tampa, FL	1,179	1,259	1,500	+19.1
Mobile, AL	1,229	791	624	-21.1
Galveston, TX	1,873	2,050	2,103	+2.6
Corpus Christi, TX	646	541	545	+0.7
Totals	28,423	23,476	23,288	-0.8

Source: Foreign Commerce Statistical Report 1984, Maryland Department of Transportation. Data from U.S. Department of Commerce, Bureau of the Census.

Table 6-3.--Spills of oil, hazardous materials, and other substances by month, Gulf of Mexico, 1984.

Month	Oil	Hazardous	Other	Totals
January	167	8	15	190
February	158	10	6	174
March	159	4	4	167
April	129	5	2	136
May	187	5	8	200
June	189	7	3	199
July	220	9	5	234
August	182	7	4	193
September	141	1	3	145
October	171	5	8	184
November	95	0	2	97
December	91	3	4	98
Totals	1889	64	64	2017

Table 6-4.--Spills of hazardous substances, natural substances, and other materials, Gulf of Mexico, 1984.

Type Material	Date	Quantity
Acetyl chloride:	February 21	840 gals
Ammonia:	April 3	100 lbs
Benzene:	February 14	50 gals
	February 26	210 gals
	July 17	10 gals
	July 22	5 gals
	October 29	15 gals
Biological materials:	May 5	2000 gals
Caustic soda:	January 4	1000 lbs
	February 4	1750 lbs
	February 12	37000 lbs
Chemical waste:	January 4	494 lbs
	May 23	3 gals
	August 29	5 lbs
Chlorine:	July 3	100 lbs
	September 14	150 lbs
Chlorosulphonic acid:	April 7	2500 lbs
Ethyl alcohol:	October 21	1 lb
Garbage:	December 29	1 gal
Methyl chloride:	March 13	2 gals
Methyl ethyl ketone:	January 4	3 gals
	March 9	7 gals
Monomethylamine:	June 23	350 gals
Natural substances:	May 31	10 lbs
	June 19	5 gals
	October 19	1 gal
	October 24	11 gals
Other hazardous substances:	July 24	2 gals
	December 2	5 gals

Table 6-4.--(Continued). Spills of hazardous substances, natural substances, and other materials, Gulf of Mexico, 1984.

Type Material	Date	Quantity
Other Material:	January 8	42 gals
	January 12	200 gals
	January 17	10 gals
	January 29	5 gals
	February 4	2 lbs
	February 7	210 gals
	February 17	80 lbs
	February 18	252 gals
	March 9	126 gals
	March 24	210 gals
	April 22	15 lbs
	April 24	18 lbs
	June 7	20 gals
	June 27	125 lbs
	July 3	3 gals
	July 17	294 gals
	July 19	1000 lbs
	July 24	1 lb
	July 24	1 gal
	August 6	5 gals
	August 12	24 lbs
	August 20	1 gal
	August 25	2 gals
	October 16	250 gals
	December 28	1 lb
Poly-chlorinated biphenyls:	June 18	40 lbs
	August 26	30 gals
Perchloroethylene:	April 2	1 gal
	May 4	100 lbs
	May 6	20000 gals
Phenol:	January 27	300 gals
Sewage:	August 19	10 gals
Xylene:	June 22	30 gals
Vinyl Acetate:	February 24	1 gal
	June 15	1 gal

Table 6-5.--Spills of 1,000 gallons or more, Gulf of Mexico, 1984.

Type Material	Quantity	Date	Location
Asphalt or other materials:			
1062	1680	March 13	28 54°N 95 20°W
Crude oil:			
1001	6720	January 4	29 27°N 94 59°W
	1680	March 17	28 54°N 95 20°W
	24150	September 1	28 42°W 96 15°W
1002	4200	April 18	28 53°N 92 12°W
	29400	May 22	28 54°N 90 02°W
	2000	June 20	28 39°N 91 29°W
	1300	July 15	28 37°N 90 14°W
1000	5460	May 25	27 52°N 93 59°W
	8400	May 13	29 47°N 94 39°W
Diesel oil:			
1041	1000	January 24	28 05°N 93 50°W
1040	1000	January 24	28 10°N 94 27°W
	1000	January 24	28 02°N 94 28°W
	9000	April 2	28 54°N 95 20°W
	6300	June 30	29 44°N 95 17°W
	3678	July 8	28 07°N 91 39°W
	1000	September 20	30 11°N 87 57°W
Gasoline:			
1011	2100	March 7	27 48°N 97 25°W
	8400	March 17	29 43°N 95 13°W
	1600	October 11	27 46°N 94 27°W
Residual fuel oil:			
1052	2730	March 7	29 45°N 95 17°W
	49980	July 14	29 44°N 95 08°W

Table 6-6.--Potential spills of oil, hazardous substances, natural substances, and other pollutants, Gulf of Mexico, 1984.

Type Material	Date	Quantity
Acetic anhydride:	February 29	------
Asphalt or other residual:		
1062	January 21	20 gals
Benzene:	April 6	21000 gals
	May 26	84000 gals
	June 8	84000 gals
Carbon tetrachloride:	June 5	17200 lbs
Caustic soda:	April 7	2500 lbs
	April 21	1000 gals
Chemical waste:	January 4	494 lbs
Chlorine:	September 14	150 lbs
Crude oil:		
1001	January 1	------
1001	February 3	1864308 gals
1002	February 23	84 gals
1000	February 24	4200 gals
1000	February 29	420 gals
1000	April 5	126 gals
1002	April 16	6 gals
1000	May 13	1260 gals
1000	June 9	630 gals
1000	July 1	20 gals
1000	July 11	15 gals
1000	September 22	15 gals
Diesel oil:		
1040	January 6	10000 gals
1040	January 7	------
1041	January 12	2 gals
1040	February 1	5 gals
1040	February 1	------
1040	February 17	1680 gals
1040	June 16	300 gals
1040	November 19	42000 gals
1040	December 3	15 gals
Epichlorohydrin:	December 27	55 gals

Table 6-6.--(Continued). Potential spills of oil, hazardous substances, natural substances, and other pollutants, Gulf of Mexico, 1984.

Type Material	Date	Quantity
Gasoline:		
1011	January 4	42 gals
1011	February 22	48 gals
Methyl chloride:	January 5	10 gals
Natural substances:	October 11	84 gals
	November 19	1280 gals
Nitric acid:	June 20	5000 gals
	June 22	3000 lbs
Other material:	January 17	2000 lbs
	January 19	1810 gals
	February 13	1 lb
	February 14	100 gals
	April 2	1050000 gals
	May 10	405 lbs
	June 9	200 lbs
	July 22	5 gals
	July 27	1320 lbs
Other oil:		
1080	January 10	117600 gals
1099	February 18	10 gals
1099	April 29	21 gals
1099	July 26	100 gals
1080	August 21	100 gals
1089	December 14	630000 gals
Other pollutants:		
7008	May 2	15 gals
Perchloroethylene:	January 28	530 lbs
	November 5	2000 lbs
Residuel fuel oil:		
1052	January 10	147000 gals
1052	June 6	2 gals
Solvents:		
1030	January 4	2100 gals
Xylene:	May 22	100 gals
Waste oil:	July 16	1 gal
	July 24	20 gals
	October 9	1 gal

largest quantities of hazardous substances spilled. Large quantities of crude oil were spilled during the months of May and September. The total spills amounted to 29,400 gallons in May and 24,150 gallons in September (Table 6-5). The British tanker Alvenus, carrying 14.7 million gallons of crude oil, ran aground on July 30 southeast of Louisiana. This was considered the worst disaster to hit the U.S. coastline in at least five years. An 85 mile-long oil slick resulted affecting the Gulf beaches and shoreline from Louisiana to Texas (see Section 5.2). Little harm was done to marine life due to a storm that drove the marine life landward while the oil slick was approaching. Clearing the shorelines cost millions of dollars, and it took weeks before everything returned to normal. The U.S. Coast Guard responds to every call where a possiible spill might occur but does not necessarily take place. Potential spills are shown in Table 6-6. These are calls to which the Coast Guard responded but which did not materialize as actual spills.

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