COASTAL ZONE MANAGEMENT SERIES

ENVIRONMENTAL FACTORS RELATING TO LOUISIANA MENHADEN HARVEST

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CENTER FOR WETLAND RESOURCES • LOUISIANA STATE UNIVERSITY • BATON ROUGE, LOUISIANA 70803

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Abstract

The relationship between selected environmental factors of coastal Louisiana to Louisiana menhaden harvest and effort was studied by analyzing the factors separately, by factor analysis, by multiple regression, and by cross correlations. The environmental factors were air temperatures, water temperatures, rainfall data, tide data, and wind speeds and directions applicable to coastal Louisiana from 1950 through 1971; these data were reduced to weekly and monthly statistics. The menhaden catch and effort data were for the Louisiana harvest during 1950 through 1971 expressed as weekly and monthly totals.

Only tide range data showed significant changes during the last 20 years, namely an increase of mean tide range, which is probably related to the rise in sea level noted by other Louisiana researchers. Factor analysis and multiple regressions both indicate that the same general type of data have a significant relationship to menhaden harvest, namely effort, time effects, water or air temperature, and some interactions among them. Significant relationships still exist between menhaden catch and selected environmental data when the effects of effort and time are removed; however, time effects are probably masking important environmental effects. A variety of variables can be used to produce a significant predictive relationship; examples are effort; minimum air temperature interacting with month, both not lagged and lagged for 12 months; wind direction at New Orleans interacting with month; wind direction at Baton Rouge interacting with minimum air temperature and lagged for 12 months; wind direction at New Orleans; mean air temperature; and maximum water temperature. The resulting coefficient of determination (R^2) is 86 percent and is significant at $p < 0.0001$. The harvest data were fitted to an sine curve adding the significant environmental variables, and the coefficient of determination (R^2) is 89 percent.

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Introduction

Previous work by the principal investigator showed that five to eight environmental factors significantly accounted for about 70 to 85 percent of the menhaden catch/effort data. These factors were tide range, sea level, air and water temperature, salinity, rainfall, wind speed and direction, and interactions among them. Predictor equations for menhaden harvest based on these environmental factors showed reasonable agreement with observations; however, there were only about 64 monthly observations (8 years x 8 months), and partitioning for monthly effects (i.e., 8 April points, 8 May points, etc.) made extensive extrapolations a tenuous procedure. As a result, it was proposed that all available data, over 20 years on at least a weekly basis, should be similarly brought to analysis.

Objectives

The objectives of this work were as follows:

1. To identify those environmental factors that are significantly related to menhaden harvest and, given sufficient data availability, to determine how these factors affect juvenile distribution and abundance.
2. To measure the extent of each of these factors on a yearly, seasonal, monthly, and geographical basis giving particular attention to short-lived environmental effects such as warm air and water temperatures during winter.
3. To develop and test predictor equations for menhaden harvest and possibly for juvenile distribution and abundance.

Materials and Methods

Environmental Data

Data on air temperature, water temperature, rainfall, tides, and wind speed and direction for coastal Louisiana were collected from various federal government sources for the years 1950 through 1971.

Data on air temperature, rainfall, and wind speed and direction were purchased for the years 1950 through 1971 from the Environmental Data Service, National Climatic Center, Federal Building, Asheville, N.C. 28801. Air temperatures were taken at some 68 stations in coastal Louisiana; each station usually made 200 observations per week. Rainfall data were taken at some 68 stations in coastal Louisiana; each station usually made daily observations and an average of 30 observations per week. Wind speeds and directions were taken at New Orleans, Baton Rouge, and Lake Charles; usually data were collected every three hours in terms of one speed observation expressed in terms of knots and one direction observation expressed in terms of 16 possible compass divisions. Water temperatures and tide data were purchased from the National Oceanic and Atmospheric Administration in Rockville, MD. 20852. Temperature data were recorded daily about 8 miles offshore of Grand Isle, La.; daily inshore observations were obtained from publications of the United States Coast and Geodetic Survey and on an hourly basis from the Louisiana Wildlife and Fisheries Commission. Tide data were recorded at three locations along the Louisiana coast.

Menhaden Harvest and Effort Data

Data on menhaden harvest and effort for Louisiana were obtained by courtesy of Robert B. Chapoton, Leader, Mendaden Resources Assessment Task, Atlantic Estuarine Fisheries Center, National Marine Fisheries Service, Beaufort, N.C. 28516. Menhaden harvest data were expressed on a weekly basis for three coastal regions of Louisiana from 1950 through 1971; these data were combined into one total value for Louisiana by weeks and by months. Effort data corresponding to the catch data were also obtained in terms of vessel weeks. They were combined into one total value for Louisiana by weeks and by months. The proprietary aspects of these data were maintained.

Analytical Techniques

All environmental data were screened and checked by means of computer printouts; they were reduced to various statistics including minimums, means, maximums, ranges, frequencies, and/or vectors on the basis of weekly and monthly sets in order to match the menhaden catch and effort data.

Statistical treatment was done by means of the Statistical Analysis System (Barr and Goodnight, 1972), which includes general statistics (means, standard deviations, confidence limits, etc.), factor analysis, stepwise multiple regression (and others), and correlations. Cross correlations were computed by means of the subroutine "cross" (available at the LSU Computer Center), whereby cross covariances are computed for two series of data; and one series can lead or lag the other series in time. These covariances were normalized to correlation values. The sine curve function was devised by L. Gulick and R. Hebert, research associates of the Center for Wetland Resources.

The initial group of environmental variables used in the analysis is given in table 20. A variety of models were devised for testing as selected from the 120 variables listed on table 20. The structure of each model was basically the same, namely, the menhaden harvest was the dependent variable and all the others (environmental data plus effort and yearly effects) were considered independent variables. An interaction between 2 variables is defined as their product; air temperature times (x) wind speed means the interaction between air temperature and wind speed.

Results

Environmental Data

Air temperatures, water temperatures, rainfall, and tide data for coastal Louisiana, 1950 through 1971, are summarized in figures 1 through 4. Wind speed and direction frequencies for the same period for New Orleans, Baton Rouge, and Lake Charles, La., are summarized in tables 1 through 3.

Air temperature and water temperature data for coastal Louisiana indicate a general trend that is comparable to a sine curve (figures 1 and 2). The winds of coastal Louisiana can be characterized as a predominantly easterly system, as the wind blows out of the east more than 50 percent of the time (tables 1 through 3), with winter winds mainly out of the north and summer winds mainly out of the south. Figures 13 through 15 show a progressive increase in minimum tide range, mean tide range, and maximum tide range, respectively, especially after 1962 (year #13). No similar trends, increases or decreases, are evident in the data on air temperatures, water temperatures, rainfall, and wind speeds and directions (figures 1 through 3 and figures 8 through 12 and tables 1 through 3).

Menhaden Catch Effort Data

Menhaden catch data for Louisiana from 1950 to 1971 are illustrated in figure 5. The general trend of the data is one of increase, especially after 1958 (year #9 on figure 5). Effort data for Louisiana menhaden catch are illustrated in figure 6; these data also show a general increase starting in the late 1950s and early 1960s. The catch/effort ratios are plotted in figure 7; these data reflect the same trend of increase as illustrated in figures 5 and 6 for catch and effort separately.

Factor Analysis

Factor analysis was used to "screen" the environmental and menhaden catch and effort data in order to determine how the environmental data could best be manipulated for the multiple regressions. Table 4 gives the rotated factor matrix and cumulative percentages of eigen values for a 22-variable model using weekly data. The acronyms of the environmental variables are defined in table 20. Six factors are identified as important and they account for 72 percent of the data. Each of these factors can be identified with the following groups of environmental data and characterized as indicated below:

Factor and % Value	Variables		Characterization
#1 - 30.6%	Amin	= mean air temperature	
	X20	= (maximum air temperature)^2	
	max wt	= maximum water temperature	air and water
	min wt	= minimum water temperature	temperatures
	A wt	= mean water temperature	
#2 - 14.8%	catch	= menhaden harvest	
(45.4%)*	effort	= menhaden vessel week	
	max wt	= maximum water temperature	
	min wt	= minimum water temperature	water temperatures
	A wt	= mean water temperature	
#3 - 8.6%	Rmax	= maximum rainfall	rainfall
(54.0%)*	Rmin	= minimum rainfall	
#4 - 6.7%	MinR	= minimum tide range	tide
(60.7%)*	ATR	= mean tide range	
#5 - 5.9%	NOSP	= wind speed at New Orleans	
(66.6%)*	BRSP	= wind speed at Baton Rouge	wind speed
	LCSP	= wind speed at Lake Charles	
#6 - 5.6%	MTR	= maximum tide range	tide
(72.2%)*			

*(%) = cumulative percentage

Monthly data were similarly analyzed and the results are given in table 5. Yearly and monthly effects were added and the effects of time (IS in table 4) and X20 maximum air temperature were deleted. The cumulative percentage of eigen values is only slightly increased to 73 percent. The six important factors can be characterized as follows: (1) air and water temperatures; (2) yearly and tidal effects; (3) wind speed; (4) rainfall; (5) wind direction and tide range; and (6) wind direction (see table 5).

A complex environmental model was constructed by using the same variables listed in tables 5 and 6 and also by lagging them by 12 months (these are indicated by the prefix L). Additional variables were added as defined on table 20.

The results for factor analysis of this complex model are given in table 6. Fourteen factors account for about 89 percent of the data.

Factor and % Value	Variables		Characterization
#1 - 30.7% continued	L max wt	= maximum water temperature lagged 12 months	
	L min wt	= minimum water temperature lagged 12 months	
	LA max	= maximum air temperature lagged 12 months	air and water temperatures
	LA mean	= mean air temperature lagged 12 months	
	X20	= (maximum air temperature)^2	
	LX20	= (maximum air temperature)^2 lagged 12 months	
	X21	= (minimum air temperature)^2	
	LX21	= (minimum air temperature)^2 lagged 12 months	
#2 - 19.5% (50.2%)*	I yr	= year effects	
	X100	= mean air temperature interacting with month	
	LX100	= X100 lagged 12 months	
	X46	= wind direction New Orleans interacting with month	time effects of wind interacting with air temperatures
	X36	= wind speed New Orleans interacting with month	
	LX36	= X36 lagged 12 months	
	X78	= wind speed Lake Charles interacting with month	
	LX78	= X78 lagged 12 months	
	X96	= minimum air temperature interacting with month	
	LX96	= X96 lagged 12 months	
#3 - 9.4% (59.6%)*	NOSP	= wind speed New Orleans	
	BRSP	= wind speed Baton Rouge	
	LCSP	= wind speed Lake Charles	wind speed interacting with air temperature
	X27	= (NOSP x maximum air temperature)	
	X28	= (NOSP x minimum air temperature)	
#4 - 4.4% (66.0%)*	LBRDR	= wind direction Baton Rouge lagged 12 months	
	LX59	= (BRDR x minimum air temperature) lagged	wind direction interacting with air temperature
	LX60	= (BRDR x mean air temperature) lagged	
#5 - 3.3% (67.3%)*	IMON	= monthly effects	time effects
#6 - 3.3% (70.6%)*	LNOSP	= wind speed New Orleans lagged	wind effects lagged
	LX27	= (NOSP x maximum air temperature)	
#7 - 3.2% (73.8%)*	LNODR	= wind direction New Orleans lagged	
	LX44	= (NODR x minimum tide range)	lagged time effects and tide
	LX46	= (NODR x monthly effects)	
#8 - 2.8% (76.6%)*	BRDR	= wind direction Baton Rouge	wind
#9 - 2.5% (79.1%)*	MINR	= minimum tide range	
	X44	= (NODR x minimum tide range)	tide
#10 - 2.5% (81.6%)*	RMAX	maximum rainfall	
	RMEAN	= mean rainfall	rainfall
#11 - 2.1% (83.7%)*	MTR	= maximum tide range	tide
#12 - 1.8% (85.5%)*	LCDR	= wind direction Lake Charles	wind
#13 - 1.8% (87.3%)*	cat eff	= menhaden catch effort ratio	catch/effort
#14 - 1.7% (89.0%)*	SAMDJF	= sum minimum air temperatures for December, January and February	min air temperatures in winter

*(%) = cumulative percentage

Multiple Regressions

A variety of models were devised and tested using multiple regression. A stepwise search technique for maximizing the coefficient of determination (R^2) was used in all cases in order to avoid creating a high R^2 value by loading variables into the model. In other words, this means that the technique searches among the variables and selects only those that maximize R^2; it does not include those that are statistically unimportant, but which would also add to the R^2 value (see Barr and Goodnight, 1972). The results of these regressions are given in tables 7 through 18.

Tables 7 and 8 give the analysis of variance table, regression coefficients, and statistics for fitting an 11- and 6-variable model, respectively. The 11-variable model significantly accounts for about 73 percent of the data; the variables are effort, X96 (minimum air temperature interacting with month), X36 (wind speed at New Orleans x month), X78 (wind speed at Lake Charles x month), X21 (minimum air temperature^2), X90 (maximum air temperature x minimum water temperature), X94 (minimum air temperature x mean water temperature), X46 (wind direction at New Orleans x month), and X44 (wind direction at New Orleans x minimum tide range). The data used were weekly observations.

The 6-variable model (table 8) is based on monthly data and significantly accounts for about 81 percent of the data. The variables are effort, yearly effects, X60 (wind direction at Baton Rouge x mean air temperature), X59 (wind direction at Baton Rouge x minimum air temperature) and X28 (wind speed at New Orleans x minimum air temperature).

Table 9 gives the best possible model for individual months, April through August, for 1950 through 1971, but only 19 variables were screened. Table 10 gives the best possible model for individual months, April through August, for 1950 through 1971, but 124 variables were screened. The models with the highest R^2 values from table 10 and summarized below:

	R^2 per Model	
	19 Variables*	124 Variables*
April	84.9	93.6
May	66.8	81.6
June	71.8	77.9
July	77.4	89.0
August	72.2	97.7
September	--	99.5
October	--	65.7

*Number of variables screened

These models should be treated cautiously since the number of observations (20 or less) is small because the data were expressed on a yearly basis.

Table 11 presents an 8-variable model screened from 84 variables using monthly data. The coefficient of determination (R^2) is 86.2 percent. Significant variables are effort, LX96 (minimum air temperature x month but lagged 12 months), X46 (wind direction at New Orleans x month), LX59 (wind direction at Baton Rouge x minimum air temperature but lagged 12 months), NODR (wind direction at New Orleans), AMEAN (mean air temperature), X96 (minimum air temperature x month), and MAX WT (maximum water temperature).

Table 12 presents a 4-variable model screened from 11 variables using monthly data; the R^2 is 75.8 percent. Significant variables are effort, year effects, BRDR (wind direction at Baton Rouge), and X59 (wind direction at Baton Rouge x minimum air temperature.

Table 13 presents a 4-variable model screened from 11 variables using weekly data; the R^2 value is 71 percent. Significant variables are effort, X86 (wind direction at Lake Charles x minimum tide range), X32 (wind speed at New Orleans x mean water temperature), and ATR (mean tide range).

Table 14 presents an 8-variable model screened from 9 variables using monthly data; the R^2 is 54.7 percent. Effort and yearly effects were not included in the 9 variables. Significant variables are X59 (wind direction at Baton Rouge x minimum air temperature), BRDR (wind direction at Baton Rouge), X86 (wind direction at Lake Charles x minimum tide range), X89 (maximum air temperature x maximum water temperature), X32 (wind speed at New Orleans x mean water temperature), ATR (mean tide range), X112 (maximum rainfall x mean tide range), and X29 (wind speed at New Orleans x mean air temperature).

Table 15 presents a 4-variable model from monthly data; the R^2 is 78.8 percent. The significant variables are effort, yearly effects, BRDR (wind direction at Baton Rouge), and X59 (wind direction at Baton Rouge x minimum air temperature). Predicted catches calculated by this model are compared with observed values (see table 15).

Table 16 presents a 2-variable model from yearly data; the R^2 value is 77.2 percent. The variables are effort and SAM (sum of minimum air temperatures during December, January, and February). Predicted catch values from this model are compared with observed values.

Table 17 presents a 3-variable model from the yearly data of table 16; the R^2 value is 80.0 percent. Predicted menhaden catch values are calculated from this model and compared with observed values.

Cross-Correlations

Table 18 presents cross-correlations calculated between menhaden catch and environmental data for each month from time 0 (i.e., the same month) to 24 months before the catch. Sixteen environmental variables are used. Significant correlations at $p = 0.05$ are 0.138 and at $p = 0.01$ are 0.181 for more than 200 observations.

Table 19 also presents cross-correlations calculated as follows: April menhaden catch is related to each month from 0 month to 24 months prior to the catch. Those parameters having a significant correlation with menhaden catch for each month are listed according to the particular lag month. For example, the May menhaden catch is significantly related to maximum tide range when maximum tide range is considered 1, 11, 12, and 13 months prior to the catch. The times of these significant correlations were plotted onto figure 16 in order to see if environmental parameters were operative in some way during the same time period. The circled months on figure 16 indicate time periods when important environmental variables were most significant; there appear to be four important time periods, i.e., spring to early summer, winter, the previous spring and summer, and the previous winter. Other significant variables are wind direction and speed at Lake Charles and Baton Rouge, maximum rainfall, and mean tide range--a total of seven significant variables.

Sine-Curve Models

Menhaden catch data were fitted to a modified sine curve with effort and time effects being incorporated. The expression used is as follows:

$$y = EB_1 + EB_2 \sin (B_3t + B_4)$$

where

y = catch and E is effort = $\frac{\text{Mean}}{\text{Mean effort}}$

t = time and B_1, B_2, B_3, and B_4 are coefficients for the sine curve

The results of this fit is given in figure 18; the R^2 value (coefficient of determination) is approximately 76 percent. The results may be visually compared with observed data on figure 21.

The coefficients of signficant environmental variables were added to the above expression; these variables are

$$y = EB_1 + EB_2 \sin (B_3t + B_4) + EB_5L \times 96 + EB_6L \times 59 + EB_6L \times 59 + EB_7\ LL \times 100 + EB_8\ \text{Amean}$$

as defined above and on table 20 where L = 12 months lag and LL = 18 months lag.

The results of this fit are given in figure 22; the R^2 value is approximately 89 percent. The results may be visually compared with observed data on figure 19.

Discussion

Effort and Time Effects

Models devised to account for menhaden harvest data were somewhat different from previous attempts. Regressions were set up whereby menhaden catch was a function of the environmental variables of table 20 and of effort and time effects. This approach usually resulted in effort and time effects having the most significant relationship to menhaden catch ($R^2 \geq 70\%$); this fact is not surprising and indeed Chaptoton's predictive scheme (1975) is based primarily on the relationship of effort to catch. Present analyses show that the addition of a time variable can increase the R^2 value and thus make a better prediction possible; this time variable probably masks important environmental factors. The analyses also show that partitioning of time effects, such as by years and by months in each year, also increases the R^2 value and predictive capacity of the model.

Important Environmental Variables and Predictor

Environmental data of present analyses were reduced to some 17 variables; with month effects and effort added, the total was 19 variables (table 20). These variables were then partitioned into potential squared functions and interactions as indicated in table 20; this increased the list to 120 variables that potentially are related to (or might affect) menhaden catch. In addition, some of these variables were expressed as a lag effect (their effect being made prior to the catch). The time lags used were 12 and 18 months. These dates are somewhat of a compromise because all possible lagged months could not be tested in one computer run since the capacity of the program and the computer was overloaded.

These results are given in tables 4 through 17. Table 11 illustrates the results of using some of these partitioned variables. A R^2 value of 86 percent is one of the highest obtained for monthly data. This model indicates that effort plus five environmental variables, from the same time period as the menhaden catch, plus two environmental variables lagged 12 months prior to the time period of the menhaden catch, are all significantly related to the harvest. The variables are effort, LX96 (minimum air temperature interacting with month; and lagged for 12 months), X46 (wind direction at New Orleans interacting with month), LX59 (wind direction at Baton Rouge interacting with minimum air temperature, and lagged for 12 months), NODR (wind direction at New Orleans), AMEAN (mean air temperature), X96 (minimum air temperature interacting with month but not lagged), and MAX WT (maximum water temperature). Other variables, however, also provided a good estimate of the data, but I am confident that a more systematic approach could now determine which variables are biologically more realistic to use in the predictor model. In particular, I believe the wind effects could be more effectively partitioned in terms of a specific direction and speed. There was not sufficient time to do this analysis, but the data are now in the proper form to do so; preparing these data for this type of analysis required considerable effort and talent by our programming and analysis staff. This aspect should be pursued in future work of this sort.

Cross-Correlations

These analyses suggest that the effect of an environmental variable during a particular month is more important than at other times. For example, field workers have long believed that a warm wind blowing out of the southeast for 2 weeks during January or February and causing water temperatures to rise above 60°F probably, in a significant way, improves the well-being of estuarine fishes such as menhaden. This effect should be reflected in some way at the time of harvest, such as by producing larger and/or more fish. This, of course, is speculation; but consider the data of table 19 plotted onto figure 16. This plot indicates the month that a particular environmental variable was significantly related to menhaden harvest. For example, April harvest is significantly related to maximum tide range 10 months prior to the harvest. May catch is significantly related to maximum tide range 11 months prior to the harvest. June catch is significantly related to maximum tide range 12 months prior to the harvest. July catch is significantly related to maximum tide range 13 months prior to the harvest. August catch is significantly related to maximum tide range 14 months prior to the harvest. Note that figure 16 shows that the maximum tide range occurred during June of the previous year. Figure 16 also indicates the possibility of at least four important time periods during the life history of the menhaden. The first time period is the spring and early summer period before harvest. The second period is the winter before harvest; this is the period of spawning offshore and migration to the estuaries (see figure 17). The third period is the prior spring and summer (March through July and/or August); this is the period when Ao stock resides in the estuaries (see figure 17). The fourth period is the winter before when most of the harvested stock is spawned (figure 17). This approach, I believe, illustrates how realistic monthly models could be constructed for prediction and for additional understanding of the menhaden life cycle.

Conclusions

1. Effort and yearly effects account for most of the data variation of Louisiana menhaden harvest. Effort accounts for approximately 70 percent of the data, and yearly effects account for approximately 5 to 10 percent. Yearly effects are probably masking certain environmental factors that vary significantly from one year to another.

2. When effort and yearly effects are removed from the analysis (mixed-mode analysis) the coefficient of determination (R^2) is reduced to about 55 percent. However, quite a few environmental variables have the same effect on the R^2. Most of these variables are interactions between wind and water temperature or air temperature or rainfall or tide range. Thus, it is possible to construct several significant predictor models.

3. Partitioning of the environmental data (such as is illustrated in tables 1, 2, and 3) usually increases the R^2 value and thus improves the overall prediction capability of a model. This technique makes it possible to construct predictor models that are more realistic from a biological viewpoint. It also eliminates some of the problem of expressing (and using) data in the form of means or other measures of control tendency; a great deal of information is lost when data are expressed only as means. This approach could yield information in regard to critical times in the life history of the menhaden as illustrated in figure 16 and table 19.

4. Lag effects or environmental conditions prior to harvest can be readily incorporated into predictor models. Variables that are lagged and significantly related to menhaden harvest are the minimum air temperatures and wind direction interacting with minimum air temperature; the critical time periods for the operation of these variables are still not identified.

5. Predictor equations based on effort and time significant account for 70 percent of the data. If selected environmental variables (such as minimum air temperature, maximum water temperature, and wind direction) are added to these equations then the R^2 is improved to 86 percent.

6. Significant change in the tide range has occurred along the Louisiana coast during the last 20 years; in particular the tide range has increased. These changes show a significant relationship to menhaden harvest, which is suggestive that there have been increases of potential fish habitats in coastal Louisiana.

7. Some cross-correlations produced by lagging each environmental variable with catch of a particular month are highly significant. These data suggest important environmental occurrences during the life history of the menhaden. For example, maximum tide range has an important effect on menhaden during the months of May and June when the juveniles are residing in the estuaries. This technique could provide an indirect measure of the effects of past environs on the fish populations.

Recommendations

Because major effort (labor and money) was expended procuring and preparing the environmental data and because the potential worth of these data is only now being realized, it is recommended that research be continued on these data. Work should be continued for an additional year or two. Approximately one-half of the present financial support would be adequate.

Specific objectives of continued research should be (1) to disaggregate the data into geographic sections; (2) to relate the environmental variables to the distribution and abundance of juvenile menhaden; and (3) to partition the environmental data in more detail so as to more adequately account for the effects and times of interactions. In particular, air temperature should be partitioned and related to wind data of tables 1, 2, and 3 so that critical air temperatures, wind directions, and wind speeds can be isolated in terms of specific time periods.

Air and water temperatures in coastal Louisiana are closely related (correlation coefficient >0.9), and because air temperatures are monitored in more locations and more often than water, the former could be used as our index for monitoring and predicting changes in menhaden harvest.

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Table 1

Wind Percentage Frequency for New Orleans

WIND SPEED GROUPS PER CENT FREQUENCIES

DIRECTION	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	TOTAL
1	1.7	3.3	1.4	0.2	0.0	0.0	0.0	0.0	0.0	4206
2	1.8	3.8	2.2	0.4	0.1	0.0	0.0	0.0	0.0	5236
3	1.5	4.1	2.3	0.4	0.1	0.0	0.0	0.0	0.0	5306
4	1.0	3.3	2.1	0.6	0.1	0.0	0.0	0.0	0.0	4498
5	1.5	3.7	2.6	0.8	0.2	0.0	0.0	0.0	G.0	5546
6	1.1	2.2	1.7	0.7	0.2	0.0	0.0	0.0	0.0	3736
7	0.9	1.5	1.0	0.4	0.1	0.0	0.0	0.0	0.0	2478
8	1.0	1.6	0.7	0.2	0.0	0.0	0.0	0.0	0.0	2217
9	1.7	1.7	0.6	0.2	0.0	0.0	0.0	0.0	C.0	2665
10	1.1	1.7	0.5	0.1	0.0	0.0	0.0	0.0	0.0	2142
11	1.2	2.5	0.8	0.1	0.0	0.0	0.0	0.0	0.0	2976
12	1.1	3.4	1.3	0.4	0.1	0.0	0.0	0.0	0.0	3918
13	1.4	4.9	2.8	0.8	0.1	0.0	0.0	0.0	0.0	6297
14	0.9	3.8	2.2	0.6	0.1	0.0	0.0	0.0	0.0	4607
15	1.1	3.3	1.3	0.2	0.0	0.0	0.0	0.0	0.0	3723
16	1.2	2.9	1.1	0.2	C.0	0.0	0.0	0.0	0.0	3366
TOTAL	12674	30077	15420	4106	720	96	13	8	3	63117

QUARTERLY TOTAL PERCENTAGE

East	North	West	South
49.5	45.9	31.9	43.1

Note: Percentage frequency of wind direction and speed for New Orleans, Louisiana, 1950-1971. Direction is given in terms of 16 possible divisions of 360° and speed is given in terms of 9 classes in mph. Total column is number of observations; quarterly totals are overlapping.

Table 2

Wind Percentage Frequency for Baton Rouge

WIND SPEED GROUPS PER CENT FREQUENCIES

DIRECTION	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	TOTAL
1	2.2	4.8	1.6	0.2	0.0	0.0	0.0	0.0	0.0	5473
2	1.8	3.4	1.0	0.1	0.0	0.0	0.0	0.0	0.0	3929
3	2.2	4.0	1.3	0.2	0.0	0.0	0.0	0.0	0.0	4808
4	1.3	2.8	1.4	0.3	0.0	0.0	0.0	0.0	0.0	3629
5	1.5	4.3	2.2	0.6	0.1	0.0	0.0	0.0	0.0	5459
6	0.7	2.1	1.1	0.4	0.1	0.0	0.0	0.0	0.0	2759
7	1.0	2.4	1.3	0.4	0.1	0.0	0.0	0.0	0.0	3208
8	0.7	1.8	0.7	0.2	0.0	0.0	0.0	0.0	0.0	2115
9	1.4	3.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	3303
10	0.7	2.4	0.8	0.1	0.0	0.0	0.0	0.0	0.0	2470
11	0.8	2.5	1.4	0.2	0.0	0.0	0.0	0.0	0.0	3088
12	0.5	1.4	1.3	0.4	0.0	0.0	0.0	0.0	0.0	2266
13	1.1	3.9	2.5	0.7	0.1	0.0	0.0	0.0	0.0	5113
14	0.9	3.4	1.6	0.3	0.1	0.0	0.0	0.0	0.0	3895
15	1.9	5.0	2.1	0.5	0.0	0.0	0.0	0.0	0.0	5916
16	1.4	4.2	1.5	0.3	0.0	0.0	0.0	0.0	0.0	4674
TOTAL	12496	31958	14076	3157	360	41	10	6	1	62105

QUARTERLY TOTAL PERCENTAGE

EAST	NORTH	WEST	SOUTH
52.05	41.71	30.93	44.15

Note: Percentage frequency of wind direction and speed for Baton Rouge, Louisiana, 1950-1971. Direction is given in terms of 16 possible divisions of 360° and speed is given in terms of 9 classes in mph. Total column is number of observations; quarterly totals are overlapping.

Table 3

Wind Percentage Frequency for Lake Charles

WIND SPEED GROUPS PER CENT FREQUENCIES

DIRECTION	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40+	TOTAL
1	2.1	4.4	1.2	0.2	0.0	0.0	0.0	0.0	0.0	4938
2	1.6	3.8	1.4	0.2	0.0	0.0	0.0	0.0	0.0	4418
3	2.2	3.9	1.5	0.3	0.0	0.0	0.0	0.0	0.0	4883
4	1.4	2.8	1.4	0.4	0.0	0.0	0.0	0.0	0.0	3748
5	2.0	3.8	2.3	0.8	0.1	0.0	0.0	0.0	0.0	5607
6	0.8	1.8	1.1	0.5	0.1	0.0	0.0	0.0	0.0	2705
7	1.1	1.5	0.7	0.2	0.0	0.0	0.0	0.0	0.0	2261
8	0.6	1.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	1385
9	0.9	1.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	1668
10	0.7	1.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	1532
11	1.2	2.6	1.2	0.3	0.1	0.0	0.0	0.0	0.0	3417
12	0.8	2.7	2.1	0.7	0.2	0.0	0.0	0.0	0.0	4048
13	1.9	5.1	3.7	1.3	0.3	0.1	0.0	0.0	0.0	7755
14	1.0	3.0	2.0	0.8	0.2	0.0	0.0	0.0	0.0	4391
15	1.7	4.3	2.1	0.7	0.2	0.0	0.0	0.0	0.0	5671
16	1.2	3.6	1.4	0.3	0.1	0.0	0.0	0.0	0.0	4126
TOTAL	13339	29448	14404	4264	870	168	41	17	2	62553

QUARTERLY TOTAL PERCENTAGE

EAST	NORTH	WEST	SOUTH
51.44	39.98	27.20	49.46

Note: Percentage frequency of wind direction and speed for Lake Charles, Louisiana, 1950-1971. Direction is given in terms of 16 possible divisions of 360° and speed is given in terms of 9 classes in mph. Total column is number of observations; quarterly totals are overlapping.

Table 4

Factor Analysis Results of 22 Variables (Weekly)

MENHADEN REGRESSION FOR LOUISIANA COAST DATA ALL 21:20 FRIDAY, OCTOBER 24, 1975

ROTATED FACTOR MATRIX

	1	2	3	4	5	6
NOSP	0.10119	-0.09456	-0.03635	0.05950	0.60980	0.00526
NODR	-0.02025	0.08648	0.07537	-0.00144	0.34589	-0.46250
BRSP	0.09916	-0.04921	0.06929	-0.08260	0.62383	0.00385
BRDR	-0.06917	0.09354	0.06904	0.14933	0.16590	-0.53168
LCSP	0.10824	-0.09024	-0.05192	0.06280	0.57393	-0.03387
LCDR	-0.00058	-0.03089	0.03120	0.02801	-0.11187	-0.34638
IS	0.35718	0.40666	-0.05001	0.46664	-0.29957	-0.25412
AMAX	-1.00658	-0.16228	0.10492	0.00095	-0.13663	-0.04609
RMAX	-0.19751	-0.02393	0.91307	0.00232	0.02227	-0.05097
RMEAN	-0.07823	0.00218	0.93700	0.01690	-0.01979	-0.04183
AMEAN	-0.98341	0.00836	0.12513	0.00549	-0.13515	-0.06377
AMIN	-0.12397	1.02717	-0.00299	-0.13724	-0.06017	0.01652
MAXWT	-0.83254	0.57268	0.06875	-0.06992	-0.12696	0.01421
MINWT	-0.83395	0.57515	0.03736	-0.03687	-0.13169	-0.03802
AWT	-0.76609	0.57246	0.04440	-0.05720	-0.06458	0.02380
MTR	0.02006	0.03079	0.20934	0.43237	0.19366	0.62282
MINR	0.01183	-0.02453	-0.06208	0.68228	-0.06124	-0.31955
ATR	0.04435	-0.01145	0.07808	0.82385	0.10310	0.23564
CAT	0.02538	0.67570	-0.04724	0.40986	-0.48141	-0.09999
EFF	-0.41130	0.54997	-0.05050	0.40040	-0.34867	-0.10403
X20	-0.98078	-0.00723	0.09941	-0.01080	-0.14377	-0.03933
CATEFF	-0.23774	0.39828	-0.04424	0.37594	-0.52169	-0.14159

CUMULATIVE PERCENTAGE OF EIGENVALUES

0.30628	0.45393	0.53991	0.60729	0.66612	0.72210

EIGEN VALUES

6.73817	3.24820	1.89166	1.48232	1.29432	1.23151	0.98474	0.97039	0.90413	0.85113
0.73985	0.70158	0.50546	0.40509	0.29975	0.20458	0.13200	0.08286	0.02937	0.00331
-0.03409	-0.66633								

Note: Results of factor analysis of 22 variables on a weekly basis (environmental and catch/effort data) involved in Louisiana menhaden harvest for 1950 through 1971. Variables defined in table 20 (15 = time effects). Circled numbers indicate those types of variables that exert the same effect; there are six important types of variables (see text).

Table 5

Factor Analysis Results of 22 Variables (Monthly)

MENHADEN REGRESSION FOR LOUISIANA COAST   DATA ALL   21:01 FRIDAY, OCTOBER 24, 1975

ROTATED FACTOR MATRIX

	1	2	3	4	5	6
NOSP	0.19982	-0.10266	0.77053	0.09367	-0.13431	-0.03851
NODR	0.00047	-0.01276	0.15885	-0.01680	0.00155	-0.74078
BRSP	0.13287	-0.21590	0.80955	-0.02315	-0.06073	-0.05501
BRDR	-0.08941	0.26805	-0.10726	-0.01136	0.08592	-0.62603
LCSP	0.18887	0.01024	0.80859	-0.01269	-0.02528	-0.02818
LCDR	0.01600	0.14970	-0.05832	0.16690	0.69286	0.02548
AMAX	-0.88165	-0.18859	-0.05673	0.13153	-0.09921	-0.02660
RMAX	-0.13608	-0.09877	0.12021	0.80741	-0.07160	-0.10302
RMEAN	-0.15028	0.09466	-0.10553	0.77298	0.12946	0.14074
AMEAN	-0.93270	-0.04780	-0.09709	0.12827	-0.03937	-0.04537
AMIN	-0.87016	0.01505	-0.21859	0.13025	0.04058	0.08239
MAXWT	-0.94260	-0.06360	-0.22317	0.05244	-0.07667	-0.07388
MINWT	-0.90919	0.04342	-0.19060	0.05746	-0.00922	-0.02974
AWT	-0.95446	0.01230	-0.19024	0.10338	-0.03368	-0.12040
MTR	0.01269	0.26490	0.16888	0.13572	-0.64629	0.27043
MINR	0.05988	0.74040	-0.12802	0.07716	0.10619	-0.13365
ATR	0.09693	0.72207	0.14652	0.08929	-0.29417	-0.02393
CAT	-0.63055	0.63258	0.02981	-0.12857	0.21072	0.05658
EFF	-0.76132	0.50641	0.14876	-0.06386	0.23628	0.00686
IYR	0.04423	0.81268	-0.25121	-0.07978	0.06172	-0.10720
IMON	-0.16986	-0.19655	-0.47172	0.13634	-0.43918	-0.27486
CATEFF	-0.52821	0.52629	-0.16996	-0.22423	0.08800	0.05636

CUMULATIVE PERCENTAGE OF EIGENVALUES

0.32335	0.45829	0.55514	0.61913	0.67653	0.73013

EIGEN VALUES

7.11376	2.96855	2.13080	1.40768	1.26282	1.17929	0.94948	0.92604	0.79506	0.62007
0.59734	0.43782	0.42226	0.37486	0.27635	0.23719	0.18384	0.15654	0.11249	0.06690
0.02319	-0.24235								

Note: Results of factor analysis of 22 variables on a monthly basis (environmental and catch/effort data) involved in Louisiana menhaden harvest for 1950 through 1971. Variables defined in table 20 (15 = times effects). Circled numbers indicate those types of variables that exert the same effect; there are six important types of variables (see text).

Table 6

Factor Analysis Results of 120 Variables (Weekly)

MENHADEN REGRESSION FOR LOUISIANA COAST DATA ALL 22:11 MONDAY, NOVEMB | REGRESSION FOR LOUISIANA COAST

ROTATED FACTOR MATRIX

	1	2	3	4	5	6	7
NUSP	0.28940	0.09314	0.87850	0.00334	0.01928	0.06618	0.03907
NODR	-0.01706	0.07987	0.09865	-0.05007	0.24800	-0.06869	0.01964
BRSP	0.20537	-0.04606	0.71017	[illegible]	0.09054	0.14979	-0.11693
BRDR	-0.07516	0.14266	-0.09850	-0.14875	-0.00994	-0.12982	-0.04664
LCSP	0.24147	0.11742	0.67079	0.04663	0.18753	0.14346	-0.00669
LCDP	-0.00916	0.06024	-0.06193	-0.04934	0.10970	-0.07073	-0.06168
AMAX	-0.31885	0.02378	0.06879	0.11930	-0.13164	-0.06056	-0.00707
RMAX	-0.14763	0.05770	0.23173	-0.01318	-0.20566	0.00430	0.00968
BMEAN	-0.18651	-0.06894	-0.14959	-0.01890	0.11643	0.11947	-0.02321
AMEAN	-0.89000	-0.00540	-0.02042	0.00755	-0.00299	-0.01914	-0.08168
AMIN	-0.87982	-0.01660	-0.17357	0.02343	0.13678	0.03199	-0.02553
MAXWT	-0.96151	0.01018	-0.00356	-0.04259	-0.25313	-0.07574	-0.00754
MINWT	-0.94494	0.06690	-0.01824	-0.00070	-0.10326	-0.11351	-0.02798
AWT	-0.97713	0.02034	0.00388	-0.07062	-0.18853	-0.08606	-0.09358
MTR	-0.00986	0.04393	0.11783	0.08191	-0.04226	-0.01029	0.08816
MINR	0.05426	0.44927	-0.24181	-0.10096	0.06907	-0.12403	0.12756
ATR	0.11954	0.31645	-0.01345	0.00426	0.06395	-0.12699	-0.12559
CAT	-0.58406	0.38310	-0.09478	-0.08645	0.26433	-0.12649	-0.04285
BPF	-0.69395	0.32988	0.12844	-0.17490	0.19336	0.03003	0.00048
IYR	0.09247	0.93823	-0.41116	-0.15550	0.09784	-0.20822	0.01371
IMON	-0.19306	-0.02910	-0.17853	-0.05695	-0.79101	-0.08794	0.08175
LNOSP	0.27647	0.10585	0.24699	0.09467	-0.00242	0.85255	-0.06908
LBRDR	-0.02176	0.09872	0.00783	-0.88806	-0.02932	-0.18575	-0.12262
LLCSP	0.23866	0.05314	0.33023	0.07615	0.19420	0.60932	-0.01081
LMAXWT	-0.95344	0.01608	-0.07468	-0.07973	-0.30771	0.00506	0.00321
LMINWT	-0.93558	0.06101	-0.07134	-0.04615	-0.15870	-0.03006	0.03223
LMINR	0.05274	0.45059	-0.12350	-0.02715	0.17846	-0.30705	0.14797
LAMAX	-0.83139	0.01131	0.02079	-0.08902	-0.07514	0.05796	0.04468
LAMEAN	-0.89490	-0.01808	-0.06428	-0.20275	0.03200	-0.00187	-0.03558
LNODR	0.00301	-0.08680	-0.01713	0.06371	-0.06248	-0.03457	0.84074
LAMIN	-0.88458	-0.03118	-0.18539	[illegible]	0.16294	-0.06359	0.04267
SANDJF	-0.01996	-0.11252	0.15054	-0.09784	0.01089	0.10423	-0.02010
CATEPP	-0.44433	0.46948	-0.14998	-0.09497	0.12719	0.10693	0.03330
LX20	-0.89766	0.00120	0.00644	-0.10261	-0.01872	0.02528	0.03971
LX21	-0.86228	-0.04157	-0.20281	-0.20362	0.15812	-0.09127	0.03651
LX27	0.07601	0.28828	0.22721	-0.08669	-0.04730	0.93929	-0.00951
LX28	-0.51229	0.26743	0.08468	-0.13082	0.05659	0.76253	0.01340
LX36	0.19961	0.44460	0.05915	-0.05152	0.02141	0.30693	0.00972
LX44	0.00980	0.22912	0.05317	0.04393	0.04665	-0.05491	0.74961
LX46	0.05817	0.34451	-0.00249	0.01025	-0.05902	0.02355	0.85623
LX59	-0.60550	0.22571	-0.08946	-0.70675	0.03638	0.13976	0.02202
LX60	-0.37996	0.31383	-0.00313	-0.81543	-0.04347	0.21533	-0.01179
LX61	-0.24082	0.59414	0.32745	-0.40350	-0.28965	0.23961	0.01035
LX78	0.17791	0.96881	0.10122	-0.04179	0.09961	0.20566	0.07559
LX90	-0.57390	0.52536	0.32522	0.01134	-0.35131	0.32058	0.08585
LX96	-0.42502	0.86029	0.01080	-0.03550	-0.02752	0.04023	0.05680
LX100	-0.18814	0.96496	0.04042	[illegible]	-0.00681	0.05107	0.04238
X20	-0.48623	0.00558	0.02212	0.07425	-0.06881	-0.02319	-0.00815
X21	-0.85380	-0.03047	-0.21256	0.01112	0.12831	0.03668	-0.02811
X27	0.07340	0.24941	0.48598	-0.12353	-0.02654	0.33229	0.10430
X28	-0.51708	0.23989	0.67282	-0.06856	0.02512	0.26745	0.06363
X36	0.27617	0.88821	0.26571	-0.08083	0.03755	0.05776	0.08768
X44	0.02376	0.49666	0.00618	-0.06907	0.01066	0.02576	0.14888
X46	0.01453	0.92106	0.07495	-0.05783	0.01880	0.04651	0.06946
X59	-0.66298	0.24042	0.00993	-0.09993	0.03934	0.20183	0.03182
X60	-0.45200	0.32609	0.12712	-0.15433	-0.03632	0.23427	0.02996
X61	-0.26506	0.53794	0.38191	0.04166	-0.27410	0.14227	-0.01305
X78	0.18219	0.87542	0.18570	-0.05135	0.09154	0.08700	0.07802
X90	-0.58861	0.45648	0.45561	0.10252	-0.33884	0.15911	0.01530
X96	-0.42344	0.86217	0.02374	-0.02358	-0.03263	0.02919	0.03940
X100	-0.18665	0.96647	0.04926	-0.04605	-0.00595	0.04026	0.04054

	8	9	10	11	12	13	14
NUSP	-0.04698	0.11810	-0.10084	-0.14439	0.02526	-0.06653	0.03111
NODR	0.28959	-0.13768	0.00622	0.06267	-0.32955	0.37462	0.40433
BRSP	-0.03030	[illegible]	0.06629	0.00962	-0.07669	0.23873	-0.05389
BRDR	0.91796	-0.04553	0.04901	-0.01846	0.08148	0.10379	0.02503
LCSP	-0.01508	-0.11220	0.02748	0.07280	-0.07629	0.37193	-0.25698
LCDP	0.04335	-0.04984	-0.08829	0.12966	[illegible]	[illegible]	0.07452
AMAX	0.02537	[illegible]	-0.19100	0.19941	-0.20765	-0.10369	-0.04403
RMAX	-0.04370	0.06556	-0.76932	-0.02172	0.06234	0.10454	0.03144
BMEAN	-0.00712	-0.13424	-0.75257	-0.06095	0.02149	-0.06066	-0.04751
AMEAN	0.14749	0.00193	-0.15999	0.06999	-0.14462	[illegible]	-0.03649
AMIN	0.11962	[illegible]	-0.10686	0.00771	-0.09048	-0.20319	[illegible]
MAXWT	0.01089	0.04298	0.02566	0.05115	-0.03652	-0.13941	[illegible]
MINWT	-0.01335	-0.11524	0.00995	0.09690	-0.07003	[illegible]	0.10936
AWT	0.10458	-0.07244	-0.01395	0.02504	-0.02733	[illegible]	0.10910
MTR	-0.01357	-0.01325	-0.06827	-0.80996	-0.10025	-0.00255	[illegible]
MINR	0.01605	-0.71383	-0.07221	-0.01114	0.07544	[illegible]	[illegible]
ATR	0.08177	-0.53611	0.00154	-0.50883	-0.08445	-0.03311	-0.22953
CAT	-0.04324	-0.29883	0.14967	-0.06706	0.23775	[illegible]	-0.17265
BPF	0.05731	-0.30953	0.12387	-0.07031	0.25270	-0.25357	-0.05925
IYR	0.06530	-0.03565	-0.00591	-0.07179	[illegible]	[illegible]	-0.09298
IMON	0.03609	0.07725	-0.07070	-0.04418	-0.12701	-0.00234	-0.00266
LNOSP	-0.01206	0.05321	-0.08926	0.03560	-0.05597	0.04177	0.00027
LBRDR	[illegible]	-0.11104	-0.05595	0.12679	-0.04869	0.04648	-0.09352
LLCSP	0.05815	-0.15266	-0.02509	0.13275	-0.09562	0.18235	-0.21347
LMAXWT	0.02616	0.00036	0.01752	-0.00300	0.09301	0.02006	0.04227
LMINWT	0.03847	-0.03259	-0.04088	0.03359	0.17477	0.09902	-0.10581
LMINR	0.12237	-0.21555	-0.05007	0.06636	0.13546	-0.05496	[illegible]
LAMAX	-0.02198	0.10014	0.01493	-0.13927	0.10962	0.36658	0.01033
LAMEAN	0.09511	0.04341	0.03257	-0.12000	0.08345	0.20623	0.03856
LNODR	-0.00810	0.02329	0.00064	-0.10317	-0.02754	0.07569	0.09959
LAMIN	0.02123	0.07695	0.03752	-0.13494	0.12077	0.06124	0.05137
SANDJF	-0.07529	0.13916	-0.00119	-0.13837	-0.20148	[illegible]	[illegible]
CATEPP	-0.00785	-0.11044	0.19587	-0.00826	-0.01513	-0.50300	-0.07244
LX20	-0.00540	0.09919	0.02092	-0.13083	[illegible]	0.24567	0.01255
LX21	0.01954	0.03988	0.14311	-0.12752	0.11028	0.01715	0.04559
LX27	0.03498	0.05656	-0.01863	-0.01047	-0.00951	-0.14573	0.02132
LX28	0.01602	0.12976	-0.15884	-0.06353	0.04071	-0.03613	0.04276
LX36	0.03684	-0.01923	-0.10116	-0.05051	0.01362	-0.04732	0.01532
LX44	0.00983	-0.17939	0.10893	0.09087	0.09859	-0.08393	-0.31566
LX46	-0.02509	-0.02912	0.11035	-0.03722	-0.04278	-0.02739	0.08546
LX59	0.09463	0.03901	0.12434	-0.06394	0.11920	-0.06994	0.02546
LX60	0.16276	-0.01750	0.12033	-0.01302	0.08123	-0.06112	-0.00265
LX61	0.07802	-0.09047	0.11021	0.13443	0.07025	0.01433	-0.01924
LX78	0.05851	-0.09439	-0.01559	0.05985	-0.00796	0.06765	-0.08285
LX90	-0.00488	-0.07630	0.04186	0.05805	0.19665	0.07444	-0.03624
LX96	0.00685	-0.06875	0.01691	-0.03065	0.04214	-0.00603	0.02664
LX100	[illegible]	-0.10636	0.01918	-0.03401	0.02383	-0.01511	0.01247
X20	0.03051	0.05736	-0.15468	0.15652	-0.14598	-0.10346	-0.03551
X21	0.13431	-0.00967	-0.18060	0.03810	-0.08234	-0.20650	-0.05022
X27	0.05348	0.12856	-0.00808	-0.12131	[illegible]	[illegible]	0.04967
X28	0.06653	0.13270	-0.16029	-0.06248	-0.02506	-0.23442	0.02829
X36	0.09744	0.03349	-0.15910	-0.11343	0.02714	-0.11067	0.04370
X44	0.02753	-0.75639	-0.45831	0.01291	0.03433	0.02748	0.22610
X46	0.07850	-0.19321	0.01079	-0.01065	-0.04173	0.01117	0.14549
X59	0.62741	0.02434	-0.06436	0.00813	-0.06686	-0.15226	0.00427
X60	0.75424	-0.01469	0.01212	0.00516	-0.05095	-0.10396	0.04107
X61	[illegible]	[illegible]	0.10587	0.10933	0.06757	0.03060	0.24948
X78	0.09471	-0.08423	0.00124	0.00733	-0.00788	0.07160	-0.12404
X90	-0.05866	-0.11627	0.10263	0.16434	-0.07360	-0.02263	0.25371
X96	0.02165	-0.06862	-0.00298	-0.00804	0.00530	-0.03649	-0.00548
X100	0.06263	-0.10332	0.01618	-0.02730	0.00815	-0.02319	0.00767

Table 6 (continued)

Factor Analysis Results of 120 Variables (Weekly)

CUMULATIVE PERCENTAGE OF EIGENVALUES

0.30757	0.50237	0.59587	0.64016	0.67521	0.70829	0.74034	0.76831	0.79344	0.81762
0.83880	0.85699	0.87505	0.89207						

EIGEN VALUES

18.76183	11.88257	5.70395	2.70145	2.13824	2.01759	1.95505	1.70600	1.53344	1.47496
1.29168	1.10990	1.10140	1.03848	0.98227	0.85504	0.74600	0.72512	0.64675	0.58097
0.56607	0.49019	0.48469	0.42463	0.38088	0.32441	0.28547	0.24463	0.21019	0.18974
0.15840	0.14492	0.12223	0.093[illegible]	0.07813	0.06527	0.05632	0.04984	0.04256	0.03676
0.02816	0.02352	0.02082	0.01895	0.01314	0.01146	0.01012	0.00601	0.00546	0.00059
-0.00864	-0.01441	-0.01632	-0.03851	-0.06196	-0.09051	-0.15089	-0.26772	-0.32243	-0.45851
-1.09575									

Note: Results of factor analysis of 120 variables on a weekly basis (environmental and catch/effort data) involved in Louisiana menhaden harvest for 1950 through 1971. Variables defined in table 20 (15 = time effects). Checked numbers indicate those types of variables that exert the same effect; there are six important types of variables (see text).

Table 7

Stepwise Regression Results for Maximizing R^2 Value (120 Variables, weekly)

MENHADEN REGRESSION FOR LOUISIANA COAST

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	11	298694054542.27880	27154004958.38898	141.88271	0.0001	0.72298269	49.14039
ERROR	598	114447311999.09980	191383464.88144				
CORRECTED TOTAL	609	413141366541.37870					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	251028666909.19620	1311.65285	0.0001	37433176149.39894	195.59253	0.0001
X96	1	26402177914.13231	137.95433	0.0001	7015785845.06054	36.65827	0.0001
X36	1	6184697430.07210	32.31574	0.0001	3336602136.76499	17.43412	0.0001
X78	1	2789188691.97840	14.57382	0.0004	1873993639.56617	9.79183	0.0022
X21	1	1297459795.05831	6.77937	0.0093	4590448210.93271	23.98561	0.0001
X90	1	1400884032.33701	7.31978	0.0071	4209250548.88750	21.99390	0.0001
X100	1	2315975558.78371	12.10123	0.0009	2353533640.76559	12.29748	0.0008
MINWT	1	2634039330.87513	13.76315	0.0005	5102801890.71893	26.66271	0.0001
X94	1	2549625480.08379	13.32208	0.0006	2361730876.74450	12.34031	0.0008
X46	1	979367979.22149	5.11731	0.0226	1770577326.11600	9.25146	0.0028
X44	1	1111971420.54028	5.81017	0.0154	1111971420.54028	5.81017	0.0154

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	56985.52809051				
EFF	809.04053577	13.98544	0.0001	57.84877268	0.48812277
X96	1.77505133	6.05461	0.0001	0.29317367	1.36598459
X36	-0.05349451	-4.17542	0.0001	0.01281177	-0.11899176
X78	-0.03112200	-3.12919	0.0022	0.00994571	-0.08959173
X21	-27.53553439	-4.89751	0.0001	5.62235378	-1.18796925
X90	14.79763880	4.68976	0.0001	3.15531150	0.62621500
X100	-0.77410764	-3.50678	0.0008	0.22074626	-0.75395222
MINWT	-2716.92623442	-5.16359	0.0001	526.16953609	-0.91908622
X94	27.65240573	3.51288	0.0008	7.87172517	1.24737681
X46	-0.02566451	-3.04162	0.0028	0.00843777	-0.10052203
X44	22.51303342	2.41043	0.0154	9.33983943	0.06117743

Note: Results of stepwise regression for maximizing R^2 value; 120 variables were screened using weekly data. Final model is the "best" 11-variables which give the highest R^2 value.

Table 8

Stepwise Regression Results for Maximizing R^2 Value (120 Variables, monthly)

MENHADEN REGRESSION FOR LOUISIANA COAST

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
6	0.80858684	X28 X59 X60 X61 IYR EFF

THE ABOVE MODEL IS THE 'BEST' 6 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	6	1.34586035821D 12	2.24310059701D 11	109.12778	0.0001	0.80858684	41.12724
ERROR	155	3.18599518487D 11	2.05548076443D 09				
CORRECTED TOTAL	161	1.66445987669D 12					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	1.19687905165D 12	582.28667	0.0001	4.28622056806D 11	208.52643	0.0001
IYR	1	9.19869445487D 10	44.75203	0.0001	9.17867276536D 10	44.65463	0.0001
X60	1	1.49018910719D 10	7.24983	0.0078	3.06547989789D 10	14.91369	0.0004
X59	1	1.95279573103D 10	9.50043	0.0028	3.48713191669D 10	16.96504	0.0002
X61	1	1.46652084259D 10	7.13469	0.0083	1.25446203859D 10	6.10301	0.0139
X28	1	7.89930520039D 09	3.84305	0.0488	7.89930520039D 09	3.84305	0.0488

SOURCE	B VALUES	T FOR H0 B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-24374.09755704				
EFF	1030.16124516	14.44044	0.0001	71.33861247	0.73741850
IYR	4419.53706611	6.68241	0.0001	661.36856001	0.27227399
X60	-21.09116031	-3.86182	0.0004	5.46144979	-1.13654237
X59	11.85596090	4.11886	0.0002	2.87845390	0.50437912
X61	10.67458574	2.47043	0.0139	4.32094737	0.60678665
X28	-0.93141429	-1.96037	0.0488	0.47512202	-0.07688995

Note: Results of stepwise regression for maximizing R^2 value; 120 variables were screened using monthly data. Final model is the "best" 11-variables which give the highest R^2 value.

Table 9

Stepwise Regression Results Maximizing R^2 Value (Month of April, 1950-71; 19 Variables)

APRIL

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
4	0.84934518	NODR BRDR IYR EFF

THE ABOVE MODEL IS THE 'BEST' 4 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	4	2981318313.54036	745329578.38509	22.55076	0.0001	0.84934518	30.47574
ERROR	16	528819111.66916	33051194.47932				
CORRECTED TOTAL	20	3510137425.20953					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	1876249783.17739	56.76799	0.0001	2457958053.78873	74.36821	0.0001
IYR	1	620527943.09231	18.77475	0.0008	1087488559.43572	32.90315	0.0001
NODR	1	251484337.15265	7.60893	0.0134	349302161.13733	10.56852	0.0051
BRDR	1	233056250.11801	7.05137	0.0165	233056250.11801	7.05137	0.0165

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-33643.11007753				
EFF	642.43126881	8.62370	0.0001	74.49601080	0.88847518
IYR	1410.11816814	5.73613	0.0001	245.83105194	0.69032391
NODR	86.47972452	3.25093	0.0051	26.60156828	0.36335402
BRDR	-54.03210276	-2.65544	0.0165	20.34768810	-0.29189809

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of April, 1950 through 1971. Nineteen variables were screened. Final model is the "best" 4-variables which give the highest R^2 value.

Table 9 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of May, 1950-71, 19 Variables)

MAY

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
3	0.66804501	NOSP LCSP IYR

THE ABOVE MODEL IS THE 'BEST' 3 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	3	49088254725.25538	16362751575.08512	11.40392	0.0004	0.66804501	30.87686
ERROR	17	24392205311.18762	1434835606.54045				
CORRECTED TOTAL	20	73480460036.44300					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
IYR	1	31032765703.97566	21.62810	0.0004	36874545085.31633	25.69949	0.0002
LCSP	1	11630470097.75415	8.10579	0.0108	7638319743.19410	5.32348	0.0322
NOSP	1	6425018923.52557	4.47788	0.0470	6425018923.52557	4.47738	0.0470

SOURCE	B VALUES	T FOR H0 B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	161678.71445351				
IYR	6953.06091384	5.06947	0.0002	1371.55671667	0.74395997
LCSP	-71.61967970	-2.30727	0.0322	31.04091611	-0.33063669
NOSP	-110.25652130	-2.11610	0.0470	52.10365063	-0.31769424

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of May, 1950 through 1971. Nineteen variables were screened. Final model is the "best" 3-variables which gives the highest R^2 value.

Table 9 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of June, 1950-71; 19 Variables)

JUNE MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
1	0.71857784	IYR

THE ABOVE MODEL IS THE 'BEST' 1 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	1	172319544727.32890	172319544727.32890	48.51423	0.0001	0.71857784	31.05666
ERROR	19	67486828811.04383	3551938358.47599				
CORRECTED TOTAL	20	239806373538.37270					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
IYR	1	172319544727.32890	48.51423	0.0001	172319544727.32890	48.51423	0.0001

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	22880.50475490				
IYR	14312.24637156	6.96522	0.0001	2054.81744648	0.84768970

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of June, 1950 through 1971. Nineteen variables were screened. Final model is the "best" 1-variable which gives the highest R^2 value.

Table 9 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of July, 1950-71; 19 Variables)

JULY MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
1	0.77381665	IYR

THE ABOVE MODEL IS THE 'BEST' 1 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	1	229963899791.27230	229963899791.27230	65.00265	0.0001	0.77381665	29.84767
ERROR	19	67217480720.14612	3537762143.16559				
CORRECTED TOTAL	20	297181380511.41840					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
IYR	1	229963899791.27230	65.00265	0.0001	229963899791.27230	65.00265	0.0001

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	4020.24472999				
IYR	16533.71193819	8.06242	0.0001	2050.71283449	0.87966849

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of July, 1950 through 1971. Nineteen variables were screened. Final model is the "best" 1-variable which gives the highest R^2 value.

Table 9 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of August, 1950-71; 19 Variables)

AUGUST MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
1	0.72232130	EFF

THE ABOVE MODEL IS THE 'BEST' 1 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	1	113783327947.65920	113783327947.65920	46.82312	0.0001	0.72232130	31.37473
ERROR	18	43741207419.10661	2430067078.83926				
CORRECTED TOTAL	19	157524535366.76580					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	113783327947.65920	46.82312	0.0001	113783327947.65920	46.82312	0.0001

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-196601.49843537				
EFF	1902.80378332	6.84274	0.0001	278.07620077	0.84989488

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of August, 1950 through 1971. Nineteen variables were screened. Final model is the "best" 1-variable which gives the highest R^2 value.

Table 10

Stepwise Regression Results Maximizing R^2 Value (Month of April, 1950-71; 124 Variables)

APRIL

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
6	0.91397321	MODR X32 X36 X66 X83 EPP
6	0.92314734	MODR X32 X66 X67 X83 EPP
6	0.93633493	X26 X32 X66 X67 X83 EPP

THE ABOVE MODEL IS THE 'BEST' 6 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	6	3286664266.30452	547777377.71742	34.31680	0.0001	0.93633493	21.17939
ERROR	14	223473158.90500	15962368.49321				
CORRECTED TOTAL	20	3510137425.20953					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EPP	1	1876249783.17739	117.54207	0.0001	2682825809.65724	168.07191	0.0001
X32	1	592104328.12964	37.09376	0.0001	614135784.46249	38.47394	0.0001
X67	1	74005735.87278	4.63626	0.0470	762775237.79816	47.78598	0.0001
X83	1	270113004.56097	16.92186	0.0013	384556657.91087	24.09145	0.0004
X66	1	204564336.22873	12.81541	0.0033	446222541.02698	27.95465	0.0003
X26	1	269627078.33503	16.89142	0.0013	269627078.33503	16.89142	0.0013

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	12895.84621130				
EPP	708.32365625	12.96426	0.0001	54.63666404	0.97963361
X32	-0.66375019	-6.20274	0.0001	0.10700920	-0.53417826
X67	9.52969339	6.91273	0.0001	1.37857152	1.22522191
X83	-1.27374898	-4.90830	0.0004	0.25950895	0.47923646
X66	-121.53093233	-5.28722	0.0003	22.98580634	-0.72327939
X26	0.13536399	4.10992	0.0013	0.03293594	0.45731502

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of April, 1950 through 1971. One hundred and twenty-four variables were screened. Final model is the "best" 6-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of May, 1950-71; 124 Variables)

MAY

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
3	0.80839717	X35 X67 X68
3	0.81582531	NOSP X67 X68

THE ABOVE MODEL IS THE 'BEST' 3 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	3	59947219365.98536	19982406455.32845	25.10122	0.0001	0.81582531	22.99897
ERROR	17	13533240670.45764	796072980.61516				
CORRECTED TOTAL	20	73480460036.44300					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X67	1	31815058338.63068	39.96500	0.0001	48605144861.24645	61.05614	0.0001
NOSP	1	20442970453.58211	25.67977	0.0002	17165229189.31567	21.56238	0.0004
X68	1	7689190573.77257	9.65890	0.0064	7689190573.77257	9.65899	0.0064

SOURCE	B VALUES	T FOR H0 B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	216148.26740792				
X67	28.68999456	7.81384	0.0001	3.67168814	0.91672971
NOSP	-190.38399259	-4.64353	0.0004	40.99983122	-0.54857433
X68	-0.34440457	-3.10788	0.0064	0.11081666	-0.32605760

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of June, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 2-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Mximizing R^2 Value (Month of June, 1950-71; 124 Variables)

JUNE MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
2	0.77371850	X45 X109
2	0.77928651	X45 X106

THE ABOVE MODEL IS THE 'BEST' 2 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	2	186877872384.08740	93438936192.04373	31.77685	0.0001	0.77928651	28.25729
ERROR	18	52928501154.28528	2940472286.34918				
CORRECTED TOTAL	20	239806373538.37270					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X106	1	173080161464.24980	58.86135	0.0001	179946349113.38000	61.17641	0.0001
X45	1	13797710919.83769	4.69235	0.0418	13797710919.83769	4.69235	0.0418

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	169082.07243291				
X106	220.47629303	7.82281	0.0001	29.18375947	0.97109688
X45	-703.03551528	-2.16618	0.0418	324.55050506	-0.26830233

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of June, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 2-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of July, 1950-71; 124 Variables)

JULY MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
3	0.87217266	X46 X67 X106
3	0.89044570	X37 X46 X106

THE ABOVE MODEL IS THE 'BEST' 3 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	3	264623982535.31700	88207960845.10566	46.05806	0.0001	0.89044570	21.96075
ERROR	17	32557497976.10183	1915146939.77067				
CORRECTED TOTAL	20	297181360511.41840					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X106	1	237050662789.63080	123.77675	0.0001	62818365382.61141	32.80081	0.0001
X46	1	11748297346.53406	6.13441	0.0228	24359857063.42248	12.71958	0.0027
X37	1	15824922399.15211	8.26303	0.0102	15824922399.15211	8.26303	0.0102

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-262983.82838310				
X106	533.22151232	5.72720	0.0001	93.10336913	2.30762457
X46	-131.93908067	-3.56645	0.0027	36.99449781	-1.66333843
X37	14.05947593	2.87455	0.0102	4.89101944	0.6514263[illegible]

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of July, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 3-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of August, 1950-71; 124 Variables)

AUGUST MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
7	0.97571081	X21 X25 X45 X92 X95 X96 X120
7	0.97710074	X21 X25 X42 X92 X95 X96 X120

THE ABOVE MODEL IS THE 'BEST' 7 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	7	153917340365.73810	21988191480.81973	73.14778	0.0001	0.97710074	11.24584
ERROR	12	3607195001.02769	300599583.41897				
CORRECTED TOTAL	19	157524535366.76580					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X96	1	119592190596.63760	397.84550	0.0001	39590865508.75646	131.70632	0.0001
X92	1	4257359817.56290	14.16299	0.0030	29333558848.84280	97.58350	0.0001
X21	1	9857822169.04791	32.79387	0.0002	15174066864.84044	50.47933	0.0001
X120	1	5049458844.88709	16.79796	0.0018	6928840950.94356	23.05017	0.0007
X95	1	1361414984.61114	4.52900	0.0525	12765951920.75998	42.46830	0.0001
X25	1	11046353237.41328	36.74773	0.0002	10801310891.19855	35.93255	0.0002
X42	1	2752740715.57814	9.15750	0.0103	2752740715.57814	9.15750	0.0103

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	372451.56107775				
X96	1932.77557969	11.47634	0.0001	168.41397207	8.66663180
X92	-904.77537038	-9.87844	0.0001	91.59095321	-6.34881352
X21	-1410.06587248	-7.10488	0.0001	198.46438927	-8.76104026
X120	-10068.98030635	-4.80105	0.0007	2097.24603712	-1.04264570
X95	1651.93311998	6.51677	0.0001	253.48954129	7.92637562
X25	-509.54788308	-5.99438	0.0002	85.00431180	-1.45010004
X42	-3.55064020	-3.02614	0.0103	1.17332466	-0.17756731

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of August, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 7-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of September, 1950-71; 124 Variables)

SEPTEMBER MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
9	0.99517835	X21 X47 X64 X77 X92 X95 X109 X114 EFF

THE ABOVE MODEL IS THE 'BEST' 9 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	9	62462031936.65967	6940225770.73996	229.33089	0.0001	0.99517835	4.36442
ERROR	10	302629353.43041	30262935.34304				
CORRECTED TOTAL	19	62764661290.09008					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X92	1	42759249101.54048	1412.92471	0.0001	1880862946.85252	62.15071	0.0001
X114	1	8188136936.80816	270.56651	0.0001	6699860146.97425	221.38831	0.0001
EFF	1	4061623962.13506	134.21117	0.0001	850440562.88279	28.10172	0.0006
X64	1	1703168304.18660	56.27302	0.0001	496167077.06789	16.39521	0.0026
X21	1	1042403769.09349	34.44490	0.0003	5089712836.98384	168.18305	0.0001
X95	1	2790472547.71434	92.20760	0.0001	4552218307.38463	150.42223	0.0001
X109	1	606134291.59177	20.02993	0.0015	1596870654.66153	52.76655	0.0001
X47	1	1153506822.66197	38.11616	0.0002	1279329123.18791	42.27379	0.0002
X77	1	157336300.92781	5.19898	0.0439	157336300.92781	5.19898	0.0439

SOURCE	B VALUES	T FOR H0 P=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-454716.51403921				
X92	736.45493340	7.88357	0.0001	93.41639567	7.65450678
X114	-154347.05995535	-14.87912	0.0001	10373.39744374	-0.51715410
EFF	281.23516730	5.30111	0.0006	53.05217192	0.16957459
X64	51.57569508	4.04910	0.0026	12.73757174	0.26036863
X21	-255.59830956	-12.96854	0.0001	19.70910314	-2.54450244
X95	296.96985835	12.26467	0.0001	24.21343232	2.49610217
X109	-815.33840547	-7.26406	0.0001	112.24281619	-7.11873917
X47	-0.48550141	-6.50183	0.0002	0.07467150	-0.30206204
X77	21.70377900	2.28013	0.0439	9.51967318	0.06949012

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of September, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 9-variables which give the higher R^2 value.

Table 10 (continued)

Stepwise Regression Results Maximizing R^2 Value (Month of October, 1950-71; 124 Variables)

OCTOBER MENHADEN

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
2	0.65731006	X38 EFF

THE ABOVE MODEL IS THE 'BEST' 2 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	2	16363378718.49184	8181689359.24592	16.30376	0.0002	0.65731006	45.18157
ERROR	17	8531081005.39365	501828294.43492				
CORRECTED TOTAL	19	24894459723.88549					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	13679917859.17073	27.26016	0.0002	14373996909.83366	28.64326	0.0001
X38	1	2683460859.32111	5.34737	0.0318	2683460859.32111	5.34737	0.0318

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	44169.78516779				
EFF	626.64351113	5.35194	0.0001	117.08717974	0.76127222
X38	-6.59662338	-2.31244	0.0318	2.85353551	-0.32892648

Note: Results of stepwise regression for maximizing R^2 value for all environmental data and Louisiana menhaden harvest during the month of October, 1950 through 1971. One hundred and twenty four variables were screened. Final model is the "best" 2-variables which give the higher R^2 value.

Table 11

Stepwise Regression Results Maximizing R^2 Value (84 Variables; monthly)

THE CORRELATION COEFFICIENTS

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
8	0.86280054	NODR AMEAN MAXWT EFF LX59 LX96 X46 X96

THE ABOVE MODEL IS THE 'BEST' 8 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	8	1.36299272404D 12	1.70374090505D 11	107.76610	0.0001	0.86280054	33.92626
ERROR	137	2.16591766701D 11	1.58096180074D 09				
CORRECTED TOTAL	145	1.57958449074D 12					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	1.16184016758D 12	734.89452	0.0001	9.93738453579D 10	62.85658	0.0001
LX96	1	1.06239692465D 11	67.19941	0.0001	2.11866811412D 10	13.40113	0.0006
X46	1	2.06356522568D 10	13.05259	0.0007	6.23732574026D 10	39.45273	0.0001
LX59	1	2.49566476102D 10	15.78574	0.0003	1.03711775932D 10	6.56004	0.0111
NODR	1	1.17578275175D 10	7.43714	0.0072	3.10552603495D 10	19.66857	0.0001
AMEAN	1	1.22692807115D 10	7.76064	0.0062	2.76850036493D 10	17.51149	0.0002
X96	1	1.60699066246D 10	10.16464	0.0022	1.77932339857D 10	11.25469	0.0014
MAXWT	1	9.22354927609D 09	5.83414	0.0162	9.22354927609D 09	5.83414	0.0162

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-52301.66611651				
EFF	809.89777564	7.92821	0.0001	102.15387532	0.57518770
LX96	164.43821647	3.66076	0.0006	44.91919666	0.53169765
X46	-46.45330926	-6.26114	0.0001	7.39568038	-0.62875582
LX59	-2.83119183	-2.56126	0.0111	1.10539106	-0.11770035
NODR	519.58841076	4.43493	0.0001	117.15829569	0.24616415
AMEAN	-4036.03674574	-4.18467	0.0002	964.48062509	-0.31061874
X96	153.51374599	3.35480	0.0014	45.75942016	0.49492645
MAXWT	2570.47473113	2.41540	0.0162	1066.69830742	0.14058217

Note: Results of stepwise regression for maximizing R^2 value. Eight environmental variables regressed on catch data of Louisiana menhaden. Eighty four variables were screened on a monthly basis for 1950 through 1971.

Table 12

Stepwise Regression Results Maximizing R^2 Value (11 Variables; monthly)

MENHADEN VESSEL WEEKS NEW EFFORT

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
4	0.74874850	IYR EFF X32 BRDR
4	0.75824234	IYR EFF BRDR X59

THE ABOVE MODEL IS THE 'BEST' 4 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	4	1.29231773476D 12	3.23079433690D 11	130.15951	0.0001	0.75824234	46.48841
ERROR	166	4.12042020685D 11	2.48218084750D 09				
CORRECTED TOTAL	170	1.70435975545D 12					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	1.17464134037D 12	473.22956	0.0001	2.71892353197D 11	109.53769	0.0001
IYR	1	8.13811817780D 10	32.78616	0.0001	1.12266389395D 11	45.22893	0.0001
BRDR	1	8.10978631824D 09	3.26720	0.0689	3.62416780618D 10	14.60074	0.0004
X59	1	2.81854262919D 10	11.35511	0.0011	2.81854262919D 10	11.35511	0.0013

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-17059.87443848				
EFF	797.07116001	10.46603	0.0001	76.15796116	0.60250251
IYR	4932.75381263	6.72525	0.0001	733.46817302	0.30908913
BRDR	-469.34654646	-3.82109	0.0004	122.83049093	-0.30745994
X59	7.01996419	3.36973	0.0013	2.08323900	0.30245176

Note: Results of stepwise regression for maximizing R^2 Value. Four environmental variables regressed on catch data of Louisiana menhaden. Eleven variables were screened on a monthly basis for 1950 through 1971.

Table 13

Stepwise Regression Results Maximizing R^2 Value (11 Variables; weekly)

MENHADEN VESSEKS NEW EFFORT G BY WEEK

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
4	0.71052166	EFF ATR X32 X86

THE ABOVE MODEL IS THE 'BEST' 4 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	4	454997348116.88580	113749337029.22140	689.09805	0.0001	0.71052166	79.39057
ERROR	1123	185373483626.81620	165069887.64632				
CORRECTED TOTAL	1127	640370831943.70210					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
EFF	1	447713808696.02530	2712.26821	0.0001	435618151290.86090	2638.99223	0.0001
X86	1	3812156618.42558	23.09420	0.0001	2460682916.91260	14.90692	0.0003
X32	1	2862933547.49329	17.34377	0.0001	2904328577.72138	17.59454	0.0001
ATR	1	608449254.94167	3.68601	0.0520	608449254.94167	3.68601	0.0520

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-2818.17007749				
EFF	985.09795381	51.37112	0.0001	19.17610332	0.82751725
X86	22.04066544	3.86095	0.0003	5.70861564	0.06610481
X32	-0.28209813	-4.19458	0.0001	0.06725294	-0.06745755
ATR	2280.99481005	1.91990	0.0520	1188.08097956	0.03286335

Note: Results of stepwise regression for maximizing R^2 value. Four environmental variables regressed on catch data of Louisiana menhaden. Eleven variables were screened on a weekly basis for 1950 through 1971.

Table 14

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 8 variable model)

MENHADEN VESSEL WEEKS NEW EFFORT

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE CAT

NUMBER IN MODEL	R-SQUARE	VARIABLES IN MODEL
8	0.54710893	X89 ATR X112 X29 X32 BRDR X59 X86

THE ABOVE MODEL IS THE 'BEST' 8 VARIABLE MODEL FOUND BY THE MAXIMUM R-SQUARE IMPROVEMENT PROCEDURE

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR THE ABOVE MODEL

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB GT F	R-SQUARE	C.V.
REGRESSION	8	9.32470443881D 11	1.16558805485D 11	24.46274	0.0001	0.54710893	64.40921
ERROR	162	7.71889311564D 11	4.76474883682D 09				
CORRECTED TOTAL	170	1.70435975545D 12					

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB GT F	PARTIAL SS	F VALUE	PROB GT F
X59	1	3.73474093358D 11	78.38275	0.0001	5.04196921446D 10	10.58182	0.0018
BRDR	1	2.21719406612D 11	46.53328	0.0001	3.49190838912D 10	7.32863	0.0075
X86	1	1.64846732769D 11	34.59715	0.0001	8.04991189269D 10	16.89472	0.0002
X89	1	5.22272276327D 10	10.96117	0.0015	7.04384942470D 10	14.78325	0.0004
X32	1	3.73754115653D 10	7.84415	0.0059	3.19624909703D 10	6.70812	0.0102
ATR	1	3.25429515199D 10	6.82994	0.0096	6.03579857189D 10	12.66761	0.0008
X112	1	2.92506230784D 10	6.13896	0.0136	3.30571603167D 10	6.93786	0.0091
X29	1	2.10339973458D 10	4.41450	0.0349	2.10339973458D 10	4.41450	0.0349

SOURCE	B VALUES	T FOR HO B=0	PROB GT ABS(T)	STD ERR B	STD B VALUES
MEAN	-259878.15139171				
X59	10.89644224	3.25297	0.0018	3.34969012	0.46946794
BRDR	-495.48517004	-2.70714	0.0075	183.02872154	-0.32500518
X86	1547.28946738	4.11032	0.0002	376.44021441	0.24501399
X89	34.25890781	3.84490	0.0004	8.91022125	0.47135172
X32	-5.32639690	-2.59000	0.0102	2.05729355	-0.71741656
ATR	120900.04886859	3.55916	0.0008	33968.71464711	0.21507667
X112	-4967.14675800	-2.63398	0.0091	1885.79389788	-0.15077989
X29	4.51638855	2.10107	0.0349	2.14956408	0.53948527

Note: Results of stepwise regression of Louisiana menhaden catch on 8 environmental variables using monthly data for 1950 through 1971. Nine variables were screened on basis of maximizing R^2 value.

Table 15

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 variable model)

MENHADEN VESSEL WEEKS NEW EFFORT

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CAT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	4	1.33947601575D 12	3.34869503938D 11	150.48107	0.0001	0.78793709	43.1450 %
ERROR	162	3.60502891321D 11	2.22532644964D 09			STD DEV	CAT MEAN
CORRECTED TOTAL	166	1.69998090707D 12				47173.35631657	109336.67605

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
EFF	1	1.22767256213D 12	551.68200	0.0001	3.41151426551D 11	153.30399	0.0001
IYR	1	9.08725353657D 10	40.83560	0.0001	1.11124371082D 11	49.93621	0.0001
BRDR	1	1.44435751837D 10	6.49059	0.0118	1.67575160972D 10	7.53036	0.0068
X59	1	6.48924307032D 09	2.91609	0.0896	6.48924307032D 09	2.91609	0.0896

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	-37256.08961107	-2.82464	0.0053	13189.66755751	0.0
EFF	974.24617563	12.38160	0.0001	78.68500609	0.70712714
IYR	4742.56056632	7.06656	0.0001	671.12759572	0.29980224
BRDR	-327.63383014	-2.74415	0.0068	119.39352739	-0.21732356
X59	3.60631913	1.70766	0.0896	2.11185455	0.15532152

OBS NUMBER		OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	****	0.0	4457.33478571	0.0	-54577.44817361	63492.11774503
2	****	0.0	46703.00064187	0.0	22136.94950127	71269.05278248
3	****	0.0	54780.42686920	0.0	33908.03427268	75652.81946573
4		498.00000000	-42962.09963442	43460.09963442	-59992.55039703	-25931.64867176
5		33195.70000000	26104.96918807	7090.73081193	5515.22496896	46694.71340719
6		62306.00000000	86922.20697219	-24616.20697219	71620.50186632	102223.91207806
7		50229.00000000	100139.07300438	-49910.07300438	83011.44228267	117266.70372610
8		74471.70000000	94508.49630767	-20036.79630767	77637.43308597	111379.55952937
9		66932.60000000	82119.12823794	-15186.52823794	66249.43774208	97988.81873379
10		27560.60000000	50184.86597998	-22624.26597998	32822.80393603	67546.92802393
11		8015.40000000	-44482.11143440	52497.51143440	-66315.19296804	-22649.02990075
12		10.00000000	-47794.24584131	47804.24584131	-67231.86364649	-28356.62803613
13	***	56.00000000	59789.30331618	0.0	34067.63066730	85510.97596506
14	****	0.0	49422.58780801	0.0	19126.11785732	79719.05775871
15	****	0.0	56060.92106776	0.0	33094.68570036	79027.15641467

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 variables model)

16		19072.70000000	-10111.72668948	29184.42668948	-19797.10641520	5573.65101624
17		67056.90000000	117460.91396508	-50404.01396508	99771.12678540	135150.73114476
18		58869.30000000	79805.86876643	-20936.56876643	65560.04199352	94051.69553934
19		62067.90000000	56886.22223357	5181.67776643	41966.22249422	71805.21157292
20		38148.00000000	71297.56161497	-33149.56161497	56451.97337664	86143.14335331
21		43567.10000000	63309.03704341	-19741.93704341	49208.28760139	77409.78694543
22		37639.70000000	47600.90364317	-9961.20364317	29444.50276548	65757.30452085
23		2534.30000000	-31866.26293990	34400.56293990	-46223.50532532	-15509.02055448
24	****	0.0	61561.61180115	0.0	39131.16809724	84022.45550505
25	****	0.0	91093.28351349	0.0	70938.65332990	111247.71369709
26	****	0.0	69229.82055307	0.0	51342.16704477	87117.47406137
27		87.00000000	-53469.07592210	53556.07592210	-68968.79161397	-38069.36023022
28		35313.10000000	36305.19292929	-992.09292929	21642.59566803	50967.79019054
29		65473.60000000	53565.36622033	11908.23377967	40177.05125098	66953.65114964
30		90560.10000000	73895.69742924	16664.40257076	60699.71570539	87091.67915310
31		85845.40000000	76232.41832688	9612.98167312	61237.17591148	81227.65027227
32		66146.70000000	70465.87690637	-4319.17690637	54465.53074968	86460.22105395
33		72298.80000000	74711.42318237	-2412.62318237	55775.05400905	93647.75235569
34		62481.90000000	4733.06755635	57748.83244365	-10298.00155509	19764.13666778
35		6696.30000000	-13322.67447941	20018.97447941	-31460.81231205	4817.44339322
36	****	0.0	79907.03329786	0.0	60453.40873896	99360.63745675
37	****	0.0	63246.11611987	0.0	41970.60623094	84521.62690979
38	****	0.0	85600.40279778	0.0	68992.79688004	102208.00871551
39		5.10000000	-32293.87238692	32298.97238692	-51960.91937865	-12626.82534520
40		11110.10000000	26188.46924383	-15078.36924383	10755.11372201	41621.82476506
41		60117.70000000	45400.49873424	14717.20126576	34102.13162541	56693.86554306
42		86429.10000000	109870.53904569	-23441.43904569	96897.59578636	122843.48230503
43		77106.20000000	116203.74252264	-39097.54252264	100791.62759052	111615.85745476
44		94254.40000000	106552.62316119	-12298.22316119	92934.88061726	120170.36570512
45		93879.40000000	102797.66305515	-8918.26305515	89463.36795838	116131.95615192
46		65948.70000000	49818.93523957	16129.76476043	33884.77319702	65753.05728213
47	****	0.0	63164.43535945	0.0	43021.30765749	83307.56285141
48	****	0.0	62573.53497049	0.0	39173.76423995	85973.30570103
49	****	0.0	61501.99624983	0.0	37639.14399147	85364.84850814
50	****	0.0	59102.35255109	0.0	33319.55267890	84885.15242329
51	****	0.0	51922.18168134	0.0	23899.47489411	79944.83340837
52	***	15571.40000000	80410.81720463	0.0	67468.27145938	93353.36294988
53	***	53251.90000000	57551.47947672	0.0	37482.19542980	77620.76352364
54	***	100337.40000000	94065.23118253	0.0	81143.82372962	106986.63863543
55	***	68993.70000000	90630.23588775	0.0	73826.10921020	107434.36356530
56	***	68546.60000000	81274.19900110	0.0	66721.12818695	95827.27181526
57	***	77177.10000000	84260.92982564	0.0	73463.25519038	95061.56445090
58	***	1997.60000000	63390.44915803	0.0	42317.26086780	83963.63544826
59	****	0.0	72076.43679248	0.0	54121.73438160	90031.13920337
60	****	0.0	48496.36066261	0.0	17908.62725564	79184.09406957
61	****	0.0	36604.25143398	0.0	-2677.26576775	75885.76863571
62	****	0.0	69700.30554779	0.0	46465.24296637	92934.36812921
63	****	0.0	60782.61222456	0.0	35154.15990392	86411.06494520
64		3742.30000000	-25116.97296597	28859.27296597	-38601.27985728	-11632.66506466
65		44914.70000000	76944.15064093	-32029.45064093	55541.62982277	98346.67245909
66		143684.60000000	111023.46596589	32661.13403411	99990.79371529	122056.13821650
67		101339.40000000	109736.37463624	-8396.97463624	97243.94360133	122228.86567114
68		81703.60000000	96117.12913299	-14413.52913299	81477.45437712	110756.80388886
69		73095.90000000	85775.68115890	-12679.78115890	68159.10362365	103392.25869415
70		41228.60000000	-4352.63512557	45581.23512557	-16699.45535349	7984.18510235
71		498.90000000	-46102.77233825	46601.67233825	-61183.20703426	-31022.33764223
72	****	0.0	56664.37793227	0.0	27642.13522141	85691.62064314
73	****	0.0	43038.35681828	0.0	12990.76726531	85085.94635125
74	****	0.0	69931.01234956	0.0	49306.11111268	90555.91358644
75	****	0.0	83097.66771613	0.0	67086.20733423	99149.06810203
76		13426.00000000	-6765.41184719	20191.41184719	-18837.33109640	5276.50740202

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 variable model)

77		125489.80000000	119798.24934755	5691.55065245	106218.55209399	113377.94653511
78		126398.40000000	126012.48220040	385.91779960	109031.61168296	142943.35271785
79		103132.20000000	139807.40363620	-36675.20363620	121927.70872030	157687.09855210
80		102687.20000000	135983.51552403	-33296.31552403	125125.68665940	146841.34439866
81		85260.10000000	130694.15950732	-45434.05950732	117683.60002877	143704.71898587
82		34286.60000000	45383.96204482	-11097.36204482	24460.50476673	66307.41932292
83		2035.40000000	-53614.18424553	55649.58424553	-75301.37343847	-31926.99505258
84	****	0.0	87974.48309379	0.0	70019.84558466	105929.12058292
85	****	0.0	54751.01723140	0.0	20385.66838236	89116.36608045
86	****	0.0	104472.73323549	0.0	89316.65251301	119628.81395797
87	****	0.0	80132.81145259	0.0	61992.00493671	98273.61806847
88		1494.10000000	-23132.74202625	24626.84202625	-37526.84647958	-8738.63757291
89		71861.60000000	96360.52521992	-24498.92521992	87236.34599960	105484.70444025
90		47872.70000000	102875.89771838	-55003.19771838	76152.34541399	129599.45002278
91		74358.90000000	65523.63073831	8835.26926169	41142.52804690	89904.73342972
92		60831.90000000	127587.38708239	-66755.48708239	109711.14202616	145463.63213861
93		75070.70000000	86655.33511490	-11584.63511490	76759.81792325	46550.85230654
94		16819.00000000	6564.32469084	10254.67530916	-6611.94831821	19740.59769988
95		1199.00000000	-34102.84145330	35301.84145330	-48303.42758042	-19902.25532618
96	****	0.0	57795.10437090	0.0	23277.80495481	92312.40388698
97	****	0.0	64684.68940105	0.0	34316.38449255	95052.99430955
98	****	0.0	97022.51623266	0.0	78041.89485578	116003.13760953
99	****	0.0	83443.66858519	0.0	67242.16518839	99645.17198199
100		6364.60000000	-2220.44733271	8585.04733271	-17023.08821478	12582.15354936
101		92888.50000000	98777.76010433	-5889.26010433	86771.25907224	110784.26113641
102		89315.80000000	128450.15504833	-39134.35504833	116361.00974200	140539.30035465
103		56564.40000000	123946.34723704	-67381.94723704	103540.85172624	144351.84274784
104		96787.50000000	147087.06002199	-50299.56002199	131729.92288380	162444.19716017
105		44605.30000000	82754.65956840	-38149.35956840	67342.65168925	98166.66744755
106		24977.60000000	62591.76777355	-37614.16777355	52636.63795500	72546.89759210
107		20860.90000000	14791.86438002	6069.03561998	-5766.13753167	35349.86629171
108		1097.30000000	-49632.04979656	50729.34979656	-73659.40299090	-25604.69660222
109	****	0.0	84388.22863129	0.0	61649.48963833	107126.96762424
110	****	0.0	124097.54866651	0.0	104910.37428157	143284.72305145
111	****	0.0	112386.76380576	0.0	98121.98672157	126651.54088994
112		19512.60000000	21727.75375483	-2215.15375483	10547.32202860	32908.18548105
113		133820.90000000	132331.44975049	1489.45024951	123610.40291865	141052.49658234
114		122882.20000000	154862.50203316	-31980.30203316	138096.98837385	171628.01569246
115		164676.10000000	132015.38034550	32660.71965450	119385.63917009	144645.12152090
116		91672.00000000	136952.60407324	-45280.60407324	123479.40178478	150425.80636171
117		126130.60000000	140055.37682715	-13924.77682715	129588.64447224	150522.10918206
118		61134.40000000	99520.56481582	-38386.16481582	89486.24468539	109554.88494625
119		7303.00000000	8044.69739122	-741.69739122	-4804.20136998	20893.59615242
120	****	0.0	97227.79664280	0.0	81479.07830261	112976.51498299
121	****	0.0	80818.05196237	0.0	54559.87435394	107076.22957080
122	****	0.0	101994.33686341	0.0	84941.44246689	119047.23125993
123	****	0.0	115524.87141114	0.0	99399.90031207	131649.84251020
124		10435.30000000	26064.57502610	-15629.27502610	1956.23428069	50172.91577151
125		115610.70000000	65404.88760276	50205.81239724	47471.59551214	83338.17969338
126		210255.90000000	178629.38101449	31626.51898551	156764.03363101	200494.72839797
127		212347.60000000	161838.10143754	50509.49856246	148535.97964237	175140.22323272
128		106031.90000000	133757.58582560	-27725.68582560	116128.32107455	151386.85057665
129		138988.20000000	90682.83848925	48305.36151075	78882.65083711	102483.02614140
130		53524.90000000	54678.42368437	-1153.52368437	43115.91768227	66240.92968647
131		7151.30000000	-1275.01292886	8426.31292886	-17593.41198029	15043.38612257
132	****	0.0	100214.43884459	0.0	81949.92512746	118478.95256172
133	****	0.0	107727.91182266	0.0	90315.55600631	125140.26763901
134	****	0.0	111790.60985272	0.0	97415.92624485	126165.29346059
135	****	0.0	115802.63725722	0.0	102574.27826106	129030.99625338
136		28215.30000000	40790.54282243	-12575.24282243	28508.05193324	53073.03371163
137		197847.50000000	134837.11125382	63010.38874618	125097.80179727	144576.42071036

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 Variables model)

138		234498.10000000	153354.98994351	81143.11005649	144229.56934021	162480.41054682
139		235845.90000000	157952.02699711	77893.87300289	146068.87202636	169835.18196795
140		187105.90000000	144572.76846692	42533.13153308	127775.76975418	161369.76717366
141		128104.10000000	75528.72549127	52575.37450873	64918.75097859	86138.70010396
142		65124.90000000	113545.30812960	-48420.40812960	100940.52384628	125150.09241291
143		2165.00000000	12409.37344525	-10244.37344525	-5449.16517259	30267.91206308
144	****	0.0	93065.17522484	0.0	71243.63713338	114886.71331630
145	****	0.0	58852.84403710	0.0	9242.09276279	108463.59531141
146	****	0.0	108001.53013864	0.0	92223.35599939	123779.70427788
147	****	0.0	106159.42443030	0.0	89926.35804900	122392.49081160
148		39135.30000000	39316.17683647	-180.87683647	28156.37157777	50475.98209517
149		133423.10000000	147736.52569624	-14313.42569624	136920.66686553	158552.38452696
150		232678.10000000	160717.05904822	71961.04095178	142537.69420614	178896.42389030
151		290790.40000000	195031.80629402	95758.59370598	182879.41684455	207184.19574349
152		154942.10000000	186745.48956730	-31803.38956730	173443.38221417	200047.59692044
153		199754.10000000	180943.19885767	18810.90114233	169972.52089563	191913.87690970
154		139416.20000000	176966.23074666	-37550.03074666	157577.95568681	196354.50480650
155		14011.40000000	28211.55109123	-14200.15109123	14735.79636415	41687.30581831
156	****	0.0	81496.54177202	0.0	46222.98639185	116770.09715220
157	****	0.0	91359.16998096	0.0	59720.34960232	122997.99135399
158	****	0.0	112367.40462008	0.0	92082.65089583	132652.15834433
159	****	0.0	77984.26415326	0.0	47261.67643147	108706.85187505
160		37716.00000000	49745.00092487	-12029.00092487	38376.21894978	61113.78289996
161		235812.40000000	185222.89337410	50589.50662590	173570.08645232	196875.70029589
162		193661.50000000	206998.95029000	-13337.45029000	189662.51636826	224335.38421174
163		193934.10000000	214912.62347037	-20978.52347037	201301.05663280	228524.19030794
164		200774.60000000	198422.72884852	2351.87115148	183645.84127950	213199.61641753
165		186647.50000000	126766.65955930	59880.84044070	117256.10518648	136277.29393212
166		59703.90000000	101253.68013632	-41549.78013632	80486.50346074	122020.85681191
167		1112.70000000	-13775.80294488	14888.50294488	-29979.29360676	2427.68771701
168	****	0.0	106654.45916441	0.0	84001.67686601	129307.24146281
169	****	0.0	91196.42368183	0.0	59444.42334477	122948.42401890
170	****	0.0	119007.07120810	0.0	101803.15983561	136210.98258059
171	****	0.0	97940.24572281	0.0	76146.68263467	119733.80881096
172		7760.70000000	12271.87232848	-4511.17232848	-7252.90164222	31796.64629917
173		168747.60000000	184634.95955494	-15887.35955494	174614.22803372	194655.69107617
174		317046.10000000	210046.67519820	106999.42480180	196663.10717334	223430.24322305
175		249037.60000000	230187.98098445	18849.61901555	213364.14614858	247011.81582032
176		140301.40000000	239428.78711962	-99127.38711962	221821.49699294	257036.07724630
177		157474.20000000	177108.55422943	-19634.35422943	161254.69275216	192962.41570669
178		2541.00000000	29572.24123868	-27031.24123868	13751.20208054	45393.28039682
179	****	0.0	95381.38277125	0.0	71327.73824994	119435.02729256
180	****	0.0	108468.69911888	0.0	89694.45629146	127242.94194631
181	****	0.0	116403.56496244	0.0	95551.64665048	137255.48327439
182	****	0.0	111025.83029056	0.0	90035.92296992	132015.73761120
183	****	0.0	132313.72892702	0.0	115394.32807661	149233.12977743
184		31520.00000000	50534.34391535	-19014.34391535	36162.31862707	64906.36920363
185		130409.10000000	186614.24755140	-56205.14755140	172129.74147106	201098.75363175
186		296392.80000000	257364.37682771	39028.42317229	241645.32679294	273083.42686247
187		353873.20000000	255253.28709114	98619.91290886	241029.05592774	269477.51825454
188		214608.80000000	255437.31450895	-40828.51450895	241437.86692144	269436.76209645
189		129215.80000000	101026.22040711	28189.57959289	86197.42968253	115855.01113169
190		2248.00000000	12336.47360992	-10088.47360992	-4242.27334867	28915.22056851
191	****	0.0	89255.76205010	0.0	55072.93703922	123438.58706098
192	****	0.0	87416.72144992	0.0	52195.91996752	122637.52293232
193	****	0.0	113223.04765548	0.0	87576.77450171	138869.32080925
194	****	0.0	128267.69502813	0.0	107734.54779292	148800.84226333
195		456.10000000	-16917.14592749	17373.24592749	-37858.21218069	4023.92032572
196		16019.00000000	58359.75182970	-42340.75182970	40691.81401964	76027.68963576
197		113279.70000000	209281.47595074	-96001.77595074	196236.04451098	222326.90739051
198		253651.20000000	260730.22254837	-7079.02254837	243034.79590529	278425.64919145

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 Variable model)

199		229766.10000000	258824.64786673	-29058.54786673	243498.64091073	274150.65482274
200		120678.60000000	212117.22781615	-91438.62781615	198655.85335175	225578.50228055
201		178419.40000000	175167.08438220	3252.31561780	159258.24563281	191075.92313159
202		4378.60000000	19845.11119436	-15466.51119436	3038.75456035	36601.46792436
203	****	0.0	117461.19600553	0.0	97545.59948406	137376.79252699
204	****	0.0	104201.67560376	0.0	78676.95709237	129726.39611465
205	****	0.0	124333.46754658	0.0	105861.46232712	142805.47276603
206	****	0.0	151615.78142668	0.0	131899.10346786	171332.45938550
207	****	0.0	106292.33328973	0.0	79576.90477371	113007.76180574
208		17354.00000000	47369.31518634	-30005.31518634	25320.35375073	69418.27662195
209		84817.00000000	168236.02974447	-83419.02974447	154634.27307897	181837.78640998
210		165026.70000000	270912.86760980	-105886.16760980	244881.51998757	241944.21523203
211		240624.80000000	252585.62565757	-11960.82565757	238650.78345709	266520.46795804
212		165753.20000000	227909.03397619	-42155.83397619	215300.37617716	240517.69177523
213		109408.50000000	159755.08009391	-50346.58009391	143271.15863898	176239.00154883
214		18792.90000000	48849.67605282	-30056.77605282	32175.14996143	65524.20214421
215		78.70000000	4952.31171920	-4873.61171920	-13881.76339886	23796.38663727
216	****	0.0	118720.59976237	0.0	98442.12772367	138999.06980109
217	****	0.0	120773.74551967	0.0	96940.91801118	144606.57302816
218	****	0.0	132967.05903769	0.0	113372.49928287	152561.61879251
219	****	0.0	110552.72951416	0.0	83663.12272572	137442.33630261
220		9218.70000000	43409.03944597	-34190.33944597	21039.15373595	65718.92515594
221		76241.90000000	218433.65416883	-142191.75416883	200537.90440997	236329.40392770
222		205038.80000000	251796.38266107	-46757.58266107	237609.77036704	255982.99495509
223		236700.20000000	234208.31623150	2491.88376850	220564.38831681	247852.24414620
224		182003.40000000	197705.31123441	-15701.91123441	185601.81835650	209808.89411231
225		176600.40000000	190275.87321484	-13675.47321484	175353.66960057	205198.07682911
226		78299.20000000	94057.41666712	-15758.21666712	79706.72212275	108208.11121148
227	****	0.0	113640.63895634	0.0	89220.41460871	138060.86330398
228	****	0.0	97709.19613024	0.0	63075.75768030	132342.63459018
229	****	0.0	134584.74670625	0.0	113500.46642738	155669.02698512
230	****	0.0	164720.38238930	0.0	142846.65304523	185594.11173336
231	****	0.0	132051.85661940	0.0	113419.28510140	153684.42813739
232		26271.10000000	42078.55365285	-15807.45365285	23671.54092130	59485.56618390
233		190351.50000000	187281.83098780	3069.66901220	172830.36772968	231733.29424591
234		297139.60000000	228945.14276076	63194.45723924	214938.03021477	242952.25530675
235		270128.60000000	247957.44576716	22171.15423284	231634.83142614	264280.06010819
236		254689.80000000	231444.45354490	23245.34645510	210929.19698858	251959.71020122
237		250765.20000000	212570.55617575	38194.64382425	199361.82044152	225779.29190997
238		84051.80000000	110408.30935043	-26356.50835043	94861.87184421	125934.74485664
239	****	0.0	153386.27308920	0.0	134053.61864964	172718.92752977
240	****	0.0	123699.44987370	0.0	101315.74033455	145483.15941284
241	****	0.0	124508.59342566	0.0	96124.42257643	152892.76427489
242	****	0.0	130570.81062627	0.0	105127.94530159	156013.67595095
243	****	0.0	129295.26659933	0.0	108526.00808400	150064.52511466
244		15726.00000000	49677.00820037	-33951.00820037	39269.35628292	69084.66011781
245		162680.40000000	174059.02819182	-11378.62819182	155507.63994027	192610.41644338
246		327229.60000000	259772.91439829	67456.88560171	244907.83113982	274637.99765676
247		409082.20000000	293620.34329727	115461.85670273	275057.44981189	312183.23678265
248		310409.30000000	278007.61948410	32401.68051590	256135.68959089	299879.54937731
249		184701.10000000	217351.75077556	-32650.65077556	202510.42378921	232193.07776190
250		111463.80000000	125372.63073468	-13908.83073468	109609.66395544	141135.59751392
251	****	0.0	151716.26228603	0.0	131256.89654510	172175.62803097
252	****	0.0	142844.90990256	0.0	123569.07055989	162120.74924523
253	****	0.0	141438.70160908	0.0	119700.30716736	163177.09605080
254	****	0.0	143640.69801975	0.0	122378.33371847	164903.46232053
255	****	0.0	140552.99383968	0.0	120330.63202696	160775.35565241
256		46239.10000000	80604.15388825	-34370.05388825	62107.23269593	99101.07508058
257		252205.50000000	240569.12420056	11636.37579944	223247.25081146	257890.99758966
258		463590.00000000	297247.68557601	181743.21442399	270169.59832790	304325.77262412
259		487335.50000000	298538.70631587	188796.79368413	277300.20960853	319777.20302321

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly; 4 Variable model)

260		401118.90000000	297331.11227186	103787.78772814	279799.45081536	314862.77372837
261		214969.70000000	253723.69664033	-38753.99664033	234872.45096914	272574.94241151
262		101881.00000000	138369.00905217	-36488.00905217	121545.71996652	155192.29613782
263		1632.90000000	43567.81073316	-41934.91073316	16026.56719937	71109.05426694
264		653.10000000	-5434.29892350	6087.39892350	-32527.50555173	21658.90770472
265	****	0.0	74585.78200061	0.0	43088.85577817	105282.70822304
266	****	0.0	99719.09925489	0.0	83292.05949080	116146.13501898
267	****	0.0	110006.65789983	0.0	98001.47721585	122011.63858181
268	***	21325.70000000	16733.60797385	0.0	4349.95724864	29117.25569907
269	***	274518.40000000	204265.82270877	0.0	187459.46847261	221072.17694494
270	***	309332.80000000	207623.36102374	0.0	193179.03152037	222067.69052711
271	***	236183.80000000	211059.23415443	0.0	195554.00244453	226564.46586434
272	***	336264.20000000	245180.20673208	0.0	228174.52279119	262185.89467297
273	***	182335.60000000	190169.79217776	0.0	173741.23657579	206598.28777973
274	***	81697.10000000	128956.88452722	0.0	117950.93493056	139962.83412389
275	****	0.0	103739.23556192	0.0	86715.76331599	118762.71530734
276	****	0.0	92588.87037992	0.0	71781.79067408	113395.95008575
277	****	0.0	87200.85269950	0.0	62591.35927458	111810.34612443
278	****	0.0	92566.50909645	0.0	70400.37770188	114732.64049101
279	****	0.0	81367.11397026	0.0	61152.72795488	101581.49998563
280	***	14542.60000000	51340.41833055	0.0	38051.57663288	64629.26002822
281	***	142213.20000000	306945.51242513	0.0	273338.32690890	340552.19904136
282	***	181447.40000000	308657.33365583	0.0	282917.98609144	334396.68122022
283	***	362999.90000000	250123.60178452	0.0	233518.93784116	266728.36572787
284	***	310778.70000000	236462.62119857	0.0	219030.41052053	253894.83187660
285	***	212014.40000000	159716.18421992	0.0	147627.05037359	171805.31806626
286	***	111720.60000000	128403.67879913	0.0	113674.26334666	143133.09425160
287	****	0.0	115123.83732987	0.0	101988.38736890	128259.28729085
288	***	13718.00000000	36318.08390108	0.0	11020.53909354	61615.62870862
289	***	23528.00000000	44101.76864032	0.0	19160.46443301	69043.07284764
290	***	26732.00000000	35308.15149021	0.0	7083.86634032	63532.43664010
291	***	900.00000000	-51091.64343911	0.0	-91067.98353261	-11115.29734561
292	***	20793.00000000	50190.12267486	0.0	23402.34266570	76977.90268402
293	***	25632.00000000	24701.62325576	0.0	-16273.97025690	65677.51676842
294	***	24242.00000000	27035.27524628	0.0	-4896.23407148	58966.78956404
295	***	23652.00000000	24979.49524376	0.0	-5965.63094586	55924.62143337
296	***	18071.00000000	18537.91341502	0.0	-25305.62257982	62381.44940986
297	***	17655.00000000	15936.64773267	0.0	-19705.02924496	51578.72471029
298	***	11211.00000000	20360.70430176	0.0	-8928.30580610	49649.71440961
299	***	17701.00000000	24172.17972844	0.0	-4552.05286254	52896.41231942
300	***	11115.00000000	-22278.20893390	0.0	-50741.73606989	6185.28820210
301	***	12646.00000000	14503.83081455	0.0	-9093.53120093	39101.19283004
302	***	8464.00000000	17094.78632292	0.0	-7747.54332364	41937.11596949
303	***	3863.00000000	-2812.97044649	0.0	-18819.66599390	13193.72910092
304	***	582.00000000	-2991.48753351	0.0	-19828.65342234	13845.67835531
305	****	0.0	98437.60190722	0.0	85497.80039156	111377.40342289
306	****	0.0	76224.14909531	0.0	53129.46822205	99318.82996856
307	****	0.0	112466.88565515	0.0	100182.92754823	124750.84376208
308	****	0.0	120563.77969127	0.0	104150.46374124	136977.09564130
309	****	0.0	73238.82969756	0.0	44782.13044768	101695.52894745
310	****	0.0	74271.13197177	0.0	43897.54806768	104644.71587587
311	****	0.0	93455.63576518	0.0	64496.63704267	122414.53445769
312	****	0.0	35464.44783123	0.0	-30241.32114876	101170.21681124
313	****	0.0	73469.97212692	0.0	32922.06749498	114017.97675887
314	****	0.0	116390.00387465	0.0	95798.52856625	136981.47918305
315	****	0.0	25635.43292717	0.0	-46835.56444203	98106.43029637
316	****	0.0	29239.40505866	0.0	-40743.93993699	99222.75005431
317	****	0.0	49225.06869691	0.0	-7136.52407921	105566.66147303
318	****	0.0	31860.47569974	0.0	-36318.62135206	100039.57275154
319	****	0.0	75108.14127760	0.0	35579.13077549	114637.15177971
320	****	0.0	88868.76214329	0.0	57453.51476514	120284.09952142

Table 15 (continued)

Stepwise Regression Results Maximizing R^2 Value (9 Variables, monthly: 4 Variable model)

321	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
322	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
323	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
324	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
325	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
326	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
327	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702
328	****	0.0	-27829.75672948	0.0	-56959.69046422	1200.17700527
329	****	0.0	-29778.24908114	0.0	-58688.02149371	-858.47666857
330	****	0.0	-18087.29497115	0.0	-47759.56575367	11564.39581136
331	****	0.0	-9319.07938866	0.0	-39626.01589997	20987.85712264
332	****	0.0	-6396.34086116	0.0	-36926.13106001	24133.44933765
333	****	0.0	-5422.09468533	0.0	-36027.38660551	25183.19723484
334	****	0.0	-4447.84650950	0.0	-35129.24327253	26233.54625354
335	****	0.0	-4447.84850950	0.0	-35129.24327253	26233.54625354
336	****	0.0	-9319.07938866	0.0	-39626.01589997	20987.85712264
337	****	0.0	-5422.09468533	0.0	-36027.38660551	25183.19723484
338	****	0.0	-4447.84850950	0.0	-35129.24327253	26233.54625354
339	****	0.0	-5422.09468533	0.0	-36027.38660551	25183.19723484
340	****	0.0	-7370.58703700	0.0	-37825.46110683	23084.30703283
341	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
342	****	0.0	-6396.34086116	0.0	-36926.13106001	24133.44933769
343	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
344	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
345	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
346	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
347	****	0.0	-14190.31026782	0.0	-44138.26504957	15757.64451392
348	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
349	****	0.0	-10293.32556449	0.0	-40527.20962488	19940.55849589
350	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
351	****	0.0	-8344.83321283	0.0	-38725.44122479	22035.77479913
352	****	0.0	-10293.32556449	0.0	-40527.20962488	19940.55849589
353	****	0.0	-9319.07938866	0.0	-39626.01589997	20987.85712264
354	****	0.0	-31726.74143281	0.0	-60519.22534022	-2934.27752540
355	****	0.0	-32700.98760864	0.0	-61435.87802161	-3966.09719568
356	****	0.0	-32700.98760864	0.0	-61435.87802161	-3966.09719568
357	****	0.0	-44391.94171863	0.0	-72493.82270850	-16290.06072877
359	****	0.0	76461.83794103	0.0	37767.93143505	115155.74444702

SUM OF RESIDUALS	=	-0.00000001
SUM OF SQUARED RESIDUALS	=	360502891321.29900000
SUM OF SQUARED RESIDUALS - ERROR SS	=	-0.00202942
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.38632040
DURBIN-WATSON D	=	1.22406343

NOTE : NO STARRED OBSERVATION WAS INCLUDED IN THE REGRESSION.

*** INDEPENDENT VARIABLE(S) MISSING , PREDICTED VALUE BASED ON MEAN VALUE FOR MISSING INDEPENDENT(S).

**** DEPENDENT & INDEPENDENT VARIABLE(S) MISSING , PREDICTED VALUE BASED ON MEAN VALUE FOR MISSING INDEPENDENT(S).

Note: Results of stepwise regression of Louisiana menhaden catch on 4 environmental variables using monthly data for 1950 through 1971. Nine variables were screened on basis of maximizing R^2 value. Predicted values are compared with observed values.

Table 16

Stepwise Regression Results Maximizing R^2 Value (9 Variables, yearly; 2 variable model)

MENHADEN REGRESSION BY YEAR 2 YEAR TIME LAG

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CAT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	2	2.99356598396D 12	1.49678349198D 12	32.19560	0.0001	0.77215821	22.83714
ERROR	19	8.83315964216D 11	4.64903139061D 10			STD DEV	CAT MEAN
CORRECTED TOTAL	21	3.87688294818D 12				215616.12636631	944113.90909

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
Y3	1	2.88683108202D 12	62.05230	0.0001	2.68898026773D 12	57.83559	0.0001
SAM	1	1.08735901937D 11	2.33889	0.1427	1.08735901937D 11	2.33889	0.1427

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	934457.30166483	1.83170	0.0827	510164.94916773	0.0
Y3	55596.20342673	7.60523	0.0001	7310.26530463	0.84023300
SAM	-2200.38930474	-1.52934	0.1427	1439.10657917	-0.16896289

OBS NUMBER	OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	504903.00000000	383762.39207885	121140.60792115	190222.97086106	577301.81329664
2	488851.00000000	307305.31722094	181545.68277906	91052.97482651	523556.65962138
3	385876.00000000	406919.38674256	-21043.38674256	231035.89593271	582832.87749232
4	490208.00000000	519738.79209263	-29530.79209263	370574.63996152	668902.94422374
5	592716.00000000	590741.30065257	1974.69934743	450895.83858870	730586.76271645
6	349508.00000000	608922.46589866	-259414.46589866	478302.91647369	739542.01532364
7	433462.00000000	534666.28034550	-101204.28034550	294814.03384070	774518.52685030
8	727132.00000000	801547.93702765	-74415.93702765	666625.90059551	936469.97344979
9	854346.00000000	863746.88836862	-9400.88836862	729692.55466174	997801.22207550
10	1078907.00000000	855517.38195778	223389.61804222	756566.07279887	954468.69111668
11	1204151.00000000	974939.45522209	229211.54477791	848783.46736484	1101095.44307933
12	1109363.00000000	964509.05950650	144853.94049350	867354.77599650	1061663.34201650
13	1042909.00000000	1143355.14399890	-100446.14399889	959083.84350665	1327626.44449114
14	1162268.00000000	1216558.54186358	-54290.54186358	1011067.46636933	1422049.61715784
15	916649.00000000	1129097.02048196	-212448.02048196	1017363.91412789	1240830.12683602
16	821988.00000000	1233112.36861306	-411124.36861306	1107214.33959239	1359011.69763223
17	964103.00000000	1288709.15203979	-324606.15203979	1154633.94267504	1422784.36140455
18	1373398.00000000	1291484.09215267	81913.90784733	1147169.62140527	1435978.56289997
19	1521293.00000000	1344879.48627466	176413.51372534	1191282.64195635	1498476.33059297

Table 16 (continued)

Stepwise Regression Results Using R^2 Value (9 Variables, yearly; 2 variable model)

20	1975022.00000000	1470904.22745320	504117.77254680	1300257.44894336	1641551.00596304
21	1441858.00000000	1453871.16382338	-12013.16382338	1275013.44881823	1632728.87882854
22	1335717.00000000	1386217.64618446	-50500.64618446	1101779.05622283	1670656.23614608

SUM OF RESIDUALS	=	0.00000001
SUM OF SQUARED RESIDUALS	=	883115964215.73920000
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.50236511
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.49264596
DURBIN-WATSON D	=	1.00483770

Note: Results of stepwise regression of Louisiana menhaden catch on 2 environmental variables using yearly data for 1950 through 1971. Nine variables were screened on basis of maximizing R^2 value. Predicted values are compared with observed values.

Table 17

Stepwise Regression Results Using R^2 Value (yearly; 3 variable model)

MENHADEN REGRESSION BY YEAR 2 YEAR TIME LAG

ANALYSIS OF VARIANCE TABLE , REGRESSION COEFFICIENTS , AND STATISTICS OF FIT FOR DEPENDENT VARIABLE CAT

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB > F	R-SQUARE	C.V.
REGRESSION	3	2.84139012944D 12	9.47130043148D 11	22.70899	0.0001	0.80029828	21.03867 %
ERROR	17	7.09023752580D 11	4.17072795636D 10				
CORRECTED TOTAL	20	3.55041388202D 12				STD DEV	CAT MEAN
						204223.60187684	970696.66667

SOURCE	DF	SEQUENTIAL SS	F VALUE	PROB > F	PARTIAL SS	F VALUE	PROB > F
YR	1	2.56447964705D 12	61.48758	0.0001	1.27280802555D 11	3.05176	0.0987
EFF	1	1.10306308441D 11	2.64477	0.1223	1.73770045610D 11	4.16642	0.0571
SAM	1	1.66604173954D 11	3.99461	0.0619	1.66604173954D 11	3.99461	0.0619

SOURCE	B VALUES	T FOR H0:B=0	PROB > |T|	STD ERR B	STD B VALUES
INTERCEPT	605001.93665775	1.16884	0.2586	517607.02154549	0.0
YR	27198.04099491	1.74693	0.0987	15569.04963022	0.41076135
EFF	906.52743392	2.04118	0.0571	444.11907389	0.47879381
SAM	-2839.64208743	-1.99865	0.0619	1420.77922175	-0.22325434

OBS NUMBER		OBSERVED VALUE	PREDICTED VALUE	RESIDUAL	LOWER 95% CL FOR MEAN	UPPER 95% CL FOR MEAN
1	***	173292.00000000	415743.75071912	0.0	142808.90654531	688678.59489294
2	***	329012.00000000	443848.31914795	0.0	198367.30819883	689329.33009708
3		504903.00000000	411159.13796616	93743.86203384	215361.43982150	606956.83611083
4		488851.00000000	402144.71393539	86706.28606461	160090.75706609	644198.67080469
5	***	385876.00000000	641151.78787951	0.0	341139.63902194	941163.93673709
6		490208.00000000	434867.72304839	55340.27695161	257641.10873500	612094.33736178
7		592716.00000000	733051.35785153	-140335.35785153	530853.54552626	935249.17017679
8		349508.00000000	456334.74699427	-106826.74699427	246844.77161902	665824.72236951
9		433462.00000000	515429.94029326	-81967.94029326	273063.48443763	757796.39614889
10		727132.00000000	843335.97213337	-116203.97213337	705743.47574813	980528.46851862
11		854346.00000000	742167.29686847	112178.70313153	561131.80072846	923202.79300849
12		1078907.00000000	764977.07664503	313929.92335497	627855.91195913	902099.24133093
13		1204151.00000000	1139230.74888053	64920.25111947	931241.73422279	1347219.76353826
14		1109363.00000000	1044071.90246165	65291.09753835	919111.12239408	1169032.68252922
15		1042909.00000000	1175898.25431758	-132989.25431758	996331.14796494	1355465.36067021
16		1158268.00000000	1243943.98069038	-85675.98069038	1044656.86753855	1443231.09384222
17		916649.00000000	1121919.85592502	-205270.85592502	1014582.59528417	1229257.11656589

Table 17 (continued)

Stepwise Regression Results Using R^2 Value (yearly; 3 variable model)

18	821866.00000000	1196179.05646682	-374313.05646682	1070010.98907230	1322347.12386133
19	964103.00000000	1166265.86912469	-202162.86912469	986356.42816510	1346175.31008427
20	1373398.00000000	1170638.87171725	202759.12828275	986728.14760485	1354549.59582964
21	1521293.00000000	1312845.83703449	208447.16296551	1162449.50517001	1463242.16889836
22	1975022.00000000	1572330.70451899	402691.29548101	1376046.64263980	1768614.76639819
23	1441858.00000000	1447802.80085763	-5944.80085763	1276364.56421934	1619241.03749592
24	1335717.00000000	1490034.15226912	-154317.15226912	1198069.86774254	1781996.43679571

SUM OF RESIDUALS	=	0.00000000
SUM OF SQUARED RESIDUALS	=	709023752580.37440000
SUM OF SQUARED RESIDUALS - ERROR SS	=	0.00251770
FIRST ORDER AUTOCORRELATION OF RESIDUALS	=	0.49340967
DURBIN-WATSON D	=	0.98994379

NOTE : NO STARRED OBSERVATION WAS INCLUDED IN THE REGRESSION.

*** INDEPENDENT VARIABLE(S) MISSING , PREDICTED VALUE BASED ON MEAN VALUE FOR MISSING INDEPENDENT(S).

Note: Results of stepwise regression of Louisiana menhaden catch on 3 environmental variables using yearly data for 1950 through 1971. Procedure maximized R^2 value. Predicted values are compared to observed values.

Table 18

Cross-correlation Coefficients between Harvest and Indicated Environmental Variables

Cross Correlations Months	Max Water	Min Water	Avg Water	Mean Tide	Tide Range	Air Min	NØSP	NØDR	BRSP	BRDR	LCSP	LCDR	Air Max	Rain Max	Air Mean	Rain Mean
0	56	57	56	- 7	29	62	-41	-3	-39	17	-31	16	53	-14	57	22
1	43	45	45	-13	13	43	-44	3	-45	16	-37	15	34	-19	-19	40
2	19	20	28	7	2	12	-19	12	-29	28	-29	17	8	- 4	18	16
3	- 2	- 3	- 6	5	- 7	-28	-11	16	-14	15	-13	8	-17	12	-14	-11
4	-17	-20	-25	8	- 1	-43	- 1	-3	-10	-9	- 8	-6	-36	21	-42	-17
5	11	2	14	- 5	24	3	-24	1	-24	1	-20	24	- 4	6	7	- 1
6	19	30	19	0	3	34	-24	-7	-27	14	-15	3	23	- 7	19	25
7	5	12	8	- 1	- 9	17	-10	0	- 7	22	- 7	0	2	-12	16	3
8	-34	-28	-30	5	- 1	-29	18	2	7	28	21	8	-33	- 4	-23	-23
9	-45	-33	-53	15	7	-29	17	-1	9	8	38	4	-42	0	-41	-27
10	-27	-17	-29	12	31	- 7	0	12	4	17	25	13	-25	-16	-16	-17
11	5	18	9	11	37	30	-22	2	-14	17	7	18	13	-11	20	10
12	43	49	46	3	34	50	-37	2	-31	18	-24	9	42	-10	46	21
13	33	34	37	-10	15	32	-42	-5	-39	15	-37	12	26	-17	32	30
14	12	10	21	- 7	6	3	-21	7	-30	23	-26	15	0	5	13	19
15	- 4	- 9	- 3	3	- 6	-30	- 4	17	-21	17	-10	7	-23	9	-16	-15
16	-16	-22	-23	10	1	-43	- 4	-5	-15	1	- 9	-1	-35	19	-41	-17
17	10	- 4	11	- 4	30	1	-17	0	-25	-3	-23	15	-10	5	2	11
18	16	26	19	- 5	2	35	-28	-3	-21	8	-11	5	23	- 6	21	24
19	1	4	6	- 6	-14	10	-16	-11	- 9	19	- 5	2	3	-21	12	0
20	-33	-27	-28	- 3	- 7	-32	19	- 5	1	22	30	8	-33	- 2	-23	-21
21	-44	-31	-50	5	6	-35	21	- 6	2	15	38	9	-42	1	-42	-22
22	-26	-15	-27	7	26	- 8	11	2	- 1	10	27	12	-21	-10	-15	-14
23	6	17	9	5	33	26	-11	6	-17	12	12	18	14	- 8	18	9
24	37	43	39	- 3	34	43	-32	5	-29	12	-16	8	34	-10	39	15

Note: Cross-correlation coefficients between Louisiana menhaden catch and indicated environmental variable by month 0 to 24 prior to the catch. Values ≥0.138 are significant at p = 0.05 and those ≥0.181 are significant at p = 0.01.

Table 19

Cross-correlation Coefficients between Harvest and Indicated Environmental Variables (month of harvest)

	Months Lag	Significant Parameter		Months Lag	Significant Parameter
April	10	M Tide Range	Aug.	1	Rain Max
	11	M Tide Range		2	M Tide Range
	20	Lake Charles Wind Direction		3	M Tide Range
	23	Lake Charles Wind Speed		6	Baton Rouge Wind Speed
	24	M Tide Range		7	Tide Range
				12	Tide Range
May	1	M Tide Range		14	M Tide Range
	10	Rain Max		15	M Tide Range
	11	M Tide Range		16	M Tide Range and Lake Charles Wind Direction
	12	M Tide Range			
	13	M Tide Range		18	Baton Rouge Wind Speed
	24	Lake Charles Wind Speed		19	Tide Range
June	2	Lake Charles Wind Direction	Sept.	8	Tide Range
	5	Tide Range		14	Rain Max
	12	M Tide Range		16	M Tide Range
	13	M Tide Range		17	M Tide Range
	17	Tide Range		19	Baton Rouge Wind Speed
				20	Tide Range
July	0	Rain Max			
	1	M Tide Range	Oct.	5	M Tide Range
	2	M Tide Range		11	Baton Rouge Wind Direction
	3	M Tide Range		18	M Tide Range
	6	Tide Range			
	13	M Tide Range	Nov.	0	Rain Max
	14	M Tide Range		9	New Orleans Wind Direction
	15	M Tide Range		17	Rain Max
	17	Baton Rouge Wind Speed		20	Rain Mean
	18	Tide Range			

Note: Cross-correlation coefficients between Louisiana menhaden catch and indicated environmental variable. Significant level is $p \leq 0.01$. Coefficients done by individual month of harvest.

Table 20

List of Environmental Variables Used in Analyses

		X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}	X_{17}	X_{18}	X_{19}
NOSP	X_1		26					27	28	29	30	31	32			33	34	35	36	
NODR	X_2							37	38	39	40	41	42			43	44	45	46	
BRSP	X_3				47			48	49	50	51	52	53			54	55	56	57	
BRDR	X_4							58	59	60	61	62	63			64	65	66	67	
LCSP	X_5						68	69	70	71	72	73	74			75	76	77	78	
LCDR	X_6							79	80	81	82	83	84			85	86	87	88	
Air Max	X_7										89	90	91						92	
Air Min	X_8										93	94	95						96	
Air Mean	X_9										97	98	99						100	
Water Max	X_{10}													101	102				103	
Water Min	X_{11}													104	105				106	
Water Mean	X_{12}													107	108				109	
Rain Max	X_{13}															110	111	112	113	
Rain Mean	X_{14}															114	115	116	117	
Tide Max	X_{15}																		118	
Tide Min	X_{16}																		119	
Tide Mean	X_{17}																		120	
Month	X_{18}																			
Effort	X_{19}																			

$X_{20} = (X_7)^2$
$X_{21} = (X_8)^2$
$X_{22} = (X_9)^2$
$X_{23} = (X_{10})^2$
$X_{24} = (X_{11})^2$
$X_{25} = (X_{12})^2$

NOSP = New Orleans Wind Speed
NODR = New Orleans Wind Direction
BRSP = Baton Rouge Wind Speed
BRDR = Baton Rouge Wind Direction
LCSP = Lake Charles Wind Speed
LCDR = Lake Charles Wind Direction
Air Max = Maximum Air Temperature
Air Mean = Minimum Air Temperature
Water Max = Maximum Water Temperature
Water Min = Minimum Water Temperature
Rain Max = Maximum Rainfall
Rain Mean = Mean Rainfall
Tide Max = Maximum Tide Range
Tide Min = Minimum Tide Range
Tide Mean = Mean Tide Range

Note: List of environmental variables used for analyses. Base list is made up of 19 variables, but matrix implies that 120 variables are possible by considering squared-functions and interactions. For example, X20 is X7 squared and X80 is the interaction of <CDR with air min.

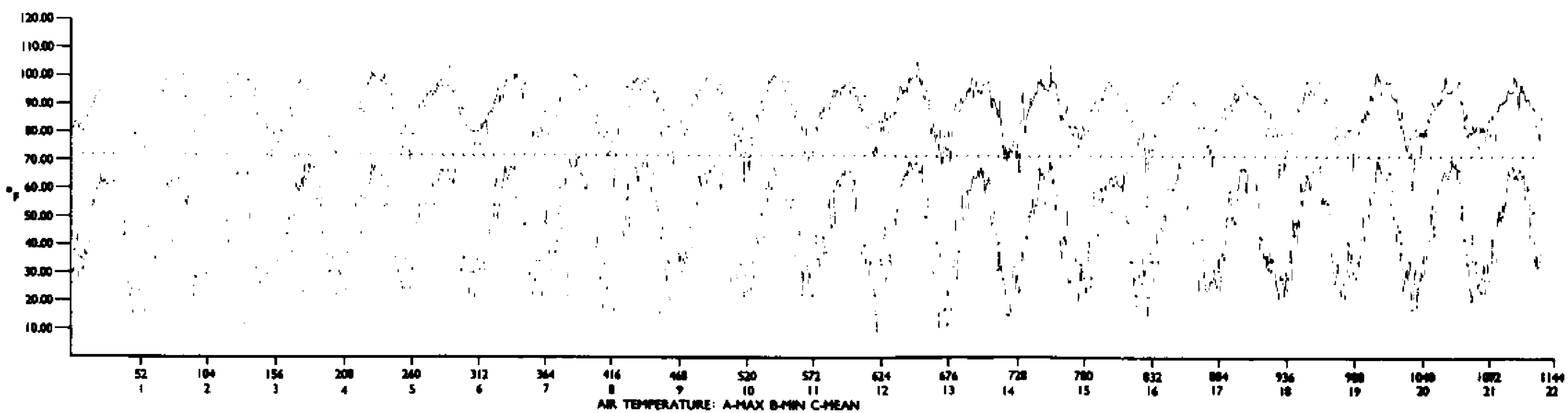


Fig. 1. Scatter diagram of air temperature data for coastal Louisiana, 1950 to 1971, in degrees Fahrenheit. Plot A is maximum air temperature and plot B is minimum air temperature. The straight line plot is the overall mean air temperature. See text for data sources and derivations. Horizontal scale is given in terms of years (#1, #2, #3, etc.) and weeks (#52, #104, #156, etc.).

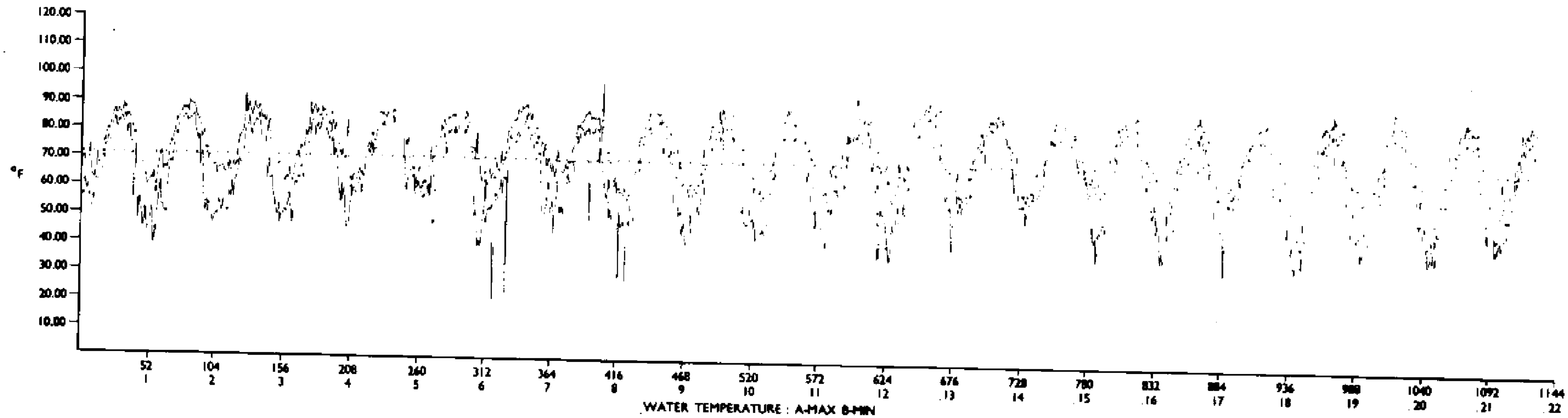


Fig. 2. Scatter diagram of water temperature data for coastal Louisiana, 1950 to 1971, in degrees Fahrenheit from nearshore and inshore sampling stations. Plot A is maximum water temperature and plot B is minimum water temperature. The straight line plot is the overall mean water temperature. See text for data sources and derivations. Horizontal scale is given in terms of years (#1, #2, #3, etc.) and weeks (#52, #104, #156, etc.).

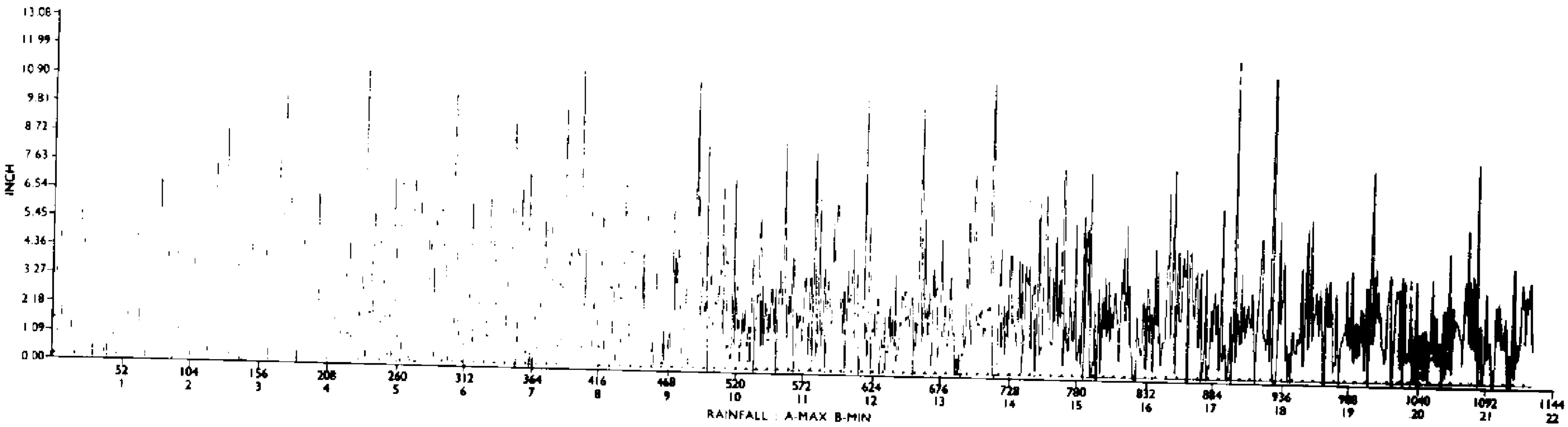


Fig. 3. Scatter diagram of rainfall data for coastal Louisiana, 1950 to 1971, in inches. Plot A is maximum rainfall. See text for data sources and derivations. Horizontal scale is given in terms of years (#1, #2, #3, etc.) and weeks (#52, #104, #156, etc.).

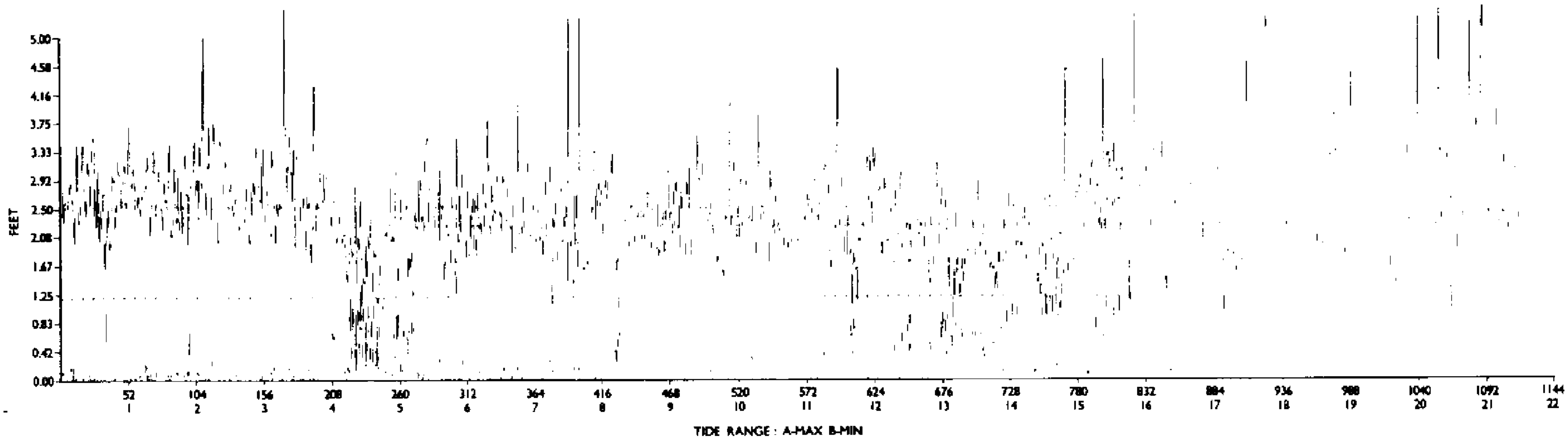


Fig. 4. Scatter diagram of tidal data for coastal Louisiana, 1950 to 1971, in feet. Plot A is maximum tide range. The straight line plot is the overall tide mean. See text for data sources and derivations. Horizontal scale is given in terms of years (#1, #2, #3, etc.) and weeks (#52, #104, #156, etc.).

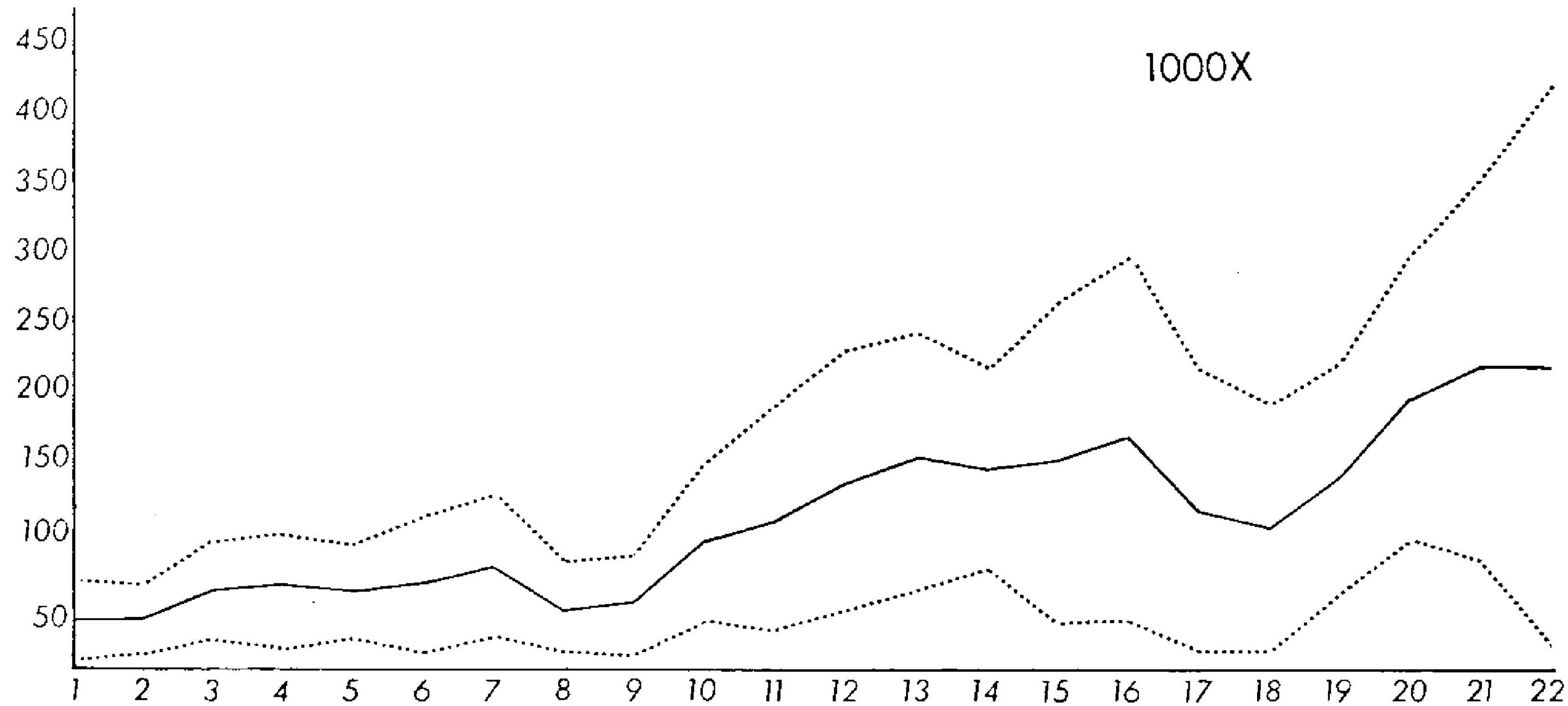


Fig. 5. Diagram of menhaden catch off Louisiana coast, 1950 to 1971. Vertical units are standard fish units (1 standard fish unit = 0.3 metric tons) with ±1 standard deviations plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

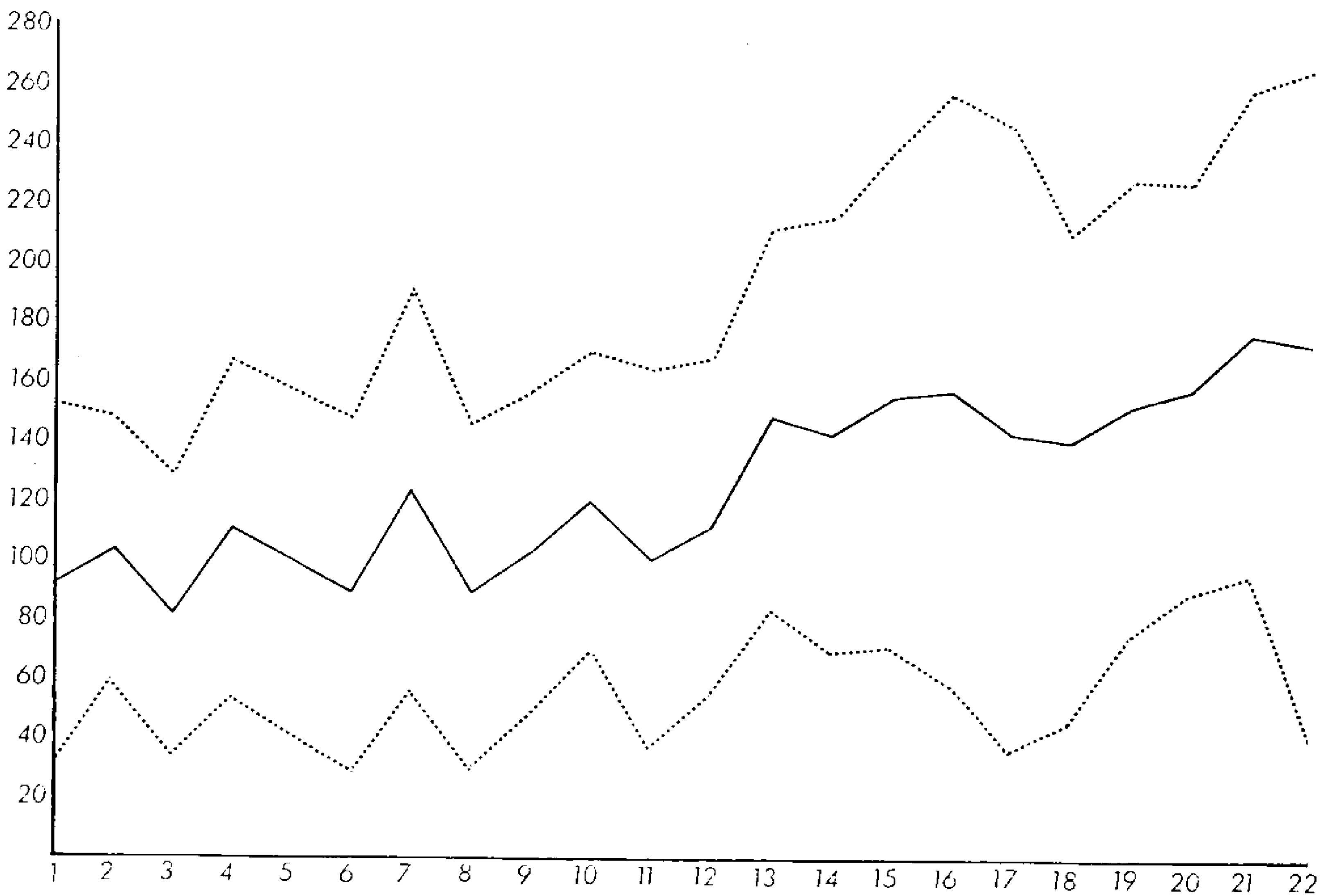


Fig. 6. Diagram of effort for Louisiana menhaden catch, 1950 to 1971, in terms of vessel weeks. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

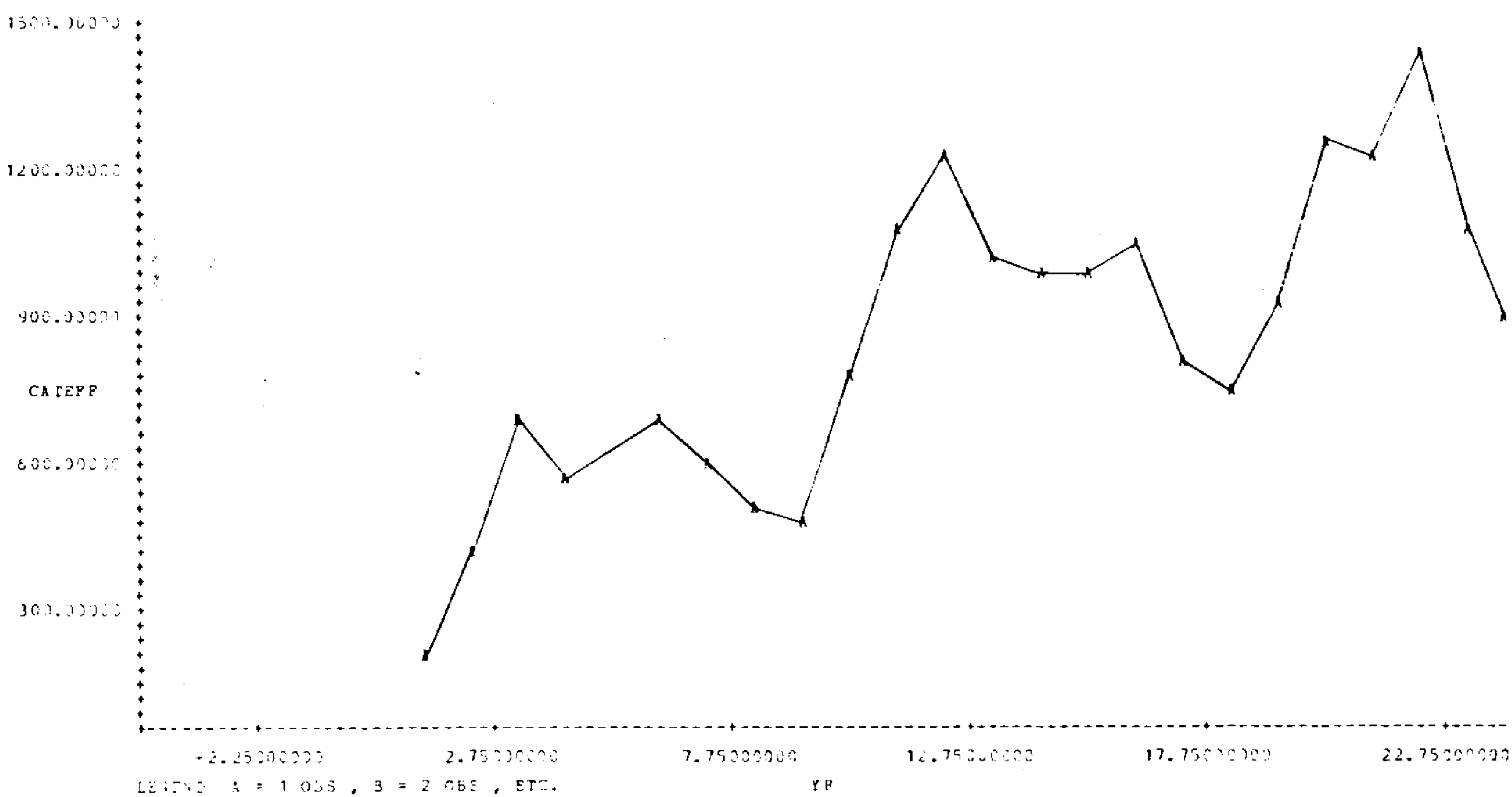


Fig. 7. Diagram of menhaden catch/effort ratio for coastal Louisiana, 1950 to 1971.

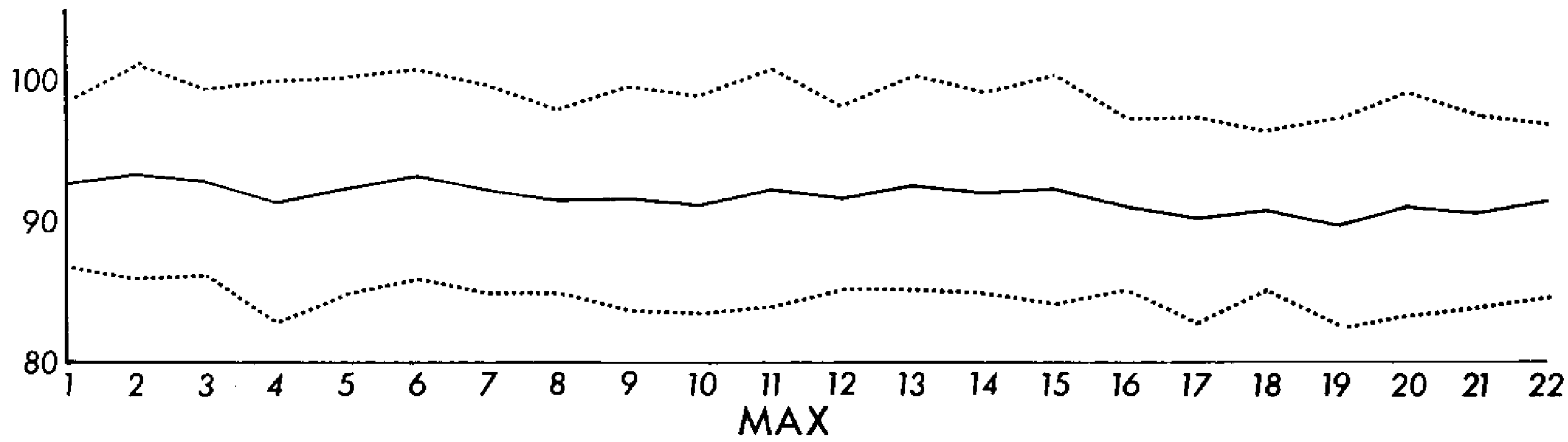


Fig. 8. Diagram of maximum air temperature for coastal Louisiana, 1950 to 1971. Vertical scale is given in degrees Fahrenheit and horizontal scale in years (#1, #2, #3, etc.). Standard deviations are plotted in dashed lines.

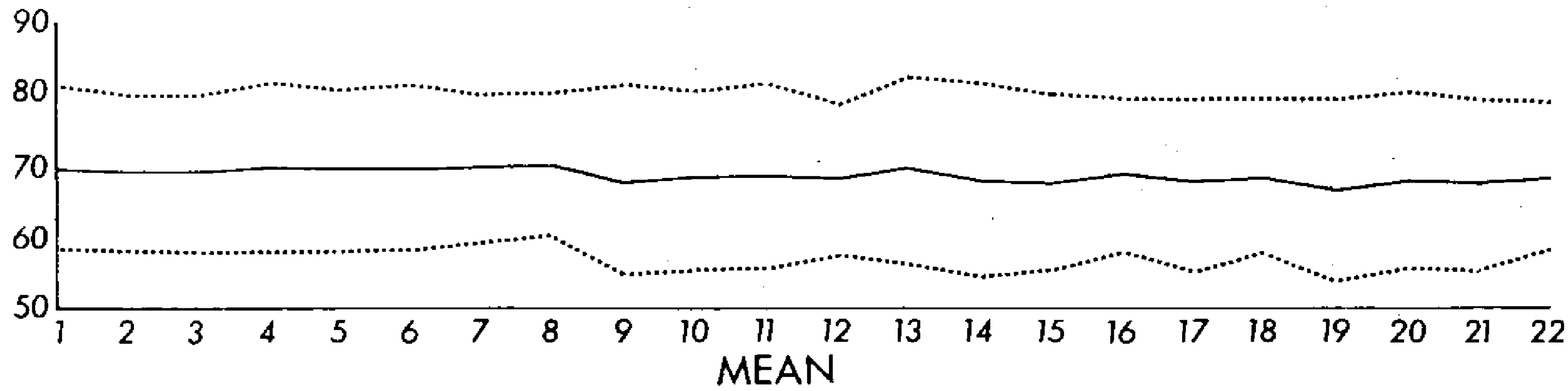


Fig. 9. Diagram of mean air temperatures for coastal Louisiana, 1950 to 1971. Vertical scale in degrees Fahrenheit and horizontal scale in years (#1, #2, #3, etc.). Standard deviations are plotted in dashed lines.

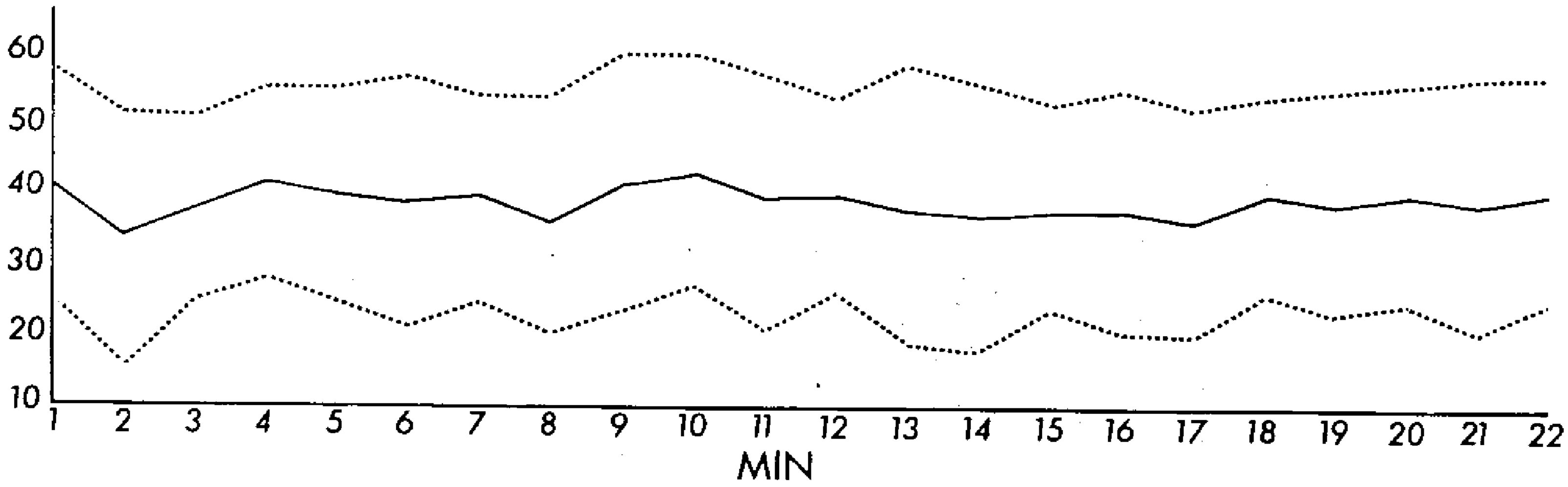


Fig. 10. Diagram of minimum air temperatures for coastal Louisiana, 1950 to 1971. Vertical scale in degrees Fahrenheit and horizontal scale in years (#1, #2, #3, etc.). Standard deviations are plotted in dashed lines.

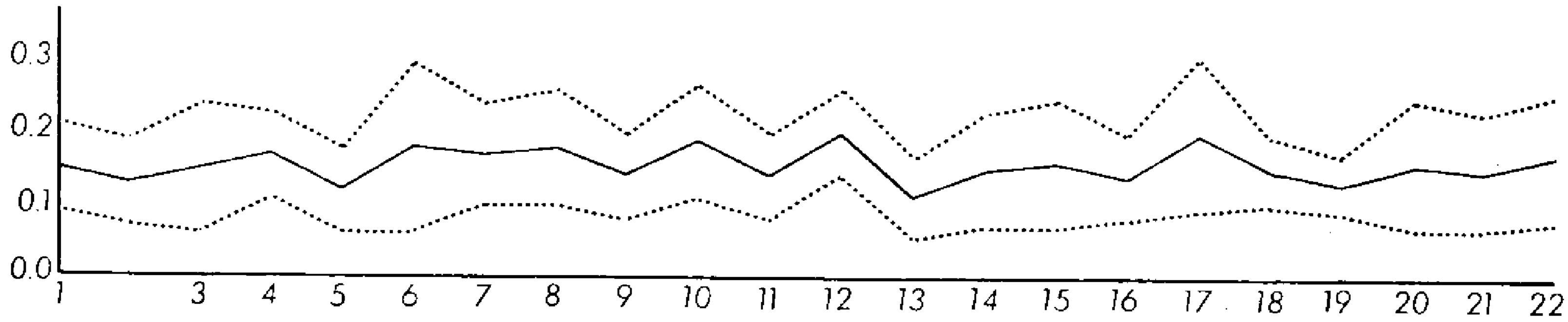


Fig. 11. Diagram of mean rainfall by day for coastal Louisiana, 1950 to 1971, in inches. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

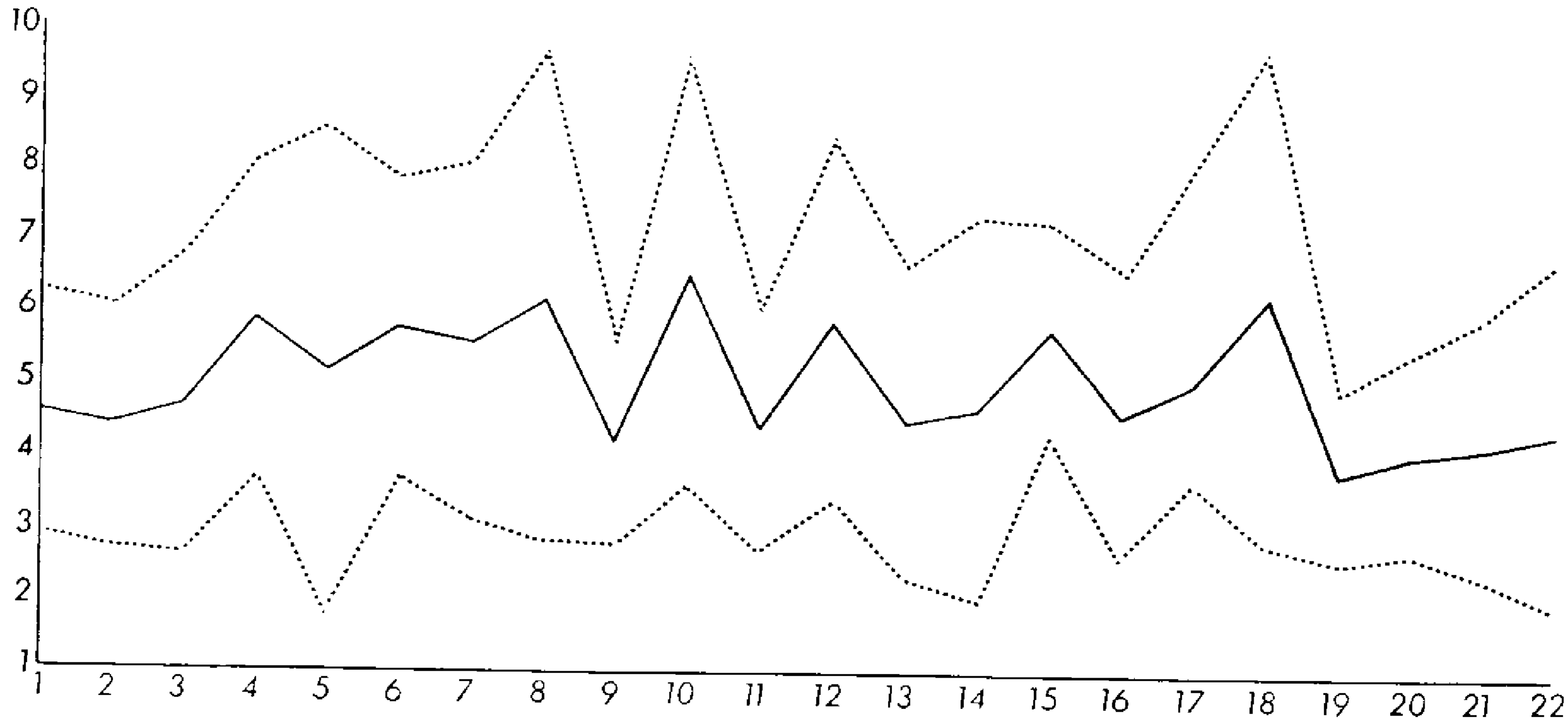


Fig. 12. Diagram of maximum rainfall for coastal Louisiana, 1950 to 1971, in inches. Maximum rainfall for particular day per month divided by 12. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

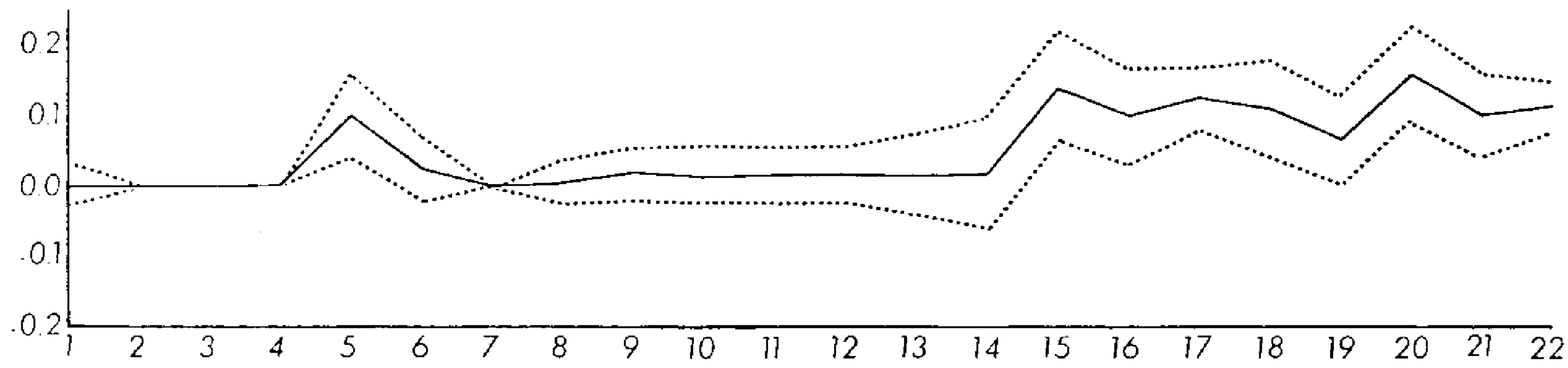


Fig. 13. Diagram of minimum tide range for coastal Louisiana, 1950 to 1971, in feet. Minimum tide range for particular day per month divided by 12. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

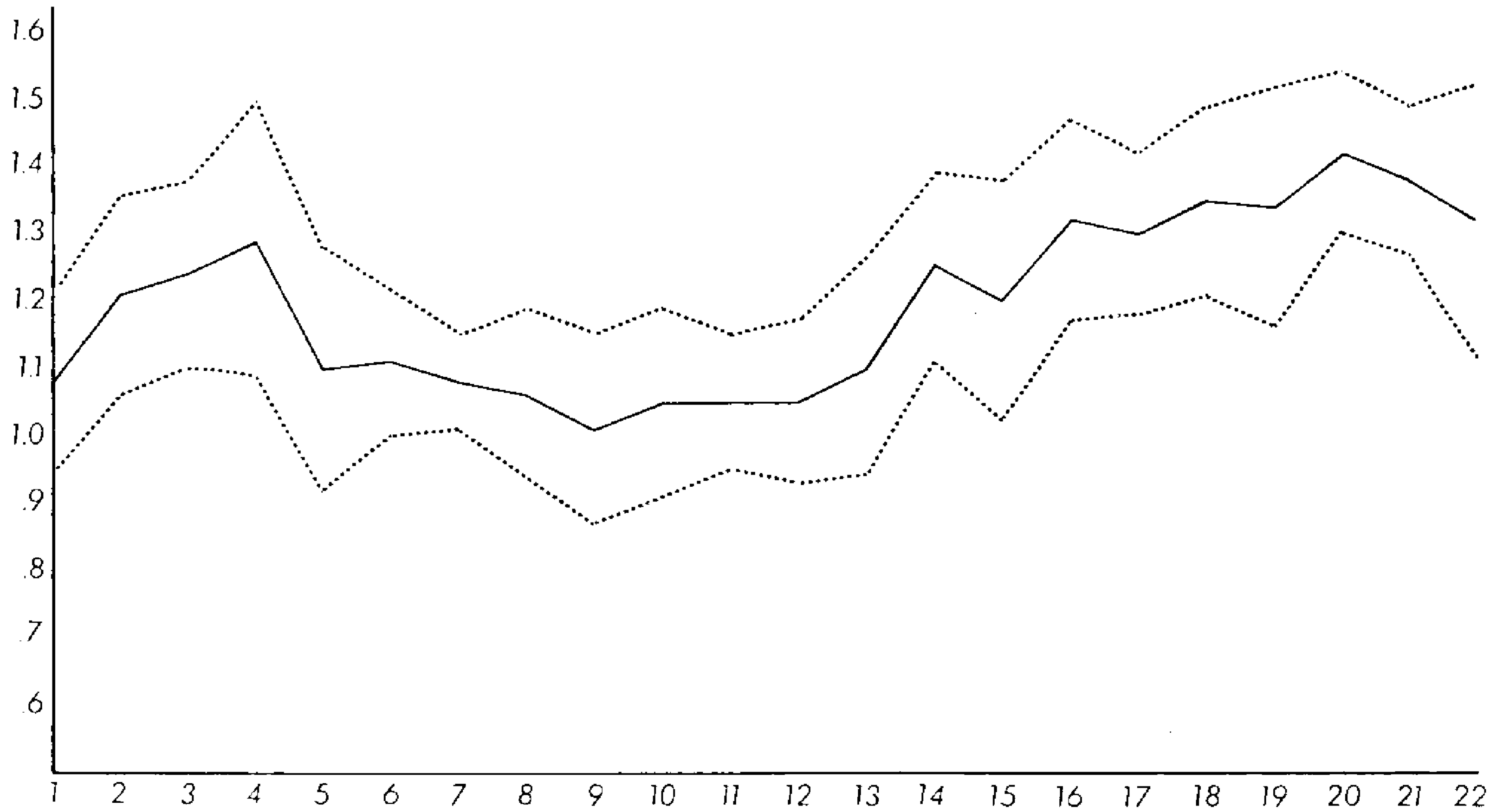


Fig. 14. Diagram of mean tide range for coastal Louisiana, 1950 to 1971, in feet. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

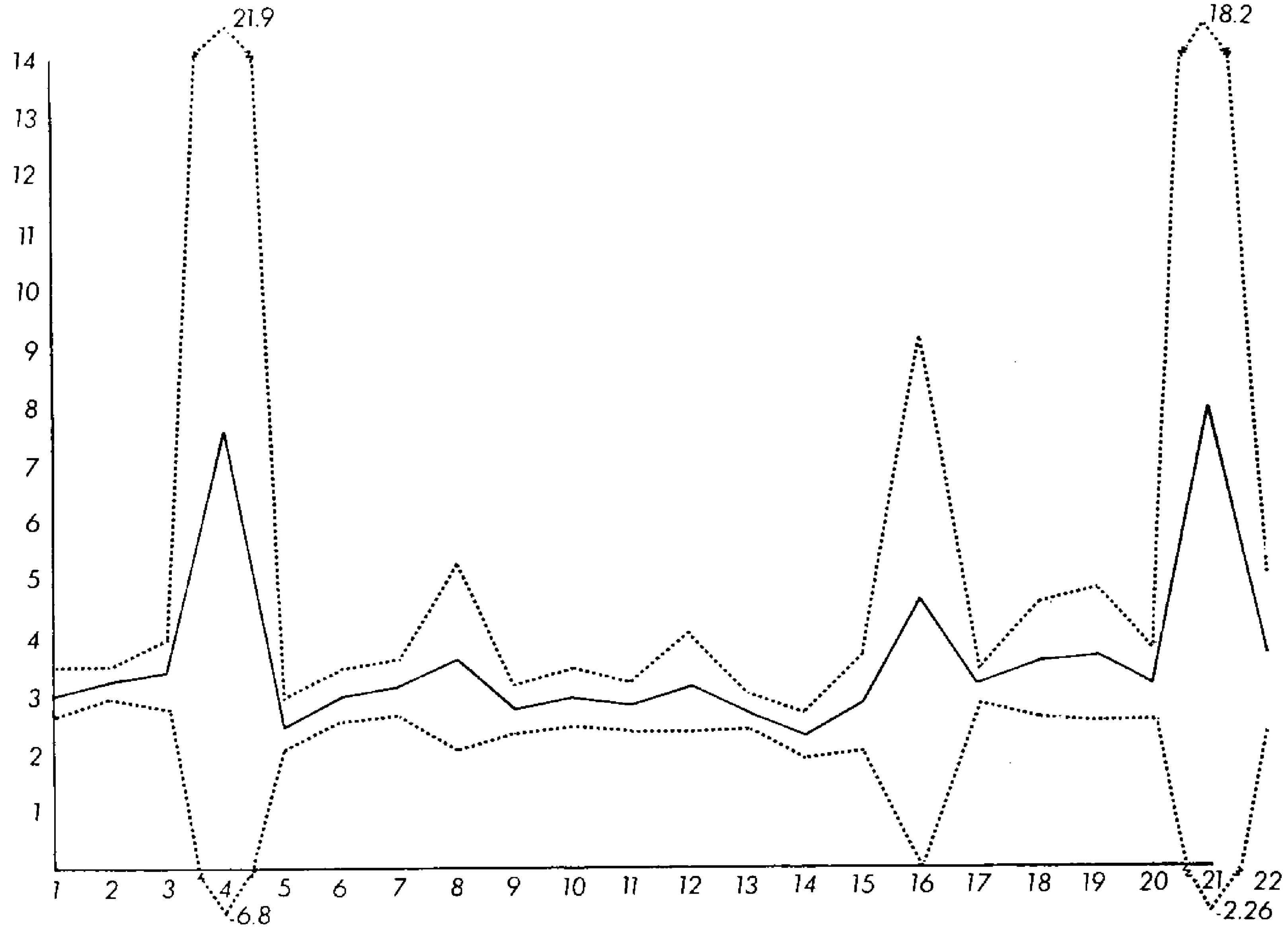


Fig. 15. Diagram of maximum tide range for coastal Louisiana, 1950 to 1971, in feet. Maximum tide range for particular day per month divided by 12. Standard deviations are plotted in dashed lines. Horizontal scale is given in years (#1, #2, #3, etc.).

APR	24							
MAY	23	24						
JUN	22	23	24					
JUL	21	22	23	24				
AUG	20	21	22	23	24			
SEP	19	20	21	22	23	24		
OCT	18	19	20	21	22	23	24	
NOV	17	18	19	20	21	22	23	24
DEC	16	17	18	19	20	21	22	23
JAN	15	16	17	18	19	20	21	22
FEB	14	15	16	17	18	19	20	21
MAR	13	14	15	16	17	18	19	20
APR	12	13	14	15	16	17	18	19
MAY	11	12	13	14	15	16	17	18
JUN	10	11	12	13	14	15	16	17
JUL	9	10	11	12	13	14	15	16
AUG	8	9	10	11	12	13	14	15
SEP	7	8	9	10	11	12	13	14
OCT	6	7	8	9	10	11	12	13
NOV	5	6	7	8	9	10	11	12
DEC	4	5	6	7	8	9	10	11
JAN	3	4	5	6	7	8	9	10
FEB	2	3	4	5	6	7	8	9
MAR	1	2	3	4	5	6	7	8
APR	0	1	2	3	4	5	6	7
MAY		0	1	2	3	4	5	6
JUN			0	1	2	3	4	5
JUL				0	1	2	3	4
AUG					0	1	2	3
SEP						0	1	2
OCT							0	1
NOV								0

Fig. 16. Diagram to illustrate effects of selected environmental variables 0 to 24 months prior to month of menhaden harvest.

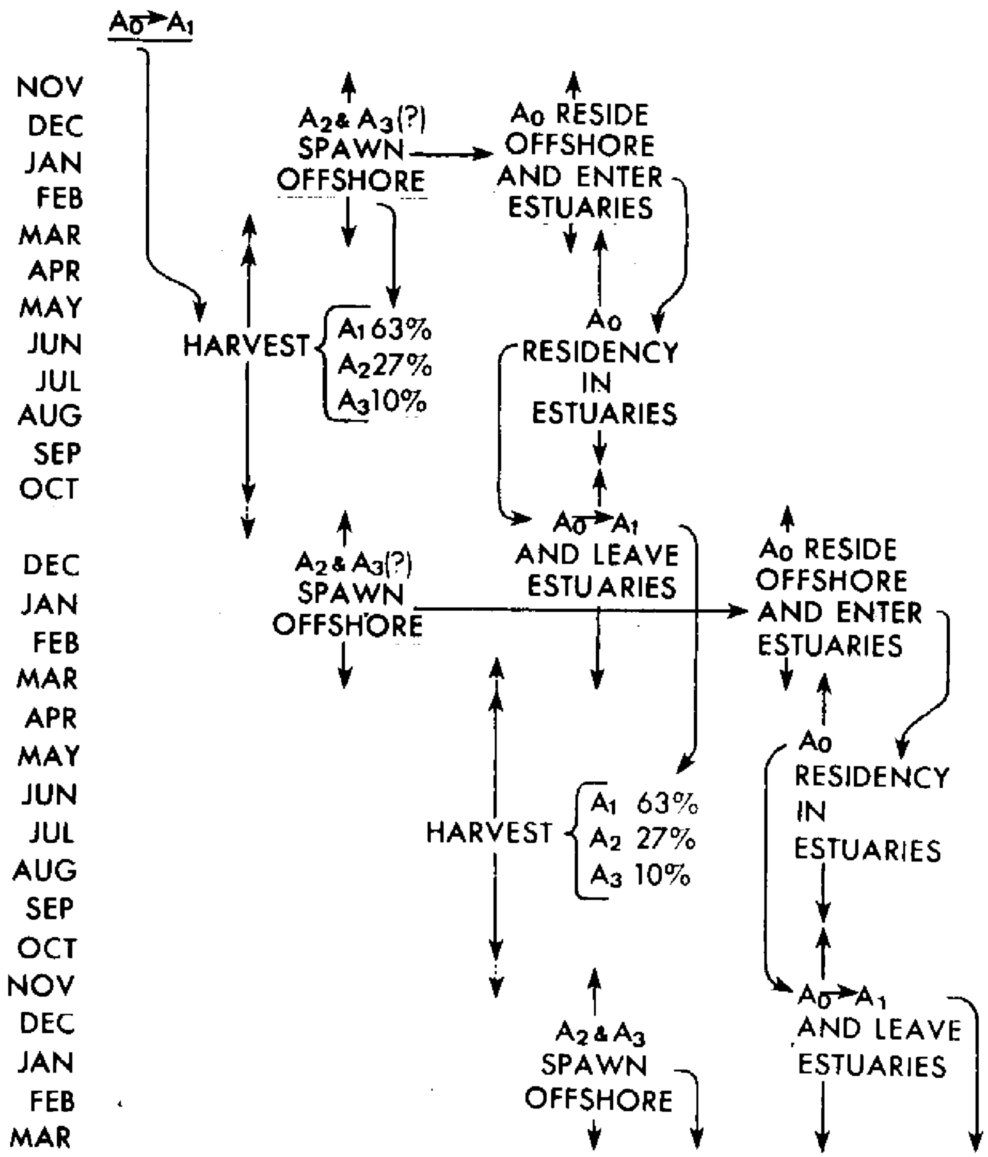


Fig. 17. Diagram of a proposed life cycle of Louisiana menhaden. Harvest percentages derived from Chapoton (1975).

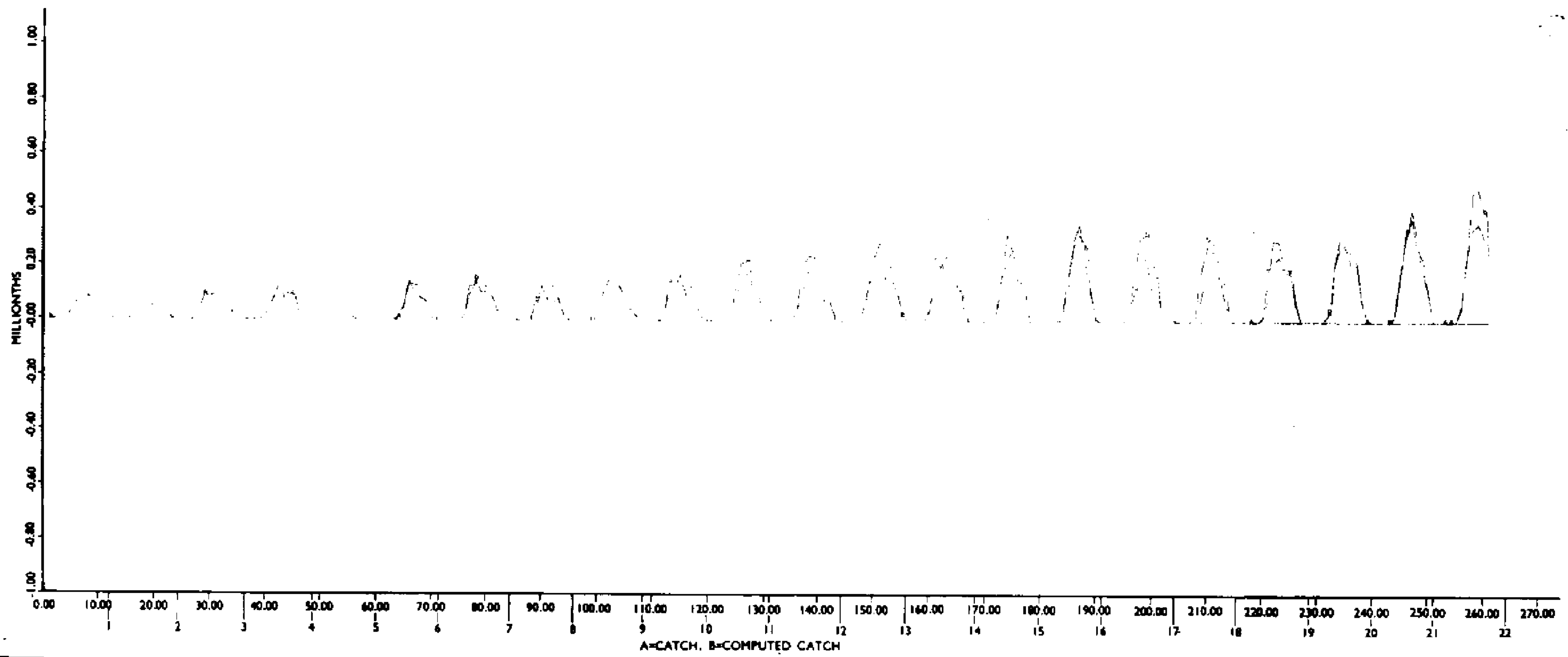


Fig. 18. Diagram of predicted versus observed Louisiana menhaden catch, 1950 to 1971. Predicted values based on a sine curve. Vertical scale is in standard fish units (1 standard fish unit = 0.3 metric tons) and horizontal scale in years (#1, #2, #3, etc.).

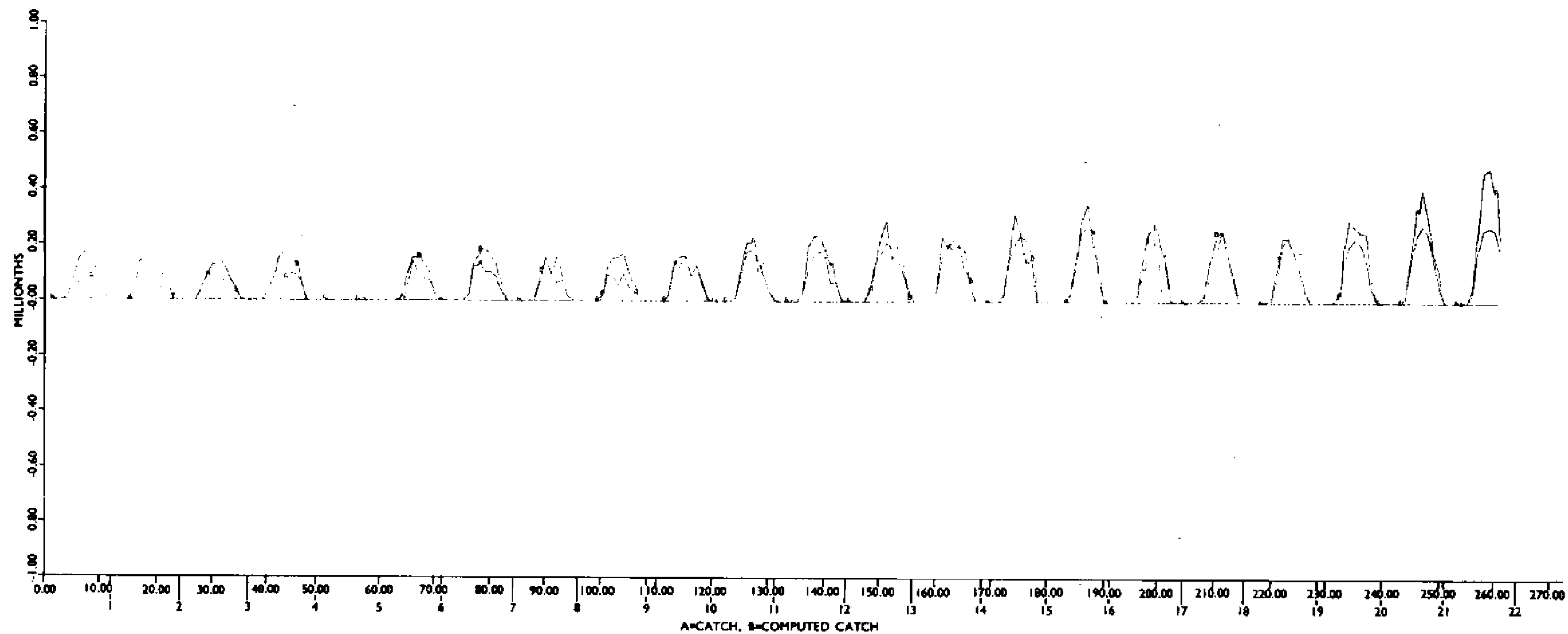
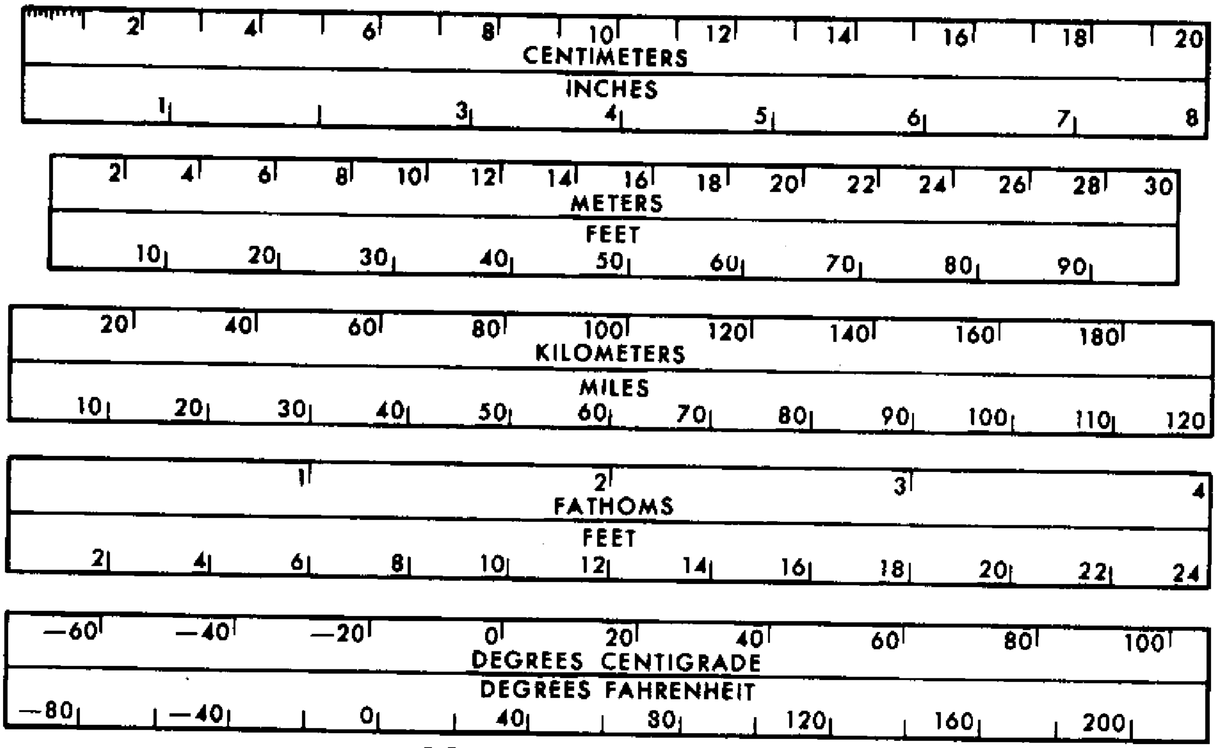


Fig. 19. Diagram of predicted versus observed Louisiana menhaden catch, 1950 to 1971. Predicted values based on a sine curve modified by coefficients of selected environmental variables. Vertical scale is in standard fish units (1 standard fish unit = 0.3 metric tons) and horizontal scale in years (#1, #2, #3, etc.).



CONVERSION FACTORS

LENGTH

1 inch	=	2.54 centimeters	1 centimeter	=	0.40 inch
1 inch	=	25.40 millimeters	1 millimeter	=	0.04 inch
1 foot	=	0.30 meter	1 meter	=	3.28 feet
1 yard	=	0.91 meter	1 meter	=	1.09 yards
1 fathom	=	1.83 meters	1 meter	=	0.55 fathom
1 fathom	=	6.00 feet	1 meter	=	39.37 inches
1 foot	=	0.17 fathom	1 meter	=	100 centimeters
1 mile	=	1.61 kilometers	1 kilometer	=	0.62 mile
1 mile	=	1609.34 meters	1 kilometer	=	1000 meters
1 mile	=	5280 feet	1 kilometer	=	3280.84 feet

AREA

1 foot^2	=	0.09 meter^2	1 meter^2	=	10.76 feet^2
1 yard^2	=	0.84 meter^2	1 meter^2	=	1.20 yards^2
1 mile^2	=	2.59 kilometers^2	1 kilometer^2	=	0.39 mile^2
1 acre	=	0.40 hectare	1 hectare	=	2.47 acres

VOLUME AND CAPACITY

1 foot^3	=	0.03 meter^3	1 meter^3	=	35.31 feet^3
			1 meter^3	=	264.17 gallons (US)

VELOCITY

1 foot/second	=	0.68 mile/hour	1 meter/second	=	3.60 kilometers/hour
1 foot/second	=	1.10 kilometers/hour	1 meter/second	=	2.24 miles/hour
1 foot^3/second	=	0.03 meter^3/second	1 meter^3/second	=	35.31 feet^3/second
1 mile/hour	=	1.47 feet/second	1 kilometer/hour	=	0.91 foot/second
1 mile/hour	=	0.45 meter/second	1 kilometer/hour	=	0.28 meter/second

TEMPERATURE

°Fahrenheit	=	9/5 (°C + 32)	°Centigrade	=	5/9 (°F - 32)