NOAA Technical Memorandum NMFS-SEFC-65

NOAA/NMFS FINAL REPORT TO DOE

Shrimp and Redfish Studies, Bryan Mound Brine Disposal Site Off Freeport, Texas 1979-1981

A report to the Department of Energy on work conducted under provisions of Interagency Agreement DE-A10178US07146 during 1979-1981.

Volume I (A)

SHRIMPING SUCCESS

MAY 1982

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

NOAA Technical Memorandum NMFS-SEFC-65

Shrimp and Redfish Studies; Bryan Mound Brine Disposal Site Off Freeport, Texas, 1979-1981.

VOL.I (A) ANALYSIS OF DATA ON SHRIMPING SUCCESS, SHRIMP RECRUITMENT AND ASSOCIATED ENVIRONMENTAL VARIABLES

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A report to the Department of Energy on work conducted under provisions of Interagency Agreement DE-A10178US07146 during 1979-1981.

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This volume should be cited as follows:

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Volume I (A) - SHRIMPING SUCCESS

Table of Contents

I. Project Administration Section

	Page
Project Administration	vi
List of Volumes	viii
Introduction	x
Fig. 1. Regions of Study for Brine Disposal Assessment	x
List of Reports and Publications	xiii

II. Principal Investigator's Section

Work Unit 2 - Analysis of Data on Shrimping Success, Shrimp Recruitment and Associated Environmental Variables	xviii
Important Notice to Readers	xix

I. PROJECT ADMINISTRATION SECTION

PROJECT ADMINISTRATION

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LIST OF VOLUMES

This Final Report is printed in six separate volumes:

Volume I(A) - SHRIMPING SUCCESS

Work Unit 2 - Analysis of Data on Shrimping Success, Shrimp Recruitment and Associated Environmental Variables

Science Applications, Inc.

C. E. Comiskey, Ph.D., et al.

Volume I(B) - SHRIMP CATCH-EFFORT ANALYSIS

Work Unit 3 - Texas Coast Shrimp Catch and Effort Data Analysis

Science Applications, Inc.

C. E. Comiskey, Ph.D., et al.

Volume II - SHRIMP MARK-RELEASE

Work Unit 4 - Shrimp Mark-Release Investigations

LGL Ecological Research Associates, Inc.

M. F. Johnson, Ph.D.

Volume III - SHRIMP SPAWNING SITE SURVEY

Work Unit 5 - Shrimp Spawning Site

LGL Ecological Research Associates, Inc.

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Volume IV - CATCH-EFFORT SAMPLING SURVEY

Work Unit 6 - Interview Sampling Survey of Shrimp Catch and Effort

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Volume V - REDFISH BIOASSAYS

Work Unit 7(A) - Brine Toxicity Bioassays on Redfish

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Work Unit 7(B) - Brine Avoidance/Attraction Bioassays on Redfish

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Volume VI - SHRIMP BIOASSAYS

Work Unit 8 - Brine Toxicity and Avoidance/Attraction Bioassays on Shrimp

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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) with the goal of storing a minimum of one billion barrels of crude oil. 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.

Four coastal areas along the northwestern Gulf of Mexico were assessed for brine discharge into nearshore waters (Figure 1). This project, "Shrimp and Redfish Studies; Bryan Mound Brine Disposal Site off Freeport, Texas", deals with potential impacts of brine disposal from the Bryan Mound site. Under permit from the Environmental Protection Agency (EPA), this brine discharge site (Latitude 28° 44.28'N; Longitude 95° 14.64'W) was selected about 12.5 miles directly offshore of Bryan Mound.

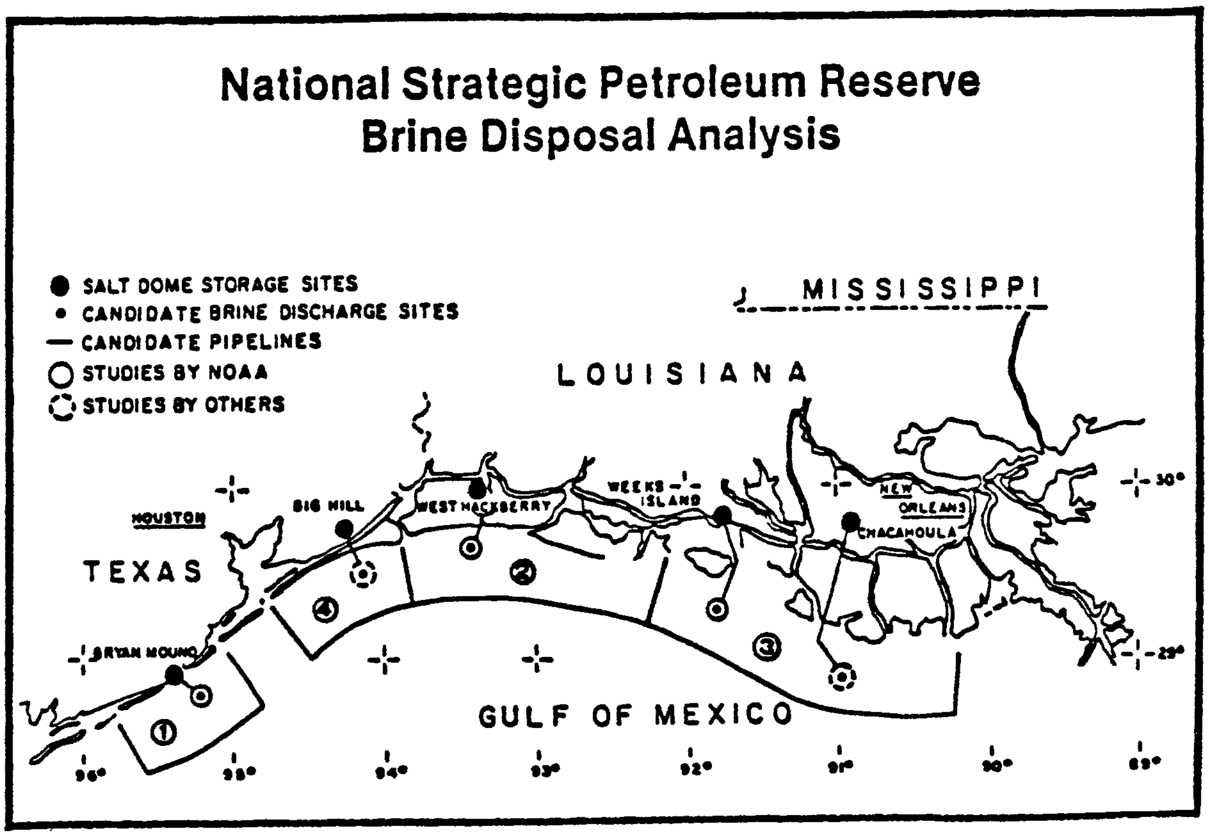

Figure 1. Regions of Study for Brine Disposal Assessment-DOE/NOAA Interagency Agreement (adapted from Environmental Data and Information Service, DOC/NOAA).

The process of creating a storage cavern within a salt dome involves dissolving the solid salts with raw water. The water source for leaching of the Bryan Mound salt dome is the Brazos River. Water from the Brazos River is piped under pressure into the dome. The resultant brine (dissolved salts) is discharged, at variable rates (over 100,000 barrels/day) into the Gulf of Mexico.

To complement the site-specific oceanographic and biological monitoring of brine disposal conducted by Texas A&M University, a regional assessment of important commercial and recreational fisheries was initiated in August, 1979. The objectives of this assessment were (1) to conduct a pre-discharge/post-discharge assessment of shrimp populations in relation to the Bryan Mound salt dome brine disposal site and (2) to determine acute toxicity and avoidance/attraction responses of shrimp and redfish to Bryan Mound brine. These objectives were achieved through field and laboratory investigations and through statistical analysis of the data. Specific studies included (1) analysis of data on shrimping success, shrimp recruitment and associated environmental variables, (2) analysis of Texas coast shrimp catch and effort data, (3) shrimp mark-release investigations, (4) shrimp spawning site survey, (5) interview sampling survey of shrimp catch and effort, (6) brine toxicity and avoidance/attraction bioassays on redfish and (7) brine toxicity and avoidance/attraction bioassays on shrimp.

The major products of the Shrimp and Redfish Studies 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 publications that may be written by participating principal investigators and submitted to scientific or technical journals. Preliminary results have been made available through DOE/NOAA/NMFS project reviews and workshops attended by project participants and various governmental, private and public user groups.

The DOE has developed comprehensive Environmental Impact Statements listed below:

1. Strategic Petroleum Reserve - Seaway Group Salt Domes, June 1978, Final EIS, DOE/EIS-0021.

2. Strategic Petroleum Reserve - Bryan Mound Salt Domes, January 1977, Final EIS, FES 76/77-6.

3. Strategic Petroleum Reserve - Expansion of Reserve, January 1979, Final Supplement to Final EIS, FEA-FES-76-2.

All three reports are available from the U.S. Department of Commerce, National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161.

Texas A&M University (TAMU) has conducted studies of physical oceanography, sediments, water quality, benthos and nekton at the Bryan Mound brine disposal site from September, 1977 to February, 1979. In addition, TAMU has developed a towed sensing system for tracking the brine plume. Results of this research are available in:

Metzbower, H. T., S. S. Curry and F. A. Godshall. 1980. Handbook of the Marine Environment - Bryan Mound. NOAA Report to DOE Strategic Petroleum Reserve Program, Salt Dome Storage/Brine. 92 p.

The Massachusetts Institute of Technology (MIT) has developed a mathematical, 3-dimensional, hydrodynamic simulation model of the brine plume dispersion. The model and test-tank simulations have the capacity to evaluate effects of varying effluent discharge rates and currents and to identify various plume configurations and densities. Salinity dispersion was modeled showing that a dilution rate of 100:1 can be expected within 100 feet of the diffuser head. The MIT analyses are available in DOE's final Bryan Mound EIS (FES 76/77-6) listed earlier.

LIST OF REPORTS AND PUBLICATIONS

Shrimp and Redfish Studies, Bryan Mound Brine Disposal Site off Freeport, Texas 1979-1981

Comiskev, C., R. McCord, D. Bozworth, S. Gradv, C. Hall, C. Brandt and T. Farmer. 1982. Analyses of data on shrimping success, shrimp recruitment and associated environmental variables. Vol. I(A). In: Klima, E. F. (Contracting Officer's Technical Representative). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-65. 449 p. NOAA, NTIS, Accession No. ______________.

Comiskev, C., R. McCord, D. Bozworth, S. Grady, C. Hall, C. Brandt and T. Farmer. 1982. Texas coast shrimp catch and effort data analvsis. Vol. I(B). In: Klima, E. F. (Contracting Officer's Technical Representative). Shrimp and redfish studies; Brvan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-65. 217 p. NOAA, NTIS Accession No. ______________

Gallawav, B. J. and L. A. Reitsema. 1981. Shrimp spawning site survev. Vol. III. In: Jackson, W. B. and E. P. Wilkens (eds.). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-67, 84 p. NOAA, NTIS, Accession No. PB81-249591.

Howe, N. R. 1981. Brine toxicity and avoidance/attraction bioassays on shrimp. Vol. VI. In: Jackson, W. B. and E. P. Wilkens (eds.). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-70, 60 p. NOAA, NTIS Accession No. PB81-249609

Johnson, M. F. 1981. Shrimp mark-release investigations. Vol. II. In: Jackson, W. B. and E. P. Wilkens (eds.). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-66, 110 p. NOAA, NTIS Accession No. PB81-249583.

Johnson, M. F. 1981. Interview sampling survey of shrimp catch and effort. Vol. IV. In: Jackson, W. B. and J. R. Bennett (eds.). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-68, 38 p. NOAA, NTIS Accession No. PB82-116062.

Neff, J. M., M. P. Coglianse, L. A. Reitsema, S. Anderson and W. McCulloch. 1981. Brine toxicity bioassays on redfish. Vol. V (Part A). In: Jackson, W. B. (editor). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-69. 109 p. NOAA, NTIS Accession No. ______________.

Owens, D. W., K. A. Jones and L. A. Reitsema. 1981. Brine avoidance/attraction bioassays on redfish. Vol. V (Part B). In: Jackson, W. B. (editor). Shrimp and redfish studies; Bryan Mound brine disposal site off Freeport, Texas, 1979-1981. NOAA Technical Memorandum NMFS-SEFC-69. 75 p. NOAA, NTIS Accession No. ______________.

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

Boehm, P. D. and D. L. Fiest. 1980. Determine hydrocarbon 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, 164 p. NOAA, NTIS Accession No. PB81-174971.

Brooks, J. M. 1980. Determine seasonal variations in inorganic nutrient compostion 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, 55 p. NOAA, NTIS Accession No. PB81-182685.

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, 19798-1979. NOAA Technical Memorandum NMFS-SEFC-29, 83 p. NOAA, NTIS, Accession No. PB81-174963.

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, 226 p. NOAA, NTIS Accession No. PB81-174955.

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, 335 p. NOAA, NTIS Accession No. PB81-133803.

Parker, R. H., A. L. Crowe and L. S. Bohme. 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. NOAA, NTIS Accession No. PB81-133795.

Reitsema. L. A. 1980. Determine seasonal abundance, distributiona nd 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, 162 p. NOAA, NTIS Accession No. PB81-175838.

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, 74 p. NOAA, NTIS Accession No. PB81-174948.

Tillerv, 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, 100 p. NOAA, NTIS Accession No., PB81-174989.

Related Publications

Caillouet, C. W. and F. J. Patella. 1978. Relationship between size composition and ex-vessel value of reported shrimp catches from two gulf coast states with different harvesting strategies. Marine Fisheries Review 40(2):14-18.

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. 1980. Relationship between ex-vessel value and size composition and annual landings of shrimp from the gulf and south Atlantic coasts. Marine Fisheries Review 42(12):28-33.

Caillouet, C. W. and D. B. Koi. 1980. 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 42(2):18-27.

Caillouet, C. W. and D. B. Koi. (1981). Trends in ex-vessel value and size composition of reported Mav-August catches of brown and white shrimp from the Texas, Louisiana, Mississippi and Alabama coasts, 1960-1978. Gulf Research Reports 7(1):(in press).

II. PRINCIPAL INVESTIGATOR'S SECTION

WORK UNIT 2 - ANALYSIS OF DATA ON SHRIMPING SUCCESS,
SHRIMP RECRUITMENT AND ASSOCIATED
ENVIRONMENTAL VARIABLES

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IMPORTANT NOTICE TO READERS

In Section 1.3.3.6, Density Dependent Factors, pages 35-37, and Section 1.3.6, Summary, pages 41-42, of this report by Science Applications, Inc., the authors concluded (as indicated in the published literature available to them at the time they prepared this report) that shrimp recruitment is independent of the density of the spawning stock. Contrary to this earlier consensus summarized by the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico (GMFMC, 1980), Rothschild and Parrack (1981) demonstrated a good relationship between an index of stock size and an index of recruitment for Gulf of Mexico brown shrimip, *Penaeus aztecus*, but the relationship for white shrimp, *P. setiferus*, was not as clear as that for brown shrimp.

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Gulf of Mexico Fishery Management Council (GMFMC). 1980. Fishery management plan for the shrimp fishery of the Gulf of Mexico. Federal Register 45(216):74190-74308.

Rothschild, B. J. and M. L. Parrack. 1981. Review paper on the U.S. Gulf of Mexico Shrimp Fishery. Paper presented at the FAO/NOAA Workshop on the Scientific Basis for the Management of Penaeid Shrimps, Key West, Florida, November 1981, 40 p. plus figures.

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ABSTRACT

The analyses reported herein address the potential impacts to the Texas shrimp fishery from offshore disposal of brine associated with the U.S. Department of Energy Strategic Petroleum Reserve Program at the Bryan Mound storage site, near Freeport, Texas through the analysis of the historical data base for the fishery (Gulf Coast Shrimp Data) and associated shrimp recruitment and environmental variables.

Time series analyses, involving ARIMA modeling and fourier analysis of monthly brown and white shrimp catches in area 19 for the period 1960-1977 were performed. The fourier analysis power spectrum estimates were disappointing indicating that there was a large amount of variability in the phase of the seasonal cycle from year to year for both species. As such, predictive models based on the results of the fourier analysis were not presented. ARIMA models were estimated for both brown and white shrimp catch. The seasonal trend for both species, based on a twelve month cycle, was evident in the results of the analysis. However, the absolute magnitude of the shrimp catch for any month was not predicted closely, indicating that environmental factors not in the model were influencing the size of the seasonal peaks from year to year. Deviations from historical trends on the order of 30-50 percent should be detectable with these models.

Environmental variables used in the study were grouped into six categories: (1) river discharge; (2) precipitation; (3) temperature; (4) salinity; (5) winds, tides, and Ekman transport; and (6) recruitment and postlarval indices. Based on the availability of data, two temporal groups of variables were defined. These were a 10 year data set (1964-1973) and an 18 year data set (1960-1977). Ekman transport, Texas Park and Wildlife Department (TPWD) Galveston Bay and Matagorda Bay catch/effort, salinity and temperature, and Bureau of Commercial Fisheries - National Marine Fisheries Service (BCF-NMFS) postlarval catch/tow and salinity variables were available only for the ten year period.

A stepwise multiple regression procedure in SPSS was utilized to develop predictive equations relating indices of shrimping success (catch and catch/effort) for brown and white shrimp to these environmental and recruitment variables. The analysis scheme was structured in two phases. In the first phase, regressions were run for each shrimping success index for area 18, area 19, and area 19, 11-15 fm depths, with each group of categorical variables (e.g., discharge or recruitment variables), yielding a total of one hundred and thirty eight equations for the 10 and 18 year analyses. The results of these analyses are presented as summary tables in this report, along with appropriate means and correlation tables. From these results, a best fit data set composed of important variables from each categorical group was formed for each dependent variable. Twenty three final best fit regression models were generated and the results are presented in this report in tabular form. For each of these best fit regressions, a plot of the time series of the dependent variable and two most important independent

variables and a plot of the observed, estimated, and predicted values for the dependent variable are presented. In the majority of cases, these final equations should be used to test hypotheses concerning the impact of brine discharge on the shrimp fishery.

In almost all cases for both species, the 10 year regressions explained a greater amount of the variance in catch and catch/effort than did the regressions for the 18 year data set. This was partly due to the unavailability of certain important variables (e.g., zonal Ekman transport, postlarval catch/tow, TPWD bay catch and associated environmental variables) for the entire 1960-1977 period, but was also due to lower correlations in the 18 year record between the dependent variables and important environmental variables. Possible reasons for this poorer fit over the 18 year period include inaccuracies in the reporting system during the early years and the introduction of other factors (e.g., economic considerations) during the mid 1970's (at the end of the 18 year period).

In general, the brown shrimp regressions explained more variance than did those for white shrimp, especially for the 10 year data. Some of the differences are attributable to the fact that several important variables (e.g., TPWD bay shrimp catch and associated environmental variables) were available only for brown shrimp 10 year analyses. These data were not collected in a systematic manner for white shrimp ove the entire 10 year (1964-1973) period. Even taking this into consideration, the regressions for brown shrimp were better. The explanation for this probably involves the fact that white shrimp catch in areas 18 and 19, and especially area 19, 11-15 fm depths, contains more spurious variation than does brown shrimp catch in these same spatial strata.

Discharge and precipitation variables were, for the most part, positively correlated with white shrimping success indicators while being negatively correlated with brown shrimping success indicators. Lagged precipitation and discharge variables appeared to be more important for predicting white shrimp indices. Wind, tide, and Ekman transport variables proved to be very important in predicting both white and brown shrimp catch and catch/effort, with Ekman transport being more important for brown shrimp than for white shrimp. Ekman transport variables were generally positively correlated with brown shrimp catch and negatively correlated to white shrimp catch. White shrimp catch was more closely related to wind speed and direction, but the ecological basis for these trends are not clear. The results of this study point to these relationships as areas of concern for future studies. For brown shrimp, TPWD bay shrimp catch and postlarval catch were important predictors of brown shrimping success, as were the environmental variables (temperature and salinity) collected with these recruitment data.

To assess the importance of fishing effort in predicting shrimp catch, best fit regressions were run with effort as one of the independent variables and the results were compared to the results of the best fit regression analyses without effort. Effort was more important for the

18 year equations than for the 10 year equations due to the better fits with environmental variables and recruitment for the ten year period.

The methodology whereby these regressions equations can be used in impact assessment is discussed. The methodology centers on establishing 95 percent confidence limits for predicted shrimp catch or catch/effort from the models, using the suite of pertinent environmental variables for the year to be tested. If the observed value for catch or catch/effort for the year falls outside these confidence limits, the null hypothesis of no significant change in catch or catch/effort due to brine discharge is rejected. This methodology assumes that other environmental factors not considered in the development of the model and not operative during the 1960-1977 period, are not occurring in the year for which impacts are being assessed.

Q-mode cluster analysis was used in an attempt to classify good and poor brown and white shrimping years (based on the criteria of catch) using environmental variables that were important in the categorical equations. As expected, the results were better for the cluster analyses based on the ten year data set as compared to the results for the 18 year period, with especially poor results for brown shrimp catch in area 19 for the 18 year period. Analyses which included variables important to white shrimping success and to brown shrimping success generally showed results similar to those from analyses involving only variables important to predicting white shrimping success.

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TABLE OF CONTENTS

	Page
List of Tables	xi
List of Figures	xli
1.0 INTRODUCTION	1
1.1 SPR BACKGROUND	1
1.2 CHARACTERIZATION OF THE STUDY AREA	4
1.3 SUMMARY OF RELEVANT INFORMATION ON THE PENAEID LIFE STYLE	7
1.3.1 Introduction	7
1.3.2 Generalized Life Cycles	8
1.3.3 Factors Influencing the Success of the Year Class	12
1.3.3.1 Temporal and Spatial Patterns in Spawning Activity	12
1.3.3.2 Transport of Larvae and Postlarvae to the Estuaries	16
1.3.3.3 Postlarval Abundance as an Index of Shrimping Success	20
1.3.3.4 Juvenile Abundance as an Index of Shrimping Success	22
1.3.3.5 Salinity Relationships	34
1.3.3.6 Density Dependent Factors	37
1.3.4 Historical Trends	40
1.3.5 Texas Department of Water Resources Studies	41
1.3.6 Summary	44
1.4 NATIONAL MARINE FISHERIES SERVICE PROGRAM	46
1.5 OBJECTIVES	48
2.0 METHODOLOGIES	51
2.1 DATA SOURCES AND DATA PROCESSING	51
2.1.1 Gulf Coast Shrimp Data	51
2.1.2 Environmental and Shrimp Recruitment Variables	55
2.2 TIME SERIES ANALYSIS	58
2.2.1 General ARIMA Modeling	58
2.2.2 Fourier Analysis	62
2.3 STEPWISE MULTIPLE REGRESSION ANALYSIS	66
2.4 CLUSTER ANALYSIS	73

TABLE OF CONTENTS (cont.)

	Page
3.0 RESULTS AND DISCUSSION	75
3.1 TIME SERIES ANALYSIS	75
3.1.1 ARIMA Modeling	75
3.1.1.1 Brown Shrimp	76
3.1.1.2 White Shrimp	78
3.2.1 Fourier Analysis	79
3.2 REGRESSION ANALYSIS	80
3.2.1 Initial Categorical Regressions for Brown Shrimp Catch and Catch/Effort	80
3.2.1.1 Characterization of the Dependent Variables	80
3.2.1.2 Brown Shrimp Regressions for the Period 1964-1973	81
3.2.1.3 Brown Shrimp Regressions for the Period 1960-1977	92
3.2.2 Initial Categorical Regressions for White Shrimp Catch and Catch/Effort	98
3.2.2.1 Characterization of the Dependent Variables	98
3.2.2.2 White Shrimp Regressions for the Period 1964-1973	100
3.2.2.3 White Shrimp Regressions for the Period 1960-1977	109
3.2.3 Overall Regression Analysis	117
3.2.3.1 Brown Shrimp Regressions for the Period 1964-1973	117
3.2.3.2 Brown Shrimp Regressions for the Period 1960-1977	120
3.2.3.3 White Shrimp Regressions for the Period 1964-1973	125
3.2.3.4 White Shrimp Regressions for the Period 1960-1977	128
3.2.4 Use of Stepwise Multiple Regression Equations for Impact Assessment	132

TABLE OF CONTENTS (cont.)

	Page
3.3 CLUSTER ANALYSIS	135
3.3.1 Introduction	135
3.3.2 Brown Shrimp Cluster Analysis for the Period 1964-1973	135
3.3.3 Brown Shrimp Cluster Analysis for the Period 1960-1977	138
3.3.4 White Shrimp Cluster Analysis for the Period 1964-1973	139
3.3.5 White Shrimp Cluster Analysis for the Period 1960-1977	140
3.3.6 Brown and White Shrimp Cluster Analysis for the Period 1964-1973	141
3.3.7 Brown and White Shrimp Cluster Analysis for the Period 1960-1977	143
4.0 SUMMARY AND CONCLUSIONS	145
4.1 TIME SERIES ANALYSIS	145
4.2 REGRESSION ANALYSIS	145
4.3 CLUSTER ANALYSIS	152
5.0 REFERENCES	155
6.0 TABLES	168
7.0 FIGURES	407

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LIST OF TABLES

Table	Title	Page
1	Reference list of environmental and shrimp catch variables entered into the stepwise multiple regression analyses for annual brown shrimp total catch and interview catch/effort.	171
2	Reference list of environmental and shrimp catch variables entered into the stepwise multiple regression analyses for annual white shrimp total catch and interview catch/effort.	175
3	Detailed locations, units and sources of variables entered into the stepwise multiple regression analyses for annual brown shrimp total catch and interview catch/effort.	178
4	Detailed locations, units and sources of variables entered into the stepwise multiple regression analyses for annual white shrimp total catch and interview catch/effort.	183
5	List of variable labels, variable numbers and reference numbers for cross-referencing of computer generated data products to reference list and support information for brown shrimp ten year (1964-1973) and eighteen year (1960-1977) data sets.	187
6	List of variable labels, variable numbers and reference numbers for cross-referencing of computer generated data products to reference list and support information for white shrimp ten year (1964-1973) and eighteen year (1960-1977) data sets.	189
7	Summary statistics for white and brown shrimp total monthly catch (pounds, heads off, untransformed data) in area 19 for the eighteen year (1960-1977) data set.	191
8	Summary statistics for white and brown shrimp total monthly catch (pounds, heads off, transformed data) in area 19 for the eighteen year (1960-1977) data set.	191
9	Autocorrelations for brown shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	192

LIST OF TABLES (cont.)

Table	Title	Page
10	Estimation of the parameters of the final ARIMA model for brown shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	192
11	Autocorrelations of the residuals from the ARIMA model for brown shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	193
12	Observed and predicted values (from ARIMA model) for brown shrimp total monthly catch (pounds, heads off) in area 19 for 1977.	194
13	Forecast values for brown shrimp total monthly catch (pounds, heads off) in area 19 from the ARIMA model (with confidence limits) for 1978.	195
14	Autocorrelations for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	196
15	Estimation of the parameters of the final ARIMA model for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	196
16	Autocorrelations of the residuals from the ARIMA model for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.	197
17	Observed and predicted values (from ARIMA model)for white shrimp total monthly catch (pounds, heads off) in area 19 for 1977.	198
18	Forecast values for white shrimp total monthly catch (pounds, heads off) in area 19 from the ARIMA model (with confidence limits) for 1978.	199
19	Power spectrum estimates for white and brown shrimp total monthly catch (pounds, heads off) in area 19 from Fourier analysis of the eighteen year (1960-1977) data set.	200

LIST OF TABLES (cont.)

Table	Title	Page
20	Summary statistics for the ten year (1964-1973) data set used to develop the stepwise multiple regression models relating brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	201
21	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to river discharge variables.	204
22	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with river discharge variables for the ten year (1964-1973) data set.	207
23	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with river discharge variables for the ten year (1964-1973) data set.	208
24	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.	209
25	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with river discharge variables for the ten year (1964-1973) data set.	210
26	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with river discharge variables for the ten year (1964-1973) data set.	211
27	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.	212

LIST OF TABLES (cont.)

Table	Title	Page
28	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to salinity variables.	213
29	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with salinity variables for the ten year (1964-1973) data set.	214
30	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with salinity variables for the ten year (1964-1973) data set.	214
31	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.	215
32	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with salinity variables for the ten year (1964-1973) data set.	215
33	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with salinity variables for the ten year (1964-1973) data set.	216
34	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.	216
35	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to precipitation variables.	217

LIST OF TABLES (cont.)

Table	Title	Page
36	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with precipitation variables for the ten year (1964-1973) data set.	218
37	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with precipitation variables for the ten year (1964-1973) data set.	219
38	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.	220
39	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with precipitation variables for the ten year (1964-1973) data set.	221
40	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with precipitation variables for the ten year (1964-1973) data set.	222
41	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.	223
42	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to temperature variables.	224
43	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with temperature variables for the ten year (1964-1973) data set.	226

Table	Title	Page
44	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with temperature variables for the ten year (1964-1973) data set.	227
45	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.	228
46	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with temperature variables for the ten year (1964-1973) data set.	229
47	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with temperature variables for the ten year (1964-1973) data set.	230
48	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.	231
49	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to wind, tide and Ekman transport variables.	232
50	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	234
51	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	235

LIST OF TABLES (cont.)

Table	Title	Page
52	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	236
53	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	237
54	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	238
55	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	239
56	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to recruitment, bay catch and bay effort variables.	240
57	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	243
58	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	244
59	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	245

Table	Title	Page
60	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	246
61	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	247
62	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	248
63	Summary statistics for the eighteen year (1960-1977) data set used to develop the stepwise multiple regression models relating brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	249
64	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to discharge variables.	251
65	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with river discharge variables for the eighteen year (1960-1977) data set.	254
66	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with river discharge variables for the eighteen year (1960-1977) data set.	255
67	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.	256

LIST OF TABLES (cont.)

Table	Title	Page
68	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with river discharge variables for the eighteen year (1960-1977) data set.	257
69	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with river discharge variables for the eighteen year (1960-1977) data set.	258
70	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.	259
71	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to salinity variables.	260
72	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with salinity variables for the eighteen year (1960-1977) data set.	261
73	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with salinity variables for the eighteen year (1960-1977) data set.	261
74	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with salinity variables for the eighteen year (1960-1977) data set.	262
75	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with salinity variables for the eighteen year (1960-1977) data set.	262

Table	Title	Page
76	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with salinity variables for the eighteen year (1960-1977) data set.	263
77	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with salinity variables for the eighteen year (1960-1977) data set.	263
78	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to precipitation variables.	264
79	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with precipitation variables for the eighteen year (1960-1977) data set.	265
80	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with precipitation variables for the eighteen year (1960-1977) data set.	265
81	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.	266
82	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with precipitation variables for the eighteen year (1960-1977) data set.	266
83	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with precipitation variables for the eighteen year (1960-1977) data set.	267

LIST OF TABLES (cont.)

Table	Title	Page
84	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.	268
85	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to temperature variables.	269
86	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with temperature variables for the eighteen year (1960-1977) data set.	270
87	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with temperature variables for the eighteen year (1960-1977) data set.	271
88	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.	272
89	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with temperature variables for the eighteen year (1960-1977) data set.	273
90	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with temperature variables for the eighteen year (1960-1977) data set.	274
91	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.	274

Table	Title	Page
92	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to wind and tide variables.	275
93	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.	276
94	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.	277
95	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.	278
96	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.	279
97	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.	280
98	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.	281

Table	Title	Page
99	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to bay catch and bay effort variables.	282
100	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	283
101	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with bay catch and bay effort variables for eighteen year (1960-1977) data set.	284
102	Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	285
103	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	286
104	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	287
105	Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	288
106	Summary statistics for the ten year (1964-1973) data set used to develop the stepwise multiple regression models relating white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	288

Table	Title	Page
107	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to discharge variables.	291
108	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with river discharge variables for the ten year (1964-1973) data set.	294
109	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with river discharge variables for the ten year (1964-1973) data set.	295
110	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.	296
111	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with river discharge variables for the ten year (1964-1973) data set.	297
112	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with river discharge variables for the ten year (1964-1973) data set.	298
113	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.	299
114	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to precipitation variables.	300

LIST OF TABLES (cont.)

Table	Title	Page
115	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with precipitation variables for the ten year (1964-1973) data set.	301
116	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with precipitation variables for the ten year (1964-1973) data set.	302
117	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.	303
118	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with precipitation variables for the ten year (1964-1973) data set.	304
119	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with precipitation variables for the ten year (1964-1973) data set.	305
120	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.	306
121	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to temperature variables.	307
122	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with temperature variables for the ten year (1964-1973) data set.	308

Table	Title	Page
123	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with temperature variables for the ten year (1964-1973) data set.	308
124	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.	309
125	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with temperature variables for the ten year (1964-1973) data set.	309
126	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with temperature variables for the ten year (1964-1973) data set.	310
127	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.	310
128	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to wind, tide and Ekman transport variables.	311
129	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	314
130	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	315

LIST OF TABLES (cont.)

Table	Title	Page
131	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	316
132	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.	317
133	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	318
134	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.	319
135	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to salinity variables.	320
136	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with salinity variables for the ten year (1964-1973) data set.	321
137	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with salinity variables for the ten year (1964-1973) data set.	321
138	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.	322

LIST OF TABLES (cont.)

Table	Title	Page
139	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with salinity variables for the ten year (1964-1973) data set.	322
140	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with salinity variables for the ten year (1964-1973) data set.	323
141	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.	323
142	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to recruitment, bay catch and bay effort variables.	324
143	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	325
144	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	326
145	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	327
146	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	328

LIST OF TABLES (cont.)

Table	Title	Page
147	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	329
148	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.	330
149	Summary statistics for the eighteen year (1960-1977) data set used to develop the stepwise multiple regression models relating white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	331
150	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to river discharge variables.	332
151	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with river discharge variables for the eighteen year (1960-1977) data set.	336
152	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with river discharge variables for the eighteen year (1960-1977) data set.	337
153	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.	338
154	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with river discharge variables for the eighteen year (1960-1977) data set.	339

Table	Title	Page
155	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with river discharge variables for the eighteen year (1960-1977) data set.	340
156	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.	341
157	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to precipitation variables.	342
158	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with precipitation variables for the eighteen year (1960-1977) data set.	343
159	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with precipitation variables for the eighteen year (1960-1977) data set.	344
160	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.	345
161	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with precipitation variables for the eighteen year (1960-1977) data set.	346
162	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with precipitation variables for the eighteen year (1960-1977) data set.	347

LIST OF TABLES (cont.)

Table	Title	Page
163	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.	348
164	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to temperature variables.	349
165	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with temperature variables for the eighteen year (1960-1977) data set.	350
166	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with temperature variables for the eighteen year (1960-1977) data set.	350
167	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.	351
168	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with temperature variables for the eighteen year (1960-1977) data set.	351
169	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with temperature variables for the eighteen year (1960-1977) data set.	352
170	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.	352

LIST OF TABLES (cont.)

Table	Title	Page
171	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to wind and tide variables.	353
172	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.	356
173	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.	357
174	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with wind and tide variables for eighteen year (1960-1977) data set.	358
175	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.	359
176	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.	360
177	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.	361

LIST OF TABLES (cont.)

Table	Title	Page
178	Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to bay catch and bay effort variables.	362
179	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	363
180	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	364
181	Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	365
182	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	365
183	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	366
184	Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.	366

LIST OF TABLES (cont.)

Table	Title	Page
185	Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	367
186	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	370
187	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	370
188	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	371
189	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	371
190	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	372
191	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	372

LIST OF TABLES (cont.)

Table	Title	Page
192	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	373
193	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	373
194	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	374
195	Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	375
196	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	379
197	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	380
198	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	381

LIST OF TABLES (cont.)

Table	Title	Page
199	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	382
200	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	382
201	Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	383
202	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	383
203	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	384
204	Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	384
205	Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	385

Table	Title	Page
206	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	388
207	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	388
208	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	389
209	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	389
210	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	390
211	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	390
212	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	391

Table	Title	Page
213	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	391
214	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	392
215	Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.	393
216	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	397
217	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	398
218	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	399
219	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	400

LIST OF TABLES (cont.)

Table	Title	Page
220	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	401
221	Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	402
222	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	403
223	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	404
224	Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	405

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LIST OF FIGURES

Figure	Title	Page
1	Location of the offshore diffuser for the Bryan Mound SPR storage site.	2
2	Important bay systems along the Texas coast (from TDWR 1979b).	6
3	Location of Bryan Mound brine diffuser with reference to NMFS grid zones. Also shown are locations of several regional sources of environmental data.	52
4	Locations of sources of environmental data in the Galveston Bay - Matagorda Bay area.	56
5	The pattern of monthly brown shrimp total catch for area 19 for the period 1960-1977.	409
6	The pattern of monthly white shrimp total catch for area 19 for the period 1960-1977.	410
7	The pattern of (a) annual brown shrimp total catch and (b) brown shrimp interview catch/effort, for area 18, area 19 and area 19, 11-15 fathom depths for the period 1960-1977.	411
8	The pattern of (a) annual white shrimp total catch and (b) annual white shrimp interview catch/effort, for area 18, area 19 and area 19, 11-15 fathom depths for the period 1960-1977.	412
9	Plot of brown shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	413
10	Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	413
11	Plot of brown shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	414

LIST OF FIGURES (cont.)

Figure	Title	Page
12	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	414
13	Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	415
14	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths)based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	415
15	Plot of brown shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the ten year (1964-1973) data set.	416
16	Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	416
17	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.	417
18	Plot of brown shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	418

LIST OF FIGURES (cont.)

Figure	Title	Page
19	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	418
20	Plot of brown shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1963-1974) data set.	419
21	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	419
22	Plot of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1963-1974) data set.	420
23	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	420
24	Plot of brown shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	421
25	Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	421

LIST OF FIGURES (cont.)

Figure	Title	Page
26	Plot of brown shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	422
27	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	422
28	Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	423
29	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	423
30	Plot of brown shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	424
31	Plot of the actual, predicted and residual values of brown shrimp total catch (area 13) based on the final stepwise multiple regression model with environmental variables, indices of recruitment and offshore non-directed effort for the eighteen year (1960-1977) data set.	424
32	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	425

LIST OF FIGURES (cont.)

Figure	Title	Page
33	Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	426
34	Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	426
35	Plot of brown shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	427
36	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	427
37	Plot of brown shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	428
38	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	428
39	Plot of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	429

LIST OF FIGURES (cont.)

Figure	Title	Page
40	Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	429
41	Plot of white shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	430
42	Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	430
43	Plot of white shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	431
44	Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	431
45	Plot of white shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	432
46	Plot of the actual, predicted and residual values of white shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	432

Figure	Title	Page
47	Plot of white shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	433
48	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	433
49	Plot of white shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise regression model for the ten year (1964-1973) data set.	434
50	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	434
51	Plot of white shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.	435
52	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.	435
53	Plot of white shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	436

LIST OF FIGURES (cont.)

Figure	Title	Page
54	Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	436
55	Plot of white shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	437
56	Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	437
57	Plot of white shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	438
58	Plot of the actual, predicted and residual values of white shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	438
59	Plot of white shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	439
60	Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	439

Figure	Title	Page
61	Plot of white shrimp total catch (area 19) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	440
62	Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.	440
63	Plot of white shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	441
64	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	441
65	Plot of white shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	442
66	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	442
67	Plot of white shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.	443

LIST OF FIGURES (cont.)

Figure	Title	Page
68	Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.	443
69	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.	444
70	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.	445
71	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for white shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.	446
72	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for white shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.	447
73	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown and white shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.	448

LIST OF FIGURES (cont.)

Figure	Title	Page
74	Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown and white shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.	449

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1.0 INTRODUCTION

1.1 SPR BACKGROUND

In 1975 the United States Congress passed the Energy Policy Conservation Act which mandated the development of a Strategic Petroleum Reserve (SPR) Program. The SPR program managed by the Department of Energy (DOE) involves leaching of salt domes to create caverns for storage of imported oil. The Bryan Mound salt dome near Freeport, Texas, has been selected as one such oil storage facility (Figure 1).

The process of creating a storage cavern within a salt dome involves dissolving the solid salt with raw water. The water source used for leaching Bryan Mound is the Brazos River. Water is piped under pressure into the salt, and saturated brine solution is displaced out. Initially, DOE attempted to dispose of the brine into underground aquifers through deep injection wells, but the aquifers would not accept the brine at the required rate or quantity. The only practicable alternative was disposal in the ocean.

The Environmental Protection Agency (EPA), Region VI issued to the DOE Permit No. TS-0074012 under the National Pollutant Discharge Elimination System (NPDES). This allows brine discharge from the Bryan Mound storage facility to flow by pipeline to the receiving waters of the Gulf of Mexico seaward of the mean low water (MLW) 70 foot depth contour. This discharge was initially limited to 680,000 barrels per day (maximum permitted leach rate). The EPA has granted an amended permit, effective August 23, 1981, to increase the maximum permitted discharge rate at Bryan Mound from 680,000 bbl/d to 1,100,000 bbl/d as a Phase II (expansion) action to sustain an average accelerated rate of 980,000 bbl/d. Brine is pumped from the storage facility through a buried pipeline to a diffuser system located twelve and one-half miles offshore of Freeport, Texas (Figure 1). The original choice for a diffuser site was five miles offshore along the same route, but this site was abandoned because of the possibility that the area might be a spawning site for white shrimp (*Penaeus setiferus*). Results of the

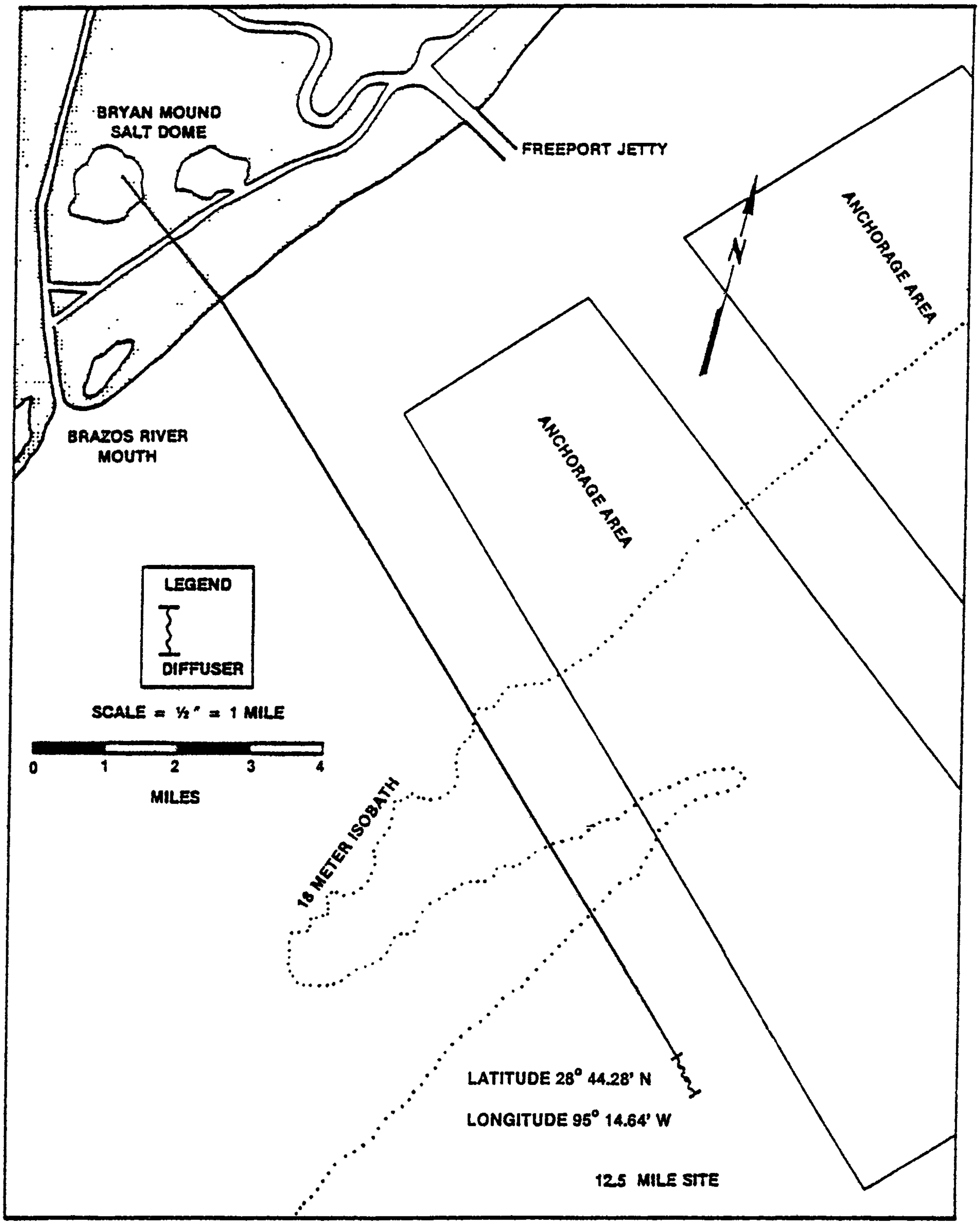

Figure 1. Location of the offshore diffuser site for the Bryan Mound SPR storage site.

spawning site survey in the region of the diffuser site (Gallaway and Reitsema 1981) have confirmed that white shrimp spawning is restricted to the nearshore zone.

The diffuser system is 3000 feet long, oriented onshore to offshore and contains 54 diffuser ports. Brine is jetted from these ports into the water column at exit velocities of approximately 25 feet/second (U.S. Department of Energy 1978).

Initially, there was concern for the possible effects of brine discharge on the shrimp fishery because: (1) the diffuser is located in what might have been a brown shrimp (Penaeus aztecus) spawning grounds; (2) the larvae and postlarvae might have keyed on salinity gradients to aid in transport to the estuaries (e.g. changes in vertical position); (3) since the diffuser is oriented normal to the shore and the dominant current patterns are longshore, a large volume of water, which would, at times, harbor large numbers of penaeid larvae and postlarvae in longshore transport, would pass over the diffuser. These concerns were initially expressed at the Strategic Petroleum Reserve Workshop on Environmental Considerations of Brine Disposal held in Houston, Texas, in February 1977 (James 1977). In addition to these concerns, brine discharge could preclude shrimping in the area of the diffuser. The statistical reporting unit (statistical area x five fathom depth cell) in which the diffuser resides produces economically significant quantities of shrimp. NOAA (1979) reported that statistical area 19, 11-15 fm depths, yielded more than 2.4 million pounds (heads off) of brown shrimp but just over 300,000 pounds (heads off) of white shrimp. Total catches of brown and white shrimp along the Texas coast in 1977 were 35.0 and 11.2 million pounds (heads off), respectively.

The results of the analyses reported herein provide a methodology by which impacts from brine disposal can be assessed. This assessment relates the historical data base for the Gulf coast shrimp fishery to a number of environmental variables which are known to be important in determining the success of a particular year class.

1.2 CHARACTERIZATION OF THE STUDY AREA

The climate of the Texas coast is subtropical with short, mild winters and long hot summers. The transition between summer and winter is rapid. The climate becomes progressively drier westward, with semiarid conditions prevalent in the vicinity of Brownsville. Annual rainfall decreases from greater than 45 inches in the east to less than 27 inches at the Mexican border. The average annual mean temperature (^{o}F) varies from 70 in the east to 24 at the Mexican border. Because of this gradient in climate, Texas estuaries are generally more saline to the westward. The Laguna Madre, which spans the entire southern third of the Texas coast from Corpus Christi to Brownsville, is a hypersaline estuary.

The winds along the Texas coast are dominated by persistent southeasterly flow during much of the year, with the pattern being disrupted during the winter (December through February) as "northers" or polar fronts from the continental interior push through the area. The persistent southeast winds are generaly moderate to strong (speed) while the northers are the most intensive winds. Fifteen to twenty northers, of about 24 to 36 hour duration, generally occur each year, often with winds up to 50 miles/hour.

Gunn (1978) discussed the relationship of wind direction and Ekman transport for the period 1964 to 1973 for the Texas coast based on data from 27^{o} N, 96^{o} W. During most months at this latitude (over the open Gulf), where northers do not have as great an effect as they do at the coast, winds are generally from the east to southeast, with the most southerly flow occurring during the spring and summer. Correspondingly, Ekman transport is to the north and northeast during most of the year, with the most easterly flows occurring during the spring and summer. Strongest transport occurs during the spring and summer months, with peaks for both zonal and meridional (to the east and north, respectively) indices occurring in April.

The study area for this project was the area of the Texas coast in proximity to the Bryan Mound brine diffuser site. Since the brine diffuser is located in the eastern portion of statistical area 19, both area 18 and area 19, along with the contiguous coastal estuarine zone, are considered as part of the study area.

Major estuaries along the Texas coast are shown in Figure 2. As can be seen, three estuary systems, the Trinity-San Jacinto estuary, the Lavaca-Tres Palacios estuary and the Guadalupe estuary are within statistical area 18 and 19, and are, therefore, of direct interest to this study.

The Trinity-San Jacinto estuary (Figure 2) consists of Trinity Bay, Galveston Bay, East Bay, West Bay and several smaller bays and covers about 600 square miles (TDWR 1979b). Areas contributing freshwater inflow to this estuary include the entire Trinity and San Jacinto River Basins and the Trinity-San Jacinto Coastal Basin, plus parts of the Neches-Trinity and Jacinto-Brazos Coastal Basins (Figure 2). The estuary is the largest of eight major Texas estuarine systems and ranks first in shellfish and fourth in finfish production (TDWR 1979b). Since 1962, the average annual commercial catch (all species) from the Trinity-San Jacinto estuary system has been more than 9 million pounds. Shellfish constitute the major portion of commercial landings, accounting for approximately 94 percent of the total annual harvest by weight with the remaining catch being distributed among a number of finfish species. With respect to commercial Texas bay landings from 1972 to 1976, bays of the Trinity-San Jacinto estuary contributed an average 11.0 percent of finfish landings and 45.4 percent of shellfish landings.

The Lavaca-Tres Palacios estuary (Figure 2) is the second largest estuarine system on the Texas coast (352 square miles). Of Texas' eight major estuarine areas, it ranks second in inshore commercial harvest of seafood, which include 17.7 percent of the shellfish landings for the Texas coast. The Lavaca-Tres Palacios estuary includes Matagorda Bay, Lavaca Bay, Cox Bay, Keller Bay, Carancahua Bay, Tres Palacios Bay and

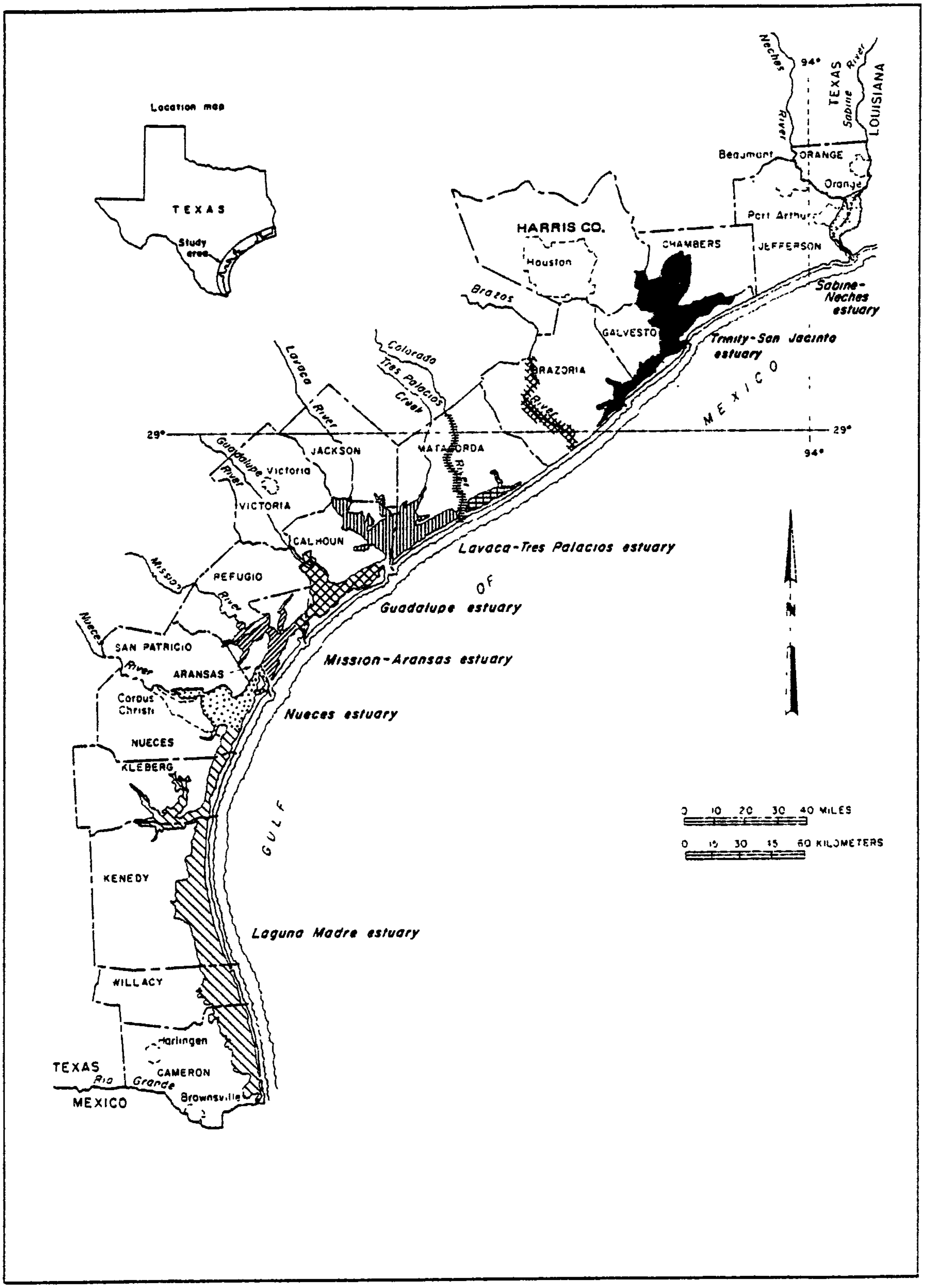

Figure 2. Important bay systems along the Texas Coast (from TDWR 1979b).

several smaller bays. The drainage basin of the Lavaca-Tres Palacios estuary (Figure 2) is approximately 44,000 square miles (TDWR 1980a) and includes the Colorado River Basin, the Lavaca River Basin, the Colorado-Lavaca Coastal Basin, and the Lavaca-Guadalupe Coastal Basin. By far the greatest contribution is from the Colorado River Basin.

The Guadalupe estuary (Figure 2) consists of San Antonio Bay, Espiritu Santo Bay, Mesquite Bay, and several smaller bays. Areas contributing inflow to the estuary include the entire Guadalupe and San Antonio River Basins (15,151 and 10,826 km^2, respectively) plus parts of the Lavaca-Guadalupe and San Antonio-Nueces Coastal Basins (Figure 2). The estuary is shallow (average depth 2.5 ft.) and has a total surface area of 579 km^2 (TDWR 1980b).

1.3 SUMMARY OF RELEVANT INFORMATION ON THE PENAEID LIFE CYCLE

1.3.1 Introduction

In this section the important aspects of the shrimp (*Penaeus* spp.) life cycle are discussed in terms of those recruitment and environmental variables which determine the success of the year class. This information provided the basis for identifying those variables which were utilized in developing predictive equations for shrimping success indicators. A number of data sources were particularly pertinent to the goals of this program and the methodologies, results and conclusions of these studies are discussed below. The Texas Parks and Wildlife Department (TPWD) and the Louisiana Department of Wildlife and Fisheries (LDWF) have been conducting estuarine monitoring studies of penaeid shrimp and the factors influencing their abundance for much of the 1960's and 1970's. In addition, the Bureau of Commercial Fisheries (BCF) and its successor, National Marine Fisheries Service (NMFS), have established a data collection system for gathering information on commercial shrimp catch in the Gulf of Mexico and have also conducted extensive penaeid research in the Gulf.

1.3.2 Generalized Life Cycles

The life cycle of commercially important penaeid shrimp has been the subject of numerous investigations. According to Kutkuhn (1966b) spawning occurs in the nearshore Gulf, with each female producing large numbers of microscopic, demersal eggs. Within hours these semibuoyant eggs hatch into small, planktonic nauplii. Development proceeds rapidly through the protozoal and mysis stages, with the larval shrimp being transported landward toward the mouths of shallow estuaries as they develop. The amount of time elapsing between hatching offshore and entry of the one-half inch (1.25 cm) postlarval shrimp into brackish waters inshore is usually three to five weeks. Once in the estuary, the postlarvae quickly transform into juveniles. Over the subsequent two to four months, they grow rapidly and reach commercial size shortly before their return to the sea, where the life cycle is completed (Kutkuhn 1966b). The management plan for the shrimp fishery of the Gulf of Mexico (Gulf of Mexico Fishery Management Council 1980) is another source of information on the shrimp fishery, including discussions of life history, biology and population dynamics.

Off Texas, fishable stocks of brown shrimp reach maximum density at depths of from 20 to 100 meters (Comiskey et al. 1981) where most spawning occurs (Kutkuhn 1962a, Gallaway and Reitsema 1981). Upon hatching, the young have a fairly great distance to traverse before reaching the estuaries. Once there, they remain a comparatively short time. In contrast, adult white shrimp are rarely found at depths greater than 35 meters, well within that part of the littoral zone measurably influenced by land drainage. Kutkuhn et al. (1969) stated that penaeid larvae are found closer than ten kilometers from shore off Texas only during the summer, when white shrimp are spawning. During the spring (when brown shrimp postlarvae are entering estuaries) larvae are absent in water closer than ten kilometers from shore, being present further offshore. Brown shrimp postlarvae, however, do traverse shallow waters in their journey to the estuaries. The young white shrimp not only spend more time in the estuaries, but penetrate them to a greater degree as well (Burkenroad 1934, Gunter 1950, Lindner and Anderson

1956). Because of their longer stay in the estuaries and especially the fact that they reach large size in the estuaries (larger than the brown shrimp, which remain for a shorter time) they are subject to much more intense inshore exploitation. While some brown shrimp are collected for bait inshore, the commercial catch of adult brown shrimp for Texas is almost entirely offshore. Because brown shrimp generally leave the estuaries as subadults, their immediate harvest could reduce overall shrimp production. Therefore the State of Texas has, for the entire period of concern to this study (1960-1977), regulated the offshore fishery in the outside waters (within state jurisdiction) with a spring closure (Texas Shrimp Conservation Act). Although the normal closure period is 45 days (usually June 1 to July 15), the closed season can be extended up to 15 additional days if it appears that spring growth of brown shrimp was slow and gulf migration late. TPWD conducts spring estuarine sampling to help determine the timing of the closure. Beginning in 1981, this closure to shrimping for brown shrimp has been extended to the fisheries conservation zone (Federal jurisdiction seaward of state waters and extending 200 miles from the coastal baseline).

Moffett (1972) described the typical shrimp life cycle in Texas. Brown shrimp spawn in the open Gulf, at depths of 18.3-91.4 m (60-300 ft), while white shrimp also spawn in the open Gulf, but at depths of 12.2-45.7 m (40-150 ft) or shallower. Postlarvae, which are transported shoreward by tidal currents, are 7-13 mm (0.25-0.50 in) long by the time they reach tidal passes to the bays. In the bays, the postlarvae drift or migrate to fertile and protected backwater nursery areas, including tidal creeks, bayous, marshes and shallow bays. The nursery and bay areas occupied by young shrimp are determined in part by water salinity. White shrimp are generally most abundant at salinities of 10 ppt or less, while brown shrimp prefer 10-20 ppt salinity. Neither tolerates freshwater.

The growth rates of young shrimp, depending primarily on water temperature, are generally 30-60 mm (1.2-2.4 in) per month (Moffett 1970). When 50-75 mm (2-3 in) in length, young shrimp move to the deeper waters of the bays where they become vulnerable to fishing. Juvenile and subadult shrimp, 75-125 mm (3-5 in) in length, migrate back to the Gulf of Mexico, completing the life cycle. Shrimp spend 2-3 months in inshore waters. While in the estuary, juvenile penaeid shrimp feed mainly at the interface of the marsh and open water. The small juveniles feed on detritus, while the larger bay shrimp become more predaceous bottom feeders as they move to the deeper portions of the bay (Gulf of Mexico Fishery Management Council 1980).

Postlarval brown shrimp begin entering bays from the Gulf in February with peak migration in March-April; migration back to the Gulf begins in May or June. White shrimp postlarvae first enter Texas bays in May and continue to migrate through the summer; bay-to-Gulf migrations begin in late summer and continue through fall (Moffett 1972).

At the time of the early summer egress, most brown shrimp have not reached the Texas minimum legal size for harvest (108 mm long; 39 whole shrimp per pound or 65 shrimp per pound, heads off). Trent (1967) found that brown shrimp emigrating from Galveston Bay to the Gulf averaged less than 100 mm (4 in) in length from mid-May to July. White shrimp grow larger (115-140 mm or 4.5-5.5 in) in the bays than do brown shrimp and support an important sport and commercial fishery in both the bays and in the Gulf.

A similar situation was seen in Louisiana (Gaidry and White 1973). A steady increase in estuarine juvenile postlarval density occurs from late March through mid May, during which time a period of peak density of brown shrimp occurred. After this, there was an abrupt decline in the population due to the opening of the spring season (15th-31st of May) and natural egression of larger juvenile shrimp from smaller estuaries upon reaching a length of 65-75 mm. Gaidry and White (1973) stated that the data showed a delay in the first appearance of newly recruited juvenile brown shrimp as one proceeded westward along the Louisiana coast, implying a westward movement of juvenile brown shrimp from the bay systems in the area of the Mississippi and

Atchafalaya river outfalls (e.g., Barataria, Caminada, Timbalier, and Terrebonne bays) where the Louisiana brown shrimp population appeared to be centered. These bay systems, which were created by barrier islands, serve as important staging areas in the early life history of juvenile brown shrimp. Apparently, shortly after juvenile brown shrimp leave the estuaries, they reenter certain estuarine systems that mimic coastal bays. Gaidry and White (1973) showed definitive evidence for an emigration of young adult brown shrimp from Rockefeller Wildlife Refuge and subsequent entry of the same size shrimp to Calcasieu Lake. The movement was consistent for all years of their study. Lakes such as the Calcasieu Lake apparently serve as staging areas prior to the offshore emigration of this group.

Gaidry and White (1973) found that most white shrimp postlarvae entered Louisiana estuarine waters from June to September with the first presence of juveniles in bay catches in June and July, and recruitment continuing through September. Juvenile white shrimp may have migrated offshore during the early winter, reentering the estuaries in early spring. Larger white shrimp moved to offshore waters (after estuarine growth) during July-September. Few white shrimp were found in shallow waters from December-February, with the approaching winter forcing subadult white shrimp prematurely from the shallow nursery areas into the larger lakes or staging areas (e.g., Calcasieu Lake) and finally into the Gulf, where they apparently overwinter. Largest white shrimp populations inshore occurred in April, May, August and September. The populations of the inshore deep lakes and bays from July to December were mainly dependent on recruitment of shrimp from the nursery, while the spring inshore population depended on immigration of the stocks that overwintered offshore. Highest density of white shrimp in offshore waters occured during November-January period.

1.3.3 Factors Influencing the Success of the Year Class

Estuarine areas are vital to the life cycle of penaeid shrimp (Kutkuhn 1966a, Gunter 1967) providing the salinity, temperature, substrate, food, and cover needed by the postlarvae and juveniles. Therefore, the majority of the efforts in the study of shrimp production and forecasting have relied on analysis of recruitment of postlarval and juvenile shrimp to the estuaries and their subsequent development as juveniles in the estuaries. Berry and Baxter (1969) summarized the work conducted in Texas estuaries by BCF-NMFS Galveston Laboratories.

1.3.3.1 Temporal and Spatial Patterns in Spawning Activity

The seasonal occurrence of postlarvae in the estuary depends, to a large degree, on the seasonal pattern in penaeid shrimp reproductive activity. Numerous workers (e.g., Orton 1920 and Subrahmanyam 1971) have stressed the importance of temperature in controlling spawning activity, with most activity occurring in spring or summer and in fall, when temperatures are rising and falling. Baxter and Renfro (1967) stated that the only postlarval penaeids that entered Galveston Bay during the first four months of the year were brown shrimp. By June, advanced postlarval and early juvenile white shrimp became abundant and both brown and white shrimp were present throughout the summer. During times when postlarvae of both species were present, the mean length of the whites was always less than that of the browns, indicating that the white shrimp postlarvae entered the bay at a much smaller size, probably due to the closer proximity of their spawning sites to the estuaries.

Female white shrimp are believed to reach sexual maturity at approximately 135 mm (Moffet 1970, Lindner and Bailey 1968, Gallaway and Reitsema 1981). In males, the joining of the petasmal endopods occurs within a size range of 105 to 127 mm. Burkenroad (1939) stated that males possess spermatophores of maximum size and development at a length of 155 mm. Effective sperm however, is present in specimens as small as 118 mm. During copulation (between hard shelled individuals), the male spermatophore is attached to the thelycum of the female. The spermatophore is anchored by various attachment mechanisms including an adhesive produced by the male and modifications of the exoskeleton in the form of bristles and plates in the female (Lindner and Bailey 1968).

The monthly percentage of female white shrimp, according to stage of ovarian development for the Louisiana offshore fishery (Lindner and Anderson 1956) showed ripe female white shrimp to be present in April, and, by September or October, spawning appeared to be complete (as represented by the decline in ripe ovaries and the increase in the occurrence of spent females). Considerable evidence indicates that P. setiferus may spawn more than once during the season. The percentage of spent females remains low throughout the summer and evidence of subsequent redevelopment of ovaries has been reported (Lindner and Bailey 1968). Spawning in white shrimp is thought to take place in the open Gulf close to shore. Lindner and Anderson (1956) reported that white shrimp spawn in the Gulf at depths of 4 to 17 fathoms during the spring, summer and fall. Based upon the presence of ripe and spent female white shrimp, it appears that the early spring spawning occurred in depths between 9-17 fm. Around June, a second group of spawners appeared in depths under 9 fm and subsequently moved to deeper waters through August and September as they continued to mature. The juveniles resulting from the spring spawning were found in shallow depths in August and were found to move offshore in September. Anderson et al. (1949) reported that larval development in white shrimp took two to three weeks, and the shrimp underwent transformation to the postlarval stage inside the estuary. At depths within which white shrimp were assumed to spawn (7.6 m station), Temple and Fischer (1967) found the greatest abundance of Penaeus sp. larvae during the period from May to August. Gallaway and Reitsema (1981) found spawning white shrimp within about 8 km of the beach. Ripe females have been collected inside bays and estuaries on occasion.

The bulk of white shrimp postlarvae enter the Louisiana estuaries from June to September with smaller pulses occurring in the late fall and early spring. Baxter and Renfro (1967) reported that postlarval white shrimp recruitment to Texas estuaries occurred from May through

October. These postlarvae appeared in waves suggesting periodicity in spawning pulses or in survival of larval stages, possibly related to fluctuations in environmental conditions such as currents, O_2 deficits, predation, etc.

Maturation of female brown shrimp occurs around 115-140 mm total length (Burkenroad 1939, Renfro 1964, and Moffett 1970). Males with joined petasmal endopods are usually found between lengths of 85-101 mm (Lindner and Bailey 1968) and are considered capable of spawning at least by the time they reach 135-140 mm (Renfro 1964, Moffett 1970). The thelycum of brown shrimp is different than that of white shrimp in that it is considered closed. Copulation appears to occur with softshelled females without regard to ovarian developmental stage. Spawning is believed to occur between depths of 25 to 60 fathoms throughout the year and between 10 and 25 fathoms from March to December (Lindner and Anderson 1956, Moffett 1970).

Based upon the abundance of juveniles in estuaries, Gunter (1950) proposed a February-March spawning peak for brown shrimp in Texas. Gaidry and White (1973) and White and Boudreaux (1977) report February and March peak recruitments of brown shrimp postlarvae in Louisiana. However, Moffett (1970) reported that brown shrimp spawned off Texas between 25-30 fm throughout the year and between 10 and 25 fm from March to December. The difference in these findings can be reconciled by the fact that only the early (February-March) wave of brown shrimp postlarvae apparently contributed significantly to the estuarine stocks and subsequent offshore production (Moffett 1971). Renfro and Brusher (1965) reported two peaks in brown shrimp spawning, September to November and April to June. They found that brown shrimp spawned continuously in the open Gulf at depths from 25 to 60 fathoms, and seasonally (from spring to early summer) at depths of 10 to 25 fathoms. Temple and Fischer (1967) found that planktonic stages of penaeid shrimp were found in the open Gulf off Texas in greatest numbers at depths of 15 to 45 fathoms in the late summer and fall, following the peak occurrence of brown shrimp at these depths. They found that the breeding season tended to be protracted with depth, so that penaeid larvae were continually produced at spawning depths greater than 50 meters. Temple and Fischer (1967) proposed an overwintering of postlarval brown shrimp in the nearshore Gulf and this hypothesis is supported by the work of Aldrich et al. (1968) which showed that postlarval brown shrimp burrowed at low temperatures (approximately 15°C) and emerged when temperatures reached 18° to 21.5°C. White shrimp did not burrow, possibly requiring migration either to deeper water or south along the Texas coast to avoid low temperatures. The greater burrowing tendency in juveniles and subadults of brown shrimp as compared to white shrimp was also shown in the laboratory experiments of Wickham and Minkler (1975). This behavioral difference might be related to the less well-defined pattern for white shrimp seasonal distribution.

Angelovic (1976) reported the results of the analyses of plankton samples collected monthly in the STOCS study area from February 1962 to December 1965. Depth zones studied were 7.3-13.7 m, 22.9-27.5 m, 45.8 m, 64.0-82.3 m, and 109.7 m. In the nearshore zone (7.3-13.7 m) abundance of penaeid larvae showed two peaks, one in spring and the other in late summer and early fall, with the occurrence of *Penaeus* spp. larvae in this depth range generally restricted to the April through October period. In the intermediate depth zones (22.9-82.3 meters) *Penaeus* sp. larvae (assumed to be mainly *P. aztecus*) also showed the two peaks characteristic of the nearshore zone, but some spawning occurred during the entire year. During the fall to early winter period the spawning peak occurred later with depth. Greatest catches of *Penaeus* spp. larvae occurred at the 45.8 meter station, and lowest catches at the 109.7 meter station, indicating that the outer limits of the spawning area were being approached.

Results of the Shrimp Spawning Site Survey (Gallaway and Reitsema 1981), conducted as Work Unit 5 of the Shrimp and Redfish Studies, also showed peak spawning for brown shrimp in the autumn at their 46 meter depth study area. They did not, however, locate any overwintering brown shrimp postlarvae in their offshore study areas, leaving in question the fate of these fall spawned brown shrimp larvae. Gallaway and Reitsema (1981) felt strongly that brown shrimp postlarvae were overwintering in the Gulf, and had probably moved inshore from the spawning area after hatching. They felt that the large size of the early (February to March) arriving postlarvae indicated that they were spawned the previous fall. They noted that Ekman transport is generally not favorable for transport of larvae to the estuaries of the northwest Gulf in the fall and early winter, with net transport predominantly offshore.

Subrahmanyam (1971) conducted a thorough study of the abundance and distribution of penaeid shrimp larvae along a six station transect off the Mississippi Coast out to 50 fm (approximately 100 meter depth) depth. He concluded that penaeid spawning occurred within the bottom temperature range of 17^{o} and 29^{o}C, and intense spawning was associated with rising temperatures in spring and falling temperatures in late fall or early winter. He concluded that spawning occurred close to shore during the warmer months, and shifted farther offshore as temperatures began to fall in the autumn. Penaeus spp. spawned in all depths, but mainly at 18 m in summer, 36 m in fall and 72 to 90 m in winter.

1.3.3.2 Transport of Larvae and Postlarvae to the Estuaries

One of the most important aspects of the penaeid life cycle is the transport of the developing larvae to the estuaries. Current patterns and large scale transport of water masses on the Continental Shelf probably govern, to a large degree, the eventual occurrence of postlarvae at the entrances to the nursery areas. In addition to passive transport, postlarvae are capable of extended swimming. Aldrich (1966) estimated that swimming alone could transport postlarvae 4.8 km per day.

The data relating postlarval recruitment to wind-generated currents (as transport mechanisms) are not conclusive. Williams and Deubler (1968), working on the Atlantic Coast of the U.S., found that ten years of data did not show a definitive link between wind-generated onshore currents and larvae collected at flood tide in tidal passes. Wind direction at time of catch apparently had no effect on sampling success. There was also no relationship between the magnitude of current and number of postlarvae collected. In fact, King (1971) showed a positive correlation between offshore winds and the number of postlarval brown shrimp caught on flood tides in a Texas tidal inlet.

Nelson et al. (1977) used wind drift data (Ekman transport) computed from mean monthly atmospheric pressure distributions to help predict Atlantic menhaden catches. In general they found that stronger westward transport (offshore to onshore) occurred between November and February in the south Atlantic region, the period of peak menhaden spawning, and suggested that this might provide a mechanism by which menhaden larvae could be transported long distances to the estuaries. They used a Ricker spawner-recruit curve to account for density-dependent variations, with the potential number of eggs that could be produced by the spawning stock used as the independent variable. The potential number of eggs depended on the age distribution of the spawners and their size. The parameters of the model were estimated from a linear regression of ln (R/S) on S, where R equals recruitment and S equals the spawning stock. The authors then attempted to explain deviations from this curve that might be caused by density-independent factors, such as environmental variables. They calculated a survival index as the ratio of observed recruits (number of age 1 individuals and estimated exploitation rates) to the number of recruits calculated from the Ricker spawner- recruit model. They felt this ratio, which is density-independent, should reflect the environmental effects that influence survival of menhaden before recruitment to the fishery. They found that 62 percent of the variance in the survival index was explained by zonal Ekman transport. They then developed a multiple regression model to predict survival index from several environmental variables and found that 84 percent of the variation in survival index was explained by the model. Nelson et al. (1977) attributed the lower correlations between survival index and Ekman transport in the middle Atlantic (as compared with the south Atlantic) to the increasing importance of long-distance oceanic transport as spawning activities move progressively southward (and offshore) in the Atlantic. If, as can be surmised from the various studies involving brown shrimp spawning, maximum activity takes place in waters greater than 30 meters (100 ft), long range Ekman transport may be important to the success of the brown shrimp year class. For white shrimp, which spawn closer to shore, long range transport vectors might be expected to be less important.

Kutkuhn et al. (1969) discussed work which was initiated in the late 1950's by the Galveston Biological Laboratory of the Bureau of Commercial Fisheries to identify migration of larval and postlarval penaeid shrimp into Galveston Bay. They studied the spatial and temporal distribution of penaeid postlarvae and juveniles near Galveston Entrance for one year with high-intensity sampling. They found that even at this intensity of sampling, the temporal changes associated with rapid onshore movement of postlarvae waves were not well documented; however, spatial variations were more effectively discerned. They found that the distribution of pre-juvenile Penaeus spp. approaching Galveston Entrance was nearly homogeneous (spatially). In spring, most larval and postlarval brown shrimp approached from the east, and in summer white shrimp postlarvae approached from the south and west. This is in agreement with the net longshore transport in the northwest Gulf, which is from east to west in all seasons except late summer, when it reverses. They concluded that spawning grounds for the brown and white shrimp in the Galveston Bay area lay to the east and west, respectively. During their study, they found that the peak abundance of larval and postlarval white shrimp offshore was not paralleled by evidence of greater postlarval abundance in Galveston Entrance, possibly indicating that oceanic conditions were not right for transport. They also found that very few penaeid larvae were present in the water column during fall and winter, or on the bottom during any season. No postlarvae were found during winter. Berry and Baxter (1969) felt that the rapid influx of postlarvae to the estuaries in the spring required that intense sampling be conducted to more accurately determine the amount and periodicity of recruitment.

Joyce (1965) felt that postlarval shrimp, through behavioral mechanisms, have the ability to choose a tide favorable for transport. Hughes (1969a and b) found, in laboratory experiments, that reduction in salinity caused postlarval pink shrimp to settle to the bottom while an increase in salinity initiated a movement up into the water column. Hughes postulated that this response would allow the shrimp to use incoming tides (high salinity) to enter estuaries and avoid the low salinity ebb tide. He also found that postlarval pink shrimp responded to changes in salinity of as little as 1 ppt. The hypothesis of Hughes to account for movement of postlarvae into the estuaries rests on the importance of predictable tides for transport. In the northwest Gulf, where winds are important in determining tidal fluxes, this is often not the case. Although some exceptions were seen, Berry and Baxter (1969) did find that strong tides carried large numbers of postlarvae into the Galveston Bay estuaries. This same phenomenon has been documented by Pearson (1939), Tabb et al. (1962), St. Amant et al. (1965), Caillouet et al. (1968) and Fontaine et al. (1972). Because of this importance of passive transport in delivering the postlarvae to the estuaries, normal tidal exchanges, storms and wind-induced current movements, or excessive runoff could change the number of postlarvae entering the estuaries. King (1971), who sampled only on flood tides, found that the rate of brown shrimp postlarval immigration was positively related to tidal amplitude.

Field surveys disagree as to whether postlarval shrimp exhibit diel changes in vertical position in the water column. Much evidence shows maximum numbers of postlarvae in the surface at night (Tabb et al., 1962; Baxter and Furr 1964; Copeland and Truitt 1966; Williams and Deubler 1968; and Caillouet et al. 1968). Temple and Fischer (1965) found vertical migration of penaeid postlarvae during times of stratification with upward migration at night and a return to lower depths at dawn. When water was isothermal no vertical differences were seen. Subrahmanyam (1971) stated that his results differed from those of Temple and Fischer (1965) regarding vertical distribution of penaeid larvae. He did not see the distinct depth patterns reported by Temple and Fischer (1965), and indicated that, in his estimation, their data did not indicate a distinct ascent to the surface at night. He concluded that the protozoea and mysis stages showed random patterns of vertical distribution, and that postlarvae were also randomly distributed in the water column. Fontaine et al. (1972) and Duronslet et al. (1972) found postlarvae of brown and white shrimp occurring in greatest numbers near the surface during immigration through tidal passes. On the other hand, St. Amant et al. (1965), Berry and Baxter (1969), and Caillouet et al. (1968) found no difference in postlarval brown shrimp distribution with depth. Jones et al. (1970) found no significant difference between the numbers of pink shrimp postlarvae caught at the surface during the day and during the night. Williams and Deubler (1968) also showed that bright light at night drastically reduced penaeid postlarval catch/tow. Also, catches on new moons were higher than those taken when the moon was full.

1.3.3.3 Postlarval Abundance as an Index of Shrimping Success

In the early 1960's, the Galveston Biological Laboratory of the Bureau of Commercial Fisheries began studies aimed at forecasting brown shrimp abundance (Berry and Baxter 1969). The basic premise under investigation was that abundance of postlarvae entering coastal bays and density of juvenile shrimp in the bays were related to subsequent commercial stocks. Initial studies (2 years) indicated that a poor brown shrimp crop in June and July was related to low catches of postlarvae entering Galveston Bay earlier in the year, while during a good catch year, high numbers of postlarvae entered the estuaries during the late winter and spring. These results led to intensive sampling (every two weeks) as part of an effort to predict shrimp catch from catches of postlarvae. Overall, the predictive capability of postlarval abundance has not been good. Berry and Baxter (1969) note that while postlarval collections from March to April for 1960-1966 in Texas were very similar (except for 1961), there were significant differences in commercial catch (adult shrimp) during these years.

Christmas et al. (1966) stated that

> "...it has been surmised for a long time that prediction of at least the relative abundance of the future shrimp (production) could be deduced from studies of the number of

young or juvenile shrimp in the bay right after they have completed their larval immigration..."

Christmas et al. (1966) reported the results of sampling of postlarval penaeid shrimp in Mississippi Sound from November 1962 to October 1964. This study was conducted under contract to the Bureau of Commercial Fisheries and used sampling gear (Renfro small beam trawl, see also Renfro 1963) and techniques similar to those first employed by Baxter (1963). One of the goals of the program was the development of an index of postlarval "success". The index for brown shrimp which was developed was the average postlarval haul for the period of February through July, and covered the period of significant postlarval immigration. They noted that white shrimp postlarval immigration began in May, with movement of postlarvae into the estuaries continuing until the end of October. Average numbers of white shrimp postlarvae per haul from May through the remainder of the year were used as the index of white shrimp postlarval abundance. Using catch and catch/effort as indices of shrimp abundance, they found that postlarval indices could be used to predict the 1964 catch from the 1963 data with surprising accuracy for both species. Subrahmanyam (1971) stated that the relationship developed by Christmas et al. (1966) is an uncertain one, due mainly to the short time period involved. He examined the relationship between spawning success and postlarval abundance for white and brown shrimp, and found that during the major spawning periods the increases and decreases in larval abundance were closely followed by corresponding trends for the postlarvae.

Christmas et al. (1976), who report on further development of a brown shrimp postlarval index for Mississippi waters, defined the index as the average number of postlarvae per tow taken during the peak spring recruitment period (usually March to May). For the period 1971 to 1973, the postlarval index of brown shrimp abundance predicted the subsequent commercial catch for 1972 and 1973 with a maximum discrepancy of less than 10 percent.

1.3.3.4 Juvenile Abundance as an Index of Shrimping Success

In conjunction with their postlarval studies, members of the staff of the Galveston Biological Laboratory also conducted a survey of the Galveston Bay bait shrimp fishery, recording weekly information on total landings, fishing effort, and species and size composition. Commercial harvests, as reported in USFWS-BCF Fishery Circulars, were also used. Berry and Baxter (1969) reported that the relative sizes of the shrimp stocks developing in Galveston Bay were better reflected by bait shrimp landings than by postlarval abundance, indicating that conditions in the estuary during arrival of the postlarvae or early in the juvenile growth period greatly influence the subsequent abundance of commercial shrimp. For brown shrimp, Berry and Baxter (1969) noted that bait shrimp landings from Galveston Bay were greatest during the period from May to July. Offshore, young of the year began appearing in catches in late June and reached peak density in July and/or August. They concluded that the early season bait fishery catch/effort (weekly mean for 25 April - 31 July) was the best predictor of commercial abundance offshore. April 25 was the earliest expected appearance of juvenile brown shrimp in commercial bait catches (Chin 1960), while most brown shrimp have left Galveston Bay by the end of July. They also found that, with the exception of 1963 when unusually warm weather caused early emigration of brown shrimp from the estuaries, a close relationship existed between the 14-week mean catch (25 April - 31 July) and that of the 25 April to 12 June period. Total catch of brown shrimp in area 18 during 1963 was higher than average. Using average catch per day during the July-September period in offshore waters (>20 meters depth) of subarea 18 (as reported in Gulf Coast Shrimp Data) as an index of brown shrimp stocks offshore from Galveston Bay, they found a close relationship between the relative stock size in Galveston Bay (from bait dealer survey data) and the offshore stock for most years from 1960 to 1966. The exception was 1966, when spring floods decreased bay salinities in May 1966 and may have caused young shrimp to move seaward. The offshore index was, however, relatively high, indicating that young shrimp were not detrimentally affected by the reduction in salinity.

Comparing the juvenile (25 April - 12 June) and offshore indices (Gulf Coast Shrimp Data), they also found a strong positive relationship in five of seven years. These results indicated that postlarval abundance offshore or the number entering the estuaries were not well reflected in subsequent offshore shrimp production. However, the results for Texas (Baxter 1963) were better than those subsequently developed in Louisiana (Gaidry and White 1973). For the years 1960 to 1972, Caillouet and Baxter (1973) obtained a simple correlation coefficient of $r = 0.85$ for the relationship between annual offshore catch of brown shrimp in Texas and the average weekly catch per hour for brown (bait) shrimp in Galveston Bay (during the period from April 25 to June 12). St. Amant et al. (1962) showed that populations of postlarval brown shrimp were quite responsive to certain unstable hydrologic conditions that often existed during and shortly after their arrival at the estuary. Postlarval density (offshore) alone was shown to be a poor indicator of impending production levels in Louisiana. Gaidry and White (1973) pointed out that postlarval data alone had proven inconsistent in Louisiana's efforts to predict commercial shrimp catch. Therefore, Louisiana has relied heavily on juvenile indices for predicting offshore catch. The success or failure of a shrimp year class appears to depend more on factors occurring subsequent to entry of the postlarvae to the estuary. Because of the apparent close correlation between recruitment (juvenile) stocks and subsequent offshore catches, a greater effort has recently gone into the identification of those factors which are responsible for success of juvenile shrimp inside the estuaries. Of these, temperature and salinity have received the most attention.

One group of studies that provides a wealth of information on the abundance of juvenile white and brown shrimp in Texas and the factors influencing the seasonality and success of the shrimp year classes are the TPWD estuarine shrimp studies. Results of segments of this continuing project, which covers the entire Texas Coast, were reported by Leary and Compton (1960), Compton (1962), Pullen (1963), Moffett (1964, 1965a, 1965b, 1966, 1967, 1968, 1969, 1970, 1971, 1972), Moffett and McEachron (1973, 1974), and Johnson (1975). To manage the

Texas shrimp fishery, TPWD personnel have studied shrimp growth rates, movements, trends in seasonal abundance and habitat requirements since 1959. Since brown shrimp are less than the legal size of 108 mm (65 headless shrimp per pound) when they leave the estuaries, Texas law provides a 45-day closed season in the shallow Gulf (from the coast out to 9 nautical miles). Usually this season begins on 1 June, but the TPWD can adjust the closing date to coincide with the start of emigration. State biologists, therefore, sample brown shrimp in bays during April and May to predict when emigration will begin. It is felt that a good prediction will allow a portion of the brown shrimp population to reach larger size and weight before harvest begins, and prevent the discarding of great numbers of shrimp too small to be sold legally. State biologists also sample white shrimp in late summer and fall to determine if areas in commercially fished bays harbor large concentrations of illegal size white shrimp (less than 113 mm, or 65 headless to a pound). The fall bay season and minimum legal shrimp size are set by law.

Shrimp sampling stations in the TPWD study were described by Leary and Compton (1960). These include: 1) nursery area or tertiary bay stations (areas of estuaries 1-2 ft deep (less than 1 meter) used by postlarval and small juvenile brown shrimp during their early days in bays, e.g., salt marshes, shallow back bays and small bayous); 2) secondary bay stations (bays 4 to 5 ft (1.3-1.6 meter) deep, through which juvenile shrimp pass when they are 40 to 70 mm, e.g., Clear Lake, Jones Lake and Moses Lake in the Galveston Bay area); and 3) primary bay stations (stations in large bays usually deeper than six feet (2 meter), e.g., Galveston Bay, Matagorda Bay and Aransas Bay).

During April and May, brown shrimp were sampled weekly by TPWD personnel at designated stations in Galveston and Matagorda Bays, and twice a month in Aransas Bay and the Lower Laguna Madre. Gear used included : 1) bar seines, 1.80 m (6 ft) wide, 1.3 cm (0.50 in) mesh, pulled 152.4 m (500 ft) by hand in nursery areas, and 2) trawls, 3.05 m (10 ft) wide, 3.2 cm (1.25 in) mesh, 1.3 cm mesh liner in cod end, pulled 15 minutes per station (2 mi/hr) in secondary and primary bays.

Shrimp were measured to the nearest millimeter (tip of rostrum to end of telson) and counted. During summer and fall shrimp were sampled twice a month with trawls at designated stations on the commercial shrimping grounds of Galveston, Matagorda and Aransas bays (Moffett 1972). Because of the change in sampling methodologies for white shrimp during the course of these studies, only the data from the TPWD estuarine studies for brown shrimp are of quantitative value for predictive purposes.

Based on the results of the analyses of data up to 1970, a number of trends were apparent. For the 1962-1970 period, there was a strong positive correlation ($r = 0.92$) between brown shrimp sample catch/unit effort (in the estuaries) and annual commercial (offshore) brown shrimp catches (Moffett 1970), indicating that (juvenile) shrimp recruitment was a good indicator of subsequent offshore harvest. The least squares equation for this relationship was $Y = 12.67 + 0.21X$, where Y is offshore commercial catch (in pounds, heads off, X 10^{-6}) and X is the catch/unit effort (average number of shrimp per sample) from the estuary samples collected with 6 ft bar seines and 10 ft otter trawls during the period 1962 to 1970. Moffett (1970) also noted that the relationship between shrimp abundance and salinity was not clear because of the confounding effects of environmental covariates, such as temperature, sediment composition and predation.

Moffett (1971) also compared annual rainfall for the 1962-1970 period to brown shrimp landings in Texas and the trend was for increased catch during years with drier springs. Gunter and Hildebrand (1954) had previously found a positive correlation between white shrimp production and rainfall in Texas but their work related mainly to the very severe drought years of the early 1950's when the effects of the drought were obvious. Gunter and Edwards (1969), in their study of white shrimp yield in Texas, found a strong statistical correlation between yearly catch and rainfall of the two previous years and between yearly catch and the combined rainfall of the year and two previous years. Moffett (1971) noted that white shrimp catches in Texas in 1964, 1968, 1969 and 1970 were high, and, excluding the higher 1969 catch (which was at least partly due to increased fishing pressure on white shrimp stocks due to low availability of brown shrimp), large catches were made two years after a "wet" year. Gunter and Edwards (1969) found no correlation between catches of brown shrimp and rainfall in Texas, nor between catches of either species in Louisiana and discharge from Mississippi river. However, Barrett and Gillespie (1973) compared spring river discharge with brown shrimp production, and summer river discharge with white shrimp production, and in both cases, an inverse relationship was seen. Coastal rainfall (and temperature) appeared to be very important to inshore catches. This apparently different response of white shrimp in Louisiana and Texas may be related to different ambient salinities in the estuaries of the two states.

Moffett (1967) noted that a good brown shrimp season was likely in Texas if postlarvae were abundant in the spring and the period of peak immigration was late. Differences in the temporal occurrence of the different stages of the shrimp life cycle from year to year were common and were probably caused by trends in environmental covariates. Prolonged flooding of marshes during long-lasting periods of high spring tides and prevailing onshore winds along the upper coast apparently increased the brown shrimp population by increasing the amount of nursery space (Moffett 1972). Moffett felt that favorable large scale water movements in the Gulf of Mexico in spring, resulting from onshore winds, carry more than the usual number of postlarvae to the expanded nurseries. In this case, the same environmental variables (tides, onshore winds) apparently fostered both postlarval immigration and survival inside the estuary. During 1967, which was a peak year for brown shrimp catch in Texas but a poor year for white shrimp catch, rainfall was low and salinity was high in the spring. Drought and semi-drought conditions prevailed during the mild winter and spring, leading to high salinities and high water temperatures in the spring. The first wave of brown shrimp postlarvae was large and successful. By early May, brown shrimp were migrating offshore due to early immigration of the postlarvae to the bays and rapid growth. White shrimp production was low in summer, with a large wave entering the estuary in the fall.

Because 1981, the first year of sustained discharge of high volumes of brine at the Bryan Mound site, was environmentally similar to 1967 (high salinity and low rainfall in spring), it will be interesting to compare predicted and actual catches for this period.

These results indicate that temperatures in the spring may affect both abundance and growth of brown shrimp. Berry and Baxter (1969), found a strong relationship between average April air temperature at Galveston and time of peak abundance of juvenile shrimp in Galveston Bay. In 1967, the average April air temperature was high and peak brown shrimp abundance was reached in early May. Generally the peak occurred later. The fact that brown shrimp growth rate varies with temperature is considered by TPWD when adjusting the 45 day closed Gulf season in the spring. Results from the TPWD surveys (Moffett 1970) indicated that the first waves of brown shrimp postlarvae entering coastal bays in March and April generally determined the success of the fishery for the year. Usually brown shrimp growth rates were slow in Texas bays in April and rapid in May, with the subadults generally leaving the estuary in late May and early June. In the cold spring of 1964, brown shrimp growth in Galveston Bay was slow in April; however, the bays warmed in May and the young brown shrimp reached "emigration" size by June (Moffett 1965a).

In 1972, the apparent abundance of brown shrimp in estuaries and the early availability of bait size brown shrimp in Galveston Bay indicated that the year class was strong (Moffett 1972). The year class benefited from a steady, early ingression of postlarvae, lack of cold periods after postlarvae had entered bays and extreme high tides in April and May, expanding the size of the nursery area available for brown shrimp production.

The 1973 to 1975 period was especially bad for brown shrimp catch in Texas (Moffett and McEachron 1973, 1974; Johnson 1975). During 1973, which was the worst year during the 1960 to 1977 period for commercial brown shrimp catch in Texas, annual rainfall for the upper Texas coast was 174.5 cm (57.2 cm above normal). This was combined with cool temperatures in April to render the upper Texas coast estuaries relatively unsuitable for brown shrimp production. During the first week of April, postlarval and juvenile shrimp (13 to 38 mm) were caught on nursery grounds of Moses Lake, Jones Lake, Dickinson Bayou, and Christmas Bay in Texas. They virtually disappeared, however, during the record cold spell of 9-13 April. The lowest recorded air temperature during this period was -5.6°C; the lowest recorded water temperature was 11.5°C. Brown shrimp that virtually disappeared from samples collected in Galveston Bay nursery areas during the April cold spell may have suffered extensive mortality, burrowed in the substrate or moved to deeper water (Moffett and McEachron 1973). Low brown shrimp abundance and low salinity during April and May were also apparently related. Gunter et al. (1964) had previously reported that brown shrimp in Texas bays are most abundant at salinities of 10 to 20 ppt and least abundant at salinities of 0 to 4.99 ppt. Between 1 April and 23 May, 1973, the average weekly bay salinity of upper coastal bays was less than 9.8 ppt. Therefore, Sabine Lake, Galveston Bay and Matagorda Bay were not suitable for good brown shrimp production (Moffett and McEachron 1973). The strength of the 1973 white shrimp year class that yielded a record high of 14.9 million pounds in Texas may have been positively related to abundant rainfall (Moffett and McEachron, 1973). This agrees with the conclusion of Gunter and Edwards (1969) that a positive correlation exists between large catch of white shrimp and abundant rainfall in Texas, but this is somewhat different from the response seen in Louisiana. Kutkuhn (1966a) suggested that increases in white shrimp abundance and fishing success may be related to increased nutrient materials carried to bays by flood water.

Moffett and McEachron (1974) reported that although the late pre-recruitment groups of small brown shrimp in bays indicated that the stocks may have been adequate, the brown shrimp season in Texas in 1974 was a poor one. The reduced 1974 catch was probably a result of less effort, due to inflated operational costs and low shrimp prices. In 1975, the third consecutive year of poor brown shrimp harvest, the problems appeared to be due to a combination of low density of shrimp and economic conditions in the shrimping industry (Johnson 1975). Salinities in portions of Texas estuaries in 1975 were not ideal for brown shrimp survival. Values in most areas were 10 ppt or higher, but low salinities were recorded in the Tres Palacios River area of the Matagorda Bay system (0.0-5.0 ppt) and in upper and middle Galveston Bay nurseries (0.0-9.9 ppt) during April and May. After the first week of April, most water temperatures recorded were above 20^{0}C; however, daily temperatures in Galveston Bay at the TPWD Marine Laboratory at Seabrook, Texas exceeded 20^{0}C only on 17-19 April and after 23 April. The water temperatures at Seabrook were below 20^{0}C for more than 200 hours after the first week of April (Johnson 1975).

For white shrimp, the results of the TPWD surveys conducted from 1960 to 1970 showed that postlarvae often enter bays of the upper Texas coast in several waves from June through October. Unlike the situation for brown shrimp, the first wave of white shrimp was not always the largest or most successful. This implies that a postlarval wave occurring during mid-summer or early fall could be very important to subsequent bay and offshore catches. In both 1965 and 1966 white shrimp were scarce in summer and abundant in the fall in Galveston Bay. Moffett (1966) noted that the large waves of small white shrimp that appeared in Galveston Bay late in the season in 1966 would contribute to the 1967 catch if conditions were suitable for survival and growth. Moffett (1969) noted that the large numbers of adult white shrimp caught in the spring of 1969 reflected the large late-fall to winter white shrimp wave of the 1968 year class. Many of the shrimp spent the mild 1968-1969 winter in Clear Lake and apparently migrated to Galveston Bay in April. Moffett (1966) noted that prediction of white shrimp abundance poses greater problems than for brown shrimp since the second or third waves of postlarvae entering the estuaries in the summer or early fall can be larger than the first.

Occasionally, winter conditions are severe, and shrimp kills have been reported by Gunter (1941), Gunter and Hildebrand (1951), and Joyce (1965). In 1966, heavy mortalities were experienced in Galveston Bay by the young white shrimp that had resulted from the late arriving wave of postlarvae. (Moffett 1966). Chapman (1964) found a scarcity of white shrimp in Galveston Bay in late February after high numbers were found in mid-January. Apparently, heavy mortality was experienced when temperatures dropped to about 4°C. Prerecruitment waves of white shrimp usually moved from back bays to primary bays during the fall's first "norther." At this time they first became vulnerable to the fishery.

Movement of juvenile shrimp from peripheral bays and nurseries to commercial fishing grounds can be influenced by rainfall as well as temperature (Moffett 1966). In 1966, higher than normal tides flooded peripheral marshes and increased nursery space. However, in late April, as the Trinity River flooded and salinities declined in Trinity Bay, brown shrimp moved from upper bays to lower saltier bays, but there did not appear to be an early premature offshore migration. The movement of small white shrimp from peripheral bays to the commercial fishing grounds of Galveston Bay in September 1973 appeared also to be related to rainfall and runoff associated with tropical storm Delia. Upper coast rainfall in September was 21.1 cm (8.3 in), 12.5 cm (4.9 in) higher than normal (Moffett and McEachron 1973).

Although trends for white shrimp along the Texas coast are generally similar, some geographical differences have been noted. For example, in 1968, the first (June) wave of postlarval white shrimp entering Matagorda Bay was large, while in Galveston Bay, the first wave was much smaller than the major wave, which occurred in mid-July.

Parallel studies of the penaeid resource have been conducted in Louisiana estuaries by LDWF. Barrett and Gillespie (1973), in findings similar to those of Berry and Baxter (1969) in Texas, reported that a good shrimp year in Louisiana reflected good catches both inshore and offshore and a poor year was poor both inshore and offshore. Caillouet and Baxter (1973) showed similar patterns for Texas and Louisiana. These results reinforce the usefulness of recruitment (juvenile catch) to predict offshore (adult) catch. Barrett and Ralph (1976) found that while trends in both white and brown shrimp catch inshore and offshore were similar, years of good brown shrimp catch differed considerably from years of good white shrimp catch. Using data from the May to July period to develop an index of brown shrimp catch, a higher percentage of the shrimp catch consisted of larger individuals in poor years. This was due, presumably, to better recruitment during good years, which contributed a larger proportion of young of the year shrimp to the fishery.

St. Amant, Broom, and Ford (1965), St. Amant, Corkum, and Broom (1962), and Ford and St. Amant (1971) had earlier found increasing numbers of juveniles and maximum postlarval densities of brown shrimp in Louisiana estuaries when water temperature remained at or above 18^{o} and $20^{o}C$, respectively. However, salinities were also shown to be important, as denser populations and larger postlarvae were found at salinities above 15 ppt. Barrett and Gillespie (1973) stated that unseasonally low temperatures in Louisiana coastal waters, especially in the early weeks following spawning, are critical factors in the survival of larval brown shrimp during metamorphosis and of postlarvae arriving in estuarine nursery areas. They suggested that the number of hours that temperature remained below $20^{o}C$ after April 8 was important in determining brown shrimp production for the year. If temperatures remained below $20^{o}C$ for 33 hours or more, then temperature became a limiting factor to shrimp production. If temperature remained below $20^{o}C$ for less than 33 hours, other factors, such as rainfall, river discharge and availability of food, became important. Upper to lower bay salinities of 15 and 20 ppt, respectively, appeared to be ideal for brown shrimp production. In the Barataria - Caminada bay area, during years when May brown shrimp production exceeded one million pounds (1963, 1967-1972), weekly mean salinities were above 18.3 ppt. During those years when production was less than one million pounds, weekly salinities were below 18.3 ppt. According to Barrett and Gillespie (1973) the annual brown shrimp catch appeared related to the number of acres of estuarine surface water in coastal Louisiana above 10 ppt salinity in the spring. The large amount of freshwater which entered the estuaries in 1973 resulted in a drastic reduction in the amount of nursery area as compared to 1972. Turner (1977) found a strong linear correlation (r^2 = 0.69) between the area of intertidal land and yield of penaeid shrimp caught in inshore Louisiana waters. For the total inshore penaeid shrimp catch, the percent that were brown shrimp was found to be directly related to the percent of saline vegetation in the estuaries.

Gaidry and White (1973) also found that hydrologic conditions prevailing shortly after the arrival of postlarval brown shrimp can be directly correlated with commercial offshore production. They reported that above average abundance of brown shrimp for 1970-1972 was the result of abnormally high salinity levels in the estuaries during the spring of these three years. White (1975), noting that past studies showed that juvenile (brown shrimp) numbers were good indicators of future production, stated that juvenile abundance was directly related to the hydrologic conditions that occurred during and after postlarval recruitment. The low production year of 1964 was characterized by low temperatures shortly after peak larval recruitment, along with low salinities. They also concluded that hydrologic conditions (low temperatures and salinities) during late April and early May of 1973 restricted growth and dispersal, leading to reduced production. The crucial period for brown shrimp growth occurred in Louisiana between April 26 and May 20. It appeared that an average temperature of 20°C was minimum for normal growth of brown shrimp in the natural state (a growth rate of 1 mm per day). As temperatures increase above 20°C during the spring, accelerated growth could be expected, especially when combined with adequate salinity levels. Barrett and Gillespie (1975) reported that, after April, salinity is the dominant factor influencing brown shrimp distribution. Cool April waters with low salinities in May and June resulted in lower than average catches. While salinity varies considerably over the spring, good years have higher seasonal means.

White (1975) reported that, in Louisiana in 1973, when floods were prevalent in early spring, high discharge from the Calcasieu River and nearby local drainages caused juvenile brown shrimp recruitment to be low. Otherwise, where local flooding was not present, there was no significant reduction in juvenile abundance due to flooding of the Mississippi or Atchafalaya River. White concluded that it was the salinity and temperature conditions that prevailed following the recruitment of these postlarval that affected juvenile growth and production.

Barrett and Ralph (1976) found that in Louisiana years with low spring rainfall and river runoff had good brown shrimp production. It should be noted that coastal rainfall would be most closely related to local discharge. The flows of the Mississippi and Atchafalaya Rivers are not significantly influenced by rainfall along the coast. They conclude that good brown shrimp catches occurred when salinities were above average due to low spring rainfall and river discharge, and water temperatures in the spring were mild. Higher than average salinities in Louisiana estuaries were related to increased production of both white and brown shrimp. However, as seen during the drought of the early 1950's, excessively high salinities can lead to reduced white shrimp production, probably due to the occurrence of the estuarine phases of the white shrimp life cycle during periods of highest ambient salinities (mid-summer). In forecasting shrimp harvest based on the historic record and environmental data collected from early in the season, Barrett and Ralph (1976) stated that, if river discharge and rainfall remained relatively low throughout the summer, white shrimp production should also be well above the average for the year. They found, based on the response of catch to environmental factors during previous years, that conditions in 1976 indicated a good brown shrimp harvest. These conditions were mild water temperatures and low river discharge. The brown shrimp catch in Louisiana offshore waters did indeed show a sharp increase in 1976 compared with the previous three years with a total catch of approximately 20 million pounds, which was the highest annual catch for the period 1963 - 1976 (Sass 1979).

1.3.3.5 Salinity Relationships

Because a major environmental concern associated with brine discharge is the brine (salt) itself, some general salinity background for taxa characteristic of the nearshore Gulf of Mexico is presented in this section.

Estuarine-related species (including white and brown shrimp) are almost invariably euryhaline, able to survive and grow over a wide range of salinities (Kinne 1971). Euryhaline species generally have a greater tolerance to both lower salinity and higher salinity than the members of the true marine fauna from which they were derived. Most members of the hypersaline realm have, in turn, evolved from the estuarine fauna (Day 1951, Hedgpeth 1957, Emery and Stevenson 1957). Simmons (1957) presented a list of fishes taken in the Laguna Madre (at hypersaline conditions of 60-75 ppt) and all ten were also found on Gunter's (1956b) list of euryhaline fishes of the U.S. The estuarine fauna has relatively few taxa compared to the marine fauna.

Pearse and Gunter (1957) stated that, in the early (larval) stages, shrimp apparently require oceanic water, but the older larvae and postlarvae must reach estuarine water to survive. Zein-Eldin and Aldrich (1965) concluded, on the basis of their own work and that of others (e.g., Williams 1960, McFarland and Lee 1963), that brown shrimp postlarvae are better osmoregulators than juveniles or adults. McFarland and Lee (1963) found that white shrimp were better adapted to low salinities than brown shrimp, with the latter being better adapted to high salinities. This may explain why the greatest production of white shrimp has always been from the Louisiana coast, while brown shrimp production has been historically greater in the more saline Texas estuaries. Keiser and Aldrich (1976) concluded from their laboratory studies that postlarvae of both brown and white shrimp sought salinities lower than those generally found in the open Gulf of Mexico, and that the postlarvae apparently oriented to bays using natural salinity gradients. However, laboratory studies (Zein-Eldin 1963) have shown that postlarval brown shrimp can both survive and grow over a salinity range of 2-40 ppt. Johnson and Fielding (1956) raised white shrimp at salinities of 18.5-36.0 ppt. Zein-Eldin and Griffith (1969) reported that extreme salinities tolerated by 80 percent of brown shrimp postlarvae were greater than 40 ppt and less than 5 ppt. Similar ranges for white shrimp postlarvae were 40-45 ppt and 4 ppt. However, Zein-Eldin and Aldrich (1965) and Zein-Eldin and Griffith (1969) have shown that low salinity in concert with low temperature is detrimental to both white and brown postlarval shrimp, probably due to osmoregulation stress (Williams 1960). This is consistent with the results of field studies, as discussed in Section 1.3.3.4. In addition, white shrimp appeared to be more tolerant of high temperatures while brown shrimp were more tolerant of low temperatures. This is in agreement with the seasonality of the occurrence of brown and white shrimp postlarvae.

In their laboratory studies, Keiser and Aldrich (1976) found a marked seasonal difference in salinity preferences exhibited by brown shrimp postlarvae, most probably related to the interactive effects of salinity and temperature. During early spring, brown shrimp postlarval distributions showed a median occurrence at a salinity of 30 ppt, 9 ppt greater than that found for brown shrimp tested in summer. No significant difference was seen in salinity preference of white shrimp postlarvae tested in summer and fall, except at low salinities. In the summer, brown and white shrimp postlarvae did not exhibit markedly different preference for salinity, suggesting that there is less difference in salinity preference between the two species at the postlarval stage than has been suggested for subsequent stages in the life cycle. Keiser and Aldrich (1976) found salinity ranges preferred by 90 percent of the brown shrimp tested of 15.0-34.2, 16.8-37.3 and 16.2-37.7 ppt for the summer, fall and spring respectively. Similar values for white shrimp for the summer and fall were 13.4-32.3 and 5.8-35.5 ppt respectively. Keiser and Aldrich (1976) reported that there was no evidence to suggest that brown shrimp postlarvae are adapted to specific salinities, and they concluded that temperature is apparently more important than salinity to postlarvae growth and survival. These results therefore indicate that penaeid postlarvae are euryhaline.

Bioassay results using Bryan Mound brine (NOAA 1978) indicated that white shrimp eggs showed similar hatching success from 31-36 ppt brine with a dramatic decrease beyond 38 ppt(to zero hatchability). Postlarval stages tested showed some effects over 96 hour periods of exposure when concentrations exceeded 36 ppt, but for most time periods tested, 40 ppt seemed to be the general area where the first deleterious effects were seen. Similar results were seen regardless of temperature (28^{o}-33^{o}C). Nauplii appeared to be more resistant than postlarvae to increased salinities. Howe (1981), who performed bioassays on adult white and brown shrimp, concluded that large animals of either species should not be deleteriously affected by salinity increases at the levels expected in the SPR program. In experiments involving salinity preference, adult shrimp showed no negative reactions to salinities that were less than 20 ppt above ambient.

Field studies, mainly estuarine, have generally corroborated the euryhaline nature of all stages of the life cycle of the penaeid shrimp. Gunter and Shell (1958) reported that white shrimp entered waters with salinities as low as 0.4 ppt, while the lower limit for brown shrimp was 0.8 ppt. Investigations by Truesdale (1970), Conte (1971) and Caillouet et al. (1971) suggested that salinity itself did not influence spatial distribution of postlarval white and brown shrimp in the estuaries. Truesdale (1970) concluded that postlarval distribution and abundance in a portion of Trinity Bay was effected by salinity only during periods of high river discharge. When salinity decreased to 0 ppt over much of the area, postlarvae disappeared. Conte (1971) found no relationship between salinity and the distribution of postlarval brown shrimp in two shallow marsh embayments near West Bay of the Galveston Bay System.

Hoese (1960), Zein-Eldin (1963) and Parker (1970) have all discounted the role of salinity in shrimp distribution. Extensive field investigations have shown both brown and white shrimp to be present in both hypo- and hypersaline waters (Simmons 1957, Joyce 1965).

Considering all stage of the shrimp life cycle, brown shrimp have been collected in salinity extremes of 0.1 ppt (Williams and Deubler 1968) to 69.0 ppt (Simmons 1957) and white shrimp have been collected in extremes of 0.2 ppt (Gunter and Hall 1963) to 48.0 ppt (Lindner and Cook 1970). Lindner and Anderson (1956) who found that size of young shrimp correlated more with locality than with salinity, concluded that salinity over broad ranges was not important to survival, although it appeared to be an important stimulus to migration. Hoese (1960) found juvenile white shrimp on an outer (high salinity) beach at the same time that populations of the same size class were in the adjacent low salinity estuary. He concluded that juvenile white and brown shrimp could populate areas of relatively high salinity if other environmental factors were ideal. Parker (1970) found that salinities in spring (0.9-36.5 ppt) apparently did not influence the distribution of juvenile brown shrimp in Galveston Bay. McFarland and Lee (1963) found that juvenile brown shrimp could osmoregulate over a wide range of salinities but there was some indication that the optimum range was 23-43 ppt. Finally, after reviewing ten years of data from the TPWD studies of commercial shrimp production and environmental variables in coastal bays of Texas and offshore commercial catch, Moffett (1970) concluded that

> "...the relationship between salinity and abundance is vague because other ecological factors vary with salinity. Apparently, salinities between 1 and 2, and, at least 30 ppt do not affect abundance."

1.3.3.6 <u>Density Dependent Factors</u>

Kutkuhn (1966b) stated that waters inshore of 20 fathom depths along the Gulf coast from central Louisiana to central Texas have historically received some of the heaviest fishing pressure in the world. Because of this intensive effort, densities of shrimp may be kept below maximum. This is especially true for white shrimp which are heavily exploited in the estuaries before they immigrate to the offshore grounds (Chin 1960). Christmas et al. (1966) pointed out that most shrimp that are caught have never spawned.

The penaeid fishery and also the "industrial" finfish industry (Chittenden and McEachran 1976) are based mainly on single year classes, and substantial year-to-year fluctuations in populations are to be expected because of the short life span of the commercially important species. Fluctuations in the annual yield of shrimp are partly the result of variations in spawning success and in survival of young in the inshore nursery grounds, the latter generally subject to more extreme variations in environmental conditions than the offshore habitat of the adult shrimp.

According to Gaidry and White (1973), most workers in the field would agree that the tremendous reproductive capacity of penaeid shrimp renders little chance that the species are in danger of recruitment overfishing. A limited number of spawners appear to be able to produce a maximum population if environmental conditions are optimum (St. Amant et al. 1965). A spawning female white shrimp may release up to 1 million eggs (Burkenroad 1934, Anderson et al. 1949). Gallaway and Reitsema (1981) found that one female white shrimp captured in their spawning site survey released over one-half million eggs. As mentioned previously, continuous spawning and multiple spawnings by individual shrimp help insure an adequate supply of eggs. Jones and Dragovich (1977), in discussing the U.S. shrimp fishery off the northeast coast of South America where four species (brown, white, pink (*P. duoarum*) and pink-spotted (*P. brasiliensis*) shrimp) are harvested, stated that

> "...there is no evidence that the abundance of shrimp recruits is dependent on the abundance of the parent stock in the fishery."

Berry and Baxter (1969) concluded that, of the many factors influencing the size of brown shrimp populations in the open Gulf, only those that affect broad areas of the Gulf have a major effect on abundance. Gunter (1956a) and Kutkuhn (1963) have emphasized that the greatest concerns to future shrimp production are the long-range effects of man-induced environmental changes in the estuaries.

According to GMFMC (1980),

> "...Although annual catches appear somewhat cyclical, they are caused by environmental conditions. A poor year can be followed by an exceptionally good year for any of these (brown, white, and pink shrimp) species. Catch for a given year appears to be independent of the preceding year's catch, and no-spawner-recruit relationship suggests itself..."

The clear indication is that recruitment is independent of the density of the spawning stock. Quoting again from the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico (GMFMC, 1980),

> "...The biological characteristics which affect sustainable yields for penaeid shrimp are unusual. They are an annual crop. Very few individuals live a year and the majority harvested are less than six months old. There is no demonstrable stock-recruitment relation and recruitment overfishing given present technology, is essentially impossible. That is, it is not economically or technically feasible to take so many shrimp that there are too few survivors to provide an adequate supply for the following year. Because of these characteristics, fishing mortality and yield in one year do not affect yield in the following year. The maximum yield in number for a given year is essentially all the shrimp available to harvest, using current technology."

When environmental conditions are conducive, shrimp production can rebound after a bad year or series of bad years. Gunter (1962) reported that the end of the long drought in the mid-1950's resulted in a 331 percent increase in white shrimp production (from 1957 to 1958). Gunter, Christmas and Killebrew (1964), in recounting this dramatic increase in white shrimp catch in 1958 as the long Texas drought was broken, went so for as to say that

> "...The commercial catch of white shrimp is limited by rainfall in Texas, much as the cotton crop is..."

1.3.4 Historical Trends

In the historical record there has been a notable change in trends for shrimp catch for the two major species, brown and white shrimp. Prior to the development of the otter trawl in 1917, shrimp were commercially harvested with haul seines (GMFMC 1980). This restricted the fishing to the nearshore region, resulting primarily in the exploitation of white shrimp. Until the late 1940's most trawling was done from relatively small vessels rigged with single trawls, fishing within approximately six miles of the coast. During the 1950's, increased market demand and the discovery of new brown and pink shrimp grounds further offshore resulted in a rapid expansion of the industry. Lindner and Anderson (1956) stated that white shrimp made up 95 percent of the total catch off the Louisiana coast prior to WW II. A large decline in white shrimp harvest occurred after 1952, coincident with an increase in brown shrimp production. Viosca (1958) noted that reduction of the number of white shrimp was coincident with increasing salinities during the summer of 1952 to the spring of 1957, a prolonged period of drought. The question of extended droughts and their relation to the annual productivity of commercial shrimp was discussed in the works of Hildebrand and Gunter (1953), Gunter and Hildebrand (1954), Parker (1955), and Viosca (1958). Because young white shrimp displayed a greater propensity for less saline water than do other species, it was assumed that higher estuarine salinities accompanying the drought caused environmental stress and reduced habitat carrying capacity, resulting in a lower annual production of white shrimp.

Through the 1960's the Gulf coast shrimp fishery evolved into the most valuable fishery in the U.S., with dockside values in 1977 exceeding $355 million (GMFMC 1980). User groups of the shrimp resource are diverse and include recreational, bait, and food industries. According to the GMFMC (1980), the shrimp resources are not overfished and entry into the fishery is unlimited. In 1980, the Gulf of Mexico Fishery Management Council, Tampa, Florida, developed the Environmental Impact Statement and Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, United States Waters (GMFMC 1980). This plan reviewed the history of the shrimp industry and recommended a management strategy which would alter the directed shrimping efforts in the Gulf of Mexico.

1.3.5 Texas Department of Water Resources Studies

A series of related studies has recently been concluded by the Texas Department of Water Resources (TDWR 1979a). These studies resulted from Senate Bill 137, enacted by the 64th Texas Legislature in 1975. This bill was

> "...a mandate for comprehensive studies of 'the effects of freshwater inflow upon the bays and estuaries of Texas.' Reports published as a part of the effort were to address the relationship of freshwater inflow to the health of living estuarine resources (e.g., fish, shrimp, etc.) and to present methods of providing and maintaining a suitable ecological environment..." (TDWR 1979a).

Much of the data base utilized in these studies resulted from a program initiated in 1968 by the Texas Water Development Board and carried on by its successor agency, the Texas Department of Water Resources (TDWR). TDWR (1979a) summarized the results of a number of these studies for individual Texas bays and estuaries. According to TDWR (1979a)

> "...The objective of these technical analyses was to describe and quantify the freshwater inflow/salinity/biological relationships of the estuarine environments and to estimate the annual and seasonal freshwater inflows associated with the production of finfish and shellfish at observed historic levels. Program studies drawing from all available sources of information considered the effects of freshwater inflows on nutrient supplies, habitat maintenance, and production of fishery resources (including economic aspects)..."

The main thrust of the effort was to relate volumes of freshwater inflow to estuarine production (TDWR 1979a). This involved quantifying the response of shrimp productivity (inshore and offshore in area 18) to water inflow (in thousands of acre-feet) in the particular estuary system utilizing a stepwise multiple regression procedure in BMDP (Dixon and Brown 1977). Seasonal inflows, in thousands of acre-feet (lagged and unlagged), for the winter (January-March), spring (April-June), summer (July-August), autumn (September-October) and late fall (November to December) periods were used in the analyses. Lags of one year or a running average of the three previous years were also used for some independent variables. Annual offshore effort in area 18 (measured in terms of number of trips) was also used in the regression analyses for offshore catch, which were conducted only for the Trinity-San Jacinto estuary. Natural log transformations of both the dependent and independent variables were utilized to improve the fit of the relationship of landings to freshwater inflow where appropriate.

Data for inshore and offshore landings of penaeid shrimp (in pounds, heads off) were derived from Texas landings and not Gulf Coast Shrimp Data (TDWR 1979a). As such, they do not necessarily represent the catch in Texas waters, since catches from other areas (e.g., Mexico) might be landed in Texas, and Texas catch may be landed in other states. This represents a major distinction between the TDWR studies and our studies under Work Unit 2, which used reported catches (GCSD) rather than landings. Since reporting procedures were not standardized until the early 1960's, data for the period 1962 to 1976 were used in the analyses for inshore landings, and for the period 1959 to 1976 for offshore landings (TDWR 1979a). The time period, which is very similar to that used in Work Unit 2 of the Shrimp and Redfish Studies, included both wet and dry years, and was probably adequate to identify positive and negative responses to seasonal inflow. The results for three estuary systems, the Trinity-San Jacinto estuary (TDWR 1979b), the Lavaca-Tres Palacios estuary (TDWR 1980a) and the Guadalupe estuary (TDWR 1980b) are discussed below.

For the Trinity-San Jacinto estuary, multiple regression analyses were conducted relating both inshore and offshore (statistical area 18) landings of white shrimp and brown plus pink shrimp to freshwater inflow to the estuary system (TDWR 1979b). Relationships for white shrimp landings were not significant. For combined brown and pink shrimp inshore landings (brown shrimp were not analyzed separately in the TDWR studies), the best regression equation (log - log model) explained 64 percent of the variance, with negative contributions for January-March and July-August inflow and positive contributions for September-October inflow and also for (one-year) lagged November-December inflow.

The multiple regression models for offshore landings included effort as an independent variable (TDWR 1979b). As such, significant relationships were developed for landings for white shrimp and for brown plus pink shrimp. For white shrimp catch ($\leq$ 20 fathoms) 61 percent of the variance was explained by the multiple regression model (untransformed data), with effort and spring, summer and fall (September-October) inflows contributing significantly. All contributions were positive except for summer inflow. For landings of brown plus pink shrimp, 80 percent of the variance was explained by the best multiple regression equation, with significant negative contributions from winter, spring, and fall inflow, and positive contributions from summer inflow and offshore effort. The responses of brown plus pink shrimp landings to summer and autumn inflow were opposite in the offshore and inshore analyses, a result that is difficult to explain.

For white shrimp, the best regression relating inshore landings to inflow for the Guadalupe River estuary (log-log model) accounted for 72 percent of the variance in the dependent variable, with inflows in the January to March and September to October periods showing positive relationships to landings (TDWR 1980b). For brown plus pink shrimp, the best regression equation for inshore landings indicated a positive response to inflows during the July to August and September to October periods, with a total explained variance of 62 percent.

Results of TDWR regression analyses of inshore penaeid catches for the Lavaca-Tres Palacios estuary (TDWR 1980a) showed that for white shrimp, the best regression equation explained only 48 percent of the variance in annual inshore landings, and suggested a positive response to spring (April-June) inflow and a negative response to inflow during the previous November to December period. For annual brown plus pink shrimp inshore landings, no statistically significant equations were obtained from the analyses (TDWR 1980a). Comparison of the annual freshwater seasonal inflow needs and the associated predicted commercial shrimp landings for the Lavaca-Tres Palacios estuary indicated that nearly equal volumes of freshwater may result in significantly different landings. This condition reflects the importance of the seasonality of estuarine inflows to fisheries productivity. It generaly was observed that inflows in the April through June period were most beneficial for overall estuarine productivity (TDWR 1980a).

1.3.6 Summary

These results discussed in Section 1.3 indicate that there is a strong relationship between inshore and offshore catch of penaeid shrimp. There appears to be a consensus that white and brown shrimp respond somewhat differently to environmental variables (especially freshwater discharge and salinity). The historical record indicates a significant correlation between long-term environmental change (salinity) and shrimp catch statistics. Short-term fluctuations are also evident based on year to year variability in important environmental variables. Postlarval abundance near estuarine passes does not appear to be a good indicator of subsequent commercial catch or abundance, since the factors inside the estuaries probably determine the success of the year class. However, other studies (e.g., menhaden) indicate that long range transport in the ocean system is critical to successful year classes (Nelson et al. 1977). The dominating factors operating in the estuarine system appear to be the synergistic actions of salinity and temperature during critical growth periods of the juvenile shrimp.

Both white and brown shrimp are dependent on estuaries at some stage in their life cycle. These estuarine-dependent forms represent the most euryhaline members of the demersal fauna of coastal Texas. Euryhaline organisms are generally tolerant of both high and low salinities. All literature reviewed agreed that all stages of the penaeid life cycle can tolerate relatively wide ranges of salinity.

For brown shrimp some larvae may be spawned in the fall but brown shrimp postlarvae do not enter the estuaries until the following spring. Estuarine production of brown shrimp in one year contributes mainly to the offshore catch during the same year. For white shrimp, individuals spawned in the fall of one year can contribute significantly to the offshore catch in the following year. This was clearly seen in the results of the analyses for Work Unit 3, Texas Coast Shrimp Catch and Effort Data Analysis, of the Shrimp and Redfish Studies (Comiskey et al. 1981).

The populations of penaeid shrimp and also those of many demersal finfishes of the northwest Gulf Coast are exploited to a very heavy degree, perhaps receiving the heaviest pressure of any fishery in the world (Kutkuhn 1966a). Catches of both species are dependent primarily on the success of a single (and first) year class.

The great fecundity of female shrimp allows successful recruitment despite the high degree of exploitation by man. It also allows quick recovery from a bad year. The amount of recruitment does not appear to be dependent on the size of the parent stock (GMFMC 1980).

The conclusion of most recent studies is that factors inside the estuaries (especially temperature and salinity) determine the success or failure of the shrimp year class. Studies which have attempted to utilize postlarval shrimp catch near the estuaries as an indicator of subsequent production have generally proven to be inaccurate. On the other hand, juvenile shrimp abundance in the estuaries has been closely linked to subsequent offshore production.

1.4 NATIONAL MARINE FISHERIES SERVICE PROGRAM

Due to a concern for the potential effects of offshore brine discharge and the possibility that a naturally poor shrimping year could coincide with, but be unrelated to, the initiation of brine discharge, it was important to develop mathematical tools which could utilize historic trends to forecast, predict, or classify the catch for any given year based on environmental variables. Such tools are needed to distinguish natural fluctuations from those that might be attributed to brine discharge. Referring to the life cycle of penaeid shrimp and our knowledge thereof, Kutkuhn (1966b) stated that as of the mid-1960's our ability to define the functional role of the environment (and therefore the spatial and temporal trends in shrimp catch) was poor. He felt that delineation of the specific cause-effect relationships between components of the estuarine environment and the vitality of estuarine shrimp resources awaited the development of suitable mathematical and experimental techniques. Later is the same paper, Kutkuhn (1966b) stated:

> "The difficulty seems to lie not so much in our basic approach to the problem at hand but in our inability to develop the analytical tools to resolve it... Awaiting the theoretician's skills, however, is the involvement of autoregression, serial correlation, or other computer-oriented techniques without which the fishery scientist cannot synthesize quantitatively the multitude of concurrent biological, physical, and chemical data he is so carefully accumulating in many areas... Statistical comparison of time-series... with corresponding series of environmental factors, singly and in combination, represents one way in which vitally needed information can be obtained. ...."

Kutkuhn felt that the key to the proper understanding of the shrimp fishery is a knowledge of the functional relationship between the shrimp and the dimensions of its environment.

Caillouet and Baxter (1973) discussed the general thrust of the NMFS Shrimp Resource Research Program. As stated, "The main objective of this research is to develop a mathematical model capable of explaining and predicting changes in shrimp catch. A systems analysis approach is being used to develop the model." Brown, white, and also pink shrimp (P. duoarum) are the key species. The research stresses the role of the shrimp life cycle and the physical-chemical parameters that define the spatial and temporal patterns of these shrimp populations.

Much of the NMFS Shrimp Resource Research program has been implemented through the SPR Environmental Assessment Program. The different Work Units of the Shrimp and Redfish Studies contribute to the overall synthesis of information concerning the ecology and management of the penaeid shrimp resource in the Gulf of Mexico. Important aspects of the shrimp life cycle are revealed in the current NMFS program through mark-recapture studies (Johnson 1981a), catch and effort interview sampling surveys (Johnson 1981b), and determination of possible spawning grounds (Gallaway and Reitsema 1981). While the thrust of the effort is offshore, the importance of the estuarine system is recognized especially in Work Unit 2, Analysis of Data on Shrimping Success, Shrimp Recruitment and Associated Environmental Variables for the Texas Coast, which is the subject of this report.

In simplest form, the goals of the DOE/NMFS Project is to determine predischarge (baseline) conditions and, by monitoring after discharge, to assess post discharge changes and determine their significance. The analyses conducted in Work Unit 2 utilized predischarge data to quantify the responses of indicators of shrimping success to variations in shrimp recruitment and environmental variables. In this way, confidence limits could be placed on post discharge data in order to determine if the relationship of shrimping success to environmental variables has changed during the period of brine discharge. Work Unit 3 of the Shrimp and Redfish Studies (Comiskey et al. 1981) utilized similar techniques to provide a methodology by which historical shrimp catch and effort data could be utilized to assess brine impacts. The applicability of this technique in the context of Work Unit 3 is based on the assumption that if brine is impacting shrimp populations, the impact is restricted to the offshore area surrounding the 12.5 mile diffuser site. If brine discharge is having a more indirect or subtle impact on the shrimp fishery (e.g., influencing recruitment into the estuaries), the impact would not be expected to manifest itself only in reduced catch for the offshore diffuser site, but would be expected to have a more widespread impact. In this case the methodology utilized in Work Unit 3 (using catch and effort data for adjacent areas) would not be applicable.

The methodology utilized in Work Unit 2 does not rely on catch or effort data as independent variables. The methodology utilizes recruitment and environmental variables as independent variables in prediction shrimping success. Those models utilizing only environmental variables as predictor variables do not depend on any shrimp variables and, as such, can be utilized in all cases to assess change in shrimping success. Those models involving recruitment have somewhat the same deficiency as the models used in Work Unit 3. That is, the use of recruitment as an independent variable assumes that recruitment itself is not impacted by brine discharge. If recruitment is impacted by brine discharge, the model will not be applicable and could lead to fallacious conclusions if misused.

1.5 OBJECTIVES

The objectives of this study are to: (1) study the temporal-spatial variability in shrimping success for brown and white shrimp, recruitment for brown and white shrimp and selected environmental variables, to provide an information base upon which to gauge fluctuations and trends in shrimping success following brine disposal, and to estimate the contributions to the variance (in shrimping success) of recruitment and selected environmental variables, (2) determine the relationships among shrimping success in the vicinity of the brine diffuser and surrounding area and recruitment and selected environmental variables, and (3) develop a method to compare pre-disposal information on shrimping success, recruitment and environmental variables with post-disposal information to provide a means of testing the null hypothesis that there are no changes in shrimping success attributable to brine disposal.

These objectives were accomplished by analyzing data on shrimping success, recruitment and selected environmental variables. Recruitment variables include postlarval shrimp catch and bay shrimp catch. Environmental variables include, tides, winds, Ekman transport, river discharge, water temperature, salinity, precipitation, and bay effort. The goal was to determine the inter-relationships among these variables, including the degree of dependence or degree of association, as a means of hindcasting shrimping success, with a view toward forecasting the effects of brine disposal on shrimping success. Each recruitment variable, shrimping success variable, and environmental variable used is documented, giving its data source, method of calculation and/or transformation, its limitations, and the rationale and justification for its use in the analyses.

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2.0 METHODOLOGIES

2.1 DATA SOURCES AND DATA PROCESSING

The data utilized in this study included summaries of detailed Gulf Coast Shrimp Data, published monthly and annual summaries of these same data and ancillary data for recruitment and environmental variables from a variety of sources as discussed below. Gulf Coast Shrimp Data are available from NMFS, Southeast Fisheries Center, Technical and Information Management Services (TIMS), Miami, Florida. (Attn: Regional Data Base Administrator).

2.1.1 Gulf Coast Shrimp Data

The Bureau of Commercial Fisheries (BCF), U.S. Fish and Wildlife Service established a grid reporting system along the Atlantic and Gulf Coasts to standardize reported catches of penaeid shrimp (Figure 3). NMFS/TIMS has adopted this system. The basic spatial reporting unit or stratum of the Gulf Coast Shrimp Data grid (NOAA 1979) is the statistical area x 5 fm depth zone (e.g., zone 1 = 0-5 fm, 2 = 6-10 fm, etc.). Four statistical areas (18 to 21) have been established along the Texas Coast (Figure 3). The Bryan Mound brine diffuser is located within statistical area 19, at a depth of approximately 12 fm. Therefore, it is located within depth zone 3, the 11-15 fm depth interval. Since the location of the brine diffuser is in the northeast corner of statistical area 19, the dynamics of the penaeid populations in the region of the brine diffuser are probably closely related to those of statistical area 18, especially for white shrimp. Statistical areas 18 and 19, and especially the 11-15 fm depths in area 19, are areas that are potentially affected by brine discharge.

The Gulf Coast Shrimp Data have been collected and compiled as catch and fishing effort data files by trip, date, area and depth of capture, fishing craft identification, shrimp species and marketing size category (number of shrimp, heads off/pound), and number of days fished,

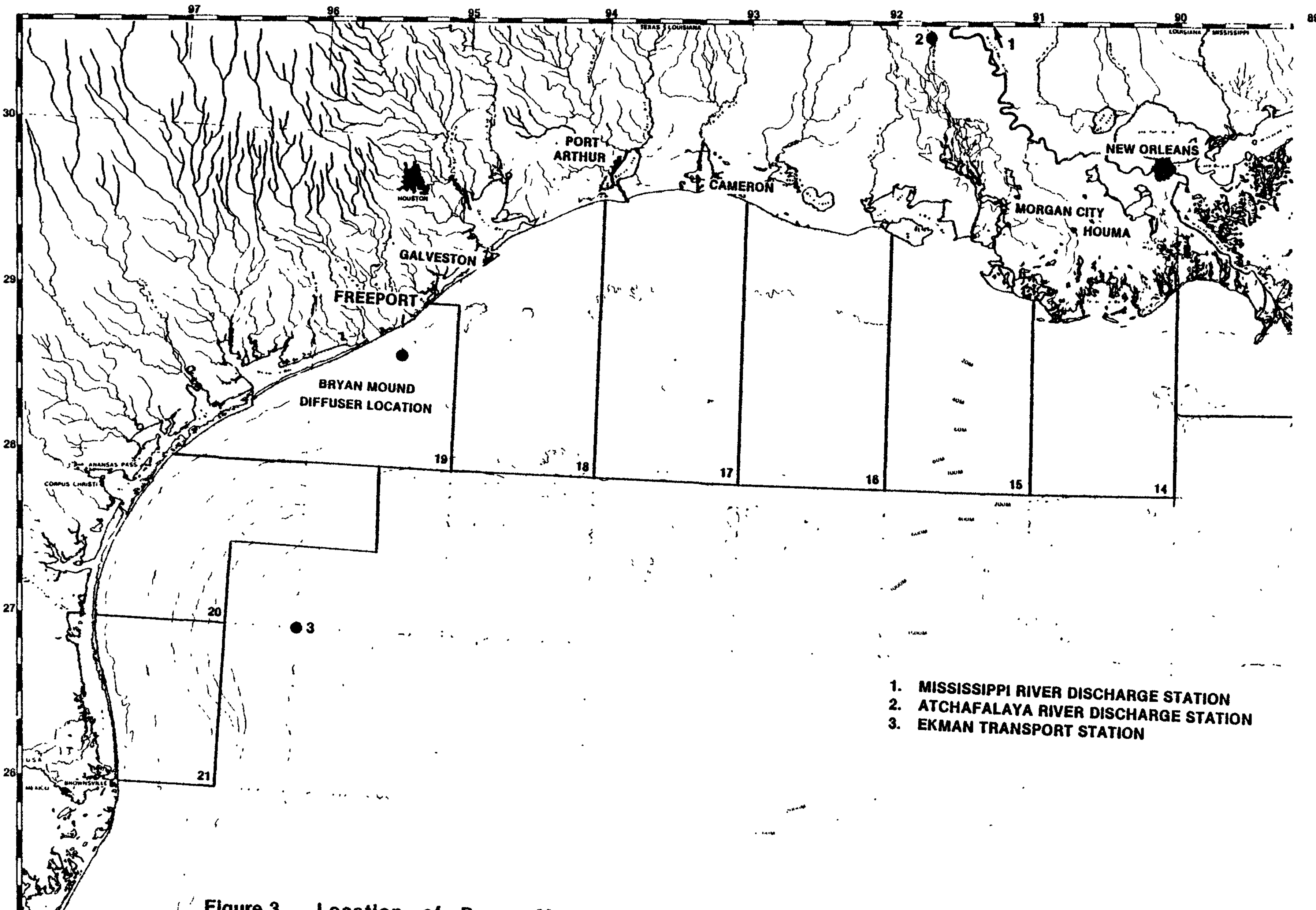

Figure 3. Location of Bryan Mound brine diffuser with reference to NMFS grid zones. Also shown are locations of several regional sources of environmental data.

for catches landed by U.S. craft at U.S. ports along the Gulf of Mexico for trips completed with U.S. waters.

"Days fished" represents actual fishing time expressed in number of 24-hour days, a day of fishing being equivalent to 24 hours of fishing time. No distinction is made between nighttime fishing vs. daytime fishing in these records. A single trip is reported for each voyage. Unsuccessful trips (i.e., those in which fishing took place without producing a catch) are not reported. For a craft which has a portion of its catch transported to port by another vessel, the trip is assigned to the area and depth last fished by the craft. For a craft landing its entire catch, the trip is allocated to the areas and depths fished. Monthly summaries of the detailed Gulf Coast Shrimp Data are not equivalent to those published in Shrimp Landings which include quantities landed within a reporting period, regardless of when trips were completed or where fishing took place. The monthly summaries of the detailed GCSD files are not identical to the monthly summaries published as BCF or NMFS Fishery Circulars, since corrections have been made to many of the records in the computer-compatible data files, while errors in the published summaries may not have been corrected.

Gulf Coast Shrimp Data are composed of two distinct components. The Shrimp Dealer Data, obtained from shrimp dealer records, include port of landing, type and identification of fishing craft, month of landing, number of trips, method of shrimp size grading (box grading, machine grading), dealer number, total landings, species and size composition of landings, and value (dollars) by species and marketing size category. The Shrimp Trip Interview Data obtained from interviews of fishermen upon completion of fishing trips, include name and registry number of vessel, catch by species and size category, area and depth fished, days fished (in 24-hour units), shrimp dealer number, port of landing, date of landing, method of shrimp size grading (box grading, machine gradient), and value of catch by species and size.

The Gulf Coast (detailed historical) Shrimp Data for 1960-1977 were received from the NMFS, SEFC, TIMS on 17 magnetic tapes. The detailed data contained a separate record for each year, month, trip, area, depth, species, and size. Therefore the total catch for any combination of these factors was obtained by summing data on several records. The detailed data were in separate files for each year. However, within a file the records were not sorted except generally by month.

The first phase of the data processing was to separate the records for brown and white shrimp for statistical areas 18, 19, 20, and 21 from those representing other areas of the Gulf of Mexico. Because some errors had been previously reported in the data files, the temporal-spatial categories to be used later in summarization (e.g., year, month, area, etc.) were checked to determine that they were valid. If an invalid character, code or value was detected on a record, the record was not included in the subsequent file of Texas catch. Errors due to alphanumeric characters occurring in numeric fields also resulted in records being dropped from the Texas file. In all years the percentage of erroneous records was low.

The second step in the data processing involved production of a subset of the data consisting of interview records only (Interview File), which were used to prepare the interview catch and effort summaries. The total historical data and interview data for the Texas Coast were initially summarized by year, month, area, depth and species. Variables included brown and white shrimp catch from the total data and the interview data, and non-directed nominal effort from the interview data. These data were further summarized for various spatial strata of interest in this study (area 18, area 19, area 19, 11-15 fm depths) on a monthly and annual basis. Dependent variables involving effort (i.e., catch/effort) utilized only interview data in their calculation. These values could not be calculated for the total data because effort (as days fished) was not reported for every stratum in the total data and catch/effort would be undefined in some cases. In order to utilize effort as an independent variable in the regressions where total (interview plus non-interview) catch was a dependent variable, non-directed nominal effort (days fished) was expanded from the interview data to the total data using the ratio of the total catch to the interview catch.

2.1.2 Environmental and Shrimp Recruitment Variables

The locations of the stations where the various environmental and shrimp recruitment variables utilized in these analyses were collected are shown in Figure 4. Data from four river discharge stations were used in the analyses. These included the Trinity River near Romayor, Texas (United States Geological Service (USGS) Station No. 8066500), the Guadalupe River near Victoria, Texas (USGS Station No. 8176500), the Mississippi River near Tarbert Landing, Mississippi, (U.S. Army Corps of Engineers) and the Atchafalaya River near Simmesport, Louisiana (U.S. Army Corps of Engineers). Water temperature data were also taken from the USGS Trinity River Station. Tide data were obtained from National Ocean Survey (NOS) Tide Station (No. 877-2440) near Freeport, Texas, while precipitation and air temperature data were obtained from the NOAA National Weather Service (NWS) Station at Freeport. Wind data were taken from the NOAA NWS Galveston Weather Station records, while Ekman transport data were calculated by the NMFS Pacific Environmental Group (PEG) for the location 27^{o}N - 96^{o}W. Density and water temperature data which were utilized in this study were collected in Galveston Channel by NOS (Tide Station No. 877-1450), while temperature, salinity and shrimp recruitment data collected by the TPWD in various parts (tertiary, secondary and primary bays) of Galveston and Matagorda Bays were also utilized. The TPWD data were taken from TPWD annual reports. Finally, the USFWS, BCF and NMFS conducted postlarval sampling at the Galveston Bay entrance and supplemented these data with salinity and temperature measurements. These raw data were provided by NMFS and were summarized for use in this study.

For many variables (e.g., river discharge and precipitation) annual and seasonal data were used. For most variables, data for a specific month for the ten or eighteen year periods (1964-1973 and 1960-1977, respectively) were used. For certain critical periods and variables

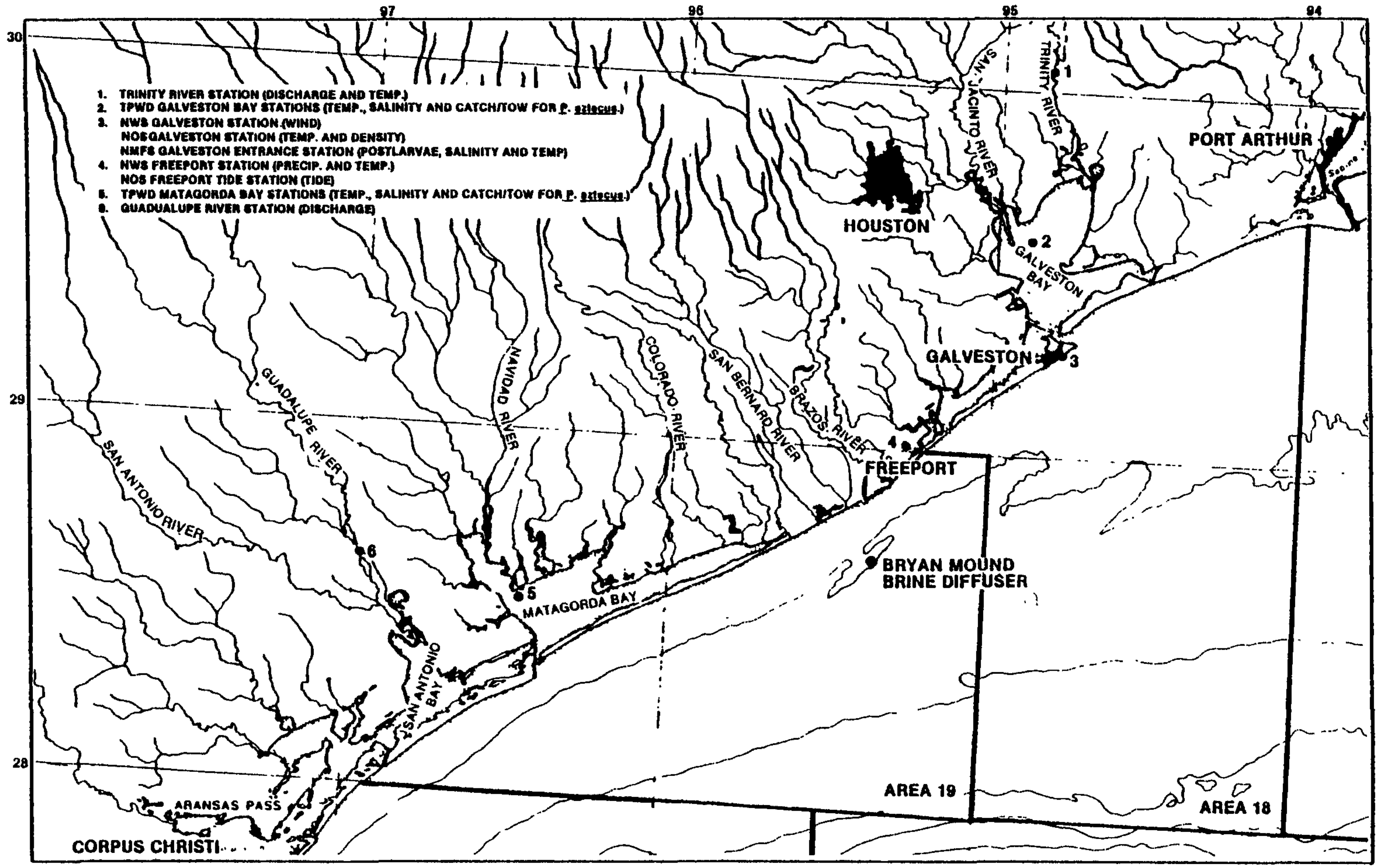

Figure 4. **Locations of sources of environmental data in the Galveston Bay - Matagorda Bay area.**

(e.g., temperature and salinity in the winter and spring) data for specific two week periods were also used.

Tables 1 and 2 list the variables utilized in the brown and white shrimp regressions, respectively. Tables 3 and 4 give detailed locations limits and sources of all variables utilized in these analyses. These tables also provide information on missing values for these variables. In all cases, missing values were due to gaps in the data record as received from the source, and represented problems in the various sampling programs in data acquisition. Note that the variable reference number in these tables are not the same as the variable numbers (the number that appears on the data products, such as the regression outputs) in the data sets themselves. Tables 5 and 6 provide the information necessary to relate the variable numbers and names in the regression output to the same variables described in Tables 1 through 4.

Because of the occurrence of missing observations for a number of important environmental or recruitment variables, the correlations presented in the correlation matrices in this report may not be identical to those given in the regression tables for the same variable pairs. The differences in these data products are due to the fact that if an important variable was included in the regression analysis, but had a missing value, the entire year (that is, the data for all variables for that year) was deleted from the data set. This is further discussed in the Section 2.3. The values in the correlation matrices, each of which applies to a set of regression analyses, are based only on bivariate relationships, and, as such, reflected the number of pairs of non zero observations for that particular pair of variables. Because of this, the entries in the correlation matrices occasionally included more observations than those in the regression tables. In most cases, the differences in the correlation coefficients in the two tables were small.

The data sets utilized in the analyses which are presented in this report have been sent to the NMFS, SEFC, TIMS for archiving. These data include all variables used in the regression analyses (as listed in Tables 1 and 2 and described in Tables 3 and 4), as well as the monthly catch summaries used in the time series analyses. All data sets were written as files on magnetic tape, in a form compatible with the computing system used by the NMFS, SEFC, TIMS. Accompanying each data set was written documentation providing format and file descriptions.

All programs used in these analyses have been documented and fully described and have been sent, as a separate deliverable, to NMFS, TIMS. For Fortran programs, a listing of each program with comments was provided. Several of the analyses utilized commercial statistical software. A listing of the control statements used in these analyses and a brief discussion of their functions were delivered to TIMS as documentation for these programs. Multiple regression and time series analysis procedures were also documented.

2.2 TIME SERIES ANALYSIS

Univariate time series data analysis techniques were applied to catch data in order to assess their usefulness in analyzing the impacts of brine discharge on shrimp catch. The dependent variables were the total (interview and non-interview) monthly brown and white shrimp catch from 1960 to 1977 summarized from the detailed GCSD as discussed in Section 2.1.1. Brown and white shrimp catches were analyzed separately, with 216 observations (18 years x 12 months) for each species. The time series techniques used were ARIMA modeling and fourier analysis. These techniques are considered separately below. All data products associated with the time series analyses are presented in Section 6 (Tables) or Section 7 (Figures).

2.2.1 General ARIMA Modeling

ARIMA model is a term that refers to a broad class of models based upon autoregressive and/or moving average properties. These models have been found useful in dealing with stationary and non-stationary time series data that may or may not have systematic components at fixed frequencies. Stationary times series data fluctuate about a fixed mean, while fluctuations in non-stationary time series data are not around a fixed mean. Time series data with system components at fixed frequencies follow repetitive cycles, with each cyclic component equivalent in terms of length and amplitude. A complete description of the properties of the ARIMA models as applied to time series analysis may be found in Box and Jenkins (1976) and Jenkins (1979). The following is a brief summary of the basic ideas presented in these references.

An autoregressive model for a single time series can be characterized as:

$$Y_t = a_1 Y_{t-1} + a_2 Y_{t-2} + \ldots + a_p Y_{t-p} + \varepsilon_t$$

where the Y_t's are deviations from the mean of the series and t indicates the time period, which is months. This indicates that, for an autoregressive process, the current deviation, Y_t, can be expressed as a finite linear combination of the past deviations of Y plus a random error term, ε_t. Following Box and Jenkins (1976), if $B^n Y_t = Y_{t-n}$ then B^n can be defined as a backshift operator of order n. A backshift operator applied to any value in time period t means that the value from the previous time period is substituted. If the operator is of order n, where $n > 1$, then the value substituted for the current value is n periods previous to the current value. For example, if Y_t is the current value of Y, then $B^n Y_t = Y_{t-n}$.

An autoregressive operator is a mathematical expression used to translate past values of a variable to current values. For example,

$$(1 - a_1 B - a_2 B^2) Y_t = \varepsilon_t$$

$$Y_t - a_1 Y_{t-1} - a_2 Y_{t-2} = \varepsilon_t$$

$$Y_t = a_1 Y_{t-1} + a_2 Y_{t-2} + \varepsilon_t$$

where the autoregressive operator is $(1 - a_1B - a_2B^2)$. The autoregressive model can be written as follows:

$$Y_t = a_1BY_t + a_2B^2Y_t + \ldots + a_pB^p\,Y_t + \varepsilon_t$$

This reduces to $(1-a_1B - a_2B^2 - \ldots - a_pB^p)Y_t = 0_t$. If the expression in parenthesis in the previous sentence is defined as an autoregressive operator of order p, the autoregressive model can be further simplified as follows:

$$a(B)Y_t = \varepsilon_t \tag{1}$$

where $\quad a(B) = (1 - a_1B - a_2B^2 - \ldots - a_pB^p)$

A moving average process can be represented as

$$Y_t = \varepsilon_t - b_1\varepsilon_{t-1} - b_2\varepsilon_{t-2} - \ldots - b_q\varepsilon_{t-q}$$

where the ε_t's are random shocks. Random shocks are external, random events that occur and alter the pattern of the variable being evaluated. In this case, the series Y_t is expressed as a finite linear function of a series of random shocks, with the corresponding weights b. Again using the backshift operator, the moving average model can be written as

$$Y_t = \varepsilon_t - b_1B\varepsilon_t - b_2B^2\varepsilon_t - \ldots - b_qB^q\varepsilon_t$$

$$\text{or} \quad Y_t = (1 - b_1B - b_2B^2 - \ldots - b_qB^q)\varepsilon_t$$

Simplified, this expression becomes

$$Y_t = b(B)\varepsilon_t \tag{2}$$

where $\quad b(B) = (1 - b_1B - b_2B^2 - \ldots - b_qB^q)$

Combining these processes into a single autoregressive-moving-average (ARMA) model would result in the following

$$
\begin{aligned}
Y_t &= a_1 Y_{t-1} + a_2 Y_{t-2} + \cdots + a_p Y_{t-p} + \\
&\quad \varepsilon_t - b_1 \varepsilon_{t-1} - b_2 \varepsilon_{t-2} - \cdots - b_q \varepsilon_{t-q} \\
\text{or} \quad & a(B) Y_t = b(B) \varepsilon_t
\end{aligned} \tag{3}
$$

For this combined model there are p + q + 2 unknown parameters (the unknown parameters are the mean, a's, b's, and variance of the error) to be estimated. To provide a useful tool, a search procedure must be employed to reduce the number of possible parameters. Box and Jenkins (1976) have shown that the estimated autocorrelation functions provide an efficient search procedure and therefore allow the ARMA to achieve operational usefulness by reducing the number of parameters that have to be considered. As an example, the final model may be an ARMA of order 2 in both parameters, such as

$$
Y_t = a_1 Y_{t-1} + a_2 Y_{t-2} + \varepsilon_t - b_1 \varepsilon_{t-1} - b_2 \varepsilon_{t-2}
$$

where the AR order is defined by the number of logs in Y_t, and the MA order is defined by the number of time periods for which the random shock will produce an impact on the dependent variable. Models of larger order have rarely been found in practical application.

To allow for non-stationarity in the original data series, Y_t, Box and Jenkins (1976) suggest differencing the data. Differencing refers to subtracting a previous value of the dependent variable from the current value. For example, if $Y_t = Y_t' - \mu$, where μ is the mean of the series, a difference of order 1 is $Y_t - Y_{t-1} = (Y_t' - \mu) - (Y_{t-1}' - \mu) = Y_t' - Y_{t-1}$. In many cases, the differenced data provides a stationary series for analysis. If this procedure is followed, the resulting model is referred to as an ARIMA (autoregressive integrated moving average) model. Integrated indicates that a new stationary time series has been approximated by integrating a non-stationary time series. Other ways of removing trends or transforming the data are also available including various regression schemes such as ordinary least squares.

Seasonal variation in the time series is dealt with in an equivalent fashion as a non-seasonal model except that the lags are in the terms of the length of the season. For instance, a seasonal ARMA of order 2 with a 12-month seasonal period can be written as,

$$Y_t = a_1' Y_{t-12} + a_2' Y_{t-24} + \varepsilon_t - b_1' \varepsilon_{t-12} - b_2' \varepsilon_{t-24}$$

Combining the seasonal, non-seasonal, and differencing into one model allows the ARIMA to be useful in a wide variety of problems.

2.2.2 Fourier Analysis

Much of the following discussion has been adapted from Brigham (1974) and Box and Jenkins (1976). A fourier series model of a finite number of discrete observations made at equi-spaced time intervals can be written as:

$$Y(t) = \alpha_0 + \sum_{i=1}^{r} [\alpha_i \cos (2\pi f_i t) + \beta_i \sin (2\pi f_i t)] \qquad (4)$$

where $Y(t)$ = sampled observations where $t = 1, \ldots, N$,

$r = (N - 1)/2$ if N is odd and $N/2$ if N is even,

N = number of sampled observations,

t = time period,

f = frequency, and

α_i, β_i = amplitude estimates at each frequency.

The unknowns of this model, α_0, r α_i's, and r β_i's, can be estimated by ordinary least squares with the following results when N is odd:

$$\alpha_0 = \bar{Y}(t) \tag{5}$$

$$\alpha_i = \frac{2}{N} \sum_{t=1}^{N} Y(t) \cos (2\pi f_i t) \quad i = 1, \ldots, r \tag{6}$$

$$\beta_i = \frac{2}{N} \sum_{t=1}^{N} Y(t) \sin (2\pi f_i t) \quad i = 1, \ldots, r \tag{7}$$

When N is even, the estimates for α_r and β_r are $\frac{1}{N} \sum_{t=1}^{N} (-1)^t Y(t)$ and 0, respectively. The estimates of these coefficients are important because they provide estimates of the periodogram or sample spectrum, depending on the definition of the frequency. A periodogram for a data set of time series observations is:

$$I(f_i) = \frac{N}{2} (a_i^2 + b_i^2)$$

where

$$f_i = \frac{i}{N}$$

a_i = least squares estimate of α_i from equation (4), and

b_i = least squares estimate of β_i from equation (4).

The sample spectrum is equivalent, but the frequency varies continuously from $0 \leqq f_i \leqq 0.5$.

If the frequencies are defined as $f_i = i/N$ where $1/N$ is the fundamental frequency, then the periodogram is $N/2\ (\alpha_i^2 + \beta_i^2)$ for each frequency i. On the other hand, if the frequencies are not assumed to be harmonics of the fundamental frequency 1/N and are allowed to vary continuously between 0 and 0.5, the sample spectrum can be written as

$2/N\ (\alpha_f^2 + \beta_f^2)$ where $0 \leq f \leq 0.5$. It can be shown [see, for instance, Box and Jenkins (1976), p. 44-45] that the sample spectrum defined above is also equal to the fourier cosine transform of the estimate of the autocovariance function of the data set, Y(t). In this report, the amplitude estimates are used to estimate the fourier spectrum $(\alpha_i^2 + \beta_i^2)^{1/2}$ at each f_i.

The estimating equations of the α_i and β_i are discrete fourier cosine and sine transforms, respectively, of the original time series Y(t). The discrete fourier transform can be shown to be a special case of the continuous fourier transform (Brigham 1974). Since the continuous fourier transform applies to a continuous process defined within $-\infty < t < +\infty$, the discrete fourier transform can be considered an estimate of the continuous form. By considering the result of reducing the continuous transform to the discrete case, namely truncation of the data record and sampling, the researcher may better understand the potential problems of aliasing and lag windows, both considered below. The underlying assumption of the fourier transform is that the process generating the data is continuous and infinite. In practical applications of fourier analysis, such as the fourier series model, the researcher must be cognizant of this assumption in order to assess its impact on the estimates of the α_i's and β_i's that result.

Truncation of the data record refers to the fact that rarely, if ever, does the researcher obtain samples over the entire length of the time series. As a practical matter, the number of data elements subjected to analysis has to be finite. With a finite data record, the researcher may run into problems with his estimates of the various amplitudes (α_i and β_i). Truncation of the data record at a multiple of the longest periodic component results in a discrete fourier transform that is equivalent to the continuous fourier transform except for a scaling constant. If truncation occurs at something other than this multiple of the longest periodic component, a discontinuity is created in the time record, resulting in additional frequency components after the data series is fourier transformed. The practical result is that the fourier transform of a truncated data record may provide estimates of amplitudes at frequencies that are not accurate representations of the actual behavior of the generation process. To overcome this problem, the concept of a lag window is introduced. This basically smooths the data record by applying weights to each of the amplitudes. Unfortunately, unless the researcher has _a priori_ expectations concerning the period components in the data, this introduction of the lag window may only increase the complexity of the analysis without increasing the understanding of the behavior of the data. Maximum Entry Spectral Analysis does not have this problem since nothing is assumed about the behavior of the data outside the available time interval.

A second set of problems, known as aliasing, can arise because the observations available to the researcher necessarily reflect a sample of an underlying process that is assumed continuous. These samples are obtained at at equidistant time intervals, Δt. The highest frequency sinusoidal component that can be identified with a sampling interval of Δt is $1/2\Delta t$, which is called the Nyquist frequency. This limit is based upon the sampling theorem which states that if a frequency, f_c, exists for which the fourier transform of the function $Y(t)$ is equal to zero for all frequencies greater than f_c, then $Y(t)$ can be uniquely determined from sampled values where $\Delta t = 1/2f_c$. Of course, this sampling theorem is explicitly or implicitly applied in almost every case of application of the fourier transform, but the importance of the Nyquist frequency cannot be overlooked. If important harmonic components exist in the data at frequencies greater than f_c, the lower frequency estimates of the amplitudes may be distorted. This is due to the fact that the discrete fourier transform cannot distinguish between the frequencies f_i and $[(1/\Delta t) - f_i]$. Therefore, if $\Delta t = 1$ and f_c is then assumed to be 0.5, harmonic components at frequencies greater than 0.5 will distort the amplitude estimates of frequencies at less than 0.5.

In summary, the analyses in this report are based upon the fourier series model of equation 4. The unknowns of this model, $\hat{\alpha}_0$, $r\ \hat{\alpha}_i$'s and $r\ \hat{\beta}_i$'s, are estimated with equations 5-7, respectively. The discrete fourier transform is an approximation of the continuous fourier transform, defined for continuous processes within $-\infty < t < +\infty$. In certain instances, the utilization of the discrete approximation may cause distortions in the amplitude estimates. These problems arise due to truncation of the data record and sampling intervals that are too large to reflect important periodic components.

In using the fourier series model to analyze a particular set of data, two important questions arise. The first deals with the number of coefficients that are estimated. The second question involves the lag window, or the determination of a set of weights that may be applied to the data being transformed before the transformation occurs. Without _a priori_ expectations of the periodic components in the data set, the use of a lag window is dependent upon the judgement of the researcher concerning the resolution of the power spectrum.

2.3 STEPWISE MULTIPLE REGRESSION ANALYSIS

A stepwise multiple regression procedure in SPSS (Statistical Package for the Social Science, Nie et al. 1975) was utilized to develop predictive equations for future use in testing the null hypothesis that no changes occur in shrimping success parameters attributable to brine discharge. The stepwise procedure (Subprogram Regression) is a forward inclusion procedure, with the order of inclusion determined by the contribution of each independent variable toward explaining residual variance in the dependent variable. The first independent variable entered into the regression equation is the one that has the strongest simple bivariate correlation coefficient (r) with the dependent variable. At each step following the first, the variable that explains the greatest amount of variance unexplained by variables already in the equation (residual variance) enters the equation. As mentioned above (Section 2.1.1) a number of important independent variables had missing values during certain years. These are documented in Table 3 and 4 for brown and white shrimp variables, respectively. The listwise deletion option in SPSS (Nie et al. 1975) was used in the regression analyses. In listwise deletion, if a certain independent variable (e.g., NOS temperature, Galveston Channel) is included in the analysis and it has a missing value (e.g., April 1966), that year (including the entire suite of independent variables and the dependent variable for that year) is eliminated from the analysis. Thus, if one observation (e.g. 1966) were dropped from the ten year data set, the analysis would be conducted using only 9 observations (years) for each independent variable and the dependent variable. The implications of this listwise deletion process on the values for the simple bivariate correlation coefficients (r) in the correlation and regression tables presented in this report were discussed in Section 2.1.2.

In the application to this study, no hierarchy of variable entry was imposed in the stepwise process. Few limitations on inclusion of variables in the analyses were employed, and the default options in SPSS (Nie et al 1975) were used. These default options included; (1) n = 80, where n is the maximum number of independent variables that will be entered into the equation; (2) F = 0.01, where F is the F ratio computed in a test of significance of the regression coefficient for each variable as if it were the variable to enter into the equation on the next step; (3) t = 0.001, where t is the tolerance of the independent variable being considered for inclusion in the equation, and is the proportion of the variance of that variable not explained by the independent variables already in the regression equation. As pointed out by Nie et al. (1975) these default options place little restriction on a stepwise regression. The default options were especially applicable during the first level or stage of the regression analysis scheme, where, for each type of environmental variable (e.g. river discharge), the inclusion of the maximum number of variables in the equations was desired, and no attempt was made to reduce the number of variables in those initial equations to include only the best predictors. This was done because of the exploratory nature of these preliminary regression analyses, wherein these equations were used to select variables to be included in the analyses used to develop the final predictive equations.

Due to the very high correlations between some pairs of independent variables (e.g., water and air temperature) and the possible multicollinearity problems associated with this, only one variable of each group of highly correlated predictors was used in each of these equations, with the other highly correlated variables being excluded from the particular analysis. Decisions regarding omission of variables were made after examination of correlation matrices, with deletion of variables occurring in both the categorical and final regressions.

Four potential indicators of shrimping success for each species were considered for use in these analyses. These were (1) catch (pounds, heads off); (2) catch/effort (pounds, heads off/day); (3) catch/area (pounds, heads off/10000 hectares) and (4) catch/effort/area (pounds, heads off/10000 hectares/day). Because the regressions for catch and catch/area (and those for catch/effort and catch/effort/area) would yield identical predictive capabilities (because area does not enter into any of the independent variables and the effect of area on each dependent variable is nothing more than scaling by a constant), regressions were developed only for catch and catch/effort for brown and for white shrimp.

Inspection of the historical records indicated that the available data fell into either of two main groups. These were (1) those data available for the entire (or almost the entire) eighteen year period (1960-1977); and (2) those data available for only the ten year period, 1964-1973. Of course, any data available for the eighteen year period were also available for the 1964-1973 period. Therefore, the 1964-1973 data set included a number of variables (some of which were important in predicting shrimp catch) that were not available for the entire eighteen year period. This ten year time period (1964-1973) seemed appropriate since it included years showing extremes in both catch and important environmental variables for both species. Based on this evaluation it was decided that complete sets of analyses would be run for data from each of the two time periods. Therefore, this report includes stepwise multiple regression analyses for the following combinations of dependent variables and periods.

(1) Annual brown shrimp total catch - 10 years - 1964-1973
(2) Annual brown shrimp total catch - 18 years - 1960-1977
(3) Annual brown shrimp interview catch/effort - 10 years - 1964-1973
(4) Annual brown shrimp interview catch/effort - 18 years - 1960-1977
(5) Annual white shrimp total catch - 10 years - 1964-1973
(6) Annual white shrimp total catch - 18 years - 1960-1977
(7) Annual white shrimp interview catch/effort - 10 years - 1964-1973
(8) Annual white shrimp interview catch/effort - 18 years - 1960-1977

For each type of dependent variable (e.g., brown shrimp catch), analyses were conducted using three different statistical reporting units. These were:

(1) statistical area 18
(2) statistical area 19
(3) statistical area 19, 11-15 fm depths

Because of the large number of variables potentially of interest in developing the predictive equations, there were two stages in the analytic process. First, similar environmental variables were grouped into separate (categorical) data sets for initial or exploratory correlation and regression analysis. The following groups of variables were established:

- Discharge
- Precipitation
- Salinity and density
- Temperature
- Winds, tides, and Ekman transport
- Recruitment, bay shrimp catch and bay effort

For each dependent variable, separate regression equations were developed using each of these groups of independent variables. The particular biweekly, monthly, seasonal and annual variables (including lagged variables) which were utilized in the brown and white shrimp regressions were determined by the historial information presented in Section 1.2. In this report, the initial regression equations are summarized in tabular form and all independent variables which entered into these equations (based on the default criteria of SPSS) are presented in these regression tables. This yielded a total of one hundred and thirty eight initial regressions. Only the sets of regressions relating white shrimp catch and catch/effort to salinity variables for the eighteen (1960-1977) year data set were not run, due to the lack of quantitative salinity or density data covering this entire time period.

Based on the results of these initial (categorical) regression analyses, the variables that provided the best fit for each regression analysis were identified. The "best fit" variables identified in the initial regression analyses for each dependent variable were then pooled to form a "best fit" suite of variables for each dependent variable. For each dependent variable, a "best fit" multiple regression analysis was then run, utilizing the suite of most important or best fit variables as determined in the initial regression analyses. This overall regression analysis for each dependent variable was first run with all the best fit variables included in the data set. Then, after the final best fit variables had been identified for each dependent variable (based on the increase in variance explained (ΔR^2 or change in the square of the multiple correlation coefficient) and the reduction in error mean square), a final regression analysis was run using only these final best fit variables. The final predictive equations which are presented in this report are the ones that should be utilized in quantitative impact assessment for testing the null hypothesis that no change is occurring in shrimping success attributable to brine discharge.

All analyses were conducted using untransformed data (independent and dependent variables). Examination of the behavior of the residuals with respect to time and with respect to the actual and predicted values of the dependent variables over time (Draper and Smith 1966) did not reveal trends in the data indicative of a need for transformation of the data.

The question of the importance of fishing effort in estimating shrimp catch is thoroughly covered in Work Unit 3 of the Shrimp and Redfish Studies (Comiskey et al. 1981), in which similar predictive equations were developed based on various catch and effort variables. In the Work Unit 2 study, the overall goal was the development of relationships of shrimping success variables with environmental and recruitment variables. In order to assess the relative importance of effort to predicting catch, the following methodology was employed. The best overall regressions for brown shrimp catch and white shrimp catch were developed first utilizing the suites of best fit variables (as determined from the initial regressions). A second regression was then run utilizing the same suite of best fit variables, but also including fishing effort. Results of both analyses (with and without effort) are presented in this report. In the case of the regressions with effort as a dependent variable, effort was forced into the equation even if it was not important, to allow the reader to better understand the relative importance of, and the need for, these effort variables toward predicting shrimp catch.

The regression equations which were developed for catch variables (as dependent variables) used total (interview plus non-interview) catch data, while only the interview data were used to calculate catch/effort dependent variables. Also, the fishing effort data used to calculate catch/effort involved non-directed nominal interview effort. The process of prorating effort (by catch of brown and of white shrimp at the individual trip level) disallows development of equations relating catch to directed effort because directed effort is not independent of catch. This use of non-directed effort is consistent with the methods employed in Work Unit 3 regression analyses (Comiskey et al. 1981). As discussed above (Section 2.1.1), when effort was used as an independent variable, it was calculated by expanding interview non-directed nominal effort (days fished) to the total (interview plus non-interview) data, using the ratio of total catch to interview catch for the particular spatial stratum.

In this report, all data products associated with the multiple regression analyses are presented in either Section 6 (Tables) or Section 7 (Figures).

Results of the multiple regression analyses are presented as summary tables. In these tables, MULTIPLE R is the multiple correlation coefficient, which increases as each new variable is entered into the equation. R SQUARE is the square of the multiple correlation coefficient, R^2, and is the proportion of the variance in Y explained by the independent variables which have been entered into the equation. RSQ CHANGE in these tables is the change in the square of the multiple correlation coefficient (ΔR^2) at each step. Since this is equivalent to the amount of residual variance explained at each step, it is a measure of the value of the independent variable toward explaining residual variance (i.e., the variance that has not been explained by previously entered variables) in the dependent variable. SIMPLE R is the simple bivariate Pearson product moment correlation coefficient, r. B is the unstandardized regression coefficient associated with each variable entered into the model, while BETA is the standardized regression coefficient for each variable. Correlation matrices and summary statistics associated with each set of multiple regression models are also presented in Section 6.

For each of the final, best fit regression models, plots of the dependent variable and two most important independent variables are presented in Section 7, as are plots of the actual, predicted and residual values of the dependent variable based on the final stepwise multiple regression model. Also presented in Section 7 are plots of the three dependent variables (values in area 18, area 19, and area (19, 11-15 fm depths) for each penaeid species for the eighteen year period.

2.4 CLUSTER ANALYSIS

Cluster analyses were conducted to determine if the environmental variables which were shown to be important in predicting shrimping catch in the correlation and regression analyses could be used to classify or group years of good and poor shrimp catch. Q-mode clustering of years was performed using a hierarchical, agglomerative, unweighted pair-group method, with Czekanowski's coefficient as a distance measure. Program options were executed to standardize values of each variable to a zero to one-hundred (0-100) scale. The scaling removed the effects of the differences in the magnitudes of the original variables. Thus, a variable with a small mean (e.g. salinity) will have an importance equal to that of a variable (e.g. river discharge) with a much larger mean and range. Six cluster analyses were run, as follows: (1) brown shrimp variables, 1964-1973; (2) brown shrimp variables, 1960-1977; (3) white shrimp variables, 1964-1973; (4) white shrimp variables, 1960-1977; (5) brown shrimp plus white shrimp variables, 1964-1973; (6) brown shrimp plus white shrimp variables, 1960-1977. Results are presented as dendrograms showing classification results based on the particular suite of important environmental and recruitment variables. The values of total shrimp catch (brown, white or brown and white) are printed on each dendrogram. It is important to recognize that these catch variables were not used in the cluster analyses. They are presented so the success of the cluster analyses in grouping years based on catch can be assessed.

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3.0 RESULTS AND DISCUSSION

3.1 TIME SERIES ANALYSIS

3.1.1 ARIMA Modeling

Summary statistics for monthly total brown and white shrimp are summarized in Table 7, and are presented graphically in Figures 5 and 6, respectively. The high coefficients of variation and wide ranges for the white and brown shrimp indicate that the choice of an appropriate analysis for these data are difficult. Since large variations in the numbers indicate that problems such as non-constant (heterogeneous) variance may exist, and since several efforts to analyze the data on the untransformed scale yielded inconsistent results, another metric for analysis was sought through the use of the technique of transformation of variables according to Box and Cox (1964). These authors suggest a transformation of the following form,

$$X^{(\lambda)} = \begin{cases} \dfrac{X^{\lambda} - 1}{\lambda} & \text{for} \quad \lambda \neq 0 \\ \\ \log X & \text{for} \quad \lambda = 0 \end{cases}$$

where $X^{(\lambda)}$ is the transformed observation and λ is the transformation parameter. Utilizing the change-of-variable theorem from mathematical statistics, Box and Cox (1964) showed that, for a general class of specifications with $X^{(\lambda)}$ as the dependent variable, the appropriate value of λ can be found by maximum likelihood techniques. This approach was utilized on white shrimp total catch, where the value of λ was estimated to be 0.1. Since this value is close to $\lambda = 0$, the log transformation (base 10) was applied independently to both brown shrimp catch and white shrimp catch data. Table 8 summarizes the vital statistics for the transformed catch data. As can be seen from the information in Tables 7 and 8, transformation resulted in a data set more amenable to analysis. Further discussion deals with each species separately.

3.1.1.1 Brown Shrimp

An examination of the plot of shrimp catch versus calendar time in months indicates that a strong seasonal pattern existed with peaks about every twelve months occurring in late summer or early fall. The autocorrelations for the transformed data, presented in Table 9, verified this strong seasonal pattern and also indicated a seasonal non-stationarity in the data exhibited by the fact that the autocorrelations at lags which are multiples of twelve did not decline in value. Differencing at lag 12 resulted in a stationary series with both seasonal and non-seasonal characteristics. The final model identified for the brown shrimp was of the following form.

$$(1 - a_1'B^{12} - a_2'B^{24})(1 - a_1B)(1 - B^{12})z_t = \varepsilon_t \qquad (1)$$

where $z_t = \log(Y_t)$, Y_t = brown shrimp catch in month t, and ε_t is a random disturbance with a normal distribution and zero mean. The model is non-seasonal autoregressive order 1, and seasonal autoregressive order 2, with a seasonal difference. The terms a_1' and a_2' are the seasonal autocorrelation coefficients, and the term a_1 is the non-seasonal autocorrelation coefficient. Multiplying out the terms in equation (1) and using the definition of the backshift operator (p. 59), equation (1) can be written in terms of the z's and ε as follows:

$$(z_t - z_{t-12}) = a_1z_{t-1} - a_1'z_{t-12} - (a_1 + a_1a_1')z_{t-13} - (a_1' - a_2')z_{t-24} - (a_1a_2' - a_1a_1')z_{t-25} - a_2'z_{t-36} + a_1a_2'z_{t-37} + \varepsilon_t \quad (2)$$

The parameter estimates for equation (1) are provided in Table 10. The residuals (difference between the actual and forecasted value) from the model were examined to determine if any patterns emerged which would indicate that all the available information had not been included in the model. Table 11 presents autocorrelations for the residuals through time lag 36. These autocorrelations show that the residual series was basically random and most likely does not contain much additional information concerning elements having an impact on shrimp catch.

These results reflect quantitatively the seasonal and non-seasonal factors apparent from a plot of the data. The non-seasonal autoregressive term of order 1 means that the current level of shrimp catch is highly related to the value in the previous period (month) and, ignoring seasonal factors, that trends have a tendency to continue once established. The seasonal autoregressive terms of order 2 indicate that the current catch is highly related to the catch in the same month 12 and 24 months in the past, but do not imply a cause-effect relationship (as might be inferred if a spawner-recruit relationship were known to exist). Rather, the results substantiate the strong and repeatable seasonal pattern in brown shrimp catch. In contrast to the trend-reinforcing effect estimated for the non-seasonal autoregressive term, the seasonal autoregressive terms relate to the current shrimp catch in a negative fashion, as shown by the coefficient estimates for a_1' and a_2'. These offsetting effects from the seasonal and non-seasonal factors provide stability in the forecasts of monthly brown shrimp catch.

Forecasts from the model and actual monthly brown shrimp catch values for observations 205 (January 1977) through 216 (December 1977) are listed in Table 12. These forecasts were obtained by re-estimating the model with observations 1-204 (January 1960 to December 1976). Of the 12 forecasts, the correct direction in the month-to-month change in brown shrimp catch was predicted by the model eight times. In several cases, the absolute magnitude in the observed and forecasted monthly values for brown shrimp catch differed substantially. This result is due to the fact that peaks or troughs in brown shrimp catch in the last year of the sample were substantially above or below the monthly values that would have been expected from an evaluation of the previous 17 years of shrimp catch data. Table 13 provides forecasts of shrimp catch from observation 217 (January 1978) through observation 228 (December 1978). To obtain these forecasts, the model was estimated with observations 1-216 (January 1960 to December 1977).

These forecasts indicated that brown shrimp catch would reach a trough in month 220 (April 1978) and a peak in month 223 (July 1978).

3.1.1.2 White Shrimp

Examination of a plot of monthly white shrimp catch versus calendar time in months indicated a strong seasonal pattern, with 12-month and 6-month peaks. The autocorrelations for the transformed data are provided in Table 14. These autocorrelations indicated that, as was the situation for brown shrimp catch, the time series for white shrimp catch exhibited non-stationary behavior for the seasonal effects. Differencing at lag 12 (current (monthly) value minus value 12-months previous) led to the identification and estimation of the following model,

$$(1 - a_1B - a_2B^2)(1 - B^{12})z_t = (1 - b_1'B^{12})a_t \tag{3}$$

where z_t = log (Y_t) and Y_t = white shrimp catch in month t. The model is a non-seasonal autoregressive order 2, seasonal moving average of order 1, with a seasonal difference. The terms a_1, and a_2 are the non-seasonal autocorrelation coefficients, and the term b_1', is the seasonal moving average coefficient. Multiplying out the terms in equation (1) results in

$$\begin{aligned}(z_t - z_{t-12}) &= a_1z_{t-1} + a_2z_{t-2} - \\ &a_1z_{t-13} - a_2z_{t-14} + a_t - b_1' a_{t-12}\end{aligned} \tag{4}$$

The parameter estimates for equation (3) are provided in Table 15, while Table 16 lists the autocorrelation estimates from the residuals of the fitted model. Although the autocorrelations did not indicate the presence of any systematic trends that have not been included in the model, the degree of explained variation (R^2) is below that obtained for brown shrimp catch. A secondary seasonal trend consisting of a 6-month cycle has not been included due to the lack of the available logic in the algorithm used to solve equations (1) and (3). Although the trends in the residuals did not indicate that this problem was serious, it has not been thoroughly investigated.

The systematic elements identified in the time series for monthly white shrimp catch indicate that once a trend had started there was a tendency for the trend to continue. The seasonal factor indicated that white shrimp monthly catch in period t - 12 was related to the catch in period t in a positive manner, supporting the 12 month cycle as the basic recurring trend in the data.

Table 17 provides both the observed and forecasted monthly values of white shrimp catch for observations 205 to 216 (January 1977 to December 1977). The forecasts were obtained by estimating the model with observations 1-204 (January 1960 to December 1976). Except for month 215 (November), white shrimp catch in 1977 was considerably below what would have been expected based on the variation of the previous 17 years. Forecasts for observations 217 to 228 (January 1978 to December 1978) are listed in Table 18, along with the 90 percent and 50 percent confidence limits. These forecasts were obtained by estimating the model with observations 1-216 (January 1960 to December 1977). Due to the low percent of explained variation available from the model, the confidence limits are relatively wide. These forecasts suggest that, based on past catch history, white shrimp catch would peak in month 227 (November 1977).

3.1.2 Fourier Analysis

The estimated power spectra for both the brown and white shrimp data are provided in Table 19. The corresponding periods can be found by computing the reciprocal of the frequency. In both cases, the power spectra are estimated to be relatively flat, indicating that the periodicity in both sets of data is weak. Since the power spectrum estimates provide a measure of the relative contribution of each frequency component to the overall variance in the data, equivalent relative contributions for a large number of frequencies indicates that the frequencies of the cycles in the time series are probably not fixed. For instance, over the 18 years catch history available for brown shrimp, the peaks in the catch data are twelve months apart only nine times. Similarly for the white shrimp catch history, the primary peaks are twelve months apart only six times.

In Table 19, asterisks identify those frequencies, determined by the fourier analysis, that account for relatively large portions of the variance in the catch variables. As noted above, no frequency or small set of frequencies dominated the variance. The numbers in parenthesis indicate the corresponding periods. The strongest repetitive cycle in both sets of data is the twelve month cycle, but it was not identified by the fourier analysis for either the brown or white shrimp catches. The problem is that the cycle in the time series is not consistently twelve periods long, causing difficulty when trying to estimate the power spectrum, which is based on consistent cycles. The results showed that the seasonal component was erratic, and was obviously influenced by many factors.

3.2 REGRESSION ANALYSIS

3.2.1 Initial Categorical Regressions for Brown Shrimp Catch and Catch/Effort

3.2.1.1 Characterization of the Dependent Variables

The patterns of annual brown shrimp total catch and interview catch/effort for area 18, area 19 and area 19, 11 to 15 fm depths, for the period 1960-1977 are shown in Figures 7a and 7b, respectively. In general, the trends for brown shrimp catch in the three spatial strata are similar, with notable exceptions (Figure 7a). Catch in all three spatial strata was highest in 1967, with catch in area 18 approaching that in area 19. Other years of high brown shrimp catch in all three spatial strata included 1960 and 1971. During all years except 1974, brown shrimp catch in area 19 exceeded that in area 18. Compared to 1973, catch in area 19 in 1974 decreased, but increased sharply in area

18. Catch in area 19, 11 to 15 fm depths, in 1974 was the lowest for the eighteen year period for that spatial stratum. Major differences in the trends for area 19 and area 19, 11 to 15 fm depths occurred in 1970, 1976 and 1977. During all three years, brown shrimp catch in area 19 was higher than during the previous year, while just the opposite was true for catch in area 19, 11 to 15 fm depths.

For brown shrimp catch/effort (Figure 7b), annual trends for the three spatial strata (area 18, area 19, and area 19, 11 to 15 fm depths) for the period 1960 to 1977 were very similar, with highest catch/effort in all three spatial strata occurring in 1967, the year of maximum catch (Figure 7a). The trends for catch/effort for each spatial stratum were generally similar to the trends for catch for the same stratum. Major differences in the trends for catch and catch/effort in area 19, 11 to 15 fm depths, occurred in 1970 and 1974. In both years, catch was considerably lower as compared to the previous year, while just the opposite was true for catch/effort. At least for 1974, these differences may be explainable in terms of other factors (e.g., economics) that substantially reduced effort and, therefore, catch (Johnson 1975). Catch/effort was higher in area 19, 11 to 15 fm depths, as compared to area 19, in all years except 1961. Catch/effort was substantially higher in area 19, as compared to area 18 only during 1968, 1972, and 1975. During all other years, catch/effort for the two areas was similar or was greater in area 18. Catch/effort in area 18 substantially exceeded that in area 19 in 1961, 1965, 1967, 1969, 1974 and 1977.

3.2.1.2 Brown Shrimp Regressions for the Period 1964-1973

Summary statistics for the ten year data (1964-1973) used to develop the regressions relating brown shrimp catch and catch/effort variables to environmental variables and indices of recruitment are shown in Table 20. Data for some variables have been scaled up or down by powers of ten or have otherwise been modified by transformation. All such scalings or transformations are documented in Table 3.

Table 21 is the correlation matrix of simple bivariate Pearson product-moment correlation coefficients, r, between all possible pairs of variables in the ten year data set used to relate brown shrimp catch and catch/effort to river discharge variables. Tables 22 to 27 show the results of the stepwise multiple regression analyses relating brown shrimp catch and catch/effort variables to river discharge variables for the ten year data set. In these tables, MULTIPLE R is the multiple correlation coefficient, which increases as each new variable is entered into the equation. R SQUARE is the square of the multiple correlation coefficient, R^2, and is the proportion of the variance in Y explained by the independent variables which have been entered into the equation. RSQ CHANGE in these tables is the change in the square of the multiple correlation coefficient (ΔR^2) at each step. Since this is equivalent to the amount of residual variance explained at each step, it is a measure of the value of the independent variable toward explaining residual variance (i.e., the variance that has not been explained by previously entered variables) in the dependent variable. SIMPLE R is the simple bivariate Pearson product moment correlation coefficient, r, and B is the regression coefficient associated with each variable entered into the model.

The model for brown shrimp catch for area 18 (Table 22) accounts for the most variance with the fewest number of variable, with 90.5 percent of the variance explained with three variables. Trinity River discharge during the January-March period was most highly (and negatively) correlated with brown shrimp catch ($r = -0.71$) demonstrating the negative effect of lowered salinity in Galveston Bay in the winter and early spring on brown shrimp success. The second variable entered into the model, July-September Guadalupe River discharge, was the only variable in the model that was positively related to catch.

For area 19 and area 19, 11-15 fm depths (Tables 23 and 24), four variables explained almost 90 percent of the variance in brown shrimp catch. Annual Mississippi River discharge was the variable most highly (and negatively) correlated with catch in area 19 ($r = -0.63$) while the July-September Guadalupe River discharge was the second variable entered (r = 0.17). For area 19, 11-15 fm depths, the order of entry of these two variables was reversed, with July-September Guadalupe River discharge having a simple correlation coefficient of r = 0.54 with catch, and annual Mississippi River discharge having a simple correlation of r = 0.25 with catch.

It is interesting that summer Guadalupe River discharge, which was, in all cases, positively correlated with brown shrimp catch, was an important independent variable in all brown shrimp catch models. The ecological basis for this relationship is not evident. A positive relationship of brown shrimp catch to summer discharge from the Guadalupe River had been noted previously (TDWR 1979b). The negative correlations with Atchafalaya and Mississippi River discharges are expected and probably represent the influence of low estuarine and near coast salinity in the winter and spring periods.

Brown shrimp catch/effort trends were also explained well by the models based on the ten year data, and, again, catch/effort for area 18 (Table 25) provided the best fit with the fewest number of variables, with 93.5 percent of the variance in catch/effort explained by four variables. Of these, lagged annual Atchafalaya River discharge, with a simple correlation coefficient of r = -0.68 with catch/effort, was entered first. The second variable entered was lagged Trinity River discharge (r = 0.11). The greater importance of lagged variables to catch/effort and their relative unimportance toward explaining the variability in catch is not readily apparent.

For catch/effort of brown shrimp in area 19 and area 19, 11-15 fm depths (Tables 26 and 27), lagged variables were much less important. As in the regression equations for brown shrimp catch, the first two variables entered into both equations were the same but the order of entry was reversed. For area 19, January-March Mississippi River discharge (r = -0.72) was entered first, but the correlation for the March Trinity River discharge (r = -0.71) was almost as strong. Both of these relationships suggest the effects of low salinity during the estuarine phase of the shrimp life cycle on shrimping success.

For area 19, 11-15 fm depths, the correlations of catch/effort with these same two river discharge variables were also negative (r = -0.66 for the March Trinity River discharge and r = -0.60 for the January-March Mississippi River discharge). Again, virtually all river discharge variables (except July-September Guadalupe River discharge) were negatively correlated with catch and catch/effort variables. This strongly suggests that brown shrimp are more successful in years of low river discharge in winter and spring.

Table 28 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp catch and catch/effort variables to salinity variables. Tables 29 to 34 show the results of the regression analyses relating brown shrimp catch and catch/effort variables to salinity variables for the ten year data set.

While most river discharge variables that entered the catch and catch/effort equations were negatively related to catch (see Table 22 to 27), virtually all salinity variables that entered into the regressions were positively related to catch, emphasizing the negative relationship of estuarine salinity to river discharge. The best fit for the stepwise regression models relating brown shrimp catch to salinity variables was achieved for area 18, where four variables explained greater than 99 percent of the variance in catch. For area 18 (Table 29), the April TPWD Galveston Bay mean salinity was highly correlated with catch (r = 0.86), explaining 75 percent of the variance in the dependent variable. The second through the fourth variables entered in the equation were minimum salinities for two week periods during the mid-winter to early spring period for Galveston Bay. These minimum salinities were based on data collected during the BCF-NMFS postlarval shrimp sampling in Galveston Entrance.

For area 19 (Table 30), the first four variables, which together accounted for 90 percent of the variance in brown shrimp catch, were all two-week minimum salinities from the BCF-NMFS postlarval shrimp survey, with the salinities for the second half of March being most highly correlated with catch (r = 0.77). A similar situation was seen for area 19, 11-15 fm depths (Table 31), with the March minimum salinity (monthly minimum from the NOS samples) having the highest correlation with catch (r = 0.60). The next three variables entered were two-week minimum salinities from the postlarval shrimp survey.

The results unquestionably demonstrate that estuarine salinity during the late winter and spring period is very important in determining the success of brown shrimp which enter the estuaries as postlarvae during the February-April period.

For brown shrimp catch/effort, the results (Tables 32 and 34) were almost as good as were those for catch (Tables 29 to 31). Four independent variables explained 89 percent of the variance in catch/effort in area 18, and for area 19 and area 19, 11-15 fm depths, 92 percent and 95 percent, respectively, of the variances were explained by four variables. In all three cases, April TPWD Galveston Bay mean salinity was very highly correlated with catch, with the correlations for area 18, area 19 and area 19, 11-15 fm depths, being r = 0.84, r = 0.89 and r = 0.90, respectively. This mean salinity variable entered the equation for the area 18 first, but for area 19 and area 19, 11-15 fm depths, the minimum salinity for the second half of March was most highly correlated with catch/effort (r = 0.91 and r = 0.92, respectively) and entered the equations first. In all cases, the second variable entered was TPWD Matagorda Bay salinity (either March or April values). These results generally conform to those of previous studies (Barrett and Gillespie 1975), emphasizing that salinity during the late February through April period is critical to the success of brown shrimp postlarvae and juveniles.

Table 35 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year data (1964-1973) set used to relate brown shrimp catch and catch/effort variables to precipitation variables. Tables 36 to 41 show the results of the stepwise multiple regression analyses relating brown shrimp catch and catch/effort variables to precipitation variables for the ten year data set.

As might be expected, precipitation variables were not as good predictors of brown shrimp catch or catch/effort as were river discharge variables and salinities of the bays and near coastal zones, since precipitation is only effective in influencing shrimp catch when it alters salinity. Duration, intensity and temporal occurrence of precipitation are important factors along with amount of precipitation in influencing the relationship of precipitation to discharge. For areas 18 and 19 (Tables 36 and 37), respectively, 62 percent and 82 percent of the variance in brown shrimp catch were explained by the first four variables entered into the equation. For area 19, 11-15 fm depths (Table 38), the first four variables entered into the equation explained less than 30 percent of the variance in brown shrimp catch. For area 18, annual precipitation at Freeport was the variable first entered into the equation, giving a correlation of $r = -0.63$ with catch. For area 19 and area 19, 11-15 fm depths, lagged annual precipitation at Freeport was positively correlated with catch (correlation coefficients of $r = 0.36$ with both independent variables) and was the first variable entered into these equations. Annual precipitation at Freeport was negatively related to all three catch variables. The negative correlation of precipitation variables with brown shrimp catch was expected, but the positive relationship of lagged annual precipitation at Freeport to brown shrimp catch was not expected. However, the amount of variance in catch that remained unexplained by the suite of precipitation (independent) variables was rather high.

For brown shrimp catch/effort, the variables first entered into each of the equations (Tables 39 to 41) were either April precipitation at Freeport (area 19 and area 19, 11-15 fm depths) or April-June precipitation at Freeport (area 18), and in all cases, the simple r was negative, ranging from -0.56 in area 18 to -0.64 in area 19. In no case did the first four variables which entered the equations explain greater than 80 percent of the variance in catch/effort. The negative relationship between springtime precipitation and brown shrimp success is clearly depicted by these results.

Table 42 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp catch and catch/effort variables to temperature variables. Tables 43 to 48 show the results of the stepwise regression analyses relating brown shrimp catch and catch/effort variables to temperature variables for the ten year data set.

In all cases, greater than 90 percent of the variance in brown shrimp catch was explained by four or fewer temperature variables, and in the case of area 19, 11-15 fm depths, greater than 97 percent of the variance was explained by two variables (March and April TPWD Matagorda Bay mean temperature). Virtually all of the temperature variables entered in these equations were positively related to catch, indicating that high temperatures in the spring (when most brown shrimp were in the estuaries) were conducive to growth and survival of the postlarvae and juveniles. This is reflected in higher commercial catch for those years when temperatures were high in the spring. For area 18 the first variable entered was the April TPWD mean temperature for Galveston Bay, while for area 19, April TPWD mean temperature for Matagorda Bay was the first variable entered into the regression equation. The correlation coefficients for these two variables with catch variables for areas 18 and 19 were almost identical ($r = 0.85$). Even though the first variable that entered the equations for areas 18 and 19 was more highly correlated with the respective catch variables than was the case for area 19, 11-15 fm depths, (where the correlation coefficient was $r = 0.76$ for brown shrimp catch and March TPWD Matagorda Bay mean temperature), the overall fit of the equation was better for catch in area 19, 11-15 fm depths. The importance of low temperatures during the early spring period is supported by these results. Catastrophic low temperatures, especially in April, can apparently kill bay shrimp, while generally low temperatures will decrease the growth rate of juvenile brown shrimp.

For brown shrimp catch/effort, where greater than 97 percent of the variance was explained by four temperature variables in the equations for each of the three spatial strata (Tables 46 to 48), April NOS Galveston Bay mean temperature and April TPWD Galveston Bay mean temperature were the first variables to enter all regression equations, with correlations ranging from $r = 0.79$ in area 19, 11-15 fm depths, to $r = 0.91$ in area 18. The only major difference among the results for the three spatial strata was the reversal in the order of entry of variables into the equation for catch/effort in area 19, 11-15 fm depths, where TPWD Galveston Bay mean temperature entered first. As was the case with catch, virtually all temperature variables entered in the equations were positively related to catch/effort.

Table 49 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964 to 1973) data set used to related brown shrimp catch and catch/effort variables to wind, tide and Ekman transport variables. Tables 50 to 55 show the results of the stepwise multiple regression analyses relating brown shrimp catch and catch/effort variables to wind, tide and Ekman transport variables for the ten year data set.

The results of the stepwise regressions analyses for brown shrimp catch with wind, tide and Ekman transport variables (Tables 50-52) showed that in all cases, four variables explained greater than 93 percent of the variance in the particular dependent variable. In all cases, March zonal Ekman transport was the first variable entered into the equations. For area 18 (Table 50), March zonal Ekman transport and April Galveston Station fastest wind (with correlations with catch of $r = 0.92$ and $r = -0.63$, respectively) were entered first and together explained greater than 99 percent of the variance in catch. March zonal Ekman transport was not as highly correlated with catches of brown shrimp in either area 19 or area 19, 11-15 fm depths, as it was with catch in area 18 ($r = 0.68$, 0.66, and 0.92 respectively), even though statistical area 19 is in closer geographical proximity to the location of the Ekman transport station than is area 18. For area 19 (Table 51), March NOS Freeport highest tide, with a simple correlation of r = -0.62 with catch, was the second variable entered, while for area 19, 11-15 fm depths (Table 52), the first three variables entered were all Ekman transport variables.

The results for brown shrimp catch/effort were generally similar to those for catch. March zonal Ekman transport, with correlations of r = 0.84 to r = 0.90 with catch/effort variables, was the first variable entered into each of the equations. In area 18 (Table 53), March and April zonal Ekman transport, with correlations of r = 0.90 and r = 0.89 with catch/effort, respectively, together explained 92 percent of the variance in catch/effort. Correlations of this magnitude indicate that zonal Ekman transport is an extremely important variable for predicting brown shrimp catch/effort in area 18. In the case of both area 19 and area 19, 11-15 fm depths (Tables 54 and 55), March NOS highest tide at Freeport was the second variable entered, being negatively related to brown shrimp catch/effort in both cases (r = -0.70 and r = -0.62 respectively). The greater relative importance of zonal Ekman transport (east-west) as compared to meridional transport (north-south) is interesting. During the 1964-1973 period, monthly net meridional Ekman transport was almost always positive (to the north), due to the predominance of winds from the east to south-southeast during all months at the latitude of the Ekman transport station. Due to the greater frequency of winds from the east in the fall and winter, zonal Ekman transport was relatively low during this time, and was negative (to the west) during some years (Gunn 1978). The greater relative importance of zonal Ekman transport indicates that the effects of winds on the nearshore current regime may be more critical than long range northern transport of the brown shrimp postlarvae. This is not to say that meridional Ekman transport was not important, as can be seen by the relatively strong positive correlations of meridional transport variables from the winter and spring to brown shrimp catch and catch/effort variables.

Except for Ekman transport variables, all variables entering these equations were negatively related to brown shrimp catch and catch/effort. This behavior is not difficult to explain for most variables. The index for direction of the fastest wind, as expressed in degrees from north (regardless of east-west direction), would be low for winds from the north, while a high value for this variable (approaching 180^{o}) would indicate winds from the south. Since strong winds from the north might be expected to decrease the shoreward transport of larvae as well as lower the water level in the estuaries (thereby decreasing the area of the estuary with optimum salinities), indicators of shrimping success might be expected to be negatively related to direction of the fastest wind. In addition, strong winds from the north are usually accompanied by the coldest temperatures of the winter, further stressing the postlarvae and juveniles in the estuaries. Table 20 reveals that the (10-year) means for the March and April fastest wind direction are less than 60, indicating that fastest winds approach from approximately the east north east or west north west. These winds should be detrimental to brown shrimp productivity in the critical spring period.

The negative relationships for catch and catch/effort variables and tides are not as easy to understand. Many researchers (e.g., Baxter 1963, Hughes 1969a and b, Berry and Baxter 1969) have felt that high tides transport large numbers of postlarvae into the estuaries and also high spring flood tides will expand the area of the estuary suitable for brown shrimp production by moving higher salinity water into the upper reaches of the estuary and flooding peripheral nurseries (Moffett 1972). The consistent negative relationship between shrimp success variables and the highest tide variables in the spring is impressive and perplexing. Tides in the northwest Gulf of Mexico are complex, and result from the interaction of meteorological and astronomical factors. The result of this study indicate that the relationship of tides to brown shrimp catch and catch/effort variables is much more complex than had previously been indicated.

Table 56 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp catch and catch/effort variables to brown shrimp recruitment, bay catch and bay effort variables. Tables 57 to 62 show the results of the stepwise regression analyses relating brown shrimp catch and catch/effort variables to these recruitment, bay catch and bay effort variables for the ten year data set.

The stepwise regression models for catch (Tables 57 to 59) indicate that recruitment, bay catch and bay effort variables explain most of the variance in each dependent variable, with the R^2 values for area 18 and area 19, 11-15 fm depths, being 94 and 97 percent, respectively, with three independent variables. For area 19, the fit was not as good, with four variables accounting for approximately 89 percent of the variance in catch. For both area 18 and area 19 (Tables 57 and 58), May TPWD bay catch/effort variables (secondary and primary bays respectively) were most important, being positively correlated with offshore brown shrimp catch. The second variable entered in both equations was postlarval catch/tow (February mean for area 18 and April mean for area 19). For area 19, 11-15 fm depths (Table 59), TPWD bay catch/effort variables were relatively unimportant. February postlarval catch/tow in Galveston entrance (BCF and NMFS data), with a correlation of r = 0.83 with catch, was entered into the equation first. Other variables of importance were bay catch and bay effort variables taken from GCSD.

The results for catch/effort variables (Tables 59 to 61) show that for all dependent variables, a minimum of 89 percent of the variance was explained by the first three independent variables which entered the equations (this minimum amount explained for catch/effort in area 19, 11 to 15 fm depths). For area 18, greater than 96 percent of the variance in catch/effort was explained by two variables and almost 93 percent of the variance in catch/effort for area 19 was explained by the first three variables entered. May TPWD Galveston Bay (primary bay) catch/effort, with correlations of r = 0.92, r = 0.86 and r = 0.83 with catch for area 18, 19 and 19, 11-15 fm depths, respectively, was the first variable entered into the regression equations. For both areas 18 and 19, April postlarval catch/tow at Galveston Entrance was the second variable entered, but the simple correlations between this variable and the catch/effort variables were very low and not significant ($\alpha = 0.05$).

For area 19, 11-15 fm depths, April postlarval catch/tow was the third variable entered, but again the simple correlation with catch/effort was very low (r = 0.04). It was preceeded into the regression model by annual GCSD bay catch/trip in area 18 which was highly and positively correlated with offshore brown shrimp catch/effort (r = 0.74). Bay catch/trip in area 19 was an important variable in the equation for area 19, while for area 18, this variable was preceeded by April TPWD Galveston Bay (tertiary bay) catch/tow.

It is not surprising that the TPWD catch/effort variables for the spring months, and especially for May, are highly and positively correlated with offshore catch and catch/effort. That is precisely why these indicators of recruitment were collected. Our results confirm their efficacy. They have been used for a number of years by TPWD as guides toward regulating the closing and opening of shrimping seasons for the Texas brown shrimp fishery. These trawl samples are taken during closed seasons on unfished grounds, and should be excellent indices of bay abundance of juvenile brown shrimp. Since the May indices represent the success of the juvenile life stage through the spring period (just prior to offshore migration) they serve as integrators of the effects of early season postlarval recruitment and environmental variables on shrimping success. Although the correlations of postlarval catch/tow variables with (commercial) brown shrimp catch and catch/effort variables were generally low, they were shown to account for a significant portion of the residual variance for several dependent variables.

3.2.1.3 Brown Shrimp Regressions for the Period 1960-1977

Summary statistics for the eighteen year (1960-1977) data used to develop the stepwise regressions relating brown shrimp catch and catch/effort variables to environmental variables and indices of recruitment are shown in Table 63. All scalings or transformations of variables are documented in Table 3. Table 64 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year data set used to relate brown shrimp catch and catch/effort variables to river discharge variables.

Tables 65 to 70 show the results of the stepwise regression analyses relating brown shrimp catch and catch/effort variables to river discharge variables for the eighteen year (1960-1977) data set. Compared to the results for the ten year (1964-1973) data set (see Tables 22 to 27), the results of the regressions for the eighteen year data set showed poorer fit for all catch and catch/effort variables, with four independent variables explaining a maximum of 83 percent of the variance (for catch in area 18 and catch/effort in area 19). It should be pointed out that the poorer fits for these regressions over the eighteen year period as compared to the ten year period are not due to the lack of availability of certain important variables for the eighteen year data set. The variables which were shown to be important in the ten year regressions were available for both time periods.

For the most part, the variables which first entered the eighteen year equations for brown shrimp catch were the same or were related to those that were entered first into the catch regressions for the ten year data (see Tables 22 to 27). One exception was catch in area 19, 11-15 fm depths, where lagged annual Guadalupe River discharge had the strongest (and negative) correlation with catch ($r = -0.41$). It was, however, only marginally stronger than the correlation between catch and lagged annual Mississippi River discharge ($r = 0.40$). As in the results for the ten year data, negative correlations were seen for most river discharge variables with brown shrimp catch and catch/effort during the 1960-1977 period. As was also seen for the ten year period, July-September Guadalupe River discharge was an exception to this trend, with positive correlations of $r = 0.47$ and $r = 0.32$ with catches in area 18 and area 19, 11-15 fm depths, respectively.

For catch/effort variables for the eighteen year period, the first four variables entered into all equations were much the same (Tables 68 to 70), and, as a group, were somewhat different from those entered into the regressions based on the ten year data (see Tables 25-27). The second through fourth variables entered (July-September Guadalupe River discharge, lagged annual Guadalupe River discharge and lagged annual Trinity River discharge) were the same for all three catch/effort equations. For area 18 and area 19, annual Mississippi River discharge was the first variable entered (r = -0.56 and r = -0.69, respectively) while, for area 19, 11-15 fm depths, April-June Mississippi River discharge (r = -0.57) was the first variable entered. Except for summer Guadalupe River discharge, all variables entered in the final regression equations were negatively correlated with catch/effort. The positive relationships of summer Guadalupe River discharge with catch/effort variables were also seen in the analyses for the ten year period, but for this shorter time period summer Guadalupe River discharge was not as important in predicting brown shrimp catch/effort.

Table 71 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp catch and catch/effort variables to salinity variables. Tables 72 to 77 show the results of the stepwise regression analyses relating brown shrimp catch and catch/effort variables to salinity variables for the eighteen year period. Salinity or density data for the eighteen year period were very limited. The results showed that March and April NOS Galveston Channel minimum densities were not closely related to either catch or catch/effort variables. This does not mean there is a lack of relationship between catch and bay salinity. It probably means that the NOS data set did not provide good indicators of bay salinity. The station is very close to Galveston entrance and not really representative of estuarine conditions. The TPWD data, which was available for only the ten year (1964-1973) period was far better in this regard.

Table 78 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp catch and catch/effort variables to precipitation variables. Tables 79 to 84 show the results of the regression analyses relating brown shrimp catch and catch/effort variables to precipitation variables for the eighteen year period.

As was the case for the ten year data set, the amounts of variance explained by these regression equations relating brown shrimp catch and catch/effort to precipitation variables for the eighteen year period were not as high as those for discharge for the same time period (see Tables 65-70). Compared to the ten year regressions for precipitation (see Tables 36 to 41), the eighteen year data yielded much poorer results. Very little of the variance in catch or catch/effort was explained by precipitation variables, with especially poor fits for catch in area 19 and area 19, 11-15 fm depths. The amount of explained variance was much greater for catch/effort than it was for catch, especially in area 19 and area 19, 11-15 fm depths. As was the case for discharge, the differences in the results for the ten and eighteen year data sets cannot be explained in terms of kinds of variables available for the two periods. The variables used in both sets of analyses were virtually identical. What is more likely is other factors not included in these analyses (e.g., economic constraints) became important during the latter part of the period (Johnson 1975) and may also have been operative earlier in the eighteen year period.

Table 85 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp catch and catch/effort variables to temperature variables. Tables 86 to 91 show the results of the regression analyses relating brown shrimp catch and catch/effort variables to temperature variables for the eighteen year data set.

The results of the regression analyses relating catch and catch/effort variables to temperature variables for the eighteen year period (1960-1977) were not as satisfying as those for the ten year period (see Tables 43 to 48) and apparently suffered, at least partly, from the unavailability of TPWD monthly temperature data for Galveston and Matagorda Bays, which was available for only the ten year period. Total explained variance for each of these equations was low. The regression model for catch in area 19 showed the best fit, with 80 percent of the variance explained by six variables. Of these, March NOS Galveston Channel minimum temperature ($r = -0.64$) and April NOS Galveston mean temperature ($r = 0.51$) were the most important. The relatively strong negative relationship of March NOS minimum temperature with most catch and catch/effort variables is difficult to explain. These results would indicate that lower minimum temperatures in March are correlated with higher brown shrimp catches. It should be pointed out that due to the more widespread nature of temperature phenomena (as compared to salinity), the NOS station was probably a reasonable indicator of bay temperature.

As in the equations for the ten year period (see Tables 46 to 48), temperature in April (NOS Galveston Channel mean temperature) was a very important independent variable for predicting catch/effort for the eighteen year period, being the variable most highly correlated with all three catch/effort variables (range of correlations of $r = 0.72$ to $r = 0.81$). Only for area 18 did three variables explain as much as 70 percent of the variance in catch/effort.

Table 92 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp catch and catch/effort variables to wind and tide variables. Ekman transport variables were not available for the entire eighteen year period. Tables 93 to 98 show the results of the regression analyses relating brown shrimp catch and catch/effort variables to wind and tide variables for the eighteen year period.

At least partly due to the lack of Ekman transport data for the eighteen year period, the amounts of variance in the dependent variables (catch and catch/effort) which were explained by the regression models were not as great as those for the ten year data set, where Ekman transport variables were included in the analyses and were important in virtually all regression models (see Tables 50 to 55). Best fit for any catch variable was for area 18, where four variables explained greater than 81 percent of the variance in catch. For area 19, March NOS Freeport highest tide was entered first in the eighteen year regression model. This variable had a stronger correlation with catch in area 19 for the ten year data set as compared to that for the eighteen year data set ($r = -0.61$ vs $r = -0.52$) but was entered second in the ten year regression due to the importance and availability of Ekman transport data for the ten year period. For all other catch and catch/effort regression models, February, March or April fastest wind or fastest wind direction variables were among the first variables to be entered.

The results of the regression analyses for catch/effort variables for the eighteen year period (Tables 96 to 98), did not show appreciably greater amounts of explained variance than did the equations for catch (Tables 93-95). Except for area 18, where March Galveston fastest wind was the first variable entered into the equations for both catch and catch/effort ($r = -0.63$ and $r = -0.47$, respectively), the variables which were most highly correlated with catch differed from those which were most highly correlated with catch/effort. For catch/effort regressions, wind variables (either the fastest wind or the direction of the fastest wind) were the first two variables to be entered in the regression equations and, in all cases, the correlations with catch/effort were negative. Virtually all the bivariate correlations between either catch or catch/effort variables and either wind or tide variables were negative. These results were similar to those for the the ten year data set, but in the latter case, Ekman transport variables were included in the suite of independent variables and some of these were highly and positively correlated with catch and catch/effort.

Table 99 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp catch and catch/effort variables to bay catch and bay effort variables. Tables 100 to 105 show the results of the regression analyses relating brown shrimp catch and catch/effort variables to bay catch and bay effort variables for the eighteen year data set. The results of these regression analyses showed that a relatively small amount of the variance in the dependent variables was explained by the suite of independent variables. In no case did four variables explain as much as 60 percent of the variance in catch, while the regressions for catch/effort were even poorer, with the amount of explained variance being especially low in areas 18 and 19. These analyses for the eighteen year period included only inshore catch and effort variables from GCSD and probably suffered from the absence of data which were available for only the ten year period. These data include TPWD primary, secondary and tertiary bay catch/effort data and BCF-NMFS Galveston Entrance postlarval catch/tow data. In the ten year data set, variables from these studies were consistently the most important ones in predicting brown shrimp catch and brown shrimp catch/effort (see Tables 57 to 62). In general, the results support the hypothesis that brown shrimp catch was not closely related to bay catch or bay effort as measured by the GCSD system. This is in agreement with the lesser amount of exploitation of brown shrimp inside the estuaries, as a result of TPWD limitations on inshore shrimping.

3.2.2 Initial Categorical Regressions for White Shrimp Catch and Catch/Effort

3.2.2.1 Characterization of the Dependent Variables

The patterns of annual white shrimp total catch and interview catch/effort for area 18, area 19 and area 19, 11 to 15 fm depths, are shown in Figures 8a and 8b for the period 1960 to 1977. While substantial catches were made in both area 18 and area 19 during most years, the catch in area 19, 11 to 15 fm depths, was generally low, reflecting the fact that the 11 to 15 fm depths in statistical area 19 are beyond the range of maximum white shrimp catch (Figure 8a). This nearshore restriction of white shrimp catch was dramatically shown by Comiskey et al. (1981) and Gallaway and Reitsema (1981). Highest annual catches in area 19, 11 to 15 fm depths, were made in 1960 and 1961, the first two years of the study period. Comparing the trends for areas 18 and 19, there is general similarity, with major exceptions being noted for 1961, 1971, and 1974. Highest catches were made in 1973 and 1974 in area 18, and in the period 1968 to 1970 and in 1973 in area 19. With the exception of 1963, 1964, and 1967, when annual catch of white shrimp in area 18 was greater than that in area 19, catch in area 18 during the period 1960 to 1970 was less than that in area 19. With the exception of 1973 and 1977, catch in area 18 was higher than that in area 19 for the period 1971 to 1977. Therefore, over the eighteen year period (1960-1977) substantial differences were seen in the trends for white shrimp catch in the two statistical areas.

Trends in annual white shrimp catch/effort (Figure 8b) were similar in areas 18 and 19 during the 1960 to 1977 period, especially after 1965. Major differences were noted in 1961, 1965, and 1974. In 1961 catch/effort values in area 19 and area 19, 11 to 15 fm depths, were high. In 1965 and 1974, catch/effort in area 19 increased over that of the preceeding year, while, in area 18, catch/effort decreased as compared to the previous year. The difference in 1974 was especially dramatic, and may be related to the effect of the economy on fishing effort along parts of the Texas Coast during 1974 (Moffett and McEachron 1974). Catch/effort in area 19 substantially exceeded that in area 18 only in 1961 and 1974, with catch/effort being higher in area 18 in most years when a substantial difference was seen. Highest catch/effort values for both area 18 and area 19 occurred in 1973, while highest catch/effort for area 19, 11 to 15 fm depths, occurred in 1961. 1961 was the only year that catch/effort in area 19, 11 to 15 fm depths, was higher than that in either area 18 or area 19. A second, but less dramatic peak in catch/effort in area 19, 11 to 15 fm depths, occurred in 1973, when catch/effort was high for all three spatial strata. As was the case for area 18, catch/effort in area 19, 11 to 15 fm depths, in 1974 diverged from the trend in area 19 as a whole. In 1968, catch/effort in area 19, 11 to 15 fm depths, was relatively low, while that for areas 18 and 19 exhibited minor peaks. Some of the divergent behavior of catch and catch/effort values in area 19, 11-15 fm depths, was undoubtedly due to the greater variability of the values for these variables at these depths. This was, in turn, related to the offshore occurrence of most white shrimp nearer to the coast.

3.2.2.2 White Shrimp Regressions for the Period 1964-1973

Summary statistics for the ten year data (1964-1973) used to develop the regressions relating white shrimp catch and catch/effort variables to environmental variables and indices of recruitment are shown in Table 106. As was the case for data used in the brown shrimp analyses, some variables have been scaled up or down by powers of ten or have otherwise been modified. All such scalings or transformations are documented in Table 4.

Table 107 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year data set used to related white shrimp catch and catch/effort variables to river discharge variables. Tables 108 to 113 show the results of the regression analyses relating white shrimp catch and catch/effort variables to river discharge variables for the ten year data set.

For both areas 18 and 19 (Tables 108 and 109), the strong influence of (one year) lagged river discharge variables was apparent, much more so than for brown shrimp catch for the same time period (see Tables 22 and 23). Lagged annual Atchafalaya River discharge was highly correlated with catch in area 18 ($r = 0.85$) and was entered into the regression equation first. The first three variables entered into the model were lagged variables, and together explained 94.5 percent of the variance in white shrimp catch. For area 19, lagged annual Guadalupe River discharge ($r = 0.77$) was the first variable entered into the equation. Of the first five variables entered (accounting for 99.4 percent of the variance in catch in area 19), three were lagged variables. Virtually all of the variables (except lagged October to December Trinity River discharge) which entered the regression equations were positively correlated with catch. No river discharge variable was highly correlated with catch in area 19, 11 to 15 fm depths, and lagged variables did not enter the equation until the third and fourth steps. Two quarterly (July-September and January-March) Trinity River discharge variables entered the equation on the first and second steps, respectively. Unlike the results for area 19, where winter (January-March) Trinity River discharge was positively correlated with catch, catch in area 19, 11-15 fm depths, was negatively correlated with the two variables (January-March Trinity River discharge and lagged annual Atchafalaya River discharge) that were important in the regression equation for area 19, 11-15 fm depths (Table 110). These two variables were entered into the regression equation on the second and third steps.

The results of the regression analyses for white shrimp catch/effort variables with discharge variables (Tables 111-113) showed about the same amount of explained variance as did the catch regressions (Tables 108-110). Again the importance of lagged river discharge variables was evident. For catch/effort in area 18, the first variable entered (lagged annual Atchafalaya River discharge with a correlation of $r = 0.77$ with catch/effort) was also the first variable entered into the catch regression for area 18. Spring (April-June) Mississippi River discharge was also highly (and positively) related to catch/effort ($r = 0.71$). The first three variables to enter the equation for catch/effort in area 19 (Table 112) were Mississippi River variables (April-June discharge, lagged annual discharge and July-September discharge). For both area 18 and area 19, four variables explained greater than 90 percent of the variance in catch/effort, with three Mississippi River discharge variables explaining 96 percent of the variance in catch/effort for area 19. For catch/effort area in 19, 11-15 fm depths, April-June Mississippi River discharge, with a simple correlation of $r = 0.78$, was the most important predictor variable.

The close relationship of white shrimp catch and catch/effort to lagged river discharge variables, especially for area 18, emerges from these results as a dominant, recurring trend and is in agreement with the results from numerous other studies (see Section 1.3). In a fishery based on a single year class, lagged variables would not be expected to be very important, especially where a lag of more than one year was employed. In fisheries involving populations with a more complex age structure (e.g., the Gulf of Maine) highest correlations between catch indicators and environmental variables has been found for lags which approximate the age at which the particular species are taken in commercial catch hauls (Sutcliffe et al. 1977). Lagged discharge values were not consistently related to indicators of brown shrimp fishing success (see Tables 22 to 27) for the same ten year period. The exception was brown shrimp catch/effort in area 18, where two lagged variables (lagged annual Atchafalaya and Trinity River discharges) entered the equation on the first two steps. However, for brown shrimp, the first variables entering all catch/effort equations were negatively correlated with the dependent variables, while the opposite trend was seen for white shrimp catch/effort. The difference in the relationship of lagged variables and catch or catch/effort for the two species may be related to the fact that the success of white shrimp in one year appears to influence the commercial catch in the next year, especially in years when a late season postlarval wave contributes significantly to the success of the year class in the next calendar year. This white shrimp production, resulting from a late summer or fall wave of postlarvae would probably not reach commercial size until the following spring. These individuals probably overwinter as juveniles or subadults, either remaining in the estuaries (during mild winters) or migrating offshore in the fall or winter (with dropping temperatures). They probably return to the estuaries after the coldest temperatures have passed (mid to late winter), and become available to the offshore fishery several months later.

Table 114 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp catch and catch/effort variables to precipitation variables. Tables 115 to 120 show the results of the regression analyses relating white shrimp catch and catch/effort variables to precipitation variables for the ten year data set.

Of the three regression equations relating white shrimp catch variables to precipitation variables (Tables 115 to 117), only the one for area 19 showed an R^2 greater than 80 percent with four independent variables in the model. As was the case for river discharge (see Tables 108 to 110), there is a distinct trend for lagged precipitation variables to be important in explaining the variance in white shrimp catch (Tables 115 to 117). Most variables entering the regression equations were positively correlated with catch. An exception was lagged October to December Freeport precipitation, which was negatively correlated with catch in area 18 ($r = -0.30$), but positively correlated with catch in area 19, 11-15 fm depths ($r = 0.36$). For both area 18 and area 19, 11-15 fm depths, lagged October to December Freeport precipitation was the first variable to be entered in the regression models. For area 19, lagged July-September Freeport precipitation which was also negatively correlated with catch in area 19, was the second variable to be entered in the regression model. In this equation, April-June precipitation at Freeport was the first variable entered, having a simple correlation of $r = 0.77$ with catch in area 19.

The results of the stepwise multiple regression analyses for catch/effort in area 18 (Table 118) showed 81 percent of the variance explained with four precipitation variables entered in the equation. Of these, annual Freeport precipitation ($r = 0.60$) was the first variable entered in the equation, although the fourth variable (April-June Freeport precipitation) was almost as highly correlated with catch/effort ($r = 0.59$). For area 19 (Table 119), four variables explained greater than 91 percent of the variance in catch/effort. As was the case for area 18, Annual Freeport precipitation, with a simple correlation of $r = 0.74$ with catch/effort in area 19, was the first variable entered into the regression equation for this dependent variable. As was also seen for area 18, April-June Freeport precipitation was strongly (and positively) correlated with catch/effort in area 19. For area 19, 11-15 fm depths, the July-September Freeport precipitation was the first variable entered, but its correlation with catch/effort ($r = 0.56$) was not particularly high. In no case was a lagged variable the first entered. In all cases, the first variable entering the catch/effort regressions was positively related to the dependent variable.

These results support the hypothesis that precipitation is positively correlated with white shrimping success. Lagged summer and fall precipitation, as well as spring and summer precipitation, appear to be particularly important. Generally, the results for discharge and precipitation were very similar, except that more variance was explained with discharge variables. A similar relative effectiveness of discharge and precipitation variables was seen for brown shrimp catch and catch/effort for the ten year data, (see Tables 36 to 41).

Table 121 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp catch and catch/effort variables to temperature variables. Tables 122 to 127 show the results of the regression analyses relating white shrimp catch and catch/effort variables to temperature variables for the ten year data set.

As might be expected from the seasonal patterns in the white shrimp life cycle (see Section 3.1), temperature variables were not particularly effective in accounting for variance in white shrimp catch or catch/effort variables (Tables 122 to 127). Of the six equations for the various catch and catch/effort variables, no dependent variable had as much as 60 percent of the variance explained by the first three temperature variables entered into the equations. For area 18 and area 19, 11-15 fm depths, the response of white shrimp catch to the number of summer days greater than 90^{o}F showed opposite trends (positive for area 18 and negative for area 19, 11-15 fm depths). For all catch/effort equations (Tables 125 to 127), January NOS minimum temperature at Galveston Channel was the first variable entered and was, in all cases, negatively related to catch/effort. This variable was also negatively related to all white shrimp catch variables. There does not appear to be a clear cut ecological explanation as to why white shrimp catch and catch/effort should be highest during those years that show the lowest January temperatures.

Table 128 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1963-1973) data set used to relate white shrimp catch and catch/effort variables to wind, tide and Ekman transport variables. Tables 129 to 134 show the results of the regression analyses relating white shrimp catch and catch/effort variables to wind, tide and Ekman transport variables for the ten year data set.

For catch variables with wind, tide and Ekman transport variables (Tables 129 to 131), all three regression equations showed at least 94.5 percent of the variance explained by three or fewer independent variables. For area 18, June fastest wind at Galveston was strongly and negatively correlated with catch ($r = -0.94$). While an adequate ecological explanation for this strong negative relationship between strongest wind in June and catch in area 18 is lacking, it should be noted that there was almost no relationship between the fastest wind and the direction of the fastest wind ($r = 0.02$), which varied from north to south during the ten year period. This indicates that white shrimp catch in area 18 was negatively related to fastest wind at Galveston regardless of the direction of the wind. Other variables that were strongly correlated with catch in area 18 included April-June Freeport mean high tide and August Freeport high tide ($r = 0.62$ and $r = 0.52$, respectively). For area 19, two wind variables (August Galveston fastest wind direction and April to June Galveston mean fastest wind) explained greater than 95 percent of the variance in catch. However, only the August fastest wind direction was strongly correlated with catch ($r = 0.84$). The trend was for catch to increase with increasing southerly direction of the fastest wind, (i.e., from the south). For area 19, 11-15 fm depths, two wind variables (October and July fastest wind at Galveston) were the first to enter the regression equation (Table 131), with October fastest wind correlated positively with catch ($r = 0.88$) and July fastest wind correlated negatively with catch (r = -0.55). Since the direction of the October fastest winds were in the north quadrant, it appears that they could have been operating by forcing higher salinity water from the estuary. The July fastest wind direction varied from 45^{o} to 180^{o} from north, and there was only a weak negative correlation (r = -0.17) between direction and speed. The different relationship of this variable and catch in area 19, 11-15 fm depths, as compared to that between catch and October fastest wind (mainly from the north) is also difficult to explain. If catch or (catch/effort) increases as the indicator of fastest wind direction decreases, then annual catch or (catch/effort) increases as the winds blow more from the north, possibly indicating the importance of strong northerly winds in the fall in preventing intrusion of salt water from the ocean at times of low seasonal discharge. Although July Ekman zonal transport was relatively unimportant in the regression equation, it was positively and strongly correlated with catch in area 19.11-15 fm depths (r = 0.56).

For catch/effort variables, all three equations (Tables 132 to 134) showed three independent variables explaining greater than 90 percent of the variance in the dependent variables. For area 18, August zonal Ekman transport (r = -0.73) was the first variable entered, followed by August Galveston Station fastest wind direction (r = 0.61), and July-September Galveston mean fastest wind (r = 0.61). August Galveston Station fastest wind direction entered into the equation for area 19 on the second step also. For both area 19 and area 19, 11-15 fm depths, the same wind variable (October Galveston Station fastest wind direction) was the first to be entered (r = -0.80 for area 19, and r = -0.81 for area 19, 11-15 fm depths). All important variables in the equation for area 19 were wind variables. Only in area 18 was any catch/effort variable most highly correlated with an Ekman transport variable.

Table 135 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp catch and catch/effort variables to salinity variables.

Tables 136 to 141 show the results of the regression analyses relating white shrimp catch and catch/effort variables to salinity variables for the ten year data set.

Salinity, as represented by the data collected by BCF-NMFS during their postlarval surveys at Galveston Entrance, explained only a modest amount of the variance in catch and catch/effort, with only the regressions for catch/effort in area 19 and area 19, 11-15 fm depths (Tables 137 and 138) explaining greater than 50 percent of the variance in the dependent variable. Salinity may have more of an effect on white shrimp success than is indicated by these results. Unlike the ten year analyses for brown shrimp, those for white shrimp did not include TPWD bay salinity data since the data record was insufficient. It appears that the data needed to establish the relationship of salinity to white shrimp catch and catch/effort success have not been collected on a continuous systematic basis. The availability of these data might go along way toward explaining the influence of winds and tides on white shrimping success.

Table 142 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp catch and catch/effort variables to recruitment, bay catch and bay effort variables. Tables 143 to 148 show the results of the regression analyses relating white shrimp catch and catch/effort variables to recruitment, bay catch and bay effort variables for the ten year data set.

Unlike the situation for brown shrimp catch and catch/effort (see Tables 57 to 62), the white shrimp equations did not include data for TPWD bay recruitment studies since the data record was not adequate. Therefore, while the results did not explain as much of the variance in white shrimp catch and catch/effort as was seen for brown shrimp, they do explain a significant amount of the variance.

The results for catch (Tables 143 to 145) are quite interesting. For area 18, the postlarval data were of no importance, with bay trips in area 18 and a number of catch and lagged effort variables (all from GCSD) entering the equation before any postlarval variable. In this case, five variables explained about 75 percent of the variance in catch in area 18. For area 19, where five variables explained 71 percent of the variance in white shrimp catch, three postlarval catch/tow variables, all positively correlated with catch, were the first variables to enter the equation. The results for area 19, 11-15 fm depths, were similar to those for area 18, in that postlarval catch/tow variables were relatively unimportant and lagged bay catch and bay effort were the most important variables. Lagged bay trips in area 19 showed a correlation of r = 0.82 with catch in area 19, 11-15 fm depths, and was entered into the equation first.

As in the results for catch, postlarval variables were important in the catch/effort equation for area 19 (Table 147), but, unlike the results for catch, these postlarval variables were also important in predicting catch/effort in area 18 (Table 146). The correlations between offshore white shrimp catch/effort (dependent) variables and postlarval catch/tow variables were not strong. The first three variables entered into the equations for areas 18 and 19 were the same and were entered in the same order. June and July postlarval catch/tow variables were the first to enter, followed by bay catch/trip in area 19 (from GCSD). This latter variable had the highest correlation with catch/effort in area 19, 11-15 fm depths (Table 148). The best fit was seen for area 19, where 85 percent of the variance in catch/effort was explained by four independent variables.

It is clear from these results that postlarval indices did contribute significantly toward predicting white shrimp catch, with positive correlations for most pairwise comparisons of catch or catch/effort and postlarval catch/tow variables. Bay catch and bay effort appeared to be more important predictors of white shrimp catch and catch/effort than was the case for brown shrimp. White shrimp bay catch and total bay effort should be more closely related to white shrimp stocks than brown shrimp bay catch and total bay effort variables should be to brown shrimp stocks since the inshore fishery for white shrimp is much less restricted than for brown shrimp, with heavy exploitation. The effect of lagged variables also appears to be more important for white shrimp than for brown shrimp. This was seen in the equations for discharge and precipitation as well as those for recruitment, bay catch and bay effort.

3.2.2.3 White Shrimp Regressions for the Period 1960-1977

Summary statistics for the eighteen year data (1960-1977) used to develop the regressions relating white shrimp catch and catch/effort variables to environmental variables and indices of recruitment are show in Table 149. All scalings or transformations of variables are documented in Table 4.

Table 150 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year data set used to relate white shrimp catch and catch/effort variables to river discharge variables. Tables 151 to 156 show the results of the regression analyses relating white shrimp catch and catch/effort variables to river discharge variables for the eighteen year data set.

Although the same river discharge variables were used in the analyses for the eighteen year data (Tables 151 to 156) as were used in the analyses for the ten year data set (see Tables 108 to 113), the results showed that the amounts of explained variance were less for the models for the eighteen year data. There was also a lesser amount of variance in brown shrimp catch and catch/effort explained by the eighteen year analyses (see Tables 22 to 27) as compared to the results for the ten year analyses (see Tables 65 to 70). These differences for brown and white shrimp catch and catch/effort variables for the two time periods were not due to the unavailability of certain variables in the eighteen year record that were important in the regressions based on the ten year data. Rather, they represent a closer relationship of both catch and catch/effort to discharge during the shorter time period.

For area 18, (see Table 151) lagged annual Atchafalaya River discharge, with a simple correlation of r = 0.62 with white shrimp catch, was the first variable entered in the regression equation. This is consistent with the trend for the ten year data set (see Table 108) but, in the case of the latter, the correlation was considerably stronger (r = 0.85). Four variables explained 75 percent of the variance in white shrimp catch in the analysis for area 18 for the eighteen year period.

For area 19, there was again a considerably lower total amount of variance explained in the analyses based on the eighteen year data set (Table 152) as compared to that for the ten year data set (see Table 109), with four variables explaining only 63 percent of the variance in white shrimp catch for the 1960-1977 period. The entry of variables into the eighteen year regression equation was considerably different from that for the ten year analysis, with annual Trinity River discharge (r = 0.57) the first variable to enter the eighteen year equation. For the ten year analysis (see Table 109), lagged annual Guadalupe River discharge was the variable most highly correlated with catch (r = 0.77). For the eighteen year period, lagged annual Guadalupe River discharge had a correlation with catch in area 19 of r = 0.23.

As was the case for area 19, the results for area 19, 11-15 fm depths, showed different variables entering the eighteen year (Table 153) and ten year equations (see Table 110). Both the seasonality (October-December) and the location (Guadalupe River) of the first variable entered in the eighteen year equation differed from those for the first variable entered for the ten year equation. It is interesting to note that lagged variables were the second through fourth variables entered in the eighteen year analysis, and that the first three variables entered into the equation for area 19, 11-15 fm depths, were from the October to December period. Lagged annual Atchafalaya discharge, with a simple correlation of r = -0.42 with white shrimp catch in area 19, 11-15 fm depths, was almost as highly correlated with catch as was the first variable to enter the equation (October-December Guadalupe River discharge).

As was the case for white shrimp catch variables, the regression models for catch/effort with discharge variables for the eighteen year data set (Tables 154 to 156) did not show as much of the variation in catch/effort explained as was accounted for in the equations for the ten year data (see Tables 111 to 113). For area 18 (Table 154), the first two variables entering the model for the eighteen year period were April to June Mississippi River discharge ($r = 0.60$) and annual Atchafalaya River discharge ($r = 0.59$). Annual Mississippi River discharge was the variable most highly correlated with catch/effort for area 19 ($r = 0.69$). The results for area 19 again demonstrate the importance of annual discharge (first variable to enter) and lagged discharge for the period October to December (second and third variables to enter) toward predicting white shrimp catch/effort during this eighteen year period. This same relationship was evident in the results for catch/effort in area 19, 11-15 fm depths (Table 156) for the eighteen year period, where lagged Guadalupe River discharge for the period October-December, with a correlation of $r = 0.65$ with catch/effort, was the first variable to enter the regression equation. The importance of river discharge in the fall period (lagged and unlagged) is evident in a number of results for white shrimping success indicators.

Table 157 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp catch and catch/effort variables to precipitation variables. Tables 158 to 163 show the results of the regression analyses relating white shrimp catch and catch/effort variables to precipitation variables for the eighteen year data set.

Precipitation variables explained only a modest portion of the variance in catch and catch/effort variables for white shrimp (Tables 158 to 163), with four variables explaining a maximum of 56 percent of the variance (for catch in area 19). The results for area 18 (Table 158) showed very weak relationships between catch and precipitation variables, with the highest simple correlation being r = -0.19.

The results of the regression analyses for white shrimp catch/effort variables and precipitation variables (Tables 161 to 163) showed considerably more explained variance as compared to the catch equations (Tables 158-160). The same two variables (April to June Freeport precipitation and lagged October to December Freeport precipitation) were entered first in both the catch and catch/effort equations for area 18, but in reverse order (Tables 158 and 161). April to June Freeport precipitation was also the variable most highly correlated with total catch in area 19 (Table 159). Annual Freeport precipitation, with a simple correlation of r = 0.75 with catch/effort, was the variable most highly correlated with this dependent variable in area 19 (Table 162). July-September Freeport precipitation was the variable most highly correlated (r = 0.69) with catch/effort in area 19, 11-15 fm depths (Table 163). Otherwise lagged October to December precipitation was an important variable in all three catch/effort equations (Tables 161 to 163). As was the case with discharge variables, most of the precipitation variables that had strong correlations with white shrimp catch or catch/effort variables for the eighteen year period were positively related.

Table 164 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp catch and catch/effort variables to temperature variables. Tables 165 to 170 show the results of the regression analyses relating white shrimp catch and catch/effort variables to temperature variables for the eighteen year data set.

As in the case of the ten year data (see Tables 122 to 127), white shrimp catch and catch/effort variables were not closely related to temperature variables over the eighteen year record, with the equations for catch in area 18 (Table 165) and for catch/effort in area 19, 11-15 fm depths (Table 168), explaining the most variance for each category of dependent variable. However, in the case of catch/effort, less than 40 percent of the variance was accounted for by the precipitation variables. All simple correlations for catch and catch/effort area 19, 11-15 fm depths, with temperature variables were negative (see Table 121). The strongest simple correlation between any catch variable and temperature variable was that between catch in area 19, 11-15 fm depths, and minimum NOS temperature in February ($r = -0.54$). Low temperatures in February, generally one of the coldest months of the year along the northwest Gulf Coast, have been known to kill finfish and shellfish in shallow waters (Gunter 1941, 1953), and low winter temperatures also have been associated with offshore and longshore (southern) migrations of white shrimp (Lindner and Anderson 1956). During mild winters white shrimp may remain in the estuaries or in the near offshore gulf in areas 18 and 19, but are apparently driven offshore or south during colder winters. While a positive relationship between catch and minimum temperature was seen for area 18 ($r = 0.53$), the negative relationship of catch in area 19, 11-15 fm depths, to temperature may indicate that in colder winters white shrimp move farther offshore (into the 11 to 15 fm depths).

Table 171 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp catch and catch/effort variables to wind and tide variables. Tables 172 to 177 show the results of the regression analyses relating white shrimp catch and catch/effort variables to wind and tide variables for the eighteen year data set.

At least partly, but not entirely, due to the absence of Ekman transport data for the eighteen year period, the relationships of annual white shrimp catch variables with wind and tide variables (Tables 172 to 174) were not as well defined as they were for the ten year data set (see Tables 129 to 134), with less than 80 percent of the variance being explained by the first three variables entered in each of the equations. For area 19, the same variable (August Galveston Station fastest wind direction) was the first to enter the ten and eighteen year equations for catch, but the correlation was much lower for the eighteen year data (see Tables 130 and 173). For area 18 (Table 172), the April-June Freeport mean high tide was the first variable to enter the catch equation ($r = 0.75$), and this may be related to larval transport into the estuaries. June Galveston Station fastest wind speed, which was the first variable entered in the ten year equation for catch ($r = -0.94$), had a lower correlation ($r = -0.61$) with catch for the eighteen year data set. For area 19, 11-15 fm depths (Table 174), July Freeport high tide, with a simple correlation of $r = -0.57$ with white shrimp catch, was the first variable to enter the equation. The relationship may reflect the increased salinities and reduced carrying capacity of the estuaries associated with high tides during this period of high offshore salinity. October Galveston Station fastest wind, which was the first variable to enter the ten year equation (see Table 133), was the seventh variable to enter the eighteen year equation (Table 174). July fastest wind, which was the second variable to enter the ten year equation, did not enter the eighteen year regression model. Thus, the results for catch in area 19, 11-15 fm depths, were considerably different for the two time periods.

For white shrimp catch/effort variables, the eighteen year regression equations with only wind and tide variables (Tables 175 to 177) explained considerably less of the variance as compared to the results for the ten year data (see Tables 132 to 134), where three variables consistently explained greater than 90 percent of the variance in the dependent variables. Only for area 19 (Table 176) did three variables explain as much as 80 percent of the variance in white shrimp catch/effort. In no case was the first variable entered the same for the ten and eighteen year data sets.

For area 18, the first variable which entered the ten year regression (August zonal Ekman transport) was not available for the eighteen year analysis (see Tables 132 and 175). September Freeport high tide was the variable most highly correlated with catch/effort in area 18 (r = 0.47) for the eighteen year period. Along with June Freeport high tide which entered the equation on the second step (r = 0.43), 41 percent of the variation in catch/effort was explained by two variables. All high tide variables which entered the equations were positively correlated with catch/effort.

For area 19, four variables explained 88 percent of the variance in catch/effort and five variables explained greater than 92 percent of the variance. August Galveston Station fastest wind direction, with a correlation of r = 0.61 with catch/effort, was the first variable to enter the equation for area 19 (Table 176), followed by October and September Freeport high tides. All three variables were positively correlated with catch/effort in area 19. For area 19, 11-15 fm depths, the variable which first entered the ten year equation (October Galveston Station fastest wind direction, with a correlation with catch/effort of r = -0.91) did not enter the eighteen year equation at all (see Tables 133 and 176). For the eighteen year data set for area 19, 11-15 fm depths (Table 177), August Freeport high tide was the variable most highly correlated with catch/effort (r = 0.46) and was entered into the equation first.

Table 178 is the correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp catch and catch/effort variables to bay catch and bay effort variables. Tables 179 to 184 show the results of the regression analyses relating white shrimp catch and catch/effort variables to bay catch and bay effort variables for the eighteen year data set.

The eighteen year data set for bay catch and bay effort (see Table 149) differed from the comparable ten year data set (see Table 106) by the absence of BCF-NMFS postlarval catch/tow data. Since postlarval variables were important only for catch and catch/effort in area 19 in the ten year analyses (see Tables 144 and 147), their absence might be expected to influence the results for this statistical area the most. The order of entry of variables into the eighteen year catch equations (Tables 179 to 181) generally showed a different pattern than those for the ten year equations (see Tables 143 to 145). In general, the correlations and the amount of variance explained by the regressions for the eighteen year data set were lower.

For white shrimp catch in area 18, bay trips in area 18, which entered first in the ten year regression (see Table 143), did not enter the eighteen year equation (Table 179) until the seventh step. However, its correlation with catch over the eighteen year period ($r = 0.54$) was almost as high as the correlation of the variable (lagged bay trips in area 18) which was entered into the eighteen year model first ($r = 0.56$ with catch). The variable with the highest simple correlation with catch in area 19 for the eighteen year data set was bay catch in area 19 ($r = 0.39$). For area 19, five variables failed to explain as much as 50 percent of the variability in catch (Table 180). For the ten year data, postlarval catch/tow variables were the most important independent variables for predicting white shrimp catch in area 19 (see Table 144), but even there, the total amount of explained variance was not large. As an indication of how much relationships can differ for different periods of time, lagged bay trips in area 19, with a correlation of $r = 0.82$ with catch in area 19, 11-15 fm depths, was entered first in the ten year equation for this dependent variable (see Table 145) while it entered the equivalent eighteen year equation fourth (Table 181), with a correlation of $r = -.040$ with catch in area 19, 11-15 fm depths. In the case of area 19, 11-15 fm depths, five variables explained 80 percent of the variance in catch for the eighteen year period (Table 181).

For catch/effort variables, the amounts of variance explained in the equations for areas 18 and 19 (Tables 182 to 183) were less than 20 percent. For area 19, 11-15 fm depths, lagged bay catch/trip in area 19, with a correlation of $r = 0.74$ with catch/effort, was by far the most important independent variable and contributed greatly to the total explained variance (66 percent) for this equation (Table 184).

3.2.3 Overall Regression Analyses

3.2.3.1 Brown Shrimp Regressions for the Period 1964-1973

The correlation matrix showing simple bivariate relationships between brown shrimp catch and catch/effort variables and best fit categorical variables and effort for the ten year (1964-1973) period is shown in Table 185. For this ten year data set, the results of the regressions for brown shrimp catch and environmental variables (without effort) are shown in Tables 186 to 188. The stepwise multiple regression results for brown shrimp catch for the ten year data set benefited greatly from the inclusion of those variables available only for the common time period of 1964 to 1973.

For total catch in area 18, all the variables in the final best fit regression for the period 1964 to 1973 (Table 186) were missing from the 18 year record. Three variables, May TPWD Galveston Bay catch/effort for secondary bays, February zonal Ekman transport and February mean postlarval catch/tow in Galveston Bay entrance, all of which were positively correlated with brown shrimp catch (Table 185), together accounted for 99 percent of the variance and provided a very good predictive capability for brown shrimp catch in statistical area 18. A plot of brown shrimp total catch in area 18 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 9, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 10.

A similar situation is seen for total catch of brown shrimp in area 19 (Table 187), where three of the most important variables (minimum salinities from BCF-NMFS postlarval data for the second half of March and for the first half of April, and April mean postlarval catch/tow from the same study) were available for only the ten year period. The other variables of importance were March and April Freeport precipitation, and the five variables in the final best fit regression (Table 187) accounted for 99 percent of the variance in the catch of brown shrimp in statistical area 19. Unlike the analyses for area 18 (Table 186), TPWD data for catch/effort of juvenile brown shrimp in Galveston and Matagorda Bays were not important for area 19. A plot of brown shrimp total catch in area 19 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 11, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 19 based on this final stepwise multiple regression model is presented in Figure 12.

For area 19, 11-15 fm depths, three variables accounted for 97 percent of the variance in brown shrimp catch and four variables accounted for 99 percent of the variance in the final best fit regression model (Table 188). Of these, the variable with the highest correlation with catch in area 19, 11 to 15 fm depths (February mean postlarval catch/tow in Galveston Bay Entrance from BCF-NMFS studies), was not available for the 18 year period. The other important variables, including bay effort in area 19, lagged bay catch in area 18, and discharge of the Guadalupe River in summer (July-September), were also available for the entire 1960-1977 period. A plot of brown shrimp total catch in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 13, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 19, 11-15 fm depths, based on this final stepwise multiple regression model, is presented in Figure 14.

As can be seen for the regressions of brown shrimp catch with offshore non-directed effort (Table 189 to 191), the inclusion of effort did little to change the analyses for area 19 and area 19, 11-15 fm depths. Only in the model for statistical area 18 (Table 189) was effort an important component of the final best fit model, but it also entered the equation for catch in area 19, 11-15 fm depths, explaining about two percent of the residual variance in brown shrimp catch. A plot of brown shrimp catch in area 18 and the most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 15, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 16. A plot of the actual, predicted and residual values of brown shrimp total catch in area 19, 11-15 fm depths, based on the final multiple regression model with environmental variables including non-directed effort for the eighteen year (1960-1977) data set is presented in Figure 17. This plot for area 19, 11-15 fm depths, is presented because the inclusion of effort led to a slightly different predictive equation than the one with effort omitted, even though effort was relatively unimportant in this equation.

The best fit regression models for brown shrimp interview catch/effort variables for the period 1964 to 1973 are shown in Tables 192 to 194. In all three equations, 99 percent of the variance is explained by four or fewer variables. For area 18 (Table 192), two variables, May TPWD Galveston Bay primary bay catch/effort (which had a simple correlation of $r = 0.92$ with catch/effort in area 18) and minimum salinity from the BCF-NMFS postlarval data for Galveston entrance (which had a simple correlation with catch/effort in area 18 of $r = 0.77$) accounted for 98 percent of the variance. The third variable to enter the equation (April-June Freeport precipitation) was negatively related to catch/effort of brown shrimp area 18 ($r = -0.56$). A plot of brown shrimp interview catch/effort in area 18 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 18, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 18 based on this final stepwise multiple regression model is presented in Figure 19.

For area 19, the most important variable in the ten year regression, April TPWD Galveston Bay salinity, had a simple correlation of $r = 0.89$ with brown shrimp interview catch/effort, while the remaining three variables in the final regression model (Table 193) all had correlations with absolute values greater than r = 0.70. March Trinity River discharge was the only variable in the model that was negatively correlated with catch/effort. In addition to April TPWD Galveston Bay salinity, the minimum salinity during the second half of March (from the BCF-NMFS postlarval data for Galveston Entrance), and the April NOS Galveston mean temperature were strongly and positively correlated with catch/effort in area 19 (Table 193). A plot of brown shrimp interview catch/effort in area 19 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 20, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 19 based on this final stepwise multiple regression model is presented in Figure 21.

The same variable that first entered the equation for catch/effort in area 19 (April TPWD Galveston Bay mean salinity), also was the first variable to enter the equation for catch/effort in area 19, 11-15 fm depths (Table 194), with a simple correlation of r = 0.89 with catch/effort. The other three variables in the equation were discharge variables (March Trinity River discharge, October-December Trinity River discharge and January-March Mississippi River discharge), and all were negatively correlated with catch/effort. A plot of brown shrimp interview catch/effort in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 22, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 19, 11-15 fm depths, based on this final stepwise multiple regression model, is presented in Figure 23.

3.2.3.2 Brown Shrimp Regressions for the Period 1960-1977

The correlation matrix showing simple bivariate relationships between brown shrimp catch and catch/effort variables and best fit categorical variables and effort for the eighteen year (1960-1977) period is shown in Table 195.

For the eighteen year data set, the results of the regressions of brown shrimp catch and environmental variables (without effort) are shown in Tables 196 to 198. These results are very different from those for the ten years data set (see Tables 186 to 188), with much less of the variance in catch explained by the most important independent variables. The major differences, especially those for the model for catch in area 18 (see Tables 186 and 196), are due to the absence of a number of variables in the eighteen year data set (including BCF-NMFS postlarval catch/effort and salinity, TPWD bay catch/effort and salinity, and Ekman transport) that were available for the ten year period. The most important variable for predicting brown shrimp catch in area 18 in the eighteen year data set was lagged bay catch in area 19 (from GCSD). Other variables of importance included spring precipitation at Freeport, summer Guadalupe River discharge and bay catch and bay effort in area 18 (both of these also from GCSD). Seven variables explained about 91 percent of the variance in brown shrimp catch in area 18. A plot of brown shrimp total catch in area 18 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 24, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 25.

As was the situation for the catch in area 18, the regression model for catch of brown shrimp in area 19 for the period 1960-1977 (Table 197) is completely different from that for the 1964-1973 period (see Table 187). Again, the most important variables for the ten year data set (minimum salinities in Galveston entrance in March and in April from BCF-NMFS postlarval studies) were not available for the eighteen year record. In fact, the two models (see Tables 187 and 197) have no variables in common. For the 18 year model, the discharge of the Mississippi River was the variable most strongly correlated with catch ($r = -0.64$), while April fastest wind, April NOS Galveston Bay mean temperature, March NOS Galveston Bay minimum temperature, March high tide (Freeport) and March NOS Galveston minimum density were also important. Five variables explained 94 percent of the variance in catch in area 19. A plot of brown shrimp total catch in area 19 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 26, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 19 based on this final stepwise multiple regression model is presented in Figure 27.

For area 19, 11-15 fm depths, a number of variables contributed to the final regression model (Table 198), including April Galveston fastest wind direction, April mean NOS temperature, April minimum NOS density, lagged annual Mississippi River discharge, spring Trinity and Guadalupe River discharges, February Galveston fastest wind and lagged bay trips in area 19 (from GCSD). Five variables explained 85 percent of the variance in catch in area 19, 11-15 fathom depths. The regression results for the ten year data set (see Table 188) showed February postlarval catch/tow to be the most important independent variable. This variable was not in the 18 year data set. A plot of brown shrimp total catch in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 28, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 19, 11-15 fm depths, based on this final stepwise multiple regression model is presented in Figure 29.

When effort was included in the set of independent variables, its importance in predicting brown shrimp catch was easily recognized (Table 199 to 201). For area 18, effort was the variable most highly correlated with catch ($r = 0.68$) and was, therefore, entered into the equation first (Table 199). The importance of effort for the eighteen year period, and its relative lack of importance in the analyses conducted over the ten year (1964-1973) period was at least partly due to the lack of data for some of the most important environmental variables in the eighteen year data set. A plot of brown shrimp total catch in area 18 and the most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 30, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 31.

For area 19, effort, with a correlation of r = 0.60 with catch, entered the equation on the fourth step, accounting for about 12 percent of the residual variance in catch (Table 200). It was of much less importance in predicting shrimp catch in area 19 as compared to area 18 (Table 199). A plot of the actual, predicted and residual values of brown shrimp total catch in area 19 based on the final multiple regression model with most important independent variables including non-directed effort for the eighteen year (1960-1977) data set is presented in Figure 32.

For area 19, 11-15 fm depths, effort, with a simple correlation of r = 0.84 with catch, entered the equation first (Table 201). This largely determined which variables would be entered subsequently. April NOS mean temperature, Galveston Station direction of fastest wind, and minimum density variables were important in this equation (Table 201), as was March NOS minimum temperature and February Galveston fastest wind. A plot of brown shrimp total catch in area 19, 11 to 15 fm depths, and the most important independent variables including non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 33, while a plot of the actual, predicted and residual values of brown shrimp total catch in area 19, 11 to 15 fm depths, based on this final stepwise multiple regression model is presented in Figure 34.

As was the case with catch, the catch/effort regressions for the 18 year data set (Table 202 to 204) were considerably different from the ten year models (see Tables 192 to 194), with less of the variance in catch/effort explained by the eighteen year models. This was again at least partly due to the availability of important variables the ten year period. For area 18, only 77 percent of the variance is explained in the best fit regression equation (Table 202), with April NOS Galveston Channel mean water temperature the variable most strongly correlated with brown shrimp catch/effort. Other important variables were April Galveston Station fastest wind direction, lagged bay catch/effort in area 18 and Freeport precipitation from April-June. A plot of brown shrimp interview catch/effort in area 18 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) period is presented in Figure 35, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 18 based on this final stepwise multiple regression model is presented in Figure 36.

For area 19, April NOS Galveston Bay mean temperature,April minimum density (both positively correlated with catch/effort) and three discharge variables comprised the suite of variables in the best fit regression (see Table 203), where 93 percent of the variance in brown shrimp catch/effort was explained. A plot of brown shrimp interview catch/effort in area 19 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 37, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 19 based on this final stepwise multiple regression model is presented in Figure 38.

Finally, for brown shrimp interview catch/effort in area 19, 11-15 fm depths (Table 204), a variety of variables were important in the best fit regression, including April fastest wind and April mean temperature from the Galveston NOS Station (simple correlations of $r = -0.74$ and $r = 0.69$, respectively), direction of the fastest wind in February at Galveston, fall Mississippi River discharge during the period October to December, and bay catch/trip in area 18. These five variables accounted for 83 percent of the variation in brown shrimp catch/effort. A plot of brown shrimp interview catch/effort in area 19, 11 to 15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 39, while a plot of the actual, predicted and residual values of brown shrimp interview catch/effort in area 19, 11 to 15 fm depths, based on this final stepwise multiple regression model is presented in Figure 40.

3.2.3.3 White Shrimp Regressions for the Period 1964-1973

The correlation matrix showing simple bivariate relationships between white shrimp catch and catch/effort variables and best fit categorical variables for the ten year (1964-1973) period is shown in Table 205.

The regression results for the three white shrimp catch variables with best fit recruitment and environmental variables for the period 1964-1973 are shown in Tables 206 to 208. The results are very rewarding, with four independent variables explaining at least 98 percent of the variance in each analysis. What is most interesting is the great importance of wind, tide, and zonal Ekman transport variables in explaining the variance in the dependent variables. In all three models, wind and wind-related variables (i.e., Ekman transport) are the first two variables entering the equations. Precipitation and discharge variables are of only secondary importance, and are represented only in the final model for area 18. While most studies in the past have emphasized salinity, discharge, and precipitation in determining white shrimp catch (Gunter 1950, 1956a; Gunter and Hildebrand 1954, Hildebrand and Gunter 1953), the results of these analyses clearly indicate that other environmental and recruitment variables are also important in predicting white shrimp catch. These results suggest a completely different set of mechanisms controlling white shrimp catch than has previously been put forth.

For area 18, all five variables entered in the final regression model (Table 206) were negatively correlated with catch, with the first two variables entered (June Galveston Station fastest wind and August zonal Ekman transport) very strongly correlated with catch ($r = 0.89$ and $r = 0.83$, respectively). Lagged bay trips in area 19 (from GCSD), January NOS Galveston Bay minimum temperature, and lagged October-December Freeport precipitation were also in the final model. A plot of white shrimp total catch in area 18 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 41, while a plot of the actual, predicted and residual values of white shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 42. None of the variables that were in the final model for area 18 were included in the final model for area 19 (Table 207). August Galveston Station fastest wind direction was strongly and positively correlated with catch in area 19 ($r = 0.83$) and was entered in the regression equation on the first step. The other three variables in the final model (April-June Galveston Station mean fastest wind, June Freeport highest tide and number of days during the April-June period at Freeport greater than 90^{o} F) were less stongly related to catch, with only highest tide in June positively correlated to catch in area 19. A plot of white shrimp total catch in area 19 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) period is presented in Figure 43, while a plot of the actual, predicted and residual values of white shrimp total catch in area 19, based on this final stepwise multiple regression model is presented in Figure 44.

For area 19, 11-15 fm depths, October Galveston Station fastest wind was strongly and positively correlated with catch ($r = 0.88$), and entered the regression equation first. The other three variables that entered the regression equation on steps 2-4 were all negatively correlated with catch, with July Galveston Station fastest wind entering on the second step (correlation of $r = -0.50$ with catch). Together, the two fastest wind variables explained almost 88 percent of the variance in catch in area 19, 11-15 fm depths, a truely surprising result. The other two variables in the model were June Freeport highest tide and January NOS Galveston Bay minimum temperature. A plot of white shrimp total catch in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 45, while a plot of the actual, predicted and residual values of white shrimp total catch in area 19, 11-15 fm depths, based on this final stepwise multiple regression model, is presented in Figure 46.

When effort is brought into the picture (Tables 209 to 211) and these results are compared to those with effort excluded (see Tables 206 to 208), it is quite clear that effort has little influence on white shrimp catch that is not explained by environmental variables. In no case did the inclusion of effort improve the fit of any regression model.

The results of the regression analyses for white shrimp interview catch/effort for the period 1964-1973 are shown in Tables 212 to 214. For all dependent variables, four independent variables explained at least 96 percent of the variance in the dependent variables. For areas 18 and 19, wind, tide and Ekman transport variables are much less important than they were in the equations for catch (Tables 206 and 207). The results for areas 18 and 19 are similar, with lagged regional discharge (Mississippi or Atchafalaya River) and April-June Mississippi River discharge the most important variables, together explaining 85 and 90 percent of the variance in catch/effort in areas 18 and 19, respectively. In both cases, bay catch/effort in area 19 was the third variable entered, while a postlarval catch/tow variable (August or June) entered on the fourth step. The first four variables in both equations all had positive simple correlations with catch/effort demonstrating the positive relationship of white shrimp catch to important discharge variables, bay indices and postlarval indices. A plot of white shrimp interview catch/effort in area 18 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 47, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 18 based on this final stepwise multiple regression model is presented in Figure 48.

For area 19 (see Table 213), discharge variables were of major importance, with the first two variables entering the equation (April-June Mississippi River discharge and lagged Mississippi River discharge) both positively related to white shrimp catch/effort and, together, explaining greater than 90 percent of the variance in white shrimp catch/effort. A plot of white shrimp interview catch/effort in area 19 and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 49, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 19 based on this final stepwise multiple regression model is presented in Figure 50.

Only for area 19, 11-15 fm depths, were wind and Ekman transport variables of major importance (Table 214). October Galveston Station fastest wind direction ($r = -0.81$) and speed ($r = 0.48$) were the first variables to enter the equation. A plot of white shrimp interview catch/effort in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set is presented in Figure 51, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 19, 11-15 fm depths, based on this final stepwise multiple regression model is presented in Figure 52.

3.2.3.4 White Shrimp Regressions for the Period 1960-1977

The correlation matrix showing simple bivariate relationships between white shrimp catch and catch/effort variables and best fit categorical variables for the period 1960 to 1977 is shown in Table 215. The results of the stepwise multiple regression analyses for white shrimp catch variables with best fit recruitment and environmental variables for the 1960-1977 period are shown in Tables 216 to 218. In all cases, the eighteen year catch regressions did not explain as much of the variance in catch as did the regressions for the ten year data (see Tables 206 to 208). Since the only variables which were important in the ten year regressions which are not in the eighteen year data set were Ekman transport variables, the results indicated that, for the 1960 to 1977 period, the relationships between catch and environmental variables were somewhat different from that seen during the 1964 to 1973 period.

For area 18, discharge and wind direction variables were the most important independent variables in the final regression equation for white shrimp catch (Table 206), with lagged annual Atchafalaya River discharge showing the strongest correlation with catch ($r = 0.62$). A plot of white shrimp catch in area 18 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 53, while a plot of the actual, predicted and residual values of white shrimp total catch in area 18 based on this final stepwise multiple regression model is presented in Figure 54.

For area 19, spring (April-June) Freeport precipitation, number of summer days at Freeport greater than 90°F, lagged fall Trinity River discharge and lagged bay catch in area 19 (from GCSD) were most important in predicting white shrimp catch (Table 217). A plot of white shrimp total catch in area 19 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 55, while a plot of the actual, predicted and residual values of white shrimp total catch in area 19 based on this final stepwise multiple regression model is presented in Figure 56.

Of the three dependent variables, catch in statistical area 19, 11-15 fm depths, showed the highest amount of the variance explained by the best fit environmental and recruitment variables (Table 218). Bay effort and bay catch (both from GCSD) were the most important independent variables, followed by spring Trinity River discharge, July Freeport high tide, annual Guadalupe River discharge and number of summer days greater than 90°F at Freeport. A plot of white shrimp catch in area 19, 11-15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 57, while a plot of the actual, predicted and residual values of white shrimp total catch in area 19, 11-15 fm depths, based on this final stepwise multiple regression model is presented in Figure 58.

When effort was considered (Tables 219 to 221), the relative influence of effort compared to that for environmental variables and bay catch and bay effort variables could be assessed. For both areas 18 and 19 (Tables 219 and 220), effort was very important in the final regression models. However, in the case of area 18, where effort was the most important independent variable ($r = 0.71$ with catch), inclusion of effort did not improve the fit of the model as compared to the model without effort (see Table 216), with a total explained variance of only 72 percent. A plot of white shrimp total catch in area 18 and the most important independent variables (including non-directed effort) in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 59, while a plot of the actual, predicted and residual values of white shrimp catch in area 18 based on this final stepwise multiple regression model is presented in Figure 60.

For area 19, effort was the second most strongly correlated variable with catch ($r = 0.69$), and its inclusion on the second step of the regression analysis improved the fit of the model (Table 220) as compared to the results with effort excluded (see Table 217). In this case, seven variables explained greater than 95 percent of the variance in white shrimp catch in area 19 for the 1960-1977 period. A plot of white shrimp total catch in area 19 and the most important independent variables (including offshore non-directed effort) in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 61, while a plot of the actual, predicted and residual values of white shrimp catch in area 19 based on this final stepwise multiple regression model is presented in Figure 62.

For area 19, 11 to 15 fm depths, effort in this reporting unit was not strongly related to white shrimp catch (r = 0.09). As can be seen from comparing Tables 218 and 221, the inclusion of effort in the regression analysis for total catch in area 19, 11 to 15 fm depths, did nothing to improve the fit of the model.

Compared to the catch/effort analyses for white shrimp for the period 1964-1973 (see Tables 212 to 214), the results for the 1960-1977 period (Tables 222-224) showed considerably different trends. For areas 18 and 19, the results of the analyses for the eighteen year period showed much less importance of discharge variables and greater importance of precipitation variables in predicting white shrimp interview catch/effort.

For catch/effort in area 18 (Table 222), spring Freeport precipitation was the first variable to enter the equation, with a simple correlation with catch/effort of r = 0.64. All variables that entered the equation were positively correlated with catch/effort, with five variables together explaining greater than 90 percent of the variance. A plot of white shrimp interview catch/effort in area 18 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 63, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 18 based on this final stepwise multiple regression model is presented in Figure 64.

For area 19, annual Freeport precipitation was the variable most highly correlated with white shrimp interview catch/effort (r = 0.75), and it was entered into the equation first. Five variables explained almost 88 percent of the variance in white shrimp catch/effort in the final best fit regression model and all were positively correlated with catch/effort (Table 223). A plot of white shrimp interview catch/effort in area 19 and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 65, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 19 based on this final stepwise multiple regression model is presented in Figure 66.

As in the ten year analysis (see Table 214), the eighteen year analysis for white shrimp catch/effort for area 19, 11-15 fm depths (see Table 224), showed trends different from those for areas 18 and 19. The first variable to enter the equation for area 19, 11-15 fm depths (number of summer days at Freeport with temperature greater than 90°F), was negatively correlated with catch/effort ($r = -0.51$). Two Mississippi River discharge variables (April-June and January-March) entered the equation on the second and third steps. Four variables explained less than 50 percent of the variance in white shrimp catch/effort in area 19, 11-15 fm depths, for the eighteen year data. A plot of white shrimp interview catch/effort in area 19, 11 to 15 fm depths, and the most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set is presented in Figure 67, while a plot of the actual, predicted and residual values of white shrimp interview catch/effort in area 19, 11 to 15 fm depths, based on this final stepwise multiple regression model is presented in Figure 68.

3.2.4 Use of the Stepwise Multiple Regression Equations for Impact Assessment

The estimated value of the dependent variable (Y) is found by substituting the values of the relevant independent variables (X's) for the year of brine discharge into the particular model, using the slopes and intercepts from the regression model (as given in the summary tables presented in this report). For example, if brown shrimp catch in area 18 in 1978 is being predicted from the model in Table 186, the (R=3) independent variables (X's) would be May TPWD secondary Galveston Bay catch/effort, February Ekman transport zonal index and February postlarval catch/tow. Y is found by substituting the values of these independent variables for 1978 into the model, using the slopes and the intercepts given in Table 186 (column B). Thus,

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3$$

where a is the constant in Table 186 (listed under column B), b_1 to b_3 are the coefficients (column B in Table 186) associated with each of the three independent variables (X_1 to X_3), and the values of the three independent variables (including any scalings or transformations) for the year of discharge are substituted for X_1 to X_3.

The use of these regression equations for impact assessment centers around developing 95 percent confidence limits for Y (i.e., catch or catch/effort in statistical area 19, 11-15 fathom depths) for an individual post discharge observation (Draper and Smith 1966). The 95 percent confidence limits can be calculated as follows:

> Let X_0 equal the 1 x (k+1) matrix of post discharge observations of the k independent variables used in the particular regression equation, let C equal the inverse of the variance - covariance matrix $(X'X)^{-1}$ for the data used to build the regression model (the matrix of environmental and recruitment data), and let s be the standard error of the estimate, which is equal to the square root of the residual mean square from the regression analysis. Then, 95 percent confidence limits for Y, the estimated value of catch or catch/effort during the post-discharge year (what Y should be given no impact), are given by
>
> $$Y \pm t(df,0.975) \cdot s \cdot (1 + X_0{}'C\ X_0)^{1/2}$$
>
> where df = the degrees of freedom for the residual mean square in the regression analysis and t is the table Student's t value. Since we are dealing with a two-tailed test (the catch could either be enhanced or decreased by brine discharge), table values for alpha = 0.975 are entered for 95 percent confidence limits.

If the observed value of Y falls within the 95 percent confidence limits, then the null hypothesis of no significant change attributable to brine discharge cannot be rejected. If the observed value of Y falls outside the 95 percent confidence limits, then the null hypothesis is rejected. By rejecting the null hypothesis, we assume that something not in the model (e.g. brine discharge effects) has caused the trend for catch or catch/effort to differ significantly from that predicted by those variables in the final regression model. Rejection of the null hypothesis, therefore, does not necessarily imply that brine discharge has caused the significant deviation. Brine discharge is just one of a number of environmental variables that are operative at any time. Our ability to relate the rejection of the null hypothesis to brine discharge impacts depends, to a large degree, on there being no other "new" or man-induced changes in the ecosystem that are not included in the model but are affecting catch or catch rate of penaeid shrimp.

It should be pointed out that confidence intervals become wider the farther the values of the independent variables are away from the grand mean for the particular variables. As such, the model will have its greatest impact assessment capability during those years when the environmental and recruitment regime in the areas surrounding the diffuser are "typical" and do not include extreme values. Stated another way, it is more difficult (greater Type II error) to detect a significant deviation during years when the environmental conditions are very conducive (very good years) to, or very detrimental (very bad years) to shrimping success. For example, if 1981 environmental conditions were similar to those for 1967, with high salinities prevailing throughout the spring, this would represent an "atypical" year, and confidence limits would be wider for estimates of shrimp catch from the suite of important environmental variables, and significant differences in observed and predicted catch will be more difficult to detect (greater Type II error). Of course, the multiple regression model should never be used for prediction purposes when the values for the important environmental variables lie outside the range of values for these independent variables used to calculate the regression model. At extreme values of the X's, the linearity of the relationship may no longer exist.

3.3 CLUSTER ANALYSIS

3.3.1 Introduction

The dendrograms presented in this document (Figures 69 to 74) have been enhanced by printing the value for annual total catch of brown and/or white shrimp next to each observation (= year). The reader is reminded that the clustering was not accomplished by using catch as a variable in any of the analyses. The clustering was conducted using only independent (environmental and recruitment) variables which were important in predicting shrimp catch in the regression analyses (Section 3.2). If the clustering strategy was at all successful, "good" shrimping years should segregate from "bad" shrimping years, and this should be reflected in a similarity in the value of catch for the observations (= years) in the various cluster groups.

3.3.2 Brown Shrimp Cluster Analysis for the Period 1964-1973

The results of the Q-mode cluster analysis using variables which were important in the categorical regression equations developed in Section 3.2.1 for annual brown shrimp total catch in area 19 for the period 1964-1973 are shown in Figure 69. The variables which were used in this analysis were as follows:

VAR11	Annual Mississippi River discharge
VAR26	March NOS Freeport highest tide
VAR41	Lagged annual Freeport precipitation
VAR51	May TPWD primary bay Galveston catch/effort
VAR66	Second half of March, Galveston Bay minimum salinity (BCF-NMFS postlarval data)
VAR71	April TPWD Matagorda Bay mean temperature
VAR78	March Ekman zonal index
VAR103	Lagged bay trips in area 18 (from GCSD)
VAR109	April Freeport precipitation

See Tables 5 and 3 for the reference number and units, respectively, for each variable.

The dendrogram (Figure 69) shows one major, well defined grouping (Group I) and four relatively unrelated observations (Groups 2-5). Based on the values for annual brown shrimp catch, three of the outlier years (samples) (1964, 1969 and 1973) are among the four lowest years of brown shrimp catch in area 19, while the other outlier (1967) was the year of highest catch in area 19. The six observations that make up the major grouping (1965-1966, 1968, and 1970-1972) are, with the exception of 1972, all years of good brown shrimp catch in area 19. The range of catch for the five years excluding 1972 was 12.6 million to 14.5 million pounds (heads off), while, for 1972 the total annual brown shrimp catch was only 6.7 million pounds. Except for the low value for 1972, the cluster analysis using variables that were important in predicting brown shrimp catch in area 19 was successful in segregating good shrimping years from both poor years and also the exceptionally good year (1967).

The lack of similarity among the four poor years was due to different environmental regimes during these years. Based on the relative magnitude of the values of the different variables, 1973, the year with the lowest brown shrimp total catch in area 19 (5.8 million pounds, heads off), was clearly differentiated on the basis of high values for both annual Mississippi River discharge and March NOS Freeport highest tide, and low values for both Galveston Bay minimum salinity during the second half of March and April TPWD Matagorda Bay mean temperature. The year (1964) with the second lowest brown shrimp catch in area 19 (8.7 million pounds, heads off), was quite different from 1973 based on environmental variables, and this is evident in the dendrogram. While 1973 had high values for annual Mississippi River discharge and March NOS Freeport highest tide, these variables, along with lagged annual Freeport precipitation and April Freeport precipitation, were all very low for 1964. It can be concluded that on the basis of the trends in the variables, the low catch in 1973 was related to regional phenomena, while the low catch in 1964 was more closely related to local phenomena. The other year of relatively poor brown shrimp catch to be represented by an outlying observation in the cluster dendrogram (Figure 69) was 1969 (with 9.8 million pounds, heads off). It was characterized by highest values for lagged annual Freeport precipitation and April Freeport precipitation, lowest values for lagged bay trips in area 18 and May TPWD primary bay Galveston Bay catch/effort, and relatively low values for Galveston Bay minimum salinity in the second half of March and March Ekman zonal index.

Clearly, the best year for brown shrimp catch for the 1964 to 1973 period was 1967, with a catch of 19.1 million pounds, heads off. It was clearly distinguished from the other years on the basis of environmental variables, and was characterized by relatively low annual Mississippi River discharge, and highest values for May TPWD primary bay Galveston Bay catch/effort, Galveston Bay minimum salinity during the second half of March, April TPWD Matagorda Bay mean temperature and March Ekman zonal index.

Based on the trends in environmental variables, the years in the major grouping in the dendrogram that showed good catch did not appear to be clearly related. The variable that most differentiated these years from the others was Galveston Bay minimum salinity during the second half of March. These years might be best categorized by lack of extreme values for the important environmental variables.

The year 1972, which was the only year that was misclassified by the suite of environmental variables (according to the criterion of total catch), did not show any unique trends based on environmental variables. However, of the six years that are in the major cluster (Figure 69), 1972 had the highest annual Mississippi River discharge and lowest Galveston Bay minimum salinity during the second half of March. Both of these variables have been shown repeatedly to be very important in determining brown shrimp production in Texas and Louisiana.

3.3.3 Brown Shrimp Cluster Analysis for the Period 1960-1977

The results of the Q-mode cluster analysis using variables which were important in the categorical regression equations developed in Section 3.2.1 for annual brown shrimp total catch in area 19 for the period 1960-1977 are shown in Figure 70. The variables which were used in this analysis were as follows:

VAR11	Annual Mississippi River discharge
VAR22	March NOS Galveston Channel minimum temperature
VAR26	March NOS Freeport highest tide
VAR99	Bay trips in area 18 (from GCSD)
VAR109	April Freeport precipitation

The reference number and units for each of these variables are presented in Tables 5 and 3, respectively.

The results (Figure 70) indicated that good and poor brown shrimp catch years were not well differentiated based on the five variables entered into the analysis. At any level of similarity chosen, years with relatively high catch and relatively low catch occur within the same group. However, except for the positions of 1962 and 1967, the groupings in Figure 70 do show a temporal pattern. A major grouping is composed of all years from 1970 to 1977 in addition to 1962 and 1967 (Group 5). No 1970-1977 year was clustered outside this group. At the level indicated in the dendrogram (Figure 70), 1960 and 1961 appear as outlier years (Groups 1 and 2) while samples from 1963-1965 and those from 1966, 1968 and 1969 make up Groups 3 and 4, respectively. The year 1960 is an outlier in the dendrogram primarily because of its very low values for March NOS Galveston Channel minimum temperature, March NOS Freeport high tide, and bay trips in area 18 (from GCSD). The year 1961, with a relatively low catch, also showed low values for March NOS Freeport highest tide and bay trips in area 18. The 1963-1965 observations also differed from those of the main group of the dendrogram by showing low values for March NOS Freeport highest tide. The poor segregation of good and bad shrimping years for the eighteen year data was probably due to the lack of inclusion of any salinity variables in the data set. No salinity variables were available for the entire 18 year period.

3.3.4 White Shrimp Cluster Analysis for the Period 1964-1973

The results of the Q-mode cluster analysis using variables which were important in the categorical regression equations developed in Section 3.2.2 for annual white shrimp total catch in area 19 for the period 1964-1973 are shown in Figure 71. The variables which were used in this analysis were as follows:

VAR26	April-June Freeport precipitation
VAR38	Lagged annual Guadalupe River discharge
VAR40	January NOS Galveston Channel minimum temperature
VAR43	Lagged July-September Freeport precipitation
VAR47	Bay catch in area 19 (from GCSD)
VAR53	June postlarval catch/tow (from BCF-NMFS studies)
VAR56	June Galveston Bay minimum salinity (BCF-NMFS postlarval studies)
VAR65	July Ekman meridional index
VAR81	January-March Trinity River discharge
VAR94	August Galveston Station fastest wind direction

The reference number and units for each of these variables are presented in Tables 6 and 4, respectively.

The results indicated that the clustering was successful in grouping good and bad years of white shrimp catch. Two major groups are revealed, each consisting of five years. Both groups include three observations from the 1964 to 1969 period and two observations from the 1970 to 1973 period. As can be seen from the catch values that are printed alongside the dendrogram (Figure 71), there was no overlap in the annual catch for the two groups, although the year in the "bad" catch group (Group 1) that had the highest annual white shrimp catch in area 19 (1971 with 2.27 million pounds, heads off) had a catch that was almost as high as that for the year with the lowest catch in the "good" catch group (1966 with 2.30 million pounds, heads off).

Based on the relative magnitude of the values for the different variables, it appears that the variables most important in differentiating the two groups include April-June Freeport precipitation and lagged annual Guadalupe River discharge (both of which were low for the "bad" years), August Galveston fastest wind direction (also low for the "bad" years) and June Galveston Bay minimum salinity (high for the bad years).

3.3.5 White Shrimp Cluster Analysis for the Period 1960-1977

The results of the Q-mode cluster analysis using variables which were important in the categorical regression equations developed in Section 3.2.2 for annual white shrimp total catch in area 19 for the period 1960-1977 are shown in Figure 72. The variables which were used in this analysis were as follows:

VAR17	Annual Trinity River discharge
VAR26	April-June Freeport precipitation
VAR40	January NOS Galveston Channel minimum temperature
VAR47	Bay catch in area 19 (from GCSD)
VAR82	January-March Freeport precipitation
VAR94	August Galveston fastest wind direction
VAR96	October Galveston fastest wind direction

See Tables 6 and 4 for the reference number and units, respectively, for each variable.

The results (Figure 72) showed groupings which are in general agreement with the magnitude of the annual white shrimp catch in area 19. At the level indicated in the dendrogram (Figure 72) three groups of years are evident, although Group 3, consisting of only 1962 and 1976, was very different from the other two groups. These two years in Group 1 were more dissimilar (to each other) than were any two samples in either Group 2 or Group 3. Annual catches for the two years in Group 1 included the lowest catch (1.01×10^6 pounds, heads off in 1962) and the third lowest catch (1.50×10^6 pounds, heads off in 1976) for the eighteen year period.

Except for one atypical year in each of the two other groups (Groups 2 and 3), the annual catch values (Figure 72) showed that the suite of environmental variables were able to segregate good white shrimping years from poor white shrimping years. Group 2, which included only one year (1971) with catch greater than 2 million pounds, heads off, otherwise included the years 1963-1965 and 1971-1972. Group 3, which included only one year (1975) with catch less than 2 million pounds, otherwise included the years 1960-1961, 1966, 1968-1970, 1973-1974 and 1977. The year 1973, which showed very high discharge and the second highest catch for the eighteen year period, was in Group 3 (the "good" white shrimping years) but was an outlier to this group.

The low catch in 1975 can be attributed, to some degree, to a decrease in shrimping effort (see Figure 61), related to economic factors (Johnson 1975). Effort was not included in the cluster analysis. Perhaps its inclusion would provide more satisfying groupings. Even with effort not included in the analysis, the dendrogram clustered the years into ecologically meaningful groupings.

3.3.6 Brown and White Shrimp Cluster Analysis for the Period 1964-1973

The results of the Q-mode cluster analysis using variables which were important in the categorical regression equations developed in Section 3.2.3.1 for annual brown shrimp catch in area 19 and in Section 3.2.3.3 for annual white shrimp catch in area 19 for the period 1964-1973 are shown in Figure 73. These were the same variables previously used in the individual white shrimp and brown shrimp cluster analyses for the period 1964 - 1973, and are listed in Sections 3.3.2 and 3.3.4. Reference numbers for these variables are presented in Tables 5 and 6, while units are presented in Tables 3 and 4.

The results for the combined environmental and recruitment data set for the two species (i.e., including best fit independent variables for both white and brown shrimp catch) for the period 1964-1973 (Figure 73) exhibited trends characteristic of both the brown and white shrimp dendrograms for the same period (see Figures 69 and 71). The groupings of the years are generally similar to those for the white shrimp dendrogram (Figure 71), with Groups 1 and 2 (at the level indicated in Figure 73) essentially representing groups of good and poor white shrimp years, respectively. The difference in this dendrogram and that one based only on variables of importance to white shrimp catch (Figure 71) is that one year has been segregated out of each of the two major groups that were evident in the white shrimp catch dendrogram. Thus, 1964, which was a poor year for white shrimp catch, and 1973, which was a good year for white shrimp catch, are outliers in the cluster dendrogram resulting from the analyses of the combined data (Figure 73). The segregation of these two years is identical to the pattern shown in the brown shrimp dendrogram based only on environmental variables important to brown shrimp production (Figure 69). The year 1973 was unique, with lowest brown shrimp catch and near highest white shrimp catch. It behaved as an outlier due to the pattern of the variables that were important to predicting brown shrimp catch. The year 1964, with low white shrimp catch and relatively low brown shrimp catch, would be expected to group with the low white shrimp catch years. The fact that it was an outlier indicates that the environmental and/or recruitment regimes during 1964 were unique. Of the nineteen variables in the analysis, three from the brown shrimp data set (annual Mississippi River discharge, March NOS Freeport highest tide, and lagged annual Freeport precipitation) and three from the white shrimp data set (April - June Freeport precipitation, lagged annual Guadalupe River discharge and January NOS Galveston Channel minimum temperature) were lowest during 1964 for the ten year period.

3.3.7 Brown and White Shrimp Cluster Analysis for the Period 1960-1977

The results of the Q-mode cluster analysis using the independent variables which were important in the categorical regression equations developed in Sections 3.2.3.2 and 3.2.3.4 for annual white shrimp catch and annual brown shrimp catch, respectively in area 19, for the period 1960-1977 are shown in Figure 74. All variables previously used in the white shrimp and brown shrimp cluster analyses for the period 1960-1977 were used in this analysis. These variables are listed in Section 3.3.3 and 3.3.5. Reference numbers for these variables are presented in Tables 5 and 6, while units are presented in Tables 3 and 4.

The results for the combined environmental and recruitment data set for the two species (i.e., including best fit independent variables for both white and brown shrimp catch) for the period 1960 to 1977 showed groupings that corresponded most closely to the trends for catch of white shrimp (Figure 71). Of the three major groups in Figure 74, Group 1 consists of only one outlying year (1960), characterized by relatively high brown shrimp catch and intermediate white shrimp catch. The other two groups include years of low white shrimp catch (Group 2) and years of high white shrimp catch (Group 3). Except for 1971 (where catch of white shrimp was 2.3 million pounds, heads off) all years in Group 2 had white shrimp catch less than 2.0 million pounds. Except for 1975, which may be atypical due to the effect economic factors may have had on effort, white shrimp catch for group 3 years was greater than 2.0 million pounds, heads off. The exceptional behavior of the years 1971 and 1975 parallel the trends seen in the dendrogram based only on those best fit independent variables that were most important toward predicting white shrimp catch (Figure 71). No strong and consistent trends were apparent based on brown shrimp catch, with both Group 2 and Group 3 including years with both high and low catches of brown shrimp. However, the years of low white shrimp catch (Group 2, with the exception of 1971) were generally the years with high brown shrimp catch, while the years of high white shrimp catch (Group 3, with the exception of 1975) were generally years of low brown shrimp catch. This indicates to some degree, brown and white shrimp catch responded to some of the same environmental variables, but in opposite ways.

4.0 SUMMARY AND CONCLUSIONS

4.1 TIME SERIES ANALYSIS

Two univariate time series techniques (ARIMA modeling and Fourier analysis) were used to evaluate trends in monthly total catch of brown shrimp and white shrimp in area 19 for the period 1960-1977. Strong seasonal trends based upon a 12-month cycle were evident for both species. The ARIMA models identified these seasonal trends for both brown and white shrimp. Although the seasonal patterns were strong and repetitive, the absolute magnitude of the shrimp catch in a particular month was influenced by factors not included in the models, as exhibited by the relatively low percentages of explained variation. For white shrimp catch, an obvious secondary 6-month peak in the trends may have been responsible for the lower degree of explained variation, as compared to brown shrimp catch, where no such secondary trend was apparent. The usefulness of these results for impact assessment is dependent upon the magnitude of the expected impact. If the deviation is on the order of 30 to 50 percent, these results will be beneficial. On the other hand, if the change is minor, it is doubtful that this change could be distinguished from random occurrences.

The fourier analyses power spectrum estimates were disappointing due to the fact that the seasonal trends, althogh averaging 12-months, varied considerably throughout the 1960-1977 period. Over the 18 year period, peaks in catch were twelve months apart only nine time for brown shrimp and only six times for white shrimp. Therefore, predictive models were not presented for the fourier analysis.

4.2 MULTIPLE REGRESSION ANALYSES

Stepwise multiple regression analysis was used to develop predictive equations relating indices of shrimping success for brown the white shrimp (annual catch and catch/effort) to environmental variables and indices of recruitment for areas 18, 19, and 19 11-15 fm depths, for two time periods (1964-1973 and 1960-1977). The analytic scheme first involved developing preliminary regressions utilizing groups of categorical independent variables. These categories of variables included discharge, precipitation, salinity, temperature, winds, tides and Ekman transport, and indices of recruitment. From the results of these initial regressions, variables were selected for use in the final best fit "predictor" equations.

For brown shrimp, for the period 1964 to 1973, excellent results were obtained with the initial categorical regressions, with generally greater than 90 percent of the variance in catch and catch/effort explained by three independent variables. As expected, annual and spring river discharge variables were negatively related to catch and catch/effort, while the opposite trend was seen for river discharge (esp. Guadalupe River) in the summer. Lagged annual discharge variables were, for the most part negatively related to catch and catch/effort, with especially strong trends seen for catch/effort in areas 18 and 19 with lagged Atchafalaya River discharge. Precipitation variables were not as closely related to catch and catch/effort as were discharge variables, but showed similar trends. All precipitation variables except lagged annual precipitation at Freeport were negatively related to brown shrimp catch and catch/effort variables. Strongest negative correlations were seen with annual, spring, and winter precipitation variables. Of all the categories of variables, those for precipitation showed the least explained variance. This is expected since precipitation is several stages removed from its ultimate medium of expression (i.e., as a determinator of salinity).

Both salinity and temperature variables generally showed positive correlations with brown shrimp catch and catch/effort variables. There were virtually no variables in any of the regressions with salinity or tempeture that were negative. The importance of the TPWD salinity and temperature data and the salinity data from BCF-NMFS postlarval sampling for predicting brown shrimp catch was clearly demonstrated in the results of the regression analyses. Since most of the variables that were important were from the February to April period, these regression equations are very useful in predicting shrimp success (since a predicting can be made relatively early in the season). This is much different from the results of the analyses for precipitation and discharge, where, in some cases, annual discharge data would be required for predictive purposes. These results confirm the utility of the present estaurine sampling programs conducted by the agencies in Texas and Louisiana in predicting shrimping success.

Wind, tide and Ekman transport variables were also quite effective in predicting indices of brown shrimp shrimping success. March zonal Ekman transport was entered first into all equations for catch and catch/effort, showing strong positive relationships with the dependent variables. The relatively greater importance of zonal (east-west) over meridional (north-south) transport is difficult to explain if brown shrimp spawn very far from shore. As in the cases for salinity and temperature, the fact that important predictor variables for wind, tide and Ekman transport could be found for the February-April period, increases the utility of these variables for predicting shrimping success. The utility of the TPWD and the BCF-NMFS recruitment data for the winter and spring months is evident. As might be expected, MAY TPWD primary and secondary bay catch/effort in Galveston Bay were particularly effective predictors of brown shrimp catch and catch/effort. Postlarval catch/tow variables (especially values for February) were strongly and positively related to catch in area 19, 11-15 fm depths, but the trends were not consistent for all dependent variables. While postlarval catch/tow variables for other spring months were important in several equations in explaining residual variance in the dependent variables, they were not strongly correlated with the dependent variables.

The results for the 18 year data showed basically the same trends as were seen for the 10 year data, but the amounts of explained variance were much lower, due, at least in part, to the lack of important variables for the 18 year data set. These included Ekman transport variables, TPWD bay temperature, salinity and catch/effort variables and BCF-NMFS postlarval salinity and catch/tow vaiables. However, even for those variables present in both the 10 and 18 year data sets (e.g., precipitation and discharge), the correlations for the 10 year data were much stronger. This can best be attributed to the presence of other factors, such as possible inaccuracies in the reporting process during the early years, and economic factors during the late years, which were influencing shrimping success and were not included in any of the categorical analyses. None of the categorical regression models alone provided an adequate predictor of brown shrimping success for the 1960-1977 period.

The best fit regression equations for the 10 year data for brown shrimp variables showed that TPWD Galveston Bay catch/effort variables in the spring, spring zonal Ekman transport variables, spring mean postlarval catch/tow variables, and spring postlarval salinity variables, all of which were positively related to catch and catch/effort, were the most important types of variables. In all cases, four variables explained at least 93 percent of the variance in the dependent variables. Inclusion of effort into these best fit 10 year regression analyses did little to improve the fit of the models, due to the number of environmental and recruitment variables that were closely related to catch and catch/effort. Only for area 18 was effort an important variable in the final best fit equation, but the equation with effort explained less variance in catch than did the one with effort excluded.

Since most of the variables that were important in the 10 year best fit regression equations were available for only the 10 year period, the best fit regressions for the 18 year data were quite different, and did not provide nearly as good predictive capabilities. Besides effort, very few independent variables showed correlations stronger than $r = 0.50$ with any dependent variables for the eighteen year period. However, for several dependent variables, 90 percent of the variance was explained by five or six variables, with the best fits seen for area 19. As such, effort was not important in the best fit regression equation for catch in area 19. For area 18 and especially area 19, 11-15 fm depths, effort was the most important variable in the final equations, helping to provide a very good predictor model for catch in area 19, 11-15 fm depths.

For white shrimp, (one year) lagged and annual river discharge and precipitation variables were strongly correlated with catch and catch/effort during the 1964-1973 period. The difference in the response of white and brown shrimp indices to discharge and precipitation variables is impressive, with most variables showing negative correlations for brown shrimp and postive correlations for white shrimp. Although the correlations of white shrimp catch and catch/effort variables with precipitation variables were lower than those with discharge variables, catch and catch/effort in area 19 were strongly related to annual and April-June Freeport precipitation, respectively. The importance of lagged variables may indicate a preconditioning of the estuary system in one year for shrimping success in the next year. As in the other categorical equations, shrimping success indices in area 19, 11-15 fm depths, showed somewhat different relationships to the set of independent variables (e.g., a negative correlation with lagged annual discharge), and showed few strong correlations with discharge and precipitation vaiables. Since this spatial stratum is at the outer and western limits of the white shrimp grounds, catch and catch/effort would be expected to be more variable as compared to the subunits closer to shore.

Temperature and salinity variables which were used in the white shrimp regressions were not closely related to shrimping success, with few equations for any of the dependent variables with greater than 50 percent of the variance explained. However, important salinity data (i.e., TPWD estuarine studies) that were available for brown shrimp were not collected on a systematic basis for white shrimp. The salinity variables that were used in the white shrimp regressions were from the BCF-NMFS postlarval studies conducted near Galveston Entrance, and are probably not indicative of conditions in the nursery areas. Temperature would not be expected to be very important for predicting white shrimp success because of the seasonality of their estuarine phase.

As was the case for salinity, the recruitment data set did not include TPWD bay catch/effort data (as did the brown shrimp data set). BCF-NMFS postlarval catch/tow variables for the summer months were important predictor variables for catch in area 19 and for catch/effort in all three spatial strata, being positively correlated with most shrimping success indicators. However, the correlations were not strong and, in most cases, less than 70 percent of the variance in white shrimping success variables was explained by four or fewer independent variables. Bay catch and bay effort variables (from GCSD) were very important in several regressions, and, overall, were more important to predicting white shrimp catch than brown shrimp catch for the ten year period.

On of the most surprising results of this study was the importance of wind, tide and Ekman transport vaiables in predicting white shrimp catch and catch/effort. These equations provided the best fits for any group of the categorical regression equations for white shrimp, with at least 93 percent of the variance in white shrimp catch and catch/effort in all spatial strata explained by three or fewer variables. While these variables are very inexpensive to collect, the ecological basis for their importance was not always clear, and their use in predicting white shrimping success should be approached with caution. Since several of the equations utilized variables from early in the year (June to August) they might provide a means for an early prediction of white shrimping success. Since white shrimp spawn close to shore, the effects of winds, tides and Ekman transport variables on shrimping success probably involved longshore current regimes (and longshore transport of larvae) and/or an effect on the size of the nursery area in the estuaries. The most important variables in most 10 year equations were wind and tide variables, with only catch/effort in area 13 being strongly (and negatively) correlated with an Ekman transport variable.

As in the case for brown shrimp, the 18 year (1960-1977) best fit regression equations for white shrimp catch and catch/effort were similar to those for the 10 year period (1964-1973), but with considerably less variance explained. Unlike the situation for brown shrimp, most variables that were important in the 10 year analyses for white shrimp were also available for the 18 year period. Only Ekman transport variables and BCF-NMFS postlaval catch/tow and salinity variables were not available for the entire eighteen year period. Therefore, as was also seen for brown shrimping success indicators, the relationship of these indices to environmental variables is less well defined for the longer time period. The same factors which were put forth to explain these trends for brown shrimping success variables (i.e., inaccuracies in the data reporting early in the BCF-NMFS program and the imposition of other (economic) factors in the mid 1970's) are also put forth as the explanation for the same trends for white shrimp variables. While wind and tide variables again explained the most variance for most dependent variables, the amounts of explained variance were considerably less than was seen for the ten year (1964-1973) period.

The best fit equations for white shrimp catch and catch/effort variables for the 10 year data set explained at least 96 pecent of the variance with four or fewer variables. Becaue of this, effort was not important for any of the final equations for the 10 year period. The importance of wind, tide and Ekman transport variables in predicting white shrimp catch was evident in these results, with precipitation and discharge variables being of minor importance in these equations. For catch/effort variables, wind, tide and Ekman transport variables were less important, with lagged annual regional discharge being the most important variable for areas 18 and 19.

At least for areas 18 and 19, effort was more important in the equations based on the 18 year data set than in those for the 10 year period, due mainly to the weaker relationships of catch variables with environmental and recruitment variable for the 18 year period. The best fit equations without effort generally showed less than 80 percent of the variance in catch explained by four or fewer variables with effort included. For area 19, the inclusion of effort did increase the amount of explained variance in the final best fit equation, while for area 18, the total amount of explained variance actually decreased with the inclusion of effort. For catch/effort, a variety of variables were important in the final best fit equations, including annual and spring precipitation, summer tide variables, several discharge variables and GCSD bay catch/effort variables. Only for area 19, 11-15 fm depths, were lagged variables important in predicting white shrimp catch/effort. In all three, equations, at least 85 percent of the variance in catch/effort was explained by five independent variables.

The utility of these regression models in predicting brown and white shrimping success and in testing the null hypothesis that there are no significant impacts associated with brine discharge depends not only on the amount of variance explained in the models (as expressed in the size of the confidence intervals for the estimates from the model) but also depends on the adequacy of the premise upon which the models are based. The models assume that variables other than brine disposal which were not operative during the 10 or 18 year periods, and which could impact shrimping success, are not operative during the years when the effects of brine discharge are being tested. To utilize the models for impact assessment, the estimated value of the particular dependent variable is found by substituting the values of the relevant independent variables for the year of brine discharge into the particular model, using the slopes and intercepts from the regression models presented in this report. Confidence limits are then calculated for this estimate of the dependent variable, and the observed value for annual catch is compared with the confidence intervals for the estimate. If the observed value of Y falls outside the 95 percent confidence limits of the expected value, the null hypothesis is rejected.

4.3 CLUSTER ANLYSIS

Results of the cluster analysis showed that years of good and poor shrimping success (catch) could be differentiated based on those variables identified as being important in the 10 year categorical regressions for white and brown shrimp catch. For the 18 year record, the dendrogram for brown shrimp did not show as clear a differentiation of good and poor catch years, while that based on white shrimp variables was relatively successful in grouping "good" and "poor" white shrimping years. This is probably due to the availability of most of the variables that were important for predicting white shrimp catch and catch/effort during the 10 year period (1964-1973) for the 18 year period (1960-1977) also. The major problem for the brown shrimp analyses involved the lack of salinity data for the entire 18 year period.

Dendrograms resulting from the analysis of data sets including variables important to both brown and white shrimping success generally resembled the white shrimp dendrograms, but the dendrogram for the 1964-1973 period showed two outlier years (1964 and 1973) that exhibited similar behavior in the brown shrimp analyses for the same time period.

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6.0 TABLES

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Table 1. Reference list of environmental and shrimp catch variables entered into the stepwise multiple regression analyses for annual brown shrimp total catch and interview catch/effort.

Reference* Number	Variable
1.	Annual brown shrimp total catch, area 19
2.	Annual brown shrimp total catch, area 18
3.	Annual brown shrimp interview catch, area 18
4.	Annual brown shrimp interview catch, area 19
5.	Annual white shrimp total catch, area 18
6.	Annual white shrimp total catch, area 19
7.	Annual brown shrimp total catch, area 19, 11-15 fathoms
8.	Annual brown shrimp interview catch, area 19, 11-15 fathoms
9.	Annual brown shrimp directed effort, area 18
10.	Annual brown shrimp directed effort, area 19
11.	Annual non-directed nominal expanded effort, area 18
12.	Annual non-directed nominal expanded effort, area 19
13.	Annual non-directed nominal expanded effort, area 19, 10-15 fathoms
14.	Lagged annual brown shrimp total catch, area 18
15.	Lagged annual brown shrimp total catch, area 19
16.	Lagged annual brown shrimp interview catch, area 18
17.	Lagged annual brown shrimp interview catch, area 19
18.	Lagged annual brown shrimp total catch, area 19, 10-15 fathoms
19.	Lagged annual brown shrimp interview catch, area 19, 10-15 fathoms
20.	Lagged non-directed nominal interview effort, area 18
21.	Lagged non-directed nominal interview effort, area 19
22.	Lagged total non-directed nominal effort, area 19, 10-15 fathoms
23.	Annual brown shrimp total bay catch, subareas 18.1-18.5
24.	Annual brown shrimp total bay catch, subareas 19.1-19.8
25.	Annual number of bay trips, subareas 18.1-18.5
26.	Annual number of bay trips, subareas 19.1-19.6
27.	Lagged annual brown shrimp total bay catch, subareas 18.1-18.5
28.	Lagged annual brown shrimp total bay catch, subareas 19.1-19.8
29.	Lagged number of bay trips, subareas 18.1-18.5
30.	Lagged number of bay trips, subareas 19.1-19.8
31.	Annual Mississippi River discharge
32.	January-March Mississippi River discharge
33.	April-June Mississippi River discharge
34.	July-September Mississippi River discharge
35.	October-December Mississippi River discharge
36.	Lagged annual Mississippi River discharge
37.	Annual Trinity River discharge
38.	January-March Trinity River discharge
39.	April-June Trinity River discharge
40.	July-September Trinity River discharge
41.	October-December Trinity River discharge
42.	March Trinity River discharge
43.	April Trinity River discharge

Table 1. continued

Reference* Number	Variable
44.	May Trinity River discharge
45.	Lagged annual Trinity River discharge
46.	Annual Guadalupe River discharge
47.	January-March Guadalupe River discharge
48.	April-June Guadalupe River discharge
49.	July-August Guadalupe River discharge
50.	October-December Guadalupe River discharge
51.	Lagged annual Guadalupe River discharge
52.	Annual Atchafalaya River discharge
53.	Lagged annual Atchafalaya River discharge
54.	NOS March minimum density, Galveston Channel
55.	NOS April minimum density, Galveston Channel
56.	Annual precipitation, Freeport
57.	January-March precipitation, Freeport
58.	April-June precipitation, Freeport
59.	July-September precipitation, Freeport
60.	October-December precipitation, Freeport
61.	March precipitation, Freeport
62.	April precipitation, Freeport
63.	May precipitation, Freeport
64.	Lagged annual precipitation, Freeport
65.	March minimum Trinity River temperature
66.	April minimum Trinity River temperature
67.	January NOS minimum temperature, Galveston Channel
68.	February NOS minimum temperature, Galveston Channel
69.	March NOS minimum temperature, Galveston Channel
70.	April NOS minimum temperature, Galveston Channel
71.	March NOS mean temperature, Galveston Channel
72.	April NOS mean temperature, Galveston Channel
73.	May NOS mean temperature, Galveston Channel
74.	February fastest wind, Galveston
75.	March fastest wind, Galveston
76.	April fastest wind, Galveston
77.	February fastest wind direction, Galveston
78.	March fastest wind direction, Galveston
79.	April fastest wind direction, Galveston
80.	February NOS highest tide, Freeport
81.	March NOS highest tide, Freeport
82.	April NOS highest tide, Freeport
83.**	TPWD April primary bay average brown shrimp catch per effort, Galveston Bay
84.	TPWD April secondary bay average brown shrimp catch per effort, Galveston Bay

Table 1. continued

Reference* Number	Variable
85.	TPWD April tertiary bay average brown shrimp catch per effort, Galveston Bay
86.	TPWD April primary bay average brown shrimp catch per effort, Matagorda Bay
87.	TPWD April secondary bay average brown shrimp catch per effort, Matagorda Bay
88.	TPWD April tertiary bay average brown shrimp catch per effort, Matagorda Bay
89.	TPWD May primary bay average brown shrimp catch per effort, Galveston Bay
90.	TPWD May secondary bay average brown shrimp catch per effort, Galveston Bay
91.	TPWD May tertiary bay average brown shrimp catch per effort, Galveston Bay
92.	TPWD May primary bay average brown shrimp catch per effort, Matagorda Bay
93.	TPWD May secondary bay average brown shrimp catch per effort, Matagorda Bay
94.	TPWD May tertiary bay average brown shrimp catch per effort, Matagorda Bay
95.	February mean brown shrimp postlarval catch/tow, Galveston entrance
96.	March mean brown shrimp postlarval catch/tow, Galveston entrance
97.	April mean brown shrimp postlarval catch/tow, Galveston entrance
98.	TPWD March primary bay salinity, Galveston Bay
99.	TPWD April primary bay salinity, Galveston Bay
100.	TPWD March primary bay salinity, Matagorda Bay
101.	TPWD April primary bay salinity, Matagorda Bay
102.	Second half, February, minimum salinity, Galveston entrance (postlarval data set)
103.	First half, March, minimum salinity, Galveston entrance (postlarval data set)
104.	Second half March, minimum salinity, Galveston entrance (postlarval data set)
105.	First half April, minimum salinity, Galveston entrance (postlarval data set)
106.	TPWD March primary bay temperature, Galveston Bay
107.	TPWD April primary bay temperature, Galveston Bay
108.	TPWD March primary bay temperature, Matagorda Bay
109.	TPWD April primary bay temperature, Matagorda Bay
110.	Second half, February, minimum temperature, Galveston entrance (postlarval data set)
111.	First half, March, minimum temperature, Galveston entrance (postlarval data set)

Table 1. continued

Reference* Number	Variable
112.	Second half, March, minimum temperature, Galveston entrance (postlarval data set)
113.	Final half, April, minimum temperature, Galveston entrance (postlarval data set)
114.	February mean Ekman transport, zonal index
115.	February mean Ekman transport, meridional index
116.	March mean Ekman transport, zonal index
117.	March mean Ekman transport, meridional index
118.	April mean Ekman transport, zonal index
119.	April mean Ekman transport, meridional index

* Detailed information on locations, units and sources of data is provided in Table 3.

**Variables 83-119 are available for a common time period of 1964-1973.

Table 2. Reference list of environmental and shrimp catch variables entered into the stepwise multiple regression analyses for annual white shrimp total catch and interview catch/effort.

Reference* Number	Variable
1.	Annual white shrimp total catch, area 18
2.	Annual white shrimp total catch, area 19
3.	Annual white shrimp interview catch, area 18
4.	Annual white shrimp interview catch, area 19
5.	Annual brown shrimp total catch, area 18
6.	Annual brown shrimp total catch, area 19
7.	Annual white shrimp total catch, area 19, 11-15 fathoms
8.	Annual white shrimp interview catch, area 19 11-15 fathoms
9.	Annual white shrimp directed effort, area 18
10.	Annual white shrimp directed effort, area 19
11.	Annual non-directed nominal expanded effort, area 18
12.	Annual non-directed nominal expanded effort, area 19
13.	Annual non-directed nominal expanded effort, area 19, 10-15 fathoms
14.	Annual white shrimp total bay catch, subareas 18.1-18.5
15.	Annual white shrimp total bay catch, subareas 19.1-19.8
16.	Lagged annual white shrimp total catch, area 18
17.	Lagged annual white shrimp total catch, area 19
18.	Lagged annual white shrimp total catch, area 19, 11-15 fathoms
19.	Lagged annual white shrimp interview catch, area 18
20.	Lagged annual white shrimp interview catch, area 19
21.	Lagged annual white shrimp interview catch, area 19, 11-15 fathoms
22.	Lagged non-directed nominal interview effort, area 18
23.	Lagged non-directed nominal interview effort, area 19
24.	Lagged non-directed nominal interview effort, area 19, 11-15 fathoms
25.	Lagged white shrimp total bay catch, subareas 18.1-18.5
26.	Lagged white shrimp total bay catch, subareas 19.1-19.8
27.	Annual number of bay trips, subareas 18.1-18.5
28.	Annual number of bay trips, subareas 19.1-19.8
29.	Lagged annual number of bay trips, subareas 18.1-18.5
30.	Lagged annual number of bay trips, subareas 19.1-19.8
31.	Annual Mississippi River discharge
32.	January-March Mississippi River discharge
33.	April-June Mississippi River discharge
34.	July-September Mississippi River discharge
35.	October-December Mississippi River discharge
36.	Lagged annual Mississippi River discharge
37.	Lagged October-December Mississippi River discharge
38.	Annual Trinity River discharge
39.	January-March Trinity River discharge
40.	April-June Trinity River discharge
41.	July-September Trinity River discharge
42.	October-December Trinity River discharge
43.	Lagged annual Trinity River discharge
44.	Lagged October-December Trinity River discharge

Table 2. continued

Reference* Number	Variable
45.	Annual Guadalupe River discharge
46.	January-March Guadalupe River discharge
47.	April-June Guadalupe River discharge
48.	July-September Guadalupe River discharge
49.	October-December Guadalupe River discharge
50.	Lagged annual Guadalupe River discharge
51.	Lagged October-December Guadalupe River discharge
52.	Annual Atchafalaya River discharge
53.	Lagged annual Atchafalaya River discharge
54.	Annual precipitation, Freeport
55.	January-March precipitation, Freeport
56.	April-June precipitation, Freeport
57.	July-September precipitation, Freeport
58.	October-December precipitation, Freeport
59.	Lagged annual precipitation, Freeport
60.	Lagged July-September precipitation, Freeport
61.	Lagged October-December precipitation, Freeport
62.	January NOS minimum temperature, Galveston Channel.
63.	February, NOS minimum temperature, Galveston Channel
64.	Number of days >90 ^{o}F, April-June, Freeport
65.	Number of days >90 ^{o}F, July-September, Freeport
66.	Mean fastest wind, April-June, Galveston
67.	Mean fastest wind, July-September, Galveston
68.	June fastest wind, Galveston
69.	July fastest wind, Galveston
70.	August fastest wind, Galveston
71.	September fastest wind, Galveston
72.	October fastest wind, Galveston
73.	Mean fastest wind direction, April-June, Galveston
74.	Mean fastest wind direction, July-September, Galveston
75.	June fastest wind direction, Galveston
76.	July fastest wind direction, Galveston
77.	August fastest wind direction, Galveston
78.	September fastest wind direction, Galveston
79.	October fastest wind direction, Galveston
80.	Mean highest tide, April-June, Freeport
81.	Mean highest tide, July-September, Freeport
82.	June highest tide, Freeport
83.	July highest tide, Freeport
84.	August highest tide, Freeport
85.	September highest tide, Freeport
86.	October highest tide, Freeport
87.**	June mean white shrimp postlarval catch/tow, Galveston entrance

Table 2. continued

Reference* Number	Variable
88.	July mean white shrimp postlarval catch/tow, Galveston entrance
89.	August mean white shrimp postlarval catch/tow, Galveston entrance
90.	June minimum salinity, Galveston entrance (postlarval data set)
91.	June maximum salinity, Galveston entrance (postlarval data set)
92.	July minimum salinity, Galveston entrance (postlarval data set)
93.	July maximum salinity, Galveston entrance (postlarval data set)
94.	August minimum salinity, Galveston entrance (postlarval data set)
95.	August maximum salinity, Galveston entrance (postlarval data set)
96.	June mean Ekman transport, zonal index
97.	June mean Ekman transport, meridional index
98.	July mean Ekman transport, zonal index
99.	July mean Ekman transport, meridional index
100.	August mean Ekman transport, zonal index
101.	August mean Ekman transport, meridional index

* Detailed information on locations, units and sources of data is provided in Table 4.

**Variables 87-101 only available for a common time period of 1964-1973.

Table 3. **Detailed locations, units and sources of variables entered into the stepwise multiple regression analyses for annual brown shrimp total catch and interview catch/effort.**

Variables:*	Shrimp catch and effort.
Reference Numbers:**	1-30
Location:	Statistical areas 18, 19 and 19, 11-15 fathom depths for offshore catch, effort and catch/effort. Statistical areas 18.1-18.5 and 19.1-19.8 for inshore (bay) catch and effort.
Units:	Offshore catch = pounds, heads-off x 10^{-5}; inshore (bay) catch = pounds, heads-off x 10^{-4}; offshore effort = number of days fished; bay effort = trips x 10^{-3}.
Source:	Summaries prepared from the detailed historic Gulf Coast Shrimp Data reported by the Bureau of Commercial Fisheries (BCF) and National Marine Fisheries Service (NMFS). Bay catch values were obtained from Gulf Coast Shrimp Data (GCSD) annual summaries published by BCF and NMFS. The annual total offshore effort (in days) was expanded to the total catch from the interview data using the total catch/interview catch ratio.

Variables:	Mississippi River discharge.
Reference Numbers:	31-36
Location:	U.S. Army Corps of Engineers (COE) gaging station at Tarbert Landing, Mississippi.
Units:	Sum of the daily discharge rate (cfs x 10^{-6}).
Source:	Monthly and annual summaries obtained from the New Orleans District, COE, New Orleans, La.

Table 3. continued

Variables:	Trinity and Guadalupe River discharge.
Reference Numbers:	37-51
Location:	United States Geological Survey (USGS) Station No. 8066500, Trinity River at Romayor, Texas and USGS Station No. 8176500, Guadalupe River at Victoria, Texas.
Units:	Acre feet x 10^{-4}.
Missing Values:	Monthly means were substituted for missing values of October-December, 1977.
Source:	Data were extracted from the Monthly Data Systems of the Texas Water Oriented Data Bank by Texas Natural Resources Information System (TNRIS).
Variables:	Atchafalaya River discharge.
Reference Numbers:	52-53
Location:	COE Station at Simmesport, Louisiana.
Units:	Sum of the daily discharge rate (cfs x 10^{-6}).
Source:	Data table published in Gunter, G. (1979).
Variables:	National Ocean Survey (NOS) minimum density.
Reference Numbers:	54-55
Location:	NOS Tide Station No. 877-1450, Galveston Channel.
Units:	Specific gravity at 15°C (transformed by (specific gravity - 1.000) x 10^3).
Missing Values:	No data for April 1977.
Source:	Data obtained from the NMFS Marine Resource Monitoring Assessment and Prediction (MARMAP) information system, NMFS NEFC, Atlantic Environmental Group (AEG), Narragansett, Rhode Island.

Table 3. continued

Variables:	Precipitation
Reference Numbers:	56-64
Location:	National Weather Service Station, Freeport, Texas.
Units:	Inches.
Source:	Prepared from Tape Data Set 9924, monthly data received from NOAA National Climate Center, Asheville, N.C.
Variables:	River temperature.
Reference Numbers:	65-66
Location:	USGS Station NO. 8066500, Trinity River.
Units:	Degrees centigrade (^{o}C)
Missing Values:	Missing values for 1960 and 1966.
Source:	Prepared from daily water temperature data obtained from Texas Natural Resource Information System.
Variables:	National Ocean Survey (NOS) mean and minimum temperature.
Reference Numbers:	69-73
Location:	NOS Tide Station No. 877-1450, Galveston Channel.
Units:	Degrees centigrade (^{o}C)
Missing Values:	No mean data for April 1977.
Source:	Data obtained from NMFS Marine Resource Monitoring Assessment and Prediction (MARMAP) Information System, NMFS, NEFC, Atlantic Environmental Group (AEG), Narragansett, Rhode Island.

Table 3. continued

Variables:	Fastest wind speed and direction.
Reference Numbers:	74-79
Location:	National Weather Service Station, Galveston, Texas and Galveston airport.
Units:	Fastest wind = miles per hour; direction = degree from North.
Missing Values:	No data for February 1965.
Source:	Climatological data for Texas. Monthly summaries published by Environmental Data and Information Services (EDIS), NOAA.
Variables:	Highest tide.
Reference Numbers:	80-82
Location:	NOS Tide Station No. 877-2440, Freeport.
Units:	Feet below benchmark.
Source:	NOS complete tidal summaries from the Tidal Datums and Information Branch, Rockville, MD.
Variables:	Texas Parks and Wildlife Department (TPWD) bay catch/effort, salinity and temperature.
Reference Numbers:	83-94, 98-101, 106-109.
Location:	Primary, secondary, and tertiary bays in Galveston and Matagorda Bay complexes.
Units:	Number of individuals per effort (trawl), parts per thousand, degrees centigrade ($^{\circ}C$).

Table 3. continued

Missing Values:	Missing values were not included in the calculation of monthly average catch per effort. Missing values for March 1962 (Galveston Bay salinity), March 1972 (Matagorda Bay salinity), March and April 1963 (Galveston Bay temperature) and March 1966 (Galveston Bay temperature).
Source:	Data taken from tables and figures of the Annual Coastal Fisheries Project Reports of the Texas Parks and Wildlife Department.
Variables:	BCF-NMFS postlarval shrimp catch/effort, salinity, temperature.
Reference Numbers:	95-97, 102-105, 110-113.
Location:	Entrance to Galveston Bay.
Units:	Number of individuals per tow; parts per thousand; degrees centigrade (^{o}C).
Source:	Variables were prepared from data obtained from postlarval studies, NMFS, SEFC, Galveston Labs.
Variables:	Ekman transport.
Reference Numbers:	114-119
Location:	$27^{o}N$ - $96^{o}W$
Units:	Metric tons per second per kilometer ($T/s^{-1}/km^{-1}$).
Source:	Data obtained from NMFS, Galveston Laboratory. These data were originally summarized into monthly averages from model output produced by the Pacific Environmental Group (PEG), NMFS, Monterey, California.

* See Table 5 for variable names and labels.
**See Table 1.

Table 4. Detailed locations, units and sources of variables entered into the stepwise multiple regression analyses for annual white shrimp total catch and interview catch/effort.

Variables:*	Shrimp catch and effort.
Reference Numbers:**	1-30
Location:	Statistical areas 18, 19 and 19, 11-15 fathom depths for offshore catch, effort, and catch/effort. Statistical areas 18.1-18.5 and 19.1-19.8 for inshore (bay) catch and effort.
Units:	Offshore catch = pounds, heads-off x 10^{-5}; inshore (bay) catch = pounds, heads-off x 10^{-4}; offshore effort = number of days fished; bay effort = trips x 10^{-3}.
Source:	Summaries prepared from the detailed historical Gulf Coast Shrimp Data reported by the Bureau of Commercial Fisheries (BCF) and National Marine Fisheries Service (NMFS). Bay catch values were obtained from Gulf Coast Shrimp Data (GCSD) annual summaries published by BCF and NMFS. The annual total offshore effort (in days) was expanded to the total catch from the interview data using the total catch/interview catch ratio.
Variables:	Mississippi River discharge.
Reference Numbers:	31-36
Location:	U.S. Army Corps of Engineers (COE) gaging station at Tarbert Landing, Mississippi.
Units:	Sum of the daily discharge rate (cfs x 10^{-6}).
Source:	Monthly and annual summaries obtained from the New Orleans District, COE, New Orleans, La.

Table 4. continued

Variables:	Trinity and Guadalupe River discharge.
Reference Numbers:	37-51
Location:	United States Geological Survey (USGS) Station No. 8066500, Trinity River at Romayor, Texas and USGS Station No. 8176500, Guadalupe River at Victoria, Texas.
Units:	Acre feet x 10^{-4}.
Missing Values:	Monthly means were substituted for missing values October-December, 1977.
Source:	Data were extracted from the Monthly Data Systems of the Texas Water Oriented Data Bank by Texas Natural Resources Information System (TNRIS).

Variables:	Atchafalaya River discharge.
Reference Numbers:	52-53
Location:	COE Station at Simmesport, Louisiana.
Units:	Sum of the daily discharge rate (cfs x 10^{-6}).
Source:	Data table published in Gunter, G. (1979).

Variables:	Precipitation; number of days >90^{o}F.
Reference Numbers:	54-61, 64-65
Location:	National Weather Service Station, Freeport, Texas.
Units:	Inches; days
Missing Values:	No data for April-September 1962, and April-June 1966 for number of days >90^{o}F.
Source:	Prepared from Tape Data Set 9924, monthly data received from the National Climate Center, Asheville, N.C.

Table 4. continued

Variables:	National Ocean Survey (NOS) minimum temperature.
Reference Numbers:	62-63
Location:	NOS Tide Station No. 877-1450, Galveston Channel.
Units:	Degrees centigrade (°C)
Source:	Data obtained from the NMFS Marine Resource Monitoring Assessment and Prediction (MARMAP) Information System, NMFS, NEFC, Atlantic Environmental Group (AEG), Narragansett, Rhode Island.
Variables:	Fastest wind speed and direction.
Reference Numbers:	66-79
Location:	National Weather Service Station, Galveston, Texas and Galveston airport.
Units:	Fastest wind = miles per hour; direction = degrees from North.
Source:	Climatological Data for Texas. Monthly summaries published by Environmental Data and Information Service (EDIS), NOAA.
Variables:	Highest tide.
Reference Numbers:	80-86
Location:	NOS Tide Station No. 877-2440, Freeport.
Units:	Feet below benchmark.
Missing Values:	No data for September 1961, June-October 1966, and October 1970.
Source:	NOS complete tidal summaries from the Tidal Datums and Information Branch, Rockville, MD.

Table 4. continued

Variables:	BCF-NMFS postlarval shrimp catch/effort and salinity.
Reference Numbers:	87-95
Location:	Entrance to Galveston Bay.
Units:	Number of individuals per tow; parts per thousand.
Source:	Variables were prepared from data obtained from postlarval studies, NMFS, SEFC, Galveston Labs.
Variables:	Ekman transport.
Reference Numbers:	96-101
Location:	$27^{o}N$ - $96^{o}W$
Units:	Metric tons per second per kilometer ($T/s^{-1}/km^{-1}$).
Source:	Data obtained from NMFS, Galveston Laboratory. These data were originally summarized into monthly averages from model output produced by the Pacific Environmental Group (PEG), NMFS, Monterey, California.

* See Table 5 for variable names and labels.
**See Table 1.

Table 5. **List of variable labels, variable numbers and reference numbers for cross-referencing of computer generated data products to reference list and support information for brown shrimp ten (1964-1973) and eighteen year (1960-1977) data sets.**

Variable name	Variable label	Reference number
VAR1	TOT CAT 19	1
VAR2	TOT CAT 18	2
VAR3	LAG TOT CAT 19	15
VAR4	LAG TOT CAT 18	14
VAR5	BRN EFF 19	10
VAR6	BRN EFF 18	9
VAR7	INT CAT 19	4
VAR8	INT CAT 18	3
VAR9	LAG INT CAT 19	17
VAR10	LAG INT CAT 18	16
VAR11	ANNUAL MISS DIS	31
VAR12	ANNUAL TRIN DIS	37
VAR13	ANNUAL FRE PREC	56
VAR14	JAN-MAR TRIN DIS	38
VAR15	APR-JUN TRIN DIS	39
VAR16	JAN-MAR MISS DIS	32
VAR17	APR-JUN MISS DIS	33
VAR18	JAN-MAR FRE PREC	57
VAR19	APR-JUN FRE PREC	58
VAR20	MAR TRIN MIN TEMP	65
VAR21	APR TRIN MIN TEMP	66
VAR22	MAR NOS GAL MIN TEMP	69
VAR23	APR NOS GAL MIN TEMP	70
VAR24	MAR NOS GAL MIN DEN	54
VAR25	APR NOS GAL MIN DEN	55
VAR26	MAR NOS FRE HI TIDE	81
VAR27	APR NOS FRE HI TIDE	82
VAR28	MAR GAL FASTEST WIND	75
VAR29	APR GAL FASTEST WIND	76
VAR30	MAR GAL FAST WIND DIR	78
VAR31	APR GAL FAST WIND DIR	79
VAR32	WHT TOT CAT 19	6
VAR33	WHT TOT CAT 18	5
VAR34	LAG BRN EFF 19	21
VAR35	LAG BRN EFF 18	20
VAR36	JAN NOS GAL MIN TEMP	67
VAR37	FEB NOS GAL MIN TEMP	68
VAR38	ANNUAL GUAD DIS	46
VAR39	LAG ANNUAL MISS DIS	36
VAR40	LAG ANNUAL TRIN DIS	45
VAR41	LAG ANNUAL FRE PREC	64
VAR42	LAG ANNUAL GUAD DIS	51
VAR43	ANNUAL ATCH DIS	52
VAR44	LAG ANNUAL ATCH DIS	53
VAR45	APR TPWD PRI GAL CAT-EFF	83
VAR46	APR TPWD SEC GAL CAT-EFF	84
VAR47	APR TPWD TER GAL CAT-EFF	85
VAR48	APR TPWD PRI MAT CAT-EFF	86
VAR49	APR TPWD SEC MAT CAT-EFF	87
VAR50	APR TPWD TER MAT CAT-EFF	88
VAR51	MAY TPWD PRI GAL CAT-EFF	89
VAR52	MAY TPWD SEC GAL CAT-EFF	90
VAR53	MAY TPWD TER GAL CAT-EFF	91
VAR54	MAY TPWD PRI MAT CAT-EFF	92
VAR55	MAY TPWD SEC MAT CAT-EFF	93
VAR56	MAY TPWD TER MAT CAT-EFF	94
VAR57	FEB POSTLARVAL CAT-TOW	95
VAR58	MAR POSTLARVAL CAT-TOW	96
VAR59	APR POSTLARVAL CAT-TOW	97
VAR60	MAR TPWD GAL SAL	98
VAR61	APR TPWD GAL SAL	99
VAR62	MAR TPWD MAT SAL	100
VAR63	APR TPWD MAT SAL	101
VAR64	2ND FEB POSTLAV MIN SAL	102
VAR65	1ST MAR POSTLAV MIN SAL	103
VAR66	2ND MAR POSTLAV MIN SAL	104
VAR67	1ST APR POSTLAV MIN SAL	105
VAR68	MAR TPWD GAL TEMP	106
VAR69	APR TPWD GAL TEMP	107
VAR70	MAR TPWD MAT TEMP	108
VAR71	APR TPWD MAT TEMP	109
VAR72	2ND FEB POSTLAV MIN TEMP	110
VAR73	1ST MAR POSTLAV MIN TEMP	111
VAR74	2ND MAR POSTLAV MIN TEMP	112
VAR75	1ST APR POSTLAV MIN TEMP	113
VAR76	FEB EKMAN ZONAL IND	114
VAR77	FEB EKMAN MERID. IND	115
VAR78	MAR EKMAN ZONAL IND	116
VAR79	MAR EKMAN MERID. IND	117
VAR80	APR EKMAN ZONAL IND	118
VAR81	APR EKMAN MERID. IND	119
VAR82	JUL-SEP MISS DIS	34
VAR83	OCT-DEC MISS DIS	35
VAR84	JUL-SEP TRIN DIS	40
VAR85	OCT-DEC TRIN DIS	41
VAR86	APR-JUN GUAD DIS	48
VAR87	JUL-SEP GUAD DIS	49
VAR88	OCT-DEC GUAD DIS	50
VAR89	JUL-SEP FRE PREC	59
VAR90	OCT-DEC FRE PREC	60
VAR91	TOT CAT 19 DPTH 3	7
VAR92	INT CAT 19 DPTH 3	8
VAR93	LAG TOT CAT 19 DPTH 3	18
VAR94	LAG INT CAT 19 DPTH 3	19
VAR95	TOT INT EFF 19 DPTH 3	13
VAR96	LAG TOT INT EFF 19 DPTH 3	22
VAR97	BAY CAT 18	23
VAR98	BAY CAT 19	24
VAR99	BAY TRIPS 18	25
VAR100	BAY TRIPS 19	26
VAR101	LAG BAY CAT 18	27
VAR102	LAG BAY CAT 19	28
VAR103	LAG BAY TRIPS 18	29
VAR104	LAG BAY TRIPS 19	30
VAR105	TOT INT EFF 18	11
VAR106	TOT INT EFF 19	12
VAR107	JAN-MAR GUAD DIS	47
VAR108	MAR FRE PREC	61
VAR109	APR FRE PREC	62
VAR110	MAY FRE PREC	63
VAR111	MAR TRIN DIS	42
VAR112	APR TRIN DIS	43
VAR113	MAY TRIN DIS	44
VAR114	FEB FRE HI TIDE	80
VAR115	FEB GAL FASTEST WIND	74
VAR116	FEB GAL FAST WIND DIR	77
VAR117	MAR NOS GAL MEAN TEMP	71
VAR118	APR NOS GAL MEAN TEMP	72
VAR119	MAY NOS GAL MEAN TEMP	73

Table 5 continued

Variable name	Variable label	Reference number	Variable name
XE18	EXP TOT EFF 18	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 18
XE19	EXP TOT EFF 19 DPTH	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 19
XE193	EXP TOT EFF 193	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 19, 11-15 FATHOM DEPTHS
CTEF18	CAT-EFF 18	*	ANNUAL BROWN SHRIMP CATCH/EFFORT IN AREA 18
CTEF19	CAT-EFF 19	*	ANNUAL BROWN SHRIMP CATCH/EFFORT IN AREA 19
CTEF193	CAT-EFF 193	*	ANNUAL BROWN SHRIMP CATCH/EFFORT IN AREA 19, 11-15 FATHOM DEPTHS
BCE18	BAY CAT-TRIP	*	ANNUAL BROWN SHRIMP BAY CATCH/EFFORT IN AREA 18
BCE19	BAY CAT-TRIP 19	*	ANNUAL BROWN SHRIMP BAY CATCH/EFFORT IN AREA 19
BCEL18	LAG BAY CAT-TRIP 18	*	ANNUAL LAGGED BROWN SHRIMP BAY CATCH/EFFORT IN AREA 18
BCEL19	LAG BAY CAT-TRIP 19	*	ANNUAL LAGGED BROWN SHRIMP BAY CATCH/EFFORT IN AREA 19

*VARIABLES COMPUTED FROM VARIABLES WITH REFERENCE NUMBERS 1-30 IN TABLE 3.

Table 6. List of variable labels, variable numbers and reference numbers for cross-referencing of computer generated data products to reference list and support information for white shrimp ten year (1964-1973) and eighteen year (1960-1977) data sets.

Variable name	Variable label	Reference number
VAR1	TOT CAT 19	2
VAR2	TOT CAT 18	1
VAR3	LAG TOT CAT 19	17
VAR4	LAG TOT CAT 18	16
VAR5	WHT EFF 19	10
VAR6	WHT EFF 18	9
VAR7	INT CAT 19	4
VAR8	INT CAT 18	3
VAR9	LAG INT CAT 19	20
VAR10	LAG INT CAT 18	21
VAR11	LAG WHT EFF 19	23
VAR12	LAG WHT EFF 18	22
VAR13	BRN CAT 19	6
VAR14	BRN CAT 18	5
VAR15	ANNUAL MISS DIS	31
VAR16	ANNUAL GUAD DIS	45
VAR17	ANNUAL TRIN DIS	38
VAR18	APR-JUN MISS DIS	33
VAR19	JUL-SEP MISS DIS	34
VAR20	OCT-DEC MISS DIS	35
VAR21	APR-JUN GUAD DIS	47
VAR22	OCT-DEC GUAD DIS	49
VAR23	JUL-SEP TRIN DIS	41
VAR24	OCT-DEC TRIN DIS	42
VAR25	ANNUAL FRE PREC	54
VAR26	APR-JUN FRE PREC	56
VAR27	JUL-SEP FRE PREC	57
VAR28	OCT-DEC FRE PREC	58
VAR29	APR-JUN FRE DAYS GT 90 F	64
VAR30	JUL-SEP FRE DAYS GT 90 F	65
VAR31	APR-JUN GAL MEAN FASTEST WIND	66
VAR32	JUL-SEP GAL MEAN FASTEST WIND	67
VAR33	APR-JUN FRE MEAN HI TIDE	80
VAR34	JUL-SEP FRE MEAN HI TIDE	81
VAR35	APR-JUN GAL MEAN FAST WIND DIR	73
VAR36	JUL-SEP GAL MEAN FAST WIND DIR	74
VAR37	LAG ANNUAL MISS DIS	36
VAR38	LAG ANNUAL GUAD DIS	50
VAR39	LAG ANNUAL TRIN DIS	43
VAR40	JAN NOS GAL MIN TEMP	62
VAR41	FEB NOS GAL MIN TEMP	63
VAR42	LAG ANNUAL FRE PREC	59
VAR43	LAG JUL-SEP FRE PREC	60
VAR44	LAG OCT-DEC FRE PREC	61
VAR45	APR-JUN TRIN DIS	40
VAR46	JUL-SEP GUAD DIS	48
VAR47	BAY CAT 19	15
VAR48	BAY CAT 18	14
VAR49	LAG BAY CAT 19	26
VAR50	LAG BAY CAT 18	25
VAR51	ANNUAL ATCH DIS	52
VAR52	LAG ANNUAL ATCH DIS	53
VAR53	JUN POSTLARVAL CAT-TOW	87
VAR54	JUL POSTLARVAL CATCH-TOW	88
VAR55	AUG POSTLARVAL CATCH-TOW	89
VAR56	JUN POSTLAV MIN SAL	90
VAR57	JUN POSTLAV MAX SAL	91
VAR58	JUL POSTLAV MIN SAL	92
VAR59	JUL POSTLAV MAX SAL	93
VAR60	AUG POSTLAV MIN SAL	94
VAR61	AUG POSTLAV MAX SAL	95
VAR62	JUN EKMAN ZONAL IND	96
VAR63	JUN EKMAN MERID. IND	97
VAR64	JUL EKMAN ZONAL IND	98
VAR65	JUL EKMAN MERID. IND	99
VAR66	AUG EKMAN ZONAL IND	100
VAR67	AUG EKMAN MERID. IND	101
VAR68	TOT CAT 19 DPTH 3	7
VAR69	INT CAT 19 DPTH 3	8
VAR70	LAG TOT CAT 19 DPTH 3	18
VAR71	LAG INT CAT 19 DPTH 3	21
VAR72	TOT INT EFF 19 DPTH 3	13
VAR73	LAG TOT INT EFF 19 DPTH 3	24
VAR74	TOT INT EFF 18	11
VAR75	TOT INT EFF 19	12
VAR76	BAY TRIPS 18	27
VAR77	BAY TRIPS 19	28
VAR78	LAG BAY TRIPS 18	29
VAR79	LAG BAY TRIPS 19	30
VAR80	JAN-MAR MISS DIS	32
VAR81	JAN-MAR TRIN DIS	39
VAR82	JAN-MAR FRE PREC	55
VAR83	LAG OCT-DEC MISS DIS	37
VAR84	LAG OCT-DEC TRIN DIS	44
VAR85	LAG OCT-DEC GUAD DIS	51
VAR86	JAN-MAR GUAD DIS	46
VAR87	JUNE GAL FASTEST WIND	68
VAR88	JUL GAL FASTEST WIND	69
VAR89	AUG GAL FASTEST WIND	70
VAR90	SEP GAL FASTEST WIND	71
VAR91	OCT GAL FASTEST WIND	72
VAR92	JUN GAL FAST WIND DIR	75
VAR93	JUL GAL FAST WIND DIR	76
VAR94	AUG GAL FAST WIND DIR	77
VAR95	SEP GAL FAST WIND DIR	78
VAR96	OCT GAL FAST WIND DIR	79
VAR97	JUN FRE HI TIDE	82
VAR98	JUL FRE HI TIDE	83
VAR99	AUG FRE HI TIDE	84
VAR100	SEP FRE HI TIDE	85
VAR101	OCT FRE HI TIDE	86

Table 6 continued

Variable name	Variable label	Reference number	Variable name
XE18	EXP TOT-EFF 18	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 18
XE19	EXP TOT-EFF DPTH 19	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 19
XE193	EXP TOT-EFF 193	*	EXPANDED TOTAL ANNUAL EFFORT IN AREA 19, 11-15 FATHOM DEPTHS
CTEF18	CAT EFF 18	*	ANNUAL WHITE SHRIMP CATCH/EFFORT IN AREA 18
CTEF19	CAT EFF 19	*	ANNUAL WHITE SHRIMP CATCH/EFFORT IN AREA 19
CTEF193	CAT EFF DPTH 193	*	ANNUAL WHITE SHRIMP CATCH/EFFORT IN AREA 19, 11-15 FATHOM DEPTHS
WCE18	BAY CATCH-TRIP 18	*	ANNUAL WHITE SHRIMP BAY CATCH/EFFORT IN AREA 18
WCE19	BAY CATCH-TRIP 19	*	ANNUAL WHITE SHRIMP BAY CATCH/EFFORT IN AREA 19
WCEL18	LAG BAY CAT-TRIP 18	*	LAGGED ANNUAL WHITE SHRIMP CATCH/EFFORT IN AREA 18
WCEL19	LAG BAY CAT-TRIP 19	*	LAGGED ANNUAL WHITE SHRIMP CATCH/EFFORT IN AREA 19

*VARIABLES COMPUTED FROM VARIABLES WITH REFERENCE NUMBERS 1-30 IN TABLE 4.

Table 7. Summary statistics for white and brown shrimp total monthly catch (pounds, heads off, untransformed data) in area 19 for the eighteen year (1960 - 1977) data set.

	White	Brown
Observations	216	216
Mean	1.85×10^5	9.24×10^5
Std. Error of Mean	1.35×10^4	7.84×10^4
Std. Deviation	1.98×10^5	1.15×10^6
Coeff. of Variation	106.9	124.7
Range of Values	1.13×10^6	5.17×10^6

Table 8. Summary statistics for white and brown shrimp total monthly catch (pounds, heads off, transformed data) in area 19 for the eighteen year (1960 - 1977) data set.

	White	Brown
Observations	216	216
Mean	11.55	12.90
Std. Error of Mean	8.75×10^{-2}	9.5×10^{-2}
Std. Deviation	1.29	1.39
Coeff. of Variation	11.13	10.8
Range of Values	9.33	5.4

Table 9. Autocorrelations for brown shrimp total monthly catch (pounds, heads off) in area 1 the eighteen year (1960 - 1977) data set.

Lags	Autocorrelation Estimates								
1-10	0.78	0.44	0.04	-0.03	-0.61	-0.70	-0.59	-0.32	0.04
Std. Error	0.07	0.10	0.11	0.11	0.11	0.13	0.15	0.16	0.16
11-20	0.66	0.77	0.64	0.35	0.03	-0.28	-0.50	-0.62	-0.52
Std. Error	0.16	0.18	0.19	0.20	0.20	0.20	0.20	0.21	0.22
21-30	-0.01	0.30	0.59	0.70	0.62	0.37	0.04	-0.27	-0.51
Std. Error	0.23	0.23	0.23	0.23	0.24	0.25	0.25	0.25	0.26
31-36	-0.56	-0.35	-0.05	0.27	0.54	0.66			
Std. Error	0.27	0.27	0.27	0.27	0.28	0.28			

Table 10. Estimation of the parameters of the final ARIMA model for brown shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.

Parameter	Estimate	Std. Error	95% Confidence Limits
a_1	0.58	0.05	0.48 to 0.69
a_1'	-0.64	0.06	-0.75 to -0.53
a_2'	-0.52	0.06	-0.63 to -0.40

Residual Standard Error	0.52
Transformed Data Standard Error	1.93
Explained Variation	73%

Table 11. Autocorrelations of the residuals from the ARIMA model for brown shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.

Lags	Autocorrelation Estimates									
1-10	0.00	0.03	-0.03	-0.02	-0.14	0.06	-0.03	0.10	0.16	0.13
Std. Error	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07
11-20	-0.03	-0.05	-0.08	-0.02	0.06	0.02	0.16	0.01	0.08	0.11
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
21-30	0.03	-0.11	0.11	-0.11	0.03	0.05	-0.03	-0.02	0.11	0.01
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
31-36	-0.03	-0.02	-0.03	-0.06	-0.03	-0.17				
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07				

Table 12. **Observed and predicted values (from ARIMA model) for brown shrimp total monthly catch (pounds, heads off) in area 19 for 1977.**

Month	Observed	Estimated
205	36,920	94,765
206	43,785	106,136
207	47,592	85,467
208	89,337	60,220
209	109,597	70,507
210	208,916	293,256
211	2,962,260	1,426,660
212	2,468,980	1,422,380
213	939,033	889,423
214	804,899	522,080
215	1,462,700	303,244
216	813,108	163,305

Table 13. **Forecast values for brown shrimp total monthly catch (pounds, heads off) in area 19 from the ARIMA models (with confidence limits) for 1978.**

Month	Forecast	90% Confidence Limits	50% Confidence Limits
217	99,682	38,965 to 255,016	67,818 to 146,518
218	66,933	25,144 to 178,173	44,802 to 99,997
219	66,966	24,828 to 180,622	44,583 to 100,587
220	46,979	17,341 to 127,275	31,219 to 70,694
221	84,348	31,087 to 228,858	56,018 to 127,004
222	300,690	110,765 to 816,271	199,656 to 452,851
223	2,158,950	795,157 to 5,861,840	1,433,430 to 3,251,700
224	2,056,760	757,472 to 5,584,690	1,365,540 to 3,097,850
225	1,065,330	392,335 to 2,892,730	707,296 to 1,604,590
226	756,846	278,727 to 2,055,110	502,487 to 1,139,960
227	655,173	241,283 to 1,779,040	434,984 to 986,823
228	357,125	126,147 to 1,011,030	233,083 to 547,181

Table 14. **Autocorrelations for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.**

Lags	Autocorrelation Estimates								
1-10	0.53	0.20	-0.06	0.04	0.07	0.08	0.01	-0.07	-0.17
Std. Error	0.07	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09
11-20	0.19	0.38	0.17	-0.01	-0.16	-0.08	0.01	0.05	0.05
Std. Error	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10
21-30	-0.17	-0.01	0.17	0.38	0.17	0.01	-0.12	-0.05	0.05
Std. Error	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11
31-36	0.08	-0.04	-0.16	0.02	0.24	0.42			
Std. Error	0.11	0.11	0.11	0.11	0.11	0.11			

Table 15. **Estimation of the parameters of the final ARIMA model for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.**

Parameter	Estimate	Std. Error	95% Confidence Limits
a_1	0.56	0.06	0.43 to 0.68
a_2	0.11	0.06	-0.02 to 0.23
b_1'	0.95	0.03	0.89 to 1.00
Residual Standard Error		0.74	
Transformed Data Standard Error		1.65	
Explained Variation		55%	

Table 16. Autocorrelations of the residuals from the ARIMA model for white shrimp total monthly catch (pounds, heads off) in area 19 for the eighteen year (1960-1977) data set.

Lags	Autocorrelation Estimates									
1-10	-0.01	-0.03	-0.06	0.11	-0.02	-0.03	-0.06	0.09	0.03	0.04
Std. Error	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07
11-20	-0.01	-0.03	0.03	-0.06	0.01	0.01	-0.03	-0.07	0.12	0.00
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
21-30	0.03	-0.02	-0.01	-0.01	0.00	-0.04	0.08	0.00	0.01	-0.04
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
31-36	0.10	0.06	-0.06	-0.01	0.08	0.07				
Std. Error	0.07	0.07	0.07	0.07	0.07	0.07				

Table 17. **Observed and predicted values (from ARIMA model) for white shrimp total monthly catch (pounds, heads off) in area 19 for 1977.**

Month	Observed	Estimated
205	21,935	29,535
206	3,955	668,711
207	53,822	322,310
208	62,373	217,470
209	53,932	241,440
210	29,002	102,560
211	41,573	322,017
212	34,059	308,086
213	417,534	102,479
214	579,281	270,625
215	797,246	144,331
216	253,792	30,844

Table 18. Forecast values for white shrimp total monthly catch (pounds, heads off) in area 19 from the ARIMA model (with confidence limits) for 1978.

Month	Forecast	90% Confidence Limits	50% Confidence Limits
217	319,433	50,964 to 2,002,130	150,501 to 677,984
218	16,775	2,373 to 118,606	7,522 to 37,407
219	299,652	40,030 to 2,243,110	131,267 to 684,036
220	260,034	33,761 to 2,002,840	112,588 to 600,578
221	114,321	14,632 to 893,214	49,208 to 265,591
222	117,742	14,961 to 926,614	50,531 to 274,350
223	126,513	16,017 to 999,292	54,213 to 295,230
224	27,174	3,434 to 215,040	11,636 to 63,462
225	414,800	52,368 to 3,285,590	177,547 to 969,088
226	401,602	50,677 to 3,182,570	171,864 to 938,439
227	492,657	62,152 to 3,905,100	210,810 to 115,133
228	85,374	10,739 to 678,715	36,488 to 199,757

Table 19. **Power spectrum estimates for white and brown shrimp total monthly catch (pounds, heads off) in area 19 from Fourier analysis of the eighteen year (1960-1977) data set.**

Frequencies of Power Spectrum Density	Power Spectrum Estimates for Each Frequency	
	Brown	White
0.00	0.278	0.908
0.0208	0.290	1.724 * (48)
0.0417	0.512 * (24)	2.012 * (24)
0.0625	0.444 * (16)	1.028 * (16)
0.0833	0.316	0.554
0.1042	0.792 * (10)	0.842 * (10)
0.1250	0.725 * (8)	0.855 * (8)
0.1458	0.250	0.487
0.1667	0.082	0.246
0.1875	0.154	0.379
0.2083	0.189	0.528
0.2292	0.092	0.387
0.2500	0.043	0.185
0.2708	0.060	0.179
0.2917	0.145	0.213
0.3125	0.140	0.142
0.3333	0.060	0.088
0.3542	0.065	0.163
0.375	0.075	0.241
0.3958	0.056	0.130
0.4167	0.027	0.041
0.4375	0.055	0.136
0.4583	0.107	0.302
0.4792	0.096	0.260
0.5000	0.060	0.141

* Frequencies that account for relatively large portions of the variance in catch variables

(#) Indicates the periods that account for relatively large portions of the variance in the catch variables

Table 20. Summary statistics for the ten year (1964-1973) data set used to develop the stepwise multiple regression models relating brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 3)

VARIABLE	MEAN	STANDARD DEV	CASES
VAR2	40.8496	28.5947	10
VAR1	118.5536	40.6780	10
VAR91	54.8499	27.4093	10
CTEF18	552.9698	257.8296	10
CTEF19	523.4578	194.0003	10
CTEF193	639.3569	180.8575	10
XE18	80.9301	23.0437	10
XE19	227.7682	51.2435	10
XE193	83.2440	32.1624	10
VAR11	162.4491	37.7817	10
VAR12	492.5122	309.8261	10
VAR13	55.6900	11.8441	10
VAR14	128.5832	83.9930	10
VAR15	234.5005	203.2598	10
VAR16	48.6514	12.4562	10
VAR17	58.2846	19.8272	10
VAR18	9.9660	4.7898	10
VAR19	13.9700	8.7364	10
VAR20	10.7111	2.3046	9
VAR21	15.8667	3.1492	9
VAR22	12.2800	1.4459	10
VAR23	17.6100	2.0739	10
VAR24	13.6200	4.3014	10
VAR25	11.5100	5.5675	10
VAR26	5.7180	0.5973	10
VAR27	5.9550	0.6975	10
VAR28	37.9000	4.8408	10
VAR29	35.6000	5.6608	10
VAR30	58.5000	47.6707	10
VAR31	67.5000	41.9821	10
VAR36	7.0700	1.8117	10
VAR37	9.4600	1.8518	10
VAR38	136.8256	66.1030	10
VAR39	147.6169	18.0021	10
VAR40	397.3383	239.2765	10
VAR41	51.5670	11.3639	10
VAR42	112.9752	52.1843	10
VAR43	206.3000	73.3319	10
VAR44	179.6000	48.7675	10
VAR45	5.1500	7.7739	10

Table 20 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR46	12.7100	28.2081	10
VAR47	109.1100	112.7042	10
VAR48	8.7900	15.5796	10
VAR49	15.2900	22.2259	10
VAR50	76.2300	76.8730	10
VAR51	69.5900	89.0154	10
VAR52	129.3500	164.8075	10
VAR53	205.5400	107.5617	10
VAR54	47.1600	30.6379	10
VAR55	72.6100	27.2954	10
VAR56	101.3100	64.0517	10
VAR57	100.5700	65.6361	10
VAR58	179.1400	72.3172	10
VAR59	139.7400	96.0974	10
VAR60	16.4889	5.3335	9
VAR61	16.9600	5.9392	10
VAR62	21.0111	6.9988	9
VAR63	21.6700	5.5562	10
VAR64	22.6750	4.8133	10
VAR65	21.4890	6.0224	10
VAR66	22.0970	4.2383	10
VAR67	19.8910	3.8321	10
VAR68	17.4778	2.4783	9
VAR69	22.9700	1.9385	10
VAR70	17.4778	2.5044	9
VAR71	22.7400	1.8344	10
VAR72	11.0000	2.2608	10
VAR73	12.0500	2.4089	10
VAR74	14.8000	2.9269	10
VAR75	18.2000	2.9833	10
VAR76	18.1000	22.7178	10
VAR77	66.7000	30.1185	10
VAR78	55.0000	40.8738	10
VAR79	67.8000	18.3896	10
VAR80	138.1000	68.1542	10
VAR81	115.4000	22.4212	10
VAR82	24.8516	4.7823	10
VAR83	30.6615	10.6118	10
VAR84	35.2349	26.5912	10
VAR85	94.1936	96.5308	10

Table 20 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR86	48.7536	34.0776	10
VAR87	26.3433	17.5447	10
VAR88	30.4837	25.2123	10
VAR89	18.5710	4.7918	10
VAR90	13.1830	5.1444	10
VAR97	65.0728	33.2027	10
VAR98	53.4815	42.3199	10
VAR99	14.7355	3.8314	10
VAR100	18.7165	4.8754	10
VAR101	62.8704	34.3363	10
VAR102	40.6165	26.4602	10
VAR103	14.5416	3.6488	10
VAR104	17.2329	3.2715	10
VAR107	31.2450	18.1366	10
VAR108	2.1120	1.4541	10
VAR109	3.6150	2.8052	10
VAR110	4.7960	2.3421	10
VAR111	58.6484	54.8110	10
VAR112	66.6077	62.3888	10
VAR113	104.8939	107.3042	10
VAR114	5.7550	0.7325	10
VAR115	34.0000	3.8406	9
VAR116	60.0000	38.9711	9
VAR117	15.8300	1.6139	10
VAR118	21.2500	1.3986	10
VAR119	24.8000	0.5715	10
BCE18	44.0332	20.5766	10
BCE19	25.7613	13.4598	10
BCEL18	43.0892	21.4101	10
BCEL19	22.1056	10.5018	10

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 21. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to river discharge variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR11	VAR12	VAR14	VAR15	VAR16	VAR17
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	-0.62791	-0.40453	-0.48611	-0.22858	-0.51014	-0.53666
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	-0.36784	-0.59420	-0.71152	-0.58499	-0.44319	-0.44383
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	-0.25015	-0.10584	-0.33362	-0.06383	-0.16741	-0.31267
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	-0.57814	-0.56643	-0.59961	-0.42305	-0.65594	-0.50669
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	-0.66690	-0.67107	-0.63160	-0.52011	-0.72116	-0.62683
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	-0.60496	-0.63992	-0.63571	-0.53029	-0.59503	-0.60389
VAR11	-0.62791	-0.36784	-0.25015	-0.57814	-0.66690	-0.60496	1.00000	0.70536	0.66963	0.39386	0.77448	0.88934
VAR12	-0.40453	-0.59420	-0.10584	-0.56643	-0.67107	-0.63992	0.70536	1.00000	0.73019	0.91915	0.77923	0.70322
VAR14	-0.48611	-0.71152	-0.33362	-0.59961	-0.63160	-0.63571	0.66963	0.73019	1.00000	0.62674	0.57995	0.60867
VAR15	-0.22858	-0.58499	-0.06383	-0.42305	-0.52011	-0.53029	0.39386	0.91915	0.62674	1.00000	0.60268	0.41652
VAR16	-0.51014	-0.44319	-0.16741	-0.65594	-0.72116	-0.59503	0.77448	0.77923	0.57995	0.60268	1.00000	0.55611
VAR17	-0.53666	-0.44383	-0.31267	-0.50669	-0.62683	-0.60389	0.88934	0.70322	0.60867	0.41652	0.55611	1.00000
VAR38	-0.38471	-0.35777	-0.02062	-0.39760	-0.43970	-0.39338	0.85978	0.77469	0.80992	0.55119	0.68634	0.75093
VAR39	-0.17836	-0.20451	-0.00676	-0.50986	-0.57904	-0.39393	0.61191	0.50296	0.45943	0.34720	0.76325	0.40821
VAR40	0.33628	0.16965	0.17278	0.11290	-0.01681	0.01852	-0.13669	-0.04620	0.05436	0.09080	-0.10666	-0.17130
VAR42	-0.15185	-0.27345	0.07781	-0.49675	-0.60099	-0.50050	0.38669	0.60352	0.40326	0.62437	0.63229	0.22707
VAR43	-0.47697	-0.27673	-0.05730	-0.52715	-0.58925	-0.48535	0.95018	0.66869	0.71812	0.37116	0.79265	0.76010
VAR44	-0.35144	-0.28926	-0.04786	-0.67838	-0.68236	-0.53411	0.54512	0.42322	0.42511	0.28836	0.70187	0.29177
VAR82	-0.17379	0.20116	0.25220	-0.03443	-0.15516	-0.13423	0.56117	0.28739	0.37561	0.12864	0.32279	0.34299
VAR83	-0.55573	-0.05083	-0.22357	-0.32622	-0.28681	-0.26663	0.73670	0.15326	0.39686	-0.14136	0.39909	0.49063
VAR84	-0.20738	-0.40109	0.03106	-0.38841	-0.45091	-0.41974	0.56958	0.86236	0.48061	0.80331	0.57770	0.63188
VAR85	-0.33697	0.05421	0.07644	-0.29850	-0.38493	-0.26854	0.69505	0.40129	0.02142	0.07786	0.56821	0.67634
VAR86	-0.56844	-0.58952	-0.31914	-0.52089	-0.46315	-0.49176	0.65794	0.59135	0.87703	0.46274	0.54754	0.48979
VAR87	0.16558	0.52186	0.53540	0.22845	0.13959	0.23777	0.52562	0.23225	-0.01318	0.00438	0.24201	0.44222
VAR88	-0.31318	-0.06301	0.01992	-0.26229	-0.41046	-0.30846	0.87247	0.64983	0.37782	0.34636	0.69661	0.84204
VAR107	-0.05891	-0.61353	-0.02111	-0.32680	-0.29677	-0.31099	0.17613	0.58439	0.79159	0.65376	0.27024	0.21831
VAR111	-0.31197	-0.60213	-0.20603	-0.60049	-0.71117	-0.66195	0.58388	0.66424	0.82581	0.55673	0.49132	0.63452
VAR112	-0.22383	-0.57461	0.08958	-0.51183	-0.57793	-0.57617	0.41396	0.84571	0.72604	0.87012	0.49788	0.43989
VAR113	-0.13235	-0.49736	-0.16364	-0.27068	-0.35098	-0.39012	0.09780	0.69140	0.36688	0.89498	0.44431	0.10036

Table 21 continued

	VAR38	VAR39	VAR40	VAR42	VAR43	VAR44	VAR82	VAR83	VAR84	VAR85	VAR86	VAR87
VAR1	-0.38471	-0.17836	0.33628	-0.15185	-0.47697	-0.35144	-0.17379	-0.55573	-0.20738	-0.33697	-0.56844	0.16558
VAR2	-0.35777	-0.20451	0.16965	-0.27345	-0.27673	-0.28926	0.20116	-0.05083	-0.40109	0.05421	-0.58952	0.52186
VAR91	-0.02062	-0.00676	0.17278	0.07781	-0.05730	-0.04786	0.25220	-0.22357	0.03106	0.07644	-0.31914	0.53540
CTEF18	-0.39760	-0.50986	0.11290	-0.49675	-0.52715	-0.67838	-0.03443	-0.32622	-0.38841	-0.29850	-0.52089	0.22845
CTEF19	-0.43970	-0.57904	-0.01681	-0.60099	-0.58925	-0.68236	-0.15516	-0.28681	-0.45091	-0.38493	-0.46315	0.13959
CTEF193	-0.39338	-0.39393	0.01852	-0.50050	-0.48535	-0.53411	-0.13423	-0.26663	-0.41974	-0.26854	-0.49176	0.23777
VAR11	0.85978	0.61191	-0.13669	0.38669	0.95018	0.54512	0.56117	0.73670	0.56958	0.69505	0.65794	0.52562
VAR12	0.77469	0.50296	-0.04620	0.60352	0.66869	0.42322	0.28739	0.15326	0.86236	0.40129	0.59135	0.23225
VAR14	0.80992	0.45943	0.05436	0.40326	0.71812	0.42511	0.37561	0.39686	0.48061	0.02142	0.87703	-0.01318
VAR15	0.55119	0.34720	0.09080	0.62437	0.37116	0.28836	0.12864	-0.14136	0.80331	0.07786	0.46274	0.00438
VAR16	0.68634	0.76325	-0.10666	0.63229	0.79265	0.70187	0.32279	0.39909	0.57770	0.56821	0.54754	0.24201
VAR17	0.75093	0.40821	-0.17130	0.22707	0.76010	0.29177	0.34299	0.49063	0.63188	0.67634	0.48979	0.44222
VAR38	1.00000	0.47841	-0.20299	0.29176	0.90046	0.37280	0.52802	0.61449	0.65439	0.44083	0.84017	0.50380
VAR39	0.47841	1.00000	0.39423	0.79648	0.70844	0.91851	0.29674	0.38626	0.45177	0.35903	0.31671	0.32743
VAR40	-0.20299	0.39423	1.00000	0.61883	-0.04005	0.37819	0.30922	-0.18077	-0.06721	-0.36827	-0.25122	0.02498
VAR42	0.29176	0.79648	0.61883	1.00000	0.45558	0.82666	0.34908	0.05300	0.51502	0.12961	0.17563	0.15105
VAR43	0.90046	0.70844	-0.04005	0.45558	1.00000	0.64187	0.64603	0.74122	0.50654	0.60029	0.70683	0.55749
VAR44	0.37280	0.91851	0.37819	0.82666	0.64187	1.00000	0.30543	0.43415	0.36215	0.28151	0.33813	0.19423
VAR82	0.52802	0.29674	0.30922	0.34908	0.64603	0.30543	1.00000	0.52757	0.05026	0.31085	0.33570	0.58083
VAR83	0.61449	0.38626	-0.18077	0.05300	0.74122	0.43415	0.52757	1.00000	0.14654	0.40387	0.63336	0.49932
VAR84	0.65439	0.45177	-0.06721	0.51502	0.50654	0.36215	0.05026	0.14654	1.00000	0.38269	0.43341	0.39636
VAR85	0.44083	0.35903	-0.36827	0.12961	0.60029	0.28151	0.31085	0.40387	0.38269	1.00000	0.04111	0.63851
VAR86	0.84017	0.31671	-0.25122	0.17563	0.70683	0.33813	0.33570	0.63336	0.43341	0.04111	1.00000	0.07118
VAR87	0.50380	0.32743	0.02498	0.15105	0.55749	0.19423	0.58083	0.49932	0.39636	0.63851	0.07118	1.00000
VAR88	0.74256	0.49874	-0.20276	0.26448	0.80837	0.31235	0.50009	0.48997	0.56661	0.87154	0.33339	0.70698
VAR107	0.54648	0.13853	-0.01012	0.21959	0.29080	0.10135	0.03666	-0.11455	0.39962	-0.29977	0.65093	-0.24769
VAR111	0.57234	0.58319	0.39065	0.59912	0.62212	0.53523	0.38210	0.14438	0.41545	0.12667	0.47782	0.01668
VAR112	0.58952	0.33593	0.18313	0.62296	0.46157	0.36413	0.33100	-0.08164	0.65263	0.07073	0.49696	0.03233
VAR113	0.22264	0.23741	0.16584	0.57881	0.04934	0.19392	-0.11877	-0.30732	0.65264	-0.16440	0.25579	-0.20976

Table 21 continued

	VAR88	VAR107	VAR111	VAR112	VAR113
VAR1	-0.31318	-0.05891	-0.31197	-0.22383	-0.13235
VAR2	-0.06301	-0.61353	-0.60213	-0.57461	-0.49736
VAR91	0.01992	-0.02111	-0.20603	0.08958	-0.16364
CTEF18	-0.26229	-0.32680	-0.60049	-0.51183	-0.27068
CTEF19	-0.41046	-0.29677	-0.71117	-0.57793	-0.35098
CTEF193	-0.30846	-0.31099	-0.66195	-0.57617	-0.39012
VAR11	0.87247	0.17613	0.58388	0.41396	0.09780
VAR12	0.64983	0.58439	0.66424	0.84571	0.69140
VAR14	0.37782	0.79159	0.82581	0.72604	0.36688
VAR15	0.34636	0.65376	0.55673	0.87012	0.89498
VAR16	0.69661	0.27024	0.49132	0.49788	0.44431
VAR17	0.84204	0.21831	0.63452	0.43989	0.10036
VAR38	0.74256	0.54648	0.57234	0.58952	0.22264
VAR39	0.49874	0.13853	0.58319	0.33593	0.23741
VAR40	-0.20276	-0.01012	0.39065	0.18313	0.16584
VAR42	0.26448	0.21959	0.59912	0.62296	0.57881
VAR43	0.80837	0.29080	0.62212	0.46157	0.04934
VAR44	0.31235	0.10135	0.53523	0.36413	0.19392
VAR82	0.50009	0.03666	0.38210	0.33100	-0.11877
VAR83	0.48997	-0.11455	0.14438	-0.08164	-0.30732
VAR84	0.56661	0.39962	0.41545	0.65263	0.65264
VAR85	0.87154	-0.29977	0.12667	0.07073	-0.16440
VAR86	0.33339	0.65093	0.47782	0.49696	0.25579
VAR87	0.70698	-0.24769	0.01668	0.03233	-0.20976
VAR88	1.00000	0.00597	0.39241	0.29684	0.05867
VAR107	0.00597	1.00000	0.62656	0.77097	0.45221
VAR111	0.39241	0.62656	1.00000	0.75688	0.27102
VAR112	0.29684	0.77097	0.75688	1.00000	0.61624
VAR113	0.05867	0.45221	0.27102	0.61624	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 22. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR14	JAN-MAR TRIN DIS	0.71152	0.50626	0.50626	-0.71152	0.1400687E-01	0.04114
VAR87	JUL-SEP GUAD DIS	0.87689	0.76894	0.26269	0.52186	1.518051	0.93142
VAR17	APR-JUN MISS DIS	0.95165	0.90564	0.13670	-0.44383	-0.5732530	-0.39749
VAR84	JUL-SEP TRIN DIS	0.98092	0.96220	0.05656	-0.40109	-0.2158886	-0.20076
VAR83	OCT-DEC MISS DIS	0.99107	0.98222	0.02002	-0.05083	-1.052026	-0.39042
VAR112	APR TRIN DIS	0.99795	0.99589	0.01367	-0.57461	-0.1797427	-0.39217
VAR82	JUL-SEP MISS DIS	0.99926	0.99853	0.00263	0.20116	0.8901924	0.14888
VAR16	JAN-MAR MISS DIS	0.99999	0.99998	0.00145	-0.44319	-0.6872268E-01	-0.02994
VAR85	OCT-DEC TRIN DIS	1.00000	1.00000	0.00002	0.05421	-0.1172562E-01	-0.03958
(CONSTANT)						66.63090	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

SEE PAGE 72 OF TEXT FOR DEFINITION OF SUMMARY TABLE HEADINGS.

Table 23. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.62791	0.39427	0.39427	-0.62791	-2.259734	-2.09884
VAR87	JUL-SEP GUAD DIS	0.85655	0.73367	0.33941	0.16558	2.246607	0.96898
VAR111	MAR TRIN DIS	0.92304	0.85200	0.11832	-0.31197	0.4427139	0.59653
VAR16	JAN-MAR MISS DIS	0.93847	0.88072	0.02872	-0.51014	4.164821	1.27533
VAR42	LAG ANNUAL GUAD DIS	0.96944	0.93982	0.05910	-0.15185	-1.182249	-1.51666
VAR40	LAG ANNUAL TRIN DIS	0.98287	0.96602	0.02620	0.33628	0.1391309	0.81840
VAR84	JUL-SEP TRIN DIS	0.99657	0.99316	0.02714	-0.20738	0.5917857	0.38685
VAR44	LAG ANNUAL ATCH DIS	1.00000	1.00000	0.00684	-0.35144	0.1627632	0.19513
VAR17	APR-JUN MISS DIS	1.00000	1.00000	0.00000	-0.53666	-0.6366079E-02	-0.00310
(CONSTANT)						226.4435	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 24. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR87	JUL-SEP GUAD DIS	0.53540	0.28665	0.28665	0.53540	1.629237	1.04287
VAR11	ANNUAL MISS DIS	0.82285	0.67708	0.39042	-0.25015	-1.118601	-1.54191
VAR112	APR TRIN DIS	0.92007	0.84652	0.16945	0.08958	0.2855658	0.65000
VAR17	APR-JUN MISS DIS	0.94513	0.89327	0.04674	-0.31267	-0.1401746	-0.10140
VAR113	MAY TRIN DIS	0.96734	0.93575	0.04249	-0.16364	-0.1231796	-0.48223
VAR16	JAN-MAR MISS DIS	0.99685	0.99372	0.05797	-0.16741	1.407738	0.63975
VAR38	ANNUAL GUAD DIS	0.99990	0.99980	0.00608	-0.02062	0.6267733E-01	0.15116
VAR42	LAG ANNUAL GUAD DIS	1.00000	1.00000	0.00020	0.07781	-0.1830628E-01	-0.03485
VAR83	OCT-DEC MISS DIS	1.00000	1.00000	0.00000	-0.22357	-0.3012799E-03	-0.00012
(CONSTANT)						120.7292	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 25. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with river discharge variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR44	LAG ANNUAL ATCH DIS	0.67838	0.46019	0.46019	-0.67838	-8.943047	-1.69154
VAR40	LAG ANNUAL TRIN DIS	0.78707	0.61947	0.15928	0.11290	-0.1647189	-0.15287
VAR87	JUL-SEP GUAD DIS	0.87798	0.77085	0.15137	0.22845	9.272876	0.63100
VAR17	APR-JUN MISS DIS	0.96698	0.93506	0.16421	-0.50669	-2.817158	-0.21664
VAR112	APR TRIN DIS	0.97350	0.94770	0.01264	-0.51183	-4.336673	-1.04937
VAR107	JAN-MAR GUAD DIS	0.98606	0.97232	0.02462	-0.32680	11.78311	0.82886
VAR42	LAG ANNUAL GUAD DIS	0.99720	0.99441	0.02209	-0.49675	8.728335	1.76660
VAR15	APR-JUN TRIN DIS	1.00000	1.00000	0.00559	-0.42305	-0.7411318	-0.58427
VAR111	MAR TRIN DIS	1.00000	1.00000	0.00000	-0.60049	0.1567403	0.03332
(CONSTANT)						1243.719	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 26. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR16	JAN-MAR MISS DIS	0.72116	0.52008	0.52008	-0.72116	4.208356	0.27021
VAR111	MAR TRIN DIS	0.82942	0.68794	0.16786	-0.71117	0.6685340	0.18888
VAR87	JUL-SEP GUAD DIS	0.87420	0.76423	0.07629	0.13959	11.82516	1.06943
VAR85	OCT-DEC TRIN DIS	0.92195	0.85000	0.08577	-0.38493	-0.9883979	-0.49181
VAR44	LAG ANNUAL ATCH DIS	0.94985	0.90222	0.05223	-0.68236	-2.562747	-0.64422
VAR17	APR-JUN MISS DIS	0.97468	0.94999	0.04777	-0.62683	-4.815267	-0.49213
VAR112	APR TRIN DIS	0.98975	0.97960	0.02961	-0.57793	-0.2507150	-0.08063
VAR82	JUL-SEP MISS DIS	0.99889	0.99778	0.01818	-0.15516	-15.22171	-0.37523
VAR84	JUL-SEP TRIN DIS	1.00000	1.00000	0.00222	-0.45091	-2.228075	-0.30540
(CONSTANT)						1275.508	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 27. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19,11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR111	MAR TRIN DIS	0.66195	0.43818	0.43818	-0.66195	1.658883	0.50274
VAR16	JAN-MAR MISS DIS	0.73084	0.53413	0.09595	-0.59503	17.01567	1.17192
VAR87	JUL-SEP GUAD DIS	0.80804	0.65293	0.11879	0.23777	11.54817	1.12027
VAR11	ANNUAL MISS DIS	0.89798	0.80637	0.15344	-0.60496	-4.663181	-0.97415
VAR42	LAG ANNUAL GUAD DIS	0.94820	0.89909	0.09272	-0.50050	-4.055026	-1.17003
VAR40	LAG ANNUAL TRIN DIS	0.98462	0.96947	0.07038	0.01852	0.1599432	0.21161
VAR85	OCT-DEC TRIN DIS	0.99787	0.99574	0.02627	-0.26854	-1.537649	-0.82070
VAR14	JAN-MAR TRIN DIS	0.99995	0.99990	0.00416	-0.63571	-1.335856	-0.62039
VAR39	LAG ANNUAL MISS DIS	1.00000	1.00000	0.00010	-0.39393	0.7619686	0.07584
(CONSTANT)						766.2342	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 28. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to salinity variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR24	VAR25	VAR60	VAR61	VAR62	VAR63
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	0.47877	0.48490	0.57447	0.59189	0.16443	0.23360
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	0.62697	0.68653	0.85483	0.83761	0.55082	0.60989
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	0.61992	0.18912	0.52123	0.46341	-0.08855	0.15074
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	0.44508	0.70164	0.74223	0.81970	0.46260	0.56079
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	0.55963	0.78870	0.81417	0.88795	0.42652	0.62741
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	0.56967	0.78878	0.83209	0.88740	0.42976	0.61548
VAR24	0.47877	0.62697	0.61992	0.44508	0.55963	0.56967	1.00000	0.53445	0.81497	0.68650	0.40436	0.61757
VAR25	0.48490	0.68653	0.18912	0.70164	0.78870	0.78878	0.53445	1.00000	0.92068	0.93162	0.74623	0.80212
VAR60	0.57447	0.85483	0.52123	0.74223	0.81417	0.83209	0.81497	0.92068	1.00000	0.97794	0.69774	0.86946
VAR61	0.59189	0.83761	0.46341	0.81970	0.88795	0.88740	0.68650	0.93162	0.97794	1.00000	0.67127	0.83591
VAR62	0.16443	0.55082	-0.08855	0.46260	0.42652	0.42976	0.40436	0.74623	0.69774	0.67127	1.00000	0.86475
VAR63	0.23360	0.60989	0.15074	0.56079	0.62741	0.61548	0.61757	0.80212	0.86946	0.83591	0.86475	1.00000
VAR64	0.29884	0.39468	0.20256	0.17741	0.18370	0.23460	0.69225	0.33264	0.47434	0.32132	0.62309	0.44772
VAR65	0.21491	0.48495	0.45634	0.27119	0.37334	0.36774	0.91628	0.35635	0.75218	0.52769	0.43708	0.66756
VAR66	0.76612	0.58605	0.36869	0.77046	0.82515	0.83165	0.46494	0.83389	0.83746	0.79951	0.42352	0.48800
VAR67	0.24870	0.35144	-0.12355	0.48908	0.62629	0.55711	0.42430	0.90869	0.76003	0.75874	0.65552	0.70467

	VAR64	VAR65	VAR66	VAR67
VAR1	0.29884	0.21491	0.76612	0.24870
VAR2	0.39468	0.48495	0.58605	0.35144
VAR91	0.20256	0.45634	0.36869	-0.12355
CTEF18	0.17741	0.27119	0.77046	0.48908
CTEF19	0.18370	0.37334	0.82515	0.62629
CTEF193	0.23460	0.36774	0.83165	0.55711
VAR24	0.69225	0.91628	0.46494	0.42430
VAR25	0.33264	0.35635	0.83389	0.90869
VAR60	0.47434	0.75218	0.83746	0.76003
VAR61	0.32132	0.52769	0.79951	0.75874
VAR62	0.62309	0.43708	0.42352	0.65552
VAR63	0.44772	0.66756	0.48800	0.70467
VAR64	1.00000	0.70080	0.20446	0.25346
VAR65	0.70080	1.00000	0.15500	0.27468
VAR66	0.20446	0.15500	1.00000	0.75301
VAR67	0.25346	0.27468	0.75301	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 29. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR61	APR TPWD GAL SAL	0.86456	0.74747	0.74747	0.86456	8.058747	1.67967
VAR67	1ST APR POSTLAV MIN SAL	0.94319	0.88960	0.14213	0.46447	-6.936323	-0.83967
VAR64	2ND FEB POSTLAV MIN SAL	0.96738	0.93581	0.04621	0.39101	3.817665	0.56927
VAR65	1ST MAR POSTLAV MIN SAL	0.99558	0.99117	0.05536	0.48497	-2.672538	-0.47257
VAR62	MAR TPWD MAT SAL	0.99724	0.99449	0.00332	0.54032	-0.4890659	-0.11308
(CONSTANT)						20.92823	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 30. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR66	2ND MAR POSTLAV MIN SAL	0.76612	0.58693	0.58693	0.76612	-15.23596	-1.58745
VAR67	1ST APR POSTLAV MIN SAL	0.91416	0.83570	0.24876	0.24870	23.18617	2.18427
VAR65	1ST MAR POSTLAV MIN SAL	0.94152	0.88645	0.05076	0.21491	51.73397	7.65918
VAR64	2ND FEB POSTLAV MIN SAL	0.94654	0.89594	0.00949	0.29884	103.5193	12.24900
VAR61	APR TPWD GAL SAL	0.95043	0.90332	0.00738	0.59189	104.0901	15.19762
VAR62	MAR TPWD MAT SAL	0.96164	0.92475	0.02143	0.16443	-79.27029	-13.63880
VAR24	MAR NOS GAL MIN DEN	1.32323	1.75093	0.82618	0.47877	-190.3261	-20.12547
(CONSTANT)						-972.5546	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 31. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR24	MAR NOS GAL MIN DEN	0.60079	0.36095	0.36095	0.60079	-5.050864	-0.81794
VAR64	2ND FEB POSTLAV MIN SAL	0.79665	0.63465	0.27371	0.03114	2.499074	0.41267
VAR67	1ST APR POSTLAV MIN SAL	0.84401	0.71236	0.07771	0.04773	-3.068682	-0.41137
VAR66	2ND MAR POSTLAV MIN SAL	0.96289	0.92715	0.21479	0.48506	-1.266756	-0.19142
VAR60	MAR TPWD GAL SAL	0.97627	0.95310	0.02595	0.57051	12.56361	2.47270
VAR62	MAR TPWD MAT SAL	0.99947	0.99895	0.04584	-0.12992	-5.389894	-1.38011
(CONSTANT)						66.92531	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 32. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR61	APR TPWD GAL SAL	0.84496	0.71397	0.71397	0.84496	144.4837	3.31563
VAR63	APR TPWD MAT SAL	0.88994	0.79200	0.07803	0.62108	13.60933	0.27693
VAR24	MAR NOS GAL MIN DEN	0.93963	0.88290	0.09090	0.45911	-92.70793	-1.49267
VAR66	2ND MAR POSTLAV MIN SAL	0.94171	0.88681	0.00391	0.83193	94.68656	1.42253
VAR25	APR NOS GAL MIN DEN	0.94390	0.89095	0.00414	0.75629	-170.5963	-3.54668
VAR64	2ND FEB POSTLAV MIN SAL	0.98432	0.96889	0.07794	0.16362	66.82131	1.09705
(CONSTANT)						-2645.135	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 33. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR66	2ND MAR POSTLAV MIN SAL	0.91216	0.83204	0.83204	0.91216	-48.80907	-0.97080
VAR61	APR TPWD GAL SAL	0.92753	0.86031	0.02826	0.88998	127.9091	3.88602
VAR63	APR TPWD MAT SAL	0.95148	0.90531	0.04500	0.66386	-86.97041	-2.34290
VAR24	MAR NOS GAL MIN DEN	0.95951	0.92066	0.01536	0.59234	-34.17993	-0.72857
VAR67	1ST APR POSTLAV MIN SAL	0.97748	0.95546	0.03480	0.67979	115.9794	2.04648
VAR25	APR NOS GAL MIN DEN	0.99999	0.99998	0.04452	0.81092	-43.56248	-1.19901
VAR64	2ND FEB POSTLAV MIN SAL	1.00000	1.00000	0.00002	0.23749	-0.9549742	-0.02076
(CONSTANT)						122.6079	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 34. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19,11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR66	2ND MAR POSTLAV MIN SAL	0.92198	0.85005	0.85005	0.92198	-29.06745	-0.61985
VAR67	1ST APR POSTLAV MIN SAL	0.94372	0.89060	0.04055	0.64793	58.25827	1.10213
VAR61	APR TPWD GAL SAL	0.97182	0.94444	0.05383	0:90221	79.96291	2.60460
VAR63	APR TPWD MAT SAL	0.97488	0.95039	0.00596	0.65333	-64.77023	-1.87071
VAR24	MAR NOS GAL MIN DEN	0.99472	0.98947	0.03908	0.58313	-18.57872	-0.42459
VAR64	2ND FEB POSTLAV MIN SAL	0.99637	0.99276	0.00329	0.24343	-5.285413	-0.12317
(CONSTANT)						642.8158	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 35. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to precipitation variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR13	VAR18	VAR19	VAR41	VAR89	VAR90
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	-0.31714	-0.15429	-0.17180	0.35665	-0.32037	0.00366
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	-0.63387	-0.56596	-0.60804	0.30642	0.05076	0.05288
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	-0.10215	-0.11553	0.02547	0.36032	-0.11590	-0.06291
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	-0.55386	-0.36559	-0.56364	0.25900	-0.17249	0.18307
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	-0.55303	-0.29555	-0.54434	0.10439	-0.11928	0.03746
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	-0.53791	-0.40653	-0.50582	0.15837	-0.08711	0.08019
VAR13	-0.31714	-0.63387	-0.10215	-0.55386	-0.55303	-0.53791	1.00000	0.63497	0.82070	-0.44244	0.33953	0.00113
VAR18	-0.15429	-0.56596	-0.11553	-0.36559	-0.29555	-0.40653	0.63497	1.00000	0.65916	-0.32958	-0.04107	-0.55031
VAR19	-0.17180	-0.60804	0.02547	-0.56364	-0.54434	-0.50582	0.82070	0.65916	1.00000	-0.05446	-0.10629	-0.32345
VAR41	0.35665	0.30642	0.36032	0.25900	0.10439	0.15837	-0.44244	-0.32958	-0.05446	1.00000	-0.77895	0.10626
VAR89	-0.32037	0.05076	-0.11590	-0.17249	-0.11928	-0.08711	0.33953	-0.04107	-0.10629	-0.77895	1.00000	0.06900
VAR90	0.00366	0.05288	-0.06291	0.18307	0.03746	0.08019	0.00113	-0.55031	-0.32345	0.10626	0.06900	1.00000
VAR108	0.00390	-0.39514	-0.31924	-0.24748	-0.28431	-0.31660	0.16290	0.38180	0.31223	-0.02243	-0.26240	-0.26625
VAR109	-0.32573	-0.53422	0.02558	-0.55744	-0.64157	-0.61406	0.66485	0.42750	0.82149	0.28942	-0.22521	-0.05262
VAR110	0.25175	-0.19537	0.09158	-0.09761	-0.01591	0.01656	0.10543	0.42119	0.55730	0.23923	-0.49180	-0.63775

	VAR108	VAR109	VAR110
VAR1	0.00390	-0.32573	0.25175
VAR2	-0.39514	-0.53422	-0.19537
VAR91	-0.31924	0.02558	0.09158
CTEF18	-0.24748	-0.55744	-0.09761
CTEF19	-0.28431	-0.64157	-0.01591
CTEF193	-0.31660	-0.61406	0.01656
VAR13	0.16290	0.66485	0.10543
VAR18	0.38180	0.42750	0.42119
VAR19	0.31223	0.82149	0.55730
VAR41	-0.02243	0.28942	0.23923
VAR89	-0.26240	-0.22521	-0.49180
VAR90	-0.26625	-0.05262	-0.63775
VAR108	1.00000	0.02521	0.19284
VAR109	0.02521	1.00000	0.32865
VAR110	0.19284	0.32865	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 36. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR13	ANNUAL FRE PREC	0.63387	0.40180	0.40180	-0.63387	5.239923	2.17041
VAR108	MAR FRE PREC	0.69951	0.48931	0.08752	-0.39514	-13.08647	-0.66547
VAR89	JUL-SEP FRE PREC	0.72569	0.52663	0.03731	0.05076	-0.3117359	-0.05224
VAR41	LAG ANNUAL FRE PREC	0.78845	0.62165	0.09502	0.30642	4.888465	1.94273
VAR109	APR FRE PREC	0.90054	0.81098	0.18933	-0.53422	-22.71534	-2.22841
VAR90	OCT-DEC FRE PREC	0.96249	0.92638	0.11540	0.05288	-5.677485	-1.02142
VAR110	MAY FRE PREC	0.97356	0.94781	0.02143	-0.19537	-6.334541	-0.51885
VAR18	JAN-MAR FRE PREC	0.98400	0.96826	0.02045	-0.56596	-2.643575	-0.44281
(CONSTANT)						-255.9287	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 37. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR41	LAG ANNUAL FRE PREC	0.35665	0.12720	0.12720	0.35665	8.348147	2.33215
VAR109	APR FRE PREC	0.57273	0.32801	0.20082	-0.32573	-45.49315	-3.13723
VAR13	ANNUAL FRE PREC	0.84153	0.70817	0.38015	-0.31714	11.09159	3.22951
VAR110	MAY FRE PREC	0.90556	0.82005	0.11188	0.25175	-1.701865	-0.09799
VAR108	MAR FRE PREC	0.95407	0.91024	0.09020	0.00390	-16.67011	-0.59590
VAR90	OCT-DEC FRE PREC	0.98631	0.97280	0.06256	0.00366	-5.859858	-0.74107
VAR89	JUL-SEP FRE PREC	0.99142	0.98291	0.01011	-0.32037	-3.995337	-0.47064
VAR18	JAN-MAR FRE PREC	0.99480	0.98962	0.00670	-0.15429	-2.153006	-0.25351
(CONSTANT)						-548.8942	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 38. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR41	LAG ANNUAL FRE PREC	0.36032	0.12983	0.12983	0.36032	5.863638	2.43106
VAR108	MAR FRE PREC	0.47612	0.22669	0.09686	-0.31924	-22.06981	-1.17083
VAR90	OCT-DEC FRE PREC	0.51310	0.26327	0.03658	-0.06291	-4.874809	-0.91494
VAR89	JUL-SEP FRE PREC	0.53984	0.29143	0.02816	-0.11590	-1.242584	-0.21723
VAR13	ANNUAL FRE PREC	0.55511	0.30815	0.01672	-0.10215	4.471278	1.93213
VAR109	APR FRE PREC	0.88349	0.78055	0.47240	0.02558	-31.43375	-3.21706
VAR110	MAY FRE PREC	0.93816	0.88015	0.09960	0.09158	-13.64759	-1.16618
VAR19	APR-JUN FRE PREC	0.99734	0.99468	0.11453	0.02547	5.996731	1.91139
(CONSTANT)						-267.2612	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 39. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR19	APR-JUN FRE PREC	0.56364	0.31769	0.31769	-0.56364	-7.732902	-0.26203
VAR110	MAY FRE PREC	0.62104	0.38569	0.06799	-0.09761	-19.21214	-0.17452
VAR90	OCT-DEC FRE PREC	0.64880	0.42094	0.03525	0.18307	-22.04839	-0.43992
VAR109	APR FRE PREC	0.66882	0.44732	0.02638	-0.55744	-208.0442	-2.26351
VAR41	LAG ANNUAL FRE PREC	0.72979	0.53259	0.08527	0.25900	36.55495	1.61116
VAR13	ANNUAL FRE PREC	0.81168	0.65883	0.12624	-0.55386	46.36448	2.12988
VAR108	MAR FRE PREC	0.87879	0.77226	0.11343	-0.24748	-107.4406	-0.60594
VAR89	JUL-SEP FRE PREC	0.89514	0.80128	0.02902	-0.17249	-21.13156	-0.39273
(CONSTANT)						-2051.835	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 40. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.64157	0.41162	0.41162	-0.64157	-171.0725	-2.47365
VAR41	LAG ANNUAL FRE PREC	0.70954	0.50345	0.09183	0.10439	21.55292	1.26250
VAR108	MAR FRE PREC	0.75531	0.57049	0.06704	-0.28431	-107.7819	-0.80786
VAR19	APR-JUN FRE PREC	0.84552	0.71490	0.14441	-0.54434	27.18941	1.22442
VAR13	ANNUAL FRE PREC	0.87718	0.76945	0.05455	-0.55303	9.087798	0.55483
VAR18	JAN-MAR FRE PREC	0.91485	0.83695	0.06750	-0.29555	18.88717	0.46632
VAR110	MAY FRE PREC	0.92392	0.85363	0.01667	-0.01591	-28.28870	-0.34152
VAR89	JUL-SEP FRE PREC	0.92527	0.85613	0.00250	-0.11928	-4.534083	-0.11199
(CONSTANT)						-596.1893	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 41. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19,11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.61406	0.37708	0.37708	-0.61406	-177.7807	-2.75746
VAR41	LAG ANNUAL FRE PREC	0.70736	0.50036	0.12328	0.15837	24.85049	1.56144
VAR13	ANNUAL FRE PREC	0.76852	0.59062	0.09026	-0.53791	14.20092	0.93000
VAR108	MAR FRE PREC	0.88067	0.77558	0.18497	-0.31660	-102.7364	-0.82600
VAR19	APR-JUN FRE PREC	0.95500	0.91202	0.13644	-0.50582	27.43437	1.32523
VAR18	JAN-MAR FRE PREC	0.96122	0.92395	0.01193	-0.40653	7.803800	0.20667
VAR110	MAY FRE PREC	0.96732	0.93570	0.01175	0.01656	-20.47711	-0.26518
VAR90	OCT-DEC FRE PREC	0.96787	0.93677	0.00107	0.08019	-2.761015	-0.07854
(CONSTANT)						-899.7254	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 42. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to temperature variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR20	VAR21	VAR22	VAR23	VAR36	VAR37
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	0.03034	0.39840	-0.41880	0.50563	0.10674	0.31212
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	0.56141	0.49409	0.16487	0.63345	0.19835	0.23821
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	0.10291	0.30720	-0.02813	0.50580	0.08168	0.05885
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	0.27201	0.69413	-0.23099	0.69027	0.32283	0.10947
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	0.26819	0.66521	-0.11830	0.67012	0.33898	-0.03887
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	0.26238	0.51032	-0.10797	0.55422	0.27968	0.07919
VAR20	0.03034	0.56141	0.10291	0.27201	0.26819	0.26238	1.00000	0.25066	0.58898	0.33182	-0.41780	-0.03139
VAR21	0.39840	0.49409	0.30720	0.69413	0.66521	0.51032	0.25066	1.00000	-0.25989	0.87415	0.22111	-0.18009
VAR22	-0.41880	0.16487	-0.02813	-0.23099	-0.11830	-0.10797	0.58898	-0.25989	1.00000	-0.01697	0.00696	-0.28043
VAR23	0.50563	0.63345	0.50580	0.69027	0.67012	0.55422	0.33182	0.87415	-0.01697	1.00000	0.31119	0.00098
VAR36	0.10674	0.19835	0.08168	0.32283	0.33898	0.27968	-0.41780	0.22111	0.00696	0.31119	1.00000	0.07379
VAR37	0.31212	0.23821	0.05885	0.10947	-0.03887	0.07919	-0.03139	-0.18009	-0.28043	0.00098	0.07379	1.00000
VAR68	0.11444	0.60609	0.36249	0.46352	0.55038	0.47863	0.67851	0.48150	0.63529	0.55994	0.10250	-0.54708
VAR69	0.65060	0.84772	0.67937	0.76206	0.75296	0.77301	0.14361	0.58392	0.00254	0.72529	0.61126	0.25157
VAR70	0.28450	0.38670	0.70266	0.10449	0.15565	0.29057	0.23905	-0.14106	0.56053	-0.02247	-0.23258	-0.40330
VAR71	0.70754	0.60620	0.53471	0.72531	0.74030	0.69832	-0.02633	0.51031	-0.08848	0.76540	0.62059	0.21346
VAR72	-0.25525	0.07088	-0.49622	0.16161	0.12009	0.01435	0.33685	-0.00559	0.42148	0.08294	0.33367	0.02123
VAR73	-0.37010	0.21826	0.06038	-0.04178	-0.08261	-0.07296	0.56784	0.02672	0.56336	-0.05460	-0.21602	-0.42667
VAR74	-0.19369	0.45611	0.00547	0.08976	0.07095	0.08003	0.95331	0.14023	0.65663	0.18250	-0.36795	-0.03239
VAR75	0.56045	0.63713	0.42405	0.75484	0.68946	0.66095	0.07561	0.38140	0.03838	0.59587	0.64674	0.19569
VAR117	-0.18089	0.46258	0.03702	0.14828	0.20005	0.20217	0.82978	0.01183	0.85927	0.13402	-0.08364	-0.26686
VAR118	0.53799	0.62907	0.38325	0.83255	0.85291	0.73034	0.23043	0.76662	0.01538	0.83873	0.51239	-0.10553
VAR119	0.20435	0.06756	0.05570	0.36810	0.51125	0.36327	-0.17669	0.67524	-0.28772	0.45088	0.30152	-0.40732

Table 42 continued

	VAR68	VAR69	VAR70	VAR71	VAR72	VAR73	VAR74	VAR75	VAR117	VAR118	VAR119
VAR1	0.11444	0.65060	0.28450	0.70754	-0.25525	-0.37010	-0.19369	0.56045	-0.18089	0.53799	0.20435
VAR2	0.60609	0.84772	0.38670	0.60620	0.07088	0.21826	0.45611	0.63713	0.46258	0.62907	0.06756
VAR91	0.36249	0.67937	0.70266	0.53471	-0.49622	0.06038	0.00547	0.42405	0.03702	0.38325	0.05570
CTEF18	0.46352	0.76206	0.10449	0.72531	0.16161	-0.04178	0.08976	0.75484	0.14828	0.83255	0.36810
CTEF19	0.55038	0.75296	0.15565	0.74030	0.12009	-0.08261	0.07095	0.68946	0.20005	0.85291	0.51125
CTEF193	0.47863	0.77301	0.29057	0.69832	0.01435	-0.07296	0.08003	0.66095	0.20217	0.73034	0.36327
VAR20	0.67851	0.14361	0.23905	-0.02633	0.33685	0.56784	0.95331	0.07561	0.82978	0.23043	-0.17669
VAR21	0.48150	0.58392	-0.14106	0.51031	-0.00559	0.02672	0.14023	0.38140	0.01183	0.76662	0.67524
VAR22	0.63529	0.00254	0.56053	-0.08848	0.42148	0.56336	0.65663	0.03838	0.85927	0.01538	-0.28772
VAR23	0.55994	0.72529	-0.02247	0.76540	0.08294	-0.05460	0.18250	0.59587	0.13402	0.83873	0.45088
VAR36	0.10250	0.61126	-0.23258	0.62059	0.33367	-0.21602	-0.36795	0.64674	-0.08364	0.51239	0.30152
VAR37	-0.54708	0.25157	-0.40330	0.21346	0.02123	-0.42667	-0.03239	0.19569	-0.26686	-0.10553	-0.40732
VAR68	1.00000	0.43928	0.56788	0.31029	0.31253	0.60795	0.62071	0.39556	0.80256	0.61187	0.22359
VAR69	0.43928	1.00000	0.19106	0.80247	-0.00254	-0.05199	0.08303	0.71395	0.14842	0.70263	0.29784
VAR70	0.56788	0.19106	1.00000	-0.01740	-0.42489	0.53930	0.24690	0.05407	0.52369	-0.07581	-0.27000
VAR71	0.31029	0.80247	-0.01740	1.00000	0.18219	-0.42043	-0.21564	0.83286	-0.03460	0.82027	0.32535
VAR72	0.31253	-0.00254	-0.42489	0.18219	1.00000	0.17342	0.31065	0.46952	0.52684	0.33383	-0.20638
VAR73	0.60795	-0.05199	0.53930	-0.42043	0.17342	1.00000	0.71074	-0.04793	0.72266	-0.06184	-0.29456
VAR74	0.62071	0.08303	0.24690	-0.21564	0.31065	0.71074	1.00000	-0.05217	0.85528	0.05021	-0.26568
VAR75	0.39556	0.71395	0.05407	0.83286	0.46952	-0.04793	-0.05217	1.00000	0.19132	0.81087	0.03258
VAR117	0.80256	0.14842	0.52369	-0.03460	0.52684	0.72266	0.85528	0.19132	1.00000	0.20256	-0.24574
VAR118	0.61187	0.70263	-0.07581	0.82027	0.33383	-0.06184	0.05021	0.81087	0.20256	1.00000	0.52819
VAR119	0.22359	0.29784	-0.27000	0.32535	-0.20638	-0.29456	-0.26568	0.03258	-0.24574	0.52819	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 43. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with temperature variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR69	APR TPWD GAL TEMP	0.84574	0.71527	0.71527	0.84574	7.844051	0.52593
VAR117	MAR NOS GAL MEAN TEMP	0.97728	0.95507	0.23979	0.62125	21.44820	0.95400
VAR73	1ST MAR POSTLAV MIN TEMP	0.98539	0.97099	0.01592	0.21421	-4.198103	-0.34057
VAR22	MAR NOS GAL MIN TEMP	0.99210	0.98427	0.01328	0.25974	-11.09709	-0.35101
VAR70	MAR TPWD MAT TEMP	0.99975	0.99949	0.01523	0.41446	2.358896	0.19576
VAR71	APR TPWD MAT TEMP	1.00000	0.99999	0.00050	0.61902	0.9339798	0.06033
VAR74	2ND MAR POSTLAV MIN TEMP	1.00000	1.00000	0.00001	0.47106	0.1738745	0.01734
(CONSTANT)						-352.2398	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 44. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with temperature variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR71	APR TPWD MAT TEMP	0.84792	0.71897	0.71897	0.84792	30.90162	1.54669
VAR117	MAR NOS GAL MEAN TEMP	0.88436	0.78209	0.06312	0.13738	22.73426	0.78358
VAR74	2ND MAR POSTLAV MIN TEMP	0.92789	0.86099	0.07890	-0.08740	-2.203608	-0.17031
VAR119	MAY NOS GAL MEAN TEMP	0.96001	0.92162	0.06064	0.29251	29.82880	0.46379
VAR23	APR NOS GAL MIN TEMP	0.99677	0.99355	0.07193	0.57460	-15.66120	-0.88920
VAR36	JAN NOS GAL MIN TEMP	0.99996	0.99992	0.00637	0.39227	-2.527318	-0.11074
VAR37	FEB NOS GAL MIN TEMP	1.00000	1.00000	0.00008	0.16277	-2.142937	-0.09391
(CONSTANT)						-1320.564	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 45. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR70	MAR TPWD MAT TEMP	0.76254	0.58146	0.58146	0.76254	7.496925	0.68898
VAR71	APR TPWD MAT TEMP	0.98630	0.97278	0.39132	0.61167	13.40891	0.95913
VAR75	1ST APR POSTLAV MIN TEMP	0.99640	0.99281	0.02003	0.50436	-2.732969	-0.31020
VAR73	1ST MAR POSTLAV MIN TEMP	0.99986	0.99973	0.00691	0.12525	1.680460	0.15097
VAR72	2ND FEB POSTLAV MIN TEMP	0.99999	0.99998	0.00025	-0.38519	-0.7490867	-0.04982
VAR69	APR TPWD GAL TEMP	1.00000	1.00000	0.00002	0.71213	0.1114726	0.00828
VAR74	2ND MAR POSTLAV MIN TEMP	1.00000	1.00000	0.00000	0.07076	0.5306862E-01	0.00586
(CONSTANT)						-340.8310	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 46. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.90521	0.81941	0.81941	0.90521	242.1874	1.26156
VAR69	APR TPWD GAL TEMP	0.93019	0.86526	0.04585	0.79108	61.42803	0.45347
VAR23	APR NOS GAL MIN TEMP	0.96577	0.93270	0.06744	0.69733	-101.3513	-0.81763
VAR74	2ND MAR POSTLAV MIN TEMP	0.99876	0.99752	0.06482	0.12239	26.81960	0.29452
VAR119	MAY NOS GAL MEAN TEMP	0.99997	0.99995	0.00242	0.38630	28.07608	0.06203
VAR68	MAR TPWD GAL TEMP	1.00000	1.00000	0.00005	0.62480	1.969980	0.01501
VAR37	FEB NOS GAL MIN TEMP	1.00000	1.00000	0.00000	0.07614	0.1371098	0.00085
(CONSTANT)						-5324.703	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 47. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with temperature variables ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.88219	0.77826	0.77826	0.88219	214.2380	1.47743
VAR69	APR TPWD GAL TEMP	0.90705	0.82275	0.04449	0.77254	86.09135	0.84139
VAR23	APR NOS GAL MIN TEMP	0.94571	0.89436	0.07161	0.67313	-87.04381	-0.92965
VAR36	JAN NOS GAL MIN TEMP	0.98740	0.97495	0.08059	0.36090	-42.97955	-0.35424
VAR75	1ST APR POSTLAV MIN TEMP	0.99986	0.99972	0.02477	0.70238	-19.85197	-0.29659
VAR73	1ST MAR POSTLAV MIN TEMP	1.00000	1.00000	0.00028	-0.10060	-1.633896	-0.01932
VAR119	MAY NOS GAL MEAN TEMP	1.00000	1.00000	0.00000	0.51084	4.425202	0.01294
(CONSTANT)						-3906.810	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 48. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19,11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR69	APR TPWD GAL TEMP	0.78802	0.62097	0.62097	0.78802	128.2665	1.34400
VAR118	APR NOS GAL MEAN TEMP	0.84391	0.71218	0.09121	0.77047	162.9218	1.20459
VAR23	APR NOS GAL MIN TEMP	0.91770	0.84217	0.12999	0.55459	-98.58285	-1.12884
VAR36	JAN NOS GAL MIN TEMP	0.99323	0.98651	0.14434	0.33020	-88.35004	-0.78071
VAR117	MAR NOS GAL MEAN TEMP	0.99980	0.99961	0.01309	0.28957	-33.15434	-0.23046
VAR71	APR TPWD MAT TEMP	1.00000	1.00000	0.00039	0.70687	-5.108399	-0.05157
VAR72	2ND FEB POSTLAV MIN TEMP	1.00000	1.00000	0.00000	0.05619	-0.3285259	-0.00308
(CONSTANT)						-2788.570	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 49. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to wind, tide and Ekman transport variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR26	VAR27	VAR28	VAR29	VAR30	VAR31
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	-0.62348	-0.46638	-0.41089	-0.08687	0.07261	-0.56273
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	-0.27998	0.06675	-0.58969	-0.51844	-0.01508	-0.40521
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	-0.14776	-0.03540	-0.52410	-0.41323	-0.21270	-0.57867
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	-0.66073	-0.31337	-0.42782	-0.07159	0.27752	-0.24891
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	-0.73545	-0.33808	-0.28391	-0.15750	0.21377	-0.23827
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	-0.66259	-0.29956	-0.31568	-0.21944	0.23101	-0.45848
VAR26	-0.62348	-0.27998	-0.14776	-0.66073	-0.73545	-0.66259	1.00000	0.79274	-0.08615	-0.25362	-0.25181	0.02592
VAR27	-0.46638	0.06675	-0.03540	-0.31337	-0.33808	-0.29956	0.79274	1.00000	-0.36377	-0.56560	-0.28043	0.14143
VAR28	-0.41089	-0.58969	-0.52410	-0.42782	-0.28391	-0.31568	-0.08615	-0.36377	1.00000	0.49711	0.35317	-0.00410
VAR29	-0.08687	-0.51844	-0.41323	-0.07159	-0.15750	-0.21944	-0.25362	-0.56560	0.49711	1.00000	0.63368	0.01403
VAR30	0.07261	-0.01508	-0.21270	0.27752	0.21377	0.23101	-0.25181	-0.28043	0.35317	0.63368	1.00000	-0.35602
VAR31	-0.56273	-0.40521	-0.57867	-0.24891	-0.23827	-0.45848	0.02592	0.14143	-0.00410	0.01403	-0.35602	1.00000
VAR76	0.31779	0.55517	0.32125	0.22191	0.21396	0.34489	-0.08498	0.18073	-0.56570	-0.62346	-0.29687	-0.23504
VAR77	-0.18089	-0.15497	-0.32139	-0.17977	-0.33201	-0.20951	0.30118	0.15536	0.00511	0.27554	0.61256	-0.34337
VAR78	0.50383	0.81873	0.65637	0.56626	0.56394	0.59421	-0.05862	0.13952	-0.45037	-0.49174	-0.34386	-0.24670
VAR79	0.33059	0.71937	0.25208	0.38256	0.37567	0.48232	-0.09219	0.07683	-0.28108	-0.50785	-0.12776	-0.33461
VAR80	0.58472	0.71185	0.30020	0.75589	0.70460	0.64097	-0.36246	-0.08885	-0.46675	-0.28788	-0.18821	0.04922
VAR81	0.10738	0.56775	-0.11547	0.36689	0.30467	0.32202	-0.06788	0.22301	-0.39372	-0.43719	-0.06175	0.07614
VAR114	-0.24137	-0.19968	-0.02858	-0.33701	-0.49109	-0.44209	0.38616	0.22408	-0.46486	-0.09807	-0.15250	0.13902
VAR115	0.11693	0.09961	0.14408	-0.21824	-0.27089	-0.04803	0.42899	0.15549	-0.04490	-0.30703	0.19528	-0.66982
VAR116	-0.27826	-0.61389	-0.45198	-0.54479	-0.59781	-0.60740	0.09703	-0.05404	-0.11378	0.21707	-0.57735	0.39606

Table 49 continued

	VAR76	VAR77	VAR78	VAR79	VAR80	VAR81	VAR114	VAR115	VAR116
VAR1	0.31779	-0.18089	0.50383	0.33059	0.58472	0.10738	-0.24137	0.11693	-0.27826
VAR2	0.55517	-0.15497	0.81873	0.71937	0.71185	0.56775	-0.19968	0.09961	-0.61389
VAR91	0.32125	-0.32139	0.65637	0.25208	0.30020	-0.11547	-0.02858	0.14408	-0.45198
CTEF18	0.22191	-0.17977	0.56626	0.38256	0.75589	0.36689	-0.33701	-0.21824	-0.54479
CTEF19	0.21396	-0.33201	0.56394	0.37567	0.70460	0.30467	-0.49109	-0.27089	-0.59781
CTEF193	0.34489	-0.20951	0.59421	0.48232	0.64097	0.32202	-0.44209	-0.04803	-0.60740
VAR26	-0.08498	0.30118	-0.05862	-0.09219	-0.36246	-0.06788	0.38616	0.42899	0.09703
VAR27	0.18073	0.15536	0.13952	0.07683	-0.08885	0.22301	0.22408	0.15549	-0.05404
VAR28	-0.56570	0.00511	-0.45037	-0.28108	-0.46675	-0.39372	-0.46486	-0.04490	-0.11378
VAR29	-0.62346	0.27554	-0.49174	-0.50785	-0.28788	-0.43719	-0.09807	-0.30703	0.21707
VAR30	-0.29687	0.61256	-0.34386	-0.12776	-0.18821	-0.06175	-0.15250	0.19528	-0.57735
VAR31	-0.23504	-0.34337	-0.24670	-0.33461	0.04922	0.07614	0.13902	-0.66982	0.39606
VAR76	1.00000	0.15188	0.32751	0.75405	0.20229	0.68290	0.31459	0.36291	0.13109
VAR77	0.15188	1.00000	-0.49849	0.05023	-0.38181	0.19534	0.47923	0.75475	0.32815
VAR78	0.32751	-0.49849	1.00000	0.64184	0.72241	0.39258	-0.37631	-0.10373	-0.74303
VAR79	0.75405	0.05023	0.64184	1.00000	0.50339	0.83506	-0.13486	0.35503	-0.36662
VAR80	0.20229	-0.38181	0.72241	0.50339	1.00000	0.56589	-0.38859	-0.17688	-0.36767
VAR81	0.68290	0.19534	0.39258	0.83506	0.56589	1.00000	0.02483	0.17249	-0.09511
VAR114	0.31459	0.47923	-0.37631	-0.13486	-0.38859	0.02483	1.00000	0.32797	0.61145
VAR115	0.36291	0.75475	-0.10373	0.35503	-0.17688	0.17249	0.32797	1.00000	0.07516
VAR116	0.13109	0.32815	-0.74303	-0.36662	-0.36767	-0.09511	0.61145	0.07516	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 50. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.92059	0.84749	0.84749	0.92059	0.6589543	0.83848
VAR29	APR GAL FASTEST WIND	0.99233	0.98473	0.13723	-0.63957	-2.467324	-0.39669
VAR116	FEB GAL FAST WIND DIR	0.99697	0.99395	0.00922	-0.61389	0.1130281	0.14523
VAR31	APR GAL FAST WIND DIR	0.99948	0.99896	0.00501	-0.41227	-0.5994694E-01	-0.08644
VAR80	APR EKMAN ZONAL IND	0.99991	0.99983	0.00087	0.71914	0.2229301E-01	0.05261
VAR27	APR NOS FRE HI TIDE	0.99995	0.99990	0.00007	0.07476	-1.427450	-0.03143
VAR26	MAR NOS FRE HI TIDE	1.00000	1.00000	0.00010	-0.31846	1.326549	0.02429
VAR114	FEB FRE HI TIDE	1.00000	1.00000	0.00000	-0.20028	-0.3022403E-01	-0.00077
(CONSTANT)						81.34371	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 51. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.68073	0.46340	0.46340	0.68073	-0.1613404	-0.14723
VAR26	MAR NOS FRE HI TIDE	0.78880	0.62220	0.15881	-0.61477	-49.23274	-0.64651
VAR31	APR GAL FAST WIND DIR	0.89364	0.79859	0.17639	-0.54583	-0.7130235	-0.73730
VAR28	MAR GAL FASTEST WIND	0.96663	0.93438	0.13578	-0.45527	-4.119465	-0.49427
VAR76	FEB EKMAN ZONAL IND	0.99084	0.98176	0.04739	0.35616	-0.4714125	-0.26591
VAR80	APR EKMAN ZONAL IND	0.99959	0.99917	0.01741	0.63091	0.1626091	0.27521
VAR114	FEB FRE HI TIDE	0.99998	0.99997	0.00079	-0.26092	2.448734	0.04488
VAR30	MAR GAL FAST WIND DIR	1.00000	1.00000	0.00003	-0.23980	-0.6334303E-01	-0.03370
(CONSTANT)						591.7583	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 52. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.65711	0.43179	0.43179	0.65711	0.5889277	0.79434
VAR81	APR EKMAN MERID. IND	0.79485	0.63179	0.20000	-0.12130	-1.348120	-1.12022
VAR76	FEB EKMAN ZONAL IND	0.95464	0.91134	0.27955	0.30411	0.6298260	0.52512
VAR29	APR GAL FASTEST WIND	0.97556	0.95173	0.04038	-0.38774	-1.364382	-0.23252
VAR114	FEB FRE HI TIDE	0.98432	0.96888	0.01716	-0.01657	5.838500	0.15815
VAR80	APR EKMAN ZONAL IND	0.99112	0.98232	0.01344	0.28266	0.1021775	0.25561
VAR115	FEB GAL FASTEST WIND	1.00000	1.00000	0.01768	0.14408	1.117144	0.14995
VAR31	APR GAL FAST WIND DIR	1.00000	1.00000	0.00000	-0.63317	-0.1100486E-02	-0.00168
(CONSTANT)						125.5877	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 53. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.90302	0.81545	0.81545	0.90302	3.161643	0.48350
VAR80	APR EKMAN ZONAL IND	0.95737	0.91655	0.10110	0.88615	1.239077	0.35146
VAR30	MAR GAL FAST WIND DIR	0.97885	0.95815	0.04160	-0.16440	-0.8794432	-0.07841
VAR114	FEB FRE HI TIDE	0.98956	0.97923	0.02108	-0.39520	-51.46314	-0.15806
VAR28	MAR GAL FASTEST WIND	0.99517	0.99037	0.01114	-0.53349	-9.955502	-0.20019
VAR81	APR EKMAN MERID. IND	0.99712	0.99425	0.00389	0.40685	-1.781365	-0.16783
VAR29	APR GAL FASTEST WIND	0.99974	0.99947	0.00522	-0.39548	-7.122367	-0.13762
VAR26	MAR NOS FRE HI TIDE	1.00000	1.00000	0.00053	-0.58760	-64.68640	-0.14236
(CONSTANT)						1691.827	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 54. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.83518	0.69752	0.69752	0.83518	-6.977832	-1.37764
VAR26	MAR NOS FRE HI TIDE	0.94108	0.88563	0.18811	-0.70266	-94.58323	-0.26873
VAR27	APR NOS FRE HI TIDE	0.97110	0.94304	0.05740	-0.23741	-140.4009	-0.47960
VAR116	FEB GAL FAST WIND DIR	0.97659	0.95373	0.01069	-0.59781	-6.013734	-1.19896
VAR28	MAR GAL FASTEST WIND	0.98699	0.97415	0.02042	-0.35312	-57.47927	-1.49216
VAR114	FEB FRE HI TIDE	0.99387	0.98778	0.01364	-0.54114	-179.2115	-0.71058
VAR79	MAR EKMAN MERID. IND	0.99957	0.99915	0.01137	0.46526	4.151060	0.40689
VAR115	FEB GAL FASTEST WIND	1.00000	1.00000	0.00085	-0.27089	-5.711707	-0.11222
(CONSTANT)						5790.603	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 55. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	MAR EKMAN ZONAL IND	0.85742	0.73516	0.73516	0.85742	2.735771	0.57620
VAR26	MAR NOS FRE HI TIDE	0.92166	0.84946	0.11430	-0.62122	-242.3414	-0.73452
VAR29	APR GAL FASTEST WIND	0.96293	0.92724	0.07778	-0.50548	-12.90038	-0.34331
VAR31	APR GAL FAST WIND DIR	0.98225	0.96482	0.03758	-0.42931	-1.706376	-0.40726
VAR27	APR NOS FRE HI TIDE	0.99005	0.98021	0.01538	-0.19963	84.24505	0.30700
VAR76	FEB EKMAN ZONAL IND	0.99662	0.99326	0.01305	0.40875	-2.636917	-0.34331
VAR116	FEB GAL FAST WIND DIR	0.99946	0.99892	0.00566	-0.60740	0.9186372	0.19538
VAR81	APR EKMAN MERID. IND	1.00000	1.00000	0.00108	0.34400	0.4831940	0.06270
(CONSTANT)						1858.570	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 56. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate brown shrimp total catch and interview catch/effort variables to recruitment, bay catch and bay effort variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	BCE18	BCE19	BCEL18	BCEL19	VAR45	VAR46
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	0.59803	-0.10990	-0.12139	0.42863	0.66773	0.61040
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	0.86343	0.05287	0.03619	0.23269	0.70661	0.87591
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	0.49036	-0.26981	0.32037	0.24896	0.36775	0.62095
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	0.60063	0.08151	-0.14623	0.34980	0.83944	0.80490
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	0.61109	-0.12072	0.05494	0.45186	0.74768	0.74154
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	0.74383	-0.05830	0.09156	0.46732	0.74287	0.72878
BCE18	0.59803	0.86343	0.49036	0.60063	0.61109	0.74383	1.00000	0.12610	0.04572	0.27200	0.60912	0.64217
BCE19	-0.10990	0.05287	-0.26981	0.08151	-0.12072	-0.05830	0.12610	1.00000	-0.39496	-0.10289	0.28047	0.06521
BCEL18	-0.12139	0.03619	0.32037	-0.14623	0.05494	0.09156	0.04572	-0.39496	1.00000	0.41598	-0.27296	-0.00512
BCEL19	0.42863	0.23269	0.24896	0.34980	0.45186	0.46732	0.27200	-0.10289	0.41598	1.00000	0.10560	0.21273
VAR45	0.66773	0.70661	0.36775	0.83944	0.74768	0.74287	0.60912	0.28047	-0.27296	0.10560	1.00000	0.82080
VAR46	0.61040	0.87591	0.62095	0.80490	0.74154	0.72878	0.64217	0.06521	-0.00512	0.21273	0.82080	1.00000
VAR47	0.18323	0.66530	0.22030	0.57500	0.62649	0.55355	0.55805	-0.09233	0.24823	0.11364	0.62524	0.76040
VAR48	-0.26856	-0.03799	-0.31082	-0.14013	-0.00238	-0.03152	0.23701	-0.23516	0.29347	-0.04997	0.13974	0.02476
VAR49	0.08146	0.55834	0.25069	0.43412	0.48795	0.42301	0.44567	-0.12531	0.38818	0.07454	0.53668	0.70704
VAR50	-0.35421	0.08533	-0.23304	-0.03744	0.13529	0.06825	0.16253	-0.24493	0.58174	0.32027	-0.21240	-0.00744
VAR51	0.70613	0.79195	0.58756	0.91801	0.85504	0.83457	0.52889	0.15925	-0.04357	0.18884	0.90307	0.88382
VAR52	0.64701	0.88047	0.51986	0.86540	0.80291	0.78478	0.67025	0.10417	-0.20057	0.08083	0.87062	0.93202
VAR53	0.31719	0.52691	0.29314	0.27902	0.41689	0.49987	0.73990	-0.37331	0.28162	0.07572	0.29616	0.29335
VAR54	0.04587	0.17771	0.50376	0.02418	0.09592	0.12414	0.07354	-0.21906	0.69608	0.05273	0.20103	0.37264
VAR55	-0.44859	-0.30901	-0.13196	-0.30563	-0.18016	-0.25945	-0.32751	-0.34512	0.56083	-0.26805	-0.10797	-0.11656
VAR56	0.18902	0.22724	0.07839	0.18215	0.26090	0.34227	0.30264	-0.01300	-0.01892	-0.07835	-0.09577	-0.21155
VAR57	0.48952	0.61621	0.83245	0.44619	0.45444	0.56477	0.43698	0.04845	0.57290	0.40162	0.29176	0.54523
VAR58	0.11293	0.03036	0.27442	0.06004	0.04958	0.07751	-0.13262	0.23535	0.24141	0.38768	-0.05840	0.10254
VAR59	0.14287	-0.09820	-0.23523	0.01647	-0.00209	0.03934	0.03010	0.11800	-0.40037	0.22245	-0.29738	-0.41616
VAR97	0.17770	0.49419	0.08476	0.18333	0.24196	0.39457	0.82377	0.18578	0.08439	0.02511	0.27016	0.16625
VAR98	-0.23673	-0.07027	-0.26719	-0.05837	-0.24092	-0.18286	-0.01756	0.96572	-0.21266	-0.06532	0.14686	-0.00723
VAR99	-0.62776	-0.27991	-0.65902	-0.43661	-0.41627	-0.38099	0.02646	0.39113	-0.09611	-0.45809	-0.22654	-0.44473
VAR100	-0.29147	-0.07837	-0.29387	-0.05894	-0.21144	-0.18195	-0.03527	0.89153	-0.05466	0.10709	0.10730	0.02843
VAR101	-0.36482	0.03072	-0.00940	-0.23485	-0.07206	-0.01822	0.17103	-0.03971	0.84342	0.34724	-0.33226	-0.11160
VAR102	0.42343	0.22494	0.26731	0.34655	0.40268	0.40265	0.20542	-0.06428	0.32328	0.97304	0.11846	0.27552
VAR103	-0.42448	-0.09083	-0.53389	-0.15996	-0.14837	-0.12045	0.11414	0.57407	0.03013	0.14122	-0.22197	-0.29143
VAR104	0.41358	0.32158	0.41243	0.36291	0.34751	0.35706	0.20926	0.09290	0.28274	0.81564	0.26169	0.49189

Table 56 continued

	VAR47	VAR48	VAR49	VAR50	VAR51	VAR52	VAR53	VAR54	VAR55	VAR56	VAR57	VAR58
VAR1	0.18323	-0.26856	0.08146	-0.35421	0.70613	0.64701	0.31719	0.04587	-0.44859	0.18902	0.48952	0.11293
VAR2	0.66530	-0.03799	0.55834	0.08533	0.79195	0.88047	0.52691	0.17771	-0.30901	0.22724	0.61621	0.03036
VAR91	0.22030	-0.31082	0.25069	-0.23304	0.58756	0.51986	0.29314	0.50376	-0.13196	0.07839	0.83245	0.27442
CTEF18	0.57500	-0.14013	0.43412	-0.03744	0.91801	0.86540	0.27902	0.02418	-0.30563	0.18215	0.44619	0.06004
CTEF19	0.62649	-0.00238	0.48795	0.13529	0.85504	0.80291	0.41689	0.09592	-0.18016	0.26090	0.45444	0.04958
CTEF193	0.55355	-0.03152	0.42301	0.06825	0.83457	0.78478	0.49987	0.12414	-0.25945	0.34227	0.56477	0.07751
BCE18	0.55805	0.23701	0.44567	0.16253	0.52889	0.67025	0.73990	0.07354	-0.32751	0.30264	0.43698	-0.13262
BCE19	-0.09233	-0.23516	-0.12531	-0.24493	0.15925	0.10417	-0.37331	-0.21906	-0.34512	-0.01300	0.04845	0.23535
BCEL18	0.24823	0.29347	0.38818	0.58174	-0.04357	-0.20057	0.28162	0.69608	0.56083	-0.01892	0.57290	0.24141
BCEL19	0.11364	-0.04997	0.07454	0.32027	0.18884	0.08083	0.07572	0.05273	-0.26805	-0.07835	0.40162	0.38768
VAR45	0.62524	0.13974	0.53668	-0.21240	0.90307	0.87062	0.29616	0.20103	-0.10797	-0.09577	0.29176	-0.05840
VAR46	0.76040	0.02476	0.70704	-0.00744	0.88382	0.93202	0.29335	0.37264	-0.11656	-0.21155	0.54523	0.10254
VAR47	1.00000	0.55829	0.96444	0.53372	0.63739	0.70543	0.56228	0.41165	0.33141	-0.13999	0.28272	-0.24082
VAR48	0.55829	1.00000	0.59664	0.55835	-0.08698	-0.00779	0.64639	0.30954	0.62410	-0.19449	-0.26948	-0.56566
VAR49	0.96444	0.59664	1.00000	0.53398	0.56803	0.57978	0.51644	0.59902	0.50521	-0.29112	0.35503	-0.23497
VAR50	0.53372	0.55835	0.53398	1.00000	-0.14550	-0.10511	0.44066	0.09304	0.35987	0.08019	0.04369	-0.26285
VAR51	0.63739	-0.08698	0.56803	-0.14550	1.00000	0.90174	0.19309	0.33979	-0.06695	0.00229	0.56309	0.17490
VAR52	0.70543	-0.00779	0.57978	-0.10511	0.90174	1.00000	0.31341	0.16808	-0.21986	0.04722	0.37570	0.08201
VAR53	0.56228	0.64639	0.51644	0.44066	0.19309	0.31341	1.00000	0.18205	0.17251	0.31637	0.16151	-0.57131
VAR54	0.41165	0.30954	0.59902	0.09304	0.33979	0.16808	0.18205	1.00000	0.69493	-0.40018	0.60989	0.21016
VAR55	0.33141	0.62410	0.50521	0.35987	-0.06695	-0.21986	0.17251	0.69493	1.00000	-0.29726	-0.00106	-0.23164
VAR56	-0.13999	-0.19449	-0.29112	0.08019	0.00229	0.04722	0.31637	-0.40018	-0.29726	1.00000	0.05615	-0.00448
VAR57	0.28272	-0.26948	0.35503	0.04369	0.56309	0.37570	0.16151	0.60989	-0.00106	0.05615	1.00000	0.44198
VAR58	-0.24082	-0.56566	-0.23497	-0.26285	0.17490	0.08201	-0.57131	0.21016	-0.23164	-0.00448	0.44198	1.00000
VAR59	-0.52152	-0.43251	-0.68243	-0.03902	-0.33685	-0.26612	-0.08194	-0.88637	-0.74614	0.56068	-0.28576	-0.07144
VAR97	0.35435	0.45413	0.25716	0.30499	0.10936	0.27148	0.77754	-0.06230	-0.14008	0.51817	0.12698	-0.29560
VAR98	-0.14040	-0.23936	-0.11723	-0.19988	0.07823	-0.02850	-0.48129	-0.05765	-0.19984	-0.12605	0.12434	0.35870
VAR99	-0.01696	0.42950	-0.05492	0.27325	-0.41061	-0.27761	0.15457	-0.24783	0.17729	0.36763	-0.45528	-0.24723
VAR100	-0.02378	-0.13644	0.02223	0.01676	0.05882	-0.07046	-0.45271	0.01343	-0.11258	-0.26756	0.16932	0.33207
VAR101	0.27571	0.37609	0.35961	0.78103	-0.19735	-0.25796	0.30549	0.39286	0.38713	0.12798	0.39615	0.13605
VAR102	0.09094	-0.14606	0.06687	0.23280	0.20243	0.10350	-0.05100	0.04548	-0.32430	-0.24284	0.39648	0.40649
VAR103	-0.03621	0.04932	-0.12971	0.43398	-0.25981	-0.19381	-0.08523	-0.40580	-0.22825	0.40209	-0.13748	0.19193
VAR104	0.16708	-0.23361	0.18728	0.03145	0.36661	0.27588	-0.19926	0.27549	-0.27712	-0.46075	0.54348	0.57449

Table 56 continued

	VAR59	VAR97	VAR98	VAR99	VAR100	VAR101	VAR102	VAR103	VAR104
VAR1	0.14287	0.17770	-0.23673	-0.62776	-0.29147	-0.36482	0.42343	-0.42448	0.41358
VAR2	-0.09820	0.49419	-0.07027	-0.27991	-0.07837	0.03072	0.22494	-0.09083	0.32158
VAR91	-0.23523	0.08476	-0.26719	-0.65902	-0.29387	-0.00940	0.26731	-0.53389	0.41243
CTEF18	0.01647	0.18333	-0.05837	-0.43661	-0.05894	-0.23485	0.34655	-0.15996	0.36291
CTEF19	-0.00209	0.24196	-0.24092	-0.41627	-0.21144	-0.07206	0.40268	-0.14837	0.34751
CTEF193	0.03934	0.39457	-0.18286	-0.38099	-0.18195	-0.01822	0.40265	-0.12045	0.35706
BCE18	0.03010	0.82377	-0.01756	0.02646	-0.03527	0.17103	0.20542	0.11414	0.20926
BCE19	0.11800	0.18578	0.96572	0.39113	0.89153	-0.03971	-0.06428	0.57407	0.09290
BCEL18	-0.40037	0.08439	-0.21266	-0.09611	-0.05466	0.84342	0.32328	0.03013	0.28274
BCEL19	0.22245	0.02511	-0.06532	-0.45809	0.10709	0.34724	0.97304	0.14122	0.81564
VAR45	-0.29738	0.27016	0.14686	-0.22654	0.10730	-0.33226	0.11846	-0.22197	0.26169
VAR46	-0.41616	0.16625	-0.00723	-0.44473	0.02843	-0.11160	0.27552	-0.29143	0.49189
VAR47	-0.52152	0.35435	-0.14040	-0.01696	-0.02378	0.27571	0.09094	-0.03621	0.16708
VAR48	-0.43251	0.45413	-0.23936	0.42950	-0.13644	0.37609	-0.14606	0.04932	-0.23361
VAR49	-0.68243	0.25716	-0.11723	-0.05492	0.02223	0.35961	0.06687	-0.12971	0.18728
VAR50	-0.03902	0.30499	-0.19988	0.27325	0.01676	0.78103	0.23280	0.43398	0.03145
VAR51	-0.33685	0.10936	0.07823	-0.41061	0.05882	-0.19735	0.20243	-0.25981	0.36661
VAR52	-0.26612	0.27148	-0.02850	-0.27761	-0.07046	-0.25796	0.10350	-0.19381	0.27588
VAR53	-0.08194	0.77754	-0.48129	0.15457	-0.45271	0.30549	-0.05100	-0.08523	-0.19926
VAR54	-0.88637	-0.06230	-0.05765	-0.24783	0.01343	0.39286	0.04548	-0.40580	0.27549
VAR55	-0.74614	-0.14008	-0.19984	0.17729	-0.11258	0.38713	-0.32430	-0.22825	-0.27712
VAR56	0.56068	0.51817	-0.12605	0.36763	-0.26756	0.12798	-0.24284	0.40209	-0.46075
VAR57	-0.28576	0.12698	0.12434	-0.45528	0.16932	0.39615	0.39648	-0.13748	0.54348
VAR58	-0.07144	-0.29560	0.35870	-0.24723	0.33207	0.13605	0.40649	0.19193	0.57449
VAR59	1.00000	0.13535	-0.00839	0.08285	-0.05671	-0.17520	0.18989	0.39602	-0.10954
VAR97	0.13535	1.00000	0.06009	0.53993	0.00690	0.37153	-0.11878	0.42852	-0.21450
VAR98	-0.00839	0.06009	1.00000	0.36028	0.95733	0.09726	-0.02019	0.56575	0.16870
VAR99	0.08285	0.53993	0.36028	1.00000	0.28218	0.32399	-0.57520	0.70924	-0.63961
VAR100	-0.05671	0.00690	0.95733	0.28218	1.00000	0.25522	0.16210	0.58326	0.31993
VAR101	-0.17520	0.37153	0.09726	0.32399	0.25522	1.00000	0.23627	0.51321	0.15315
VAR102	0.18989	-0.11878	-0.02019	-0.57520	0.16210	0.23627	1.00000	0.05045	0.90073
VAR103	0.39602	0.42852	0.56575	0.70924	0.58326	0.51321	0.05045	1.00000	-0.06785
VAR104	-0.10954	-0.21450	0.16870	-0.63961	0.31993	0.15315	0.90073	-0.06785	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 57. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	MAY TPWD SEC GAL CAT-EFF	0.88047	0.77523	0.77523	0.88047	0.2304703	1.32833
VAR57	FEB POSTLARVAL CAT-TOW	0.93278	0.87008	0.09485	0.61621	0.1778547	0.40825
VAR97	BAY CAT 18	0.96743	0.93591	0.06584	0.49419	0.1072672	0.12455
VAR59	APR POSTLARVAL CAT-TOW	0.97959	0.95959	0.02368	-0.09820	-0.1100468	-0.36983
VAR58	MAR POSTLARVAL CAT-TOW	0.98884	0.97780	0.01820	0.03036	-0.1437262	-0.36349
VAR50	APR TPWD TER MAT CAT-EFF	0.99085	0.98178	0.00398	0.08533	0.2555472	0.68700
VAR55	MAY TPWD SEC MAT CAT-EFF	0.99535	0.99071	0.00894	-0.30901	-0.2958010	-0.28236
VAR47	APR TPWD TER GAL CAT-EFF	0.99994	0.99987	0.00916	0.66530	-0.2499885	-0.98531
VAR100	BAY TRIPS 19	1.00000	1.00000	0.00013	-0.07837	-0.1275850	-0.02175
(CONSTANT)						58.95825	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 58. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR51	MAY TPWD PRI GAL CAT-EFF	0.70613	0.49862	0.49862	0.70613	0.3272124	0.71604
VAR59	APR POSTLARVAL CAT-TOW	0.81372	0.66213	0.16351	0.14287	0.1002507	0.23683
VAR103	LAG BAY TRIPS 18	0.91170	0.83120	0.16907	-0.42448	-4.769723	-0.42784
VAR97	BAY CAT 18	0.94176	0.88691	0.05571	0.17770	0.2460263	0.20081
VAR58	MAR POSTLARVAL CAT-TOW	0.98004	0.96048	0.07357	0.11293	0.4462066E-01	0.07933
VAR102	LAG BAY CAT 19	0.99404	0.98811	0.02763	0.42343	0.4784416	0.31122
VAR49	APR TPWD SEC MAT CAT-EFF	0.99928	0.99856	0.01045	0.08146	-0.6897707	-0.37688
VAR53	MAY TPWD TER GAL CAT-EFF	0.99996	0.99991	0.00136	0.31719	0.1158703	0.30639
VAR50	APR TPWD TER MAT CAT-EFF	1.00000	1.00000	0.00009	-0.35421	-0.5382634E-01	-0.10172
(CONSTANT)						98.53147	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 59. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR57	FEB POSTLARVAL CAT-TOW	0.83245	0.69297	0.69297	0.83245	0.3700195	0.88607
VAR100	BAY TRIPS 19	0.94214	0.88762	0.19465	-0.29387	-3.064824	-0.54515
VAR101	LAG BAY CAT 18	0.98397	0.96820	0.08058	-0.00939	-0.1631154	-0.20434
VAR97	BAY CAT 18	0.98731	0.97478	0.00658	0.08476	0.3289064	0.39843
VAR56	MAY TPWD TER MAT CAT-EFF	0.99234	0.98474	0.00996	0.07839	-0.1255079	-0.29329
VAR48	APR TPWD PRI MAT CAT-EFF	0.99856	0.99711	0.01237	-0.31082	-0.5041287	-0.28655
VAR59	APR POSTLARVAL CAT-TOW	0.99988	0.99977	0.00265	-0.23523	-0.1941714E-01	-0.06808
VAR53	MAY TPWD TER GAL CAT-EFF	0.99999	0.99997	0.00020	0.29314	-0.1658794E-01	-0.06510
VAR50	APR TPWD TER MAT CAT-EFF	1.00000	1.00000	0.00003	-0.23304	-0.5344348E-02	-0.01499
(CONSTANT)						87.52880	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 60. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR51	MAY TPWD PRI GAL CAT-EFF	0.91801	0.84274	0.84274	0.91801	3.163289	1.09212
VAR59	APR POSTLARVAL CAT-TOW	0.98102	0.96240	0.11966	0.01647	1.428764	0.53252
VAR47	APR TPWD TER GAL CAT-EFF	0.99196	0.98399	0.02159	0.57500	0.2837709	0.12404
BCE19	BAY CAT-TRIP 19	0.99746	0.99492	0.01094	0.08151	-2.251975	-0.11756
VAR56	MAY TPWD TER MAT CAT-EFF	0.99939	0.99879	0.00386	0.18215	-0.3289962	-0.08173
VAR48	APR TPWD PRI MAT CAT-EFF	0.99983	0.99966	0.00088	-0.14013	1.558147	0.09415
VAR45	APR TPWD PRI GAL CAT-EFF	0.99995	0.99990	0.00023	0.83944	-1.579195	-0.04761
VAR53	MAY TPWD TER GAL CAT-EFF	1.00000	1.00000	0.00010	0.27902	-0.5528507E-01	-0.02306
BCEL19	BAY CAT-TRIP 19	1.00000	1.00000	0.00000	0.34980	0.9796984E-01	0.00399
(CONSTANT)						197.1976	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 61. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR51	MAY TPWD PRI GAL CAT-EFF	0.85504	0.73110	0.73110	0.85504	2.527632	1.15978
VAR59	APR POSTLARVAL CAT-TOW	0.90737	0.82332	0.09222	-0.00209	1.100815	0.54529
BCE19	BAY CAT-TRIP 19	0.96275	0.92689	0.10357	-0.12072	-4.395282	-0.30495
VAR50	APR TPWD TER MAT CAT-EFF	0.98958	0.97927	0.05238	0.13529	0.3348730	0.13269
VAR48	APR TPWD PRI MAT CAT-EFF	0.99391	0.98786	0.00859	-0.00238	3.487164	0.28004
VAR58	MAR POSTLARVAL CAT-TOW	0.99964	0.99929	0.01143	0.04958	0.3975117	0.14818
VAR52	MAY TPWD SEC GAL CAT-EFF	0.99998	0.99995	0.00066	0.80291	-0.6816055E-01	-0.05790
VAR53	MAY TPWD TER GAL CAT-EFF	1.00000	1.00000	0.00005	0.41689	-0.2340434E-01	-0.01298
VAR55	MAY TPWD SEC MAT CAT-EFF	1.00000	1.00000	0.00000	-0.18016	0.2919179E-02	0.00041
(CONSTANT)						192.9856	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 62. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR51	MAY TPWD PRI GAL CAT-EFF	0.83457	0.69650	0.69650	0.83457	2.110149	1.03858
BCE18	BAY CAT-TRIP 18	0.90747	0.82349	0.12699	0.74383	2.189577	0.24911
VAR59	APR POSTLARVAL CAT-TOW	0.94297	0.88920	0.06571	0.03934	0.8685511	0.46150
BCE19	BAY CAT-TRIP 19	0.97858	0.95761	0.06841	-0.05830	-2.683708	-0.19973
BCEL18	LAG BAY CAT-TRIP 18	0.99331	0.98666	0.02905	0.09156	1.863485	0.22060
VAR48	APR TPWD PRI MAT CAT-EFF	0.99622	0.99246	0.00580	-0.03152	2.451730	0.21120
VAR49	APR TPWD SEC MAT CAT-EFF	0.99989	0.99978	0.00732	0.42301	-1.400314	-0.17209
VAR58	MAR POSTLARVAL CAT-TOW	1.00000	0.99999	0.00022	0.07751	0.9332167E-01	0.03732
VAR52	MAY TPWD SEC GAL CAT-EFF	1.00000	1.00000	0.00001	0.78478	-0.3566009E-01	-0.03250
(CONSTANT)						251.3212	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 63. Summary statistics for the eighteen year (1960-1977) data set used to develop the stepwise multiple regression models relating brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 3)

VARIABLE	MEAN	STANDARD DEV	CASES
VAR2	45.9188	26.8701	18
VAR1	104.9322	41.4248	18
VAR91	44.0505	25.2547	18
CTEF18	559.2587	231.0820	18
CTEF19	510.0411	171.5263	18
CTEF193	624.0893	182.6940	18
XE18	89.1081	32.7578	18
XE19	203.3556	52.0091	18
XE193	69.3395	32.3205	18
VAR11	163.2923	35.9985	18
VAR12	501.0516	261.9093	18
VAR13	52.7872	13.7307	18
VAR14	152.6362	103.3874	18
VAR15	195.2136	167.2327	18
VAR16	51.3477	14.9693	18
VAR17	57.7572	17.8762	18
VAR18	8.4289	4.3649	18
VAR19	13.4756	7.2058	18
VAR20	11.3750	2.2638	16
VAR21	15.8375	2.4698	16
VAR22	12.6389	1.8069	18
VAR23	17.6944	1.9264	18
VAR24	17.5222	18.4394	18
VAR25	14.4118	10.0872	17
VAR26	5.7428	0.6199	18
VAR27	5.9511	0.6587	18
VAR28	35.9444	4.7088	18
VAR29	36.6667	6.7823	18
VAR30	60.0000	47.9890	18
VAR31	72.5000	39.2672	18
VAR36	6.8444	1.6964	18
VAR37	9.6556	1.9233	18
VAR38	150.1449	71.5719	18
VAR39	163.3561	35.9526	18
VAR40	495.0816	261.2084	18
VAR41	54.7422	13.9580	18
VAR42	143.9442	69.7521	18
VAR43	209.2222	71.7385	18
VAR44	209.1667	71.7776	18
VAR82	24.9901	4.6827	18

Table 63 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR83	29.1972	10.6647	18
VAR84	44.8700	30.6364	18
VAR85	108.1799	102.3199	18
VAR86	52.2644	35.5192	18
VAR87	26.6625	15.3928	18
VAR88	38.0157	33.6093	18
VAR89	16.9961	6.7987	18
VAR90	13.8867	5.6160	18
VAR97	60.2767	35.5524	18
VAR98	56.3552	43.4917	18
VAR99	14.1787	4.7994	18
VAR100	18.2192	5.0817	18
VAR101	55.5883	37.4985	18
VAR102	51.0435	42.9254	18
VAR103	13.4335	5.5785	18
VAR104	17.1790	5.0933	18
VAR107	33.3689	18.9375	18
VAR108	1.7778	1.2931	18
VAR109	3.1339	2.2953	18
VAR110	4.0344	3.2032	18
VAR111	49.6886	43.5903	18
VAR112	61.5504	59.5453	18
VAR113	79.3049	86.3253	18
VAR114	5.6578	0.6371	18
VAR115	36.1765	4.9779	17
VAR116	58.2353	38.1994	17
VAR117	16.1222	1.6875	18
VAR118	21.0824	1.3817	17
VAR119	24.9833	0.7501	18
BCE18	39.4609	20.8445	18
BCE19	27.9227	17.0681	18
BCEL18	36.7620	21.7365	18
BCEL19	26.4322	17.1968	18

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY

Table 64. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to river discharge variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR11	VAR12	VAR14	VAR15	VAR16	VAR17
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.62675	-0.41050	-0.42785	-0.09108	-0.52257	-0.48961
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	-0.23781	-0.27429	-0.29427	-0.42887	-0.14325	-0.44768
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	-0.28498	-0.16273	-0.30067	0.06689	-0.28674	-0.23188
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	-0.55916	-0.44582	-0.33680	-0.34193	-0.46548	-0.51567
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	-0.68683	-0.62516	-0.48314	-0.31014	-0.60893	-0.60407
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	-0.43502	-0.40151	-0.52494	-0.26428	-0.20202	-0.57043
VAR11	-0.62675	-0.23781	-0.28498	-0.55916	-0.68683	-0.43502	1.00000	0.73183	0.62697	0.29723	0.73081	0.87686
VAR12	-0.41050	-0.27429	-0.16273	-0.44582	-0.62516	-0.40151	0.73183	1.00000	0.68394	0.76553	0.57015	0.66539
VAR14	-0.42785	-0.29427	-0.30067	-0.33680	-0.48314	-0.52494	0.62697	0.68394	1.00000	0.32451	0.28799	0.62044
VAR15	-0.09108	-0.42887	0.06689	-0.34193	-0.31014	-0.26428	0.29723	0.76553	0.32451	1.00000	0.21550	0.31913
VAR16	-0.52257	-0.14325	-0.28674	-0.46548	-0.60893	-0.20202	0.73081	0.57015	0.28799	0.21550	1.00000	0.49504
VAR17	-0.48961	-0.44768	-0.23188	-0.51567	-0.60407	-0.57043	0.87686	0.66539	0.62044	0.31913	0.49504	1.00000
VAR38	-0.30551	0.10212	-0.10024	-0.11488	-0.25907	-0.14631	0.52252	0.67611	0.62578	0.40343	0.24442	0.39806
VAR39	-0.50985	0.10215	-0.40484	-0.32995	-0.40698	0.04631	0.46612	0.28130	0.14060	-0.02324	0.77920	0.23703
VAR40	-0.24804	0.26139	-0.24762	-0.07545	-0.26405	0.05851	0.23461	0.15569	0.18722	-0.06879	0.46137	0.05007
VAR42	-0.55435	0.13681	-0.41265	-0.40540	-0.60254	-0.26742	0.39959	0.51112	0.37419	0.21669	0.47799	0.14572
VAR43	-0.55550	-0.14217	-0.18445	-0.51393	-0.61624	-0.30380	0.96447	0.70693	0.61740	0.29267	0.76749	0.76923
VAR44	-0.55350	0.05643	-0.38647	-0.42752	-0.45875	-0.02908	0.45645	0.29748	0.16209	0.03785	0.73420	0.20086
VAR82	-0.31631	0.25681	0.04092	-0.09755	-0.31537	-0.09241	0.67960	0.50948	0.56581	0.13151	0.39897	0.45809
VAR83	-0.42251	0.03597	-0.18874	-0.32687	-0.31268	-0.18811	0.58151	0.33097	0.42367	0.10813	0.05824	0.38763
VAR84	-0.58120	-0.15356	-0.33480	-0.47037	-0.61489	-0.34178	0.65667	0.67330	0.42103	0.32156	0.71603	0.56791
VAR85	-0.29537	0.34016	-0.12055	-0.10184	-0.42150	0.03606	0.55845	0.41536	0.08353	-0.09980	0.60393	0.38643
VAR86	-0.42300	-0.17007	-0.25824	-0.31433	-0.23026	-0.21646	0.38762	0.51794	0.55572	0.48871	0.08915	0.25298
VAR87	-0.03018	0.47009	0.31960	0.14918	0.00316	0.14049	0.53397	0.39384	0.28224	0.07376	0.22286	0.43129
VAR88	-0.04118	0.33205	0.01383	0.19285	-0.11569	0.02108	0.26713	0.35684	0.16820	0.02403	0.28322	0.19923
VAR107	-0.26478	-0.25465	-0.18639	-0.30415	-0.34166	-0.29341	0.33322	0.63324	0.79659	0.50998	0.06022	0.31525
VAR111	-0.14795	-0.48499	-0.03000	-0.46791	-0.54389	-0.51207	0.49242	0.62893	0.60869	0.57737	0.16361	0.58042
VAR112	-0.11234	-0.24835	0.05216	-0.32370	-0.29262	-0.24639	0.20186	0.65006	0.38473	0.81675	-0.02516	0.18913
VAR113	0.02201	-0.42882	0.04045	-0.22836	-0.20273	-0.17071	0.12078	0.57025	0.14146	0.88103	0.22311	0.13205

Table 64 continued

	VAR38	VAR39	VAR40	VAR42	VAR43	VAR44	VAR82	VAR83	VAR84	VAR85	VAR86	VAR87
VAR1	-0.30551	-0.50985	-0.24804	-0.55435	-0.55550	-0.55350	-0.31631	-0.42251	-0.58120	-0.29537	-0.42300	-0.03018
VAR2	0.10212	0.10215	0.26139	0.13681	-0.14217	0.05643	0.25681	0.03597	-0.15356	0.34016	-0.17007	0.47009
VAR91	-0.10024	-0.40484	-0.24762	-0.41265	-0.18445	-0.38647	0.04092	-0.18874	-0.334[illegible]0	-0.12055	-0.25824	0.31960
CTEF18	-0.11488	-0.32995	-0.07545	-0.40540	-0.51393	-0.42752	-0.09755	-0.32687	-0.47037	-0.10184	-0.31433	0.14918
CTEF19	-0.25907	-0.40698	-0.26405	-0.60254	-0.61624	-0.45875	-0.31537	-0.31268	-0.61489	-0.42150	-0.23026	0.00316
CTEF193	-0.14631	0.04631	0.05851	-0.26742	-0.30380	-0.02908	-0.09241	-0.18811	-0.34178	0.03606	-0.21646	0.14049
VAR11	0.52252	0.46612	0.23461	0.39959	0.96447	0.45645	0.67960	0.58151	0.65667	0.55845	0.38762	0.53397
VAR12	0.67611	0.28130	0.15569	0.51112	0.70693	0.29748	0.50948	0.33097	0.67330	0.41536	0.51794	0.39384
VAR14	0.62578	0.14060	0.18722	0.37419	0.61740	0.16209	0.56581	0.42367	0.42103	0.08353	0.55572	0.28224
VAR15	0.40343	-0.02324	-0.06879	0.21669	0.29267	0.03785	0.13151	0.10813	0.32156	-0.09980	0.48871	0.07376
VAR16	0.24442	0.77920	0.46137	0.47799	0.76749	0.73420	0.39897	0.05824	0.71603	0.60393	0.08915	0.22286
VAR17	0.39806	0.23703	0.05007	0.14572	0.76923	0.20086	0.45809	0.38763	0.56791	0.38643	0.25298	0.43129
VAR38	1.00000	0.17548	0.06798	0.42273	0.56282	0.24449	0.55997	0.50759	0.37863	0.32400	0.82525	0.63270
VAR39	0.17548	1.00000	0.75139	0.60133	0.55798	0.96448	0.29660	-0.04787	0.66897	0.41700	0.08011	0.21081
VAR40	0.06798	0.75139	1.00000	0.67836	0.33032	0.72443	0.43555	-0.13084	0.49141	0.17549	-0.07281	0.19154
VAR42	0.42273	0.60133	0.67836	1.00000	0.44760	0.63950	0.42564	0.24672	0.68112	0.37004	0.30915	0.26117
VAR43	0.56282	0.55798	0.33032	0.44760	1.00000	0.56096	0.73205	0.56746	0.63704	0.51766	0.44192	0.56569
VAR44	0.24449	0.96448	0.72443	0.63950	0.56096	1.00000	0.31412	0.03558	0.60890	0.35450	0.20228	0.21680
VAR82	0.55997	0.29660	0.43555	0.42564	0.73205	0.31412	1.00000	0.52702	0.33361	0.41795	0.34145	0.68459
VAR83	0.50759	-0.04787	-0.13084	0.24672	0.56746	0.03558	0.52702	1.00000	0.11311	0.20608	0.60930	0.46608
VAR84	0.37863	0.66897	0.49141	0.68112	0.63704	0.60890	0.33361	0.11311	1.00000	0.47411	0.19899	0.37460
VAR85	0.32400	0.41700	0.17549	0.37004	0.51766	0.35450	0.41795	0.20608	0.47411	1.00000	-0.09641	0.49046
VAR86	0.82525	0.08011	-0.07281	0.30915	0.44192	0.20228	0.34145	0.60930	0.19899	-0.09641	1.00000	0.28944
VAR87	0.63270	0.21081	0.19154	0.26117	0.56569	0.21680	0.68459	0.46608	0.37460	0.49046	0.28944	1.00000
VAR88	0.67250	0.17852	0.08868	0.24088	0.25503	0.18500	0.32496	0.02752	0.23362	0.63425	0.23090	0.53840
VAR107	0.53315	0.01682	0.07537	0.39037	0.37970	0.03422	0.34051	0.36232	0.33235	-0.11913	0.61217	0.07850
VAR111	0.43250	-0.02831	0.10524	0.22472	0.49203	0.04422	0.38022	0.29267	0.16360	0.00203	0.40930	0.11488
VAR112	0.49152	-0.13027	-0.07206	0.34782	0.23510	-0.02086	0.21514	0.30520	0.15014	-0.10794	0.60996	0.07787
VAR113	0.06397	-0.03584	-0.02196	0.09685	0.09484	-0.01192	-0.06054	-0.10025	0.25073	-0.19801	0.18709	-0.15282

Table 64 continued

	VAR88	VAR107	VAR111	VAR112	VAR113
VAR1	-0.04118	-0.26478	-0.14795	-0.11234	0.02201
VAR2	0.33205	-0.25465	-0.48499	-0.24835	-0.42882
VAR91	0.01383	-0.18639	-0.03000	0.05216	0.04045
CTEF18	0.19285	-0.30415	-0.46791	-0.32370	-0.22836
CTEF19	-0.11569	-0.34166	-0.54389	-0.29262	-0.20273
CTEF193	0.02108	-0.29341	-0.51207	-0.24639	-0.17071
VAR11	0.26713	0.33322	0.49242	0.20186	0.12078
VAR12	0.35684	0.63324	0.62893	0.65006	0.57025
VAR14	0.16820	0.79659	0.60869	0.38473	0.14146
VAR15	0.02403	0.50998	0.57737	0.81675	0.88103
VAR16	0.28322	0.06022	0.16361	-0.02516	0.22311
VAR17	0.19923	0.31525	0.58042	0.18913	0.13205
VAR38	0.67250	0.53315	0.43250	0.49152	0.06397
VAR39	0.17852	0.01682	-0.02831	-0.13027	-0.03584
VAR40	0.08868	0.07537	0.10524	-0.07206	-0.02196
VAR42	0.24088	0.39037	0.22472	0.34782	0.09685
VAR43	0.25503	0.37970	0.49203	0.23510	0.09484
VAR44	0.18500	0.03422	0.04422	-0.02086	-0.01192
VAR82	0.32496	0.34051	0.38022	0.21514	-0.06054
VAR83	0.02752	0.36232	0.29267	0.30520	-0.10025
VAR84	0.23362	0.33235	0.16360	0.15014	0.25073
VAR85	0.63425	-0.11913	0.00203	-0.10794	-0.19801
VAR86	0.23090	0.61217	0.40930	0.60996	0.18709
VAR87	0.53840	0.07850	0.11488	0.07787	-0.15282
VAR88	1.00000	-0.10400	0.11629	-0.00189	-0.15697
VAR107	-0.10400	1.00000	0.56819	0.67322	0.29191
VAR111	0.11629	0.56819	1.00000	0.65962	0.32783
VAR112	-0.00189	0.67322	0.65962	1.00000	0.53051
VAR113	-0.15697	0.29191	0.32783	0.53051	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 65. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR111	MAR TRIN DIS	0.48499	0.23521	0.23521	-0.48499	-0.3003354	-0.48722
VAR87	JUL-SEP GUAD DIS	0.71790	0.51538	0.28017	0.47009	1.217901	0.69768
VAR17	APR-JUN MISS DIS	0.87252	0.76129	0.24590	-0.44768	-0.7154064	-0.47595
VAR85	OCT-DEC TRIN DIS	0.91224	0.83218	0.07090	0.34016	0.8257540E-01	0.31444
VAR15	APR-JUN TRIN DIS	0.92723	0.85976	0.02757	-0.42887	-0.6655966E-01	-0.41425
VAR40	LAG ANNUAL TRIN DIS	0.93347	0.87138	0.01162	0.26139	0.7406835E-01	0.72003
VAR84	JUL-SEP TRIN DIS	0.95029	0.90306	0.03168	-0.15356	-0.5531390	-0.63067
VAR107	JAN-MAR GUAD DIS	0.96990	0.94071	0.03765	-0.25465	0.7905533E-01	0.05572
VAR82	JUL-SEP MISS DIS	0.97927	0.95898	0.01827	0.25681	-1.906782	-0.33229
VAR44	LAG ANNUAL ATCH DIS	0.98868	0.97749	0.01851	0.05643	-0.3420796	-0.91379
VAR112	APR TRIN DIS	0.99269	0.98542	0.00793	-0.24835	0.2043217	0.45279
VAR39	LAG ANNUAL MISS DIS	0.99701	0.99404	0.00861	0.10215	0.5721530	0.76555
VAR11	ANNUAL MISS DIS	0.99846	0.99692	0.00289	-0.23781	0.6329452E-01	0.08480
VAR42	LAG ANNUAL GUAD DIS	0.99888	0.99776	0.00084	0.13681	-0.6065118E-01	-0.15744
VAR12	ANNUAL TRIN DIS	0.99947	0.99894	0.00118	-0.27429	0.4628263E-01	0.45113
VAR83	OCT-DEC MISS DIS	1.00000	1.00000	0.00106	0.03597	0.2746063	0.10899
VAR86	APR-JUN GUAD DIS	1.00000	1.00000	0.00000	-0.17007	0.6918180E-03	0.00091
(CONSTANT)						39.57401	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 66. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.62675	0.39282	0.39282	-0.62675	-1.051308	-0.91360
VAR87	JUL-SEP GUAD DIS	0.72285	0.52251	0.12969	-0.03018	3.552955	1.32022
VAR42	LAG ANNUAL GUAD DIS	0.80506	0.64812	0.12561	-0.55435	-0.5340614	-0.89927
VAR111	MAR TRIN DIS	0.85235	0.72650	0.07838	-0.14795	-0.8747861E-01	-0.09205
VAR16	JAN-MAR MISS DIS	0.90204	0.81367	0.08717	-0.52257	3.377530	1.22050
VAR44	LAG ANNUAL ATCH DIS	0.92952	0.86401	0.05034	-0.55350	-0.1223308	-0.21197
VAR88	OCT-DEC GUAD DIS	0.95117	0.90473	0.04073	-0.04118	2.958159	2.40005
VAR15	APR-JUN TRIN DIS	0.95868	0.91907	0.01433	-0.09108	0.3768852	1.52149
VAR83	OCT-DEC MISS DIS	0.96140	0.92429	0.00522	-0.42251	3.971438	1.02243
VAR12	ANNUAL TRIN DIS	0.96531	0.93182	0.00753	-0.41050	-0.4097029	-2.59036
VAR38	ANNUAL GUAD DIS	0.97064	0.94213	0.01031	-0.30551	-1.672744	-2.89009
VAR40	LAG ANNUAL TRIN DIS	0.97496	0.95054	0.00841	-0.24804	0.8917417E-01	0.56230
VAR82	JUL-SEP MISS DIS	0.98715	0.97446	0.02391	-0.31631	-4.796746	-0.54222
VAR84	JUL-SEP TRIN DIS	0.98978	0.97966	0.00520	-0.58120	0.4843712E-01	0.03582
VAR107	JAN-MAR GUAD DIS	0.99165	0.98337	0.00372	-0.26478	3.726036	1.70337
VAR112	APR TRIN DIS	0.99325	0.98655	0.00317	-0.11234	0.4668692	0.67109
VAR14	JAN-MAR TRIN DIS	1.00000	1.00000	0.01345	-0.42785	0.2679347	0.66871
(CONSTANT)						149.2874	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 67. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR42	LAG ANNUAL GUAD DIS	0.41265	0.17028	0.17028	-0.41265	-0.1070928	-0.29578
VAR87	JUL-SEP GUAD DIS	0.60523	0.36630	0.19602	0.31960	0.8198648	0.49971
VAR11	ANNUAL MISS DIS	0.72312	0.52290	0.15659	-0.28498	-2.676030	-3.81445
VAR43	ANNUAL ATCH DIS	0.79146	0.62641	0.10351	-0.18445	1.091261	3.09983
VAR39	LAG ANNUAL MISS DIS	0.83799	0.70223	0.07582	-0.40484	-0.5990765	-0.85284
VAR86	APR-JUN GUAD DIS	0.92055	0.84741	0.14518	-0.25824	-0.1946656	-0.27378
VAR15	APR-JUN TRIN DIS	0.97575	0.95209	0.10468	0.06689	0.2689768	1.78112
VAR84	JUL-SEP TRIN DIS	0.97938	0.95918	0.00709	-0.33480	0.4498473	0.54571
VAR107	JAN-MAR GUAD DIS	0.98701	0.97419	0.01501	-0.18639	-1.410755	-1.05787
VAR113	MAY TRIN DIS	0.99177	0.98361	0.00942	0.04045	-0.2850403	-0.97432
VAR14	JAN-MAR TRIN DIS	0.99410	0.98824	0.00463	-0.30067	0.2118868	0.86742
VAR83	OCT-DEC MISS DIS	0.99551	0.99104	0.00280	-0.18874	-0.8258756E-01	-0.03488
VAR111	MAR TRIN DIS	0.99616	0.99234	0.00129	-0.03000	0.1452733	0.25074
VAR88	OCT-DEC GUAD DIS	0.99631	0.99264	0.00030	0.01383	-0.5197952	-0.69175
VAR85	OCT-DEC TRIN DIS	0.99826	0.99653	0.00388	-0.12055	0.1550664	0.62825
VAR112	APR TRIN DIS	0.99980	0.99960	0.00308	0.05216	-0.1968350	-0.46410
VAR17	APR-JUN MISS DIS	1.00000	1.00000	0.00040	-0.23188	-0.3901998	-0.27620
(CONSTANT)						351.7788	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 68. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.55916	0.31266	0.31266	-0.55916	18.31352	2.85292
VAR87	JUL-SEP GUAD DIS	0.77013	0.59310	0.28044	0.14918	13.62448	0.90755
VAR42	LAG ANNUAL GUAD DIS	0.80421	0.64675	0.05364	-0.40540	-2.864997	-0.86480
VAR40	LAG ANNUAL TRIN DIS	0.83373	0.69510	0.04835	-0.07545	0.7598938	0.85896
VAR44	LAG ANNUAL ATCH DIS	0.86066	0.74074	0.04564	-0.42752	0.2282453	0.07090
VAR16	JAN-MAR MISS DIS	0.89342	0.79821	0.05747	-0.46548	-3.693420	-0.23926
VAR38	ANNUAL GUAD DIS	0.90957	0.82732	0.02912	-0.11488	-12.06943	-3.73820
VAR111	MAR TRIN DIS	0.93633	0.87671	0.04939	-0.46791	-8.896061	-1.67811
VAR84	JUL-SEP TRIN DIS	0.94520	0.89340	0.01669	-0.47037	-2.648415	-0.35112
VAR12	ANNUAL TRIN DIS	0.95131	0.90498	0.01158	-0.44582	-3.704549	-4.19875
VAR82	JUL-SEP MISS DIS	0.96198	0.92541	0.02042	-0.09755	-24.11353	-0.48864
VAR113	MAY TRIN DIS	0.97436	0.94937	0.02397	-0.22836	4.196899	1.56784
VAR112	APR TRIN DIS	0.97953	0.95949	0.01011	-0.32370	7.753439	1.99791
VAR83	OCT-DEC MISS DIS	0.98226	0.96484	0.00535	-0.32687	7.075006	0.32652
VAR85	OCT-DEC TRIN DIS	0.98272	0.96573	0.00089	-0.10184	-1.163067	-0.51499
VAR88	OCT-DEC GUAD DIS	0.98549	0.97119	0.00546	0.19285	30.87886	4.49112
VAR107	JAN-MAR GUAD DIS	1.00000	1.00000	0.02881	-0.30415	40.65727	3.33192
(CONSTANT)						-1205.947	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 69. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.68683	0.47174	0.47174	-0.68683	13.19402	2.76905
VAR87	JUL-SEP GUAD DIS	0.81434	0.66315	0.19141	0.00316	4.307058	0.38652
VAR42	LAG ANNUAL GUAD DIS	0.90103	0.81185	0.14870	-0.60254	-1.900244	-0.77274
VAR40	LAG ANNUAL TRIN DIS	0.91286	0.83332	0.02146	-0.26405	0.2698347	0.41092
VAR86	APR-JUN GUAD DIS	0.92281	0.85157	0.01826	-0.23026	-6.687447	-1.38482
VAR111	MAR TRIN DIS	0.93990	0.88340	0.03183	-0.54389	-5.709622	-1.45100
VAR112	APR TRIN DIS	0.95083	0.90409	0.02068	-0.29262	5.891726	2.04531
VAR44	LAG ANNUAL ATCH DIS	0.95920	0.92006	0.01597	-0.45875	0.6914921	0.28936
VAR16	JAN-MAR MISS DIS	0.96207	0.92558	0.00552	-0.60893	-2.454386	-0.21420
VAR15	APR-JUN TRIN DIS	0.96660	0.93432	0.00873	-0.31014	-3.126609	-3.04834
VAR82	JUL-SEP MISS DIS	0.97312	0.94696	0.01264	-0.31537	-17.76288	-0.48492
VAR84	JUL-SEP TRIN DIS	0.97982	0.96005	0.01310	-0.61489	-4.391045	-0.78429
VAR107	JAN-MAR GUAD DIS	0.98710	0.97437	0.01431	-0.34166	19.20430	2.12026
VAR85	OCT-DEC TRIN DIS	0.98857	0.97727	0.00290	-0.42150	-3.694265	-2.20372
VAR88	OCT-DEC GUAD DIS	0.99051	0.98111	0.00384	-0.11569	11.11925	2.17873
VAR14	JAN-MAR TRIN DIS	0.99403	0.98810	0.00699	-0.48314	-2.907843	-1.75270
VAR113	MAY TRIN DIS	1.00000	1.00000	0.01190	-0.20273	3.366539	1.69430
(CONSTANT)						-603.1176	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 70. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR17	APR-JUN MISS DIS	0.57043	0.32539	0.32539	-0.57043	-24.27004	-2.37477
VAR87	JUL-SEP GUAD DIS	0.71338	0.50892	0.18353	0.14049	1.574206	0.13263
VAR42	LAG ANNUAL GUAD DIS	0.76958	0.59226	0.08334	-0.26742	-3.589666	-1.37053
VAR40	LAG ANNUAL TRIN DIS	0.81430	0.66309	0.07083	0.05851	1.167031	1.66857
VAR85	OCT-DEC TRIN DIS	0.85056	0.72346	0.06037	0.03606	-2.397706	-1.34286
VAR107	JAN-MAR GUAD DIS	0.88681	0.78643	0.06297	-0.29341	13.03081	1.35073
VAR14	JAN-MAR TRIN DIS	0.93583	0.87579	0.08936	-0.52494	-3.165533	-1.79139
VAR86	APR-JUN GUAD DIS	0.94645	0.89577	0.01998	-0.21646	-5.337911	-1.03779
VAR111	MAR TRIN DIS	0.95463	0.91132	0.01555	-0.51207	-4.662948	-1.11257
VAR82	JUL-SEP MISS DIS	0.95920	0.92006	0.00874	-0.09241	-50.30081	-1.28927
VAR84	JUL-SEP TRIN DIS	0.96811	0.93725	0.01719	-0.34178	-6.100800	-1.02306
VAR113	MAY TRIN DIS	0.98187	0.96407	0.02682	-0.17071	-2.506161	-1.18419
VAR11	ANNUAL MISS DIS	0.98779	0.97574	0.01167	-0.43502	21.37236	4.21126
VAR44	LAG ANNUAL ATCH DIS	0.98957	0.97926	0.00352	-0.02908	-0.1642077	-0.06451
VAR12	ANNUAL TRIN DIS	0.99302	0.98609	0.00683	-0.40151	2.115812	3.03322
VAR16	JAN-MAR MISS DIS	0.99418	0.98840	0.00231	-0.20202	-13.97558	-1.14511
VAR88	OCT-DEC GUAD DIS	1.00000	1.00000	0.01160	0.02108	4.720903	0.86848
(CONSTANT)						493.1719	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 71. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to salinity variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR24	VAR25
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.13777	-0.06943
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	0.01970	0.20257
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	-0.00215	-0.08152
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	-0.01606	0.16882
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	0.17078	0.36166
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	0.09780	0.28237
VAR24	-0.13777	0.01970	-0.00215	-0.01606	0.17078	0.09780	1.00000	0.92009
VAR25	-0.06943	0.20257	-0.08152	0.16882	0.36166	0.28237	0.92009	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 72. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with salinity variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	APR NOS GAL MIN DEN	0.20257	0.04104	0.04104	0.20257	268590.7	1.03138
VAR24	MAR NOS GAL MIN DEN	0.40687	0.16554	0.12451	0.04817	-124912.6	-0.90080
(CONSTANT)						2753265.	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 73. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with salinity variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR24	MAR NOS GAL MIN DEN	0.14079	0.01982	0.01982	-0.14079	-112927.8	-0.50124
VAR25	APR NOS GAL MIN DEN	0.20826	0.04337	0.02355	-0.06943	165753.1	0.39175
(CONSTANT)						0.1015295E+08	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 74. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with salinity variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	APR NOS GAL MIN DEN	0.08152	0.00665	0.00665	-0.08152	-105231.0	-0.41643
VAR24	MAR NOS GAL MIN DEN	0.16424	0.02698	0.02033	-0.01915	48979.35	0.36400
(CONSTANT)						5166834.	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 75. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with salinity variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	APR NOS GAL MIN DEN	0.16882	0.02850	0.02850	0.16882	26.88392	1.14499
VAR24	MAR NOS GAL MIN DEN	0.44857	0.20122	0.17272	-0.00746	-13.26465	-1.06095
(CONSTANT)						403.1495	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 76. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with salinity variables for the eighteen year (1960-1977) data set.**

REGRESSION ON BROWN CATCH/EFFORT WITH ENVIRONMENTAL VARIABLES 05/25/81 PAGE 21

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	APR NOS GAL MIN DEN	0.36166	0.13080	0.13080	0.36166	22.53847	1.28955
VAR24	MAR NOS GAL MIN DEN	0.53559	0.28685	0.15605	0.17802	-9.385573	-1.00848
(CONSTANT)						349.9570	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 77. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with salinity variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	APR NOS GAL MIN DEN	0.28237	0.07974	0.07974	0.28237	21.77898	1.17787
VAR24	MAR NOS GAL MIN DEN	0.47443	0.22509	0.14535	0.11047	-9.582612	-0.97327
(CONSTANT)						475.5757	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 78. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to precipitation variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR13	VAR18	VAR19	VAR41	VAR89	VAR90
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.15218	-0.01283	-0.19688	-0.02894	-0.21275	0.14807
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	-0.32945	-0.32235	-0.46965	0.16822	-0.19941	0.28907
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	0.03525	0.03950	0.01500	0.02232	-0.00500	0.04230
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	-0.32459	-0.26916	-0.48790	0.09096	-0.29031	0.39306
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	-0.51805	-0.30890	-0.55649	-0.18080	-0.33316	0.09084
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	-0.44762	-0.15274	-0.45830	-0.08263	-0.42375	0.12535
VAR13	-0.15218	-0.32945	0.03525	-0.32459	-0.51805	-0.44762	1.00000	0.59707	0.76649	0.01058	0.67903	0.17537
VAR18	-0.01283	-0.32235	0.03950	-0.26916	-0.30890	-0.15274	0.59707	1.00000	0.60929	-0.06346	0.20706	-0.34987
VAR19	-0.19688	-0.46965	0.01500	-0.48790	-0.55649	-0.45830	0.76649	0.60929	1.00000	0.12092	0.25729	-0.19411
VAR41	-0.02894	0.16822	0.02232	0.09096	-0.18080	-0.08263	0.01058	-0.06346	0.12092	1.00000	-0.20196	0.16455
VAR89	-0.21275	-0.19941	-0.00500	-0.29031	-0.33316	-0.42375	0.67903	0.20706	0.25729	-0.20196	1.00000	-0.04149
VAR90	0.14807	0.28907	0.04230	0.39306	0.09084	0.12535	0.17537	-0.34987	-0.19411	0.16455	-0.04149	1.00000
VAR108	0.12284	-0.06794	-0.07632	-0.05621	-0.21756	0.02438	0.28803	0.51313	0.29716	0.07541	-0.09210	0.03560
VAR109	-0.21738	-0.40810	0.06245	-0.50590	-0.57316	-0.47627	0.50816	0.44830	0.66288	0.11358	0.10449	-0.08304
VAR110	-0.06057	0.03209	0.00502	-0.18018	-0.19558	0.27842	0.14180	0.49347	0.40060	0.25657	-0.18385	-0.32829

	VAR108	VAR109	VAR110
VAR1	0.12284	-0.21738	-0.06057
VAR2	-0.06794	-0.40810	0.03209
VAR91	-0.07632	0.06245	0.00502
CTEF18	-0.05621	-0.50590	-0.18018
CTEF19	-0.21756	-0.57316	-0.19558
CTEF193	0.02438	-0.47627	0.27842
VAR13	0.28803	0.50816	0.14180
VAR18	0.51313	0.44830	0.49347
VAR19	0.29716	0.66288	0.40060
VAR41	0.07541	0.11358	0.25657
VAR89	-0.09210	0.10449	-0.18385
VAR90	0.03560	-0.08304	-0.32829
VAR108	1.00000	0.09529	0.39899
VAR109	0.09529	1.00000	0.17273
VAR110	0.39899	0.17273	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 79. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR19	APR-JUN FRE PREC	0.46965	0.22057	0.22057	-0.46965	-1.602133	-0.42965
VAR110	MAY FRE PREC	0.52759	0.27835	0.05777	0.03209	2.724930	0.32484
VAR90	OCT-DEC FRE PREC	0.59720	0.35665	0.07830	0.28907	1.352473	0.28267
VAR109	APR FRE PREC	0.60634	0.36764	0.01099	-0.40810	-1.895822	-0.16194
VAR41	LAG ANNUAL FRE PREC	0.61652	0.38009	0.01245	0.16822	0.2198844	0.11422
VAR108	MAR FRE PREC	0.61983	0.38419	0.00410	-0.06794	-1.519492	-0.07312
(CONSTANT)						34.33914	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 80. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.21738	0.04726	0.04726	-0.21738	-4.240944	-0.23498
VAR89	JUL-SEP FRE PREC	0.28943	0.08377	0.03651	-0.21275	-4.289774	-0.70405
VAR13	ANNUAL FRE PREC	0.31877	0.10162	0.01785	-0.15218	2.807453	0.93056
VAR19	APR-JUN FRE PREC	0.36414	0.13260	0.03098	-0.19688	-3.295171	-0.57319
VAR90	OCT-DEC FRE PREC	0.37568	0.14114	0.00854	0.14807	-1.654860	-0.22435
VAR110	MAY FRE PREC	0.39017	0.15223	0.01109	-0.06057	-1.871550	-0.14472
VAR108	MAR FRE PREC	0.39192	0.15360	0.00137	0.12284	1.551149	0.04842
(CONSTANT)						115.1125	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 81. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR108	MAR FRE PREC	0.07632	0.00582	0.00582	-0.07632	-3.469194	-0.17763
VAR18	JAN-MAR FRE PREC	0.11927	0.01422	0.00840	0.03950	1.042237	0.18013
VAR90	OCT-DEC FRE PREC	0.15150	0.02295	0.00873	0.04230	0.4919523	0.10940
VAR89	JUL-SEP FRE PREC	0.15991	0.02557	0.00262	-0.00500	-0.2010417	-0.05412
(CONSTANT)						38.01841	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 82. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with precipitation variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.50590	0.25593	0.25593	-0.50590	-47.65464	-0.47334
VAR90	OCT-DEC FRE PREC	0.61646	0.38002	0.12409	0.39306	16.43586	0.39944
VAR89	JUL-SEP FRE PREC	0.65700	0.43165	0.05163	-0.29031	-9.059969	-0.26656
VAR18	JAN-MAR FRE PREC	0.66867	0.44712	0.01547	-0.26916	20.97449	0.39618
VAR108	MAR FRE PREC	0.68660	0.47142	0.02430	-0.05621	-29.51476	-0.16516
VAR19	APR-JUN FRE PREC	0.69828	0.48760	0.01618	-0.48790	-6.260417	-0.19522
VAR41	LAG ANNUAL FRE PREC	0.70309	0.49434	0.00674	0.09096	1.838304	0.11104
VAR110	MAY FRE PREC	0.70652	0.49917	0.00483	-0.18018	-6.939198	-0.09619
(CONSTANT)						521.7526	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 83. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.57316	0.32852	0.32852	-0.57316	-36.81856	-0.49268
VAR89	JUL-SEP FRE PREC	0.63562	0.40402	0.07550	-0.33316	-12.57031	-0.49825
VAR108	MAR FRE PREC	0.66429	0.44128	0.03727	-0.21756	-35.68103	-0.26899
VAR41	LAG ANNUAL FRE PREC	0.68615	0.47080	0.02952	-0.18080	-1.692139	-0.13770
VAR18	JAN-MAR FRE PREC	0.69286	0.48005	0.00925	-0.30890	8.152277	0.20745
VAR19	APR-JUN FRE PREC	0.70533	0.49749	0.01744	-0.55649	-7.453866	-0.31314
VAR13	ANNUAL FRE PREC	0.71454	0.51057	0.01308	-0.51805	3.453215	0.27643
VAR110	MAY FRE PREC	0.71662	0.51355	0.00298	-0.19558	-4.045640	-0.07555
(CONSTANT)						860.9037	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 84. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR109	APR FRE PREC	0.47627	0.22683	0.22683	-0.47627	-23.65207	-0.29715
VAR89	JUL-SEP FRE PREC	0.60683	0.36824	0.14141	-0.42375	-17.21528	-0.64065
VAR110	MAY FRE PREC	0.67474	0.45528	0.08704	0.27842	33.17747	0.58171
VAR19	APR-JUN FRE PREC	0.72539	0.52618	0.07091	-0.45830	-19.78619	-0.78041
VAR13	ANNUAL FRE PREC	0.75089	0.56384	0.03765	-0.44762	9.972243	0.74948
VAR41	LAG ANNUAL FRE PREC	0.77465	0.60008	0.03624	-0.08263	-3.054411	-0.23336
VAR108	MAR FRE PREC	0.78856	0.62182	0.02174	0.02438	-23.45177	-0.16599
VAR18	JAN-MAR FRE PREC	0.78988	0.62391	0.00209	-0.15274	-3.163144	-0.07557
(CONSTANT)						832.7344	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 85. **Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to temperature variables.**

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR20	VAR21	VAR22	VAR23	VAR36	VAR37
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.11998	0.31908	-0.63786	0.36554	0.10933	-0.16407
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	0.27488	0.32104	0.03076	0.46818	0.18755	0.07653
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	-0.13251	0.21548	-0.34241	0.24972	0.17490	-0.15753
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	0.13134	0.58306	-0.46874	0.50184	0.28831	-0.18952
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	0.07211	0.46879	-0.30064	0.50657	0.23450	-0.20968
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	-0.05368	0.26794	-0.12267	0.50983	0.25111	0.07493
VAR20	-0.11998	0.27488	-0.13251	0.13134	0.07211	-0.05368	1.00000	0.27419	0.52762	0.35021	-0.36573	-0.16409
VAR21	0.31908	0.32104	0.21548	0.58306	0.46879	0.26794	0.27419	1.00000	-0.25331	0.76171	0.00815	-0.19991
VAR22	-0.63786	0.03076	-0.34241	-0.46874	-0.30064	-0.12267	0.52762	-0.25331	1.00000	0.05499	-0.11209	0.22904
VAR23	0.36554	0.46818	0.24972	0.50184	0.50657	0.50983	0.35021	0.76171	0.05499	1.00000	-0.02602	-0.06008
VAR36	0.10933	0.18755	0.17490	0.28831	0.23450	0.25111	-0.36573	0.00815	-0.11209	-0.02602	1.00000	0.04301
VAR37	-0.16407	0.07653	-0.15753	-0.18952	-0.20968	0.07493	-0.16409	-0.19991	0.22904	-0.06008	0.04301	1.00000
VAR117	-0.49219	0.26202	-0.28656	-0.20630	-0.12591	0.10658	0.69758	-0.03360	0.90101	0.17990	-0.09160	0.18011
VAR118	0.51118	0.45416	0.32608	0.64421	0.72344	0.70669	0.14741	0.59736	-0.01650	0.86059	0.19878	-0.10895
VAR119	-0.14415	-0.03498	-0.22690	0.01275	0.16111	0.20304	0.02885	0.33708	0.09989	0.29140	0.12635	0.06225

	VAR117	VAR118	VAR119
VAR1	-0.49219	0.51118	-0.14415
VAR2	0.26202	0.45416	-0.03498
VAR91	-0.28656	0.32608	-0.22690
CTEF18	-0.20630	0.64421	0.01275
CTEF19	-0.12591	0.72344	0.16111
CTEF193	0.10658	0.70669	0.20304
VAR20	0.69758	0.14741	0.02885
VAR21	-0.03360	0.59736	0.33708
VAR22	0.90101	-0.01650	0.09989
VAR23	0.17990	0.86059	0.29140
VAR36	-0.09160	0.19878	0.12635
VAR37	0.18011	-0.10895	0.06225
VAR117	1.00000	0.13440	0.15924
VAR118	0.13440	1.00000	0.24608
VAR119	0.15924	0.24608	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 86. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with temperature variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR23	APR NOS GAL MIN TEMP	0.46818	0.21919	0.21919	0.46818	15.68756	1.12471
VAR36	JAN NOS GAL MIN TEMP	0.50903	0.25911	0.03992	0.18755	4.212767	0.26597
VAR20	MAR TRIN MIN TEMP	0.55078	0.30336	0.04425	0.27488	-1.705330	-0.14367
VAR119	MAY NOS GAL MEAN TEMP	0.58693	0.34449	0.04113	-0.03498	-8.414130	-0.23489
VAR37	FEB NOS GAL MIN TEMP	0.60455	0.36548	0.02099	0.07653	0.4486525	0.03211
VAR22	MAR NOS GAL MIN TEMP	0.62088	0.38549	0.02000	0.03076	-21.04711	-1.41532
VAR117	MAR NOS GAL MEAN TEMP	0.71249	0.50764	0.12215	0.26202	24.44322	1.53510
VAR21	APR TRIN MIN TEMP	0.73062	0.53380	0.02616	0.32104	-4.962647	-0.45615
VAR118	APR NOS GAL MEAN TEMP	0.74796	0.55945	0.02564	0.45416	-8.582840	-0.44134
(CONSTANT)						96.25676	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 87. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR22	MAR NOS GAL MIN TEMP	0.63786	0.40686	0.40686	-0.63786	-15.76290	-0.68756
VAR118	APR NOS GAL MEAN TEMP	0.81092	0.65759	0.25072	0.51118	24.63121	0.82155
VAR119	MAY NOS GAL MEAN TEMP	0.83822	0.70262	0.04503	-0.14415	-4.988624	-0.09033
VAR20	MAR TRIN MIN TEMP	0.85148	0.72502	0.02240	-0.11998	10.88773	0.59499
VAR21	APR TRIN MIN TEMP	0.88647	0.78582	0.06080	0.31908	-6.036822	-0.35992
VAR37	FEB NOS GAL MIN TEMP	0.89452	0.80017	0.01434	-0.16407	3.796063	0.17625
VAR117	MAR NOS GAL MEAN TEMP	0.89897	0.80814	0.00797	-0.49219	-9.813098	-0.39976
VAR36	JAN NOS GAL MIN TEMP	0.90055	0.81099	0.00285	0.10933	1.303781	0.05339
VAR23	APR NOS GAL MIN TEMP	0.90129	0.81232	0.00133	0.36554	-2.745397	-0.12767
(CONSTANT)						42.47699	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 88. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR22	MAR NOS GAL MIN TEMP	0.34241	0.11725	0.11725	-0.34241	-4.394412	-0.31441
VAR118	APR NOS GAL MEAN TEMP	0.46899	0.21995	0.10270	0.32608	3.424976	0.18738
VAR119	MAY NOS GAL MEAN TEMP	0.54742	0.29967	0.07973	-0.22690	-10.26567	-0.30490
VAR36	JAN NOS GAL MIN TEMP	0.55694	0.31018	0.01051	0.17490	2.241598	0.15058
VAR23	APR NOS GAL MIN TEMP	0.56204	0.31588	0.00570	0.24972	3.369051	0.25699
VAR37	FEB NOS GAL MIN TEMP	0.56358	0.31763	0.00174	-0.15753	-0.7004906	-0.05335
VAR21	APR TRIN MIN TEMP	0.56516	0.31941	0.00178	0.21548	-0.8279267	-0.08097
(CONSTANT)						228.7750	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 89. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.80811	0.65303	0.65303	0.80811	100.4722	0.66206
VAR37	FEB NOS GAL MIN TEMP	0.82383	0.67870	0.02567	0.00722	23.34213	0.19686
VAR21	APR TRIN MIN TEMP	0.83751	0.70142	0.02272	0.58752	6.202800	0.07149
VAR22	MAR NOS GAL MIN TEMP	0.84598	0.71567	0.01426	-0.25889	-49.58331	-0.34693
VAR20	MAR TRIN MIN TEMP	0.85435	0.72991	0.01423	0.13999	33.63191	0.35501
VAR36	JAN NOS GAL MIN TEMP	0.88006	0.77451	0.04460	0.27837	35.59752	0.28054
VAR119	MAY NOS GAL MEAN TEMP	0.88344	0.78047	0.00596	0.18465	-23.84406	-0.08435
(CONSTANT)						-1322.523	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 90. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.77281	0.59724	0.59724	0.77281	92.44649	0.73165
VAR22	MAR NOS GAL MIN TEMP	0.78420	0.61497	0.01773	-0.23148	-29.75161	-0.25003
VAR36	JAN NOS GAL MIN TEMP	0.78800	0.62094	0.00597	0.24237	15.05233	0.14248
VAR20	MAR TRIN MIN TEMP	0.79447	0.63118	0.01025	0.07652	14.36016	0.18206
VAR21	APR TRIN MIN TEMP	0.79665	0.63465	0.00347	0.46921	-7.096517	-0.09824
VAR119	MAY NOS GAL MEAN TEMP	0.79771	0.63635	0.00169	0.23737	10.58205	0.04496
(CONSTANT)						-1493.064	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 91. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19,11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.72228	0.52169	0.52169	0.72228	118.6422	0.87075
VAR37	FEB NOS GAL MIN TEMP	0.77756	0.60461	0.08291	0.14869	28.07496	0.26372
VAR21	APR TRIN MIN TEMP	0.79607	0.63373	0.02912	0.26819	-19.52054	-0.25059
VAR119	MAY NOS GAL MEAN TEMP	0.80636	0.65022	0.01650	0.22794	29.15345	0.11487
VAR36	JAN NOS GAL MIN TEMP	0.81051	0.65693	0.00670	0.30287	9.865129	0.08659
VAR22	MAR NOS GAL MIN TEMP	0.81195	0.65927	0.00234	-0.11805	-6.441553	-0.05020
(CONSTANT)						-2582.398	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 92. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to wind and tide variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR26	VAR27	VAR28	VAR29	VAR30	VAR31
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.52860	-0.50371	-0.09341	-0.28389	-0.28377	-0.38538
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	-0.08945	0.09308	-0.62797	-0.52132	0.08369	-0.30075
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	-0.20145	-0.12270	-0.05883	-0.31774	-0.28851	-0.45931
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	-0.51649	-0.35456	-0.37089	-0.27706	-0.04312	-0.23163
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	-0.47087	-0.36227	-0.13987	-0.29646	-0.04868	-0.16280
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	-0.22334	-0.07273	-0.31250	-0.61554	0.21728	-0.19755
VAR26	-0.52860	-0.08945	-0.20145	-0.51649	-0.47087	-0.22334	1.00000	0.65061	-0.01123	-0.25483	0.21772	-0.05371
VAR27	-0.50371	0.09308	-0.12270	-0.35456	-0.36227	-0.07273	0.65061	1.00000	-0.21712	-0.31209	0.25484	0.14475
VAR28	-0.09341	-0.62797	-0.05883	-0.37089	-0.13987	-0.31250	-0.01123	-0.21712	1.00000	0.37513	0.15619	-0.20599
VAR29	-0.28389	-0.52132	-0.31774	-0.27706	-0.29646	-0.61554	-0.25483	-0.31209	0.37513	1.00000	0.21959	-0.08614
VAR30	-0.28377	0.08369	-0.28851	-0.04312	-0.04868	0.21728	0.21772	0.25484	0.15619	0.21959	1.00000	-0.16154
VAR31	-0.38538	-0.30075	-0.45931	-0.23163	-0.16280	-0.19755	-0.05371	0.14475	-0.20599	-0.08614	-0.16154	1.00000
VAR114	-0.18307	-0.04506	-0.02735	-0.27765	-0.35835	-0.01717	0.47185	0.32382	-0.22633	-0.31167	0.11429	0.05832
VAR115	-0.08450	-0.09185	-0.07226	-0.05625	-0.12781	-0.33001	0.10702	-0.04930	0.02882	0.34807	-0.02236	-0.43393
VAR116	-0.22761	-0.46513	-0.30672	-0.45788	-0.53089	-0.39833	0.12841	-0.09232	-0.05482	0.05662	-0.24708	0.31298

	VAR114	VAR115	VAR116
VAR1	-0.18307	-0.08450	-0.22761
VAR2	-0.04506	-0.09185	-0.46513
VAR91	-0.02735	-0.07226	-0.30672
CTEF18	-0.27765	-0.05625	-0.45788
CTEF19	-0.35835	-0.12781	-0.53089
CTEF193	-0.01717	-0.33001	-0.39833
VAR26	0.47185	0.10702	0.12841
VAR27	0.32382	-0.04930	-0.09232
VAR28	-0.22633	0.02882	-0.05482
VAR29	-0.31167	0.34807	0.05662
VAR30	0.11429	-0.02236	-0.24708
VAR31	0.05832	-0.43393	0.31298
VAR114	1.00000	-0.01653	0.45191
VAR115	-0.01653	1.00000	0.07569
VAR116	0.45191	0.07569	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 93. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR28	MAR GAL FASTEST WIND	0.62797	0.39435	0.39435	-0.62797	-3.660900	-0.64155
VAR116	FEB GAL FAST WIND DIR	0.80290	0.64465	0.25031	-0.46513	-0.1598403	-0.22723
VAR31	APR GAL FAST WIND DIR	0.85701	0.73447	0.08982	-0.30075	-0.2553135	-0.37311
VAR29	APR GAL FASTEST WIND	0.90125	0.81226	0.07779	-0.52132	-1.704686	-0.43028
VAR26	MAR NOS FRE HI TIDE	0.91385	0.83511	0.02286	-0.08945	-5.057733	-0.11668
VAR30	MAR GAL FAST WIND DIR	0.92857	0.86225	0.02713	0.08369	0.1255175	0.22417
VAR114	FEB FRE HI TIDE	0.93420	0.87272	0.01047	-0.04506	-6.071243	-0.14394
VAR27	APR NOS FRE HI TIDE	0.93607	0.87623	0.00350	0.09308	-3.463119	-0.08490
VAR115	FEB GAL FASTEST WIND	0.93709	0.87815	0.00192	-0.09185	-0.3096137	-0.05736
(CONSTANT)						355.5058	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 94. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	MAR NOS FRE HI TIDE	0.52860	0.27942	0.27942	-0.52860	-30.30703	-0.45351
VAR29	APR GAL FASTEST WIND	0.68324	0.46681	0.18740	-0.28389	-2.630526	-0.43069
VAR31	APR GAL FAST WIND DIR	0.82455	0.67989	0.21307	-0.38538	-0.4809324	-0.45588
VAR27	APR NOS FRE HI TIDE	0.84975	0.72207	0.04218	-0.50371	-18.31531	-0.29124
VAR30	MAR GAL FAST WIND DIR	0.85171	0.72541	0.00334	-0.28377	-0.8985297E-01	-0.10409
VAR115	FEB GAL FASTEST WIND	0.85425	0.72974	0.00433	-0.08450	-0.7688891	-0.09240
VAR28	MAR GAL FASTEST WIND	0.85658	0.73372	0.00398	-0.09341	-0.6065553	-0.06895
VAR116	FEB GAL FAST WIND DIR	0.85753	0.73535	0.00163	-0.22761	-0.7804732E-01	-0.07197
VAR114	FEB FRE HI TIDE	0.85810	0.73634	0.00099	-0.18307	2.917921	0.04487
(CONSTANT)						562.3407	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 95. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR31	APR GAL FAST WIND DIR	0.45931	0.21097	0.21097	-0.45931	-0.3922357	-0.60987
VAR30	MAR GAL FAST WIND DIR	0.58826	0.34605	0.13508	-0.28851	-0.2100519	-0.39914
VAR115	FEB GAL FASTEST WIND	0.68020	0.46268	0.11663	-0.07226	-1.153802	-0.22742
VAR116	FEB GAL FAST WIND DIR	0.70363	0.49510	0.03242	-0.30672	-0.1541668	-0.23319
VAR114	FEB FRE HI TIDE	0.72352	0.52348	0.02838	-0.02735	8.434911	0.21278
VAR26	MAR NOS FRE HI TIDE	0.74349	0.55278	0.02931	-0.20145	-12.69720	-0.31165
VAR29	APR GAL FASTEST WIND	0.75696	0.57299	0.02021	-0.31774	-0.6221364	-0.16708
VAR27	APR NOS FRE HI TIDE	0.76093	0.57901	0.00602	-0.12270	4.457963	0.11628
(CONSTANT)						157.2853	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 96. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR28	MAR GAL FASTEST WIND	0.46676	0.21787	0.21787	-0.46676	-22.03954	-0.45957
VAR116	FEB GAL FAST WIND DIR	0.67254	0.45231	0.23445	-0.45788	-2.016445	-0.33883
VAR30	MAR GAL FAST WIND DIR	0.79637	0.63420	0.18189	-0.30765	-0.9066688	-0.15415
VAR29	APR GAL FASTEST WIND	0.82264	0.67673	0.04253	-0.40576	-14.40979	-0.42179
VAR114	FEB FRE HI TIDE	0.86920	0.75550	0.07877	-0.32205	-94.71685	-0.27237
VAR27	APR NOS FRE HI TIDE	0.88743	0.78753	0.03203	-0.28591	-71.29134	-0.20156
VAR31	APR GAL FAST WIND DIR	0.89824	0.80684	0.01931	-0.19096	-0.7840882	-0.13746
VAR26	MAR NOS FRE HI TIDE	0.90044	0.81080	0.00396	-0.46247	-46.78337	-0.12369
VAR115	FEB GAL FASTEST WIND	0.90186	0.81336	0.00256	-0.05625	2.976000	0.06517
(CONSTANT)						3200.472	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 97. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR116	FEB GAL FAST WIND DIR	0.53089	0.28184	0.28184	-0.53089	-2.056333	-0.46148
VAR30	MAR GAL FAST WIND DIR	0.68553	0.46995	0.18810	-0.28909	-0.8259127	-0.18754
VAR29	APR GAL FASTEST WIND	0.77515	0.60086	0.13092	-0.41403	-13.63919	-0.53320
VAR114	FEB FRE HI TIDE	0.82645	0.68302	0.08215	-0.40069	-82.56738	-0.31710
VAR28	MAR GAL FASTEST WIND	0.84153	0.70817	0.02516	-0.21060	-6.071762	-0.16909
VAR27	APR NOS FRE HI TIDE	0.85844	0.73692	0.02875	-0.30183	-69.64142	-0.26296
VAR115	FEB GAL FASTEST WIND	0.86093	0.74120	0.00428	-0.12781	3.365025	0.09841
VAR31	APR GAL FAST WIND DIR	0.86192	0.74291	0.00171	-0.12187	0.2285522	0.05351
(CONSTANT)						2118.025	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 98. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR29	APR GAL FASTEST WIND	0.74012	0.54778	0.54778	-0.74012	-21.99153	-0.79829
VAR116	FEB GAL FAST WIND DIR	0.82172	0.67523	0.12745	-0.39833	-0.6666048	-0.13891
VAR26	MAR NOS FRE HI TIDE	0.85610	0.73290	0.05767	-0.15906	-113.3800	-0.37175
VAR30	MAR GAL FAST WIND DIR	0.89553	0.80198	0.06907	0.09780	2.214982	0.46703
VAR27	APR NOS FRE HI TIDE	0.91815	0.84300	0.04102	0.00119	-75.96703	-0.26635
VAR28	MAR GAL FASTEST WIND	0.92985	0.86463	0.02163	-0.38048	-7.567168	-0.19568
VAR31	APR GAL FAST WIND DIR	0.94074	0.88499	0.02037	-0.16436	-0.9543252	-0.20747
VAR115	FEB GAL FASTEST WIND	0.94319	0.88961	0.00461	-0.33001	-3.294905	-0.08947
VAR114	FEB FRE HI TIDE	0.94342	0.89004	0.00043	-0.04014	-9.122807	-0.03253
(CONSTANT)						2955.598	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 99. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to bay catch and bay effort variables.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	BCE18	BCE19	BCEL18	BCEL19	VAR97	VAR98
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	0.22037	-0.31790	0.05451	-0.02873	-0.02176	-0.30136
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	0.57738	0.05037	0.07466	0.48192	0.40979	0.06572
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	0.24175	-0.27568	0.29291	-0.18450	-0.02513	-0.26515
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	0.21100	-0.14426	-0.08071	0.16918	-0.00813	-0.13771
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	0.29911	-0.05804	0.19104	0.17941	0.10214	-0.11295
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	0.61072	0.02909	0.34978	0.54084	0.47568	0.03817
BCE18	0.22037	0.57738	0.24175	0.21100	0.29911	0.61072	1.00000	0.34887	0.33569	0.50319	0.89621	0.30943
BCE19	-0.31790	0.05037	-0.27568	-0.14426	-0.05804	0.02909	0.34887	1.00000	0.07772	0.34004	0.44426	0.94783
BCEL18	0.05451	0.07466	0.29291	-0.08071	0.19104	0.34978	0.33569	0.07772	1.00000	0.37079	0.35015	0.17341
BCEL19	-0.02873	0.48192	-0.18450	0.16918	0.17941	0.54084	0.50319	0.34004	0.37079	1.00000	0.51937	0.38380
VAR97	-0.02176	0.40979	-0.02513	-0.00813	0.10214	0.47568	0.89621	0.44426	0.35015	0.51937	1.00000	0.40498
VAR98	-0.30136	0.06572	-0.26515	-0.13771	-0.11295	0.03817	0.30943	0.94783	0.17341	0.38380	0.40498	1.00000
VAR99	-0.33596	-0.09863	-0.35582	-0.33480	-0.12769	0.17100	0.45787	0.55061	0.36435	0.33078	0.71891	0.53478
VAR100	-0.22101	0.16477	-0.24921	-0.08628	-0.12268	0.20874	0.41989	0.66926	0.35789	0.51936	0.45323	0.83815
VAR101	-0.13253	0.15364	0.01853	-0.12821	0.08914	0.32099	0.42742	0.28609	0.90551	0.46384	0.52176	0.39321
VAR102	-0.11550	0.49844	-0.22681	0.11420	0.05897	0.52778	0.47497	0.29422	0.32737	0.95449	0.45661	0.34413
VAR103	-0.18768	0.15482	-0.24193	-0.12137	0.01069	0.39349	0.52130	0.52888	0.54175	0.56594	0.66181	0.59222
VAR104	-0.10532	0.36792	-0.05602	0.01349	0.02389	0.51742	0.47384	0.33415	0.46924	0.68127	0.38462	0.37579

	VAR99	VAR100	VAR101	VAR102	VAR103	VAR104
VAR1	-0.33596	-0.22101	-0.13253	-0.11550	-0.18768	-0.10532
VAR2	-0.09863	0.16477	0.15364	0.49844	0.15482	0.36792
VAR91	-0.35582	-0.24921	0.01853	-0.22681	-0.24193	-0.05602
CTEF18	-0.33480	-0.08628	-0.12821	0.11420	-0.12137	0.01349
CTEF19	-0.12769	-0.12268	0.08914	0.05897	0.01069	0.02389
CTEF193	0.17100	0.20874	0.32099	0.52778	0.39349	0.51742
BCE18	0.45787	0.41989	0.42742	0.47497	0.52130	0.47384
BCE19	0.55061	0.66926	0.28609	0.29422	0.52888	0.33415
BCEL18	0.36435	0.35789	0.90551	0.32737	0.54175	0.46924
BCEL19	0.33078	0.51936	0.46384	0.95449	0.56594	0.68127
VAR97	0.71891	0.45323	0.52176	0.45661	0.66181	0.38462
VAR98	0.53478	0.83815	0.39321	0.34413	0.59222	0.37579
VAR99	1.00000	0.53708	0.54644	0.27271	0.78765	0.32603
VAR100	0.53708	1.00000	0.57123	0.52983	0.71878	0.56144
VAR101	0.54644	0.57123	1.00000	0.42564	0.76200	0.51269
VAR102	0.27271	0.52983	0.42564	1.00000	0.57215	0.82674
VAR103	0.78765	0.71878	0.76200	0.57215	1.00000	0.66109
VAR104	0.32603	0.56144	0.51269	0.82674	0.66109	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 100. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR102	LAG BAY CAT 19	0.49844	0.24844	0.24844	0.49844	0.1524294	0.24351
VAR99	BAY TRIPS 18	0.55487	0.30788	0.05944	-0.09863	-4.962399	-0.88637
VAR97	BAY CAT 18	0.76037	0.57816	0.27029	0.40979	0.6277017	0.83053
VAR103	LAG BAY TRIPS 18	0.76347	0.58288	0.00472	0.15482	0.7370256	0.15301
VAR101	LAG BAY CAT 18	0.76429	0.58414	0.00125	0.15364	-0.3864599E-01	-0.05393
VAR104	LAG BAY TRIPS 19	0.76468	0.58474	0.00060	0.36792	0.2689963	0.05099
VAR98	BAY CAT 19	0.76508	0.58534	0.00060	0.06572	0.1916076E-01	0.03101
(CONSTANT)						57.20944	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 101. **Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19) with bay catch and bay effort variables for eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR99	BAY TRIPS 18	0.33596	0.11287	0.11287	-0.33596	-7.799008	-0.90359
VAR97	BAY CAT 18	0.46133	0.21282	0.09995	-0.02176	0.6712068	0.57606
VAR102	LAG BAY CAT 19	0.48852	0.23865	0.02582	-0.11550	-0.3627485	-0.37589
VAR103	LAG BAY TRIPS 18	0.52095	0.27139	0.03274	-0.18768	4.014061	0.54056
VAR98	BAY CAT 19	0.54666	0.29884	0.02744	-0.30136	-0.3121598	-0.32773
VAR101	LAG BAY CAT 18	0.55531	0.30837	0.00953	-0.13253	-0.1985652	-0.17975
VAR100	BAY TRIPS 19	0.56009	0.31370	0.00533	-0.22101	1.363953	0.16732
VAR104	LAG BAY TRIPS 19	0.56047	0.31413	0.00043	-0.10532	0.3456032	0.04249
(CONSTANT)						137.4896	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 102. Summary of results of stepwise multiple regression analysis of brown shrimp total catch (area 19,11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR99	BAY TRIPS 18	0.35582	0.12661	0.12661	-0.35582	-4.307465	-0.81860
VAR97	BAY CAT 18	0.48656	0.23674	0.11013	-0.02513	0.4898149	0.68954
VAR102	LAG BAY CAT 19	0.56483	0.31903	0.08229	-0.22681	-0.4891424	-0.83139
VAR104	LAG BAY TRIPS 19	0.67431	0.45470	0.13567	-0.05602	3.166802	0.63867
VAR101	LAG BAY CAT 18	0.69847	0.48785	0.03316	0.01853	0.2165861	0.32159
VAR100	BAY TRIPS 19	0.70396	0.49556	0.00771	-0.24921	-0.4904294	-0.09868
VAR103	LAG BAY TRIPS 18	0.70670	0.49943	0.00387	-0.24193	-0.7884386	-0.17416
(CONSTANT)						53.65250	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 103. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
BCE18	BAY CAT-TRIP 18	0.21100	0.04452	0.04452	0.21100	3.170406	0.28598
BCE19	BAY CAT-TRIP 19	0.31395	0.09856	0.05404	-0.14426	-4.039542	-0.29837
BCEL18	LAG BAY CAT-TRIP 18	0.35770	0.12795	0.02939	-0.08071	-2.471523	-0.23248
BCEL19	LAG BAY CAT-TRIP 19	0.39771	0.15817	0.03022	0.16918	2.861294	0.21293
(CONSTANT)						562.1741	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 104. Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
BCE18	BAY CAT-TRIP 18	0.29911	0.08947	0.08947	0.29911	2.546517	0.30946
BCE19	BAY CAT-TRIP 19	0.34568	0.11949	0.03003	-0.05804	-1.933875	-0.19243
BCEL18	LAG BAY CAT-TRIP 18	0.35685	0.12734	0.00784	0.19104	0.6318710	0.08007
BCEL19	LAG BAY CAT-TRIP 19	0.36013	0.12969	0.00235	0.17941	0.5928271	0.05944
(CONSTANT)						424.6536	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 105. **Summary of results of stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 3)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
BCE18	BAY CAT-TRIP 18	0.61072	0.37298	0.37298	0.61072	4.418630	0.50415
BCEL19	LAG BAY CAT-TRIP 19	0.66783	0.44600	0.07303	0.54084	3.757110	0.35365
BCE19	BAY CAT-TRIP 19	0.71541	0.51182	0.06581	0.02909	-2.917161	-0.27254
BCEL18	LAG BAY CAT-TRIP 18	0.71828	0.51592	0.00411	0.34978	0.5933519	0.07060
(CONSTANT)						410.0595	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 106. **Summary statistics for the ten year (1964-1973) data set used to develop the step-wise multiple regression models relating white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.**

(UNITS GIVEN IN TABLE 4)

VARIABLE	MEAN	STANDARD DEV	CASES
VAR2	19.1249	5.4036	10
VAR1	23.7770	7.7008	10
VAR68	1.4759	0.6991	10
CTEF18	179.1299	82.1244	10
CTEF19	134.3243	81.2364	10
CTEF193	37.3631	22.9945	10
XE18	80.9301	23.0437	10
XE19	227.7682	51.2435	10
XE193	83.2440	32.1624	10
VAR15	162.4491	37.7817	10
VAR16	136.8256	66.1030	10
VAR17	492.5122	309.8261	10
VAR18	58.2846	19.8272	10
VAR19	24.8516	4.7823	10
VAR20	30.6615	10.6118	10
VAR21	48.7536	34.0776	10
VAR22	30.4837	25.2123	10
VAR23	35.2349	26.5912	10
VAR24	94.1936	96.5308	10
VAR25	55.6900	11.8441	10
VAR26	13.9700	8.7364	10
VAR27	18.5710	4.7918	10
VAR28	13.1830	5.1444	10
VAR29	13.6667	6.1441	9
VAR30	59.4000	12.0296	10
VAR31	33.2400	3.8147	10
VAR32	31.6400	3.3804	10
VAR33	5.9920	0.5399	10
VAR34	6.1444	0.4361	9
VAR35	93.0000	35.2136	10
VAR36	88.5000	27.7939	10
VAR37	147.6169	18.0021	10
VAR38	112.9752	52.1843	10
VAR39	397.3383	239.2765	10
VAR40	7.0700	1.8117	10
VAR41	9.4600	1.8518	10
VAR42	51.5670	11.3639	10
VAR43	17.0080	4.4281	10
VAR44	12.2720	4.9134	10
VAR45	234.5005	203.2598	10

Table 106 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR46	26.3433	17.5447	10
VAR47	224.4764	75.3143	10
VAR48	196.3802	75.7088	10
VAR49	207.8700	72.2351	10
VAR50	189.5591	71.8345	10
VAR51	206.3000	73.3319	10
VAR52	179.6000	48.7675	10
VAR53	47.4000	39.8814	10
VAR54	77.6800	94.3994	10
VAR55	131.9000	100.6282	10
VAR56	15.0590	7.1041	10
VAR57	28.2110	6.4235	10
VAR58	20.8880	8.3351	10
VAR59	32.7970	3.2456	10
VAR60	27.1860	4.0446	10
VAR61	33.6450	2.4373	10
VAR62	110.8000	41.0820	10
VAR63	87.3000	23.7208	10
VAR64	100.3000	37.4494	10
VAR65	62.4000	17.5891	10
VAR66	77.2000	41.6808	10
VAR67	62.1000	18.2419	10
VAR76	14.7355	3.8314	10
VAR77	18.7165	4.8754	10
VAR78	14.5416	3.6488	10
VAR79	17.2329	3.2715	10
VAR80	48.6514	12.4562	10
VAR81	128.5832	83.9930	10
VAR82	9.9660	4.7898	10
VAR83	27.1688	10.0021	10
VAR84	62.6898	54.3744	10
VAR85	21.5425	9.4149	10
VAR86	31.2450	18.1366	10
VAR87	30.7000	5.6184	10
VAR88	31.4000	7.9190	10
VAR89	28.7000	7.0719	10
VAR90	34.8000	8.4958	10
VAR91	33.3000	6.3605	10
VAR92	117.0000	67.7495	10
VAR93	90.0000	47.4342	10

Table 106 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR94	108.0000	52.8205	10
VAR95	67.5000	38.2426	10
VAR96	36.0000	18.9737	10
VAR97	5.9533	0.4809	9
VAR98	5.6822	0.3819	9
VAR99	5.8478	0.5468	9
VAR100	6.9011	1.0844	9
VAR101	6.4650	0.4543	8
WCE18	132.1603	42.2317	10
WCE19	127.4724	59.8210	10
WCEL18	129.7333	42.3643	10
WCEL19	126.8781	60.0856	10

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 107. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to river discharge variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR15	VAR16	VAR17	VAR18	VAR19	VAR20
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	0.47583	0.42149	0.65592	0.48991	0.14459	0.03420
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	0.58181	0.29913	0.20291	0.37449	0.35972	0.53402
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	-0.11033	-0.08470	0.05074	0.07710	-0.31029	-0.19923
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	0.74170	0.59392	0.53205	0.70676	0.23833	0.50094
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	0.80279	0.70607	0.71849	0.85402	0.14762	0.41034
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	0.76957	0.60666	0.55405	0.78105	0.20517	0.57929
VAR15	0.47583	0.58181	-0.11033	0.74170	0.80279	0.76957	1.00000	0.85978	0.70536	0.88934	0.56117	0.73670
VAR16	0.42149	0.29913	-0.08470	0.59392	0.70607	0.60666	0.85978	1.00000	0.77469	0.75093	0.52802	0.61449
VAR17	0.65592	0.20291	0.05074	0.53205	0.71849	0.55405	0.70536	0.77469	1.00000	0.70322	0.28739	0.15326
VAR18	0.48991	0.37449	0.07710	0.70676	0.85402	0.78105	0.88934	0.75093	0.70322	1.00000	0.34299	0.49063
VAR19	0.14459	0.35972	-0.31029	0.23833	0.14762	0.20517	0.56117	0.52802	0.28739	0.34299	1.00000	0.52757
VAR20	0.03420	0.53402	-0.19923	0.50094	0.41034	0.57929	0.73670	0.61449	0.15326	0.49063	0.52757	1.00000
VAR21	0.33788	0.25554	-0.30907	0.44845	0.52035	0.42255	0.65794	0.84017	0.59135	0.48979	0.33570	0.63336
VAR22	0.29215	0.36355	0.16733	0.55058	0.67385	0.75077	0.87247	0.74256	0.64983	0.84204	0.50009	0.48997
VAR23	0.51346	0.04665	0.40719	0.49837	0.69170	0.64111	0.56958	0.65439	0.86236	0.63188	0.05026	0.14654
VAR24	0.16574	0.45579	0.08168	0.52275	0.49183	0.57775	0.69505	0.44083	0.40129	0.67634	0.31085	0.40387
VAR37	0.73011	0.74080	-0.11935	0.74390	0.72887	0.34473	0.61191	0.47841	0.50296	0.40821	0.29674	0.38626
VAR38	0.76827	0.51816	-0.11395	0.51096	0.49046	0.15636	0.38669	0.29176	0.60352	0.22707	0.34908	0.05300
VAR39	0.38546	0.17628	-0.01334	0.06060	0.03886	-0.22460	-0.13669	-0.20299	-0.04620	-0.17130	0.30922	-0.18077
VAR45	0.58189	-0.05341	0.13171	0.25853	0.48345	0.34410	0.39386	0.55119	0.91915	0.41652	0.12864	-0.14136
VAR46	-0.04052	0.16510	0.34169	0.30584	0.28997	0.49248	0.52562	0.50380	0.23225	0.44222	0.58083	0.49932
VAR51	0.52973	0.64896	-0.24768	0.76512	0.76542	0.59038	0.95018	0.90046	0.66869	0.76010	0.64603	0.74122
VAR52	0.74451	0.85434	-0.34921	0.76921	0.61524	0.20041	0.54512	0.37280	0.42322	0.29177	0.30543	0.43415
VAR80	0.57881	0.57557	-0.16850	0.60645	0.66935	0.51871	0.77448	0.68634	0.77923	0.55611	0.32279	0.39909
VAR81	0.65834	0.33914	-0.35433	0.57839	0.69615	0.34404	0.66963	0.80992	0.73019	0.60867	0.37561	0.39686
VAR83	0.51566	0.60941	-0.05410	0.74906	0.75655	0.60652	0.86754	0.80055	0.70698	0.68430	0.41267	0.58210
VAR84	-0.23236	-0.13450	-0.28084	-0.15934	-0.11277	0.06238	0.12877	0.39870	0.04481	-0.09501	0.15741	0.45329
VAR85	0.30801	-0.01898	-0.04363	0.11928	0.13388	-0.04042	-0.04385	0.21227	0.29003	-0.19716	-0.18236	0.07174
VAR86	0.53443	-0.05498	-0.29112	0.26083	0.37845	-0.10290	0.17613	0.54648	0.58439	0.21831	0.03666	-0.11455

Table 107 continued

	VAR21	VAR22	VAR23	VAR24	VAR37	VAR38	VAR39	VAR45	VAR46	VAR51	VAR52	VAR80
VAR1	0.33788	0.29215	0.51346	0.16574	0.73011	0.76827	0.38546	0.58189	-0.04052	0.52973	0.74451	0.57881
VAR2	0.25554	0.36355	0.04665	0.45579	0.74080	0.51816	0.17628	-0.05341	0.16510	0.64896	0.85434	0.57557
VAR68	-0.30907	0.16733	0.40719	0.08168	-0.11935	-0.11395	-0.01334	0.13171	0.34169	-0.24768	-0.34921	-0.16850
CTEF18	0.44845	0.55058	0.49837	0.52275	0.74390	0.51096	0.06060	0.25853	0.30584	0.76512	0.76921	0.60645
CTEF19	0.52035	0.67385	0.69170	0.49183	0.72887	0.49046	0.03886	0.48345	0.28997	0.76542	0.61524	0.66935
CTEF193	0.42255	0.75077	0.64111	0.57775	0.34473	0.15636	-0.22460	0.34410	0.49248	0.59038	0.20041	0.51871
VAR15	0.65794	0.87247	0.56958	0.69505	0.61191	0.38669	-0.13669	0.39386	0.52562	0.95018	0.54512	0.77448
VAR16	0.84017	0.74256	0.65439	0.44083	0.47841	0.29176	-0.20299	0.55119	0.50380	0.90046	0.37280	0.68634
VAR17	0.59135	0.64983	0.86236	0.40129	0.50296	0.60352	-0.04620	0.91915	0.23225	0.66869	0.42322	0.77923
VAR18	0.48979	0.84204	0.63188	0.67634	0.40821	0.22707	-0.17130	0.41652	0.44222	0.76010	0.29177	0.55611
VAR19	0.33570	0.50009	0.05026	0.31085	0.29674	0.34908	0.30922	0.12864	0.58083	0.64603	0.30543	0.32279
VAR20	0.63336	0.48997	0.14654	0.40387	0.38626	0.05300	-0.18077	-0.14136	0.49932	0.74122	0.43415	0.39909
VAR21	1.00000	0.33339	0.43341	0.04111	0.31671	0.17563	-0.25122	0.46274	0.07118	0.70683	0.33813	0.54754
VAR22	0.33339	1.00000	0.56661	0.87154	0.49874	0.26448	-0.20276	0.34636	0.70698	0.80837	0.31235	0.69661
VAR23	0.43341	0.56661	1.00000	0.38269	0.45177	0.51502	-0.06721	0.80331	0.39636	0.50654	0.36215	0.57770
VAR24	0.04111	0.87154	0.38269	1.00000	0.35903	0.12961	-0.36827	0.07786	0.63851	0.60029	0.28151	0.56821
VAR37	0.31671	0.49874	0.45177	0.35903	1.00000	0.79648	0.39423	0.34720	0.32743	0.70844	0.91851	0.76325
VAR38	0.17563	0.26448	0.51502	0.12961	0.79648	1.00000	0.61883	0.62437	0.15105	0.45558	0.82666	0.63229
VAR39	-0.25122	-0.20276	-0.06721	-0.36827	0.39423	0.61883	1.00000	0.09080	0.02498	-0.04005	0.37819	-0.10666
VAR45	0.46274	0.34636	0.80331	0.07786	0.34720	0.62437	0.09080	1.00000	0.00438	0.37116	0.28836	0.60268
VAR46	0.07118	0.70698	0.39636	0.63851	0.32743	0.15105	0.02498	0.00438	1.00000	0.55749	0.19423	0.24201
VAR51	0.70683	0.80837	0.50654	0.60029	0.70844	0.45558	-0.04005	0.37116	0.55749	1.00000	0.64187	0.79265
VAR52	0.33813	0.31235	0.36215	0.28151	0.91851	0.82666	0.37819	0.28836	0.19423	0.64187	1.00000	0.70187
VAR80	0.54754	0.69661	0.57770	0.56821	0.76325	0.63229	-0.10666	0.60268	0.24201	0.79265	0.70187	1.00000
VAR81	0.87703	0.37782	0.48061	0.02142	0.45943	0.40326	0.05436	0.62674	-0.01318	0.71812	0.42511	0.57995
VAR83	0.52816	0.84371	0.65111	0.74227	0.77068	0.51266	-0.15802	0.43098	0.59806	0.90436	0.68185	0.88782
VAR84	0.75836	-0.15810	-0.08529	-0.38690	-0.13734	-0.24054	-0.30891	0.06537	-0.18938	0.21234	-0.08142	0.09519
VAR85	0.51454	-0.34723	0.40182	-0.51344	0.26433	0.40580	0.15316	0.46480	-0.24691	0.06160	0.38251	0.18970
VAR86	0.65093	0.00597	0.39962	-0.29977	0.13853	0.21959	-0.01012	0.65376	-0.24769	0.29080	0.10135	0.27024

Table 107 continued

	VAR81	VAR83	VAR84	VAR85	VAR86
VAR1	0.65834	0.51566	-0.23236	0.30801	0.53443
VAR2	0.33914	0.60941	-0.13450	-0.01898	-0.05498
VAR68	-0.35433	-0.05410	-0.28084	-0.04363	-0.29112
CTEF18	0.57839	0.74906	-0.15934	0.11928	0.26083
CTEF19	0.69615	0.75655	-0.11277	0.13388	0.37845
CTEF193	0.34404	0.60652	0.06238	-0.04042	-0.10290
VAR15	0.66963	0.86754	0.12877	-0.04385	0.17613
VAR16	0.80992	0.80055	0.39870	0.21227	0.54648
VAR17	0.73019	0.70698	0.04481	0.29003	0.58439
VAR18	0.60867	0.68430	-0.09501	-0.19716	0.21831
VAR19	0.37561	0.41267	0.15741	-0.18236	0.03666
VAR20	0.39686	0.58210	0.45329	0.07174	-0.11455
VAR21	0.87703	0.52816	0.75836	0.51454	0.65093
VAR22	0.37782	0.84371	-0.15810	-0.34723	0.00597
VAR23	0.48061	0.65111	-0.08529	0.40182	0.39962
VAR24	0.02142	0.74227	-0.38690	-0.51344	-0.29977
VAR37	0.45943	0.77068	-0.13734	0.26433	0.13853
VAR38	0.40326	0.51266	-0.24054	0.40580	0.21959
VAR39	0.05436	-0.15802	-0.30891	0.15316	-0.01012
VAR45	0.62674	0.43098	0.06537	0.46480	0.65376
VAR46	-0.01318	0.59806	-0.18938	-0.24691	-0.24769
VAR51	0.71812	0.90436	0.21234	0.06160	0.29080
VAR52	0.42511	0.68185	-0.08142	0.38251	0.10135
VAR80	0.57995	0.88782	0.09519	0.18970	0.27024
VAR81	1.00000	0.50569	0.47875	0.40792	0.79159
VAR83	0.50569	1.00000	0.00806	0.08667	0.17401
VAR84	0.47875	0.00806	1.00000	0.49747	0.43124
VAR85	0.40792	0.08667	0.49747	1.00000	0.52844
VAR86	0.79159	0.17401	0.43124	0.52844	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 108. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with river discharge variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	LAG ANNUAL ATCH DIS	0.85434	0.72989	0.72989	0.85434	0.1825820	1.64781
VAR85	LAG OCT-DEC GUAD DIS	0.93270	0.86994	0.14005	-0.01898	-0.9254635E-02	-0.01612
VAR38	LAG ANNUAL GUAD DIS	0.97208	0.94494	0.07500	0.51816	-0.1211008	-1.16952
VAR46	JUL-SEP GUAD DIS	0.98072	0.96180	0.01686	0.16510	-0.1194883	-0.38796
VAR19	JUL-SEP MISS DIS	0.98932	0.97876	0.01696	0.35972	0.5881188	0.52050
VAR84	LAG OCT-DEC TRIN DIS	0.99355	0.98715	0.00839	-0.13450	-0.4178993E-01	-0.42052
VAR17	ANNUAL TRIN DIS	0.99991	0.99982	0.01267	0.20291	0.3118456E-02	0.17880
VAR20	OCT-DEC MISS DIS	1.00000	1.00000	0.00018	0.53402	-0.1887404E-01	-0.03707
VAR80	JAN-MAR MISS DIS	1.00000	1.00000	0.00000	0.57557	0.1265394E-02	0.00292
(CONSTANT)						-9.653040	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 109. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR38	LAG ANNUAL GUAD DIS	0.76827	0.59024	0.59024	0.76827	-0.8267667E-02	-0.05603
VAR81	JAN-MAR TRIN DIS	0.85750	0.73530	0.14506	0.65834	0.1072012	1.16925
VAR84	LAG OCT-DEC TRIN DIS	0.94143	0.88629	0.15099	-0.23236	-0.1139135	-0.80433
VAR22	OCT-DEC GUAD DIS	0.96358	0.92849	0.04220	0.29215	-0.2288150	-0.74914
VAR83	LAG OCT-DEC MISS DIS	0.99722	0.99446	0.06597	0.51566	0.6319859	0.82085
VAR16	ANNUAL GUAD DIS	0.99947	0.99893	0.00447	0.42149	-0.3997255E-01	-0.34512
VAR19	JUL-SEP MISS DIS	0.99997	0.99994	0.00101	0.14459	0.9639565E-01	0.05986
VAR17	ANNUAL TRIN DIS	1.00000	1.00000	0.00006	0.65592	0.8425303E-03	0.03390
VAR45	APR-JUN TRIN DIS	1.00000	1.00000	0.00000	0.58189	-0.2800947E-03	-0.00739
(CONSTANT)						10.59722	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 110. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR23	JUL-SEP TRIN DIS	0.40719	0.16581	0.16581	0.40719	0.1274166E-01	0.48465
VAR81	JAN-MAR TRIN DIS	0.74780	0.55921	0.39340	-0.35433	-0.1351878E-01	-1.62422
VAR52	LAG ANNUAL ATCH DIS	0.82886	0.68700	0.12779	-0.34921	-0.1187854E-01	-0.82862
VAR39	LAG ANNUAL TRIN DIS	0.86643	0.75070	0.06370	-0.01334	0.3779488E-02	1.29359
VAR86	JAN-MAR GUAD DIS	0.90342	0.81616	0.06546	-0.29112	-0.3989915E-01	-1.03510
VAR19	JUL-SEP MISS DIS	0.92920	0.86342	0.04725	-0.31029	-0.1146927	-0.78458
VAR16	ANNUAL GUAD DIS	0.97858	0.95762	0.09420	-0.08470	0.3403875E-01	3.21853
VAR46	JUL-SEP GUAD DIS	0.99892	0.99785	0.04023	0.34169	-0.4058029E-01	-1.01841
VAR15	ANNUAL MISS DIS	1.00000	1.00000	0.00215	-0.11033	-0.5173174E-02	-0.27958
(CONSTANT)						4.745809	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 111. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	LAG ANNUAL ATCH DIS	0.76921	0.59168	0.59168	0.76921	2.307120	1.37002
VAR18	APR-JUN MISS DIS	0.91976	0.84596	0.25429	0.70676	2.154769	0.52022
VAR38	LAG ANNUAL GUAD DIS	0.94317	0.88957	0.04361	0.51096	-0.7736207	-0.49158
VAR20	OCT-DEC MISS DIS	0.96865	0.93829	0.04871	0.50094	-1.018285	-0.13158
VAR80	JAN-MAR MISS DIS	0.98118	0.96272	0.02444	0.60645	-3.232300	-0.49026
VAR86	JAN-MAR GUAD DIS	0.99076	0.98161	0.01889	0.26083	1.779337	0.39295
VAR24	OCT-DEC TRIN DIS	0.99965	0.99930	0.01769	0.52275	0.3276358	0.38511
VAR51	ANNUAL ATCH DIS	1.00000	1.00000	0.00070	0.76512	-0.1612469	-0.14398
VAR45	APR-JUN TRIN DIS	1.00000	1.00000	0.00000	0.25853	-0.1154638E-02	-0.00286
(CONSTANT)						-137.8612	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 112. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with river discharge variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE..   CTEF19   CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR18	APR-JUN MISS DIS	0.85402	0.72935	0.72935	0.85402	1.835528	0.68153
VAR37	LAG ANNUAL MISS DIS	0.95018	0.90284	0.17350	0.72887	1.518971	0.51208
VAR19	JUL-SEP MISS DIS	0.97875	0.95796	0.05511	0.14762	-2.815920	-0.25219
VAR86	JAN-MAR GUAD DIS	0.99203	0.98412	0.02616	0.37845	1.010855	0.34333
VAR80	JAN-MAR MISS DIS	0.99790	0.99581	0.01169	0.66935	-0.4706439	-0.10979
VAR20	OCT-DEC MISS DIS	0.99866	0.99732	0.00151	0.41034	1.132375	0.22503
VAR84	LAG OCT-DEC TRIN DIS	0.99950	0.99901	0.00169	-0.11277	-0.1291300	-0.13149
VAR16	ANNUAL GUAD DIS	1.00000	1.00000	0.00099	0.70607	-0.9343800E-01	-0.11567
(CONSTANT)						-172.9216	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 113. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR18	APR-JUN MISS DIS	0.78105	0.61005	0.61005	0.78105	1.077894	0.92942
VAR86	JAN-MAR GUAD DIS	0.82978	0.68854	0.07850	-0.10290	-1.047526	-0.82622
VAR85	LAG OCT-DEC GUAD DIS	0.90179	0.81323	0.12469	-0.04042	1.862078	0.76241
VAR52	LAG ANNUAL ATCH DIS	0.93767	0.87923	0.06599	0.20041	-0.2768809	-0.58722
VAR80	JAN-MAR MISS DIS	0.97533	0.95127	0.07204	0.51871	1.732788	0.93866
VAR39	LAG ANNUAL TRIN DIS	0.98665	0.97347	0.02220	-0.22460	0.6053880E-01	0.62996
VAR38	LAG ANNUAL GUAD DIS	0.99888	0.99776	0.02428	0.15636	-0.3527129	-0.80046
VAR23	JUL-SEP TRIN DIS	0.99999	0.99999	0.00223	0.64111	0.1239724	0.14336
VAR45	APR-JUN TRIN DIS	1.00000	1.00000	0.00001	0.34410	0.8348506E-02	0.07380
(CONSTANT)						-57.95258	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 114. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to precipitation variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR25	VAR26	VAR27	VAR28	VAR42	VAR43
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	0.59040	0.77034	-0.16388	-0.13170	0.14411	-0.30119
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	0.09509	0.20816	0.19054	-0.10231	0.03470	-0.22319
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	0.13955	-0.03045	0.28166	0.03190	-0.12352	0.01853
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	0.59802	0.59181	0.35903	-0.07709	-0.22724	-0.24099
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	0.73709	0.66182	0.32026	0.12958	-0.22040	-0.10892
CIEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	0.46029	0.20849	0.55789	0.23601	-0.29070	0.24664
VAR25	0.59040	0.09509	0.13955	0.59802	0.73709	0.46029	1.00000	0.82070	0.33953	0.00113	-0.44244	0.00378
VAR26	0.77034	0.20816	-0.03045	0.59181	0.66182	0.20849	0.82070	1.00000	-0.10629	-0.32345	-0.05446	-0.03867
VAR27	-0.16388	0.19054	0.28166	0.35903	0.32026	0.55789	0.33953	-0.10629	1.00000	0.06900	-0.77895	-0.10536
VAR28	-0.13170	-0.10231	0.03190	-0.07709	0.12958	0.23601	0.00113	-0.32345	0.06900	1.00000	0.10626	0.53097
VAR42	0.14411	0.03470	-0.12352	-0.22724	-0.22040	-0.29070	-0.44244	-0.05446	-0.77895	0.10626	1.00000	0.25307
VAR43	-0.30119	-0.22319	0.01853	-0.24099	-0.10892	0.24664	0.00378	-0.03867	-0.10536	0.53097	0.25307	1.00000
VAR44	0.03800	-0.30682	0.35814	-0.20567	0.00542	0.11589	0.18764	0.37512	-0.19578	-0.41695	-0.11497	-0.05833
VAR82	0.36026	-0.22527	0.08458	0.12294	0.15597	-0.05369	0.63497	0.65916	-0.04107	-0.55031	-0.32958	-0.38498

	VAR44	VAR82
VAR1	0.03800	0.36026
VAR2	-0.30682	-0.22527
VAR68	0.35814	0.08458
CTEF18	-0.20567	0.12294
CTEF19	0.00542	0.15597
CTEF193	0.11589	-0.05369
VAR25	0.18764	0.63497
VAR26	0.37512	0.65916
VAR27	-0.19578	-0.04107
VAR28	-0.41695	-0.55031
VAR42	-0.11497	-0.32958
VAR43	-0.05833	-0.38498
VAR44	1.00000	0.42347
VAR82	0.42347	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 115. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with precipitation variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR44	LAG OCT-DEC FRE PREC	0.30682	0.09414	0.09414	-0.30682	-0.3958697	-0.35996
VAR26	APR-JUN FRE PREC	0.46449	0.21575	0.12161	0.20816	0.5624138	0.90930
VAR82	JAN-MAR FRE PREC	0.60633	0.36763	0.15189	-0.22527	-1.158401	-1.02682
VAR43	LAG JUL-SEP FRE PREC	0.77540	0.60124	0.23361	-0.22319	-0.5027471	-0.41199
VAR28	OCT-DEC FRE PREC	0.79902	0.63843	0.03719	-0.10231	-0.3132168	-0.29819
VAR42	LAG ANNUAL FRE PREC	0.81359	0.66192	0.02349	0.03470	-0.5013674E-01	-0.10544
VAR27	JUL-SEP FRE PREC	0.81431	0.66310	0.00118	0.19054	0.7846318E-01	0.06958
(CONSTANT)						41.47879	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 116. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.77034	0.59342	0.59342	0.77034	1.043387	1.18370
VAR43	LAG JUL-SEP FRE PREC	0.81682	0.66719	0.07377	-0.30119	-1.032186	-0.59352
VAR82	JAN-MAR FRE PREC	0.89727	0.80510	0.13791	0.36026	-0.4756721	-0.29586
VAR28	OCT-DEC FRE PREC	0.92611	0.85769	0.05259	-0.13170	0.4875659	0.32571
VAR42	LAG ANNUAL FRE PREC	0.94585	0.89463	0.03694	0.14411	0.1157998	0.17088
VAR44	LAG OCT-DEC FRE PREC	0.95266	0.90755	0.01293	0.03800	-0.2245037	-0.14324
VAR25	ANNUAL FRE PREC	0.95282	0.90787	0.00031	0.59040	-0.5775862E-01	-0.08885
(CONSTANT)						25.06951	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 117. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

		SUMMARY TABLE					
VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR44	LAG OCT-DEC FRE PREC	0.35814	0.12827	0.12827	0.35814	0.1100584	0.77352
VAR27	JUL-SEP FRE PREC	0.50690	0.25695	0.12868	0.28166	0.1771686	1.21437
VAR42	LAG ANNUAL FRE PREC	0.62956	0.39635	0.13940	-0.12352	0.6595651E-01	1.07213
VAR28	OCT-DEC FRE PREC	0.65223	0.42540	0.02905	0.03189	0.5507037E-01	0.40524
VAR82	JAN-MAR FRE PREC	0.68370	0.46744	0.04204	0.08458	0.9319081E-01	0.63849
VAR26	APR-JUN FRE PREC	0.75018	0.56277	0.09533	-0.03045	-0.3404715E-01	-0.42548
VAR43	LAG JUL-SEP FRE PREC	0.75187	0.56531	0.00254	0.01853	-0.1034719E-01	-0.06554
(CONSTANT)						-7.569270	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 118. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with precipitation variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	ANNUAL FRE PREC	0.59802	0.35763	0.35763	0.59802	-0.1830360	-0.02640
VAR82	JAN-MAR FRE PREC	0.68419	0.46811	0.11048	0.12294	-12.60434	-0.73513
VAR43	LAG JUL-SEP FRE PREC	0.83223	0.69260	0.22449	-0.24099	-7.955797	-0.42897
VAR26	APR-JUN FRE PREC	0.90115	0.81208	0.11947	0.59181	11.53391	1.22698
VAR44	LAG OCT-DEC FRE PREC	0.93226	0.86912	0.05704	-0.20567	-5.911390	-0.35367
VAR27	JUL-SEP FRE PREC	0.95227	0.90682	0.03770	0.35903	3.655747	0.21331
VAR42	LAG ANNUAL FRE PREC	0.95586	0.91366	0.00684	-0.22724	-1.303258	-0.18034
(CONSTANT)						360.9803	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 119. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with precipitation variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
		SUMMARY TABLE					
VAR25	ANNUAL FRE PREC	0.73709	0.54331	0.54331	0.73709	4.598358	1.01993
VAR82	JAN-MAR FRE PREC	0.84052	0.70648	0.16317	0.15597	-10.82917	-0.97135
VAR43	LAG JUL-SEP FRE PREC	0.91565	0.83842	0.13194	-0.10892	-5.735877	-0.47564
VAR26	APR-JUN FRE PREC	0.95642	0.91474	0.07632	0.66182	2.634447	0.43101
VAR27	JUL-SEP FRE PREC	0.95710	0.91604	0.00130	0.32026	-0.7323877	-0.06572
VAR44	LAG OCT-DEC FRE PREC	0.95730	0.91641	0.00037	0.00542	0.2508407	0.02308
(CONSTANT)						33.95080	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 120. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19,11-15 fathom depths) with precipitation variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR27	JUL-SEP FRE PREC	0.55789	0.31124	0.31124	0.55789	5.270835	1.09838
VAR43	LAG JUL-SEP FRE PREC	0.63684	0.40556	0.09433	0.24664	0.4116968	0.07928
VAR26	APR-JUN FRE PREC	0.69777	0.48688	0.08132	0.20849	0.4697333	0.17847
VAR42	LAG ANNUAL FRE PREC	0.73083	0.53411	0.04723	-0.29070	1.286236	0.63566
VAR44	LAG OCT-DEC FRE PREC	0.77862	0.60625	0.07214	0.11589	2.042605	0.43646
VAR28	OCT-DEC FRE PREC	0.81681	0.66717	0.06093	0.23601	1.296830	0.29013
VAR25	ANNUAL FRE PREC	0.81735	0.66806	0.00089	0.46029	0.2710151	0.13960
(CONSTANT)						-197.6690	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 121. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to temperature variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR29	VAR30	VAR40	VAR41
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	-0.50693	0.20480	-0.39519	0.28601
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	0.12387	0.47532	-0.23296	0.35114
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	-0.18930	-0.56379	-0.36873	-0.18163
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	-0.34825	0.14447	-0.59227	0.08009
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	-0.48604	0.09473	-0.62186	0.03579
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	-0.05361	-0.06407	-0.42372	-0.30603
VAR29	-0.50693	0.12387	-0.18930	-0.34825	-0.48604	-0.05361	1.00000	0.22218	0.63960	0.01664
VAR30	0.20480	0.47532	-0.56379	0.14447	0.09473	-0.06407	0.22218	1.00000	0.24125	0.33248
VAR40	-0.39519	-0.23296	-0.36873	-0.59227	-0.62186	-0.42372	0.63960	0.24125	1.00000	0.07379
VAR41	0.28601	0.35114	-0.18163	0.08009	0.03579	-0.30603	0.01664	0.33248	0.07379	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 122. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR30	JUL-SEP FRE DAYS GT 90 F	0.48411	0.23436	0.23436	0.48411	0.2107874	0.50256
VAR40	JAN NOS GAL MIN TEMP	0.66414	0.44108	0.20672	-0.32949	-2.191425	-0.77475
VAR29	APR-JUN FRE DAYS GT 90 F	0.76546	0.58592	0.14484	0.12387	0.4389479	0.50520
VAR41	FEB NOS GAL MIN TEMP	0.77884	0.60659	0.02067	0.29832	0.4244798	0.15235
(CONSTANT)						12.85000	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 123. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR29	APR-JUN FRE DAYS GT 90 F	0.50693	0.25698	0.25698	-0.50693	-0.5956043	-0.44827
VAR30	JUL-SEP FRE DAYS GT 90 F	0.60153	0.36184	0.10487	0.20311	0.1795440	0.27993
VAR41	FEB NOS GAL MIN TEMP	0.63346	0.40128	0.03943	0.28596	0.8895204	0.20877
VAR40	JAN NOS GAL MIN TEMP	0.65060	0.42328	0.02200	-0.40888	-0.8408051	-0.19438
(CONSTANT)						18.78961	

Table 124. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR30	JUL-SEP FRE DAYS GT 90 F	0.67107	0.45034	0.45034	-0.67107	-0.3155597E-01	-0.69785
VAR40	JAN NOS GAL MIN TEMP	0.69396	0.48158	0.03124	-0.32810	-0.7630446E-01	-0.25022
VAR41	FEB NOS GAL MIN TEMP	0.71296	0.50831	0.02673	-0.05661	0.5322254E-01	0.17718
VAR29	APR-JUN FRE DAYS GT 90 F	0.71911	0.51712	0.00882	-0.18930	0.1150740E-01	0.12285
(CONSTANT)						3.099387	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 125. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR40	JAN NOS GAL MIN TEMP	0.59227	0.35079	0.35079	-0.59227	-30.17434	-0.66567
VAR30	JUL-SEP FRE DAYS GT 90 F	0.66216	0.43846	0.08768	0.14447	2.011719	0.29468
VAR41	FEB NOS GAL MIN TEMP	0.66282	0.43933	0.00087	0.08009	1.385096	0.03123
(CONSTANT)						259.8634	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 126. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR40	JAN NOS GAL MIN TEMP	0.62186	0.38671	0.38671	-0.62186	-16.86162	-0.57208
VAR30	JUL-SEP FRE DAYS GT 90 F	0.67106	0.45032	0.06361	0.09473	1.211431	0.27291
VAR29	APR-JUN FRE DAYS GT 90 F	0.68518	0.46947	0.01915	-0.48604	-1.571136	-0.18077
(CONSTANT)						179.5592	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 127. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19,11-15 fathom depths) with temperature variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR40	JAN NOS GAL MIN TEMP	0.42372	0.17954	0.17954	-0.42372	-8.203464	-0.64635
VAR29	APR-JUN FRE DAYS GT 90 F	0.50944	0.25953	0.07999	-0.05361	1.267849	0.33877
VAR41	FEB NOS GAL MIN TEMP	0.57399	0.32946	0.06993	-0.30603	-3.762146	-0.30298
VAR30	JUL-SEP FRE DAYS GT 90 F	0.58388	0.34091	0.01145	-0.06407	0.2242702	0.11733
(CONSTANT)						100.3026	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 128. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to wind, tide and Ekman transport variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR31	VAR32	VAR33	VAR34	VAR35	VAR36
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	-0.35859	0.58089	0.23214	0.17847	-0.53276	0.48895
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	-0.84287	0.67838	0.54994	0.66394	-0.17098	0.07905
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	0.51396	-0.51126	-0.25226	0.09216	-0.15695	-0.13674
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	-0.48468	0.60602	0.49962	0.52334	-0.24099	0.33858
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	-0.14331	0.43190	0.38802	0.42825	-0.25685	0.22043
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	0.15567	-0.12221	0.49301	0.45208	0.08862	-0.26941
VAR31	-0.35859	-0.84287	0.51396	-0.48468	-0.14331	0.15567	1.00000	-0.51575	-0.49646	-0.63655	0.32532	-0.10469
VAR32	0.58089	0.67838	-0.51126	0.60602	0.43190	-0.12221	-0.51575	1.00000	0.05090	0.07009	0.05769	-0.09686
VAR33	0.23214	0.54994	-0.25226	0.49962	0.38802	0.49301	-0.49646	0.05090	1.00000	0.59887	-0.14586	0.13238
VAR34	0.17847	0.66394	0.09216	0.52334	0.42825	0.45208	-0.63655	0.07009	0.59887	1.00000	-0.38620	-0.02664
VAR35	-0.53276	-0.17098	-0.15695	-0.24099	-0.25685	0.08862	0.32532	0.05769	-0.14586	-0.38620	1.00000	-0.63348
VAR36	0.48895	0.07905	-0.13674	0.33858	0.22043	-0.26941	-0.10469	-0.09686	0.13238	-0.02664	-0.63348	1.00000
VAR62	-0.05772	-0.24067	0.21486	-0.24692	-0.18984	-0.39626	0.08294	-0.32549	-0.54007	0.02322	-0.40968	0.30915
VAR63	0.12611	-0.15906	0.44838	-0.13520	0.13580	0.23831	0.13714	-0.36515	-0.22821	0.14938	-0.42819	-0.01947
VAR64	-0.44520	-0.55324	0.49820	-0.62533	-0.54914	-0.24992	0.11634	-0.48819	-0.31111	-0.14901	-0.30029	0.10136
VAR65	-0.32950	-0.37170	0.37234	-0.47662	-0.37232	0.07845	0.02557	-0.15596	0.06624	-0.20476	-0.06673	-0.23046
VAR66	-0.44363	-0.82686	0.37992	-0.72607	-0.48737	-0.20999	0.78214	-0.24232	-0.74198	-0.87879	0.36178	-0.35363
VAR67	-0.13991	-0.37989	0.48323	-0.42753	-0.18369	0.30285	0.24807	-0.22855	-0.10877	-0.32554	-0.05241	-0.40729
VAR87	-0.51424	-0.89160	0.43085	-0.61170	-0.36401	-0.03561	0.89180	-0.70776	-0.41843	-0.59686	0.25778	0.09285
VAR88	0.55793	0.27265	-0.18950	0.18143	0.15205	-0.20418	-0.38937	0.58333	0.04943	-0.11052	-0.48292	0.10904
VAR89	-0.11603	-0.00692	-0.26526	-0.14007	-0.22520	-0.21090	0.06475	0.47185	-0.40984	-0.57921	0.67998	-0.48587
VAR90	0.26965	0.56119	-0.21128	0.67264	0.56345	0.22133	-0.30657	0.25798	0.35786	0.72216	-0.04791	0.18916
VAR91	-0.31821	-0.43421	0.67240	-0.19158	0.06087	0.48104	0.35161	-0.43368	0.10366	0.08485	-0.04167	-0.01603
VAR92	-0.25099	0.17760	-0.54321	0.02915	-0.13699	-0.29464	0.00890	0.23710	-0.16840	-0.10739	0.68533	-0.29474
VAR93	-0.08897	-0.16663	-0.05153	-0.13766	-0.34322	-0.46552	-0.09119	-0.43655	0.06442	0.01538	-0.44901	0.73954
VAR94	0.80841	0.17124	0.01527	0.60809	0.77779	0.34842	0.20944	0.22794	0.11606	-0.10142	-0.35484	0.48022
VAR95	0.05985	0.14254	-0.25532	0.06907	-0.16796	-0.49125	-0.40444	0.01547	0.04843	0.07837	-0.33416	0.59977
VAR96	-0.27791	-0.07340	-0.58452	-0.32470	-0.57065	-0.81276	-0.12573	0.12317	-0.26648	-0.55512	0.26941	0.11378
VAR97	0.21790	0.20638	-0.12052	0.38077	0.37457	0.51914	-0.05945	-0.18404	0.87112	0.26275	-0.14740	0.32212
VAR98	0.00152	0.52120	-0.53725	0.16062	-0.06878	-0.03886	-0.64029	0.04929	0.69375	0.58447	-0.21285	-0.02366
VAR99	0.56888	0.55279	-0.18924	0.63939	0.62062	0.22323	-0.39233	0.72615	0.37581	0.35018	-0.30150	0.05430
VAR100	-0.07501	0.34051	0.39922	0.25349	0.22845	0.45176	-0.34758	-0.30182	0.29502	0.83034	-0.23898	-0.05238
VAR101	0.03052	0.39076	-0.22784	0.31842	0.37577	0.63668	-0.05103	0.53970	0.48355	0.16952	0.60879	-0.65926

Table 128 continued

	VAR62	VAR63	VAR64	VAR65	VAR66	VAR67	VAR87	VAR88	VAR89	VAR90	VAR91	VAR92
VAR1	-0.05772	0.12611	-0.44520	-0.32950	-0.44363	-0.13991	-0.51424	0.55793	-0.11603	0.26965	-0.31821	-0.25099
VAR2	-0.24067	-0.15906	-0.55324	-0.37170	-0.82686	-0.37989	-0.89160	0.27265	-0.00692	0.56119	-0.43421	0.17760
VAR68	0.21486	0.44838	0.49820	0.37234	0.37992	0.48325	0.43085	-0.18950	-0.26526	-0.21128	0.67240	-0.54321
CTEF18	-0.24692	-0.13520	-0.62533	-0.47662	-0.72607	-0.42753	-0.61170	0.18143	-0.14007	0.67264	-0.19158	0.02915
CTEF19	-0.18984	0.13580	-0.54914	-0.37232	-0.48737	-0.18369	-0.36401	0.15205	-0.22520	0.56345	0.06087	-0.13699
CTEF193	-0.39626	0.23831	-0.24992	0.07845	-0.20999	0.30285	-0.03561	-0.20418	-0.21090	0.22133	0.48104	-0.29464
VAR31	0.08294	0.13714	0.11634	0.02557	0.78214	0.24807	0.89180	-0.38937	0.06475	-0.30657	0.35161	0.00890
VAR32	-0.32549	-0.36515	-0.48819	-0.15596	-0.24232	-0.22855	-0.70776	0.58333	0.47185	0.25798	-0.43368	0.23710
VAR33	-0.54007	-0.22821	-0.31111	0.06624	-0.74198	-0.10877	-0.41845	0.04943	-0.40984	0.35786	0.10366	-0.16840
VAR34	0.02322	0.14938	-0.14901	-0.20476	-0.87879	-0.32554	-0.59686	-0.11052	-0.57921	0.72216	0.08485	-0.10739
VAR35	-0.40968	-0.42819	-0.30029	-0.06673	0.36178	-0.05241	0.25778	-0.48292	0.67998	-0.04791	-0.04167	0.68533
VAR36	0.30915	-0.01947	0.10136	-0.23046	-0.35363	-0.40729	0.09285	0.10904	-0.48587	0.18916	-0.01603	-0.29474
VAR62	1.00000	0.62728	0.59976	-0.09383	0.04026	-0.19375	0.28517	-0.17493	-0.32684	0.04794	0.21584	-0.03916
VAR63	0.62728	1.00000	0.47193	0.19994	0.05489	0.45827	0.14248	0.03892	-0.27958	-0.24061	0.37419	-0.48473
VAR64	0.59976	0.47193	1.00000	0.69443	0.26220	0.33956	0.38861	0.06549	-0.18884	-0.48417	0.59946	-0.46863
VAR65	-0.09383	0.19994	0.69443	1.00000	0.28844	0.67859	0.13177	0.42310	0.10558	-0.66637	0.56789	-0.58490
VAR66	0.04026	0.05489	0.26220	0.28844	1.00000	0.49040	0.64082	0.00343	0.45219	-0.67104	0.07812	-0.01275
VAR67	-0.19375	0.45827	0.33956	0.67859	0.49040	1.00000	0.09464	0.37581	0.22678	-0.81574	0.21422	-0.66188
VAR87	0.28517	0.14248	0.38861	0.13177	0.64082	0.09464	1.00000	-0.50396	-0.08361	-0.30401	0.48784	0.02364
VAR88	-0.17493	0.03892	0.06549	0.42310	0.00343	0.37581	-0.50396	1.00000	0.15515	-0.36532	-0.20780	-0.50698
VAR89	-0.32684	-0.27958	-0.18884	0.10558	0.45219	0.22678	-0.08361	0.15515	1.00000	-0.41722	-0.33373	0.35273
VAR90	0.04794	-0.24061	-0.48417	-0.66637	-0.67104	-0.81574	-0.30401	-0.36532	-0.41722	1.00000	-0.03989	0.46214
VAR91	0.21584	0.37419	0.59946	0.56789	0.07812	0.21422	0.48784	-0.20780	-0.33373	-0.03989	1.00000	-0.38058
VAR92	-0.03916	-0.48473	-0.46863	-0.58490	-0.01275	-0.66188	0.02364	-0.50698	0.35273	0.46214	-0.38058	1.00000
VAR93	0.28481	-0.20886	0.25614	-0.17379	-0.19979	-0.36404	0.18761	-0.17304	-0.50679	0.06204	-0.13258	-0.14003
VAR94	-0.15484	0.14685	-0.43527	-0.29923	-0.07903	0.03425	-0.01348	0.29167	-0.14456	0.12033	-0.06251	-0.33952
VAR95	0.53466	0.01378	0.50448	0.12636	-0.41406	-0.48379	-0.01164	0.04955	-0.23110	0.16928	0.21584	0.00000
VAR96	0.27326	-0.35994	0.22236	0.01199	0.09104	-0.47383	0.15947	-0.03993	0.27575	-0.04543	-0.18230	0.56011
VAR97	-0.58923	-0.28224	-0.34707	0.00296	-0.48199	-0.05498	-0.02705	-0.04337	-0.47065	0.23327	0.14488	-0.32490
VAR98	-0.35718	-0.37088	-0.28559	-0.11258	-0.63210	-0.28515	-0.53690	0.08993	-0.40865	0.34338	-0.36037	0.10372
VAR99	-0.30139	-0.22374	-0.29589	0.06703	-0.39759	-0.24307	-0.52815	0.61487	-0.14023	0.46139	0.06563	-0.14447
VAR100	0.30349	0.42311	0.07096	-0.23920	-0.64242	-0.16977	-0.26633	-0.47832	-0.48802	0.52067	0.20005	-0.09525
VAR101	-0.81003	-0.27821	-0.64999	-0.01127	-0.09164	0.28421	-0.33287	-0.02340	0.34328	0.13436	-0.09312	0.29796

Table 128 continued

	VAR93	VAR94	VAR95	VAR96	VAR97	VAR98	VAR99	VAR100	VAR101
VAR1	-0.08897	0.80841	0.05985	-0.27791	0.21790	0.00152	0.56888	-0.07501	0.03052
VAR2	-0.16663	0.17124	0.14254	-0.07340	0.20638	0.52120	0.55279	0.34051	0.39076
VAR68	-0.05153	0.01527	-0.25532	-0.58452	-0.12052	-0.53725	-0.18924	0.39922	-0.22784
CTEF18	-0.13766	0.60809	0.06907	-0.32470	0.38077	0.16062	0.63939	0.25549	0.31842
CTEF19	-0.34322	0.77779	-0.16796	-0.57065	0.37457	-0.06878	0.62062	0.22845	0.37577
CTEF193	-0.46552	0.34842	-0.49125	-0.81276	0.51914	-0.03886	0.22323	0.45176	0.63668
VAR31	-0.09119	0.20944	-0.40444	-0.12573	-0.05945	-0.64029	-0.39233	-0.34758	-0.05103
VAR32	-0.43655	0.22794	0.01547	0.12317	-0.18404	0.04929	0.72615	-0.30182	0.53970
VAR33	0.06442	0.11606	0.04843	-0.26648	0.87112	0.69375	0.37581	0.29502	0.48355
VAR34	0.01538	-0.10142	0.07837	-0.55512	0.26275	0.58447	0.35018	0.83034	0.16952
VAR35	-0.44901	-0.35484	-0.33416	0.26941	-0.14740	-0.21285	-0.30150	-0.23898	0.60879
VAR36	0.73954	0.48022	0.59977	0.11378	0.32212	-0.02366	0.05430	-0.05238	-0.65926
VAR62	0.28481	-0.15484	0.53466	0.27326	-0.58923	-0.35718	-0.30139	0.30349	-0.81003
VAR63	-0.20886	0.14685	0.01378	-0.35994	-0.28224	-0.37088	-0.22374	0.42311	-0.27821
VAR64	0.25614	-0.43527	0.50448	0.22236	-0.34707	-0.28559	-0.29589	0.07096	-0.64999
VAR65	-0.17379	-0.29923	0.12636	0.01199	0.00296	-0.11258	0.06703	-0.23920	-0.01127
VAR66	-0.19979	-0.07903	-0.41406	0.09104	-0.48199	-0.63210	-0.39759	-0.64242	-0.09164
VAR67	-0.36404	0.03425	-0.48379	-0.47383	-0.05498	-0.28515	-0.24307	-0.16977	0.28421
VAR87	0.18761	-0.01348	-0.01164	0.15947	-0.02705	-0.53690	-0.52815	-0.26633	-0.33287
VAR88	-0.17304	0.29167	0.04953	-0.03993	-0.04337	0.08993	0.61487	-0.47832	-0.02340
VAR89	-0.50679	-0.14456	-0.23110	0.27575	-0.47065	-0.40865	-0.14023	-0.48802	0.34328
VAR90	0.06204	0.12033	0.16928	-0.04343	0.23327	0.34338	0.46139	0.52067	0.13436
VAR91	-0.13258	-0.06251	0.21584	-0.18230	0.14488	-0.36037	0.06563	0.20005	-0.09312
VAR92	-0.14003	-0.33952	0.00000	0.56011	-0.32490	0.10372	-0.14447	-0.09525	0.29796
VAR93	1.00000	-0.08980	0.49614	0.25000	0.22317	0.29276	-0.33121	0.08351	-0.74428
VAR94	-0.08980	1.00000	-0.22277	-0.49391	0.39048	-0.29576	0.36332	-0.20454	0.08587
VAR95	0.49614	-0.22277	1.00000	0.62017	-0.14703	-0.01543	0.04310	0.07879	-0.85588
VAR96	0.25000	-0.49391	0.62017	1.00000	-0.47304	0.02182	-0.20039	-0.58056	-0.47586
VAR97	0.22317	0.39048	-0.14703	-0.47304	1.00000	0.47867	0.22475	0.03956	0.39022
VAR98	0.29276	-0.29576	-0.01543	0.02182	0.47867	1.00000	0.21646	0.24816	0.24752
VAR99	-0.33121	0.36332	0.04310	-0.20039	0.22475	0.21646	1.00000	-0.15781	0.55522
VAR100	0.08351	-0.20454	0.07879	-0.58056	0.03956	0.24816	-0.15781	1.00000	-0.02565
VAR101	-0.74428	0.08587	-0.85588	-0.47586	0.39022	0.24752	0.55522	-0.02565	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 129. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR87	JUNE GAL FASTEST WIND	0.94392	0.89098	0.89098	-0.94392	-0.7820135	-0.84788
VAR94	AUG GAL FAST WIND DIR	0.98355	0.96737	0.07639	0.20278	0.1711861E-01	0.18516
VAR90	SEP GAL FASTEST WIND	0.99808	0.99617	0.02880	0.41911	0.2046149	0.31972
VAR93	JUL GAL FAST WIND DIR	0.99919	0.99838	0.00221	-0.06750	-0.8296223E-02	-0.07883
VAR88	JUL GAL FASTEST WIND	0.99992	0.99983	0.00145	0.27901	0.1135828	0.14311
VAR33	APR-JUN FRE MEAN HI TIDE	1.00000	0.99999	0.00016	0.61732	-0.6315398	-0.07058
VAR99	AUG FRE HI TIDE	1.00000	1.00000	0.00001	0.51560	0.9131473	0.05130
(CONSTANT)						30.97392	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 130. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR94	AUG GAL FAST WIND DIR	0.84219	0.70928	0.70928	0.84219	0.1804457	1.33511
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.97661	0.95377	0.24449	-0.27798	-0.7196421	-0.36777
VAR97	JUN FRE HI TIDE	0.98985	0.97981	0.02603	0.39802	-8.054964	-0.51070
VAR98	JUL FRE HI TIDE	0.99534	0.99071	0.01090	0.04248	7.747938	0.40445
VAR65	JUL EKMAN MERID. IND	0.99979	0.99958	0.00888	-0.39060	0.6438605E-01	0.16012
VAR89	AUG GAL FASTEST WIND	1.00000	1.00000	0.00041	-0.18788	-0.5068244E-01	-0.05140
VAR32	JUL-SEP GAL MEAN FASTEST WIND	1.00000	1.00000	0.00000	0.42302	0.9971916E-01	0.02914
(CONSTANT)						26.95876	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 131. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR91	OCT GAL FASTEST WIND	0.88479	0.78285	0.78285	0.88479	0.3841751E-01	0.45382
VAR88	JUL GAL FASTEST WIND	0.94506	0.89315	0.11030	-0.54800	-0.7128519E-01	-0.78474
VAR97	JUN FRE HI TIDE	0.97219	0.94515	0.05200	-0.16292	-0.2482446	-0.20103
VAR92	JUN GAL FAST WIND DIR	0.99148	0.98303	0.03789	-0.25841	-0.6214728E-02	-0.62142
VAR89	AUG GAL FASTEST WIND	0.99996	0.99991	0.01688	-0.22509	0.1380938E-01	0.17887
VAR64	JUL EKMAN ZONAL IND	1.00000	1.00000	0.00008	0.55738	0.3737369E-03	0.02573
VAR35	APR-JUN GAL MEAN FAST WIND DIR	1.00000	1.00000	0.00000	0.04144	0.4092588E-03	0.02460
(CONSTANT)						3.963434	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 132. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with wind, tide and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR66	AUG EKMAN ZONAL IND	0.72607	0.52718	0.52718	-0.72607	-0.9471919	-0.48073
VAR94	AUG GAL FAST WIND DIR	0.91234	0.83236	0.30518	0.60809	0.6737637	0.43335
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.97082	0.94249	0.11013	0.60602	15.93006	0.65571
VAR88	JUL GAL FASTEST WIND	0.99248	0.98502	0.04253	0.18143	-4.067740	-0.39224
VAR92	JUN GAL FAST WIND DIR	0.99894	0.99787	0.01285	0.02915	-0.2008727	-0.16571
VAR96	OCT GAL FAST WIND DIR	0.99956	0.99913	0.00125	-0.32470	-0.4499317	-0.10395
VAR67	AUG EKMAN MERID. IND	0.99991	0.99982	0.00069	-0.42753	-0.3500833	-0.07776
VAR33	APR-JUN FRE MEAN HI TIDE	0.99999	0.99998	0.00016	0.49962	2.054399	0.01351
VAR65	JUL EKMAN MERID. IND	1.00000	1.00000	0.00002	-0.47662	0.7531189E-01	0.01613
(CONSTANT)						-152.3832	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 133. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR96	OCT GAL FAST WIND DIR	0.79986	0.63978	0.63978	-0.79986	-2.333369	-0.61840
VAR94	AUG GAL FAST WIND DIR	0.91943	0.84535	0.20557	0.79809	0.2682791	0.26124
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.96570	0.93257	0.08723	0.43352	9.937040	0.61657
VAR89	AUG GAL FASTEST WIND	0.98840	0.97693	0.04436	-0.23252	-3.018558	-0.39643
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.99845	0.99690	0.01997	-0.13840	2.527120	0.17333
VAR33	APR-JUN FRE MEAN HI TIDE	0.99995	0.99990	0.00300	0.38821	-8.673799	-0.08617
VAR36	JUL-SEP GAL MEAN FAST WIND DIR	1.00000	1.00000	0.00010	0.21735	-0.4628076E-01	-0.02375
(CONSTANT)						-79.09820	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 134. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind, tide, and Ekman transport variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR96	OCT GAL FAST WIND DIR	0.90550	0.81993	0.81993	-0.90550	-0.9807229	-0.62037
VAR91	OCT GAL FASTEST WIND	0.94639	0.89565	0.07572	0.50047	1.442411	0.41348
VAR101	OCT FRE HI TIDE	0.99727	0.99455	0.09890	0.63668	22.16801	0.40040
VAR67	AUG EKMAN MERID. IND	0.99990	0.99979	0.00525	0.17683	-0.1586802	-0.09459
VAR89	AUG GAL FASTEST WIND	0.99998	0.99996	0.00017	-0.17593	0.5464873E-01	0.01718
VAR100	SEP FRE HI TIDE	1.00000	1.00000	0.00004	0.43715	-0.2037303	-0.00902
VAR35	APR-JUN GAL MEAN FAST WIND DIR	1.00000	1.00000	0.00000	0.15630	0.3699918E-03	0.00054
(CONSTANT)						-106.8704	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 135. **Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to salinity variables.**

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR56	VAR57	VAR58	VAR59	VAR60	VAR61
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	-0.61917	-0.45196	-0.45158	-0.42526	-0.56970	-0.41667
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	-0.07584	-0.02264	0.06112	0.24493	-0.16390	0.19733
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	-0.17810	-0.17164	-0.13347	-0.08252	0.00778	-0.23559
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	-0.44490	-0.44828	-0.39499	-0.17030	-0.52658	-0.26909
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	-0.70455	-0.65876	-0.54749	-0.23688	-0.55612	-0.43173
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	-0.58387	-0.61047	-0.43567	0.09393	-0.31359	-0.20017
VAR56	-0.61917	-0.07584	-0.17810	-0.44490	-0.70455	-0.58387	1.00000	0.91811	0.85640	0.57116	0.74612	0.72004
VAR57	-0.45196	-0.02264	-0.17164	-0.44828	-0.65876	-0.61047	0.91811	1.00000	0.92169	0.57741	0.80219	0.73050
VAR58	-0.45158	0.06112	-0.13347	-0.39499	-0.54749	-0.43567	0.85640	0.92169	1.00000	0.81091	0.89995	0.89432
VAR59	-0.42526	0.24493	-0.08252	-0.17030	-0.23688	0.09393	0.57116	0.57741	0.81091	1.00000	0.76258	0.92037
VAR60	-0.56970	-0.16390	0.00778	-0.52658	-0.55612	-0.31359	0.74612	0.80219	0.89995	0.76258	1.00000	0.77893
VAR61	-0.41667	0.19733	-0.23559	-0.26909	-0.43173	-0.20017	0.72004	0.73050	0.89432	0.92037	0.77893	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 136. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR59	JUL POSTLAV MAX SAL	0.24493	0.05999	0.05999	0.24493	1.470832	0.88345
VAR60	AUG POSTLAV MIN SAL	0.59486	0.35386	0.29387	-0.16390	-1.219152	-0.91254
VAR56	JUN POSTLAV MIN SAL	0.59861	0.35833	0.00447	-0.07584	0.7638889E-01	0.10043
(CONSTANT)						2.87949/	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 137. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR56	JUN POSTLAV MIN SAL	0.61917	0.38337	0.38337	-0.61917	-0.4746359	-0.43786
VAR60	AUG POSTLAV MIN SAL	0.63996	0.40955	0.02618	-0.56970	-0.4626689	-0.24300
(CONSTANT)						43.50266	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 138. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR61	AUG POSTLAV MAX SAL	0.23559	0.05550	0.05550	-0.23559	-0.1497182	-0.52198
VAR60	AUG POSTLAV MIN SAL	0.38542	0.14855	0.09304	0.00778	0.1193544	0.69052
VAR57	JUN POSTLAV MAX SAL	0.43294	0.18743	0.03889	-0.17164	-0.3746687E-01	-0.34426
(CONSTANT)						4.325330	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 139. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with salinity variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR60	AUG POSTLAV MIN SAL	0.52658	0.27728	0.27728	-0.52658	-17.43989	-0.85891
VAR59	JUL POSTLAV MAX SAL	0.63646	0.40508	0.12780	-0.17030	13.99914	0.55326
VAR56	JUN POSTLAV MIN SAL	0.64146	0.41147	0.00639	-0.44490	-1.387893	-0.12006
(CONSTANT)						215.0211	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 140. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR56	JUN POSTLAV MIN SAL	0.70455	0.49639	0.49639	-0.70455	-4.927412	-0.65553
VAR59	JUL POSTLAV MAX SAL	0.73284	0.53706	0.04067	-0.23688	7.416853	0.45080
VAR60	AUG POSTLAV MIN SAL	0.76388	0.58351	0.04646	-0.55612	-5.423465	-0.41079
(CONSTANT)						89.22805	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 141. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with salinity variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR57	JUN POSTLAV MAX SAL	0.61047	0.37267	0.37267	-0.61047	-3.356152	-0.93755
VAR59	JUL POSTLAV MAX SAL	0.81954	0.67164	0.29897	0.09393	5.094140	0.71903
VAR60	AUG POSTLAV MIN SAL	0.82117	0.67432	0.00268	-0.31359	-0.6243909	-0.10983
(CONSTANT)						-18.05435	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 142. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to recruitment, bay catch and bay effort variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	WCE18	WCE19	WCEL18	WCEL19	VAR47	VAR48
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	0.54682	0.33035	0.34017	0.29704	0.41270	0.36899
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	0.31710	0.01348	0.30916	0.22556	0.12232	0.55256
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	-0.69664	-0.41845	-0.37631	-0.41578	-0.21662	-0.64733
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	0.36837	0.30485	0.06629	-0.07463	0.54004	0.46011
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	0.24063	0.18962	0.13576	-0.03891	0.59216	0.35483
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	-0.26304	-0.30203	-0.20889	-0.25225	0.27400	0.05901
WCE18	0.54682	0.31710	-0.69664	0.36837	0.24063	-0.26304	1.00000	0.70462	0.21318	0.38192	0.60441	0.74585
WCE19	0.33035	0.01348	-0.41845	0.30485	0.18962	-0.30203	0.70462	1.00000	-0.16544	-0.28459	0.81046	0.38423
WCEL18	0.34017	0.30916	-0.37631	0.06629	0.13576	-0.20889	0.21318	-0.16544	1.00000	0.72531	-0.14986	0.43224
WCEL19	0.29704	0.22556	-0.41578	-0.07463	-0.03891	-0.25225	0.38192	-0.28459	0.72531	1.00000	-0.29844	0.35224
VAR47	0.41270	0.12232	-0.21662	0.54004	0.59216	0.27400	0.60441	0.81046	-0.14986	-0.29844	1.00000	0.51953
VAR48	0.36899	0.55256	-0.64733	0.46011	0.35483	0.05901	0.74585	0.38423	0.43224	0.35224	0.51953	1.00000
VAR49	0.30583	0.13605	-0.13986	-0.09011	0.02985	-0.10340	0.16356	-0.46109	0.62990	0.94156	-0.40952	0.11577
VAR50	-0.00596	0.20424	-0.07980	0.00268	0.14961	0.14123	-0.11523	-0.34696	0.75538	0.43959	-0.11955	0.40541
VAR53	0.42828	0.41240	-0.20651	0.48248	0.56386	0.13357	0.20398	0.15723	0.68932	0.18395	0.36483	0.54506
VAR54	0.41965	-0.01260	-0.21478	0.37077	0.32637	-0.00642	0.65177	0.78823	-0.46957	-0.21149	0.74967	0.17400
VAR55	0.47235	0.14739	-0.08002	0.15734	0.32010	0.24945	0.32838	-0.25794	0.28542	0.72185	-0.03975	0.13050
VAR76	0.02680	0.55799	-0.38094	0.34827	0.29896	0.30233	0.11230	-0.10252	0.45593	0.16493	0.18823	0.72561
VAR77	-0.00344	0.00992	0.54063	0.18316	0.49775	0.91863	-0.40469	-0.53745	-0.04570	-0.01621	0.04404	-0.06586
VAR78	-0.29777	0.11347	0.24787	0.02697	0.14216	0.53739	-0.35970	-0.40239	0.06513	-0.09311	-0.04152	0.23674
VAR79	-0.14338	-0.42422	0.82386	-0.10086	0.05554	0.35110	-0.63218	-0.21832	-0.65358	-0.60922	-0.15212	-0.82284

	VAR49	VAR50	VAR53	VAR54	VAR55	VAR76	VAR77	VAR78	VAR79
VAR1	0.30583	-0.00596	0.42828	0.41965	0.47235	0.02680	-0.00344	-0.29777	-0.14338
VAR2	0.13605	0.20424	0.41240	-0.01260	0.14739	0.55799	0.00992	0.11347	-0.42422
VAR68	-0.13986	-0.07980	-0.20651	-0.21478	-0.08002	-0.38094	0.54063	0.24787	0.82386
CTEF18	-0.09011	0.00268	0.48248	0.37077	0.15734	0.34827	0.18316	0.02697	-0.10086
CTEF19	0.02985	0.14961	0.56386	0.32637	0.32010	0.29896	0.49775	0.14216	0.05554
CTEF193	-0.10340	0.14123	0.13357	-0.00642	0.24945	0.30233	0.91863	0.53739	0.35110
WCE18	0.16356	-0.11523	0.20398	0.65177	0.32838	0.11230	-0.40469	-0.35970	-0.63218
WCE19	-0.46109	-0.34696	0.15723	0.78823	-0.25794	-0.10252	-0.53745	-0.40239	-0.21832
WCEL18	0.62990	0.75538	0.68932	-0.46957	0.28542	0.45593	-0.04570	0.06513	-0.65358
WCEL19	0.94156	0.43959	0.18395	-0.21149	0.72185	0.16493	-0.01621	-0.09311	-0.60922
VAR47	-0.40952	-0.11955	0.36483	0.74967	-0.03975	0.18823	0.04404	-0.04152	-0.15212
VAR48	0.11577	0.40541	0.54506	0.17400	0.13050	0.72561	-0.06586	0.23674	-0.82284
VAR49	1.00000	0.41881	0.08781	-0.26003	0.78721	0.02175	0.17432	-0.02598	-0.32690
VAR50	0.41881	1.00000	0.62317	-0.61998	0.01374	0.75063	0.32446	0.68034	-0.49579
VAR53	0.08781	0.62317	1.00000	-0.19894	-0.02304	0.59745	0.14007	0.17148	-0.45131
VAR54	-0.26003	-0.61998	-0.19894	1.00000	0.17393	-0.36493	-0.20367	-0.45068	0.08978
VAR55	0.78721	0.01374	-0.02304	0.17393	1.00000	-0.13837	0.38479	-0.22245	-0.12233
VAR76	0.02175	0.75063	0.59745	-0.36493	-0.13837	1.00000	0.28218	0.70924	-0.63961
VAR77	0.17432	0.32446	0.14007	-0.20367	0.38479	0.28218	1.00000	0.58326	0.31993
VAR78	-0.02598	0.68034	0.17148	-0.45068	-0.22245	0.70924	0.58326	1.00000	-0.06785
VAR79	-0.32690	-0.49579	-0.45131	0.08978	-0.12233	-0.63961	0.31993	-0.06785	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 143. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR76	BAY TRIPS 18	0.55799	0.31135	0.31135	0.55799	5.405813	3.83303
VAR78	LAG BAY TRIPS 18	0.68679	0.47168	0.16033	0.11347	-1.762002	-1.18980
VAR79	LAG BAY TRIPS 19	0.74213	0.55075	0.07907	-0.42422	3.839351	2.32447
VAR49	LAG BAY CAT 19	0.79664	0.63464	0.08389	0.13605	0.1004458	1.34274
VAR50	LAG BAY CAT 18	0.86766	0.75284	0.11820	0.20424	-0.4702121E-01	-0.62510
VAR77	BAY TRIPS 19	0.97456	0.94977	0.19694	0.00992	-1.181596	-1.06610
VAR54	JUL POSTLARVAL CATCH-TOW	0.99898	0.99795	0.04818	-0.01260	0.1881743E-01	0.32874
VAR53	JUN POSTLARVAL CAT-TOW	0.99999	0.99999	0.00204	0.41240	-0.2049871E-01	-0.15129
VAR47	BAY CAT 19	1.00000	1.00000	0.00001	0.12232	0.2574423E-02	0.03588
(CONSTANT)						-91.99195	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 144. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR55	AUG POSTLARVAL CATCH-TOW	0.47235	0.22311	0.22311	0.47235	0.9288853E-01	1.21380
VAR53	JUN POSTLARVAL CAT-TOW	0.64504	0.41608	0.19297	0.42828	-0.1956606E-01	-0.10133
VAR54	JUL POSTLARVAL CATCH-TOW	0.77990	0.60825	0.19217	0.41965	-0.3886676E-01	-0.47644
VAR47	BAY CAT 19	0.83145	0.69131	0.08306	0.41270	0.1251224	1.22371
VAR78	LAG BAY TRIPS 18	0.84337	0.71127	0.01995	-0.29777	-1.443310	-0.68387
VAR79	LAG BAY TRIPS 19	0.84984	0.72222	0.01096	-0.14338	6.660476	2.82954
VAR77	BAY TRIPS 19	0.88353	0.78063	0.05841	-0.00344	-3.221856	-2.03976
VAR76	BAY TRIPS 18	0.99371	0.98745	0.20682	0.02680	5.428812	2.70104
VAR49	LAG BAY CAT 19	1.00000	1.00000	0.01255	0.30583	0.1002625	0.94048
(CONSTANT)						-146.9426	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 145. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR79	LAG BAY TRIPS 19	0.82386	0.67874	0.67874	0.82386	0.4654827E-03	0.00218
VAR50	LAG BAY CAT 18	0.90662	0.82196	0.14323	-0.07980	0.4194420E-02	0.43099
VAR77	BAY TRIPS 19	0.91076	0.82949	0.00753	0.54063	0.2103988	1.46729
VAR76	BAY TRIPS 18	0.91982	0.84606	0.01657	-0.38094	-0.3696949	-2.02614
VAR55	AUG POSTLARVAL CATCH-TOW	0.94962	0.90178	0.05571	-0.08002	-0.7262959E-02	-1.04543
VAR48	BAY CAT 18	0.96319	0.92773	0.02596	-0.64733	0.1025061E-01	1.11009
VAR47	BAY CAT 19	0.99782	0.99564	0.06791	-0.21662	-0.4901809E-02	-0.52808
VAR53	JUN POSTLARVAL CAT-TOW	0.99997	0.99994	0.00430	-0.20651	0.1749733E-02	0.09982
VAR49	LAG BAY CAT 19	1.00000	1.00000	0.00006	-0.13986	-0.5991900E-03	-0.06191
(CONSTANT)						2.269375	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 146. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR53	JUN POSTLARVAL CAT-TOW	0.48248	0.23279	0.23279	0.48248	0.8311757	0.40364
VAR54	JUL POSTLARVAL CATCH-TOW	0.67796	0.45963	0.22684	0.37077	4.045629	4.65032
WCE19	BAY CAT-TRIP 19	0.75063	0.56345	0.10382	0.30485	-7.002881	-5.10103
VAR55	AUG POSTLARVAL CATCH-TOW	0.79201	0.62727	0.06382	0.15734	-1.711751	-2.09743
WCE18	BAY CAT-TRIP 18	0.84375	0.71191	0.08464	0.36837	3.082879	1.58534
WCEL18	LAG BAY CAT-TRIP 18	0.87637	0.76803	0.05612	0.06629	4.814857	2.48377
WCEL19	LAG BAY CAT-TRIP 19	0.94615	0.89521	0.12718	-0.07463	-2.063934	-1.51006
(CONSTANT)						173.7082	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 147. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR53	JUN POSTLARVAL CAT-TOW	0.56386	0.31794	0.31794	0.56386	0.6754013	0.50443
VAR54	JUL POSTLARVAL CATCH-TOW	0.71985	0.51819	0.20025	0.32637	2.232351	3.94636
WCE19	BAY CAT-TRIP 19	0.88807	0.78868	0.27049	0.18962	-3.583433	-4.01437
WCEL19	LAG BAY CAT-TRIP 19	0.92164	0.84941	0.06074	-0.03891	-1.354133	-1.52369
WCEL18	LAG BAY CAT-TRIP 18	0.95071	0.90386	0.05444	0.13576	2.823288	2.23986
WCE18	BAY CAT-TRIP 18	0.96857	0.93813	0.03427	0.24063	1.139314	0.90105
VAR55	AUG POSTLARVAL CATCH-TOW	0.99954	0.99909	0.06096	0.32010	-0.6502952	-1.22545
(CONSTANT)						102.9374	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 148. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19,11-15 fathom depths) with recruitment, bay catch and bay effort variables for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
WCE19	BAY CAT-TRIP 19	0.30203	0.09122	0.09122	-0.30203	-0.9197173	-2.39268
VAR54	JUL POSTLARVAL CATCH-TOW	0.48261	0.23292	0.14170	-0.00642	0.3055685	1.25363
VAR53	JUN POSTLARVAL CAT-TOW	0.66155	0.43765	0.20473	0.13357	0.1766303	0.30635
WCEL19	LAG BAY CAT-TRIP 19	0.84149	0.70810	0.27046	-0.25225	-0.7223620	-1.88756
WCE18	BAY CAT-TRIP 18	0.88416	0.78174	0.07363	-0.26304	0.5511772	1.01229
WCEL18	LAG BAY CAT-TRIP 18	0.91280	0.83320	0.05147	-0.20889	0.4710784	0.86790
VAR55	AUG POSTLARVAL CATCH-TOW	0.91372	0.83489	0.00168	0.24945	0.4654824E-01	0.20370
(CONSTANT)						74.06227	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 149. Summary statistics for the eighteen year (1960-1977) data set used to develop the stepwise multiple regression models relating white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 4)

VARIABLE	MEAN	STANDARD DEV	CASES
VAR2	18.5084	6.3769	18
VAR1	21.4060	7.0215	18
VAR68	1.8919	1.5652	18
CTEF18	161.6400	64.3608	18
CTEF19	110.3550	54.4512	18
CTEF193	48.8672	48.0279	18
XE18	89.1081	32.7578	18
XE19	203.3556	52.0091	18
XE193	69.3395	32.3205	18
VAR15	163.2923	35.9985	18
VAR16	150.1449	71.5719	18
VAR17	500.7331	261.8101	18
VAR18	57.7572	17.8762	18
VAR19	24.9901	4.6827	18
VAR20	29.1972	10.6647	18
VAR21	52.2644	35.5192	18
VAR22	38.0157	33.6093	18
VAR23	44.8700	30.6364	18
VAR24	108.1799	102.3199	18
VAR25	52.7872	13.7307	18
VAR26	13.4756	7.2058	18
VAR27	16.9961	6.7987	18
VAR28	13.8867	5.6160	18
VAR29	14.0000	6.5218	16
VAR30	58.7059	13.0277	17
VAR31	33.8056	4.8888	18
VAR32	30.8778	6.7468	18
VAR33	6.0111	0.5591	18
VAR34	5.9847	0.5490	17
VAR35	98.3333	29.2052	18
VAR36	94.1667	26.1360	18
VAR37	163.3561	35.9526	18
VAR38	143.9442	69.7521	18
VAR39	495.0816	261.2084	18
VAR40	6.8444	1.6964	18
VAR41	9.6556	1.9233	18
VAR42	54.7422	13.9580	18
VAR43	18.4389	8.0208	18
VAR44	13.7678	5.6772	18
VAR45	195.2136	167.2327	18

Table 149 continued

VARIABLE	MEAN	STANDARD DEV	CASES
VAR46	26.6625	15.3928	18
VAR47	229.4129	110.5807	18
VAR48	184.9871	68.9793	18
VAR49	213.3453	101.6894	18
VAR50	180.1021	74.3777	18
VAR51	209.2222	71.7385	18
VAR52	209.7222	71.4207	18
VAR76	14.1787	4.7994	18
VAR77	18.2192	5.0817	18
VAR78	13.4335	5.5785	18
VAR79	17.1790	5.0933	18
VAR80	51.3477	14.9693	18
VAR81	152.6362	103.3874	18
VAR82	8.4289	4.3649	18
VAR83	28.4503	9.8826	18
VAR84	110.4006	102.7044	18
VAR85	37.6042	33.6627	18
VAR86	33.3689	18.9375	18
VAR87	31.4444	7.6943	18
VAR88	29.0000	7.4439	18
VAR89	28.1111	6.3699	18
VAR90	35.5000	14.0220	18
VAR91	32.0000	5.6464	18
VAR92	117.5000	63.8990	18
VAR93	102.5000	50.7372	18
VAR94	112.5000	58.2654	18
VAR95	67.5000	41.5597	18
VAR96	57.5000	45.8017	18
VAR97	5.9865	0.5096	17
VAR98	5.6124	0.4333	17
VAR99	5.8118	0.6740	17
VAR100	6.5950	1.0120	16
VAR101	6.2756	0.6350	16
WCE18	137.7039	47.6875	18
WCE19	137.7469	96.5305	18
WCEL18	150.1563	63.5081	18
WCEL19	137.9456	96.5741	18

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 150. **Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to river discharge variables.**

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR15	VAR16	VAR17	VAR18	VAR19	VAR20
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	0.31614	0.31568	0.57002	0.32192	0.24151	0.24623
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	0.43129	0.34866	0.30163	0.13662	0.43366	0.38548
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	-0.20402	0.21263	0.02795	-0.04083	-0.06407	-0.09807
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	0.59517	0.40891	0.50701	0.59860	0.27443	0.48267
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	0.69445	0.48977	0.68442	0.66383	0.42348	0.50055
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	0.34214	0.31932	0.30461	0.45127	0.26288	0.39179
VAR15	0.31614	0.43129	-0.20402	0.59517	0.69445	0.34214	1.00000	0.52252	0.73300	0.87686	0.67960	0.58151
VAR16	0.31568	0.34866	0.21263	0.40891	0.48977	0.31932	0.52252	1.00000	0.67506	0.39806	0.55997	0.50759
VAR17	0.57002	0.30163	0.02795	0.50701	0.68442	0.30461	0.73300	0.67506	1.00000	0.66710	0.50998	0.32911
VAR18	0.32192	0.13662	-0.04083	0.59860	0.66383	0.45127	0.87686	0.39806	0.66710	1.00000	0.45809	0.38763
VAR19	0.24151	0.43366	-0.06407	0.27443	0.42348	0.26288	0.67960	0.55997	0.50998	0.45809	1.00000	0.52702
VAR20	0.24623	0.38548	-0.09807	0.48267	0.50055	0.39179	0.58151	0.50759	0.32911	0.38763	0.52702	1.00000
VAR21	0.20743	0.28303	-0.07626	0.33184	0.27805	0.21126	0.38762	0.82525	0.51622	0.25298	0.34145	0.60930
VAR22	0.16642	0.28239	0.42936	0.23020	0.28763	0.08751	0.26713	0.67250	0.35700	0.19923	0.32496	0.02752
VAR23	0.09712	0.16189	-0.13071	0.22019	0.58227	0.34689	0.65667	0.37863	0.67443	0.56791	0.33361	0.11311
VAR24	0.19244	0.50996	0.05064	0.32637	0.52115	0.06335	0.55845	0.32400	0.41555	0.38643	0.41795	0.20608
VAR37	-0.07430	0.52580	-0.41922	0.09722	0.25903	-0.09260	0.46612	0.17548	0.28250	0.23703	0.29660	-0.04787
VAR38	0.23086	0.38145	-0.08033	0.16092	0.50557	0.31202	0.39959	0.42273	0.50960	0.14572	0.42564	0.24672
VAR39	0.03256	0.35489	-0.20551	-0.06121	0.18711	-0.03629	0.23461	0.06798	0.15644	0.05007	0.43555	-0.13084
VAR45	0.51429	0.09158	-0.13900	0.32675	0.26555	0.00020	0.29723	0.40343	0.76520	0.31913	0.13151	0.10813
VAR46	0.08498	0.29945	0.15263	0.32422	0.36627	0.29154	0.53397	0.63270	0.39419	0.43129	0.68459	0.46608
VAR51	0.32374	0.52659	-0.29470	0.59242	0.63969	0.22279	0.96447	0.56282	0.70805	0.76923	0.73205	0.56746
VAR52	0.02388	0.62147	-0.41793	0.21279	0.24891	-0.10397	0.45547	0.25389	0.30117	0.19973	0.31784	0.02716
VAR80	0.12486	0.46374	-0.35195	0.28673	0.38821	-0.07747	0.73081	0.24442	0.57210	0.49504	0.39897	0.05824
VAR81	0.39287	0.06351	0.28558	0.36677	0.61563	0.60605	0.62697	0.62578	0.68396	0.62044	0.56581	0.42367
VAR83	0.20732	0.56327	-0.25331	0.46449	0.44629	-0.12751	0.71370	0.42597	0.56125	0.47135	0.40184	0.18798
VAR84	-0.17437	0.16738	0.00416	-0.11896	0.20055	0.24775	0.45367	0.32258	0.33307	0.28619	0.45860	0.22970
VAR85	0.08932	0.06437	0.23709	-0.02551	0.52519	0.64768	0.29518	0.34496	0.37183	0.15089	0.35868	0.39933
VAR86	0.44233	0.04490	0.06789	0.24906	0.52301	0.42099	0.33322	0.53515	0.63176	0.31525	0.34051	0.36232

Table 150 continued

	VAR21	VAR22	VAR23	VAR24	VAR37	VAR38	VAR39	VAR45	VAR46	VAR51	VAR52	VAR80
VAR1	0.20743	0.16642	0.09712	0.19244	-0.07430	0.23086	0.03256	0.51429	0.08498	0.32374	0.02388	0.12486
VAR2	0.28303	0.28239	0.16189	0.50996	0.52580	0.38145	0.35489	0.09158	0.29945	0.52659	0.62147	0.46374
VAR68	-0.07626	0.42936	-0.13071	0.05064	-0.41922	-0.08033	-0.20551	-0.13900	0.15263	-0.29470	-0.41793	-0.35195
CTEF18	0.33184	0.23020	0.22019	0.32637	0.09722	0.16092	-0.06121	0.32675	0.32422	0.59242	0.21279	0.28673
CTEF19	0.27805	0.28763	0.58227	0.52115	0.25903	0.50557	0.18711	0.26555	0.36627	0.63969	0.24891	0.38821
CTEF193	0.21126	0.08751	0.34689	0.06335	-0.09260	0.31202	-0.03629	0.00020	0.29154	0.22279	-0.10397	-0.07747
VAR15	0.38762	0.26713	0.65667	0.55845	0.46612	0.39959	0.23461	0.29723	0.53397	0.96447	0.45547	0.73081
VAR16	0.82525	0.67250	0.37863	0.32400	0.17548	0.42273	0.06798	0.40343	0.63270	0.56282	0.25389	0.24442
VAR17	0.51622	0.35700	0.67443	0.41555	0.28250	0.50960	0.15644	0.76520	0.39419	0.70805	0.30117	0.57210
VAR18	0.25298	0.19923	0.56791	0.38643	0.23703	0.14572	0.05007	0.31913	0.43129	0.76923	0.19973	0.49504
VAR19	0.34145	0.32496	0.33361	0.41795	0.29660	0.42564	0.43555	0.13151	0.68459	0.73205	0.31784	0.39897
VAR20	0.60930	0.02752	0.11311	0.20608	-0.04787	0.24672	-0.13084	0.10813	0.46608	0.56746	0.02716	0.05824
VAR21	1.00000	0.23090	0.19899	-0.09641	0.08011	0.30915	-0.07281	0.48871	0.28944	0.44192	0.20031	0.08915
VAR22	0.23090	1.00000	0.23362	0.63425	0.17852	0.24088	0.08868	0.02403	0.53840	0.25503	0.20677	0.28322
VAR23	0.19899	0.23362	1.00000	0.47411	0.66897	0.68112	0.49141	0.32156	0.37460	0.63704	0.60753	0.71603
VAR24	-0.09641	0.63425	0.47411	1.00000	0.41700	0.37004	0.17549	-0.09980	0.49046	0.51766	0.36420	0.60393
VAR37	0.08011	0.17852	0.66897	0.41700	1.00000	0.60133	0.75139	-0.02324	0.21081	0.55798	0.96383	0.77920
VAR38	0.30915	0.24088	0.68112	0.37004	0.60133	1.00000	0.67836	0.21669	0.26117	0.44760	0.63879	0.47799
VAR39	-0.07281	0.08868	0.49141	0.17549	0.75139	0.67836	1.00000	-0.06879	0.19154	0.33032	0.72737	0.46137
VAR45	0.48871	0.02403	0.32156	-0.09980	-0.02324	0.21669	-0.06879	1.00000	0.07376	0.29267	0.03155	0.21550
VAR46	0.28944	0.53840	0.37460	0.49046	0.21081	0.26117	0.19154	0.07376	1.00000	0.56569	0.22170	0.22286
VAR51	0.44192	0.25503	0.63704	0.51766	0.55798	0.44760	0.33032	0.29267	0.56569	1.00000	0.55995	0.76749
VAR52	0.20031	0.20677	0.60753	0.36420	0.96383	0.63879	0.72737	0.03155	0.22170	0.55995	1.00000	0.73803
VAR80	0.08915	0.28322	0.71603	0.60393	0.77920	0.47799	0.46137	0.21550	0.22286	0.76749	0.73803	1.00000
VAR81	0.55572	0.16820	0.42103	0.08355	0.14060	0.37419	0.18722	0.32451	0.28224	0.61740	0.17006	0.28799
VAR83	0.17393	0.53058	0.65619	0.75348	0.68465	0.44282	0.32436	0.18825	0.45147	0.76298	0.67086	0.89381
VAR84	0.33988	-0.03106	0.42173	0.12598	0.54181	0.32228	0.41351	-0.03284	0.18347	0.50884	0.50545	0.44213
VAR85	0.30393	-0.03091	0.48444	0.18491	0.27561	0.69684	0.35875	-0.00232	0.17431	0.29613	0.26264	0.13297
VAR86	0.61217	-0.10400	0.33235	-0.11913	0.01682	0.39037	0.07537	0.50998	0.07850	0.37970	0.03070	0.06022

Table 150 continued

	VAR81	VAR83	VAR84	VAR85	VAR86
VAR1	0.39287	0.20732	-0.17437	0.08932	0.44233
VAR2	0.06351	0.56327	0.16738	0.06437	0.04490
VAR68	0.28558	-0.25331	0.00416	0.23709	0.06789
CTEF18	0.36677	0.46449	-0.11896	-0.02551	0.24906
CTEF19	0.61563	0.44629	0.20055	0.52519	0.52301
CTEF193	0.60605	-0.12751	0.24775	0.64768	0.42099
VAR15	0.62697	0.71370	0.45367	0.29518	0.33322
VAR16	0.62578	0.42597	0.32258	0.34496	0.53315
VAR17	0.68396	0.56125	0.33307	0.37183	0.63176
VAR18	0.62044	0.47135	0.28619	0.15089	0.31525
VAR19	0.56581	0.40184	0.45860	0.35868	0.34051
VAR20	0.42367	0.18798	0.22970	0.39933	0.36232
VAR21	0.55572	0.17393	0.33988	0.30393	0.61217
VAR22	0.16820	0.53058	-0.03106	-0.03091	-0.10400
VAR23	0.42103	0.65619	0.42173	0.48444	0.33235
VAR24	0.08353	0.75348	0.12598	0.18491	-0.11913
VAR37	0.14060	0.68465	0.54181	0.27561	0.01682
VAR38	0.37419	0.44282	0.32228	0.69684	0.39037
VAR39	0.18722	0.32436	0.41351	0.35875	0.07537
VAR45	0.32451	0.18825	-0.03284	-0.00232	0.50998
VAR46	0.28224	0.45147	0.18347	0.17431	0.07850
VAR51	0.61740	0.76298	0.50884	0.29613	0.37970
VAR52	0.17006	0.67086	0.50545	0.26264	0.03070
VAR80	0.28799	0.89381	0.44213	0.13297	0.06022
VAR81	1.00000	0.17527	0.64682	0.62180	0.79659
VAR83	0.17527	1.00000	0.23203	0.02615	-0.03233
VAR84	0.64682	0.23203	1.00000	0.62596	0.48723
VAR85	0.62180	0.02615	0.62596	1.00000	0.66331
VAR86	0.79659	-0.03233	0.48723	0.66331	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 151. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with river discharge variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	LAG ANNUAL ATCH DIS	0.62147	0.38622	0.38622	0.62147	0.1662913	1.86245
VAR20	OCT-DEC MISS DIS	0.72263	0.52219	0.13597	0.38548	0.6977389	1.16689
VAR23	JUL-SEP TRIN DIS	0.78981	0.62379	0.10161	0.16189	-0.5634267E-01	-0.27069
VAR24	OCT-DEC TRIN DIS	0.86604	0.75003	0.12624	0.50996	0.7165326E-01	1.14970
VAR45	APR-JUN TRIN DIS	0.91180	0.83138	0.08135	0.09158	0.5044005E-03	0.01323
VAR84	LAG OCT-DEC TRIN DIS	0.91744	0.84170	0.01032	0.16738	-0.3443071E-01	-0.55453
VAR86	JAN-MAR GUAD DIS	0.93226	0.86910	0.02741	0.04490	0.3671728	1.09039
VAR38	LAG ANNUAL GUAD DIS	0.93997	0.88354	0.01443	0.38145	-0.7318672E-01	-0.80053
VAR39	LAG ANNUAL TRIN DIS	0.95479	0.91163	0.02809	0.35489	0.1701855E-01	0.69711
VAR51	ANNUAL ATCH DIS	0.96910	0.93916	0.02753	0.52659	-0.6494988E-01	-0.73067
VAR80	JAN-MAR MISS DIS	0.97888	0.95820	0.01905	0.46374	0.5993920	1.40702
VAR37	LAG ANNUAL MISS DIS	0.98477	0.96977	0.01156	0.52580	-0.1389417	-0.78334
VAR83	LAG OCT-DEC MISS DIS	0.99016	0.98042	0.01065	0.56327	-0.7359021	-1.14047
VAR46	JUL-SEP GUAD DIS	0.99604	0.99209	0.01167	0.29945	0.1084894	0.26188
VAR85	LAG OCT-DEC GUAD DIS	0.99848	0.99696	0.00487	0.06437	-0.1117539	-0.58993
VAR19	JUL-SEP MISS DIS	0.99934	0.99869	0.00172	0.43366	-0.3059388	-0.22466
VAR15	ANNUAL MISS DIS	1.00000	1.00000	0.00131	0.43129	-0.8444886E-01	-0.47673
(CONSTANT)						0.7879979	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 152. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with river discharge variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR17	ANNUAL TRIN DIS	0.57002	0.32492	0.32492	0.57002	0.1181396	4.40504
VAR23	JUL-SEP TRIN DIS	0.69018	0.47635	0.15142	0.09712	-0.1645103	-0.71779
VAR84	LAG OCT-DEC TRIN DIS	0.74782	0.55923	0.08288	-0.17437	-0.1667350	-2.43884
VAR39	LAG ANNUAL TRIN DIS	0.79551	0.63283	0.07360	0.03256	0.3235173E-01	1.20352
VAR81	JAN-MAR TRIN DIS	0.82659	0.68325	0.05042	0.39287	0.3798103E-01	0.55925
VAR52	LAG ANNUAL ATCH DIS	0.84467	0.71346	0.03021	0.02388	0.8975709E-01	0.91298
VAR16	ANNUAL GUAD DIS	0.87040	0.75760	0.04413	0.31568	-0.2228036	-2.27108
VAR86	JAN-MAR GUAD DIS	0.88718	0.78710	0.02950	0.44233	0.1505988E-01	0.04062
VAR45	APR-JUN TRIN DIS	0.91988	0.84618	0.05908	0.51429	-0.8769257E-01	-2.08858
VAR38	LAG ANNUAL GUAD DIS	0.93343	0.87129	0.02511	0.23086	-0.2351335	-2.33582
VAR85	LAG OCT-DEC GUAD DIS	0.96005	0.92169	0.05040	0.08932	0.2699578	1.29423
VAR18	APR-JUN MISS DIS	0.96997	0.94085	0.01916	0.32192	-0.3854316	-0.98127
VAR21	APR-JUN GUAD DIS	0.99289	0.98583	0.04498	0.20743	0.3925989	1.98600
VAR46	JUL-SEP GUAD DIS	0.99695	0.99391	0.00808	0.08498	0.2375495	0.52076
VAR19	JUL-SEP MISS DIS	0.99972	0.99945	0.00554	0.24151	-0.3370311	-0.22477
VAR20	OCT-DEC MISS DIS	1.00000	0.99999	0.00054	0.24623	-0.1539950	-0.23390
VAR51	ANNUAL ATCH DIS	1.00000	1.00000	0.00001	0.32374	0.6372614E-02	0.06511
(CONSTANT)						28.15867	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 153. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 ,(POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR22	OCT-DEC GUAD DIS	0.42936	0.18435	0.18435	0.42936	0.7616136E-01	1.63538
VAR83	LAG OCT-DEC MISS DIS	0.71171	0.50652	0.32217	-0.25331	0.6903814E-01	0.43590
VAR85	LAG OCT-DEC GUAD DIS	0.76456	0.58456	0.07803	0.23709	-0.1794355	-3.85906
VAR52	LAG ANNUAL ATCH DIS	0.81749	0.66828	0.08372	-0.41793	0.6167702E-02	0.28143
VAR21	APR-JUN GUAD DIS	0.84893	0.72069	0.05240	-0.07626	-0.2070181	-4.69781
VAR24	OCT-DEC TRIN DIS	0.90651	0.82176	0.10107	0.05064	-0.3106305E-01	-2.03062
VAR38	LAG ANNUAL GUAD DIS	0.93452	0.87332	0.05156	-0.08033	0.7548233E-01	3.36377
VAR39	LAG ANNUAL TRIN DIS	0.94056	0.88465	0.01133	-0.20551	-0.9949240E-02	-1.66036
VAR20	OCT-DEC MISS DIS	0.94620	0.89529	0.01065	-0.09807	0.4463097	3.04094
VAR45	APR-JUN TRIN DIS	0.96264	0.92667	0.03138	-0.13900	-0.2479108E-02	-0.26487
VAR16	ANNUAL GUAD DIS	0.96873	0.93843	0.01176	0.21263	0.3260593E-01	1.49095
VAR84	LAG OCT-DEC TRIN DIS	0.97073	0.94231	0.00388	0.00416	0.4454437E-01	2.92284
VAR19	JUL-SEP MISS DIS	0.98041	0.96120	0.01889	-0.06407	-0.8158570E-01	-0.24408
VAR86	JAN-MAR GUAD DIS	0.98351	0.96729	0.00609	0.06789	0.1681371	2.03428
VAR51	ANNUAL ATCH DIS	0.98519	0.97061	0.00331	-0.29470	-0.7139574E-01	-3.27227
VAR18	APR-JUN MISS DIS	0.99948	0.99897	0.02836	-0.04083	0.7162061E-01	0.81797
VAR23	JUL-SEP TRIN DIS	1.00000	1.00000	0.00103	-0.13071	0.1489105E-01	0.29147
(CONSTANT)						-5.072349	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 154. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with river discharge variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR18	APR-JUN MISS DIS	0.59860	0.35832	0.35832	0.59860	-2.901050	-0.80577
VAR84	LAG OCT-DEC TRIN DIS	0.67089	0.45009	0.09177	-0.11896	-0.8163848	-1.30275
VAR51	ANNUAL ATCH DIS	0.77913	0.60705	0.15696	0.59242	0.5462098	0.60882
VAR81	JAN-MAR TRIN DIS	0.81622	0.66621	0.05916	0.36677	1.413881	2.27122
VAR19	JUL-SEP MISS DIS	0.84564	0.71511	0.04890	0.27443	-8.053846	-0.58597
VAR80	JAN-MAR MISS DIS	0.86846	0.75423	0.03912	0.28673	-4.152068	-0.96570
VAR52	LAG ANNUAL ATCH DIS	0.89715	0.80487	0.05064	0.21279	0.9011994	1.00005
VAR38	LAG ANNUAL GUAD DIS	0.91679	0.84050	0.03563	0.16092	-0.5888414	-0.63817
VAR24	OCT-DEC TRIN DIS	0.95047	0.90340	0.06290	0.32637	0.9631038	1.53113
VAR22	OCT-DEC GUAD DIS	0.98054	0.96146	0.05806	0.23020	-2.602956	-1.35927
VAR45	APR-JUN TRIN DIS	0.98652	0.97322	0.01177	0.32675	0.6340946E-01	0.16476
VAR86	JAN-MAR GUAD DIS	0.99159	0.98326	0.01003	0.24906	-1.945396	-0.57241
VAR39	LAG ANNUAL TRIN DIS	0.99358	0.98720	0.00394	-0.06121	0.6822768E-01	0.27690
VAR16	ANNUAL GUAD DIS	0.99860	0.99720	0.01001	0.40891	0.6113307	0.67982
VAR85	LAG OCT-DEC GUAD DIS	0.99904	0.99809	0.00088	-0.02551	-1.093590	-0.57198
VAR23	JUL-SEP TRIN DIS	0.99988	0.99975	0.00167	0.22019	0.4189975	0.19945
VAR20	OCT-DEC MISS DIS	1.00000	1.00000	0.00025	0.48267	0.5451734	0.09034
(CONSTANT)						327.6032	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 155. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with river discharge variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR15	ANNUAL MISS DIS	0.69445	0.48226	0.48226	0.69445	-1.049802	-0.69404
VAR85	LAG OCT-DEC GUAD DIS	0.77109	0.59457	0.11231	0.52519	1.250603	0.77314
VAR84	LAG OCT-DEC TRIN DIS	0.86625	0.75039	0.15582	0.20055	-0.7603354	-1.43412
VAR81	JAN-MAR TRIN DIS	0.88060	0.77545	0.02506	0.61563	0.2041150E-01	0.03876
VAR24	OCT-DEC TRIN DIS	0.89570	0.80227	0.02682	0.52115	-0.2970403	-0.55817
VAR19	JUL-SEP MISS DIS	0.90741	0.82339	0.02112	0.42348	0.1927140	0.01657
VAR37	LAG ANNUAL MISS DIS	0.91597	0.83901	0.01562	0.25903	1.762400	1.16366
VAR38	LAG ANNUAL GUAD DIS	0.95554	0.91306	0.07406	0.50557	-1.011993	-1.29637
VAR45	APR-JUN TRIN DIS	0.96472	0.93069	0.01763	0.26555	-0.5411061	-1.66187
VAR20	OCT-DEC MISS DIS	0.97347	0.94765	0.01696	0.50055	4.166147	0.81597
VAR39	LAG ANNUAL TRIN DIS	0.98725	0.97466	0.02701	0.18711	0.7016695E-01	0.33660
VAR46	JUL-SEP GUAD DIS	0.99174	0.98356	0.00890	0.36627	-0.8484262	-0.23984
VAR17	ANNUAL TRIN DIS	0.99501	0.99004	0.00648	0.68442	0.6453881	3.10313
VAR86	JAN-MAR GUAD DIS	0.99530	0.99061	0.00057	0.52301	-0.2737978E-01	-0.00952
VAR21	APR-JUN GUAD DIS	0.99533	0.99068	0.00007	0.27805	-0.2148277	-0.14013
VAR83	LAG OCT-DEC MISS DIS	0.99544	0.99090	0.00022	0.44629	-0.6632155	-0.12037
(CONSTANT)						-119.6158	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 156. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with river discharge variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR85	LAG OCT-DEC GUAD DIS	0.64768	0.41949	0.41949	0.64768	4.344256	3.04488
VAR18	APR-JUN MISS DIS	0.73986	0.54739	0.12791	0.45127	2.758705	1.02680
VAR80	JAN-MAR MISS DIS	0.83493	0.69711	0.14972	-0.07747	4.303151	1.34120
VAR86	JAN-MAR GUAD DIS	0.86050	0.74046	0.04335	0.42099	-0.8737216	-0.34451
VAR81	JAN-MAR TRIN DIS	0.87436	0.76451	0.02404	0.60605	-0.1762632	-0.37943
VAR84	LAG OCT-DEC TRIN DIS	0.90090	0.81162	0.04712	0.24775	-0.6932926	-1.48256
VAR24	OCT-DEC TRIN DIS	0.91336	0.83424	0.02261	0.06335	-0.6825311	-1.45408
VAR39	LAG ANNUAL TRIN DIS	0.93296	0.87042	0.03618	-0.03629	-0.7077824E-01	-0.38494
VAR22	OCT-DEC GUAD DIS	0.94532	0.89364	0.02322	0.08751	1.017979	0.71237
VAR38	LAG ANNUAL GUAD DIS	0.96006	0.92171	0.02808	0.31202	-0.9853633	-1.43107
VAR19	JUL-SEP MISS DIS	0.97889	0.95823	0.03652	0.26288	7.971002	0.77716
VAR37	LAG ANNUAL MISS DIS	0.98593	0.97206	0.01383	-0.09260	0.4866398	0.36429
VAR51	ANNUAL ATCH DIS	0.99785	0.99570	0.02364	0.22279	-0.6007846	-0.89738
VAR46	JUL-SEP GUAD DIS	0.99870	0.99741	0.00170	0.29154	0.4204967	0.13477
VAR23	JUL-SEP TRIN DIS	0.99973	0.99947	0.00206	0.34689	-0.4297121	-0.27411
VAR52	LAG ANNUAL ATCH DIS	1.00000	1.00000	0.00053	-0.10397	0.2311279	0.34370
VAR20	OCT-DEC MISS DIS	1.00000	1.00000	0.00000	0.39179	-0.6952944E-01	-0.01544
(CONSTANT)						-341.5399	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 157. **Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to precipitation variables.**

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR25	VAR26	VAR27	VAR28	VAR42	VAR43
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	0.58528	0.66999	0.14901	-0.01832	0.00062	-0.17935
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	0.02331	0.12484	-0.14824	0.01800	-0.04227	-0.17269
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	0.26499	0.06515	0.18441	0.40102	0.10874	0.23943
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	0.50095	0.57027	0.30280	-0.07854	-0.16921	-0.17409
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	0.75182	0.67541	0.53046	0.06157	0.07814	-0.06145
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	0.49307	0.33789	0.68627	-0.02278	0.02208	-0.16565
VAR25	0.58528	0.02331	0.26499	0.50095	0.75182	0.49307	1.00000	0.76649	0.67903	0.17537	0.01058	0.07373
VAR26	0.66999	0.12484	0.06515	0.57027	0.67541	0.33789	0.76649	1.00000	0.25729	-0.19411	0.12092	0.00190
VAR27	0.14901	-0.14824	0.18441	0.30280	0.53046	0.68627	0.67903	0.25729	1.00000	-0.04149	-0.20196	-0.17037
VAR28	-0.01832	0.01800	0.40102	-0.07854	0.06157	-0.02278	0.17537	-0.19411	-0.04149	1.00000	0.16455	0.43027
VAR42	0.00062	-0.04227	0.10874	-0.16921	0.07814	0.02208	0.01058	0.12092	-0.20196	0.16455	1.00000	0.69654
VAR43	-0.17935	-0.17269	0.23943	-0.17409	-0.06145	-0.16565	0.07373	0.00190	-0.17037	0.43027	0.69654	1.00000
VAR44	0.07687	-0.19209	0.25671	-0.12559	0.40374	0.64518	0.28068	0.39764	0.27591	-0.36357	0.09648	-0.14334
VAR82	0.52653	0.07496	-0.07718	0.26384	0.34455	-0.04638	0.59707	0.60929	0.20706	-0.34987	-0.06346	-0.05944

	VAR44	VAR82
VAR1	0.07687	0.52653
VAR2	-0.19209	0.07496
VAR68	0.25671	-0.07718
CTEF18	-0.12559	0.26384
CTEF19	0.40374	0.34455
CTEF193	0.64518	-0.04638
VAR25	0.28068	0.59707
VAR26	0.39764	0.60929
VAR27	0.27591	0.20706
VAR28	-0.36357	-0.34987
VAR42	0.09648	-0.06346
VAR43	-0.14334	-0.05944
VAR44	1.00000	0.26451
VAR82	0.26451	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 158. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with precipitation variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR44	LAG OCT-DEC FRE PREC	0.19209	0.03690	0.03690	-0.19209	-0.3392385	-0.30202
VAR26	APR-JUN FRE PREC	0.29154	0.08500	0.04810	0.12484	0.6052647E-01	0.06839
VAR43	LAG JUL-SEP FRE PREC	0.36344	0.13209	0.04709	-0.17269	-0.3565149	-0.44842
VAR27	JUL-SEP FRE PREC	0.40227	0.16182	0.02973	-0.14824	-0.3002079	-0.32007
VAR42	LAG ANNUAL FRE PREC	0.42188	0.17798	0.01617	-0.04227	0.1019175	0.22308
VAR25	ANNUAL FRE PREC	0.43484	0.18909	0.01111	0.02331	0.1410416	0.30369
(CONSTANT)						21.01501	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 159. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.66999	0.44889	0.44889	0.66999	0.6130133	0.62910
VAR44	LAG OCT-DEC FRE PREC	0.70112	0.49157	0.04268	0.07687	-0.2845474	-0.23007
VAR43	LAG JUL-SEP FRE PREC	0.73356	0.53811	0.04655	-0.17935	-0.4617544	-0.52747
VAR28	OCT-DEC FRE PREC	0.74964	0.56196	0.02384	-0.01832	0.4124275	0.32987
VAR82	JAN-MAR FRE PREC	0.77485	0.60040	0.03844	0.52653	0.5475690	0.34039
VAR42	LAG ANNUAL FRE PREC	0.79840	0.63744	0.03704	0.00062	0.1419010	0.28208
VAR25	ANNUAL FRE PREC	0.79881	0.63810	0.00066	0.58528	-0.2941558E-01	-0.05752
(CONSTANT)						9.019320	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 160. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR28	OCT-DEC FRE PREC	0.40102	0.16082	0.16082	0.40102	0.1374166	0.49305
VAR44	LAG OCT-DEC FRE PREC	0.58950	0.34751	0.18669	0.25671	0.1287525	0.46700
VAR27	JUL-SEP FRE PREC	0.59539	0.35448	0.00697	0.18441	0.2095055E-01	0.09100
VAR43	LAG JUL-SEP FRE PREC	0.60126	0.36151	0.00703	0.23943	0.4108940E-01	0.21056
VAR42	LAG ANNUAL FRE PREC	0.60868	0.37050	0.00898	0.10874	-0.1665420E-01	-0.14852
VAR82	JAN-MAR FRE PREC	0.60995	0.37204	0.00155	-0.07718	-0.1576338E-01	-0.04396
(CONSTANT)						-1.858162	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 161. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with precipitation variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.57027	0.32521	0.32521	0.57027	8.519177	0.95380
VAR44	LAG OCT-DEC FRE PREC	0.68752	0.47268	0.14747	-0.12559	-5.772445	-0.50918
VAR27	JUL-SEP FRE PREC	0.72866	0.53094	0.05826	0.30280	3.305654	0.34919
VAR43	LAG JUL-SEP FRE PREC	0.75678	0.57271	0.04177	-0.17409	-0.9421408	-0.11741
VAR82	JAN-MAR FRE PREC	0.76655	0.58761	0.01489	0.26384	-1.823859	-0.12369
VAR25	ANNUAL FRE PREC	0.76966	0.59237	0.00477	0.50095	-1.129049	-0.24087
VAR42	LAG ANNUAL FRE PREC	0.77182	0.59571	0.00334	-0.16921	-0.4076612	-0.08841
(CONSTANT)						184.7906	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 162. Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with precipitation variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	ANNUAL FRE PREC	0.75182	0.56524	0.56524	0.75182	2.904241	0.73235
VAR44	LAG OCT-DEC FRE PREC	0.77817	0.60555	0.04032	0.40374	1.304061	0.13596
VAR82	JAN-MAR FRE PREC	0.79377	0.63008	0.02452	0.34455	-3.059432	-0.24525
VAR26	APR-JUN FRE PREC	0.80734	0.65180	0.02173	0.67541	1.415182	0.18728
VAR43	LAG JUL-SEP FRE PREC	0.81362	0.66198	0.01018	-0.06145	-1.637400	-0.24119
VAR42	LAG ANNUAL FRE PREC	0.82275	0.67692	0.01494	0.07814	0.7297656	0.18707
(CONSTANT)						-63.94570	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 163. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with precipitation variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR27	JUL-SEP FRE PREC	0.68627	0.47097	0.47097	0.68627	2.729850	0.38643
VAR44	LAG OCT-DEC FRE PREC	0.83419	0.69587	0.22490	0.64518	4.349742	0.51417
VAR82	JAN-MAR FRE PREC	0.88811	0.78874	0.09287	-0.04638	-5.659324	-0.51433
VAR25	ANNUAL FRE PREC	0.91305	0.83365	0.04492	0.49307	1.273289	0.36402
VAR43	LAG JUL-SEP FRE PREC	0.91692	0.84074	0.00708	-0.16565	-1.034077	-0.17269
VAR42	LAG ANNUAL FRE PREC	0.92148	0.84913	0.00839	0.02208	0.4400104	0.12788
VAR26	APR-JUN FRE PREC	0.92178	0.84969	0.00056	0.33789	0.3548081	0.05323
(CONSTANT)						-86.72861	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 164. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to temperature variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR29	VAR30	VAR40	VAR41
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	-0.21282	0.12676	-0.08151	-0.07818
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	0.44111	0.41840	0.10932	0.35438
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	-0.09160	-0.30434	-0.03974	-0.57523
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	-0.22503	0.05453	-0.29431	-0.01176
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	-0.24438	-0.20041	-0.23950	-0.02656
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	-0.43223	-0.50555	-0.13775	-0.30111
VAR29	-0.21282	0.44111	-0.09160	-0.22503	-0.24438	-0.43223	1.00000	0.42417	0.45642	0.08582
VAR30	0.12676	0.41840	-0.30434	0.05453	-0.20041	-0.50555	0.42417	1.00000	-0.03663	0.14492
VAR40	-0.08151	0.10932	-0.03974	-0.29431	-0.23950	-0.13775	0.45642	-0.03663	1.00000	0.04301
VAR41	-0.07818	0.35438	-0.57523	-0.01176	-0.02656	-0.30111	0.08582	0.14492	0.04301	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 165. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR41	FEB NOS GAL MIN TEMP	0.52624	0.27693	0.27693	0.52624	1.701908	0.52890
VAR29	APR-JUN FRE DAYS GT 90 F	0.65944	0.43486	0.15794	0.44111	0.4936042	0.52492
VAR40	JAN NOS GAL MIN TEMP	0.75580	0.57124	0.13638	-0.06244	-1.412598	-0.38433
VAR30	JUL-SEP FRE DAYS GT 90 F	0.76151	0.57990	0.00866	0.42244	0.4968731E-01	0.10895
(CONSTANT)						3.221232	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 166. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with temperature variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR40	JAN NOS GAL MIN TEMP	0.26202	0.06865	0.06865	-0.26202	-0.6551511	-0.15983
VAR30	JUL-SEP FRE DAYS GT 90 F	0.28711	0.08243	0.01378	0.12822	0.1064808	0.20936
VAR29	APR-JUN FRE DAYS GT 90 F	0.34339	0.11792	0.03549	-0.21282	-0.2476730	-0.23617
VAR41	FEB NOS GAL MIN TEMP	0.35377	0.12515	0.00723	0.07053	0.3138050	0.08745
(CONSTANT)						20.82282	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 167. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19,11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR41	FEB NOS GAL MIN TEMP	0.54395	0.29588	0.29588	-0.54395	-0.4259313	-0.50015
VAR30	JUL-SEP FRE DAYS GT 90 F	0.58985	0.34789	0.05201	-0.30267	-0.3390850E-01	-0.28094
VAR29	APR-JUN FRE DAYS GT 90 F	0.59241	0.35095	0.00305	-0.09160	0.2674530E-01	0.10747
VAR40	JAN NOS GAL MIN TEMP	0.59627	0.35554	0.00459	-0.10235	-0.7880611E-01	-0.08101
(CONSTANT)						8.169934	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 168. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with temperature variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR40	JAN NOS GAL MIN TEMP	0.29431	0.08662	0.08662	-0.29431	-7.801110	-0.20562
VAR29	APR-JUN FRE DAYS GT 90 F	0.31146	0.09701	0.01039	-0.22503	-1.818429	-0.18426
VAR30	JUL-SEP FRE DAYS GT 90 F	0.32986	0.10881	0.01180	0.05453	0.6183171	0.12516
(CONSTANT)						204.1934	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 169. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with temperature variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE..   CTEF19   CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR29	APR-JUN FRE DAYS GT 90 F	0.24438	0.05972	0.05972	-0.24438	-0.5973846	-0.07155
VAR40	JAN NOS GAL MIN TEMP	0.28355	0.08040	0.02068	-0.23950	-6.848184	-0.21336
VAR30	JUL-SEP FRE DAYS GT 90 F	0.32285	0.10423	0.02383	-0.20041	-0.7434490	-0.17787
(CONSTANT)						209.2353	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 170. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with temperature variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE..   CTEF193   CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR30	JUL-SEP FRE DAYS GT 90 F	0.50555	0.25558	0.25558	-0.50555	-1.371631	-0.37206
VAR29	APR-JUN FRE DAYS GT 90 F	0.55983	0.31341	0.05784	-0.43223	-1.771243	-0.24052
VAR41	FEB NOS GAL MIN TEMP	0.60292	0.36351	0.05010	-0.30111	-5.623129	-0.22518
VAR40	JAN NOS GAL MIN TEMP	0.60353	0.36425	0.00074	-0.13775	-0.9034756	-0.03191
(CONSTANT)						214.6657	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 171. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to wind and tide variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR31	VAR32	VAR33	VAR34	VAR35	VAR36
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	-0.19458	0.31323	0.13425	0.31316	-0.34876	0.12389
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	-0.64244	-0.19425	0.70926	0.65511	-0.00711	-0.10561
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	0.31861	0.19907	-0.44293	-0.34722	0.11333	-0.11719
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	-0.23846	0.28954	0.37952	0.45698	-0.25707	0.12961
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	0.22141	0.43986	0.32630	0.30906	-0.08815	0.01735
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	0.67835	0.69295	-0.03332	-0.06075	-0.00465	-0.09243
VAR31	-0.19458	-0.64244	0.31861	-0.23846	0.22141	0.67835	1.00000	0.41147	-0.30131	-0.38673	0.07814	-0.04232
VAR32	0.31323	-0.19425	0.19907	0.28954	0.43986	0.69295	0.41147	1.00000	-0.23406	-0.21651	-0.18081	-0.20010
VAR33	0.13425	0.70926	-0.44293	0.37952	0.32630	-0.03332	-0.30131	-0.23406	1.00000	0.55564	-0.10434	-0.01301
VAR34	0.31316	0.65511	-0.34722	0.45698	0.30906	-0.06075	-0.38673	-0.21651	0.55564	1.00000	-0.12588	0.06975
VAR35	-0.34876	-0.00711	0.11333	-0.25707	-0.08815	-0.00465	0.07814	-0.18081	-0.10434	-0.12588	1.00000	-0.34294
VAR36	0.12389	-0.10561	-0.11719	0.12961	0.01735	-0.09243	-0.04232	-0.20010	-0.01301	0.06975	-0.34294	1.00000
VAR87	-0.19336	-0.68023	0.39276	-0.28708	0.18079	0.62229	0.92663	0.36700	-0.36505	-0.38458	0.11998	0.09555
VAR88	0.55809	0.04843	0.07645	0.27525	0.21161	0.14127	-0.03346	0.60542	-0.07787	-0.17505	-0.50733	-0.25130
VAR89	-0.01621	-0.23867	0.04730	-0.03892	0.06961	0.38379	0.46277	0.61449	-0.34 73	-0.36363	0.35994	-0.40574
VAR90	0.16425	-0.19765	0.22683	0.29066	0.49348	0.75327	0.40292	0.84476	-0.13985	-0.05917	-0.15513	0.01806
VAR91	-0.02462	-0.19981	0.37464	-0.01648	0.08350	0.09620	0.23419	-0.10793	0.05720	0.00734	-0.06421	-0.23318
VAR92	0.09217	0.14140	0.21145	0.12995	0.20604	0.21403	0.18675	0.20842	-0.06907	0.17762	0.55083	-0.21530
VAR93	-0.40782	-0.25016	-0.23459	-0.26054	-0.47506	-0.18363	-0.04832	-0.30613	-0.00892	-0.02685	-0.28880	0.64709
VAR94	0.55946	0.24691	0.17759	0.38350	0.40058	-0.13216	-0.19004	-0.20942	0.08288	0.05934	-0.04667	0.37807
VAR95	-0.05273	-0.24001	-0.18366	0.02495	0.05111	0.23508	0.24558	0.28982	-0.12986	0.08673	-0.22899	0.56660
VAR96	-0.46505	0.02879	-0.33874	-0.33444	-0.16244	-0.21665	0.02804	-0.32542	0.11416	-0.28891	0.24406	0.21929
VAR97	0.12985	0.60102	-0.30751	0.26023	0.23908	-0.18573	-0.24457	-0.49185	0.88922	0.39713	0.00274	0.06398
VAR98	0.12179	0.64797	-0.51896	0.23554	0.19456	0.00171	-0.22333	-0.05844	0.76495	0.69794	-0.14897	-0.12288
VAR99	0.39261	0.55122	-0.25923	0.43521	0.38436	-0.02312	-0.21225	-0.17305	0.46367	0.73820	-0.01473	0.18587
VAR100	0.20443	0.35927	-0.07433	0.35970	0.31150	0.44224	-0.30398	-0.01191	0.23754	0.82531	-0.16221	0.02821
VAR101	0.19401	0.69233	-0.50155	0.29869	0.34044	-0.03860	-0.18027	-0.08311	0.64504	0.50093	0.29025	-0.50519

Table 171 continued

	VAR87	VAR88	VAR89	VAR90	VAR91	VAR92	VAR93	VAR94	VAR95	VAR96	VAR97	VAR98
VAR1	-0.19336	0.55809	-0.01621	0.16425	-0.02462	0.09217	-0.40782	0.55946	-0.05273	-0.46505	0.12985	0.12179
VAR2	-0.68023	0.04843	-0.23867	-0.19765	-0.19981	0.14140	-0.25016	0.24691	-0.24001	0.02879	0.60102	0.64797
VAR68	0.39276	0.07645	0.04730	0.22683	0.37464	0.21145	-0.23459	0.17759	-0.18366	-0.33874	-0.30751	-0.51896
CTEF18	-0.28708	0.27525	-0.03892	0.29066	-0.01648	0.12995	-0.26054	0.38350	0.02495	-0.33444	0.26023	0.23554
CTEF19	0.18079	0.21161	0.06961	0.49348	0.08350	0.20604	-0.47506	0.40058	0.05111	-0.16244	0.23908	0.19456
CTEF193	0.62229	0.14127	0.38379	0.75327	0.09620	0.21403	-0.18363	-0.13216	0.23508	-0.21665	-0.18573	0.00171
VAR31	0.92663	-0.03346	0.46277	0.40292	0.23419	0.18675	-0.04832	-0.19004	0.24558	0.02804	-0.24457	-0.22333
VAR32	0.36700	0.60542	0.61449	0.84476	-0.10793	0.20842	-0.30613	-0.20942	0.28982	-0.32542	-0.49185	-0.05844
VAR33	-0.36505	-0.07787	-0.34373	-0.13985	0.05720	-0.06907	-0.00892	0.08288	-0.12986	0.11416	0.88922	0.76495
VAR34	-0.38458	-0.17505	-0.36363	-0.05917	0.00734	0.17762	-0.02685	0.05934	0.08673	-0.28891	0.39713	0.69794
VAR35	0.11998	-0.50733	0.35994	-0.15513	-0.06421	0.55083	-0.28880	-0.04667	-0.22899	0.24406	0.00274	-0.14897
VAR36	0.09555	-0.23130	-0.40574	0.01806	-0.23318	-0.21530	0.64709	0.37807	0.56660	0.21929	0.06398	-0.12288
VAR87	1.00000	-0.09038	0.37339	0.41000	0.29922	0.23749	-0.02185	-0.15942	0.43045	0.08095	-0.30422	-0.29411
VAR88	-0.09038	1.00000	0.32627	0.19555	0.05038	-0.22817	-0.36445	0.02441	-0.02567	-0.40372	-0.20892	0.01777
VAR89	0.37339	0.32627	1.00000	0.25948	-0.14883	0.31072	-0.34036	-0.34235	0.12999	-0.04133	-0.46943	-0.17238
VAR90	0.41000	0.19555	0.25948	1.00000	-0.11219	0.28214	-0.09488	-0.16038	0.37474	-0.23699	-0.39777	-0.01488
VAR91	0.29922	0.05038	-0.14883	-0.11219	1.00000	-0.07337	-0.35111	0.02414	-0.04512	-0.26612	0.13386	-0.20983
VAR92	0.23749	-0.22817	0.31072	0.28214	-0.07337	1.00000	-0.36945	0.04799	-0.02243	-0.16506	-0.12770	0.13526
VAR93	-0.02185	-0.36445	-0.34036	-0.09488	-0.35111	-0.36945	1.00000	-0.30220	0.42368	0.39014	0.05684	0.11792
VAR94	-0.15942	0.02441	-0.34235	-0.16038	0.02414	0.04799	-0.30220	1.00000	-0.31975	-0.24550	0.26849	-0.28221
VAR95	0.43045	-0.02567	0.12999	0.37474	-0.04512	-0.02243	0.42368	-0.31975	1.00000	0.28160	-0.35579	0.02428
VAR96	0.08095	-0.40372	-0.04133	-0.23699	-0.26612	-0.16506	0.39014	-0.24550	0.28160	1.00000	0.16263	0.02402
VAR97	-0.30422	-0.20892	-0.46943	-0.39777	0.13386	-0.12770	0.05684	0.26849	-0.35579	0.16263	1.00000	0.59455
VAR98	-0.29411	0.01777	-0.17238	-0.01488	-0.20983	0.13526	0.11792	-0.28221	0.02428	0.02402	0.59455	1.00000
VAR99	-0.27015	0.01883	-0.18305	-0.17765	-0.02357	0.17520	-0.06945	0.24611	0.09401	-0.07172	0.42186	0.53045
VAR100	-0.19710	-0.25547	-0.31861	0.40312	0.11364	0.18844	-0.06640	-0.02530	0.20090	-0.46995	0.02727	0.36682
VAR101	-0.33263	-0.00755	0.10446	-0.16128	-0.02641	0.11366	-0.32514	-0.16611	-0.35900	-0.00141	0.59810	0.69204

Table 171 continued

	VAR99	VAR100	VAR101
VAR1	0.39261	0.20443	0.19401
VAR2	0.55122	0.35927	0.69233
VAR68	-0.25923	-0.07433	-0.50155
CTEF18	0.43521	0.35970	0.29869
CTEF19	0.38436	0.31150	0.34044
CTEF193	-0.02312	0.44224	-0.03860
VAR31	-0.21225	-0.30398	-0.18027
VAR32	-0.17305	-0.01191	-0.08311
VAR33	0.46367	0.23754	0.64504
VAR34	0.73820	0.82531	0.50093
VAR35	-0.01473	-0.16221	0.29025
VAR36	0.18587	0.02821	-0.50519
VAR87	-0.27015	-0.19710	-0.33263
VAR88	0.01883	-0.25547	-0.00755
VAR89	-0.18305	-0.31861	0.10446
VAR90	-0.17765	0.40312	-0.16128
VAR91	-0.02357	0.11364	-0.02641
VAR92	0.17520	0.18844	0.11366
VAR93	-0.06945	-0.06640	-0.32514
VAR94	0.24611	-0.02530	-0.16611
VAR95	0.09401	0.20090	-0.35900
VAR96	-0.07172	-0.46995	-0.00141
VAR97	0.42186	0.02727	0.59810
VAR98	0.53045	0.36682	0.69204
VAR99	1.00000	0.27870	0.46431
VAR100	0.27870	1.00000	0.21253
VAR101	0.46431	0.21253	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 172. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR33	APR-JUN FRE MEAN HI TIDE	0.74748	0.55873	0.55873	0.74748	-13.55177	-1.31415
VAR87	JUNE GAL FASTEST WIND	0.82516	0.68089	0.12216	-0.61599	-2.356957	-2.22715
VAR92	JUN GAL FAST WIND DIR	0.87469	0.76508	0.08419	0.16513	0.6842686E-01	0.67285
VAR93	JUL GAL FAST WIND DIR	0.88548	0.78408	0.01900	-0.27029	-0.1280885	-1.10785
VAR95	SEP GAL FAST WIND DIR	0.90445	0.81802	0.03394	-0.27863	0.2323493	1.41617
VAR97	JUN FRE HI TIDE	0.93917	0.88204	0.06402	0.62740	23.53615	1.90012
VAR96	OCT GAL FAST WIND DIR	0.95861	0.91893	0.03689	-0.05605	0.4239536E-01	0.32713
VAR35	APR-JUN GAL MEAN FAST WIND DIR	0.97510	0.95083	0.03190	-0.07281	-0.3051540E-01	-0.14567
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.98760	0.97534	0.02452	-0.53172	1.429852	0.81661
VAR100	SEP FRE HI TIDE	0.99388	0.98780	0.01246	0.40469	5.074007	0.85602
VAR34	JUL-SEP FRE MEAN HI TIDE	0.99832	0.99665	0.00885	0.62501	-12.50405	-1.15190
VAR98	JUL FRE HI TIDE	0.99956	0.99912	0.00247	0.72415	3.956534	0.29767
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.99981	0.99963	0.00051	0.06240	-0.2064914	-0.12286
VAR89	AUG GAL FASTEST WIND	1.00000	1.00000	0.00037	-0.12190	-0.8354268E-01	-0.08097
(CONSTANT)						1.752797	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 173. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR94	AUG GAL FAST WIND DIR	0.61417	0.37721	0.37721	0.61417	-0.1391105E-01	-0.12254
VAR88	JUL GAL FASTEST WIND	0.74827	0.55991	0.18270	0.44594	1.584259	1.39796
VAR100	SEP FRE HI TIDE	0.85261	0.72694	0.16703	0.29476	10.85231	1.62730
VAR98	JUL FRE HI TIDE	0.86941	0.75587	0.02893	0.13986	-19.70102	-1.31742
VAR33	APR-JUN FRE MEAN HI TIDE	0.88622	0.78538	0.02951	0.21968	-13.67805	-1.17893
VAR97	JUN FRE HI TIDE	0.93420	0.87273	0.08735	0.28525	32.10692	2.30387
VAR91	OCT GAL FASTEST WIND	0.96558	0.93235	0.05963	-0.05145	-1.165324	-1.04390
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.98083	0.96202	0.02967	-0.26532	0.9000591	0.45689
VAR96	OCT GAL FAST WIND DIR	0.98749	0.97514	0.01312	-0.47964	0.3419896E-01	0.23455
VAR95	SEP GAL FAST WIND DIR	0.99664	0.99329	0.01815	-0.13201	0.3004739E-01	0.16278
VAR92	JUN GAL FAST WIND DIR	0.99837	0.99675	0.00346	0.11722	0.3402310E-01	0.29736
VAR89	AUG GAL FASTEST WIND	0.99894	0.99789	0.00114	-0.11002	-0.2158876	-0.18598
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.99932	0.99864	0.00075	0.31839	-0.2639990	-0.13961
VAR36	JUL-SEP GAL MEAN FAST WIND DIR	1.00000	1.00000	0.00136	0.18175	-0.6898610E-01	-0.28122
(CONSTANT)						-73.97077	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 174. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with wind and tide variables for eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR98	JUL FRE HI TIDE	0.56514	0.31939	0.31939	-0.56514	-2.737737	-0.81125
VAR95	SEP GAL FAST WIND DIR	0.66062	0.43641	0.11703	-0.35990	-0.9922950E-01	-2.38208
VAR89	AUG GAL FASTEST WIND	0.74241	0.55118	0.11476	-0.16292	0.1187693	0.45338
VAR92	JUN GAL FAST WIND DIR	0.79218	0.62756	0.07638	0.24708	-0.1015637E-01	-0.39334
VAR90	SEP GAL FASTEST WIND	0.83948	0.70472	0.07716	-0.07649	-0.5243887E-01	-0.29480
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.89232	0.79623	0.09151	0.00355	-1.007047	-2.26526
VAR91	OCT GAL FASTEST WIND	0.94981	0.90215	0.10592	0.43040	0.3242650E-01	0.12872
VAR93	JUL GAL FAST WIND DIR	0.97292	0.94658	0.04443	-0.26230	0.3465098E-01	1.18040
VAR87	JUNE GAL FASTEST WIND	0.97737	0.95524	0.00866	0.16630	0.8002554	2.97830
VAR34	JUL-SEP FRE MEAN HI TIDE	0.99187	0.98381	0.02856	-0.27923	3.393773	1.23137
VAR101	OCT FRE HI TIDE	0.99647	0.99296	0.00916	-0.48399	-0.2930887	-0.12171
VAR33	APR-JUN FRE MEAN HI TIDE	0.99905	0.99810	0.00514	-0.41373	1.144743	0.43722
VAR35	APR-JUN GAL MEAN FAST WIND DIR	0.99961	0.99923	0.00113	0.20894	-0.1250346E-01	-0.23508
VAR97	JUN FRE HI TIDE	1.00000	1.00000	0.00077	-0.22729	-1.586379	-0.50442
(CONSTANT)						12.75709	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 175. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR100	SEP FRE HI TIDE	0.47325	0.22397	0.22397	0.47325	93.21207	1.55097
VAR97	JUN FRE HI TIDE	0.64250	0.41280	0.18884	0.43309	400.0320	3.18522
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.77365	0.59853	0.18573	0.31315	52.91407	3.10502
VAR98	JUL FRE HI TIDE	0.84178	0.70859	0.11005	0.26788	-649.2408	-4.81753
VAR91	OCT GAL FASTEST WIND	0.89600	0.80281	0.09423	-0.03391	-12.34012	-1.22664
VAR90	SEP GAL FASTEST WIND	0.90922	0.82669	0.02388	0.39363	-9.131796	-1.28554
VAR93	JUL GAL FAST WIND DIR	0.92065	0.84760	0.02091	-0.16915	-0.3066309	-0.26157
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.93396	0.87227	0.02467	-0.24724	3.642739	0.20519
VAR99	AUG FRE HI TIDE	0.94979	0.90210	0.02982	0.27870	188.9347	1.87795
VAR96	OCT GAL FAST WIND DIR	0.96045	0.92245	0.02036	-0.41763	1.488497	1.13280
VAR92	JUN GAL FAST WIND DIR	0.96199	0.92543	0.00297	0.04525	1.825055	1.76996
VAR89	AUG GAL FASTEST WIND	0.96415	0.92959	0.00416	-0.14200	-14.35994	-1.37269
VAR94	AUG GAL FAST WIND DIR	0.99375	0.98754	0.05796	0.42645	-2.353494	-2.30040
VAR35	APR-JUN GAL MEAN FAST WIND DIR	1.00000	1.00000	0.01246	-0.26351	-2.670707	-1.25739
(CONSTANT)						-632.0894	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 176. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
			SUMMARY TABLE				
VAR94	AUG GAL FAST WIND DIR	0.60965	0.37168	0.37168	0.60965	-0.3012640E-01	-0.03575
VAR101	OCT FRE HI TIDE	0.86890	0.75499	0.38331	0.46831	68.10881	0.85987
VAR100	SEP FRE HI TIDE	0.90712	0.82286	0.06787	0.37894	42.86581	0.86592
VAR96	OCT GAL FAST WIND DIR	0.93898	0.88169	0.05883	-0.13143	-0.2320197	-0.21437
VAR99	AUG FRE HI TIDE	0.96050	0.92256	0.04087	0.41354	-58.92715	-0.71109
VAR97	JUN FRE HI TIDE	0.97216	0.94510	0.02253	0.57518	160.3151	1.54973
VAR98	JUL FRE HI TIDE	0.98100	0.96236	0.01726	0.23334	-175.3184	-1.57937
VAR95	SEP GAL FAST WIND DIR	0.98249	0.96529	0.00293	-0.22692	0.8688947	0.63413
VAR90	SEP GAL FASTEST WIND	0.98310	0.96649	0.00120	0.22548	-2.862304	-0.48919
VAR91	OCT GAL FASTEST WIND	0.98400	0.96825	0.00176	0.10382	-7.437291	-0.89753
VAR92	JUN GAL FAST WIND DIR	0.98525	0.97073	0.00248	0.11869	0.2892519	0.34057
VAR89	AUG GAL FASTEST WIND	0.98993	0.97997	0.00924	-0.25280	-4.854294	-0.56335
VAR93	JUL GAL FAST WIND DIR	0.99449	0.98901	0.00904	-0.44334	-0.4085452	-0.42310
(CONSTANT)						172.7929	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 177. **Summary of results of stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with wind and tide variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR99	AUG FRE HI TIDE	0.46339	0.21473	0.21473	0.46339	-26.69967	-0.84531
VAR93	JUL GAL FAST WIND DIR	0.62831	0.39478	0.18004	-0.38840	0.5694569	1.54728
VAR90	SEP GAL FASTEST WIND	0.71253	0.50770	0.11293	0.19113	4.985949	2.23571
VAR98	JUL FRE HI TIDE	0.80590	0.64947	0.14177	0.02192	-96.80927	-2.28809
VAR33	APR-JUN FRE MEAN HI TIDE	0.87408	0.76401	0.11455	0.36186	70.58413	2.15027
VAR36	JUL-SEP GAL MEAN FAST WIND DIR	0.96587	0.93291	0.16890	-0.12310	-0.2571994	-0.37057
VAR35	APR-JUN GAL MEAN FAST WIND DIR	0.97811	0.95670	0.02379	0.21946	2.021423	3.03136
VAR88	JUL GAL FASTEST WIND	0.97966	0.95973	0.00303	-0.25881	15.52980	4.84347
VAR100	SEP FRE HI TIDE	0.98221	0.96474	0.00501	0.43206	58.12558	3.08060
VAR32	JUL-SEP GAL MEAN FASTEST WIND	0.98455	0.96935	0.00461	-0.11737	-21.09882	-3.94356
VAR101	OCT FRE HI TIDE	0.98594	0.97209	0.00274	0.29295	-4.281856	-0.14183
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.98678	0.97373	0.00165	-0.04740	15.42331	2.76720
VAR91	OCT GAL FASTEST WIND	0.99573	0.99149	0.01776	0.36905	-3.584623	-1.13495
VAR87	JUNE GAL FASTEST WIND	1.00000	1.00000	0.00851	-0.14307	-4.185763	-1.24254
(CONSTANT)						-532.6098	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 178. Correlation matrix showing the simple bivariate Pearson product moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to bay catch and bay effort variables.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	WCE18	WCE19	WCEL18	WCEL19	VAR47	VAR48
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	0.28736	0.27426	0.11527	0.16157	0.39463	0.10519
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	-0.16757	-0.15106	-0.25317	-0.32340	0.06115	0.39749
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	0.42084	0.67665	0.64070	0.32492	0.55253	-0.62082
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	0.20483	0.13041	-0.06375	-0.00952	0.28282	0.34690
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	0.07343	0.06827	0.18185	0.35751	0.22816	-0.07577
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	0.11504	0.02161	0.38043	0.74030	-0.02074	-0.39180
WCE18	0.28736	-0.16757	0.42084	0.20483	0.07343	0.11504	1.00000	0.79529	0.63200	0.38378	0.54208	0.15690
WCE19	0.27426	-0.15106	0.67665	0.13041	0.06827	0.02161	0.79529	1.00000	0.56895	0.06948	0.84153	-0.18409
WCEL18	0.11527	-0.25317	0.64070	-0.06375	0.18185	0.38043	0.63200	0.56895	1.00000	0.64218	0.29512	-0.25018
WCEL19	0.16157	-0.32340	0.32492	-0.00952	0.35751	0.74030	0.38378	0.06948	0.64218	1.00000	-0.15936	-0.25624
VAR47	0.39463	0.06115	0.55253	0.28282	0.22816	-0.02074	0.54208	0.84153	0.29512	-0.15936	1.00000	-0.04592
VAR48	0.10519	0.39749	-0.62082	0.34690	-0.07577	-0.39180	0.15690	-0.18409	-0.25018	-0.25624	-0.04592	1.00000
VAR49	0.25105	-0.03988	0.07871	0.03029	0.51329	0.67332	0.06772	-0.22049	0.38014	0.88124	-0.34200	-0.25675
VAR50	0.10136	0.50872	-0.39163	0.04834	0.13616	-0.18229	-0.50550	-0.46085	-0.17261	-0.18724	-0.19749	0.37987
VAR76	-0.11214	0.54465	-0.72919	0.16889	-0.09900	-0.43688	-0.47463	-0.57133	-0.50908	-0.51114	-0.28170	0.75243
VAR77	0.06950	0.38786	-0.26125	0.16572	0.25296	-0.08495	-0.59482	-0.46516	-0.50205	-0.41780	0.04183	0.15486
VAR78	0.00588	0.56715	-0.48569	0.10130	0.04324	-0.26273	-0.66948	-0.54390	-0.64586	-0.52261	-0.16689	0.37323
VAR79	0.02338	0.49662	-0.40047	0.01138	0.18452	-0.19303	-0.69512	-0.48270	-0.67495	-0.50869	-0.24760	-0.11738

	VAR49	VAR50	VAR76	VAR77	VAR78	VAR79
VAR1	0.25105	0.10136	-0.11214	0.06950	0.00588	0.02338
VAR2	-0.03988	0.50872	0.54465	0.38786	0.56715	0.49662
VAR68	0.07871	-0.39163	-0.72919	-0.26125	-0.48569	-0.40047
CTEF18	0.03029	0.04834	0.16889	0.16572	0.10130	0.01138
CTEF19	0.51329	0.13616	-0.09900	0.25296	0.04324	0.18452
CTEF193	0.67332	-0.18229	-0.43688	-0.08495	-0.26273	-0.19303
WCE18	0.06772	-0.50550	-0.47463	-0.59482	-0.66948	-0.69512
WCE19	-0.22049	-0.46085	-0.57133	-0.46516	-0.54390	-0.48270
WCEL18	0.38014	-0.17261	-0.50908	-0.50205	-0.64586	-0.67495
WCEL19	0.88124	-0.18724	-0.51114	-0.41780	-0.52261	-0.50869
VAR47	-0.34200	-0.19749	-0.28170	0.04183	-0.16689	-0.24760
VAR48	-0.25675	0.37987	0.75243	0.15486	0.37323	-0.11738
VAR49	1.00000	0.08403	-0.32163	-0.14426	-0.18706	-0.07081
VAR50	0.08403	1.00000	0.73872	0.51406	0.80650	0.36152
VAR76	-0.32163	0.73872	1.00000	0.53708	0.78765	0.32603
VAR77	-0.14426	0.51406	0.53708	1.00000	0.71878	0.56144
VAR78	-0.18706	0.80650	0.78765	0.71878	1.00000	0.66109
VAR79	-0.07081	0.36152	0.32603	0.56144	0.66109	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 179. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 18) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR78	LAG BAY TRIPS 18	0.56715	0.32166	0.32166	0.56715	-0.3247233	-0.28407
VAR48	BAY CAT 18	0.60147	0.36177	0.04011	0.39749	-0.1406443E-01	-0.15214
VAR79	LAG BAY TRIPS 19	0.67814	0.45987	0.09810	0.49662	0.9256855	0.73935
VAR47	BAY CAT 19	0.71420	0.51008	0.05021	0.06115	0.4473127E-01	0.77568
VAR50	LAG BAY CAT 18	0.75319	0.56729	0.05721	0.50872	-0.1947886E-01	-0.22719
VAR49	LAG BAY CAT 19	0.76767	0.58931	0.02202	-0.03988	0.3824102E-01	0.60981
VAR76	BAY TRIPS 18	0.79489	0.63185	0.04254	0.54465	1.912217	1.43919
VAR77	BAY TRIPS 19	0.82571	0.68179	0.04994	0.38786	-0.5021157	-0.40013
(CONSTANT)						-23.30704	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 180. Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR47	BAY CAT 19	0.39463	0.15574	0.15574	0.39463	0.3133625E-01	0.49351
VAR49	LAG BAY CAT 19	0.56964	0.32449	0.16875	0.25105	0.2312222E-01	0.33487
VAR48	BAY CAT 18	0.62353	0.38879	0.06431	0.10519	0.7474901E-01	0.73433
VAR79	LAG BAY TRIPS 19	0.67250	0.45226	0.06347	0.02338	0.6486105	0.47049
VAR76	BAY TRIPS 18	0.68549	0.46989	0.01763	-0.11214	-1.047251	-0.71583
VAR50	LAG BAY CAT 18	0.69759	0.48663	0.01674	0.10136	0.4084029E-01	0.43261
VAR78	LAG BAY TRIPS 18	0.70224	0.49314	0.00651	0.00588	-0.3490371	-0.27730
VAR77	BAY TRIPS 19	0.70368	0.49517	0.00203	0.06950	0.1114784	0.08068
(CONSTANT)						-5.534994	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 181. **Summary of results of stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with bay catch and bay effort variables for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR76	BAY TRIPS 18	0.72919	0.53172	0.53172	-0.72919	-0.2385252	-0.73139
VAR47	BAY CAT 19	0.81400	0.66259	0.13087	0.55253	0.3539652E-02	0.25007
VAR50	LAG BAY CAT 18	0.84121	0.70764	0.04504	-0.39163	0.4328297E-02	0.20568
VAR79	LAG BAY TRIPS 19	0.85557	0.73200	0.02436	-0.40047	-0.1590943	-0.51770
VAR48	BAY CAT 18	0.89509	0.80119	0.06919	-0.62082	-0.8716065E-02	-0.38412
VAR78	LAG BAY TRIPS 18	0.90569	0.82027	0.01908	-0.48569	0.1028614	0.36660
VAR49	LAG BAY CAT 19	0.90780	0.82409	0.00383	0.07871	-0.2205067E-02	-0.14326
VAR77	BAY TRIPS 19	0.90893	0.82616	0.00206	-0.26125	0.2505266E-01	0.08134
(CONSTANT)						6.659958	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 182. **Summary of results of multiple regression analysis of total white shrimp catch/effort (area 18) with bay catch and effort variables for the eighteen year data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
WCE18	BAY CAT-TRIP 18	0.20483	0.04195	0.04195	0.20483	0.5542435	0.41066
WCEL18	LAG BAY CAT-TRIP 18	0.32265	0.10410	0.06215	-0.06375	-0.3724615	-0.36753
WCEL19	LAG BAY CAT-TRIP 19	0.32693	0.10689	0.00279	-0.00952	0.4591489E-01	0.06890
(CONSTANT)						134.9122	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 183. **Summary of results of multiple regression analysis of total white shrimp catch/effort (area 19) with bay catch and effort variables for the eighteen year data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
WCEL19	LAG BAY CAT-TRIP 19	0.35751	0.12781	0.12781	0.35751	0.3591165	0.63693
WCE18	BAY CAT-TRIP 18	0.36411	0.13258	0.00477	0.07343	-0.4504101	-0.39446
WCE19	BAY CAT-TRIP 19	0.40775	0.16626	0.03368	0.06827	0.2711826	0.48075
WCEL18	LAG BAY CAT-TRIP 18	0.43109	0.18584	0.01958	0.18185	-0.2155395	-0.25139
(CONSTANT)						117.8498	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 184. **Summary of results of multiple regression analysis of total white shrimp catch/effort (area 19, 11-15 fathom depths) with bay catch and effort variables for the eighteen year data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
WCEL19	LAG BAY CAT-TRIP 19	0.74030	0.54805	0.54805	0.74030	0.5529934	1.11195
WCE18	BAY CAT-TRIP 18	0.76261	0.58157	0.03352	0.11504	-0.5896942	-0.58552
WCE19	BAY CAT-TRIP 19	0.79452	0.63126	0.04969	0.02161	0.2863963	0.57562
WCEL18	LAG BAY CAT-TRIP 18	0.81088	0.65752	0.02626	0.38043	-0.2201442	-0.29110
(CONSTANT)						47.39326	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 185. Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs o f variables in the 1964-1973 (ten year) data set used to relate brown shrimp catch and catch/effort to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR16	VAR19	VAR26	VAR51	VAR52	VAR57
VAR1	1.00000	0.69666	0.73445	0.80478	0.78314	0.85591	-0.51014	-0.17180	-0.62348	0.70613	0.64701	0.48952
VAR2	0.69666	1.00000	0.69469	0.82191	0.79606	0.85812	-0.44319	-0.60804	-0.27998	0.79195	0.88047	0.61621
VAR91	0.73445	0.69469	1.00000	0.51652	0.52420	0.63296	-0.16741	0.02547	-0.14776	0.58756	0.51986	0.83245
CTEF18	0.80478	0.82191	0.51652	1.00000	0.95965	0.93194	-0.65594	-0.56364	-0.66073	0.91801	0.86540	0.44619
CTEF19	0.78314	0.79606	0.52420	0.95965	1.00000	0.96682	-0.72116	-0.54434	-0.73545	0.85504	0.80291	0.45444
CTEF193	0.85591	0.85812	0.63296	0.93194	0.96682	1.00000	-0.59503	-0.50582	-0.66259	0.83457	0.78478	0.56477
VAR16	-0.51014	-0.44319	-0.16741	-0.65594	-0.72116	-0.59503	1.00000	0.49844	0.69299	-0.53374	-0.67070	0.15187
VAR19	-0.17180	-0.60804	0.02547	-0.56364	-0.54434	-0.50582	0.49844	1.00000	0.36662	-0.43245	-0.61762	0.04784
VAR26	-0.62348	-0.27998	-0.14776	-0.66073	-0.73545	-0.66259	0.69299	0.36662	1.00000	-0.39379	-0.31254	0.00708
VAR51	0.70613	0.79195	0.58756	0.91801	0.85504	0.83457	-0.53374	-0.43245	-0.39379	1.00000	0.90174	0.56309
VAR52	0.64701	0.88047	0.51986	0.86540	0.80291	0.78478	-0.67070	-0.61762	-0.31254	0.90174	1.00000	0.37570
VAR57	0.48952	0.61621	0.83245	0.44619	0.45444	0.56477	0.15187	0.04784	0.00708	0.56309	0.37570	1.00000
VAR59	0.14287	-0.09820	-0.23523	0.01647	-0.00209	0.03934	0.00995	-0.21206	-0.47861	-0.33605	-0.26612	-0.28576
VAR61	0.59189	0.83761	0.46341	0.81970	0.88795	0.88740	-0.58772	-0.68708	-0.58322	0.68287	0.73479	0.48974
VAR66	0.76612	0.58605	0.36869	0.77046	0.82515	0.83165	-0.57693	-0.42427	-0.86761	0.48711	0.46923	0.28356
VAR67	0.24870	0.35144	-0.12355	0.48908	0.62629	0.55711	-0.61705	-0.60051	-0.69695	0.22036	0.32154	-0.07847
VAR71	0.70754	0.60620	0.53471	0.72531	0.74030	0.69832	-0.60339	-0.28027	-0.57116	0.62985	0.58822	0.26902
VAR76	0.31779	0.55517	0.32125	0.22191	0.21396	0.34489	0.02062	-0.44649	-0.08498	0.02323	0.20666	0.18847
VAR85	-0.33697	0.05421	0.07644	-0.29850	-0.38493	-0.26854	0.56821	-0.00891	0.67055	-0.11211	-0.04629	0.32400
VAR87	0.16558	0.52186	0.53540	0.22845	0.13959	0.23777	0.24201	0.03714	0.51606	0.49574	0.46790	0.71885
VAR100	-0.29147	-0.07837	-0.29387	-0.05894	-0.21144	-0.18195	0.56218	0.06654	0.42334	0.05882	-0.07046	0.16932
VAR101	-0.36482	0.03072	-0.00940	-0.23485	-0.07206	-0.01822	0.40823	0.03417	0.28320	-0.19735	-0.25796	0.39615
VAR108	0.00390	-0.39514	-0.31924	-0.24748	-0.28431	-0.31660	-0.26042	0.31223	0.04241	-0.22576	-0.09501	-0.67642
VAR109	-0.32573	-0.53422	0.02558	-0.55744	-0.64157	-0.61406	0.72225	0.82149	0.54775	-0.39747	-0.59521	0.13161
VAR111	-0.31197	-0.60213	-0.20603	-0.60049	-0.71117	-0.66195	0.49132	0.63512	0.57365	-0.38025	-0.45053	-0.30973
VAR118	0.53799	0.62907	0.38325	0.83255	0.85291	0.73034	-0.76396	-0.48140	-0.55928	0.83034	0.77832	0.26483
XE18	0.09032	0.63038	0.40087	0.11300	0.13078	0.26644	0.10489	-0.47319	0.28155	0.10267	0.32174	0.37857
XE19	0.30833	-0.13611	0.31886	-0.20398	-0.30201	-0.18413	0.23490	0.45803	0.08571	-0.24035	-0.23300	-0.03051
XE193	0.31066	0.18044	0.78257	-0.04813	-0.07326	0.03697	0.26212	0.43885	0.24483	0.09533	0.00409	0.60071

Table 185 continued

	VAR59	VAR61	VAR66	VAR67	VAR71	VAR76	VAR85	VAR87	VAR100	VAR101	VAR108	VAR109
VAR1	0.14287	0.59189	0.76612	0.24870	0.70754	0.31779	-0.33697	0.16558	-0.29147	-0.36482	0.00390	-0.32573
VAR2	-0.09820	0.83761	0.58605	0.35144	0.60620	0.55517	0.05421	0.52186	-0.07837	0.03072	-0.39514	-0.53422
VAR91	-0.23523	0.46341	0.36869	-0.12355	0.53471	0.32125	0.07644	0.53540	-0.29387	-0.00940	-0.31924	0.02558
CTEF18	0.01647	0.81970	0.77046	0.48908	0.72531	0.22191	-0.29850	0.22845	-0.05894	-0.23485	-0.24748	-0.55744
CTEF19	-0.00209	0.88795	0.82515	0.62629	0.74030	0.21396	-0.38493	0.13959	-0.21144	-0.07206	-0.28431	-0.64157
CTEF193	0.03934	0.88740	0.83165	0.55711	0.69832	0.34489	-0.26854	0.23777	-0.18195	-0.01822	-0.31660	-0.61406
VAR16	0.00995	-0.58772	-0.57693	-0.61705	-0.60339	0.02062	0.56821	0.24201	0.56218	0.40823	-0.26042	0.72225
VAR19	-0.21206	-0.68708	-0.42427	-0.60051	-0.28027	-0.44649	-0.00891	0.03714	0.06654	0.03417	0.31223	0.82149
VAR26	-0.47861	-0.58322	-0.86761	-0.69695	-0.57116	-0.08498	0.67055	0.51606	0.42334	0.28320	0.04241	0.54775
VAR51	-0.33685	0.68287	0.48711	0.22036	0.62985	0.02323	-0.11211	0.49574	0.05882	-0.19735	-0.22576	-0.39747
VAR52	-0.26612	0.73479	0.46923	0.32154	0.58822	0.20666	-0.04629	0.46790	-0.07046	-0.25796	-0.09501	-0.59521
VAR57	-0.28576	0.48974	0.28356	-0.07847	0.26902	0.18847	0.32400	0.71885	0.16932	0.39615	-0.67642	0.13161
VAR59	1.00000	0.12437	0.52186	0.41043	-0.10381	0.39719	-0.12608	-0.58694	-0.05671	-0.17520	-0.06153	-0.19893
VAR61	0.12437	1.00000	0.79951	0.75874	0.46869	0.35900	-0.06494	0.22043	-0.11936	0.21072	-0.51861	-0.74086
VAR66	0.52186	0.79951	1.00000	0.75301	0.55949	0.36974	-0.42066	-0.18043	-0.23935	-0.07991	-0.25203	-0.58122
VAR67	0.41043	0.75874	0.75301	1.00000	0.22062	0.18070	-0.33220	-0.32247	-0.17895	0.22589	-0.22822	-0.81916
VAR71	-0.10381	0.46869	0.55949	0.22062	1.00000	0.38810	-0.69250	-0.05007	-0.48714	-0.29954	-0.00716	-0.27870
VAR76	0.39719	0.35900	0.36974	0.18070	0.38810	1.00000	-0.01938	0.01361	-0.22152	0.10600	-0.28069	-0.27843
VAR85	-0.12608	-0.06494	-0.42066	-0.33220	-0.69250	-0.01938	1.00000	0.63851	0.54818	0.34204	-0.38463	0.20322
VAR87	-0.58694	0.22043	-0.18043	-0.32247	-0.05007	0.01361	0.63851	1.00000	0.48740	0.27623	-0.34145	0.16048
VAR100	-0.05671	-0.11936	-0.23935	-0.17895	-0.48714	-0.22152	0.54818	0.48740	1.00000	0.25522	-0.28883	0.27838
VAR101	-0.17520	0.21072	-0.07991	0.22589	-0.29954	0.10600	0.34204	0.27623	0.25522	1.00000	-0.65403	0.00572
VAR108	-0.06153	-0.51861	-0.25203	-0.22822	-0.00716	-0.28069	-0.38463	-0.34145	-0.28883	-0.65403	1.00000	0.02521
VAR109	-0.19893	-0.74086	-0.58122	-0.81916	-0.27870	-0.27843	0.20322	0.16048	0.27838	0.00572	0.02521	1.00000
VAR111	-0.28599	-0.90255	-0.75473	-0.86733	-0.33351	-0.34688	0.12667	0.01668	0.11525	-0.37792	0.60425	0.65790
VAR118	-0.33395	0.63551	0.48939	0.39291	0.82027	0.01871	-0.51444	0.10050	-0.28213	-0.19728	-0.12542	-0.47772
XE18	-0.04404	0.39770	0.05745	0.06452	0.14804	0.81085	0.38679	0.41679	-0.09454	0.39226	-0.43776	-0.28597
XE19	0.25486	-0.46428	-0.08048	-0.58849	0.15807	0.29391	-0.11150	-0.12985	-0.30677	-0.54597	0.40883	0.49181
XE193	-0.26790	-0.14328	-0.14542	-0.62596	0.22142	0.17231	0.19883	0.39321	-0.28010	-0.06999	-0.15368	0.55416

Table 185 continued

	VAR111	VAR118	XE18	XE19	XE193
VAR1	-0.31197	0.53799	0.09032	0.30833	0.31066
VAR2	-0.60213	0.62907	0.63038	-0.13611	0.18044
VAR91	-0.20603	0.38325	0.40087	0.31886	0.78257
CTEF18	-0.60049	0.83255	0.11300	-0.20398	-0.04813
CTEF19	-0.71117	0.85291	0.13078	-0.30201	-0.07326
CTEF193	-0.66195	0.73034	0.26644	-0.18413	0.03697
VAR16	0.49132	-0.76396	0.10489	0.23490	0.26212
VAR19	0.63512	-0.48140	-0.47319	0.45803	0.43885
VAR26	0.57365	-0.55928	0.28155	0.08571	0.24483
VAR51	-0.38025	0.83034	0.10267	-0.24035	0.09533
VAR52	-0.45053	0.77832	0.32174	-0.23300	0.00409
VAR57	-0.30973	0.26483	0.37857	-0.03051	0.60071
VAR59	-0.28599	-0.33395	-0.04404	0.25486	-0.26790
VAR61	-0.90255	0.63551	0.39770	-0.46428	-0.14328
VAR66	-0.75473	0.48939	0.05745	-0.08048	-0.14542
VAR67	-0.86733	0.39291	0.06452	-0.58849	-0.62596
VAR71	-0.33351	0.82027	0.14804	0.15807	0.22142
VAR76	-0.34688	0.01871	0.81085	0.29391	0.17231
VAR85	0.12667	-0.51444	0.38679	-0.11150	0.19883
VAR87	0.01668	0.10050	0.41679	-0.12985	0.39321
VAR100	0.11525	-0.28213	-0.09454	-0.30677	-0.28010
VAR101	-0.37792	-0.19728	0.39226	-0.54597	-0.06999
VAR108	0.60425	-0.12342	-0.43776	0.40883	-0.15368
VAR109	0.65790	-0.47772	-0.28597	0.49181	0.55416
VAR111	1.00000	-0.49083	-0.33044	0.56682	0.29294
VAR118	-0.49083	1.00000	0.01075	-0.33756	-0.05483
XE18	-0.33044	0.01075	1.00000	-0.00839	0.25082
XE19	0.56682	-0.33756	-0.00839	1.00000	0.63776
XE193	0.29294	-0.05483	0.25082	0.63776	1.00000

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 186. Summary of results of final multiple regression analysis of total brown shrimp catch (area 18) with environmental variables and indices of recruitment based on the 1964-1973 data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	MAY TPWD SEC GAL CAT-EFF	0.88047	0.77523	0.77523	0.88047	0.1213117	0.69919
VAR76	FEB EKMAN ZONAL IND	0.95955	0.92073	0.14550	0.55517	0.4489989	0.35672
VAR57	FEB POSTLARVAL CAT-TOW	0.99502	0.99007	0.06934	0.61621	0.1247239	0.28629
(CONSTANT)						4.487583	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 187. Summary of results of final multiple regression analysis of total brown shrimp catch (area 19) with environmental variables and indice s of recruitment based on the 1964-1973 data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR66	2ND MAR POSTLAV MIN SAL	0.76612	0.58693	0.58693	0.76612	14.74211	1.53599
VAR67	1ST APR POSTLAV MIN SAL	0.91416	0.83570	0.24876	0.24870	-10.99651	-1.03593
VAR109	APR FRE PREC	0.96121	0.92393	0.08823	-0.32573	-4.981232	-0.34351
VAR59	APR POSTLARVAL CAT-TOW	0.98595	0.97211	0.04817	0.14287	-0.1239930	-0.29292
VAR108	MAR FRE PREC	0.99484	0.98972	0.01761	0.00390	4.062450	0.14522
(CONSTANT)						38.28294	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 188. Summary of results of final multiple regression analysis of total brown shrimp catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment based on the 1964-1973 data set.

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR57	FEB POSTLARVAL CAT-TOW	0.83245	0.69297	0.69297	0.83245	0.3626662	0.86846
VAR100	BAY TRIPS 19	0.94214	0.88762	0.19465	-0.29387	-2.670222	-0.47496
VAR101	LAG BAY CAT 18	0.98397	0.96820	0.08058	-0.00939	-0.2347249	-0.29405
VAR87	JUL-SEP GUAD DIS	0.99253	0.98512	0.01692	0.53540	0.3496587	0.22382
(CONSTANT)						73.89984	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 189. Summary of results of final multiple regression analysis of total brown shrimp catch (area 18) with environmental variables, indices o f recruitment, and offshore non-directed effort based on the 1964-1973 data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	MAY TPWD SEC GAL CAT-EFF	0.88047	0.77523	0.77523	0.88047	0.1028451	0.59276
XE18	EXP TOT EFF 18	0.95374	0.90961	0.13439	0.63038	0.5064286	0.40812
VAR57	FEB POSTLARVAL CAT-TOW	0.97649	0.95353	0.04392	0.61621	0.1047779	0.24051
VAR26	MAR NOS FRE HI TIDE	0.99325	0.98654	0.03301	-0.27998	-10.11653	-0.21132
(CONSTANT)						33.87006	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 190. **Summary of results of final multiple regression analysis of total brown shrimp catch (area 19) with environmental variables, indices o f recruitment, and offshore non-directed effort based on the 1964-1973 data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
			SUMMARY TABLE				
VAR66	2ND MAR POSTLAV MIN SAL	0.76612	0.58693	0.58693	0.76612	14.32781	1.49282
VAR67	1ST APR POSTLAV MIN SAL	0.91416	0.83570	0.24876	0.24870	-10.16976	-0.95805
VAR109	APR FRE PREC	0.96121	0.92393	0.08823	-0.32573	-4.927501	-0.33980
VAR59	APR POSTLARVAL CAT-TOW	0.98595	0.97211	0.04817	0.14287	-0.1348680	-0.31861
VAR108	MAR FRE PREC	0.99484	0.98972	0.01761	0.00390	3.501573	0.12517
XE19	EXP TOT EFF 19	0.99505	0.99012	0.00040	0.30833	0.4906962E-01	0.06181
(CONSTANT)						22.32613	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 191. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
			SUMMARY TABLE				
VAR57	FEB POSTLARVAL CAT-TOW	0.83245	0.69297	0.69297	0.83245	0.2199356	0.52667
VAR100	BAY TRIPS 19	0.94214	0.88762	0.19465	-0.29387	-1.948730	-0.34663
VAR87	JUL-SEP GUAD DIS	0.95758	0.91695	0.02934	0.53540	0.3806186	0.24363
XE193	EXP TOT EFF 19 DPTH 3	0.96504	0.93130	0.01434	0.78257	0.1980237	0.23236
VAR71	APR TPWD MAT TEMP	0.97542	0.95145	0.02015	0.53471	2.763053	0.18492
(CONSTANT)						-20.13848	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 192. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR51	MAY TPWD PRI GAL CAT-EFF	0.91801	0.84274	0.84274	0.91801	1.974300	0.68162
VAR66	2ND MAR POSTLAV MIN SAL	0.98983	0.97976	0.13703	0.77046	24.06289	0.39555
VAR19	APR-JUN FRE PREC	0.99371	0.98746	0.00769	-0.56364	-2.982575	-0.10106
(CONSTANT)						-74.47285	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 193. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR61	APR TPWD GAL SAL	0.88795	0.78846	0.78846	0.88795	20.38631	0.62411
VAR118	APR NOS GAL MEAN TEMP	0.96342	0.92819	0.13973	0.85291	61.96273	0.44671
VAR66	2ND MAR POSTLAV MIN SAL	0.98543	0.97107	0.04288	0.82515	17.16893	0.37508
VAR111	MAR TRIN DIS	0.99629	0.99260	0.02153	-0.71117	1.254636	0.35447
(CONSTANT)						-1591.966	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 194. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR61	APR TPWD GAL SAL	0.88740	0.78748	0.78748	0.88740	58.32222	1.91524
VAR111	MAR TRIN DIS	0.94428	0.89166	0.10418	-0.66195	3.214610	0.97423
VAR85	OCT-DEC TRIN DIS	0.98098	0.96233	0.07067	-0.26854	-0.8219876	-0.43873
VAR16	JAN-MAR MISS DIS	0.99663	0.99327	0.03095	-0.59503	4.373735	0.30123
(CONSTANT)						-673.6820	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 195. Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in eighteen year (1960-1977) data set used to relate brown shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 3)

	VAR1	VAR2	VAR91	CTEF18	CTEF19	CTEF193	VAR11	VAR15	VAR19	VAR22	VAR23	VAR24
VAR1	1.00000	0.37432	0.78436	0.76625	0.77554	0.60379	-0.62675	-0.09108	-0.19688	-0.63786	0.36554	-0.13777
VAR2	0.37432	1.00000	0.30464	0.71579	0.52953	0.76571	-0.23781	-0.42887	-0.46965	0.03076	0.46818	0.01970
VAR91	0.78436	0.30464	1.00000	0.47746	0.54389	0.40899	-0.28498	0.06689	0.01500	-0.34241	0.24972	-0.00215
CTEF18	0.76625	0.71579	0.47746	1.00000	0.88137	0.74861	-0.55916	-0.34193	-0.48790	-0.46874	0.50184	-0.01606
CTEF19	0.77554	0.52953	0.54389	0.88137	1.00000	0.74772	-0.68683	-0.31014	-0.55649	-0.30064	0.50657	0.17078
CTEF193	0.60379	0.76571	0.40899	0.74861	0.74772	1.00000	-0.43502	-0.26428	-0.45830	-0.12267	0.50983	0.09780
VAR11	-0.62675	-0.23781	-0.28498	-0.55916	-0.68683	-0.43502	1.00000	0.29723	0.45534	0.31257	-0.58385	0.18402
VAR15	-0.09108	-0.42887	0.06689	-0.34193	-0.31014	-0.26428	0.29723	1.00000	0.59029	-0.15838	-0.29628	.0.10527
VAR19	-0.19688	-0.46965	0.01500	-0.48790	-0.55649	-0.45830	0.45534	0.59029	1.00000	-0.01618	-0.39230	-0.08619
VAR22	-0.63786	0.03076	-0.34241	-0.46874	-0.30064	-0.12267	0.31257	-0.15838	-0.01618	1.00000	0.05499	0.17644
VAR23	0.36554	0.46818	0.24972	0.50184	0.50657	0.50983	-0.58385	-0.29628	-0.39230	0.05499	1.00000	-0.23998
VAR24	-0.13777	0.01970	-0.00215	-0.01606	0.17078	0.09780	0.18402	0.10527	-0.08619	0.17644	-0.23998	1.00000
VAR25	-0.06943	0.20257	-0.08152	0.16882	0.36166	0.28237	-0.00082	-0.12195	-0.35373	0.21020	-0.13391	0.92009
VAR26	-0.52860	-0.08945	-0.20145	-0.51649	-0.47087	-0.22334	0.70314	0.38938	0.14417	0.42582	-0.40668	0.46104
VAR28	-0.09341	-0.62797	-0.05883	-0.37089	-0.13987	-0.31250	0.15133	0.16987	0.23859	-0.11104	-0.52659	0.14614
VAR29	-0.28389	-0.52132	-0.31774	-0.27706	-0.29646	-0.61554	0.16259	0.19102	0.34141	-0.05984	-0.35492	-0.04495
VAR30	-0.28377	0.08369	-0.28851	-0.04312	-0.04868	0.21728	0.34992	0.10956	-0.10503	0.24524	-0.33310	0.26155
VAR31	-0.38538	-0.30075	-0.45931	-0.23163	-0.16280	-0.19755	-0.17580	-0.06500	-0.18019	0.26509	0.39406	-0.16114
VAR38	-0.30551	0.10212	-0.10024	-0.11488	-0.25907	-0.14631	0.52252	0.40343	0.37994	0.15948	-0.45580	0.14604
VAR39	-0.50985	0.10215	-0.40484	-0.32995	-0.40698	0.04631	0.46612	-0.02324	0.18609	0.50317	-0.13880	0.31943
VAR43	-0.55550	-0.14217	-0.18445	-0.51393	-0.61624	-0.30380	0.96447	0.29267	0.46392	0.35539	-0.56184	0.25437
VAR44	-0.55350	0.05643	-0.38647	-0.42752	-0.45875	-0.02908	0.45645	0.03785	0.22603	0.57768	-0.18364	0.36275
VAR82	-0.31631	0.25681	0.04092	-0.09755	-0.31537	-0.09241	0.67960	0.13151	0.21807	0.26351	-0.12699	0.17067
VAR83	-0.42251	0.03597	-0.18874	-0.32687	-0.31268	-0.18811	0.58151	0.10813	0.11643	0.47793	-0.30152	0.00553
VAR86	-0.42300	-0.17007	-0.25824	-0.31433	-0.23026	-0.21646	0.38762	0.48871	0.28993	0.33293	-0.45001	0.28155
VAR87	-0.03018	0.47009	0.31960	0.14918	0.00316	0.14049	0.53397	0.07376	0.16412	0.27295	-0.13909	0.22645
VAR97	-0.02176	0.40979	-0.02513	-0.00813	0.10214	0.47568	-0.05154	-0.30891	-0.46529	0.46662	0.02819	-0.00843
VAR99	-0.33596	-0.09863	-0.35582	-0.33480	-0.12769	0.17100	0.13753	-0.03597	-0.38563	0.44272	-0.09314	0.17735
VAR102	-0.11550	0.49844	-0.22681	0.11420	0.05897	0.52778	-0.09520	0.08469	-0.02102	0.35917	0.30287	-0.01393
VAR103	-0.18768	0.15482	-0.24193	-0.12137	0.01069	0.39349	0.07523	0.14490	-0.26809	0.36625	-0.00577	0.14944
VAR104	-0.10532	0.36792	-0.05602	0.01349	0.02389	0.51742	0.18184	0.24874	0.13324	0.39788	0.22440	0.24772
VAR110	-0.06057	0.03209	0.00502	-0.18018	-0.19558	0.27842	0.23778	0.28987	0.40060	0.12255	-0.10335	0.16283
VAR115	-0.08450	-0.09185	-0.07226	-0.05625	-0.12781	-0.33001	0.30540	-0.23581	0.09547	-0.12511	-0.47763	0.40958
VAR116	-0.22761	-0.46513	-0.30672	-0.45788	-0.53089	-0.39833	0.19081	0.24463	0.26776	-0.23223	-0.19455	-0.16188
VAR118	0.51118	0.45416	0.32608	0.64421	0.72344	0.70669	-0.60005	-0.30446	-0.47849	-0.01650	0.86059	-0.17426
VAR119	-0.14415	-0.03498	-0.22690	0.01275	0.16111	0.20304	-0.09213	-0.15157	-0.14595	0.09989	0.29140	0.44480
BCE18	0.22037	0.57738	0.24175	0.21100	0.29911	0.61072	-0.14929	-0.28248	-0.45173	0.38335	0.26198	-0.03668
XE18	-0.27771	0.68173	-0.16073	0.02371	-0.13213	0.41947	0.20162	-0.25369	-0.21192	0.48513	0.15121	0.07914
XE19	0.60073	-0.14568	0.56706	0.07658	0.01717	0.00436	-0.23688	0.34552	0.26957	-0.63012	0.01467	-0.32907
XE193	0.51796	-0.11958	0.84287	0.07552	0.11355	-0.09079	-0.05613	0.33154	0.32154	-0.39389	-0.01685	-0.09251

Table 195 continued

	VAR25	VAR26	VAR28	VAR29	VAR30	VAR31	VAR38	VAR39	VAR43	VAR44	VAR82	VAR83
VAR1	-0.06943	-0.52860	-0.09341	-0.28389	-0.28377	-0.38538	-0.30551	-0.50985	-0.55550	-0.55350	-0.31631	-0.42251
VAR2	0.20257	-0.08945	-0.62797	-0.52132	0.08369	-0.30075	0.10212	0.10215	-0.14217	0.05643	0.25681	0.03597
VAR91	-0.08152	-0.20145	-0.05883	-0.31774	-0.28851	-0.45931	-0.10024	-0.40484	-0.18445	-0.38647	0.04092	-0.18874
CTEF18	0.16882	-0.51649	-0.37089	-0.27706	-0.04312	-0.23163	-0.11488	-0.32995	-0.51393	-0.42752	-0.09755	-0.32687
CTEF19	0.36166	-0.47087	-0.13987	-0.29646	-0.04868	-0.16280	-0.25907	-0.40698	-0.61624	-0.45875	-0.31537	-0.31268
CTEF193	0.28237	-0.22334	-0.31250	-0.61554	0.21728	-0.19755	-0.14631	0.04631	-0.30380	-0.02908	-0.09241	-0.18811
VAR11	-0.00082	0.70314	0.15133	0.16259	0.34992	-0.17580	0.52252	0.46612	0.96447	0.45645	0.67960	0.58151
VAR15	-0.12195	0.38938	0.16987	0.19102	0.10956	-0.06500	0.40343	-0.02324	0.29267	0.03785	0.13151	0.10813
VAR19	-0.35373	0.14417	0.23859	0.34141	-0.10503	-0.18019	0.37994	0.18609	0.46392	0.22603	0.21807	0.11643
VAR22	0.21020	0.42582	-0.11104	-0.05984	0.24524	0.26509	0.15948	0.50317	0.35539	0.57768	0.26351	0.47793
VAR23	-0.13391	-0.40668	-0.52659	-0.35492	-0.33310	0.39406	-0.45580	-0.13880	-0.56184	-0.18364	-0.12699	-0.30152
VAR24	0.92009	0.46104	0.14614	-0.04495	0.26155	-0.16114	0.14604	0.31943	0.25437	0.36275	0.17067	0.00553
VAR25	1.00000	0.30060	0.05256	-0.07288	0.34335	-0.11634	0.00193	0.32295	0.06519	0.31945	-0.02429	-0.05897
VAR26	0.30060	1.00000	-0.01123	-0.25483	0.21772	-0.05371	0.46812	0.44413	0.72963	0.54964	0.48683	0.56281
VAR28	0.05256	-0.01123	1.00000	0.37513	0.15619	-0.20599	-0.04636	-0.36003	0.06412	-0.34126	-0.29791	0.19663
VAR29	-0.07288	-0.25483	0.37513	1.00000	0.21959	-0.08614	0.09681	-0.13615	0.03111	-0.22100	-0.11111	-0.06983
VAR30	0.34335	0.21772	0.15619	0.21959	1.00000	-0.16154	0.36345	0.40641	0.38317	0.28946	0.19359	0.15614
VAR31	-0.11634	-0.05371	-0.20599	-0.08614	-0.16154	1.00000	-0.34358	0.16743	-0.24505	0.18517	-0.20988	-0.26553
VAR38	0.00193	0.46812	-0.04636	0.09681	0.36345	-0.34358	1.00000	0.17548	0.56282	0.24449	0.55997	0.50759
VAR39	0.32295	0.44413	-0.36003	-0.13615	0.40641	0.16743	0.17548	1.00000	0.55798	0.96448	0.29660	-0.04787
VAR43	0.06519	0.72963	0.06412	0.03111	0.38317	-0.24505	0.56282	0.55798	1.00000	0.56096	0.73205	0.56746
VAR44	0.31945	0.54964	-0.34126	-0.22100	0.28946	0.18517	0.24449	0.96448	0.56096	1.00000	0.31412	0.03558
VAR82	-0.02429	0.48683	-0.29791	-0.11111	0.19359	-0.20988	0.55997	0.29660	0.73205	0.31412	1.00000	0.52702
VAR83	-0.05897	0.56281	0.19663	-0.06983	0.15614	-0.26553	0.50759	-0.04787	0.56746	0.03558	0.52702	1.00000
VAR86	0.17142	0.53500	0.17841	0.08493	0.35055	-0.11990	0.82525	0.08011	0.44192	0.20228	0.34145	0.60930
VAR87	0.14009	0.43663	-0.20954	-0.09057	0.26181	-0.50867	0.63270	0.21081	0.56569	0.21680	0.68459	0.46608
VAR97	0.17118	0.26494	-0.13170	-0.52768	0.40404	-0.09028	-0.04521	0.28975	0.06071	0.31758	-0.02824	0.26959
VAR99	0.24589	0.46525	0.16118	-0.37527	0.44984	0.28380	-0.06992	0.35352	0.16821	0.38871	-0.12975	0.20684
VAR102	0.14698	0.12991	-0.38875	-0.31020	0.34079	0.08817	0.18493	0.47475	-0.02156	0.45466	-0.04947	0.05861
VAR103	0.24425	0.34766	0.18336	-0.32492	0.51198	0.01650	0.08122	0.21287	0.08592	0.23938	-0.07683	0.32216
VAR104	0.27339	0.32423	-0.15557	-0.30435	0.42345	-0.03926	0.14640	0.51644	0.25113	0.48546	0.17784	0.17980
VAR110	0.10667	0.19688	0.02544	-0.28604	0.25841	-0.02362	-0.04001	0.48228	0.34408	0.46847	0.20102	0.02474
VAR115	0.35050	0.10702	0.02882	0.34807	-0.02236	-0.43393	0.13644	0.22405	0.32824	0.20848	0.20344	-0.04973
VAR116	-0.22961	0.12841	-0.05482	0.05662	-0.24708	0.31298	-0.35000	0.20952	0.18011	0.19380	-0.02233	-0.16272
VAR118	-0.02716	-0.46152	-0.32733	-0.43579	-0.07681	0.32659	-0.37985	-0.20203	-0.53661	-0.26599	-0.17824	-0.27835
VAR119	0.48290	-0.09819	0.14961	0.05319	0.09315	0.18124	-0.40099	0.20341	-0.07590	0.11401	-0.14207	-0.16871
BCE18	0.15180	0.15481	-0.25760	-0.51704	0.28760	-0.19643	-0.15868	0.15065	-0.03721	0.14292	0.01936	0.23149
XE18	0.15661	0.35457	-0.51566	-0.52103	0.28547	-0.07791	0.24796	0.58442	0.30728	0.60511	0.44686	0.28431
XE19	-0.49449	-0.16878	-0.01264	-0.20493	-0.47008	-0.22288	-0.21488	-0.35542	-0.19662	-0.30645	-0.11841	-0.32450
XE193	-0.32556	-0.05317	0.05086	-0.10395	-0.45028	-0.33216	0.00314	-0.41263	-0.00096	-0.34199	0.12190	-0.15627

Table 195 continued

	VAR86	VAR87	VAR97	VAR99	VAR102	VAR103	VAR104	VAR110	VAR115	VAR116	VAR118	VAR119
VAR1	-0.42300	-0.03018	-0.02176	-0.33596	-0.11550	-0.18768	-0.10532	-0.06057	-0.08450	-0.22761	0.51118	-0.14415
VAR2	-0.17007	0.47009	0.40979	-0.09863	0.49844	0.15482	0.36792	0.03209	-0.09185	-0.46513	0.45416	-0.03498
VAR91	-0.25824	0.31960	-0.02513	-0.35582	-0.22681	-0.24193	-0.05602	0.00502	-0.07226	-0.30672	0.32608	-0.22690
CTEF18	-0.31433	0.14918	-0.00813	-0.33480	0.11420	-0.12137	0.01349	-0.18018	-0.05625	-0.45788	0.64421	0.01275
CTEF19	-0.23026	0.00316	0.10214	-0.12769	0.05897	0.01069	0.02389	-0.19558	-0.12781	-0.53089	0.72344	0.16111
CTEF193	-0.21646	0.14049	0.47568	0.17100	0.52778	0.39349	0.51742	0.27842	-0.33001	-0.39833	0.70669	0.20304
VAR11	0.38762	0.53397	-0.05154	0.13753	-0.09520	0.07523	0.18184	0.23778	0.30540	0.19081	-0.60005	-0.09213
VAR15	0.48871	0.07376	-0.30891	-0.03597	0.08469	0.14490	0.24874	0.28987	-0.23581	0.24463	-0.30446	-0.15157
VAR19	0.28993	0.16412	-0.46529	-0.38563	-0.02102	-0.26809	0.13324	0.40060	0.09547	0.26776	-0.47849	-0.14595
VAR22	0.33293	0.27295	0.46662	0.44272	0.35917	0.36625	0.39788	0.12255	-0.12511	-0.23223	-0.01650	0.09989
VAR23	-0.45001	-0.13909	0.02819	-0.09314	0.30287	-0.00577	0.22440	-0.10335	-0.47763	-0.19455	0.86059	0.29140
VAR24	0.28155	0.22645	-0.00843	0.17735	-0.01393	0.14944	0.24772	0.16283	0.40958	-0.16188	-0.17426	0.44480
VAR25	0.17142	0.14009	0.17118	0.24589	0.14698	0.24425	0.27339	0.10667	0.35050	-0.22961	-0.02716	0.48290
VAR26	0.53500	0.43663	0.26494	0.46525	0.12991	0.34766	0.32423	0.19688	0.10702	0.12841	-0.46152	-0.09819
VAR28	0.17841	-0.20954	-0.13170	0.16118	-0.38875	0.18336	-0.15557	0.02544	0.02882	-0.05482	-0.32733	0.14961
VAR29	0.08493	-0.09057	-0.52768	-0.37527	-0.31020	-0.32492	-0.30435	-0.28604	0.34807	0.05662	-0.43579	0.05319
VAR30	0.35055	0.26181	0.40404	0.44984	0.34079	0.51198	0.42345	0.25841	-0.02236	-0.24708	-0.07681	0.09315
VAR31	-0.11990	-0.50867	-0.09028	0.28380	0.08817	0.01650	-0.03926	-0.02362	-0.43393	0.31298	0.32659	0.18124
VAR38	0.82525	0.63270	-0.04521	-0.06992	0.18493	0.08122	0.14640	-0.04001	0.13644	-0.35000	-0.37985	-0.40099
VAR39	0.08011	0.21081	0.28975	0.35352	0.47475	0.21287	0.51644	0.48228	0.22405	0.20952	-0.20203	0.20341
VAR43	0.44192	0.56569	0.06071	0.16821	-0.02156	0.08592	0.25113	0.34408	0.32824	0.18011	-0.53661	-0.07590
VAR44	0.20228	0.21680	0.31758	0.38871	0.45466	0.23938	0.48546	0.46847	0.20848	0.19380	-0.26599	0.11401
VAR82	0.34145	0.68459	-0.02824	-0.12975	-0.04947	-0.07683	0.17784	0.20102	0.20344	-0.02233	-0.17824	-0.14207
VAR83	0.60930	0.46608	0.26959	0.20684	0.05861	0.32216	0.17980	0.02474	-0.04973	-0.16272	-0.27835	-0.16871
VAR86	1.00000	0.28944	0.05663	0.19791	0.17234	0.26005	0.14939	0.01080	-0.01825	-0.21636	-0.31138	-0.17508
VAR87	0.28944	1.00000	0.11165	-0.16223	0.14061	0.05112	0.33792	0.03247	0.17317	-0.53865	-0.14340	-0.34191
VAR97	0.05663	0.11165	1.00000	0.71891	0.45661	0.66181	0.38462	0.23584	-0.25868	-0.17557	0.17431	-0.15131
VAR99	0.19791	-0.16223	0.71891	1.00000	0.27271	0.78765	0.32603	0.14895	-0.25694	0.00695	0.09351	0.11572
VAR102	0.17234	0.14061	0.45661	0.27271	1.00000	0.57215	0.82674	0.44585	-0.49738	-0.18142	0.26772	0.14113
VAR103	0.26005	0.05112	0.66181	0.78765	0.57215	1.00000	0.66109	0.31216	-0.47724	-0.25321	0.14206	0.13422
VAR104	0.14939	0.33792	0.38462	0.32603	0.82674	0.66109	1.00000	0.66829	-0.43184	-0.17054	0.22093	0.28958
VAR110	0.01080	0.03247	0.23584	0.14895	0.44585	0.31216	0.66829	1.00000	-0.27849	0.37454	-0.03703	0.19146
VAR115	-0.01825	0.17317	-0.25868	-0.25694	-0.49738	-0.47724	-0.43184	-0.27849	1.00000	0.07569	-0.51150	0.06982
VAR116	-0.21636	-0.53865	-0.17557	0.00695	-0.18142	-0.25321	-0.17054	0.37454	0.07569	1.00000	-0.32116	0.10951
VAR118	-0.31138	-0.14340	0.17431	0.09351	0.26772	0.14206	0.22093	-0.03703	-0.51150	-0.32116	1.00000	0.24608
VAR119	-0.17508	-0.34191	-0.15131	0.11572	0.14113	0.13422	0.28958	0.19146	0.06982	0.10951	0.24608	1.00000
BCE18	-0.11441	0.24699	0.89621	0.45787	0.47497	0.52130	0.47384	0.27008	-0.33215	-0.21603	0.34124	-0.12676
XE18	0.09151	0.39679	0.62974	0.32303	0.66624	0.45928	0.57687	0.35692	-0.13539	-0.16430	0.03400	0.02330
XE19	-0.31179	-0.19709	-0.15581	-0.25164	-0.31629	-0.25736	-0.25232	0.12905	-0.06945	0.36376	-0.01744	-0.39930
XE193	-0.13262	0.19222	-0.30542	-0.43757	-0.50061	-0.45569	-0.32707	-0.06076	0.04660	0.00913	-0.04250	-0.36900

Table 195 continued

	BCE18	XE18	XE19	XE193
VAR1	0.22037	-0.27771	0.60073	0.51796
VAR2	0.57738	0.68173	-0.14568	-0.11958
VAR91	0.24175	-0.16073	0.56706	0.84287
CTEF18	0.21100	0.02371	0.07658	0.07552
CTEF19	0.29911	-0.13213	0.01717	0.11355
CTEF193	0.61072	0.41947	0.00436	-0.09079
VAR11	-0.14929	0.20162	-0.23688	-0.05613
VAR15	-0.28248	-0.25369	0.34552	0.33154
VAR19	-0.45173	-0.21192	0.26957	0.32154
VAR22	0.38335	0.48513	-0.63012	-0.39389
VAR23	0.26198	0.15121	0.01467	-0.01685
VAR24	-0.03668	0.07914	-0.32907	-0.09251
VAR25	0.15180	0.15661	-0.49449	-0.32556
VAR26	0.15481	0.35457	-0.16878	-0.05317
VAR28	-0.25760	-0.51566	-0.01264	0.05086
VAR29	-0.51704	-0.52103	-0.20493	-0.10395
VAR30	0.28760	0.28547	-0.47008	-0.45028
VAR31	-0.19643	-0.07791	-0.22288	-0.33216
VAR38	-0.15868	0.24796	-0.21488	0.00314
VAR39	0.15065	0.58442	-0.35542	-0.41263
VAR43	-0.03721	0.30728	-0.19662	-0.00096
VAR44	0.14292	0.60511	-0.30645	-0.34199
VAR82	0.01936	0.44686	-0.11841	0.12190
VAR83	0.23149	0.28431	-0.32450	-0.15627
VAR86	-0.11441	0.09151	-0.31179	-0.13262
VAR87	0.24699	0.39679	-0.19709	0.19222
VAR97	0.89621	0.62974	-0.15581	-0.30542
VAR99	0.45787	0.32303	-0.25164	-0.43757
VAR102	0.47497	0.66624	-0.31629	-0.50061
VAR103	0.52130	0.45928	-0.25736	-0.45569
VAR104	0.47384	0.57687	-0.25232	-0.32707
VAR110	0.27008	0.35692	0.12905	-0.06076
VAR115	-0.33215	-0.13539	-0.06945	0.04660
VAR116	-0.21603	-0.16430	0.36376	0.00913
VAR118	0.34124	0.03400	-0.01744	-0.04250
VAR119	-0.12676	0.02330	-0.39930	-0.36900
BCE18	1.00000	0.57206	-0.05298	-0.12937
XE18	0.57206	1.00000	-0.31121	-0.37094
XE19	-0.05298	-0.31121	1.00000	0.73325
XE193	-0.12937	-0.37094	0.73325	1.00000

Table 196. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR102	LAG BAY CAT 19	0.49844	0.24844	0.24844	0.49844	0.2703884	0.45195
VAR19	APR-JUN FRE PREC	0.67777	0.45938	0.21094	-0.46965	-2.680636	-0.71887
VAR87	JUL-SEP GUAD DIS	0.83550	0.69806	0.23868	0.47009	0.7702933	0.44127
VAR99	BAY TRIPS 18	0.92210	0.85026	0.15220	-0.09863	-3.147658	-0.56222
VAR97	BAY CAT 18	0.94171	0.88681	0.03655	0.40979	0.1901539	0.25160
VAR110	MAY FRE PREC	0.94770	0.89813	0.01132	0.03209	1.476389	0.17600
VAR30	MAR GAL FAST WIND DIR	0.95504	0.91211	0.01398	0.08369	-0.8329804E-01	-0.14877
(CONSTANT)						79.91170	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 197. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.64202	0.41219	0.41219	-0.64202	-0.8049794	-0.68929
VAR31	APR GAL FAST WIND DIR	0.84273	0.71019	0.29800	-0.39700	-0.6711570	-0.62670
VAR118	APR NOS GAL MEAN TEMP	0.89676	0.80417	0.09398	0.51118	15.93666	0.51592
VAR22	MAR NOS GAL MIN TEMP	0.95464	0.91134	0.10716	-0.63792	-8.840268	-0.38577
VAR26	MAR NOS FRE HI TIDE	0.96956	0.94005	0.02871	-0.53291	35.47581	0.52121
VAR24	MAR NOS GAL MIN DEN	0.98206	0.96443	0.02438	-0.14079	-0.4711731	-0.20913
VAR103	LAG BAY TRIPS 18	0.98678	0.97374	0.00931	-0.18627	-0.8627204	-0.11219
(CONSTANT)						-119.6971	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 198. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR31	APR GAL FAST WIND DIR	0.53120	0.28218	0.28218	-0.53120	-0.8763438	-1.34683
VAR118	APR NOS GAL MEAN TEMP	0.78871	0.62207	0.33989	0.34067	18.25951	0.97264
VAR39	LAG ANNUAL MISS DIS	0.85088	0.72401	0.10194	-0.49013	0.3738641	0.51843
VAR15	APR-JUN TRIN DIS	0.89535	0.80165	0.07764	0.09756	0.9176419E-01	0.61481
VAR104	LAG BAY TRIPS 19	0.91986	0.84614	0.04449	-0.03446	-6.487311	-1.31800
VAR115	FEB GAL FASTEST WIND	0.94634	0.89555	0.04941	-0.10979	-5.097424	-0.98280
VAR25	APR NOS GAL MIN DEN	0.96750	0.93605	0.04050	-0.08150	1.112663	0.44071
VAR86	APR-JUN GUAD DIS	0.98679	0.97376	0.03771	-0.19887	-0.2520423	-0.33561
VAR43	ANNUAL ATCH DIS	0.99347	0.98698	0.01323	-0.23036	0.7583748E-01	0.21636
(CONSTANT)						-74.67311	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 199. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
XE18	EXP TOT EFF 18	0.68173	0.46476	0.46476	0.68173	0.3547988	0.43254
VAR23	APR NOS GAL MIN TEMP	0.77535	0.60117	0.13641	0.46818	6.588375	0.47235
VAR31	APR GAL FAST WIND DIR	0.89124	0.79432	0.19314	-0.30075	-0.2740654	-0.40051
VAR19	APR-JUN FRE PREC	0.92188	0.84985	0.05554	-0.46965	-1.115876	-0.29925
VAR87	JUL-SEP GUAD DIS	0.93569	0.87553	0.02567	0.47009	0.3657956	0.20955
(CONSTANT)						-77.12055	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 200. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR11	ANNUAL MISS DIS	0.64202	0.41219	0.41219	-0.64202	-0.4404939	-0.37719
VAR31	APR GAL FAST WIND DIR	0.84273	0.71019	0.29800	-0.39700	-0.5740495	-0.53602
VAR118	APR NOS GAL MEAN TEMP	0.89676	0.80417	0.09398	0.51118	14.41049	0.46651
XE19	EXP TOT EFF 19	0.95970	0.92103	0.11685	0.60123	0.3031347	0.37854
(CONSTANT)						-145.4988	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 201. **Summary of results of final stepwise multiple regression analysis of brown shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR91 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
XE193	EXP TOT EFF 19 DPTH 3	0.84074	0.70684	0.70684	0.84074	0.6403515	0.79519
VAR118	APR NOS GAL MEAN TEMP	0.91117	0.83022	0.12339	0.34067	7.155024	0.38113
VAR31	APR GAL FAST WIND DIR	0.97679	0.95413	0.12390	-0.53120	-0.2649276	-0.40716
VAR25	APR NOS GAL MIN DEN	0.98292	0.96614	0.01201	-0.08150	1.445133	0.57240
VAR24	MAR NOS GAL MIN DEN	0.99109	0.98226	0.01612	-0.02432	-0.5519877	-0.40779
VAR115	FEB GAL FASTEST WIND	0.99702	0.99404	0.01178	-0.10979	-0.7604729	-0.14662
(CONSTANT)						-114.2778	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 202. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.64421	0.41500	0.41500	0.64421	144.5151	0.84306
VAR31	APR GAL FAST WIND DIR	0.78744	0.62006	0.20506	-0.21761	-3.278523	-0.55166
BCEL18	LAG BAY CAT-TRIP 18	0.85654	0.73366	0.11360	-0.11046	-3.854034	-0.35366
VAR19	APR-JUN FRE PREC	0.87064	0.75801	0.02435	-0.47889	-4.615282	-0.14123
VAR24	MAR NOS GAL MIN DEN	0.87691	0.76897	0.01096	-0.00746	1.480365	0.11840
(CONSTANT)						-2075.925	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 203. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR118	APR NOS GAL MEAN TEMP	0.72344	0.52336	0.52336	0.72344	53.08143	0.41600
VAR25	APR NOS GAL MIN DEN	0.81784	0.66887	0.14551	0.36166	7.692148	0.44011
VAR44	LAG ANNUAL ATCH DIS	0.91814	0.84299	0.17412	-0.45383	-0.8507021	-0.35257
VAR11	ANNUAL MISS DIS	0.93116	0.86707	0.02408	-0.68607	-2.185008	-0.45293
VAR87	JUL-SEP GUAD DIS	0.96585	0.93287	0.06580	0.00619	3.580587	0.32198
(CONSTANT)						-278.7267	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 204. **Summary of results of final stepwise multiple regression analysis of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR29	APR GAL FASTEST WIND	0.73546	0.54090	0.54090	-0.73546	-15.74319	-0.57416
VAR118	APR NOS GAL MEAN TEMP	0.81895	0.67068	0.12978	0.69366	13.07577	0.09796
VAR116	FEB GAL FAST WIND DIR	0.85532	0.73158	0.06090	-0.39073	-1.895400	-0.39826
VAR83	OCT-DEC MISS DIS	0.88124	0.77659	0.04501	-0.24797	-6.228256	-0.34689
BCE18	BAY CAT-TRIP 18	0.91023	0.82851	0.05193	0.60910	3.415300	0.39711
VAR119	MAY NOS GAL MEAN TEMP	0.93156	0.86780	0.03929	0.18785	59.89716	0.25486
VAR19	APR-JUN FRE PREC	0.95530	0.91260	0.04480	-0.40417	7.004871	0.26971
(CONSTANT)						-531.8463	

SEE TABLES 5 AND 1 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 205. Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the ten year (1964-1973) data set used to relate white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR18	VAR20	VAR26	VAR29	VAR31	VAR37
VAR1	1.00000	0.62975	-0.34055	0.80483	0.78076	0.09913	0.48991	0.03420	0.77034	-0.50693	-0.35859	0.73011
VAR2	0.62975	1.00000	-0.60146	0.81875	0.56501	0.11663	0.37449	0.53402	0.20816	0.12387	-0.84287	0.74080
VAR68	-0.34055	-0.60146	1.00000	-0.32114	-0.00981	0.47672	0.07710	-0.19923	-0.03045	-0.18930	0.51396	-0.11935
CTEF18	0.80483	0.81875	-0.32114	1.00000	0.89045	0.36957	0.70676	0.50094	0.59181	-0.34825	-0.48468	0.74390
CTEF19	0.78076	0.56501	-0.00981	0.89045	1.00000	0.61687	0.85402	0.41034	0.66182	-0.48604	-0.14331	0.72887
CTEF193	0.09913	0.11663	0.47672	0.36957	0.61687	1.00000	0.78105	0.57929	0.20849	-0.05361	0.15567	0.34473
VAR18	0.48991	0.37449	0.07710	0.70676	0.85402	0.78105	1.00000	0.49063	0.39353	-0.46564	0.04802	0.40821
VAR20	0.03420	0.53402	-0.19923	0.50094	0.41034	0.57929	0.49063	1.00000	0.03616	0.47249	-0.38779	0.38626
VAR26	0.77034	0.20816	-0.03045	0.59181	0.66182	0.20849	0.39353	0.03616	1.00000	-0.51620	0.04418	0.51352
VAR29	-0.50693	0.12387	-0.18930	-0.34825	-0.48604	-0.05361	-0.46564	0.47249	-0.51620	1.00000	-0.45175	0.02917
VAR31	-0.35859	-0.84287	0.51396	-0.48468	-0.14331	0.15567	0.04802	-0.38779	0.04418	-0.45175	1.00000	-0.60255
VAR37	0.73011	0.74080	-0.11935	0.74390	0.72887	0.34473	0.40821	0.38626	0.51352	0.02917	-0.60255	1.00000
VAR40	-0.39519	-0.23296	-0.36873	-0.59227	-0.62186	-0.42372	-0.54917	-0.03993	-0.36256	0.63960	0.00550	-0.26868
VAR44	0.03800	-0.30682	0.35814	-0.20567	0.00542	0.11589	-0.26767	-0.22054	0.37512	0.05236	0.33666	0.09061
VAR52	0.74451	0.85434	-0.34921	0.76921	0.61524	0.20041	0.29177	0.43415	0.52831	0.13011	-0.76352	0.91851
VAR53	0.42828	0.41240	-0.20651	0.48248	0.56386	0.13357	0.42422	0.16913	0.02115	-0.35549	-0.11761	0.35183
VAR55	0.47235	0.14739	-0.08002	0.15734	0.32010	0.24945	0.38185	-0.06608	0.32095	-0.12355	-0.05153	0.41025
VAR64	-0.44520	-0.55324	0.49820	-0.62533	-0.54914	-0.24992	-0.42776	-0.43316	-0.40756	0.16851	0.11654	-0.29990
VAR66	-0.44363	-0.82686	0.37992	-0.72607	-0.48737	-0.20999	-0.38270	-0.64950	-0.22706	-0.27415	0.78214	-0.73481
VAR79	-0.14338	-0.42422	0.82386	-0.10086	0.05554	0.35110	0.01091	-0.06075	0.31948	-0.10429	0.27977	0.06423
VAR87	-0.51424	-0.89160	0.43085	-0.61170	-0.36401	-0.03561	-0.09332	-0.37462	-0.10854	-0.26975	0.89180	-0.70294
VAR88	0.55793	0.27265	-0.18950	0.18143	0.15205	-0.20418	-0.13860	-0.18000	0.33850	-0.03546	-0.38937	0.38026
VAR91	-0.31821	-0.43421	0.67240	-0.19158	0.06087	0.48104	0.30775	0.17610	-0.15603	-0.01206	0.35161	-0.10706
VAR94	0.80841	0.17124	0.01527	0.60809	0.77779	0.34842	0.63331	-0.04948	0.89531	-0.74751	0.20944	0.42301
VAR96	-0.27791	-0.07340	-0.58452	-0.32470	-0.57065	-0.81276	-0.52505	-0.19991	-0.44582	0.22379	-0.12573	-0.47157
VAR97	0.21790	0.20638	-0.12052	0.38077	0.37457	0.51914	0.44421	0.70460	0.57096	0.19882	-0.05945	0.30036
WCE19	0.33035	0.01348	-0.41845	0.30485	0.18962	-0.30203	0.15339	-0.12305	0.44136	-0.65226	0.23575	-0.27488
XE18	-0.19386	0.50353	-0.24894	0.07125	-0.24398	-0.16286	-0.24959	0.31812	-0.47319	0.68227	-0.78737	0.26504
XE19	0.71490	0.27314	-0.21338	0.27105	0.22782	-0.39334	-0.07089	-0.51209	0.45803	-0.37899	-0.32699	0.47855
XE193	0.40771	0.19727	-0.22931	0.25375	0.07878	-0.30151	-0.00573	-0.16955	0.43885	-0.16887	-0.30959	0.28698

Table 205 continued

	VAR40	VAR44	VAR52	VAR53	VAR55	VAR64	VAR66	VAR79	VAR87	VAR88	VAR91	VAR94
VAR1	-0.39519	0.03800	0.74451	0.42828	0.47255	-0.44520	-0.44363	-0.14338	-0.51424	0.55793	-0.31821	0.80841
VAR2	-0.23296	-0.30682	0.85434	0.41240	0.14739	-0.55324	-0.82686	-0.42422	-0.89160	0.27265	-0.43421	0.17124
VAR68	-0.36873	0.35814	-0.34921	-0.20651	-0.08002	0.49820	0.37992	0.82386	0.43085	-0.18950	0.67240	0.01527
CTEF18	-0.59227	-0.20567	0.76921	0.48248	0.15734	-0.62533	-0.72607	-0.10086	-0.61170	0.18143	-0.19158	0.60809
CTEF19	-0.62186	0.00542	0.61524	0.56386	0.32010	-0.54914	-0.48737	0.05554	-0.36401	0.15205	0.06087	0.77779
CTEF193	-0.42372	0.11589	0.20041	0.13357	0.24945	-0.24992	-0.20999	0.35110	-0.03561	-0.20418	0.48104	0.34842
VAR18	-0.54917	-0.26767	0.29177	0.42422	0.38185	-0.42776	-0.38270	0.01091	-0.09332	-0.13860	0.30775	0.63331
VAR20	-0.03993	-0.22054	0.43415	0.16913	-0.06608	-0.43318	-0.64950	-0.06075	-0.37462	-0.18000	0.17610	-0.04948
VAR26	-0.36256	0.37512	0.52831	0.02115	0.32095	-0.40756	-0.22706	0.31948	-0.10854	0.33850	-0.15603	0.89551
VAR29	0.63960	0.05236	0.13011	-0.35549	-0.12355	0.16851	-0.27415	-0.10429	-0.26975	-0.03546	-0.01206	-0.74751
VAR31	0.00550	0.33666	-0.76352	-0.11761	-0.05153	0.11634	0.78214	0.27977	0.89180	-0.38937	0.35161	0.20944
VAR37	-0.26868	0.09061	0.91851	0.35183	0.41025	-0.29990	-0.73481	0.06423	-0.70294	0.38026	-0.10706	0.42301
VAR40	1.00000	0.00259	-0.22350	-0.28434	0.23103	0.24580	0.14841	-0.38782	0.21951	0.00790	-0.08591	-0.47442
VAR44	0.00259	1.00000	0.08092	-0.15672	-0.08503	-0.16951	0.45870	0.37304	0.03005	0.30927	-0.20566	0.24683
VAR52	-0.22350	0.08092	1.00000	0.20003	0.30467	-0.43225	-0.77382	-0.04962	-0.85451	0.48611	-0.35921	0.37191
VAR53	-0.28434	-0.15672	0.20003	1.00000	-0.02304	-0.31000	-0.11205	-0.45131	-0.29569	0.24194	0.04564	0.24875
VAR55	0.23103	-0.08503	0.30467	-0.02304	1.00000	0.07934	-0.21386	-0.12233	-0.02146	0.24960	0.10642	0.45831
VAR64	0.24580	-0.16951	-0.43225	-0.31000	0.07934	1.00000	0.26220	0.39745	0.38861	0.06549	0.59946	-0.43527
VAR66	0.14841	0.45870	-0.77382	-0.11205	-0.21386	0.26220	1.00000	0.06860	0.64082	0.00343	0.07812	-0.07903
VAR79	-0.38782	0.37304	-0.04962	-0.45131	-0.12233	0.39745	0.06860	1.00000	0.28582	-0.10257	0.51432	0.14634
VAR87	0.21951	0.03005	-0.85451	-0.29569	-0.02146	0.38861	0.64082	0.28582	1.00000	-0.50396	0.48784	-0.01348
VAR88	0.00790	0.30927	0.48611	0.24194	0.24960	0.06549	0.00343	-0.10257	-0.50396	1.00000	-0.20780	0.29167
VAR91	-0.08591	-0.20566	-0.35921	0.04564	0.10642	0.59946	0.07812	0.51432	0.48784	-0.20780	1.00000	-0.06251
VAR94	-0.47442	0.24683	0.37191	0.24875	0.45831	-0.43527	-0.07903	0.14634	-0.01348	0.29167	-0.06251	1.00000
VAR96	0.52945	-0.49804	-0.36096	0.06674	-0.28388	0.22236	0.09104	-0.55211	0.15947	-0.03993	-0.18230	-0.49391
VAR97	0.07473	0.18493	0.38719	-0.31011	0.29133	-0.34707	-0.48199	0.31383	-0.02705	-0.04337	0.14488	0.39048
WCE19	-0.25269	-0.11663	-0.12048	0.15723	-0.25794	-0.45305	0.13207	-0.21832	0.19171	0.00054	-0.32659	0.47161
XE18	0.15194	-0.45679	0.35380	-0.19519	-0.10758	0.16639	-0.64199	-0.12714	-0.55431	-0.12910	-0.15104	-0.64435
XE19	-0.06425	0.00058	0.45386	0.12746	0.52764	0.16215	-0.19272	-0.06589	-0.29966	0.61232	-0.27782	0.44174
XE193	0.02640	-0.34150	0.33295	-0.39013	0.42627	0.18734	-0.49554	0.17375	-0.04052	0.04546	-0.10810	0.27070

Table 205 continued

	VAR96	VAR97	WCE19	XE18	XE19	XE193
VAR1	-0.27791	0.21790	0.33035	-0.19386	0.71490	0.40771
VAR2	-0.07340	0.20638	0.01348	0.50353	0.27314	0.19727
VAR68	-0.58452	-0.12052	-0.41845	-0.24894	-0.21338	-0.22931
CTEF18	-0.32470	0.38077	0.30485	0.07125	0.27105	0.25375
CTEF19	-0.57065	0.37457	0.18962	-0.24398	0.22782	0.07878
CTEF193	-0.81276	0.51914	-0.30203	-0.16286	-0.39334	-0.30151
VAR18	-0.52505	0.44421	0.15339	-0.24959	-0.07089	-0.00573
VAR20	-0.19991	0.70460	-0.12305	0.31812	-0.51209	-0.16955
VAR26	-0.44582	0.57096	0.44136	-0.47319	0.45803	0.43885
VAR29	0.22379	0.19882	-0.65226	0.68227	-0.37899	-0.16887
VAR31	-0.12573	-0.05945	0.23575	-0.78737	-0.32699	-0.30959
VAR37	-0.47157	0.30036	-0.27488	0.26504	0.47855	0.28698
VAR40	0.52945	0.07473	-0.25269	0.15194	-0.06425	0.02640
VAR44	-0.49804	0.18493	-0.11663	-0.45679	0.00058	-0.34150
VAR52	-0.36096	0.38719	-0.12048	0.35380	0.45386	0.33295
VAR53	0.06674	-0.31011	0.15723	-0.19519	0.12746	-0.39013
VAR55	-0.28388	0.29133	-0.25794	-0.10758	0.52764	0.42627
VAR64	0.22236	-0.34707	-0.45305	0.16639	0.16215	0.18734
VAR66	0.09104	-0.48199	0.13207	-0.64199	-0.19272	-0.49554
VAR79	-0.55211	0.31383	-0.21832	-0.12714	-0.06589	0.17375
VAR87	0.15947	-0.02705	0.19171	-0.55431	-0.29966	-0.04052
VAR88	-0.03993	-0.04337	0.00054	-0.12910	0.61232	0.04546
VAR91	-0.18230	0.14488	-0.32659	-0.15104	-0.27782	-0.10810
VAR94	-0.49391	0.39048	0.47161	-0.64433	0.44174	0.27070
VAR96	1.00000	-0.47304	0.33843	0.20212	0.03866	0.13226
VAR97	-0.47304	1.00000	0.11263	-0.10428	-0.21409	0.26050
WCE19	0.33843	0.11263	1.00000	-0.50622	0.07298	0.16934
XE18	0.20212	-0.10428	-0.50622	1.00000	-0.00839	0.25082
XE19	0.03866	-0.21409	0.07298	-0.00839	1.00000	0.63776
XE193	0.13226	0.26050	0.16934	0.25082	0.63776	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 206. Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR87	JUNE GAL FASTEST WIND	0.89160	0.79495	0.79495	-0.89160	-0.2908958	-0.30246
VAR66	AUG EKMAN ZONAL IND	0.95170	0.90573	0.11077	-0.82686	-0.8314288E-01	-0.64133
VAR79	LAG BAY TRIPS 19	0.97943	0.95927	0.05355	-0.42422	-0.7452259	-0.45118
VAR40	JAN NOS GAL MIN TEMP	0.99382	0.98768	0.02840	-0.23296	-0.7360900	-0.24680
VAR44	LAG OCT-DEC FRE PREC	0.99906	0.99812	0.01044	-0.30682	0.1818942	0.16539
(CONSTANT)						50.28834	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 207. Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR94	AUG GAL FAST WIND DIR	0.82821	0.68593	0.68593	0.82821	0.2011332	1.35789
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.97313	0.94699	0.26106	-0.36430	-0.9263289	-0.44050
VAR97	JUN FRE HI TIDE	0.99091	0.98190	0.03491	0.21790	-7.068558	-0.41643
VAR29	APR-JUN FRE DAYS GT 90 F	0.99784	0.99568	0.01378	-0.50693	0.5207198	0.39191
(CONSTANT)						68.17908	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 208. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
			SUMMARY TABLE				
VAR91	OCT GAL FASTEST WIND	0.87988	0.77419	0.77419	0.87988	0.7048559E-01	0.82610
VAR88	JUL GAL FASTEST WIND	0.93789	0.87964	0.10546	-0.50412	-0.2327372E-01	-0.32477
VAR97	JUN FRE HI TIDE	0.97191	0.94462	0.06497	-0.12052	-0.2852020	-0.23832
VAR40	JAN NOS GAL MIN TEMP	0.99468	0.98940	0.04478	-0.32810	-0.6514174E-01	-0.21361
(CONSTANT)						1.866147	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 209. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
			SUMMARY TABLE				
VAR87	JUNE GAL FASTEST WIND	0.89160	0.79495	0.79495	-0.89160	-0.3731173	-0.38795
VAR66	AUG EKMAN ZONAL IND	0.95170	0.90573	0.11077	-0.82686	-0.8082440E-01	-0.62345
VAR79	LAG BAY TRIPS 19	0.97943	0.95927	0.05355	-0.42422	-0.6508532	-0.39405
VAR40	JAN NOS GAL MIN TEMP	0.99382	0.98768	0.02840	-0.23296	-0.5818882	-0.19510
VAR44	LAG OCT-DEC FRE PREC	0.99906	0.99812	0.01044	-0.30682	0.1082813	0.09846
XE18	EXP TOT EFF 18	0.99994	0.99988	0.00176	0.50353	-0.2045870E-01	-0.08725
(CONSTANT)						52.47613	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 210. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR94	AUG GAL FAST WIND DIR	0.82821	0.68593	0.68593	0.82821	0.1902832	1.28464
VAR31	APR-JUN GAL MEAN FASTEST WIND	0.97313	0.94699	0.26106	-0.36430	-0.8771301	-0.41710
VAR97	JUN FRE HI TIDE	0.99091	0.98190	0.03491	0.21790	-6.231857	-0.36714
VAR29	APR-JUN FRE DAYS GT 90 F	0.99784	0.99568	0.01378	-0.50693	0.4800759	0.36132
XE19	EXP TOT EFF 19	0.99852	0.99705	0.00137	0.71776	0.9283759E-02	0.06174
(CONSTANT)						61.16686	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 211. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR91	OCT GAL FASTEST WIND	0.87988	0.77419	0.77419	0.87988	0.7168820E-01	0.84019
VAR88	JUL GAL FASTEST WIND	0.93789	0.87964	0.10546	-0.50412	-0.2408448E-01	-0.33608
VAR97	JUN FRE HI TIDE	0.97191	0.94462	0.06497	-0.12052	-0.3203223	-0.26767
VAR40	JAN NOS GAL MIN TEMP	0.99468	0.98940	0.04478	-0.32810	-0.6324479E-01	-0.20739
XE193	EXP TOT EFF 19 DPTH 3	0.99927	0.99854	0.00914	-0.10343	0.1757993E-02	0.10115
(CONSTANT)						1.895755	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 212. **Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	LAG ANNUAL ATCH DIS	0.76921	0.59168	0.59168	0.76921	1.322102	0.78510
VAR18	APR-JUN MISS DIS	0.91976	0.84596	0.25429	0.70676	2.444285	0.59012
WCE19	BAY CAT-TRIP 19	0.96946	0.93986	0.09389	0.30485	0.2761489	0.20115
VAR55	AUG POSTLARVAL CATCH-TOW	0.98377	0.96780	0.02794	0.15734	-0.2268376	-0.27795
VAR44	LAG OCT-DEC FRE PREC	0.99006	0.98021	0.01241	-0.20567	-2.434175	-0.14563
VAR20	OCT-DEC MISS DIS	0.99538	0.99078	0.01057	0.50094	-1.200861	-0.15517
(CONSTANT)						-139.3729	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 213. **Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR18	APR-JUN MISS DIS	0.85402	0.72935	0.72935	0.85402	1.503842	0.55838
VAR37	LAG ANNUAL MISS DIS	0.95018	0.90284	0.17350	0.72887	1.566469	0.52809
WCE19	BAY CAT-TRIP 19	0.97810	0.95668	0.05383	0.18962	0.2077124	0.23269
VAR53	JUN POSTLARVAL CAT-TOW	0.98228	0.96488	0.00820	0.56386	0.1400522	0.10460
(CONSTANT)						-241.1698	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 214. **Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR96	OCT GAL FAST WIND DIR	0.81276	0.66058	0.66058	-0.81276	-0.7859420	-0.64851
VAR91	OCT GAL FASTEST WIND	0.88045	0.77520	0.11462	0.48104	2.515666	0.69585
VAR64	JUL EKMAN ZONAL IND	0.96661	0.93433	0.15913	-0.24992	-0.3766051	-0.61335
VAR26	APR-JUN FRE PREC	0.98429	0.96882	0.03449	0.20849	-0.5843961	-0.22203
(CONSTANT)						27.82281	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 215. **Correlation matrix showing the simple bivariate Pearson product-moment correlation coefficients between all possible pairs of variables in the eighteen year (1960-1977) data set used to relate white shrimp total catch and interview catch/effort variables to environmental variables and indices of recruitment.**

(UNITS GIVEN IN TABLE 4)

	VAR1	VAR2	VAR68	CTEF18	CTEF19	CTEF193	VAR16	VAR18	VAR19	VAR20	VAR23	VAR24
VAR1	1.00000	0.47595	0.02852	0.78575	0.67861	0.08220	0.31568	0.32192	0.24151	0.24623	0.09712	0.19244
VAR2	0.47595	1.00000	-0.45911	0.56478	0.40435	-0.29268	0.34866	0.13662	0.43366	0.38548	0.16189	0.50996
VAR68	0.02852	-0.45911	1.00000	-0.14334	0.08196	0.47257	0.21263	-0.04083	-0.06407	-0.09807	-0.13071	0.05064
CTEF18	0.78575	0.56478	-0.14334	1.00000	0.69185	0.12168	0.40891	0.59860	0.27443	0.48267	0.22019	0.32637
CTEF19	0.67861	0.40435	0.08196	0.69185	1.00000	0.55891	0.48977	0.66383	0.42348	0.50055	0.58227	0.52115
CTEF193	0.08220	-0.29268	0.47257	0.12168	0.55891	1.00000	0.31932	0.45127	0.26288	0.39179	0.34689	0.06335
VAR16	0.31568	0.34866	0.21263	0.40891	0.48977	0.31932	1.00000	0.39806	0.55997	0.50759	0.37863	0.32400
VAR18	0.32192	0.13662	-0.04083	0.59860	0.66383	0.45127	0.39806	1.00000	0.45809	0.38763	0.56791	0.38643
VAR19	0.24151	0.43366	-0.06407	0.27443	0.42348	0.26288	0.55997	0.45809	1.00000	0.52702	0.33361	0.41795
VAR20	0.24623	0.38548	-0.09807	0.48267	0.50055	0.39179	0.50759	0.38763	0.52702	1.00000	0.11311	0.20608
VAR23	0.09712	0.16189	-0.13071	0.22019	0.58227	0.34689	0.37863	0.56791	0.33361	0.11311	1.00000	0.47411
VAR24	0.19244	0.50996	0.05064	0.32637	0.52115	0.06335	0.32400	0.38643	0.41795	0.20608	0.47411	1.00000
VAR25	0.58528	0.02331	0.26499	0.50095	0.75182	0.49307	0.34617	0.53512	0.21334	0.15717	0.48199	0.37449
VAR26	0.66999	0.12484	0.06515	0.57027	0.67541	0.33789	0.37994	0.49162	0.21807	0.11643	0.60327	0.09058
VAR30	0.12676	0.41840	-0.30434	0.05453	-0.20041	-0.50555	-0.18320	-0.32511	-0.30669	0.06088	-0.47480	-0.06732
VAR34	0.31316	0.65511	-0.34722	0.45698	0.30906	-0.06075	0.38472	0.09632	0.37583	0.73499	0.01875	0.24563
VAR39	0.03256	0.35489	-0.20551	-0.06121	0.18711	-0.03629	0.06798	0.05007	0.43555	-0.13084	0.49141	0.17549
VAR45	0.51429	0.09158	-0.13900	0.32675	0.26555	0.00020	0.40343	0.31913	0.13151	0.10813	0.32156	-0.09980
VAR47	0.39463	0.06115	0.55253	0.28282	0.22816	-0.02074	0.46920	0.07176	0.02444	0.16013	-0.14764	0.25096
VAR49	0.25105	-0.03988	0.07871	0.03029	0.51329	0.67332	0.05615	0.30190	0.40770	0.12052	0.33131	0.10944
VAR52	0.02388	0.62147	-0.41793	0.21279	0.24891	-0.10397	0.25389	0.19973	0.31784	0.02716	0.60753	0.36420
VAR76	-0.11214	0.54465	-0.72919	0.16889	-0.09900	-0.43688	-0.06992	0.00524	-0.12975	0.20684	-0.12012	0.06838
VAR80	0.12486	0.46374	-0.35195	0.28673	0.38821	-0.07747	0.24442	0.49504	0.39897	0.05824	0.71603	0.60393
VAR84	-0.17437	0.16738	0.00416	-0.11896	0.20055	0.24775	0.32258	0.28619	0.45860	0.22970	0.42173	0.12598
VAR85	0.08932	0.06437	0.23709	-0.02551	0.52519	0.64768	0.34496	0.15089	0.35868	0.39933	0.48444	0.18491
VAR86	0.44233	0.04490	0.06789	0.24906	0.52301	0.42099	0.53315	0.31525	0.34051	0.36232	0.33235	-0.11913
VAR90	0.16425	-0.19765	0.22683	0.29066	0.49348	0.75327	0.02215	0.34682	0.07435	0.29028	0.11534	-0.01645
VAR91	-0.02462	-0.19981	0.37464	-0.01648	0.08350	0.09620	0.25709	0.30680	0.35768	0.10553	0.03036	0.14273
VAR92	0.09217	0.14140	0.21145	0.12995	0.20604	0.21403	0.24970	0.06868	0.18305	0.39404	-0.27214	0.16215
VAR93	-0.40782	-0.25016	-0.23459	-0.26054	-0.47506	-0.18363	-0.05620	-0.37729	-0.23637	-0.20300	0.08307	-0.32975
VAR95	-0.05273	-0.24001	-0.18366	0.02495	0.05111	0.23508	-0.19204	0.04007	0.19592	0.17064	0.05153	-0.14399
VAR96	-0.46505	0.02879	-0.33874	-0.33444	-0.16244	-0.21665	-0.12844	-0.16406	-0.00024	-0.27972	0.37204	0.21829
VAR97	0.12985	0.60102	-0.30751	0.26023	0.23908	-0.18573	0.67313	0.23233	0.59129	0.39873	0.50949	0.38195
VAR98	0.12179	0.64797	-0.51896	0.23554	0.19456	0.00171	0.38305	-0.04263	0.51489	0.59713	0.17732	0.08177
VAR99	0.39261	0.55122	-0.25923	0.43521	0.38436	-0.02312	0.46680	0.10230	0.28630	0.64914	0.11996	-0.00707
VAR100	0.20443	0.35927	-0.07433	0.35970	0.31150	0.44224	0.18829	0.19557	0.27056	0.58933	-0.04994	0.36250
WCE18	0.28736	-0.16757	0.42084	0.20483	0.07343	0.11504	0.20398	0.25549	0.14134	-0.23735	-0.05384	0.05050
WCE19	0.27426	-0.15106	0.67665	0.13041	0.06827	0.02161	0.26468	-0.00833	-0.01506	-0.16530	-0.17516	0.11564
WCEL19	0.16157	-0.32340	0.32492	-0.00952	0.35751	0.74030	0.02330	0.25922	0.27980	0.03774	0.14216	-0.04051
XE18	-0.03385	0.72658	-0.25982	0.00989	0.17281	-0.13873	0.24796	-0.17773	0.44686	0.28431	0.22747	0.58150
XE19	0.65189	0.04624	0.06239	0.31836	0.01218	-0.34390	-0.21488	-0.14546	-0.11841	-0.32450	-0.32080	-0.12133
XE193	0.38964	-0.14017	0.08988	0.30748	-0.08764	-0.14581	0.00314	0.03565	0.12190	-0.15627	-0.17634	-0.10487

Table 215 continued

	VAR25	VAR26	VAR30	VAR34	VAR39	VAR45	VAR47	VAR49	VAR52	VAR76	VAR80	VAR84
VAR1	0.58528	0.66999	0.12676	0.31316	0.03256	0.51429	0.39463	0.25105	0.02388	-0.11214	0.12486	-0.17437
VAR2	0.02331	0.12484	0.41840	0.65511	0.35489	0.09158	0.06115	-0.03988	0.62147	0.54465	0.46374	0.16738
VAR68	0.26499	0.06515	-0.30434	-0.34722	-0.20551	-0.13900	0.55253	0.07871	-0.41793	-0.72919	-0.35195	0.00416
CTEF18	0.50095	0.57027	0.05453	0.45698	-0.06121	0.32675	0.28282	0.03029	0.21279	0.16889	0.28673	-0.11896
CTEF19	0.75182	0.67541	-0.20041	0.30906	0.18711	0.26555	0.22816	0.51329	0.24891	-0.09900	0.38821	0.20055
CTEF193	0.49307	0.33789	-0.50555	-0.06075	-0.03629	0.00020	-0.02074	0.67332	-0.10597	-0.43688	-0.07747	0.24775
VAR16	0.34617	0.37994	-0.18320	0.38472	0.06798	0.40343	0.46920	0.05615	0.25389	-0.06992	0.24442	0.32258
VAR18	0.53512	0.49162	-0.32511	0.09632	0.05007	0.31913	0.07176	0.30190	0.19973	0.00524	0.49504	0.28619
VAR19	0.21334	0.21807	-0.30669	0.37583	0.43555	0.13151	0.02444	0.40770	0.31784	-0.12975	0.39897	0.45860
VAR20	0.15717	0.11643	0.06088	0.73499	-0.13084	0.10813	0.16013	0.12052	0.02716	0.20684	0.05824	0.22970
VAR23	0.48199	0.60327	-0.47480	0.01875	0.49141	0.32156	-0.14764	0.33131	0.60753	-0.12012	0.71603	0.42173
VAR24	0.37449	0.09058	-0.06732	0.24563	0.17549	-0.09980	0.25096	0.10944	0.36420	0.06838	0.60393	0.12598
VAR25	1.00000	0.76649	-0.50988	-0.09634	-0.12465	0.31106	0.31348	0.41897	-0.12003	-0.45987	0.20557	-0.02931
VAR26	0.76649	1.00000	-0.39473	-0.03367	0.15732	0.59029	0.15824	0.33944	0.22776	-0.38563	0.35677	0.20372
VAR30	-0.50988	-0.39473	1.00000	0.26232	-0.13393	0.00164	0.17314	-0.34920	0.07578	0.67248	-0.00973	-0.14169
VAR34	-0.09634	-0.03367	0.26232	1.00000	-0.00985	0.26442	-0.01380	-0.02299	0.18019	0.45961	0.11278	-0.02072
VAR39	-0.12465	0.15732	-0.13393	-0.00985	1.00000	-0.06879	-0.32870	0.28490	0.72737	-0.02883	0.46137	0.41351
VAR45	0.31106	0.59029	0.00164	0.26442	-0.06879	1.00000	0.13361	0.09852	0.03155	-0.03597	0.21550	-0.03284
VAR47	0.31348	0.15824	0.17314	-0.01380	-0.32870	0.13361	1.00000	-0.34200	-0.32024	-0.28170	-0.16713	-0.03437
VAR49	0.41897	0.33944	-0.34920	-0.02299	0.28490	0.09852	-0.34200	1.00000	0.07756	-0.32163	0.20799	0.25706
VAR52	-0.12003	0.22776	0.07578	0.18019	0.72737	0.03155	-0.32024	0.07756	1.00000	0.37302	0.73803	0.50545
VAR76	-0.45987	-0.38563	0.67248	0.45961	-0.02883	-0.03597	-0.28170	-0.32163	0.37302	1.00000	0.21770	-0.05157
VAR80	0.20557	0.35677	-0.00973	0.11278	0.46137	0.21550	-0.16713	0.20799	0.73803	0.21770	1.00000	0.44213
VAR84	-0.02931	0.20372	-0.14169	-0.02072	0.41351	-0.03284	-0.03437	0.25706	0.50545	-0.05157	0.44213	1.00000
VAR85	0.24477	0.32045	-0.23183	0.13263	0.35875	-0.00232	0.07772	0.55720	0.26264	-0.31729	0.13297	0.62596
VAR86	0.40504	0.61221	-0.18046	0.15834	0.07537	0.50998	0.28708	0.42799	0.03070	-0.27677	0.06022	0.48723
VAR90	0.43305	0.34652	-0.39489	-0.05917	-0.19125	-0.19177	-0.17005	0.56832	-0.11128	-0.25373	-0.10443	0.12501
VAR91	0.23353	0.00039	-0.48410	0.00734	0.00976	0.03483	0.21923	-0.08214	-0.32805	-0.35970	-0.08865	-0.06170
VAR92	0.16126	-0.12240	0.10092	0.17762	-0.34041	-0.33288	0.46339	0.13150	-0.25692	-0.03993	-0.15251	0.31565
VAR93	-0.38949	-0.08354	-0.19253	-0.02685	0.01684	0.06264	-0.31764	-0.27819	0.15661	-0.00277	-0.10540	-0.11532
VAR95	-0.04437	-0.02325	-0.38556	0.08673	0.13823	-0.17228	-0.30892	0.29801	-0.14313	-0.21055	-0.17960	-0.16954
VAR96	-0.26234	-0.22865	0.00975	-0.28891	0.51688	-0.39369	-0.25675	-0.06792	0.49150	0.17461	0.39081	0.16026
VAR97	0.11488	0.31654	0.00108	0.39713	0.32073	0.42094	0.14527	-0.21757	0.57454	0.24316	0.54611	0.40697
VAR98	-0.04811	0.09723	0.08623	0.69794	0.23447	0.14269	-0.31962	0.17808	0.44817	0.39169	0.26953	0.25367
VAR99	-0.07437	0.13780	0.31827	0.73820	0.25423	0.29246	0.21371	-0.09234	0.24351	0.33956	0.02638	0.12452
VAR100	0.03864	-0.11013	-0.00180	0.82531	-0.28036	0.14320	-0.08115	0.23575	-0.09210	0.26037	0.02080	-0.17213
WCE18	0.35497	0.27200	-0.13200	-0.56742	-0.09654	0.04718	0.54208	0.06772	-0.16386	-0.47463	0.03596	0.04686
WCE19	0.36855	0.21744	-0.10206	-0.41914	-0.22037	-0.08410	0.84153	-0.22049	-0.31784	-0.57133	-0.18475	0.01509
WCEL19	0.40311	0.25702	-0.37925	-0.28472	0.09330	-0.04787	-0.15936	0.88124	-0.15755	-0.51114	0.01073	0.12025
XE18	-0.20244	-0.21192	0.16293	0.54051	0.50492	-0.25369	-0.10347	0.06921	0.60523	0.32303	0.35477	0.31051
XE19	0.19566	0.26957	0.12623	-0.02153	-0.08173	0.34552	0.19220	0.01598	-0.30201	-0.25164	-0.12771	-0.58015
XE193	0.28313	0.32154	-0.34215	-0.04438	-0.25554	0.33154	0.10512	-0.00828	-0.33770	-0.43757	-0.10436	-0.45319

Table 215 continued

	VAR85	VAR86	VAR90	VAR91	VAR92	VAR93	VAR95	VAR96	VAR97	VAR98	VAR99	VAR100
VAR1	0.08932	0.44233	0.16425	-0.02462	0.09217	-0.40782	-0.05273	-0.46505	0.12985	0.12179	0.39261	0.20443
VAR2	0.06437	0.04490	-0.19765	-0.19981	0.14140	-0.25016	-0.24001	0.02879	0.60102	0.64797	0.55122	0.35927
VAR68	0.23709	0.06789	0.22683	0.37464	0.21145	-0.23459	-0.18366	-0.33874	-0.30751	-0.51896	-0.25923	-0.07433
CTEF18	-0.02551	0.24906	0.29066	-0.01648	0.12995	-0.26054	0.02495	-0.33444	0.26023	0.23554	0.43521	0.35970
CTEF19	0.52519	0.52301	0.49348	0.08350	0.20604	-0.47506	0.05111	-0.16244	0.23908	0.19456	0.38436	0.31150
CTEF193	0.64768	0.42099	0.75327	0.09620	0.21403	-0.18363	0.23508	-0.21665	-0.18573	0.00171	-0.02512	0.44224
VAR16	0.34496	0.53315	0.02215	0.25709	0.24970	-0.05620	-0.19204	-0.12844	0.67313	0.38305	0.46680	0.18829
VAR18	0.15089	0.31525	0.34682	0.30680	0.06868	-0.37729	0.04007	-0.16406	0.23233	-0.04263	0.10230	0.19557
VAR19	0.35868	0.34051	0.07435	0.35768	0.18305	-0.23637	0.19592	-0.00024	0.59129	0.51489	0.28630	0.27056
VAR20	0.39933	0.36232	0.29028	0.10553	0.39404	-0.20300	0.17064	-0.27972	0.39873	0.59713	0.64914	0.58933
VAR23	0.48444	0.33235	0.11534	0.03036	-0.27214	0.08307	0.05153	0.37204	0.50949	0.17732	0.11996	-0.04994
VAR24	0.18491	-0.11913	-0.01645	0.14273	0.16215	-0.32975	-0.14399	0.21829	0.38195	0.08177	-0.00707	0.36250
VAR25	0.24477	0.40504	0.43305	0.23353	0.16126	-0.38949	-0.04437	-0.26234	0.11488	-0.04811	-0.07437	0.03864
VAR26	0.32045	0.61221	0.34652	0.00039	-0.12240	-0.08354	-0.02325	-0.22865	0.31654	0.09723	0.13780	-0.11013
VAR30	-0.23183	-0.18046	-0.39489	-0.48410	0.10092	-0.19253	-0.38556	0.00975	0.00108	0.08623	0.31827	-0.00180
VAR34	0.13263	0.15834	-0.05917	0.00734	0.17762	-0.02685	0.08673	-0.28891	0.39713	0.69794	0.73820	0.82531
VAR39	0.35875	0.07537	-0.19125	0.00976	-0.34041	0.01684	0.13823	0.51688	0.32073	0.23447	0.25423	-0.28036
VAR45	-0.00232	0.50998	-0.19177	0.03483	-0.33288	0.06264	-0.17228	-0.39369	0.42094	0.14269	0.29246	0.14320
VAR47	0.07772	0.28708	-0.17005	0.21923	0.46339	-0.31764	-0.30892	-0.25675	0.14527	-0.31962	0.21371	-0.08115
VAR49	0.55720	0.42799	0.56832	-0.08214	0.13150	-0.27819	0.29801	-0.06792	-0.21757	0.17808	-0.09234	0.23575
VAR52	0.26264	0.03070	-0.11128	-0.32805	-0.25692	0.15661	-0.14313	0.49150	0.57454	0.44817	0.24351	-0.09210
VAR76	-0.31729	-0.27677	-0.25373	-0.35970	-0.03993	-0.00277	-0.21055	0.17461	0.24316	0.39169	0.33956	0.26037
VAR80	0.13297	0.06022	-0.10443	-0.08865	-0.15251	-0.10540	-0.17960	0.39081	0.54611	0.26953	0.02638	0.02080
VAR84	0.62596	0.48723	0.12501	-0.06170	0.31565	-0.11532	-0.16954	0.16026	0.40697	0.25367	0.12452	-0.17213
VAR85	1.00000	0.66331	0.39095	-0.20412	0.32853	-0.04326	0.21679	0.12784	0.13488	0.24449	0.33443	0.07398
VAR86	0.66331	1.00000	0.30230	-0.09870	0.36704	-0.04230	0.15919	-0.18997	0.21536	0.20108	0.43423	-0.01582
VAR90	0.39095	0.30230	1.00000	-0.11219	0.28214	-0.09488	0.37474	-0.23699	-0.3[illegible]777	-0.01488	-0.17765	0.40312
VAR91	-0.20412	-0.09870	-0.11219	1.00000	-0.07337	-0.35111	-0.04512	-0.26612	0.13386	-0.20983	-0.02357	0.11364
VAR92	0.32853	0.36704	0.28214	-0.07337	1.00000	-0.36945	-0.02243	-0.16506	-0.12770	0.13526	0.17520	0.18844
VAR93	-0.04326	-0.04230	-0.09488	-0.35111	-0.36945	1.00000	0.42368	0.39014	0.05684	0.11792	-0.06945	-0.06640
VAR95	0.21679	0.15919	0.37474	-0.04512	-0.02243	0.42368	1.00000	0.28160	-0.35579	0.02428	0.09401	0.20090
VAR96	0.12784	-0.18997	-0.23699	-0.26612	-0.16506	0.39014	0.28160	1.00000	0.16263	0.02402	-0.07172	-0.46995
VAR97	0.13488	0.21536	-0.39777	0.13386	-0.12770	0.05684	-0.35579	0.16263	1.00000	0.59455	0.42186	0.02727
VAR98	0.24449	0.20108	-0.01488	-0.20983	0.13526	0.11792	0.02428	0.02402	0.59455	1.00000	0.53045	0.36682
VAR99	0.33443	0.43423	-0.17765	-0.02357	0.17520	-0.06945	0.09401	-0.07172	0.42186	0.53045	1.00000	0.27870
VAR100	0.07398	-0.01582	0.40312	0.11364	0.18844	-0.06640	0.20090	-0.46995	0.02727	0.36682	0.27870	1.00000
WCE18	-0.04972	0.20098	0.02792	0.04378	0.31375	-0.20519	-0.08273	-0.04795	-0.12633	-0.44706	-0.31539	-0.49955
WCE19	0.01235	0.16884	-0.04574	0.21686	0.42851	-0.25849	-0.25925	-0.16532	-0.05234	-0.46322	-0.16506	-0.38265
WCEL19	0.44514	0.34867	0.62431	-0.04881	0.22178	-0.21321	0.37539	-0.05498	-0.42886	-0.07310	-0.25338	-0.07838
XE18	0.37293	-0.06492	-0.20246	-0.17959	0.14587	0.01536	-0.02849	0.36433	0.49544	0.61733	0.36962	0.34231
XE19	-0.43376	-0.03885	-0.12948	0.06509	-0.21502	-0.11828	0.07139	-0.36234	-0.27759	-0.24591	-0.06368	0.04397
XE193	-0.42284	-0.00211	0.05199	0.21232	-0.15268	0.22637	0.29007	-0.34211	-0.10648	-0.11186	-0.27006	0.14470

Table 215 continued

	WCE18	WCE19	WCEL19	XE18	XE19	XE193
VAR1	0.28736	0.27426	0.16157	-0.03385	0.65189	0.38964
VAR2	-0.16757	-0.15106	-0.32340	0.72658	0.04624	-0.14017
VAR68	0.42084	0.67665	0.32492	-0.25982	0.06239	0.08988
CTEF18	0.20483	0.13041	-0.00952	0.00989	0.31836	0.30748
CTEF19	0.07343	0.06827	0.35751	0.17281	0.01218	-0.08764
CTEF193	0.11504	0.02161	0.74030	-0.13873	-0.34390	-0.14581
VAR16	0.20398	0.26468	0.02330	0.24796	-0.21488	0.00314
VAR18	0.25549	-0.00833	0.25922	-0.17773	-0.14546	0.03565
VAR19	0.14134	-0.01506	0.27980	0.44686	-0.11841	0.12190
VAR20	-0.23735	-0.16530	0.03774	0.28431	-0.32450	-0.15627
VAR23	-0.05384	-0.17516	0.14216	0.22747	-0.32080	-0.17634
VAR24	0.05050	0.11564	-0.04051	0.58150	-0.12133	-0.10487
VAR25	0.35497	0.36855	0.40311	-0.20244	0.19566	0.28313
VAR26	0.27200	0.21744	0.25702	-0.21192	0.26957	0.32154
VAR30	-0.13200	-0.10206	-0.37925	0.16293	0.12623	-0.34215
VAR34	-0.56742	-0.41914	-0.28472	0.54051	-0.02153	-0.04438
VAR39	-0.09654	-0.22037	0.09330	0.50492	-0.08173	-0.25554
VAR45	0.04718	-0.08410	-0.04787	-0.25369	0.34552	0.33154
VAR47	0.54208	0.84153	-0.15936	-0.10347	0.19220	0.10512
VAR49	0.06772	-0.22049	0.88124	0.06921	0.01598	-0.00828
VAR52	-0.16386	-0.31784	-0.15755	0.60523	-0.30201	-0.33770
VAR76	-0.47463	-0.57133	-0.51114	0.32303	-0.25164	-0.43757
VAR80	0.03596	-0.18475	0.01073	0.35477	-0.12771	-0.10436
VAR84	0.04686	0.01509	0.12025	0.31051	-0.58015	-0.45319
VAR85	-0.04972	0.01235	0.44514	0.37293	-0.43376	-0.42284
VAR86	0.20098	0.16884	0.34867	-0.06492	-0.03885	-0.00211
VAR90	0.02792	-0.04574	0.62431	-0.20246	-0.12948	0.05199
VAR91	0.04378	0.21686	-0.04881	-0.17959	0.06509	0.21232
VAR92	0.31375	0.42851	0.22178	0.14587	-0.21502	-0.15268
VAR93	-0.20519	-0.25849	-0.21321	0.01536	-0.11828	0.22637
VAR95	-0.08273	-0.25925	0.37539	-0.02849	0.07139	0.29007
VAR96	-0.04795	-0.16532	-0.05498	0.36433	-0.36234	-0.34211
VAR97	-0.12633	-0.05234	-0.42886	0.49544	-0.27759	-0.10648
VAR98	-0.44706	-0.46322	-0.07310	0.61733	-0.24591	-0.11186
VAR99	-0.31539	-0.16506	-0.25338	0.36962	-0.06368	-0.27006
VAR100	-0.49955	-0.38265	-0.07838	0.34231	0.04397	0.14470
WCE18	1.00000	0.79529	0.38378	-0.38053	0.29828	0.39799
WCE19	0.79529	1.00000	0.06948	-0.25543	0.26516	0.28228
WCEL19	0.38378	0.06948	1.00000	-0.21233	0.06387	0.13321
XE18	-0.38053	-0.25543	-0.21233	1.00000	-0.31121	-0.37094
XE19	0.29828	0.26516	0.06387	-0.31121	1.00000	0.73325
XE193	0.39799	0.28228	0.13321	-0.37094	0.73325	1.00000

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 216. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR52	LAG ANNUAL ATCH DIS	0.62147	0.38622	0.38622	0.62147	0.9124007E-01	1.02188
VAR20	OCT-DEC MISS DIS	0.72263	0.52219	0.13597	0.38548	0.1963776	0.32842
VAR93	JUL GAL FAST WIND DIR	0.77522	0.60097	0.07878	-0.25016	-0.2572788E-01	-0.20470
VAR84	LAG OCT-DEC TRIN DIS	0.84207	0.70909	0.10812	0.16738	-0.3697756E-01	-0.59555
VAR92	JUN GAL FAST WIND DIR	0.88767	0.78795	0.07886	0.14140	0.3826196E-01	0.38340
VAR95	SEP GAL FAST WIND DIR	0.89705	0.80471	0.01675	-0.24001	-0.2384892E-01	-0.15543
(CONSTANT)						-2.526923	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 217. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.67426	0.45463	0.45463	0.67426	0.6262729	0.69423
VAR30	JUL-SEP FRE DAYS GT 90 F	0.79844	0.63751	0.18287	0.12676	0.2151817	0.42302
VAR84	LAG OCT-DEC TRIN DIS	0.86626	0.75040	0.11290	-0.22816	-0.2816857E-01	-0.44840
VAR49	LAG BAY CAT 19	0.88305	0.77978	0.02938	0.21244	0.1764662E-01	0.27613
VAR47	BAY CAT 19	0.91409	0.83557	0.05578	0.35518	0.2048253E-01	0.34609
VAR39	LAG ANNUAL TRIN DIS	0.93424	0.87280	0.03723	0.09078	0.8768947E-02	0.35352
VAR96	OCT GAL FAST WIND DIR	0.94558	0.89411	0.02131	-0.28851	-0.3685964E-01	-0.19553
(CONSTANT)						-7.036145	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 218. Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR76	BAY TRIPS 18	0.73539	0.54080	0.54080	-0.73539	-0.2837971	-0.88118
VAR47	BAY CAT 19	0.81562	0.66524	0.12444	0.57070	-0.5742787E-02	-0.40301
VAR45	APR-JUN TRIN DIS	0.86877	0.75477	0.08953	-0.24075	-0.5341583E-02	-0.53646
VAR98	JUL FRE HI TIDE	0.88954	0.79129	0.03652	-0.61440	-2.649555	-0.69575
VAR16	ANNUAL GUAD DIS	0.94309	0.88942	0.09814	0.19880	0.1921990E-01	0.82359
VAR30	JUL-SEP FRE DAYS GT 90 F	0.96945	0.93984	0.05041	-0.30267	0.6775724E-01	0.56139
VAR39	LAG ANNUAL TRIN DIS	0.98603	0.97225	0.03241	-0.18578	-0.1022130E-02	-0.17374
VAR20	OCT-DEC MISS DIS	0.99129	0.98266	0.01041	-0.12257	0.2199735E-01	0.14734
(CONSTANT)						16.08595	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 219. Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 18) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR2 TOT CAT 18 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 3)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
XE18	EXP TOT EFF 18	0.71487	0.51104	0.51104	0.71487	0.8417241E-01	0.43073
VAR97	JUN FRE HI TIDE	0.76928	0.59179	0.08075	0.60102	3.230297	0.25534
VAR93	JUL GAL FAST WIND DIR	0.82151	0.67488	0.08309	-0.26777	-0.3992710E-01	-0.32327
VAR52	LAG ANNUAL ATCH DIS	0.84289	0.71046	0.03558	0.61980	0.2303599E-01	0.26221
(CONSTANT)						-8.915727	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 220. Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. VAR1 TOT CAT 19 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.72958	0.53229	0.53229	0.72958	0.3708123	0.37584
XE19	EXP TOT EFF 19	0.86668	0.75113	0.21885	0.69334	0.1002345	0.76988
VAR30	JUL-SEP FRE DAYS GT 90 F	0.92661	0.85862	0.10748	0.15324	0.3856729	0.62234
VAR100	SEP FRE HI TIDE	0.94835	0.89937	0.04076	0.10157	1.094270	0.15503
VAR91	OCT GAL FASTEST WIND	0.95967	0.92096	0.02159	-0.08773	0.2373823	0.20639
VAR23	JUL-SEP TRIN DIS	0.96857	0.93812	0.01716	0.24320	0.1149218	0.49199
VAR49	LAG BAY CAT 19	0.97707	0.95466	0.01654	0.33401	-0.1956753E-01	-0.19755
(CONSTANT)						-42.39029	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 221. **Summary of results of final stepwise multiple regression analysis of white shrimp total catch (area 19, 11-15 fathom depths) with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. VAR68 TOT CAT 19 DPTH 3 (POUNDS, HEADS OFF) X 10^{-5}

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR76	BAY TRIPS 18	0.73539	0.54080	0.54080	-0.73539	-0.2665062	-0.82749
VAR47	BAY CAT 19	0.81562	0.66524	0.12444	0.57070	-0.6242474E-02	-0.43808
VAR45	APR-JUN TRIN DIS	0.86877	0.75477	0.08953	-0.24075	-0.6101660E-02	-0.61280
VAR98	JUL FRE HI TIDE	0.88954	0.79129	0.03652	-0.61440	-2.925421	-0.76819
VAR16	ANNUAL GUAD DIS	0.94309	0.88942	0.09814	0.19880	0.2085058E-01	0.89347
VAR30	JUL-SEP FRE DAYS GT 90 F	0.96945	0.93984	0.05041	-0.30267	0.7214201E-01	0.59772
VAR39	LAG ANNUAL TRIN DIS	0.98603	0.97225	0.03241	-0.18578	-0.7832831E-03	-0.13314
VAR20	OCT-DEC MISS DIS	0.99129	0.98266	0.01041	-0.12257	0.2813700E-01	0.18846
XE193	EXP TOT EFF 19 DPTH 3	0.99393	0.98789	0.00523	0.09410	0.5790499E-02	0.12243
(CONSTANT)						16.42840	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 222. **Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 18) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF18 CAT-EFF 18 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE (UNITS GIVEN IN TABLE 4)		MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR26	APR-JUN FRE PREC	0.64130	0.41127	0.41127	0.64130	7.452280	0.81779
VAR34	JUL-SEP FRE MEAN HI TIDE	0.80035	0.64056	0.22929	0.45698	104.8805	0.87964
VAR86	JAN-MAR GUAD DIS	0.88193	0.77780	0.13724	0.23870	-1.574755	-0.46780
WCE18	BAY CAT-TRIP 18	0.91907	0.84468	0.06688	0.16195	0.5263249	0.37293
VAR19	JUL-SEP MISS DIS	0.95119	0.90475	0.06007	0.23056	-5.329585	-0.35833
VAR18	APR-JUN MISS DIS	0.97282	0.94637	0.04162	0.58725	0.9439631	0.26194
(CONSTANT)						-501.6171	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 223. Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

DEPENDENT VARIABLE.. CTEF19 CAT-EFF 19 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR25	ANNUAL FRE PREC	0.76429	0.58414	0.58414	0.76429	2.445905	0.60997
VAR99	AUG FRE HI TIDE	0.88311	0.77989	0.19575	0.38436	37.98105	0.45625
VAR24	OCT-DEC TRIN DIS	0.90916	0.82658	0.04669	0.52833	0.1517112	0.27860
WCE19	BAY CAT-TRIP 19	0.92725	0.85979	0.03321	0.06515	-0.1615349	-0.28228
VAR98	JUL FRE HI TIDE	0.93654	0.87710	0.01731	0.19456	-25.13577	-0.19409
VAR26	APR-JUN FRE PREC	0.94623	0.89534	0.01824	0.70498	1.803385	0.23085
(CONSTANT)						-114.7661	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

Table 224. **Summary of results of final stepwise multiple regression analysis of white shrimp interview catch/effort (area 19, 11-15 fathom depths) with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

DEPENDENT VARIABLE.. CTEF193 CAT-EFF 19 DPTH 3 (POUNDS, HEADS OFF/DAY)

SUMMARY TABLE

VARIABLE	(UNITS GIVEN IN TABLE 4)	MULTIPLE R	R SQUARE	RSQ CHANGE	SIMPLE R	B	BETA
VAR90	SEP GALIFASTEST WIND	0.75327	0.56741	0.56741	0.75327	0.8194709	0.23925
VAR85	LAG OCT-DEC GUAD DIS	0.84537	0.71466	0.14725	0.64768	0.5609975	0.39320
WCEL19	LAG BAY CAT-TRIP 19	0.88108	0.77630	0.06164	0.74030	0.1607949	0.32333
VAR18	APR-JUN MISS DIS	0.89974	0.80954	0.03324	0.45127	0.9919732	0.36922
VAR80	JAN-MAR MISS DIS	0.92920	0.86341	0.05387	-0.07747	-0.9336888	-0.29101
(CONSTANT)						-32.85163	

SEE TABLES 6 AND 2 FOR REFERENCE NUMBER AND VARIABLE NAME, RESPECTIVELY.

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7.0 FIGURES

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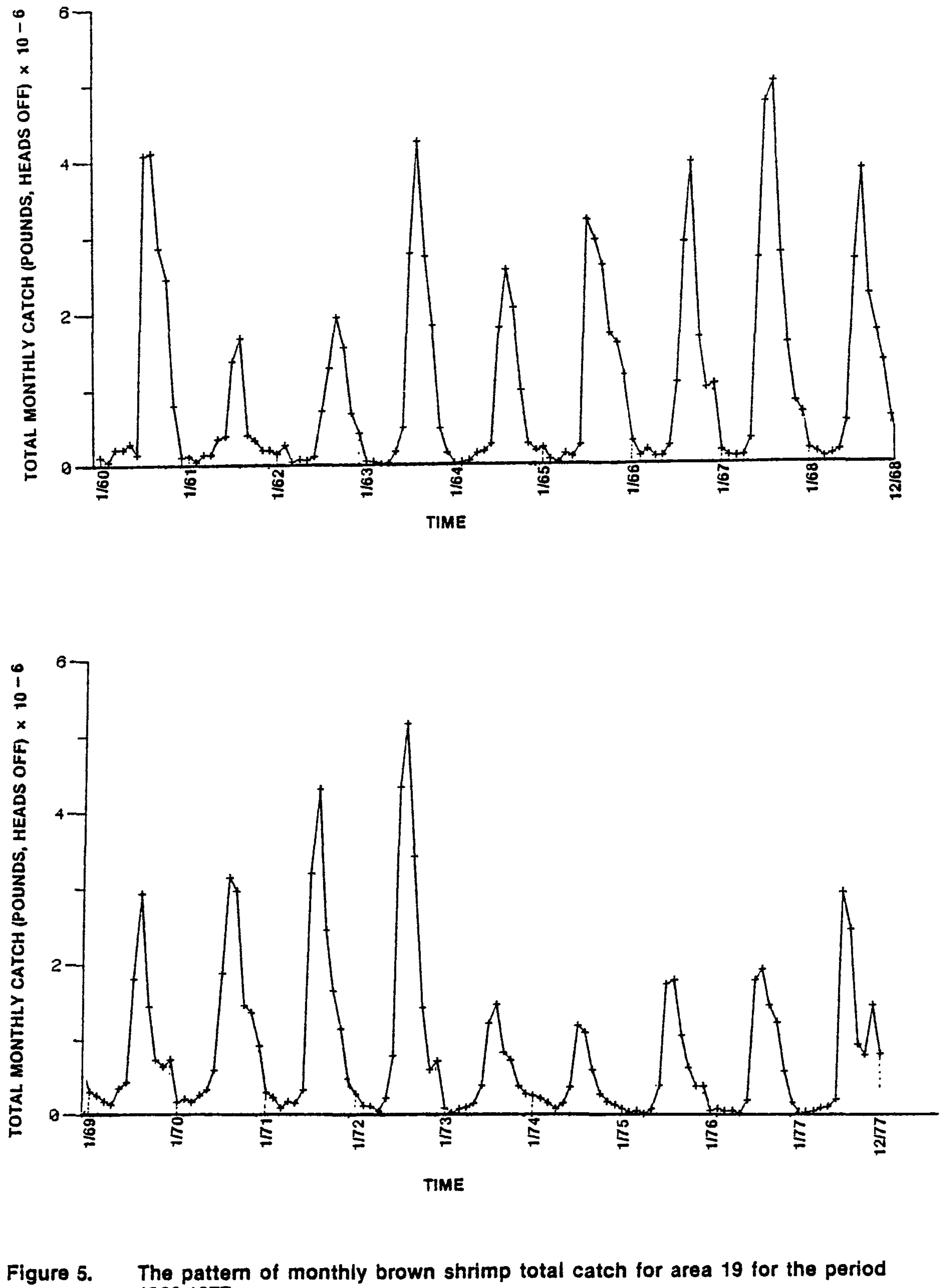
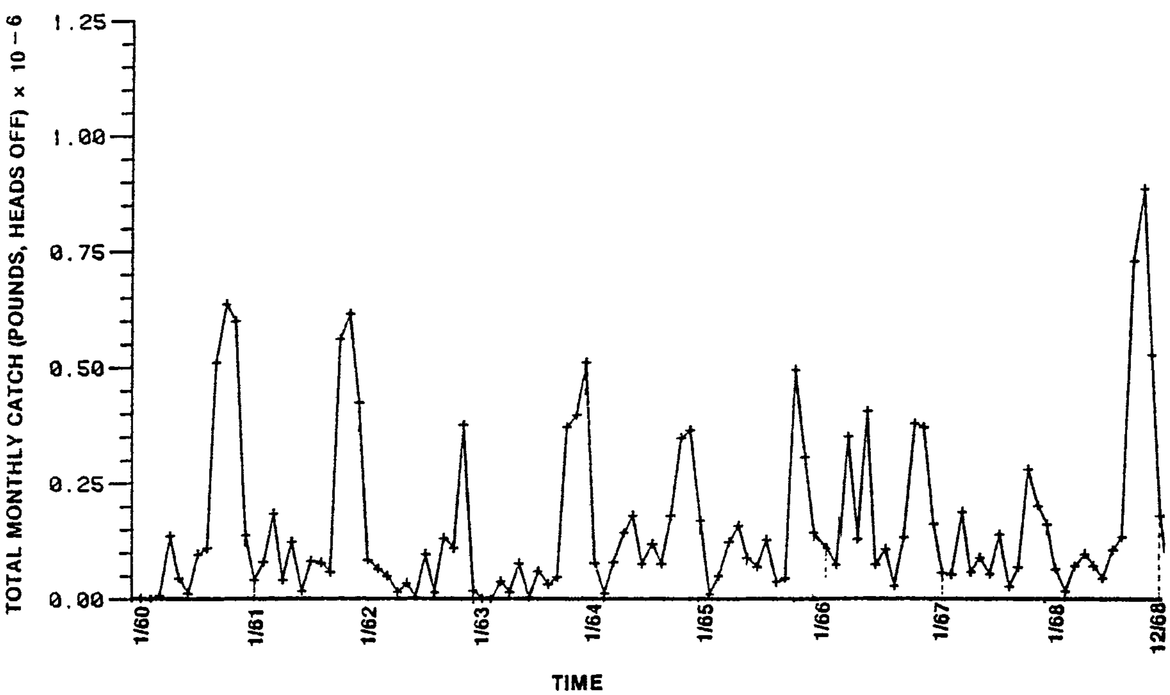


Figure 5. The pattern of monthly brown shrimp total catch for area 19 for the period 1960-1977.



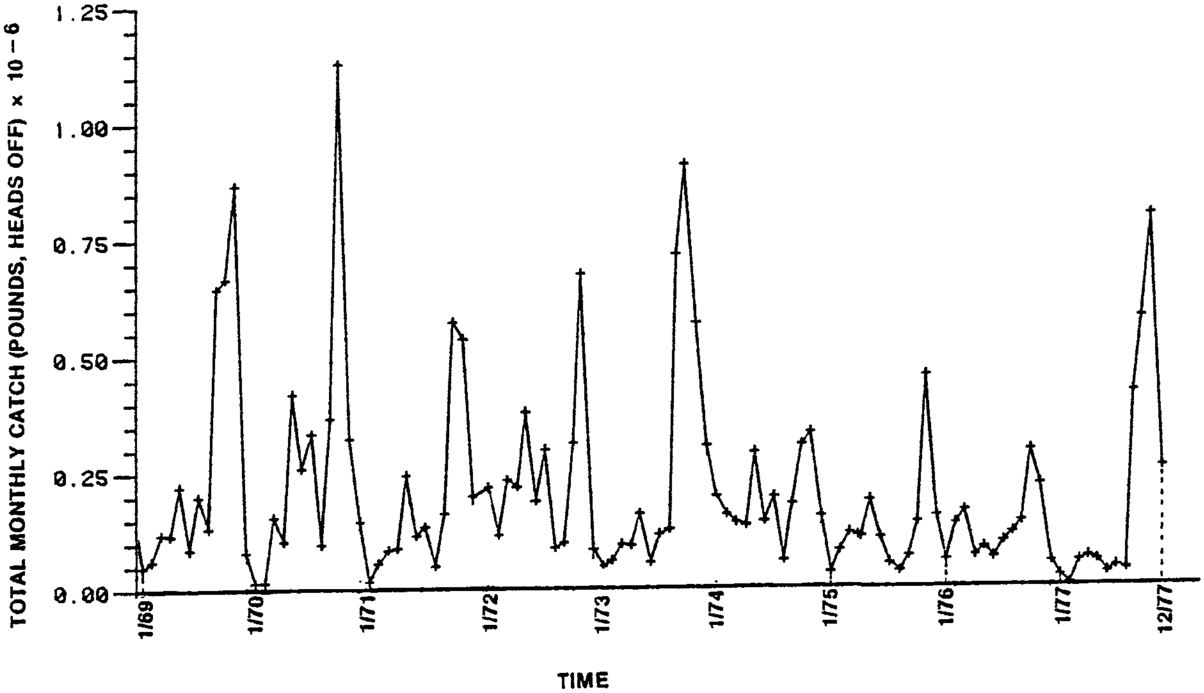
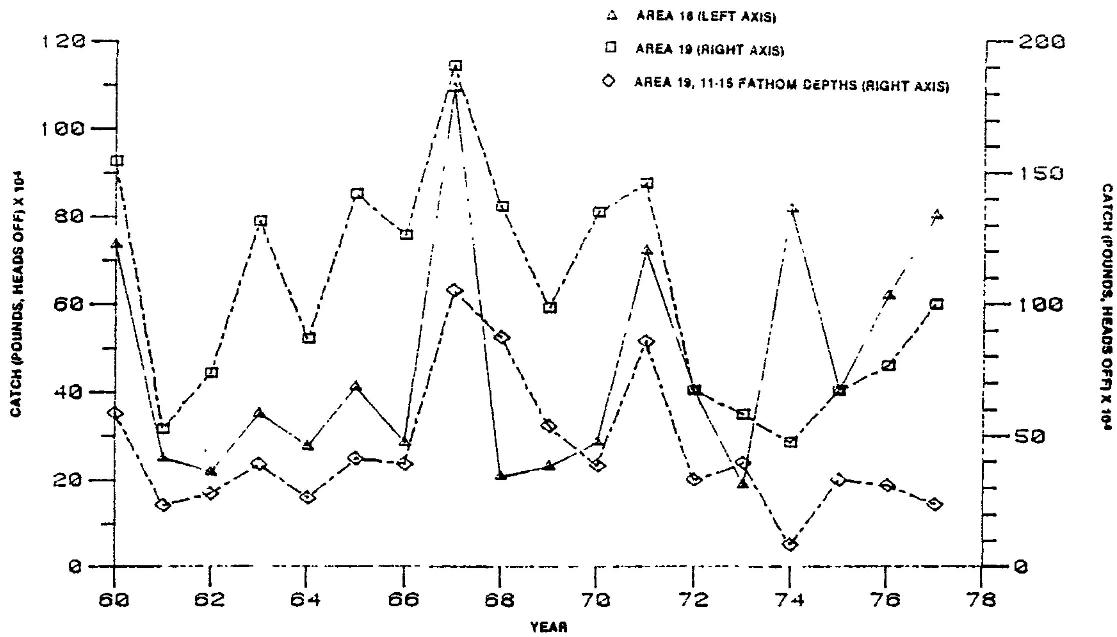


Figure 6. The pattern of monthly white shrimp total catch for area 19 for the period 1960-1977.



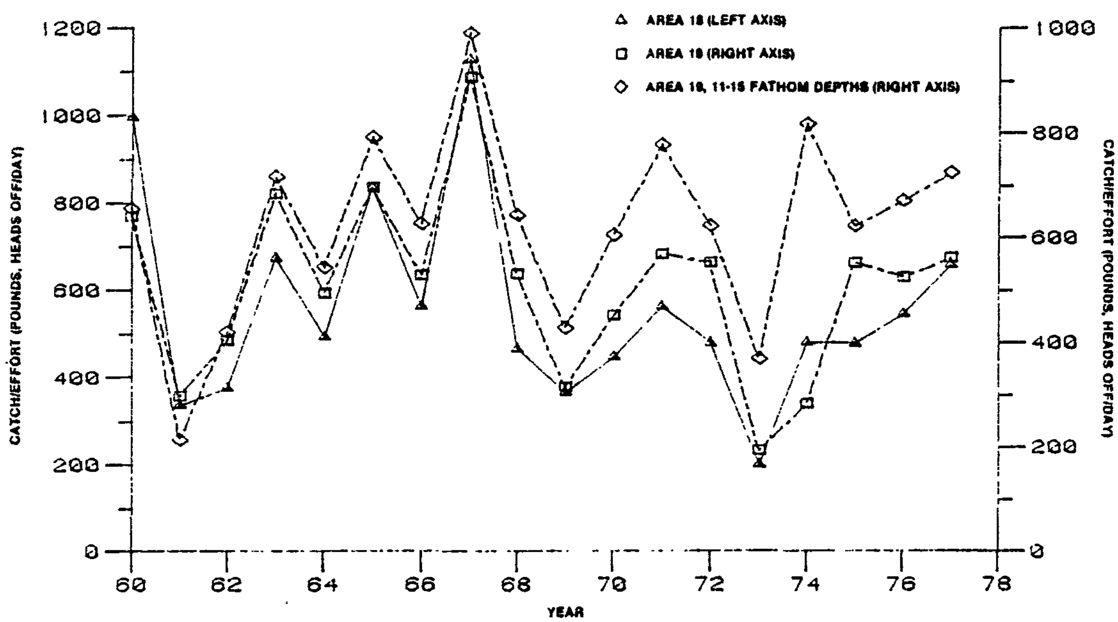
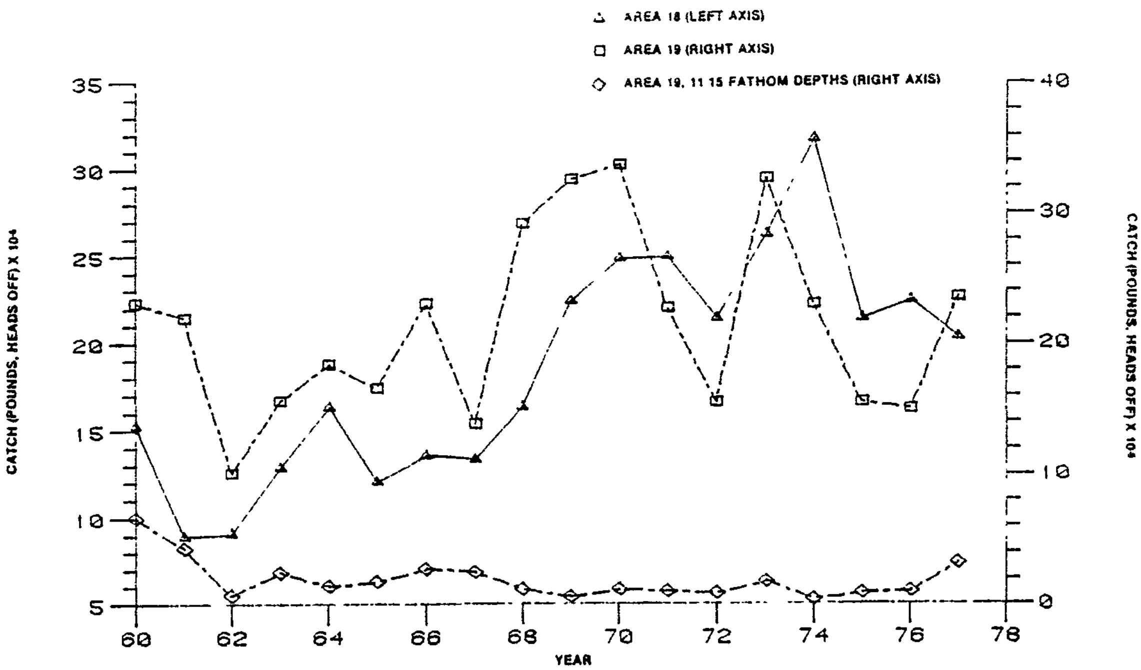


Figure 7. The pattern of (a) annual brown shrimp total catch and (b) annual brown shrimp interview catch/effort for area 18, area 19, and area 19, 11-15 fathom depths for the period 1960-1977.



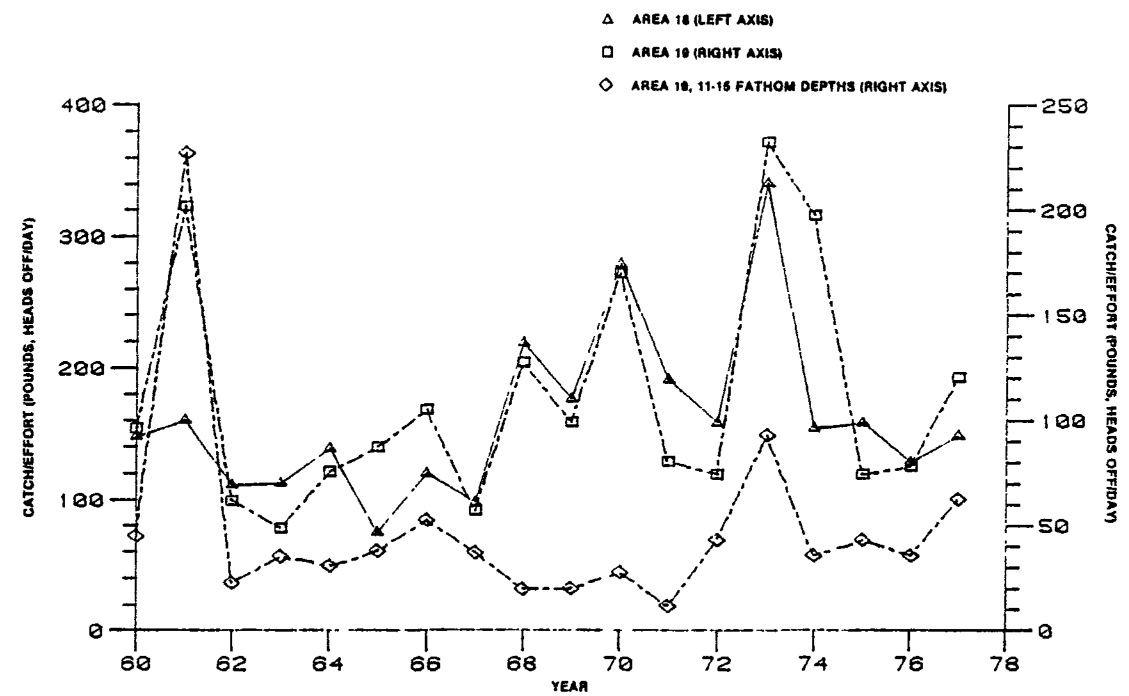


Figure 8. The pattern of (a) annual white shrimp total catch and (b) annual white shrimp interview catch/effort for area 18, area 19, and area 19, 11-15 fathom depths for the period 1960-1977.

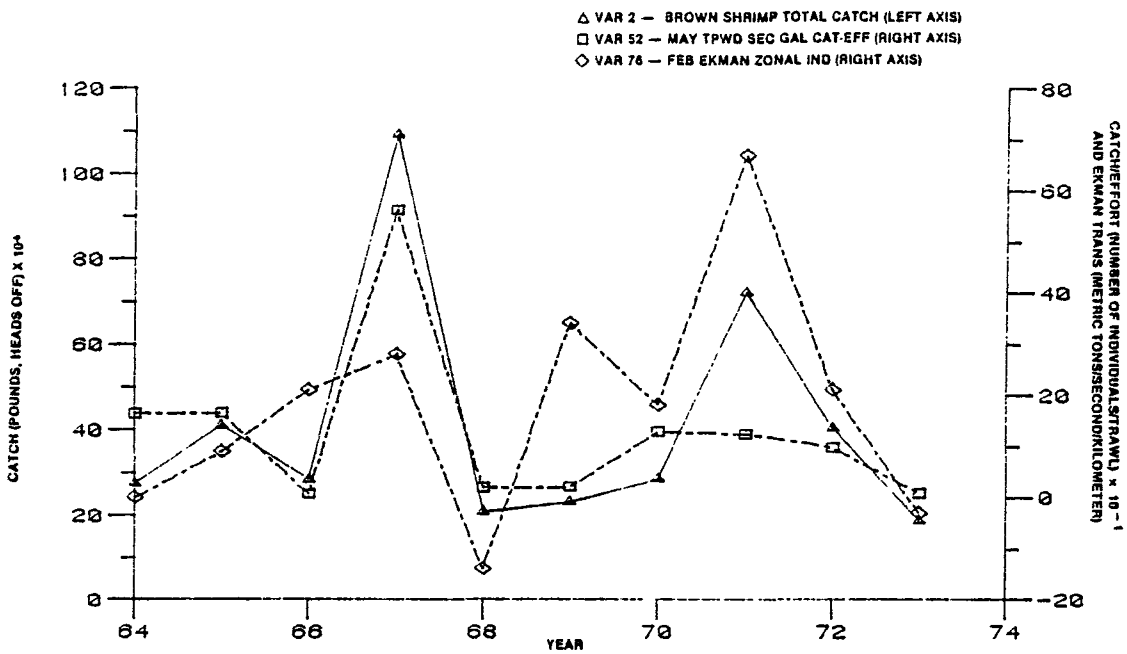


Figure 9. Plot of brown shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

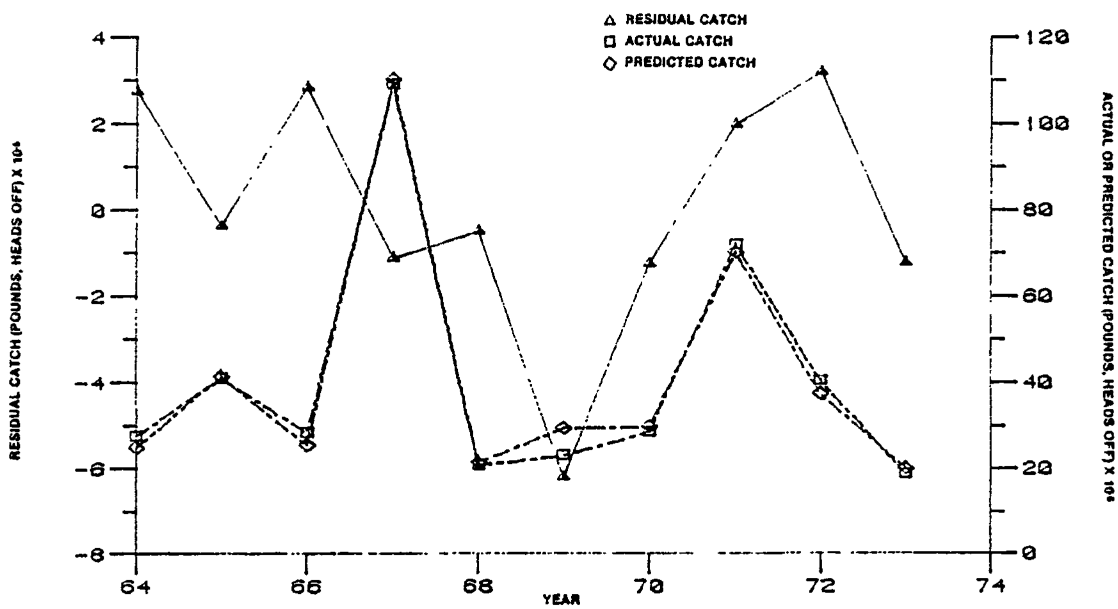


Figure 10. Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

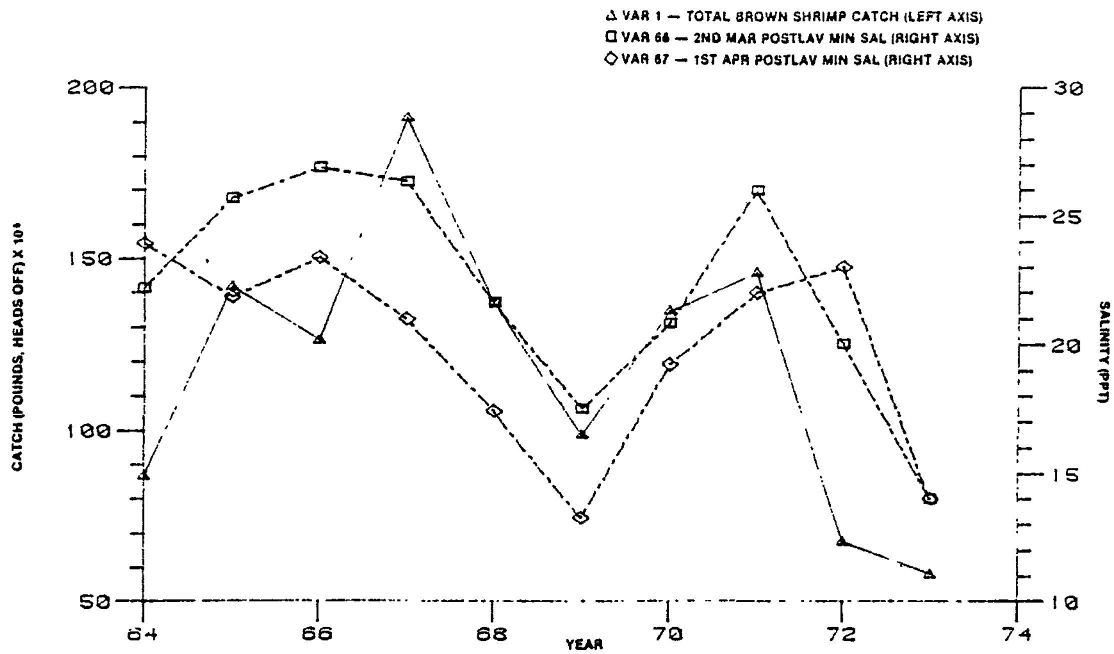


Figure 11. Plot of brown shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

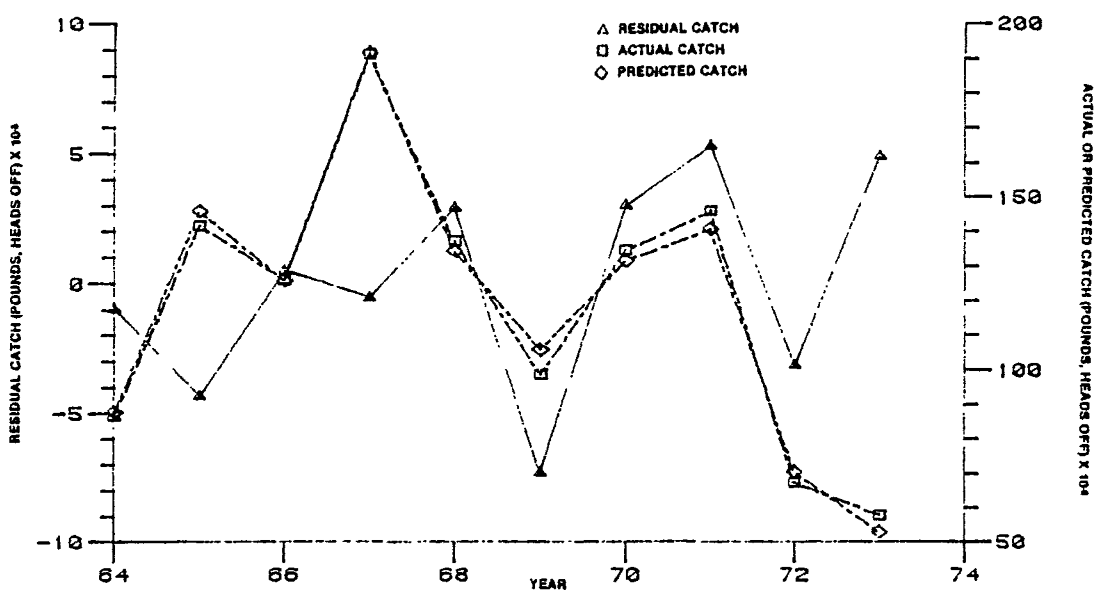


Figure 12. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

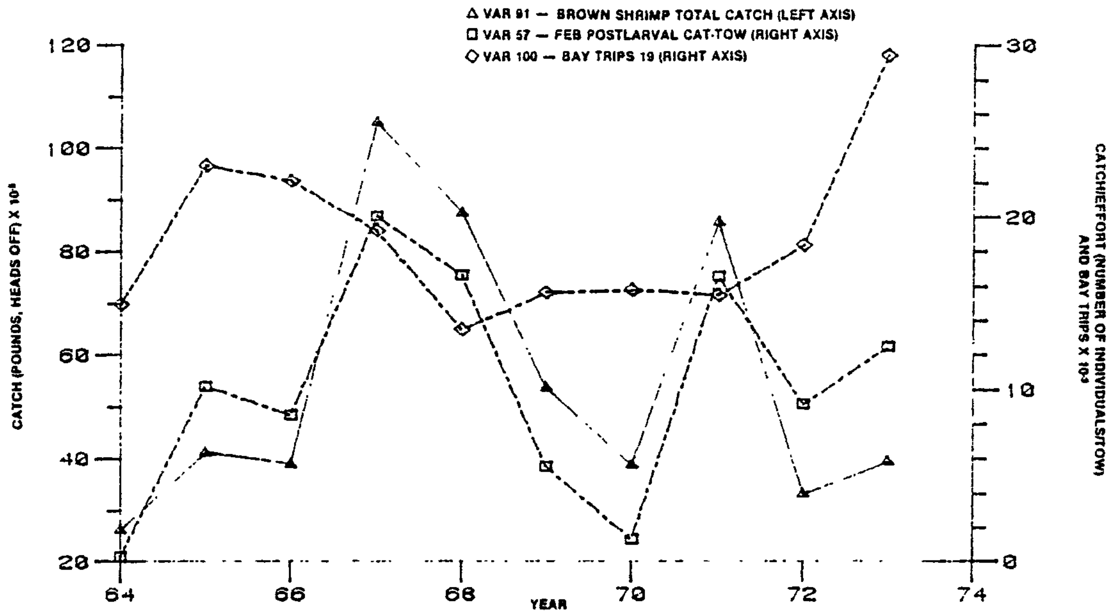


Figure 13. Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

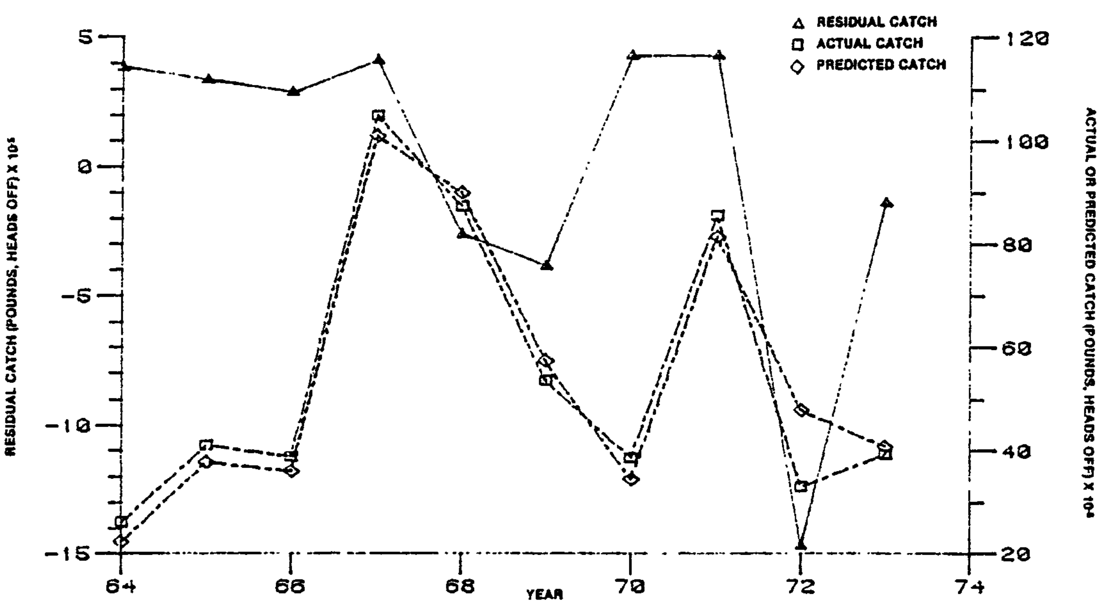


Figure 14. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

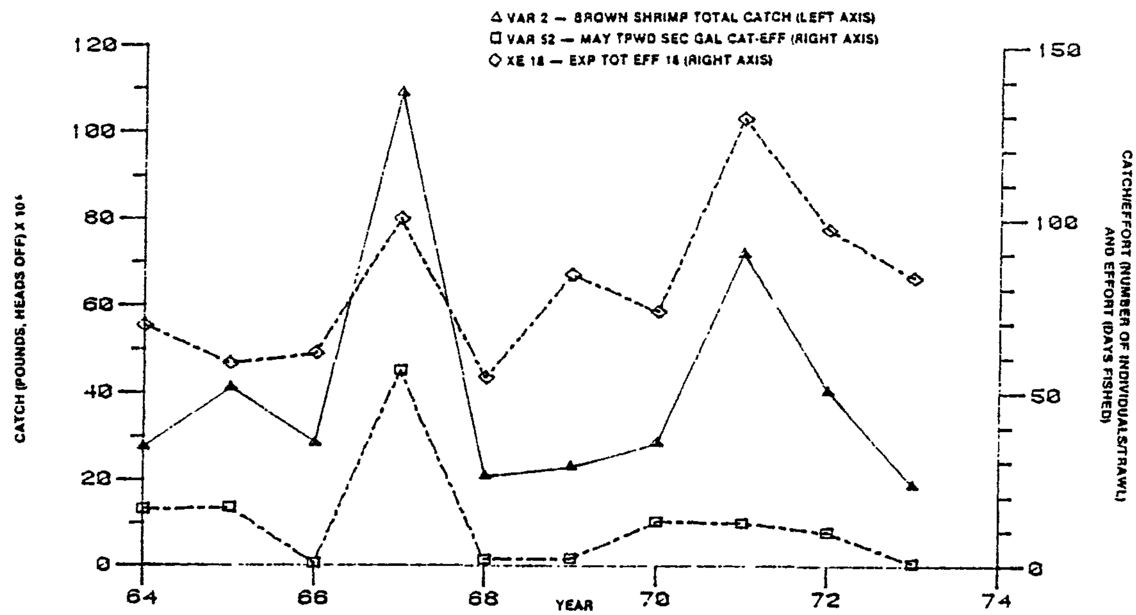


Figure 15. Plot of brown shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the ten year (1964-1973) data set.

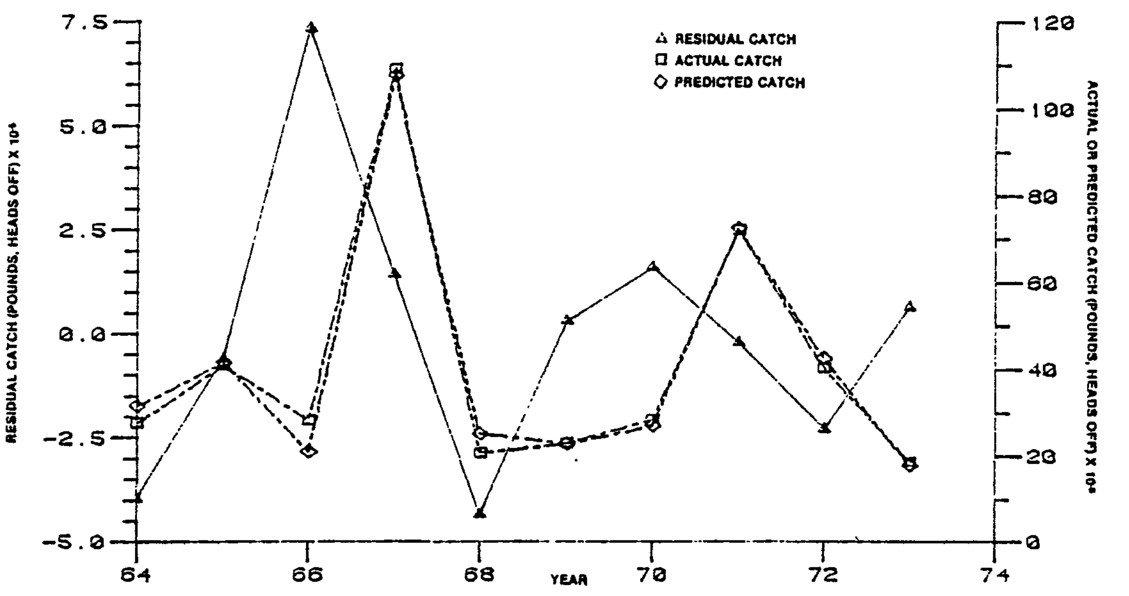


Figure 16. Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.

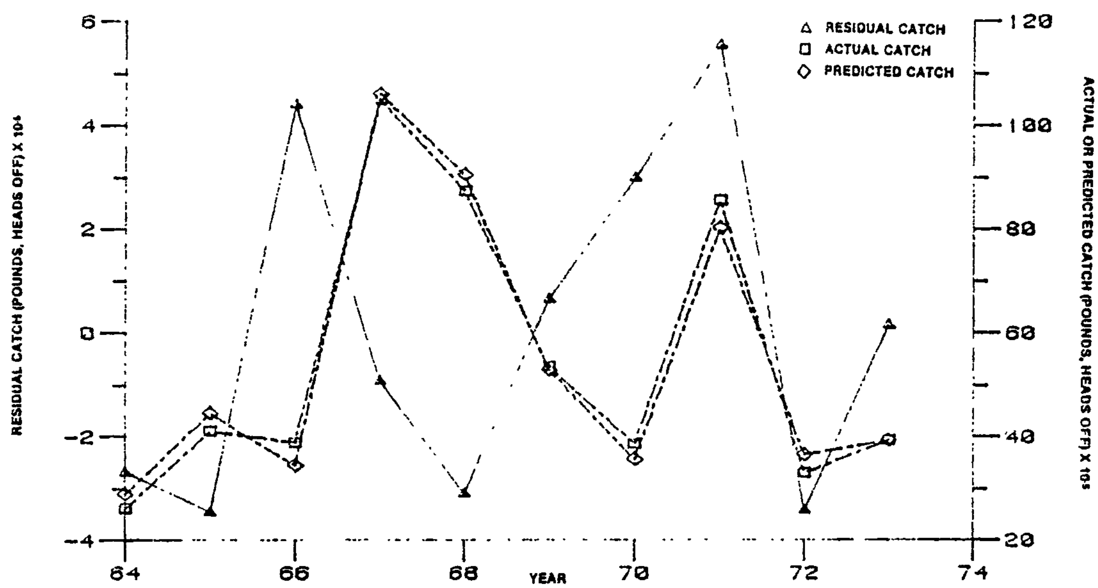


Figure 17. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the ten year (1964-1973) data set.

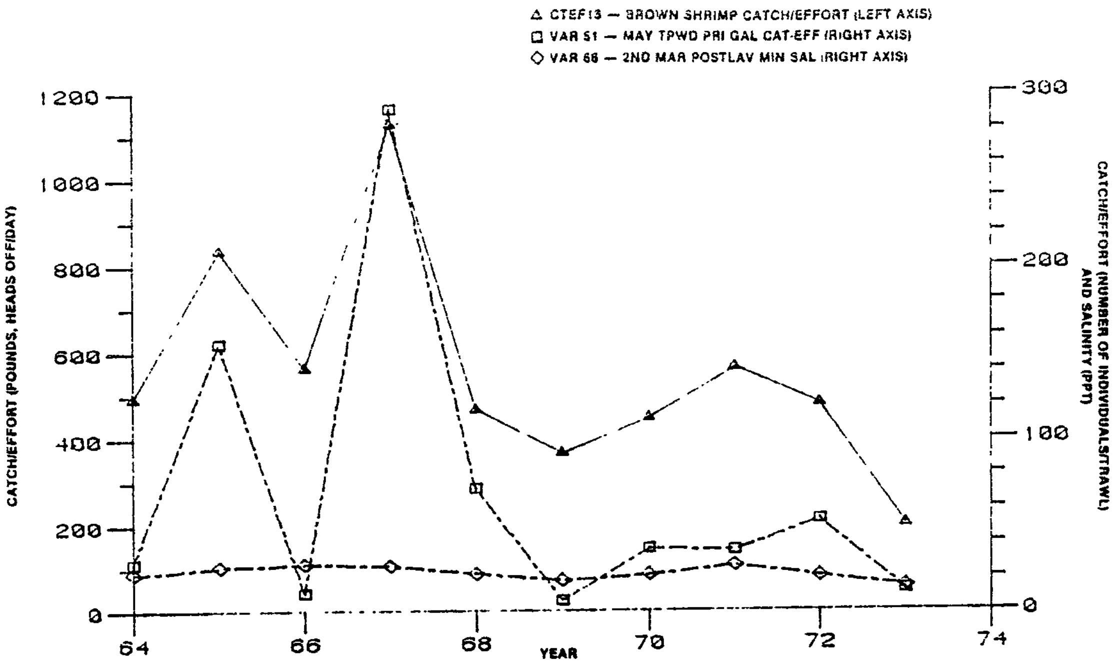


Figure 18. Plot of brown shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

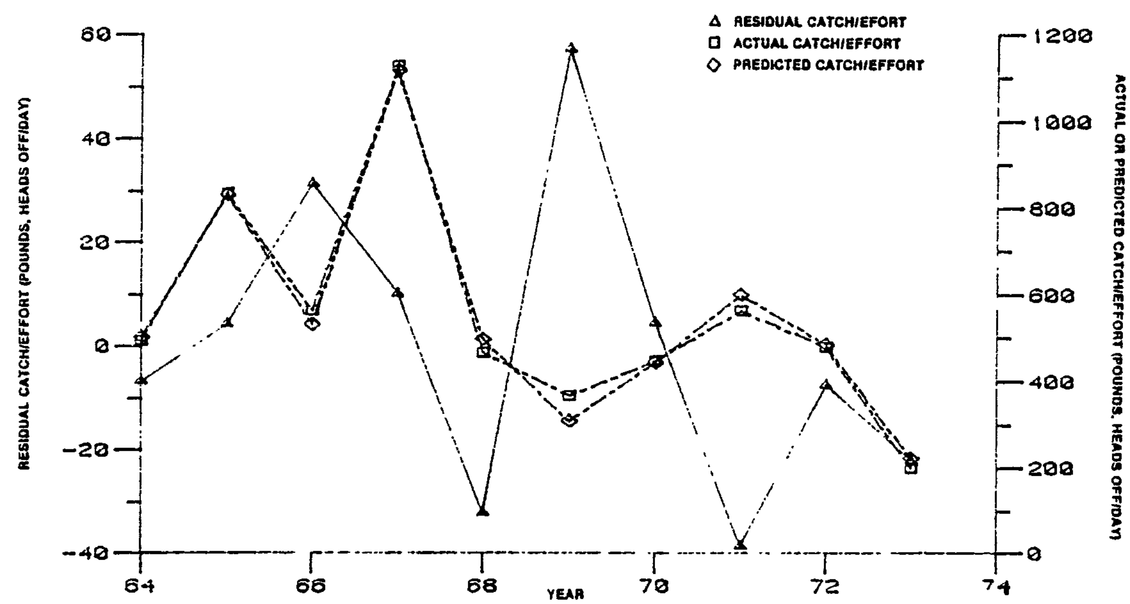


Figure 19. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

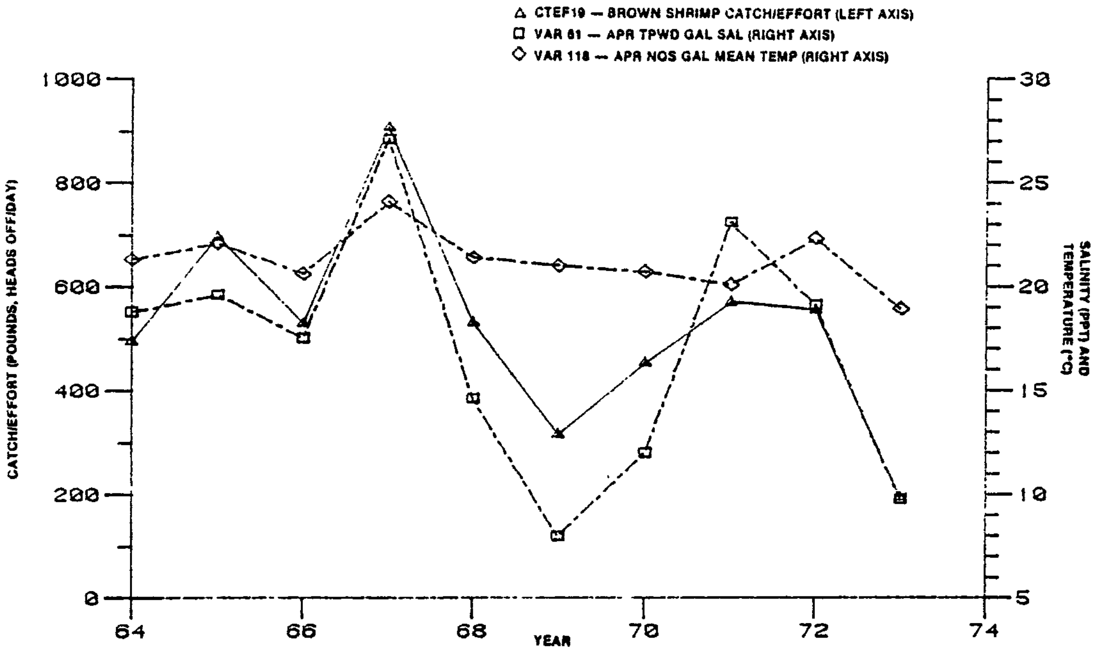


Figure 20. Plot of brown shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1963-1974) data set.

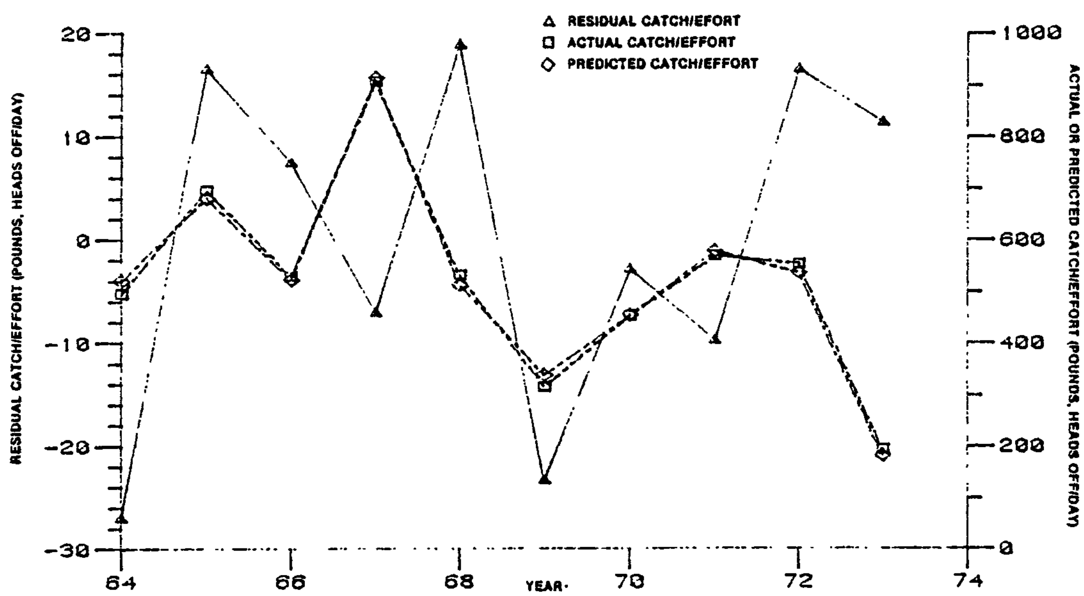


Figure 21. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

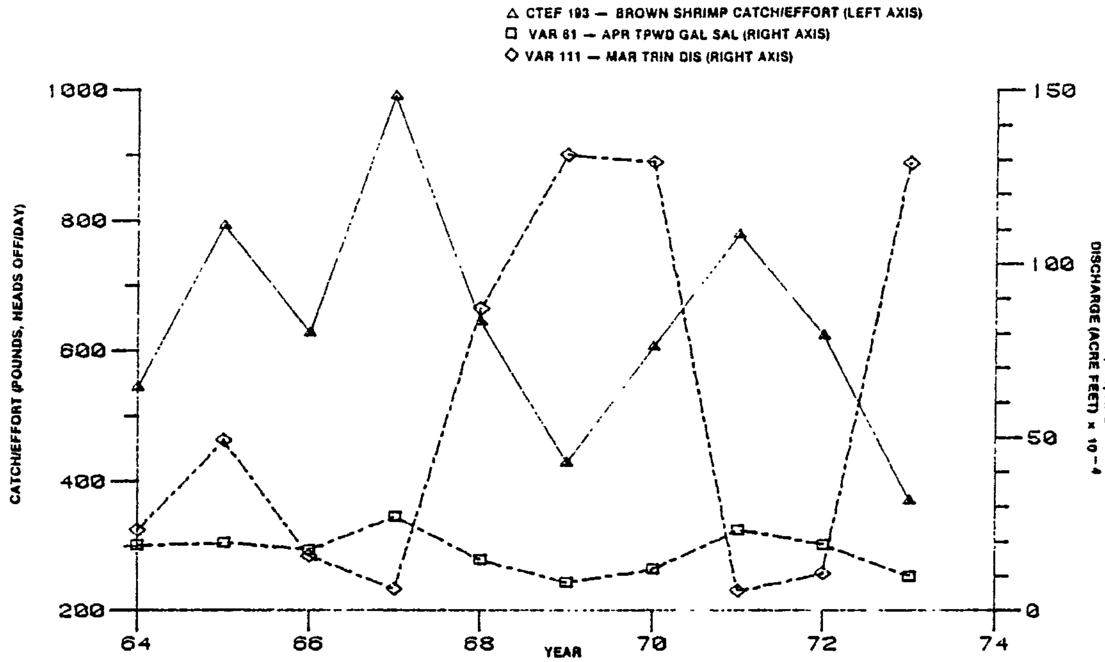


Figure 22. Plot of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1963-1974) data set.

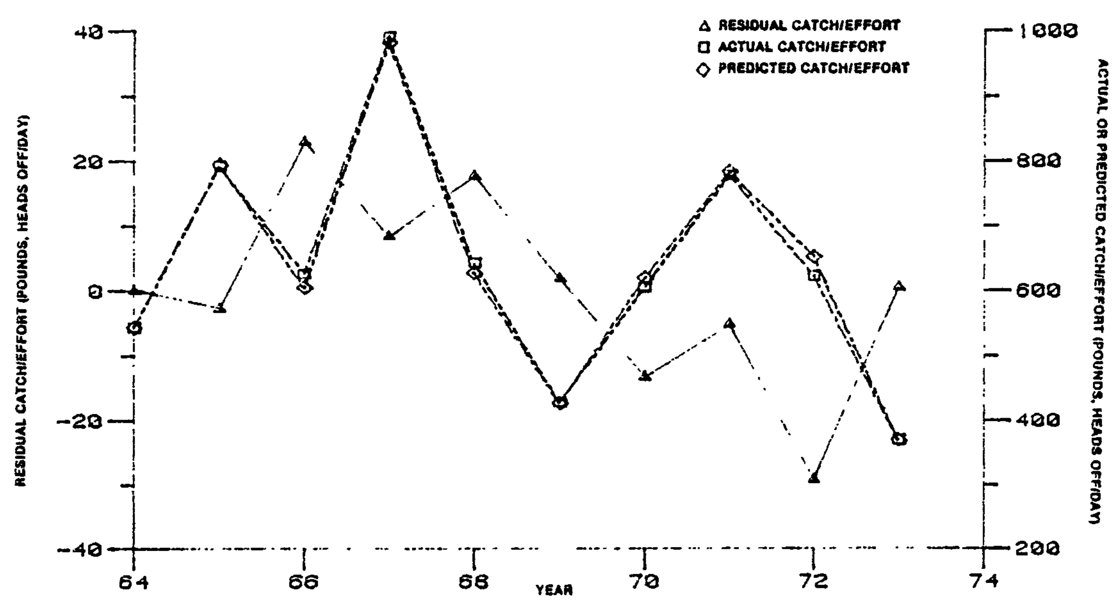


Figure 23. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

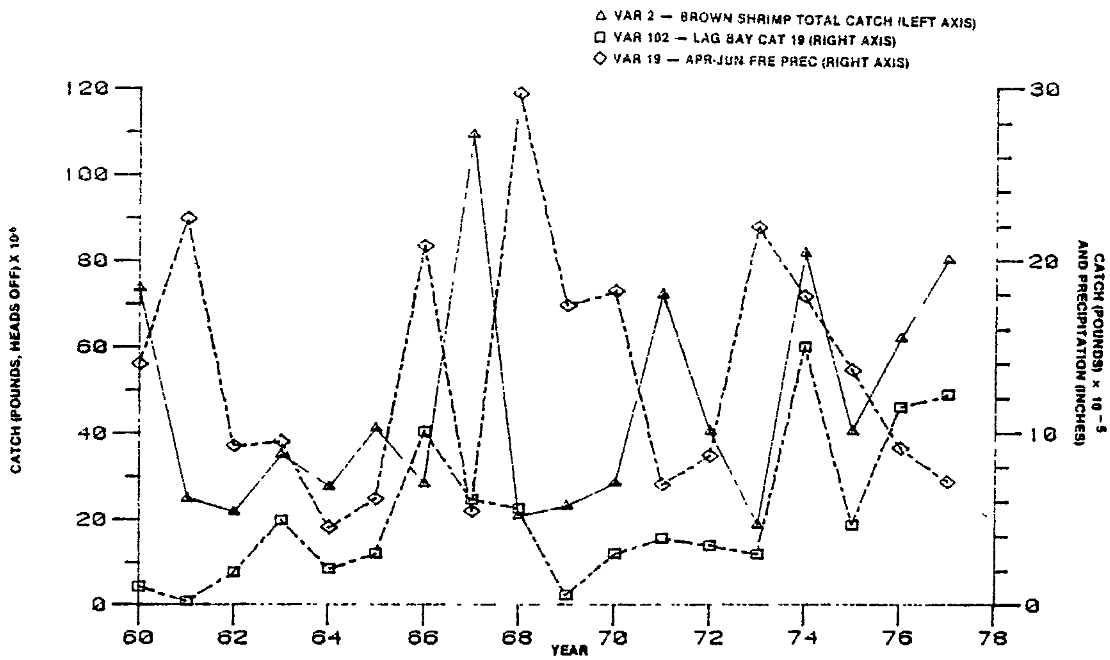


Figure 24. Plot of brown shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

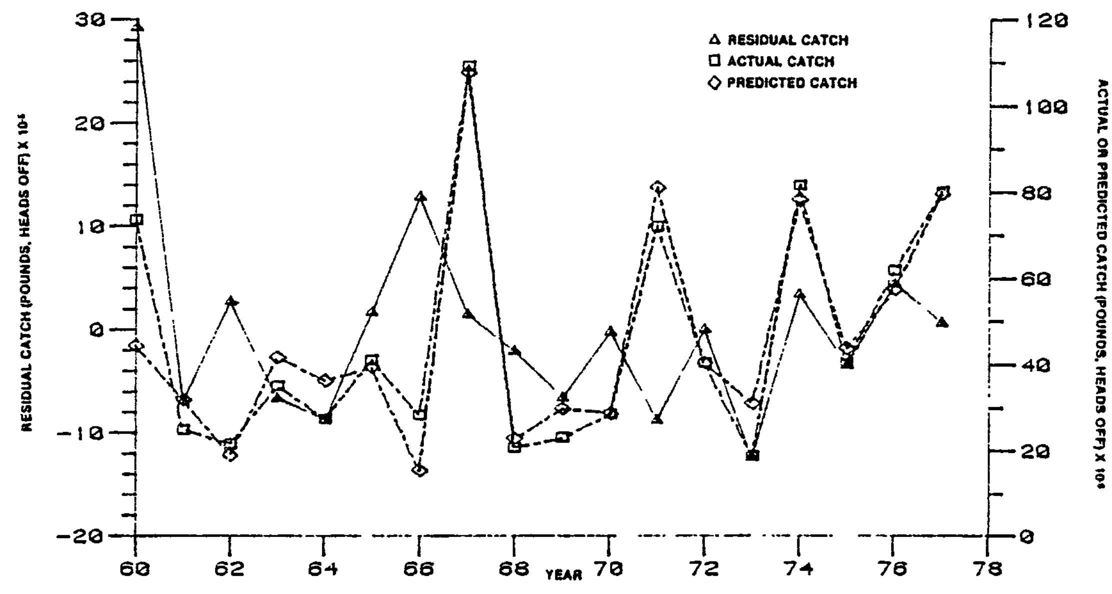


Figure 25. Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

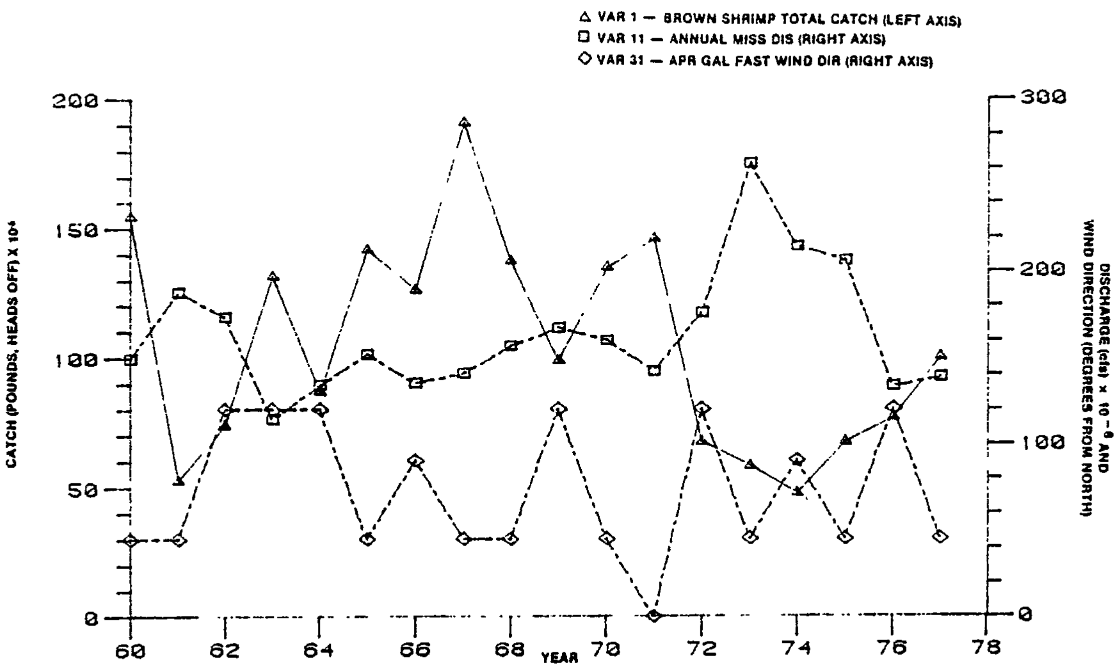


Figure 26. Plot of brown shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

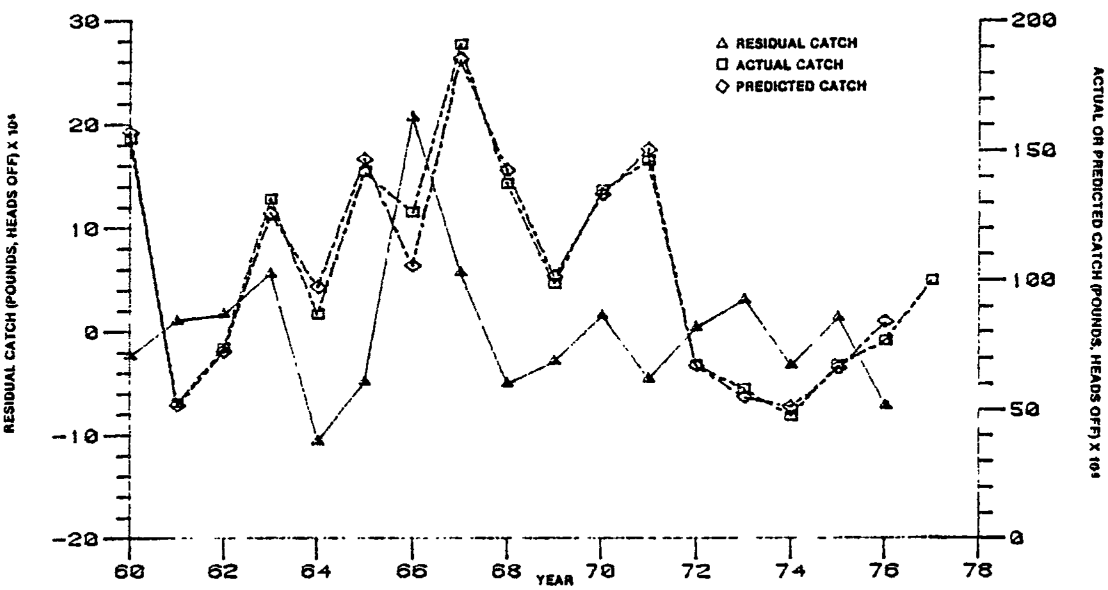


Figure 27. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

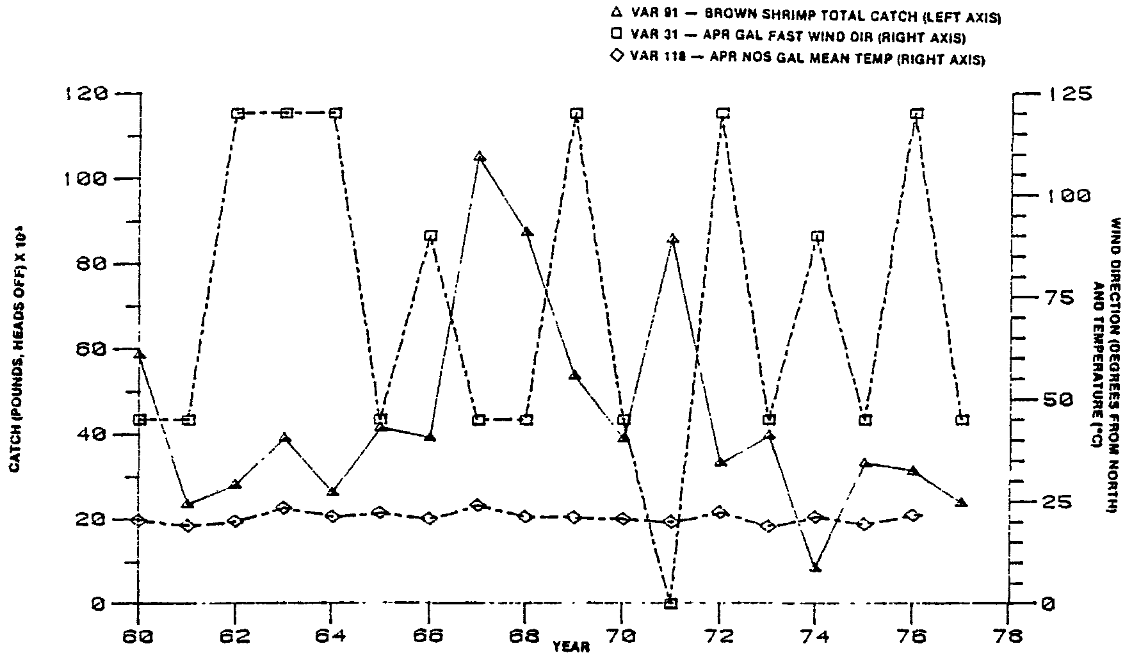


Figure 28. Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

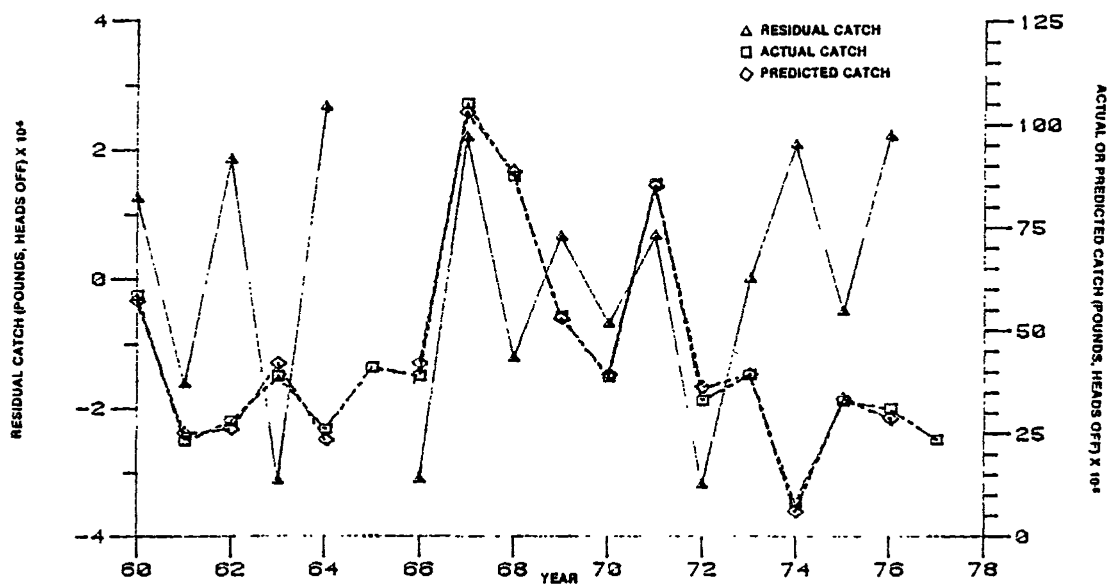


Figure 29. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

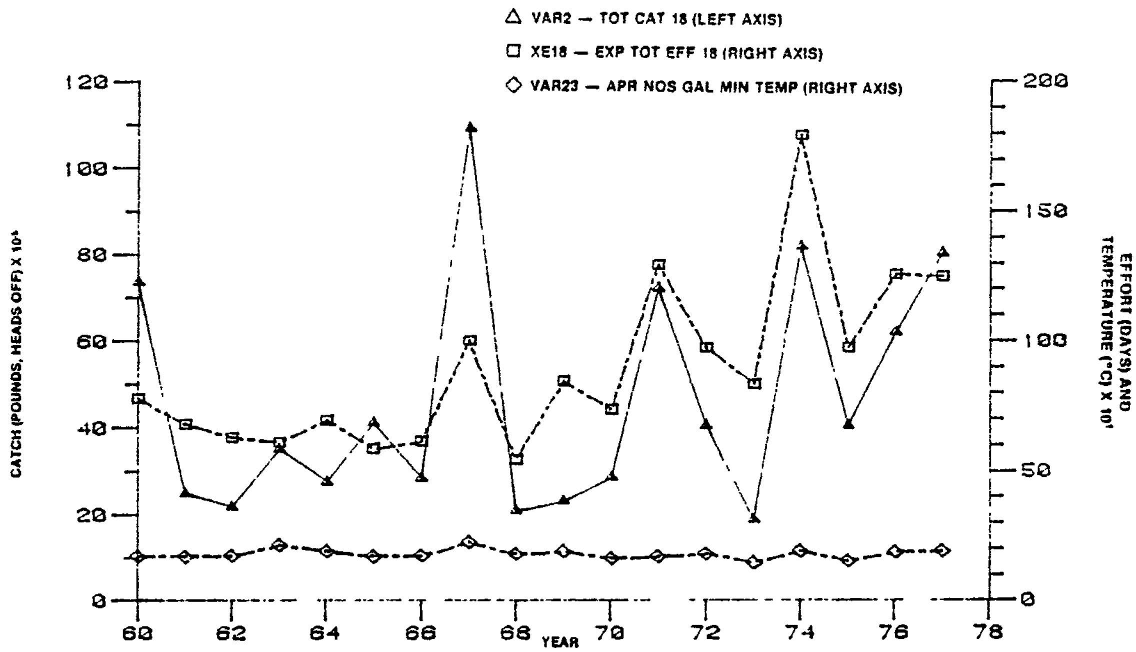


Figure 30. Plot of brown shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

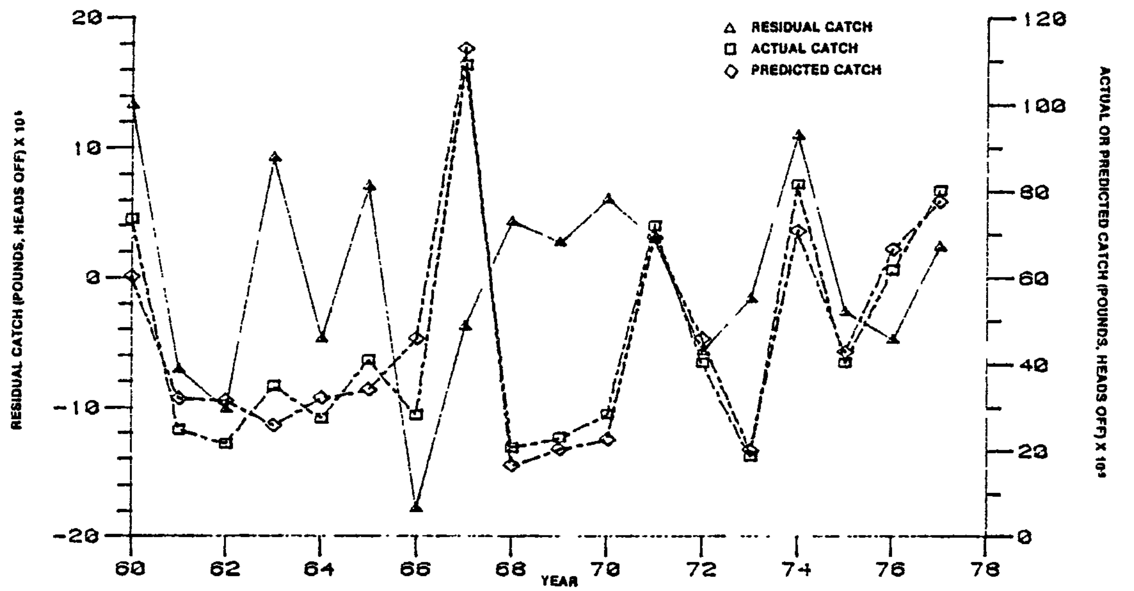


Figure 31. Plot of the actual, predicted and residual values of brown shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

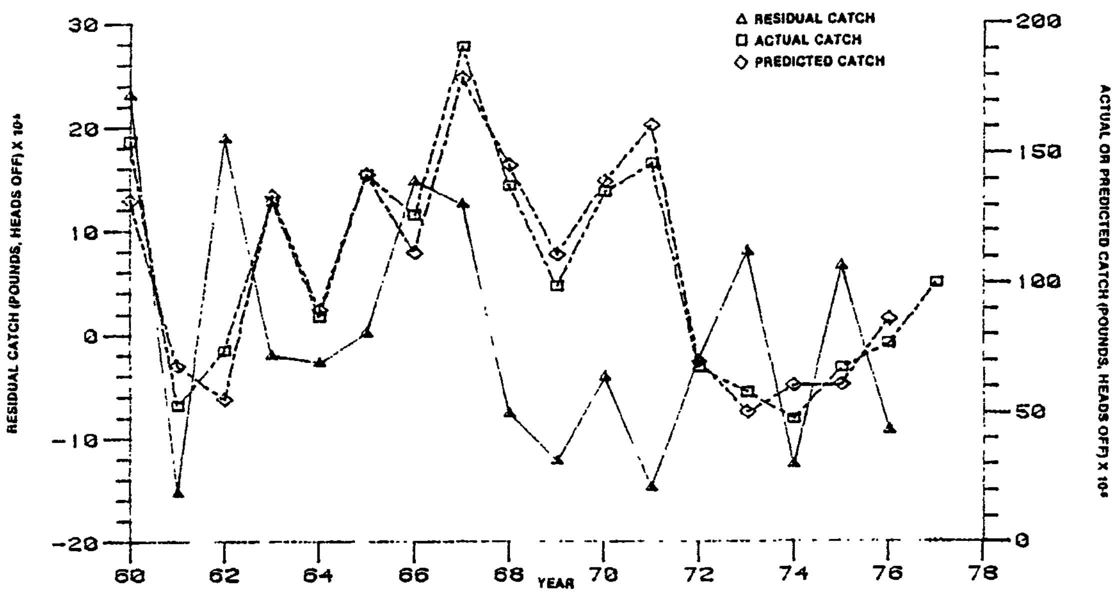


Figure 32. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

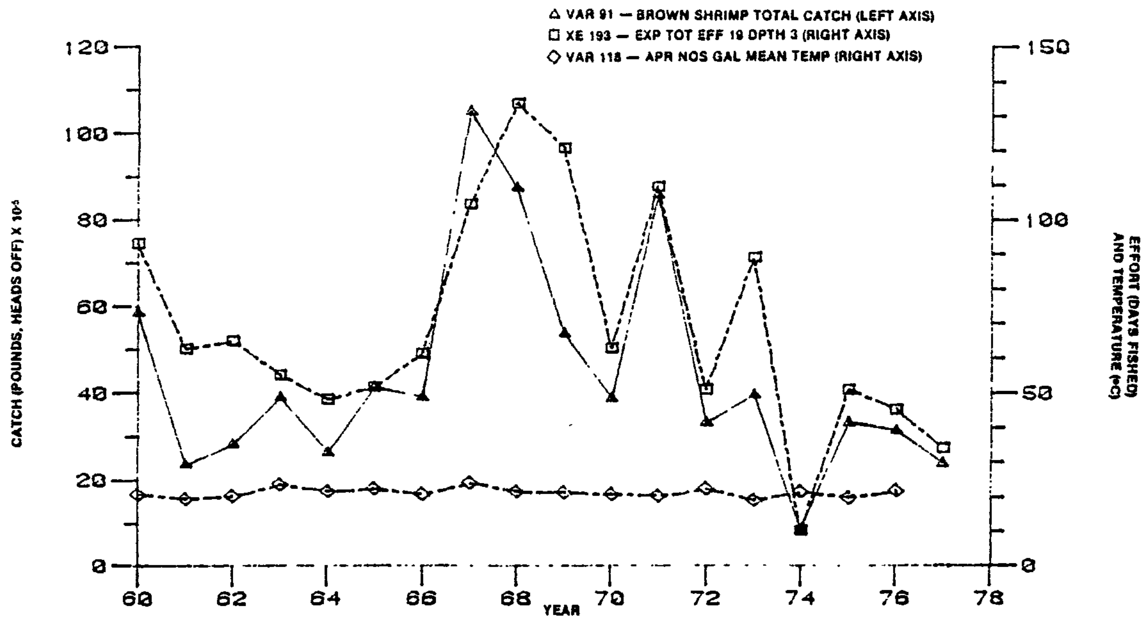


Figure 33. Plot of brown shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables including offfshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

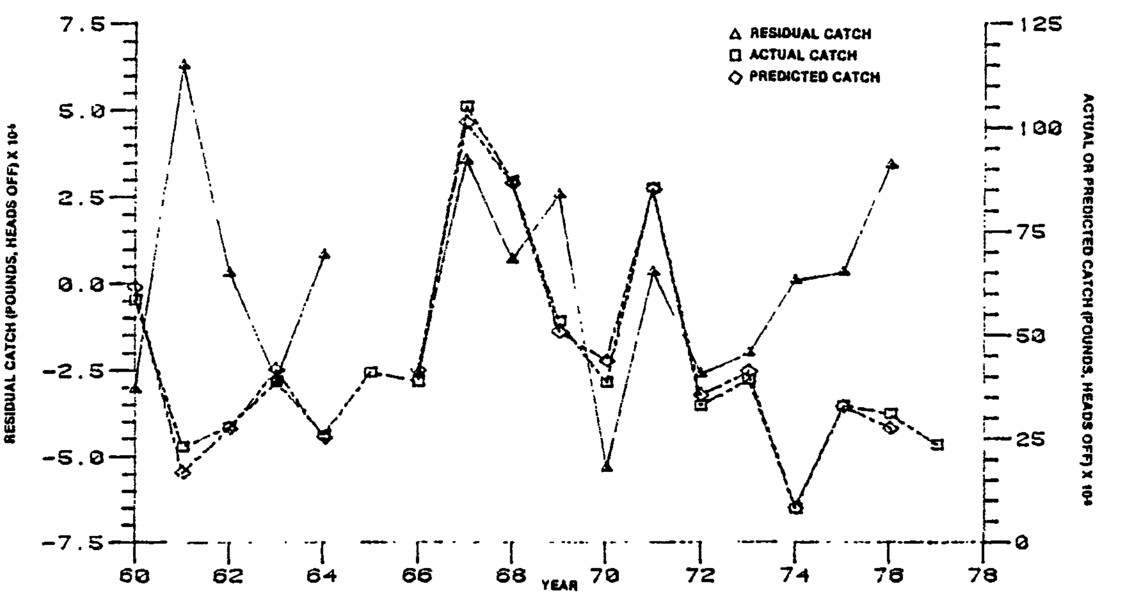


Figure 34. Plot of the actual, predicted and residual values of brown shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

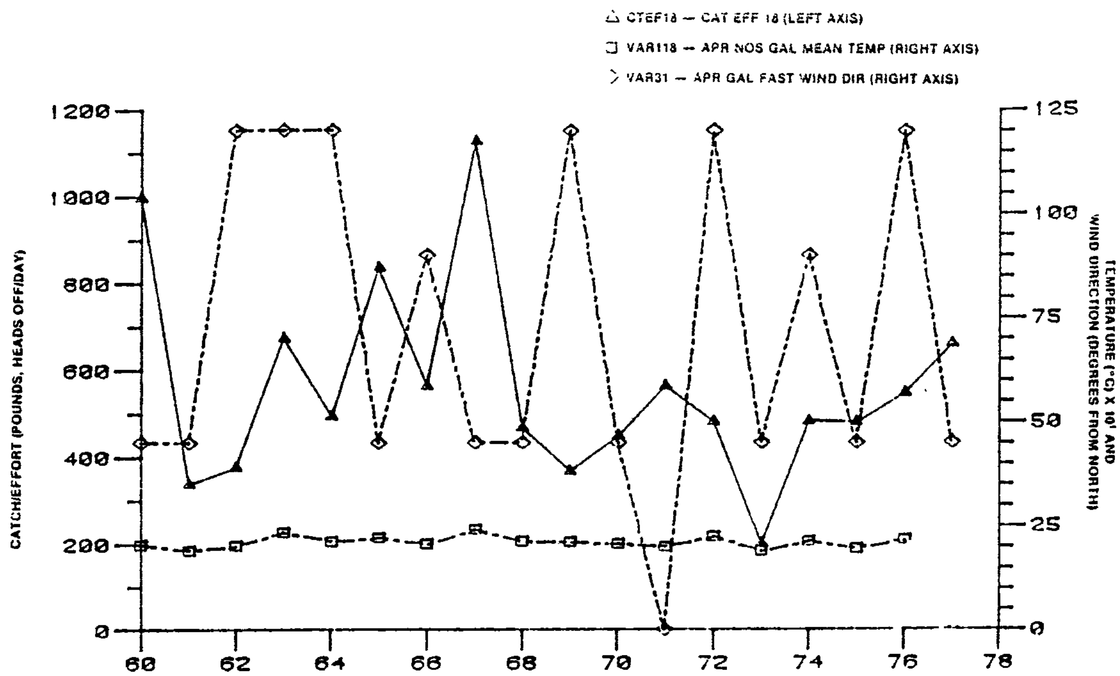


Figure 35. Plot of brown shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

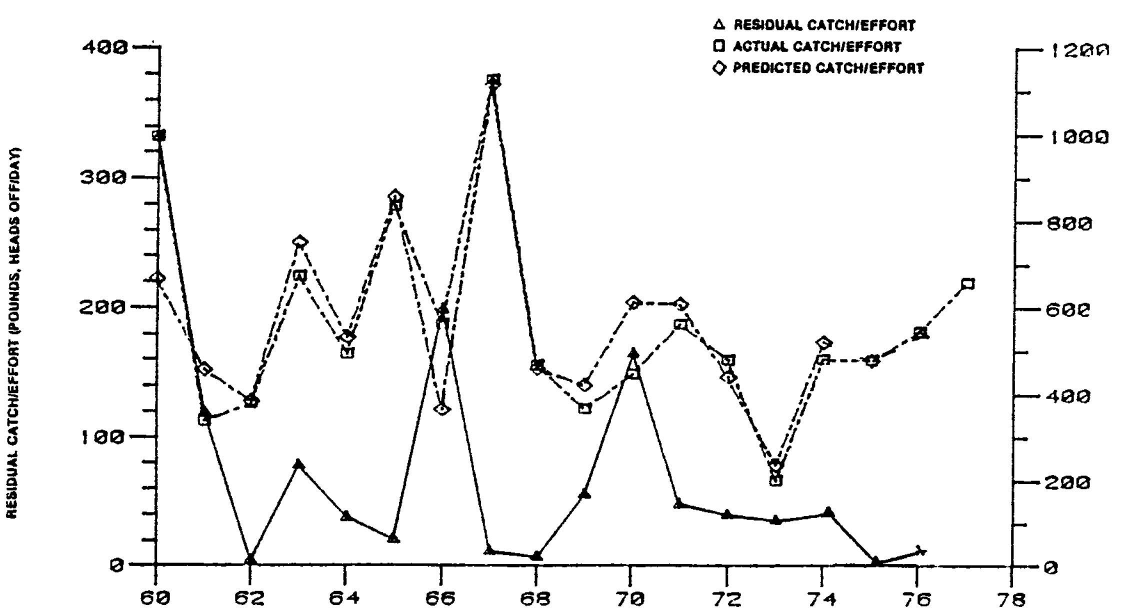


Figure 36. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

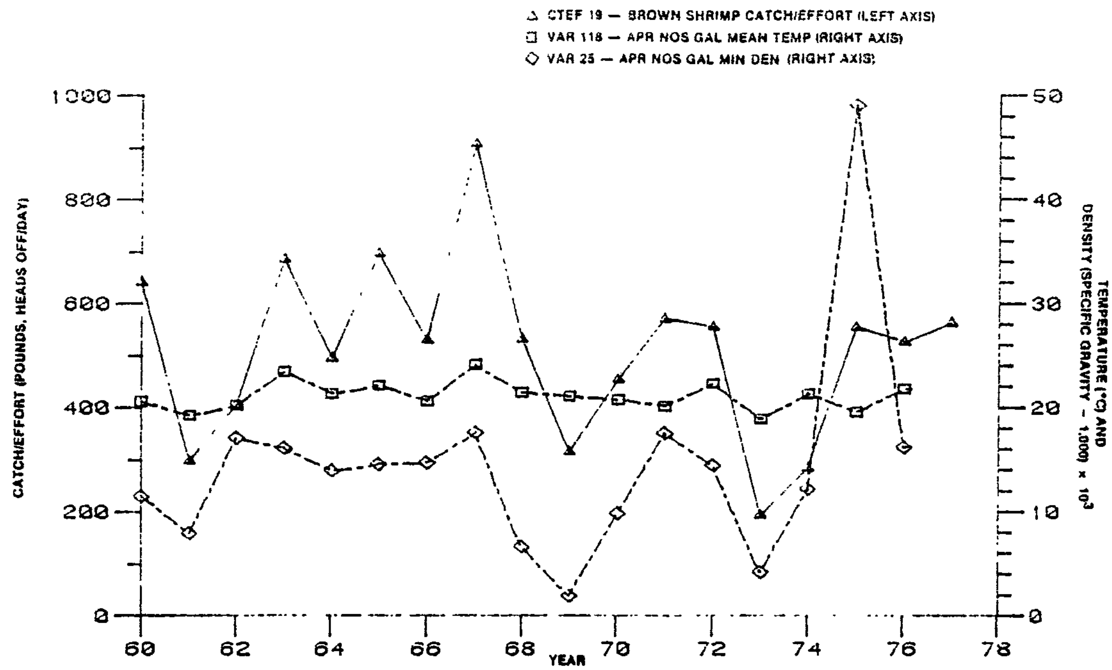


Figure 37. Plot of brown shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

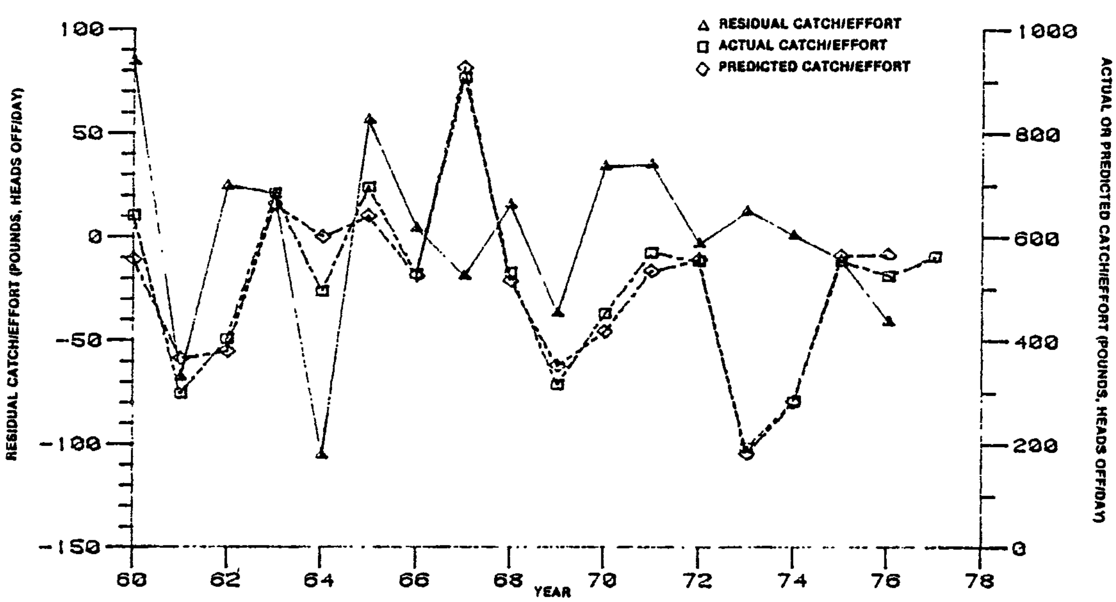


Figure 38. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

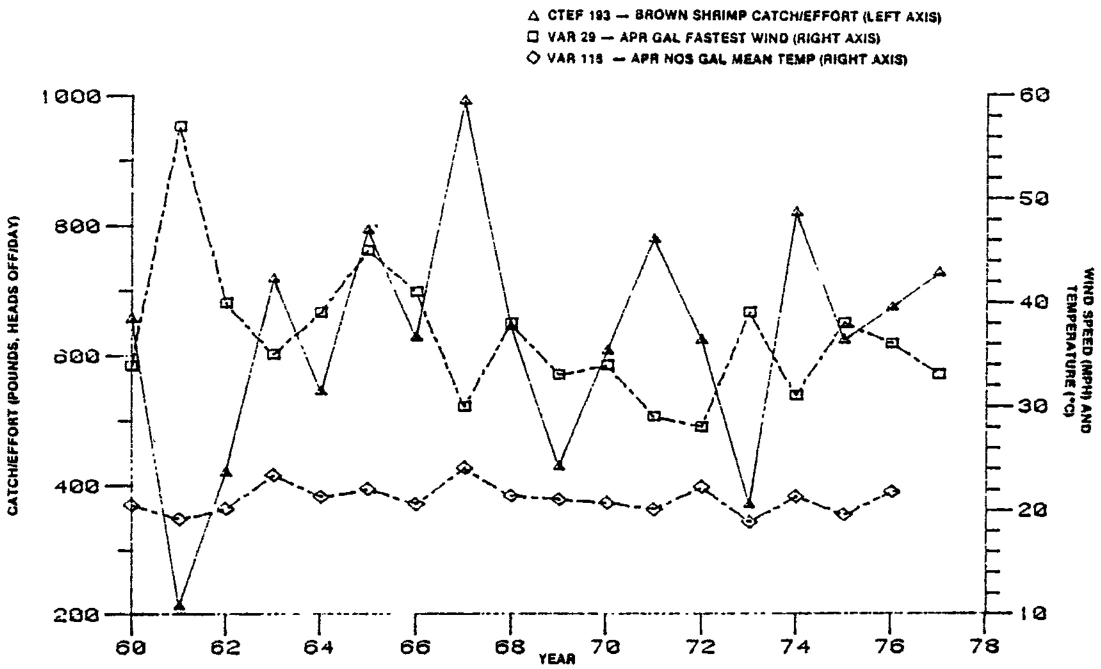


Figure 39. Plot of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

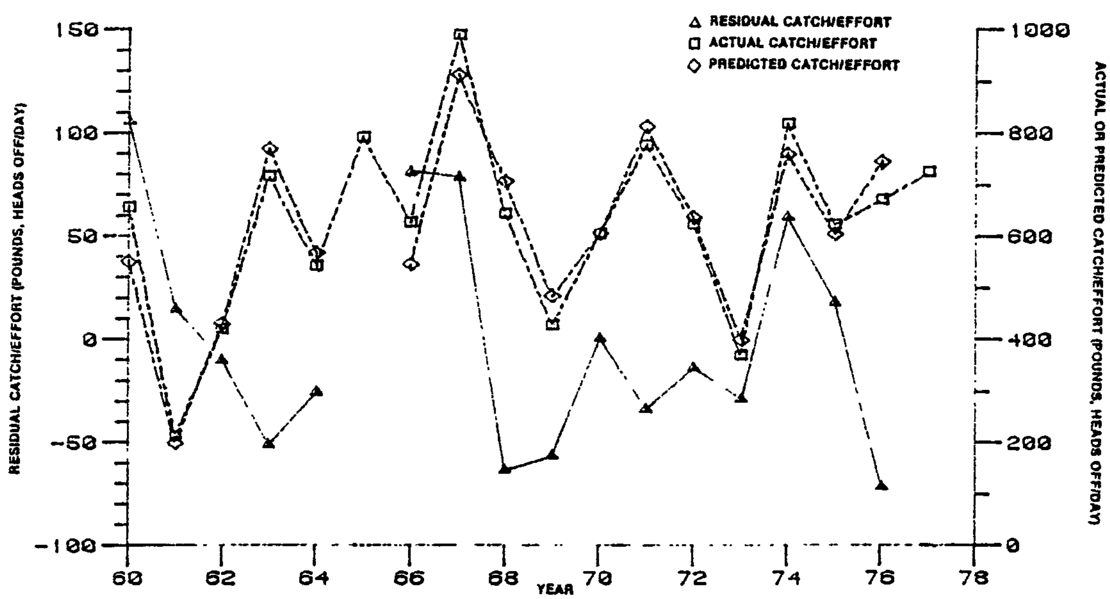


Figure 40. Plot of the actual, predicted and residual values of brown shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

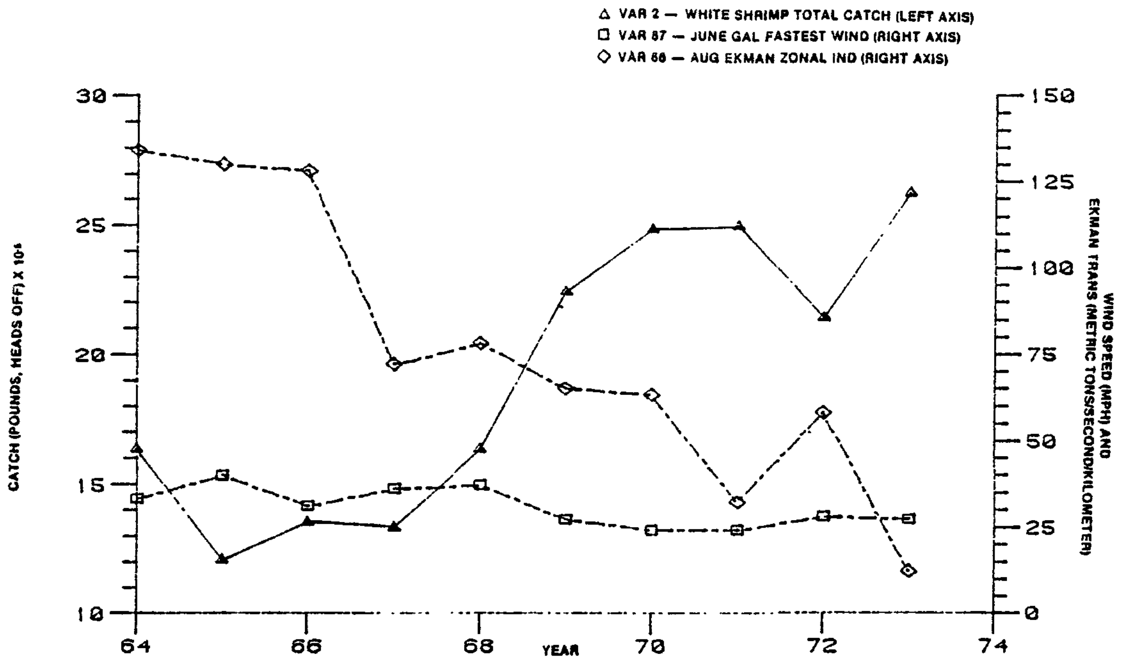


Figure 41. Plot of white shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

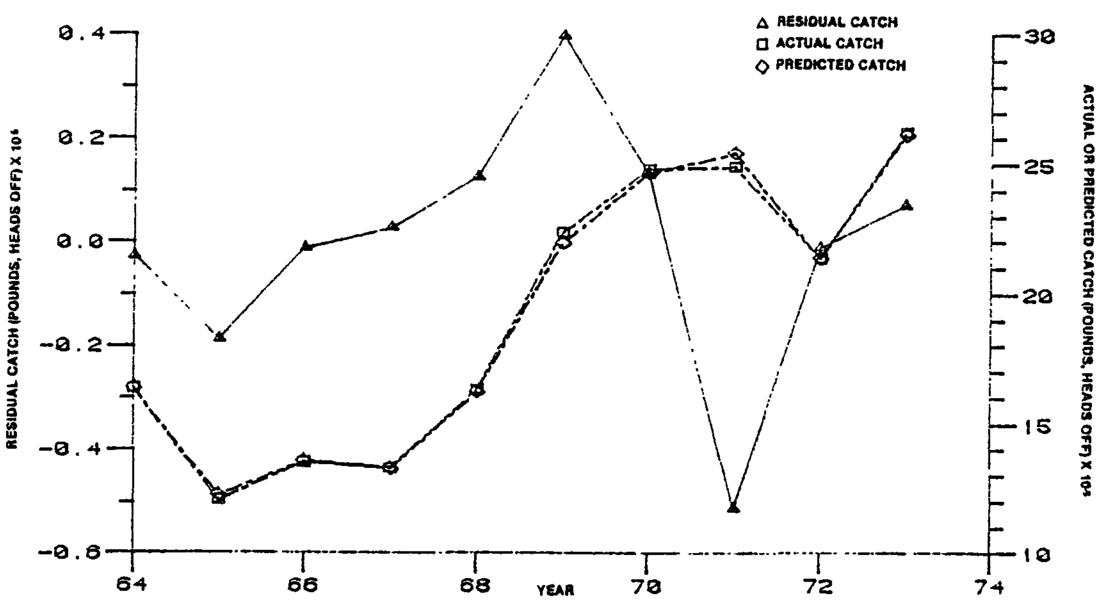


Figure 42. Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

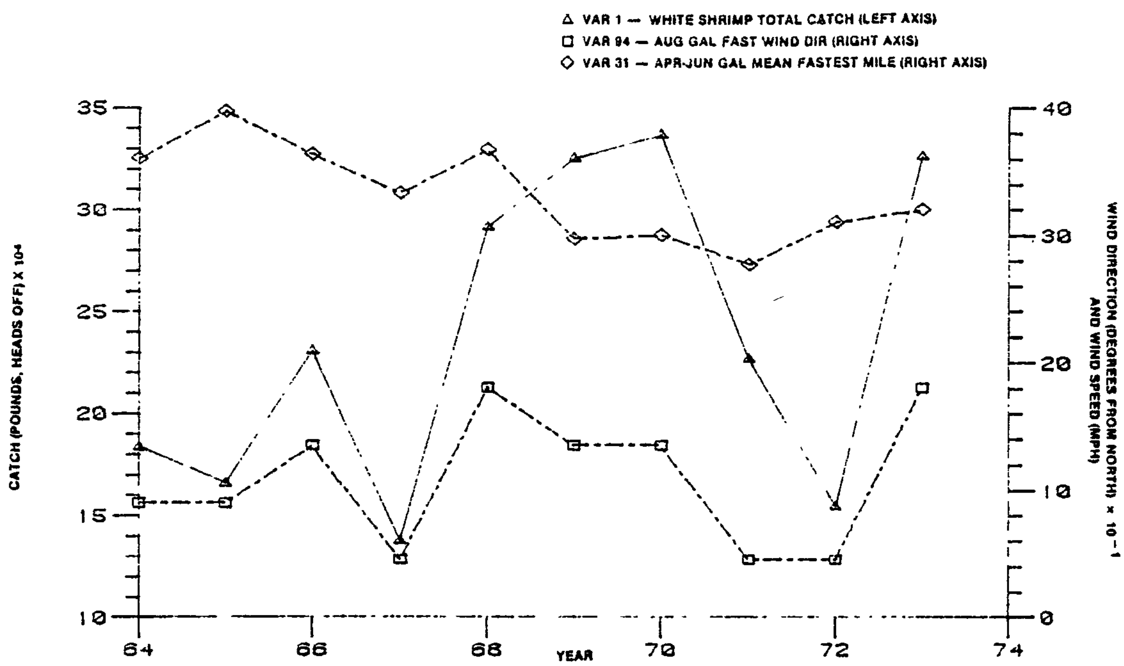


Figure 43. Plot of white shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

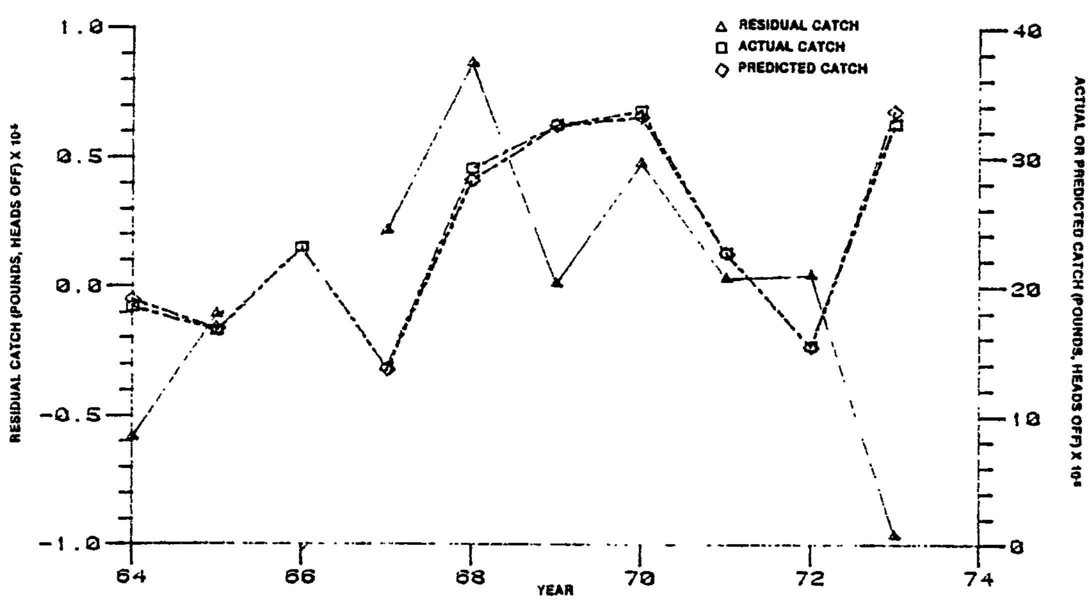


Figure 44. Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

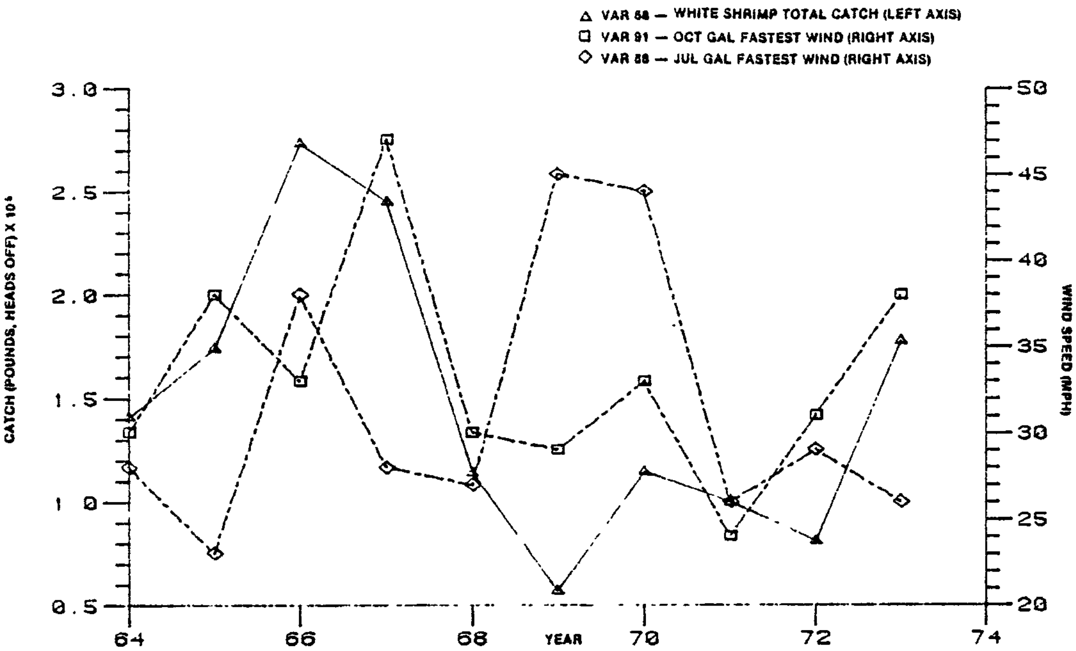


Figure 45. **Plot of white shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.**

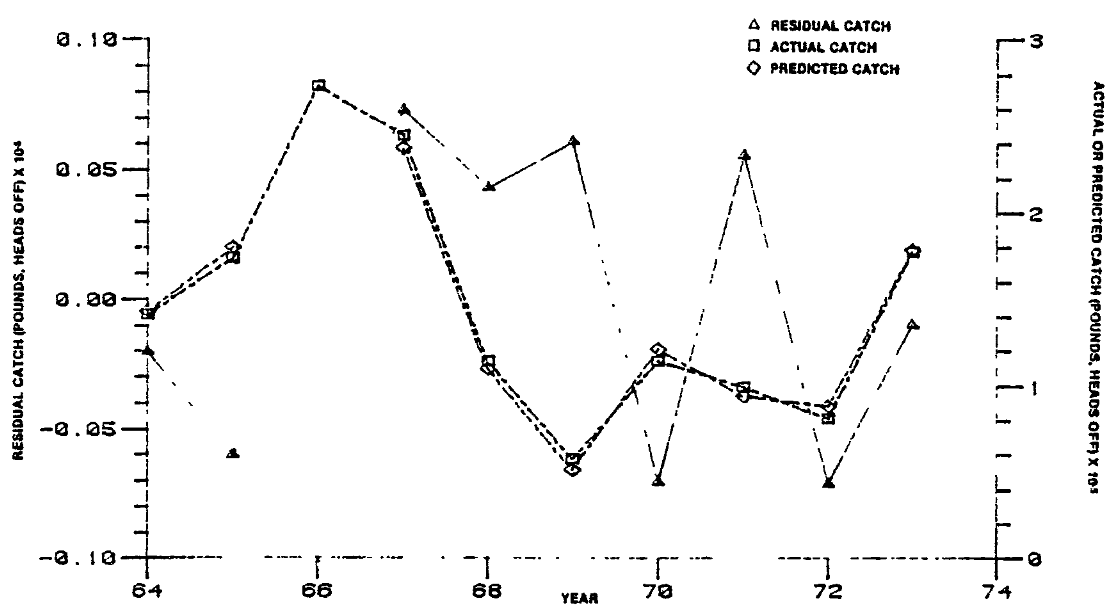


Figure 46. **Plot of the actual, predicted and residual values of white shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.**

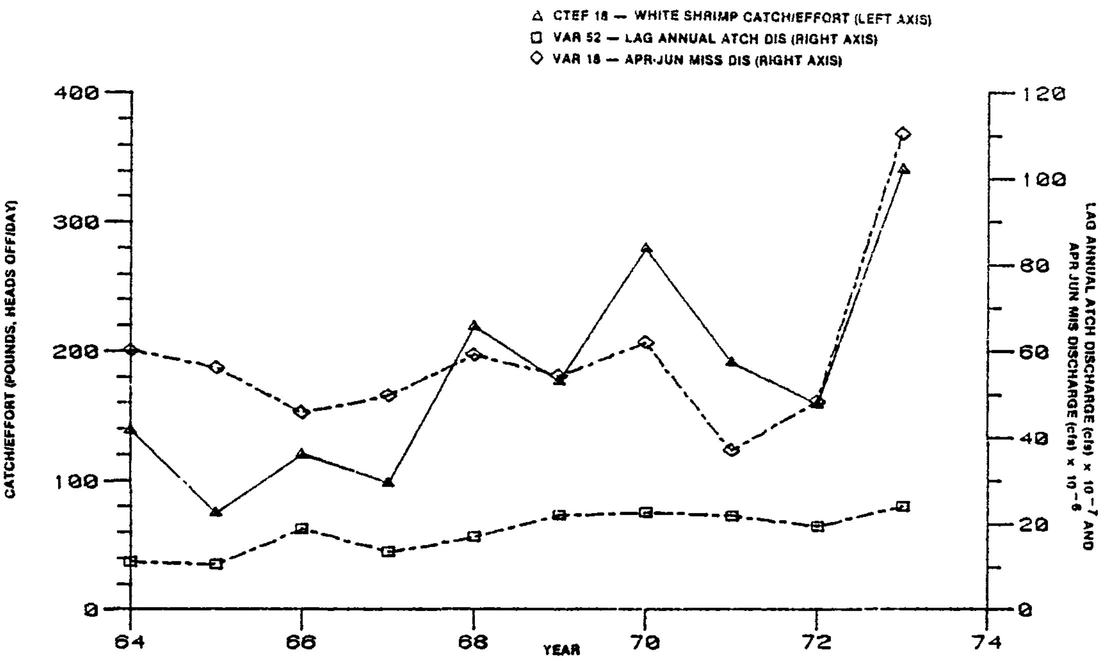


Figure 47. Plot of white shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

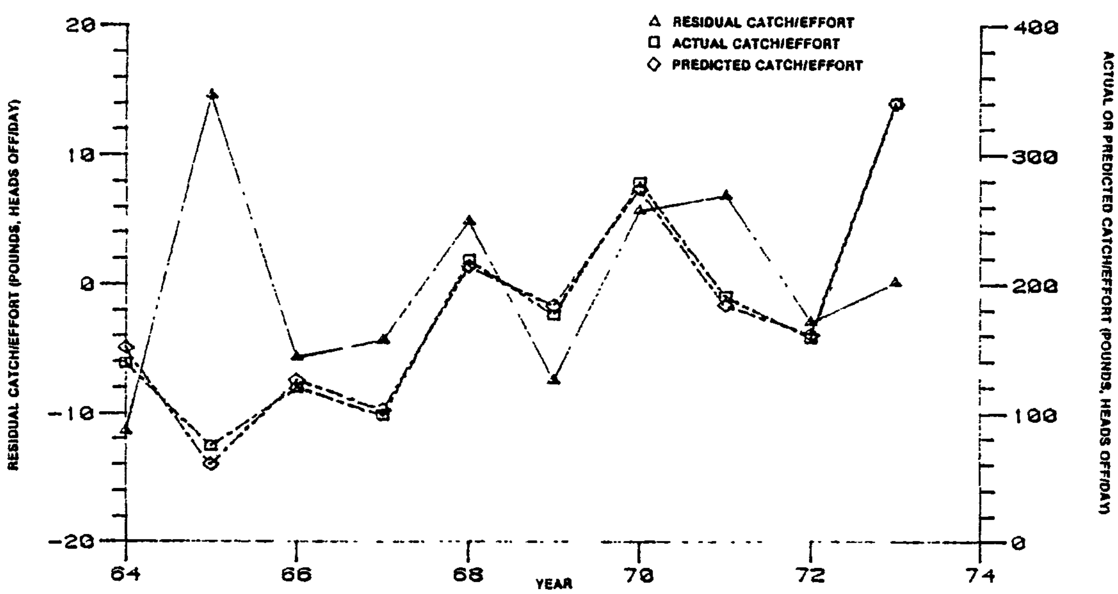


Figure 48. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

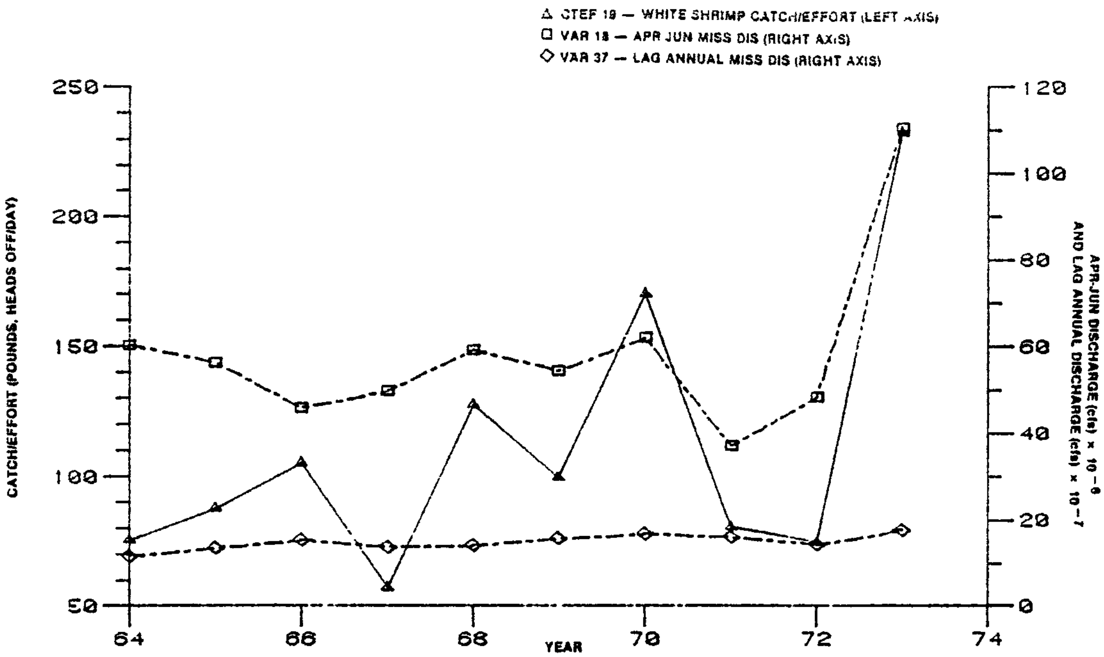


Figure 49. Plot of white shrimp interview catch/effort (area 19) and most important independent variables in he final stepwise regression model for the ten year (1964-1973) data set.

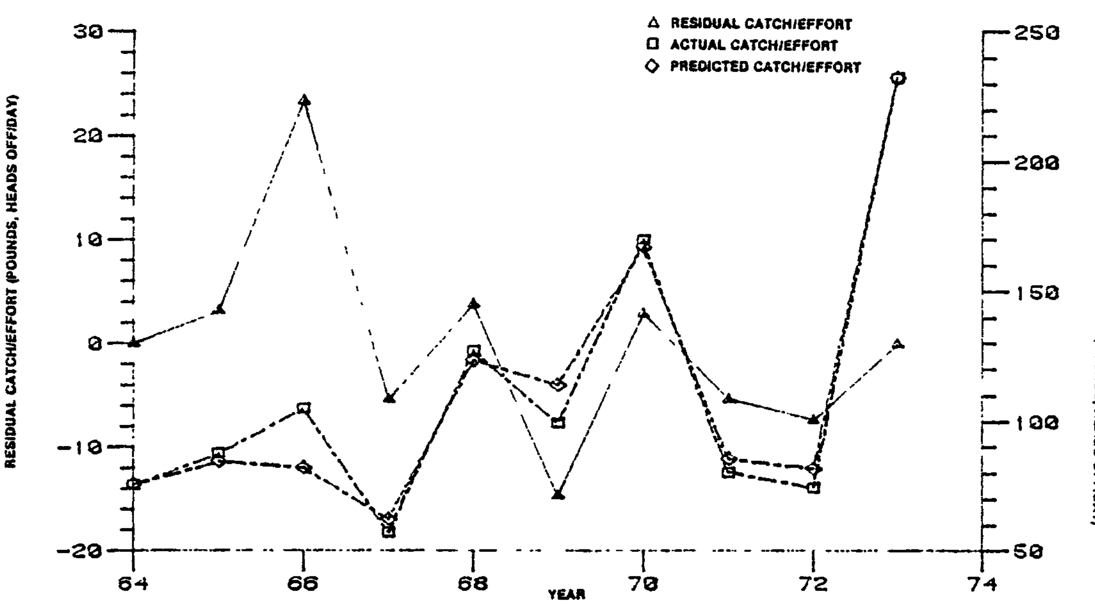


Figure 50. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

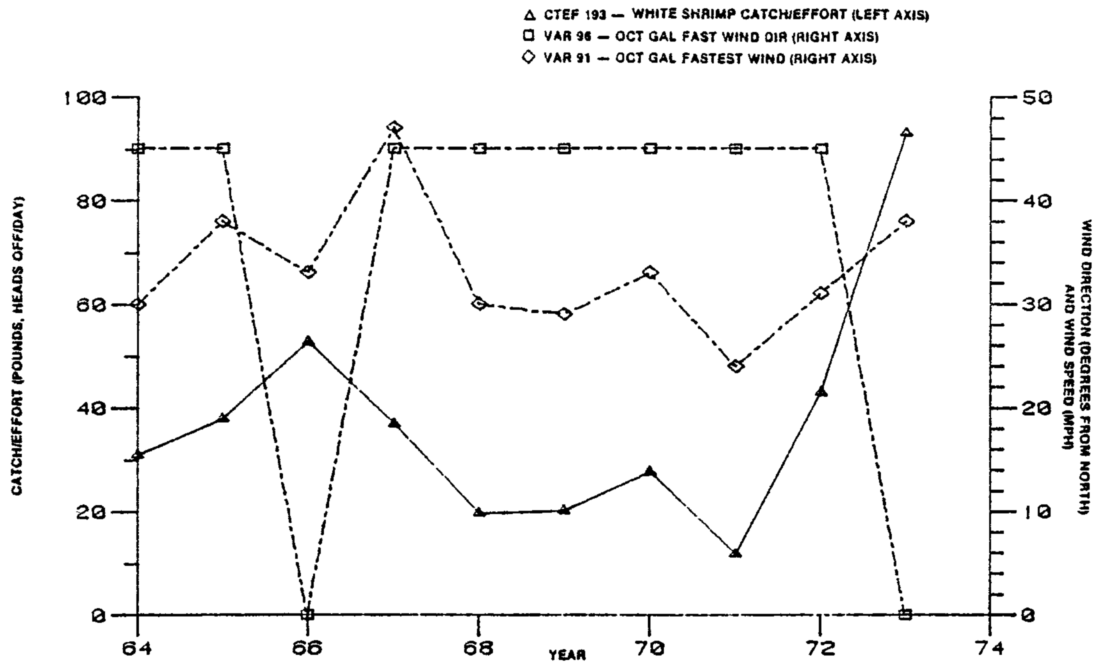


Figure 51. Plot of white shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the ten year (1964-1973) data set.

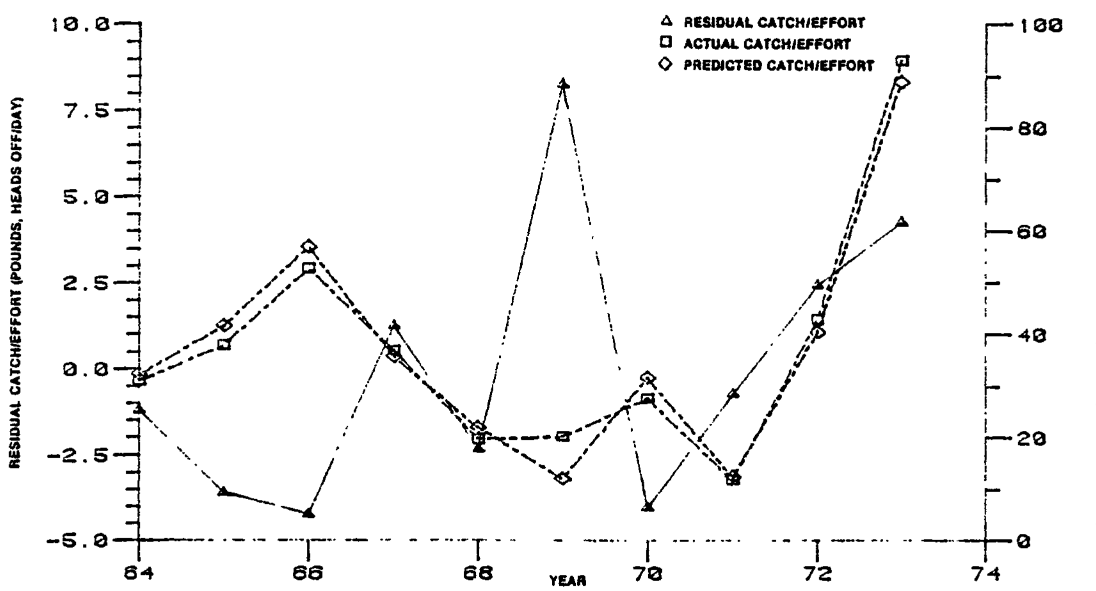


Figure 52. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the ten year (1964-1973) data set.

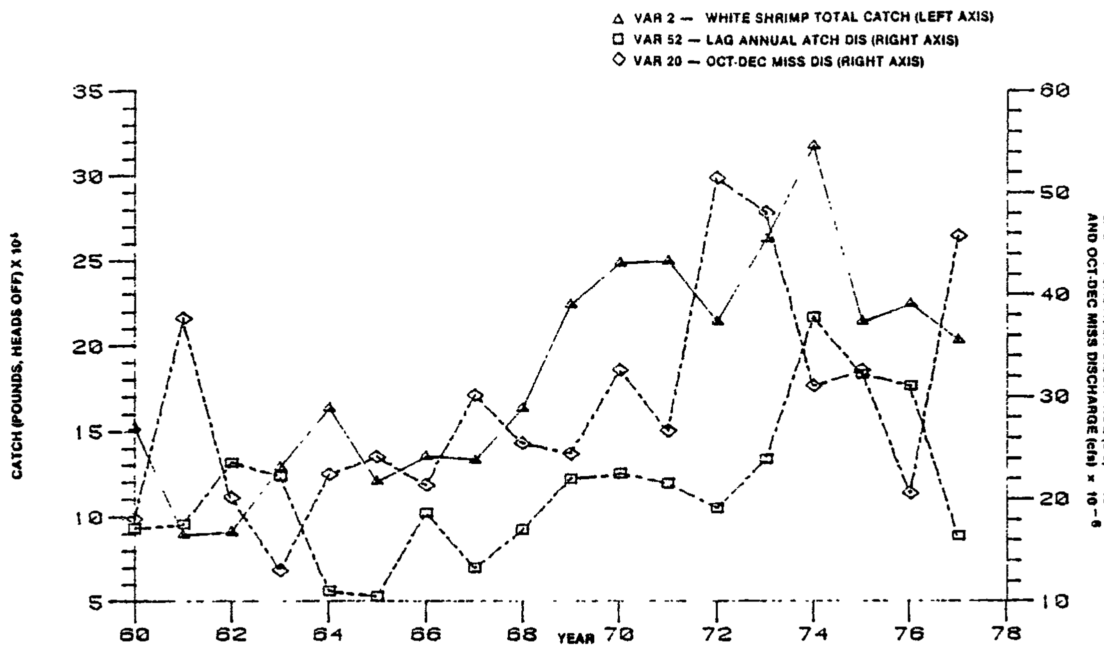


Figure 53. Plot of white shrimp total catch (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

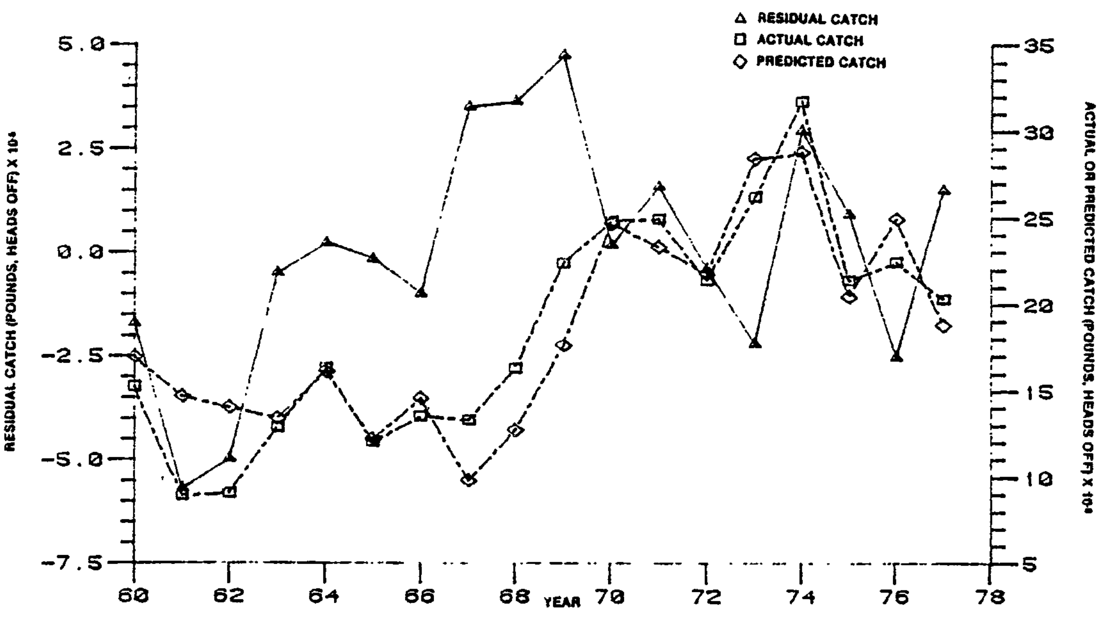


Figure 54. Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

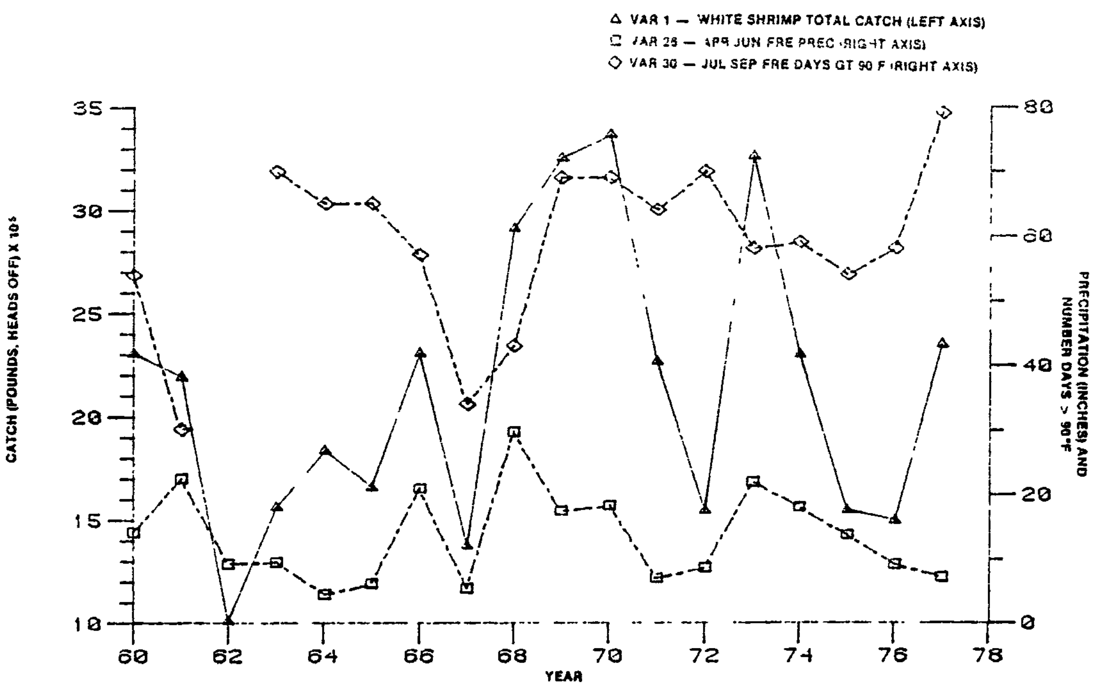


Figure 55. Plot of white shrimp total catch (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

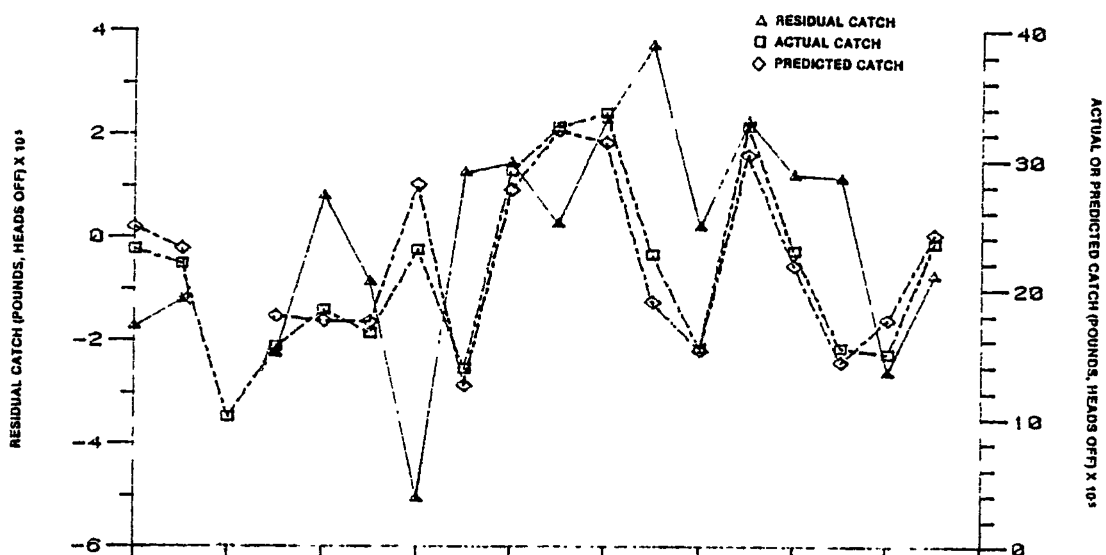


Figure 56. Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

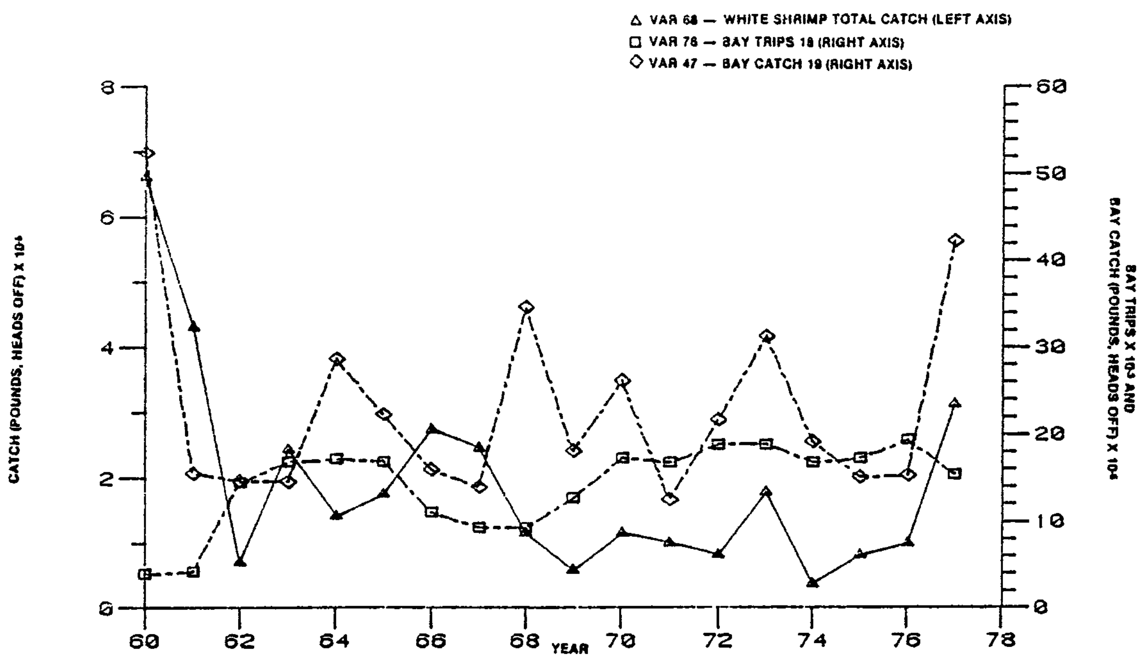


Figure 57. **Plot of white shrimp total catch (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.**

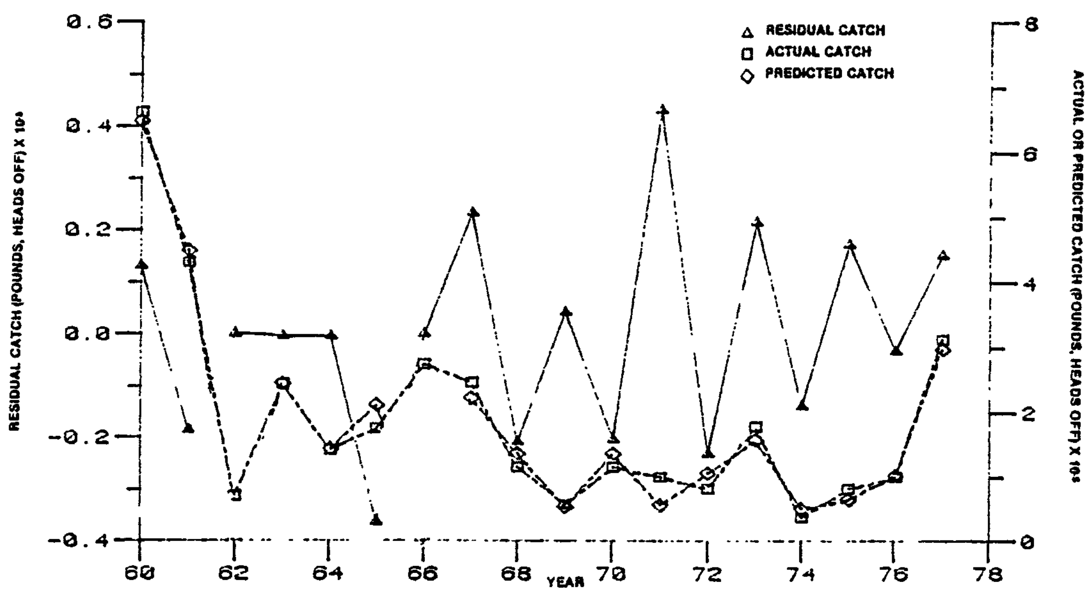


Figure 58. **Plot of the actual, predicted and residual values of white shrimp total catch (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.**

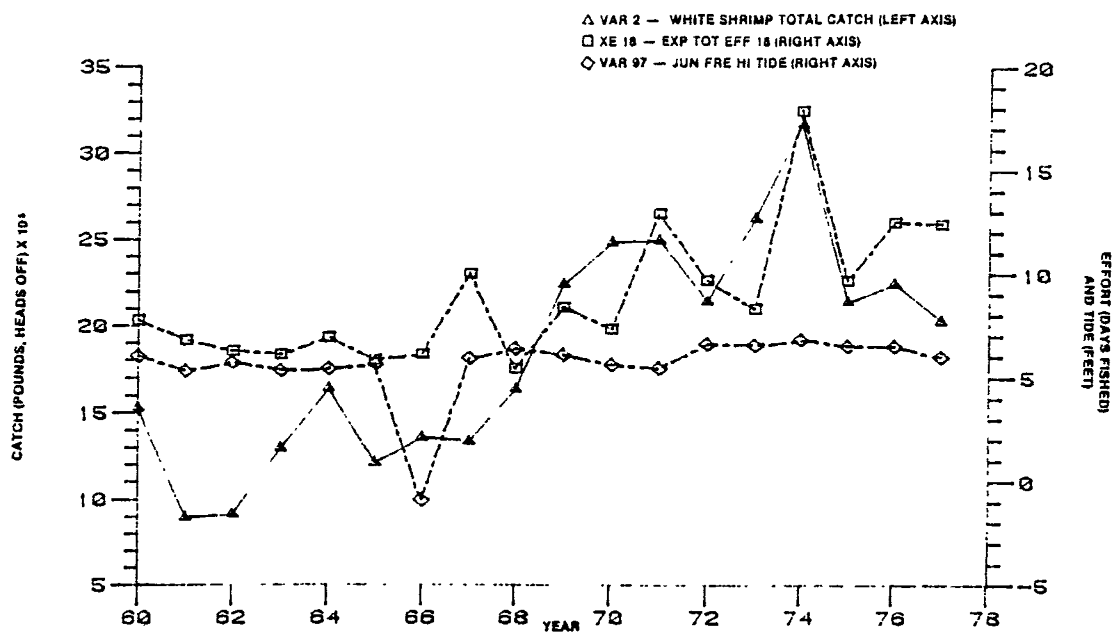


Figure 59. Plot of white shrimp total catch (area 18) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

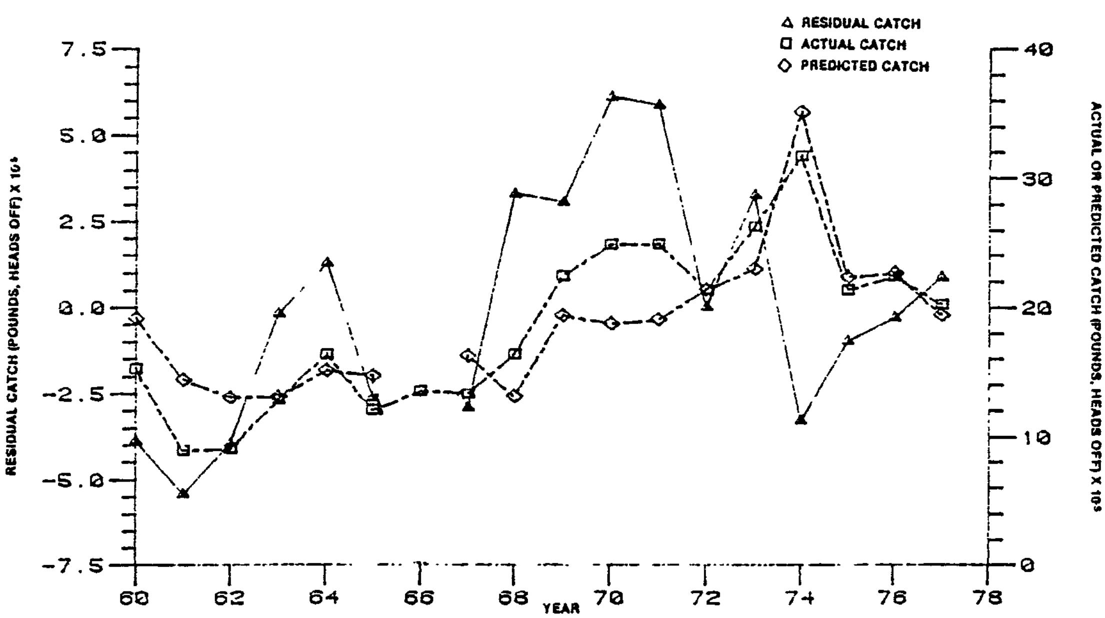


Figure 60. Plot of the actual, predicted and residual values of white shrimp total catch (area 18) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

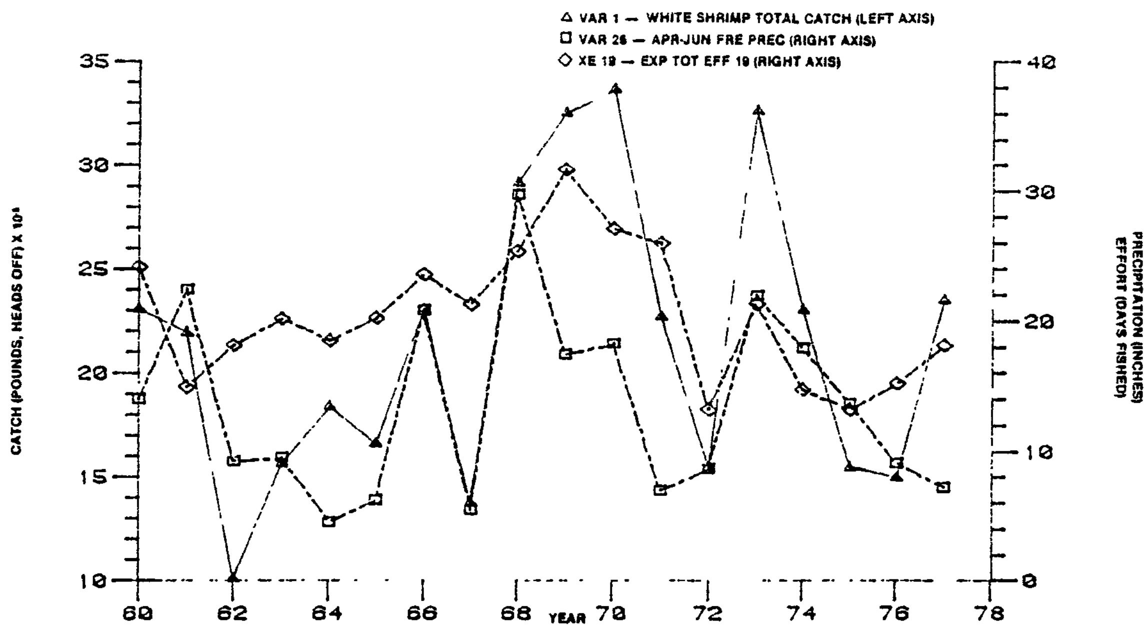


Figure 61. Plot of white shrimp total catch (area 19) and most important independent variables including offshore non-directed effort in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

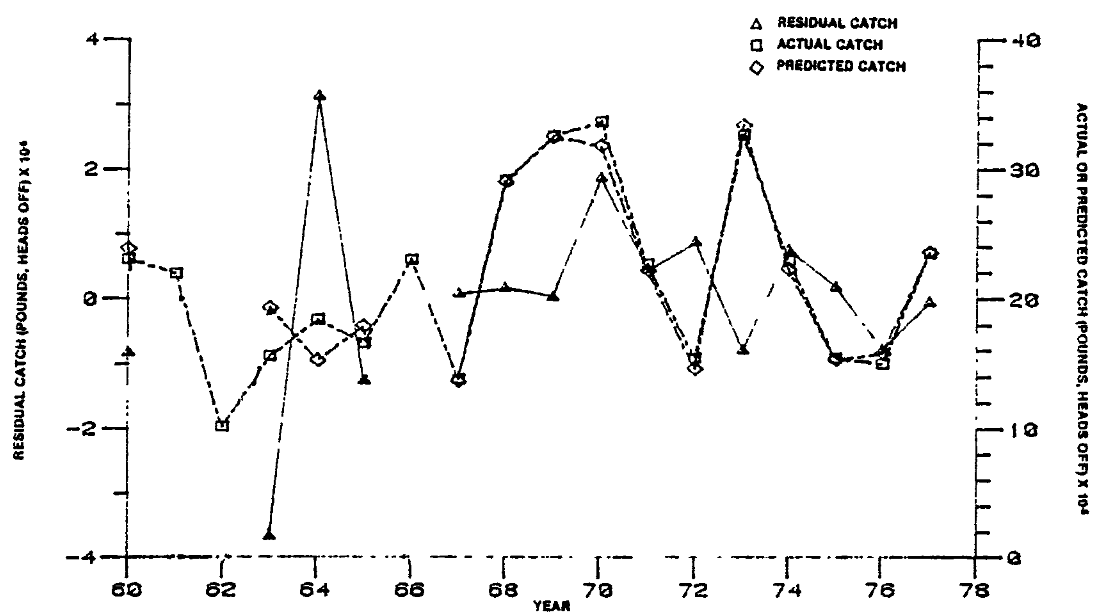


Figure 62. Plot of the actual, predicted and residual values of white shrimp total catch (area 19) based on the final stepwise multiple regression model with environmental variables, indices of recruitment, and offshore non-directed effort for the eighteen year (1960-1977) data set.

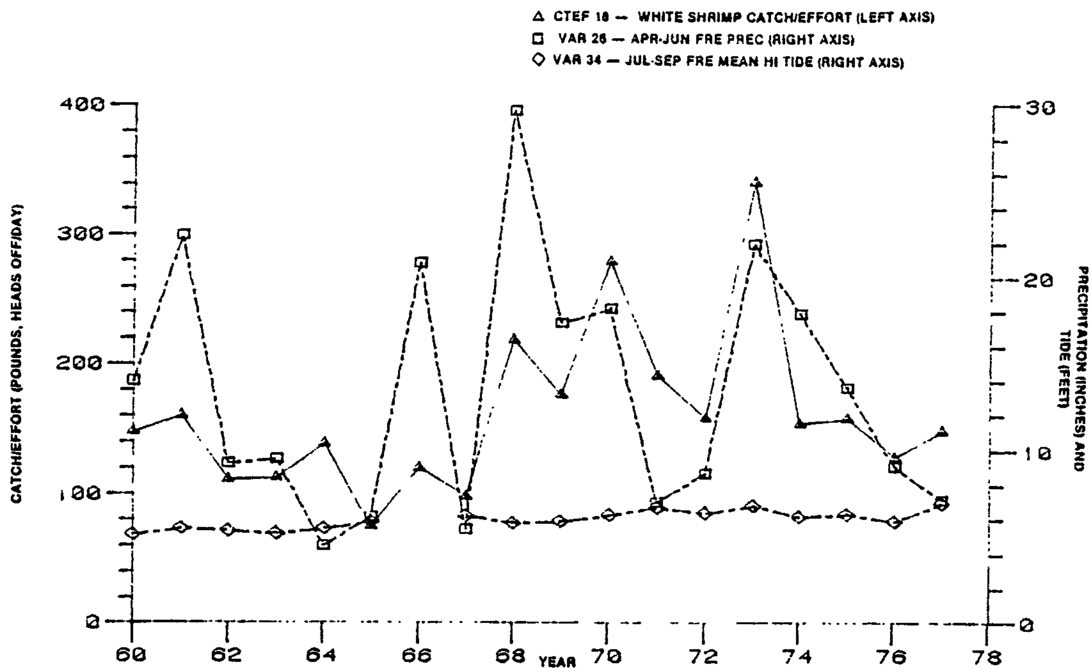


Figure 63. Plot of white shrimp interview catch/effort (area 18) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

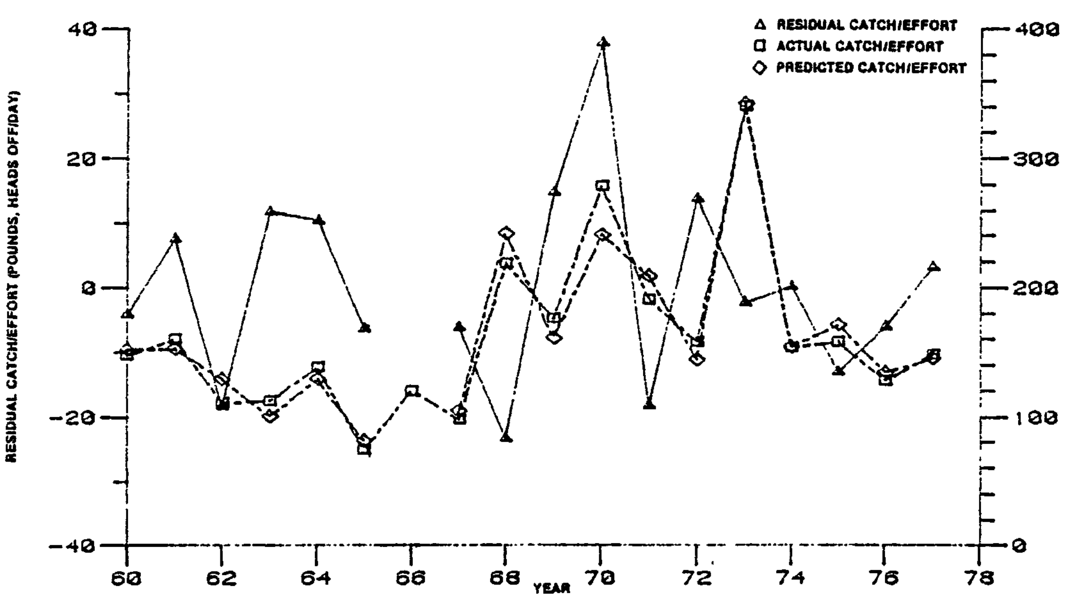


Figure 64. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 18) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

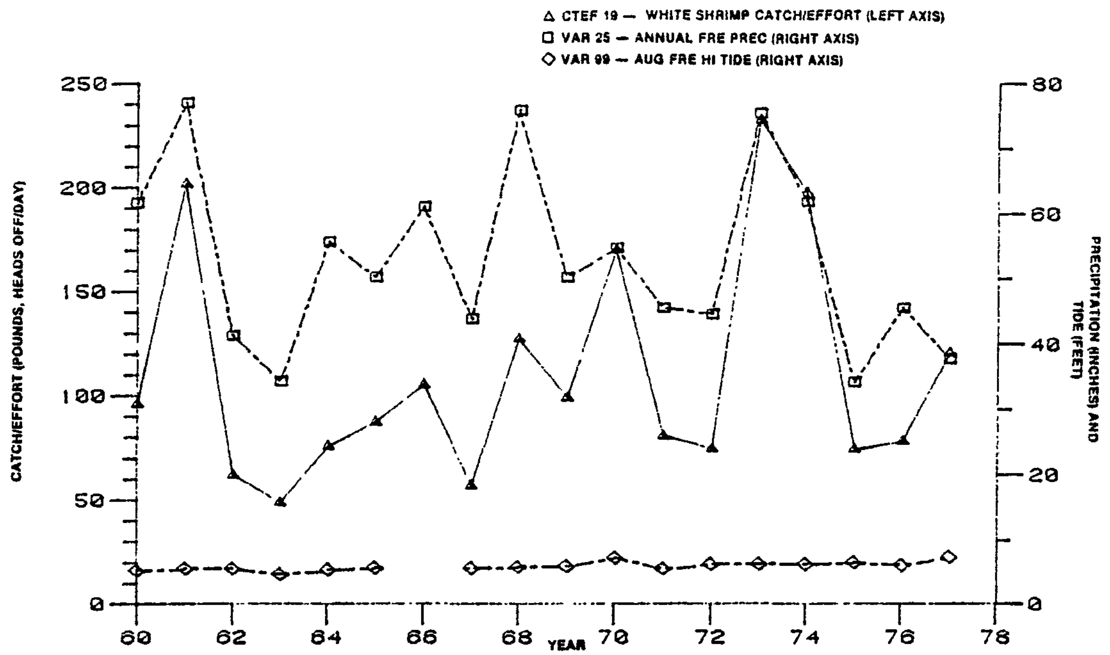


Figure 65. Plot of white shrimp interview catch/effort (area 19) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

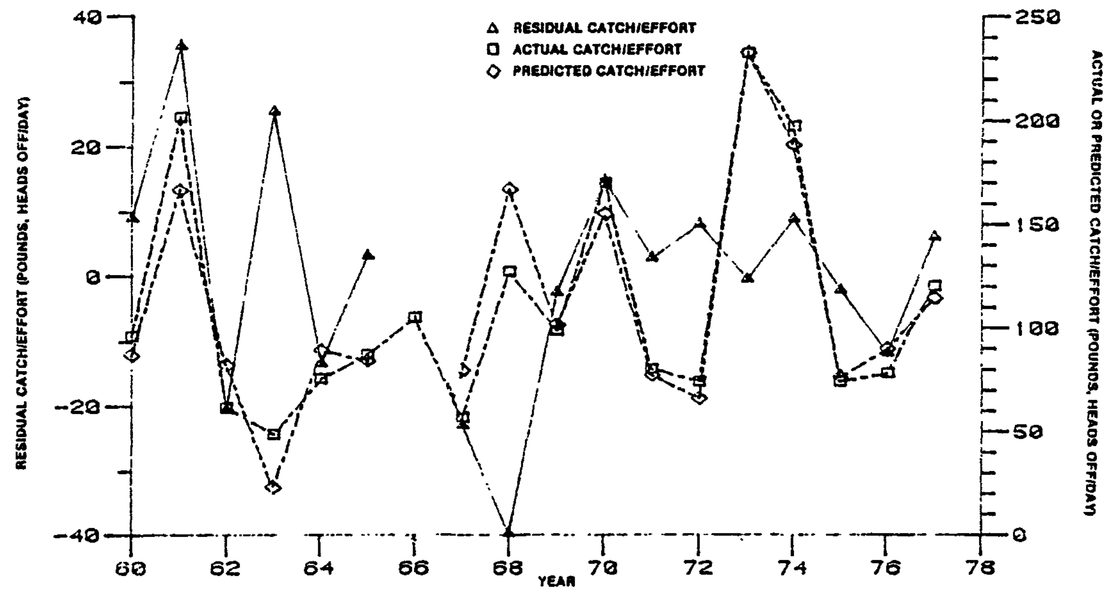


Figure 66. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

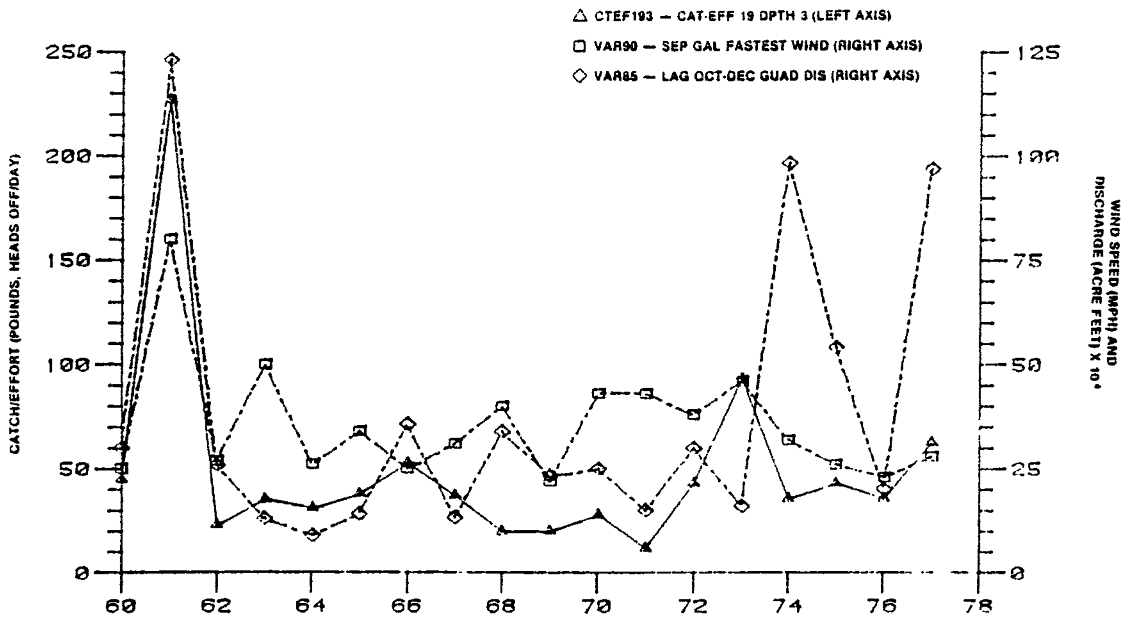


Figure 67. Plot of white shrimp interview catch/effort (area 19, 11-15 fathom depths) and most important independent variables in the final stepwise multiple regression model for the eighteen year (1960-1977) data set.

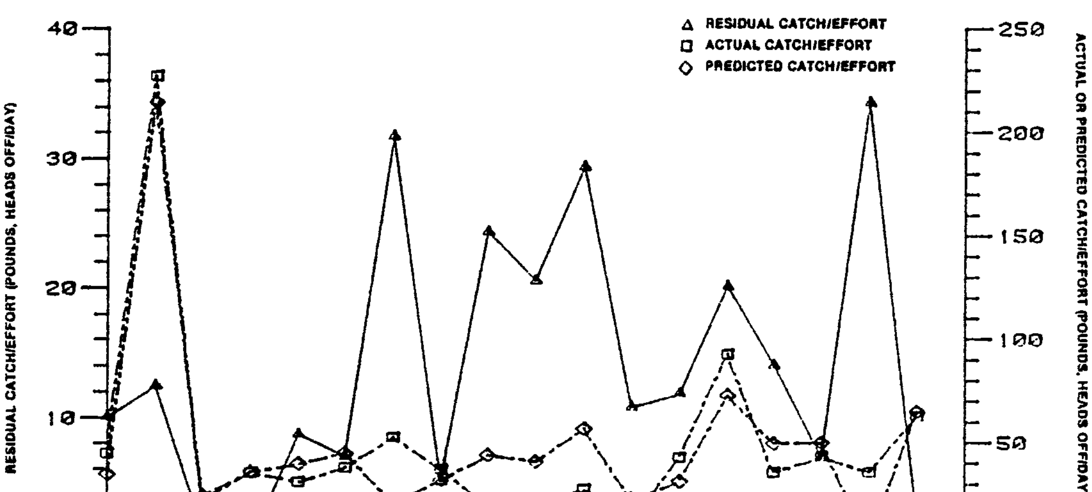


Figure 68. Plot of the actual, predicted and residual values of white shrimp interview catch/effort (area 19, 11-15 fathom depths) based on the final stepwise multiple regression model with environmental variables and indices of recruitment for the eighteen year (1960-1977) data set.

OUTPUT FOR: Q-CLUSTER ANALYSIS - SELECTED VARIABLES FROM THE BROWN 10 YR DATA

DENDROGRAM FOR THE CLUSTER ANALYSIS
USING THE QUANTIFIED CZEKANOWSKI'S COEFFICIENT OF ASSSOCIATION
AND THE UNWEIGHTED PAIR-GROUP METHOD OF CLUSTERING.

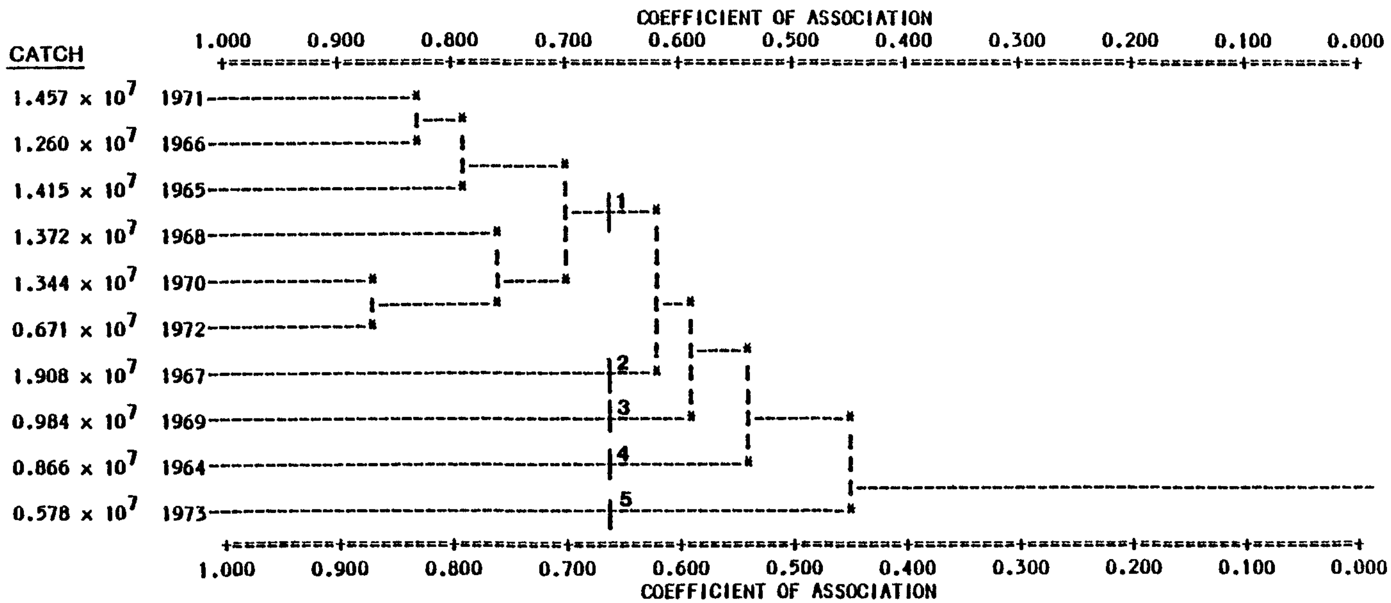


Figure 69. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.

OUTPUT FOR: Q-CLUSTER ANALYSIS - SELECTED VARIABLES FROM THE BROWN 18 YR DATA

DENDROGRAM FOR THE CLUSTER ANALYSIS
USING THE QUANTIFIED CZEKANOWSKI'S COEFFICIENT OF ASSSOCIATION
AND THE UNWEIGHTED PAIR-GROUP METHOD OF CLUSTERING.

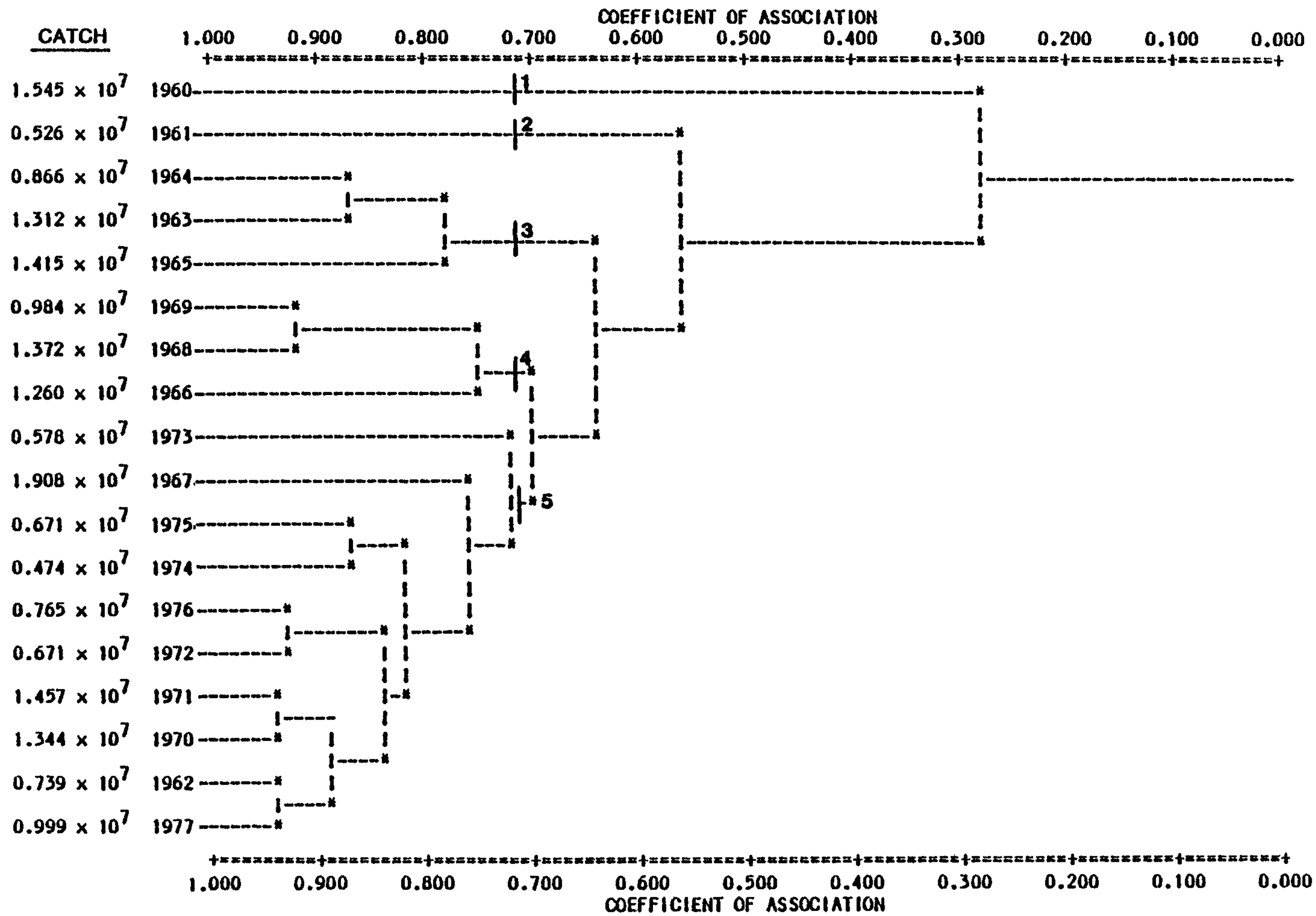


Figure 70. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.

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                     OUTPUT FOR:  Q-CLUSTER ANALYSIS - SELECTED VARIABLES FROM THE WHITE 10 YR DATA

DENDROGRAM FOR THE CLUSTER ANALYSIS
  USING THE QUANTIFIED CZEKANOWSKI'S COEFFICIENT OF ASSSOCIATION
  AND THE UNWEIGHTED PAIR-GROUP METHOD OF CLUSTERING.
                                                     COEFFICIENT OF ASSOCIATION
 CATCH         1.000    0.900    0.800    0.700    0.600    0.500    0.400    0.300    0.200    0.100    0.000
                 +=========+=========+=========+=========+=========+=========+=========+=========+=========+=========+
0.154 x 10^7  1972-------------------*
                                     I----------------*
0.166 x 10^7  1965-------------------*                I
                                                      I-*
0.183 x 10^7  1964------------------------------------* I
                                                        I--+-1---*
0.137 x 10^7  1967------------------------*             I        I
                                          I-------------*        I
0.227 x 10^7  1971------------------------*                      I
                                                                 I
0.326 x 10^7  1973----------------------*                        I--------------------------------------------------------
                                        I---------*              I
0.291 x 10^7  1968----------------------*         I              I
                                                  I--------+-2---*
0.336 x 10^7  1970------------------------------* I
                                                I I
0.231 x 10^7  1966--------------------*         I--*
                                      I---------*
0.325 x 10^7  1969--------------------*
                 +=========+=========+=========+=========+=========+=========+=========+=========+=========+=========+
               1.000    0.900    0.800    0.700    0.600    0.500    0.400    0.300    0.200    0.100    0.000
                                                     COEFFICIENT OF ASSOCIATION
```

Figure 71. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for white shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.

OUTPUT FOR: Q-CLUSTER ANALYSIS - SELECTED VARIABLES FROM THE WHITE 18 YR DATA

DENDROGRAM FOR THE CLUSTER ANALYSIS
USING THE QUANTIFIED CZEKANOWSKI'S COEFFICIENT OF ASSSOCIATION
AND THE UNWEIGHTED PAIR-GROUP METHOD OF CLUSTERING.

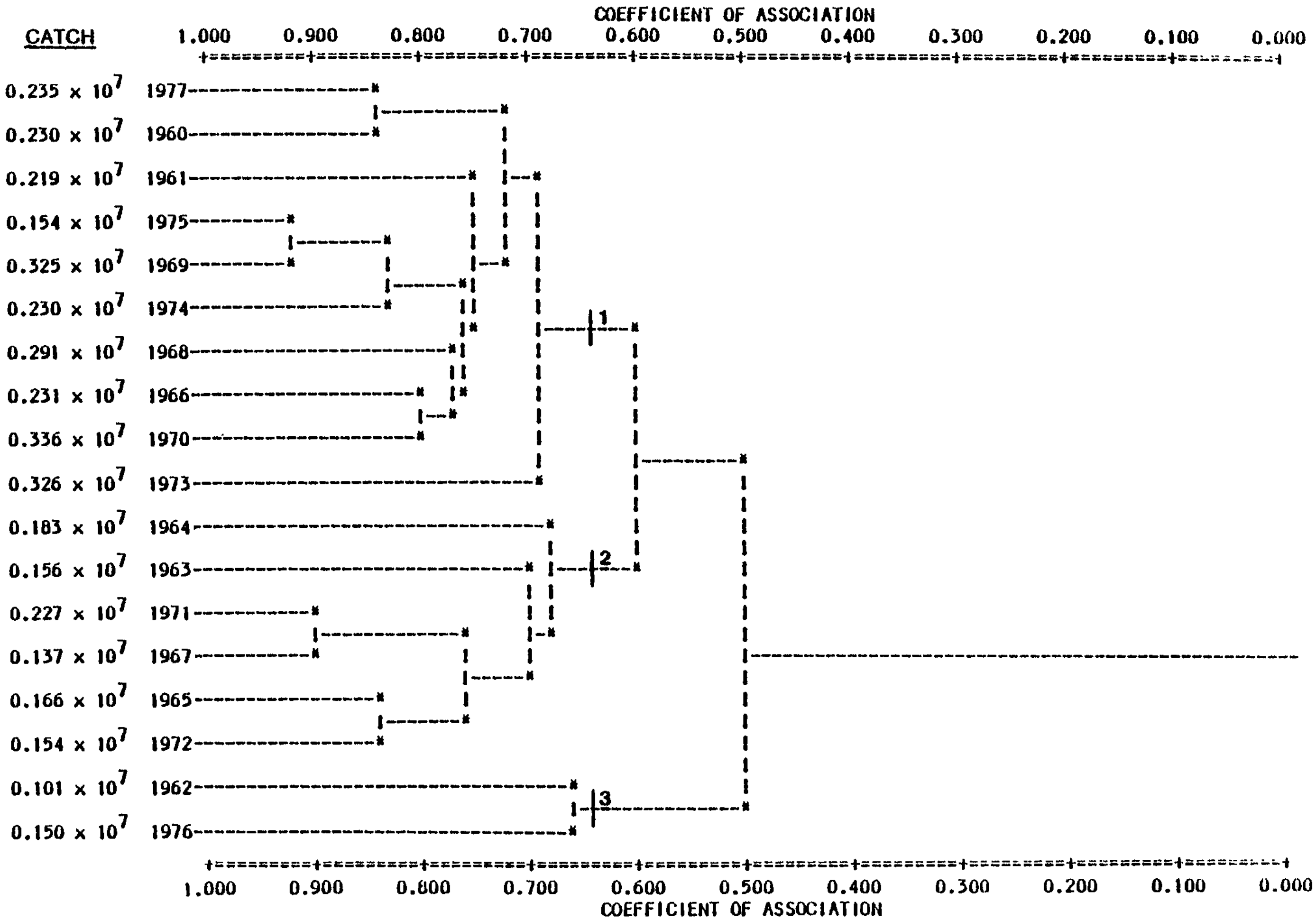

Figure 72. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for white shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.

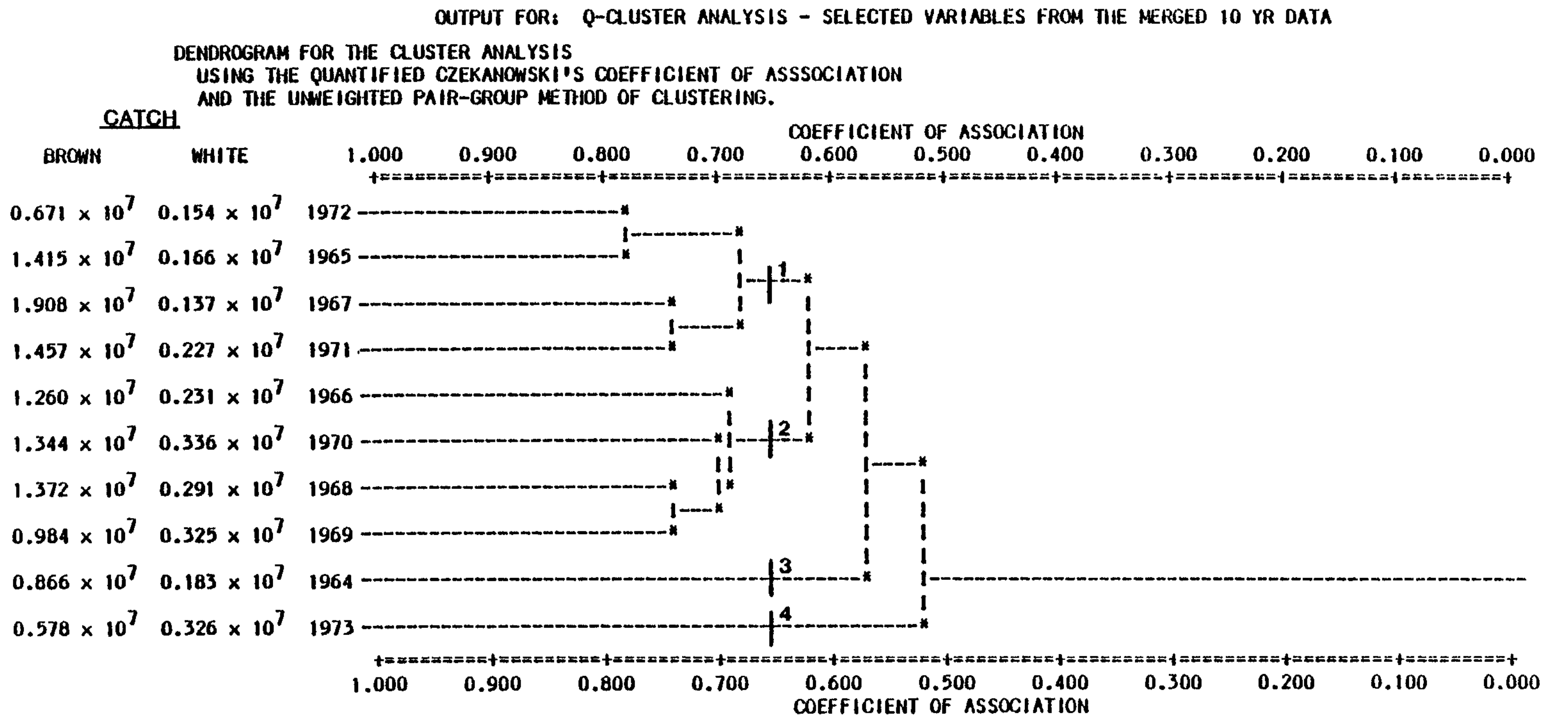

Figure 73. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown and white shrimp total catch (pounds, heads off) in area 19 for the period 1964-1973.

OUTPUT FOR: Q-CLUSTER ANALYSIS - SELECTED VARIABLES FROM THE MERGED 18 YR DATA

DENDROGRAM FOR THE CLUSTER ANALYSIS
USING THE QUANTIFIED CZEKANOWSKI'S COEFFICIENT OF ASSSOCIATION
AND THE UNWEIGHTED PAIR-GROUP METHOD OF CLUSTERING.

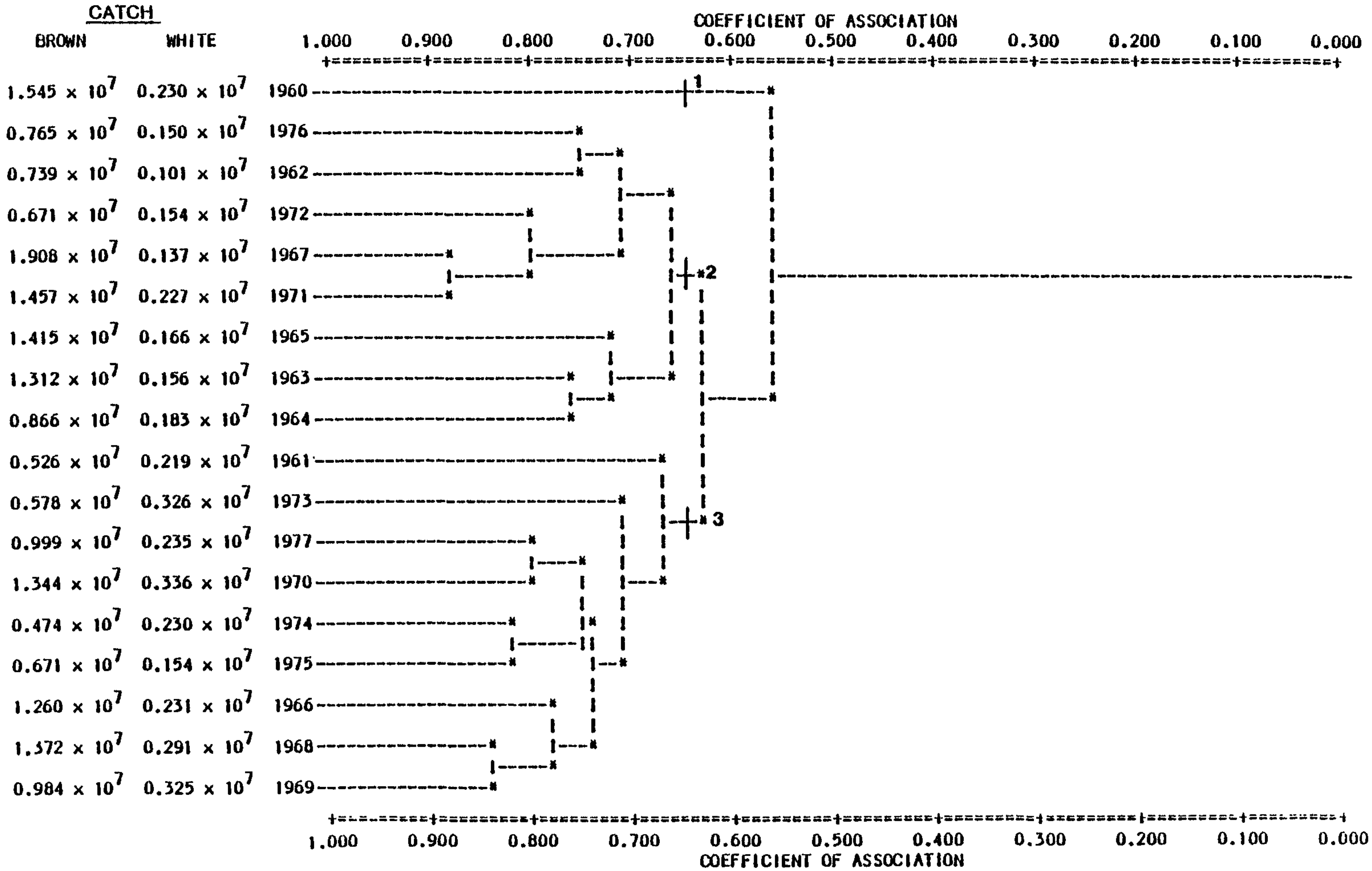

Figure 74. Dendrogram resulting from Q-mode cluster analysis based on environmental and recruitment variables that were most important in the categorical regression equations developed for brown and white shrimp total catch (pounds, heads off) in area 19 for the period 1960-1977.