NOAA Technical Memorandum NMFS-SEFC-28

NOAA/NMFS FINAL REPORT TO DOE

Biological/Chemical Survey of Texoma and Capline Sector Salt Dome Brine Disposal Sites Off Louisiana, 1978-1979

A report to the Department of Energy on work conducted under provisions of Interagency Agreement EL-78-I-0-7146 during 1978-1979.

Volume IV
DEMERSAL FISHES AND MACRO-CRUSTACEANS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Center
Galveston Laboratory
Galveston, Texas 77550

NOVEMBER 1980

NOAA Technical Memorandum NMFS-SEFC- 28

Biological/Chemical Survey of Texoma and Capline Sector Salt Dome Brine Disposal Sites Off Louisiana, 1978-1979

VOL. IV - DETERMINE SEASONAL ABUNDANCE DISTRIBUTION AND COMMUNITY COMPOSITION OF DEMERSAL FINFISHES AND MACROCRUSTACEANS

BY

A.M. Landry, Ph. D. and H.W. Armstrong, Ph. D.
Texas A&M University
Moody College, Bldg 311, FT. Crockett
Galveston, Texas 77550

A report to the Department of Energy on work conducted under provisions of Interagency Agreement EL-78-I-0-7146 during 1978-1979.

EDITORS

William B. Jackson
Senior Advisor
Contracts & Deliverables
and
Gary M. Faw
Fishery Biologist

U. S. DEPARTMENT OF COMMERCE
Philip M. Klutznick, Secretary

National Oceanic and Atmospheric Administration
Richard A. Frank, Administrator

National Marine Fisheries Service
Terry L. Leitzell, Assisistant Administrator for Fisheries

DISCLAIMER

This document is a Final Report. It has been reviewed by the National Marine Fisheries Service and the National Oceanic and Atmospheric Administration and approved for printing. Such approval does not signify that the contents necessarily reflect the views and policies of the U.S. Department of Energy, NOAA or NMFS. This Report has not been formally released by the DOE. Mention of trade names and commercial products herein does not constitute endorsement or recommendation for use.

NOTICE

This document is a Final Report. It has not been formally released by the U.S. Department of Energy and should not at this stage be construed to represent Department policy.

<u>This Report should be cited as follows:</u>

Landry, A. M. and H. W. Armstrong. 1980. Determine seasonal abundance, distribution and community composition of demersal finfishes and macro-crustaoceans. Vol. IV. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-28, 180 p. Available from: NTIS, Springfield, Virginia.

Volume IV - DEMERSAL FISHES AND MACRO-CRUSTACEANS

TABLE OF CONTENTS

I. EDITORS' SECTION

PROJECT ADMINISTRATION

NOAA Program Management:

<u>Program Manager</u>

Capt. Charles A. Burroughs
NOAA/EDIS/CEAS/MEAD

NMFS Project Management:

<u>Contracting Officer's Technical Representative</u>

Edward F. Klima, Ph.D.
Director
Galveston Laboratory
NMFS Southeast Fisheries Center

<u>Project Manager</u>

Charles W. Caillouet, Ph.D.
Chief, Environmental Research Division

<u>Project Staff</u>

William B. Jackson
Senior Advisor
Contracts and Deliverables

Gregg R. Gitschlag
Senior Advisor
Field Operations and Logistics

Gary M. Faw
Fishery Biologist

E. Peter H. Wilkens
Fishery Biologist

Robert M. Avent, Ph.D.
Oceanographer

Maurice L. Renaud, Ph.D.
Oceanographer

Petronila C. Prado
Clerk Stenographer

Dennis B. Koi
Computer Programmer

Beatrice Richardson
Clerk Typist

Susan E. Gray
Clerk Typist

Julie Mellen
Student Aide

Howard S. Hada
Fishery Biologist

LIST OF VOLUMES

This Final Report is printed in nine separate volumes:

Volume I - BENTHOS

Work Unit 2.1 Describe Living and Dead Benthic (Macro- and Meio-) Communities

Coastal Ecosystems Management, Inc.

R. H. Parker, Ph.D.
A. L. Crowe
L. S. Bohme

Volume II - ZOOPLANKTON

Work Unit 2.2 Determine Seasonal Abundance, Distribution and Community Composition of Zooplankton

LGL Ecological Research Associates, Inc.

L. A. Reitsema, Ph.D.

Volume III - BACTERIA

Work Unit 2.3 Describe Bacterial Communities

Texas A & M University

J. R. Schwarz, Ph.D.
S. K. Alexander, Ph.D.
S. J. Schropp
V. L. Carpenter

Volume IV - DEMERSAL FISHES AND MACRO-CRUSTACEANS

Work Unit 2.4 Determine Seasonal Abundance, Distribution and Community Composition of Demersal Finfishes and Macro-crustaceans

Texas A & M University

A. M. Landry, Ph.D.
H. W. Armstrong, Ph.D.

Volume V - SEDIMENTS

Work Unit 3.1 Describe Surficial Sediments and Suspended Particulate Matter

Energy Resources Company, Inc.

K. A. Hausknecht

Volume VI - HYDROCARBONS

Work Unit 3.2 Determine Hydrocarbon Composition and Concentration in Major Components of the Marine Ecosystem

Energy Resources Company, Inc.

P. D. Boehm, Ph.D.
D. L. Fiest

Volume VII- TRACE METALS

Work Unit 3.3 Determine Trace Metal Composition and Concentration in Major Components of the Marine Ecosystem

Southwest Research Institute

J. B. Tillery

Volume VIII - INORGANIC NUTRIENTS

Work Unit 3.4 Determine Seasonal Variations in Inorganic Nutrients Composition and Concentrations in the Water Column

Texas A & M University

J. M. Brooks, Ph.D.

Volume IX - SHRIMP DATA ANALYSIS

Work Unit 5.1 Analysis of Variance of Gulf Coast Shrimp Data

LGL Ecological Research Associates, Inc.

F. J. Margraf, Ph.D.

INTRODUCTION

In compliance with the Energy Policy and Conservation Act of 1975, Title 1, Part B (Public Law 94-163), the Department of Energy (DOE) implemented the Strategic Petroleum Reserve (SPR). The SPR program was implemented in August of 1977 with the goal of storing a minimum of one billion barrels of crude oil by December 22, 1982. After evaluating several physical storage possibilities, DOE determined that storage in commercially developed salt dome cavities through solution-mining processes was the most economically and environmentally advantageous option.

Six areas along the northwestern Gulf of Mexico were to be investigated as potential storage cavern sites. These areas are shown in Figure 1. This project, "Biological/Chemical Survey of Texoma and Capline Sector Salt Dome Brine Disposal Sites Off Louisiana", deals with proposed disposal sites associated with two of the cavern sites, West Hackberry and Weeks Island. The Biological/ Chemical Survey was initiated in April 1978 and was completed in December 1979. Its major products are Final Reports available through the National Technical Information Service (NTIS), Springfield, Virginia; data files available through the Environmental Data and Information Service (EDIS), Washington, D.C., and any research papers that may be written by participating principal investigators and published in scientific or technical journals. Preliminary results were also made available through DOE/NOAA/NMFS project reviews and workshops attended by project participants and various governmental, private and public user groups.

The objectives of the Biological/Chemical Survey were: (1) to describe the biological, physical and chemical components of the marine ecosystem for each disposal site; and (2) to assess, by analysis of Gulf Coast shrimp data, the importance of the Louisiana shrimping grounds in the vicinity of the proposed salt dome brine disposal sites. These objectives were achieved using historical and new data to describe and quantify the biological, chemical, and physical characteristics and the temporal variations of these characteristics in the environments of each proposed disposal site.

The two proposed disposal sites have been extensively examined, using available meteorological, oceanographic, bathymetric and ecological data, in the following two reports:

Environmental Data Service, DOC/NOAA. 1977.

Analysis of Brine Disposal in the Gulf of Mexico, #2 West Hackberry. Report to Federal Energy Administration Strategic Petroleum Reserve Program Salt Dome Storage. Center for Experiment Design and Data Analysis, NOAA, EDS, Marine Assessment Division, Washington, D.C.

Environmental Data Service, DOC/NOAA. 1977.

Analysis of Brine Disposal in the Gulf of Mexico, #3 Capline Sector. Report to Federal Energy Administration Strategic Petroleum Reserve Program Salt Dome Storage. Center for Experiment Design and Data Analysis, NOAA, EDS, Marine Assessment Division, Washington, D.C.

The above reports and other pertinent documents are available from the Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia, 22151.

Proposed locations of the West Hackberry (Texoma Sector) and Weeks Island (Capline Sector) brine disposal sites are shown in Figures 2 and 3, respectively. These sites are subject to change within the same geographic area pending results of baseline surveys presently underway.

The proposed West Hackberry disposal site is located approximately 9.7 km (6 miles) south off the coast from Mud Lake at Latitude 29^{o} 40' N and Longitude 93^{o}28' W at a bottom depth of about 9 m (30 feet). Operational requirements and engineering limitations of the proposed brine diffuser at this site are as follows: length - 933.3 m (3070 feet); orientation -normal to coast; number of ports - 52; length between ports - 18 m (59 feet); port diameter - 7.6 cm (3 inches); orientation of port riser - 90^{o} to bottom; and port exit velocity - 7.6 m/sec (25 ft/sec).

The proposed Weeks Island (Capline Sector) disposal site is located approximately 41.8 km (26 miles) off Marsh Island at Latitude 29^{o}04'N and Longitude 91^{o}45' W at a bottom depth of about 9 m (30 feet). Operational requirements and engineering limitations of the proposed brine diffuser at this site are as follows: length - 608 m (2000 feet); orientation -normal to coast; number of ports - 34; orientation to port riser - 90^{o} to bottom, and port exit velocity - 7.6 m/sec (25 ft/sec).

The Biological/Chemical Surveys in the proposed salt dome brine disposal sites described seasonal abundance, distribution and community composition of major benthic, planktonic, bacterial and demersal finfish and macro-crustacean ecosystem components; the sediments; the hydrocarbons and trace metals composition and concentration in the marine ecosystem; and the seasonal variations in inorganic nutrients composition and concentration of the water column. The sampling scheme used for sample collections around the two sites is shown in Figure 4. A separate data analysis assessed the importance of shrimping grounds in the vicinity of the proposed brine disposal sites in terms of historical data on species composition, marketing size categories and location of commercial shrimp catches within statistical reporting zones off the Louisiana coast.

Information concerning data from this project is available through the Program Data Manager: Mr. Jack Foreman, Environmental Data and Information Service, Page Building No. 2, 3300 Whitehaven Street, N.W., Washington, D.C.

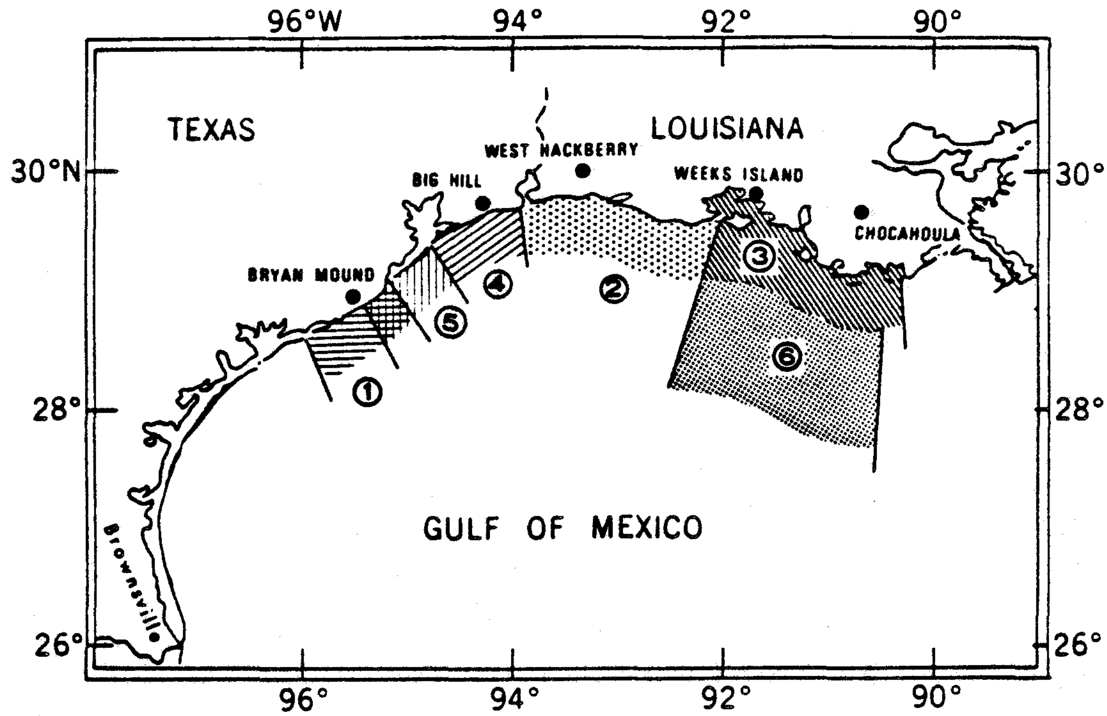


Figure 1. Regions of Study for Brine Disposal Assessment-DOE/NOAA Interagency Agreement (adapted from Environmental Data Service, DOC/NOAA. Analysis of Brine Disposal in the Gulf of Mexico, #2 West Hackberry. 1977.).

1 Texas Coastal Ocean, Colorado River to San Luis Pass (Bryan Mound)

2 Louisiana Coastal Ocean, Sabine Lake to S.W. Pass of Vermilion Bay (West Hackberry)

3 Louisiana Coastal Ocean, S.W. Pass, Vermilion Bay to Timbalier Island (Capline Sector)

4 Texas Coastal Ocean, Port Bolivar to Sabine Pass

5 Texas Coastal Ocean, Freeport Harbor to Galveston South Jetty

6 Louisiana Coastal Ocean, Offshore from Vermilion Bay to Terrebone Bay

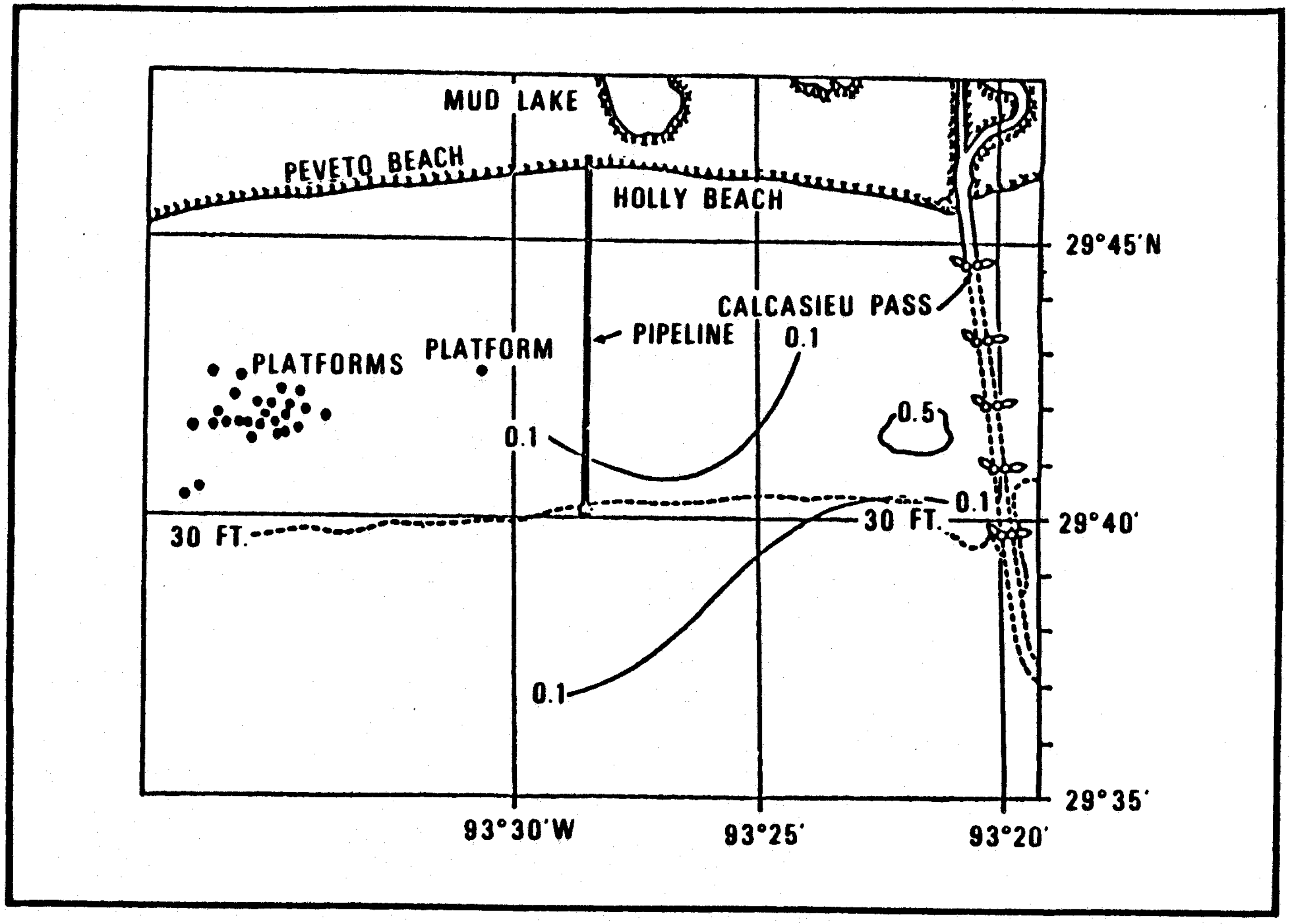


Figure 2. Proposed Texoma brine disposal site.

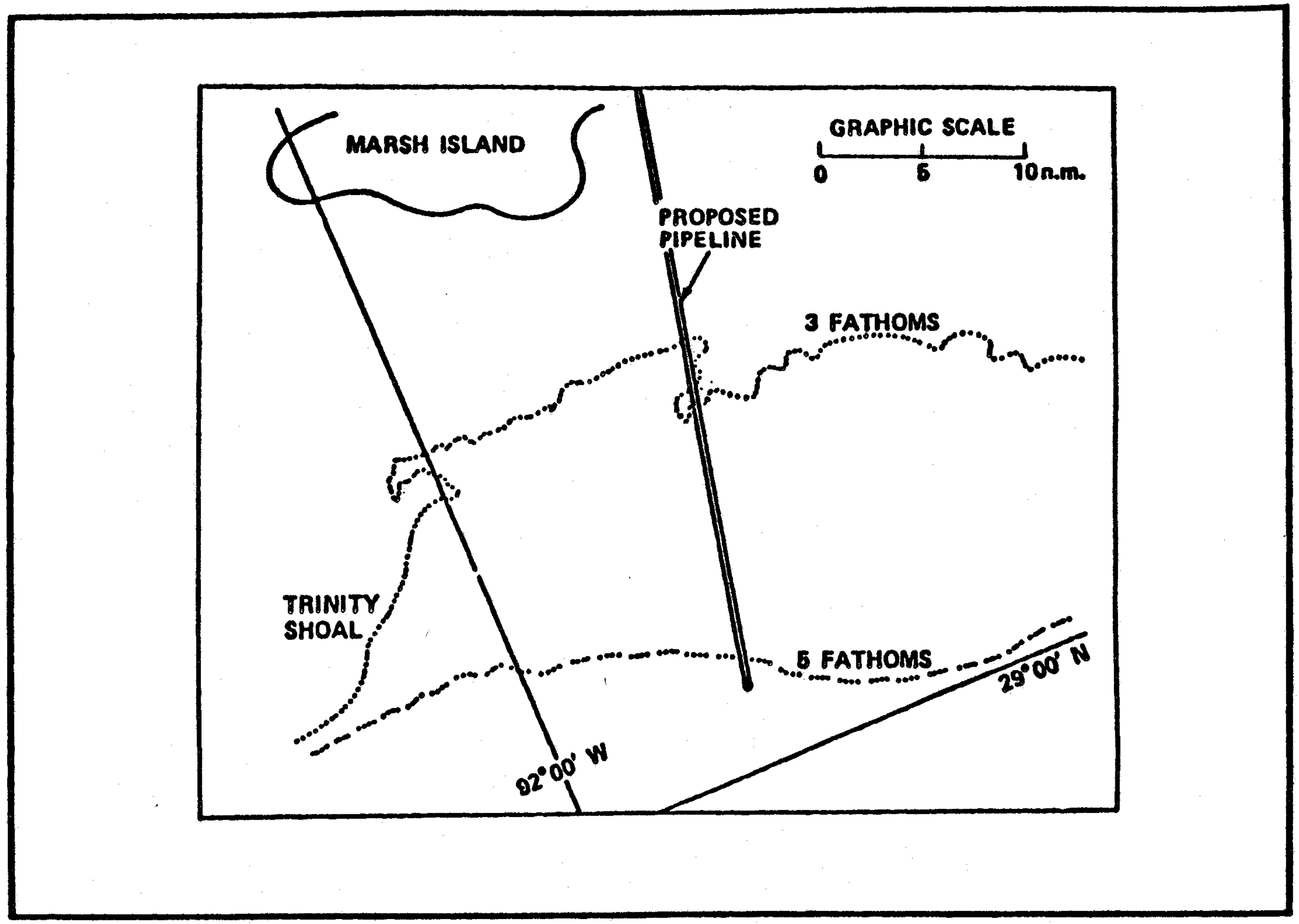


Figure 3. Proposed Capline brine disposal site.

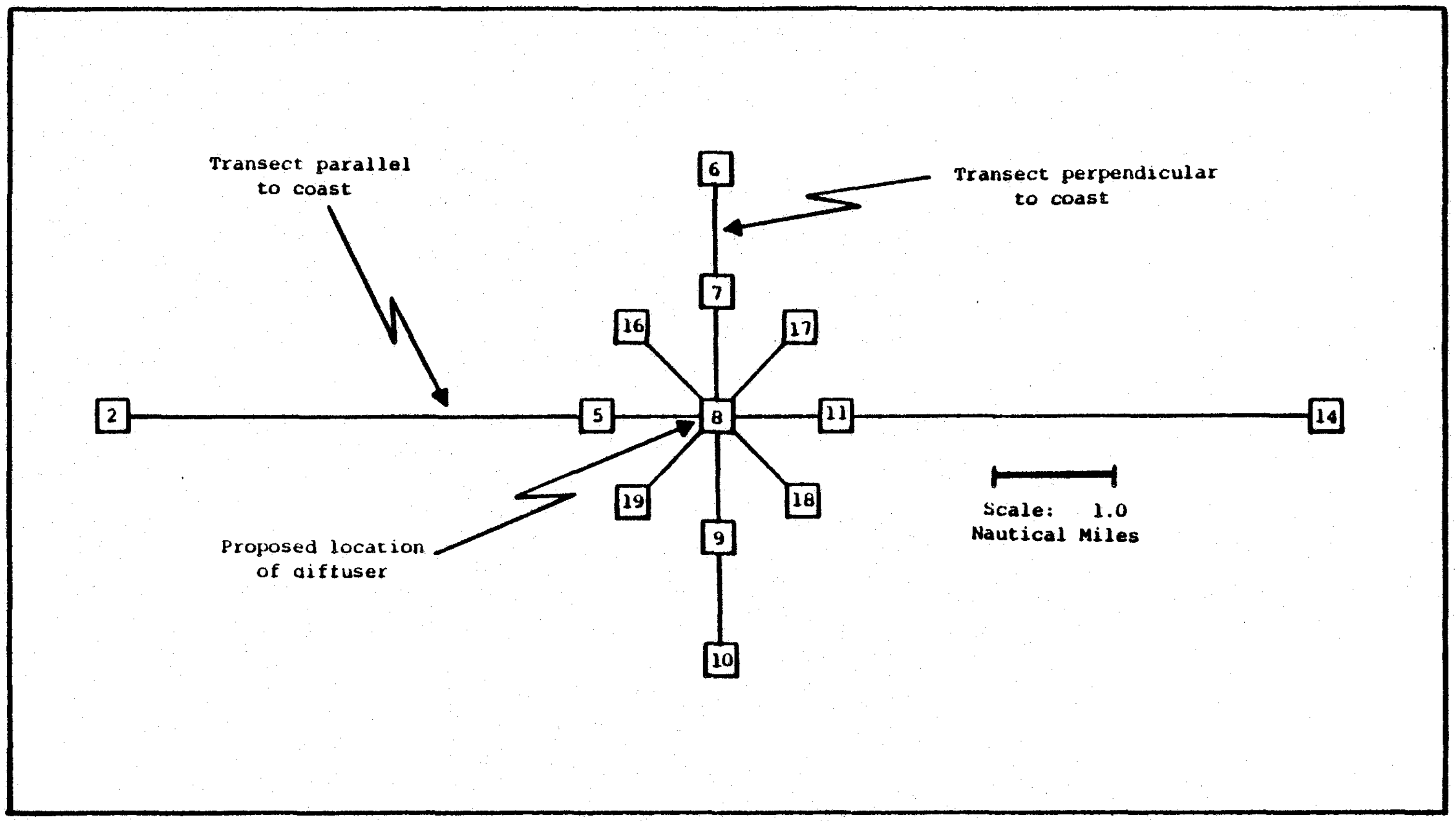


Figure 4. Sampling scheme for proposed salt dome brine disposal sites.

REPORTS AND PUBLICATIONS

Boehm, P. D. and D. L. Fiest. 1980. Determine hydrocarbons composition and concentration in major components of the marine ecosystem. Vol. VI. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-30, 136 p. Available from: NTIS, Springfield, Virginia.

Brooks, J. M. 1980. Determine seasonal variations in inorganic nutrient composition and concentration of the water column. Vol. VIII. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-32, 31 p. Available from: NTIS, Springfield, Virginia.

Caillouet, C. W., F. J. Patella and W. B. Jackson. 1979. Relationship between marketing category (count) composition and ex-vessel value of reported annual catches of shrimp in the eastern Gulf of Mexico. Marine Fisheries Review 41(5-6):1-7.

Caillouet, C. W., F. J. Patella and W. B. Jackson. 1980. Trends toward decreasing size of brown shrimp, *Penaeus aztecus*, and white shrimp, *Penaeus setiferus*, in reported annual catches from Texas and Louisiana. NOAA/NMFS Fishery Bulletin 77(4):985-989.

Caillouet, C. W., D. B. Koi and W. B. Jackson. In press. Relationship between ex-vessel value and size composition of annual landings of shrimp from the Gulf and South Atlantic Coasts. Marine Fisheries Review.

Caillouet, C. W. and D. B. Koi. In press. Trends in ex-vessel value and size composition of annual landings of brown, pink and white shrimp from the Gulf and South Atlantic coasts of the United States. Marine Fisheries Review.

Hausknecht, K. A. 1980. Describe surficial sediments and suspended particulate matter. Vol. V. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-29, 56 p. Available from: NTIS, Springfield, Virginia.

Landry, A. M. and H. W. Armstrong. 1980. Determine seasonal abundance, distribution and community composition of demersal finfishes and macro-crustaceans. Vol. IV. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-28, 180 p. Available from: NTIS, Springfield, Virginia.

Margraf, F. J. 1980. Analysis of Variance of Gulf Coast shrimp data. Vol. IX. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-33, 293 p. Available from: NTIS, Springfield, Virginia.

Parker, R. H. and A. L. Crowe. 1980. Describe living and dead benthic (macro- and meio-) communities. Vol. I. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-25, 103 p. Available from: NTIS, Springfield, Virginia.

Reitsema, L. A. 1980. Determine seasonal abundance, distribution and community composition of zooplankton. Vol. II. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-26, 133 p. Available from: NTIS, Springfield, Virginia.

Schwarz, J. R., S. K. Alexander, A. J. Schropp and V. L. Carpenter. 1980. Describe bacterial communities. Vol. III. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-27, 48 p. Available from: NTIS, Springfield, Virginia.

Tillery, J. B. 1980. Determine trace metal composition and concentration in major components of the marine ecosystem. Vol. VII. In: Jackson, W. B. and G. M. Faw (eds.). Biological/chemical survey of Texoma and Capline sector salt dome brine disposal sites off Louisiana, 1978-1979. NOAA Technical Memorandum NMFS-SEFC-31, 72 p. Available from: NTIS, Springfield, Virginia.

II. PRINCIPAL INVESTIGATORS' SECTION

WORK UNIT 2.4 - DETERMINE SEASONAL ABUNDANCE, DISTRIBUTION AND COMMUNITY COMPOSITION OF DEMERSAL FINFISHES AND MACRO-CRUSTACEANS

A. M. Landry, Ph.D.
H. W. Armstrong, Ph.D.

Texas A & M University

TABLE OF CONTENTS

TABLE OF CONTENTS
(CONT'D)

ABSTRACT

Demersal finfishes and macro-crustaceans were trawled from proposed West Hackberry and Weeks Island brine disposal sites off Louisiana during Summer and Fall 1978 and Winter and Spring 1979. Results indicated that 74 taxa of finfish comprising 41369 individuals and 25 species of macro-crustaceans representing 31120 specimens were taken. Seasonally, West Hackberry finfish catches were greatest in the Summer and Spring and lowest in Fall and Winter. Macro-crustacean yields at West Hackberry were largest and smallest during Winter and Summer, respectively. Largest catches at West Hackberry were taken at stations 2 miles (3.2 km) from the proposed diffuser site while smallest yields occurred 5 miles (8.1 km) from the proposed diffuser site. The proposed diffuser station yielded above average nekton abundance. Overall mean catch at West Hackberry stations exceeded that for Weeks Island by more than double.

Quarterly sampling at Weeks Island yielded largest catches during Winter and smallest catches during Summer. Fall and Spring catches were more closely aligned with those of the Winter and Summer, respectively. The proposed diffuser station led all Weeks Island stations in mean abundance. Smallest catches were usually taken at 5-mile station 14.

LIST OF TABLES

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF TABLES
(Cont'd)

LIST OF FIGURES

LIST OF FIGURES
(Cont'd)

LIST OF FIGURES
(Cont'd)

LIST OF FIGURES
(Cont'd)

INTRODUCTION

PURPOSE OF THE STUDY

The Department of Energy, in implementing the Strategic Petroleum Reserve Program, has proposed to use storage caverns leached out of selected salt domes along the Louisiana coast and to dispose of the leached salts (in the form of brine) at two offshore sites (Frey 1979). One site is located approximately 10 km off the coast south from Mud Lake in about 10 m of water (West Hackberry, Texoma Sector) and the second is located approximately 42 km off the coast from Marsh Island in about 10 m of water (Weeks Island, Capline Sector). The Department of Energy has proposed that the resultant leached caverns be filled with crude oil. This would form an Early Storage Reserve of up to 150 million barrels which could be utilized in time of need. In this event, the oil would be withdrawn by displacement with raw water. The caverns could later be replenished with new reserves, displacing the brine created from the added leaching of the salt cavern which, under certain circumstances, could entrain water soluble fractions from the oil. This process could be repeated up to five times, with the possibility of increasing amounts of oily brine being disposed of during subsequent oil refills. This method of oil storage is economical and is attractive ecologically in that construction of large land-based storage facilities and destruction of terrestrial habitat are negated.

The Department of Energy, however, has identified water quality as one of the most sensitive environmental issues associated with brine disposal. Large quantities of brine will be produced and even larger volumes of water will be required in construction and operation of solution-mined caverns. Disposal of brine containing up to 280 ppt of dissolved solids and unknown amounts of hydrocarbons (after subsequent oil refills) presents the most environmentally sensitive issue (U.S. Department of Commerce 1977a, 1977b).

Potential impacts of brine discharge upon estuarine and marine communities in the proposed disposal sites include osmotic effect of high salinities, altered ion ratios (most notably calcium and magnesium), salinity-induced barriers to migration of larval and adult organisms, effect of high velocity diffuser discharge on larval organisms and possible build-up of hydrocarbons in sediments. Impact from brine disposal generally is expected to be greatest in areas of productive fishing grounds and in areas along migration routes for larval and adult finfishes and macro-crustaceans.

Integrated studies of water column and sediment chemistry, meteorological conditions, current and tidal regimes, plankton, benthos and demersal fauna were initiated to delineate the structure and function of the shallow offshore ecosystem at each proposed disposal site. The research reported herein concerned the characterization of demersal finfish and macro-crustacean communities of each proposed disposal site. Specific objectives of the study include:

1) Description of the demersal finfish and macro-crustacean components of the ecosystem for each proposed brine disposal site, with respect to spatial and temporal variations in species composition, abundance, biomass, species association, sex composition, size frequency distribution, and condition.

2) Determination of the food habits and trophic dependency of selected demersal finfishes.

3) Determination of the gonad development and spawning conditions of selected demersal finfishes and macro-crustaceans.

LITERATURE REVIEW

Studies by Perret *et al*. (1971), Perret and Caillouet (1974) and Juneau (1975) document the importance of the disposal site areas in the life histories of many commercially valuable species. Spotted seatrout (*Cynoscion nebulosus*) and blue crabs (*Callinectes sapidus*) spawn and complete their life cycles in adjacent estuaries but also may be found in shallow coastal waters. Other commercially and recreationally important species such as white shrimp (*Penaeus setiferus*), brown shrimp (*P. aztecus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), red drum (*Sciaenops ocellata*), black drum (*Pogonias cromis*), sand seatrout (*Cynoscion arenarius*) and southern flounder (*Paralichthys lethostigma*) spawn in the shallow coastal waters, frequently near passes, such as Calcasieu Pass. Young of the species then migrate into estuarine nursery grounds to feed and grow, and then return to the Gulf to spawn. Both disposal sites are located near known migration routes for larvae and adults of many of the aforementioned species (Perret *et al*. 1971).

The proposed disposal sites are located along some of the most productive fishing grounds off the Louisiana coast. The total harvest of commercial finfish, blue crabs and shrimp from Louisiana waters during 1968-1970 was 443.1 million kg, 4.6 million kg and 40.0 million kg, respectively. Catches from Grid 17, which includes the West Hackberry area, during this time interval totaled over 95.8 million kg of finfish, 3.7 million kg of shrimp and 3.7 thousand kg of crabs. The average annual harvest from the Capline area during 1963-1967 was 10.4 million kg of shrimp and 500 thousand kg of crabs. The leading finfish was menhaden (*Brevoortia patronus* and *B. gunteri*) which totaled 29.4 million kg, followed by Atlantic croaker, spot and seatrout with 3.5, 0.7 and 0.1 million kg, respectively (Lindall *et al.* 1972).

More recent data reveal the high productivity of Louisiana coastal waters. Commercial landings of finfish and shellfish in Louisiana coastal and inland waters during 1975 totaled 0.5 billion pounds worth $89 million (U.S. Department of Commerce 1975).

Trawl studies in similar areas off the southeastern Louisiana coast took an average of 138 (Moore *et al.* 1970) and 170 kg of bottomfish per hour (LOOP 1975). Ragan *et al.* (1978) reported an average for the entire Louisiana shelf of 141 kg per hour and 85.1 and 174.2 kg per hour for areas of the shelf adjacent to West Hackberry and Weeks Island, respectively.

U.S. Department of Energy (1978) trawl studies at the West Hackberry site yielded 79 species of demersal finfish and macro-crustaceans. The species captured were typical of the nearshore white shrimp community characteristic of sandy-mud bottom in waters less than 20 m. Dominant finfish and crustacean species were the bay anchovy (*Anchoa mitchilli*) and net-clinger shrimp (*Acetes americanus louisianesis*). Recreationally important species captured during the study included crevalle jack (*Caranx hippos*), Atlantic spadefish (*Chaetodipterus faber*), sand and silver seatrout, spot and Atlantic croaker. However, none of these species were of a size acceptable to the recreational fishery. Commercially important macro-crustaceans taken in trawls included the brown and white shrimp and seabob (*Xiphopenaeus krøyeri*).

Literature concerning effects of brine and oily brine discharge on aquatic ecosystems is sparce. Mackin and Hopkins (1962) summarized a series of studies conducted in Louisiana from 1940 through 1960 on effects on oysters of brine bleed water from oil operations and concluded that brine discharge was not responsible for reported oyster mortalities. Mackin (1971) studied effects on estuarine organisms of oily brine effluent from oil separator platforms in several Texas bays. Ecological effects were dependent upon volume of discharge and dilution of brine. Mackin's observations ranged from no harmful effects at outfalls in Lavaca and Matagorda Bays to locally pronounced effects at two outfalls in Trinity Bay. The C-2 separator platform outfall in Trinity Bay had a surrounding area with an almost non-existent benthic fauna extending 15.2 to 22.9 m beyond the outfall. A deeply depressed zone extended outward for another 106.7 m, while the benthic fauna farther out was undamaged. A zone of benthic stimulation seemed to be present 710 m from the platform. Pelagic organisms did not appear to be significantly affected by the brine. Armstrong _et al_. (1978) also studied the C-2 separator platform in Trinity Bay to determine oil concentrations in the water and sediment and their effect on the surrounding benthic fauna. These investigators found zones of effect similar, but somewhat larger, than those described by Mackin. They determined that the adverse effect on the benthic community was not due to the hypersalinity of the brine, but rather to water soluble oil fractions in the brine. Bottom salinity was ambient and the hydrocarbon content had been diluted 2000 fold (from 25 ppm total hydrocarbons in the full strength effluent to 10.5 ppb in the water) 15.2 m from the platform. Sediment 15.2 m from the platform indicated that the hydrocarbons accumulated in surrounding sediments, being almost 4 times as high there (96 ppm) as in the full strength effluent (25 ppm). Continuous introduction of low levels of oil into the environment can result in the build-up of hydrocarbons in sediments (Giger et al. 1974) which may persist for a long period of time (Johnstone 1970; Blumer and Sass 1972a, 1972b; Scarrat and Zitko 1972; Shelton and Hunter 1974). Investigation into the disposal of brine effluent from a desalination plant showed a marked reduction in number of most marine animals in the intertidal zone within 30.5 m of the brine outfall (Dow Chemical Company 1967). Harper (1977) studied effects on macrobenthos of oily brine discharge in an active oil field in the northwestern Gulf of Mexico. Macrobenthic populations in the vicinity of brine discharge were depressed while those 1000 m east and northeast of the discharge were enlarged.

METHODS AND MATERIALS

EXPERIMENTAL DESIGN AND SAMPLING PROCEDURES

Demersal finfishes and macro-crustaceans were collected from two proposed brine disposal sites within the Capline (Weeks Island - Lat. 29°05.7'N, Long. 91°47.6'W) and Texoma Sectors (West Hackberry - Lat. 29°40.0'N, Long. 93°28.0'W) off Louisiana during 18-22 June and 26 September - 1 October 1978 and 14-17 January and 16-20 April 1979. Five stations within a 13 station complement were sampled at each site (Figs. 1 and 2). One station (designated "diffuser station" and numbered "8") was located in the center of the proposed diffuser site, two stations were 3.2 km (2 miles) from the diffuser along a north-south transect (collectively designated "2-mile stations" and numbered "6" and "10", respectively) and two stations were 8.1 km (5 miles) from the diffuser along a west-east transect (designated "5-mile stations" and numbered "2" and "14", respectively). The center station and two 3.2-km stations were on a transect perpendicular to the coastline whereas the two 8.1-km stations were on a transect parallel to the coastline.

Three, 20-minute trawl tows were made at each station. Trawls were towed at a vessel speed of approximately 2 knots along one or more sides of a triangle formed by three buoys marking the station. Direction of each trawl tow was chosen so as to reduce hydrocarbon contamination of samples by exhaust fumes from the vessel's smoke stack. Trawls were towed at night to minimize net avoidance.

Demersal finfish and macro-crustaceans were collected with a 12.2-m semi-balloon trawl having a 12.2-m float line and a 13.8-m lead line. The trawl was constructed of 47.6-mm stretched mesh, untreated nylon (#18 twine) throughout the body and 38.1-mm stretched mesh nylon (#30

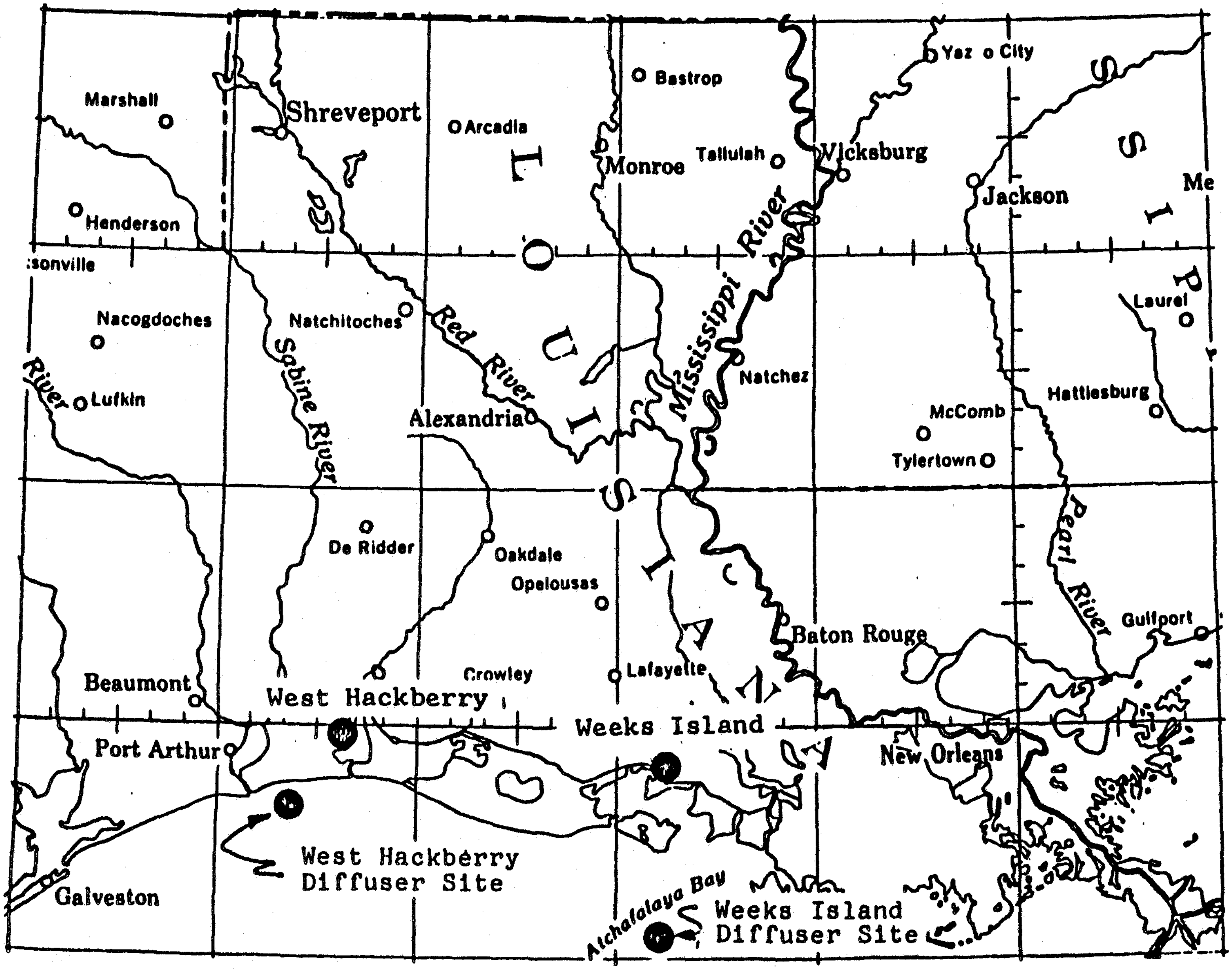
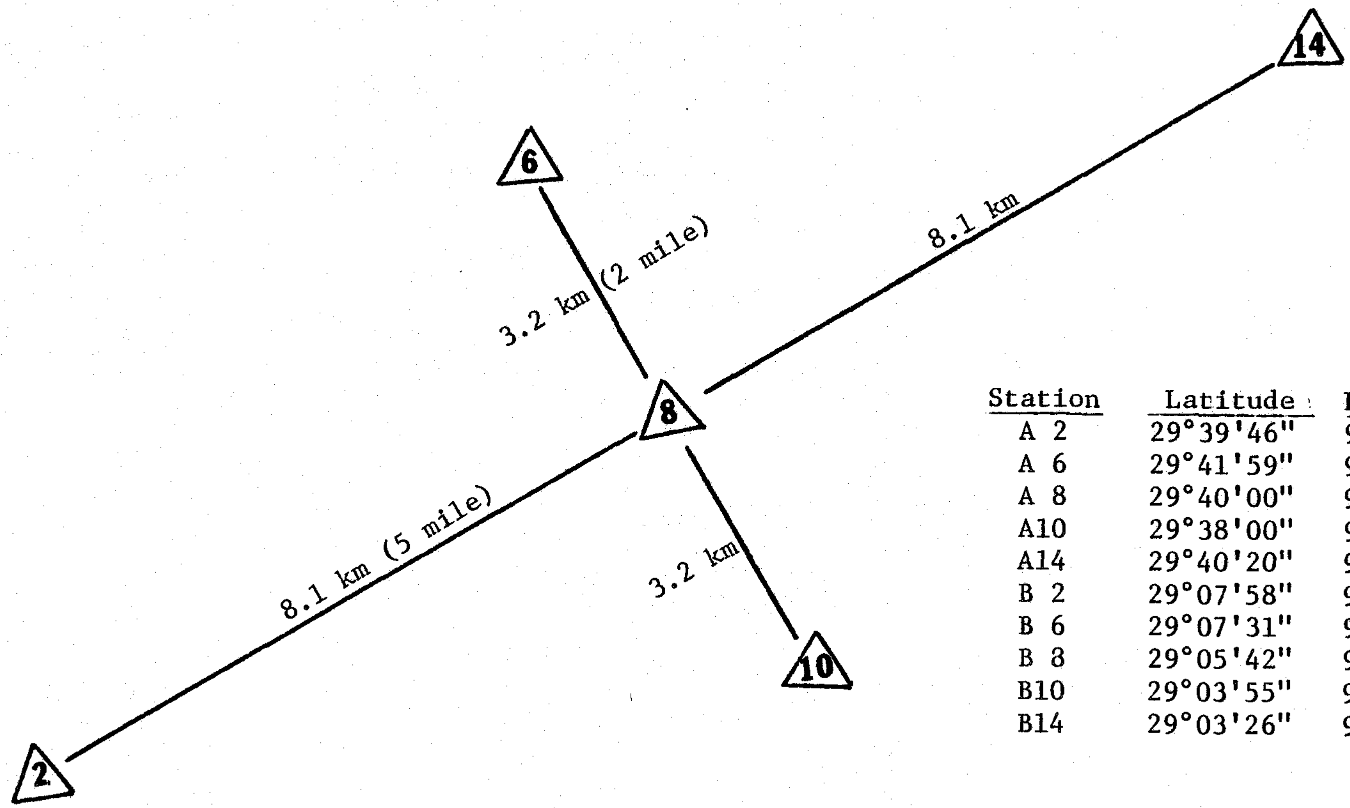


Figure 1. Map of proposed Weeks Island and West Hackberry diffuser sites.



Station	Latitude	Longitude
A 2	29°39'46"	93°33'47"
A 6	29°41'59"	93°28'12"
A 8	29°40'00"	93°28'00"
A10	29°38'00"	93°27'52"
A14	29°40'20"	93°22'17"
B 2	29°07'58"	91°52'43"
B 6	29°07'31"	91°46'35"
B 8	29°05'42"	91°47'36"
B10	29°03'55"	91°48'37"
B14	29°03'26"	91°42'13"

Figure 2. Station array and location at West Hackberry (A) and Weeks Island (B) sites. Sides of triangles enclosing stations denote paths of three trawl tows.

twine) in the cod end. Untreated nylon webbing prevented contamination of samples taken for hydrocarbon analysis. A 2/0 galvanized "tickler" chain was attached to the 2.4 x 1.0 m mahogany trawl doors to enhance capture of demersal organisms.

Hydrological parameters, including water temperature (in C), dissolved oxygen content (in ppm) and conductivity (in μmho/cm), were measured immediately prior to biological sampling. Measurements were taken with a Hydrolab Surveyor Model 6 D In-Situ Water Quality Analyzer. Readings were made from surface to bottom at 1-m intervals.

ONBOARD SAMPLE PROCESSING AND ANALYSIS

Once on-board, each trawl was shaken down to insure that the entire collection was concentrated in the cod end for easy removal. The collection was emptied into a non-contaminating (stainless steel and plastic) container and those organisms selected for hydrocarbon (Work Unit 3.2) and trace metal (Work Unit 3.3) analyses were removed, identified to species, and provided to personnel from Work Unit 3.2. Identity, length and weight data on specimens removed for hydrocarbon and trace metal analyses were incorporated with similar data taken from the remainder of the trawl collection.

After removal of hydrocarbon and trace metal specimens, the remaining sample lot was processed as follows. Collections were rough sorted as to finfish and macro-crustaceans. Sorted finfish collections weighing less than 9 kg were placed in plastic bags, properly labeled and quick frozen. Finfish collections exceeding 9 kg were subsampled as follows. The collection was emptied onto the deck, spread out and shovelled at random into one of three plastic baskets. Specimens were removed from one randomly selected basket until a total biomass of 9 kg was obtained. The 9-kg subsample was transferred to properly labeled plastic bags and quick frozen for 20 to 40 minutes in a quick-freezing unit onboard the vessel. The remainder of the collection was wet-weighed to the nearest 0.1 g and discarded. Quick-frozen finfish collections were transferred to freezers for the duration of the cruise.

Gonadal development of 10 of the largest specimens from all commercially-important macro-crustacean species was determined visually by gross appearance or by careful dissection according to the five stage scheme of King (1948) and Cummings (1961). Specimens were sexed, examined for gonad development, and measured immediately after capture. These specimens and the remaining macro-crustaceans were placed in properly labeled plastic bags and preserved in 10% formalin or quick-frozen.

LABORATORY PROCESSING AND ANALYSIS

Frozen finfish collections were removed from freezers and allowed to thaw at room temperature. Care was taken to thaw only those samples which could be processed in an uninterrupted (but reasonable) interval of time so as to prevent bacteria-caused decay and enzymatic breakdown of tissue (especially stomach contents). Finfish were identified to species using keys by Gallaway et al. (1972), Walls (1975) and Hoese and Moore (1977), and the number of individuals in each species determined. All fish were then weighed and measured individually for purposes of calculating condition factor, size frequency distribution and length-weight relationships. Each fish was measured to the nearest millimeter of standard length [that straightline distance from the anteriormost part of the snout or upper lip to the caudal fin base (Hubbs and Lagler 1967)] and wet weighed to the nearest 0.001 g on a Sartorius Model 2434 top-loading precision electronic balance according to procedures outlined by Lagler (1968).

The coelomic cavity of each fish was cut open to reveal the gonads and digestive tract immediately after weights and measurements were taken. Gross visual inspection of gonads were used in determining sex in adult fish. Gonads were removed and inspected by microscopy when sex was not readily apparent in immature fish. Gonadal development or stage of maturity was determined by visual inspection according to the generalized classification scheme of Nikolsky (1963).

Stomach analyses were performed on at least five dominant species of demersal finfish from each disposal site. Numerical abundance, size composition and trophic dependency were used in selecting species most appropiate for stomach analysis. A maximum of 50 stomachs per species per site was analyzed.

Each stomach of selected individuals was removed, labeled with a number identifying it with a particular species, placed in a glass vial filled with buffered 10% formalin and held for later analysis. Stomach analysis procedures entailed the following. Each stomach was cut open and examined under a dissecting microscope to ascertain presence of food items. All contents were washed from the stomach into a sorting tray. The stomach again was examined microscopically after this initial transfer to insure that all contents had been removed. Individual food items were sorted, identified to the lowest possible taxon and enumerated. Following enumeration, each food category was dried and baked overnight in a 37.8 C oven. The dry weight of each food category was determined to the nearest 0.0001 g.

Macro-crustaceans were identified to species using keys by Williams (1965), Felder (1973) and Wood (1974), and the number of individuals in each species determined. Individual shrimp were measured to the nearest millimeter of total length (that straightline distance from the anteriormost tip of the rostrum to the tip of the telson) while individual crabs were measured to the nearest millimeter of carapace width (that straightline distance between lateral spine tips). Shrimp and crabs were individually wet-weighed to the nearest 0.1 g. Sex and gonad development of commercially important macro-crustaceans were determined according to procedures outlined by Williams (1965), and King (1948) and Cummings (1961), respectively.

DATA ANALYSIS

Summary tables listing all species taken, their abundance by total number and total weight and the percent of total number and weight contributed by dominant species were prepared for each site and season. Catch per tow data for both number and weight were generated to characterize and compare seasonal abundance, distribution and biomass trends at each station.

Abundance and biomass data were log transformed to approximate normal distribution and subjected to analysis of variance (AOV). The AOV was used to determine the effect of station and season on organism abundance and biomass. A Duncan's Multiple Range Test was used to detect the degree of difference between mean catch values for abundance and biomass.

Species diversity indices take into account both number of species and frequency distribution of individuals within those species and, as such, were used as a measure of community structure. Diversity indices for each station were developed using the Shannon-Weaver index as formulated by Pielou (1966a). The diversity index H" was calculated by:

$$H'' = -\sum_{i=1}^{n} \frac{n_i}{N} \ln \frac{n_i}{N}$$

where n = number of individuals in the ith species
N = total number of individuals in the sample.

Evenness values were calculated to characterize the distribution of individuals within a sample. Pielou's (1966b) index was used to calculate the evenness component of diversity (J) according to the following:

$$J = \frac{H''}{\ln S}$$

where H" = Shannon-Weaver diversity index
S = total number of species in the sample.

Species richness D' was calculated to characterize the number of species in a sample relative to total number of individuals. The Dahlberg and Odum (1970) formula was used to calculate species richness as follows:

$$D' = \frac{S - 1}{\ln N}$$

where S = total number of species in the sample
N = total number of individuals in the sample.

Length-frequency histograms were developed to characterize size distribution and, to a lesser extent, age-group distribution of dominant species at each site during all seasons. Size range, modal length and mean length statistics also were employed in assessing size composition of demersal fauna.

Summary tables listing sex and gonad maturity stage of dominant species were prepared for each site and season. Percent representation by number was listed for each sex and gonad maturity stage by site and season.

Summary tables listing food items, their abundance and biomass, and frequency of occurrence in stomachs were developed for dominant demersal finfishes. Percent representation by number and weight also was listed for each food category.

RESULTS

HYDROGRAPHY

Water temperature, conductivity and dissolved oxygen data for West Hackberry and Weeks Island are presented in Tables 1-4. A nomagraph for converting conductivity to salinity is presented in Appendix A. Seasonally, stations within a site exhibited only slight differences in hydrographic conditions. A review of seasonal trends in water quality at each site is given below.

Summer water temperatures at both sites averaged near 30 C and were the highest recorded during the study (Table 1). Differences in water temperature between sites were minimal. Temperature data indicated that water masses at both sites were well mixed, with surface and bottom temperatures usually differing by no more than 1 C. These findings are in contrast to those of Reitsema (1979) who reported a vertical temperature stratification at West Hackberry during the summer. West Hackberry and Weeks Island exhibited conductivity values ranging from 28500 to 35000 μmho/cm and from 40500 to 44000 μmho/cm, respectively. Conductivity values at both sites were highest in bottom strata. Summer dissolved oxygen levels at both sites were the lowest recorded during the study. Most dissolved oxygen readings failed to exceed 5.0 ppm and generally exhibited gradual declines from surface to bottom. Bottom dissolved oxygen readings as low as 1.1 (West Hackberry) and 2.9 ppm (Weeks Island) were indicative of the potential for anoxic conditions.

Fall water temperatures at both sites exhibited slight declines from those recorded during summer (Tables 1 and 2). Temperatures at West Hackberry and Weeks Island ranged from 27.0 to 29.0 and 26.8 to 29.0 C, respectively and generally were slightly higher at Weeks Island (Table 2).

Table 1. Hydrographic data for West Hackberry (A) and Weeks Island (B) stations during 18-21 June 1978. Bottom measurements are denoted by an asterisk.

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
A2	20 June 78	0020	Surface	30.0	28,500	4.2
			1	30.5	28,500	4.1
			2	30.5	28,500	4.1
			3	30.0	28,500	4.1
			4	30.0	29,000	4.1
			5	30.5	29,000	4.0
			6	30.5	29,000	4.0
			7	30.5	29,000	4.0
			8*	30.5	29,000	4.0
A6	19 June 78	0120	Surface	30.0	29,800	3.4
			1	30.0	29,900	3.4
			2	29.9	29,900	3.4
			3	30.1	30,000	3.4
			4	30.0	30,000	3.3
			5	30.0	30,000	3.3
			6*	29.9	29,500	3.3
A8	19 June 78	0405	Surface	29.8	32,000	3.6
			1	29.8	32,500	3.7
			2	29.5	32,700	3.7
			3	29.5	32,500	3.7
			4	29.5	32,500	3.7
			5	29.5	32,800	3.7
			6	30.0	33,000	3.7
			7	30.0	34,000	3.7
			8*	29.8	34,000	3.4
A10	19 June 78	2015	Surface	30.5	29,500	4.6
			1	30.5	29,500	4.5
			2	30.5	29,500	4.3
			3	30.5	29,500	3.8
			4	29.7	30,000	3.2

Table 1. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
			5	29.5	32,000	2.9
			6	28.8	35,000	1.2
			6.5*	28.5	35,000	1.1
A14	18 June 78	2030	Surface	29.5	30,000	3.6
			1	29.5	30,000	3.6
			2	30.5	31,500	4.1
			3	30.0	32,500	3.9
			4	29.5	33,000	3.3
			5*	29.5	34,500	2.8
B2	21 June 78	2322	Surface	29.7	41,500	3.6
			1	29.7	41,500	3.6
			2	29.8	41,500	3.5
			3	29.8	41,500	3.4
			4	29.7	41,500	3.4
			5*	29.6	41,500	3.4
B6	21 June 78	0145	Surface	29.0	40,500	3.4
			1	29.0	40,500	3.4
			2	29.0	40,500	3.4
			3	29.0	40,500	3.3
			4*	29.0	40,500	3.3
B8	21 June 78	0402	Surface	27.9	43,500	3.4
			1	27.9	43,500	3.4
			2	28.0	43,500	3.3
			3	28.0	43,300	3.3
			4	27.9	43,300	3.2
			5	27.9	43,200	3.2
			6	27.9	43,300	3.2
			6.3*	27.9	43,300	3.1
B10	21 June 78	2042	Surface	29.4	41,000	3.8
			1	29.5	41,000	3.8
			2	29.8	41,000	3.7
			3	29.8	41,000	3.6

Table 1. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
			4	29.5	41,200	3.5
			5	29.1	42,000	3.4
			6	28.5	43,000	3.2
			7*	28.0	44,000	2.9
B14	20 June 78	2105	Surface	29.0	41,000	3.8
			1	29.0	40,800	3.6
			2	29.0	40,900	3.6
			3*	29.3	40,900	3.5

[1] See Appendix A for conversion of conductivity to salinity.

Table 2. Hydrographic data for West Hackberry (A) and Weeks Island (B) stations during 26 September - 1 October 1978. Bottom measurements are denoted by an asterisk.

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
A2	29 Sept 78	0207	Surface	27.0	41,900	7.4
			1	27.0	41,900	7.1
			2	27.0	41,900	6.9
			3	27.0	41,500	6.9
			4	27.0	41,900	6.8
			5	27.0	41,500	6.7
			5.3*	27.0	41,000	6.7
A6	27 Sept 78	0010	Surface	28.2	40,400	8.1
			1	28.3	40,200	7.9
			2	28.2	40,200	7.7
			3	28.1	40,300	7.5
			4	28.0	40,500	7.1
			4.7*	28.0	40,600	6.9
A8	26 Sept 78	2105	Surface	27.9	39,900	8.4
			1	28.4	40,300	8.1
			2	28.1	40,300	7.7
			3	28.0	40,600	7.2
			4	28.0	40,900	6.8
			5	27.9	41,200	6.5
			5.6*	27.9	42,100	6.1
A10	28 Sept 78	1925	Surface	27.5	42,500	7.0
			1	27.5	42,600	6.8
			2	27.5	42,600	6.7
			3	27.5	42,600	6.7
			4	27.5	42,800	6.6
			5	27.5	42,800	6.6
			5.5*	27.6	42,800	6.6

Table 2. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
A14	27 Sept 78	0505	Surface	28.0	42,000	7.6
			1	28.5	42,500	7.4
			2	28.5	42,300	7.3
			3	28.5	42,500	7.3
			4	28.5	42,500	7.2
			5	29.0	42,500	7.2
			5.5*	28.5	36,000	7.0
B2	30 Sept 78	1855	Surface	28.2	40,900	7.5
			1	28.3	41,000	7.5
			2	28.5	44,900	7.1
			3	28.6	46,000	6.4
			4	28.8	46,300	6.2
			4.2*	28.9	46,200	6.2
B6	30 Sept 78	2335	Surface	28.0	40,800	7.7
			1	28.0	40,900	7.5
			2	28.2	43,000	7.3
			3	29.0	46,100	6.3
			3.3*	29.0	46,100	6.2
B8	1 Oct 78	0137	Surface	26.8	42,200	7.1
			1	26.8	42,800	7.1
			2	27.0	42,900	7.0
			3	27.5	45,500	6.7
			4*	27.5	46,100	6.0
B10	1 Oct 78	0330	Surface	27.7	43,900	7.5
			1	27.8	43,900	7.3
			2	28.0	44,200	7.2
			3	28.7	45,400	7.0
			4	28.6	46,900	5.8
			4.8*	29.0	47,100	5.0

Table 2. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
B14	1 Oct 78	0538	Surface	27.0	45,000	7.0
			1	26.9	45,000	7.2
			2	27.0	45,000	7.1
			3	27.3	45,300	6.9
			3.5*	28.5	45,500	6.8

[1] See Appendix A for conversion of conductivity to salinity.

Table 3. Hydrographic data for West Hackberry (A) and Weeks Island (B) stations during 14-17 January 1979. Bottom measurements are denoted by an asterisk.

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
A2	15 Jan 79	2105	Surface	8.8	43,500	12.7
			1	8.8	43,500	12.1
			2	9.0	43,500	11.9
			3	9.0	43,500	11.7
			4	9.0	43,800	11.5
			5	9.0	43,500	11.3
			6	8.8	43,500	11.2
			7	8.5	43,500	11.1
			8	8.5	43,800	11.1
			9	8.5	44,000	11.1
			10*	8.5	44,000	10.9
A6	14 Jan 79	2319	Surface	9.2	45,200	12.5
			1	9.3	45,000	11.9
			2	9.3	45,000	11.7
			3	9.3	45,000	11.3
			4	9.4	45,000	11.3
			5	9.4	45,000	11.1
			6	9.5	45,000	10.9
			7	9.5	45,000	10.8
			8*	9.5	42,000	10.2
A8	15 Jan 79	0139	Surface	7.5	41,500	13.5
			1	8.0	42,000	12.4
			2	8.0	41,500	12.1
			3	8.0	41,500	12.0
			4	8.0	42,000	11.7
			5	8.3	43,000	13.1
			6	8.5	43,000	11.1
			7	8.5	44,000	11.0
			8	8.5	44,000	11.1
			9	9.0	44,000	10.8
			10*	9.0	44,000	10.8

Table 3. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
A10	15 Jan 79	0410	Surface	9.0	44,000	13.2
			1	9.2	44,000	12.1
			2	9.2	44,000	11.7
			3	9.5	44,000	11.6
			4	9.5	44,000	11.2
			5	9.5	43,800	11.1
			6	9.5	44,000	10.9
			7	9.5	44,000	10.9
			8	9.5	43,800	10.7
			9	9.5	44,000	10.7
			10	10.0	44,000	10.6
			11	10.0	44,000	10.4
			12*	10.3	45,000	10.4
A14	14 Jan 79	2009	Surface	7.5	37,500	11.5
			1	7.5	37,500	11.5
			2	8.0	38,000	11.1
			3	9.5	44,000	10.5
			4	9.5	44,800	10.4
			5	9.6	44,200	10.4
			6	9.6	44,200	10.4
			7	9.6	44,200	10.4
			8	9.6	44,200	10.3
			9	9.8	44,200	10.2
			10	9.8	44,400	10.1
			10.5*	9.8	44,200	10.0
B2	16 Jan 79	2228	Surface	11.5	40,000	11.6
			1	11.5	40,000	11.3
			2	11.5	40,000	11.1
			3	11.8	40,000	10.9
			4	12.0	42,500	10.6

Table 3. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
			5	12.0	42,500	10.5
			6	12.2	42,000	10.7
			7	12.4	42,000	10.6
			8	12.5	43,200	10.3
			9	12.5	43,500	10.1
			10*	12.5	43,500	10.1
B6	17 Jan 79	0635	Surface	11.0	40,000	12.5
			1	11.0	40,000	11.9
			2	11.0	40,000	11.6
			3	11.5	41,000	11.6
			4	11.5	41,000	11.2
			5*	12.0	44,000	10.7
B8	17 Jan 79	0200	Surface	11.9	42,500	11.5
			1	11.9	42,500	11.7
			2	11.9	42,900	10.6
			3	11.8	42,500	10.5
			4	11.8	42,500	10.4
			5	11.9	42,500	10.3
			6	12.0	43,000	10.2
			7	12.0	43,000	10.1
			8*	12.5	43,000	10.1
B10	17 Jan 79	2215	Surface	12.3	43,000	11.1
			1	12.5	43,000	11.1
			2	12.5	43,500	11.1
			3	12.5	44,000	11.0
			4	12.5	44,000	10.9
			5	12.5	44,000	10.7
			6	12.5	45,000	10.4

Table 3. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
			7	12.5	45,500	10.3
			8	12.5	46,000	10.1
			9	13.0	46,000	10.1
			10*	13.0	46,000	10.0
B14	17 Jan 79	1904	Surface	13.8	46,000	11.5
			1	13.8	46,000	11.3
			2	13.8	46,000	11.2
			3	13.5	46,000	11.0
			4	13.0	46,000	10.6
			5	12.8	46,000	10.3
			6*	12.8	46,000	10.2

[1]See Appendix A for conversion of conductivity to salinity.

Table 4. Hydrographic data for West Hackberry (A) and Weeks Island (B) stations during 16-20 April 1979. Bottom measurements are denoted by an asterisk.

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
A2	16 Apr 79	1910	Surface	23.5	32,200	7.3
			1	23.5	32,100	7.1
			2	23.5	32,500	6.9
			3	23.5	32,400	6.8
			4	23.5	32,900	6.3
			5	23.5	32,800	6.3
			6	23.5	32,700	6.4
			7	23.5	32,100	6.5
			8*	23.5	32,200	6.5
A6	16 Apr 79	2227	Surface	23.6	23,500	6.7
			1	23.6	23,500	6.6
			2	23.5	23,500	6.5
			3	23.5	23,500	6.6
			4	23.6	23,300	6.5
			5	23.8	23,300	6.5
			6	23.8	23,300	6.4
			7	23.8	23,500	6.4
			8	23.8	23,300	6.4
			9	23.8	23,500	6.4
			9.5*	23.8	23,500	6.3
A8	17 Apr 79	0105	Surface	23.3	28,800	7.0
			1	23.2	29,000	6.8
			2	23.2	29,000	6.6
			3	23.3	29,300	6.4
			4	23.3	29,300	6.4
			5	23.3	29,300	6.4
			6	23.3	29,500	6.4
			7	23.3	30,000	6.3
			8	23.3	30,000	6.2

Table 4. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
			9	23.3	30,000	6.1
			10	23.3	30,500	6.1
			11	23.3	31,000	6.0
			12*	23.3	31,000	5.6
A10	17 Apr 79	2102	Surface	22.4	41,800	6.8
			1	22.4	42,700	6.6
			2	22.4	41,800	6.7
			3	22.4	41,500	6.6
			4	22.4	41,700	6.6
			5	22.4	41,700	6.6
			6	22.4	41,800	6.6
			7	22.4	42,000	6.5
			8	22.4	42,500	6.5
			9	22.4	42,500	6.5
			10	22.4	42,500	6.5
			11	22.3	43,500	6.5
			12	22.3	43,500	6.5
			13*	22.3	44,000	6.4
A14	18 Apr 79	0001	Surface	22.3	28,500	6.7
			1	22.3	28,000	6.5
			2	22.3	28,000	6.3
			3	22.3	28,500	6.3
			4	22.3	30,500	6.2
			5	22.3	30,500	6.2
			6	22.3	31,500	6.1
			7	22.4	33,000	5.9
			8	22.4	33,000	5.9
			9	22.3	33,500	5.9
			10	22.4	34,000	5.8

Table 4. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (μmho/cm)	Dissolved Oxygen (ppm)
			11*	22.4	35,000	5.8
B2	18 Apr 79	1831	Surface	22.5	42,000	6.1
			1	22.4	41,000	6.1
			2	22.4	41,000	6.1
			3	22.4	41,000	6.1
			4	22.4	41,500	6.1
			5	22.4	41,000	6.1
			6	22.4	41,000	6.0
			7*	22.4	41,500	6.1
B6	18 Apr 79	2200	Surface	22.6	37,500	6.7
			1	22.8	37,500	6.5
			2	22.8	38,000	6.5
			3	23.0	38,200	6.4
			4	23.0	38,000	6.4
			5	23.0	38,000	6.4
			6	23.0	38,000	6.3
			7	23.0	38,000	6.4
			8	23.0	38,000	6.4
			9*	23.0	27,000	6.2
B8	19 Apr 79	0029	Surface	22.8	36,500	6.9
			1	22.6	36,300	6.7
			2	22.6	36,000	6.7
			3	22.6	37,500	6.6
			4	22.6	37,500	6.5
			5	22.6	37,500	6.5
			6	22.6	37,500	6.5
			7	22.6	37,500	6.4
			8	22.6	37,300	6.4
			9	22.6	37,300	6.5

Table 4. (Cont'd)

Station	Date	Time	Depth (m)	Temperature (C)	Conductivity[1] (µmho/cm)	Dissolved Oxygen (ppm)
			10	22.6	37,300	6.5
			11*	22.6	37,000	6.4
B10	19 Apr 79	1858	Surface	22.5	40,500	6.2
			1	22.8	41,000	6.1
			2	22.8	41,000	6.0
			3	22.8	41,000	6.0
			4	22.8	41,000	6.0
			5	22.8	41,000	6.0
			6	22.8	41,000	6.0
			7	22.6	41,000	6.0
			8	22.6	41,000	6.0
			9	22.6	41,000	5.9
			10*	22.6	41,000	5.9
B14	20 Apr 79	0057	Surface	22.6	39,500	6.3
			1	22.6	39,300	6.2
			2	22.6	39,300	6.1
			3	22.6	39,300	6.0
			4	22.6	39,300	6.0
			5	22.6	39,300	6.0
			6	22.6	39,300	6.0
			7*	22.6	39,300	6.0

[1] See Appendix A for conversion of conductivity to salinity.

Water columns at both sites were well mixed, with lowest temperatures recorded from surface strata. Conductivity trends were similar to those for temperature. Highest conductivity levels were recorded at Weeks Island stations and from bottom strata. Fall dissolved oxygen levels at both sites exhibited sizeable increases over those recorded during summer. Dissolved oxygen values usually exceeded 6.0 ppm and were greatest in surface strata.

The winter cruise yielded the lowest water temperature and highest dissolved oxygen readings recorded during the study (Table 3). West Hackberry temperatures fluctuated between 7.5 and 10.3 C, with most below 10.0 C. Temperatures at Weeks Island generally were 3 to 4 C warmer than those at West Hackberry. Although the water column at both sites exhibited no distinct thermal stratification, slightly warmer temperatures were recorded from bottom strata. Dissolved oxygen readings were usually above 10.0 ppm at both sites, with surface levels commonly near 12.5 ppm. Winter produced the highest conductivity levels observed at West Hackberry. Conductivities at West Hackberry ranged from 37500 to 45200 μmho/cm and averaged near 44000 μmho/cm. Conductivity trends at Weeks Island were similar to those from West Hackberry.

Spring hydrographic data were characterized by increased water temperatures and decreased conductivity and dissolved oxygen levels (Table 4). Water temperature measurements averaged near 23.0 C at both sites and exhibited few differences between surface and bottom strata. West Hackberry stations produced noticeable differences in conductivity levels. Nearshore station 6 exhibited conductivity measurements approximating 23500 μmhos/cm while offshore station 10 consistently yielded levels exceeding 41000 μmhos/cm. Conductivity values at Weeks Island, ranging from 27000 to 42000 μmhos/cm, were similar to those at West Hackberry but were not as variable. Dissolved oxygen levels usually exceeded 6.0 ppm at both sites, with West Hackberry readings slightly higher than those at Weeks Island.

DEMERSAL FINFISH

Quarterly trawl sampling at Weeks Island and West Hackberry sites yielded 45369 fish representing 74 taxa. A list of these taxa is given in Table 5. Combined samples at Weeks Island produced 60 taxa and 12209 individuals while those at West Hackberry yielded 52 taxa composed of 33160 specimens. Seasonal species occurrence at respective sites is given in Table 6.

Finfish catches at both disposal sites varied with season (Tables 7 and 8). For this reason, finfish results for both disposal sites will be presented on a seasonal basis.

Summer

Summer samples yielded the highest overall seasonal catch per effort (844.1 fish/tow) recorded from West Hackberry (Tables 7 and 9). Except for excessively large catches at 2-mile station 10, summer mean catch per station statistics (ranging from 242.0 to 2607.0 fish/tow) generally ranked behind those recorded during spring. Two-mile stations 6 and 10 yielded highest mean catches (684.3 and 2607.0 fish/tow, respectively) while the 5-mile stations 2 and 14 produced smallest catches. The magnitude of catches at the proposed diffuser station 8 did not approach that taken at the 2-mile stations.

Weeks Island samples taken during summer yielded the lowest seasonal

TABLE 5. Common and scientific names of demersal finfishes taken from Weeks Island and West Hackberry brine disposal sites.

Common name	Scientific name
Lemon shark	*Negaprion brevirostris*
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*
Bonnethead	*Sphyrna tiburo*
Lesser electric ray	*Narcine brasiliensis*
Atlantic stingray	*Dasyatis sabina*
Smooth butterfly ray	*Gymnura micrura*
Skipjack herring	*Alosa chrysochloris*
Gulf menhaden	*Brevoortia patronus*
Atlantic thread herring	*Opisthonema oglinum*
Striped anchovy	*Anchoa hepsetus*
Bay anchovy	*Anchoa mitchilli*
Inshore lizardfish	*Synodus foetens*
Sea catfish	*Arius felis*
Gafftopsail catfish	*Bagre marinus*
Atlantic midshipman	*Porichthys porosissimus*
Skilletfish	*Gobiesox strumosus*
Singlespot frogfish	*Antennarius radiosus*
Southern hake	*Urophycis floridanus*
Crested cusk-eel	*Ophidion welshi*
Lined seahorse	*Hippocampus erectus*
Dusky pipefish	*Syngnathus floridae*
Rock sea bass	*Centropristis philadelphica*
Cobia	*Rachycentron canadum*
Crevalle jack	*Caranx hippos*
Atlantic bumper	*Chloroscombrus chrysurus*
Lookdown	*Selene vomer*
Mutton snapper	*Lutjanus analis*
Lane snapper	*Lutjanus synagris*
Spotfin mojarra	*Eucinostomus argenteus*
Tomtate	*Haemulon aurolineatum*
Pigfish	*Orthopristis chrysoptera*
Sheepshead	*Archosargus probatocephalus*
Pinfish	*Lagodon rhomboides*
Longspine porgy	*Stenotomus caprinus*
Drum larvae	Sciaenidae
Silver perch	*Bairdiella chrysura*
Sand seatrout	*Cynoscion arenarius*
Spotted seatrout	*Cynoscion nebulosus*
Silver seatrout	*Cynoscion nothus*
Banded drum	*Larimus fasciatus*
Spot	*Leiostomus xanthurus*
Southern kingfish	*Menticirrhus americanus*
Gulf kingfish	*Menticirrhus littoralis*
Atlantic croaker	*Micropogonias undulatus*
Black drum	*Pogonias cromis*
Star drum	*Stellifer lanceolatus*

Table 5. (Cont'd)

Common name	Scientific name
Atlantic spadefish	Chaetodipterus faber
Atlantic threadfin	Polydactylus octonemus
Southern stargazer	Astroscopus y-graecum
Freckled blenny	Hypsoblennius ionthas
Atlantic cutlassfish	Trichiurus lepturus
King mackerel	Scomberomorus cavalla
Black driftfish	Hyperoglyphe bythites
Harvestfish	Peprilus alepidotus
Gulf butterfish	Peprilus burti
Blackfin searobin	Prionotus rubio
Blackwing searobin	Prionotus salmonicolor
Leopard searobin	Prionotus scitulus
Bighead searobin	Prionotus tribulus
Ocellated flounder	Ancylopsetta quadrocellata
Bay whiff	Citharichthys spilopterus
Fringed flounder	Etropus crossotus
Smallmouth flounder	Etropus microstomus
Gulf flounder	Paralichthys albigutta
Southern flounder	Paralichthys lethostigma
Shoal flounder	Syacium gunteri
Lined sole	Achirus lineatus
Hogchoker	Trinectes maculatus
Blackcheek tonguefish	Symphurus plagiusa
Gray triggerfish	Balistes capriscus
Planehead filefish	Monacanthus hispidus
Smooth puffer	Lagocephalus laevigatus
Least puffer	Sphoeroides parvus
Striped burrfish	Chilomycterus schoepfi

TABLE 6. Seasonal occurrence of demersal finfish at Weeks Island and West Hackberry brine disposal sites.

Species	Weeks Island				West Hackberry			
	Su	F	W	Sp	Su	F	W	Sp
Lemon shark								X
Atlantic sharpnose shark	X				X			
Bonnethead		X		X				
Lesser electric ray				X				
Atlantic stingray			X					
Smooth butterfly ray								X
Skipjack herring			X					
Gulf menhaden			X		X	X	X	X
Atlantic thread herring			X		X	X	X	
Striped anchovy		X				X		
Bay anchovy			X	X	X	X	X	X
Inshore lizardfish						X		
Sea catfish	X	X	X	X	X	X	X	X
Gafftopsail catfish						X		
Atlantic midshipman	X	X	X	X		X		X
Skilletfish			X				X	
Singlespot frogfish			X	X				X
Southern hake			X	X			X	X
Crested cusk-eel		X	X	X				
Lined seahorse			X					
Dusky pipefish			X					
Rock sea bass	X		X	X		X		
Cobia		X						
Crevalle jack						X		
Atlantic bumper	X	X		X	X	X		X
Lookdown						X		
Mutton snapper		X						
Lane snapper		X						
Spotfin mojarra						X		
Tomate					X			
Pigfish				X		X		X
Sheepshead					X		X	
Pinfish					X			
Longspine porgy	X	X						
Drum larvae				X				
Silver perch			X	X	X		X	X
Sand seatrout	X	X	X	X	X	X	X	X
Spotted seatrout							X	
Silver seatrout	X	X	X	X	X	X	X	X
Banded drum			X	X	X		X	X
Spot		X	X	X	X	X	X	X
Southern kingfish		X	X	X	X	X	X	X
Gulf kingfish			X				X	X
Atlantic croaker	X	X	X	X	X	X	X	X
Black drum				X			X	
Star drum		X	X	X	X	X	X	X
Atlantic spadefish	X	X	X	X	X	X		X

Table 6 (Cont'd)

Species	Weeks Island Su	F	W	Sp	West Hackberry Su	F	W	Sp
Atlantic threadfin				X	X	X		
Southern stargazer	X		X	X			X	
Freckled blenny							X	
Atlantic cutlassfish					X			X
King mackerel	X							
Black driftfish				X				
Harvestfish	X				X	X		X
Gulf butterfish			X	X	X	X	X	X
Blackfin searobin	X	X	X	X		X		
Blackwing searobin		X		X				
Leopard searobin							X	
Bighead searobin	X	X	X	X			X	X
Ocellated flounder	X	X						
Bay whiff	X	X	X	X	X	X	X	X
Fringed flounder	X	X	X	X		X	X	X
Smallmouth flounder		X						
Gulf flounder	X							
Southern flounder	X		X				X	X
Shoal flounder			X	X				
Lined sole	X	X	X	X			X	
Hogchoker	X	X	X	X			X	X
Blackcheek tonguefish		X	X	X	X	X	X	X
Gray triggerfish		X						
Planehead filefish			X					
Smooth puffer				X				
Least puffer	X	X	X	X		X	X	X
Striped burrfish	X	X			X	X		
# Species/Season	24	30	37	37	25	30	29	30

Table 7. Mean number of fish per trawl tow at Weeks Island and West Hackberry stations during seasonal cruises.

	Weeks Island Station					
Season	2	6	8	10	14	Total
Summer	14.0	17.7	9.7	15.7	15.7	14.5
Fall	143.3	375.3	404.3	271.3	109.3	260.7
Winter	507.7	297.0	620.0	406.0	274.7	421.1
Spring	227.3	95.7	134.7	70.0	60.3	117.6
All Seasons	223.1	196.4	292.2	190.8	115.0	203.5

	West Hackberry Station					
Season	2	6	8	10	14	Total
Summer	291.0	684.3	396.0	2607.0	242.0	844.1
Fall	186.3	534.7	473.7	219.0	494.3	381.6
Winter	658.7	399.3	241.0	268.7	250.0	363.5
Spring	706.0	698.7	1128.3	331.3	243.0	621.5
All Seasons	460.5	579.3	559.8	856.5	307.3	552.7

Table 8. Mean weight (g) of fish per trawl tow at Weeks Island and West Hackberry stations during seasonal cruises.

	Weeks Island Station					
Season	2	6	8	10	14	Total
Summer	1642.0	2288.0	1161.0	1028.8	1368.1	1497.6
Fall	15441.2	47455.3	41454.7	20488.5	15984.9	28164.9
Winter	3055.6	1549.1	2873.9	2451.3	1555.1	2297.0
Spring	6850.7	6313.8	7215.9	4240.5	3034.1	5531.0
All Seasons	6747.4	14401.6	13176.4	7052.3	5485.6	9372.6

	West Hackberry Station					
Season	2	6	8	10	14	Total
Summer	5440.7	7747.0	6634.3	46224.5	2943.1	13797.9
Fall	5594.9	9207.2	12462.6	3455.4	7364.0	7616.8
Winter	3188.4	2368.8	2452.9	3032.8	4573.2	3123.2
Spring	5162.7	5205.0	9424.9	7574.9	1825.4	5839.0
All Seasons	4846.7	6132.0	7743.7	15071.9	4176.4	7594.1

Table 9. Number and weight (g) of demersal finfishes trawled from West Hackberry stations during Summer 1978.

Species	Station 2		Station 6		Station 8		Station 10		Station 14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Atlantic sharpnose shark	2	379.1	1	128.6	9	1260.2			2	257.3	14	2025.2
Gulf menhaden	22	1156.2	12	371.4	36	1830.0	20	910.8	8	329.1	98	4601.5
Atlantic thread herring			1	13.7							1	13.7
Bay anchovy	21	35.5	19	30.2	14	20.8			5	8.2	59	94.7
Sea catfish			1	256.1	2	314.7	6	1031.9	3	375.9	12	1978.6
Atlantic bumper	2	69.1			2	24.1	6	151.7	2	0.9	12	245.8
Tomtate	1	62.8			1	48.6					2	111.4
Sheepshead	1	1461.3									1	1461.3
Pinfish	1	7.9			1	59.6	2	52.8			4	120.3
Silver perch									1	28.1	1	28.1
Sand seatrout	88	1246.0	144	1601.4	127	2406.1	14	349.5	148	1669.2	521	7272.2
Silver seatrout	73	2022.3	4	83.0	38	996.5	78	2431.2	29	645.8	222	6178.8
Banded drum	4	71.5	4	68.7	5	112.8	24	445.1	1	28.7	38	726.8
Spot	8	189.1	29	740.4	14	380.4	32	620.4	4	52.7	87	1983.0
Southern kingfish	12	649.4	5	325.1	1	7.1	3	113.3			21	1094.9
Atlantic croaker	222	3430.8	1520	15931.4	635	7640.4	671	11380.3	278	2491.0	3326	40873.9
Star drum	255	3017.3	232	2616.6	140	1587.2	77	1011.5	212	2421.2	916	10653.8
Atlantic spadefish			1	1.0	1	4.4					2	5.4
Atlantic threadfin	34	686.7	39	677.0	37	718.4	57	1396.8	5	93.5	172	3572.4
Atlantic cutlassfish	14	655.7	2	121.8	46	1963.0	5	199.6	3	178.0	70	3118.1
Mackerel larvae												
Harvestfish	96	907.3	25	143.2	75	445.0	60	310.3	19	170.4	275	1976.2
Gulf butterfish	11	253.4	4	96.6	3	60.4	72	1464.4	2	41.5	92	1916.3
Bay whiff	1	5.4	8	20.5							9	25.9
Blackcheek tonguefish			1	12.3	1	19.3			2	32.7	4	64.3
Striped burrfish	5	15.2	1	1.9			1	3.8	2	5.1	9	26.0
Subsample Total	873	16322.0	2053	23240.9	1188	19903.0	1128	21873.4	726	8829.3	5968	90168.6
Total Catch	873	16322.0	2053	23240.9	1188	19903.0	7821	138673.4	726	8829.3	12661	206968.6

catch per effort total (14.5 fish/tow) recorded during the study (Table 7). Catch rates for respective Weeks Island stations all failed to exceed 18 fish/tow. These low yields (Table 10) coincided with low dissolved oxygen levels (<4.0 ppm) at all Weeks Island stations (Table 1). Two-mile station 6 produced largest catches (17.7 fish/tow) while the proposed diffuser station 8 yielded smallest catches (9.7 fish/tow).

Summer trends in biomass catch rates (Table 8) at West Hackberry were similar to those for abundance (Table 7). The summer cruise netted the highest overall seasonal catch rate for biomass (Tables 8 and 9) at West Hackberry (due largely to catches at 2-mile station 10). As with abundance trends, lowest biomass catch rates per station were recorded from the 5-mile stations at West Hackberry (Table 8).

Summer biomass statistics for Weeks Island (Tables 8 and 10) were the lowest recorded for this site. Biomass catch rates ranged from 1028.8 g/tow at 2-mile station 10 to 2288.0 g/tow at 2-mile station 6.

Finfish species taken at West Hackberry and Weeks Island during the summer are given in Table 6. The 25 species taken at West Hackberry during the summer (Table 9) represented the lowest seasonal species total taken at this site (Table 11). Number of species per station ranged from 16 to 20 while mean number of species per tow was 13.3 (Table 11). Species diversity indices fluctuated between 0.99 and 1.90 and averaged 1.46, the second highest seasonal index recorded at West Hackberry (Table 12). Evenness indices (Table 13), like those for species diversity, were modest. Richness indices (Table 14) also confirmed that the summer species assemblage was slightly below average. The proposed diffuser station ranked at or near the top in terms of both number of species and species diversity (Tables 11 and 12).

Table 10. Number and weight (g) of demersal finfishes trawled from Weeks Island stations during Summer 1978.

Species	Station 2		Station 6		Station 8		Station 10		Station 14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Atlantic sharpnose shark			3	427.1							3	427.1
Sea catfish	32	4809.9	45	6104.0	19	3012.7	12	1893.1	18	2889.5	126	18709.2
Atlantic midshipman							1	40.5			1	40.5
Rock sea bass	1	14.1									1	14.1
Atlantic bumper					3	214.1	6	307.3			9	521.4
Longspine porgy			1	5.6			13	83.8			14	89.4
Sand seatrout							1	118.9	2	531.8	3	650.7
Silver seatrout							3	251.2	2	133.1	5	384.3
Atlantic croaker							3	196.7	1	56.4	4	253.1
Atlantic spadefish			3	291.0							3	291.0
Southern stargazer					2	30.2			1	16.8	3	47.0
King mackerel	1	1.3									1	1.3
Harvestfish	1	1.6					1	0.5			2	2.1
Blackfin searobin	2	14.9									2	14.9
Bighead searobin	3	78.9	1	36.3	5	225.9	3	109.6	10	272.0	22	722.7
Ocellated flounder							2	80.7	1	35.4	3	116.1
Bay whiff	1	2.6									1	2.6
Fringed flounder	1	2.8							2	10.3	3	13.1
Gulf flounder									2	48.5	2	48.5
Southern flounder									1	27.2	1	27.2
Lined sole									3	28.4	3	28.4
Hogchoker									4	55.0	4	55.0
Least puffer							1	2.8			1	2.8
Striped burrfish							1	1.4			1	1.4
Subsample Total	42	4926.1	53	6864.0	29	3482.9	47	3086.5	47	4104.4	218	22463.9
Total Catch	42	4926.1	53	6864.0	29	3482.9	47	3086.5	47	4104.4	218	22463.9

Table 11. Total number (N) and mean number per tow (n) of fish species trawled at Weeks Island and West Hackberry stations during 1978-1979 seasonal cruises.

Season		Weeks Island Station 2	6	8	10	14	Combined
Summer	N	8	5	4	12	12	24
	n	3.3	3.0	1.7	5.7	6.0	3.9
Fall	N	21	15	14	18	15	30
	n	13.7	10.5	10.0	13.0	8.3	11.1
Winter	N	28	23	26	21	23	37
	n	19.7	18.3	20.0	16.3	17.0	18.3
Spring	N	24	21	21	17	16	37
	n	15.0	14.0	13.0	11.3	11.0	12.9
Combined	N	46	33	36	34	37	60
	n	12.9	11.6	11.2	11.6	10.6	11.6

Season		West Hackberry Station 2	6	8	10	14	Combined
Summer	N	20	20	20	16	18	25
	n	16.0	13.7	14.7	11.7	10.3	13.3
Fall	N	17	21	23	14	21	30
	n	11.7	15.7	16.3	8.7	12.0	12.9
Winter	N	21	19	20	19	26	29
	n	17.0	14.0	16.3	17.7	19.7	16.9
Spring	N	23	23	24	24	15	30
	n	16.0	16.7	18.0	17.7	10.3	15.7
Combined	N	38	34	38	36	42	52
	n	15.2	15.0	16.3	13.9	13.1	14.7

Table 12. Species diversity indices for demersal finfish catches at West Hackberry and Weeks Island stations during 1978-1979 seasonal cruises.

Season	West Hackberry Station 2	6	8	10	14	Combined
Summer	1.90	0.99	1.65	1.28	1.50	1.46
Fall	1.33	1.58	1.66	1.14	0.67	1.28
Winter	1.45	1.18	2.07	2.38	2.34	1.88
Spring	0.64	1.00	0.77	1.31	0.67	0.88
Combined	1.33	1.19	1.54	1.53	1.30	1.38

Season	Weeks Island Station 2	6	8	10	14	Combined
Summer	0.92	0.62	0.34	1.50	1.39	0.95
Fall	1.60	1.08	1.44	1.94	0.94	1.42
Winter	1.85	2.08	1.97	2.03	2.24	2.03
Spring	1.97	2.01	1.97	1.86	1.98	1.82
Combined	1.58	1.48	1.43	1.83	1.64	1.57

Table 13. Evenness indices for demersal finfish catches at West Hackberry and Weeks Island stations during 1978-1979 seasonal cruises.

	West Hackberry Station					
Season	2	6	8	10	14	Combined
Summer	0.69	0.38	0.61	0.52	0.70	0.58
Fall	0.55	0.57	0.59	0.51	0.27	0.50
Winter	0.52	0.45	0.74	0.83	0.79	0.67
Spring	0.24	0.36	0.27	0.46	0.29	0.32
Combined	0.50	0.44	0.55	0.58	0.51	0.52

	Weeks Island Station					
Season	2	6	8	10	14	Combined
Summer	0.76	0.57	0.31	0.90	0.81	0.59
Fall	0.61	0.46	0.58	0.76	0.44	0.58
Winter	0.62	0.72	0.66	0.73	0.79	0.70
Spring	0.73	0.76	0.78	0.78	0.83	0.78
Combined	0.68	0.64	0.58	0.79	0.72	0.67

Table 14. Richness indices for demersal finfish catches at West Hackberry and Weeks Island stations during 1978-1979 seasonal cruises.

	West Hackberry Station					
Season	2	6	8	10	14	Combined
Summer	2.66	1.94	2.33	1.82	1.79	2.11
Fall	2.07	2.38	2.57	1.56	1.88	2.13
Winter	2.73	2.17	2.80	2.99	3.42	2.82
Spring	2.33	2.43	2.53	2.88	1.77	2.39
Combined	2.45	2.23	2.56	2.31	2.22	2.35

	Weeks Island Station					
Season	2	6	8	10	14	Combined
Summer	1.00	0.84	0.27	1.84	1.78	1.14
Fall	2.55	2.24	2.02	2.51	1.76	2.21
Winter	3.00	3.05	2.97	2.57	2.85	2.89
Spring	2.58	2.87	2.63	2.42	2.45	2.59
Combined	2.28	2.25	1.97	2.33	2.21	2.17

Number of species and species diversity indices for Weeks Island stations during the summer were generally lower than those recorded at West Hackberry (Tables 11 and 12). A total of 24 species was taken at Weeks Island, with individual species per station statistics ranging from 4 to 12 (Table 11). Species diversity indices ranged from 0.34 to 1.50 and averaged 0.95, the lowest seasonal index recorded at Weeks Island (Table 12). Evenness and richness indices confirmed the overall paucity of species at Weeks Island during the summer (Tables 13 and 14). Highest species totals and species diversity indices were recorded from stations 10 and 14 (Tables 11 and 12). The proposed diffuser station 8 yielded the fewest number of species and lowest species diversity.

Summer finfish assemblages at West Hackberry were dominated by members of the drum family Sciaenidae (Table 15). Species dominance at respective stations was relatively homogeneous during the summer, with the same five species among the dominant taxa at all stations (Table 9). The Atlantic croaker, accounting for 66.5% of the total catch by number, was the most abundant species (Table 15). Croaker and three other sciaenids, star drum (*Stellifer lanceolatus*), sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*), comprised 87.2% of the total catch. As with abundance, these same four sciaenids dominated biomass statistics (80.9% of the total biomass) at West Hackberry (Table 15).

Summer trawling at Weeks Island failed to yield five truly dominant species (Table 15). Most stations produced only one or two dominant taxa (Table 10). Summer collections from Weeks Island did not exhibit the same degree of homogeneity amongst dominant species recorded for those from West Hackberry. Another difference between proposed

Table 15. Dominant demersal finfishes trawled at Weeks Island and West Hackberry stations during Summer 1978.

Weeks Island

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Sea catfish	126	57.8	Sea catfish	18709.2	83.3
Bighead searobin	22	10.1	Bighead searobin	722.7	3.2
Longspine porgy	14	6.4	Sand seatrout	650.7	2.9
Atlantic bumper	9	4.1	Atlantic bumper	521.4	2.3
			Atlantic sharpnose shark	427.1	1.9

West Hackberry

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Atlantic croaker	8423	66.5	Atlantic croaker	129562.6	62.6
Star drum	1698	13.4	Star drum	20967.2	10.1
Sand seatrout	570	4.5	Silver seatrout	8998.9	4.3
Silver seatrout	356	2.8	Sand seatrout	7971.4	3.9
Harvestfish	342	2.7	Gulf menhaden	7647.7	3.7

disposal sites was a noticeable lack of sciaenid species among dominant summertime assemblages at Weeks Island (Tables 9, 10 and 15). Sea catfish, contributing over 57% of the total number and 83% of the total catch by weight (Table 15), dominated catch statistics at Weeks Island.

Fall

Trawl samples taken at proposed disposal sites yielded 43 species comprised of 9635 fish (Tables 6, 16 and 17). West Hackberry tows produced 5724 individuals in 30 families while Weeks Island samples yielded 3911 individuals belonging to 30 families.

Finfish abundances at West Hackberry in the fall were much lower than those taken during the summer (Tables 7 and 16). The 381.6 fish taken per tow during the fall was less than half that recorded during summer (844.1 fish/tow) and only slightly higher than the winter minimum of 363.5 individuals per tow (Table 7). Catch per effort at individual stations ranged from 186.3 to 534.7 fish per tow. As in the summer, lowest and highest abundances were taken from 5- and 2-mile stations, respectively. Mean number of fish per tow at 5-mile stations differed statistically ($\alpha = 0.05$) from that at other stations. Proposed diffuser station 8 was one of two stations whose fall catch totals exceeded those recorded for the summer.

Catch trends at Weeks Island during the fall were the converse of those observed at West Hackberry (Tables 7 and 17). Mean catch per tow during fall, ranging from 109.3 to 404.3, greatly exceeded that for summer and ranked second to that taken during winter. All stations exhibited sizeable increases in catch rate, with the proposed diffuser station 8 and the 5-mile stations yielding highest and lowest abundances, respectively. Mean number of fish per tow at both 5-mile stations differed statistically ($\alpha = 0.05$) from that at other stations. Despite the noticeable catch increases observed during the fall, mean abundance statistics for Weeks Island failed to exceed those for West

Table 16. Number and weight (g) of demersal finfishes trawled from West Hackberry during Fall 1978.

Species	Station 2 No.	Station 2 Wt.	Station 6 No.	Station 6 Wt.	Station 8 No.	Station 8 Wt.	Station 10 No.	Station 10 Wt.	Station 14 No.	Station 14 Wt.	Total No.	Total Wt.
Gulf menhaden	110	1028.9	4	300.2	4	376.8			2	215.8	120	1921.7
Atlantic thread herring			1	45.2	11	1026.6					12	1071.8
Striped anchovy									3	32.2	3	32.2
Bay anchovy			65	48.3							65	48.3
Inshore lizardfish									1	0.4	1	0.4
Sea catfish			504	4053.8	106	1056.8	6	981.6	1	8.3	617	6100.5
Gafftopsail catfish			1	51.4							1	51.4
Atlantic midshipman	1	33.4	1	14.1	8	111.0	3	19.5	2	36.1	15	214.1
Rock sea bass	1	20.7			2	32.5	2	24.4	2	17.4	7	95.0
Crevalle jack	90	1192.9	2	106.6	3	199.6			1	100.9	96	1600.0
Atlantic bumper			15	172.2	563	7325.3	536	7727.3	1000	14952.2	2114	30177.0
Lookdown							1	1.2			1	1.2
Spotfin mojarra									1	18.1	1	18.1
Pigfish					1	48.0					1	48.0
Sand seatrout	1	0.4	82	6302.2	34	3470.7			1	90.0	118	9863.3
Silver seatrout	11	18.8	32	58.8	45	64.8	20	30.7	40	101.5	148	274.6
Spot			6	482.4	19	1509.8			3	200.5	28	2192.7
Southern kingfish	9	421.3	7	226.4	3	360.8					19	1008.5
Atlantic croaker	296	13547.2	125	3780.9	281	12605.5	14	726.9	13	866.7	729	31527.2
Star drum	3	54.9	510	7459.7	3	55.2			1	15.9	517	7585.7
Atlantic spadefish	3	27.2	45	940.5	28	786.8	13	326.3	6	85.6	95	2166.4
Atlantic threadfin	5	254.5	6	235.4	23	1092.1	3	154.0	1	49.9	38	1785.9
Harvestfish	1	20.6	1	15.1	8	174.3			3	46.0	13	256.0
Gulf butterfish			6	210.3	1	17.7	1	0.3			8	228.3
Blackfin searobin	2	27.7			1	6.8	3	44.2	2	18.1	8	96.8
Bay whiff	4	45.0	12	169.8	28	324.0	22	230.0	9	127.5	75	896.3
Fringed flounder	2	21.5			1	7.0					3	28.5
Blackcheek tonguefish			2	31.1					1	20.1	3	51.2
Least puffer	19	64.9	5	17.3	28	80.4	32	97.1	59	188.9	143	448.6
Striped burrfish	1	4.8			2	155.2	1	2.7			4	162.7
Subsample Total	559	16784.7	1432	24721.7	1203	30887.7	657	10366.2	1152	17192.1	5003	99952.4
Total Catch	559	16784.7	1604	27621.7	1421	37387.7	657	10366.2	1483	22092.1	5724	114252.4

Table 17. Number and weight (g) of demersal finfishes trawled from Weeks Island stations during Fall 1978.

Species	Station 2		Station 6		Station 8		Station 10		Station 14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Bonnethead	1	154.2									1	154.2
Striped anchovy	1	12.9	1	1.5							2	14.4
Sea catfish	237	42582.6	103	16067.3	141	22778.3	103	19065.3	145	25452.0	729	125945.5
Atlantic midshipman	15	246.4	2	31.9	6	107.5	5	111.2	1	18.9	29	515.9
Crested cusk-eel	2	66.7			4	161.4	3	107.0	2	71.0	11	406.1
Cobia									1	87.7	1	87.7
Atlantic bumper	13	278.6	6	185.8	14	359.4	3	111.6	4	339.1	40	1274.5
Mutton snapper	2	1.4									2	1.4
Lane snapper	14	378.8	1	40.8			2	64.3	1	30.5	18	514.4
Longspine porgy	40	207.7			17	123.0	68	517.8			125	848.5
Sand seatrout							1	57.7			1	57.7
Silver seatrout					1	139.7					1	139.7
Spot					1	56.8					1	56.8
Southern kingfish	1	44.0	4	349.9	5	358.7	15	1169.3			25	1921.9
Atlantic croaker	11	701.1	2	122.2	18	1179.6	48	3020.0			79	5022.9
Star drum			1	20.7							1	20.7
Atlantic spadefish	18	471.6	3	329.2			26	668.7	7	224.8	54	1694.3
Blackfin searobin	5	144.9	2	58.8	15	257.1	37	725.7	1	15.9	60	1202.4
Blackwing searobin									1	27.6	1	27.6
Bighead searobin	5	270.2	1	28.9	10	428.8	1	38.5	9	431.1	26	1197.5
Ocellated flounder	1	74.5					2	158.6	1	74.9	4	308.0
Bay whiff	1	13.0					1	17.8			2	30.8
Fringed flounder	21	350.8	5	64.5	17	266.1	48	668.1	9	134.5	100	1484.0
Smallmouth flounder	1	8.9			1	11.6			2	17.5	4	38.0
Lined sole			4	41.2							4	41.2
Hogchoker			1	11.6							1	11.6
Blackcheek tonguefish	1	17.6					1	21.3			2	38.9
Gray triggerfish									1	102.0	1	102.0
Least puffer	39	202.3	2	11.7	9	36.1	20	109.5	5	27.2	75	386.8
Striped burrfish	1	95.4					1	133.1			2	228.5
Subsample Total	430	46323.6	138	17366.0	259	26264.1	385	26765.5	190	27054.7	1402	143773.9
Total Catch	430	46323.6	1126	142366.0	1213	124364.1	814	61465.5	328	47954.7	3911	422473.9

Hackberry.

Fall biomass catch rates for West Hackberry stations ranged from approximately 3.5 to 12.4 kg per tow (Table 8) and generally were higher than those recorded during the summer. Nevertheless, the overall mean catch per station during the fall ranked second to that for summer. This biomass trend is converse to that for seasonal abundance and indicates that fall catches consisted of fewer but usually larger individuals than were taken during the summer (Table 16). Lowest biomass catch rates were taken at the 2-mile station 10 (Table 8). The proposed diffuser station 8 ranked first in biomass totals at West Hackberry during the fall (Tables 8 and 16).

Fall samples produced the greatest biomass totals recorded at Weeks Island (Tables 8 and 17). Mean biomass values of approximately 1.5 and 28.0 kg per tow for summer and fall, respectively, reflect the disparity in catch volumes at Weeks Island (Table 8). Furthermore, fall biomass statistics for Weeks Island stations, ranging from near 15.5 to 47.5 kg per tow, greatly exceeded those from West Hackberry. Largest biomass values per station were recorded from 2-mile station 6 (Tables 8 and 17). The proposed diffuser station 8 ranked second in total biomass during the fall.

Overall mean number of species per station and species diversity indices for West Hackberry stations during the fall declined from those recorded in the summer. Despite an increase in total number of species taken (30), mean number of species per station decreased during the fall to the lowest level (12.9) recorded at West Hackberry (Table 11). Mean species diversity index per station (1.28 declined from that recorded during summer (1.46) and only exceeded the spring statistic (0.88). The decline in species diversity indices was accompanied by a reduction among fall evenness indices (Tables 12 and 13). The increase in total number of species taken at West Hackberry during the fall also was reflected by a slight increase in mean richness index (Table 14). The proposed diffuser station 8 yielded the highest number of species (Table 11) and mean species diversity per station (Table 12).

Fall sampling at Weeks Island produced increases in total number of species taken (30), number of species per tow (11.1) and species diversity per station statistics (1.42) over those recorded in the summer. Species richness indices (Table 14) also exhibited sharp increases in the fall. Despite these increases, fall statistics (Tables 11 and 12) ranked third behind those for winter (37 species, 18.3 species/tow and 2.03) and spring (37 species, 12.9 species/tow and 1.96). Two-mile station 10 ranked first and second in species diversity and mean number of species per tow, respectively, while the proposed diffuser station 8 yielded the fewest number of species and a near average species diversity.

Dominant species at West Hackberry during the fall, although varying from those of other seasons, were basically homogeneous among stations (Tables 16 and 18). Atlantic bumper (Chloroscombrus chrysurus), contributing 45.6% of the total catch by number, replaced Atlantic croaker as the dominant species in fall samples. Percent of total catch was more evenly distributed among the dominant species in the fall, with three sciaenids (Atlantic croaker, star drum and silver seatrout) comprising over one-third of all fish trawled during this season. Atlantic bumper and Atlantic croaker contributed over 63% of the biomass captured in fall samples from West Hackberry.

Increased catches at Weeks Island during the fall produced a

Table 18. Dominant demersal finfishes trawled at Weeks Island and West Hackberry stations during Fall 1978.

Weeks Island

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Sea catfish	2304	58.9	Sea catfish	380207.0	90.0
Longspine porgy	253	6.5	Atlantic croaker	12385.3	2.9
Fringed flounder	253	6.5	Southern kingfish	4639.5	1.1
Atlantic croaker	193	4.9	Atlantic spadefish	4090.0	1.0
Least puffer	144	3.7			

West Hackberry

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Atlantic bumper	2607	45.6	Atlantic bumper	36759.7	32.2
Atlantic croaker	831	14.5	Atlantic croaker	35785.8	31.3
Sea catfish	771	13.5	Sand seatrout	11599.2	10.2
Star drum	580	10.1	Star drum	8482.4	7.4
Silver seatrout	174	3.0	Sea catfish	7450.5	6.5
Least puffer	170	3.0			

larger and more diverse assemblage of dominant species than was taken in the summer (Tables 17 and 18). Dominant taxa during the fall differed, with two exceptions, from those of summer (Tables 15 and 18). As in the summer, fall samples from Weeks Island failed to exhibit the same homogeneity among dominant species as noted for West Hackberry catches (Table 17). Abundance and biomass totals for fall (Table 18), as in the summer, were overwhelmingly dominated by sea catfish.

Winter

Trawl tows taken at the proposed disposal sites during the winter took 42 species composed of 11769 fish (Tables 6, 19 and 20). Combined samples from West Hackberry produced 29 taxa representing 5453 individuals while those from Weeks Island yielded 6316 specimens belonging to 37 species.

Winter catch trends at West Hackberry exhibited declines in finfish abundance initially observed during the fall (Tables 7 and 19). The 363.5 fish per tow during winter was the lowest seasonal catch per effort statistic recorded at West Hackberry (Table 7). Winter also was the only season in which overall catch per effort at West Hackberry was less than that at Weeks Island. Mean catch per station values ranged from 241.0 at station 8 to 658.7 at station 2.

Weeks Island catches during winter exhibited sizeable increases from those observed during the fall (Tables 7 and 20). Overall mean catch per station during winter (421.1) was the highest seasonal catch rate recorded for Weeks Island. Trawl tows at individual stations produced mean catch rates ranging from near 275 to 620 fish per station, with highest and lowest rates occurring at proposed diffuser station 8 and 5-mile station 14, respectively (Table 7). Winter samples yielded

Table 19. Number and weight (g) of demersal finfishes trawled from West Hackberry stations during Winter 1979.

Species	Station 2 No.	Station 2 Wt.	Station 6 No.	Station 6 Wt.	Station 8 No.	Station 8 Wt.	Station 10 No.	Station 10 Wt.	Station 14 No.	Station 14 Wt.	Total No.	Total Wt.
Gulf menhaden	251	2690.1	200	1928.8	76	992.8	72	1012.4	46	479.8	645	7103.9
Atlantic thread herring	14	134.1	1	11.4	5	49.4	8	72.8	5	62.3	33	330.0
Bay anchovy	100	117.0	31	49.3	159	304.4	140	330.7	18	32.8	448	834.2
Sea catfish	1	4.9			4	26.5	20	127.8	5	31.2	30	190.4
Skilletfish	2	14.2	2	15.0	1	9.0					5	38.2
Southern hake			1	3.7							1	3.7
Sheepshead			1	634.2	1	833.9			1	1261.0	3	2729.1
Silver perch	2	49.7									2	49.7
Sand seatrout	14	106.2	11	75.4	40	381.1	72	884.2	61	707.6	198	2154.5
Spotted seatrout	3	217.8	2	173.2					4	139.7	9	530.7
Silver seatrout	1	33.5					8	22.8	1	1.7	10	58.0
Banded drum	4	4.1	2	1.7	34	42.1	44	96.4	4	5.2	88	149.5
Spot	8	201.3	9	347.6	35	1178.1	45	1444.1	95	2658.1	192	5829.2
Southern kingfish	37	294.2	21	158.7	37	378.5	58	1024.1	84	936.2	237	2791.7
Gulf kingfish	4	336.1	10	419.5	12	1139.9	4	359.0	8	308.5	38	2563.0
Atlantic croaker	7	211.4	77	541.6	17	438.4	4	131.3	69	1001.6	174	2324.3
Black drum									2	2164.6	2	2164.6
Star drum	1406	4101.5	792	2389.7	208	832.8	36	409.2	216	867.5	2658	8600.7
Southern stargazer							2	11.8			2	11.8
Freckled blenny									2	29.7	2	29.7
Gulf butterfish					1	1.1			1	2.6	2	3.7
Leopard searobin									4	98.5	4	98.5
Bighead searobin	39	77.0	25	35.0	52	106.4	78	293.1	42	86.4	236	597.9
Bay whiff	4	17.0	1	1.1	2	13.1	5	37.9	1	2.4	13	71.5
Fringed flounder	43	199.9	1	2.6	10	57.0	61	352.5	24	133.6	139	745.6
Southern flounder	2	272.5	2	259.5	2	208.1	1	125.3	13	2124.6	20	2990.0
Lined sole									1	2.2	1	2.2
Hogchoker									1	17.3	1	17.3
Blackcheek tonguefish	25	410.1	9	58.3	21	318.8	116	2090.1	25	406.5	196	3283.8
Least puffer	9	72.6			6	47.3	32	273.0	17	158.0	64	550.9
Subsample Total	1976	9565.2	1198	7106.3	723	7358.7	806	9098.5	750	13719.6	5453	46848.3
Total Catch	1976	9565.2	1198	7106.3	723	7358.7	806	9098.5	750	13719.6	5453	46848.3

Table 20. Number and weight (g) of demersal finfishes trawled from Weeks Island stations during Winter 1979.

Species	Station 2		Station 6		Station 8		Station 10		Station 14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Atlantic stingray					1	254.1					1	254.1
Skipjack herring					1	9.2					1	9.2
Gulf menhaden	1	29.8	3	58.6	3	138.6	1	33.3	2	49.3	10	309.6
Atlantic thread herring			8	74.4	5	119.8					13	194.2
Bay anchovy	51	125.2	146	266.0	105	202.9	4	7.6	55	105.7	361	707.4
Sea catfish	104	760.7	2	15.7	30	223.0	50	354.7	20	147.0	206	1501.1
Atlantic midshipman	1	3.0					1	1.6			2	4.6
Skilletfish	2	26.6	4	19.5	2	7.7			3	11.6	11	65.4
Singlespot frogfish	1	0.9									1	0.9
Southern hake			2	15.6	1	4.5	1	7.8	2	10.0	6	37.9
Crested cusk-eel	1	32.2									1	32.2
Lined seahorse					1	1.0					1	1.0
Dusky pipefish			1	0.7							1	0.7
Rock sea bass	2	14.2									2	14.2
Silver perch	1	25.3							1	11.6	2	36.9
Sand seatrout	40	357.7	52	231.9	84	412.6	44	335.9	76	408.9	296	1747.0
Silver seatrout	54	221.2			4	12.3	143	562.6	2	5.6	203	801.7
Banded drum	733	2778.3	87	324.7	775	2366.1	397	1276.9	155	536.6	2147	7282.6
Spot	8	260.7	16	471.2	13	401.4	23	701.4	13	417.4	73	2252.1
Southern kingfish	71	1568.0	136	1864.4	100	1673.7	37	789.0	85	1557.1	429	7452.2
Gulf kingfish	1	141.4			1	89.1					2	230.5
Atlantic croaker	4	319.0	2	132.5	7	262.0	3	103.0	1	42.7	17	859.2
Star drum	208	1021.4	152	513.7	206	734.7	276	1203.2	119	459.2	961	3932.2
Atlantic spadefish									1	3.3	1	3.3
Southern stargazer	3	19.6	11	58.1	9	47.2	2	79.9	22	123.7	47	328.5
Gulf butterfish	1	38.5	10	38.9	4	29.1			3	26.6	18	133.1
Blackfin searobin			1	2.2							1	2.2
Bighead searobin	100	221.1	210	318.9	243	410.5	59	139.5	163	243.4	775	1333.4
Bay whiff	7	22.3	8	36.3	27	127.9	58	264.5	2	7.6	102	458.6
Fringed flounder	45	153.1	23	50.4	58	148.4	77	278.5	22	103.0	225	733.4
Southern flounder	1	514.4					2	827.7			3	1342.1
Shoal flounder									1	3.4	1	3.4
Lined sole	56	246.0	8	47.6	156	699.6	19	102.3	67	287.2	306	1382.7
Hogchoker	1	17.3	1	8.6	1	15.2	1	15.2			4	56.3
Blackcheek tonguefish	18	195.8	6	79.0	7	98.4	18	258.2	6	73.5	55	704.9
Planehead filefish	1	0.8									1	0.8
Least puffer	7	52.2	2	18.4	16	132.7	2	11.0	3	31.0	30	245.3
Subsample Total	1523	9166.7	891	4647.3	1860	8621.7	1218	7353.8	824	4665.4	6316	34454.9
Total Catch	1523	9166.7	891	4647.3	1860	8621.7	1218	7353.8	824	4665.4	6316	34454.9

the highest seasonal abundances recorded for station 8. Mean number of fish per tow at station 8 and 5-mile station 2 differed statistically ($\alpha = 0.05$) from that at other stations.

Winter biomass trends at West Hackberry were similar to abundance trends (Tables 7 and 8). The overall mean biomass catch rate (3123.2 g/tow) for winter was the lowest recorded at West Hackberry. Despite this sizeable decline, West Hackberry biomass totals generally exceeded those from Weeks Island (Tables 8, 19 and 20). Lowest and highest biomass catch rates were observed from 2-mile station 6 and 5-mile station 14, respectively. Biomass totals at the proposed diffuser station 8 were well below the overall station average.

Trends in biomass catch rates at Weeks Island during winter were converse to those for abundance (Tables 7 and 8). Winter weight totals exhibited sharp declines from maximum catches taken in fall. Increased abundance and decreased biomass at Weeks Island coincided with influx of numerous, newly-spawned fishes into this site. Five-mile stations 2 and 14, respectively, yielded largest and smallest weight totals. Like that for abundance, mean weight per tow values for stations 2 and 8 were statistically similar ($\alpha = 0.05$).

Although abundances at West Hackberry experienced slight declines during winter, mean number of species per tow and species diversity index for stations within this disposal site exhibited moderate increases (Tables 11 and 12). A total of 29 species was taken in winter trawl tows at West Hackberry. Winter was the only season which mean number of species per tow at West Hackberry failed to exceed that at Weeks Island. Number of species per station ranged from 14.0 at 2-mile station 6 to 19.7 at 5-mile station 14. Proposed diffuser station 8, although exhibiting notable increases in fish abundance, ranked third and fourth in total number of species (20) and mean number of species per tow (16.3). Increases in species diversity (Table 12), evenness and richness were more noticeable than increases in number of species (Tables 12, 13 and 14). Mean species diversity index per station ranged from 1.18 at station 6 to 2.38 at station 10. The overall mean species diversity, evenness and richness indices during winter (1.88, 0.67 and 2.82, respectively) were the highest recorded at West Hackberry.

Weeks Island catches during the winter also produced increases in mean number of species per tow and mean species diversity index per station (Tables 11 and 12). Number of species per tow averaged 18.3, the highest such statistic recorded for Weeks Island stations (Table 11). The total number of species taken in winter (37) also ranked first (with that in spring) among seasonal catches. The 26 species taken at proposed diffuser station 8 was almost double that taken during the fall and over 6 times that netted in the summer. Mean species diversity and richness indices (Tables 12 and 14) for winter samples (2.03 and 2.89, respectively) were the highest recorded for Weeks Island stations. Mean species diversity per station, ranging from 1.85 to 2.24, was highest and lowest at 5-mile stations 2 and 14, respectively.

Winter samples yielded a different assemblage of dominant finfish than taken previously at West Hackberry (Table 21). Star drum, in comprising nearly 49% of the total catch by number, was by far the most dominant taxa. Winter marked the first time that Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), southern kingfish (*Menticirrhus americanus*) and bighead searobin (*Prionotus tribulus*) were categorized as abundant species at West Hackberry. Star drum, Gulf menhaden and spot (*Leiostomus xanthurus*) accounted for 46% of the total

Table 21. Dominant demersal finfishes trawled at Weeks Island and West Hackberry stations during Winter 1979.

Weeks Island

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Banded drum	2147	34.0	Southern kingfish	7452.2	21.6
Star drum	961	15.2	Banded drum	7282.6	21.1
Bighead searobin	775	12.3	Star drum	3932.2	11.4
Southern kingfish	429	6.8	Spot	2252.1	6.5
Bay anchovy	361	5.7	Sand seatrout	1747.0	5.1

West Hackberry

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Star drum	2658	48.7	Star drum	8600.7	18.4
Gulf menhaden	645	11.8	Gulf menhaden	7103.9	15.2
Bay anchovy	448	8.2	Spot	5829.2	12.4
Southern kingfish	237	4.3	Blackcheek tonguefish	3283.8	7.0
Bighead searobin	236	4.3	Southern kingfish	2791.7	6.0

biomass at West Hackberry during winter (Table 21).

Winter represented the only season in which sea catfish was not a dominant species at Weeks Island (Table 21). Banded drum (*Larimus fasciatus*) contributed approximately 34% of the total catch and replaced sea catfish as the dominant winter species at Weeks Island. The four remaining dominant species at Weeks Island, star drum, bighead searobin, southern kingfish and bay anchovy, were also dominant at West Hackberry. Southern kingfish, banded drum and star drum, comprising over 54% of the total catch by weight, dominated biomass statistics (Table 21).

Spring

Spring sampling efforts at proposed disposal sites yielded a combined catch of 44 species representing 11086 fish (Tables 6, 22 and 23). These combined totals were composed of 30 taxa and 9322 individuals at West Hackberry and 37 taxa comprising 1764 individuals at Weeks Island.

Fish abundances at West Hackberry exhibited a sharp increase during the spring (Tables 7 and 22). Overall mean catch during the spring (621.5 fish/tow) was nearly double that taken during winter and ranked second to that recorded for summer (Table 7). Catch increases at West Hackberry stations appeared to coincide with the spring influx of newly-spawned fishes into estuarine nursery areas. This influx resulted in mean catch per station totals ranging from 243.0 to 1128.3. Finfish catches at the proposed diffuser station exceeded those from all other stations. As with other seasonal catch totals, a 5-mile station (14) produced lowest yields.

Table 22. Number and weight (g) of demersal finfishes trawled from West Hackberry stations during Spring 1979.

Species	Station 2		6		8		10		14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Lemon shark							1	103.2			1	103.2
Smooth butterfly ray							1	117.8			1	117.8
Gulf menhaden	3	114.7	168	5028.3	2	73.6			29	776.9	202	5993.5
Bay anchovy	17	35.4	18	41.9	9	17.6	5	9.1			49	104.0
Sea catfish	15	2095.8	4	27.8	31	4305.5	81	13787.5	5	912.6	136	21129.2
Atlantic midshipman	2	6.5	1	7.5	4	21.7	3	58.1	1	6.1	11	99.9
Singlespot frogfish	1	1.6			1	1.4					2	3.0
Southern hake	11	424.9	1	36.1	14	353.7	9	393.9	1	30.5	36	1239.1
Atlantic bumper			1	9.0							1	9.0
Pigfish							1	68.9			1	68.9
Silver perch	7	222.0			13	375.2	10	317.7			30	914.9
Sand seatrout	11	260.4	3	80.1	11	282.4	1	19.5			26	642.4
Silver seatrout	69	777.6	54	399.7	131	1438.8	43	456.5	16	182.9	313	3255.5
Banded drum	7	50.3	30	183.1	25	187.0	12	102.8	9	55.5	83	578.7
Spot	10	615.1			23	1181.3	19	915.3	1	38.1	53	2749.8
Southern kingfish	14	951.6	4	132.1	5	504.6	22	1130.1			45	2718.4
Gulf kingfish	3	215.2	3	126.5			3	473.6			9	815.3
Atlantic croaker	1848	8586.7	1631	6543.2	2135	10680.5	666	3284.2	626	3195.7	6906	32290.3
Star drum	66	715.0	53	192.6	27	243.8	2	24.4	12	57.4	160	1233.2
Atlantic spadefish	1	45.4	1	4.9	2	9.4	2	69.1	2	10.4	8	139.2
Atlantic cutlassfish	8	169.6	5	97.9	22	299.8	8	214.2	2	29.6	45	811.1
Harvestfish			25	1382.4	1	69.2					26	1451.6
Gulf butterfish	1	13.4	43	802.9	2	73.5	2	74.2			48	964.0
Bighead searobin	5	24.2	10	15.3	11	38.5	7	25.2	3	5.5	36	108.7
Bay whiff	11	124.8	28	249.0	54	541.8	26	129.7	8	92.7	127	1138.0
Fringed flounder	6	20.3			2	10.7	64	243.2			72	274.2
Southern flounder			1	169.1	1	140.3	3	661.5			5	970.9
Hogchoker			2	31.7							2	31.7
Blackcheek tonguefish	1	7.2	6	35.4	2	4.5	3	44.9	3	10.3	15	102.3
Least puffer	1	10.4	4	18.5	2	19.8			11	72.1	18	120.8
Subsample Total	2118	15488.1	2096	15615.0	2530	20874.6	994	22724.6	729	5476.3	8467	80178.6
Total Catch	2118	15488.1	2096	15615.0	3385	28274.6	994	22724.6	729	5476.3	9322	87578.6

Table 23. Number and weight (g) of demersal finfishes trawled from Weeks Island stations during Spring 1979.

Species	Station 2		Station 6		Station 8		Station 10		Station 14		Total	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Bonnethead			1	735.3							1	735.3
Lesser electric ray	1	1444.1									1	1444.1
Bay anchovy	1	3.0	4	4.6	2	4.1			4	12.2	11	23.9
Sea catfish	62	11605.0	38	7639.4	87	16338.8	47	9456.3	38	7647.3	272	52686.8
Atlantic midshipman	2	39.8	2	39.3	4	78.3	10	279.0			18	436.4
Singlespot frogfish					1	1.9	2	6.4			3	8.3
Southern hake	2	78.5	2	22.5	1	37.7	3	60.8	3	83.1	11	282.6
Crested cusk-eel					1	44.2			2	56.1	3	100.3
Rock sea bass					2	52.1					2	52.1
Atlantic bumper			1	11.1			1	16.9	1	15.7	3	43.7
Pigfish	2	116.5									2	116.5
Drum	1	0.1									1	0.1
Silver perch	1	46.4									1	46.4
Sand seatrout			5	641.1							5	641.1
Silver seatrout	4	121.3	2	149.3	20	308.7	1	9.0			27	588.3
Banded drum	134	908.3	19	91.4	29	158.6			11	52.9	193	1211.2
Spot	1	102.6	2	204.9							3	307.5
Southern kingfish	88	3618.2	65	3141.1	64	3654.3	18	2015.8	15	543.8	250	12973.2
Atlantic croaker	47	109.4	82	203.9	72	151.8	6	11.7	7	17.3	214	494.1
Black drum			1	5620.0							1	5620.0
Star drum	5	163.0									5	163.0
Atlantic spadefish	15	528.0			1	66.0			1	50.4	17	644.4
Atlantic threadfin							1	49.0			1	49.0
Southern stargazer	1	4.3			3	20.2					4	24.5
Black driftfish	1	3.7									1	3.7
Gulf butterfish			2	123.9							2	123.9
Blackfin searobin	19	46.6	3	6.9	12	49.5	12	71.6	16	50.1	62	224.7
Blackwing searobin							1	17.9			1	17.9
Bighead searobin	130	803.5	33	171.9	72	462.3	37	293.1	45	321.8	317	2052.6
Bay whiff	1	7.6	4	14.9			3	29.1			8	51.6
Fringed flounder	155	720.0	6	22.4	25	117.3	64	338.8	30	144.3	280	1342.8
Shoal flounder					1	12.8	1	18.8			2	31.6
Lined sole			6	42.7	1	8.2			3	42.5	10	93.4
Hogchoker	2	37.6			1	10.8			1	9.9	4	58.3
Blackcheek tonguefish	2	19.1	2	23.5	3	65.4	1	23.1	3	50.1	11	181.2
Smooth puffer									1	4.9	1	4.9
Least puffer	5	25.4	7	31.2	2	4.6	2	24.3			16	85.5
Subsample Total	682	20552.0	287	18941.3	404	21647.6	210	12721.6	181	9102.4	1764	82964.9
Total Catch	682	20552.0	287	18941.3	404	21647.6	210	12721.6	181	9102.4	1764	82964.9

Spring catch trends at Weeks Island were converse to those at West Hackberry (Tables 7 and 23). Spring catches at Weeks Island, averaging 117.6 fish per tow, declined to approximately one-fourth of those taken in winter and were next to last in total abundance. The spring declines were most noticeable at stations 6, 10 and 14 where mean catches were all less than 100 fish per tow (Table 7). Spring was the only season that a 5-mile station (2) yielded largest catches (227.3 fish/tow) at Weeks Island.

Spring biomass totals (Tables 8 and 22) at West Hackberry almost doubled those observed during winter. Despite these noticeable increases, spring biomass statistics ranked third among seasonal weight totals. Small size of newly-spawned postlarvae probably kept biomass increases to a minimum. Biomass catch trends were similar to those for abundance, with largest and smallest weight totals taken at the proposed diffuser station 8 and 2-mile station 14, respectively (Table 22).

Weeks Island biomass statistics during spring, as with catches at West Hackberry, more than doubled those recorded in winter (Tables 8 and 23). These increased weight totals coincided with sizeable decreases in fish abundance and were indicative of an influx of larger individuals into Weeks Island environs. Biomass catch rates ranged from 3034.1 g/tow at 2-mile station 14 to 7215.9 g/tow at the proposed diffuser station 8 (Table 8).

An increase in total number of species and a decrease in mean number of species per tow and mean species diversity index per station coincided with increased abundances at West Hackberry during spring (Tables 11 and 12). The 30 species taken in spring tows was the highest such statistic recorded for West Hackberry (Table 11). Conversely, mean number of species per tow and mean species diversity for West Hackberry stations declined to 15.7 and 0.88, respectively. Spring tows yielded the lowest mean diversity index observed at this disposal site. Evenness and richness indices exhibited similar declines (Tables 13 and 14). The 5-mile stations 14 and 2 yielded the lowest mean number of species per tow and lowest mean diversity index, respectively (Tables 11 and 12). Highest species totals and species diversity index were observed at the proposed diffuser station 8 and the 2-mile stations.

Declines in number of species per tow and mean species diversity at Weeks Island during the spring coincided with catch decreases (Tables 11 and 12). Despite these declines, spring catches ranked first in seasonal number of species (37) and second in mean species diversity (1.82). Number of species at individual Weeks Island stations ranged from 16 to 24 and averaged 12.9 per tow (Table 11). Five mile stations 2 and 14 yielded highest and lowest number of species per tow, respectively. Declines in species diversity indices (Table 12) were less drastic than those for number of species per tow. The mean species diversity index for the spring was only slightly lower than the seasonal high recorded in winter. Species diversity index for respective stations ranged from 1.86 to 2.01. Highest and lowest indices were recorded at 2-mile stations 6 and 10, respectively.

Spring catches at West Hackberry were dominated by Atlantic croaker (Table 24). This species accounted for 81.9% of the total catch by number. Summer was the only other season in which one species (Atlantic croaker with 66.5% of the total catch) was overwhelmingly dominant in West Hackberry catches. Atlantic croaker and sea catfish comprised

Table 24. Dominant demersal finfishes trawled at Weeks Island and West Hackberry stations during Spring 1979.

Weeks Island

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Bighead searobin	317	18.0	Sea catfish	52686.8	63.5
Fringed flounder	280	15.9	Southern kingfish	12973.2	15.6
Sea catfish	272	15.4	Black drum	5620.0	6.8
Southern kingfish	250	14.2	Bighead searobin	2052.6	2.5
Atlantic croaker	214	12.1	Lesser electric ray	1444.1	1.7

West Hackberry

Species	Number	% Total Number	Species	Weight (g)	% Total Weight
Atlantic croaker	7635	81.9	Atlantic croaker	36116.6	41.2
Silver seatrout	376	4.0	Sea catfish	22654.6	25.9
Gulf menhaden	202	2.2	Gulf menhaden	5993.5	6.8
Star drum	169	1.8	Silver seatrout	4017.9	4.6
Sea catfish	147	1.6	Spot	3116.1	3.6

over 67% of the total weight taken during spring.

Weeks Island catches during spring contrasted sharply with those from West Hackberry in terms of dominant species (Table 24). Five species, bighead searobin (18.0%), fringed flounder (*Etropus crossotus* - 15.9%), sea catfish (15.4%), southern kingfish (14.2%), and Atlantic croaker (12.1%), contributed over 76% of the total catch at Weeks Island during the spring. These catches also were in sharp contrast to summer and fall catches overwhelmingly dominated by sea catfish. However, sea catfish, in contributing nearly 64% of the total weight, dominated spring biomass statistics.

SUMMARY OF SEASONAL TRENDS

Seasonal cruises to West Hackberry and Weeks Island disposal sites generated particular catch trends. Seasonally, West Hackberry catches were greatest in the summer and spring and lowest in fall and winter (Table 7). Seasonal mean number of fish per tow values were statistically similar; winter biomass catch rates were significantly different from other seasons ($\alpha = 0.05$). Largest mean catches at West Hackberry were taken at the 2-mile stations 6 and 10 while smallest catches occurred at 5-mile stations 2 and 14. The proposed diffuser station yielded above average abundances. Statistical comparisons of overall mean catch rates (abundance and biomass) for West Hackberry stations produced no significant differences. Overall mean catch at West Hackberry stations exceeded that for Weeks Island by more than double.

Quarterly sampling at Weeks Island yielded largest catches during the winter and smallest catches during summer (Table 7). Fall and spring catches were more closely aligned with those of the winter and summer, respectively. Nevertheless, significant differences ($\alpha = 0.05$) existed between all seasonal catch rates for abundance and biomass. The proposed diffuser site (8) lead all Weeks Island stations in mean abundance. Smallest catches were usually taken at 5-mile station 14. No statistical differences (α = 0.05) were detected between mean catch values for Weeks Island stations.

SPECIES ACCOUNTS

Gulf Menhaden

The commercially important Gulf menhaden was one of the more dominant species taken at West Hackberry. This species was ranked among the top five in abundance or biomass during all seasons except fall (Tables 15, 21 and 24). Moderate abundances of 103 to 150 mm standard length (SL) individuals (Fig. 3) enabled this species to rank fifth in total biomass during summer (Table 15). Most individuals apparently belonged to the 1-year age class (Gulf menhaden age class determinations follow those reported by Landry 1977) and were sexually immature (Table 25). Remnants of this 1-year age class, exhibiting lengths in excess of 130 mm, were also taken at West Hackberry during fall (Fig. 3). These individuals did exhibit ripening gonads (Table 25). An influx of 55 to 111 mm SL young-of-the-year (= 0-year age class) enabled menhaden to rank second in total abundance and biomass at West Hackberry during winter (Table 21 and Fig. 3). The majority of these individuals was sexually immature (Table 25). These 0-year age class menhaden remained at West Hackberry through the spring (Fig. 3) and ranked third in total abundance and biomass at this site (Table 24). Most individuals ranged from approximately 93 to 130 mm SL and were still sexually immature (Table 25). Length-weight relationships for menhaden trawled seasonally from West Hackberry are presented in Figure 4.

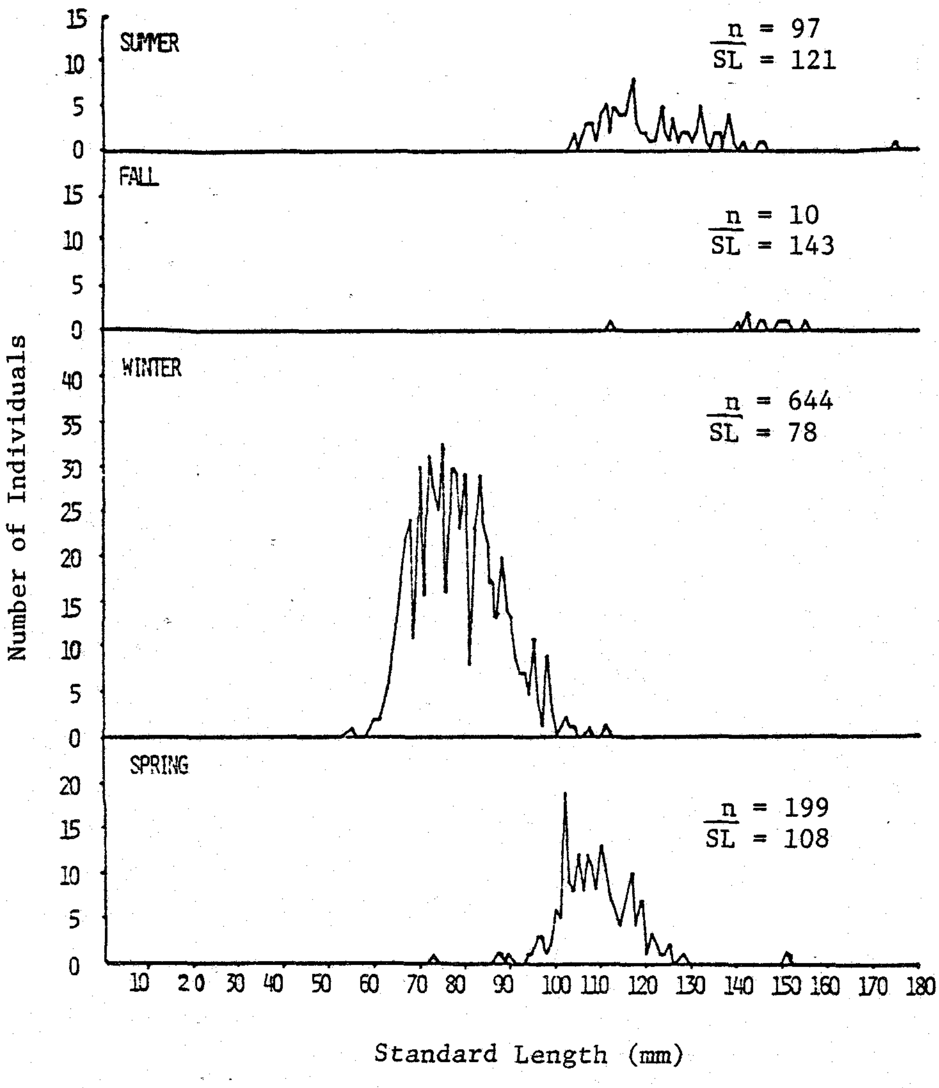


Figure 3. Length-frquency, number (n) of individuals measured and mean standard length $(\overline{SL})$ of Gulf menhaden trawled at West Hackberry.

Table 25. Gonad stage of maturity for Gulf menhaden taken from West Hackberry during 1978-1979 seasonal cruises. *Classification scheme follows that of Nikolsky (1963).*

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number	10	11	6				191	249	72	43	1	1	244	261	79
	% within stage	37.0	40.7	22.2				37.3	48.6	14.1	95.6	2.2	2.2	41.8	44.7	13.5
	% within sex	100.0	17.7	24.0				100.0	69.2	77.4	100.0	1.4	1.2	100.0	52.0	38.7
	% of catch	10.3	11.3	6.2				29.7	38.7	11.2	21.6	0.5	0.5	25.7	27.5	8.3
Quiescent	Number		51	17					110	21		73	81		234	119
	% within stage		75.0	25.0					84.0	16.0		47.4	52.6		66.3	33.7
	% within sex		82.3	68.0					30.6	22.6		98.7	98.8		46.6	58.3
	% of catch		52.6	17.5					17.1	3.3		36.7	40.7		24.6	12.5
Ripening	Number			2		6	4		1						7	6
	% within stage			100.0		60.0	40.0		100.0						53.9	46.2
	% within sex			8.0		100.0	100.0		0.3						1.4	2.9
	% of catch			2.1		60.0	40.0		0.2						0.7	0.6
Ripeness	Number	----------NONE TAKEN----------														
Reproduction	Number	----------NONE TAKEN----------														
Spent	Number	----------NONE TAKEN----------														
Grand Total		10	62	25	0	6	4	191	360	93	43	74	82	244	502	204
% of Grand Total		1.1	6.5	2.6	0.0	0.6	0.4	20.1	37.9	9.8	4.5	7.8	8.6	25.7	52.8	21.5

[1]U - denotes sex undetermined

[2]F - denotes female

[3]M - denotes male

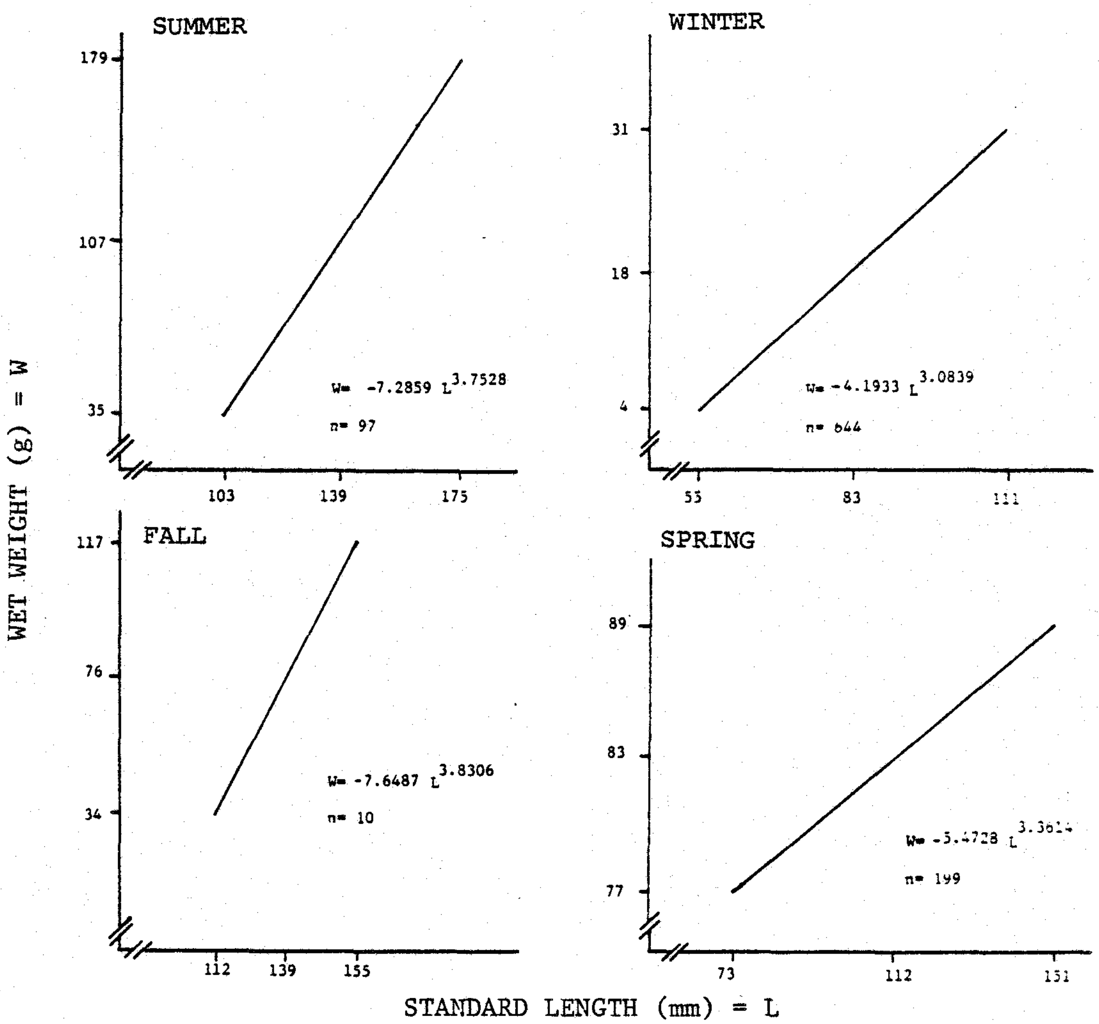


Figure 4. Length-weight relationships for Gulf menhaden trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Stomach analyses for menhaden trawled from West Hackberry during winter and spring are summarized in Table 26. Filter-feeding menhaden preyed primarily upon unidentifiable diatoms and copepods. Diatoms occurred in all stomachs from winter and over 80% of the stomachs analyzed during spring.

Bay Anchovy

The ubiquitous bay anchovy ranked seventh in total abundance at West Hackberry. Anchovy were taken in fair to sizeable abundances during every season (Fig. 5), with highest catches occurring in winter (Table 21). This species appeared to be a year-round user of the West Hackberry site (Fig. 5). The moderate summer catches were composed of 32 to 65 mm SL individuals belonging to at least two year classes. Fall catches yielded an assemblage of 28 to 51 mm SL young-of-the-year. The winter community was comprised of sizeable numbers of 33 to 66 mm SL individuals. Remnants of the winter stock also were taken in spring. Length-weight relationships for anchovy taken from West Hackberry during each season are given in Figure 6. Less than 20% of all anchovy taken at West Hackberry were sexually mature (Table 27). Anchovy failed to exhibit similar population strengths at Weeks Island.

Winter was the only season yielding an adequate number of anchovy for stomach analyses. Winter constitutents of both sites fed primarily upon diatoms, annelids and various crustaceans (Tables 28 and 29). Anchovy from West Hackberry were dependent upon unidentifiable diatoms, polychaetes and crustaceans which included ostracods, copepods (*Temora turbinata* and *Labidocera aestiva*) and natantian larvae. Although not as diverse, the principal array of food items identified from anchovy at Weeks Island was basically the same as that for specimens from West

Table 26. Stomach contents of Gulf menhaden trawled from West Hackberry during Winter and Spring 1979.

Stomach Contents	WINTER % of Occurrence	WINTER % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Arthropoda				
Class Crustacea				
Subclass Copepoda	1.9	< 0.1	3.6	0.3
Temora turbinata			1.8	
Labidocera aestiva			5.5	
Subclass Malacostraca				
Reptantia zoea			1.8	< 0.1
Fish Scales	1.9	< 0.1		
Digested Material	9.4	7.1	20.0	16.2
Digested Material & Diatoms	100.0	90.6	81.8	83.5
Digested Material & Sediment	1.9	2.2		
# of stomachs examined	53		55	
Total dry weight (g) of contents	1.087		1.655	

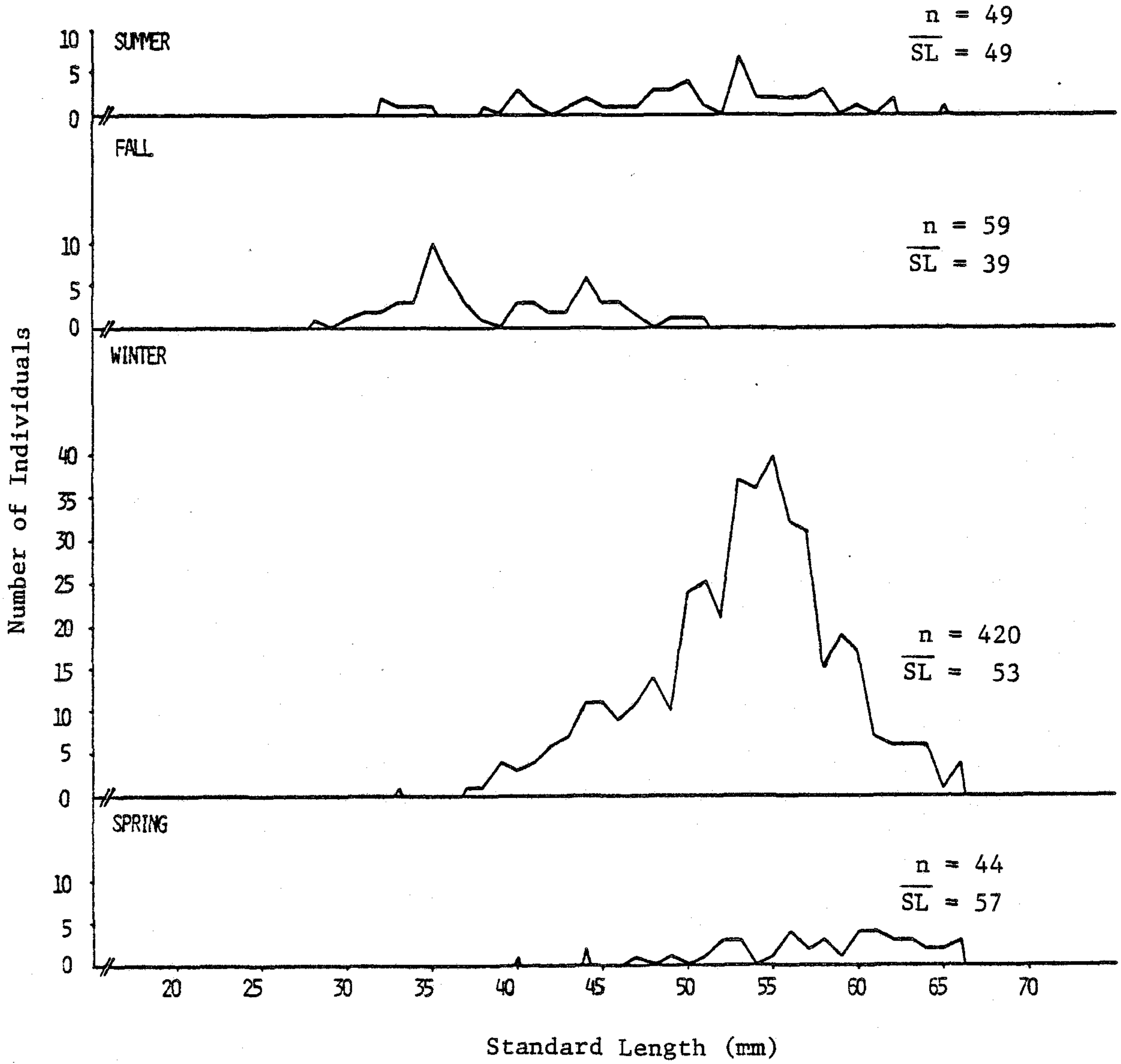


Figure 5. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of bay anchovy trawled at West Hackberry.

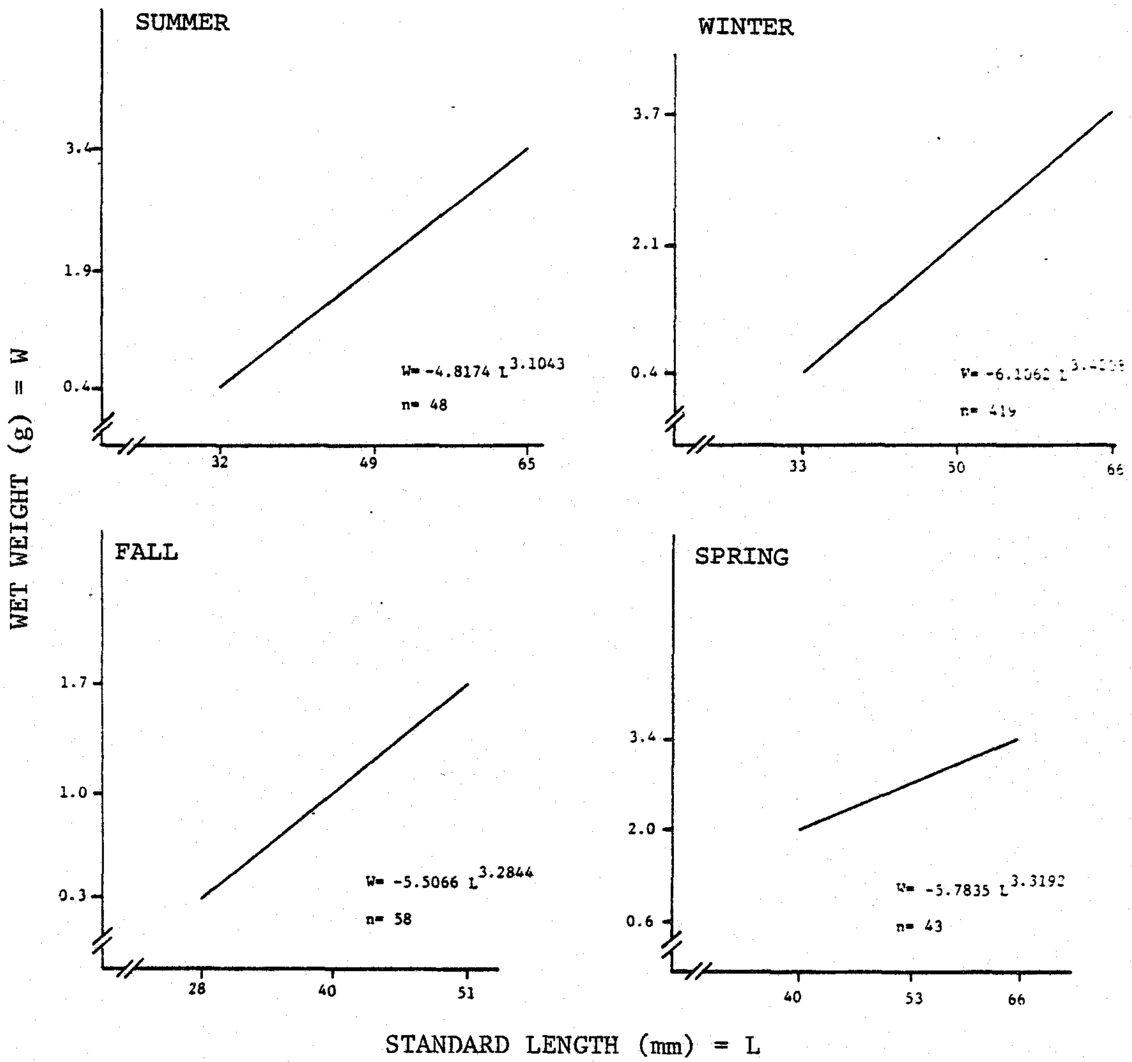


Figure 6. Length-weight relationships of bay anchovy trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 27. Gonad stage of maturity for bay anchovy taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer			Fall			Winter			Spring			Total		
		U[1]	F[2]	M[3]	U	F	M	U	F	M	U	F	M	U	F	M
Immature	Number	7	1		58			120	10	19	2			187	11	19
	% within stage	87.5	12.5		100.0			80.5	6.7	12.8	100.0			86.2	5.1	8.7
	% within sex	100.0	4.0		100.0			100.0	4.9	20.0	100.0			100.0	4.4	14.0
	% of catch	14.3	2.0		98.3			28.6	2.4	4.5	4.6			32.7	1.9	3.3
Quiescent	Number		3						166	71		1	1		170	72
	% within stage		100.0						70.0	30.0		50.0	50.0		70.3	29.8
	% within sex		12.0						81.0	74.7		5.6	4.2		68.3	52.9
	% of catch		6.1						39.5	16.9		2.3	2.3		29.7	12.6
Ripening	Number		16	13					29	5		14	17		59	35
	% within stage		55.2	44.8					85.3	14.7		45.2	54.8		62.8	37.2
	% within sex		64.0	76.5					14.2	5.3		77.8	70.8		23.7	25.7
	% of catch		32.7	26.5					6.9	1.2		31.8	38.6		10.3	6.1
Ripeness	Number		5	4		1						3	4		9	8
	% within stage		55.6	44.4		100.0						42.9	57.1		52.9	47.1
	% within sex		20.0	23.5		100.0						16.7	16.7		3.6	5.9
	% of catch		10.2	8.2		1.7						6.8	9.1		1.6	1.4
Reproduction	Number												2			2
	% within stage												100.0			100.0
	% within sex												8.3			1.5
	% of catch												4.6			0.3
Spent	Number	----------------------------------NONE TAKEN----------------------------------														
	Grand Total	7	25	17	58	1	0	120	205	95	2	18	24	187	249	136
	% of Grand Total	1.2	4.4	3.0	10.1	0.2	0.0	21.0	35.8	16.6	0.3	3.1	4.2	32.7	43.5	23.8

[1]U denotes sex undetermined
[2]F denotes female
[3]M denotes male

Table 28. Stomach contents of bay anchovy trawled from West Hackberry during Winter 1979.

Stomach Contents	WINTER % of Occurrence	 % of Dry Weight
Phylum Annelida		
Class Polychaeta	6.7	0.6
Phylum Arthropoda		
Class Crustacea	36.7	12.7
Subclass Ostracoda	6.7	0.6
Subclass Copepoda	11.6	20.4
Temora turbinata	91.7	
Labidocera aestiva	20.0	
Paracalanus sp	5.0	
Acartia tonsa	1.7	
Centropages velificatus	1.7	
Subclass Malacostraca		
Mysidopsis sp	1.7	0.1
Suborder Natantia	6.7	0.8
Subfamily Penaeidea	1.7	1.5
Trachypenaeus sp	1.7	0.3
Class Insecta		
Order Hymenoptera	1.7	0.1
Fish Material	1.7	0.3
Fish Scales	3.3	0.3
Digested Material	80.0	56.4
Digested Material & Diatoms	18.3	5.8
# of stomachs examined	60	
Total dry weight (g) of contents	0.389	

Table 29. Stomach contents of bay anchovy trawled from Weeks Island during Winter 1979.

Stomach Contents	WINTER % of Occurrences	% of Dry Weight
Phylum Annelida		
Class Polychaeta	1.6	0.3
Phylum Arthropoda		
Class Crustacea	11.5	4.6
Subclass Ostracoda	3.3	0.3
Suborder Platycopina	3.3	0.3
Subclass Copepoda	11.5	7.8
Temora turbinata	19.7	
Labidocera aestiva	26.2	
Subclass Malacostraca		
Order Amphipoda	1.6	0.2
Order Decapoda		
Suborder Natantia	16.4	2.2
Suborder Reptantia		
Reptantia zoea	1.6	0.2
Fish Material	1.6	0.6
Fish Scales	9.8	1.3
Digested Material	83.6	75.2
Digested Material & Diatoms	14.8	7.7
Sand & Sediment	1.6	0.2
Eggs	1.6	0.2

# of stomachs examined	61
Total dry weight (g) of contents	0.319

Hackberry.

Sea Catfish

Sea catfish ranked second and fourth in total abundance at Weeks Island and West Hackberry, respectively. Catfish assemblages at each site were quite different in seasonal abundance and size composition. Peak abundance of catfish at Weeks Island occurred during fall and spring (Tables 18 and 24). These catfish assemblages were comprised of larger, sexually mature or ripening individuals (Table 30) generally exceeding 190 mm SL (Fig. 7). These older catfish enabled this species to rank first in biomass totals during fall and spring. Conversely, winter catfish assemblages at Weeks Island were comprised of 66 to 107 mm SL young-of-the-year (sea catfish age-class determinations follow those reported by Landry 1977). All winter constitutents were sexually immature (Table 30). Length-weight relationships for catfish trawled seasonally from Weeks Island are presented in Figure 8.

Food habits of catfish taken from Weeks Island during summer, fall and spring were relatively similar (Table 31). Polychaetes were found in at least 31% of all catfish stomachs examined from Weeks Island. Gastropod mollusks were most frequently ingested during summer. Decapod crustaceans, including caridean shrimp (primarily *Ogyrides limicola*) and crabs in the families Porcellanidae, Albuneidae, and Portunidae represented major food items especially during the summer. The highest degree of piscivorosity among catfish was observed during the spring.

Sea catfish also were most abundant at West Hackberry during fall and spring (Fig. 9). Fall assemblages were comprised of a large number of 75 to 100 mm SL young-of-the-year and scattered abundances of individuals as large as 239 mm SL. Most catfish had migrated out of West Hack-

Table 30 . Gonad stage of maturity for sea catfish taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number	3	6	5	73			34	110	62				110	116	67
	% within stage	21.4	42.9	35.7	100.0			16.5	53.4	30.1				37.5	39.6	22.9
	% within sex	100.0	6.4	17.2	100.0			100.0	100.0	100.0				83.3	15.1	15.5
	% of catch	2.4	4.8	4.0	10.0			16.5	53.4	30.1				8.3	8.7	5.0
Quiescent	Number		11	13											11	13
	% within stage		45.8	54.2											45.8	54.2
	% within sex		11.7	44.8											1.4	3.0
	% of catch		8.7	10.3											0.8	1.0
Ripening	Number		56	11			1				22	165	85	22	221	97
	% within stage		83.6	16.4			100.0				8.1	60.7	31.3	6.5	65.0	28.5
	% within sex		59.6	37.9			0.4				100.0	100.0	100.0	16.7	28.7	22.5
	% of catch		44.4	8.7			0.1				8.1	60.7	31.3	1.7	16.6	7.3
Ripeness	Number		18												18	
	% within stage		100.0												100.0	
	% within sex		19.2												2.3	
	% of catch		14.3												1.4	
Reproduction	Number	--NONE TAKEN--														
Spent	Number		3			400	255								403	255
	% within stage		100.0			61.1	38.9								61.2	38.8
	% within sex		3.2			100.0	99.6								52.4	59.0
	% of catch		2.4			54.9	35.0								30.2	19.1
	Grand Total	3	94	29	73	400	256	34	110	62	22	165	85	132	769	432
	% of Grand Total	0.2	7.1	2.2	5.5	30.0	19.2	2.6	8.3	4.7	1.7	12.4	6.4	9.9	57.7	32.4

[1]U denotes sex undetermined
[2]F denotes female
[3]M denotes male

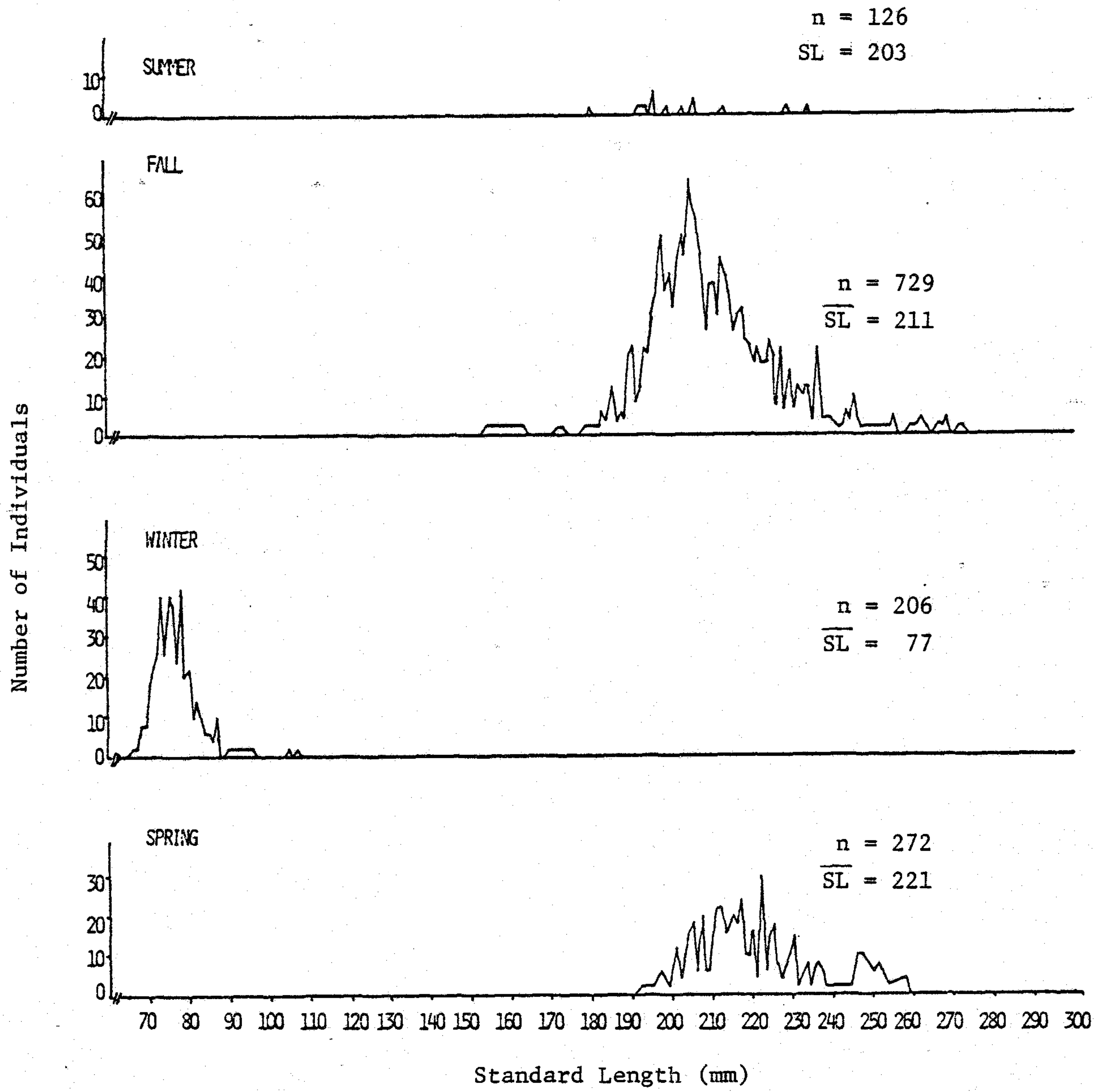


Figure 7. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of sea catfish trawled at Weeks Island.

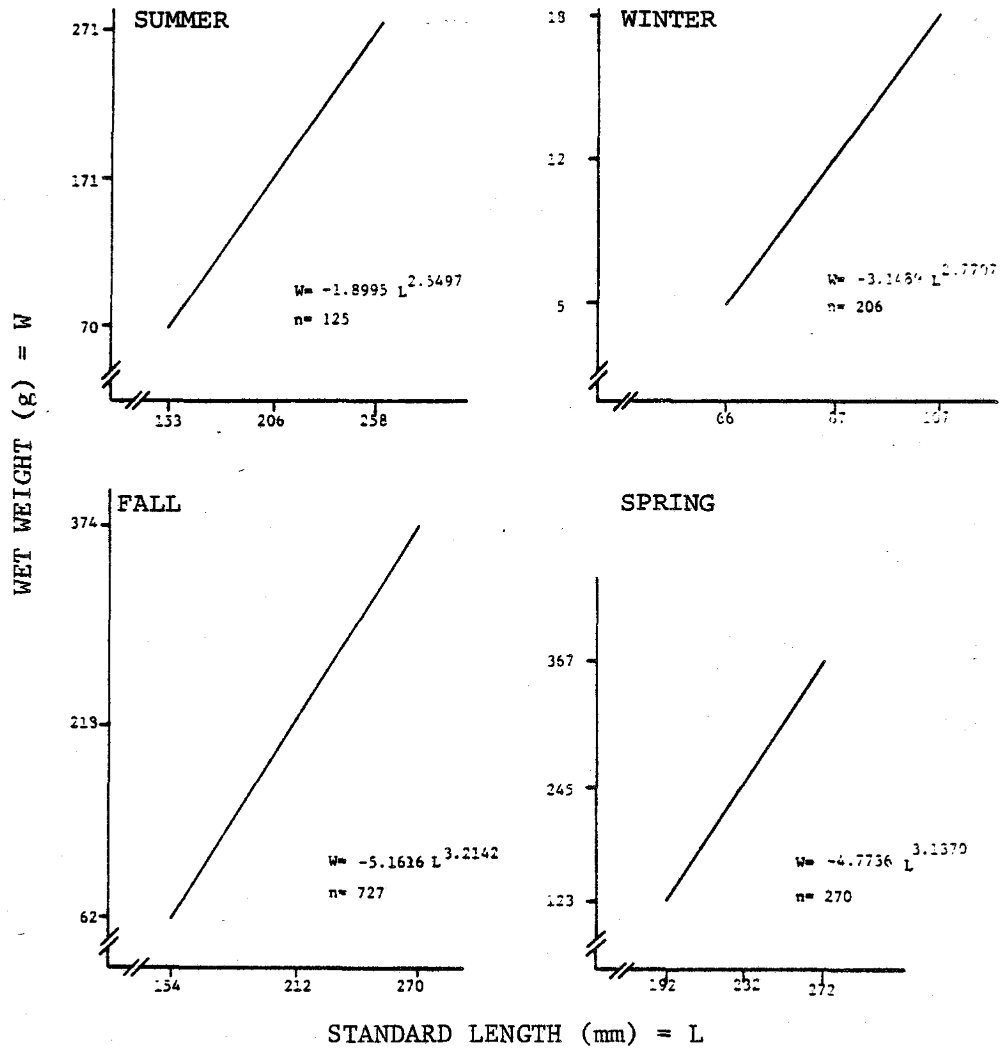


Figure 8. Length-weight relationships of sea catfish trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 31. Stomach contents of sea catfish trawled from Weeks Island during Summer, Fall, and Spring 1978-79.

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Cnidaria					1.7	0.7
Class Anthozoa	1.0	< 0.1				
Phylum Annelida						
Class Polychaeta	31.3	7.6	46.3	13.9	45.8	15.4
Glycera sp	1.0	0.5				
Diopatra sp	6.1	0.8				
Family Arabellidae	1.0	1.7				
Subclass Sedentaria	1.0	0.3				
Family Pectinariidae	1.0	< 0.1				
Pectinaria sp	11.1	0.9				
Pectinaria goullidii	1.0	< 0.1				
Phylum Mollusca	4.0	< 0.1				
Class Gastropoda	21.2	4.7	3.7	< 0.1	6.8	1.1
Narsarius acutus	3.0	0.1				
Olivella sp	1.0	0.1				
Class Bivalvia	8.1	0.3				
Mulina lateralis	6.1	1.2			6.8	0.4
Phylum Arthropoda						
Class Crustacea	2.0	0.2			3.4	1.3
Subclass Copepoda						
Labidocera aestiva					1.7	< 0.1
Subclass Malacostraca						
Squilla sp	4.0	0.5			5.1	2.1
Squilla empusa	4.0	0.5	3.7	0.1		
Mysidopsis sp					1.7	< 0.1
Order Isopoda	1.0	< 0.1				
Order Amphipoda			3.7	< 0.1		
Ampelisca sp	5.1	< 0.1				
Ampelisca verrilli	1.0	< 0.1				
Suborder Hyperiidea	1.0	< 0.1				
Superorder Eucarida						
Order Decapoda			1.9	< 0.1		
Suborder Natantia	9.1	0.2	11.1	0.9	18.6	1.0
Section Caridea	1.0	< 0.1	1.9	< 0.1		
Ogyrides limicola	40.4	1.6			39.0	4.7
Latreutes parvulus	1.0	< 0.1				
Section Penaeidea						
Family Penaeidae	6.1	2.8				
Subfamily Penaeidae					1.7	< 0.1
Penaeus sp	3.0	0.7	5.6	0.9	1.7	0.9
Penaeus aztecus	1.0	0.2				
Penaeus setiferus			3.7	0.5		
Trachypenaeus sp	8.1	0.5	1.9	0.1	1.7	0.1
Trachypenaeus similis	3.0	0.8				
Suborder Reptantia	7.1	0.4	3.7	0.1	33.9	13.7
Family Callianassidae	1.0	< 0.1				
Family Paguridae					5.1	< 0.1
Pagurus pollicaris	1.0	0.1				
Pagurus longicarpus					3.4	0.4
Family Porcellanidae						
Euceramus praelongus	27.3	0.9	1.9	0.2		
Polyonyx gibbesi	1.0	< 0.1				
Family Albuneidae						
Albunea sp	24.2	4.4	7.4	1.1	1.7	< 0.1
Albunea paretii	25.3	17.8	18.5	23.2	1.7	2.1
Lepidopa sp	1.0	< 0.1				
Section Brachyura	1.0	0.4				
Family Leucosiidae			1.9	0.1	1.7	0.3
Persephona crinata	1.0	< 0.1	1.9	0.1		
Family Parthenopidae						
Heterocrypta granulata	1.0	< 0.1				
Family Portunidae	10.1	2.7	3.7	3.5	10.2	0.9
Callinectes sp	2.0	0.1				
Callinectes sapidus					3.4	0.3
Callinectes similis	2.0	3.8			1.7	2.5
Ovalipes sp	4.0	1.9				
Ovalipes quadulpensis	2.0	3.0				
Family Pinnotheridae						
Pinnixa sp	1.0	< 0.1				
Class Insecta			3.7	0.1		
Order Plecoptera			1.9	< 0.1		
Phylum Echinodermata						
Class Holothuroidea	2.0	0.3				
Phylum Chordata						
Subphylum Urochordata	1.0	< 0.1				
Molgula sp			5.6	0.4		
Subphylum Vertebrata						
Class Osteichthyes						
Family Engraulidae					1.7	0.7
Fish Material	4.0	0.6			13.6	7.2
Fish Scales	4.0	< 0.1	1.9	< 0.1	5.1	0.4
Digested Material	99.0	37.1	100.0	54.9	98.3	42.3
Sand & sediment	5.1	0.2				
Polychaete tube/sand					1.7	< 0.1
# of stomachs examined	99		54		59	
Total dry weight (g) of contents	26.999		11.130		20.305	

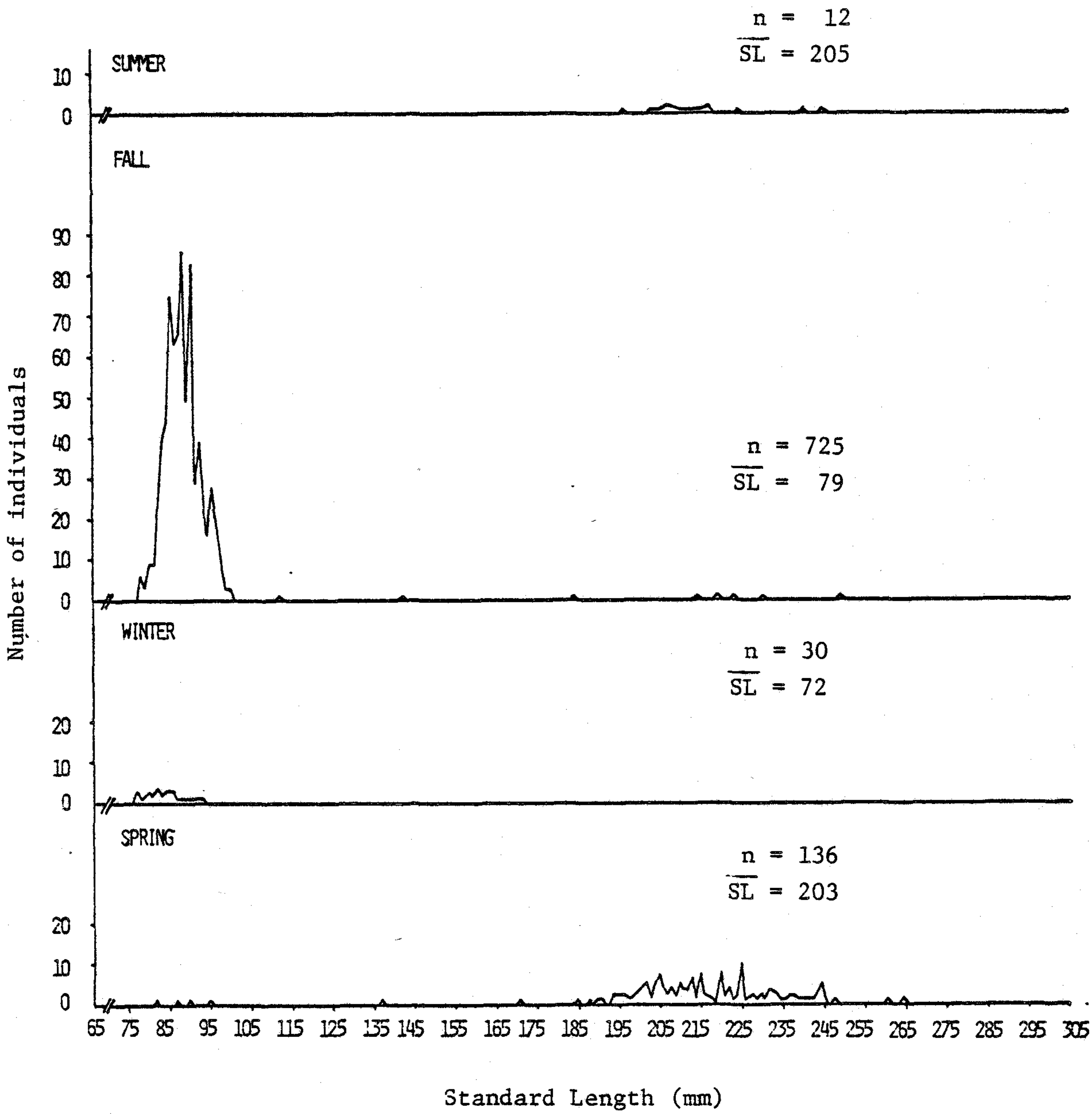


Figure 9. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of sea catfish trawled at West Hackberry.

berry environs by winter. Older, more mature individuals returned to dominate catfish assemblages in the spring. The spring constitutents, in contrast to most other seasonal catfish assemblages, appeared to be on the verge of spawning (Table 32). Length-weight relationships for catfish from West Hackberry are given in Figure 10.

Sea catfish taken from West Hackberry during fall and spring were analyzed for food contents (Table 33). Trophic relationships for these catfish were basically the same as those for specimens from Weeks Island. Polychaetes were a dominant food item during fall and spring. Copepods (especially *Temora turbinata* and *Labidocera aestiva*) and gastropod mollusks exhibited sizeable abundances during fall and spring, respectively. A similar pattern was observed for natantian and reptantian crustaceans. Dependence of West Hackberry catfish upon other fishes, unlike that for Weeks Island specimens, was highest in the fall.

Sand and Silver Seatrout

The sand seatrout and silver seatrout were two recreationally important species included among dominant taxa at Weeks Island and West Hackberry. Dominance of sand seatrout at Weeks Island was attributed to a sizeable number of 46 to 109 mm SL young-of-the-year taken during winter (Fig. 11). These winter constitutents were all sexually immature (Table 34). Other seasonal cruises at Weeks Island yielded small numbers of sexually mature or maturing sand seatrout as large as 270 mm SL (Fig. 11). Length-weight relationships for sand seatrout trawled from Weeks Island are given in Figure 12.

Sand seatrout were much more abundant at West Hackberry. Summer trawl tows yielded a sizeable abundance of 42 to 183 mm SL seatrout (Fig. 13). The majority of these individuals belonged to the 0-year

Table 32. Gonad stage of maturity for sea catfish taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number				656	44	18	6	19	5	2			664	63	23
	% within stage				91.4	6.1	2.5	20.0	63.3	16.7	100.0			88.5	8.4	3.1
	% within sex				99.7	100.0	78.3	100.0	100.0	100.0	3.7			92.5	41.5	69.7
	% of catch				90.5	6.1	2.5	20.0	63.3	16.7	1.5			73.5	7.0	2.5
Quiescent	Number			1	2						2	3	1	4	3	2
	% within stage			100.0	100.0						33.3	50.0	16.7	44.4	33.3	22.2
	% within sex			25.0	0.3						3.7	3.7	100.0	0.6	2.0	6.1
	% of catch			8.3	0.3						1.5	2.2	0.7	0.4	0.3	0.2
Ripening	Number		3	2							50	78		50	81	2
	% within stage		60.0	40.0							39.1	60.9		37.6	60.9	1.5
	% within sex		37.5	50.0							92.6	96.3		7.0	53.3	6.1
	% of catch		25.0	16.7							36.8	57.4		5.5	9.0	0.2
Ripeness	Number		4												4	
	% within stage		100.0												100.0	
	% within sex		50.0												2.6	
	% of catch		33.3												0.4	
Reproduction	Number		1												1	
	% within stage		100.0												100.0	
	% within sex		12.5												0.7	
	% of catch		8.3												0.1	
Spent	Number			1			5									6
	% within stage			100.0			100.0									100.0
	% within sex			25.0			21.7									18.2
	% of catch			8.3			0.7									0.7
	Grand Total	0	8	4	658	44	23	6	19	5	54	81	1	718	152	33
	% of Grand Total	0.0	0.9	0.4	72.9	4.9	2.5	0.7	2.1	0.6	6.0	9.0	0.1	79.5	16.8	3.7

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

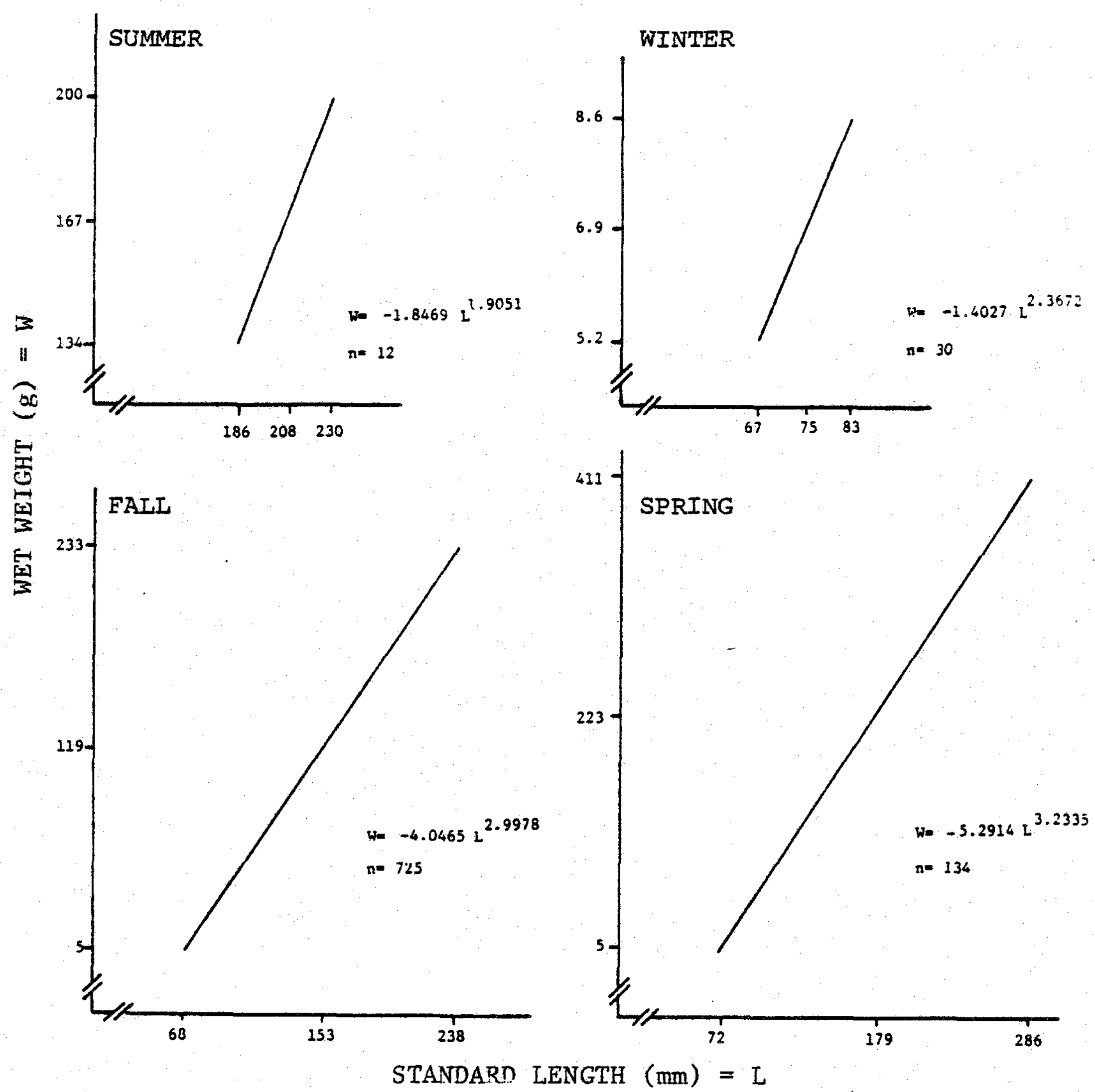


Figure 10. Length-weight relationships of sea catfish trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 33. Stomach contents of sea catfish trawled from West Hackberry during Fall and Spring 1978-79.

Stomach Contents	FALL % of Occurrence	FALL % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Cnidaria	1.0	< 0.1		
Class Anthozoa			1.6	1.2
Phylum Annelida				
Class Polychaeta	62.5	6.8	58.1	9.0
Family Terebellidae	1.0	< 0.1		
Sigambra tentaculata			1.6	0.1
Phylum Mollusca			1.6	< 0.1
Class Gastropoda	3.1	0.1	32.3	5.5
Narsarius acutus	2.1	0.2	3.2	< 0.1
Class Bivalvia			1.6	0.9
Mulinia lateralis			8.1	1.3
Class Cephalopoda				
Loligo sp	1.0	< 0.1		
Phylum Arthropoda				
Class Crustacea	9.4	0.2	16.1	0.6
Subclass Copepoda	3.1	0.3		
Temora turbinata	25.0			
Labidocera aestiva	25.0			
Eucalanus pileatus	1.0			
Order Calanoida	2.1			
Subclass Cirripedia			3.2	0.1
Subclass Malacostraca				
Order Stomatopoda			1.6	< 0.1
Squilla sp	1.0	< 0.1	1.6	1.0
Order Cumacea			3.2	< 0.1
Order Amphipoda	6.3	< 0.1		

Table 33. (Cont'd)

Stomach Contents	FALL % of Occurrence	FALL % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Superorder Eucarida	2.1	< 0.1		
Suborder Natantia	28.1	0.5	6.5	1.1
Family Penaeidae	2.1	< 0.1		
Penaeus setiferus	1.0	0.2	1.6	< 0.1
Family Sergestidae				
Acetes americanus	9.4	0.1		
Lucifer faxoni	3.1	< 0.1		
Suborder Reptatia	5.2	0.3	16.1	2.1
Reptantia Megalops	5.2	< 0.1		
Section Macrura				
Upogebia sp	1.0	< 0.1		
Section Anomura				
Pagurus longicarpus			3.2	0.6
Euceramus praelongus	2.1	0.1		
Albunea paretii	1.0	< 0.1		
Raninoides louisianensis			1.6	0.6
Section Brachyura	1.0	< 0.1		
Family Leucosiidae			1.6	0.1
Pinnixa sp			9.7	0.3
Pinnixa cristata			1.6	0.1
Class Insecta	4.2	0.1		
Subclass Pterygota	3.1	< 0.1		
Class Arachnida				
Section Hydracarina	1.0	< 0.1		
Phylum Chordata				
Subphylum Urochordata	1.0	< 0.1		
Fish Material	29.2	3.6	9.7	1.0

Table 33. (Cont'd)

Stomach Contents	FALL % of Occurrence	FALL % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Fish Scales	82.3	6.4	12.9	0.3
Eggs			1.6	< 0.1
Digested Material	97.9	80.9	100.0	74.9
Sand & Sediment	2.1	< 0.1		
# of stomachs examined	96		62	
Total dry weight (g) of contents	18.373		20.175	

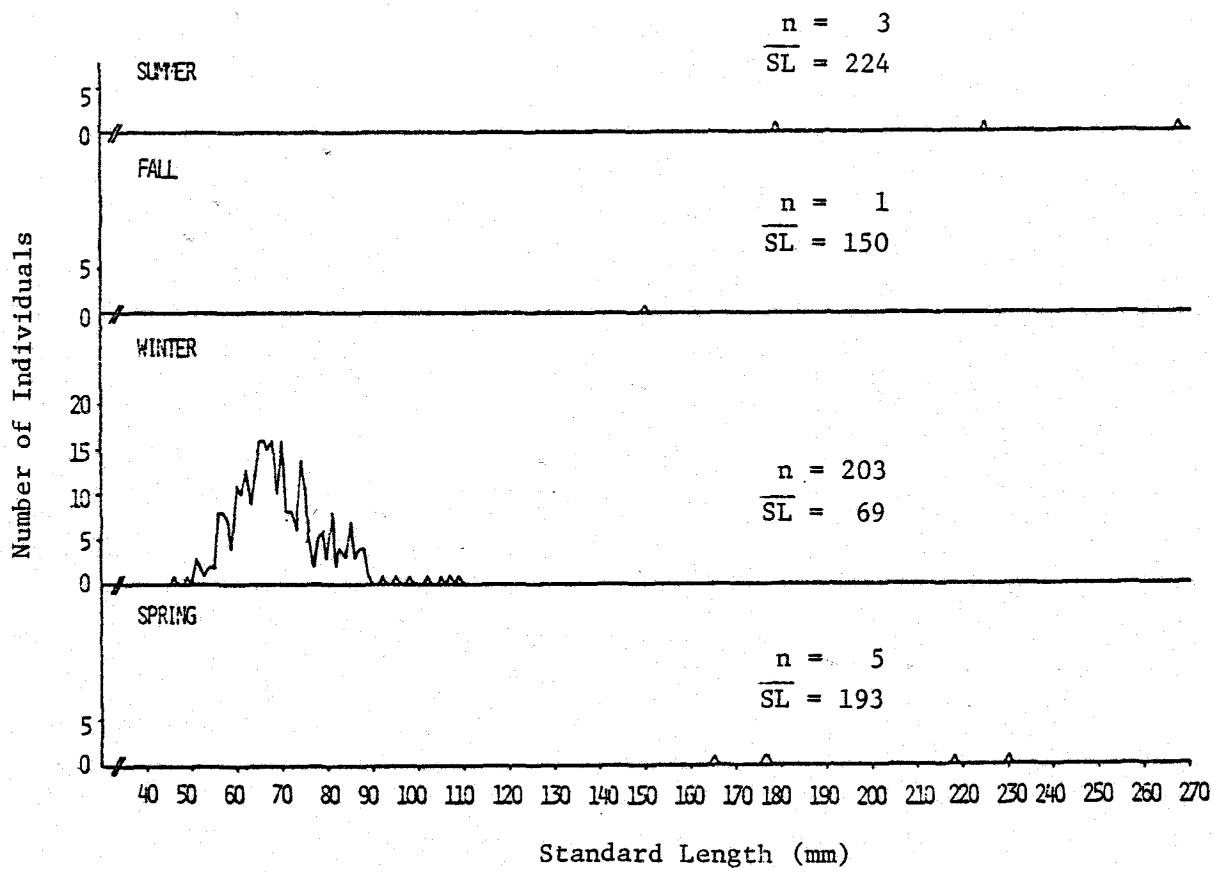


Figure 11. Length-frequency, number (n) of individuals measured and mean standard length (SL) of sand seatrout trawled at Weeks Island.

Table 34. Gonad stage of maturity for sand seatrout taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number							199	85	9				199	85	9
	% within stage							67.9	29.0	3.1				67.9	29.0	3.1
	% within sex							100.0	96.6	100.0				100.0	94.4	56.3
	% of catch							67.2	28.7	3.0				65.3	27.9	3.0
Quiescent	Number								3						3	
	% within stage								100.0						100.0	
	% within sex								3.4						3.3	
	% of catch								1.0						1.0	
Ripening	Number		1												1	
	% within stage		100.0												100.0	
	% within sex		100.0												1.1	
	% of catch		33.3												0.3	
Ripeness	Number			1		1									1	1
	% within stage			100.0		100.0									50.0	50.0
	% within sex			50.0		100.0									1.1	6.3
	% of catch			33.3		100.0									0.3	0.3
Reproduction	Number			1									5			6
	% within stage			100.0									100.0			100.0
	% within sex			50.0									100.0			37.5
	% of catch			33.3									100.0			2.0
Spent	Number	NONE TAKEN														
Grand Total		0	1	2	0	1	0	199	88	9	0	0	5	199	90	16
% of Grand Total		0.0	0.3	0.7	0.0	0.3	0.0	65.3	28.9	3.0	0.0	0.0	1.6	65.3	29.5	5.2

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

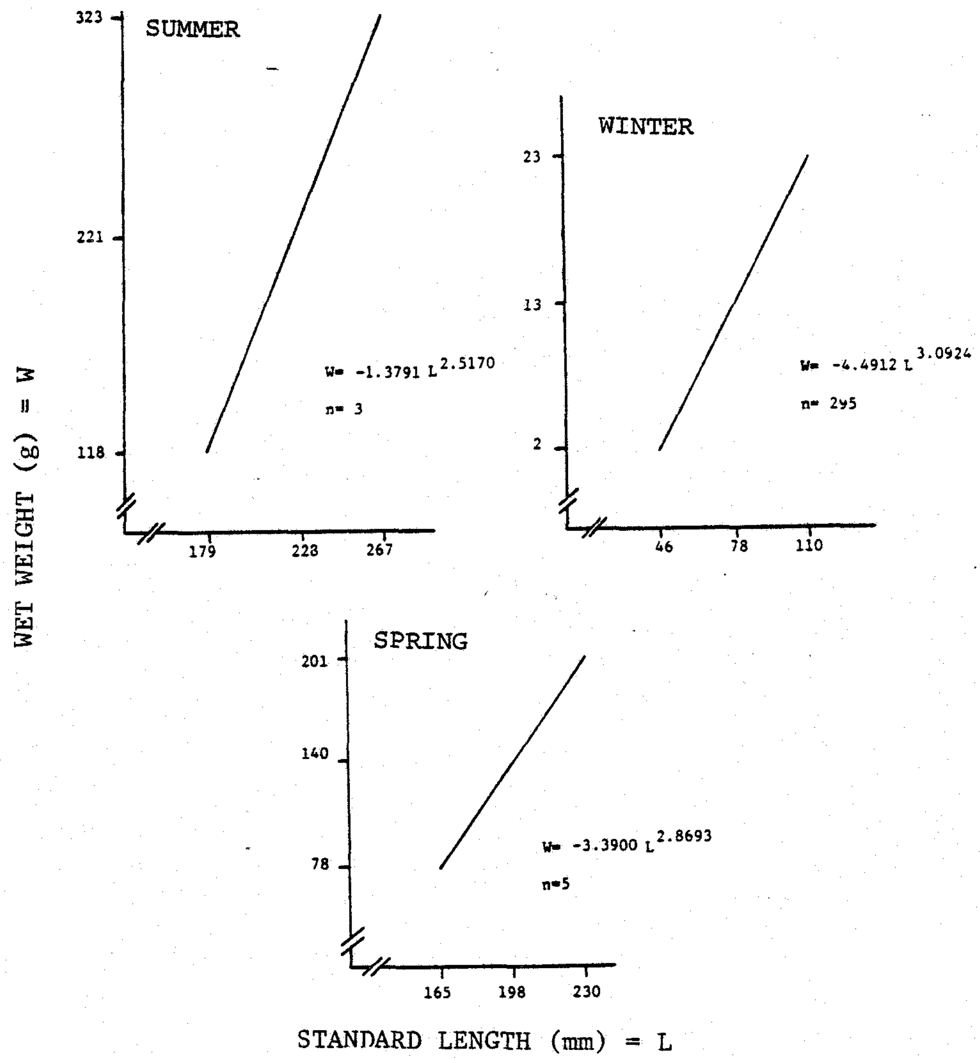


Figure 12. Length-weight relationships of sand seatrout trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

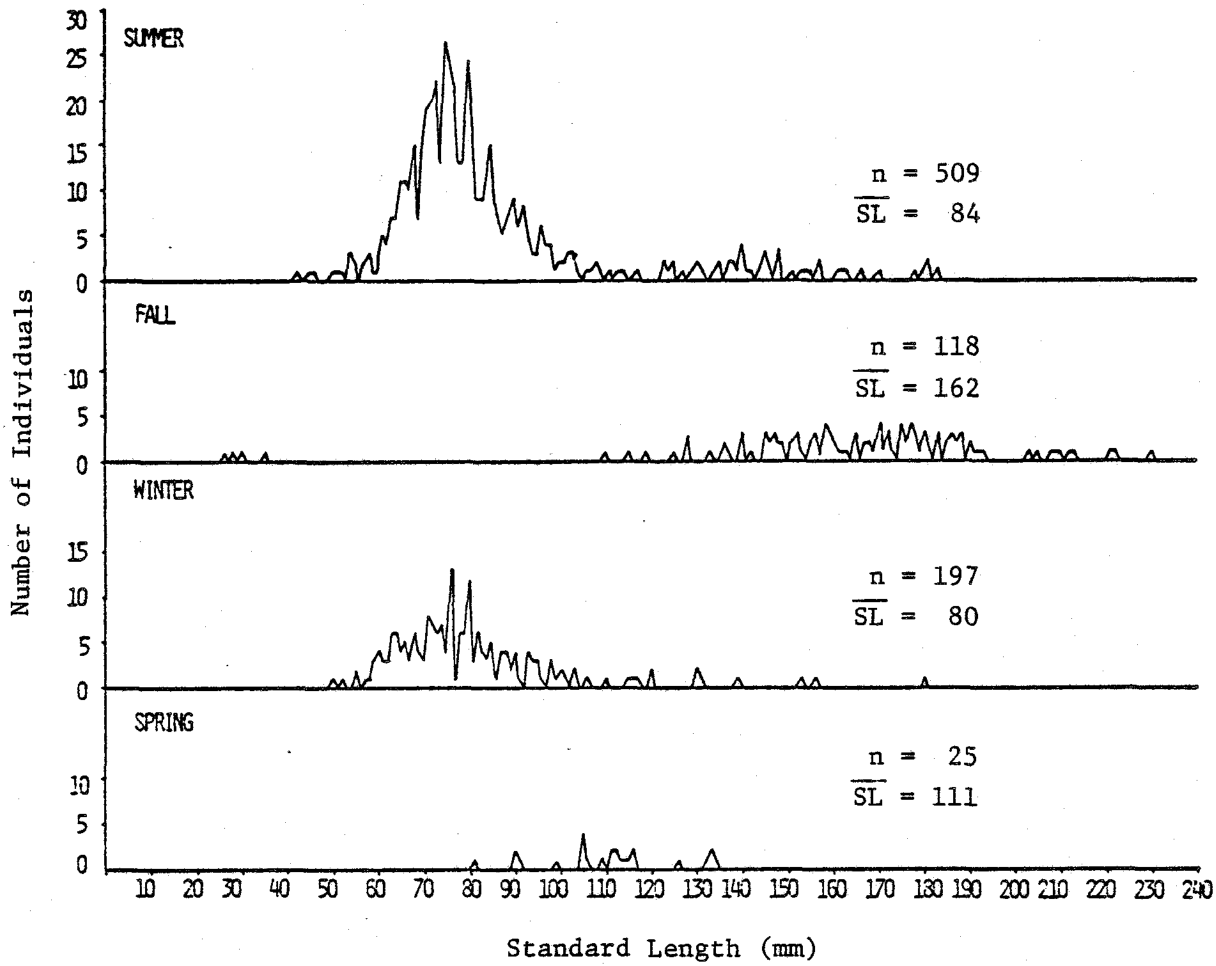


Figure 13. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of sand seatrout trawled at West Hackberry.

age class (sand seatrout age-class determinations follow those reported by Landry 1977) and exhibited undeveloped gonads (Table 35). Many of these individuals, ranging from approximately 110 to 222 mm SL (Fig. 13), were taken again in the fall and had attained sexual maturity (Table 35). A considerable number of 50 to 180 mm SL seatrout overwintered in West Hackberry environs (Fig. 13). These seatrout, apparently associated with a summer spawn, were generally immature (Table 35). Remnants of this winter assemblage also were taken during spring. Length-weight relationships for sand seatrout trawled from West Hackberry are presented in Figure 14.

Sand seatrout trawled from West Hackberry exhibited carnivorous feeding habits (Table 36). Summer specimens preyed mainly upon amphipods (*Ampelisca* sp), sergestid shrimp (*Acetes americanus* and *Lucifer faxoni*) and a diverse assemblage of other fishes. Seatrout taken during the fall continued to subsist on sergestid shrimp and fishes (particularly anchovies) and also exhibited a preference for penaeid shrimp.

Silver seatrout exhibited many of the same spatial and temporal patterns noted for sand seatrout. Winter was the only season yielding sizeable abundances of silver seatrout at Weeks Island (Fig. 15). This winter assemblage consisted of 49 to 73 mm SL young-of-the-year. Constitutents of this winter stock were taken again in spring as 70 to 100 mm SL individuals exhibiting little sexual development (Table 37). Low abundances of sexually mature and maturing silver seatrout were taken at Weeks Island during summer and fall. Length-weight relationships for silver seatrout trawled from Weeks Island are given in Figure 16.

Silver seatrout were taken in sizeable abundances at West Hackberry during summer, fall and spring (Fig. 17). The summer population was

Table 35. Gonad stage of maturity for sand seatrout taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number	175	154	101	4		3	109	56	11	6	5		294	215	115
	% within stage	40.7	35.8	23.5	57.1		42.9	61.9	31.8	6.3	54.6	45.4		47.1	34.5	18.4
	% within sex	100.0	80.2	71.1	100.0		4.1	100.0	78.9	64.7	100.0	41.7		100.0	68.0	48.1
	% of catch	34.4	30.3	19.8	3.4		2.5	55.3	28.4	5.6	24.0	20.0		34.7	25.3	13.6
Quiescent	Number		29	22		5	12		11	6		5	4		50	44
	% within stage		56.9	43.1		29.4	70.6		64.7	35.3		55.6	44.4		53.2	46.8
	% within sex		15.1	15.5		12.2	16.4		15.5	35.3		41.7	57.1		15.8	18.4
	% of catch		5.7	4.3		4.2	10.2		5.6	3.1		20.0	16.0		5.9	5.2
Ripening	Number		9	19		35	58		4			2	2		50	79
	% within stage		32.1	67.9		37.6	62.4		100.0			50.0	50.0		38.8	61.2
	% within sex		4.7	13.4		85.4	79.5		5.6			16.7	28.6		15.8	33.1
	% of catch		1.8	3.7		29.7	49.2		2.0			8.0	8.0		5.9	9.3
Ripeness	Number					1							1		1	1
	% within stage					100.0							100.0		50.0	50.0
	% within sex					2.4							14.3		0.3	0.4
	% of catch					0.9							4.0		0.3	0.3
Reproduction	Number	---NONE TAKEN---														
Spent	Number	---NONE TAKEN---														
	Grand Total	175	192	142	4	41	73	109	71	17	6	12	7	294	316	239
	% of Grand Total	20.6	22.6	16.7	0.5	4.8	8.6	12.8	8.4	2.0	0.7	1.4	0.8	34.6	37.2	28.2

[1]U denotes sex undetermined
[2]F denotes female
[3]M denotes male

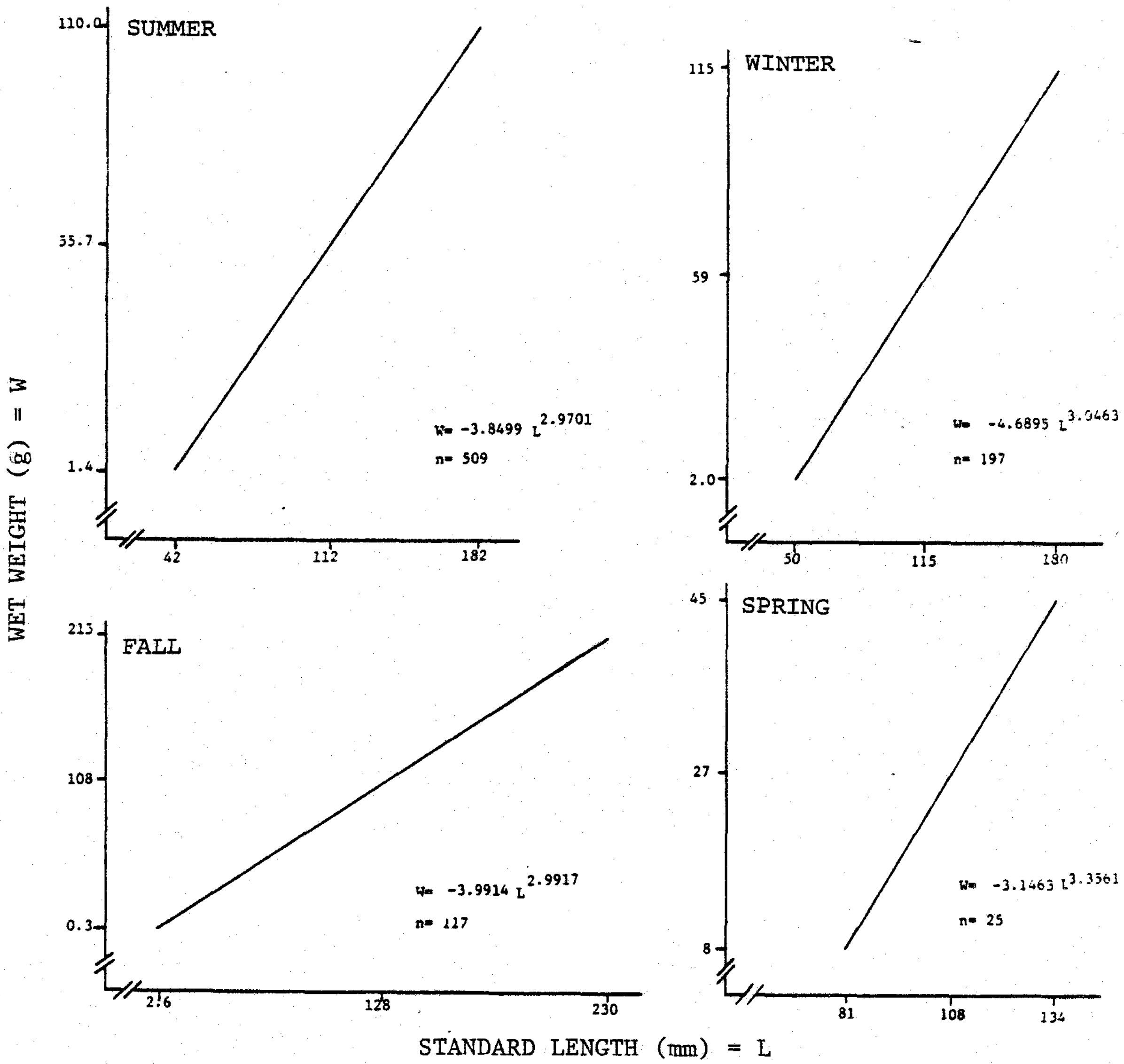


Figure 14. Length-weight relationships of sand seatrout trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 36. Stomach contents of sand seatrout trawled from West Hackberry during Summer and Fall 1978.

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight
Phylum Annelida				
Class Polychaeta			4.0	0.2
Family Arabellidae	1.7	1.9		
Phylum Arthropoda				
Class Crustacea	3.3	< 0.1	2.0	< 0.1
Subclass Copepoda	5.0	0.1		
Temora turbinata			2.0	< 0.1
Labidocera aestiva			2.0	< 0.1
Subclass Malacostraca				
Order Isopoda				
Agethoa oculata	1.7	< 0.1		
Order Amphipoda	33.3	< 0.1		
Ampelisca sp	5.0	< 0.1		
Order Decapoda				
Suborder Natantia	6.7	0.2	2.0	< 0.1
Family Penaeidae	1.7	0.5	2.0	0.3
Subfamily Sicyoninae			2.0	0.2
Subfamily Penaeidae			6.0	2.5
Penaeus sp			2.0	3.3
Penaeus aztecus			4.0	14.7
Penaeus setiferus			2.0	6.0
Family Sergestidae				
Acetes americanus	50.0	6.9	12.0	0.2
Lucifer faxoni	11.7	1.3		
Suborder Reptantia	3.3	0.1		
Family Portunidae	1.7	0.1		
Family Pinnotheridae				
Pinnixa cristata	1.7	< 0.1		

Table 36. (Cont'd)

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight
Phylum Chordata				
Order Anguilliformes	1.7	< 0.1		
Order Clupeiformes				
Family Engraulidae	6.7	6.8	18.0	12.6
Anchoa mitchilli	5.0	4.3	2.0	0.6
Order Gadiformes				
Family Gadidae	1.7	16.4		
Order Perciformes				
Family Carangidae				
Chloroscombrus chrysurus	1.7	0.9		
Family Sciaenidae			2.0	1.1
Fish Material	65.0	47.5	56.0	36.3
Fish Scales	1.7	< 0.1	6.0	< 0.1
Digested Material	96.7	12.9	96.0	21.9
# of stomachs examined	60		50	
Total dry weight (g) of contents	7.453		16.590	

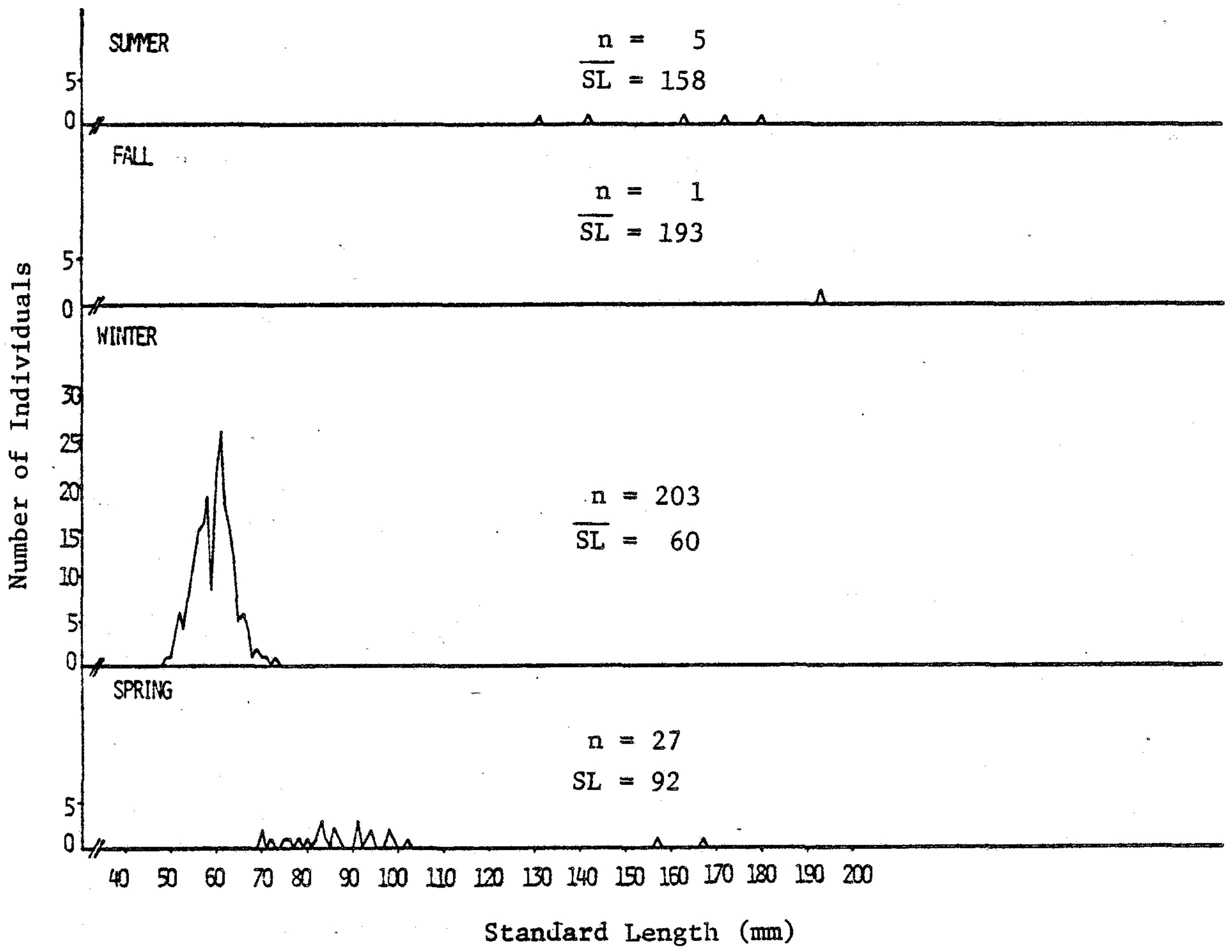


Figure 15. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of silver seatrout trawled at Weeks Island.

Table 37. Gonad stage of maturity for silver seatrout taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number							146	56	1	5			151	56	1
	% within stage							71.9	27.6	0.5	100.0			72.6	26.9	0.5
	% within sex							100.0	100.0	100.0	100.0			100.0	72.7	14.3
	% of catch							71.9	27.6	0.5	19.2			64.3	23.8	0.4
Quiescent	Number		1									18	1		19	1
	% within stage		100.0									94.7	5.3		95.0	5.0
	% within sex		33.3									100.0	33.3		24.7	14.3
	% of catch		20.0									69.2	3.9		8.1	0.4
Ripening	Number		1	2									2		1	4
	% within stage		33.3	66.7									100.0		20.0	80.0
	% within sex		33.3	100.0									66.7		1.3	57.1
	% of catch		20.0	40.0									7.7		0.4	1.7
Ripeness	Number		1				1								1	1
	% within stage		100.0				100.0								50.0	50.0
	% within sex		33.3				100.0								1.3	14.3
	% of catch		20.0				100.0								0.4	0.4
Reproduction	Number	-----	-----	-----	-----	-----	-----	-----NONE TAKEN-----	-----	-----	-----	-----	-----	-----	-----	-----
Spent	Number	-----	-----	-----	-----	-----	-----	-----NONE TAKEN-----	-----	-----	-----	-----	-----	-----	-----	-----
Grand Total		0	3	2	0	0	1	146	56	1	5	18	3	151	77	7
% of Grand Total		0.0	1.3	0.9	0.0	0.0	0.4	62.1	23.8	0.4	2.1	7.7	1.3	64.3	32.8	3.0

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

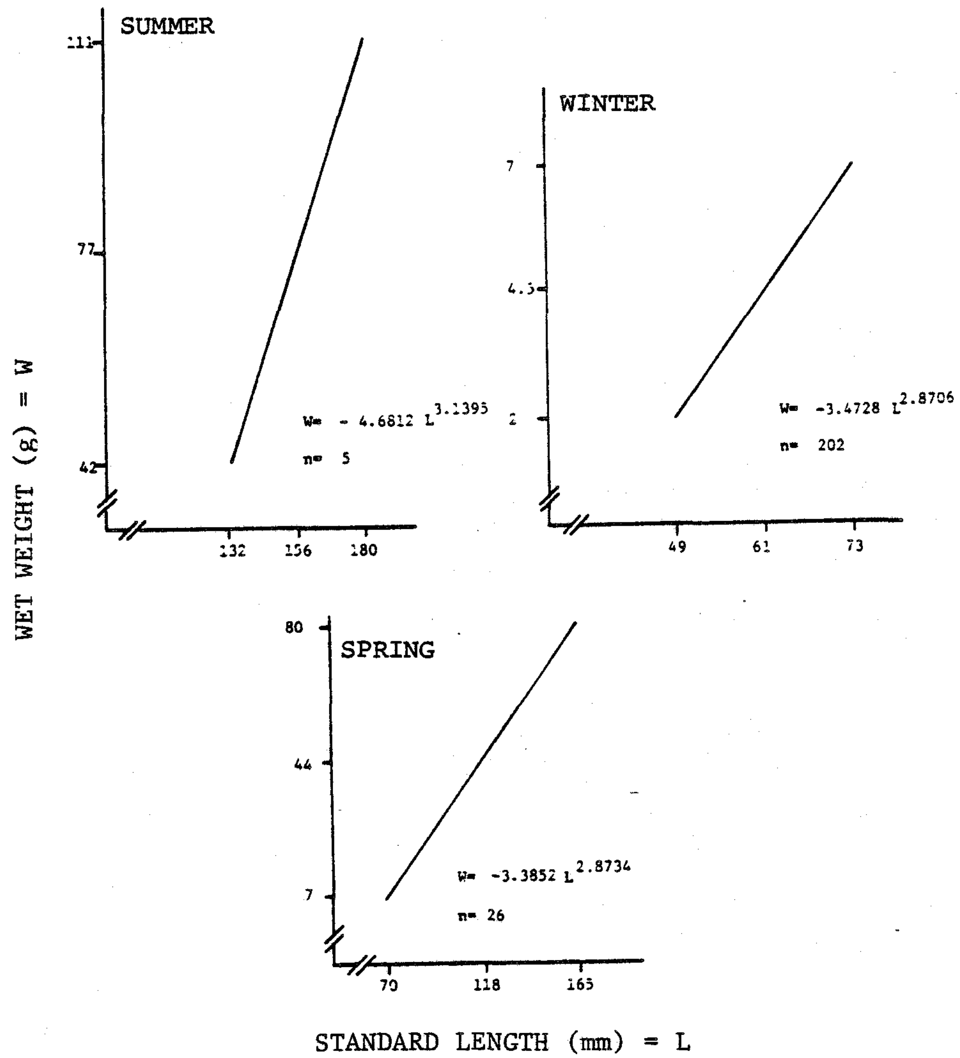


Figure 16. Length-weight relationships of silver seatrout trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

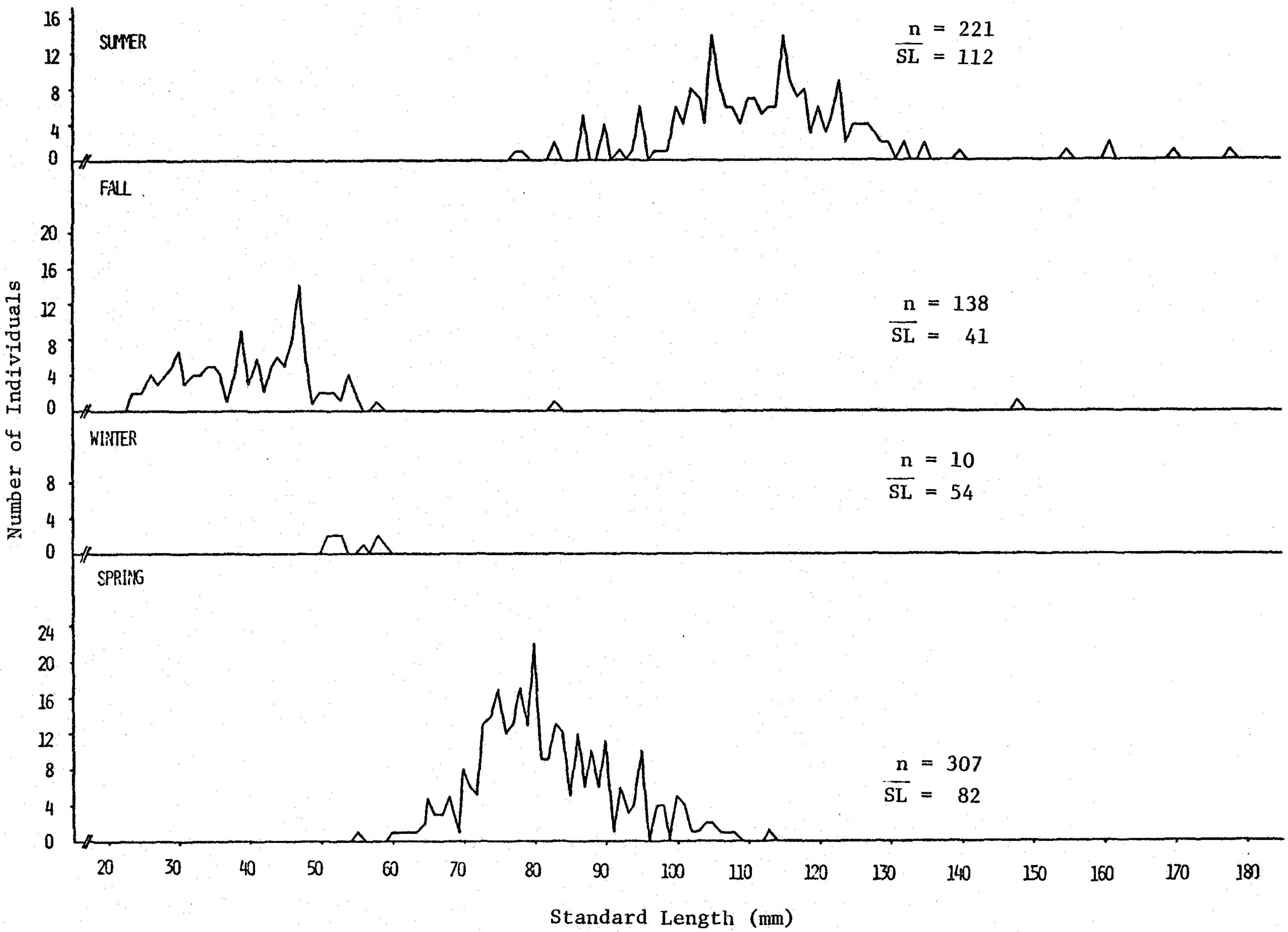


Figure 17. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of silver seatrout trawled at West Hackberry.

comprised of silver seatrout ranging from 71 to 178 mm SL, with most individuals smaller than 130 mm SL. This assemblage was replaced in the fall by recently-spawned 23 to 60 mm SL individuals. These silver seatrout migrated from West Hackberry during winter but returned as 55 to 113 mm SL individuals in the spring. Except for larger individuals taken during summer and fall, most seatrout in West Hackberry samples were sexually undeveloped (Table 38).

Feeding habits of silver seatrout from West Hackberry were similar to those of sand seatrout (Tables 36 and 39). Silver seatrout stomachs yielded penaeid and sergestid shrimp (especially _Acetes americanus_) and engraulid fishes as dominant food items during summer. Fall stomach contents were not as diverse as those of summer, with only sergestid shrimp and other natantian crustaceans dominant. Spring yielded the most varied array of food items consumed by silver seatrout at West Hackberry. Dominant items during spring included copepods (_Temora turbinata_ and _Labidocera aestiva_), cumaceans, sergestid shrimp and reptantian crabs.

Southern Kingfish

The southern kingfish was another recreationally important sciaenid exhibiting notable abundances at Weeks Island. Most kingfish were taken in winter and spring as 0- and 1-year age class individuals (southern kingfish age-class determinations follow those reported by Landry 1977). The winter assemblage ranged from 53 to 203 mm SL, with most kingfish smaller than 120 mm SL (Fig. 18). Very few kingfish had begun to mature (Table 40). These kingfish exhibited moderate growth and, by spring, were exhibiting lengths between 65 and 288 mm. Length-weight relationships for kingfish trawled from Weeks Island are presented in Figure 19. The majority of these spring constitutents had begun to ripen and develop (Table 40).

Table 38. Gonad stage of maturity for silver seatrout taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer			Fall			Winter			Spring			Total		
		U[1]	F[2]	M[3]	U	F	M	U	F	M	U	F	M	U	F	M
Immature	Number	8	22	23	137			9	1		110	58	26	264	81	49
	% within stage	15.1	41.5	43.4	100.0			90.0	10.0		56.7	29.9	13.4	67.0	20.6	12.4
	% within sex	100.0	17.9	25.6	100.0			100.0	100.0		100.0	42.7	42.6	100.0	31.0	32.5
	% of catch	3.7	10.0	10.4	100.0			90.0	10.0		35.9	18.9	8.5	39.1	12.0	7.2
Quiescent	Number		91	54								78	35		169	89
	% within stage		62.7	37.2								69.0	31.0		65.5	34.5
	% within sex		74.0	60.0								57.4	57.4		64.8	58.9
	% of catch		41.2	24.4								25.4	11.4		25.0	13.2
Ripening	Number		9	12		1									10	12
	% within stage		42.9	57.1		100.0									45.5	54.6
	% within sex		7.3	13.3		100.0									3.8	7.9
	% of catch		4.1	5.4		0.7									1.5	1.8
Ripeness	Number		1	1											1	1
	% within stage		50.0	50.0											50.0	50.0
	% within sex		0.8	1.1											0.4	0.7
	% of catch		0.5	0.5											0.1	0.1
Reproduction	Number	---NONE TAKEN---														
Spent	Number	---NONE TAKEN---														
	Grand Total	8	123	90	137	1	0	9	1	0	110	136	61	264	261	151
	% of Grand Total	1.2	18.2	13.3	20.3	0.1	0.0	1.3	0.1	0.0	16.3	20.1	9.0	39.1	38.6	22.3

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

Table 39. Stomach contents of silver seatrout trawled from West Hackberry during Summer, Fall, and Spring 1978-79.

	SUMMER		FALL		SPRING	
Stomach Contents	% of Occurrence	% of Dry Weight	% of Occurrence	% of Dry Weight	% of Occurrence	% of Dry Weight
Phylum Annelida						
Class Polychaeta					1.8	< 0.1
Phylum Mollusca						
Class Bivalvia						
Mulinia lateralis					3.5	0.6
Phylum Arthropoda						
Class Crustacea			3.8	0.8	12.3	0.7
Subclass Ostracoda					1.8	< 0.1
Subclass Copepoda	2.0	0.1	1.9	0.4	1.8	6.6
Temora turbinata			1.9	0.2	7.0	
Labidocera aestiva					71.9	
Order Calanoida			1.9	0.2		
Subclass Malacostraca					1.8	< 0.1
Mysidopsis sp					3.5	0.1
Order Cumacea					24.6	1.4
Order Amphipoda	2.0	< 0.1	9.6	2.5	1.8	< 0.1
Order Decapoda						
Suborder Natantia	2.0	< 0.1	42.3	34.9	12.3	5.7
Ogyrides limicola	3.9	0.2			1.8	0.1
Leptochela serratorbita	2.0	< 0.1				
Section Penaeidae	2.0	< 0.1				
Family Penaeidae	13.7	0.1				
Family Sergestidae						
Acetes americanus	40.4	4.2	25.0	9.4	7.0	0.3
Lucifer faxoni	3.9	< 0.1	1.9	0.4	19.3	0.5
Suborder Reptantia	3.9	< 0.1			1.8	< 0.1
Reptantiz zoea					14.0	0.4
Family Pinnotheridae						
Pinnixa sp					1.8	0.1
Pinnixa cristata	2.0	< 0.1				
Family Xanthidae	2.0	< 0.1				
Phylum Chordata						
Family Engraulidae	31.4	57.4			5.3	5.2
Family Carangidae						
Fish Material	51.0	17.6	9.6	10.5	21.1	16.7
Fish Scales	5.9	< 0.1			28.1	0.9
Digested Material	94.1	20.3	98.1	38.8	100.0	60.6
Eggs					1.8	< 0.1
# of stomachs examined	51		52		57	
Total dry weight (g) of contents	8.883		0.244		1.317	

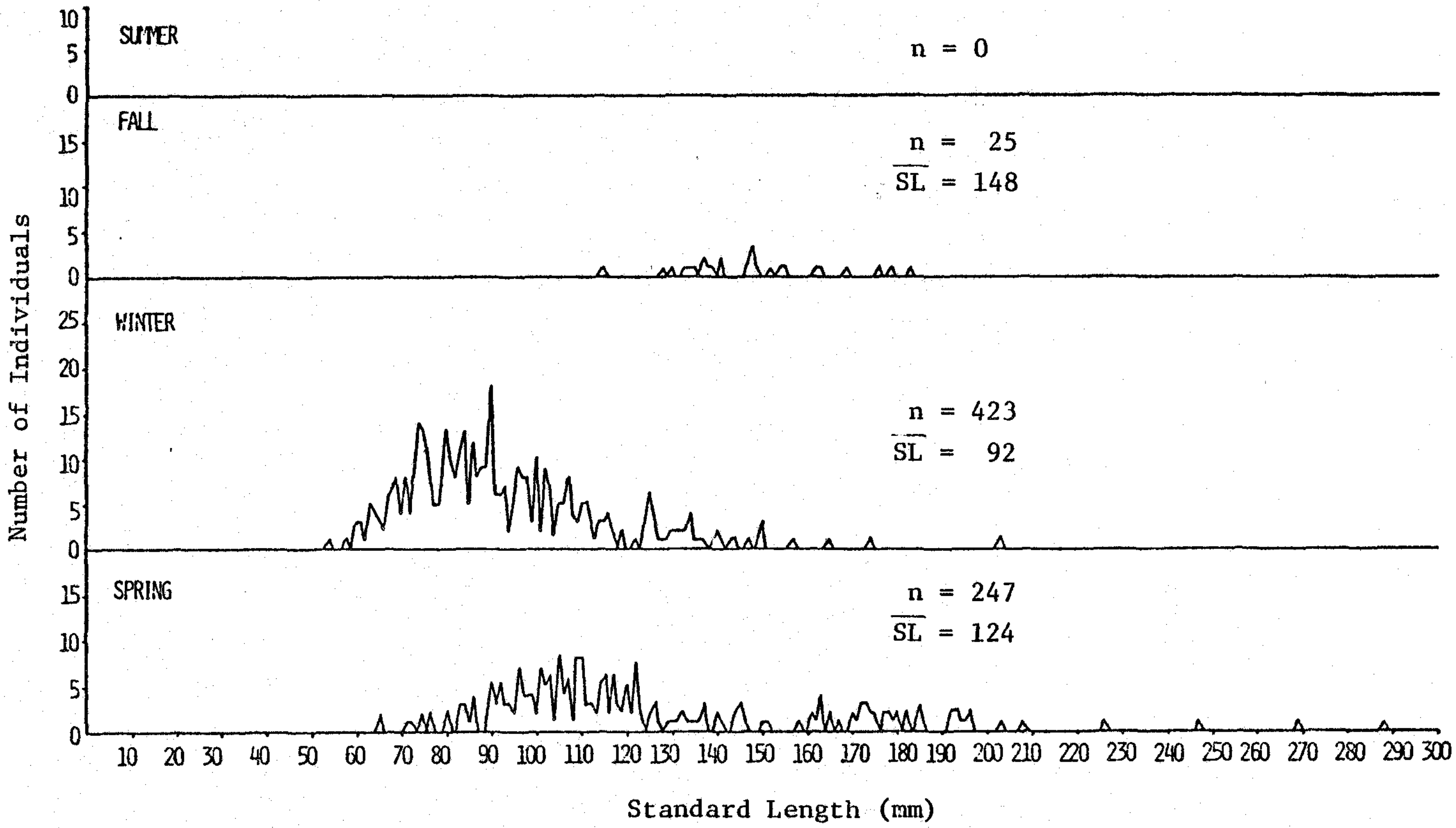


Figure 18. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of southern kingfish trawled at Weeks Island.

Table 40. Gonad stage of maturity for southern kingfish taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number							73	159	89	15			88	159	89
	% within stage							22.7	49.5	27.7	100.0			26.2	47.3	26.5
	% within sex							100.0	72.0	69.0	100.0			100.0	49.7	26.1
	% of catch							17.3	37.6	21.0	6.1			11.8	21.2	11.9
Quiescent	Number								55	27		14	60		69	87
	% within stage								67.1	32.9		18.9	81.1		44.2	55.8
	% within sex								24.9	20.9		51.9	29.3		21.6	25.5
	% of catch								13.0	6.4		5.7	24.3		9.2	11.6
Ripening	Number					24	3		7	13		6	127		37	143
	% within stage					88.9	11.1		35.0	65.0		4.5	95.5		20.6	79.4
	% within sex					33.3	42.9		3.2	10.1		22.2	62.0		11.6	41.9
	% of catch					30.4	3.8		1.7	3.1		2.4	51.4		4.9	19.1
Ripeness	Number					26	2					7	15		33	17
	% within stage					92.9	7.1					31.8	68.2		66.0	34.0
	% within sex					36.1	28.6					25.9	7.3		10.3	5.0
	% of catch					32.9	2.5					2.8	6.1		4.4	2.3
Reproduction	Number					22	2						3		22	5
	% within stage					91.7	8.3						100.0		81.5	18.5
	% within sex					30.6	28.6						1.5		6.9	1.5
	% of catch					27.9	2.5						1.2		2.9	0.7
Spent	Number							NONE TAKEN								
Grand Total		0	0	0	0	72	7	73	221	129	15	27	205	88	320	341
% of Grand Total		0.0	0.0	0.0	0.0	9.6	0.9	9.7	29.5	17.2	2.0	3.6	27.4	11.8	42.7	45.5

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

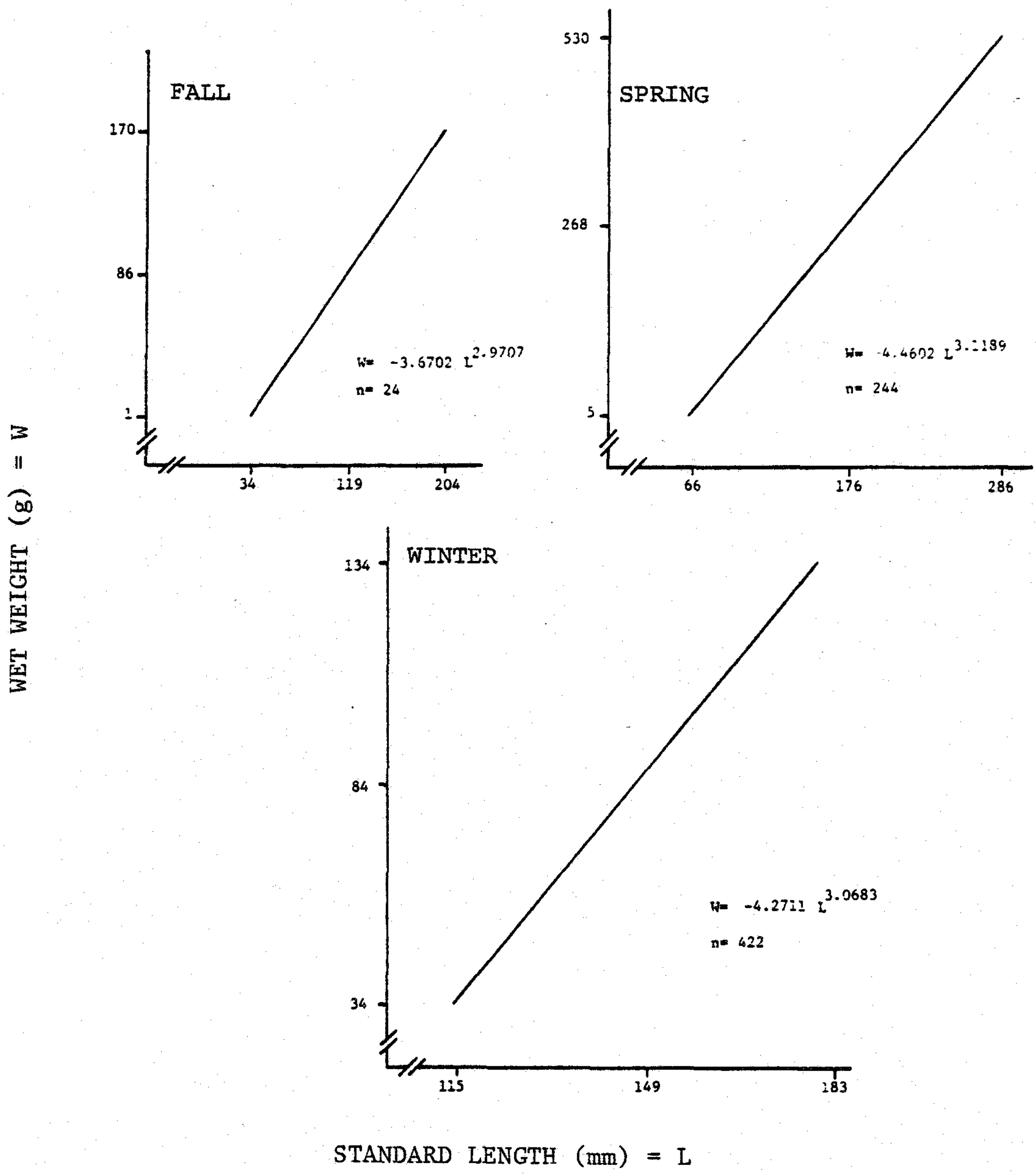


Figure 19. Length-weight relationships of southern kingfish trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Stomachs of southern kingfish trawled from Weeks Island were analyzed for winter and spring cruises (Table 41). Winter kingfish assemblages fed heavily upon natantian decapods (Ogyrides limicola), penaeid shrimp and fish matter. Kingfish food habits diversified during spring to include polychaetes, bivalve mollusks (Mulinia lateralis), natantian decapods (Ogyrides limicola), reptantian decapods (especially portunid crabs) and fish matter as dominant items.

Atlantic Croaker

Atlantic croaker was the most abundant species trawled at West Hackberry. Peak croaker abundance occurred in summer and spring (Fig. 20). The summer assemblage generally was comprised of 51 to 113 mm SL individuals spawned during the previous winter. None of the summer residents was sexually mature (Table 42). These same constitutents were taken in lower abundances during fall (Fig. 20). Most fall residents were larger than 100 mm SL and were beginning to develop sexually. The sparse winter stock consisted of newly-spawned recruits usually smaller than 80 mm SL and older croaker exceeding 100 mm SL. Strong recruitment waves of 21 to 94 mm SL young-of-the-year accounted for peak croaker abundances during spring. Length-weight relationships for croaker taken from West Hackberry are given in Figure 21.

Atlantic croaker from West Hackberry preyed mainly on polychaetes during summer, fall and spring (Table 43). Polychaetes occurred in 50 to 86.9% of all croaker stomachs examined during this period. Sergestid shrimp (Acetes americanus) and fish matter constituted other abundant food items during summer. Fall food items were dominated by copepods (Temora turbinata and Labidocera aestiva) and natantian decapods (namely Ogyrides limicola). The copepod Labidocera aestiva was the only other

Table 41. Stomach contents of southern kingfish trawled from Weeks Island during Winter and Spring 1979.

	WINTER		SPRING	
Stomach Contents	% of Occurrence	% of Dry Weight	% of Occurrence	% of Dry Weight
Phylum Annelida				
Class Polychaeta	5.7	3.5	28.6	5.2
Phylum Mollusca				
Class Bivalvia				
Mulinia lateralis			22.2	2.8
Phylum Arthropoda				
Class Crustacea	5.7	0.3		
Order Mysidacea				
Mysidopsis sp			1.6	< 0.1
Order Amphipoda				
Ampelisca abdita	1.9	< 0.1		
Monoculodes sp			4.8	0.1
Monoculodes edwardsi			1.6	< 0.1
Listriella barnardi			1.6	< 0.1
Order Decapoda				
Suborder Natantia	13.2	0.8	11.1	1.9
Ogyrides limicola	39.6	15.0	39.7	12.3
Section Penaeidea	1.9	1.0		
Family Penaeidae	9.4	3.8		
Penaeus sp			1.6	< 0.1
Trachypenaeus sp			3.2	5.5
Trachypenaeus similis	3.8	4.1		
Suborder Reptantia	3.8	0.1	42.9	5.4
Reptantia Megalops	1.9	< 0.1		
Family Portunidae			25.4	4.4
Callinectes sp			1.6	0.3
Callinectes sapidus			7.9	0.9
Callinectes similis			4.8	1.1

Table 41. (Cont'd)

Stomach Contents	WINTER % of Occurrence	WINTER % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Class Insecta	3.8	0.1		
Phylum Chordata				
Family Sciaenidae			1.6	0.2
Family Bothidae				
Etropus crossotus			1.6	15.1
Family Cynoglossidae				
Symphurus plagiusa			1.6	17.2
Fish Material			4.8	3.8
Fish Scales	34.0	1.0	9.5	0.2
Digested Material	100.0	70.2	95.2	22.4
Digested Material & Sediment			4.8	1.0
Sand & Sediment			3.2	0.1
Polychaete tube/sand			1.6	0.1
Eggs	1.9	< 0.1		
# of stomachs examined	53		63	
Total dry weight (g) of contents	2.054		4.398	

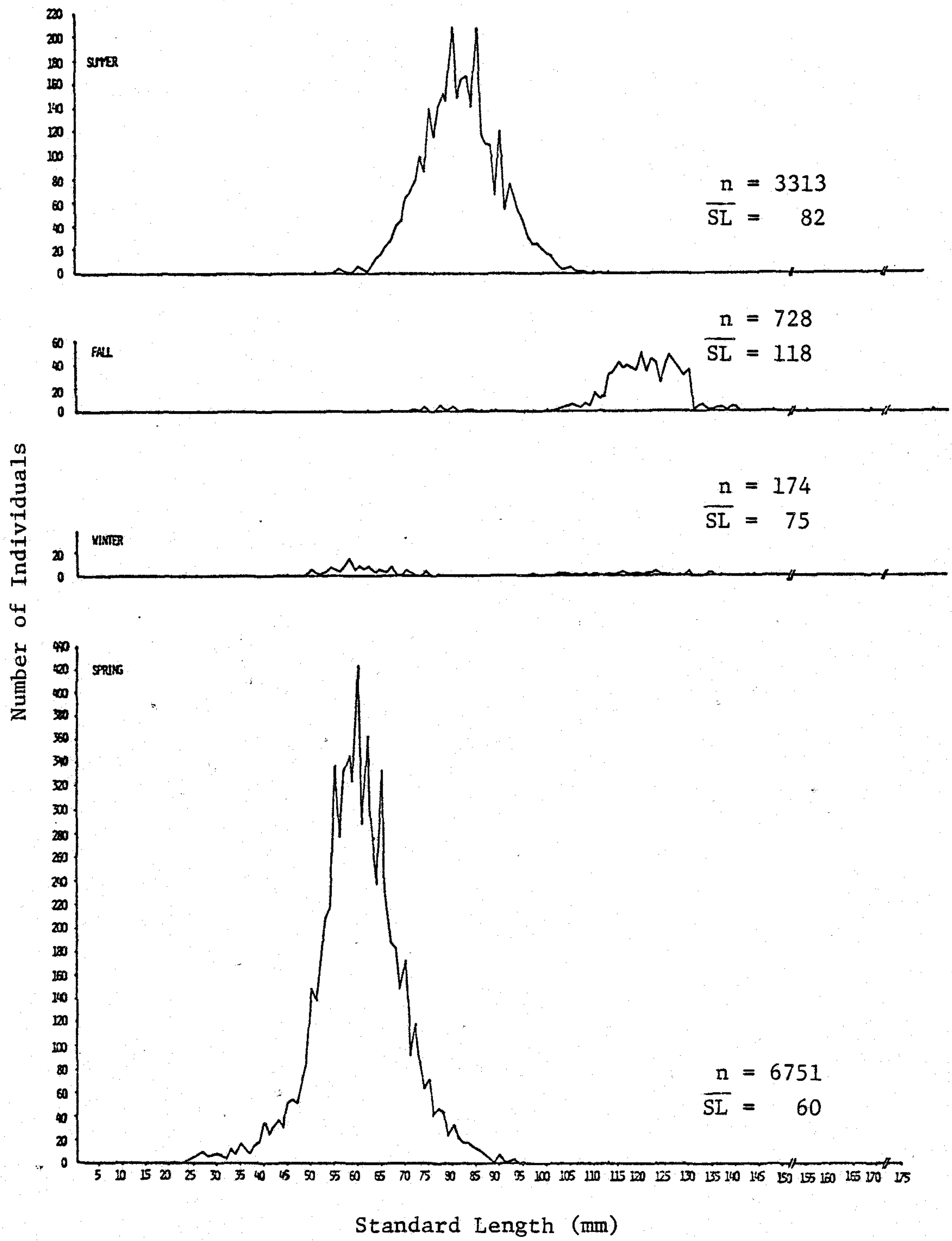


Figure 20. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of Atlantic croaker trawled at West Hackberry.

Table 42. Gonad stage of maturity for Atlantic croaker taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer			Fall			Winter			Spring			Total		
		U[1]	F[2]	M[3]	U	F	M	U	F	M	U	F	M	U	F	M
Immature	Number	2540	275	124	338		2	103	32	1	6713			9694	307	127
	% within stage	86.4	9.4	4.2	99.4		0.6	75.7	23.5	0.7	100.0			95.7	3.0	1.3
	% within sex	100.0	43.2	90.5	100.0		1.4	100.0	55.2	7.7	100.0			100.0	31.7	41.5
	% of catch	76.7	8.3	3.7	46.4		0.3	59.2	18.4	0.6	99.4			88.4	2.8	1.2
Quiescent	Number		362	13			1		25	12		28			415	26
	% within stage		96.5	3.5			100.0		67.6	32.4		100.0			94.1	5.9
	% within sex		56.8	9.5			0.7		43.1	92.3		100.0			42.9	8.5
	% of catch		10.9	0.4			0.1		14.4	6.9		0.4			3.8	0.2
Ripening	Number					94	54		1						95	54
	% within stage					63.5	36.5		100.0						63.8	36.2
	% within sex					38.5	37.0		1.7						9.8	17.6
	% of catch					12.9	7.4		0.6						0.9	0.5
Ripeness	Number					72	35						10		72	45
	% within stage					67.3	32.7						100.0		61.5	38.5
	% within sex					29.5	24.0						100.0		7.4	14.7
	% of catch					9.9	4.8						0.2		0.7	0.4
Reproduction	Number					76	54								76	54
	% within stage					58.5	41.5								58.5	41.5
	% within sex					31.2	37.0								7.9	17.6
	% of catch					10.4	7.4								0.7	0.5
Spent	Number					2									2	
	% within stage					100.0									100.0	
	% within sex					0.8									0.2	
	% of catch					0.3									<0.1	
Grand Total		2540	637	137	338	244	146	103	58	13	6713	28	10	9694	967	306
% of Grand Total		23.2	5.8	1.2	3.1	2.2	1.3	0.9	0.5	0.1	61.2	0.3	0.1	88.4	8.8	2.8

[1]U denotes sex undetermined
[2]F denotes female
[3]M denotes male

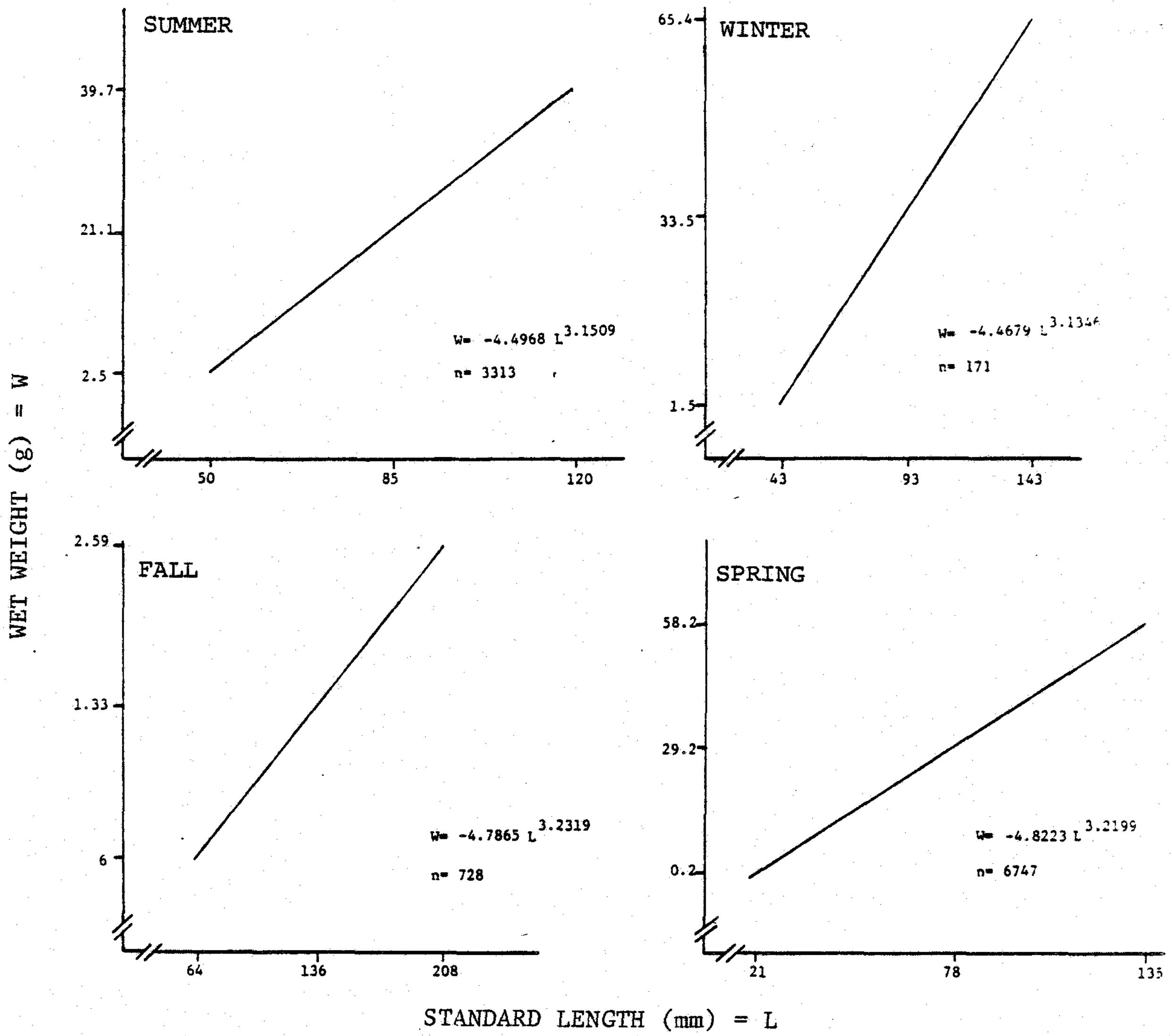


Figure 21. Length-weight relationships of Atlantic croaker trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 43. Stomach contents of Atlantic croaker trawled from West Hackberry during Summer, Fall and Spring 1978-79.

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Cnidaria			1.0	< 0.1		
Phylum Annelida						
Class Polychaeta	50.0	27.0	86.9	31.6	70.6	23.9
Family Onuphidae			1.0	0.6		
Pectinaria sp	1.7	< 0.1				
Family Terebellidae			1.0	0.1		
Phylum Mollusca						
Class Gastropoda			2.0	1.6		
Class Bivalvia						
Mulinia lateralis			1.0	< 0.1	3.9	0.8
Class Cephalopoda						
Loligo sp			1.0	< 0.1		
Phylum Arthropoda						
Class Crustacea			4.0	0.1	5.9	0.1
Subclass Ostracoda					2.0	0.6
Subclass Copepoda			0.0	0.1	5.9	0.8
Temora turbinata			8.1		2.0	
Labidocera aestiva			2.0		23.5	
Subclass Malacostraca						
Superorder Hoplocarida						
Order Stomatopoda						
Squilla empusa			2.0	0.5		
Order Mysidacea			6.1	0.3		
Mysidopsis almyra			1.0	< 0.1	2.0	< 0.1
Order Isopoda	1.7	0.1				
Order Amphipoda	5.2	0.3	3.0	0.1	2.0	< 0.1
Ampelisca sp					5.9	0.1
Ampelisca abdita					2.0	< 0.1
Stenothoe sp					2.0	< 0.1
Listriella sp					2.0	< 0.1
Superorder Eucarida			1.0	< 0.1		
Order Decapoda			1.0	< 0.1		
Suborder Natantia	5.2	0.2	13.1	0.6	2.0	< 0.1
Section Caridea			1.0	< 0.1		
Ogyrides limicola			7.1	0.6		
Section Penaeidea						
Family Penaeidae			5.1	0.4		
Subfamily Penaeidea	1.7	0.1	2.0	0.5		
Family Sergestidae						
Acetes americanus	22.4	8.0	2.0	< 0.1	3.9	0.1
Lucifer faxoni	3.4	0.2			2.0	< 0.1
Suborder Reptantia	3.4	0.2	1.0	< 0.1	7.8	0.8
Reptantia Megalops	1.7	0.1				
Section Brachyura			2.0	< 0.1		
Family Portunidae			1.0	0.2		
Class Insecta					2.0	0.1
Subclass Pterygota			1.0	< 0.1		
Phylum Chordata						
Class Larvacea			1.0	0.1		
Class Osteichthyes						
Family Engraulidae	3.4	8.0				
Fish Material	20.7	9.3	5.1	1.6	5.9	0.6
Fish Scales	5.2	0.3	14.1	0.3	21.6	0.5
Unidentified Algae			1.0	< 0.1		
Digested Material	96.6	46.1	97.0	60.9	88.2	71.2
Sand & Sediment	3.4	0.2			2.0	0.1
Eggs			1.0	< 0.1	2.0	< 0.1
# of stomachs examined	58		99		51	
Total dry weight (g) of contents	1.744		7.548		1.183	

major food item eaten by spring croaker assemblages.

Star Drum

Star drum exhibited sizeable abundances at both Weeks Island and West Hackberry. Winter samples yielded over 90% of the star drum netted at Weeks Island (Fig. 22). Young-of-the-year and older star drum ranging from 32 to 92 mm SL (star drum age-class determinations follow those reported by Landry 1977) comprised the winter assemblage. Length-weight relationships for star drum trawled from Weeks Island are presented in Figure 3. Few winter constitutents were sexually developed (Table 44).

The winter star drum assemblage at Weeks Island mainly fed on copepods (Temora turbinata and Labidocera aestiva), mysid shrimp (Mysidopsis sp), natantian decapods and fish matter (Table 45).

West Hackberry samples produced sizeable star drum abundances during summer through winter (Fig. 24). Summer and fall stocks consisted of older star drum ranging from 61 to 97 and 65 to 94 mm SL, respectively. Many summer and fall constitutents had attained sexual maturity (Table 46). The winter was characterized by a tremendous influx of 35 to 65 mm SL young-of-the-year (Fig. 24). However, comparatively few of these individuals were taken in the study area during spring. Length-weight relationships for star drum taken from West Hackberry are given in Figure 25.

Star drum exhibited slightly different feeding habits during each seasonal cruise at West Hackberry (Table 47). Summer stomach contents were dominated by amphipods (Ampelisca sp), natantian decapods (Acetes americanus and Lucifer faxoni) and fish matter. Fall food habits were characterized by star drum dependence upon polychaetes, copepods (Temora turbinata), natantian decapods and fish matter. Copepods (Temora turbinata and Labidocera aestiva) and mysid shrimp (Mysidopsis sp) overwhelmingly

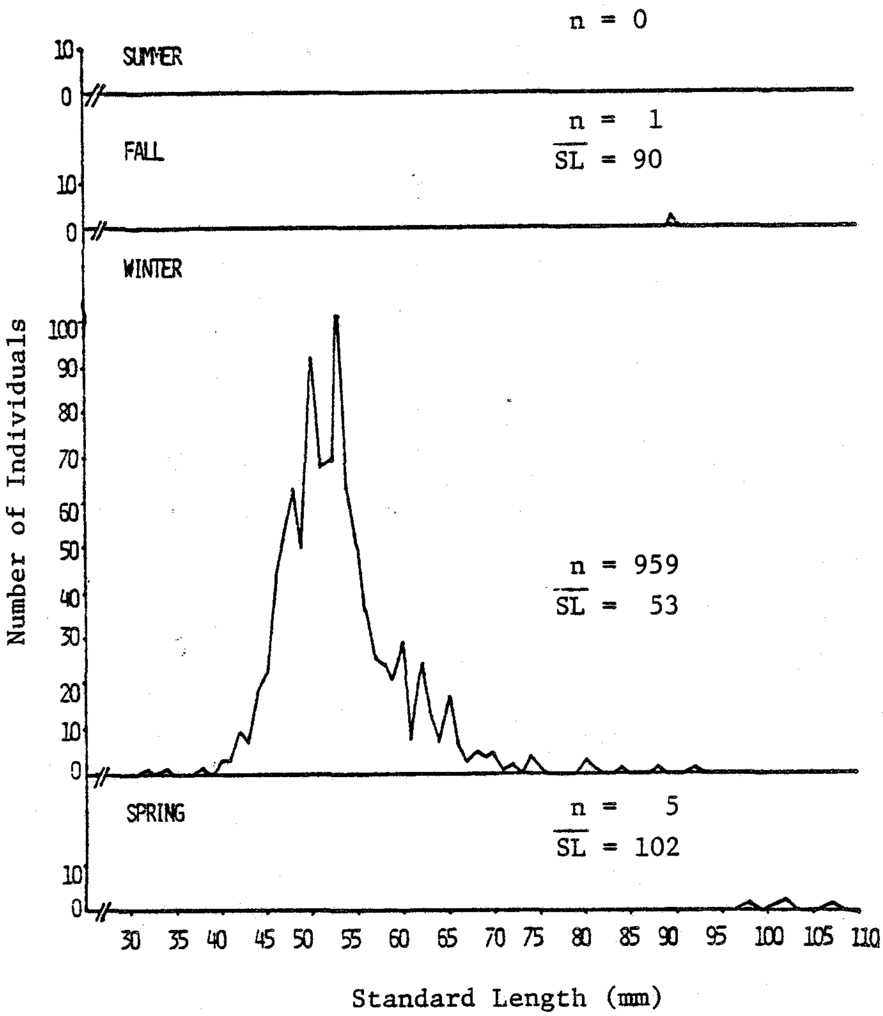


Figure 22. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of star drum trawled at Weeks Island.

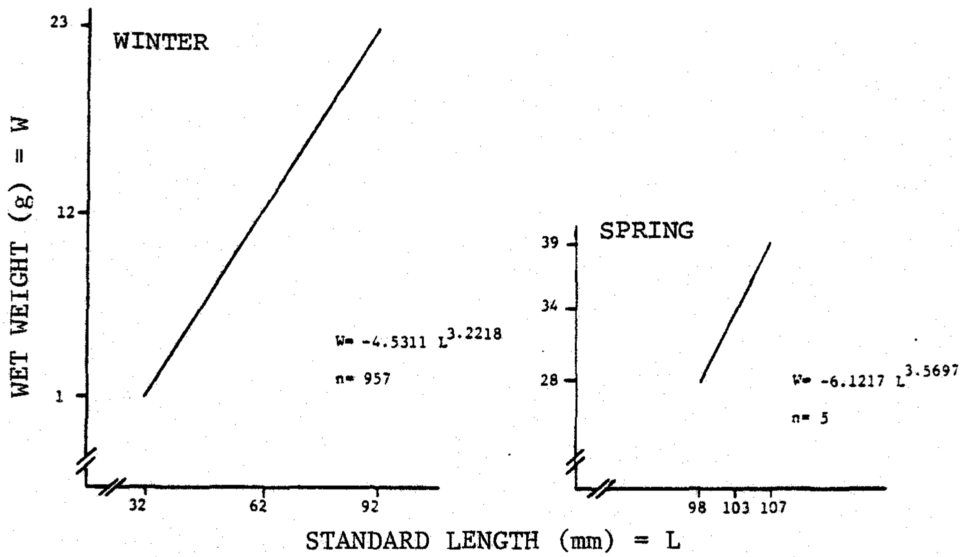


Figure 23. Length-weight relationships of star drum trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 44. Gonad stage of maturity for star drum taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number							261	291	127				261	291	127
	% within stage							38.4	42.9	18.7				38.4	42.9	18.7
	% within sex							100.0	61.4	57.2				99.2	61.1	56.2
	% of catch							27.2	30.3	13.2				27.1	30.2	13.2
Quiescent	Number							2	174	93				2	174	93
	% within stage							0.7	64.7	34.6				0.7	64.7	34.6
	% within sex							0.8	36.7	41.9				0.8	36.6	41.2
	% of catch							0.2	18.1	9.7				0.2	18.0	9.6
Ripening	Number					1			9	2		1	4		11	6
	% within stage					100.0			81.8	18.2		20.0	80.0		64.7	35.3
	% within sex					100.0			1.9	0.9		100.0	100.0		2.3	2.7
	% of catch					100.0			0.9	0.2		20.0	80.0		1.1	0.6
Ripeness	Number	--NONE TAKEN--														
Reproduction	Number	--NONE TAKEN--														
Spent	Number	--NONE TAKEN--														
Grand Total		0	0	0	0	1	0	263	474	222	0	1	4	263	476	226
% of Grand Total		0.0	0.0	0.0	0.0	0.1	0.0	27.3	49.1	23.0	0.0	0.1	0.4	27.3	49.3	23.4

[1] U denotes sex undetermined
[2] F denotes female
[3] F denotes male

Table 45. Stomach contents of star drum trawled from Weeks Island during Winter 1979.

	WINTER	
Stomach Contents	% of Occurrence	% of Dry Weight
Phylum Arthropoda		
Class Crustacea	15.4	4.3
Subclass Copepoda	4.6	14.9
Temora turbinata	32.3	
Labidocera aestiva	75.4	
Order Mysidacea	1.5	0.1
Mysidopsis sp	24.6	1.6
Order Decapoda		
Suborder Natantia	21.5	2.1
Suborder Reptantia	3.1	0.1
Section Anomura	1.5	9.6
Phylum Chordata		
Family Scombridae	1.5	0.1
Fish Material	9.2	2.4
Fish Scales	21.5	1.1
Digested Material	100.0	63.3
Eggs	9.2	0.4

# of stomachs examined 65

Total dry weight (g) of contents 1.039

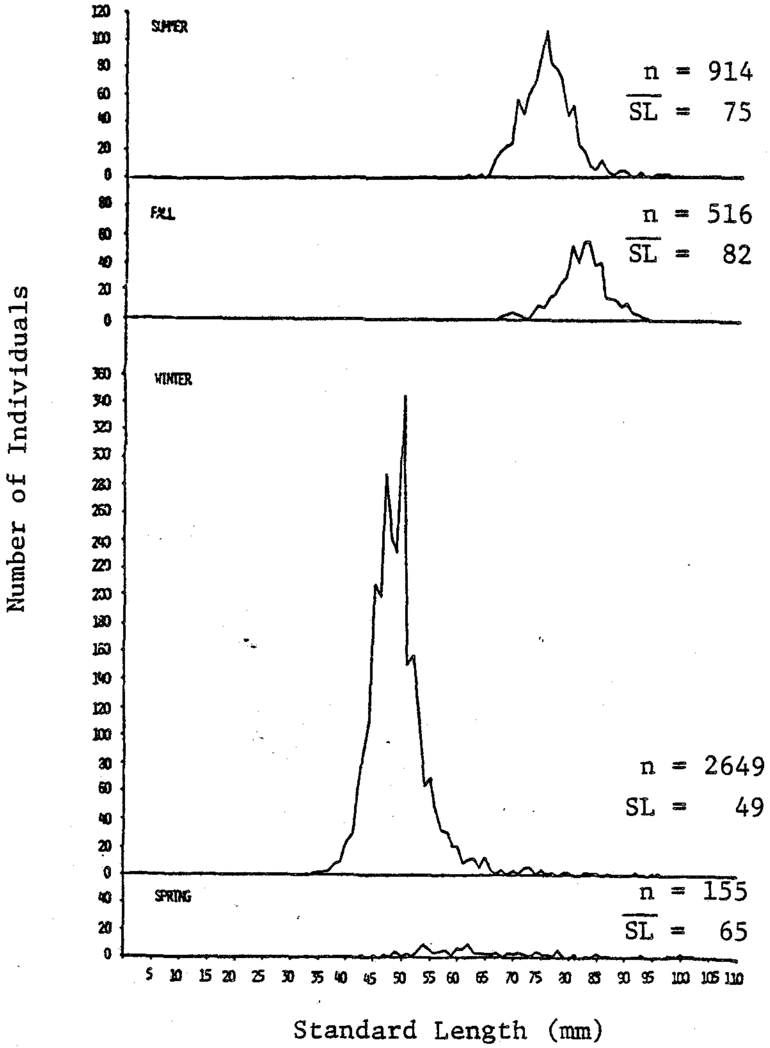


Figure 24. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of star drum trawled at West Hackberry.

Table 46. Gonad stage of maturity for star drum taken from West Hackberry during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number	346	1	1	359			2123	170	91	23	4	3	2851	175	95
	% within stage	99.4	0.3	0.3	100.0			89.1	7.1	3.8	76.7	13.3	10.0	91.3	5.6	3.0
	% within sex	100.0	0.4	0.3	100.0			100.0	42.8	70.5	100.0	6.6	4.2	100.0	22.3	15.9
	% of catch	37.9	0.1	0.1	69.6			80.2	6.4	3.4	14.9	2.6	1.9	67.3	4.1	2.2
Quiescent	Number		31	48		1	2		218	38		34	15		284	103
	% within stage		39.2	60.8		33.3	66.7		85.2	14.8		69.4	30.6		73.4	26.6
	% within sex		12.9	14.7		1.2	2.9		54.9	29.5		55.7	21.1		36.1	17.3
	% of catch		3.4	5.3		0.2	0.4		8.2	1.4		21.9	9.7		6.7	2.4
Ripening	Number		71	258		52	58		9			9	52		141	368
	% within stage		21.6	78.4		47.3	52.7		100.0			14.8	85.3		27.7	72.3
	% within sex		29.5	78.9		59.8	82.9		2.3			14.8	73.2		17.9	61.6
	% of catch		7.8	28.2		10.1	11.2		0.3			5.8	33.6		3.3	8.7
Ripeness	Number		16	15		9	9					1			26	24
	% within stage		51.6	48.4		50.0	50.0					100.0			52.0	48.0
	% within sex		6.6	4.6		10.3	12.9					1.6			3.3	4.0
	% of catch		1.8	1.6		1.7	1.7					0.7			0.6	0.6
Reproduction	Number		122	3		25	1					13	1		160	5
	% within stage		97.6	2.4		96.2	3.9					92.9	7.1		97.0	3.0
	% within sex		50.6	0.9		28.7	1.4					21.3	1.4		20.4	0.8
	% of catch		13.4	0.3		4.8	0.2					8.4	0.7		3.8	0.1
Spent	Number			2												2
	% within stage			100.0												100.0
	% within sex			0.6												0.3
	% of catch			0.2												<0.1
Grand Total		346	241	327	359	87	70	2123	397	129	23	61	71	2851	786	597
% of Grand Total		8.2	5.7	7.7	8.5	2.1	1.7	50.1	9.4	3.0	0.5	1.4	1.7	67.3	18.6	14.1

[1]U denotes sex undetermined
[2]F denotes female
[3]M denotes male

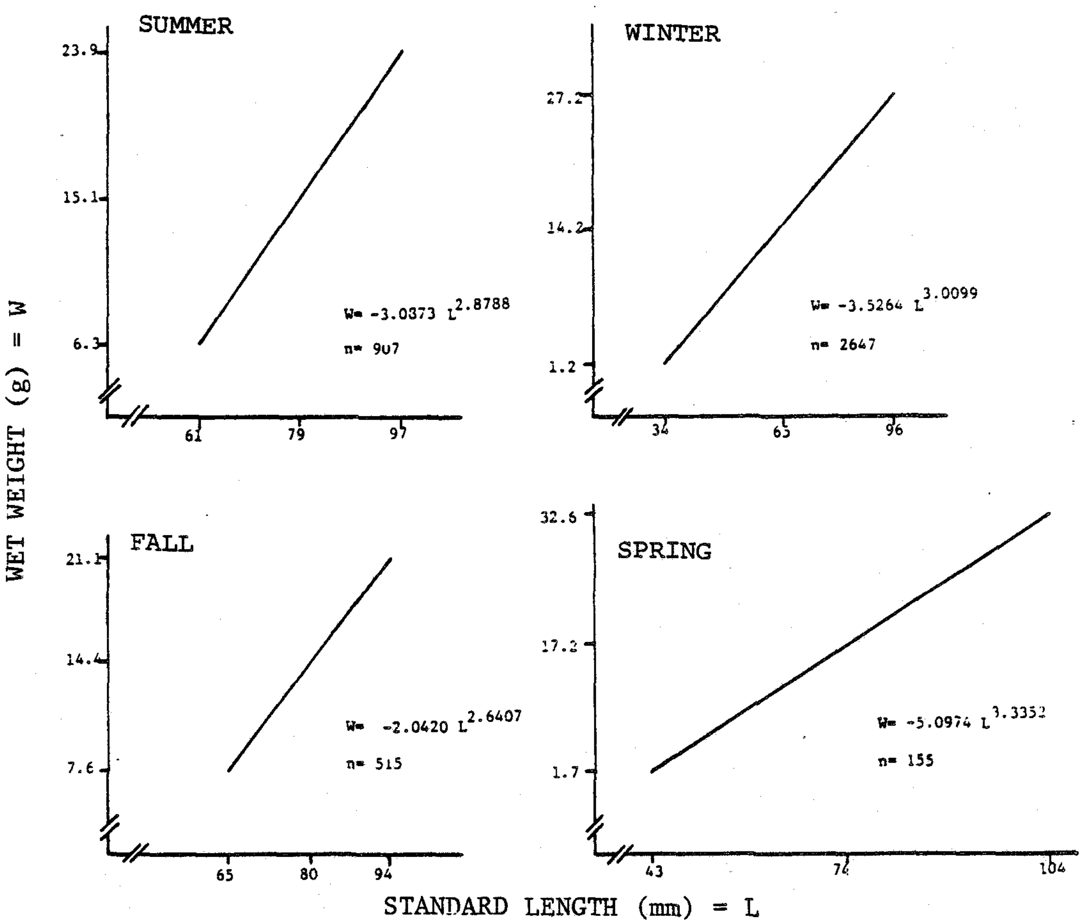


Figure 25. Length-weight relationships of star drum trawled from West Hackberry. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 47. Stomach contents of star drum trawled from West Hackberry during Summer, Fall, Winter and Spring 1978-79.

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight	WINTER % of Occurrence	WINTER % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Annelida								
Class Polychaeta	3.3	0.7	35.7	17.0				
Phylum Mollusca								
Class Gastropoda								
Creseis acicula			3.6	1.8				
Phylum Arthropoda								
Class Crustacea	3.3	1.3	1.8	0.4	3.4	1.4	4.9	< 0.1
Subclass Ostracoda							1.6	< 0.1
Subclass Copepoda	1.6	1.0	1.8	2.6	1.7	16.6	6.6	0.3
Temora turbinata			23.2		32.8		9.8	
Labidocera aestiva			3.6		65.5		50.8	
Phyllopus sp							3.6	
Acartia tonsa							37.7	
Subclass Malacostraca								
Order Mysidacea			3.6	0.8				
Mysidopsis almyra							1.6	< 0.1
Mysidopsis sp			1.8	0.4	29.3	5.8	6.6	0.2
Order Cumacea							4.9	< 0.1
Order Amphipoda	11.5	3.4	7.1	5.9				
Ampelisca sp	8.2	2.1						
Order Decapoda								
Suborder Natantia	11.5	2.8	12.5	3.0	5.2	0.6	8.2	< 0.1
Family Penaeidae	1.6	0.3	1.8	0.6	1.7	0.1		
Penaeus sp					1.7	0.3	1.6	0.5
Trachypenaeus sp							1.6	< 0.1
Family Sergestidae								
Acetes americanus	9.8	7.1	5.4	0.5				
Lucifer faxoni	3.3	0.5					19.7	< 0.1
Suborder Reptantia					1.7	0.1		
Reptantia zoea							14.8	< 0.1
Section Anomura	1.6	0.1						
Section Brachyura			1.8	0.2				
Callinectes sapidus							3.3	< 0.1
Pinnixa cristata	1.6	0.1						
Phylum Chordata								
Family Engraulidae	1.6	7.7						
Family Carangidae								
Chloroscomborus chrysurus	1.6	1.3						
Fish Material	19.7	29.0	3.6	0.8			13.1	98.3
Fish Scales	9.8	0.6	16.1	2.6	27.6	3.0	1.6	< 0.1
Eggs			10.7	2.4			3.3	< 0.1
Digested Material	95.1	42.0	94.6	61.2	100.0	72.1	90.2	0.5
# of Stomachs Examined	61		56		58		61	
Total Weight (g) of contents	0.714		0.509		0.364		20.412	

dominated winter stomach contents. Spring stomach analyses yielded copepods (*Labidocera aestiva* and *Acartia tonsa*), sergestid shrimp (*Lucifer faxoni*) and reptantian zoea larvae as major food items.

Bighead Searobin

Bighead searobin was the third most abundant species taken at Weeks Island. Older individuals, generally exceeding 80 mm SL, dominated modest summer and fall catches (Fig. 26). Most summer and fall residents appeared ready to spawn (Table 48). Recently spawned individuals ranging from 17 to 69 mm SL comprised the winter stock (Fig. 26). These fish remained in the area through spring and exhibited lengths ranging from 36 to 85 mm. Length-weight relationships for bighead searobin from Weeks Island are presented in Figure 27.

Food habits of bighead searobin taken from Weeks Island varied with season (Table 49). Dominant food items during summer included broken-necked shrimp (*Trachypenaeus similis*) and portunid crabs (namely *Callinectes* spp and *Portunus gibbesii*). Natantian and reptantian decapods became dominant prey during fall. Carid and penaeid shrimp as well as brachyuran and portunid crabs were the most abundant decapods. The copepod *Labidocera aestiva* was the primary food item eaten by winter searobin assemblages. Spring was characterized by a return to reptantian decapods as dominant searobin prey.

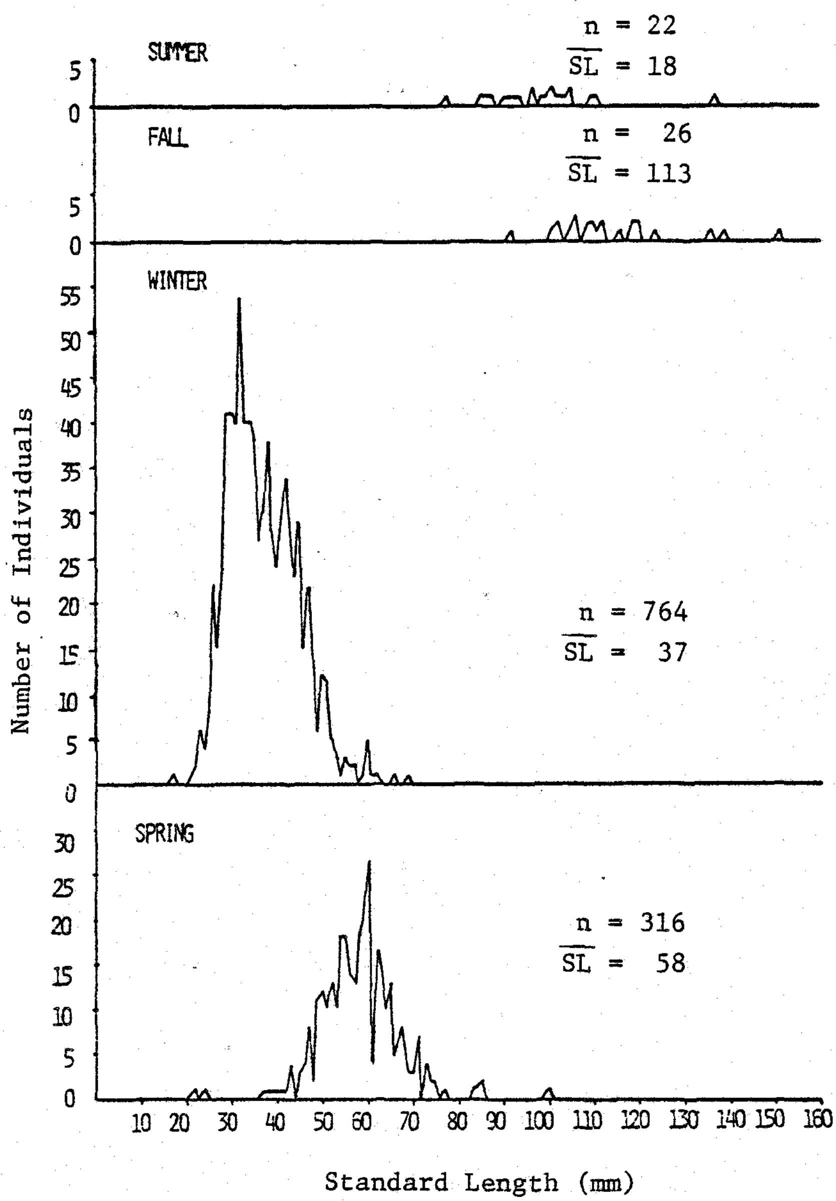


Figure 26. Length-frequency, number (n) of individuals measured and mean standard length ($\overline{SL}$) of bighead searobin trawled at Weeks Island.

Table 48. Gonad stage of maturity for bighead searobin taken from Weeks Island during 1978-1979 seasonal cruises. Classification scheme follows that of Nikolsky (1963).

Gonad Stage		Summer U[1]	Summer F[2]	Summer M[3]	Fall U	Fall F	Fall M	Winter U	Winter F	Winter M	Spring U	Spring F	Spring M	Total U	Total F	Total M
Immature	Number		1					378	308	65	75			453	309	65
	% within stage		100.0					50.3	41.0	8.7	100.0			54.8	37.4	7.9
	% within sex		6.7					100.0	96.0	100.0	100.0			100.0	59.9	40.9
	% of catch		4.6					49.5	40.3	8.5	23.7			40.2	27.4	5.8
Quiescent	Number		3	5					12			155	63		170	68
	% within stage		37.5	62.5					100.0			71.1	28.9		71.4	28.6
	% within sex		20.0	71.4					3.7			90.1	91.3		33.0	42.8
	% of catch		13.6	22.7					1.6			49.1	19.9		15.1	6.0
Ripening	Number		11	1			11		1			17	6		29	18
	% within stage		91.7	8.3			100.0		100.0			73.9	26.1		61.7	38.3
	% within sex		73.3	14.3			61.1		0.3			9.9	8.7		5.6	11.3
	% of catch		50.0	4.6			42.3		0.1			5.4	1.9		2.8	1.6
Ripeness	Number			1		8	7								8	8
	% within stage			100.0		53.3	46.7								50.0	50.0
	% within sex			14.3		100.0	38.9								1.6	5.0
	% of catch			4.6		30.8	26.9								0.7	0.7
Reproduction	Number	NONE TAKEN														
Spent	Number	NONE TAKEN														
Grand Total		0	15	7	0	8	18	378	321	65	75	172	69	453	516	159
% of Grand Total		0.0	1.3	0.6	0.0	0.7	1.6	33.5	28.5	5.8	6.6	15.3	6.1	40.2	45.7	14.1

[1] U denotes sex undetermined
[2] F denotes female
[3] M denotes male

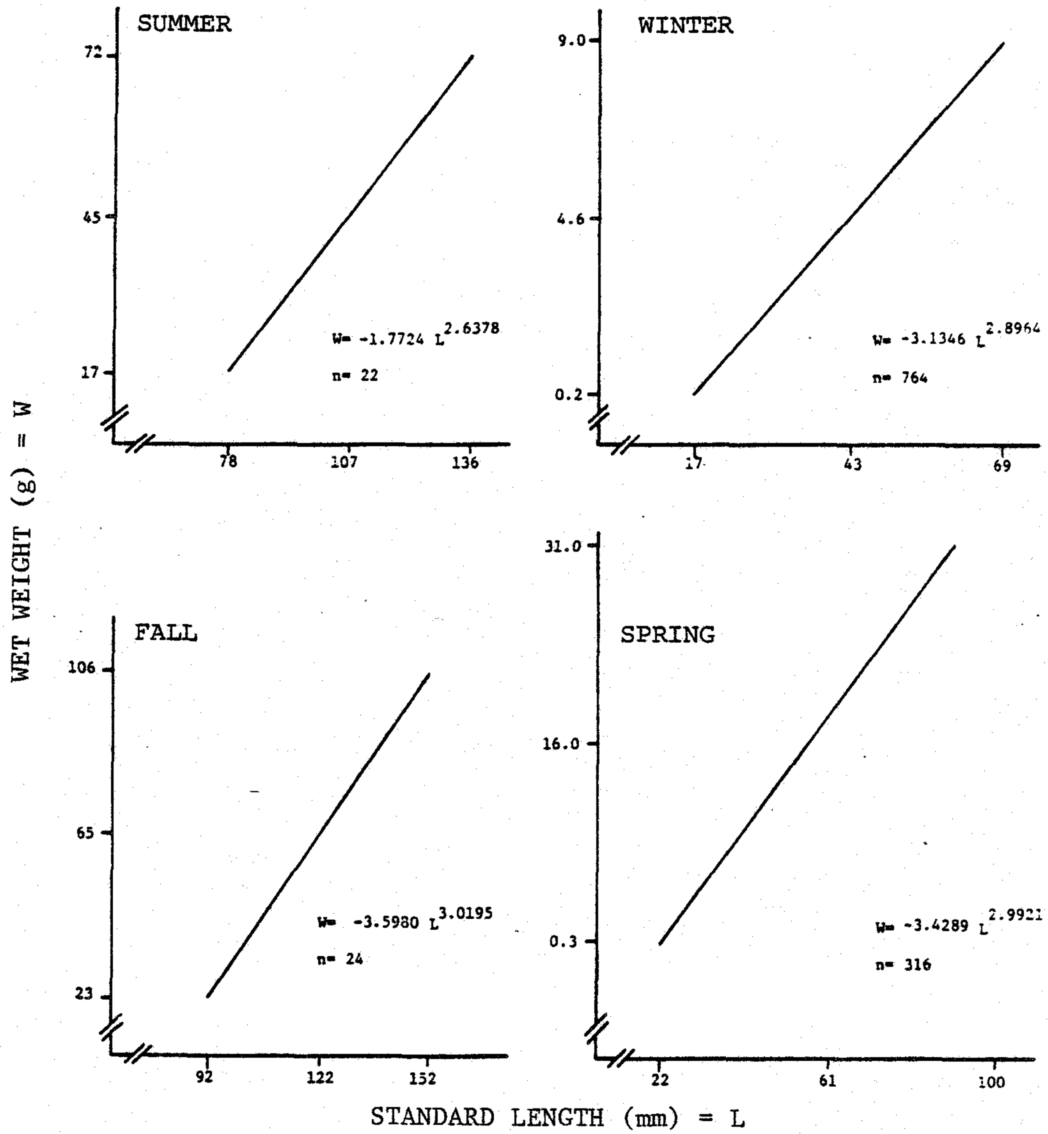


Figure 27. Length-weight relationships of bighead searobin trawled from Weeks Island. Abscissa and ordinate ranges denote length and weight ranges, respectively.

Table 49. Stomach contents of bighead searobin trawled from Weeks Island during Summer, Fall, Winter and Spring 1978-79.

Stomach Contents	SUMMER % of Occurrence	SUMMER % of Dry Weight	FALL % of Occurrence	FALL % of Dry Weight	WINTER % of Occurrence	WINTER % of Dry Weight	SPRING % of Occurrence	SPRING % of Dry Weight
Phylum Annelida								
Class Polychaeta			4.2	1.2			5.0	0.7
Phylum Mollusca								
Class Gastropoda	9.1	1.1					1.7	0.1
Narsarius acutus			8.3	1.5			1.7	0.8
Cantharus cancellarius							1.7	4.1
Mulinia lateralis	9.1	3.2					8.3	0.9
Phylum Arthropoda								
Class Crustacea			4.2	< 0.1	18.0	4.7	1.7	0.2
Subclass Copepoda			4.2	0.8	4.0	13.2		
Temora turbinata					6.0			
Labidocera aestiva					56.0		8.3	0.3
Subclass Malacostraca					2.0	0.2		
Squilla sp			4.2	1.4				
Squilla empusa	4.5	5.2						
Mysidopsis sp					6.0	1.1		
Order Cumacea					2.0	0.2		
Levcon sp							1.7	< 0.1
Order Amphipoda							1.7	< 0.1
Monoculodes sp							3.3	0.3
Suborder Hyperiidea	4.5	< 0.1						
Order Decapoda								
Suborder Natantia			20.8	5.5	20.0	2.5	3.3	0.2
Section Caridea					2.0	0.7	1.7	0.1
Ogyrides limicola	4.5	0.1					3.3	1.0
Leptochella serratorbita			8.3	4.7				
Automate sp	4.5	< 0.1						
Section Penaeidea			4.2	< 0.1				
Sicyonia dorsalis	4.5	4.9	8.3	9.2				
Sicyonia brevirostris			4.2	3.7				
Subfamily Penaeidea	4.5	2.7						
Penaeus sp	9.1	4.0					1.7	0.3
Trachypenaeus similis	13.6	9.7						
Family Sergestidae								
Acetes americanus							3.3	0.1
Lucifer faxoni							1.7	< 0.1
Suborder Reptantia	4.5	< 0.1	29.2	4.6			71.7	26.0
Reptantia Megalops					2.0	0.2	1.7	< 0.1
Reptantia zoea					2.0	0.2		
Section Anomura								
Albunea sp	9.1	0.5	4.2	0.1				
Section Brachyura			4.2	0.9				
Family Leucosiidae			4.2	0.7				
Iliacantha liodactylus	4.5	< 0.1	4.2	3.4				
Family Portinidae	36.4	31.8					26.7	21.5
Callinectes sp							3.3	2.1
Callinectes sapidus	4.5	< 0.1					26.7	7.2
Callinectes similis			4.2	3.6			5.0	0.7
Portunus gibbesii	22.7	10.2						
Portunus spinimanus			4.2	0.3				
Pinnixa sp			4.2	0.3			1.7	0.1
Neopanopeus sp			8.3	1.0				
Osachela sp			4.2	8.9				
Class Insecta								
Order Plecoptera					2.0	0.4		
Fish Material	18.2	1.0	4.2	0.4			1.7	0.2
Fish Scales	4.5	< 0.1	4.2	< 0.1	10.0	1.3		
Digested Material	90.9	25.6	100.0	47.9	96.0	74.8	96.7	26.9
Sand & Sediment					2.0	0.4	1.7	0.2
Fossilized Wood Fragments							36.7	5.9
# stomachs examined	22		24		50		60	
Total dry weight (g) of contents	2.605		1.511		0.448		1.940	

MACRO-CRUSTACEANS

Quarterly trawl sampling at Weeks Island and West Hackberry sites yielded 31120 macro-crustaceans which weighed over 193.3 kilograms and represented 25 species. Sixteen species of crabs, eight species of shrimps and one species of mantis shrimp were collected (Table 50). Combined samples at Weeks Island alone produced 22 species and 15,015 specimens which weighed almost 79.6 kilograms; while at West Hackberry, combined samples produced 21 species and 16105 specimens which weighed over 113.7 kilograms. Seasonal occurrence of species at both sites is given in Table 51. Summer samples yielded the smallest overall catch per effort statistics; while winter samples produced the largest overall catch per effort statistics (Tables 52 and 53).

Summer

Summer trawl tows at Weeks Island produced the lowest yields for any season for both sites. Overall catch per effort was only eight specimens per tow with the mean catch at any one station not exceeding 13 specimens (Table 52). Proposed diffuser station 8 and 2-mile station 10 produced the smallest catches per effort (4.7 and 5.3 specimens/tow, respectively) while 5-mile stations 2 and 14 yielded the largest catches per effort (12.7 and 11.3 specimens/tow, respectively). Number of species taken at each station ranged from four at station 10 to eight at station 14 with an overall site total of ten species. Combined tows yielded 120 specimens which weighed 3224.9 g (Tables 54 and 55).

Abundance statistics for West Hackberry show that summer trawl tows yielded the lowest overall catch per effort (39.5 specimens/tow) for any season at that site (Table 52). They, however, exhibited a five fold increase over the Weeks Island total summer yield. Smallest

TABLE 50. Common and scientific names of macro-crustaceans trawled from Weeks Island and West Hackberry brine disposal sites.

Common Name	Scientific Name
White shrimp	*Penaeus setiferus*
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*Penaeus duorarum*
Broken-necked shrimp (#1)	*Trachypeneus similis*
Broken-necked shrimp (#2)	*Trachypeneus constrictus*
Seabob shrimp	*Xiphopeneus krφyeri*
Rock shrimp	*Sicyonia dorsalis*
Striped shrimp	*Hippolysmata wurdemanni*
Blue crab	*Callinectes sapidus*
Lesser blue crab	*Callinectes similis*
Portunid crab (#1)	*Portunus gibbesii*
Portunid crab (#2)	*Portunus spinicarpus*
Lady crab	*Ovalipes ocellatus floridanus*
Spider crab (#1)	*Libinia dubia*
Spider crab (#2)	*Libinia emarginata*
Purse crab (#1)	*Persephona crinita*
Purse crab (#2)	*Persephona mediterranea*
Calico crab	*Hepatus epheliticus*
Box crab	*Calappa sulcata*
Stone crab	*Menippe mercenaria*
Mud crab	*Panopeus turgidus*
Narrow mud crab	*Hexapanopeus angusifrons*
Long-wristed hermit crab	*Pagurus longicarpus*
Hermit crab	*Pagurus pollicaris*
Mantis shrimp	*Squilla empusa*

TABLE 51. Seasonal occurrence of macro-crustaceans at Weeks Island and West Hackberry brine disposal sites.

Species	Weeks Island Su	F	W	Sp	West Hackberry Su	F	W	Sp
White shrimp		X	X	X	X	X	X	X
Brown shrimp	X	X	X	X	X	X	X	X
Pink shrimp				X		X	X	X
Broken-necked shrimp (#1)	X	X	X	X		X	X	X
Broken-necked shrimp (#2)	X	X	X	X		X	X	X
Seabob shrimp			X			X	X	X
Rock shrimp			X	X			X	
Striped shrimp			X					
Blue crab	X	X	X	X	X	X	X	X
Lesser blue crab	X	X		X	X	X	X	X
Portunid crab (#1)	X	X	X	X		X	X	X
Portunid crab (#2)							X	X
Spider crab (#1)				X				X
Spider crab (#2)	X		X	X	X		X	X
Purse crab (#1)				X		X	X	X
Purse crab (#2)	X	X	X	X		X	X	X
Lady crab	X		X					
Calico crab			X	X		X	X	X
Box crab				X				
Stone crab			X					
Mud crab						X		
Narrow mud crab			X				X	
Long-wristed hermit crab								X
Hermit crab			X	X				X
Mantis shrimp	X	X	X	X	X	X	X	X
# Species/Season	10	9	17	17	6	14	17	18

TABLE 52. Mean number of macro-crustaceans per trawl tow at Weeks Island and West Hackberry stations during seasonal sampling cruises.

Weeks Island Stations

Seasons	2	6	8	10	14	Total
Summer	12.7	6.0	4.7	5.3	11.3	8.0
Fall	56.6	49.0	33.3	49.3	23.0	42.2
Winter	451.3	721.0	1345.0	1350.0	576.3	888.7
Spring	91.7	32.3	49.3	106.0	27.3	61.3
All Seasons	153.1	200.1	358.1	377.7	159.5	250.0

West Hackberry Stations

Seasons	2	6	8	10	14	Total
Summer	51.3	68.0	26.0	28.0	24.0	39.5
Fall	43.0	65.6	83.3	49.0	48.6	57.9
Winter	450.0	801.3	632.7	734.3	1475.7	818.8
Spring	94.0	100.0	146.7	326.3	120.3	157.5
All Seasons	159.6	258.7	222.7	284.4	417.2	268.5

TABLE 53. Mean biomass (g) of macro-crustaceans per trawl tow at Weeks Island and West Hackberry stations during seasonal sampling cruises.

Weeks Island
Stations

Seasons	2	6	8	10	14	Total
Summer	89.3	126.3	376.5	38.4	444.3	215.0
Fall	1837.2	1377.7	1046.3	365.0	856.1	1096.5
Winter	2106.4	3751.6	4951.0	4236.0	2100.2	3429.0
Spring	847.5	213.2	556.0	1137.1	71.4	565.0
All Seasons	1220.1	1367.2	1732.5	1444.1	868.0	1326.4

West Hackberry
Stations

Seasons	2	6	8	10	14	Total
Summer	499.8	1058.0	497.0	440.7	682.4	635.6
Fall	377.4	1100.2	1513.7	653.8	599.5	840.9
Winter	3018.2	2645.3	3015.1	3099.4	6720.2	3699.6
Spring	1397.7	3319.5	3165.0	2279.1	1859.8	2404.2
All Seasons	1323.3	2030.8	2047.7	1618.3	2465.5	1897.0

TABLE 54. Number of individuals, total catch and mean number of individuals of macro-crustaceans per trawl tow from Weeks Island and West Hackberry stations during Summer of 1978.

	Weeks Island						West Hackberry					
Species	2	6	8	10	14	Total	2	6	8	10	14	Total
White shrimp						0	13	9	13	14	5	54
Brown shrimp	19	8	5	5	6	43	109	107	50	47	36	349
Broken-necked shrimp (#1)				2		2						0
Broken-necked shrimp (#2)	2		2	3	2	9						0
Blue crab		1	4		4	9	1	13	4	1	7	26
Lesser blue crab	2		1	6	5	14	31	75	10	20	24	160
Portunid crab (#1)	13	6	2		14	35						0
Spider crab (#2)		1			1	2			1			1
Lady crab		2			1	3						0
Purse crab (#2)	1					1						0
Mantis shrimp	1				1	2				2		2
Total Catch	38	18	14	16	34	120	154	204	78	84	72	592
Mean #/tow	12.7	6.0	4.7	5.3	11.3	8.0	51.3	68.0	26.0	28.0	24.0	39.5

TABLE 55. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from Weeks Island stations during Summer of 1978.

Species	Stations 2	6	8	10	14	Total
Brown shrimp	192.4	87.2	53.6	64.8	71.0	469.0
Broken-necked shrimp (#1)				4.8		4.8
Broken-necked shrimp (#2)	1.1		2.4	9.7	2.0	15.2
Blue crab		248.5	1052.8		1076.1	2377.4
Lesser blue crab	7.2		11.8	36.0	31.3	86.3
Portunid crab (#1)	59.2	23.1	8.9		68.2	159.4
Spider crab (#2)		3.9			72.6	76.5
Purse crab (#2)	1.0					1.0
Lady crab		16.3			3.3	19.6
Mantis shrimp	7.0				8.7	15.7
Total catch	267.9	379.0	1129.5	115.3	1333.2	3224.9
Mean wt./tow	89.3	126.3	376.5	38.4	444.4	215.0

catch came from 5-mile station 14 while 5-mile station 2 and 2-mile station 6 produced the largest catches. Six species were taken overall at West Hackberry during summer. Combined tows produced 592 specimens which weighed 9533.7 g (Tables 54 and 56).

Summer trawl tows at the Weeks Island site also produced the smallest total catch per effort of biomass (215 g/tow) for both sites for all seasons (Table 53). Station 10 produced the smallest yield (38.4 g/tow) at that site while 5-mile station 14 produced the highest (444.4 g/tow) yield (Table 53).

Summer mean biomass statistics at West Hackberry (635.6 g/tow) are the lowest at that site for any season, but show a three fold increase over the Weeks Island mean yield. At West Hackberry, 2-mile station 10 had the lowest summer biomass (440.7 g/tow) while 2-mile station 6 had the highest [1058.0 g/tow (Table 56)].

The most abundant species at Weeks Island was brown shrimp (Penaeus aztecus) which accounted for 35.8% of the total catch (Table 57). Station 2 yielded more than twice the number of brown shrimps as the other stations (Table 54). Portunid crabs (Portunus gibbesii) followed brown shrimp in abundance (29.2%). White shrimp (Penaeus setiferus) were absent from summer Weeks Island catches.

Blue crabs (Callinectes sapidus) dominated total biomass statistics at Weeks Island, composing 73.7% of the total catch (Table 57). Brown shrimp which accounted for 14.5% of the total catch was second. Blue crabs were taken at only three stations (6, 8 and 14), accounting for most of the biomass at those stations (Tables 54 and 55). Brown shrimp dominated the remaining stations.

Brown shrimp, which composed 59% of the total yield, was also the

TABLE 56. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from West Hackberry stations during Summer of 1978.

Species	Stations 2	6	8	10	14	Total
White shrimp	424.6	299.6	451.9	512.2	172.4	1860.7
Brown shrimp	698.1	503.8	312.8	282.8	225.1	2022.6
Blue crab	238.7	2080.0	682.8	197.6	1533.4	4732.5
Lesser blue crab	137.9	290.6	43.0	312.7	116.4	900.6
Spider crab (#2)			0.4			0.4
Mantis shrimp				16.9		16.9
Total catch	1499.3	3174.0	1490.9	1322.2	2047.3	9533.7
Mean wt./tow	499.8	1058.0	497.0	440.7	682.4	635.6

TABLE 57. Summer composition of macro-crustaceans at the Weeks Island site: species in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total Weight	%(Wt.)	Rank
Brown shrimp	43	35.8	469.0	14.5	2
Portunid crab (#1)	35	29.2	159.4	4.9	3
Lesser blue crab	14	11.7	86.3	2.7	4
Blue crab	9	7.5	2377.4	73.7	1
Broken-necked shrimp (#2)	9	7.5	15.2	0.5	8
Lady crab	3	2.5	19.6	0.6	6
Broken-necked shrimp (#1)	2	1.7	4.8	0.2	9
Spider crab (#2)	2	1.7	76.5	2.4	5
Mantis shrimp	2	1.7	15.7	0.5	7
Purse crab (#2)	1	0.8	1.0	> 0.1	10
Total	120		3224.9		

most abundant macro-crustacean at West Hackberry (Table 58). The lesser blue crab (Callinectes similis) and white shrimp were next in abundance, accounting for 27.0% and 9.1% of the total catch, respectively. Most of the brown shrimp were taken at 2-mile station 6 and 5-mile station 2 (Table 54). With the exception of 5-mile station 14, white shrimp were fairly evenly distributed among the five stations.

As was the case at Weeks Island, blue crabs dominated West Hackberry catches for biomass. They composed half (49.6%) of the total catch by weight (Table 58). The larger catch of blue crabs at 2-mile station 6, in comparison to the other four stations, resulted in the high biomass yield (2080 g) at that station (Tables 54 and 56). Station 14 was similarly affected. White shrimp almost equaled brown shrimp in summer biomass at the West Hackberry site with 19.5% and 21.2% of the total catch, respectively (Table 58).

The Weeks Island stations generally produced more species and higher species diversity values than did those at West Hackberry (Figures 28 and 29). Ten species were trawled at Weeks Island. The mean number per station was 6.6 specimens. Species diversity indices ranged from 0.80 to 1.20 with the mean being 1.05. Highest diversity and number of species were recorded from station 14. Station 10 produced the fewest number of species and lowest diversity. Proposed diffuser station 8 was about average.

Only six species were recorded from the West Hackberry site, less than one half that recorded for fall. This was the lowest number for any season. Mean number for all stations was 4.4. Species diversity indices ranged from 0.77 to 1.01, with the mean being 0.90. Highest diversity indices were recorded from stations 6 and 10. Station 10 also

TABLE 58. Summer composition of macro-crustaceans at the West Hackberry site: species in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total weight	%(Wt.)	Rank
Brown shrimp	349	59.0	2022.6	21.2	2
Lesser blue crab	160	27.0	900.6	9.4	4
White shrimp	54	9.1	1860.7	19.5	3
Blue crab	36	4.4	4732.5	49.6	1
Mantis shrimp	2	0.3	16.9	0.2	5
Spider crab (#2)	1	0.2	0.4	> 0.1	6
Total	592		9533.7		

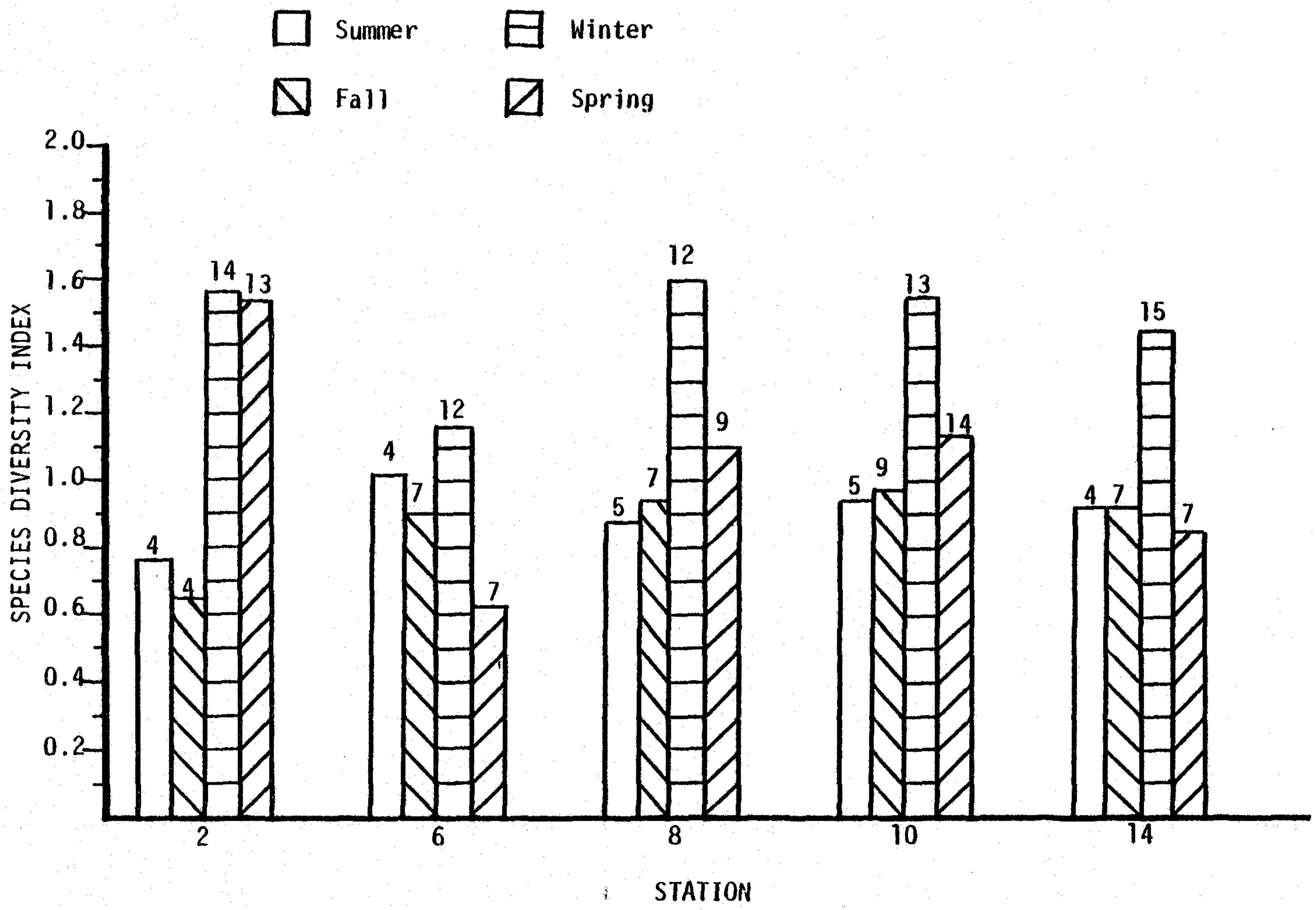


Figure 28. Species diversity indices and number of species for macro-crustacean trawled from West Hackberry sites during seasonal cruises.

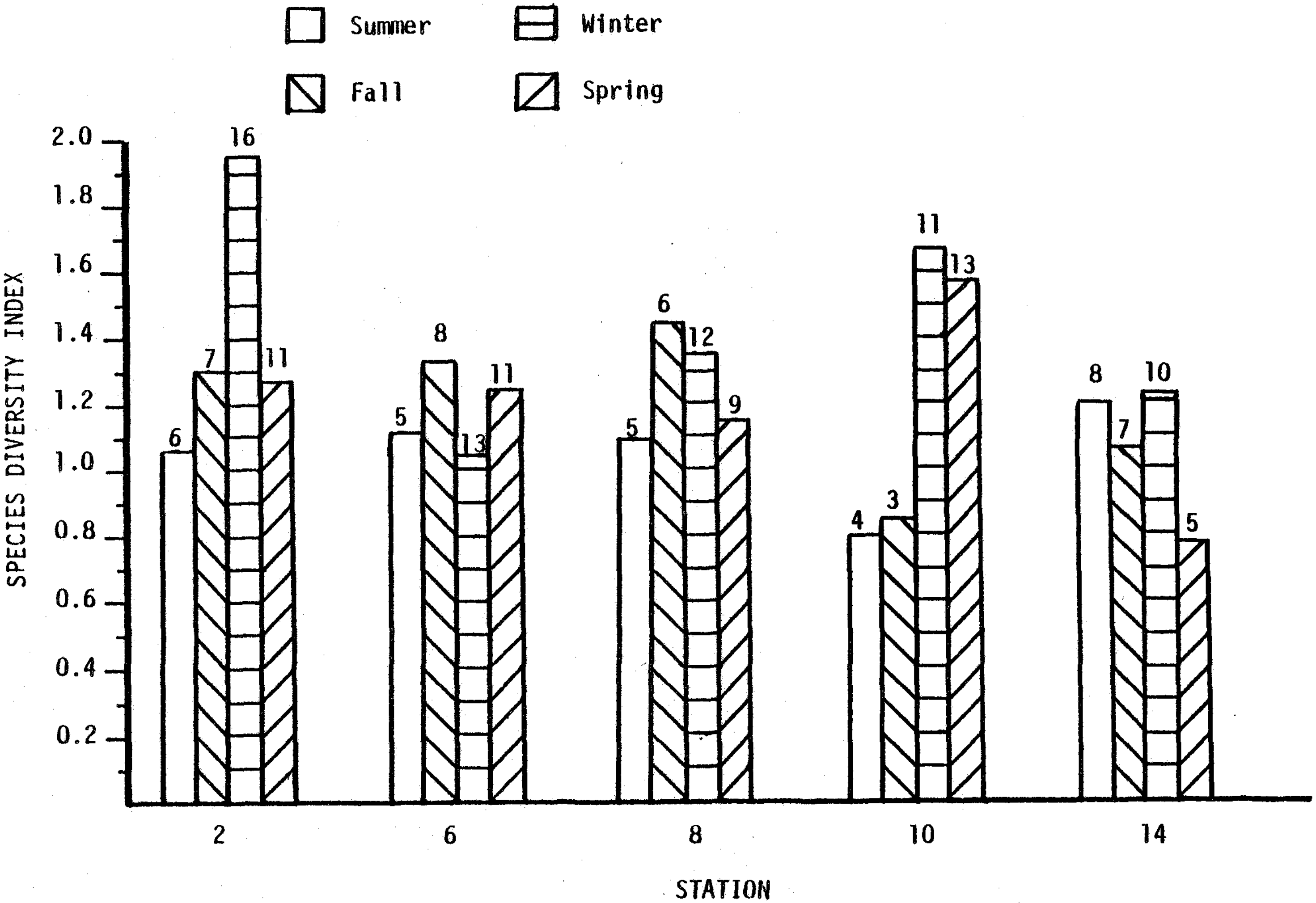


Figure 29. Species diversity indices and number of species for macro-crustaceans trawled from Weeks Island sites during seasonal cruises.

produced the largest number of species. Station 2 produced the fewest species and lowest diversity. Station 8, as at Weeks Island, was about average.

Total length of brown shrimp taken at Weeks Island ranged from 93 to 135 mm and averaged 112.6 mm. All had undeveloped gonads. Blue crabs ranged from 159 to 194 mm in carapace width and averaged 171 mm. Of nine females examined for gonad development, 6 (66.6%) were ripe (sponge) and 3 (33.3%) were spent.

White shrimp from the West Hackberry site ranged in total length from 139 to 205 mm with a mean of 165.8 mm. Of the 17 females examined for gonad development, one (5.9%) was undeveloped, five (29.5%) were developing (yellow) and eleven (64.6%) were developed (ripe or green). Gonads of three (6%) white shrimp were heavily parasitised by the sporozoan *Thelohania* sp. Total length of brown shrimp from West Hackberry ranged from 58 to 139 mm and averaged 89 mm, somewhat smaller than those from Weeks Island. All had undeveloped gonads. Carapace width of blue crabs ranged from 104 to 189 mm and averaged 150.3 mm. Of 19 females, 2 (10.5%) had developing gonads, 11 (58%) were carrying eggs and 6 (31.5%) were spent.

Fall

Abundance figures show that fall catches ranked third on a seasonal basis at both sites (Table 52). Combined tows produced 634 specimens at Weeks Island which weighed over 16.4 kg and were composed of nine species. Overall catch per effort was about 42 specimens per tow. Largest mean yield (56.6 specimens/tow) was taken at 5-mile station 2 while 5-mile station 14 produced the smallest (23.0 specimens/tow). Proposed diffuser station 8 also produced low numbers of macro-crustaceans

(33.3 specimens/tow).

Combined tows at West Hackberry yielded 864 specimens which weighed over 12.6 kg and represented 14 species. Five-mile station 2 produced the lowest catch per effort yield, both in abundance (43.0 specimens/tow) and number of species taken (Table 59). Largest catch per effort (83.3 specimens/tow) occurred at proposed diffuser station 8. Overall mean catch per effort for abundance at West Hackberry (57.9 specimens/tow) exceeded that of the Weeks Island site (42.3 specimens/tow) but not by the wide difference recorded during the previous season.

Fall produced the second highest biomass figure (1096.5 g/tow) for the Weeks Island site (Table 53). That season's yield was over five times greater than that of summer. Five-mile station 2 produced the highest biomass figure (1837.2 /tow) while 2-mile station 10 produced the lowest (365.0 g/tow). The bulk of the biomass at Weeks Island was due to blue crabs [Callinectes sapidus (Tables 59 and 60)]. Station 10 differed markedly from the other stations, however, in that no blue crabs were taken there. That station also produced more brown shrimp (Penaeus aztecus) than the other stations.

Biomass statistics for West Hackberry, like those for abundance, ranked third on an overall seasonal basis (Table 53). However, unlike other seasons, total mean biomass yield (840.9 g/tow) was below that of the Weeks Island site (1096.5 g/tow). Mean yields at West Hackberry ranged from 337.4 g/tow at 5-mile station 2 to 1513.7 g/tow at proposed diffuser station 8. The large yield at station 8 was due primarily to a large number of white shrimp (Penaeus setiferus) the biomass of which was more than eight times that of the same species at station 2 (Table 61).

Brown shrimp was the most abundant macro-crustacean at the Weeks

TABLE 59. Number of individuals, total catch and mean number of individuals of macro-crustaceans per trawl tow from Weeks Island and West Hackberry stations during Fall 1978.

	Weeks Island						West Hackberry					
Species	2	6	8	10	14	Total	2	6	8	10	14	Total
White shrimp					7	7	17	142	136	47	44	386
Brown shrimp	71	15	36	78	27	227	102	22	91	79	88	382
Pink shrimp						0			3	1	2	6
Broken-necked shrimp (#1)	2	1		8	2	13			3	5	5	13
Broken-necked shrimp (#2)	30	5	7	62	8	112					2	2
Seabob shrimp						0		20				20
Blue crab	29	25	18		15	87		2				2
Lesser blue crab	4	12	6		4	26		1	1	2		4
Portunid crab (#1)	16	80	27		6	129	9	9	14	7	4	43
Purse crab (#1)						0				4		4
Purse crab (#2)		1				1				1		1
Calico crab						0				1		1
Mud crab						0	1					1
Mantis shrimp	18	8	6			32		1	2		1	4
Total catch	170	147	100	148	69	634	129	197	250	147	146	869
Mean #/tow	56.6	49.0	33.3	49.3	23.0	42.3	43.0	65.6	83.3	49.0	48.6	57.9

TABLE 60. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from Weeks Island stations during Fall 1978.

Species	Stations 2	6	8	10	14	Total
White shrimp					97.1	97.1
Brown shrimp	878.1	165.2	434.6	980.9	321.1	2779.9
Broken-necked shrimp (#1)	2.7	2.5		14.6	4.0	23.8
Broken-necked shrimp (#2)	34.1	4.9	9.5	99.6	8.7	156.8
Blue crab	3992.8	3530.1	2447.1		2063.5	12033.5
Lesser blue crab	431.2	123.0	43.4		38.4	636.0
Portunid crab (#1)	75.7	263.8	129.5		35.4	504.4
Purse crab (#1)		1.5				1.5
Mantis shrimp	96.9	42.3	74.7			213.9
Total catch	5511.5	4133.3	3138.8	1095.1	2568.2	16446.9
Mean wt./tow	1837.2	1377.8	1046.3	365.0	856.1	1096.5

TABLE 61. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from West Hackberry stations during Fall 1978.

	Stations					
Species	2	6	8	10	14	Total
White shrimp	466.5	3043.8	3948.5	1380.7	1136.5	9976.0
Brown shrimp	530.5	88.5	547.5	541.8	628.9	2337.2
Pink shrimp			11.7	4.3	7.3	23.3
Broken-necked shrimp (#1)			1.4	3.4	4.5	9.3
Broken-necked shrimp (#2)					0.6	0.6
Seabob shrimp		99.2				99.2
Blue crab		37.5				37.5
Lesser blue crab		8.9	9.4	8.4		26.7
Portunid crab (#1)	15.0	21.4	13.5	15.4	15.2	80.5
Purse crab (#1)				4.0		4.0
Purse crab (#2)				0.9		0.9
Calico crab				2.5		2.5
Mud crab	0.2					0.2
Mantis shrimp		1.4	9.2		5.5	16.1
Total catch	1012.2	3300.7	4541.2	1961.4	1798.5	12614.0
Mean wt./tow	337.4	1100.2	1513.7	653.8	599.5	840.9

Island site, accounting for 35.8% of the total number of macro-crustaceans taken (Table 62). Largest yields were taken at stations 2 and 10. Portunid crab [#1 (Portunus gibbesii)] and the broken-necked shrimp [#2 (Trachypeneus constrictus)] ranked second and third in abundance. Brown shrimp ranked second in biomass. The bulk of the biomass (73.2%) was composed of blue crabs (Callinectes sapidus) which increased in numbers from the previous season. Five-mile station 14 was the only station at Weeks Island which yielded white shrimp (Table 59).

West Hackberry site during the fall season appears to be an important area for both white and brown shrimp, which ranked first and second, respectively, in both abundance and biomass (Table 63). Together, both species accounted for 88.4% of the total number of macro-crustaceans taken and 97.6% of the total biomass. White shrimp composed 44.4% of the total yield numerically and 79.1% of the total biomass. Largest catches occurred at stations 6 and 8 while smallest occurred at station 2. In contrast, the largest yield of brown shrimp was at station 2 while the smallest was at station 6 (Table 59). Brown shrimp composed 44% of the total yield at West Hackberry and 18.5% of the total biomass. West Hackberry during fall produced the largest yield of brown shrimp for any season for both sites and the second largest yield of white shrimp for any season at both sites. Weeks Island during winter exceeded fall West Hackberry for white shrimp. Blue crabs declined considerably in numbers from the previous season.

Except for station 10, species diversity indices at Weeks Island were, as in summer, larger than those at West Hackberry (Figures 28 and 29). Diversity indices ranged from 0.86 to 1.44, with the mean being 1.20. A total of nine species was recorded at Weeks Island. This was

TABLE 62. Fall composition of macro-crustaceans at the Weeks Island site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total Weight	%(Wt.)	Rank
Brown shrimp	227	35.8	2779.9	16.8	2
Portunid crab (#1)	129	20.3	504.4	3.1	4
Broken-necked shrimp (#2)	112	17.7	156.8	1.0	6
Blue crab	87	13.7	12033.5	73.2	1
Mantis shrimp	32	5.0	213.9	1.3	5
Lesser blue crab	26	4.1	636.0	3.9	3
Broken-necked shrimp (#1)	13	2.1	23.8	0.1	8
White shrimp	7	1.1	97.1	0.6	7
Purse crab (#2)	1	0.2	1.5	> 0.1	9
Total	634		16446.9		

TABLE 63. Fall composition of macro-crustaceans at the West Hackberry site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total weight	%(Wt.)	Rank
White shrimp	386	44.4	9976.0	79.1	1
Brown shrimp	382	44.0	2337.2	18.5	2
Portunid crab	43	4.9	80.5	0.6	4
Seabob shrimp	20	2.3	99.2	0.8	3
Broken-necked shrimp (#1)	13	1.5	9.3	> 0.1	9
Pink shrimp	6	0.7	23.3	0.2	7
Lesser blue crab	4	0.5	26.7	0.2	6
Mantis shrimp	4	0.5	16.1	0.1	8
Purse crab (#1)	4	0.5	4.0	> 0.1	10
Blue crab	2	0.2	37.5	0.3	5
Broken-necked shrimp (#2)	2	0.2	0.6	> 0.1	13
Calico crab	1	0.1	2.5	> 0.1	11
Purse crab (#2)	1	0.1	0.9	> 0.1	12
Mud crab	1	0.1	0.2	> 0.1	14
Total	869		12614.0		

the lowest number for this site during any season. The mean number per station was 6.2. Station 6 produced the largest number of species (8). Highest species diversity occurred at proposed diffuser station 8. Station 10 produced only three species, the lowest number for any station during all seasons at both sites, and the lowest species diversity (0.86). Number of species taken at the other stations ranged from six to eight (Table 59).

Species diversity indices at West Hackberry were similar to those recorded for summer (Figures 28 and 29). Diversity indices ranged from 0.64 to 0.98. The mean for the five stations was 0.70. The number of species taken was also low. The mean number of species for the site was 6.8. Two-mile station 10 yielded the largest number of species (9) and highest diversity value. Five-mile station 2 produced the fewest number of species (4) and lowest diversity. The remaining stations were about average.

White shrimp from Weeks Island ranged from 100 to 133 mm in total length and averaged 116.3 mm. Of the seven specimens taken, four were females and all had developing (yellow) ovaries. Brown shrimp ranged from 91 to 146 mm and averaged 113.5 mm. Forty-eight percent of the trawled specimens were female. Of the 94 females examined for gonadal development, 35 (37.2%) had undeveloped ovaries, 53 (56.4%) had developing (yellow) ovaries and six (6.4%) had ripe (green) ovaries. Blue crabs from Weeks Island ranged in carapace width from 125 to 173 mm with a mean of 148.1 mm. Of the 73 female specimens examined for reproductive stage, 3 (4%) bore egg masses (sponges) while 70 (96%) had already shed their eggs (spent).

At the West Hackberry site, white shrimp ranged from 80 to 191 mm in total length (mean 151.8 mm). Forty-seven percent of the trawled specimens were female. Of the 141 females examined for gonadal development, 71 (50.4%) had undeveloped ovaries, 36 (25.5%) had developing (yellow) ovaries and 34 (24.1%) had ripe (green) ovaries. Brown shrimp averaged 94.6 mm in total length and ranged from 62 to 140 mm. Females accounted for 50.5% of the total number. One hundred seventy-one (96.6%) of the 177 females examined had undeveloped ovaries. Developing (yellow) ovaries were found in six (3.4%). The six pink shrimp (Penaeus duorarum) collected at West Hackberry ranged from 63 to 88 mm in total length (mean 78.8). All of the four female specimens examined had undeveloped ovaries. The two blue crabs collected were 65 and 81 mm in carapace width; both were immature.

Winter

Winter trawl tows easily produced the largest yields of any season for both sites. Combined tows at Weeks Island produced 13341 specimens which weighed over 51.4 kg and represented 17 species. Total catch per effort at Weeks Island was 888.7 specimens/tow which was almost 15 times greater than spring, the closest season in yield, and over 100 times greater than that of summer (Table 52). Winter was the only season in which total abundance yield at Weeks Island exceeded that of the West Hackberry site. The proposed diffuser station 8 and 2-mile station 10 produced the largest catch per effort yields (1345.0 and 1350.0 specimens/tow, respectively) while 5-mile station 2 produced the smallest (451.3 specimens/tow). The large catch at station 8 was due primarily to large numbers of white (Penaeus setiferus) and seabob shrimps (Xiphopeneus krøxeri), while at station 10 it was due primarily to seabob shrimp alone.

At West Hackberry, combined trawl tows yielded 12282 specimens which weighed over 55.4 kg and consisted of 17 species. Total yield per effort (818.8 specimens/tow) was not as pronounced in comparison to the other seasons at that site as it was for the Weeks Island site (Table 52). Abundance yield at West Hackberry was over five-times greater than spring and over 20 times greater than that of summer. Five-mile station 14 produced the greatest yield per effort (1475.7 specimens/tow) while 5-mile station 2 produced the least (450.0 specimens/tow). Most of the catch at station 14 was composed of broken-necked shrimp [#1 (Trachypeneus similis)] and portunid crab [#1 (Portunus gibbesii)] whose numbers greatly exceeded those at the other stations (Table 64). Fourteen species were reported from station 14 while twelve were reported from stations 6 and 8.

Biomass yield per effort at Weeks Island exceeded that of other seasons but not by the wide margins observed for abundance (Table 53). Total biomass yield per effort at Weeks Island was 3429.0 g/tow, three times greater than that for fall (1096.5 g/tow), the second ranking season in biomass, and 16 times greater than summer (215.0 g/tow). Biomass at Weeks Island, unlike abundance, did not exceed that of West Hackberry, but they were approximate (3429.0 g/tow compared to 3,699.6 g/tow). Proposed diffuser station 8 produced the largest yield per effort (4,951.0 g/tow). The least yield per effort was produced at 5-mile station 14 (2,100.2 g/tow). Winter Weeks Island catches differed markedly from other seasons in that large numbers of white shrimp (Penaeus setiferus) were trawled. This season and site yielded the largest biomass of white shrimp of any season for both sites. With the exception of station 10, white shrimp exceeded the other species in biomass (Table 65). Seabob shrimp was the largest biomass producing species at that station with a

TABLE 64. Number of individuals, total catch and mean number of individuals of macro-crustaceans per trawl tow from Weeks Island and West Hackberry stations during Winter 1979.

	Weeks Island						West Hackberry					
Species	2	6	8	10	14	Total	2	6	8	10	14	Total
White shrimp	229	1151	1356	373	435	3544	208	749	92	100	513	1662
Brown shrimp	15	9	13	11	19	67	3	5	1	1	8	18
Pink shrimp						0				4		4
Broken-necked shrimp (#1)	326	222	344	751	34	1677	592	591	851	915	1433	4382
Broken-necked shrimp (#2)	244	247	472	126	307	1396	2	2		24	71	99
Seabob shrimp	253	224	1665	2650	885	5677	169	857	269	299	179	1773
Rock shrimp	9		10	36		55	8	5	11	35	9	68
Striped shrimp	1					1						0
Blue crab	3	19				22	2	19	2		20	43
Lesser blue crab						0			1		2	3
Portunid crab (#1)	138	249	83	24	30	524	309	136	358	419	1454	2676
Portunid crab (#2)						0					14	14
Spider crab (#2)	11	10	9	12	1	43	30	6	19	10	18	83
Purse crab (#1)						0	3	1			3	7
Purse crab (#2)	18	1		1		20	6		5	22	1	34
Lady crab	1	2	4		5	12						0
Calico crab	1				1	2	1			3	1	5
Stone crab		2				2						0
Narrow mud crab	5		1			6	1	1	1	1		4
Hermit crab	4	1	1	14		20						0
Mantis shrimp	96	26	77	62	12	273	16	32	288	370	701	1407
Total Catch	1354	2163	4035	4060	1729	13341	1350	2404	1898	2203	4427	12282
Mean #/tow	451.3	721.0	1345.0	1353.3	576.3	4889.4	450.0	801.3	632.7	734.3	1475.7	818.8

TABLE 65. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from Weeks Island stations during Winter 1979.

Species	Stations 2	6	8	10	14	Total
White shrimp	2605.5	6935.5	9252.9	3678.5	3469.1	25401.5
Brown shrimp	55.6	27.5	53.0	42.1	67.0	254.2
Broken-necked shrimp (#1)	311.3	175.7	345.7	1073.2	77.7	1983.6
Broken-necked shrimp (#2)	274.4	279.5	576.2	254.9	416.5	1801.5
Seabob shrimp	622.0	380.9	3367.7	6652.6	1837.2	12860.4
Rock shrimp	4.4		7.8	28.1		40.3
Striped shrimp	0.5					0.5
Blue crab	468.6	2778.0				3246.6
Portunid crab (#1)	290.6	547.2	183.0	45.5	54.4	1120.7
Spider crab (#2)	687.7	443.0	490.6	399.7	267.6	2288.6
Purse crab (#2)	108.9	1.9		1.2		112.0
Calico crab	6.5				4.0	10.5
Lady crab	7.4	0.7	8.9		3.0	20.0
Stone crab		4.5				4.5
Narrow mud crab	2.5		0.3			2.8
Hermit crab	10.5	6.0	1.3	14.7		32.5
Mantis shrimp	862.7	214.5	565.6	517.4	104.0	2264.2
Total catch	6319.1	11254.9	14853.0	12707.9	6300.5	51435.4
Mean wt./tow	2106.4	3751.6	4951.0	4236.0	2100.2	3429.0

sizable portion of the biomass at stations 8 and 14 composed of seabob shrimp also. Weeks Island site during winter is apparently an important area for shrimp.

At West Hackberry, 5-mile station 14 produced the largest biomass per effort yield, being over twice that of the other stations. Several species contributed significantly to the biomass at station 14 with mantis shrimp (Squilla empusa) composing an unusually large amount (6186.4 g/tow) compared to other stations and seasons (Table 66). The smallest yield per effort was produced by 2-mile station 6 (2645.3 g/tow). Station 6, however, yielded a greater weight of white and seabob shrimp and the second largest of brown shrimp (Penaeus aztecus) than the other stations. Winter production of both white and brown shrimp was below that taken during fall at this site. Winter was also the only season in which white shrimp biomass did not exceed that of Weeks Island. Seabob shrimp yield at West Hackberry for winter, however, was much larger than that taken during other seasons (Table 66).

Seabob shrimp replaced brown shrimp as the most abundant macro-crustacean at Weeks Island (Table 67). White shrimp was the second most abundant species (26.6%). Both species of broken-necked shrimp together composed over 23% of the total catch. In biomass, white shrimp was the dominant species, with almost twice the weight (24401.5 g) as the second ranked seabob shrimp. These two species composed 75% of the total biomass. White and seabob shrimps both replaced blue crabs (Callinectes sapidus) in biomass ranking from the previous two seasons. Winter also produced the largest mantis shrimp yield of any season at Weeks Island.

Broken-necked shrimp [#1 (Trachypeneus similis)] was the most

TABLE 66. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from West Hackberry stations during Winter 1979.

	Stations					
Species	2	6	8	10	14	Total
White shrimp	1016.7	2761.7	635.5	884.3	2021.6	7319.2
Brown shrimp	8.8	14.3	2.5	2.7	23.2	51.5
Pink shrimp				16.0		16.0
Broken-necked shrimp (#1)	672.7	512.8	1086.2	1018.1	1524.5	4814.3
Seabob shrimp	394.1	1555.4	580.6	688.3	277.6	3496.0
Rock shrimp	10.0	2.9	8.2	32.5	7.0	60.6
Blue crab	245.5	1099.2	214.3		3268.4	4827.4
Lesser blue crab			3.4		29.8	33.2
Portunid crab (#1)	903.6	320.6	896.7	1300.1	3590.8	7011.8
Portunid crab (#2)					64.2	64.2
Spider crab (#2)	5685.1	1402.9	3822.4	1859.0	3078.9	15848.2
Purse crab (#1)	9.9	2.4			10.7	23.0
Purse crab (#2)	35.5	0.8	27.2	128.1	4.3	195.9
Calico crab	5.6			73.0	7.7	86.3
Narrow mud crab	3.3		0.3			3.9
Mantis shrimp	58.7	262.3	1768.0	3258.1	6186.4	11533.5
Total catch	9054.5	7935.8	9045.3	9298.3	20160.7	55494.6
Mean wt./tow	3018.2	2645.3	3015.1	3099.4	6720.2	3699.6

TABLE 67. Winter composition of macro-crustaceans at the Weeks Island site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total weight	%(Wt.)	Rank
Seabob shrimp	5677	42.6	12860.4	25.0	2
White shrimp	3544	26.6	25401.5	49.4	1
Broken-necked shrimp (#1)	1677	12.6	1983.6	3.9	5
Broken-necked shrimp (#2)	1396	10.5	1801.5	3.5	6
Portunid crab (#1)	524	3.9	1120.7	2.2	7
Mantis shrimp	273	2.0	2264.2	4.4	4
Brown shrimp	67	0.5	254.2	0.5	8
Rock shrimp	55	0.4	40.3	> 0.1	10
Spider crab (#1)	43	0.3	1120.7	2.2	7
Blue crab	22	0.2	3246.6	6.3	3
Purse crab (#2)	20	0.2	112.0	0.2	9
Hermit crab	20	0.2	32.5	> 0.1	11
Lady crab	12	> 0.1	20.0	> 0.1	12
Narrow mud crab	6	> 0.1	2.8	> 0.1	15
Calico crab	2	> 0.1	10.5	> 0.1	13
Stone crab	2	> 0.1	4.5	> 0.1	14
Striped shrimp	1	> 0.1	0.5	> 0.0	16
Total	13341		51435.4		

abundant macro-crustacean at West Hackberry (Table 68). This species composed 35.7% of the total yield. In contrast to Weeks Island, large numbers of portunid crab (#1) were trawled at West Hackberry and exceeded seabob and white shrimp in abundance. Mantis shrimp ranked fifth in abundance. Spider crab [#2 (Libinia emarginata)] and mantis shrimp were the dominant macro-crustacean in biomass, accounting for 28.6% and 20.8% of the total biomass, respectively (15.8 kg and 11.5 kg). White shrimp ranked third with over 7.3 kg (13.2%) of biomass.

Overall mean species diversity (1.44) at Weeks Island during Winter was the highest value recorded at this site for any season and the second highest for both sites. Diversity indices ranged from 1.04 to 1.95 (Figures 28 and 29). Seventeen species were taken at this site. The mean number per station was 12.4, the largest number for Weeks Island during all seasons and the second largest for both sites. Station 2 yielded the largest number of species (16) and highest species diversity. The lowest diversity was seen at station 6. Station 8 was about average. Five-mile station 14 yielded the least number of species (10). The number of species at stations 8 and 10 was also small (Table 64).

Mean species diversity at West Hackberry was 1.50, the highest for any season at both sites. Diversity indices ranged from 1.16 at station 6 to 1.59 at station 8 (Figures 28 and 29). Seventeen species were taken at this site. The mean number for all stations was 13.2, the highest number for any season at both sites. Station 14 produced the most species (15) while stations 6 and 8 yielded the fewest. Highest species diversity was recorded at station 8. Lowest diversity was at station 6.

White shrimp from Weeks Island ranged from 59 to 161 mm in total length and averaged 101.9 mm, somewhat smaller than those of the previous

TABLE 68. Winter composition of macro-crustaceans at the West Hackberry site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total weight	%(Wt.)	Rank
Broken-necked shrimp (#1)	4382	35.7	4814.3	8.7	6
Portunid crab (#1)	2676	21.8	7011.8	12.6	4
Seabob shrimp	1773	14.4	3496.0	6.3	7
White shrimp	1662	13.5	7319.2	13.2	3
Mantis shrimp	1407	11.5	11533.5	20.8	2
Broken-necked shrimp (#2)	99	0.8	109.5	0.2	9
Spider crab (#2)	83	0.7	15848.2	28.6	1
Rock shrimp	68	0.6	60.6	0.1	12
Blue crab	43	0.4	4827.4	8.7	5
Purse crab (#2)	34	0.3	195.9	0.4	8
Brown shrimp	18	0.1	51.5	> 0.1	13
Portunid crab (#2)	14	0.1	64.2	0.1	11
Purse crab (#1)	7	> 0.1	23.0	> 0.1	15
Calico crab	5	> 0.1	86.3	0.2	10
Pink shrimp	4	> 0.1	16.0	> 0.1	16
Narrow mud crab	4	> 0.1	3.9	> 0.1	17
Lesser blue crab	3	> 0.1	33.2	> 0.1	14
Total	12282		55494.6		

season. Of the 946 females examined for gonadal development, 921 (97.4%) had undeveloped ovaries, 15 (1.6%) had developing (yellow) ovaries and 10 (1%) were ripe (green). Brown shrimp, smaller than the previous two seasons, averaged 80.4 mm and ranged from 69 to 101 mm. All nineteen of the female specimens examined had undeveloped ovaries. Because of the large number of broken-necked and seabob shrimps in the winter samples, gonadal development was determined on those species when possible. Slow freezing of specimens after collection, however, resulted in autolysis of the gonads in most specimens. Broken-necked shrimp [#1 (Trachypeneus similis)] ranged from 16 to 84 mm in total length and averaged 53.8 mm. Seventy eight percent of the specimens were female. Of the 18 females examined, two (11%) had undeveloped ovaries, two (11%) had developing ovaries and fourteen (78%) were ripe (green). Broken-necked shrimp [#2 (T. constrictus)] averaged 54.5 mm in length and ranged from 26 to 81 mm. Females represented 76.6% of the total. Of the 18 examined, one was undeveloped and 17 had ripe ovaries. Seabob shrimp ranged in size from 43 to 118 mm and averaged 75.8 mm. Females composed 52.7% of the total number, of which 80 were examined for gonadal development. Of those, 31 (38.8%) had undeveloped ovaries, 19 (23.8%) had developing ovaries (yellow) and 30 (37.4%) were ripe (green). Carapace width of blue crabs trawled at Weeks Island ranged from 46 to 188 mm and averaged 147.4 mm. All of the twenty female specimens examined had recently shed eggs.

The West Hackberry site produced white shrimp which were smaller than those of the previous season. Specimens had a mean length of 99.2 mm with a range of 50 to 151 mm. Fifty-five percent were female. Of the 642 female specimens examined, 638 (99.4%) had undeveloped ovaries and the remainder had developing (yellow) ovaries. Brown shrimp ranged in size from 63 to 85 mm and averaged 74.2 mm. Half were female and all had undeveloped ovaries. Brown shrimp, like white shrimp, were smaller than those trawled the previous seasons. Carapace width of blue crabs ranged from 29 to 177 mm and averaged 122 mm. Sixty-three percent were female and all had recently shed eggs.

Spring

Both sites produced total yields which were second only to the winter yields in abundance. They were, however, surpassed by the winter yield by a wide margin (Tables 52 and 69). Combined tows at Weeks Island produced 920 specimens which weighed over 8.4 kg and represented 17 species. Total catch per effort for the Weeks Island site in spring (61.3 specimens/tow) was only seven percent of that for winter, but was greater than the summer and fall yields. Station 10 gave the largest catch per effort statistics (106 specimens/tow) while station 14 produced the least (27.3 specimens/tow).

Combined trawl tows at West Hackberry yielded 2362 specimens which weighed over 36 kg and represented 18 species. Total catch per effort at West Hackberry (157.5 specimens/tow) was two and one half times greater than that for Weeks Island. Two-mile station 10 produced the largest catch per effort statistics (326.3 specimens/tow) while 5-mile station 2 yielded the least (94.0 specimens/tow) amount (Table 52).

The biomass trend for the Weeks Island site did not follow that for abundance. Total biomass per yield for spring was third behind winter and fall (Table 53). The 1137.1 g per tow at 2-mile station 10 exceeded the catch effort for the other four stations. As with abundance, 5-mile station 14 produced the least biomass per effort (71.4 g/tow),

TABLE 69. Number of individuals, total catch and mean number of individuals of macro-crustaceans per trawl tow from Weeks Island and West Hackberry stations during Spring 1979.

	Weeks Island						West Hackberry					
Species	2	6	8	10	14	Total	2	6	8	10	14	Total
White shrimp	3	4	9	7		23	26	20	21	14	6	87
Brown shrimp		1				1	2	2	1	3	5	13
Pink shrimp			2			2	1		1			2
Broken-necked shrimp (#1)	32	58	46	68	28	232	125	14	281	605	258	1283
Broken-necked shrimp (#2)	131	11	74	128	23	367	8		2	2		12
Seabob shrimp						0		1				1
Rock shrimp				1		1						0
Blue crab	1	4	2	3		10	28	254	73	20	56	431
Lesser blue crab	3	1		2		6	4	3	8	30	5	50
Portunid crab (#1)	84	9	5	54	27	179	1			3		4
Portunid crab (#2)						0				1		1
Spider crab (#1)	1	2	5			8	1			3		4
Spider crab (#2)	13		3	1		17			1		2	3
Purse crab (#1)		2				2	1			13		14
Purse crab (#2)	1	2		2		5				2		2
Calico crab				8		8	1					1
Box crab				2		2						0
Hermit crab	1	3		3	1	8	2			1		3
Long wristed hermit crab						0				2		2
Mantis shrimp	5		2	39	3	49	82	6	52	280	29	449
Total catch	275	97	148	318	82	920	282	300	440	979	361	2362
Mean #/tow	91.7	32.3	49.3	106.0	27.3	61.3	94.0	100.0	146.6	326.3	120.3	157.5

which was only 6% of that at station 10. Station 10 not only produced more species than the other stations, but in general, most species yielded a greater biomass at station 10 than at the other stations (Table 70). The converse is apparent for station 14.

The West Hackberry site produced over four times the biomass trawled at Weeks Island (Table 53). All stations surpassed those at Weeks Island in biomass. The largest yield was produced at 2-mile station 6 (3319.5 g/tow) which was almost equaled by proposed diffuser station 8 (3165.0 g/tow). Much of the difference in biomass of stations 6 and 8 and the other three stations was due largely to the greater number and biomass of blue crabs (Callinectes sapidus) trawled at those two stations (Tables 69 and 71). Five-mile station 2 yielded the smallest biomass per effort (1397.7 g/tow) at the West Hackberry stations.

Trawl tows at Weeks Island were dominated in abundance by broken-necked shrimp (Table 72). Broken-necked shrimp [#2 (Trachypeneus constrictus)] and broken-necked shrimp [#1 (T. similis)] composed 39.9% and 25.1% of the total yield, respectively. Portunid crab [#1 Portunus gibbesii)] composed 20% of the specimens trawled. The remaining 14 species each comprised five percent or less of the total number. For biomass, spider crab [#2 (Libinia emarginata)] dominated the tows by composing 35.5% of the total catch weight. White shrimp (Penaeus setiferus) and blue crabs (Callinectes sapidus) ranked second and third, composing 10.8% and 10.5% of the total biomass, respectively.

As during the winter season, broken-necked shrimp (#1) was the most abundant macro-crustacean at West Hackberry during spring, accounting for 54.3% of the specimens trawled (Table 73). Mantis shrimp (Squilla empusa) replaced portunid crab (#1) of winter as the second most numerous

TABLE 70. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from Weeks Island stations during Spring 1979.

	Stations					
Species	2	6	8	10	14	Total
White shrimp	127.5	177.4	305.8	307.8		918.5
Brown shrimp		16.8				16.8
Pink shrimp			1.4			1.4
Broken-necked shrimp (#1)	52.7	57.5	57.5	199.0	43.5	410.2
Broken-necked shrimp (#2)	189.5	10.3	103.4	373.4	34.4	711.0
Rock shrimp				1.1		1.1
Blue crab	4.6	312.1	362.0	212.6		891.3
Lesser blue crab	0.8	4.3		24.6		29.7
Portunid crab (#1)	376.7	29.5	25.8	268.3	105.0	805.7
Spider crab (#1)	3.5	8.0	17.3			28.8
Spider crab (#2)	1727.5		784.9	496.7		3009.1
Purse crab (#1)		1.9				1.9
Purse crab (#2)	11.6	7.9		358.3		377.8
Calico crab				131.0		131.0
Box crab				659.0		659.0
Hermit crab	2.6	13.5		26.8	5.3	48.2
Mantis shrimp	45.6		10.0	352.6	25.9	434.1
Total catch	2542.6	639.6	1668.1	3411.2	214	8475.6
Mean wt./tow	847.5	213.2	556.0	1137.1	71.3	565.0

TABLE 71. Biomass (g) of individual species, total biomass and mean biomass per tow of macro-crustaceans trawled from West Hackberry stations during Spring 1979.

Species	Stations 2	6	8	10	14	Total
White shrimp	808.8	323.3	539.0	410.9	150.0	2232.0
Brown shrimp	17.3	20.9	9.5	41.9	84.4	174.0
Pink shrimp	10.7		15.1			25.8
Broken-necked shrimp (#1)	232.2	12.6	366.5	1489.1	323.6	2424.0
Broken-necked shrimp (#2)	19.6		1.0	4.2		24.8
Seabob shrimp		4.5				4.5
Blue crab	2676.0	9305.2	8230.3	2874.4	4699.6	27785.5
Lesser blue crab	31.4	271.9	51.5	283.7	41.8	680.3
Portunid crab (#1)	1.3			7.1		8.4
Portunid crab (#2)				3.9		3.9
Spider crab (#1)	1.5			4.3		5.8
Spider crab (#2)			1.3		56.3	57.6
Purse crab (#1)	4.0			22.9		26.9
Purse crab (#2)				10.7		10.7
Calico crab	3.4					3.4
Long-wristed hermit crab				5.9		5.9
Hermit crab	1.1			4.4		5.5
Mantis shrimp	385.8	20.1	280.7	1674.0	223.7	2584.3
Total catch	4193.1	9958.5	9494.9	6837.4	5579.4	36063.3
Mean wt./tow	1397.7	3319.5	3165.0	2279.1	1859.8	2404.2

TABLE 72. Spring composition of macro-crustaceans at the Weeks Island site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total Weight	%(Wt.)	Rank
Broken-necked shrimp (#2)	367	39.9	711.0	8.4	5
Broken-necked shrimp (#1)	232	25.1	410.2	4.8	8
Portunid crab (#1)	179	19.4	805.7	9.5	4
Mantis shrimp	49	5.3	434.1	5.1	7
White shrimp	23	2.5	918.5	10.8	2
Spider crab (#2)	17	1.8	3009.1	35.5	1
Blue crab	10	1.1	891.3	10.5	3
Spider crab (#1)	8	0.9	28.8	0.3	13
Calico crab	8	0.9	131.0	1.5	10
Hermit crab	8	0.9	48.2	0.5	11
Lesser blue crab	6	0.6	29.7	0.4	12
Purse crab (#2)	5	0.5	377.8	4.4	9
Pink shrimp	2	0.2	1.4	> 0.1	16
Purse crab (#1)	2	0.2	1.9	> 0.1	15
Box crab	2	0.2	659.0	7.8	6
Brown shrimp	1	0.1	16.8	0.2	14
Rock shrimp	1	0.1	1.1	> 0.1	17
Total	920		8475.6		

TABLE 73. Spring composition of macro-crustaceans at the West Hackberry site: species ranked in order of abundance, number, percent of total number, total weight (g), percent of total weight and rank by weight.

Species	Number	%(No.)	Total weight	%(Wt.)	Rank
Broken-necked shrimp (#1)	1283	54.3	2424.0	6.7	3
Mantis shrimp	449	19.0	2584.3	7.2	2
Blue crab	431	18.2	27785.5	77.0	1
White shrimp	87	3.7	2232.0	6.2	4
Lesser blue crab	50	2.1	680.3	1.9	5
Purse crab (#1)	14	0.6	26.9	> 0.1	8
Brown shrimp	13	0.6	174.0	0.5	6
Broken-necked shrimp (#2)	12	0.5	24.8	> 0.1	10
Portunid crab (#1)	4	0.2	8.4	> 0.1	12
Spider crab (#1)	4	0.2	5.8	> 0.1	14
Hermit crab	3	0.1	5.5	> 0.1	15
Spider crab (#2)	3	0.1	57.6	0.2	7
Pink shrimp	2	0.1	25.8	0.1	9
Purse crab (#2)	2	0.1	10.7	> 0.1	11
Long-wristed hermit crab	2	0.1	5.9	> 0.1	13
Seabob shrimp	1	> 0.1	4.5	> 0.1	16
Portunid crab (#2)	1	> 0.1	3.9	> 0.1	17
Calico crab	1	> 0.1	3.4	> 0.1	18
Total	2362		36063.3		

species, followed by blue crabs. Mantis shrimp and blue crabs composed 19.0% and 18.2% of the total catch, respectively. Seabob shrimp (Xiphopeneus krøyeri) and white shrimp both experienced sharp drops in abundance from the previous season. Blue crabs replaced spider crab (#2) from the previous season in biomass ranking. They accounted for 77% of the total catch weight. Mantis shrimp again ranked second (7.2%) in biomass followed by broken-necked shrimp [#1 (6.7%)], white shrimp (6.2%) and lesser blue crabs [Callinectes similis (1.9%)]. The remaining 13 species each composed less than 0.5% of the total biomass.

Species diversity indices at Weeks Island ranged from 0.78 at station 14 to 1.56 at station 10, with the mean being 1.19 (Figure 28). The average number of species taken was 9.8. Station 10 produced the largest number of species (13) while station 14 produced the least (5). Species diversity at West Hackberry ranged from 0.61 at station 6 to 1.52 at station 2, with the mean being 1.04. Diversity at station 8 was about average. Eighteen species were trawled at West Hackberry, the largest number for any season at both sites. The mean number taken was 10. Station 10 produced the most species (14) while station 6 and 14 produced the fewest.

White shrimp collected at Weeks Island ranged from 162 to 205 mm in total length and averaged 180.6 mm. These constituted the largest size class trawled during the study. Each of the four females examined had developing (yellow) ovaries. The single brown shrimp collected was 121 mm in length. Reproductive stage was not determined. Broken-necked shrimp (#1) averaged 57.5 mm in length and ranged from 32 to 87 mm. Females composed 91% of the total number. Of the 71 specimens examined, 26 (36.6%) were undeveloped, 24 (33.8%) had developing (yellow) ovaries and 21 (29.6%) had ripe (green) ovaries. Some of the ripe females bore spermatophores. Broken-necked shrimp (#2) ranged in size from 19 to 88 mm and averaged 55 mm. Females composed 83.5% of the specimen trawled. Of the 177 ovaries examined for gonadal development, 16 (9%) were undeveloped, 78 (44%) were developing (yellow) and 83 (47%) were ripe (green). Some ripe females bore spermatophores. Carapace width of blue crabs ranged from 42 to 164 mm and averaged 105.9 mm. Of the five females collected, two carried eggs and three were spent.

White shrimp trawled at West Hackberry ranged from 70 to 195 mm in total length and averaged 143.3 mm. Sixty two percent were females. Of the 30 examined for gonadal development, 16 (53%) were undeveloped and 14 (47%) were developing (yellow). The 13 brown shrimp collected averaged 121.7 mm in length and ranged from 102 to 145 mm. This was the largest size class of brown shrimp collected for any season. Each of the three females examined had undeveloped ovaries. Broken-necked shrimp (#1) ranged from 30 to 80 mm in length and averaged 58.2 mm. Ninty-four percent were female. Of the 89 examined, 31 (34.8%) had undeveloped ovaries, 48 (53.9%) had developed (yellow) ovaries and 10 (11.3%) had ripe (green) ovaries. Some of the ripe specimens bore spermatophores.

DISCUSSION

Demersal nekton communities at Weeks Island and West Hackberry are representative of fish and macro-crustacea of the northcentral Gulf of Mexico. Differences in community structure at both sites were incurred on a seasonal basis. These differences were typical for demersal nekton of the northcentral Gulf. Other community differences between sites were noted and are discussed below.

The two proposed diffuser sites exhibited sizeable differences in standing crop of demersal finfish and macro-crustaceans. The West Hackberry quarterly yields, with the exception of winter, were always larger than those of Weeks Island. The disparity in standing crops at the two sites is best reflected by the fact that West Hackberry catches were generally twice as large as those for Weeks Island. As with abundance and biomass, mean number of species per tow also was higher at West Hackberry. In contrast to these trends, species diversity at West Hackberry generally was lower than that for Weeks Island despite the sizeable differences in number of species per station statistics.

These apparent differences may be explained by the role that each proposed disposal site ecosystem plays in the life history of demersal nekton. Seasonal abundance trends and catch composition support the theory that West Hackberry, in being a nearshore disposal site, acts as an estuarine nursery area. The high abundances taken in spring and summer at West Hackberry reflect the mass recruitment of young estuarine-dependent species, such as the sciaenids, which are spawned further offshore in late winter and spring. These individuals utilize West Hackberry environs to feed and develop during spring and summer. Migration of these estuarine-dependent species into deeper, more temperature stable offshore areas such as Weeks Island occurs with onset of cool water temperatures in fall and winter.

Abundance trends at Weeks Island support the theory that this deeper, offshore site serves as an overwintering ground for demersal nekton during fall and winter. The anaerobic conditions of summer and migration of nekton to inshore areas in the spring greatly reduced standing crops at Weeks Island during these seasons.

Substrate difference between the two proposed disposal sites also contributed to differential standing crop levels at respective sites. The West Hackberry sediments, characterized as clay, sandy silt and sandy mud, are of high organic content and similar to those of nearshore bays and lagoons (Hausknecht 1979). These substrate types are preferred by estuarine-dependent fauna for feeding and development. The abundant finfish fauna at West Hackberry was dominated by members of the bottom-feeding family Sciaenidae. On the other hand, sediments at Weeks Island are more sandy than those at West Hackberry and may not be as preferred by ubiquitous bottom-feeding species (Darnell 1958). This hypothesis is certainly supported by the relative lack of sciaenid species among the dominant taxa at Weeks Island.

Both sites appear to be important areas for shrimp. No white shrimp were taken at Weeks Island during summer, and only a few during fall and spring. More white shrimp were taken at Weeks Island during winter than at any other season for both sites. White shrimp was the dominant species for biomass at West Hackberry for fall. White and brown shrimp accounted for over 80% of the biomass during fall at West Hackberry. Brown shrimp ranked second in biomass at both sites for summer and fall.

Catch trends among stations at both proposed disposal sites showed station 8 standing stocks to be moderately high. Conversely, most 5-mile stations exhibited comparatively low yields. If one assumes these differences are representative of future yields at both sites, then standing stock trends should be considered in decisions regarding ultimate siting of the diffuser. Finfish and macro-crustacean data suggest that locating the proposed diffuser at Weeks Island station 14 and West Hackberry station 2 might reduce the impact of brine discharge on demersal nekton communities of both areas.

CONCLUSIONS

The following conclusions are generated from the results presented in this report:

1. Standing crop of demersal finfish and macro-crustaceans at West Hackberry exceeded that at Weeks Island during most of the year.
2. Finfish abundances at West Hackberry were greatest in the spring and summer and lowest in fall and winter. Largest and smallest macro-crustacean catches at West Hackberry were during winter and summer, respectively.
3. Nekton yields at Weeks Island were largest during winter and smallest during summer.
4. Low dissolved oxygen levels may have been responsible for reduced nekton yields at both sites during summer.
5. Largest catches at West Hackberry were taken from 2-mile stations 6 and 10 while smallest catches were netted from 5-mile station 2.
6. The proposed diffuser station 8 produced largest nekton yields at Weeks Island.
7. West Hackberry serves as a nursery area for estuarine-dependent species during spring and summer.
8. Weeks Island is an offshore overwintering ground during fall and winter.
9. Standing stock data should be considered in decisions regarding diffuser location. Catch trends indicate that locating the diffuser at Weeks Island station 2 and West Hackberry station 14 would reduce impact of brine discharge upon demersal nekton communities of both areas.

LITERATURE CITED

Armstrong, H. W., K. W. Fucik, J. W. Anderson, and J. M. Neff. 1978. Effects of oilfield brine effluent on benthic organisms in Trinity Bay, Texas. American Petroleum Institute Publication No. 4291. 81 pp. American Petroleum Institute, Department of Environmental Affairs, Washington, D.C.

Blumer, M., and J. Sass. 1972a. Indigenous and petroleum-deprived hydrocarbons in a polluted sediment. Mar. Poll. Bull. 3(5):92-94.

_____. 1972b. Oil pollution: persistence and degradation of spilled fuel oil. Science 196(9/6):1120-1122.

Cummings, W. C. 1961. Maturation and spawning of the pink shrimp _Penaeus duorarum_ Burkenroad. Trans. Amer. Fish. Soc. 90:462-468.

Dahlberg, M. P., and E. P. Odum. 1970. Annual cycles of species occurrence, abundance and diversity in Georgia estuarine populations. Am. Midl. Nat. 83(2):382-392.

Darnell, R. M. 1958. Food habits of fishes and larger invertebrates of Lake Pontchartrain, Louisiana, an estuarine community. Publ. Inst. Mar. Sci. Univ. Tex. 5:353-416.

Dow Chemical Company. 1967. A study of the disposal of the effluent from a large desalination plant. The Office of Saline Water Contract 14-01-0001-161.

Felder, D. L. 1973. An annotated key to crabs and lobsters (Decapoda, Reptantia) from coastal waters of the northwestern Gulf of Mexico. Center for Wetland Resources, Louisiana State University, Baton Rouge. Publication No. LSU-SG-73-02.

Frey, H. R. 1979. NOS strategic petroleum reserve support: mid-project report - November 1977 through March 1979. NOAA, Marine Environmental

Services Division, Office of Oceanography. 121 pp.

Gallaway, B. J., J. C. Parker, and D. Moore. 1972. Key to the estuarine and marine fishes of Texas. Texas A&M University. Sea Grant Publication No. TAMU-SG-72-402. 177 pp.

Giger, W., M. Reinhard, C. Schaffner, and W. Stumm. 1974. Petroleum-derived and indigenous hydrocarbons in recent sediments of Lake Zug, Switzerland. Environ. Sci. & Tech. 8(5):454-455.

Harper, D. E., Jr. 1977. Distribution and abundance of macrobenthic and meiobenthic organisms, p. 165-204 in E. F. Klima, Environmental assessment of an active oil field in the northwestern Gulf of Mexico. Final Report (1976-1977). NOAA/National Marine Fisheries Service.

Hauschnecht, K. A. 1979. Biological/chemical survey of Texoma and Capline Sector salt dome brine disposal sites off Louisiana. Work Unit 3.1 - Sediments and suspended particulates. Draft Final Report to the National Marine Fisheries Service. Energy Resources Co., Inc. 37 pp.

Hoese, H. D., and R. Moore. 1977. Fishes of the northwestern Gulf of Mexico, Texas, Louisiana and adjacent waters. Texas A&M University Press. College Station. 327 pp.

Hubbs, C. L., and K. F. Lagler. 1967. Fishes of the Great Lakes region. University of Michigan Press. Ann Arbor. 2nd printing. 213 pp.

Johnstone, R. 1970. The decomposition of crude oil residues in sand columns. J. Mar. Biol. Ass. U.K. 50:925-937.

Juneau, C. L., Jr. 1975. An inventory and study of the Vermilion Bay-Atchafalaya Bay Complex. Phase II, Biology. La. Wild Life Fish. Comm. Tech. Bull. 13:1-153.

King, J. E. 1948. A study of the reproductive organs of the common marine shrimp, Penaeus setiferus (Linnaeus). Biol. Bull. (Woods Hole) 94:244-262.

Lagler, K. F. 1968. Capture, sampling and examination of fishes, p. 7-45. in: W. E. Ricker (ed.), Methods for assessment of fish production in fresh waters. IBP Handbook No. 3. Blackwell Scientific Publication, Oxford.

Landry, A. M., Jr. 1977. Life history and susceptibility of fishes in Galveston Bay, Texas to power-plant cooling water operations. Ph.D. Dissertation. Texas A&M University, College Station. 543 pp.

Lindall, W. N., Jr., J. R. Hall, J. E. Sykes, and E. L. Arnold, Jr. 1972. Louisiana coastal zone: analysis of resources and resource development needs in connection with estuarine ecology. Sections 10 and 13, fishery resources and their needs. Rept. to U.S. Corps of Engrs. New Orleans Contr. No. 14-17-002-430. 323 pp.

LOOP. 1975. Environmental assessment of a Louisiana offshore oil port. New Orleans, La. BNO Bldg. Vols. I-IV.

Mackin, J. G. 1971. A study of the effect of oil field brine effluents on biotic communities in Texas estuaries. Texas A&M Research Foundation Project 735. 72 pp.

_____, and S. H. Hopkins. 1962. Studies on oyster mortalities in relation to natural environments and to the oil fields in Louisiana. Publ. Inst. Mar. Sci. Univ. Tex. 7:1-131.

Moore, D., H. A. Brusher, and L. Trent. 1970. Relative abundance, seasonal distribution and species composition of demersal fishes off Louisiana and Texas. 1962-1964. Contrib. Mar. Sci. Univ. Tex. 15:45-70.

Nikolsky, G. V. 1963. The ecology of fishes. Academic Press. New

York. 350 pp.

Perret, W. S., B. B. Barrett, W. R. Latapie, J. F. Pollard, W. R. Mock, G. B. Adkins, W. J. Guidry, and C. J. White. 1971. Cooperative Gulf of Mexico estuarine inventory and study, Louisiana. Phase I, Area Description and Phase IV, Biology. La. Wild Life Fish. Comm.

Perret, W. S., and C. W. Caillouet, Jr. 1974. Abundance and size of fishes taken by trawling in Vermilion Bay, Louisiana. Bull. Mar. Sci. 24(1):52-75.

Pielou, E. C. 1966a. Shannon's formula as a measure of specific diversity: its use and misuse. Am. Nat. 100(914):463-465.

_____. 1966b. The measurement of diversity in different types of biological collections. J. Theor. Biol. 13:131-144.

Ragan, J. G., E. J. Melancon, A. H. Harris, R. N. Falgout, J. D. Gann, and J. H. Green. 1978. Bottomfishes of the continental shelf off Louisiana. Prof. Paper Ser. (Biology) No. Two, Nicholls State University, Thibodaux, La. 34 pp.

Reitsema, L. A. 1979. Biological/chemical survey of proposed salt dome brine disposal sites (Texoma and Capline sectors) off Louisiana. Work Unit 2.2 - Zooplankton. Draft Final Report prepared by LGL Ecological Research Associates, Inc. 104 pp.

Scarratt, D. J., and V. Zitko. 1972. Bunker C oil in sediments and benthic animals from shallow depths in Chedabucto Bay, N.S. J. Fish. Res. Bd. Canada 29(9):1347-1350.

Shelton, T. B., and J. V. Hunter. 1974. Aerobic decomposition of oil pollutants in sediments. J. Water Poll. Cont. Fed. 46(9):2172-2182.

U. S. Department of Commerce. 1975. Current Fisheries Statistics No. 6922. Louisiana Landings, Annual Summary, 1975.

U. S. Department of Commerce. 1977a. Analysis of brine disposal in the Gulf of Mexico, #2 West Hackberry. Report to Federal Energy Administration Strategic Petroleum Research Program Salt Dome Storage. Center for Experiment Design and Data Analysis. NOAA, EDS, Marine Assessment Division, Washington, D.C.

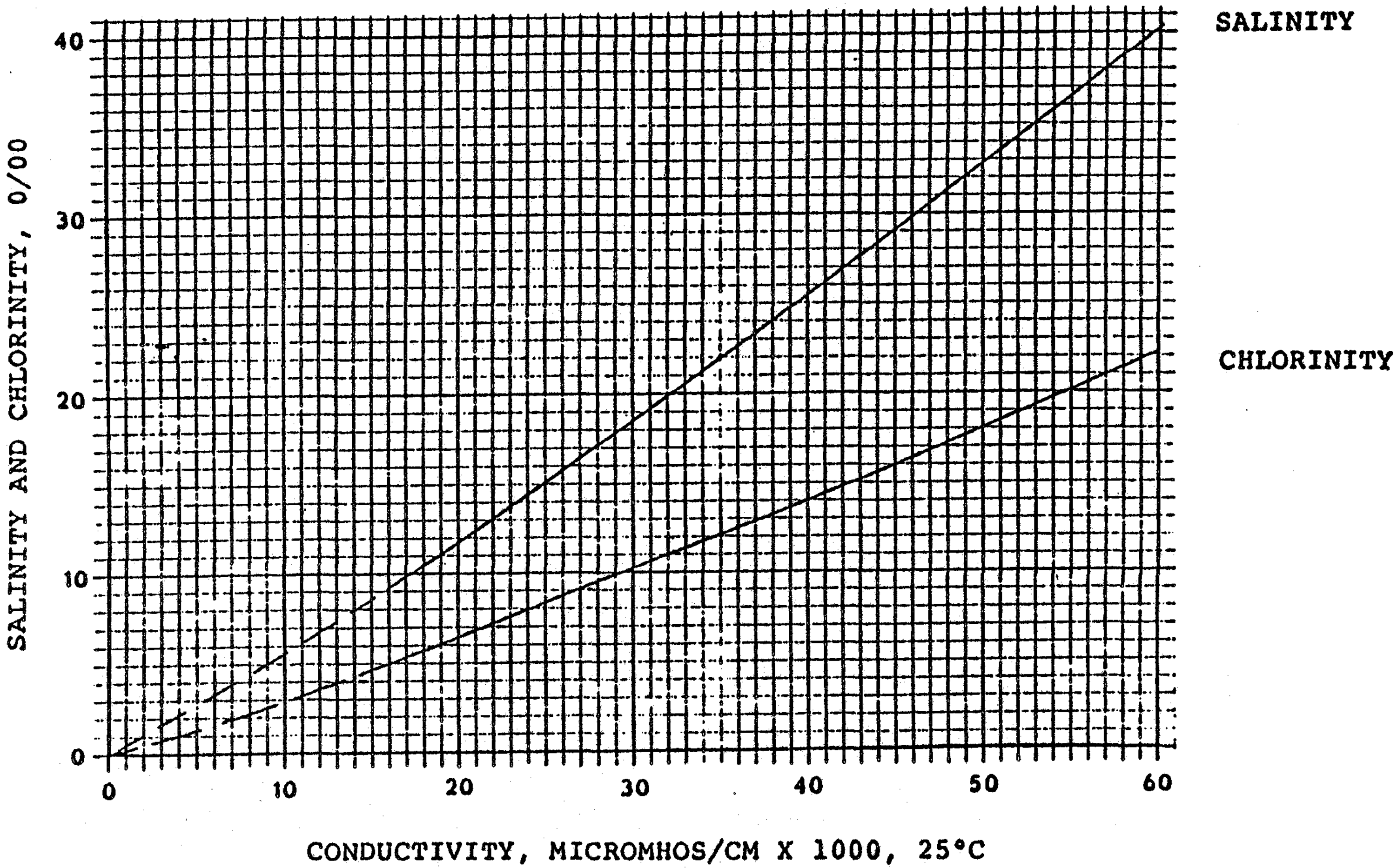
U. S. Department of Commerce. 1977b. Analysis of brine disposal in the Gulf of Mexico, #3 Capline Sector. Report to Federal Energy Administration Strategic Petroleum Research Program Salt Dome Storage. Center for Experiment Design and Data Analysis. NOAA, EDS, Marine Assessment Division, Washington, D.C.

U. S. Department of Energy. 1978. Final environmental impact statement. Strategic petroleum reserve. Texoma group salt domes. Cameron and Calcasieu Parishes, Louisiana and Jefferson County, Texas. DOE/EIS-0029 Vol. 5.

Walls, J. G. 1975. Fishes of the northern Gulf of Mexico. T. F. H. Publication Inc., Neptune City, New Jersey. 432 pp.

Williams, A. B. 1965. Marine decapod crustacea of the Carolinas. Fishery Bulletin 65(1):1-298.

Wood, C. E. 1974. Key to the Natantia (Crustacea, Decapoda) of the coastal waters on the Texas Coast. Contr. Mar. Sci. 18:35-56.



Appendix A. Relationship of salinity and chlorinity to conductivity. (Courtesy of Hydrolab Corporation)