BRUNSWICK STEAM
ELECTRIC PLANT

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BRUNSWICK STEAM ELECTRIC PLANT

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Prepared By:

C. Benedict	Impingement
G. F. Booth	Project Scientist
C. S. Cates	Water Quality
D. S. Cooke	Larval Fish
K. A. MacPherson	Editor
K. L. Nichols	Entrainment
L. W. Pollard	High Marsh
M. E. Shepherd	Statistics
R. G. S[illegible]erfinski	Discrete Depth
T. E. Thompson	Nekton

Environmental Technology Section

CAROLINA POWER & LIGHT COMPANY

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Reviewed and Approved By:

Bobby J. Ware

Principal Scientist
Biology Unit

This report was prepared under my supervision and direction, and I accept the responsibility for its content.

William T. Hogarth

Manager
Environmental Technology Section

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Metric-English Conversions

Length

1 millimeter (mm) = 0.04 inch

1 centimeter (cm) = 10 mm = 0.4 inch

1 meter (m) = 100 cm = 3.28 feet

1 kilometer (km) = 1000 m = 0.62 mile

Area

1 square meter (m^2) = 1.076 square feet

1 hectare (ha) = 10,000 m^2 = 2.47 acres

Weight

1 milligram (mg) = 0.015 grains

1 gram (g) = 10000 mg = 0.035 ounce

1 kilogram (kg) = 1000 g = 2.2 pounds

1 metric ton = 1000 kg = 1.1 tons

Volume

1 millimeter (ml) = 0.034 fluid ounce

1 liter (l) = 1000 ml = 0.26 gallons

Summary

The results presented in this report continue to document the lack of any measurable impact on the fish and shellfish populations of the Cape Fear estuary (CFE) as a result of the operation of the Brunswick Steam Electric Plant (BSEP).

The majority of the more abundant fish and shellfish larvae collected in the CFE is spawned offshore, but utilizes various sections of the estuary as primary nursery grounds. These fish and shellfish, which include the commercially important spot, croaker, flounder, mullet, seatrout, menhaden, and shrimp, move by the plant on their way to primary nursery areas. Some of these larvae pass through the plant with the plant's cooling water (i.e., they are entrained). The remaining larvae utilize the estuary as a nursery area.

River larval fish density comparisons show higher than average (1977-1981) densities in 1982 for anchovies, croaker, spot, mullet, brown shrimp, menhaden, seatrout, Gobionellus spp., and flounder. As a result, the density of total fish was also higher than the average. Linear trend analysis show an increase in densities of brown shrimp and croaker and relatively constant densities of anchovies, flounder, pink and white shrimp, seatrout, and spot for the years 1976 through 1982. Discrete depth data show that spot and croaker were more abundant in the bottom half of the water column which results in them being carried upstream away from the plant with the net nontidal drift. Entrainment densities in 1982 were not different from densities reported from all the river larval fish station densities. After nine years of plant operation, the number of larvae entering and being distributed around the estuary each year has remained constant or increased. These results show that plant operation is not having a measurable impact on larval recruitment and distribution within the CFE.

High marsh data show that catch-per-unit efforts (CPUEs) of all species analyzed, except Atlantic silverside, were higher at Walden Creek and the upriver areas than at Baldhead Creek. Generally, fish abundance was higher in the mid to upstream areas of a tidal creek.

Nekton data collected in 1982 provide further documentation that upriver areas above Snow's Cut serve as nursery grounds for many selected species. Fish and shellfish utilizing these areas are situated away from the plant. The catch of total organisms for 1982 was the highest of the past four years. Menhaden, bay anchovy, spot, croaker, pink shrimp, and white shrimp were also caught in better than average numbers, while weakfish, brown shrimp, and southern flounder numbers were about average, and only pink shrimp numbers declined.

Impingement was much higher during January and June than the other months due to low water temperatures and low salinities. Impingement was lower than in past years during the last half of the year because of reduced flows and construction of the diversion structure. In mid-November, the diversion structure was completed, and December's impingement was the lowest ever recorded for that month. In addition to reducing overall impingement, the diversion structure will also eliminate periods of heavy impingement due to reduced water temperatures and salinities.

The biological monitoring studies continue to show that larvae of the commercially important offshore spawners are able to enter the estuary, distribute to their preferred nursery grounds, and mature in the tidal creeks and upstream nursery areas without being affected by plant operations.

1.0 INTRODUCTION

In early January 1981, Carolina Power and Light Company (CP&L) successfully reached an agreement with the North Carolina Division of Environmental Management (DEM) and the U. S. Environmental Protection Agency (EPA) which eliminated the need for construction of cooling towers at the Brunswick Steam Electric Plant (BSEP) near Southport, North Carolina. One stipulation of the agreement was that biological monitoring be continued that would provide sufficient information to allow for a continuing assessment of the impact of the BSEP on the Cape Fear Estuary (CFE) with particular emphasis on the marine fisheries. With some modification this biological monitoring requirement is a continuation of research that had been conducted on the CFE by various investigators since 1976 and as a result, some programs in this report will discuss trends from 1976 to 1982. The 1981 BSEP Annual Biological Monitoring Report (CP&L 1982) contains more detailed sampling methodology and station descriptions than are included in this report.

The various segments of the 1982 BSEP Biological Monitoring Program are outlined in Table 1.1. The river larval fish and entrainment programs use relative seasonal abundance data to monitor and assess the larval cropping rates by the BSEP.

The discrete depth program defines peak winter larval densities by depth, tide, and photoperiod to better evaluate the movement of larval fish in the Cape Fear River (CFR).

The nekton and high marsh programs use relative seasonal abundance, species composition, and relative size distribution data to monitor populations of fish and shellfish in the CFE, while the impingement program uses the same types of data to determine cropping rates of juveniles and adults from these populations by the BSEP.

The study periods evaluated in this report differ by program. The river larval fish and entrainment programs report on data collected from September 1981 through August 1982 to better correspond to periods of

larval recruitment, while the nekton, high marsh, and impingement programs report on data collected from January through December 1982.

The stations sampled by each program are shown in Figures 1.1 and 1.2. Figure 1.1 contains the sampling locations for the river larval fish, discrete depth, and entrainment programs. The river larval fish stations were grouped into four adjacent areas (A, B, C, and D), distinguished primarily by salinity, to permit analysis of the spatial distributions of larvae and postlarvae as they moved through the estuary. The stations were grouped as follows:

Area	Stations
A - Lower Estuary	11 (Dutchman Creek) 18 (Buoy 15)
B - Mouth of the Intake Canal	24 (Walden Creek) 25 (Buoy 19)
C - Middle Estuary	37 (Buoy 27)
D - Upper Estuary	34 (Buoy 38) 41 (Buoy 42)

Figure 1.2 shows the high marsh and nekton sampling locations. Because several stations were sampled in each creek by the high marsh program, the entire creek is designated as a sampling area. A more detailed illustration of specific sampling locations within these areas can be found in the last annual report (CP&L 1982).

A list of fish and shellfish on which analyses were performed is presented by program in Table 1.2. The majority of these are recreationally and/or commercially important species and with few exceptions are ocean-spawned. The others are used for analysis because they occur in large numbers within the estuary and are considered indicators of estuarine conditions. Data were analyzed using analysis of variance (ANOVA) and Duncan's multiple range test. $\log_{10}$ (density + 1) (river larval fish and discrete depth), $\log_{10}$ (density + 10) (entrainment), $\log_{10}$ (CPUE + 1) (high marsh and nekton), and $\log_{10}$ (number + 1) (impingement) was used in the analysis. The effects tested were year,

depth, station, week (or month), tide, and/or period, depending on the program. Solid lines connect means which are not significantly different in the Duncan multiple range test results. Fish were measured using standard length (SL), shrimp using total length, and crabs using carapace width.

Another stipulation of the settlement was the construction of a permanent fish diversion structure across the mouth of the intake canal to prevent larger fish and shellfish from entering the canal and being impinged at the plant. This structure was fully operative on November 15, 1982 and impingement decreased to approximately 10% of the level of previous years even though organisms were already in the canal upon completion of the structure.

This report is divided into two volumes. Volume I contains the text and Volume II contains tables and figures. Pages, however, are numbered consecutively within each section.

2.0 WATER QUALITY

2.1 Introduction

This water quality program was initiated in January 1982. The purpose of this project was to supplement water temperature and salinity data for the larval fish, nekton, and high marsh programs. Water temperature and salinity measurements were collected weekly at selected stations, thus eliminating gaps in water quality data that have occurred in past years.

2.2 Sampling Stations

Water quality sampling stations were located in the CFR channel at buoys 15, 19, 25, 29, 35, 38, and 42. Station 11 was located in Dutchman's Creek and station 24 was located in Walden Creek. These nine water quality stations were sampled weekly beginning in January 1982. Water quality data is also reported for each of the 39 stations in the CFE (Figures 1.1 and 1.2).

2.3 Methods

Surface and bottom temperature and salinity measurements were recorded at each site, when visited. Surface samples were collected with a bucket and bottom samples were collected with a 2 liter Kemmerer water sampler. Temperature was measured in degrees Celsius (°C) using a Yellow Springs Instruments Model 43TD Telethermometer. Salinity was measured in parts per thousand (ppt) with an American Optical Model 10419 Refractometer.

Bottom salinity values were plotted for the water quality data from all sampling stations in the CFE from September 1981 through December 1982 (Figure 2.1). Stations are listed from the uppermost at Alligator Creek down through the stations in Baldhead Creek. Observed values were placed into a range with 5 ppt increments. A different shading was given to the range of values and this shading plotted for each station.

Average weekly temperature values were plotted for the same period (Figure 2.2).

2.4 Results and Discussion

A major period of freshwater flow occurred beginning around the first of January 1982. Low salinity (0-5 ppt) was recorded as far down as buoy 29 and from all of the stations in Walden Creek (Figure 2.1). This occurred after a period of low flow in the fall of 1981 when salinities reached 16 ppt as far up the river as Mott's Bay on October 11, 1981. Salinity this high was not seen again for forty-six weeks. A second period of freshwater flow was noted on June 22, 1982. Low salinity (0-9 ppt) was recorded from stations 42 to station 25 in the CFR and in Walden Creek (Figure 2.1)

Water temperature variations between stations was small; therefore, an average weekly water temperature was used (Figure 2.2). A minimum temperature of 3.0°C was recorded on January 15, 1982 with a maximum of 30.0°C recorded on July 27, 1982.

3.0 LARVAL/POSTLARVAL FISH

3.1 Introduction

The majority of fish larvae collected from the CFE was spawned offshore and carried by currents to the mouth of the CFR. By utilizing a net upstream flow along the bottom, they were carried into the estuary and established residence. Previous studies have shown two periods of abundance of fish larvae in the CFE (Copeland et al. 1979; CP&L 1982). One peak occurs from December through April (winter) and the other from May through August (summer). The river larval fish and entrainment programs utilize relative seasonal abundance data to monitor and assess larval cropping rates by the BSEP. The discrete depth program defines peak winter larval densities by depth, tide, and photoperiod to better evaluate the movement of larval fish.

3.2 Methods

3.2.1 Sample Collection

The larval/postlarval sampling programs used 505 micron mesh plankton nets fished for five minutes. The volume of water filtered during a tow was determined with General Oceanics Model 2030 flowmeters which were suspended in the mouth of each net. The areas of net openings were as follows:

Program	Dimensions of Net Opening	Area of Net Opening
River Larval Fish		
- Surface Net	80 cm X 80 cm	0.640 m^2
- Bottom Net	104 cm X 51.5 cm	0.536 m^2
Discrete Depth Sampling	50 cm X 50 cm	0.250 m^2
Entrainment	50 cm diameter	0.196 m^2

Samples were preserved in approximately a 5% solution of formalin.

3.2.2 Sample Analysis

In the laboratory all larval samples were processed in the same manner. The samples were washed to remove the formalin, sorted, and all larval and postlarval fish, penaeid shrimp postlarvae, portunid megalops, and portunid crabs were retained. Larger individuals of these groups were also retained when they were encountered. All specimens were identified to the lowest practical taxon, counted, and measured (up to 50 lengths per species).

A quality control program was enforced on all larval fish samples for both sorting and identification. At least 10% of each sorted and identified sample set was randomly selected and reprocessed by a technician other than the original processor. If the mean percent accuracy for a sorted set was less than 90%, the entire set was resorted. A discrepancy greater than 10% in the count or constant errors in identification caused the set to be re-identified.

Flowmeters used by the Biology Unit are calibrated quarterly and the results stored on a computer master file. The meter number and number of revolutions during each sample's collection were entered on coding forms permitting the volume of water sieved to be determined by computer. In this manner, the number of organisms collected in each sample can be expressed as densities (i.e., number/1000m^3 of water sieved).

3.2.3 Data Analysis

Trend Analysis

River larval fish data for the period September 1976 through August 1982 and entrainment data from September 1974 through August 1982 were each examined for a linear trend. Differences among years were separated into a trend component proportional to the size of the linear increase or decrease and a deviation component proportional to the size of the year to year fluctuations around the trend line. The error component, used to

judge the significance of the first two, was computed from the discrepancy between sampling periods within all years. The percent change per year was calculated from the slope of the trend line and is an average over all years.

A significant trend component with no significant deviations suggests a simple increase or decrease over the indicated period. No significant trend or deviation implies a relatively constant level of abundance. However, significant deviations indicate that the year to year fluctuations cannot be described simply by the linear trend and may be associated with fluctuations in environmental conditions such as salinity and temperature in the estuary during recruitment. Therefore, over the short term one would expect to see trends in abundance which both increase and decrease (presented as percent change per year) given no more than natural perturbations in environmental conditions. Over a long period one would see a great deal of year to year variability but a trend which shows no significant increase or decrease given estuarine condition do not deteriorate (CP&L 1980). Depending on where in a cycle a species is when analyzed, the percent change per year will be either large or small, increasing or decreasing. Therefore, one should be careful not to take the percent change per year as an indication of population density increase or decrease but to look at the significances of the linear trend and the deviations from the linear trend to determine how well the trend is explained by the linear trend analysis.

Discrete Depth Split-Plot Model

The primary emphasis of the 1982 discrete depth sampling program was to further define the depth distributions of larval fish. Previous studies (1979 and 1981) have shown that period (day/night) and tide influence these depth distributions. Therefore, an experiment to define period and tidal influences was superimposed on the depth experiment. The result was a split-plot design using period and tide combinations as the main-plot units with each unit sub-divided into sub-plots corresponding to the depths sampled. The split-plot design reduced accuracy on the main-plot (period and tide) treatments and increased accuracy on

the sub-plot (depth) treatments and interactions. Because five bottom (11 m) samples were missed when the sled was lost on round 1, predicted values were obtained by averaging the bottom samples taken at that period and station. Two main-plot units occurred at each mean tide direction which were averaged prior to analysis. Each station was analyzed separately with round (24-hour period) being used as a blocking factor (replicate).

3.2.4 River Larval Fish Sampling

Station Description

The same seven stations were used in 1982 as in 1981 (CP&L 1982). There was one station each in Dutchman and Walden Creeks and five stations located in the ship channel of the CFR. The channel stations were spaced along a distance of approximately 24.1 km from buoy 15 to marker 43 (Figure 1.1).

Sampling Procedure

No changes were made to the river larval fish sampling procedures, gear, or scheduling in 1982. Replicate samples were collected from the surface and bottom at each of the seven stations. Samples were collected only at night. Sampling trips were scheduled approximately two weeks apart except during June, July, and August when sampling was conducted once a month (Table 3.1). An alternate tidal direction (ebb or flood) was sampled on consecutive trips. Station were sampled from the lower estuary to the upper estuary in an attempt to sample all stations during the same tidal stage.

3.2.5 Discrete Depth Sampling

A discrete depth sampling program was conducted in 1979, 1981, and 1982 to supplement the regular larval fish program. The regular larval fish program collects surface and bottom samples at night. Discrete depth sampling further defines larval density distribution by collecting

samples from specific depths at stations 25 and 34 (Figure 1.1). Sampling was conducted during periods of peak larval recruitment into the estuary of winter spawners.

The river channel is maintained by the Army Corps of Engineer at -12.2 m mean sea level. In 1979 and 1981 sampling was conducted at depths of 1, 3, 5, 7, and 9 m using a half-meter Tucker trawl with a double-trip mechanism. In addition, in 1982 a sled was used to sample at the bottom (denoted as 11 m). The sled was equipped with the same type half-meter Tucker trawl and double-trip mechanism (Figure 3.1). The sled was lost after 44% of the samples had been collected. The remaining samples at 11 m were taken with the regular Tucker trawl.

In 1982, two 24-hour sampling rounds (trips) were scheduled between February 20 and March 3. To better define what effects tide and period (day-night) had on larvae density each round was scheduled to start at daylight. The first round at each station began at high slack tide. The second round at each station began at low slack tide. Each round was divided into five sets corresponding to period and tide direction. Each set consisted of four series which were related to tide level and the order of depth sampling. This order was 1, 3, 5, 7, 9, and 11 or 11, 9, 7, 5, 3, and 1 m according to the sampling scheme. Figures 3.2 and 3.3 graphically illustrate the sequence of these sets and series as they relate to period, tide, and the order of depths sampled.

The simultaneous collection of samples at the two stations was eliminated in 1982 due to the availability of only one boat. Due to travel time between stations, the order of the stations sampled was reversed between the two rounds to provide consistent sampling relative to period and tides.

All tows were taken against the tide as in 1979 and 1981 to ensure proper net alignment. Salinity (ppt) and temperature (°C) were measured prior to the start of each series at all depths. After the sampling net was lowered to the specified depth, a messenger was sent down the tow

cable and the double-trip mechanism tripped to open the net (Figure 3.1). After five minutes the double trip mechanism was tripped by a messenger to close the net and the entire trawl or sled was then raised. Meter readings were taken before and immediately after each sample to determine the water volume filtered by the net.

3.2.6 Entrainment Sampling

The entrainment sampling procedure was essentially the same in 1982 as that established in previous years (CP&L 1982). In April 1982 one program change was initiated. Two additional daytime samples were added at 0900 and 1500 EST (one hour later during EDT). This change provided additional daytime data to allow a better comparison of entrainment densities and rates with previous years.

3.3 Results and Discussion

3.3.1 River Larval Fish

Dominant Species

A total of 611 samples was collected from September 17, 1981 until August 18, 1982, the 1982 sampling period. During that time 76 species of larval fish, penaeid shrimp, and portunid crabs were identified from the CFE (Table 3.2). The ten genera analyzed represented 82% of the total mean density of organisms collected. Anchovies represented 35%; croaker 25%; gobies 11%; spot 6%; shrimp 3%; menhaden, flounder, mullet, and seatrout less than 1% each.

Seasonality

Plots of mean densities by sampling week for 1982 and the mean densities for the previous five years (1977-1981) are shown in Figures 3.4 to 3.14 for the river larval fish program. From these plots it can be seen that the occurrence of the major species was the same in 1982 as

in the previous five years. A summary of seasonality (occurrence) for these species is as follows:

Species	Seasonality
Spot	End of December - first of May
Croaker	First of October - end of April
Mullet	End of December - end of March
Menhaden	End of February - first of May
Seatrout	First of May - middle of October
Flound(	End of December - end of March
Shrimp	
- Brown	Middle of February - middle of May
- Pink and White	End of May - first of October
Anchovies	End of April - end of October
Gobiosoma spp.	First of May - end of October
Gobionellus spp.	Middle of March - middle of December

1982 River Larval/Postlarval Abundance

Results of ANOVA are presented in Tables 3.3 and 3.4 for levels of significance. Because of significant interactions, plots of cell means were examined to draw conclusions. A summary of the results is given below.

Year Comparisons

The mean log_{10} densities for total fish among years indicates that 1982 was greater than all other years except 1980:

Year	$\overline{Log}$
1980	2.86
1982	2.69
1981	2.63
1977	2.55
1979	2.53
1978	2.39

A comparison of the 1982 larval mean $\log_{10}$ densities, for the major species, to the larval mean log density for the period from 197 to 1981 shows all the species except *Gobiosoma* spp. and pink and white shrimp had a higher than average density in 1982:

Species	1982 $\overline{\text{Log}}$ Density	1977-1981 $\overline{\text{Log}}$ Density
Anchovies	2.82	2.47*
Total Fish	2.69	2.62
Croaker	2.09	1.57
Spot	1.71	1.51
Gobiosoma spp.	1.56	1.71*
Pink & White Shrimp	1.36	1.48*
Brown Shrimp	1.17	0.51
Menhaden	1.10	0.81
Seatrout	1.07	0.31*
Gobionellus spp.	1.02	0.41*
Flounder	0.94	0.83
Mullet	0.31	0.23

* 1978 data not included, see CP&L (1982)

Depth Comparisons

Overall, higher densities of larvae have been collected from the bottom than from the surface. Because river larval fish samples are collected only at night, some species were collected in higher densities from the surface due to vertical migration at night.

A summary of mean $\log_{10}$ densities by depth for 1977 through 1981 is as follows:

Most Collected From Surface	Most Collected From Bottom	No Difference
Mullet	Croaker	Spot
Shrimp (All species)	Seatrout	Menhaden
Gobionellus spp.	Anchovies	Flounder
Gobiosoma spp.	Total Fish	

These patterns of occurrence were similar during the 1982 sampling year except that seatrout and the gobies showed no difference from surface or bottom.

Station Comparisons

During the past six years the highest density of larvae has been collected from Dutchman Creek (station 11) with decreasing densities upriver. This is caused by the large number of anchovies collected downriver. A table of mean $\log_{10}$ densities by station, including the mean $\log_{10}$ densities for all larvae collected from entrainment (station 51), shows higher densities in Walden Creek (station 24) than in entrainment. Entrainment densities were not different from the river stations:

Station	$\overline{\text{Log}}$ Density
11 (Dutchman Creek)	2.88
18	2.68
25	2.65
24 (Walden Creek)	2.64
37	2.59
51 (Entrainment)	2.57
34	2.54
41	2.44

Figures 3.15 to 3.25 show the mean densities by week for the four areas of the river. From these it can be seen that most species are found downriver in areas A and B but that croaker (Figure 3.15) utilize area D more than other areas. Of particular interest is the response of croaker and total fish (Figure 3.25) in area D to the heavy freshwater flows of January 1982. The density of fish in this area dropped substantially during the initial surge of freshwater, with a corresponding increase in Area B, but densities quickly returned to normal upriver as salinity increased. This movement of larvae in response to low salinity is typical during the early spring. Further discussion of larval movement in response to freshwater flow is presented in Section 3.3.2.

Trend Analysis 1977-1982

The river larval fish data from September 1976 through August 1982 were subjected to a linear trend analysis as described in Section 3.2.3. Results of this analysis appear in Table 3.7. Plots of the linear trend analysis along with 95% confidence levels are shown in Figures 3.26 to 3.37.

Brown shrimp and croaker trends indicate a simple increase in river densities over the analysis period. Anchovy, flounder, pink and white shrimp, seatrout, and spot densities appear relatively constant over the same period. Menhaden and mullet had significant deviations which indicates that the year-to-year fluctuations cannot be described by the linear trend.

3.3.2 Discrete Depth Sampling

Water Quality

There were heavy rains the week prior to the first round of the 1982 sampling period but otherwise there were no adverse weather conditions.

Water temperatures ranged from 7.9°C to 11.0°C at station 25 (Figure 3.38). At station 34 temperatures ranged from 8.2°C to 11.0°C. Water temperatures were generally higher on the surface and lower on the bottom.

Salinities ranged from 4 ppt to 30 ppt at station 25, round 1 and 8 ppt to 32 ppt at station 25, round 2. At station 34, round 1, salinities ranged from 0 ppt to 12 ppt. About one-third of the way through round 1 at station 34, the freshwater runoff from the heavy rains up state became visible in the form of muddy water and debris (trees, etc). Salinities dropped and few readings above 0 ppt were recorded. During round 2 at station 34, salinities ranged from 0 ppt to 14 ppt. The lowest salinities were recorded at the surface (1 m)

near low tide while the highest salinities were recorded at 9 m and 11 m near nigh tide (Figure 3.39).

Densities

Overall mean densities in 1982 (Table 3.6) were substantially higher than in 1981 and were near or slightly above the 1979 level. This was primarily due to the high mean densities of croaker. Croaker mean densities were substantially higher than in 1981 and only slightly higher than 1979. Spot mean densities were also slightly higher than in 1981 and near the same level as in 1979. All other species' mean densities were similar to 1981 and slightly lower than 1979 (Table 3.6). Numbers of fishes collected were small for all taxa except spot and croaker, therefore only densities of spot and croaker were analyzed.

Figures 3.40 through 3.47 show larval densities during the 1982 study and changes in the densities from tidal and photoperiod influences.

Upon examination of data plots (Figures 3.41 and 3.46) it was observed that densities of both spot and croaker at station 25 were higher on round 1. At station 34 the opposite pattern was seen with higher catches of both species on round 2. This effect may have been caused by the heavy rains prior to round 1, causing lower salinities at station 34, and larvae avoiding the low salinity water. Round 2 was conducted a week later and the salinities had returned to normal. At that time the larvae were again moving upstream and densities were higher at station 34 than during round 1. This observed pattern corresponds with the accepted theory for transport of bottom-oriented species. This theory suggests the ability to concentrate in the upstream nursery area is strengthened by concentration in the area of greatest net upstream drift.

Analysis of Variance and Duncan's Multiple Range Test Results

Period

The 1982 data show higher larval densities at night for both species (spot and croaker) at both stations, but only croaker at station 25 show a significant difference (Table 3.7).

Tidal

The 1982 data for croaker show a significant difference between tides at station 25. Generally more croaker occurred at high tides, fewer at mean tides, and the least at low tides for both periods. However, a slightly different trend was displayed at station 34. During the day, tidal effects were mixed between high, mean, and low. During the night, generally more croaker occurred at high and mean tides, with the least at low tides (Table 3.7, Figures 3.41, 3.48, and 3.50).

The 1982 data for spot show no significant difference between tides at station 34. During the day, tidal effects were generally mixed between high, mean, and low. During the night, however, generally higher densities occurred at high and mean tides, with the lowest densities occurring at the low tides. At station 25 a significant difference was detected between tides. Generally higher densities occurred at high tides, fewer at mean tides, and the least at low tides for both periods (Table 3.7, Figures 3.46 and 3.49). The above results do, for the most part, agree with the 1979 and 1981 studies.

Depth

There was a significant difference in densities among depths at both stations during both periods for croaker. Generally, the largest densities were found at the lower depths. During the day at station 25, depths 1 m and 3 m contained the lowest densities with higher densities at the lower depths. During the night at station 25, the

1 m depth had a lower density than the other depths. No difference was observed between depths 3 m to 11 m. During the day at station 34, the lower depths contained more croaker than the mid depth. Depths 1 m and 3 m contained the least croaker. Some difference between the very bottom and upper depths occurred during the night at station 34 (Table 3.7, Figures 3.41 and 3.50). A significant tide-by-depth interaction for croaker also occurred at station 34. An examination of plots of tide-by-depth means (Figures 3.50 and 3 51) and raw data (Figure 3.41) show that the depth distribution pattern of croaker become mixed during the low tidal stages. At the high and mean tidal stages a more normal generally linear pattern is shown.

The analysis of 1982 data for spot show a significant difference in depth at both stations during both periods. The day period data at station 25 show larger densities of spot in the mid and lower portions of the water column with the upper depths showing the lowest densities. The night period data for station 25 show the larvae migrating upward in the water column with larger densities appearing in the mid and upper part of the water column, with the catch at 3 m higher than the other depths and with the bottom having the lowest densities. The day period data for spot at station 34 show densities increasing with depth. The night data for spot show them evenly distributed in the water column except for depth 11 m (Table 3.7, Figures 3.46 and 3.51). The reason for the high densities at depth 11 m was the freshwater flow which occurred during round 1, causing the larvae to seek the higher saline lower depth.

With the exception of the round with the extremely low salinity, the vertical distribution curves for 1982 show the same trends as 1979 and 1981; i.e., mostly linear for croaker during both periods, mostly linear for spot during the day, and mostly quadratic for spot at night.

3.3.3 Entrainment

Dominant Species

A total of 492 samples was collected over 52 sampling [illegible] (weeks) between September 1, 1981 and August 25, 1982 (Tab[illegible] Bay anchovy was the most abundant species caught, represen[illegible] the total density of organisms caught during 1982. Croa[illegible] each accounted for 13% of the total density. The other wi[illegible] - menhaden, mullet, and flounder - accounted for 2%, an[illegible] summer species - gobies, seatrout, and anchovies - accou[illegible] of the total density in 1982. Penaeid shrimp accounted fo[illegible] densities and percent of the total catch for each species [illegible] (1980 to 1982) are presented in Table 3.9.

Seasonality and Abundance

The mean daily flow through the BSEP for 1982 ranged between 2.18 X 10^6 and 5.41 X 10^6 cubic meters of water (Table 3.10).

The mean density of total larval and postlarval fish entrained during the year ranged between 38.12/1000 m^3 (August) and 7.26 X 10^3/1000 m^3 (June) (Table 3.11). Two periods of abundance occurred encompassing the expected winter and summer recruitment periods (Figure 3.52). The December to April peak was comprised primarily of spot, croaker, flounder, menhaden, mullet, and brown shrimp. The May to August peak consisted mostly of anchovies, seatrout, gobies, and pink and white shrimp.

Spot reached a peak density of 2.36 X 10^3/1000 m^3 in mid-March (Table 3.11). Spot appeared in the entrainment samples in mid-December and disappeared around mid-May. This period of abundance is consistent with the mean densities computed from the preceding seven years (1975 to 1981) (Figure 3.53).

Croaker occurred in the entrainment samples from September to May. This was consistent with the period of abundance reported for 1975 to 1981 (Figure 3.54). In January 1982 croaker had a peak abundance of 1.96 X 10^3/1000 m^3 (Table 3.11).

The three species of flounder collected in entrainment samples were combined to characterize the entrainment of flounder. A peak density of about 64/1000 m^3 occurred in early March (Table 3.11). The period of abundance for flounder occurred from mid December to late March - a pattern consistent with previous years (Figure 3.55).

The two species of mullet were combined to characterize the entrainment of mullet. Mullet occurred from January to March in entrainment samples. This period of abundance is consistent with previous years (Figure 3.56). A peak abundance of 284/1000 m^3 occurred in early March (Table 3.11).

Menhaden appeared in entrainment samples in February and disappeared in May - a period of occurrence consistent with previous years (Figure 3.57). Their peak density of 583/1000 m^3 occurred in mid-April (Table 3.11).

Three species of penaeid shrimp postlarvae were taken in entrainment samples but because of identification problems, were only identified to the generic level. However, those postlarvae that occurred during the spring (late February to early June) were primarily brown shrimp and those that occurred in the summer and fall (early June to late September) were a mixture of pink and white shrimp. These periods of occurrence were consistent with those reported in previous years (Figure 3.58). A peak density of 1.41 X 10^3/1000 m^3 occurred in late March for brown shrimp and a peak density of 506/1000 m^3 occurred in late August for pink and white shrimp (Table 3.11).

The period of abundance for anchovies, consisting of two species, occurred from mid-May and persisted into the fall months. This occurrence was consistent with those reported during the previous seven

years (Figure 3.59). A peak abundance of $3.29 \times 10^3/1000\ m^3$ for anchovies occurred in early July (Table 3.11).

Seatrout, consisting of two species, had a period of abundance beginning in early May and persisting into the fall months. This was consistent with periods of abundance occurring during the previous seven years (Figure 3.60). A peak abundance of about $133/1000\ m^3$ occurred in early June (Table 3.11).

Gobionellus spp. appeared to have two periods of occurrence, as seen in previous years. The first period of abundance occurred from mid-September to mid-January. The second period occurred from early February to early July (Figure 3.61). A peak density for the fall period of about $174/1000\ m^3$ occurred in early November and a spring period peak density of $122/1000\ m^3$ occurred in early May (Table 3.11).

Gobiosoma spp. appeared in entrainment samples beginning in early May and persisted through the early fall months - a pattern seen in previous years (Figure 3.62). A peak density of $3.90 \times 10^3/1000\ m^3$ occurred in early June (Table 3.11).

Number Entrained

The mean number of organisms entrained per day by the once-through cooling system was computed by multiplying the mean density per day by the mean flow per day.

Total organisms entrained per day ranged from a low of 1.18×10^5/day in August to a high of 1.96×10^7/day in June (Table 3.10).

The pattern of entrainment numbers followed closely the pattern of larval density for each of the species. The maximum entrainment of spot was 1.28×10^7/day in March and for croaker a maximum of 9.62×10^6/day occurred in January. Of the other winter species, flounder

had a maximum entrainment of 3.44×10^5/day in March, menhaden of 3.16×10^6/day in April, and mullet of 1.54×10^6/day in March. The maximum entrainment of brown shrimp was 7.62×10^6/day in March (Table 3.10).

Of the summer species, anchovies had a maximum entrainment of 12.47×10^6/day in July and sea[illegible] of 3.58×10^5/day in June. The maximum entrainment of pink [illegible] shrimp was 1.57×10^6 /day in August. The maximum fall e[illegible] for Gobionellus spp. was 9.39×10^5/day in November and [illegible] spring rate was 6.13×10^5/day in March. Gobiosoma [illegible]imum entrainment of 10.53×10^6/day in June (Table 3.10).

Cropping Rate

The estimated volume of the CFE is $2.5 \times 10^8 m^3$ (Hodson et al. 1977). The average concentration of larvae, over the past six years is 1.7 larvae per m^3. Therefore, the total number of larval/post-larval fish in the CFE at any one time is estimated to be 4.1×10^8.

During 1982, the average daily entrainment rate of larvae was estimated to be 5.66×10^6. A comparison of these two numbers yields a daily cropping rate by the BSEP of 1.4% of the larval recruitment, but because tides bring a new recruitment population in twice a day, the percentage of larvae cropped from any one recruitment population is constant, not cumulative. Although this conclusion is over-simplified, it gives some idea of the entrainment impact on the whole river larval fish population.

After eight years of cooling water withdrawal no significant or irreversible impact has been detected from river larval fish densities.

Diel Patterns

The densities of entrained organisms previously discussed in this section were based on means constructed from 24-hour periods. There was considerable variation around each mean due to the difference in densities over a 24-hour period. The densities of organisms entrained during the daytime were consistently lower than at nighttime (Figures 3.52 through 3.62). An analysis of variance was performed and the results are presented in Tables 3.12 and 3.13. Because of significant interactions, plots of cell means were examined to draw this conclusion.

Trend Analysis

The larval entrainment data from September 1974 to August 1982 was subjected to a linear trend analysis. An explanation of the analysis procedure and interpretation of results appears in Section 3.2.3.

The trends for mullet and total fish suggest a simple increase in entrainment densities over the analysis period. Menhaden exhibit a relatively constant level of abundance. All other species reported significant deviations which indicates that the year to year fluctuations cannot be described by the linear trend (Table 3.14). Plots of mean Log_{10} density (density + 10) for the years analyzed are presented for all species in Figures 3.63 to 3.74. These plots depict the observed density and the predicted density trend line including 95% confidence intervals.

3.4 Summary and Conclusions

The periods of occurrence of the major species analyzed by the river larval fish and entrainment programs were the same in 1982 as in previous years. In the river larval fish program a comparison of mean log_{10} densities for total fish showed that 1982 was the second most abundant year in terms of larval recruitment. All species except

Gobiosoma spp., pink and white shrimp, and mullet had higher average recruitment densities in 1982 than in the previous five years. Overall higher densities of fish were collected from the bottom than from the surface. The results of the linear trend analysis for the river larval fish program showed a simple increase in densities of brown shrimp and croaker and relatively constant densities of anchovies, flounder, pink and white shrimp, seatrout, and spot for the years 1976 to 1982. All other species had significant deviations which indicated that the year-to-year fluctuations could not be described by the linear trend.

Entrainment densities in 1982 for all species analyzed were not different from densities reported from all the river larval fish stations. A simplified comparison of river densities versus entrainment densities showed the estimated cropping rate by the BSEP to be 1.4% of the larval recruitment. Overall, higher densities of fish were entrained at night than during the day. Entrainment data for 1974 to 1982 that was subjected to a linear trend analysis showed a simple increase in densities of mullet and total fish and a relatively constant level of abundance of menhaden. All other species reported significant deviations.

Discrete depth sampling was conducted to include both downriver and upriver stations (25 and 34). A bottom sled was used to sample the water column between 9 m and the bottom of the river channel. Densities for 1982 were up from those of 1981, but all species (except croaker) were still lower than in 1979.

The 1982 data showed vertical distribution curves of croaker and spot larvae to be concentrated near but not on the bottom. Spot deviated from this at night and showed higher densities near but not at the surface. Croaker had maximum densities on or near the bottom and minimum densities near the surface.

The data illustrate that spot and croaker were more abundant in the bottom half of the water column, and hence they are carried upstream with the net non-tidal drift. The data also illustrate that heavy rains (causing low salinities) may reverse this situation, and the larvae are pushed downriver with the salt wedge.

4.0 HIGH MARSH

4.1 Introduction

The marshes of the CFE provide nursery areas for many ocean-spawned fish and shellfish. The populations of these fish and their distributions in these areas must be studied to determine if they are adversely affected by the amount of water being removed from the estuary for cooling the BSEP. In June 1980 CP&L began high marsh sampling based on information obtained by various other studies on the marshes of the CFE (Weinstein 1979; Hodson 1979). The objectives of this study were to determine the relative standing crops, seasonal and spatial distributions, and the influence of physical variables on the abundance of fish and shellfish in the CFE. The North Carolina Division of Marine Fisheries is also conducting similar studies throughout the state. These studies will allow comparison of the CFE to other estuaries in North Carolina when these data become available. The results of the 1980 and 1981 high marsh studies were presented in CP&L (1982).

4.2 Methods

4.2.1 Station Descriptions

The study area consists of four tidal creek systems (Figure 1.2). Baldhead and Walden creeks are located near the plant site at the lower end of the CFR. Mott's Creek Bay and Alligator Creek are located upriver near Wilmington.

Baldhead Creek is a shallow tidal creek extending approximately 8.5 km from its mouth to its headwaters on the Smith Island complex. The mouth of the creek is located approximately 0.9 km from the mouth of the CFR. For sampling purposes, it was divided into seven nearly equal sections with a station in each area.

Walden Creek is a deep tidal creek. The distance from the point where it flows into Snow's Marsh to the mouth of the CFR is approximately

11.6 km. Walden Creek has three feeder creeks: Governors Creek, Nancys Creek, and Gum Log Branch. This study area consists of nine stations. Three of these stations (21, 22, and 23) are located in Walden Creek; five stations (24 through 27 and 29) are in Nancys Creek; and station 28 is located .. Gum Log Branch. For simplicity, all of these stations will be referred to as Walden Creek stations in other sections of this report.

Mott's Bay, is a shallow area 275 m wide located approximately 30.5 km from the mouth of the CFR. The bay is formed between four small spoil islands and the east shore of the river. Mott's Creek, which is surrounded by marsh, empties into the east side of the bay approximately 260 m from the trawl site. Samples are taken on the east side of the northernmost islands of the four spoil islands surrounding the bay.

Alligator Creek is a deep creek located approximately 42.3 km from the mouth of the CFR and to the west of Wilmington on Eagle Island. Alligator Creek sampling locations include three stations in Alligator Creek and one station in Redmond Creek.

4.2.2 Sampling Methods

High marsh samples were collected approximately every three weeks using a 3.2 m trawl and a 15.2 m seine. Samples were collected on a low outgoing tide in an effort to catch the organisms which utilize the creeks and the marshes. At low tide the organisms in the marshes are forced into the creeks. An ichthyocide (rotenone) was used mainly to estimate standing crops of selected species that occupy all types of habitats. Five rotenone samples were taken semi-annually at five different locations.

The trawl, seine, and rotenone sampling gear, and methods and laboratory analysis are identical to those in the 1981 report (CP&L 1982).

4.3 Results and Discussion

4.3.1 Catch By Gear Type

The catch per unit efforts (CPUEs) discussed in this report are combined averages of all creeks. A total of 124,555 fish, comprised of 85 species, and 45,344 invertebrates, comprised of 10 species, were collected in 1982 using all gear types. The total number of fish collected using all gears was very close to the total number collected in 1981. The total number of fish collected in 1981 was 124,424 comprised of 91 species. The total catch of invertebrates increased in 1982 from the 1981 catch of 28,980 individuals comprised of 11 species (CP&L 1982). The species, number, and percentage of fish and non-fish collected by gear type in 1982 are presented in Table 4.1.

The 1982 trawl samples (357 efforts) yielded 85,096 fish and 32,012 non-finfish. This resulted in an annual CPUE of 238 fish, which was slightly higher than the CPUE of 223 reported for 1981. As in 1981, the most abundant fish collected in trawls in 1982 was spot, making up 45.1% of the total finfish collected. It was followed in abundance by bay anchovy (17.6%), menhaden (12.5%), gizzard shad (10.0%), croaker (6.7%) and southern flounder (1.6%). The annual CPUE of 90 non-finfish collected in 1982 was higher than the 1981 CPUE of 65. The most abundant invertebrate in 1981, as well as in 1982, was grass shrimp which comprised 71.7% of the 1982 catch. The grass shrimp were followed in order of abundance by brown shrimp (13.0%), blue crabs (7.9%), pink shrimp (3.3%), and white shrimp (2.3%). Two turtle species were also collected.

The 85 seine samples collected in 1982 yielded 21,430 fish (50 species) for an annual CPUE of 252. This was slightly higher than the 1981 CPUE of 216. Spot was the most abundant fish caught in 1982, as it was in 1981, and comprised 35.0% of the entire finfish catch. Spot was followed in abundance by mummichog (17.9%), white mullet (13.2%), menhaden (9.9%), gizzard shad (7.8%), and Atlantic silverside (6.2%). A total of 13,335 non-finfish (7 species) yielded an annual CPUE of 157.

This was more than twice the 1981 CPUE of 69. Grass shrimp were the dominant invertebrates in both study years and were the main reason for the increase in the invertebrate catch from 1981 to 1982. Grass shrimp comprised 89.6% of the non-finfish seine catch and were followed in abundance by blue crabs (4.5%), brown shrimp (3.5%), pink shrimp (1.0%), and white shrimp (0.8%).

A total of 18,029 (42 species) fish were collected in the ten rotenone samples. This number was much lower than the 27,381 (53 species) fish collected in 1981. The dominant fish in the rotenone samples were mummichog (47.4%), spot (28.5%), striped mullet (5.5%), menhaden (4.9%), and darter goby (3.4%). Invertebrates are not effectively collected with rotenone so they were not counted in the totals. The spring rotenone average catch of 2986 was dominated mainly by mummichog, followed by spot.

4.3.2 Seasonal Distribution

Two major gear types were used to more adequately sample the different habitat types in the study area. Discussions of variables affecting the organisms in this study were based on data gathered by the gear types considered the most effective for each species. The species analyzed by each gear type are as follows:

Trawl	Seine
Menhaden	Mummichog
Bay anchovy	Striped killifish
Spotted seatrout	Atlantic silverside
Weakfish	Inland silverside
Spot	Rough silverside
Croaker	Striped mullet
Flounder	White mullet
Brown shrimp	
Pink shrimp	
White shrimp	
Blue crab	

Striped killifish, inland silverside, spotted seatrout, and weakfish were collected in very low numbers; therefore, analysis and comparisons will not be made in this report. The number and percent collected of each of these species by gear type are presented in Table 4.1.

Total Organisms

The peak trawl CPUE of 710 total organisms occurred in April. February, May, June, and July catches were also relatively high with CPUE values of 433, 534, 543, and 555, respectively (Figure 4.1). The peak of abundance occurred approximately one month earlier in 1981 with a slightly higher CPUE of 788. Peaks in both years were dominated by spot.

The highest 1982 seine CPUE for total organisms occurred in April and May with values of 939 and 907, respectively (Figure 4.1) and were mainly grass shrimp. The 1981 peak (total CPUE of 949) occurred during June and was dominated by 551 white mullet.

Menhaden

Menhaden was the third most abundant fish collected with all gears combined in 1982. The trawl data shows that the annual 1982 CPUE for menhaden was 4, an increase from the previous year's value of 1. The monthly catch for 1982 peaked in July (CPUE = 86), March (CPUE = 77), and April (CPUE = 63). Very few menhaden were collected in the other months (Figure 4.2).

Length frequency distributions of the 1982 trawl data shows that the recruitment of menhaden into the marshes began in February at a size of about 20 mm with a peak number at 30 mm. A large portion of the catches were dominated by 50-60 mm fish that apparently spawned earlier and migrated into the marshes from other areas. The young-of-the-year (YOY) menhaden were approximately 45 mm to 65 mm when the number collected

declined in late summer (Figure 4.3). The 1981 data also shows that the recruitment in the high marsh appeared in February but at a slightly larger size of about 30 mm. This recruitment peaked in March, as it did in 1982, but was dominated by approximately 25 mm fish with substantial numbers collected at 20 mm. Few menhaden were collected after July (Figure 4.4).

Bay Anchovy

Bay anchovy was the second most abundant fish collected in 1982. The annual CPUE was 42 which was over twice as high as the 1981 catch of 19. The highest 1982 monthly CPUE in all creeks was in July with a value of 368 (Figure 4.5). The 1981 catch was very different in that the largest monthly CPUE was in November with a value of 99. The lowest catch in each year occurred in January.

Recruitment of bay anchovy into the marshes began in June at a size of about 15 mm to 20 mm. Recruitment peaked in July with the majority of the postlarvae measuring about 25 mm (Figure 4.6). Recruitment in 1981 also began in June at a size of about 15 mm and had no definite peak until November, at which time the largest number of bay anchovy collected were approximately 40 mm (Figure 4.7).

Mummichog

Mummichog was the fourth most abundant fish collected in 1982. This species comprised 10.2% of the total fish catch using all gear types. Mummichog was not analyzed in 1981, therefore, no comparisons will be made between years. The annual CPUE for mummichog collected by seines in 1982 was 45. The highest monthly CPUEs in 1982 were in April and July with values of 176 and 165, respectively (Figure 4.8).

The length frequency distribution of mummichog indicated that recruitment began in June at a size of about 15 mm. The peak collection in July had a minimum size of 10 mm and a maximum size of 80 mm (Figure 4.9).

Atlantic Silverside

Atlantic silverside ranked ninth in abundance of fish collected in 1982 from all gear types combined. This species comprised about 1.5% of the total fish catch. Atlantic silverside was not analyzed in 1981 so no comparisons will be made between years. The annual CPUE for Atlantic silverside was 16, with the largest monthly CPUE (45) occurring in November. This was followed closely by August and July with CPUEs of 41 and 39, respectively (Figure 4.10).

Due to the difficulty in identifying silversides to species, only those larger than 21 mm were used for analysis. Length frequency distributions showed that Atlantic silverside recruits of this size were first collected in seine samples in May. By December the size ranged from approximately 55 mm to 85 mm with the mode at 65 mm (Figure 4.11).

Spot

Spot was the most abundant fish collected in 1982, as was also the case in 1981. It represented 41% of the total fish catch in 1982. The trawl data shows that the abundance of spot decreased in 1982 with an annual CPUE of 107, as compared to 166 in 1981. The highest monthly CPUE for spot occurred in April 1982 with a value of 403 (Figure 4.12). The 1981 peak differed in that it occurred earlier (March) and had a higher CPUE (709). The lowest monthly CPUE occurred in January and October through December in both years.

Recruitment of spot into the marshes appeared to begin in December 1981 at a size of about 10 mm with a mode at 15 mm. Peak abundance occurred in April with the maximum number collected at a size of 15 mm to 25 mm (Figures 4.13 and 4.14). The 1981 recruitment did not appear to begin until January of that year at a length of 15 mm. Peak recruitment occurred in March with the majority of the spot measuring 20 mm to 25 mm which is a little larger than the 1982 fish during peak recruitment. At

the end of the 1982 sampling year the size range for spot was approximately 60 mm to 125 mm which was slightly larger than in 1981.

Croaker

Croaker ranked sixth in abundance representing 4.9% of the total fish catch using all gear types combined. Croaker were much more abundant in 1982 than in 1981 with respective annual CPUEs of 16 and 4. The highest monthly CPUE (82) in 1982 occurred in April. A smaller, yet noticeable, peak (28) occurred in October (Figure 4.15). The monthly CPUE in 1981 did not peak in the spring, but rather in late fall (November) with a value of 25. All other months in both study years showed relatively small monthly CPUEs.

The 1982 recruitment of croaker actually began in September of 1981 at a size of 10 mm (Figure 4.16). The CPUEs were relatively low until April 1982 when the recruitment peaked with the main portion of postlarvae measuring 15 mm (Figure 4.17). Recruitment began again in September 1982 and peaked again in November with the major portion of postlarvae measuring 10 mm to 15 mm. The 1981 recruitment year also began in September of the previous year with very low numbers and peaked in December 1980 with the highest frequency at 15 mm (Figure 4.18).

Striped Mullet

Striped mullet ranked eighth in order of abundance and comprised 1.8% of the total finfish collected in 1982. The 1982 annual seine CPUE of 6 was down from 1981 (11). The highest monthly CPUEs in 1982 was in April and May with values of 16 and 13, respectively (Figure 4.19).

The 1982 recruitment of striped mullet actually began in December 1981 with a few fish collected at a size of 20 mm. Recruitment peaked in April with a minimum size of 20 mm and a maximum size of 40 mm. Numbers remained high through May after which the number of YOY declined. The 1982 abundance appeared to drop after August at a size range of 50 mm to 115 mm (Figure 4.20). The 1981 recruitment of striped mullet began in

January at a size of about 20 mm. The abundance peaked in March with a size range of about 20 mm to 45 mm with the greatest frequency at 25 mm. The numbers decreased in September with a size range of 55 mm to 90 mm (Figure 4.21).

White Mullet

White mullet was the seventh most abundant fish collected in 1982. It comprised approximately 2.8% of the total fish catch using all gear types. White mullet was not as abundant in 1982 as it was in 1981. The 1981 annual CPUE was 75 while the 1982 value was 33. The July CPUE in 1982 peaked well above any other month with a value of 352, followed by May (52) (Figure 4.22).

Recruitment began in May at a size of 20 mm to 35 mm with a mode of 25 mm. Recruitment peaked in July at a size range of 30 mm to 70 mm with the majority at 55 mm to 60 mm. The number of white mullet collected decreased in October and were 60 mm to 95 mm in length (Figure 4.23). The 1981 recruitment of white mullet also began in May at a size of 20 mm to 40 mm with the majority at 25 mm to 30 mm. The number caught peaked in the following month at a size range of 25 mm to 50 mm with the highest frequencies at 30 mm to 40 mm. The abundance of white mullet decreased in September at a size range of 50 mm to 85 mm with the major portion measuring 65 mm (Figure 4.24).

Flounder

Flounder represented 1.2% of the total finfish catch in 1982 using all gear types and was ranked tenth in order of abundance. The trawl data shows that the abundance of flounder increased from 1981 to 1982 with annual CPUE values of 1 and 4, respectively. The highest monthly CPUE in 1982 occurred in February and April (Figure 4.25). Southern flounder were much more abundant (1349 collected) than the summer flounder (22 collected) in the 1982 sampling year.

Since the recruitment periods of southern and summer flounder are different, the length frequency distribution of each were examined independently. The recruitment of southern flounder began with very low numbers in December 1981 at a size of approximately 10 mm (Figure 4.26). The greatest peak in the abundance of southern flounder occurred in April at a size of 10 mm to 20 mm (Figure 4.27). After April, the number of southern flounder decreased as their size increased until the maximum size approached 90 mm in November. The 1982 recruitment of summer flounder began three months later than the southern flounder (Figure 4.28). Recruitment began in March at a size of about 15 mm. The 1981 catch of summer flounder was too low for length frequency analysis.

Brown Shrimp

Brown shrimp was the second most abundant invertebrate collected using trawls and seines, representing 10.2% of the total catch. The annual CPUE increased substantially in 1982 to 12, as compared to 8 in 1981. The monthly CPUE peaked in June with a value of 74. May and July had substantially lower monthly CPUEs with values of 20 and 26, respectively. All other months had very low or no catches (Figure 4.29). These periods of abundance were similar to the 1981 periods of abundance.

The smallest size shrimp identified to species was 21 mm. Some smaller shrimp were collected but are not included in these discussions. The recruitment of brown shrimp into the high marsh began in May at a size of 21 mm with the highest percentage collected at approximately 30 mm. The peak abundance occurred in June with a size range of 21 mm to 110 mm. These catches dropped off in August while the shrimp were at a size of about 45 mm to 125 mm (Figure 4.30). The 1981 recruitment also began in May with the peak appearing in June. They ranged in size from about 35 mm to 115 mm in 1981. Instead of the population decreasing in August, it showed a rise and then a decrease in September at a size range of 45 mm to 120 mm (Figure 4.31).

Pink Shrimp

Pink shrimp was the fourth most abundant invertebrate collected in 1982. This shrimp comprised about 2.6% of the invertebrate catch with all gear types. The annual 1982 CPUE of pink shrimp was the same as 1981 with values of 3. In 1982, September through November had the highest monthly CPUEs with values of 10, 9, and 10, respectively (Figure 4.32).

Pink shrimp began to appear in the 1982 high marsh samples with low numbers in June. The smallest size at which the shrimp were identified was 21 mm, but the majority of the pink shrimp were about 25 mm long when recruitment into the marshes first began. The 1982 recruitment peaked in November with a size range of approximately 21 mm to 70 mm. During this time of peak abundance the main portion of pink shrimp measured 30 mm to 40 mm (Figure 4.33). The 1981 recruitment began about a month later than in 1982. The minimum size pink shrimp collected was about 21 mm while the largest was about 85 mm. The 1981 recruitment peaked in August at a size of 21 mm and 75 mm (Figure 4.34).

White Shrimp

White shrimp was ranked fifth in abundance of the invertebrates collected using trawls and was least abundant of the three commercial shrimps. The annual CPUE for white shrimp increased to 2.1 in 1982 from the 0.3 reported in 1981. White shrimp was collected from June through December in 1982. The highest monthly CPUE (11) was in August followed in abundance by July and September with values of 8 and 4, respectively (Figure 4.35).

Recruitment of white shrimp began in June with low numbers collected at a modal length of 25 mm. The maximum size collected during this month was about 90 mm. The major portion of the white shrimp collected during the peak were approximately 45 mm to 105 mm. After peak abundance the number of white shrimp collected dropped substantially. A few small (21 mm to 25 mm) white shrimp were collected in October and November (Figure 4.36). The 1981 recruitment began in July and peaked in October and

November with very low numbers. The smallest size collected during peak abundance was approximately 25 mm. In October equal numbers of 25 mm and 35 mm shrimp made up the entire catch while in November the highest frequency occurred at 50 mm (Figure 4.37).

Blue Crab

Analysis was performed only on blue crab over 10 mm due to the difficulty in identifying smaller individuals. This cutoff was not enforced until 1982 so the 1981 measurements included all sizes.

Blue crab was the third most abundant invertebrate collected in the high marsh program and comprised approximately 6.9% of total invertebrate catch from all gear types combined. The annual CPUE of blue crab was down slightly from 1981 to 1982 with values of 9 and 7, respectively. The trawl data collected in 1982 indicated that blue crab was relatively abundant throughout the year. However, small peaks were observed in January with a monthly CPUE of 17 and again in November with a value of 11 (Figure 4.38).

The beginning of blue crab recruitment was difficult to estimate due to the small sizes that were collected year round. It appears that the 1982 recruitment began in December 1981 with a minimum size of 11 mm with a mode at 15 mm. The catches peaked in January with similar sizes as in December. The abundance decreased in March at a size range of 10 mm to 35 mm (Figure 4.39). The 1981 recruitment began in January at a size of 5 mm to 25 mm. Abundance peaked in February at sizes of 5 mm to 50 mm with the highest frequency at 11 mm. The numbers collected decreased after March with a size range similar to that in February (Figure 4.40).

4.3.3 Spatial Distribution

Within Creek

Generally, most species that utilize estuaries show a preference for the upstream areas of tidal creeks. Weinstein (1979) and CP&L (1982) indicated that this was true for the CFE as well. This report will consider the preference for upstream normal and will discuss plots of any organisms that differ from the normal.

Upstream preferences were noticed for all organisms in Baldhead Creek except bay anchovy and Atlantic silverside which were most abundant in the lower creek stations (Figures 4.41 and 4.42). Only bay anchovy preferred the lower stations in Walden Creek (Figure 4.43). Flounder, pink shrimp, and white shrimp were most abundant in the mid creek stations (Figures 4.44 through 4.46), while all other selected species preferred upstream areas. Alligator Creek is a more freshwater marsh creek and the species exhibited different spatial distributions than in the lower estuarine creeks. The uppermost station in Alligator Creek normally does not support estuarine species in large numbers. This is possibly due to the constantly low salinity, bottom makeup, or competition with the abundant freshwater species. All of the selected species collected in Alligator Creek preferred the mid or downstream stations which more closely resemble the lower estuarine habitats.

Within the Estuary

Analysis of variance and Duncan's multiple range tests were used to compare the annual CPUEs of each creek system.

The trawl CPUE for total organisms was not significantly greater at Walden Creek than at Mott's Bay but was significantly greater than at Alligator or Baldhead creeks (Table 4.2). There were no significant differences between the CPUEs of the three creek systems sampled with a seine in 1981 and 1982 (Table 4.2).

Analysis of the total 1982 CPUE for menhaden indicated that Walden Creek was significantly higher in abundance than Alligator Creek, Mott's Bay, or Baldhead Creek (Table 4.2). Walden Creek was significantly higher in abundance than Alligator and Baldhead creeks but not Mott's Bay in 1981.

There was no significant difference in CPUEs for bay anchovy between Mott's Bay, Baldhead Creek, and Walden Creek. These areas were, however, significantly higher in catch than Alligator Creek (Table 4.2). The 1981 data shows that Mott's Bay was significantly higher in abundance of bay anchovy than the other areas.

Mummichog was not analyzed in 1981, therefore, no comparison will be made to that year. CPUEs for mummichog in Walden and Baldhead creeks were not significantly different (Table 4.2).

Atlantic silverside was significantly more abundant in Baldhead Creek than in Walden Creek or Mott's Bay. Walden Creek and Mott's Bay, however, were not significantly different from each other (Table 4.2). Atlantic silverside was not analyzed in 1981, therefore, no comparison will be made to that year.

Walden Creek had a significantly higher abundance of spot than Mott's Bay, baldhead Creek or Alligator Creek. The Mott's Bay catch was not significantly higher than the catch at Baldhead Creek but was higher than Alligator Creek (Table 4.2). Mott's Bay and Walden Creek were not different in 1981 but both had significantly higher CPUEs than Alligator or Baldhead creeks.

Croaker was significantly more abundant in Mott's Bay than in the other study areas. Alligator and Walden creeks were not significantly different but were higher in abundance than Baldhead Creek (Table 4.2). Mott's Bay also had a significantly higher CPUE than the other study areas in 1981.

The striped mullet catch was not significantly different between Walden and Baldhead creeks. The CPUE for Walden Creek was, however, significantly higher than Mott's Bay (Table 4.2). No significant differences were found between creeks in 1981.

The CPUE of white mullet indicated that Walden and Baldhead creeks were not significantly different from each other, but were higher in catch than Mott's Bay (Table 4.2). There was no significant difference between areas in 1981.

Flounder was significantly more abundant in Alligator Creek than Mott's Bay, Walden Creek or Baldhead Creek. Mott's Bay was significantly higher in abundance than Walden or Baldhead creeks. Catches in Walden and Baldhead creeks were not significantly different (Table 4.2). Flounder was also most abundant in Alligator Creek in 1981.

There was no significant difference between CPUEs for brown shrimp in Walden Creek, Baldhead Creek, and Mott's Bay in 1982. These three areas had significantly higher CPUEs than Alligator Creek (Table 4.2). In 1981 brown shrimp were more abundant in Walden Creek and Mott's Bay than in Baldhead or Alligator creeks.

Pink shrimp had the highest CPUE in Mott's Bay, followed by Walden and Baldhead creeks and then by Alligator Creek (Figure 4.2). All areas were significantly different in 1981. Mott's Bay had the highest CPUE followed by Walden, Baldhead, and Alligator creeks.

No significant difference was observed for white shrimp between the CPUEs in Walden Creek and Mott's Bay. These two areas were, however, significantly higher in abundance than Baldhead and Alligator creeks (Table 4.2). White shrimp were most abundant at Mott's Bay followed by Walden, Alligator, and Baldhead creeks in 1981.

The CPUEs of blue crab in Walden and Alligator creeks were not significantly different. Walden Creek CPUEs were significantly higher than those at Mott's Bay and Baldhead Creek while Alligator Creek was not

(Table 4.2). Blue crab was collected in its highest number at Mott's Bay in 1981.

4.3.4 Effects of Salinity, Temperature, and Percent Organics on Abundance

Salinity

For the purpose of this report the salinity values are grouped into three ranges: low, mid, and high. Low salinity is considered to be from 0 ppt to 10 ppt, mid salinity is from 11 ppt to 20 ppt, and high salinity is from 21 ppt to 30 ppt. Bay anchovy, Atlantic silverside, and white mullet were most abundant in areas with high salinities. Pink shrimp were found to be most abundant in the mid salinity range while all other species were most abundant in the low salinity range. Table 4.3 indicates the salinity preference of each species.

Temperature

The water temperature values are grouped into three ranges; low (3°C to 13°C), mid (14°C to 24°C), and high (25°C to 34°C). None of the selected species was most abundant when water temperatures were in the low range. Menhaden, spot, croaker, flounder, pink shrimp, and blue crab were collected in their greatest abundance at temperatures in the mid range. The remaining species (bay anchovy, mummichog, Atlantic silverside, striped and white mullet, brown shrimp, and white shrimp) were collected at high temperatures. The temperature preference exhibited by each species is displayed in Table 4.3).

Percent Organics

The values for the percent organics in the substrates were grouped into three ranges; low (<1% to 11%), mid (12% to 22%), and high (23% to 34%). Spot, flounder, and blue crab were most abundant in areas with a mid range of organic substrate (Alligator Creek). None of the selected species was most abundant in the high organic areas. The remaining

selected species were most abundant in low organic content areas. The preference of percent organics is presented in Table 4.3.

4.3.5 Standing Crop Estimates

Standing crop estimates were determined in the spring and fall for Baldhead and Walden creeks (two rotenone stations each) and Mott's Bay (one station). Alligator Creek's substrate contained extremely soft organic ooze which made walking impossible so no sample could be taken. Since the densities of most species of fish decrease from upstream to downstream, rotenone samples were collected near the headwaters and near the mouth. By combining the high density area with the low density area, an average standing crop per hectare was obtained for the creek as a whole.

The spring rotenone sampling trip showed that the standing crop was greatest in Baldhead Creek for menhaden, bay anchovy, mummichog, and striped mullet. Walden Creek supported the highest standing crop for spot and flounder. Croaker showed the largest standing crop at Mott's Bay. The standing crops were greater in the spring for all species except Atlantic silverside, white mullet, and croaker. The spring standing crops of each species by creek are displayed in Table 4.4.

Baldhead Creek had the highest fall standing crop for mummichog, Atlantic silverside, spot, white mullet, and flounder. The highest standing crop in Walden Creek was observed for striped mullet. Mott's Bay contained the largest standing crop of bay anchovy and croaker in the fall (Table 4.5).

4.4 Summary and Conclusions

The peak abundance of fish and invertebrates occurred during recruitment of the individual species into the marshes. In some cases, such as with menhaden, the number of fish was high during the initial recruitment but increased even more when cohorts from other areas moved

into the marsh. Spot, croaker, striped mullet, flounder, and blue crabs were generally most abundant in the late winter and early spring months. Other organisms such as menhaden, bay anchovy, mummichog, Atlantic silverside, white mullet, and brown shrimp were more abundant in the late spring and summer. White and pink shrimp were collected in their highest numbers in late summer and early fall.

Most species of fish and shellfish exhibit certain spatial preferences in an estuary. Many of the species that reside in the estuary, whether temporarily or permanently, choose areas with lower salinities or small salinity fluctuations. Bay anchovy, croaker, flounder, and pink shrimp were most abundant in the upper estuary. All other selected species, except Atlantic silverside, were most abundant in Walden Creek which is generally low in salinity and has a small amount of fluctuation. Except for bay anchovy and Atlantic silverside, all of the selected species were most abundant in the mid to upstream areas of the tidal creeks. Species collected in Alligator Creek were most abundant in the mid to down creek areas, which is probably the result of the constantly low salinity, bottom makeup, and competition with the numerous freshwater fish in the upstream station.

Bay anchovy, Atlantic silverside, and white mullet were collected from areas with salinities between 21 ppt and 30 ppt. Pink shrimp was most abundant in areas with salinities between 11 ppt and 20 ppt. All other selected species were most abundant at salinities between 0 ppt and 10 ppt. Menhaden, spot, croaker, flounder, pink shrimp, and blue crabs were most abundant in the marshes when water temperatures were between 14°C and 24°C. Mummichog, Atlantic silverside, striped mullet, white mullet, brown shrimp, and white shrimp were most abundant when water temperatures were high (25°C to 34°C). All the selected species were most abundant in areas with low sediment organics except spot, flounder, and blue crab, which were most abundant in areas where organics were between 12% and 22%.

The standing crops in the tidal creeks were generally higher in the spring than in the fall. The standing crop estimates for each selected species is summarized in Tables 4.4 and 4.5.

Because most species had expected distributions within creeks and were most abundant in Walden Creek and the upriver stations, it is unlikely that the power plant is having an adverse effect on the populations of fishes utilizing the marshes of the CFE.

5.0 NEKTON

5.1 Introduction

This portion of the study program monitors long term changes in the juvenile and adult populations of nektonic organisms in the CFE. Basically, the program uses catch per unit effort and length frequency data to provide a measure of these changes.

The major objectives of this program are to determine the relative seasonal abundance, species composition, and size distribution of the juvenile and adult fish and shellfish in the CFE.

The results of the 1982 nekton monitoring program are compared to data collected from 1979 through 1981 to ascertain trends in species composition, abundance, and size distribution.

5.2 Methods

Eleven stations were sampled extending from the freshwater drainage canal, approximately 3.4 km west of Southport, to Alligator Creek, approximately 0.6 km east of the Brunswick River (Figure 1.2). Trawl samples were conducted every three weeks (Table 5.1).

Salinity and temperature measurements were taken at the surface and bottom each time a station was visited, though only bottom values are reported (Figure 2.1).

Trawl samples consisted of fish and shellfish captured in a five-minute tow. Samples were sorted by species, enumerated, and weighed. Up to 50 lengths from each size group of the dominant and/or commercially important species (Table 1.2) were recorded from each sample. A length range was recorded for all other measurable species. Large samples were subsampled. More detailed descriptions of sampling methods and gear can be found in CP&L (1982).

An ANOVA was used to examine the $\log_{10}$ (CPUE + 1) of the selected species. Year classes were separated whenever possible. YOY individuals were all specimens recruited in the 1982 calendar year. Juveniles and adults were lumped together and included all other individuals. The analysis was separated into three models. An all years model was used with stations 1 and 4 through 8, since these were the only stations with four complete years of data. A two year model, 1981 and 1982, was also used to better document the changes occurring with stations 2, 10, 11, 12, 13. Stations 11 and 12 were added in 1980 and stations 2, 10, and 13 were added in 1981. An analysis was also run on 1982 data. Results of the ANOVA are presented in Tables 5.6 through 5.8; but due to significant interactions occurring between main effects, conclusions were drawn from examination of plots of the cell means.

5.3 Results and Discussion

5.3.1 Total Organisms

In 1982 finfish comprised 74% and non-finfish comprised 26% of the total organisms caught (Table 5.2). Ninety-three species of finfish were caught and 15 species of non-finfish were caught.

Of the total organisms caught from 1979 to 1982, 68% were finfish and 32% were non-finfish (invertebrates and reptiles). Bay anchovy (35%), spot (32%), croaker (19%), menhaden (5%), and weakfish (4%) accounted for 95% of the total finfish caught (Table 5.3). Grass shrimp (56%), brown shrimp (19%), blue crabs (7%), pink shrimp (6%). and white shrimp (5%) comprised 93% of the total non-finfish caught (Table 5.4).

Catches remained fairly constant throughout the year. An unusually large catch in December was due to a high catch of YOY croaker during that month (Figure 5.1).

Analysis of CPUE of total organisms for 1982 showed that stations 1, 5, and 13 generally had higher catches than the other stations during

most of the year. Lower catches occurred at station 8 and 2. Mean log CPUE for each station is presented in the following table.

Station	1	5	13	4	6	7
$\overline{\text{Log}}$ CPUE	2.64	2.62	2.49	2.39	2.38	2.35
Station	10	12	11	8	2	
$\overline{\text{Log}}$ CPUE	2.27	2.09	2.07	1.84	1.60	

The following table presents the mean log CPUE of the total organisms for each year. The catch in 1982 was only slightly higher than previous years.

Year	$\overline{\text{Log}}$
1982	2.37
1981	2.26
1979	2.26
1980	2.25

5.3.2 Species Accounts

Menhaden

Menhaden ranked fourth in abundance for 1982 and for all years combined (Table 5.3). Since these were primarily juveniles and adults, analysis was done only on these year classes.

The CPUE for the period January 1979 through December 1982 was 12 (Table 5.5). January through March generally had higher catches than all other months (Figure 5.2).

As shown in the following table, the catch in 1982 at station 4 was higher than all other stations. Stations 10, 6, 7, 5, and 13 were generally higher than the rest. These results compare well to previous years.

Station	4	10	6	7	5	13
$\overline{\text{Log}}$ CPUE	1.27	0.84	0.82	0.80	0.75	0.72

Station	1	2	8	11	12
$\overline{\text{Log}}$ CPUE	0.56	0.42	0.38	0.37	0.03

Stations 4, 5, 6, 7, 10, and 13 are all deep water stations in the lower river. This possibly reflects a preference by adult menhaden for deeper water and the lower estuary. In 1979 the CPUE was 4. The CPUE increased to 14 in 1980, 13 in 1981, and 16 in 1982 (CP&L 1982 and Table 5.2). The 1982 catch peaked earlier and lasted longer than previous year's catches (Figure 5.2).

Length frequency distributions show that new recruits were first collected in the small trawl in March and April at 20 to 30 mm. Their numbers increased in June but quickly declined thereafter (Figure 5.3).

Bay Anchovy

The bay anchovy was the most abundant fish caught in the small trawl during 1982 and for all years combined (Table 5.3). In 1982, catches of YOY bay anchovies peaked in August and remained consistently high throughout the rest of the year (Figure 5.4). This is unlike previous years in which a bimodal period of abundance was seen with peaks in late summer and late fall. Abundance of adults peaked in April and began declining gradually until their complete disappearance by late summer. This may indicate that the bay anchovy is an annual species.

The CPUE of bay anchovy with the small trawl was 112 for the period January 1979 through December 1982 (Table 5.5). The following table presents mean log CPUE values for each station by year class.

<u>YOY Individuals</u>

Stations	1	13	4	5	8	10
$\overline{\text{Log}}$ CPUE	1.93	1.34	1.32	1.26	1.23	1.18
Station	11	6	2	7	12	
$\overline{\text{Log}}$ CPUE	1.16	1.11	0.84	0.44	0.29	

<u>Juveniles and Adults</u>

Station	4	6	8	13	2	1
$\overline{\text{Log}}$ CPUE	1.21	1.11	1.08	1.06	1.02	1.01
Station	10	5	11	7	12	
$\overline{\text{Log}}$ CPUE	0.76	0.67	0.44	0.23	0.01	

Analysis of CPUE showed that station 1 generally had higher catches of YOY fish. Juveniles and adults were generally more abundant at stations 4 and 6. Stations 7 and 12 had lower catches of both year classes. Individual year comparisons show much variation in catch per station (CP&L 1982).

YOY bay anchovies first appeared in June at 30 mm or less. In July, adults no longer dominanted the catch and disappeared completely in late August or September. The peak period for growth of YOY individuals occurred from August to October, at which time some individuals reached 65 mm (Figure 5.5).

Seatrout

Weakfish and spotted seatrout were the two commercially and recreationally important seatrout species caught during the sampling period. Because of the small numbers collected (only 15 caught in 1982) the spotted seatrout was not included in this discussion.

Weakfish was the fifth most abundant fish caught during 1982 and also over the entire sampling period (Table 5.3). This species was present from June through December with the peak abundance occurring from June through August (Figure 5.6). At this time, the catch of weakfish was made up primarily of YOY individuals, therefore it is these individuals which will be discussed in detail.

For the entire sampling period (1979-1982), the CPUE for weakfish was 10 (Table 5.5). In 1982 stations 1, 4, 6, 10, and 13 all had a mean log CPUE of 0.54 or greater. The mean log CPUE for all other stations was 0.42 or less. These results are similar to the trends in previous years and may possibly reflect a preference for the lower river areas of the estuary (CP&L 1982). The CPUE for weakfish was 7, 11, 11, and 9 in 1979, 1980, 1981, and 1982, respectively (CP&L 1982 and Table 5.2).

Recruitment began in June and continued into September (Figure 5.7). Recruits were a maximum of 65 mm in June, and by late summer some individuals had reached 140 mm.

Spot

Spot ranked second in abundance for both 1982 and the entire study period (Table 5.3). Spot were collected throughout the entire year. Juvenile and adult fish were abundant from January to July, at which time they moved into deeper water. YOY individuals were most abundant from February through July (Figure 5.8).

For years 1979 through 1982, the CPUE for spot was 90 (Table 5.5). As the following table shows, stations 5, 6, and 13 generally had higher catches of YOY spot.

Station	5	6	13	1	4	10
$\overline{\text{Log}}$ CPUE	1.48	1.34	1.32	1.10	0.99	0.73
Station	11	7	12	8	2	
$\overline{\text{Log}}$ CPUE	0.72	0.59	0.50	0.46	0.44	

In 1981 catches of YOY spot were high at Alligator Creek (station 12). The catch at this station was relatively low in 1982. This may relate to a sharp drop in mean river salinity during the late spring (Table 2.1) which is the latter period of peak abundance of YOY spot. Catches of juvenile and adult spot were highest at station 1 (mean log CPUE of 0.83) and lowest at station 12 (mean log CPUE of 0.07). Results show that adult spot generally are found in the lower reaches of the CFE, whereas YOY individuals utilize the upper reaches of the CFE in addition to the lower areas. The CPUE of all sizes of spot was 90, 40, 111, and 119 for 1979, 1980, 1981, and 1982, respectively (CP&L 1982 and Table 5.2). The mean log CPUE of YOY individuals and juvenile and adults is presented in the following table.

YOY Individuals

Year	1982	1979	1980	1981
$\overline{\text{Log}}$ CPUE	0.99	0.95	0.68	0.67

Juvenile and Adults

Year	1981	1982	1980	1979
$\overline{\text{Log}}$ CPUE	0.72	0.59	0.50	0.46

Analysis of CPUE shows that 1979 and 1982 had generally higher catches of YOY spot. For juvenile and adults, 1981 had higher catches than 1982 or 1980. Lower catches occurred in 1979.

Recruits first showed up in the small trawl during January at 15-25 mm. Steady growth was seen during all four years from May until October, at which time these individuals were 45 to 115 mm (Figure 5.9).

Croaker

Croaker was the third most abundant fish in small trawl catches for the period 1979 through 1982 and also ranked third in the 1982 catch (Table 5.3). Generally, YOY croaker were most abundant in the small trawl catches during late April to July (Figure 5.10). Also a large catch occurred in December of 1982 due to strong recruitment in the early winter. Catches of juvenile and adult croaker were higher in April and May.

The CPUE of croaker was 46 for the entire study period (Table 5.5). Stations 1, 11, 10, and 12 had a mean log CPUE of 1.06 or greater for YOY croaker. All other stations had a mean log CPUE of less than 1. Stations 4, 10, and 5 had a mean log CPUE of 0.57 or more for juvenile and adult croaker. Alligator Creek had a mean log CPUE of 0.01 for juveniles and adults. In general, juveniles and adults were abundant at and downstream of station 10 (Snow's Cut). The results show that although juvenile and adult croaker may be found anywhere in the sampling area, they are more abundant in the higher saline lower river areas. YOY individuals, on the other hand, utilized the lower saline areas upriver in addition to the lower river stations, as witnessed by 1981 data. High river flow and lowered salinity (Figure 2.1) caused by heavy rains during the period April to June (time of peak abundance of YOY croaker) may have caused the drop in the CPUE of YOY croaker at station 12 during 1982. In 1979 the overall CPUE of croaker was 55. This declined to 37 in 1980 and declined again in 1981 to 25 (CP&L 1982). The CPUE increased to 68 in 1982 (Table 5.2). The mean log CPUE for YOY individuals and juvenile and adults are presented on the following table.

	"v Individuals			
Year	1979	1.	1980	1981
$\overline{Log}$ CPUE	0.94	0.86	0.86	0.48

	Juveniles and Adults			
Year	1981	1982	1980	1979
$\overline{Log}$ CPUE	0.62	0.40	0.36	0.14

The mean log CPUE of YOY croaker was highest in 1979 and lowest 1981. This pattern was reversed for juveniles and adults.

Recruitment of YOY croaker began in September and October and continued through the following May. YOY croaker were about 15 to 20 mm when they first appeared in trawl samples (Figure 5.11). Peak periods of growth occurred from May until October of every year.

Mullet

Mullet were collected in relatively small numbers (< 0.1% of the total catch) during the study period 1979 through 1982. Approximately 96% of the mullet collected were striped and the other 4% were white (Table 5.2, 1981 report, and Table 5.2). These small numbers preclude any statistical comparison.

Flounder

Southern flounder was the most abundant flounder species and comprised roughly 79% of the total flounder catch (Table 5.2).

During the study period 1979 through 1982, southern flounder comprised 0.58%, 0.35%, 0.07%, and 0.25% of the catch, respectively (CP&L 1982 and Table 5.2).

Other Finfish

In addition to the commercially and recreationally important species, five other species were among the top ten most abundant fish caught during the study period 1979 through 1982 (Table 5.3). Blackcheek tonguefish, hogchoker, star drum, spotted hake, and silver perch ranked 6, 7, 8, 9, and 10, respectively.

In 1982 silver perch dropped out of the top ten most abundant category and white catfish appeared ranked at 9. This may not represent a change in relative abundance of either species but rather the addition of the upriver stations in 1980.

Non-Finfish

This group includes decapod crustaceans, mollusks, and reptiles. The six most abundant species in this group during the entire study period were grass shrimp, brown shrimp, blue crabs, pink shrimp, white shrimp, and hardback shrimp (Table 5.4).

The discussion will be restricted to the commercially important species of the family Penaeidae (brown, pink, and white shrimp) and blue crabs.

Brown Shrimp

The period of abundance of brown shrimp generally occurred from June to August with a peak in June (Figure 5.12).

For the period 1979 through 1982, the CPUE of brown shrimp was 20 (Table 5.5). In 1982, station 5 (mean log CPUE = 0.90) had a higher catch than stations 13, 7, 4, 6, and 1 (mean log CPUE values of 0.73 to 0.60). Stations 10 and 11 had mean log CPUE values of 0.43 and 0.35, respectively. During 1981 stations 10 and 11 had the highest catches (CP&L 1982). Low salinities during late spring (Figure 2.1) probably influenced abundances at the upriver stations during 1982. In 1979 the

CPUE of brown shrimp was 31 and decreased to 21 in 1980 and 10 in 1981. The CPUE increased to 18 in 1982 (Table 5.2).

Recruits were first collected in May of 1979 through 1981 but did not show up until June of 1982 (CP&L 1982 and Figure 5.13). Additionally, very few brown shrimp were impinged during May of 1982 (Figure 6.8). This delay may have been caused by the high freshwater flow that occurred during April through June of that year (Figure 2.1). A period of rapid growth was apparent from June through August every year. After August, the larger individuals moved offshore and were no longer abundant in the trawl catch. Smaller individuals were caught in low numbers through the end of the year.

Pink Shrimp

In 1979 and 1981 pink shrimp exhibited a period of abundance occurring from August to October. During 1980, however, the peak abundance occurred from January to May and in 1982 it occurred in January (Figure 5.14). This was a result of a large overwintering population due to a strong late summer recruitment in 1979 and 1981, coupled with low population during the late summer of 1980 and 1982.

The CPUE for the entire sampling period was 7 (Table 5.5). The following table lists the mean log CPUE by station for pink shrimp during 1982.

Station	1	7	5	4	10	13
$\overline{\text{Log}}$ CPUE	0.60	0.53	0.28	0.25	0.22	0.20

Station	8	6	11	2	12
$\overline{\text{Log}}$ CPUE	0.18	0.17	0.16	0.15	0.14

Stations 1 and 7 had generally higher catches in 1982. In 1980 station 12 (Alligator Creek) had the third highest catch of pink shrimp (CP&L 1982). The catch at station 12 decreased in 1981 and 1982. The catch

during peak abundance upriver was low due to low salinity (Figure 2.1). The CPUE for 1979, 1980, 1981, and 1982 was 14, 5, 7, and 3, respectively (CP&L 1982).

YOY recruits first began showing up in the small trawl in June at about 35 mm. A second recruitment of YOY pink shrimp were collected in the trawl during October. Growth occurred during the period July to September of 1982 (Figure 5.15).

White Shrimp

White shrimp were usually present in the small trawl catch from mid-July until November or December. August had a higher catch than any other month (Figure 5.16).

For the entire sampling period, the CPUE of white shrimp was 9 (Table 5.5). The following table lists the mean log CPUE by station for 1982. Station 5 had higher catches than stations 13 and 1 which were higher than the rest.

Station	5	13	1	7	4	6
$\overline{\text{Log}}$ CPUE	1.83	1.20	1.09	0.69	0.65	0.64
Station	11	12	10	8	2	
$\overline{\text{Log}}$ CPUE	0.58	0.57	0.47	0.08	0.04	

Station 11 (an upriver station) had a fairly high CPUE in 1980 and 1981 (CP&L 1982). This would seem to indicate that a nursery area exists upriver at least as far as that station. The CPUE at station 11 dropped somewhat in 1982 and was probably related to the sharp decrease in salinity during April and June of that year (Figure 2.1). The CPUE of white shrimp in 1979 was 3, in 1980 was 14, and in 1981 dropped to 2 (CP&L 1982). In 1982 the CPUE of white shrimp was 12 (Table 5.2).

White shrimp recruits became available to the small trawl in July of 1982 (Figure 5.17). Most of the white shrimp recruits were 25 to 80 mm at this time. A period of rapid growth occurred from July through September.

Blue Crab

Blue crabs were present during all months of the study (Figure 5.18). Generally, greater catches occurred in March through August during 1979, 1980, and 1981. In 1982, the catch of blue crabs was higher in January through February. This may have been related to the drop in salinity during May through June of 1982 (Figure 2.1).

The following table lists the mean log CPUE by station for 1982. Of the lower river stations, stations 13, 6, and 4 generally had higher catches of blue crab than the other stations.

Station	13	6	4	12	10	5
$\overline{\text{Log}}$ CPUE	0.78	0.76	0.70	0.61	0.59	0.55

Station	7	11	8	1	2
$\overline{\text{Log}}$ CPUE	0.48	0.47	0.44	0.38	0.26

During 1981, catches at station 12 were generally higher than stations 6 and 4 (CP&L 1982). The higher catches upriver at station 12 indicate usage of this area as a nursery area by blue crabs. The CPUE was down at station 12 in 1982 and may have been related to the drop in salinity during late spring of that year (Figure 2.1). The CPUE of blue crab was 11, 6, 7, and 8 in 1979, 1980, 1981, and 1982, respectively (CP&L 1982, and Table 5.2).

5.4 Summary and Conclusions

Nekton monitoring from January 1979 to December 1982 showed little difference among years for CPUE of total organisms. Differences in

individual species were seen among years, months, and stations. These differences were expected however, and were due to the variation which occurs in populations from year to year. Some of this variation can be explained by abiotic factors such as temperature, and more importantly salinity, as witnessed by changes in the abundance of some species at the upriver areas of 42 east and Alligator Creek. Additionally some organisms are more abundant in particular habitats. An example of this would be the greater relative abundance of menhaden in the deep water areas of the CFE. Other factors such as the schooling behavior of large numbers of bay anchovies also come into play.

With an additional year's data, further documentation was obtained that the upriver areas above Snow's Cut serve as a nursery ground for many of the selected species. In 1981 and 1982 catches of croaker, spot, brown shrimp, white shrimp, and blue crabs were generally high upriver. A drop in the catch of some species during part of 1982 was due to the large influx of fresh water during May and June of that year.

Because of these distributions and abundances, it is unlikely that the BSEP is limiting recruitment to the upriver nursery grounds, and therefore not causing an adverse effect on the CFE.

6.0 IMPINGEMENT

6.1 Introduction

Impingement studies have been conducted at BSEP since January 19, 1974, when water was first pumped through the plant. Objectives of these and the present study have basically remained unchanged and address the determination of numbers, lengths, weights, species composition, and length frequency of organisms impinged at BSEP.

During 1982 the diversion system evolved from a temporary diversion fence across the intake canal to a concrete and permanent screen diversion structure. Impingement varied with the different degrees of construction of the diversion structure. In January through April the temporary diversion fence was being maintained but was only partially effective due to washouts under and around the screening. In May through November the temporary diversion fence was removed and the construction of the new structure started. During this period, organisms entered the BSEP intake canal freely. On November 15, the new structure was complete. Impingement after this period consisted of organisms which were trapped in the canal when the final screens were installed and those small enough to pass through the 10 mm mesh screens.

6.2 Methods

Impingement sampling methodology in 1982 was identical to that of 1981 (CP&L 1982). In summary, dawn and dusk samples were collected over a 24-hour period each week. Occasionally, a screen malfunction or other plant problems resulted in a missed sample.

Laboratory analysis consisted of separating the organisms from the debris, identifying, enumerating, recording minimum and maximum length, and weighing as a total each species by size group. Up to 100 specimens of 14 selected species (Table 1.2) were measured from each 24-hour study period for length frequency estimations.

Monthly estimates of impingement were obtained by dividing the total number of hours in a month by the number of hours sampled during that month. This expansion factor was then multiplied by the number and weight of all the organisms collected during that month. The 12 monthly totals were then combined to obtain the annual estimate.

Statistical analysis were performed on $\log_{10}$ (number + 1) and $\log_{10}$ (weight + 1) per million cubic meters of water entrained.

For purposes of analysis all taxa were grouped into the following 12 categories:

Category	Taxa Included
Menhaden	Menhaden
Bay anchovy	Bay anchovy
Seatrout	Weakfish
	Spotted seatrout
Spot	Spot
Croaker	Croaker
Mullet	Striped mullet
	White mullet
Flounder	Summer flounder
	Southern flounder
	Gulf flounder
Shrimp	Brown shrimp
	Pink shrimp
	White shrimp
Blue crab	Blue crabs
Other finfish	All finfish not included in another group
Other shellfish	Crustaceans such as grass shrimp, mantis shrimp, and crabs other than blue crabs
Miscellaneous species	All organisms not included in another species group (turtles, squid, etc.)

6.3 Results and Discussion

6.3.1 Species Composition

The 1982 impingement catch totaled 19.8 million organisms including 137 taxa weighing 76,494 kg (Table 6.1). Thirty-five taxa were represented by 100 or fewer individuals, and 81 taxa were represented by 1000 or fewer individuals. Only 4 species represented more than 2% of the total catch. Menhaden and gizzard shad, two clupeids, represented 55.1% and 26.3%, respectively, of the annual catch (Table 6.2). The third highest annual catch was bay anchovy, totaling 5.3%, followed by blue crab (2.6%) and croaker, spot, and brown shrimp each totaling 1% to 2% of the catch. White shrimp, grass shrimp, and spotted hake were also included in the ten most abundant species totaling less than 1% of the annual catch. These species combined for 96.2% of the annual catch (Table 6.2).

Total numbers, weights, and species composition for each taxa are presented in Table 6.3 with monthly subtotals by analysis category presented in Table 6.4.

6.3.2 Seasonality

The impingement catch for January totaled 9 million organisms of which 8.2 million were menhaden. Large schools of YOY menhaden were affected by the low temperatures, 4.5°C to 6.8°C (Figure 2.2), and were impinged on the screens.

Another fish run occurred in June when heavy rains reduced salinities in the lower CFE from 25 ppt to 4 ppt (Figure 2.1) over a four week period. With the freshwater runoff came large numbers of YOY gizzard shad. Over 5 million gizzard shad were impinged in June, making it the highest June impingement on record.

The February through May catch was typical of previous years. The July through November catches were among the lowest of previous years due

to reduced intake flows during plant outages. The December catch was the lowest ever recorded and is attributable to low flow rates and the completion of the diversion structure.

6.3.3 Flow Rates

Average monthly cooling water flow rates for 1982 and the mean average for 1977-1981 are presented in Figure 6.1. The higher impingement from January through April and the lower impingement July through December correspond to the flow rates during the same periods (Figure 6.2).

For analysis all numbers and weights of organisms impinged were converted to units per million cubic meters of water entrained (Table 6.5 and 6.6). In this manner, total monthly numbers are adjusted for varying flow rates. This is important when catches are low and flows are high or vice versa. For example, June had the second highest total monthly catch in 1982. June also had the lowest monthly flow rate in 1982. By expressing the catch in number per million cubic meters, it can be seen that June recorded the highest monthly rate of impingement during 1982 (Table 6.5).

6.3.4 Day-Night Comparisons

Many estuarine organisms are more active at night. The 1982 samples were collected during day or night periods to allow comparisons between the two periods. Total day catch for each month ranged between 12 and 70 percent by number and 15 to 56 percent by weight (Table 6.7). The highest value, 70 percent by number and 56 percent by weight, is atypical and was attributed to the gizzard shad run during June. Without the June values the daytime catch was generally 25 percent of the total catch (Figure 6.2).

6.3.5 Yearly Comparisons

The results of Duncan's multiple range comparison of means of

numbers and weights of organisms impinged by year are presented in Table 6.8. The catches by number for 1982 ranked second from the last or last for trout, spot, bay anchovy, mullet, and shrimp although they were not significantly different from many of the other years. The catches for blue crabs, flounder, and croaker were ranked fourth or fifth and were also not significantly different from many of the other years. The menhaden catch for 1982 was ranked third but was not significantly different from the highest five years. The high 1982 catch is a result of the January fish run.

Analyses of biomass (weight) impinged are presented for the first time. The weight rankings were very similar to the number rankings (Table 6.8).

6.3.6 Length Frequency

Length frequency graphs for menhad… bay anchovy, weakfish, spot, croaker, brown shrimp, pink shrimp, and w…te shrimp are presented in Figures 6.3 through 6.10. The data for spotted seatrout, white mullet, striped mullet, summer flounder, and southern flounder are not presented because few individuals were caught. The species showed expected seasonality and growth as reported in 1981 (CP&L 1982).

6.3.7 Diversion Structure

The diversion structure was designed to reduce impingement by preventing juvenile and adult aquatic organisms from entering the intake canal The construction schedule of the permanent structure was as follows:

Construction started	April 23
Removal of prototype screen	May 15 - October 10
Installation of frames and supports	May - September
Installation of new screens started	October 11
Installation completed	November 15

In December the diversion structure was effective in excluding organisms from the intake canal. However, some of those organisms trapped in the intake canal were impinged.

The 1977 through 1981 average December impingement consisted of approximately 13,000 organisms per million cubic meters of water entrained. The December 1982 impingement consisted of 1500 organisms per million cubic meters of water entrained: only 11% of the 1977-1981 December average (Figure 6.11). Future impingement should be reduced even further as the organisms trapped in the canal are removed.

6.4 Summary and Conclusions

The highest monthly impingement was recorded during January and June while the lowest was recorded for December. Meterological conditions, low water temperatures in January and low salinity in June, contributed to the high impingement. The low impingement in December is directly related to the completion of the diversion structure. During the first month of operation, impingement was reduced by approximately 90%.

Impingement will not be eliminated at BSEP. Larvae and postlarvae will be able to pass through the 10 mm mesh of the diversion screens. These organisms may reside and grow in the intake canal for months before becoming impinged. Those organisms that are impinged will be returned to the estuary via the new return system. Fish runs as previously experienced will liminated.

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BRUNSWICK STEAM ELECTRIC PLANT

ANNUAL BIOLOGICAL MONITORING REPORT 1982

VOLUME II

ENVIRONMENTAL TECHNOLOGY SECTION

CP&L

Carolina Power & Light Company

[redacted]

Table 1.1   BSEP 1982 biological monitoring program.

Program	Sampling Frequency	Sampling Locations
Entrainment	Weekly	Discharge weir
Impingement	Weekly	Intake screens
Water Quality	Weekly	Dutchman Creek Walden Creek Buoy 15 Buoy 19 Buoy 25 Buoy 29 Buoy 35 Buoy 38 Buoy 42
River Larval Fish	Biweekly, September-May Monthly, June-August	Dutchman Creek (Station 11) Walden Creek (Station 24) Buoy 15 (Station 18) Buoy 19 (Station 25) Buoy 29 (Station 37) Buoy 38 (Station 34) Buoy 42 (Station 41)
Discrete Depth	February-March (Four 24-hour trips)	Buoy 19 Buoy 38
Nekton	Every three weeks	Freshwater Drainage Canal Slough east of Buoy 18 Intake Canal west of Buoy 19 Walden Creek Shallows west of Buoy 23 ICW marker 174 Shallows east of Buoy 42 Alligator Creek Intake Canal Inside Diversion Structure Between canal bends Adjacent to plant
High Marsh Trawl and Seine	Every three weeks	Baldhead Creek Trawl 7 stations Seine 2 stations Walden Creek Trawl 9 stations Seine 2 stations Mott's Creek Bay Trawl 1 station Seine 1 station Alligator Creek Trawl 4 stations
Rotenone	Late Winter and Early Fall	Baldhead Creek 2 stations Walden Creek 2 stations Mott's Creek Bay 1 station

Species of fish and shellfish analyzed by program.

...ic Name	Common Name	L	E	D	M	N	I
...e							
...ortia tyrannus	Atlantic menhaden	X	X		X	X	X
...idae							
...a hepsetus	Striped anchovy	]	]		X	X	X
...tchilli	Bay anchovy	]	]				
...odontidae							
...ulus heteroclitus	Mummichog				X		
...majalis	Striped killifish				X		
...inidae							
...mbras martinica	Rough silverside				X		
...nidia beryllina	Inland silverside				X		
... menidia	Atlantic silverside				X		
...aenidae							
...ynoscion nebulosus	Spotted seatrout	]	]		X	X	]
... regalis	Weakfish	]	]		X	X	]
...eiostomus xanthurus	Spot	X	X	X	X	X	X
...icropogonias undulatus	Atlantic croaker	X	X	X	X	X	X
...ilidae							
...ugil cephalus	Striped mullet	]	]		X	X	]
... curema	White mullet	]	]		X	X	]
...iidae							
Gobionellus boleosoma	Darter goby	]	]				
G. hastatus	Sharptail goby	]	]				
G. shufeldti	Freshwater goby	]	]				
Gobiosoma bosci	Naked goby	]	]				
G. ginsburgi	Seaboard goby	]	]				
...thidae							
Paralichthys albigutta	Gulf flounder	]	]				
P. dentatus	Summer flounder	]	]		X	X	]
P. lethostigma	Southern flounder	]	]		X	X	]
...naeidae							
Penaeus aztecus	Brown shrimp		X	X	X	X	X
P. duorarum	Pink shrimp		]	]	X	X	X
P. setiferus	White shrimp		]	]	X	X	X
...rtunidae							
Callinectes sapidus	Blue crab				]	]	]
C. similus	Blue crab				]	]	]

L = Larval fish
E = Entrainment
D = Discrete depth
M = High marsh
N = Nekton
I = Impingement

] = Species grouped for analysis purposes

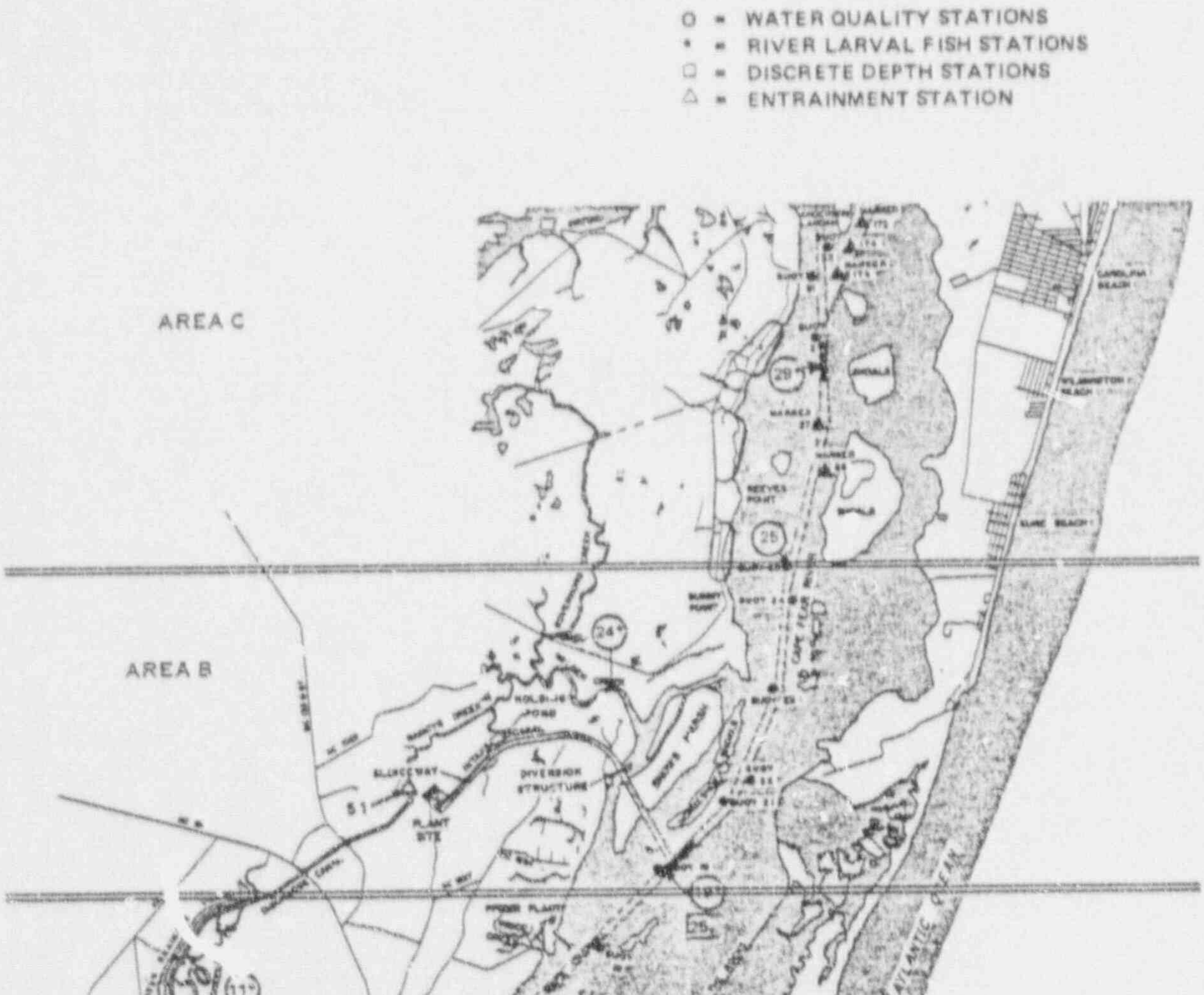


Figure 1.2 Larval/postlarval and water quality sampling locations.

O = WATER QUALITY STATIONS
* = RIVER LARVAL FISH STATIONS
□ = DISCRETE DEPTH STATIONS
△ = ENTRAINMENT STATION

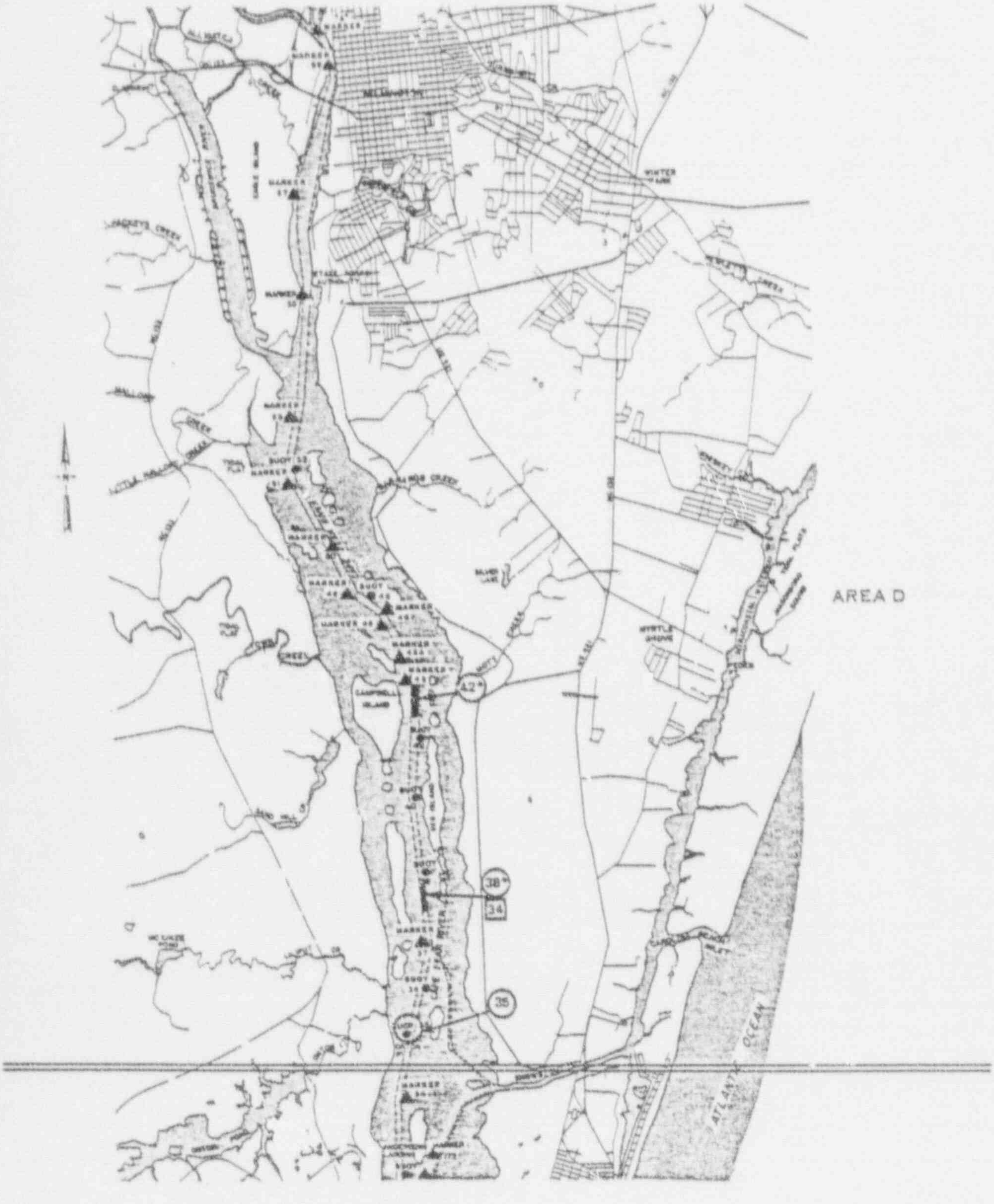


Figure 1.1 (Continued)

Table 1.1 BSEP 1982 biological monitoring program.

Program	Sampling Frequency	Sampling Locations
Entrainment	Weekly	Discharge weir
Impingement	Weekly	Intake screens
Water Quality	Weekly	Dutchman Creek Walden Creek Buoy 15 Buoy 19 Buoy 25 Buoy 29 Buoy 35 Buoy 38 Buoy 42
River Larval Fish	Biweekly, September-May Monthly, June-August	Dutchman Creek (Station 11) Walden Creek (Station 24) Buoy 15 (Station 18) Buoy 19 (Station 25) Buoy 29 (Station 37) Buoy 38 (Station 34) Buoy 42 (Station 41)
Discrete Depth	February-March (Four 24-hour trips)	Buoy 19 Buoy 38
Nekton	Every three weeks	Freshwater Drainage Canal Slough east of Buoy 18 Intake Canal west of Buoy 19 Walden Creek Shallows west of Buoy 23 ICW marker 174 Shallows east of Buoy 42 Alligator Creek Intake Canal Inside Diversion Structure Between canal bends Adjacent to plant
High Marsh Trawl and Seine	Every three weeks	Baldhead Creek Trawl 7 stations Seine 2 stations Walden Creek Trawl 9 stations Seine 2 stations Mott's Creek Bay Trawl 1 station Seine 1 station Alligator Creek Trawl 4 stations
Rotenone	Late Winter and Early Fall	Baldhead Creek 2 stations Walden Creek 2 stations Mott's Creek Bay 1 station

Table 1.2 Species of fish and shellfish analyzed by program.

Scientific Name	Common Name	L	E	D	M	N	I
		Program					
Clupeidae							
Brevoortia tyrannus	Atlantic menhaden	X	X		X	X	X
Engraulidae							
Anchoa hepsetus	Striped anchovy	]	]				
A. mitchilli	Bay anchovy	]	]		X	X	X
Cyprinodontidae							
Fundulus heteroclitus	Mummichog				X		
F. majalis	Striped killifish				X		
Atherinidae							
Membras martinica	Rough silverside				X		
Menidia beryllina	Inland silverside				X		
M. menidia	Atlantic silverside				X		
Sciaenidae							
Cynoscion nebulosus	Spotted seatrout	]	]		X	X	]
C. regalis	Weakfish	]	]		X	X	]
Leiostomus xanthurus	Spot	X	X	X	X	X	X
Micropogonias undulatus	Atlantic croaker	X	X	X	X	X	X
Mugilidae							
Mugil cephalus	Striped mullet	]	]		X	X	]
M. curema	White mullet	]	]		X	X	]
Gobiidae							
Gobionellus boleosoma	Darter goby	]	]				
G. hastatus	Sharptail goby	]	]				
G. shufeldti	Freshwater goby	]	]				
Gobiosoma bosci	Naked goby	]	]				
G. ginsburgi	Seaboard goby	]	]				
Bothidae							
Paralichthys albigutta	Gulf flounder	]	]				]
P. dentatus	Summer flounder	]	]		X	X	]
P. lethostigma	Southern flounder	]	]		X	X	]
Penaeidae							
Penaeus aztecus	Brown shrimp	X	X		X	X	X
P. duorarum	Pink shrimp	]	]		X	X	X
P. setiferus	White shrimp	]	]		X	X	X
Portunidae							
Callinectes sapidus	Blue crab				]	]	]
C. similus	Blue crab				]	]	]

L = Larval fish D = Discrete depth N = Nekton
E = Entrainment M = High marsh I = Impingement

] = Species grouped for analysis purposes

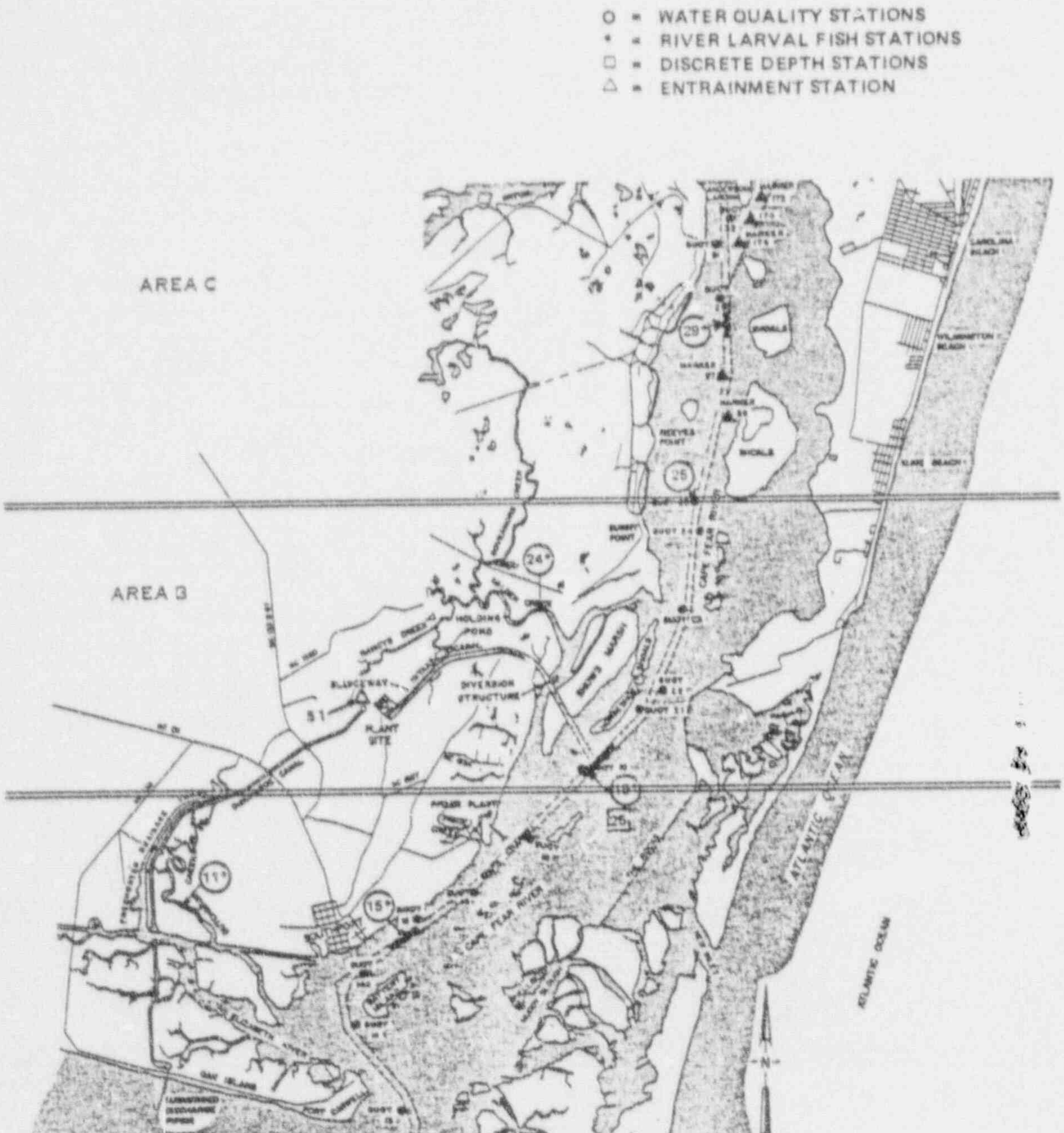


Figure 1.1 Larval/postlarval and water quality sampling locations.

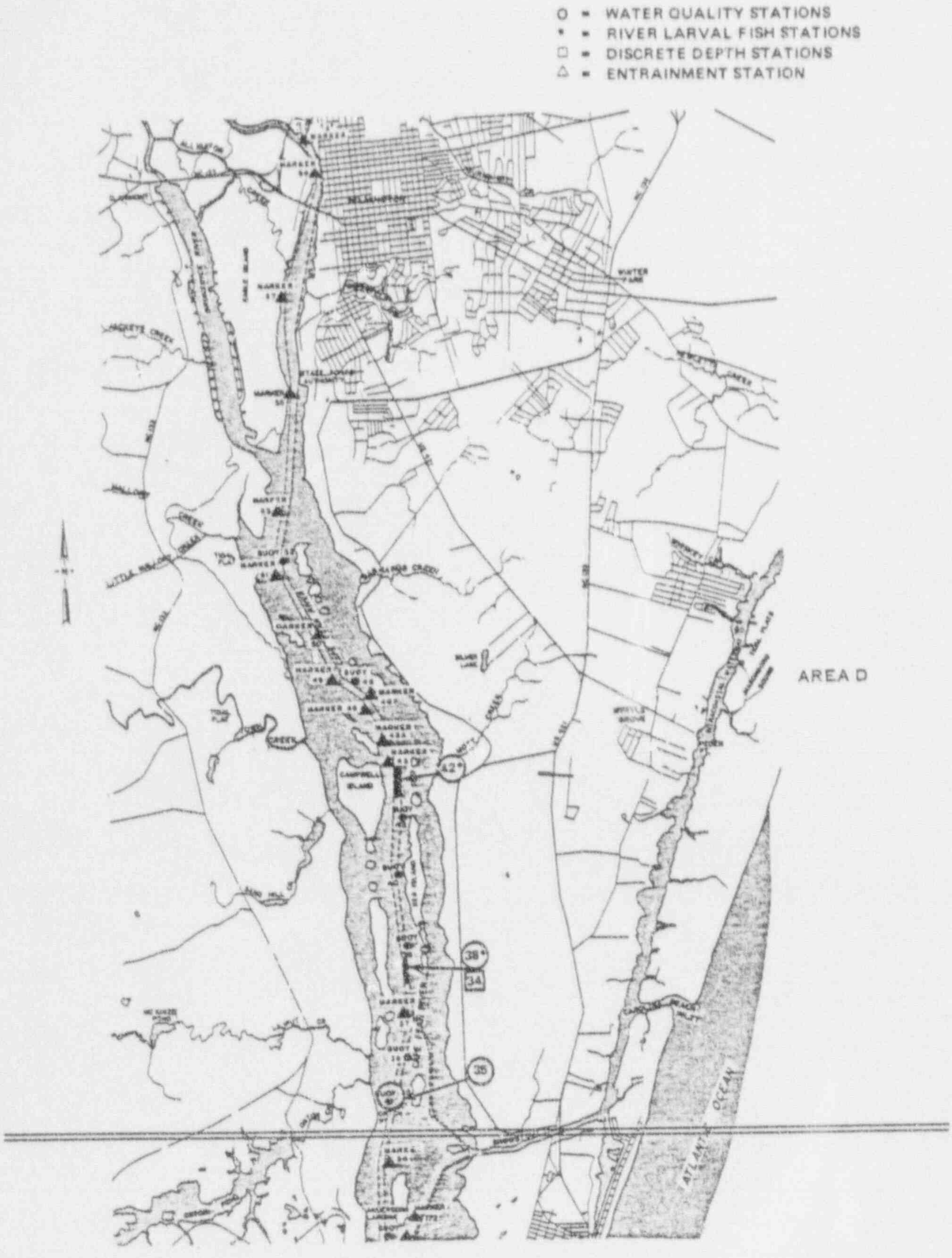


Figure 1.1 (Continued)

Figure 1.2 High marsh sampling areas and nekton sampling locations.

Figure 1.2 (Continued)

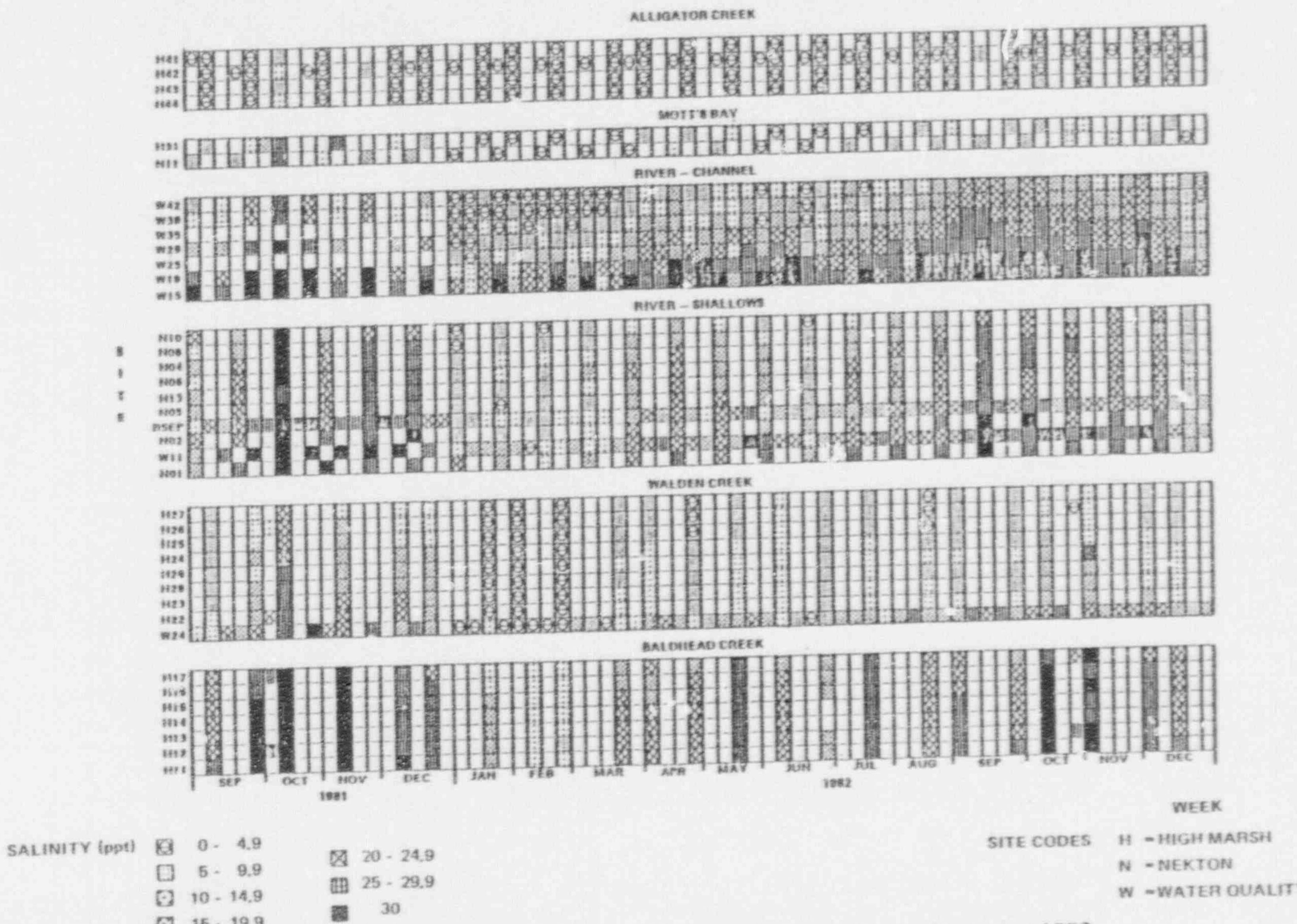


Figure 2.1 Weekly bottom salinity by station, September 1981 to December 1982.

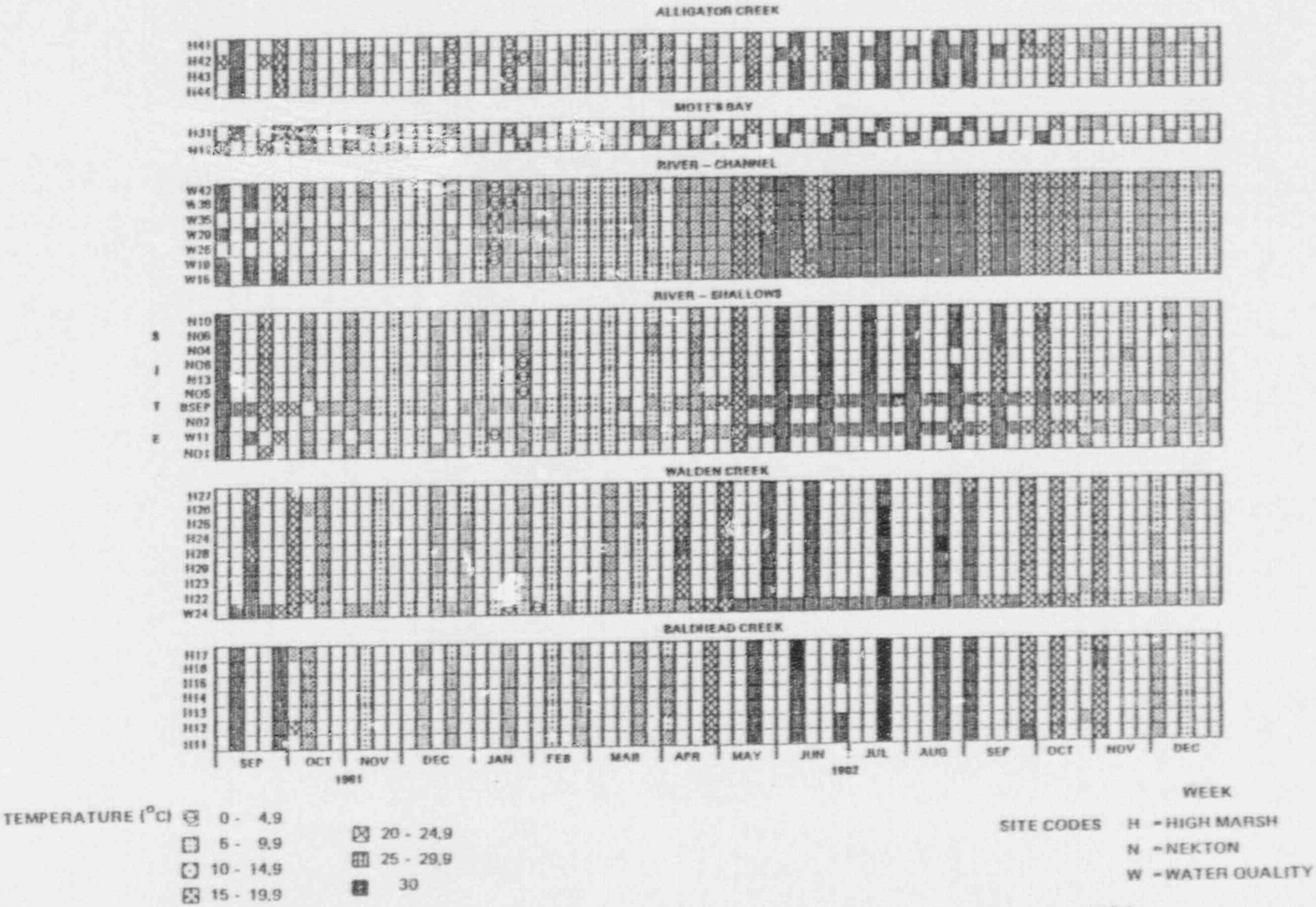


Figure 2.2 Average weekly river water temperature, September 1981 to December 1982.

TABLE 3.1 TRIP NUMBERS, DATE, EFFORTS AND ANALYSIS PERIODS FOR RIVER LARVAL FISH PROJECT, 1982.

TRIP	SAMPLE DATE	EFFORTS	WINTER ANALYSIS YEAR	WINTER ANALYSIS WEEK	SUMMER ANALYSIS YEAR	SUMMER ANALYSIS WEEK
125	17SEP81	28	82	1	81	19
126	01OCT81	28	82	2	81	20
127	15OCT81	28	82	3	81	21
128	29OCT81	28	82	4	81	22
129	11NOV81	[illegible]	82	5	81	23
130	24NOV81	28	82	6	81	24
131	09DEC81	27	82	7	81	25
132	22DEC81	28	82	8	81	26
133	06JAN82	28	82	9	82	1
134	21JAN82	28	82	10	82	2
135	03FEB82	24	82	11	82	3
136	11FEB82	28	82	12	82	4
137	24FEB82	28	82	13	82	5
138	10MAR82	28	82	14	82	6
139	24MAR82	28	82	15	82	7
140	07APR82	28	82	16	82	8
141	22APR82	28	82	17	82	9
142	05MAY82	28	82	18	82	10
143	19MAY82	28	82	19	82	11
144	09JUN82	28	82	21	82	13
145	14JUL82	28	82	23	82	15
146	18AUG82	28	82	25	82	17

TABLE 3.2 TOTAL DENSITY (NUMBER / 1000 CUBIC METERS) AND PERCENT TOTAL OF FISH, PENAEID SHRIMP AND CRABS COLLECTED IN THE CAPE FEAR RIVER, SEPTEMBER 1979 TO AUGUST 1982.

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
ELOPIDAE	TAPPONS	*	*	*	*	*	*
ELOPS SAURUS	LADYFISH	11 [illegible]	0.00	52.18	0.00	16.99	0.00
ELOPS SAURUS(LEPTOCEPHALUS)	LADYFISH(LEPTOCEPHALUS)	14[illegible]	.01	554.88	0.05	490.53	0.04
MEGALOPS ATLANTICUS	TARPON	[illegible]	.00	0.00	0.00	0.00	0.00
MEGALOPS ATLANTICUS(LEPTOCEPHA	TARPON(LEPTOCEPHALUS)	[illegible]	.00	4.23	0.00	10.62	0.00
ANGUILLIDAE	FRESHWATER EELS		*	*	*	*	*
ANGUILLA ROSTRATA	AMERICAN EEL	522.55	0.02	873.93	0.07	441.57	0.04
CONGRIDAE	CONGER EELS	*	*	*	*	*	*
CONGER OCEANICUS	CONGER EEL	0.00	0.00	12.61	0.00	0.00	0.00
OPHICHTHIDAE	SNAKE EELS	0.00	0.00	0.00	0.00	6.00	0.00
MYROPHIS PUNCTATUS	SPECKLED WORM EEL	583.90	0.02	295.60	0.02	116.56	0.01
MYROPHIS PUNCTATUS(LEPTOCEPHAL	SPECKLED WORM EEL(LEPTO.)	2,289.46	0.09	5,395.48	0.46	1,877.83	0.15
OPHICHTHUS GOMESI	SHRIMP EEL	85.27	0.00	20.99	0.00	15.46	0.00
OPHICHTHUS OCELLATUS	PALESPOTTED EEL	0.00	0.00	0.00	0.00	0.00	0.00
CLUPEIDAE	HERRINGS	168.47	0.01	6.53	0.00	81.58	0.01
ALOSA SP.	SHAD UNID.(ALOSA)	5.06	0.00	0.00	0.00	11.01	0.00
ALOSA AESTIVALIS	BLUEBACK HERRING	5.22	0.00	0.00	0.00	0.00	0.00
ALOSA PSEUDOHARENGUS	ALEWIFE	0.00	0.00	0.00	0.00	9.14	0.00
ALOSA SAPIDISSIMA	AMERICAN SHAD	0.00	0.00	0.00	0.00	0.00	0.00
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN	3,307.44	0.13	27,822.82	2.35	6,770.02	0.55
DOROSOMA CEPEDIANUM	GIZZARD SHAD	0.09	0.00	0.00	0.00	5.16	0.00
OPISTHONEMA OGLINUM	ATLANTIC THREAD HERRING	6.42	0.00	0.00	0.00	0.00	0.00
ENGRAULIDAE	ANCHOVIES	*	*	*	*	*	*
ANCHOA SP.	ANCHOVY UNID.(ANCHOA)	804,413.18	32.57	215,790.50	18.24	257,282.86	21.00
ANCHOA HEPSETUS	STRIPED ANCHOVY	25,912.[illegible]	1.05	6,664.90	0.56	18,271.31	1.49
ANCHOA MITCHILLI	BAY ANCHOVY	737,285.[illegible]	29.85	170,964.42	14.45	155,175.34	12.67
SYNODONTIDAE	LIZARDFISHES	*	*	*	*	*	*
SYNODUS FOETENS	INSHORE LIZARDFISH	80.71	0.00	76.83	0.01	54.26	0.00
CYPRINIDAE	CARPS AND MINNOWS	0.00	0.00	0.00	0.00	0.00	0.00
CYPRINUS CARPIO	COMMON CARP	1,014.37	0.04	0.00	0.00	4.68	0.00
NOTEMIGONUS CRYSOLEUCAS	GOLDEN SHINER	0.00	0.00	0.00	0.00	34.58	0.00
APHREDODERIDAE	PIRATE PERCHES	*	*	*	*	*	*
APHREDODERUS SAYANUS	PIRATE PERCH	40.85	0.00	0.00	0.00	0.00	0.00
BATRACHOIDIDAE	TOADFISHES	*	*	*	*	*	*
OPSANUS TAU	OYSTER TOADFISH	26.10	0.00	0.00	0.00	0.00	0.00
GOBIESOCIDAE	CLINGFISHES	*	*	*	*	*	*
GOBIESOX STRUMOSUS	SKILLETFISH	1,722.84	0.07	3,494.55	0.30	825.45	0.07
LOPHIIDAE	GOOSEFISHES	*	*	*	*	*	*
LOPHIUS AMERICANUS	GOOSEFISH	5.41	0.00	0.00	0.00	0.00	0.00
GADIDAE	CODFISHES	0.00	0.00	0.00	0.00	0.00	0.00
UROPHYCIS FLORIDANA	SOUTHERN HAKE	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 3.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
UROPHYCIS REGIA	SPOTTED HAKE	0.00	0.00	4.33	0.00	0.60	0.00
OPHIDIIDAE	CUSK-EELS	17.22	0.00	4.56	0.00	16.38	0.00
OPHIDION WELSHI	CRESTED CUSK-EEL	0.00	0.00	0.00	0.00	6.05	0.00
EXOCOETIDAE	FLYINGFISHES	.	.	.	.	.	.
HEMIRAMPHUS SP.	HALFBEAK UNID.(HEMIRAMPHUS)	0.00	0.00	0.00	0.00	5.59	0.00
HYPORHAMPHUS UNIFASCIATUS	HALFBEAK	83.95	0.00	14.66	0.00	6.16	0.00
BELONIDAE	NEEDLEFISHES	.	.	.	.	.	.
STRONGYLURA MARINA	ATLANTIC NEEDLEFISH	0.00	0.00	4.97	0.00	0.00	0.00
CYPRINODONTIDAE	KILLIFISHES	37.54	0.00	4.74	0.00	0.00	0.00
FUNDULUS SP.	KILLIFISH UNID.(FUNDULUS)	0.00	0.00	0.00	0.00	18.91	0.00
FUNDULUS HETEROCLITUS	MUMMICHOG	21.13	0.00	5.50	0.00	37.00	0.00
ATHERINIDAE	SILVERSIDES	9,819.71	0.37	18,127.30	1.53	9,803.95	0.30
MEMBRAS MARTINICA	ROUGH SILVERSIDE	39.15	0.00	0.00	0.00	6.10	0.00
MENIDIA BERYLLINA	INLAND SILVERSIDE	0.00	0.00	0.00	0.00	0.00	0.00
MENIDIA MENIDIA	ATLANTIC SILVERSIDE	0.00	0.00	0.00	0.00	0.00	0.00
SYNGNATHIDAE	PIPEFISHES	.	.	.	.	.	.
HIPPOCAMPUS ERECTUS	LINED SEAHORSE	0.00	0.00	11.57	0.00	19.68	0.00
SYNGNATHUS SP.	PIPEFISH UNID.(SYNGNATHUS)	27.75	0.00	696.59	0.06	150.03	0.01
SYNGNATHUS FUSCUS	NORTHERN PIPEFISH	272.33	0.01	823.19	0.07	579.67	0.05
SYNGNATHUS LOUISIANAE	CHAIN PIPEFISH	569.78	0.02	651.03	0.06	291.08	0.02
PERCICHTHYIDAE	TEMPERATE BASSES	.	.	.	.	.	.
MORONE SP.	TEMPERATE BASS UNID.(MORONE)	5.17	0.00	4.29	0.00	0.00	0.00
SERRANIDAE	SEA BASSES	0.00	0.00	79.11	0.01	33.03	0.00
CENTROPRISTIS SP.	SEA BASS UNID.(CENTROPRISTIS	0.00	0.00	0.00	0.00	5.73	0.00
EPINEPHELUS SP.	GROUPER UNID.(EPINEPHELUS)	0.00	0.00	0.00	0.00	0.00	0.00
MYCTEROPERCA SP.(LARVAE)	GROUPER LARVAE(MYCTEROPERCA)	0.00	0.00	0.00	0.00	0.00	0.00
CENTRARCHIDAE	SUNFISHES	.	.	.	.	.	.
LEPOMIS SP.	SUNFISH UNID.(LEPOMIS)	0.00	0.00	0.00	0.00	0.00	0.00
LEPOMIS GULOSUS	WARMOUTH	0.00	0.00	0.00	0.00	0.00	0.00
PERCIDAE	PERCHES	15.64	0.00	0.00	0.00	5.70	0.00
ETHEOSTOMA SP.	DARTER UNID.(ETHEOSTOMA)	5.25	0.00	0.00	0.00	0.00	0.00
PERCA FLAVESCENS	YELLOW PERCH	0.00	0.00	0.00	0.00	0.00	0.00
POMATOMIDAE	BLUEFISHES	.	.	.	.	.	.
POMATOMUS SALTATRIX	BLUEFISH	0.00	0.00	0.00	0.00	0.00	0.00
CARANGIDAE	JACKS	298.26	0.01	275.71	0.02	469.34	0.04
CARANX CRYSOS	BLUE RUNNER	0.00	0.00	0.00	0.00	0.00	0.00
CARANX HIPPOS	CREVALLE JACK	0.00	0.00	0.00	0.00	0.00	0.00
CHLOROSCOMBRUS CHRYSURUS	ATLANTIC BUMPER	30.86	0.00	60.92	0.01	0.00	0.00
SELENE VOMER	LOOKDOWN	0.00	0.00	0.00	0.00	0.00	0.00
TRACHINOTUS FALCATUS	PERMIT	6.15	0.00	0.00	0.00	4.27	0.00
LUTJANIDAE	SNAPPERS	0.00	0.00	0.00	0.00	0.00	0.00
LUTJANUS SP.	SNAPPER UNID.(LUTJANUS)	0.00	0.00	0.00	0.00	5.91	0.00

TABLE 3.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	%	SEP 80 - AUG 81 DENSITY	%	SEP81 - AUG 82 DENSITY	%
LUTJANUS GRISEUS	GRAY SNAPPER	25.60	0.00	11.12	0.00	15.39	0.00
GERREIDAE	MOJARRAS	185.75	0.01	155.82	0.01	458.22	0.04
EUCINOSTOMUS SP.	MOJARRA UNID.(EUCINOSTOMUS)	158.88	0.01	0.00	0.00	0.00	0.00
EUCINOSTOMUS ARGENTEUS	SPOTFIN MOJARRA	0.00	0.00	0.00	0.00	0.00	0.00
EUCINOSTOMUS LEFROYI	MOTTLED MOJARRA	0.00	0.00	0.00	0.00	0.00	0.00
HAEMULIDAE	GRUNTS	*	*	*	*	*	*
ORTHOPRISTIS CHRYSOPTERA	PIGFISH	249.75	0.01	4,121.90	0.35	5,858.01	0.48
SPARIDAE	PORGIES	*	*	*	*	*	*
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD	59.33	0.00	73.05	0.01	48.57	0.00
LAGODON RHOMBOIDES	PINFISH	509.04	0.02	4,450.98	0.38	3,052.47	0.25
SCIAENIDAE	DRUMS	48.53	0.00	53.89	0.00	55.75	0.00
BAIRDIELLA CHRYSOURA	SILVER PERCH	4,319.89	0.17	2,417.84	0.20	1,612.60	0.13
CYNOSCION NEBULOSUS	SPOTTED SEATROUT	1,163.97	0.05	219.59	0.02	105.21	0.01
CYNOSCION REGALIS	WEAKFISH	10,584.37	0.43	8,920.39	0.75	9,033.77	0.74
LARIMUS FASCIATUS	BANDED DRUM	0.00	0.00	0.00	0.00	24.13	0.00
LEIOSTOMUS XANTHURUS	SPOT	59,410.90	2.41	55,003.31	4.65	78,185.15	6.38
MENTICIRRHUS SP.	KINGFISH UNID.(MENTICIRRHUS)	966.06	0.04	416.98	0.04	496.31	0.04
MENTICIRRHUS AMERICANUS	SOUTHERN KINGFISH	0.00	0.00	0.00	0.00	16.54	0.00
MENTICIRRHUS SAXATILIS	NORTHERN KINGFISH	0.00	0.00	0.00	0.00	0.00	0.00
MICROPOGONIAS UNDULATUS	ATLANTIC CROAKER	177,226.46	7.18	141,010.93	11.92	303,206.32	24.75
POGONIAS CROMIS	BLACK DRUM	3,842.16	0.16	1,609.46	0.14	16,457.16	1.34
SCIAENOPS OCELLATUS	RED DRUM	157.39	0.01	316.95	0.03	90.75	0.01
STELLIFER LANCEOLATUS	STAR DRUM	1,001.76	0.04	218.84	0.02	16.74	0.00
EPHIPPIDAE	SPADEFISHES	*	*	*	*	*	*
CHAETODIPTERUS FABER	ATLANTIC SPADEFISH	31.48	0.00	30.74	0.00	0.00	0.00
LABRIDAE	WRASSES	*	*	*	*	*	*
TAUTOGA ONITIS	TAUTOG	0.00	0.00	0.00	0.00	23.57	0.00
MUGILIDAE	MULLETS	*	*	*	*	*	*
MUGIL CEPHALUS	STRIPED MULLET	805.17	0.03	3,133.95	0.26	1,004.63	0.08
MUGIL CUREMA	WHITE MULLET	133.42	0.01	149.17	0.01	168.52	0.01
SPHYRAENIDAE	BARRACUDAS	*	*	*	*	*	*
SPHYRAENA BOREALIS	NORTHERN SENNET	0.00	0.00	0.00	0.00	5.68	0.00
URANOSCOPIDAE	STARGAZERS	0.00	0.00	5.54	0.00	0.00	0.00
ASTROSCOPUS SP.	STARGAZER UNID.(ASTROSCOPUS)	16.05	0.00	0.00	0.00	0.00	0.00
ASTROSCOPUS GUTTATUS	NORTHERN STARGAZER	4.53	0.00	0.00	0.00	0.00	0.00
ASTROSCOPUS Y-GRAECUM	SOUTHERN STARGAZER	0.00	0.00	0.00	0.00	0.00	0.00
BLENNIIDAE	COMBTOOTH BLENNIES	7,779.88	0.31	11,516.53	0.97	4,782.86	0.39
CHASMODES BOSQUIANUS	STRIPED BLENNY	0.00	0.00	0.00	0.00	0.00	0.00
HYPSOBLENNIUS HENTZI	FEATHER BLENNY	0.00	0.00	0.00	0.00	0.00	0.00
ELEOTRIDAE	SLEEPERS	*	*	*	*	*	*
DORMITATOR MACULATUS	FAT SLEEPER	499.48	0.02	192.71	0.02	594.11	0.05
ELEOTRIS PISONIS	SPINYCHEEK SLEEPER	12.11	0.00	9.59	0.00	17.15	0.00

TABLE 3.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
GOBIIDAE	GOBIES	0.00	0.00	0.00	0.00	3.87	0.00
GOBIONELLUS SP.	GOBY UNID.(GOBIONELLUS)	6,354.51	0.26	4,308.33	0.36	4,098.89	0.33
GOBIONELLUS BOLEOSOMA	DARTER GOBY	5.99	0.00	0.00	0.00	5,892.46	0.48
GOBIONELLUS HASTATUS	SHARPTAIL GOBY	11.43	0.00	0.00	0.00	1,009.79	0.08
GOBIONELLUS SHUFELDTI	FRESHWATER GOBY	0.00	0.00	0.00	0.00	1,897.33	0.15
GOBIOSOMA SP.	GOBY UNID.(GOBIOSOMA)	307,617.55	12.46	296,784.79	25.08	120,611.56	9.85
GOBIOSOMA BOSCI	NAKED GOBY	7.51	0.00	0.00	0.00	2,124.07	0.17
GOBIOSOMA GINSBURGI	SEABOARD GOBY	9.37	0.00	0.00	0.00	238.88	0.02
MICROGOBIUS SP.	GOBY UNID.(MICROGOBIUS)	10,496.06	0.42	3,608.14	0.30	2,986.78	0.24
SCOMBRIDAE	MACKERELS	*	*	*	*	*	*
SCOMBEROMORUS MACULATUS	SPANISH MACKEREL	5.25	0.00	0.00	0.00	11.63	0.00
STROMATEIDAE	BUTTERFISHES	*	*	*	*	*	*
PEPRILUS ALEPIDOTUS	HARVESTFISH	105.19	0.00	37.44	0.00	29.96	0.00
PEPRILUS TRIACANTHUS	BUTTERFISH	11.72	0.00	9.25	0.00	23.09	0.00
TRIGLIDAE	SEAROBINS	*	*	*	*	*	*
PRIONOTUS SP.	SEAROBIN UNID.(PRIONOTUS)	405.06	0.02	649.30	0.05	1,481.46	0.12
PRIONOTUS CAROLINUS	NORTHERN SEAROBIN	0.00	0.00	0.00	0.00	0.00	0.00
PRIONOTUS SCITULUS	LEOPARD SEAROBIN	0.00	0.00	0.00	0.00	0.00	0.00
PRIONOTUS TRIBULUS	BIGHEAD SEAROBIN	46.57	0.00	0.00	0.00	11.90	0.00
BOTHIDAE	LEFTEYE FLOUNDERS	15.10	0.00	15.31	0.00	89.25	0.01
ANCYLOPSETTA QUADROCELLATA	OCELLATED FLOUNDER	0.00	0.00	0.00	0.00	0.00	0.00
CITHARICHTHYS SP.	WHIFF UNID.(CITHARICHTHYS)	531.18	0.02	442.95	0.04	814.50	0.07
CITHARICHTHYS SPILOPTERUS	BAY WHIFF	27.67	0.00	6.62	0.00	6.02	0.00
ETROPUS CROSSOTUS	FRINGED FLOUNDER	81.62	0.00	0.00	0.00	14.71	0.00
PARALICHTHYS SP.	FLOUNDER UNID.(PARALICHTHYS)	1,335.34	0.05	3,378.72	0.29	249.73	0.02
PARALICHTHYS ALBIGUTTA	GULF FLOUNDER	0.00	0.00	0.00	0.00	388.80	0.03
PARALICHTHYS DENTATUS	SUMMER FLOUNDER	7.80	0.00	0.00	0.00	1,210.51	0.10
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER	5.21	0.00	0.00	0.00	3,506.19	0.29
SCOPHTHALMUS AQUOSUS	WINDOWPANE	25.69	0.00	67.83	0.01	15.10	0.00
SOLEIDAE	SOLES	*	*	*	*	*	*
TRINECTES MACULATUS	HOGCHOKER	5,465.25	0.22	1,552.39	0.13	803.77	0.07
CYNOGLOSSIDAE	TONGUEFISHES	*	*	*	*	*	*
SYMPHURUS SP.	TONGUEFISH UNID.(SYMPHURUS)	12.70	0.00	11.00	0.00	182.83	0.01
SYMPHURUS CIVITATUS	OFFSHORE TONGUEFISH	369.52	0.01	35.15	0.00	103.17	0.01
SYMPHURUS PLAGIUSA	BLACKCHEEK TONGUEFISH	5,472.83	0.22	1,378.42	0.12	2,347.94	0.19
BALISTIDAE	LEATHERJACKETS	*	*	*	*	*	*
MONACANTHUS HISPIDUS	PLANEHEAD FILEFISH	41.80	0.00	16.38	0.00	44.08	0.00
OSTRACIIDAE	BOXFISHES	0.00	0.00	13.76	0.00	0.00	0.00
TETRAODONTIDAE	PUFFERS	0.00	0.00	5.09	0.00	0.00	0.00
SPHOEROIDES MACULATUS	NORTHERN PUFFER	27.73	0.00	20.42	0.00	36.44	0.00
DIODONTIDAE	PORCUPINEFISHES	*	*	*	*	*	*
CHILOMYCTERUS SCHOEPFI	STRIPED BURRFISH	21.84	0.00	0.00	0.00	0.00	0.00

TABLE 3.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	%	SEP 80 - AUG 81 DENSITY	%	SEP81 - AUG 82 DENSITY	%
FISH EGG UNID.	FISH EGG UNID.	0.00	0.00	0.00	0.00	6.03	0.00
FISH UNID.	FISH UNID.	5.80	0.00	18.20	0.00	69.13	0.01
PENAEIDAE	PENAEID SHRIMP	40.16	0.00	0.00	0.00	6.74	0.00
PENAEUS SP.(ADULT)	PENAEUS (ADULT)	469.23	0.02	0.00	0.00	0.00	0.00
PENAEUS SP.(POSTLARVAE)	PENAEUS (POSTLARVAE)	101,774.32	4.12	41,257.25	3.49	31,630.44	2.58
PENAEUS AZTECUS	BROWN SHRIMP	7.31	0.00	0.00	0.00	12.47	0.00
PENAEUS DUORARUM	PINK SHRIMP	12.11	0.00	0.00	0.00	0.00	0.00
PENAEUS SETIFERUS	WHITE SHRIMP	0.00	0.00	6.53	0.00	0.00	0.00
TRACHYPENEUS SP.(POSTLARVAE)	TRACHYPENEUS (POSTLARVAE)	52.79	0.00	0.00	0.00	0.00	0.00
TRACHYPENEUS CONSTRICTUS	T-CON OR HARDBACK SHRIMP	8,542.79	0.35	6,060.61	0.51	2,705.52	0.22
PORTUNIDAE	SWIMMING CRABS	9,326.91	0.38	7,493.82	0.63	6,650.62	0.54
PORTUNIDAE(MEGALOPS)	SWIMMING CRABS (MEGALOPS)	152,016.80	6.15	128,847.64	10.89	154,511.62	12.61
PORTUNUS SP.	SWIMMING CRABS	0.00	0.00	14.03	0.00	22.90	0.06
CALLINECTES SP.	BLUE CRABS	1,634.63	0.07	457.37	0.04	773.94	0.06
CALLINECTES SAPIDUS	BLUE CRAB	0.00	0.00	0.00	0.00	15.40	0.00
	TOTAL	2,469,821.41	99.9	1,183,336.92	100.0	1,224,934.84	99.9
	EFFORTS	807		764		611	

Table 3.3 Results of ANOVA for summer larval fish, September 1976 - August 1982

Source	Anchovies	Seatrout	*Gobionellus* spp.
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Station	***	***	***
Surface/Bottom	**	***	***
Station * Depth	***	NS	***
Time * Station	***	***	***
Year * Station	***	***	***
Week * Depth	***	***	**
Year * Depth	***	NS	NS
$\overline{\text{Log}}$	2.508	0.84	0.484
S^2	0.517	0.537	0.456
Analysis Week	9-22	10-21	6-25

NS $p > 0.05$

* $0.01 < p \leq 0.05$

** $0.001 < p \leq 0.01$

*** $p \leq 0.001$

Table 3.3 (continued)

Source	*Gobiosoma* spp.	Pink & White Shrimp	Total Fish
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Station	***	***	***
Surface/Bottom	**	***	***
Station * Depth	***	***	***
Week * Station	***	***	***
Year * Station	***	***	***
Week * Depth	NS	NS	***
Year * Depth	NS	NS	**
$\overline{\text{Log}}$	1.692	1.468	2.630
S^2	0.558	0.533	0.439
Analysis Week	10-22	12-20	1-26

NS $p > 0.05$

* $0.01 < p \leq 0.05$

** $0.001 < p \leq 0.01$

*** $p \leq 0.001$

Table 3.4 Results of ANOVA for winter larval fish (September 1976 - August 1982).

Source	Spot	Croaker	Flounder
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Station	***	***	***
Surface/Bottom	NS	***	NS
Station * Depth	***	***	***
Week * Station	***	***	***
Year * Station	***	***	***
Week * Depth	NS	***	NS
Year * Depth	***	NS	*
$\overline{\text{Log}}$	1.551	1.676	0.857
s^2	0.557	0.630	0.504
Analysis Week	8-18	2-17	8-15

NS $p > 0.05$

* $0.01 < p \leq 0.05$

** $0.001 < p \leq 0.01$

*** $p \leq 0.001$

Table 3.4 (continued)

Source	Menhaden	Mullet	Brown Shrimp
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Station	***	***	***
Surface/Bottom	*	***	***
Station * Depth	*	***	NS
Week * Station	***	***	***
Year * Station	***	**	***
Week * Depth	*	***	***
Year * Depth	*	**	NS
$\overline{\text{Log}}$	1.013	0.332	0.724
S^2	0.568	0.404	0.47
Analysis Week	13-18	8-15	12-19

NS $p > 0.05$

* $0.01 < p \leq 0.05$

** $0.001 < p \leq 0.01$

*** $p \leq 0.001$

Table 3.5 River larval fish trend analysis, September 1976 to August 1982

Species	Linear Trend	Deviation from Linear Trend	Error	% Change Per Year
Croaker	0.394^{**}	0.257^{NS}	0.015	+18.85
Gobionellus spp.	0.292^{**}	0.030^{**}	0.006	+17.56
Brown Shrimp	0.309^{**}	0.033^{NS}	0.0198	+16.50
Total Fish	0.045^{**}	0.021^{**}	0.041	+6.01
Mullet	0.024^{**}	0.015^{**}	0.001	+4.39
Seatrout	0.019^{NS}	0.02^{NS}	0.015	+4.21
Spot	0.217^{NS}	0.013^{NS}	0.076	+4.13
Anchovies	0.005^{NS}	0.324^{NS}	0.459	+2.05
Pink & White Shrimp	0.004^{NS}	0.052^{NS}	0.021	-1.998
Gobiosoma spp.	0.0001^{NS}	0.051^{*}	0.014	-0.32
Flounder	0.008^{NS}	0.071^{NS}	0.065	-2.45
Menhaden	0.0098^{NS}	0.052^{**}	0.003	-2.69

* Significance Level = 0.05
** Significance Level = 0.01
NS Not Significant

TABLE 3.6 MEAN DENSITY FROM 1979, 1981 AND 1982 DISCRETE DEPTH SAMPLING PROGRAMS.

	1979	1981		1982	
SPECIES	STA 34	STA 25	STA 34	STA 25	STA 34
BAY ANCHOVY	70.90	29.22	29.08	36.98	12.36
CROAKER	656.00	258.84	432.68	1131.69	2350.66
FLOUNDER	182.04	14.53	41.72	39.03	78.86
MENHADEN	35.14	35.28	8.03	25.75	18.31
MULLET	22.50	0.47	0.46	2.05	1.14
PINFISH	89.74	30.93	5.92	9.84	12.10
SPOT	396.63	102.35	61.88	344.32	464.48
TOTAL	1474.79	501.48	590.83	1664.61	2955.46
# EFFORTS	478	239	240	240	235

Table 3.7 ANOVA (split-plot model) for 1982 discrete depth sampling by species

SPECIES = CROAKER

Source	Station 25		Station 34
Main plot:			
Round	*		NS
Duncan's MR	Log	Round	
	2.68	1	
	2.42	2	
Period	***		NS
Duncan's MR	Log	Period	
	2.85	Night	
	2.26	Day	
Tidal	**		NS
Duncan's MR	Log	Tide	
	2.95	High Slack	
	2.82	High Out	
	2.73	High In	
	2.60	Mean Out	
	2.55	Mean In	
	2.43	Low Out	
	2.32	Low Slack	
	2.01	Low In	
Period*Tidal	NS		NS

NS Not significant - $p > .05$

* $.01 < p \leq .05$

** $.001 < p \leq .01$

*** $p \leq .001$

Table 3.7 (continued)

SPECIES = CROAKER

Source	Station 25	Station 34
Sub-plot:		
Depth	***	***
Period*Depth	***	***

Station 25 Day Log	Station 25 Day Depth	Station 25 Night Log	Station 25 Night Depth	Station 34 Day Log	Station 34 Day Depth	Station 34 Night Log	Station 34 Night Depth
3.13	9	3.13	11	3.62	11	3.40	11
3.02	11	3.01	3	3.32	9	2.90	9
2.95	7	2.99	9	2 92	7	2.72	7
2.48	5	2.89	5	2.09	5	2.60	5
1.39	3	2.88	7	0.78	3	2.17	1
0.59	1	2.18	1	0.47	1	2.14	3

Source	Station 25	Station 34
Tidal*Depth	NS	**
Period*Tidal*Depth	NS	NS

NS Not significant - $p > .05$

* $.01 < p \leq .05$

** $.001 < p \leq .01$

*** $p \leq .001$

Table 3.7 (continued)

SPECIES = SPOT

Source	Station 25	Station 34
Main plot:		
Round	NS	NS
Period	NS	NS
Tidal	**	NS

Duncan's MR

Log	Tide
2.48	High In
2.46	High Slack
2.26	High Out
2.22	Mean In
2.09	Mean Out
1.84	Low Out
1.74	Low Slack
1.46	Low In

Source	Station 25	Station 34
Period*Tidal	NS	NS

NS Not significant - $p > .05$

* $.01 < p \leq .05$

** $.001 < p \leq .01$

*** $p \leq .001$

Table 3.7 (continued)

SPECIES = SPOT

Source	Station 25				Station 34			
Sub-plot:								
Depth	***				***			
Period*Depth	***				***			
	Day		Night		Day		Night	
	$\overline{Log}$	Depth	$\overline{Log}$	Depth	$\overline{Log}$	Depth	$\overline{Log}$	Depth
	2.46	5	2.61	3	2.92	11	2.19	11
	2.38	9	2.27	5	2.35	9	2.10	1
	2.32	7	2.15	1	2.16	7	2.01	5
	2.31	11	2.06	7	1.81	5	2.01	7
	1.73	3	1.91	9	0.52	3	2.01	3
	0.77	1	1.84	11	0.17	1	1.76	9
Tidal*Depth	NS				NS			
Period*Tidal*Depth	NS				NS			

NS Not significant - $p > .05$

* $.01 < p \leq .05$

** $.001 < p \leq .01$

*** $p \leq .001$

TABLE 3.8 TRIP NUMBER, DATE, EFFORTS AND ANALYSIS PERIODS FOR ENTRAINMENT PROJECT, 1982.

TRIP	SAMPLE DATE	EFFORTS	WINTER ANALYSIS YEAR	WINTER ANALYSIS WEEK	SUMMER ANALYSIS YEAR	SUMMER ANALYSIS WEEK
157	01SEP81	8	82	1	81	36
158	08SEP81	8	82	2	81	37
159	15SEP81	8	82	3	81	38
160	22SEP81	8	82	4	81	39
161	29SEP81	8	82	5	81	40
162	06OCT81	8	82	6	81	41
163	13OCT81	8	82	7	81	42
164	20OCT81	6	82	8	81	43
165	27OCT81	8	82	9	81	44
166	03NOV81	8	82	10	81	45
167	10NOV81	8	82	11	81	46
168	17NOV81	8	82	12	81	47
169	24NOV81	8	82	13	81	48
170	01DEC81	8	82	14	81	49
171	08DEC81	8	82	15	81	50
172	15DEC81	8	82	16	81	51
173	22DEC81	8	82	17	81	52
174	29DEC81	8	82	18	82	1
175	06JAN82	8	82	19	82	2
176	13JAN82	8	82	20	82	3
177	20JAN82	8	82	21	82	4
178	27JAN82	8	82	22	82	5
179	03FEB82	8	82	23	82	6
180	10FEB82	8	82	24	82	7
181	17FEB82	8	82	25	82	8
182	24FEB82	8	82	26	82	9
183	03MAR82	8	82	27	82	10
184	10MAR82	8	82	28	82	11
185	17MAR82	8	82	29	82	12
186	24MAR82	8	82	30	82	13
187	31MAR82	8	82	31	82	14
188	07APR82	8	82	32	82	15
189	14APR82	8	82	33	82	16
190	21APR82	12	82	34	82	17
191	28APR82	12	82	35	82	18
192	05MAY82	12	82	36	82	19
193	12MAY82	12	82	37	82	20
194	19MAY82	12	82	38	82	21
195	26MAY82	12	82	39	82	22
196	02JUN82	12	82	40	82	23
197	09JUN82	12	82	41	82	24
198	16JUN82	12	82	42	82	25
199	23JUN82	12	82	43	82	26
200	30JUN82	12	82	44	82	27
201	07JUL82	12	82	45	82	28
202	14JUL82	12	82	46	82	29
203	21JUL82	12	82	47	82	30
204	28JUL82	12	82	48	82	31
205	04AUG82	12	82	49	82	32
206	11AUG82	12	82	50	82	33
207	18AUG82	12	82	51	82	34
208	25AUG82	12	82	52	82	35

TABLE 3.5 TOTAL DENSITY (NUMBER / 1000 CUBIC METERS) AND PERCENT TOTAL OF FISH, PENAEID SHRIMP AND CRABS ENTRAINED, SEPTEMBER 1979 TO AUGUST 1982.

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
ELOPIDAE	TARPONS	51.36	0.00	0.00	0.00	18.21	0.00
ELOPS SAURUS(LEPTOCEPHALUS)	LADYFISH(LEPTOCEPHALUS)	163.51	0.01	721.02	0.06	572.16	0.07
MEGALOPS ATLANTICUS(LEPTOCEPHA	TARPON(LEPTOCEPHALUS)	492.74	0.03	66.00	0.01	162.44	0.02
ANGUILLIDAE	FRESHWATER EELS	-	-	-	-	-	-
ANGUILLA ROSTRATA	AMERICAN EEL	922.78	[illegible]	1,155.96	0.09	529.80	0.06
OPHICHTHIDAE	SNAKE EELS	-	-	-	-	-	-
MYROPHIS PUNCTATUS	SPECKLED WORM EEL	1,329.64	0.09	771.23	0.06	142.66	0.02
MYROPHIS PUNCTATUS(LEPTOCEPHAL	SPECKLED WORM EEL(LEPTO.)	1,558.72	0.11	4,773.85	0.37	538.91	0.06
OPHICHTHUS GOMESI	SHRIMP EEL	167.94	0.01	60.10	0.00	80.37	0.01
CLUPEIDAE	HERRINGS	-	-	-	-	-	-
ALOSA AESTIVALIS	BLUEBACK HERRING	10.29	0.00	0.00	0.00	0.00	0.00
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN	2,916.41	0.20	9,882.48	0.77	10,138.67	1.22
DOROSOMA CEPEDIANUM	GIZZARD SHAD	0.00	0.00	0.00	0.00	7,282.94	0.88
ENGRAULIDAE	ANCHOVIES	-	-	-	-	-	-
ANCHOA SP.	ANCHOVY UNID.(ANCHOA)	193,839.30	13.46	129,827.48	10.14	45,636.36	5.51
ANCHOA HEPSETUS	STRIPED ANCHOVY	16,327.93	1.13	4,646.10	0.36	24,360.05	2.94
ANCHOA MITCHILLI	BAY ANCHOVY	83,684.07	5.81	147,527.75	11.52	150,982.65	18.24
SYNODONTIDAE	LIZARDFISHES	-	-	-	-	-	-
SYNODUS FOETENS	INSHORE LIZARDFISH	30.44	0.00	21.23	0.00	16.75	0.00
CYPRINIDAE	CARPS AND MINNOWS	-	-	-	-	-	-
CYPRINUS CARPIO	COMMON CARP	16.10	0.00	0.00	0.00	0.00	0.00
BATRACHOIDIDAE	TOADFISHES	-	-	-	-	-	-
OPSANUS TAU	OYSTER TOADFISH	0.00	0.00	21.23	0.00	34.19	0.00
GOBIESOCIDAE	CLINGFISHES	-	-	-	-	-	-
GOBIESOX STRUMOSUS	SKILLETFISH	1,679.18	0.11	3,768.09	0.29	407.52	0.05
GADIDAE	CODFISHES	-	-	-	-	-	-
UROPHYCIS SP.	HAKE UNID.(UROPHYCIS)	14.81	0.00	22.68	0.00	17.73	0.00
UROPHYCIS FLORIDANA	SOUTHERN HAKE	0.00	0.00	0.00	0.00	0.00	0.00
UROPHYCIS REGIA	SPOTTED HAKE	0.00	0.00	0.00	0.00	0.00	0.00
OPHIDIIDAE	CUSK-EELS	20.70	0.00	0.00	0.00	0.00	0.00
OPHIDION WELSHI	CRESTED CUSK-EEL	0.00	0.00	0.00	0.00	0.00	0.00
EXOCOETIDAE	FLYINGFISHES	-	-	-	-	-	-
HEMIRAMPHUS BRASILIENSIS	BALLYHOO	0.00	0.00	16.18	0.00	0.00	0.00
HYPORHAMPHUS UNIFASCIATUS	HALFBEAK	10.48	0.00	50.78	0.00	182.09	0.02
BELONIDAE	NEEDLEFISHES	-	-	-	-	-	-
STRONGYLURA MARINA	ATLANTIC NEEDLEFISH	0.00	0.00	0.00	0.00	53.46	0.01
CYPRINODONTIDAE	KILLIFISHES	31.77	0.00	0.65	0.00	0.00	0.00
FUNDULUS HETEROCLITUS	MUMMICHOG	0.00	0.00	14.64	0.00	40.58	0.00
FUNDULUS MAJALIS	STRIPED KILLIFISH	0.00	0.00	0.00	0.00	0.00	0.00
ATHERINIDAE	SILVERSIDES	34,354.14	2.39	67,586.38	5.28	36,604.38	4.42
MEMBRAS MARTINICA	ROUGH SILVERSIDE	78.10	0.01	0.00	0.00	0.00	0.00

TABLE 3.9 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
MENIDIA MENIDIA	ATLANTIC SILVERSIDE	18.73	0.00	0.00	0.00	0.00	0.00
SYNGNATHIDAE	PIPEFISHES	-	-	-	-	-	-
HIPPOCAMPUS ERECTUS	LINED SEAHORSE	0.00	0.00	17.76	0.00	15.50	0.00
SYNGNATHUS SP.	PIPEFISH UNID. (SYNGNATHUS)	33.43	0.00	0.00	0.00	15.83	0.00
SYNGNATHUS FUSCUS	NORTHERN PIPEFISH	118.41	0.01	222.45	0.02	313.91	0.04
SYNGNATHUS LOUISIANAE	CHAIN PIPEFISH	336.86	0.02	147.47	0.01	108.93	0.01
SERRANIDAE	SEA BASSES	0.00	0.00	21.28	0.00	3[illegible].89	0.00
CENTRARCHIDAE	SUNFISHES	-	-	-	-	-	-
MICROPTERUS SALMOIDES	LARGEMOUTH BASS	0.00	0.00	0.00	0.00	0.00	0.00
PERCIDAE	PERCHES	0.00	0.00	0.00	0.00	17.36	0.00
CARANGIDAE	JACKS	214.05	0.01	115.70	0.01	16.41	0.00
CARANX HIPPOS	CREVALLE JACK	0.00	0.00	0.00	0.00	0.00	0.00
CHLOROSCOMBRUS CHRYSURUS	ATLANTIC BUMPER	14.77	0.00	33.13	0.00	0.00	0.00
OLIGOPLITES SAURUS	LEATHERJACKET	0.00	0.00	[illegible].00	0.00	0.00	0.00
SELENE VOMER	LOOKDOWN	0.00	0.00	0.00	0.00	0.00	0.00
TRACHINOTUS FALCATUS	PERMIT	0.00	0.00	17.29	0.00	0.00	0.00
LUTJANIDAE	SNAPPERS	0.00	0.00	0.00	0.00	0.00	0.00
LUTJANUS GRISEUS	GRAY SNAPPER	80.43	0.01	102.14	0.01	97.28	0.01
GERREIDAE	MOJARRAS	1,223.73	0.08	524.61	0.04	1,261.25	0.15
HAEMULIDAE	GRUNTS	-	-	-	-	-	-
ORTHOPRISTIS CHRYSOPTERA	PIGFISH	247.94	0.02	4,721.63	0.37	3,635.96	0.44
SPARIDAE	PORGIES	-	-	-	-	-	-
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD	203.45	0.01	108.55	0.01	153.62	0.02
LAGODON RHOMBOIDES	PINFISH	456.37	0.03	2,697.69	0.21	3,369.18	0.41
SCIAENIDAE	DRUMS	118.88	0.01	110.28	0.01	87.17	0.01
BAIRDIELLA CHRYSOURA	SILVER PERCH	8,066.64	0.56	4,8[illegible]4.53	0.38	3,963.37	0.48
CYNOSCION NEBULOSUS	SPOTTED SEATROUT	1,411.47	0.10	667.47	0.05	272.76	0.03
CYNOSCION REGALIS	WEAKFISH	3,886.29	0.27	2,327.58	0.18	5,248.39	0.63
LEIOSTOMUS XANTHURUS	SPOT	138,682.91	9.62	62,089.96	[illegible].85	107,069.50	12.94
MENTICIRRHUS SP.	KINGFISH UNID. (MENTICIRRHUS)	512.43	0.04	629.21	0.05	466.86	0.06
MICROPOGONIAS UNDULATUS	ATLANTIC CROAKER	128,529.65	8.92	41,371.85	3.23	109,751.39	13.26
POGONIAS CROMIS	BLACK DRUM	2,558.67	0.18	785.08	0.06	4,310.12	0.52
SCIAENOPS OCELLATUS	RED DRUM	334.61	0.02	673.41	0.05	593.77	0.07
STELLIFER LANCEOLATUS	STAR DRUM	289.71	0.02	47.14	0.00	130.26	0.02
EPHIPPIDAE	SPADEFISHES	-	-	-	-	-	-
CHAETODIPTERUS FABER	ATLANTIC SPADEFISH	17.92	0.00	15.02	0.00	0.00	0.00
LABRIDAE	WRASSES	-	-	-	-	-	-
TAUTOGA ONITIS	TAUTOG	0.00	0.00	0.00	0.00	0.00	0.00
MUGILIDAE	MULLETS	-	-	-	-	-	-
MUGIL SP.	MULLET UNID. (MUGIL)	61.54	0.00	0.00	0.00	0.00	0.00
MUGIL CEPHALUS	STRIPED MULLET	6,364.55	0.44	5,125.30	0.41	5,460.45	0.66
MUGIL CUREMA	WHITE MULLET	173.74	0.01	74.17	0.01	117.42	0.01

TABLE 3.9 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	%	SEP 80 - AUG 81 DENSITY	%	SEP 81 - AUG 82 DENSITY	%
URANOSCOPIDAE	STARGAZERS	-	-	-	-	-	-
ASTROSCOPUS SP.	STARGAZER UNID. (ASTROSCOPUS)	23.87	0.00	0.00	0.00	0.00	0.00
ASTROSCOPUS GUTTATUS	NORTHERN STARGAZER	16.62	0.00	0.00	0.00	0.00	0.00
BLENNIIDAE	COMBTOOTH BLENNIES	9,198.52	0.64	9,782.48	0.76	2,962.43	0.35
ELEOTRIDAE	SLEEPERS	-	-	-	-	-	-
DORMITATOR MACULATUS	FAT SLEEPER	415.04	0.03	200.56	0.02	201.92	0.02
GOBIIDAE	GOBIES	-	-	-	-	-	-
BATHYGOBIUS SOPORATOR	FRILLFIN GOBY	0.00	0.00	0.00	0.00	5.00	0.00
GOBIONELLUS SP.	GOBY UNID. (GOBIONELLUS)	7,691.60	0.53	6,572.19	0.51	4,729.14	0.57
GOBIONELLUS BOLEOSOMA	DARTER GOBY	0.00	0.00	0.00	0.00	5,507.81	0.67
GOBIONELLUS HASTATUS	SHARPTAIL GOBY	0.00	0.00	0.00	0.00	1,089.29	0.13
GOBIONELLUS SHUFELDTI	FRESHWATER GOBY	0.00	0.00	0.00	0.00	2,768.93	0.33
GOBIOSOMA SP.	GOBY UNID. (GOBIOSOMA)	304,619.26	21.15	455,223.34	35.54	84,849.36	10.23
GOBIOSOMA BOSCI	NAKED GOBY	0.00	0.00	0.00	0.00	8,828.16	1.07
GOBIOSOMA GINSBURGI	SEABOARD GOBY	0.00	0.00	0.00	0.00	49.37	0.01
MICROGOBIUS SP.	GOBY UNID. (MICROGOBIUS)	12,956.82	0.90	14,685.87	1.15	3,759.19	0.45
MICRODESMIDAE	WORMFISHES	-	-	-	-	-	-
MICRODESMUS LONGIPINNIS	PINK WORMFISH	0.00	0.00	0.00	0.00	14.08	0.00
STROMATEIDAE	BUTTERFISHES	-	-	-	-	-	-
PEPRILUS ALEPIDOTUS	HARVESTFISH	19.34	0.00	19.18	0.00	0.30	0.00
TRIGLIDAE	SEAROBINS	-	-	-	-	-	-
PRIONOTUS SP.	SEAROBIN UNID. (PRIONOTUS)	586.17	0.04	433.34	0.03	450.60	0.05
PRIONOTUS TRIBULUS	BIGHEAD SEAROBIN	0.00	0.00	0.00	0.00	0.90	0.00
BOTHIDAE	LEFTEYE FLOUNDERS	-	-	-	-	-	-
CITHARICHTHYS SP.	WHIFF UNID. (CITHARICHTHYS)	511.57	0.04	280.11	0.02	1,771.91	0.21
ETROPUS CROSSOTUS	FRINGED FLOUNDER	34.59	0.00	49.51	0.00	0.00	0.00
PARALICHTHYS SP.	FLOUNDER UNID. (PARALICHTHYS)	1,395.09	0.10	2,879.33	0.22	137.60	0.02
PARALICHTHYS ALBIGUTTA	GULF FLOUNDER	0.00	0.00	0.00	0.00	131.75	0.02
PARALICHTHYS DENTATUS	SUMMER FLOUNDER	0.00	0.00	0.00	0.00	795.65	0.10
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER	0.00	0.00	0.00	0.00	1,466.08	0.18
SCOPHTHALMUS AQUOSUS	WINDOWPANE	0.00	0.00	20.24	0.00	17.83	0.00
SOLEIDAE	SOLES	-	-	-	-	-	-
TRINECTES MACULATUS	HOGCHOKER	930.81	0.06	1,725.24	0.13	430.52	0.05
CYNOGLOSSIDAE	TONGUEFISHES	-	-	-	-	-	-
SYMPHURUS SP.	TONGUEFISH UNID. (SYMPHURUS)	19.57	0.00	0.00	0.00	0.00	0.00
SYMPHURUS CIVITATUS	OFFSHORE TONGUEFISH	213.69	0.01	79.78	0.01	37.98	0.00
SYMPHURUS PLAGIUSA	BLACKCHEEK TONGUEFISH	1,239.32	0.09	2,523.18	0.20	3,328.44	0.40
BALISTIDAE	LEATHERJACKETS	-	-	-	-	-	-
MONACANTHUS HISPIDUS	PLANEHEAD FILEFISH	43.89	0.00	73.07	0.01	0.00	0.00
TETRAODONTIDAE	PUFFERS	-	-	-	-	-	-
SPHOEROIDES MACULATUS	NORTHERN PUFFER	23.81	0.00	53.11	0.00	15.83	0.00
FISH UNID.	FISH UNID.	162.94	0.01	68.49	0.01	0.90	0.01

TABLE 3.^ (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	SEP 79 - AUG 80 DENSITY	SEP 79 - AUG 80 %	SEP 80 - AUG 81 DENSITY	SEP 80 - AUG 81 %	SEP81 - AUG 82 DENSITY	SEP81 - AUG 82 %
PENAEIDAE	PENAEID SHRIMP	0.00	0.00	16.29	0.00	89.92	0.01
PENAEUS SP.(ADULT)	PENAEUS (ADULT)	0.00	0.00	0.00	0.00	16.26	0.00
PENAEUS SP.(POSTLARVAE)	PENAEUS (POSTLARVAE)	153,378.87	10.65	100,191.45	7.81	40,626.25	5.87
PENAEUS DUORARUM	PINK SHRIMP	0.90	0.00	0.00	0.[illegible]	0.00	0.00
PENAEUS SETIFERUS	WHITE SHRIMP	0.00	0.00	0.00	0.00	0.00	0.00
TRACHYPENEUS CONSTRICTUS	T-CON OR HARDBACK SHRIMP	2,206.00	0.15	5,992.79	0.47	[illegible]27.34	0.11
PORTUNIDAE	SWIMMING CRABS	10,049.50	0.70	5,586.80	0.44	3,260.[illegible]	0.39
PORTUNIDAE(MEGALOPS)	SWIMMING CRABS (MEGALOPS)	302,476.87	21.00	176,327.15	13.77	127,103.02	15.37
CALLINECTES SP.	BLUE CRABS	313.76	0.02	37.38	0.00	241.81	0.03
	TOTAL	1,440,355.34	99.9	1,280,973.07	100.0	827,739.28	99.9
	EFFORTS	832		559		490	

TABLE 3.10 ENTRAINMENT RATES (MILLION NUMBER PER DAY) FROM SEP1981 TO AUG1982

TRIP	FROM WEEK OF	MEAN FLOW CUBIC M (MILLION)	SAMPLE DATE	TOTAL FISH	SPOT	CROAKER	FLOUNDER	MENHADEN	MULLET	SHRIMP	ANCHOVY	SEATROUT	GOBIO-NELLUS	GOBIO-SOMA
157	01SEP81	2.704	01SEP81	0.845	0.000	0.000	0.000	0.000	0.000	0.245	0.408	0.015	0.010	0.169
158	08SEP81	2.704	08SEP81	2.846	0.000	0.010	0.000	0.000	0.000	0.246	1.695	0.021	0.010	0.047
159	15SEP81	2.704	15SEP81	1.196	0.000	0.118	0.000	0.000	0.000	0.273	0.653	0.021	0.043	0.207
160	22SEP81	4.722	22SEP81	3.716	0.000	0.591	0.000	0.000	0.000	0.161	2.229	0.154	0.116	0.256
161	29SEP81	5.408	29SEP81	2.033	0.000	0.117	0.019	0.000	0.000	0.308	1.513	0.000	0.193	0.780
162	06OCT81	5.408	06OCT81	2.014	0.000	0.055	0.000	0.000	0.010	0.390	1.163	0.000	0.139	0.095
163	13OCT81	5.408	13OCT81	1.242	0.000	0.162	0.000	0.000	0.000	0.763	0.692	0.000	0.140	0.136
164	20OCT81	5.408	20OCT81	0.943	0.000	0.178	0.000	0.000	0.000	0.975	0.529	0.000	0.044	0.015
165	27OCT81	2.976	27OCT81	0.646	0.000	0.242	0.000	0.000	0.000	0.635	0.177	0.006	0.126	0.006
166	03NOV81	5.408	03NOV81	3.725	0.000	1.982	0.000	0.000	0.070	1.390	0.713	0.000	0.939	0.000
167	10NOV81	5.408	10NOV81	0.914	0.000	0.481	0.000	0.000	0.000	0.116	0.081	0.020	0.328	0.000
168	17NOV81	4.722	17NOV81	1.847	0.000	1.385	0.011	0.000	0.011	0.315	0.033	0.000	0.424	0.011
169	24NOV81	5.408	24NOV81	0.634	0.000	0.226	0.000	0.000	0.021	0.093	0.230	0.000	0.105	0.000
170	01DEC81	5.408	01DEC81	1.441	0.000	0.759	0.021	0.011	0.000	0.158	0.115	0.000	0.109	0.000
171	08DEC81	5.236	08DEC81	1.083	0.000	0.691	0.024	0.000	0.000	0.012	0.227	0.000	0.012	0.000
172	15DEC81	4.494	15DEC81	4.039	0.106	3.071	0.000	0.000	0.011	0.000	0.348	0.000	0.011	0.011
173	22DEC81	5.408	22DEC81	1.173	0.012	0.663	0.000	0.530	0.000	0.000	0.475	0.000	0.000	0.000
174	29DEC81	5.408	29DEC81	3.999	0.054	3.300	0.025	0.000	0.024	0.000	0.147	0.000	0.123	0.000
175	05JAN82	5.408	06JAN82	2.592	0.330	1.918	0.024	0.012	0.129	0.000	0.023	0.000	0.047	0.000
176	12JAN82	4.494	13JAN82	11.366	1.281	9.615	0.055	0.000	0.256	0.000	0.090	0.000	0.057	0.000
177	19JAN82	4.722	20JAN82	3.982	0.768	2.958	0.035	0.000	0.024	0.000	0.128	0.500	0.012	0.000
178	26JAN82	4.722	27JAN82	10.579	1.640	8.453	0.047	0.000	0.244	0.000	0.070	0.000	0.000	0.000
179	02FEB82	4.494	03FEB82	6.974	4.558	1.576	0.154	0.011	0.217	0.000	0.033	0.000	0.011	0.000
180	09FEB82	3.520	10FEB82	6.771	3.616	2.278	0.146	0.032	0.477	0.000	0.054	0.000	0.031	0.000
181	16FEB82	5.408	17FEB82	4.421	2.979	1.113	0.176	0.024	0.047	0.000	0.011	0.000	0.000	0.000
182	23FEB82	5.408	24FEB82	8.371	3.210	4.067	0.133	0.000	0.085	0.012	0.122	0.000	0.298	0.000
183	02MAR82	5.408	03MAR82	10.256	6.875	0.853	0.195	0.034	1.530	0.046	0.066	0.000	0.121	0.000
184	09MAR82	5.408	10MAR82	12.928	6.872	4.876	0.344	0.158	0.240	0.146	0.060	0.000	0.613	0.000
185	16MAR82	5.408	17MAR82	17.104	12.768	2.669	0.062	1.095	0.024	0.285	0.125	0.000	0.192	0.000
186	23MAR82	5.408	24MAR82	10.491	4.693	5.003	0.013	0.101	0.000	1.785	0.114	0.000	0.442	0.000
187	30MAR82	5.408	31MAR82	15.613	10.128	3.530	0.077	0.744	0.013	7.624	0.120	0.000	0.424	0.000
188	06APR82	5.408	07APR82	5.236	3.286	0.743	0.012	0.889	0.000	0.677	0.023	0.000	0.130	0.000
189	13APR82	5.408	14APR82	7.790	2.408	0.754	0.000	3.155	0.011	0.677	0.057	0.000	0.243	0.000
190	20APR82	5.408	21APR82	9.054	1.266	3.058	0.008	0.185	0.000	0.404	0.296	0.000	0.340	0.000
191	27APR82	4.722	28APR82	3.185	0.739	0.172	0.000	0.102	0.000	0.387	0.076	0.000	0.224	0.000
192	04MAY82	4.722	05MAY82	3.792	0.293	0.267	0.014	0.035	0.000	0.261	0.098	0.000	0.409	0.006
193	11MAY82	2.704	12MAY82	6.143	0.042	0.012	0.000	0.016	0.000	0.069	1.458	0.016	0.331	0.058
194	18MAY82	2.704	19MAY82	6.594	0.026	0.000	0.000	0.004	0.000	0.198	4.531	0.006	0.214	0.486
195	25MAY82	2.704	26MAY82	4.627	0.000	0.000	0.000	0.000	0.007	0.165	2.935	0.023	0.034	1.228
196	01JUN82	2.704	02JUN82	19.640	0.000	0.000	0.000	0.000	0.000	0.160	7.665	0.358	0.022	10.531
197	08JUN82	2.704	09JUN82	7.867	0.000	0.000	0.000	0.000	0.000	0.067	5.478	0.071	0.018	2.053
198	15JUN82	2.704	16JUN82	5.109	0.000	0.000	0.000	0.000	0.004	0.103	3.380	0.186	0.004	1.427
199	22JUN82	2.704	23JUN82	1.628	0.000	0.004	0.000	0.000	0.000	0.123	1.019	0.075	0.007	0.333
200	29JUN82	2.704	30JUN82	8.208	0.000	0.000	0.005	0.000	0.000	0.063	4.995	0.236	0.011	1.328
201	06JUL82	4.722	07JUL82	5.518	0.000	0.000	0.000	0.000	0.000	0.412	3.636	0.045	0.039	1.459
202	13JUL82	3.793	14JUL82	14.820	0.000	0.000	0.000	0.000	0.005	0.761	12.471	0.031	0.010	1.885
203	20JUL82	2.174	21JUL82	0.599	0.000	0.000	0.000	0.000	0.000	0.246	0.297	0.005	0.000	0.177
204	27JUL82	2.174	28JUL82	0.331	0.000	0.000	0.000	0.000	0.000	0.090	0.101	0.000	0.000	0.130
205	03AUG82	3.187	04AUG82	0.617	0.000	0.000	0.000	0.000	0.000	0.068	0.418	0.000	0.000	0.155
206	10AUG82	3.187	11AUG82	0.322	0.000	0.000	0.005	0.000	0.000	0.325	0.166	0.000	0.000	0.096
207	17AUG82	3.187	18AUG82	1.292	0.000	0.000	0.000	0.000	0.000	0.106	0.906	0.018	0.016	0.120
208	24AUG82	3.187	25AUG82	0.118	0.000	0.000	0.000	0.000	0.000	1.573	0.041	0.021	0.000	0.019

TABLE 3.11 ENTRAINMENT DENSITIES (MEAN PER DAY) FROM SEP1981 TO AUG1982

DATE	TOTAL FISH	SPOT	CROAKER	FLOUNDER	MENHADEN	MULLET	SHRIMP	ANCHOVY	SEATROUT	G-MELLUS	G-SOMA
01SEP81	327.78	0.00	0.00	0.00	0.00	0.00	96.55	172.98	5.65	3.76	59.15
08SEP81	756.70	0.00	3.83	0.00	0.00	0.00	91.03	626.83	7.75	3.77	17.34
15SEP81	442.36	0.00	43.60	0.00	0.00	0.00	101.03	241.48	7.95	23.85	76.44
22SEP81	787.04	0.00	125.20	0.00	0.00	0.00	33.99	472.07	32.60	24.55	52.92
29SEP81	523.84	0.00	21.62	1.94	0.00	0.00	56.95	279.75	0.00	35.63	145.75
06OCT81	372.48	0.00	10.19	0.00	0.00	1.91	146.07	215.09	0.00	25.69	17.65
13OCT81	229.66	0.00	29.97	0.00	0.00	0.30	141.15	128.05	0.00	25.88	25.18
20OCT81	174.46	0.00	32.92	0.00	0.00	0.00	180.38	97.87	0.00	8.21	2.70
27OCT81	217.17	0.00	98.15	0.00	0.00	0.00	213.47	59.57	1.91	42.22	1.97
03NOV81	688.73	0.00	366.49	0.30	0.00	0.00	249.72	131.82	0.00	173.65	0.00
10NOV81	168.93	0.00	88.51	0.00	0.00	0.00	21.45	15.05	0.00	60.57	0.00
17NOV81	391.75	0.00	276.27	2.25	0.00	2.24	66.74	7.01	0.00	89.78	2.31
24NOV81	1 7.21	0.00	41.80	0.00	0.00	3.86	17.16	42.58	0.00	19.38	0.00
01DEC81	266.52	0.00	149.27	3.88	1.97	0.00	29.23	21.35	0.00	34.96	0.00
08DEC81	296.79	0.00	131.95	4.53	0.0[illegible]	0.00	2.35	43.39	0.00	2.22	0.00
15DEC81	823.38	21.42	627.51	0.00	0.[illegible]	2.28	0.00	71.12	0.00	2.24	2.24
22DEC81	216.93	2.15	122.57	0.00	0.00	0.00	0.00	87.83	0.00	0.00	0.00
29DEC81	739.41	10.82	647.18	4.60	0.00	4.40	0.00	27.09	0.00	22.66	0.00
06JAN82	479.31	60.97	354.71	4.41	2.25	23.82	0.00	4.27	0.00	8.77	0.00
13JAN82	2,327.42	261.81	1,964.75	11.27	0.00	52.21	0.00	18.43	0.00	11.72	0.00
20JAN82	843.36	162.71	626.45	7.43	0.00	4.98	0.00	27.05	0.00	2.51	0.00
27JAN82	2,240.34	347.24	1,790.16	9.92	0.00	51.61	0.00	14.74	0.00	0.00	0.00
03FEB82	1,424.97	931.35	322.00	31.40	2.20	44.32	0.00	6.67	0.00	2.24	0.00
10FEB82	1,923.59	1,027.26	647.13	41.74	8.98	135.45	0.00	15.25	0.00	8.93	0.00
17FEB82	817.41	550.84	205.87	32.18	4.41	8.78	0.00	2.07	0.00	0.00	0.00
24FEB82	1,547.87	593.57	752.10	24.52	0.00	15.66	2.23	22.52	0.00	55.02	0.00
03MAR82	1,896.42	1,271.25	357.70	36.02	6.35	284.39	4.52	12.18	0.00	22.45	0.00
10MAR82	2,371.99	1,270.66	753.68	63.59	29.20	44.34	25.97	11.01	0.00	113.33	0.00
17MAR82	3,142.76	2,360.58	493.59	11.39	202.43	4.43	52.63	23.08	0.00	35.48	0.00
24MAR82	1,939.87	867.77	925.03	2.37	18.68	0.00	330.07	21.15	0.00	81.67	0.00
31MAR82	2,887.04	1,872.73	652.79	14.27	137.52	2.41	1,400.83	22.15	0.00	78.35	0.00
07APR82	988.78	687.66	137.48	2.26	164.39	0.00	125.11	4.30	0.00	23.98	0.00
14APR82	1,448.48	445.28	139.34	0.00	583.37	2.07	124.51	10.50	0.00	44.99	0.00
21APR82	1,674.76	234.19	565.39	1.45	34.12	0.00	74.69	54.85	1.56	72.04	0.00
28APR82	474.48	156.45	36.44	0.00	21.54	0.00	82.03	16.14	0.00	47.50	0.00
05MAY82	803.08	62.11	56.49	2.91	7.37	0.00	55.36	20.73	0.60	85.54	1.22
12MAY82	2,271.86	15.47	4.30	0.00	5.86	0.00	25.41	539.17	5.88	122.42	21.58
19MAY82	2,439.99	9.79	0.89	0.00	1.50	0.00	73.31	1,675.75	31.70	79.07	179.72
26MAY82	1,711.24	0.00	0.00	0.00	0.00	2.67	60.99	1,085.55	8.51	12.55	454.12
02JUN82	7,263.46	0.00	0.00	0.00	0.00	0.00	59.30	2,834.63	132.52	8.01	3,894.51
09JUN82	2,909.56	0.10	0.00	0.00	0.00	0.00	24.67	2,025.98	26.25	6.71	759.35
16JUN82	1,885.97	0.00	0.00	0.00	0.00	1.48	30.16	1,249.96	68.71	1.48	527.05
23JUN82	601.94	0.00	1.34	0.00	0.00	0.00	45.46	376.99	27.64	2.54	123.15
30JUN82	3,035.41	0.00	0.00	0.00	0.00	0.00	23.36	1,847.11	87.31	4.06	491.26
07JUL82	1,168.53	0.00	0.00	0.00	0.00	0.00	87.18	769.94	9.49	8.18	308.95
14JUL82	3,987.88	0.00	0.00	0.00	0.00	1.33	288.54	3,287.91	8.15	2.66	496.99
21JUL82	275.20	0.00	0.00	0.00	0.00	0.00	173.08	136.36	2.51	0.00	81.23
28JUL82	152.11	0.09	0.00	0.00	0.09	0.00	41.33	46.53	0.00	0.00	59.88
04AUG82	198.54	0.00	0.00	0.00	0.00	0.00	21.46	134.43	0.00	0.00	49.93
11AUG82	103.74	0.30	0.00	0.00	0.00	0.00	104.67	53.49	0.00	0.00	27.68
18AUG82	346.79	0.00	0.00	0.06	0.00	0.00	98.48	291.74	5.89	2.01	41.13
25AUG82	38.12	0.00	0.00	0.00	0.00	0.00	506.20	13.30	6.74	0.00	6.05

Table 3.12 Results of analysis of variance for entrainment, September 1974 to August 1982 (Log_{10} [density + 10] - winter species only).

Source	Spot	Croaker	Flounder
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Day/Night	***	***	***
Week * D/N	***	***	***
Year * D/N	***	***	***
$\overline{\text{Log}}$	1.874	1.805	1.219
Std. Dev.	0.368	0.382	0.239
Analysis Week	16-37	4-35	16-31

NS $p > 0.05$
* $0.01 < p \leq 0.05$
** $0.001 < p \leq 0.01$
*** $p \leq 0.001$

Table 3.12 (continued)

Source	Menhaden	Mullet	Brown Shrimp
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Day/Night	***	***	***
Week * D/N	***	**	***
Year * D/N	***	NS	***
$\overline{\text{Log}}$	1.407	1.240	1.506
Std. Dev.	0.328	0.314	0.303
Analysis Week	26-36	16-30	24-38

NS $p > 0.05$

* $0.01 < p \leq 0.05$

** $0.001 < p \leq 0.01$

*** $p \leq 0.001$

Table 3.13 Results of analysis of variance for entrainment, September 1974 to August 1982 (Log_{10} [density + 10] - summer species only)

Source	Anchovies	Seatrout	*Gobionellus* spp.
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Day/Night	***	***	***
Week * D/N	***	***	***
Year * D/N	***	***	***
$\overline{Log}$	2.356	1.279	1.173
Std. Dev.	0.338	0.288	0.247
Analysis Week	17-44	20-42	10-50

NS $p > 0.05$
* $0.01 < p \leq 0.05$
** $0.001 < p \leq 0.01$
*** $p \leq 0.001$

Table 3.13 (continued)

Source	*Gobiosoma* spp.	Pink & White Shrimp	Total Fish
Week	***	***	***
Year	***	***	***
Week * Year	***	***	***
Day/Night	***	***	***
Week * D/N	***	***	***
Year * D/N	***	***	***
Log Std. Dev.	2.177	1.899	2.586
Analysis Week	19-44	23-39	1-52

NS $p > 0.05$
* $0.01 < p \leq 0.05$
** $0.001 < p \leq 0.01$
*** $p \leq 0.001$

Table 3.14   Entrainment trend analysis, September 1974 to August 1982

Species	Linear Trend	Deviation from Linear Trend	Error	% Change Per Year
Total Fish	0.05503**	0.000257^{NS}	0.00252	+4.26
Spot	0.12352**	0.01543**	0.00426	+6.44
Croaker	0.04209**	0.05478**	0.00553	+3.71
Flounder	0.01886**	0.00881**	0.00184	+2.47
Menhaden	0.00349^{NS}	0.022130^{NS}	0.01068	+1.05
Mullet	0.06343**	0.00091^{NS}	0.00529	+4.58
Brown Shrimp	0.00823^{NS}	0.03140*	0.01058	-1.59
Pink & White Shrimp	0.06732**	0.06011**	0.00917	+4.72
Anchovies	0.00130^{NS}	0.03644**	0.00700	+0.64
Seatrout	0.02113**	0.01770**	0.00239	-2.55
Gobionellus spp.	0.01108**	0.00445**	0.00071	+1.89
Gobiosoma spp.	0.12676**	0.03999**	0.00859	+6.53

* Significance Level = 0.05
** Significance Level = 0.01
NS Not Significant

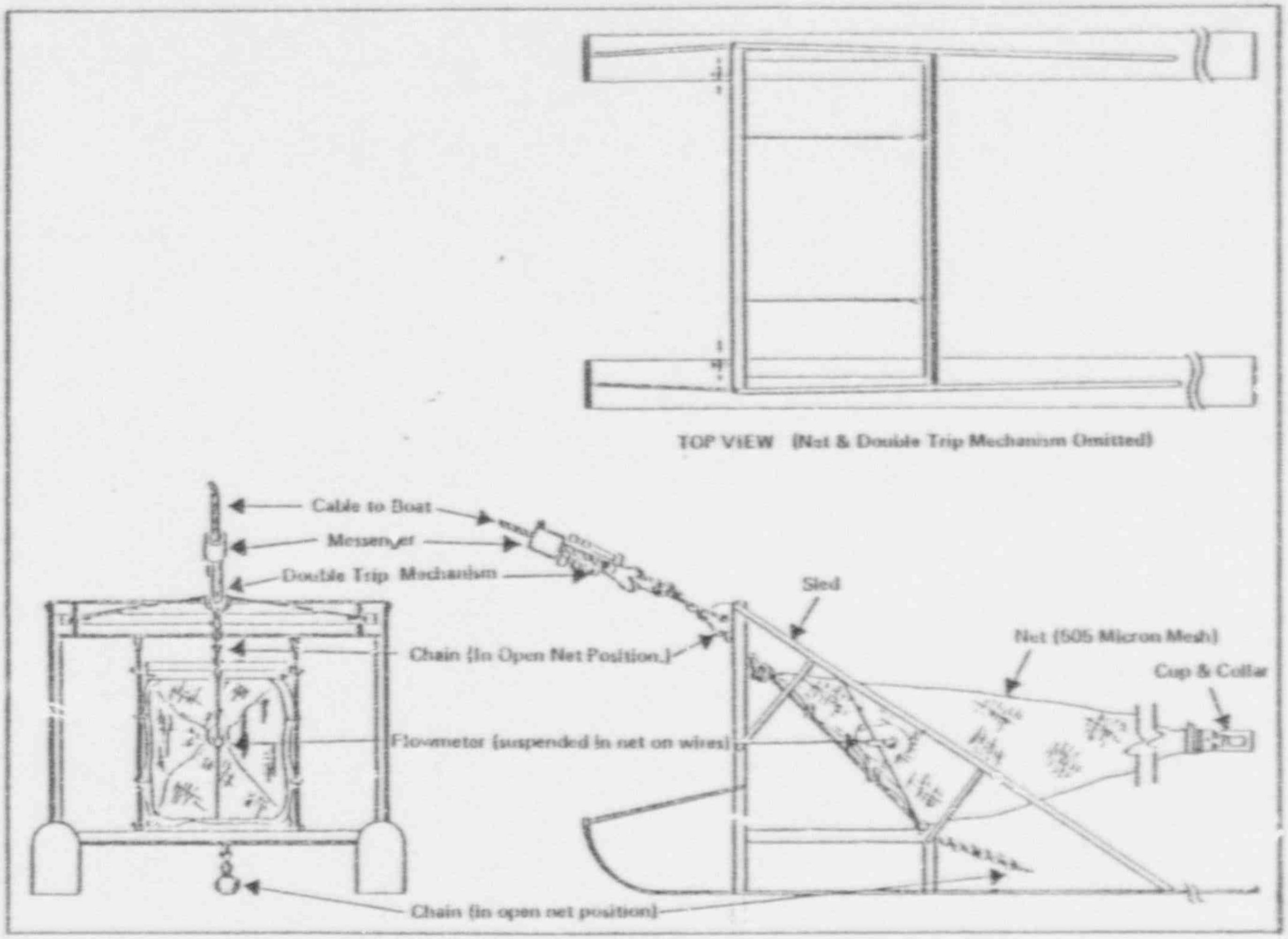


Figure 3.1 Discrete depth sampling bottom sled and net.

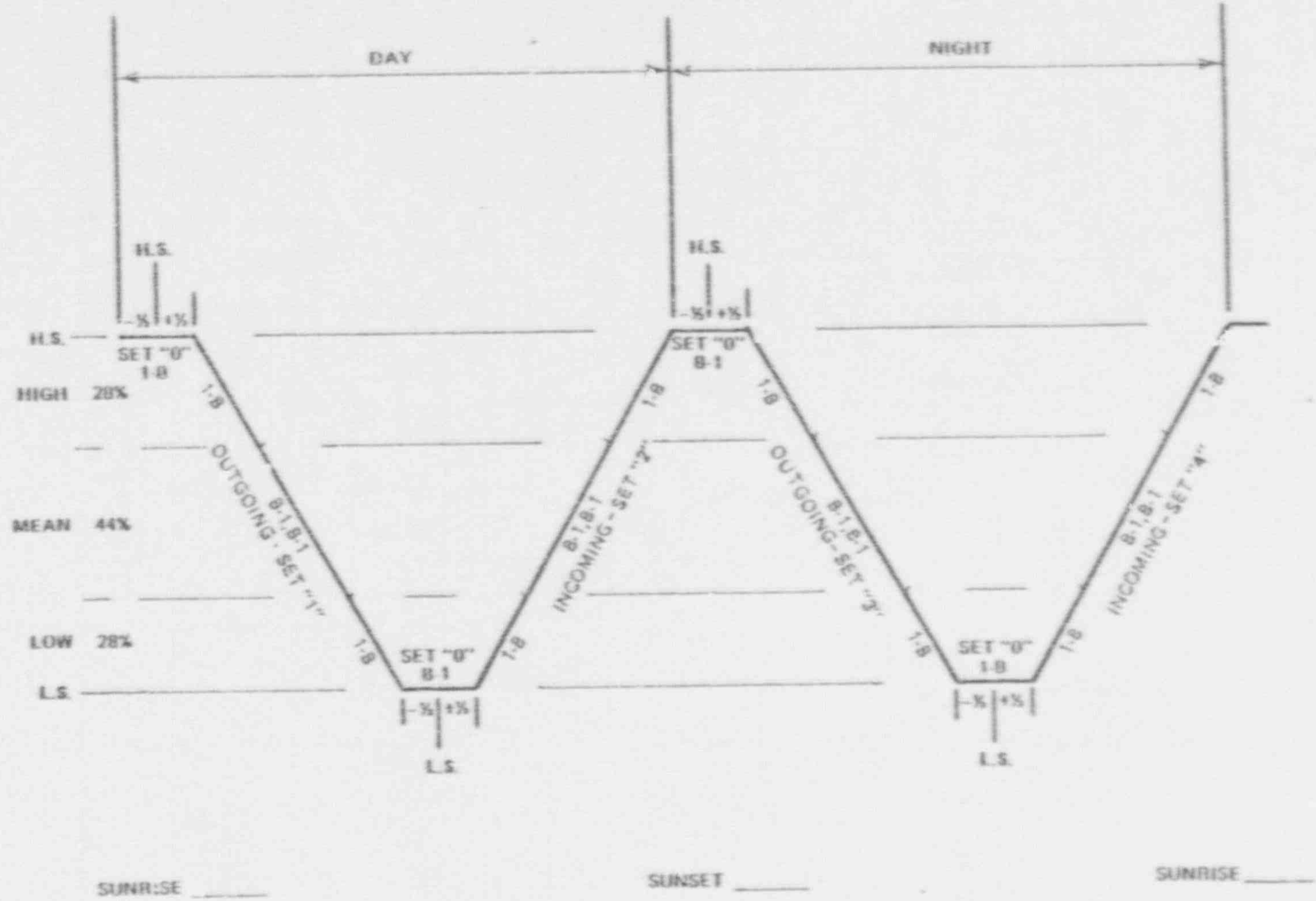


Figure 3.2 Discrete depth sampling tide tabulation graph (High Slack start).

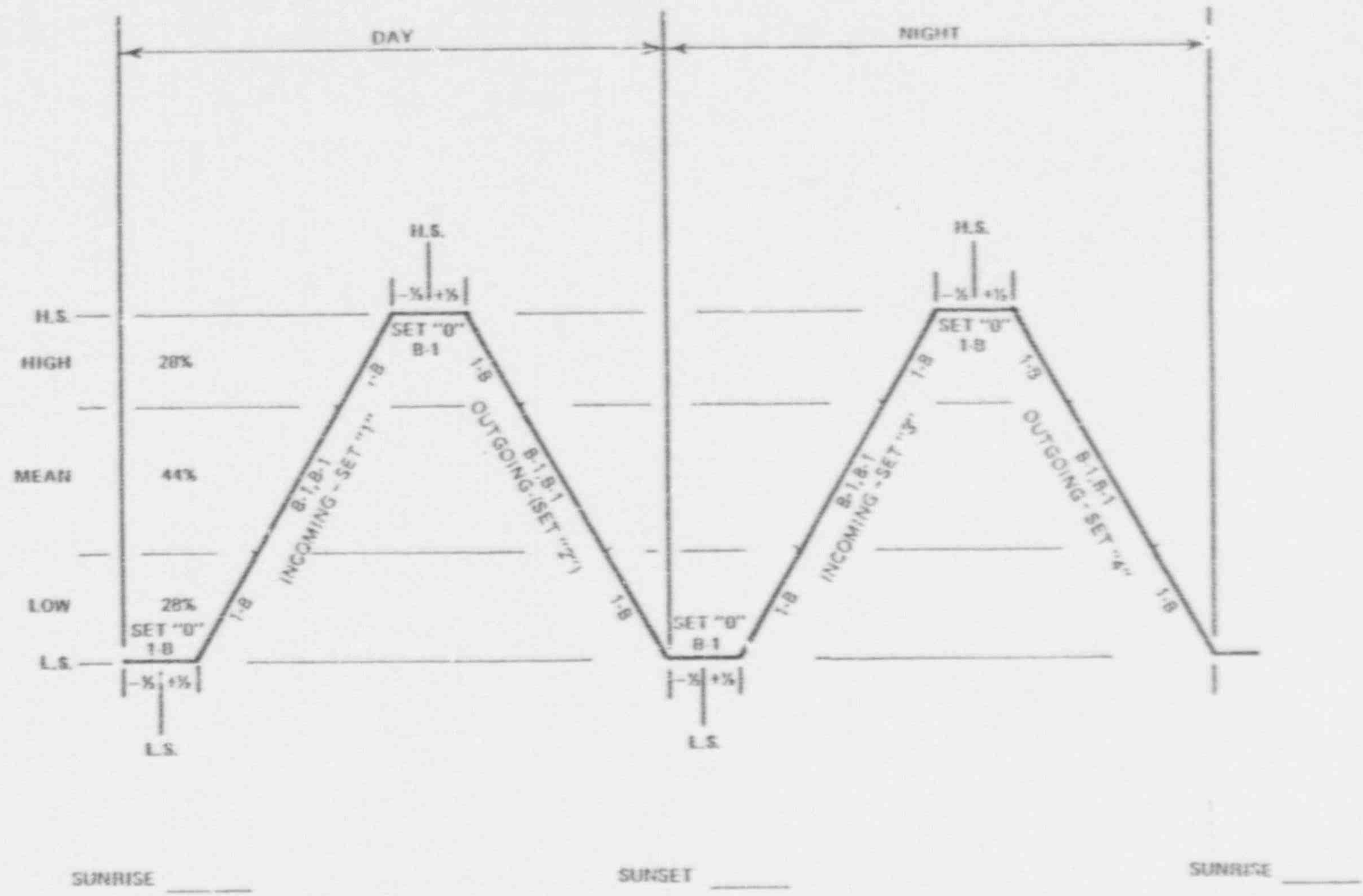


Figure 3.3 Discrete depth sampling time tabulation graph (Low Slack start).

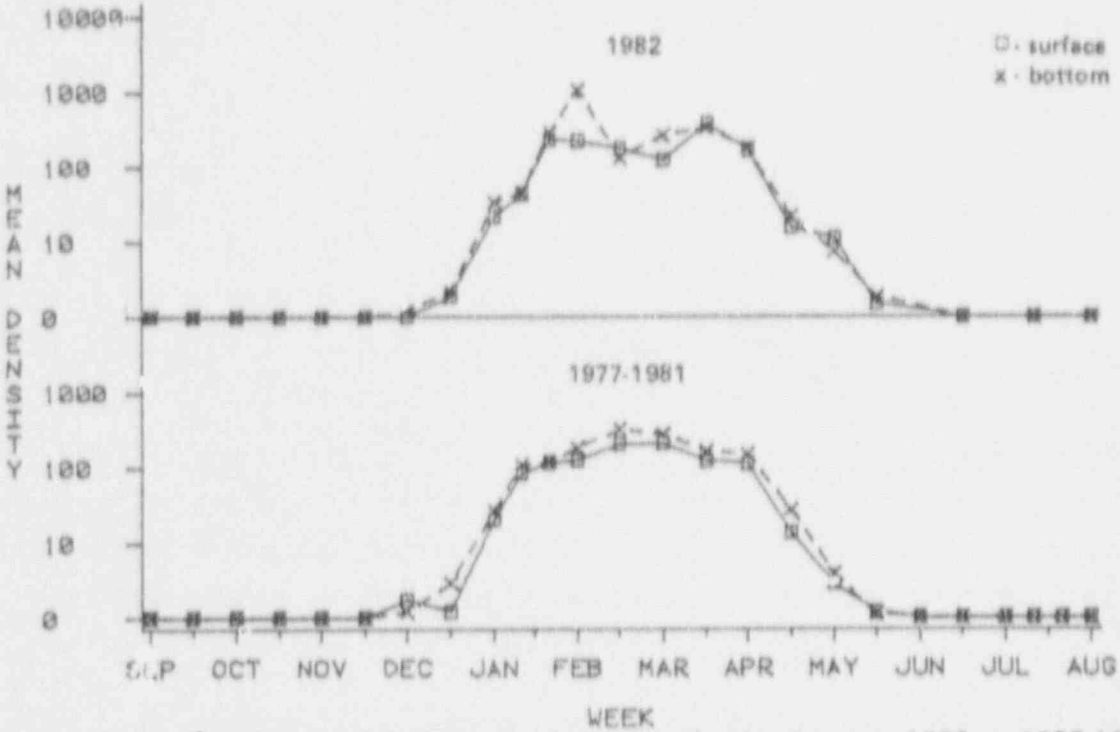


Figure 3.4 River larval fish surface/bottom mean density for spot, 1982 vs. 1977-1981 average.

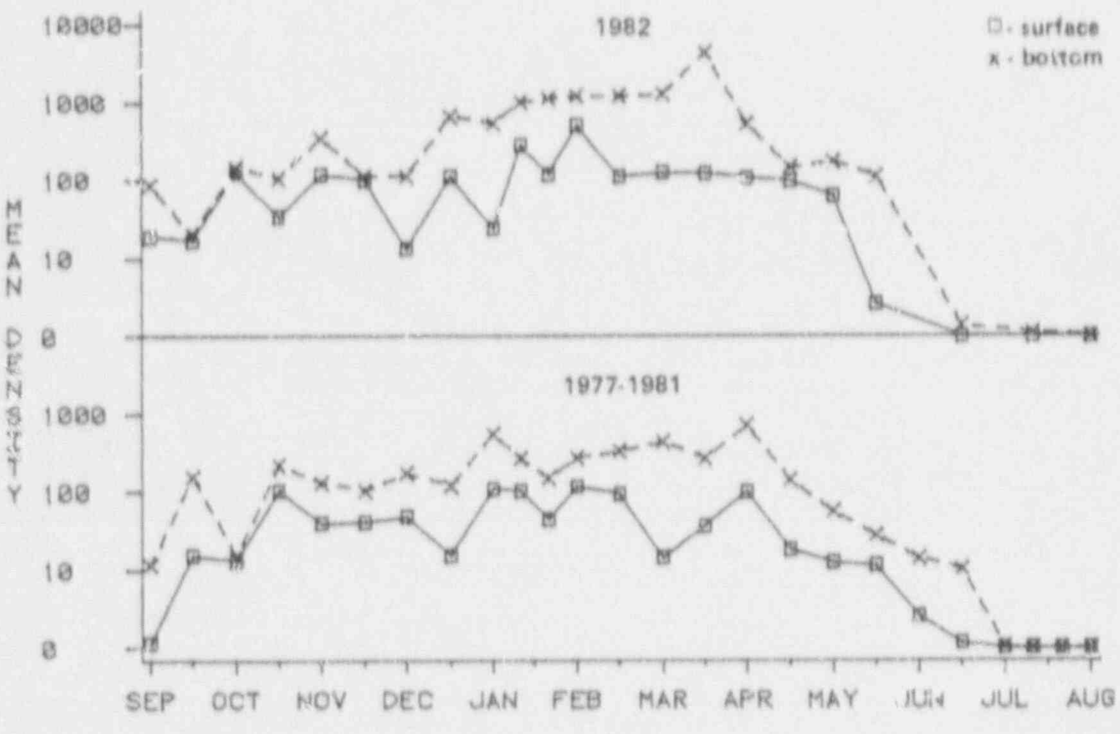


Figure 3.5 River larval fish surface/bottom mean density for croaker, 1982 vs. 1977-1981 average.

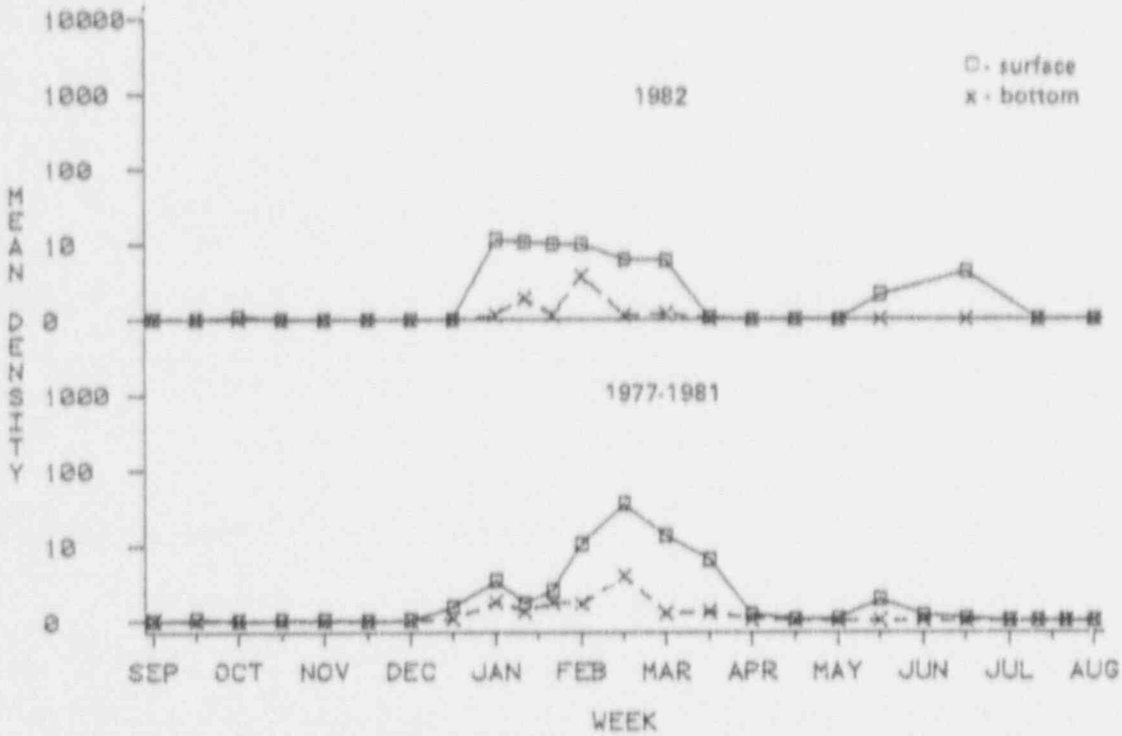


Figure 3.6 River larval fish surface/bottom mean density for mullet, 1982 vs. 1977-1981 average.

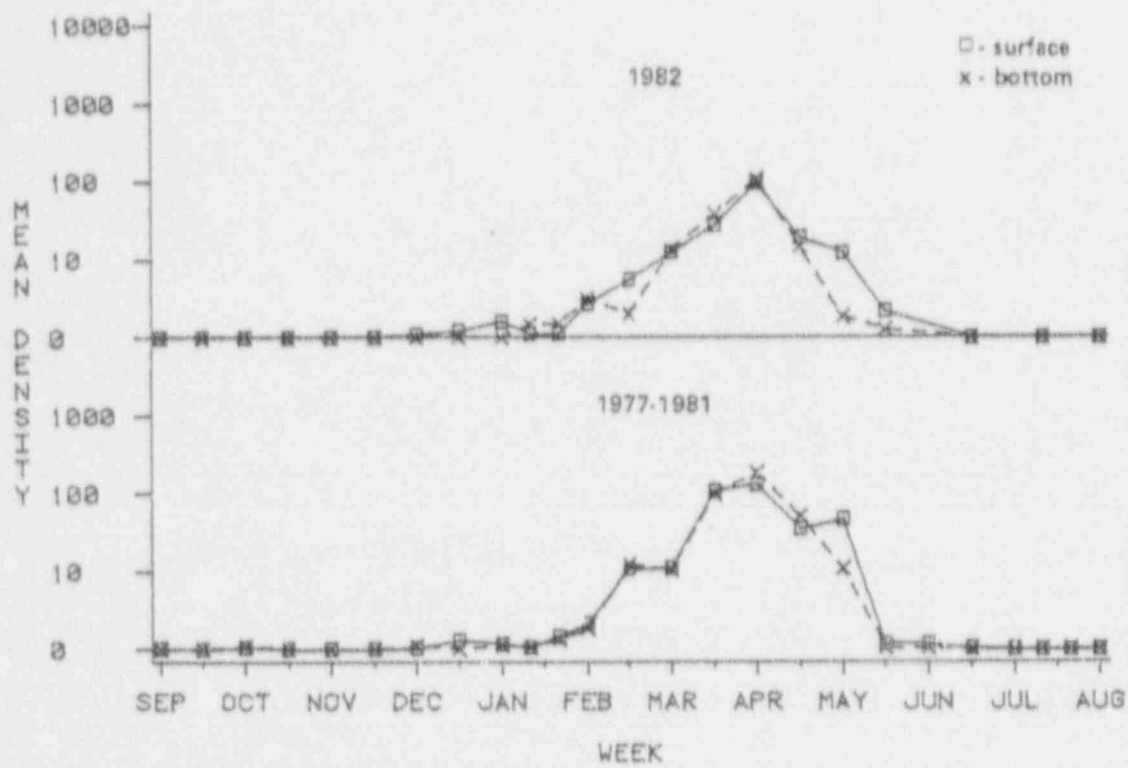


Figure 3.7 River larval fish surface/bottom mean density for menhaden, 1982 vs. 1977-1981 average.

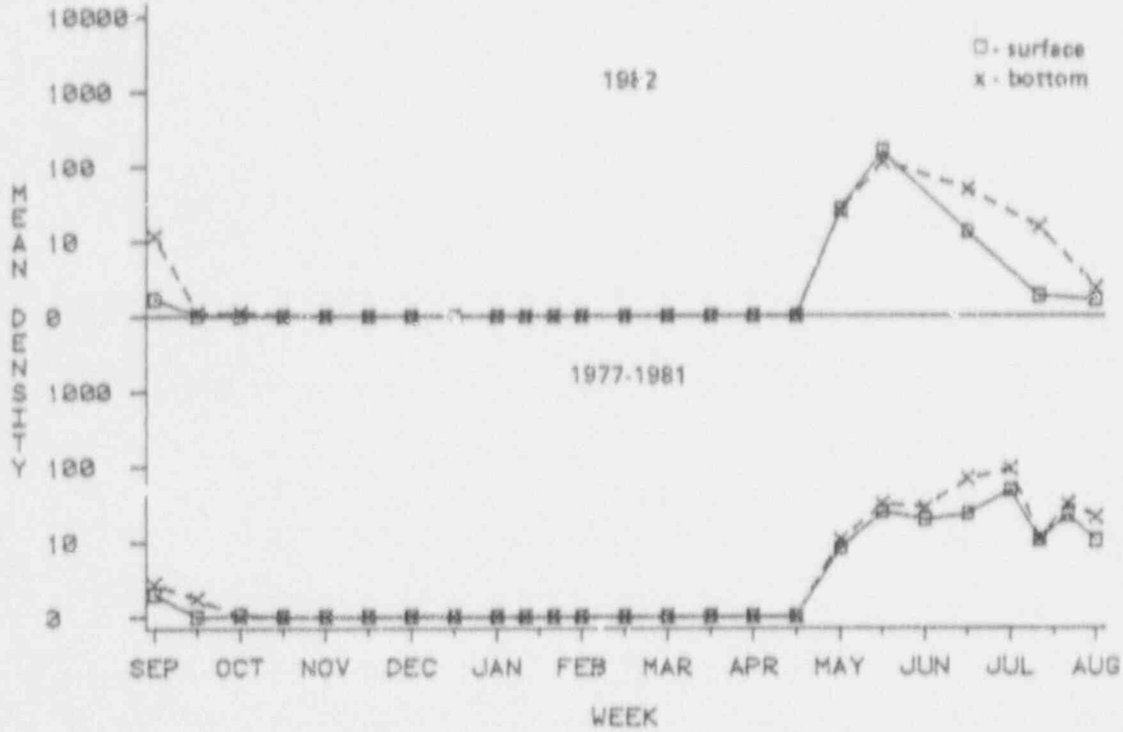


Figure 3.8 River larval fish surface/bottom mean density for seatrout, 1982 vs 1977-1981 average.

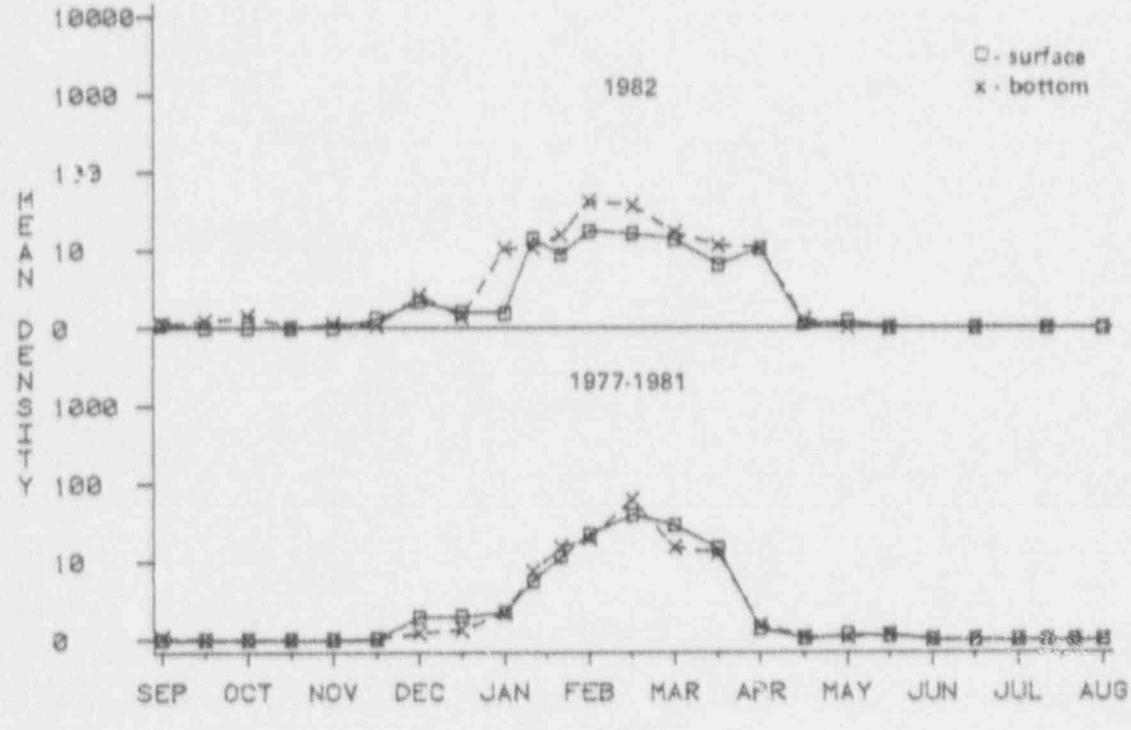


Figure 3.9 River larval fish surface/bottom mean density for flounder, 1982 vs. 1977-1981 average.

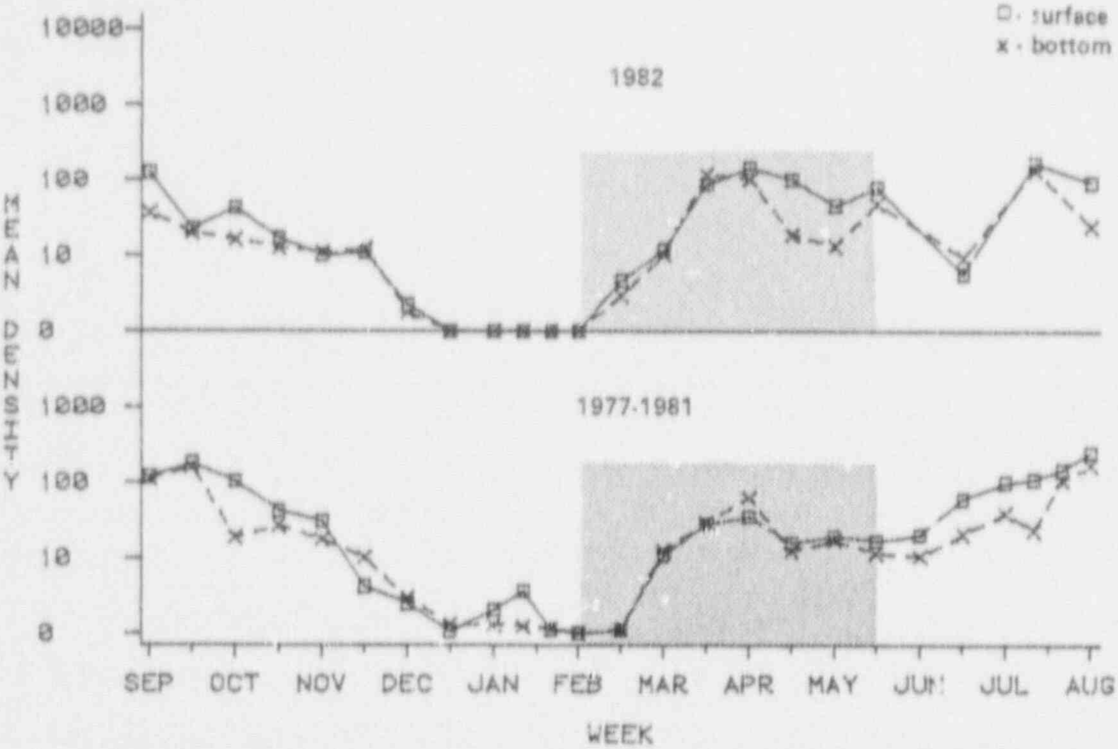


Figure 3.10 River larval fish surface/bottom mean density for shrimp, 1982 vs. 1977-1981 average (shaded area = brown shrimp analysis period).

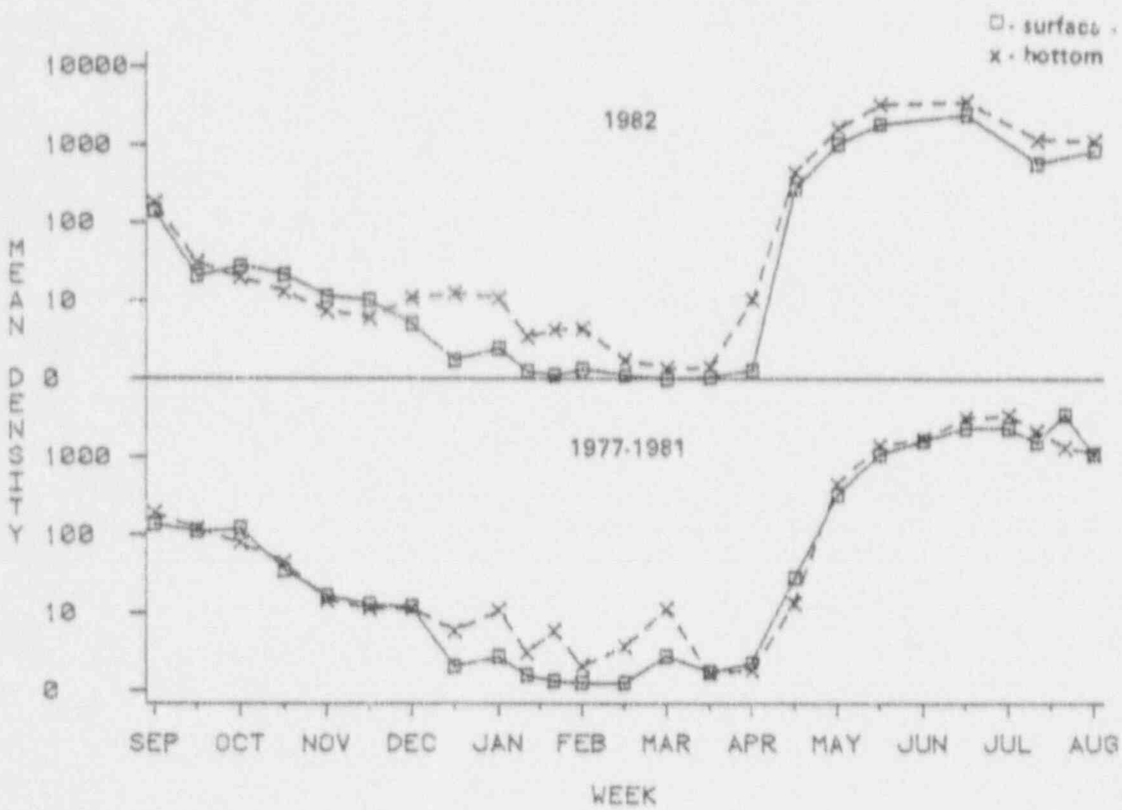


Figure 3.11 River larval fish surface/bottom mean density for anchovies, 1982 vs. 1977-1981 average.

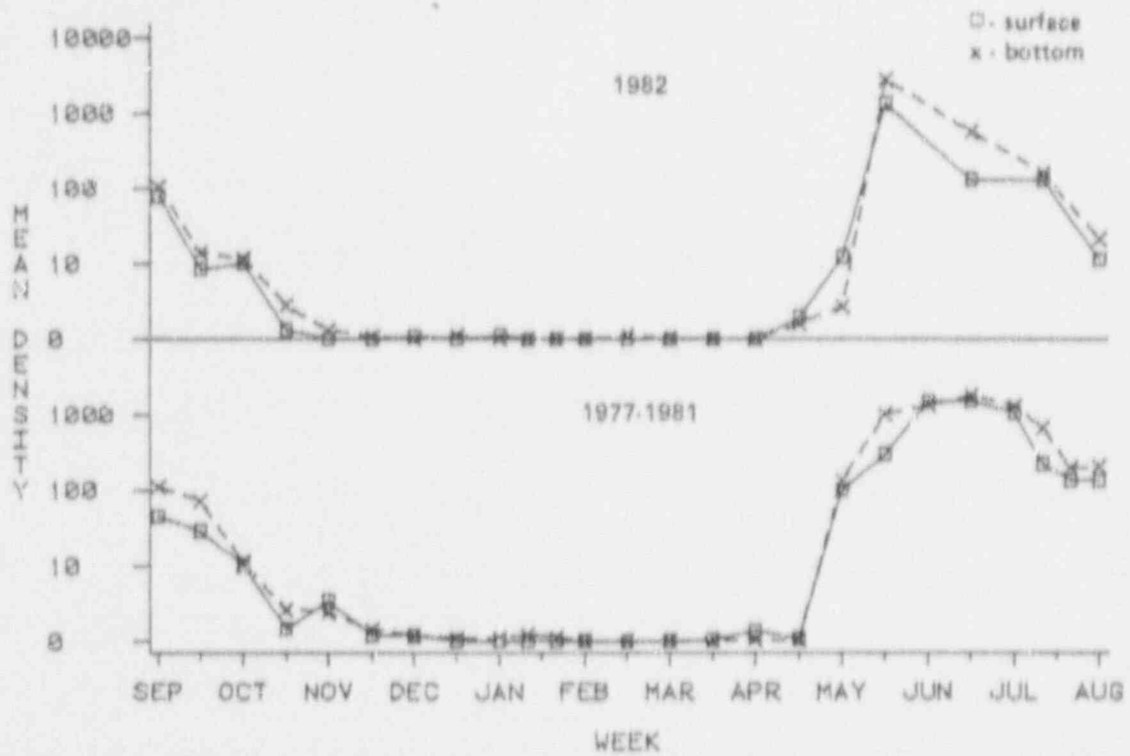


Figure 3.12 River larval fish surface/bottom mean density for <u>Gobiosoma</u> spp., 1982 vs. 1977-1981 average.

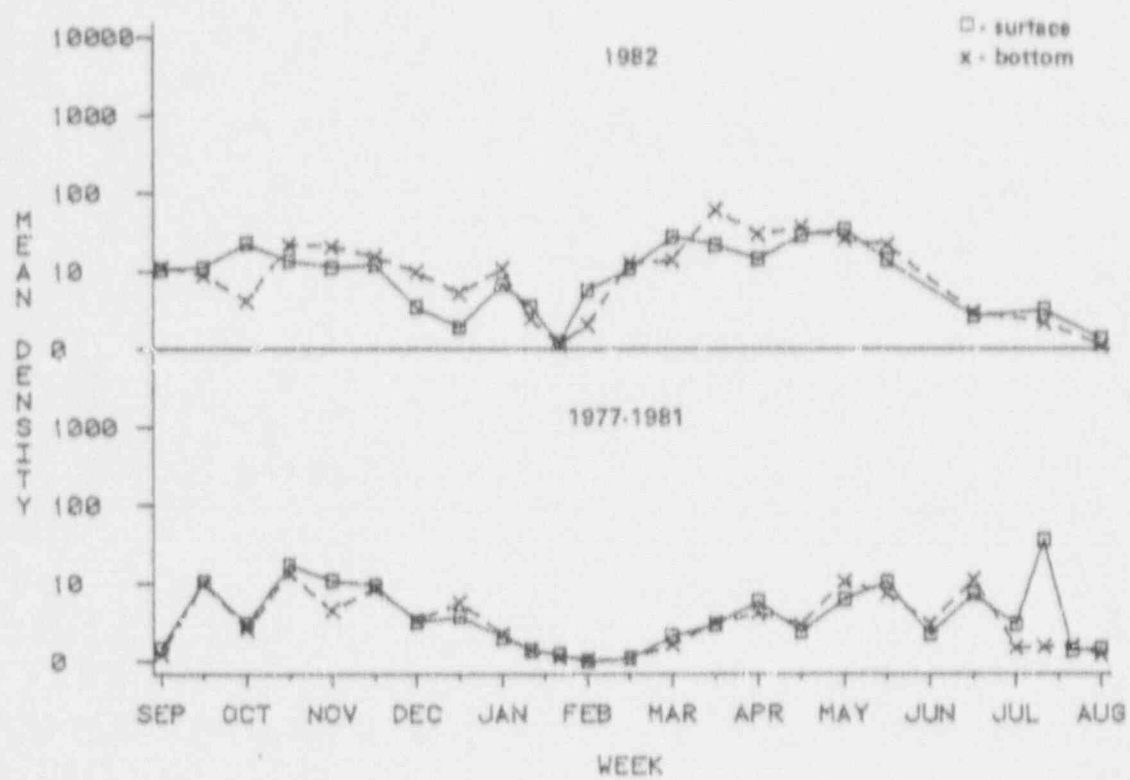


Figure 3.13 River larval fish surface/bottom mean density for <u>Gobionellus</u> spp., 1982 vs. 1977-1981 average.

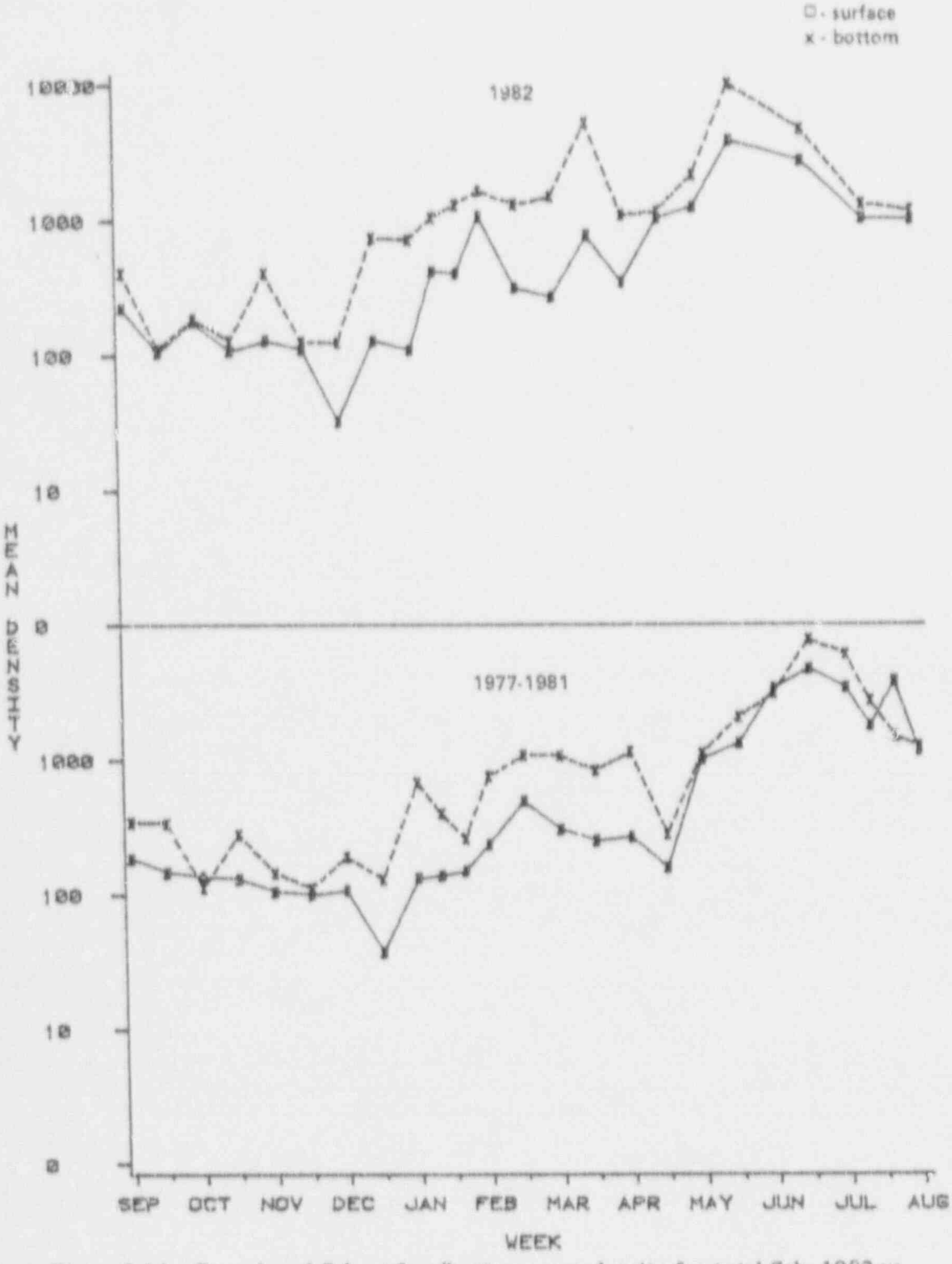


Figure 3.14 River larval fish surface/bottom mean density for total fish, 1982 vs. 1977-1981 average.

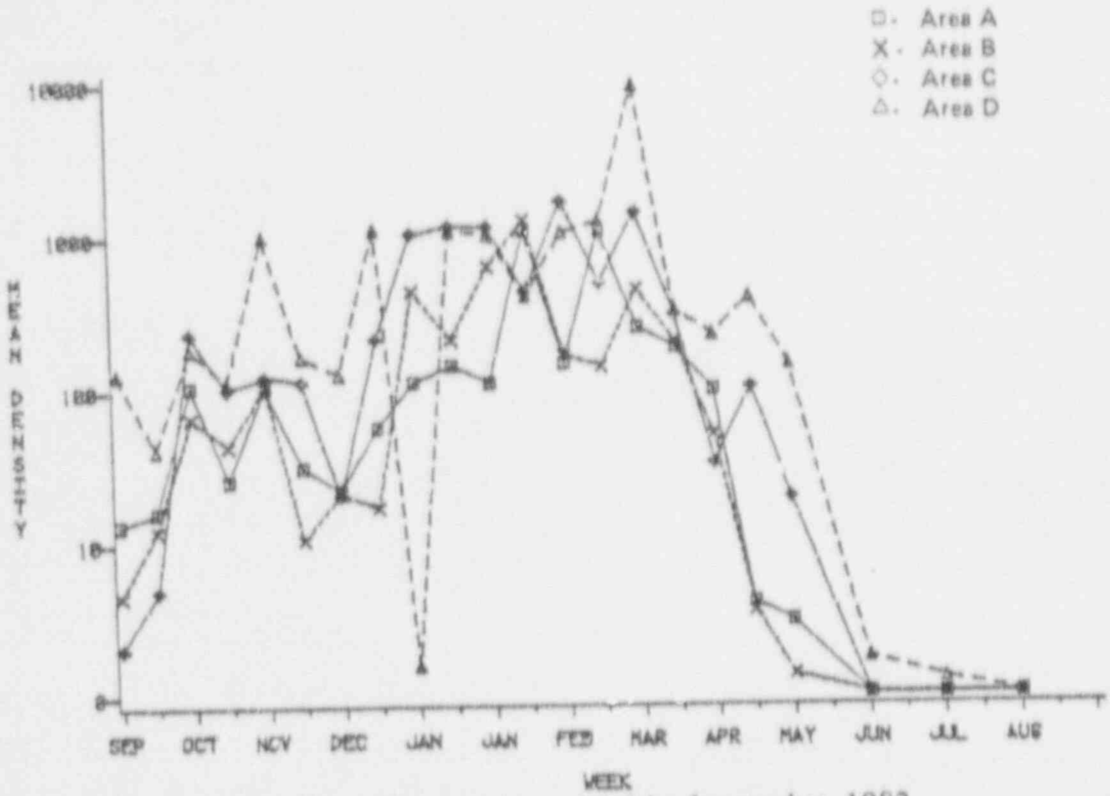


Figure 3.15 River larval fish, area mean densities for croaker, 1982.

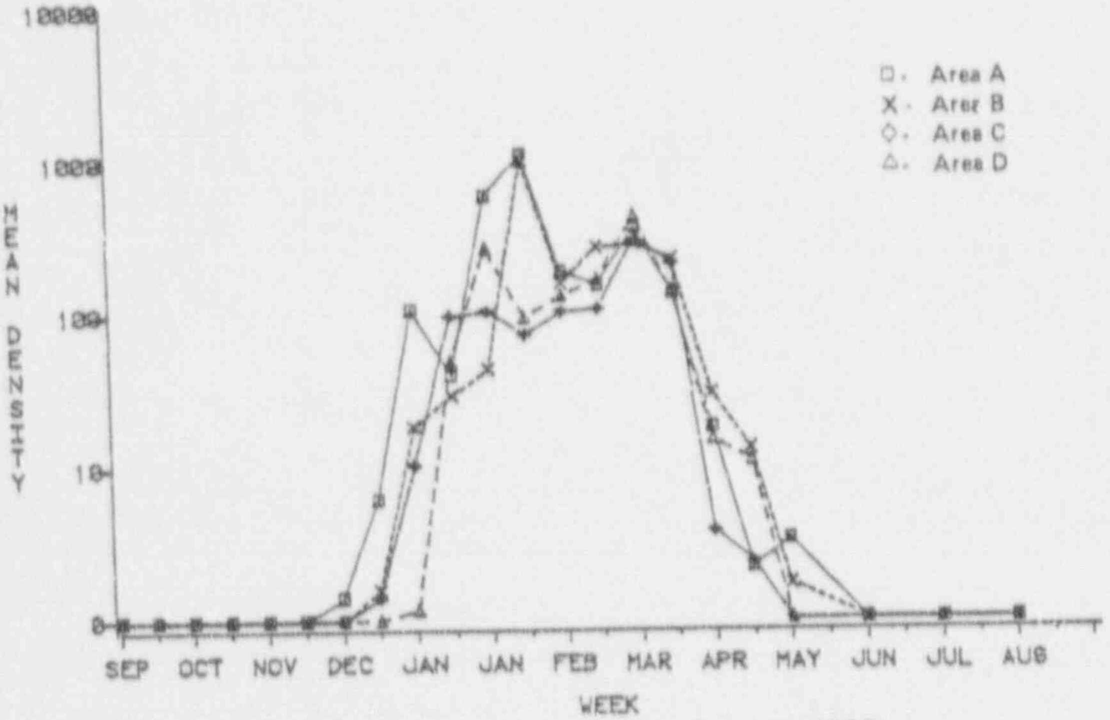


Figure 3.16 River larval fish, area mean densities for spot, 1982.

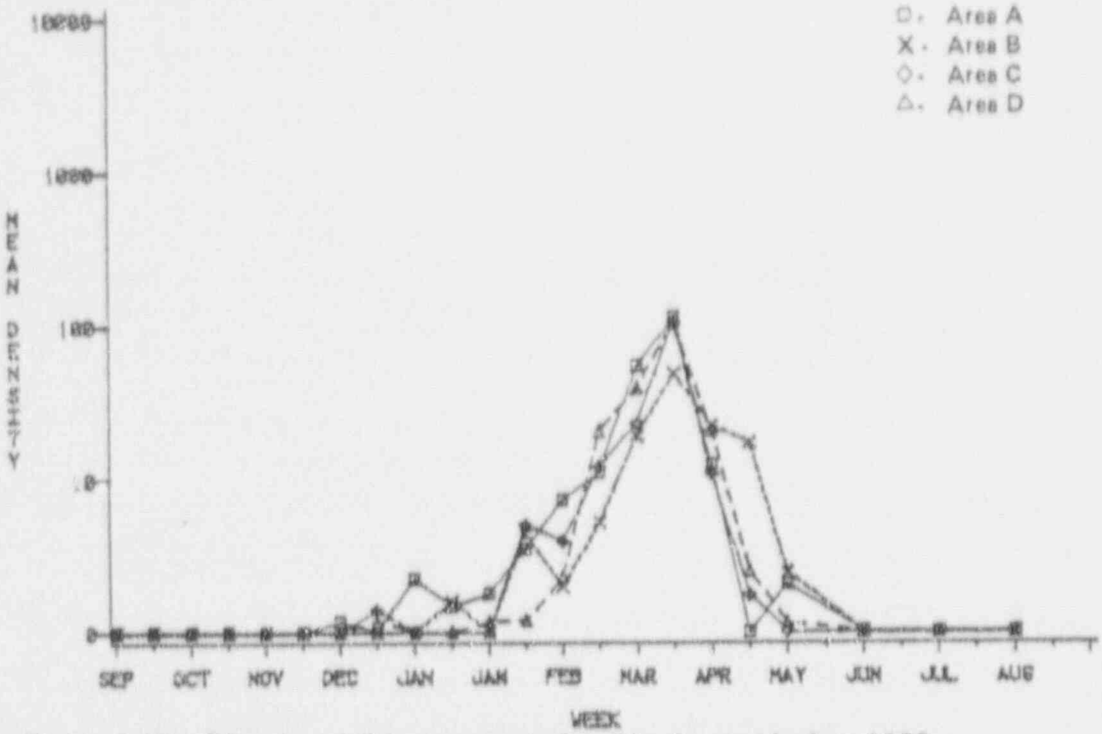


Figure 3.17 River larval fish, area mean densities for menhaden, 1982.

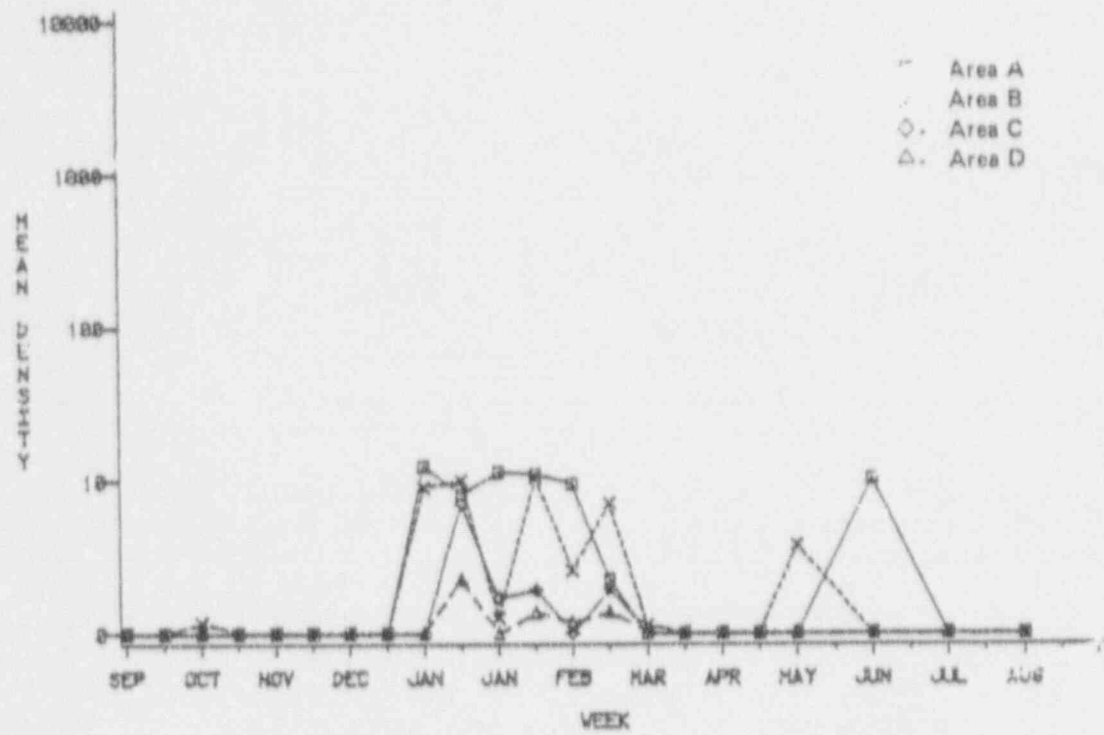


Figure 3.18 River larval fish, area mean densities for mullet, 1982.

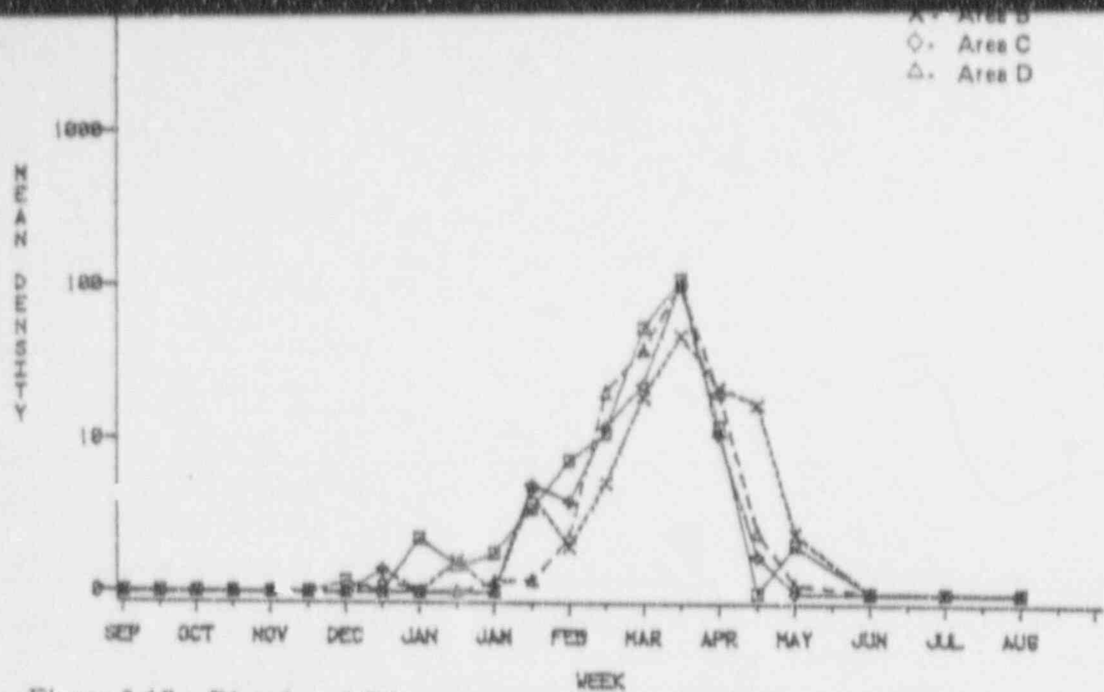


Figure 3.17 River larval fish, area mean densities for menhaden, 1982.

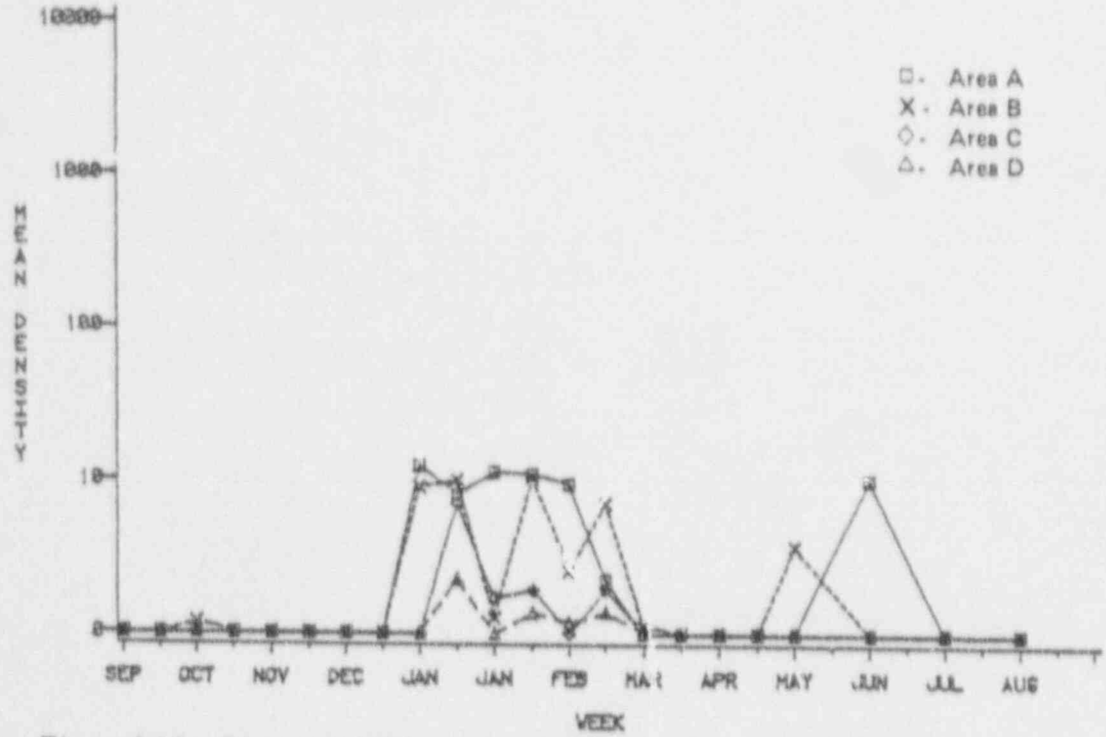


Figure 3.18 River larval fish, area mean densities for mullet, 1982.

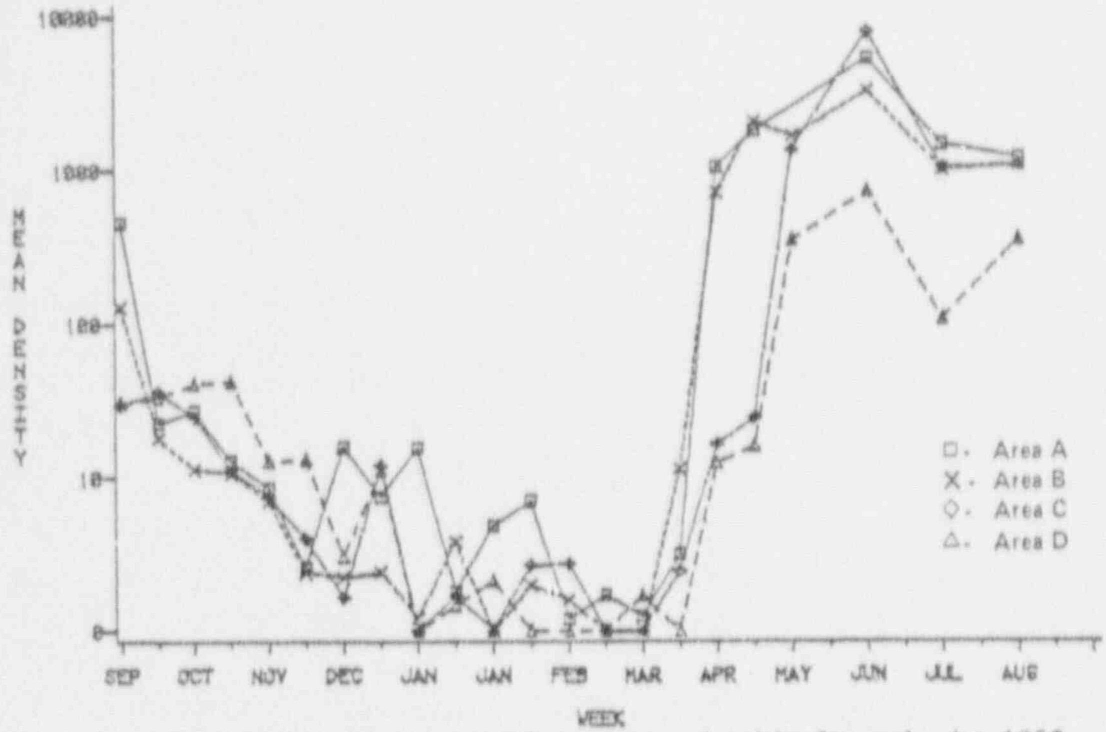


Figure 3.21 River larval fish, area mean densities for anchovies, 1982.

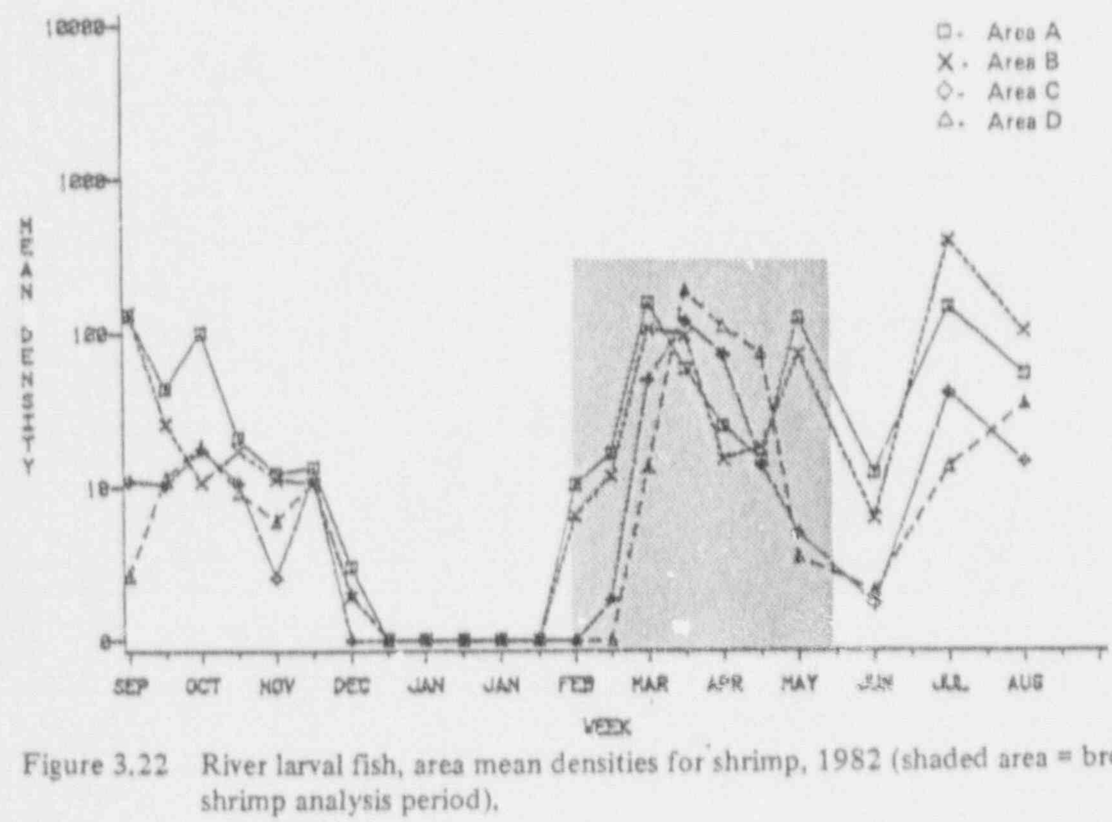


Figure 3.22 River larval fish, area mean densities for shrimp, 1982 (shaded area = brown shrimp analysis period).

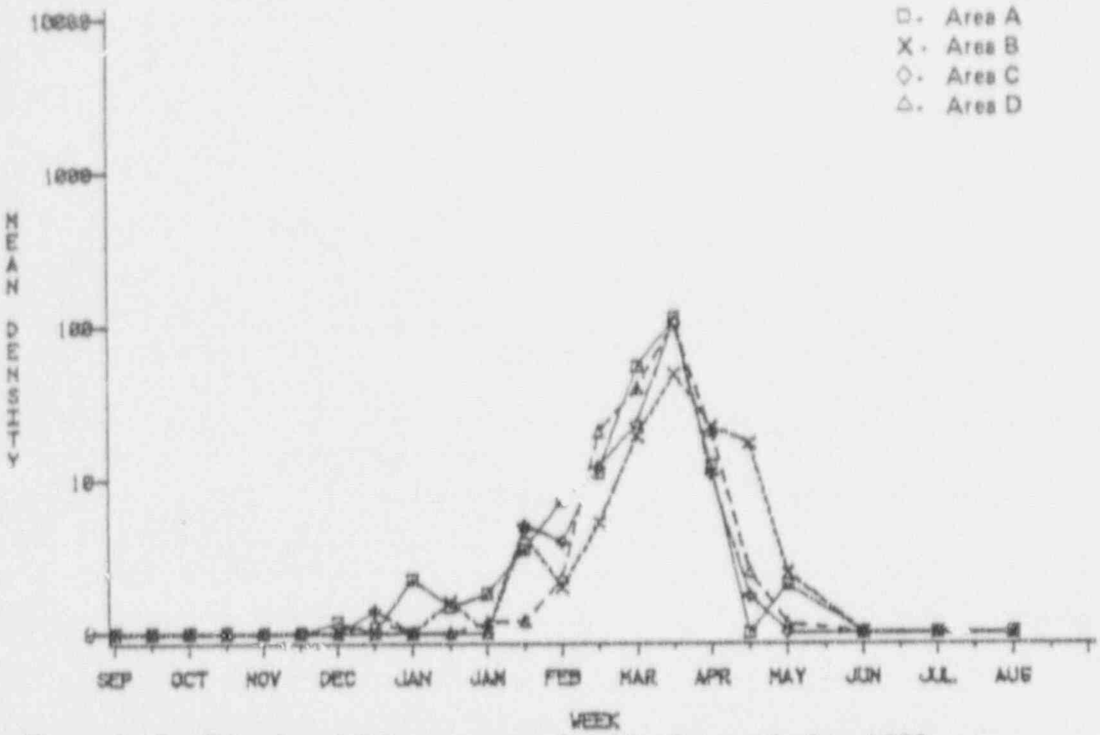


Figure 3.17 River larval fish, area mean densities for menhaden, 1982.

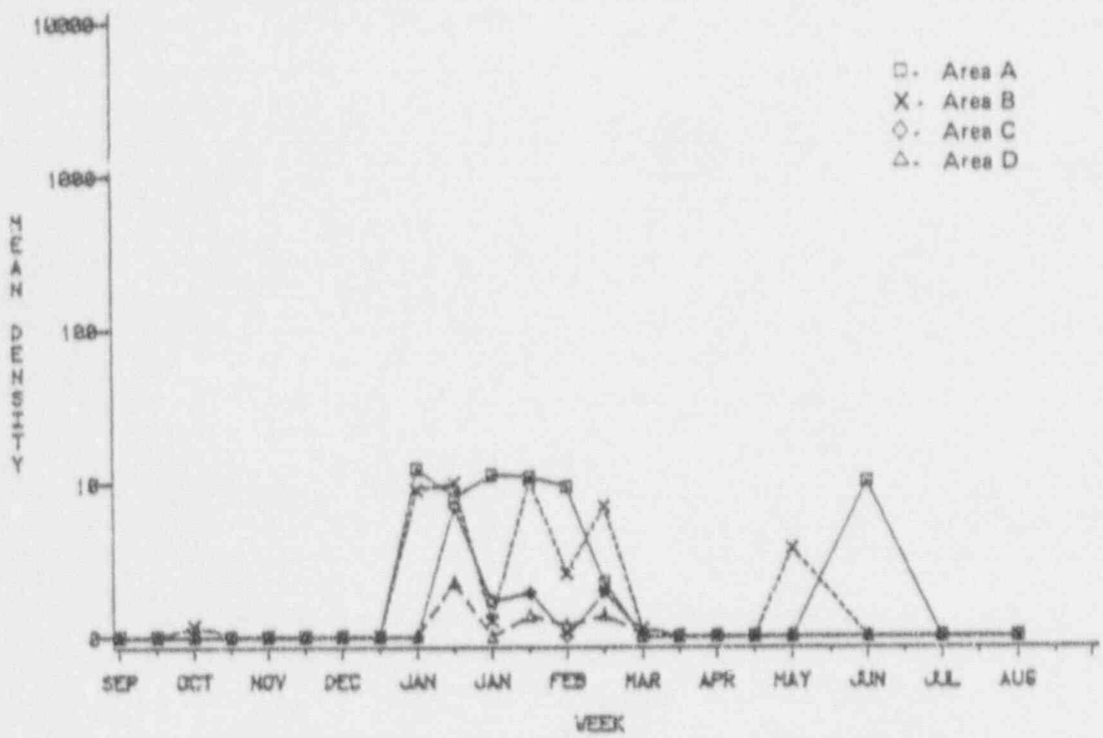


Figure 3.18 River larval fish, area mean densities for mullet, 1982.

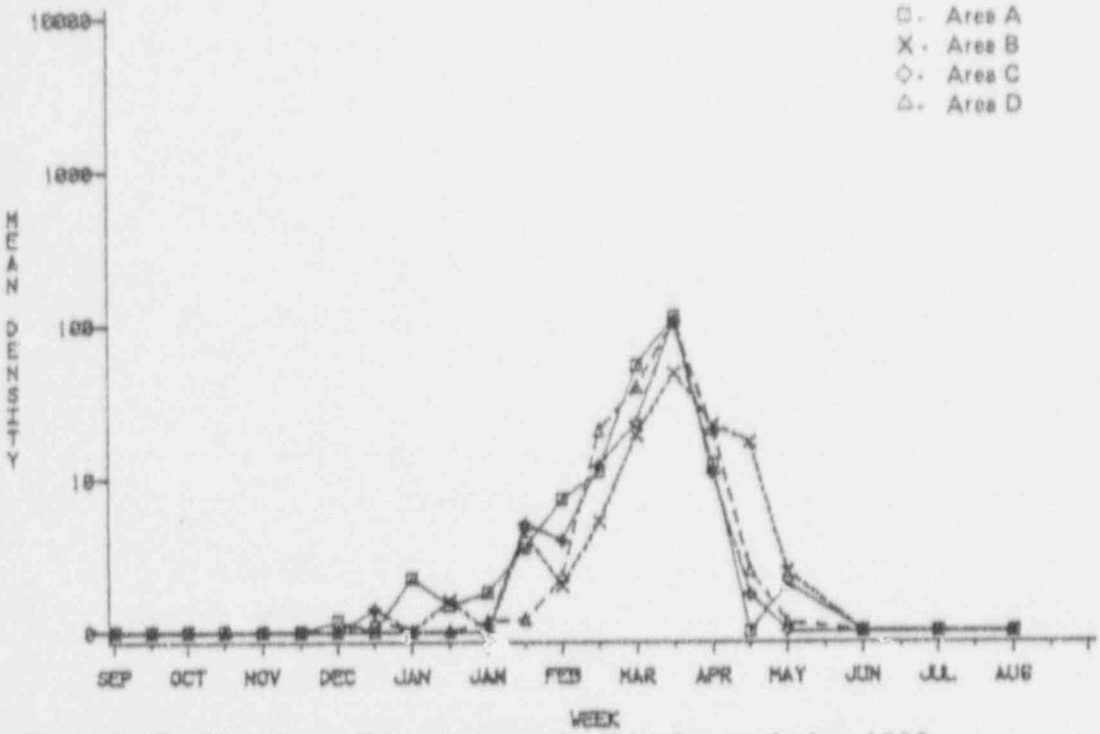


Figure 3.17 River larval fish, area mean densities for menhaden, 1982.

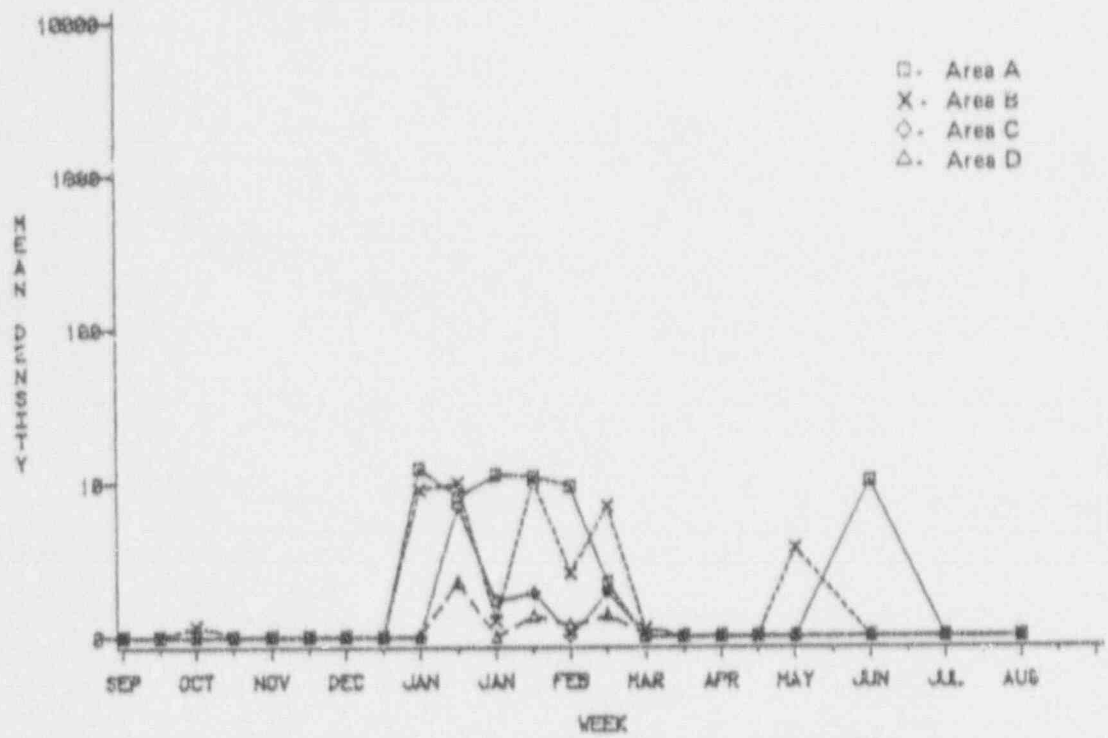


Figure 3.18 River larval fish, area mean densities for mullet, 1982.

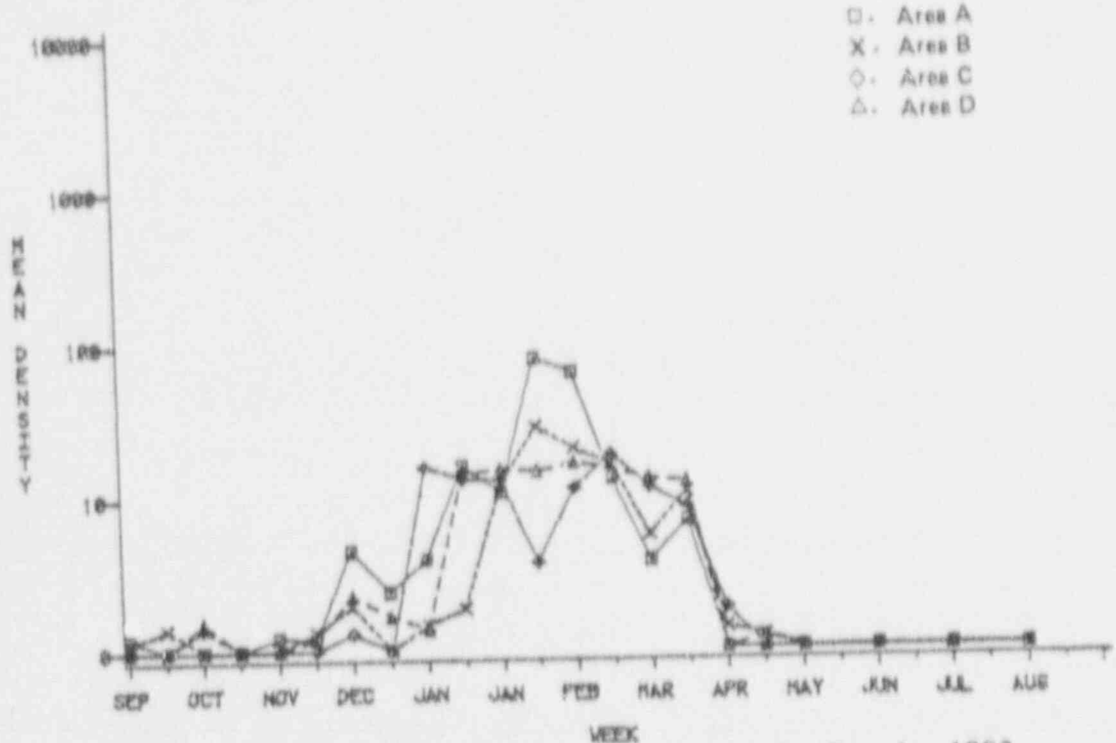


Figure 3.19 River larval fish, area mean densities for flounder, 1982.

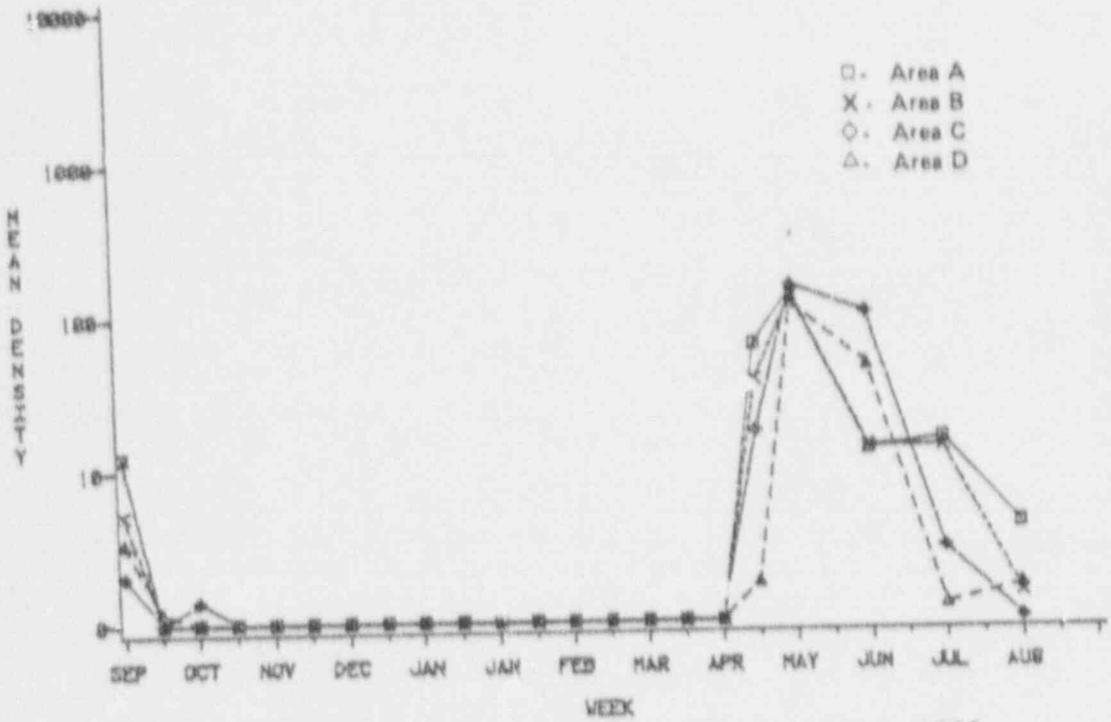


Figure 3.20 River larval fish, area mean densities for seatrout, 1982.

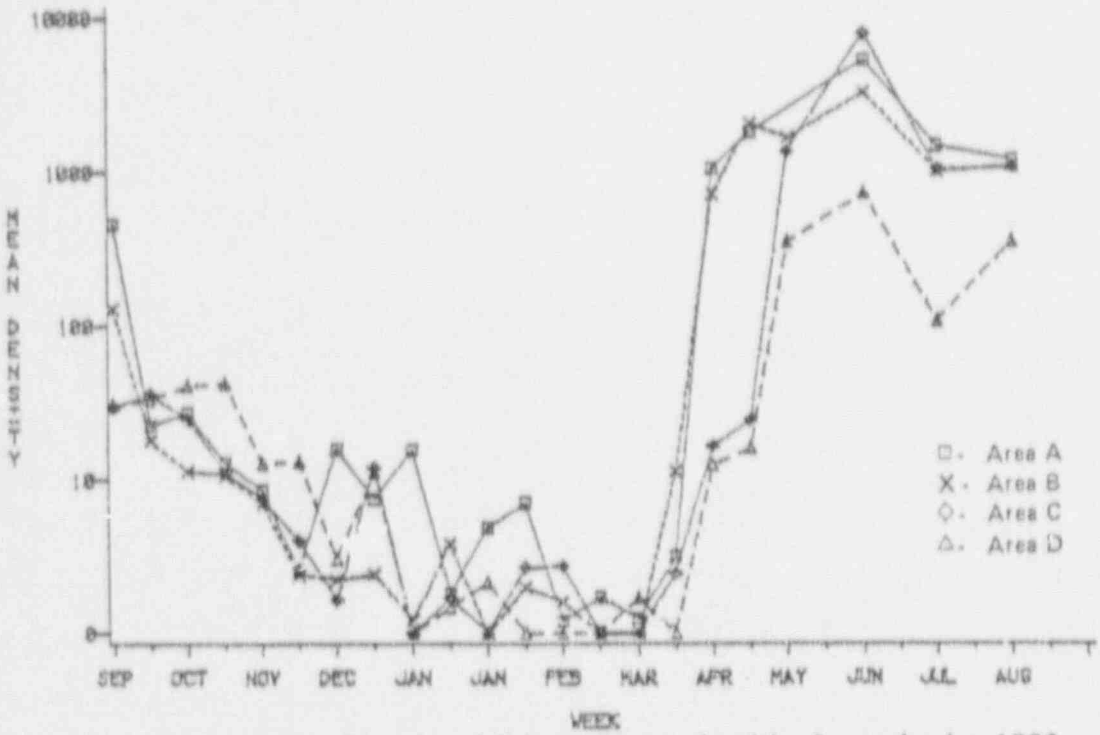


Figure 3.21 River larval fish, area mean densities for anchovies, 1982.

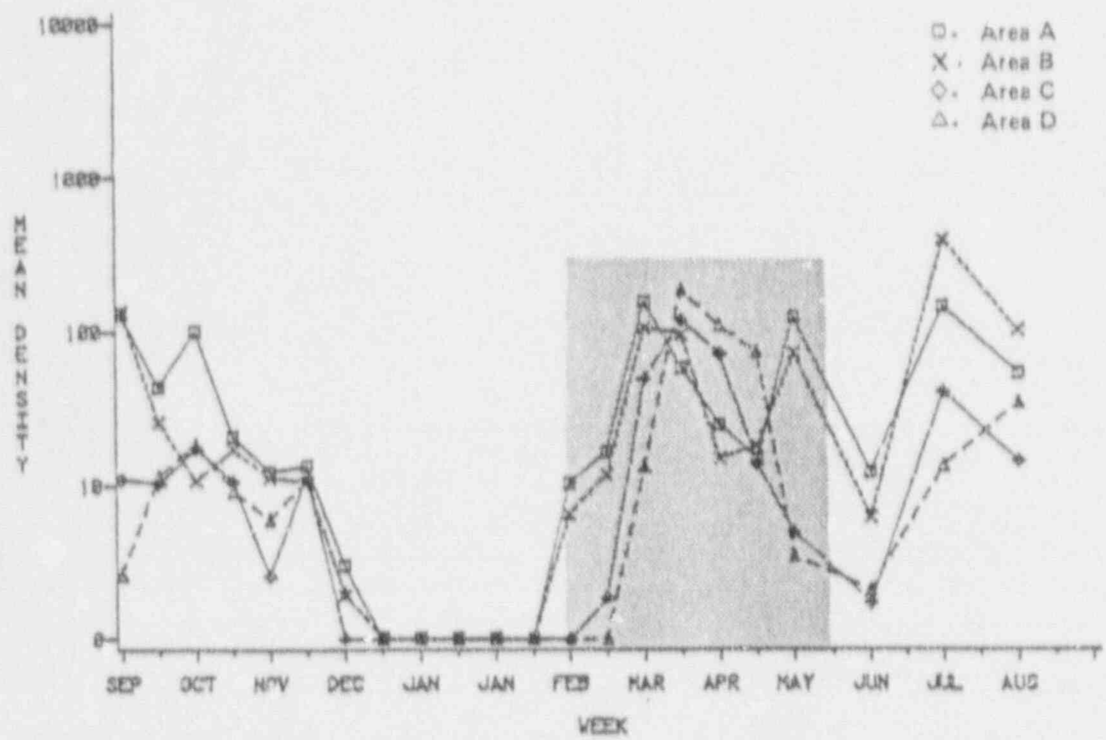


Figure 3.22 River larval fish, area mean densities for shrimp, 1982 (shaded area = brown shrimp analysis period).

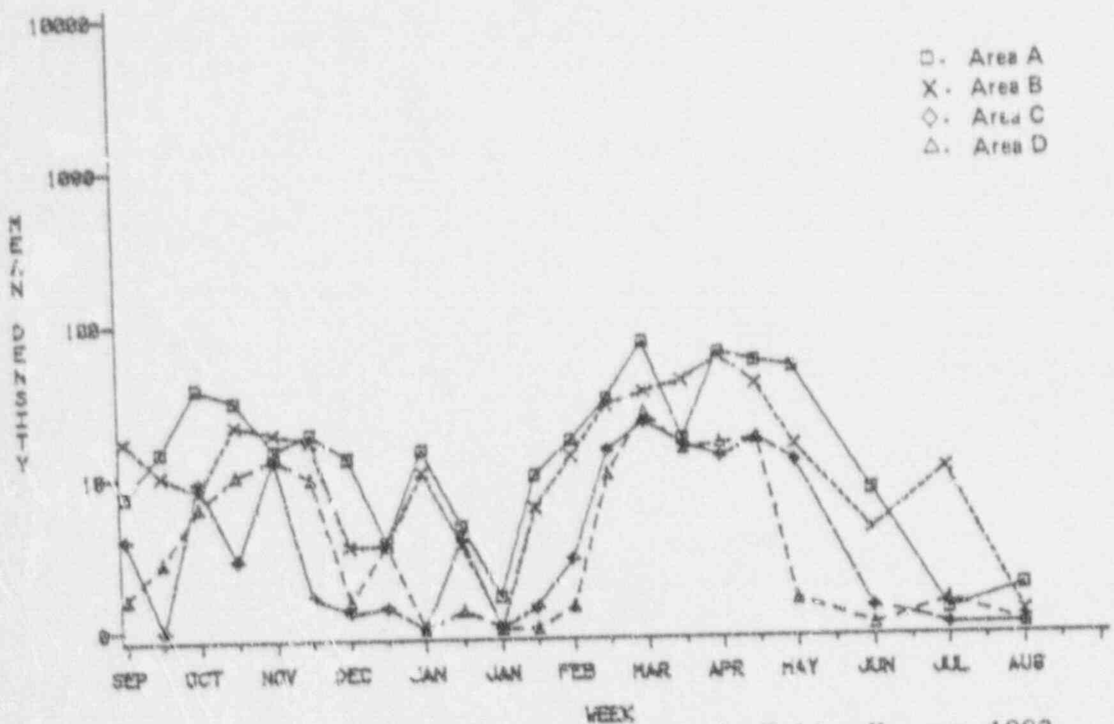


Figure 3.23 River larval fish, area mean densities for Gobionellus spp., 1982.

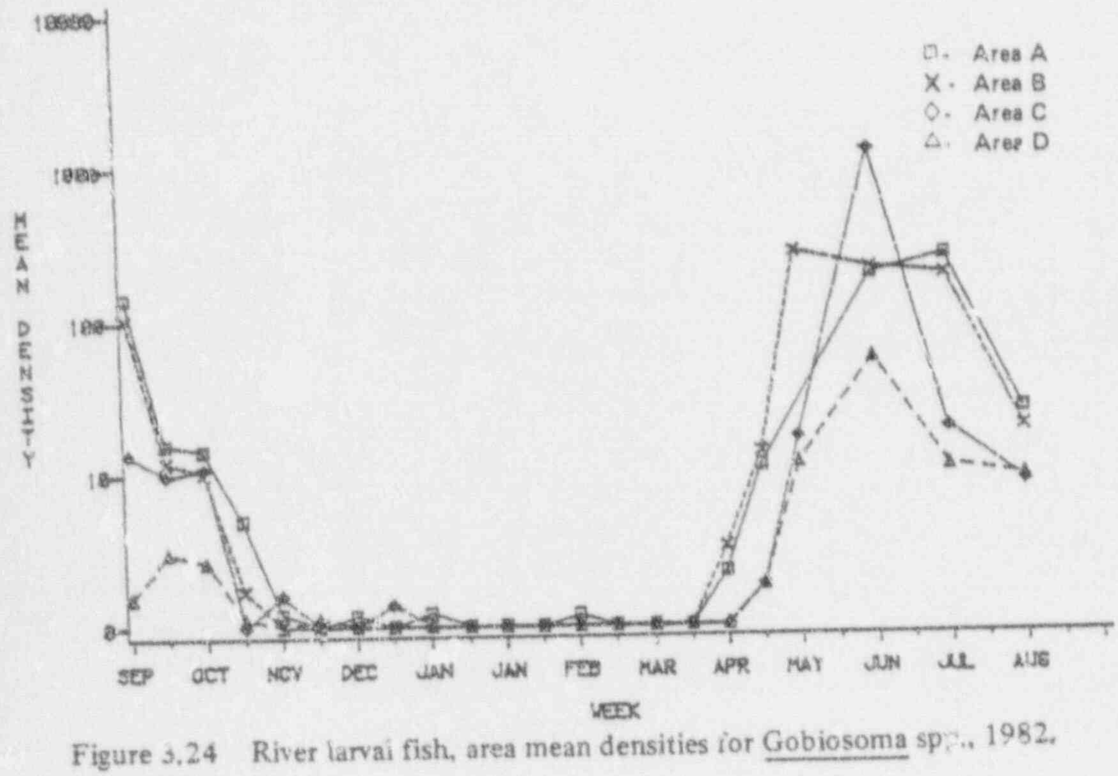


Figure 3.24 River larval fish, area mean densities for Gobiosoma spp., 1982.

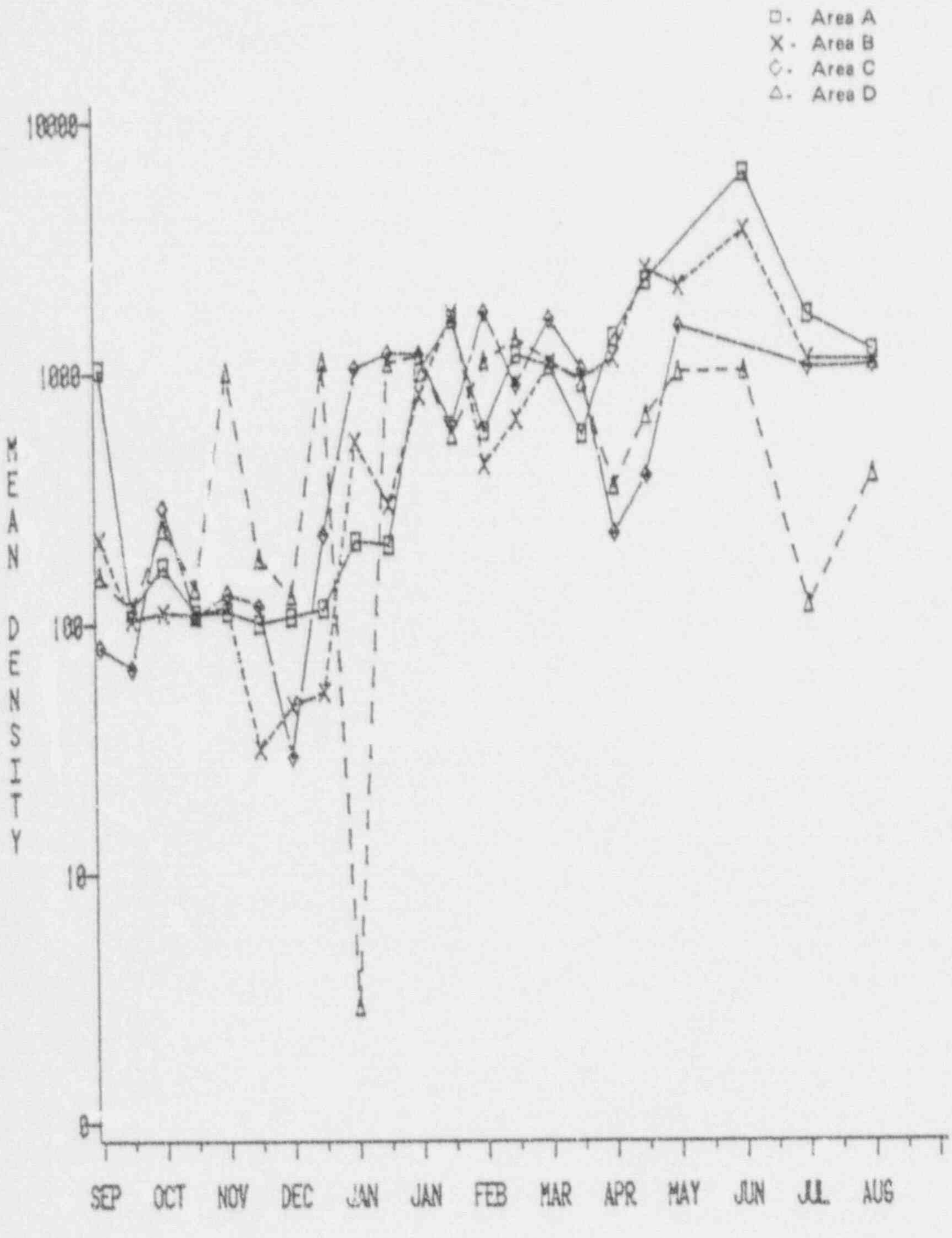


Figure 3.25 River larval fish, area densities for total fish, 1982.

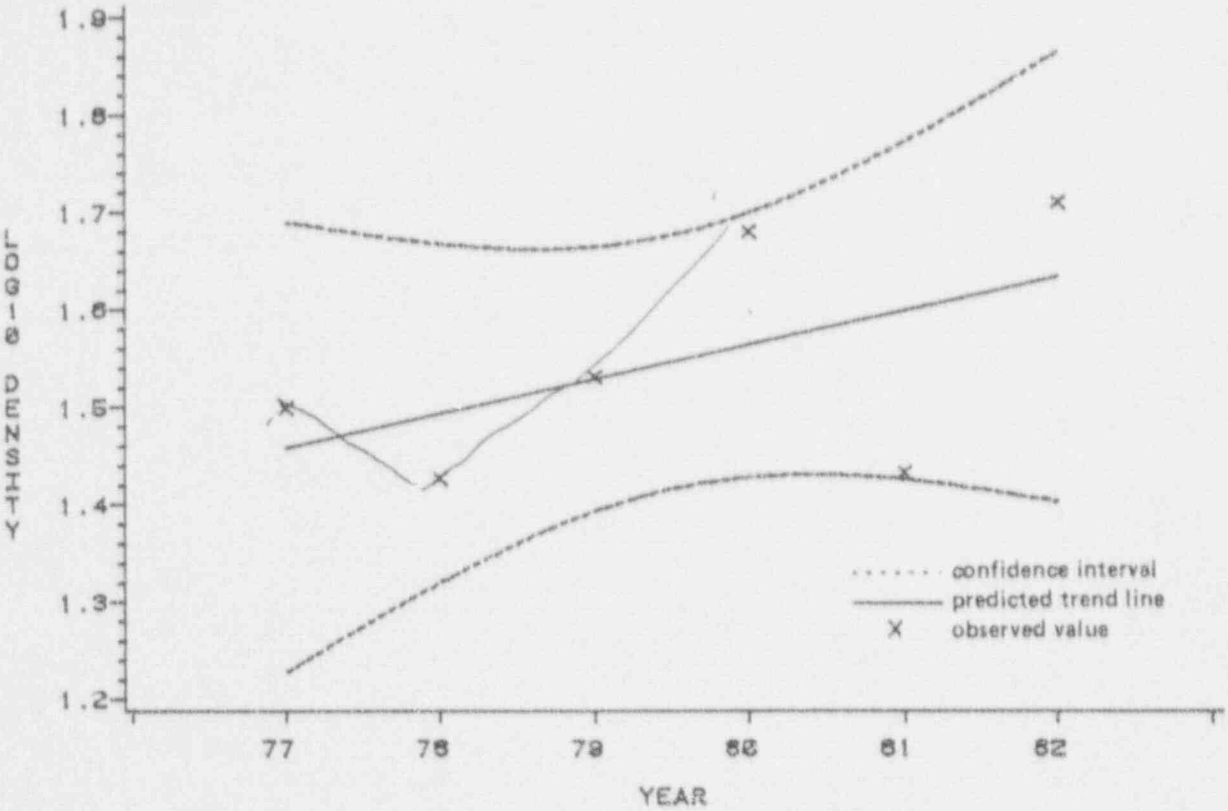


Figure 3.26 River larval fish trend analysis for spot.

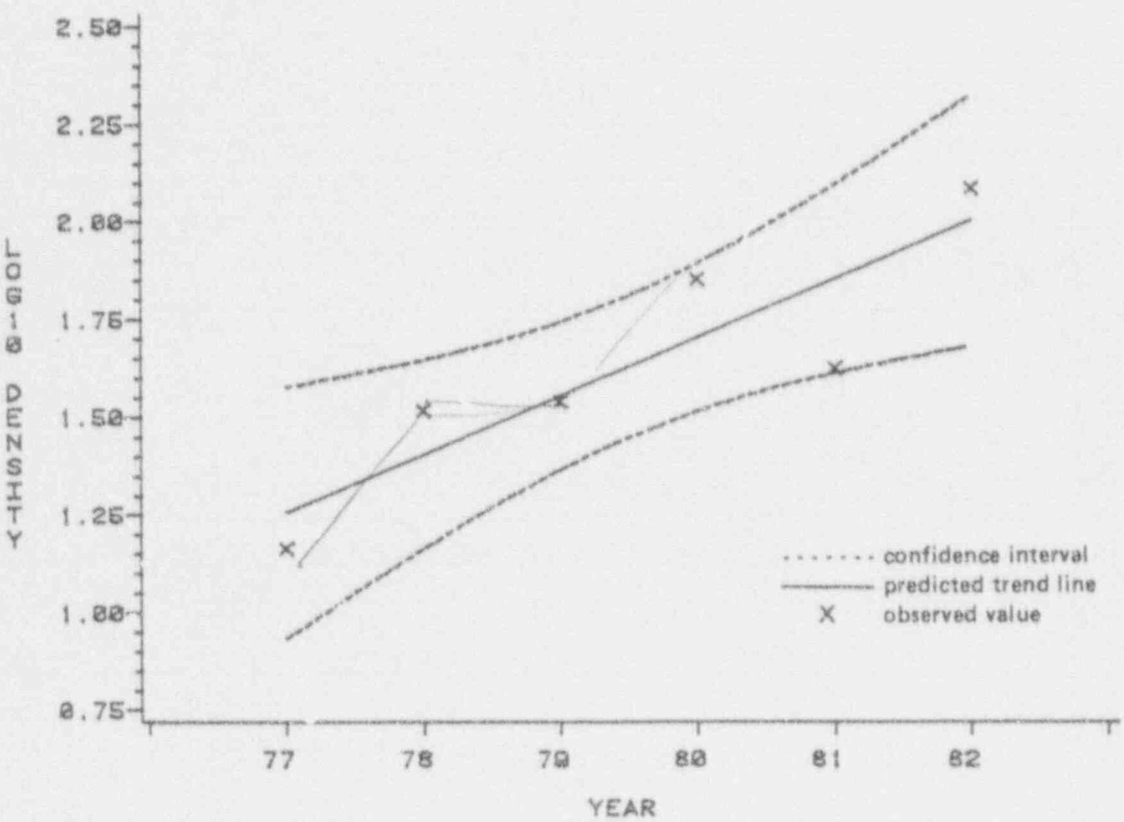


Figure 3.27 River larval fish trend analysis for croaker.

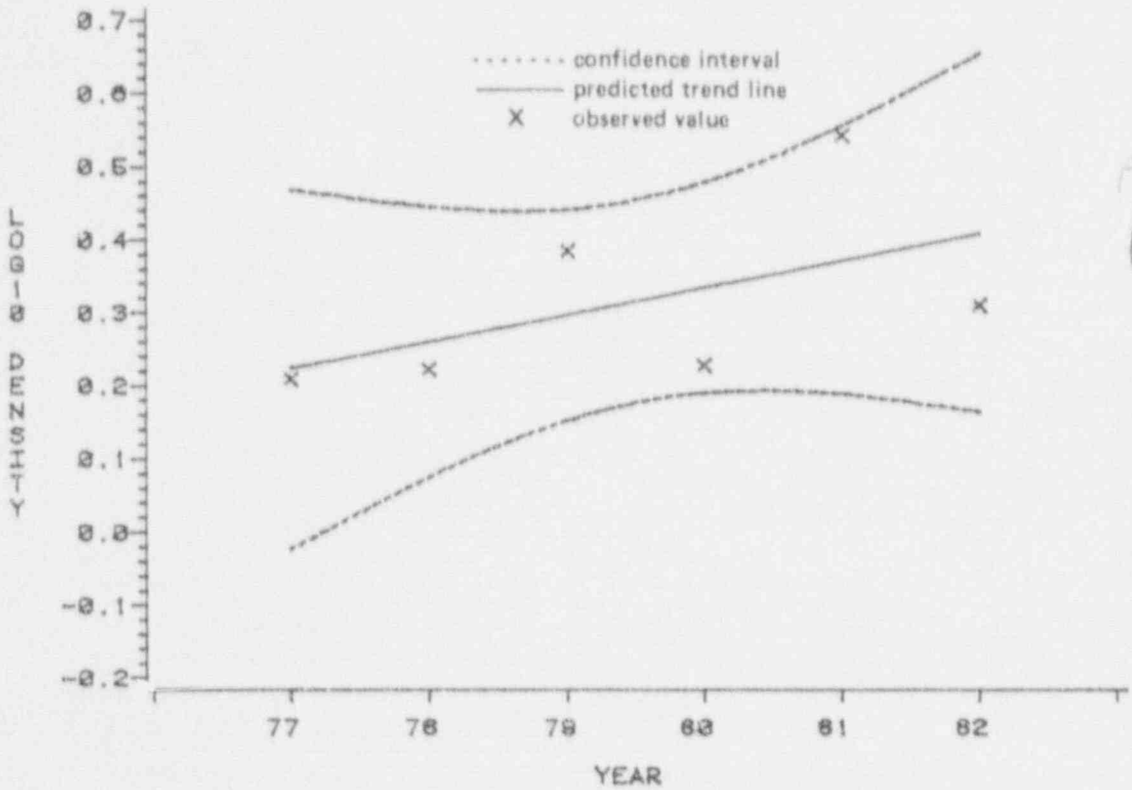


Figure 3.28 River larval fish trend analysis for mullet.

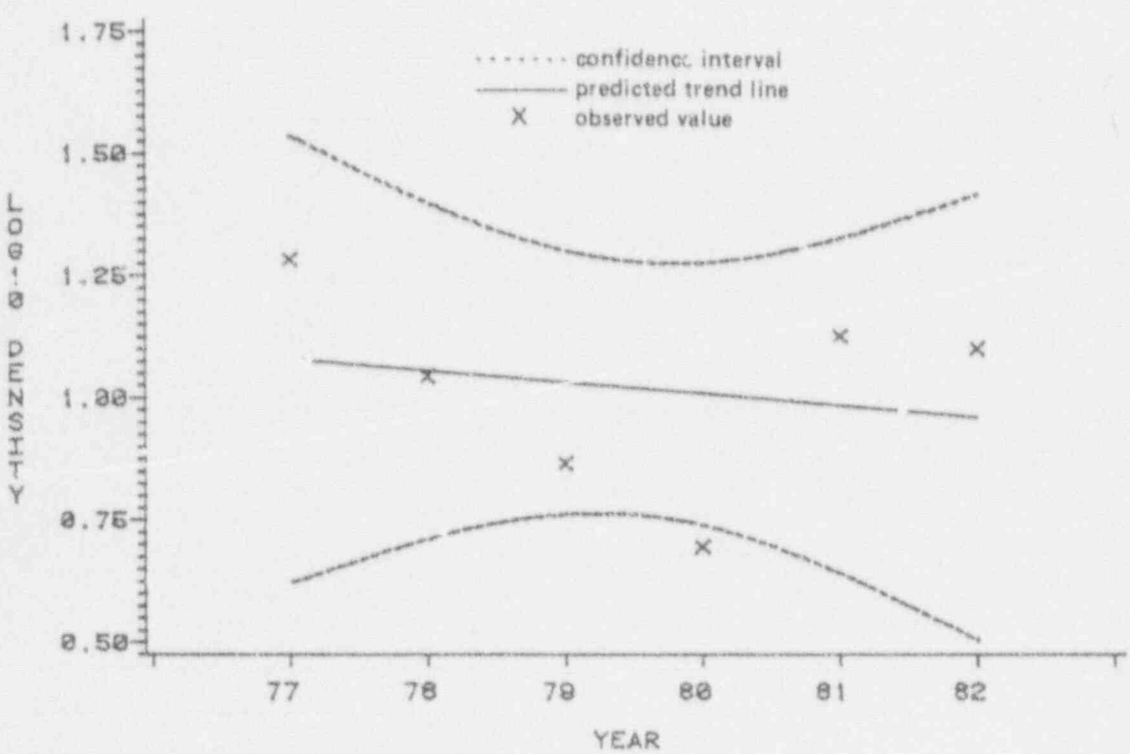


Figure 3.29 River larval fish trend analysis for menhaden.

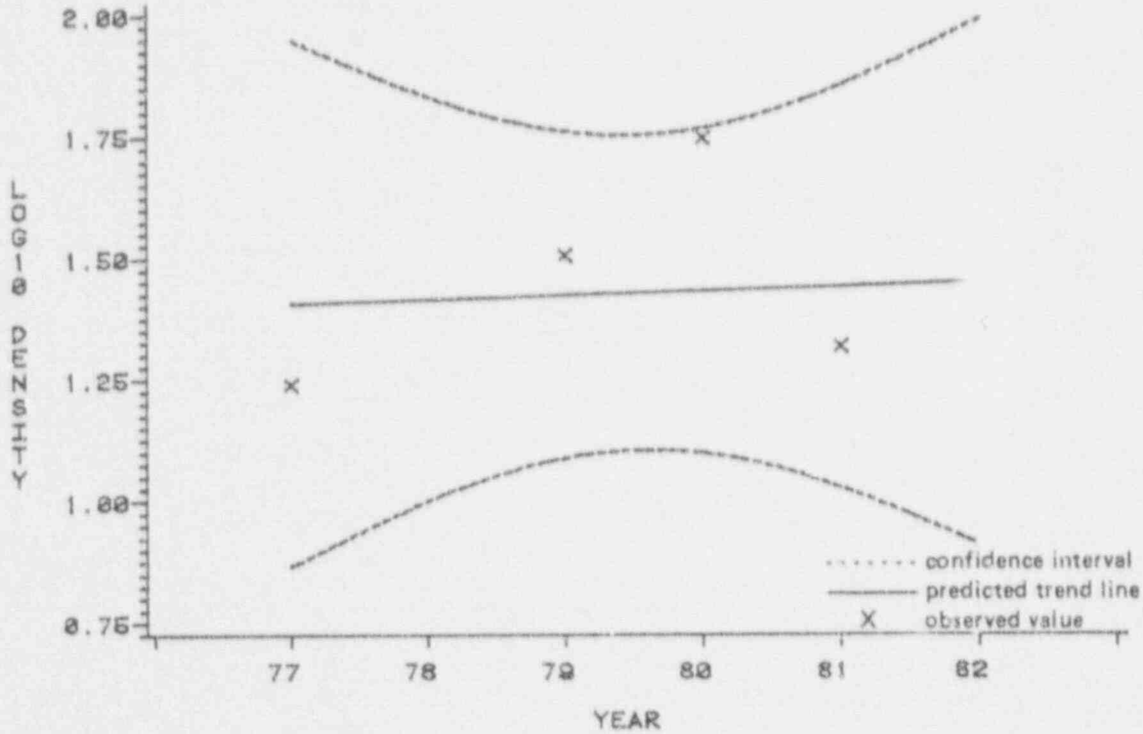


Figure 3.30 River larval fish trend analysis for pink & white shrimp.

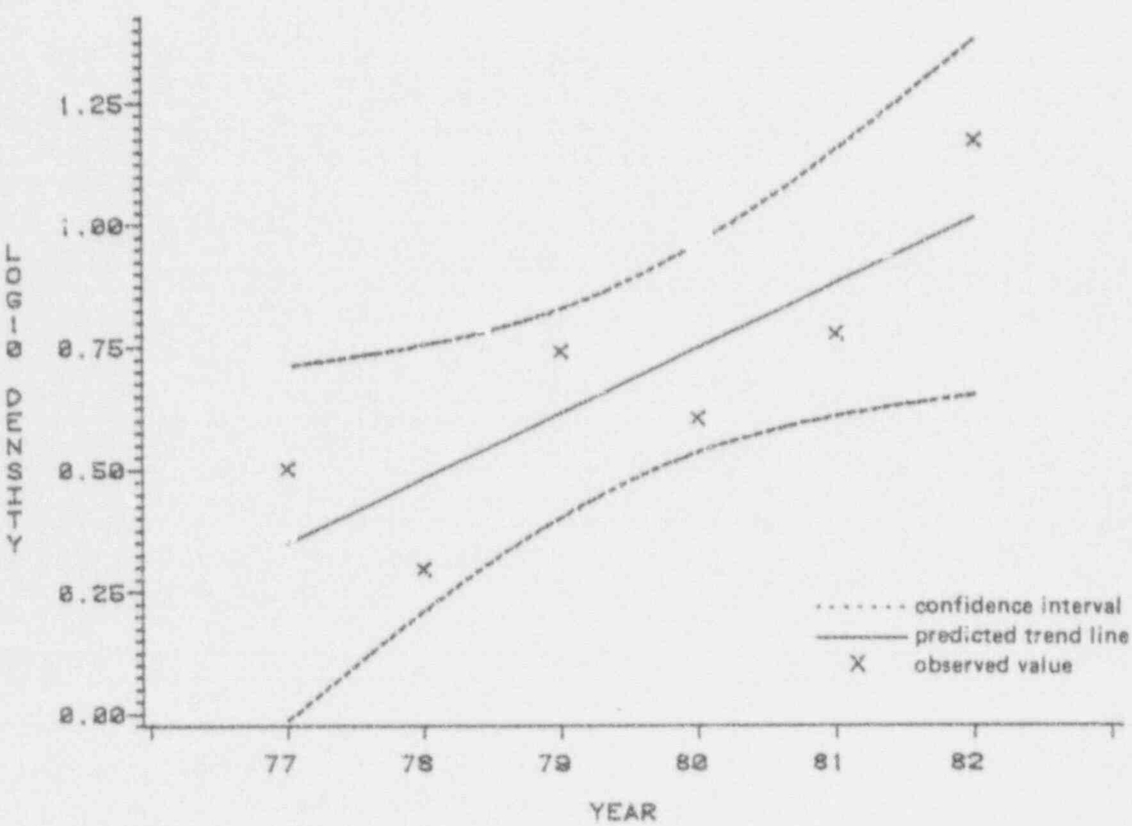


Figure 3.31 River larval fish trend analysis for brown shrimp.

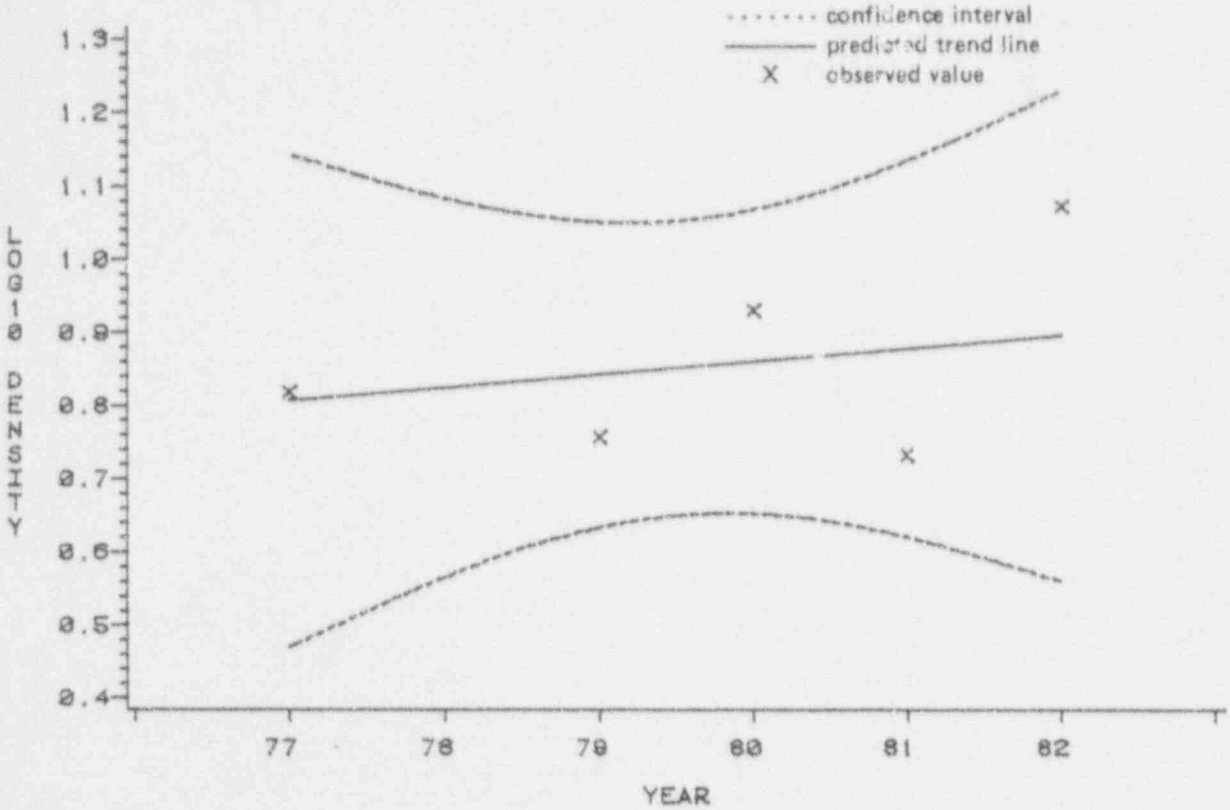


Figure 3.32 River larval fish trend analysis for seatrout.

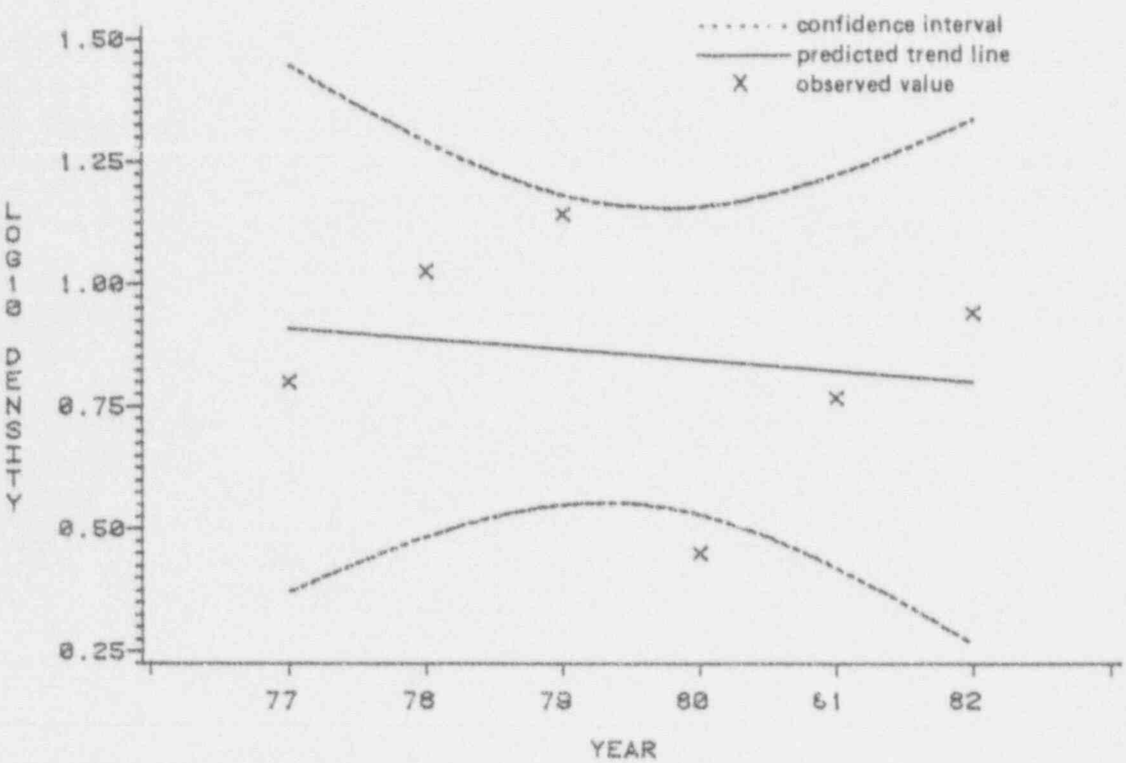


Figure 3.33 River larval fish trend analysis for flounder.

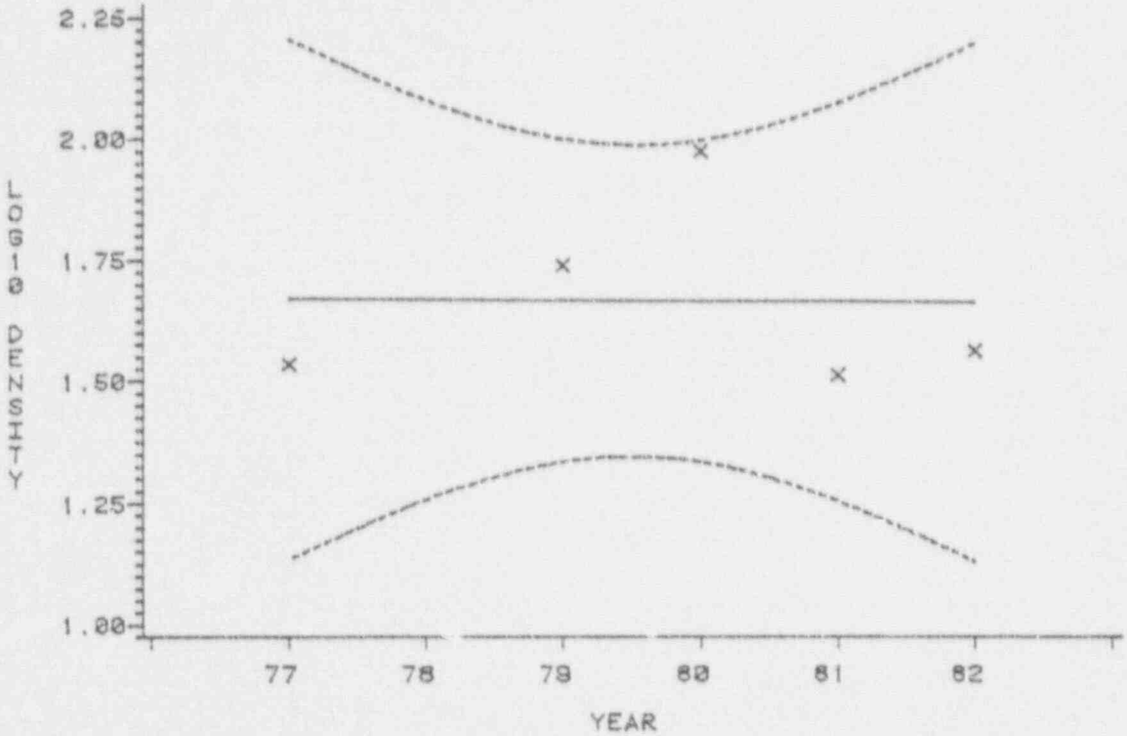


Figure 3.34 River larval fish trend analysis for Gobiosoma spp..

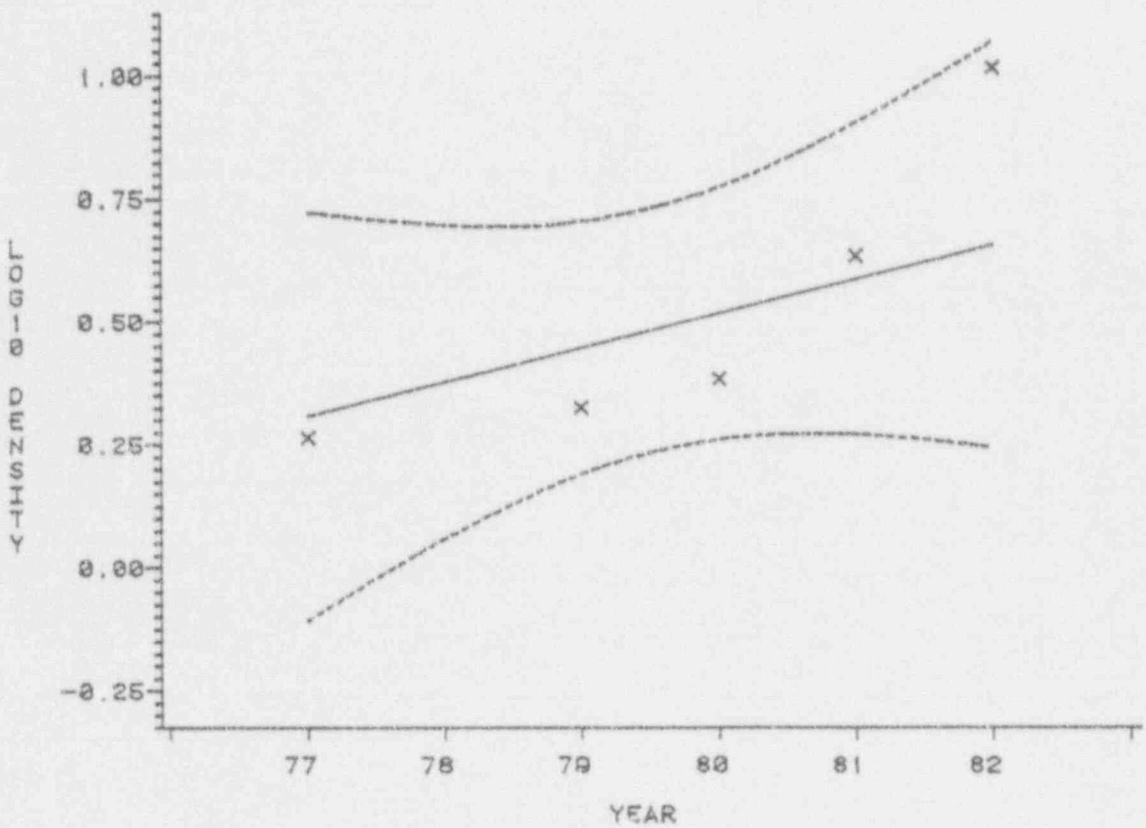


Figure 3.35 River larval fish trend analysis for Gobionellus spp..

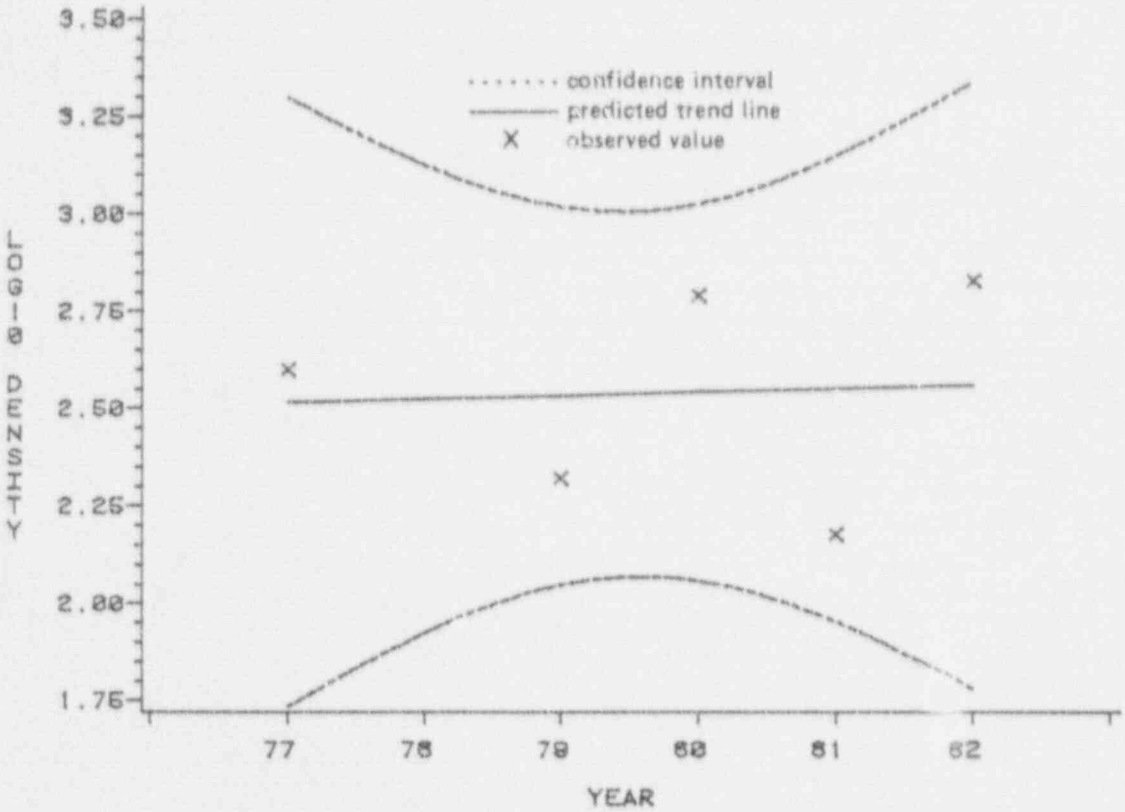


Figure 3.36 River larval fish trend analysis for anchovies.

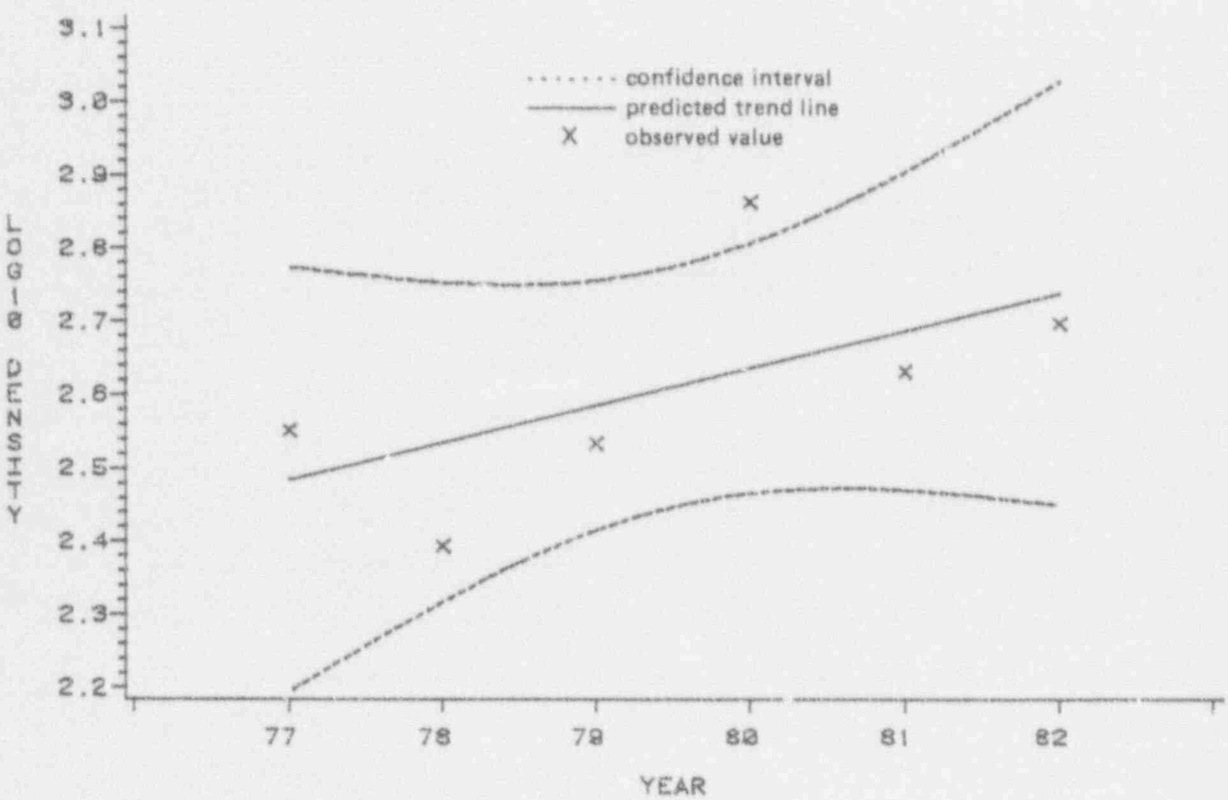


Figure 3.37 River larval fish trend analysis for total fish.

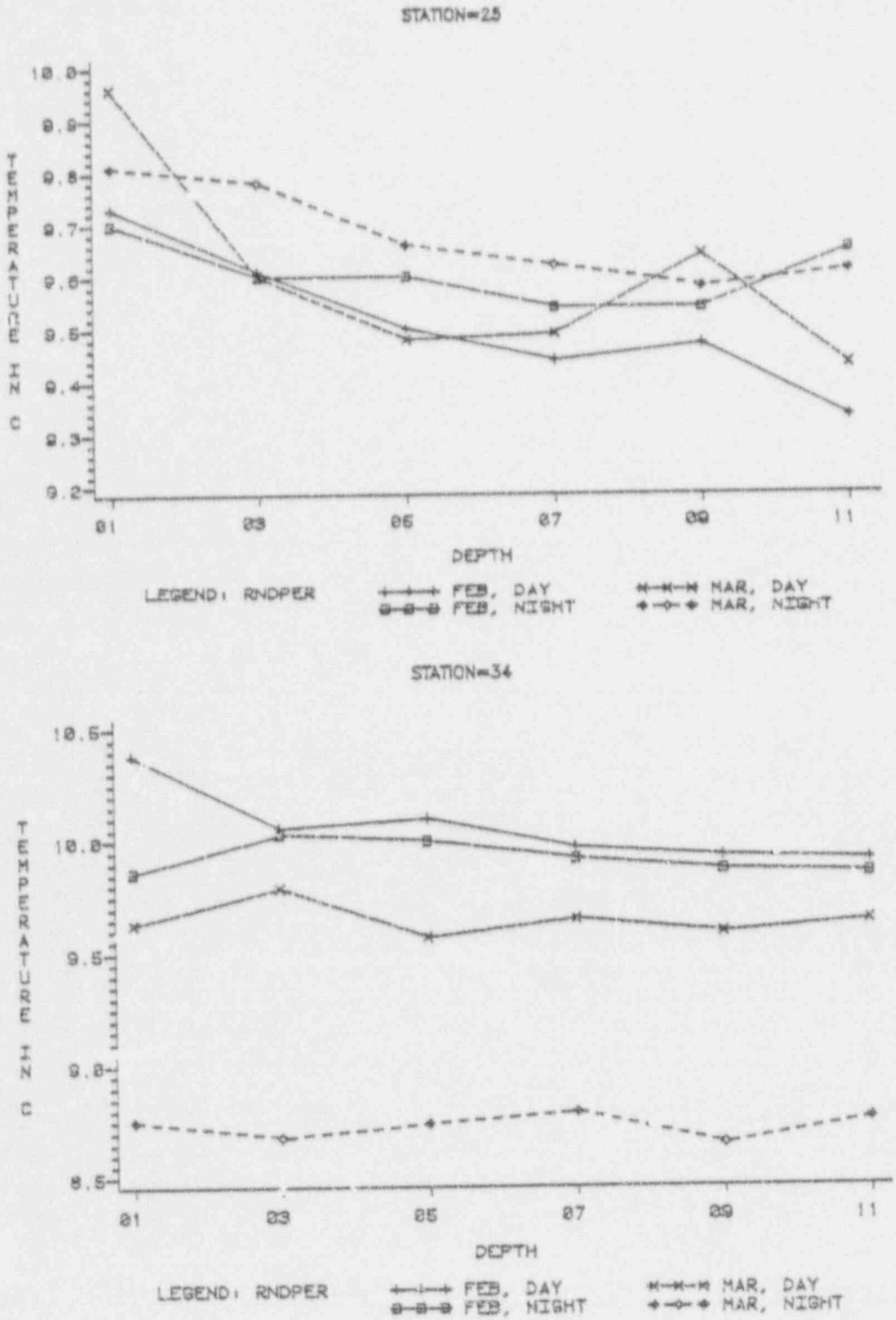


Figure 3.38 Discrete depth sampling temperature profiles, 1982.

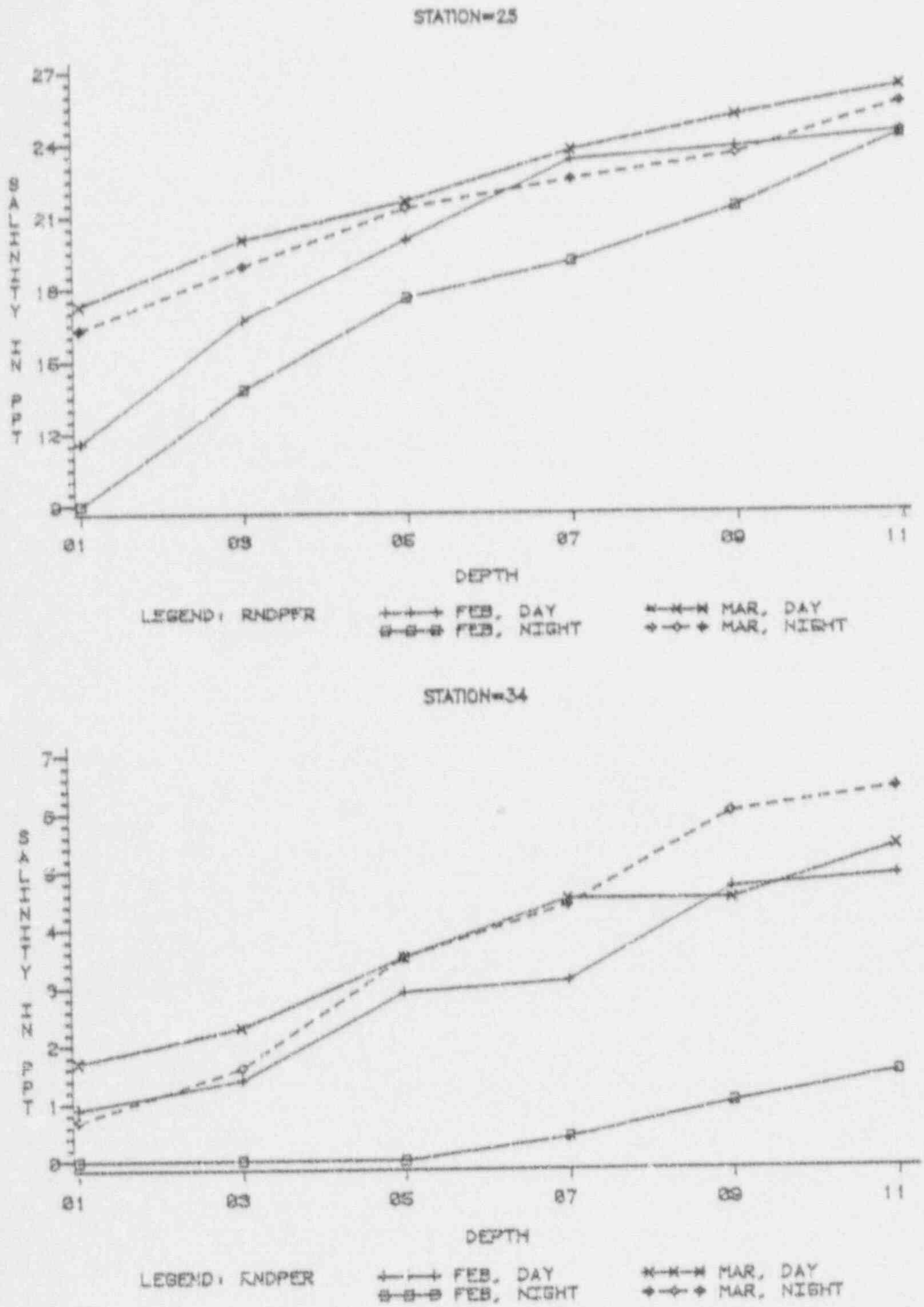


Figure 3.39 Discrete depth sampling salinity profiles, 1982.

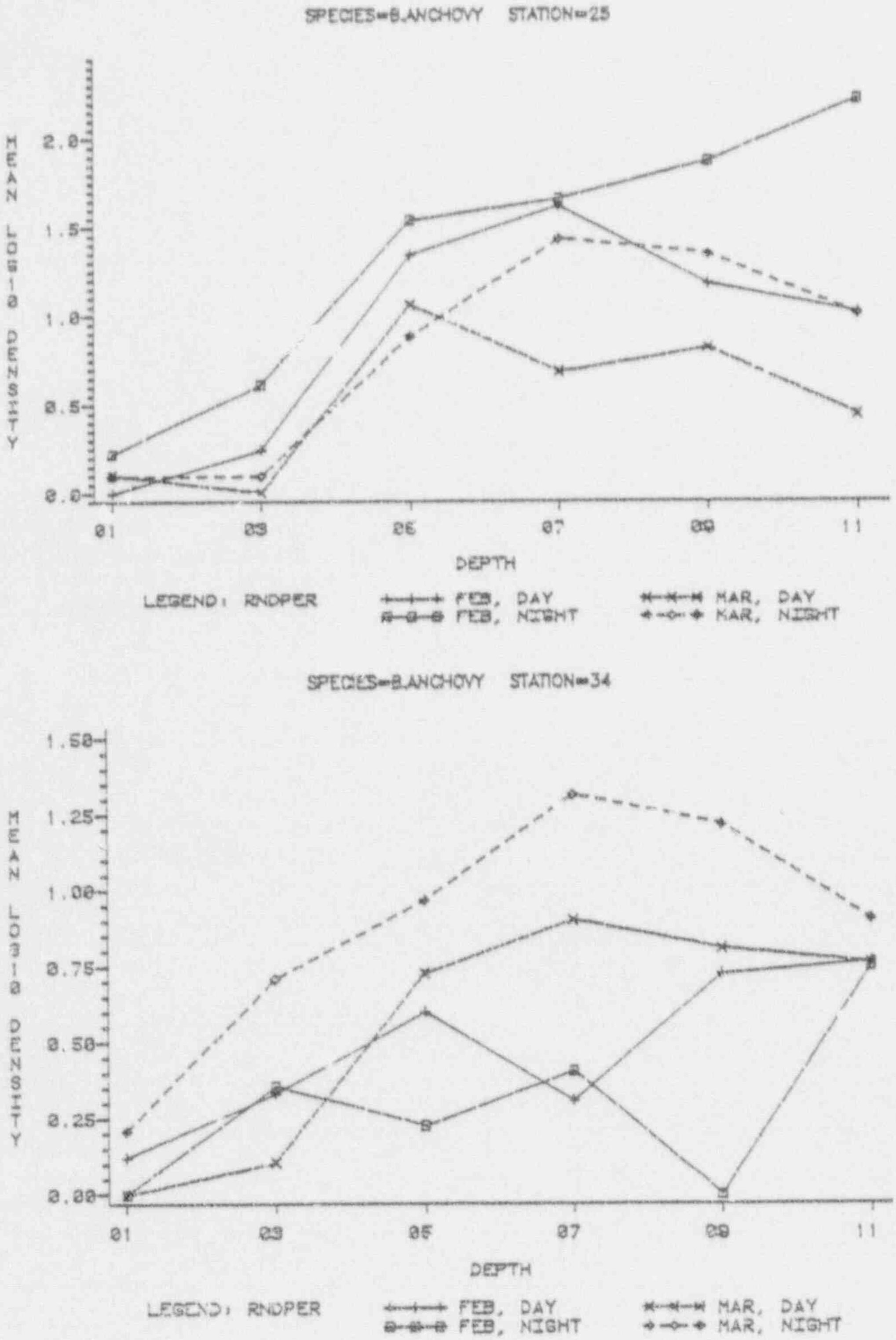


Figure 3.40 Discrete depth sampling density profiles, bay anchovy, 1982.

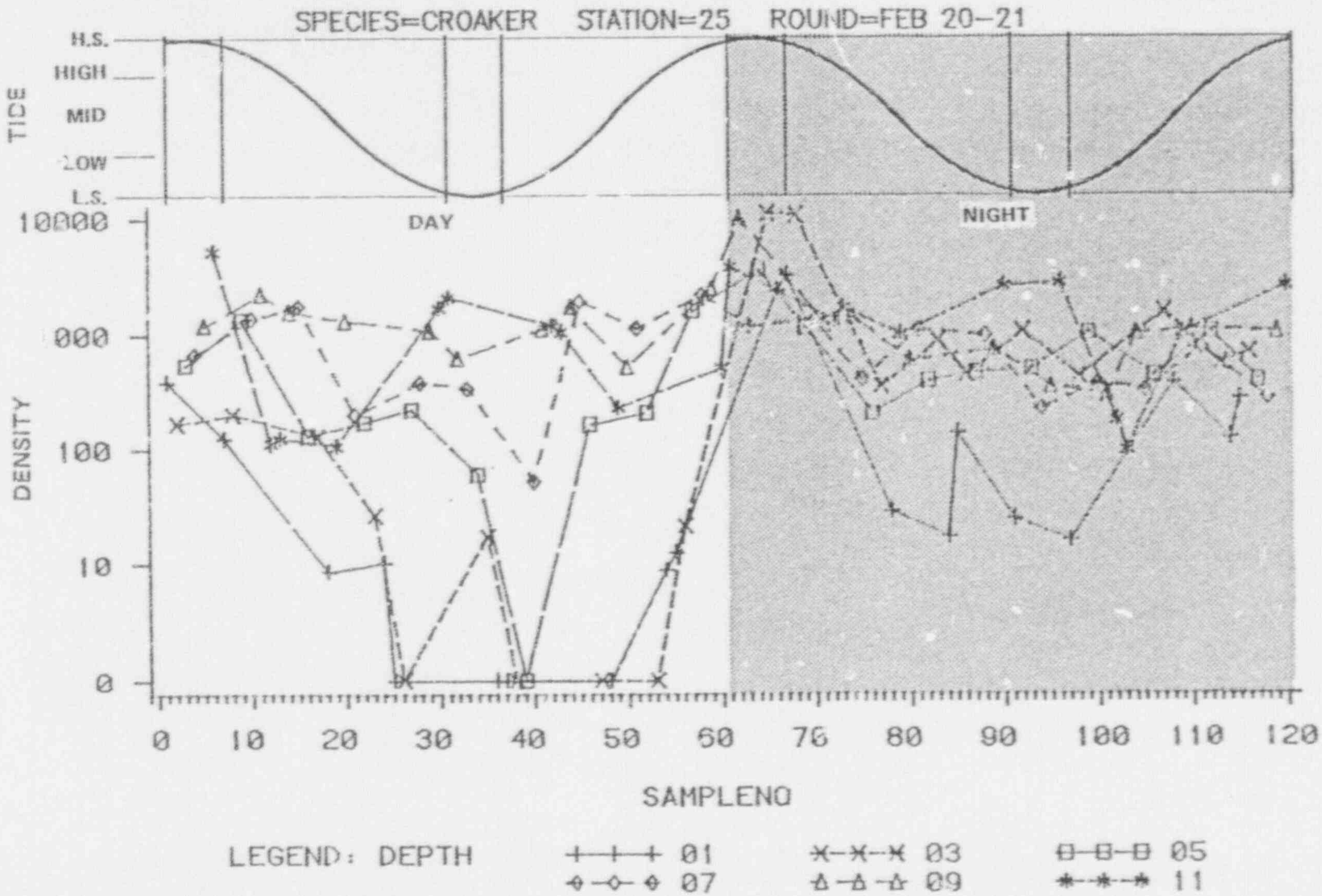


Figure 3.41 Discrete depth sampling density profiles, croaker, 1982 (Sheet 1 of 5).

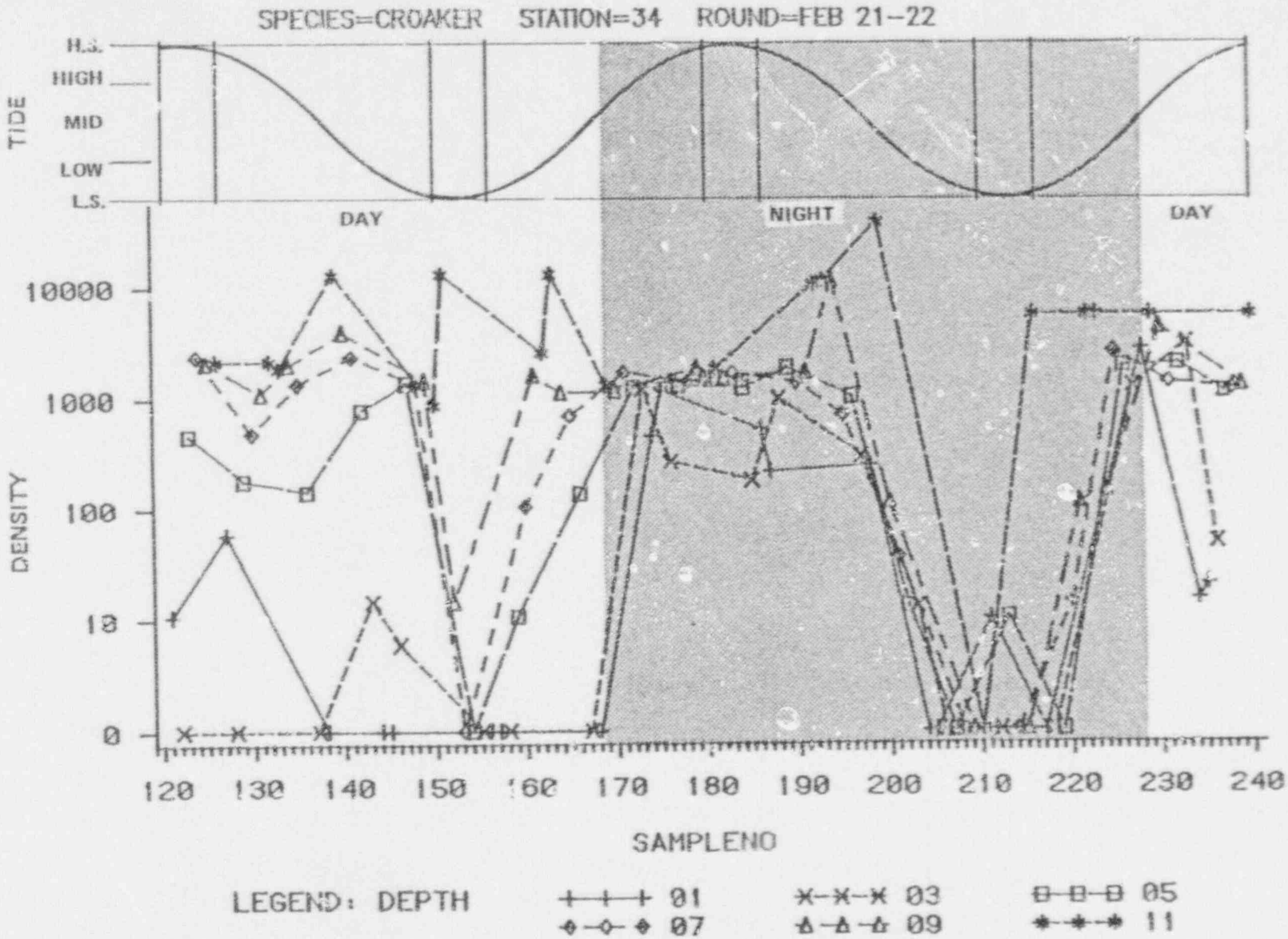


Figure 3.41 Discrete depth sampling density profiles, croaker, 1982 (Sheet 2 of 5).

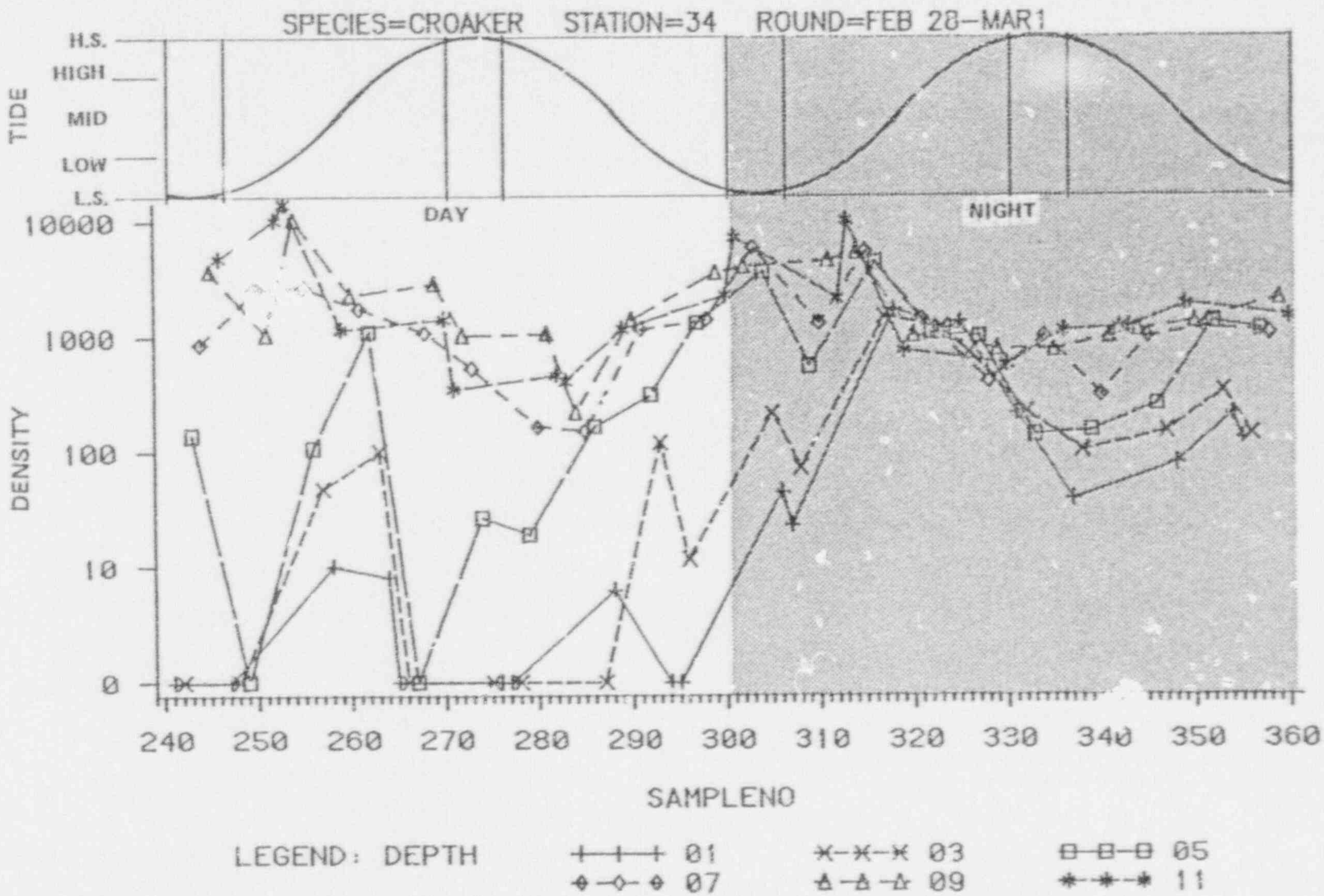


Figure 3.41 Discrete depth sampling density profiles, croaker, 1982 (Sheet 3 of 5).

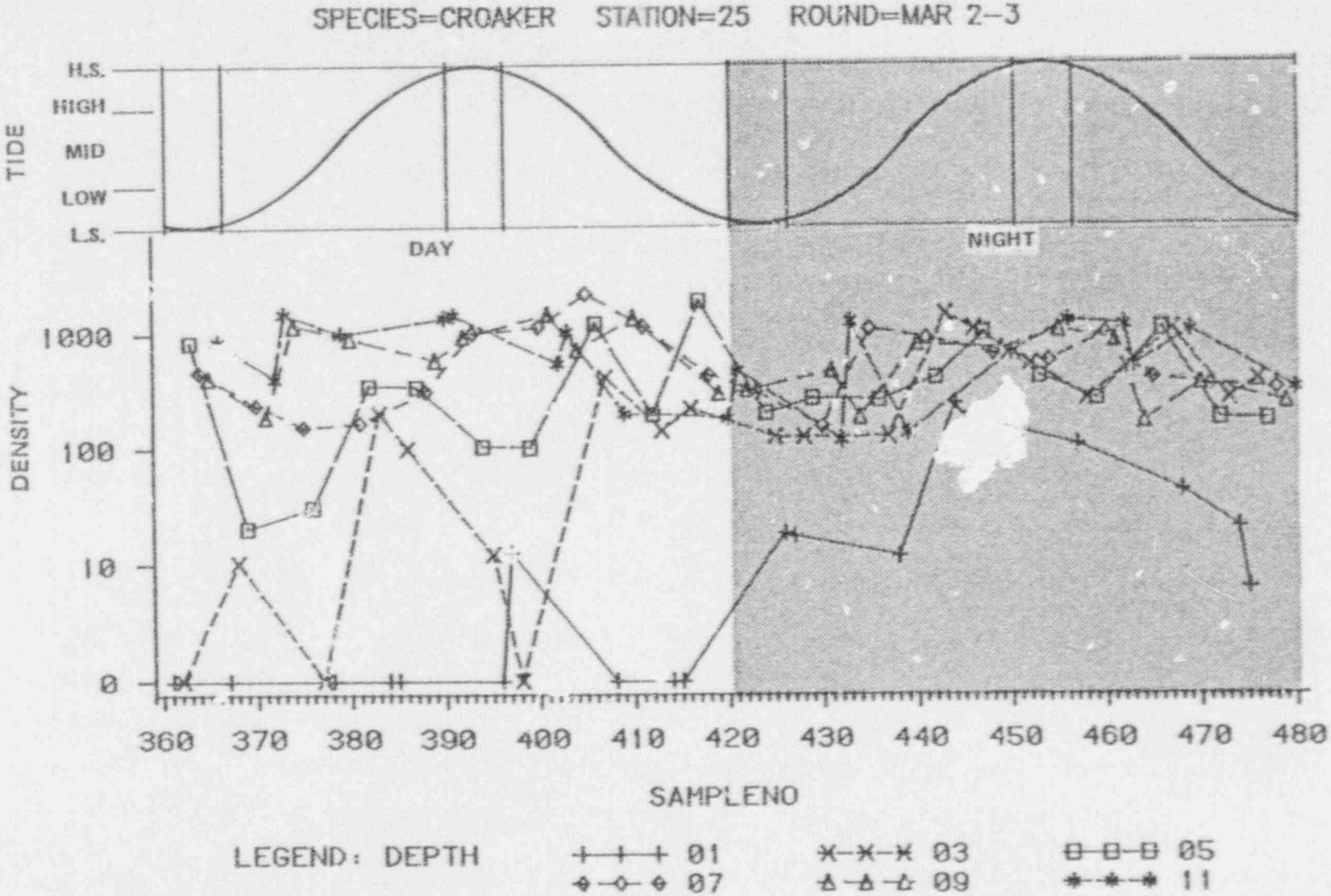


Figure 3.41 Discrete depth sampling density profiles, croaker, 1982 (Sheet 4 of 5).

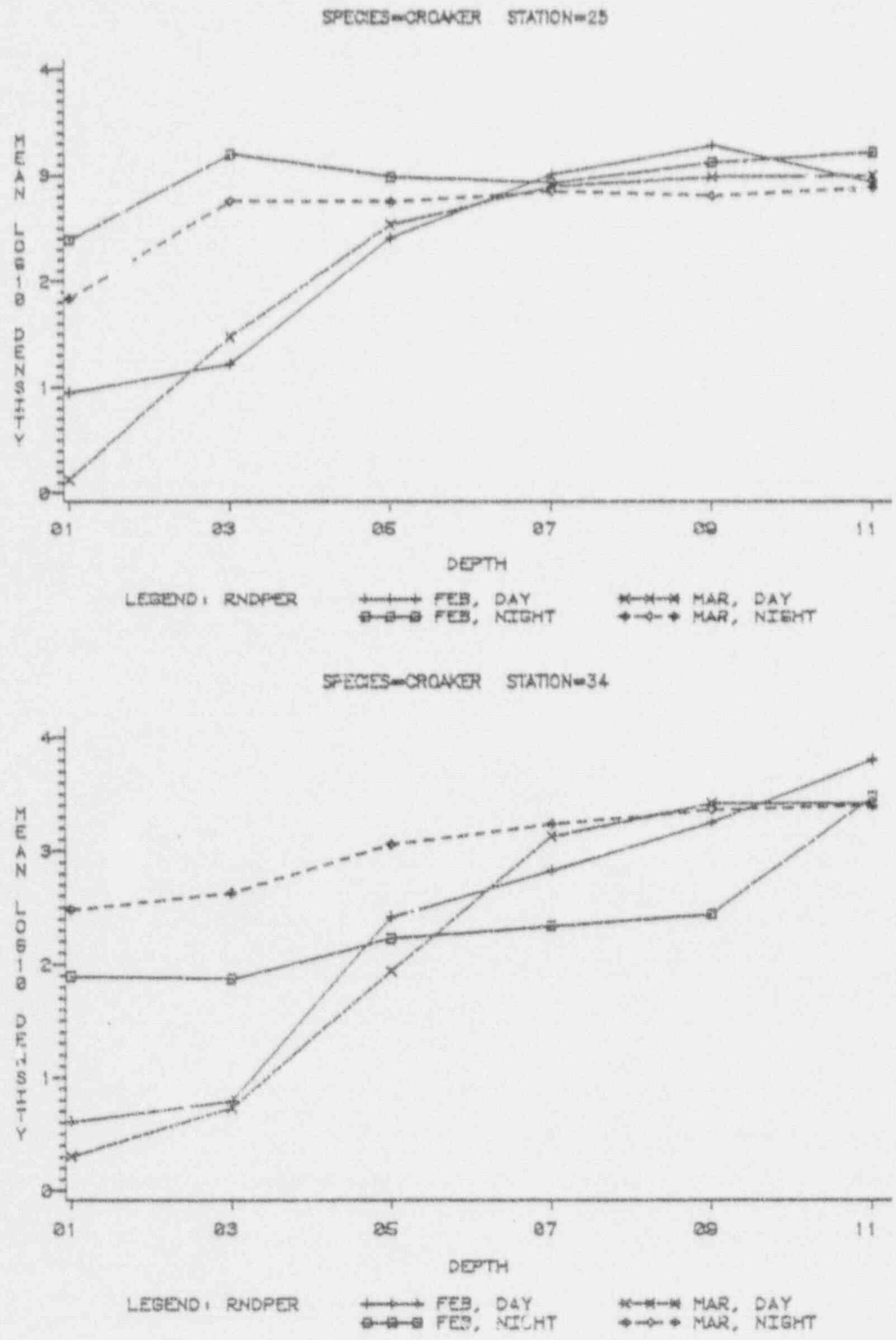
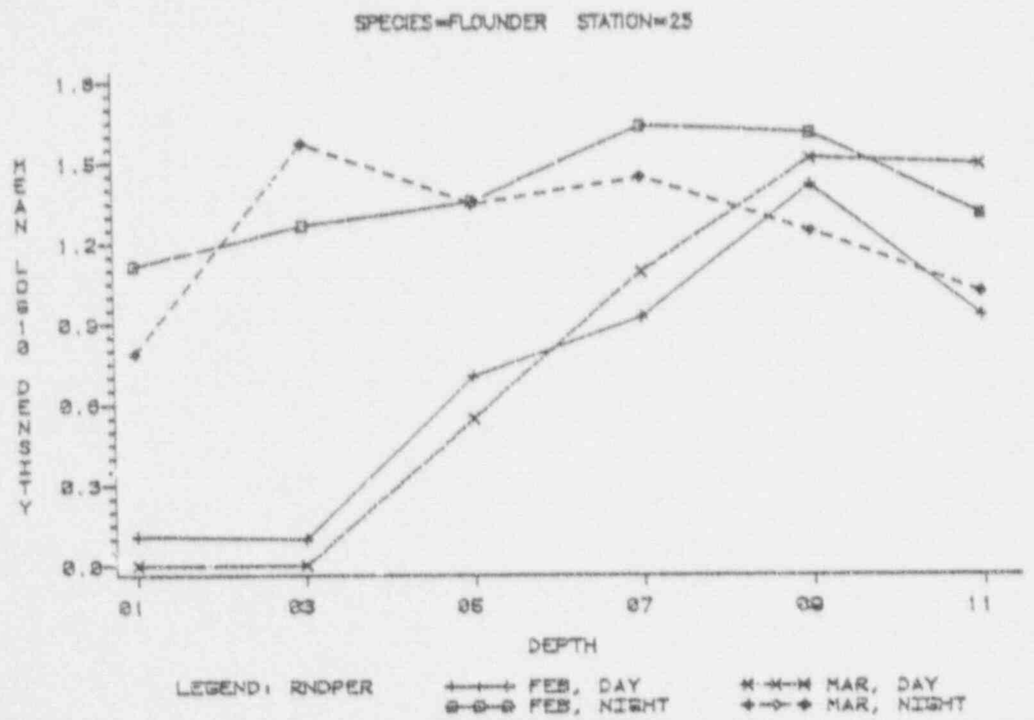


Figure 3.41 Discrete depth sampling density profiles, croaker, 1982 (Sheet 5 of 5).



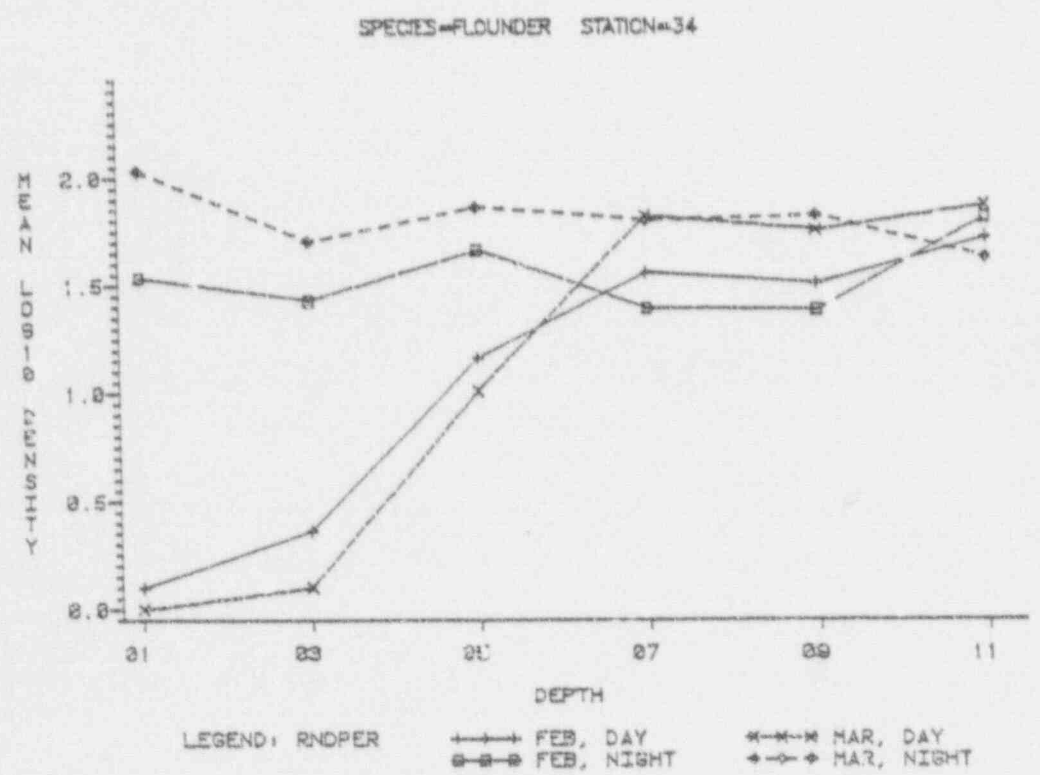


Figure 3.42 Discrete depth sampling density profiles, flounder, 1982.

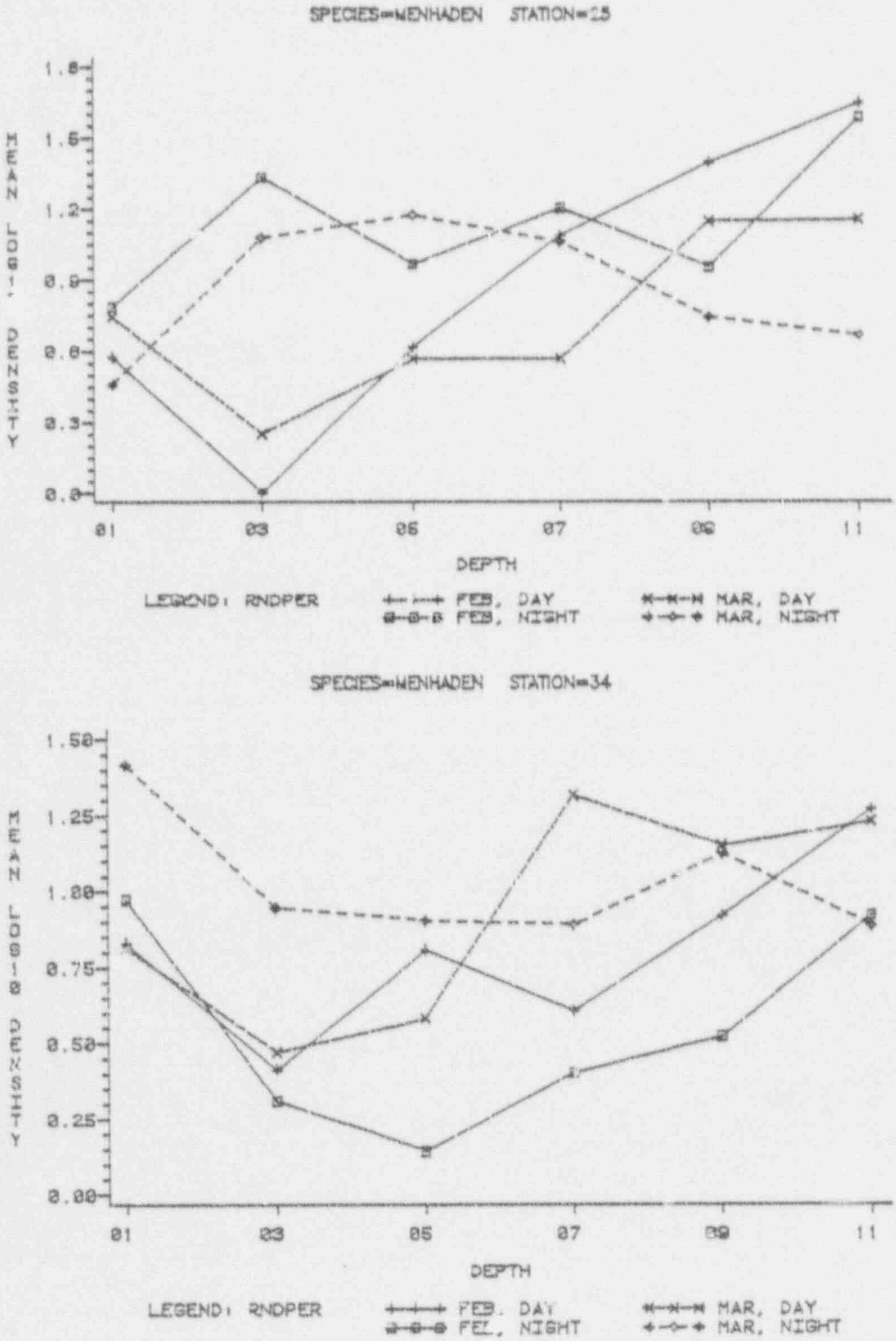
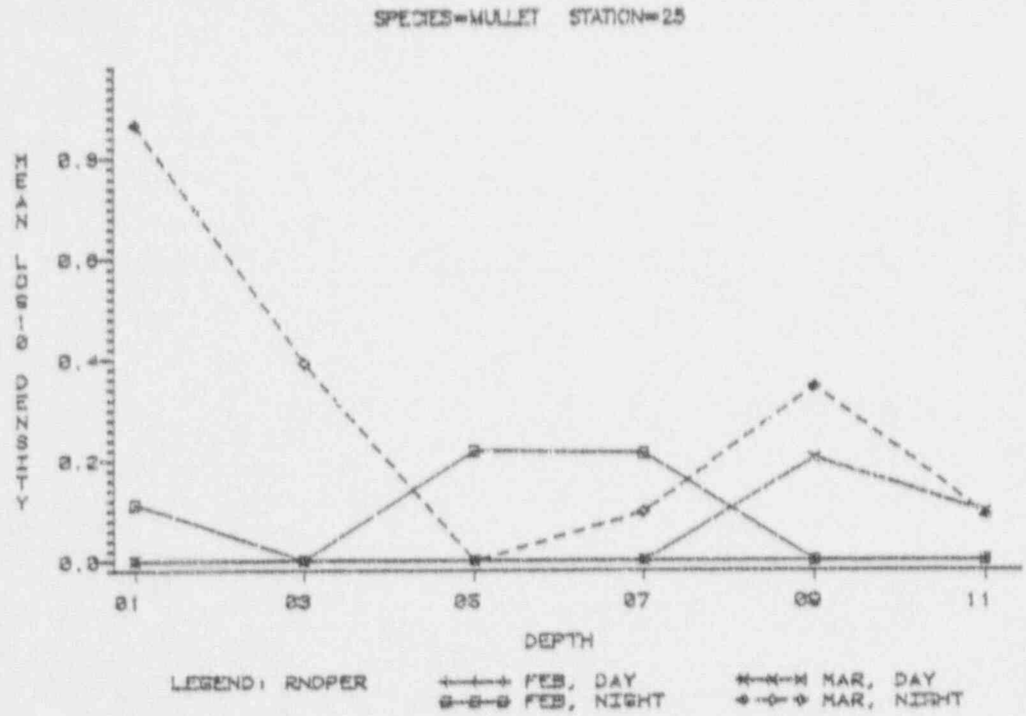


Figure 3.43 Discrete depth sampling density profiles, menhaden, 1982.



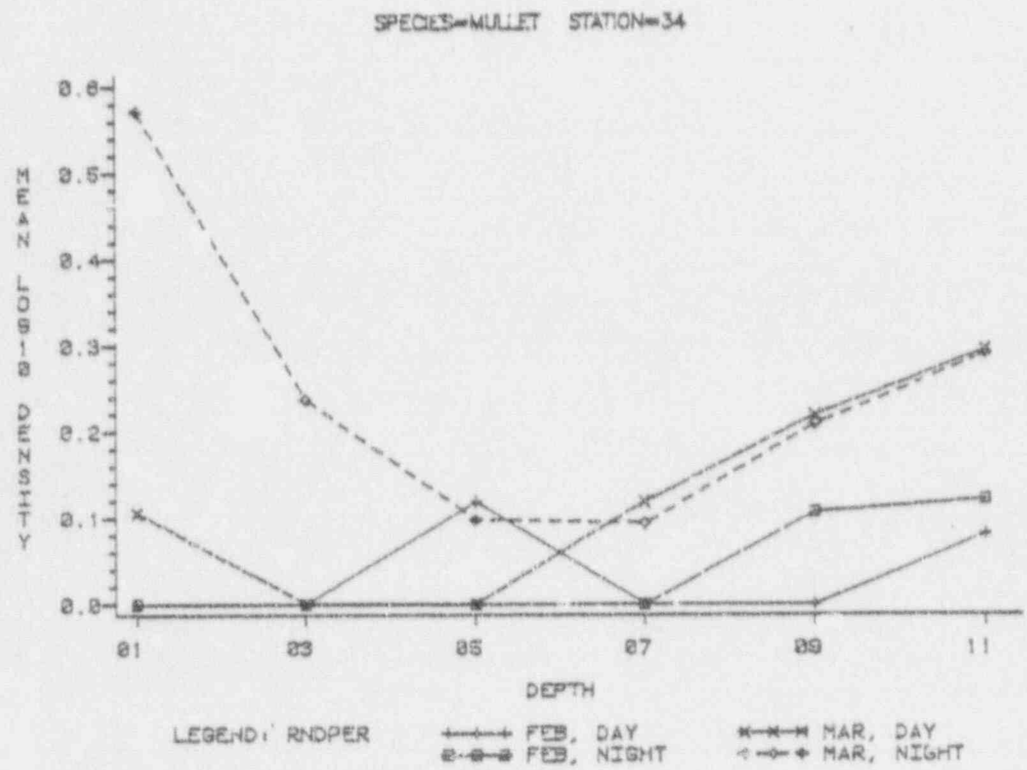


Figure 3.44 Discrete depth sampling density profiles, mullet, 1982.

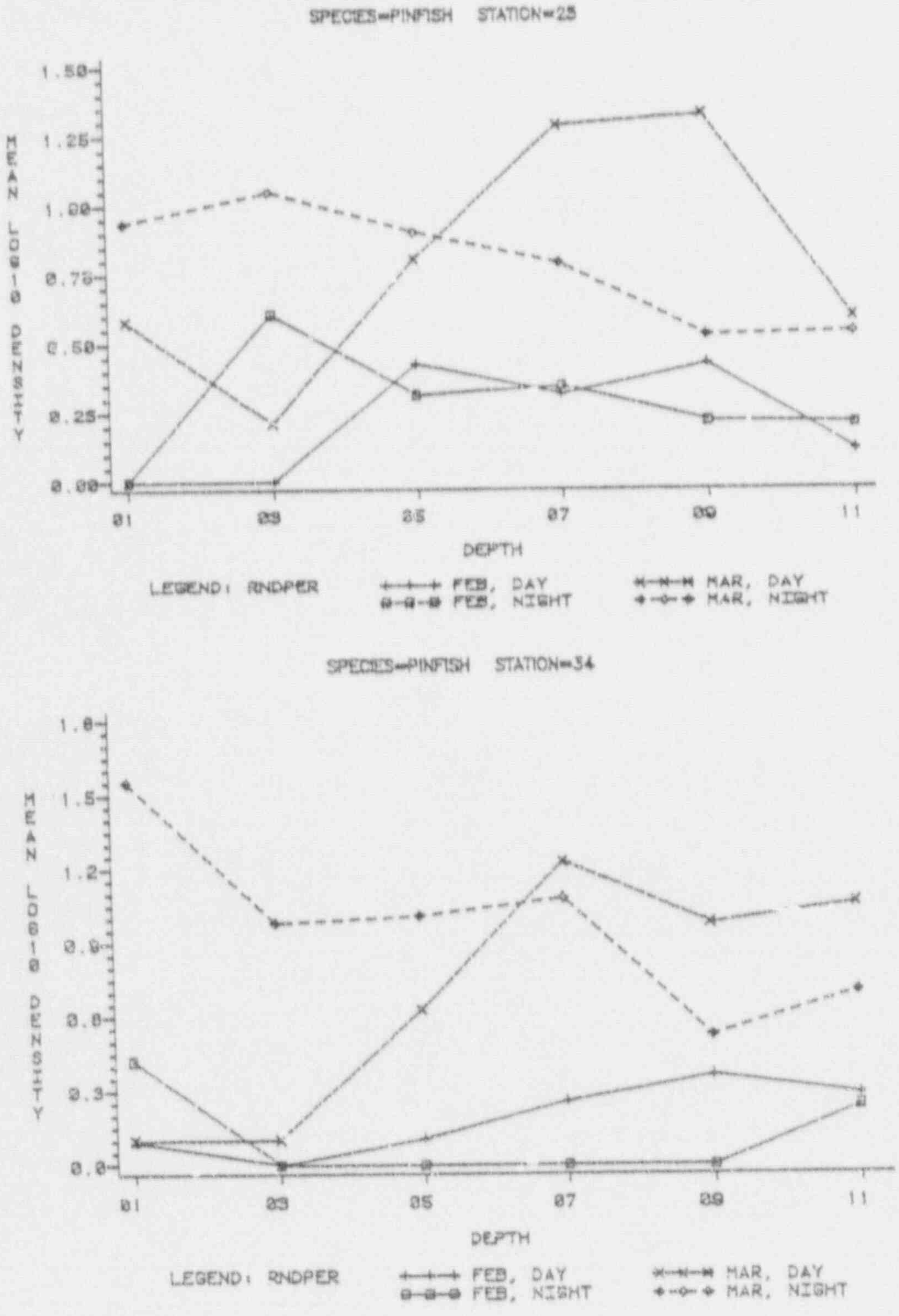


Figure 3.45 Discrete depth sampling density profiles, pinfish, 1982.

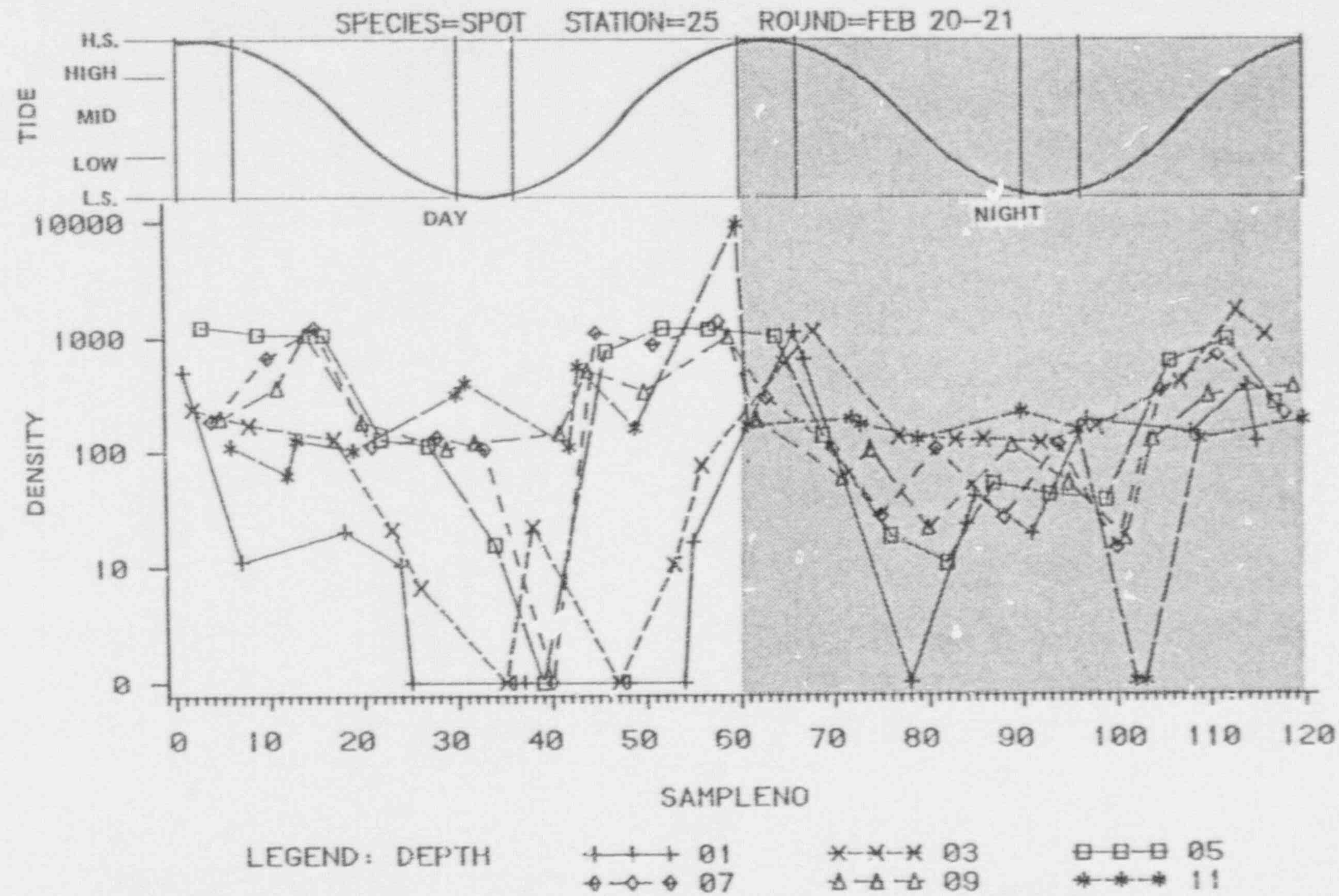


Figure 3.46 Discrete depth sampling density profiles, spot, 1982 (Sheet 1 of 5).

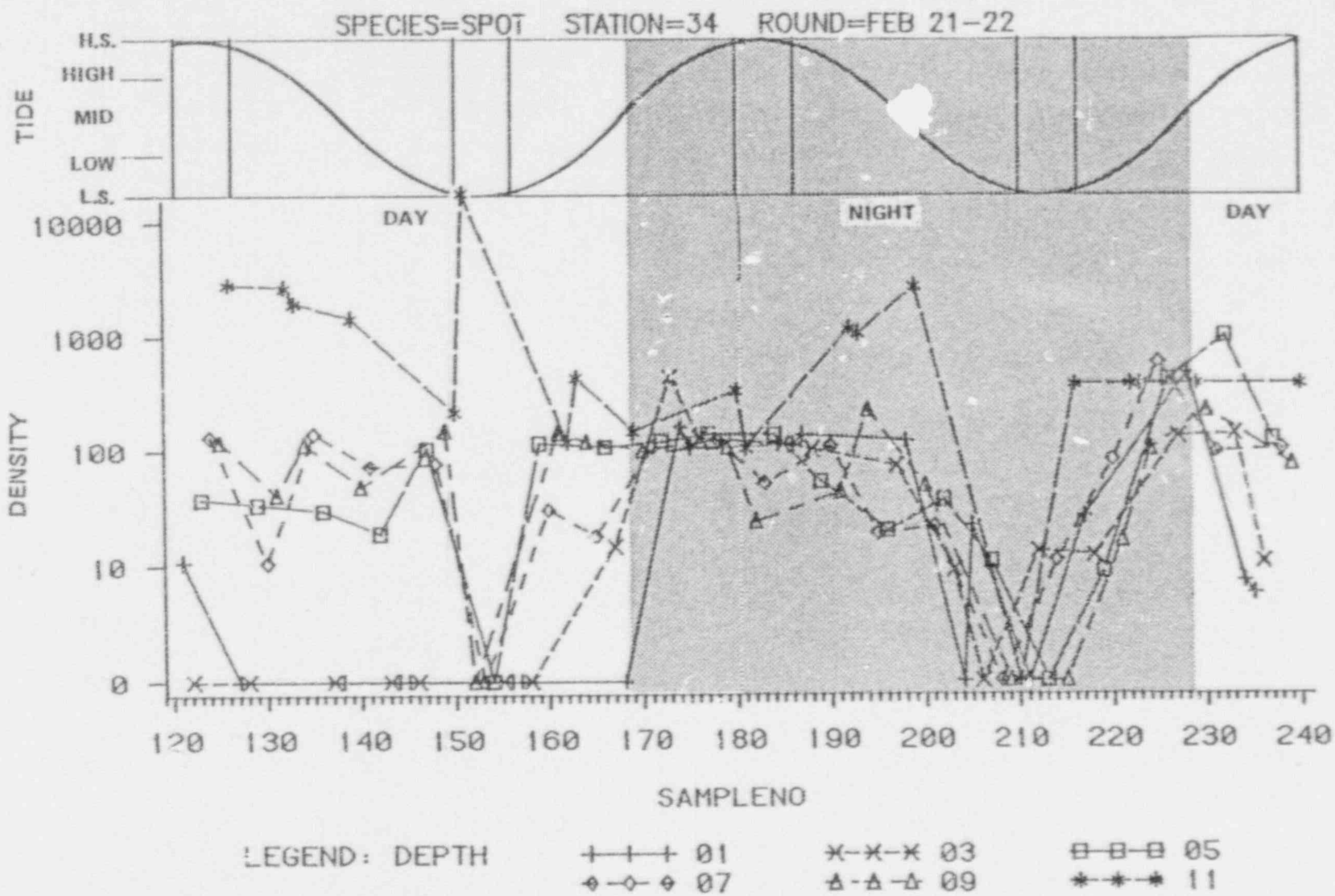


Figure 3.46 Discrete depth sampling density profiles, spot, 1982 (Sheet 2 of 5).

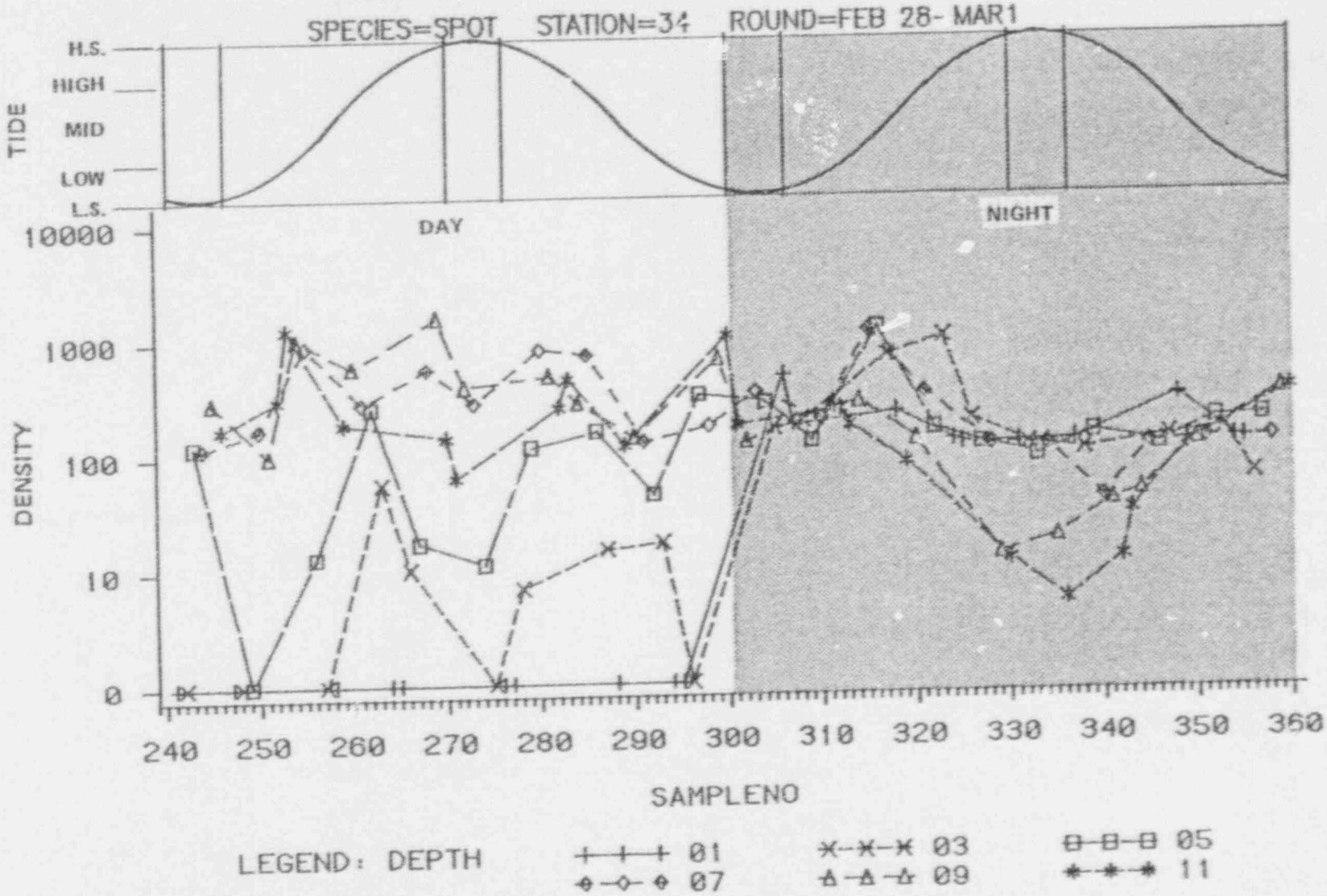


Figure 3.46 Discrete depth sampling density profiles, spot, 1982 (Sheet 3 of 5).

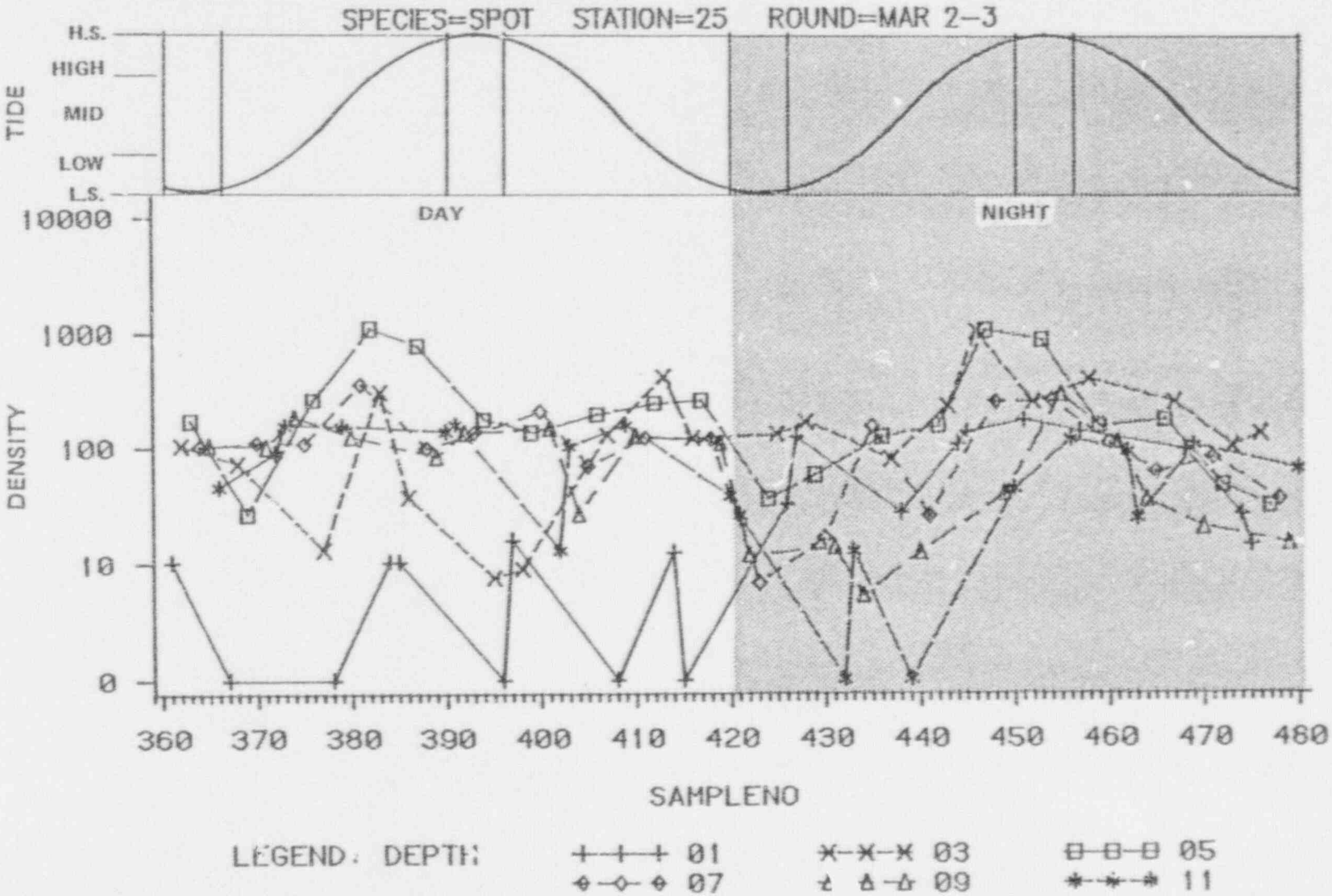
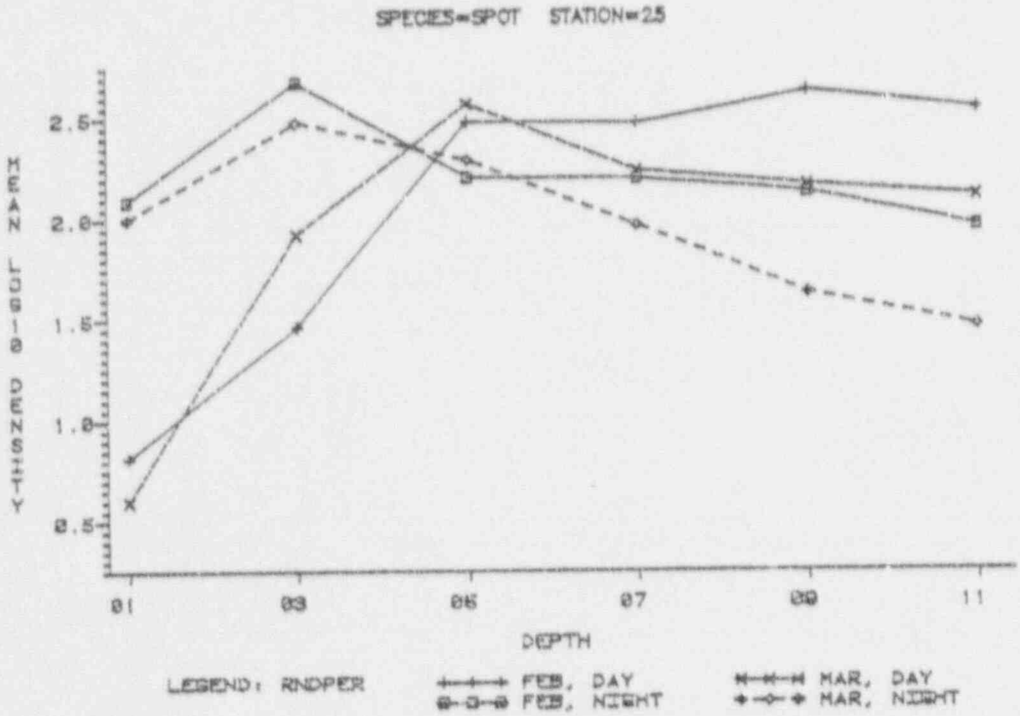


Figure 3.46 Discrete depth sampling density profiles, spot, 1982 (Sheet 4 of 5).



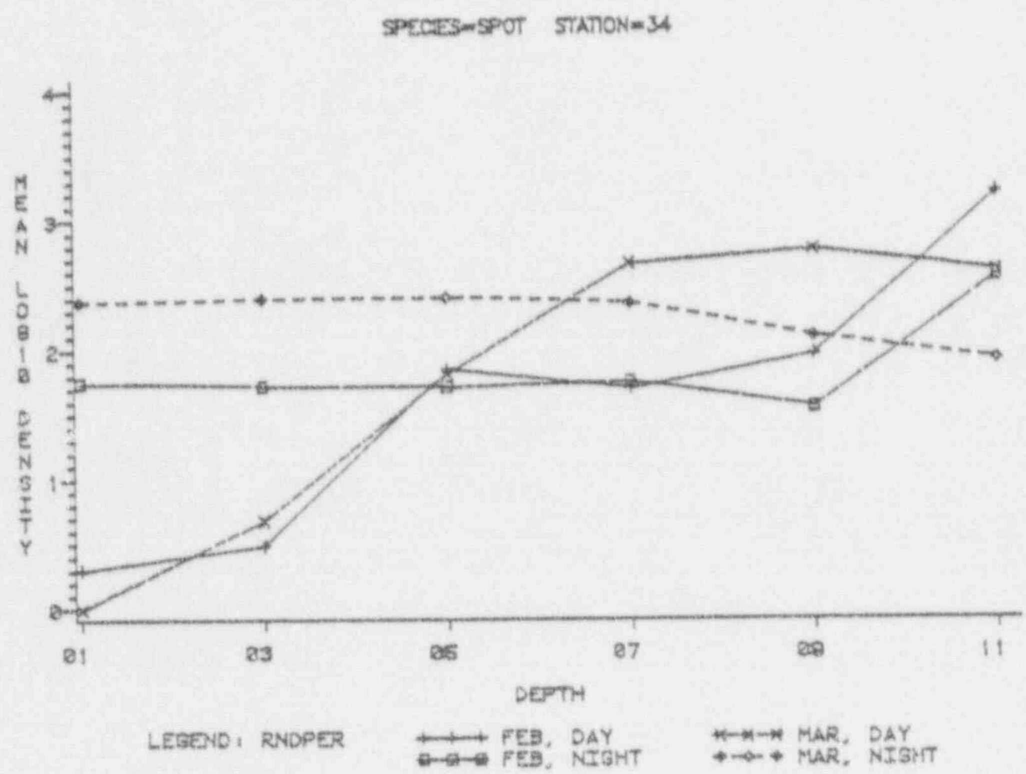


Figure 3.46 Discrete depth sampling density profiles, spot, 1982 (Sheet 5 of 5).

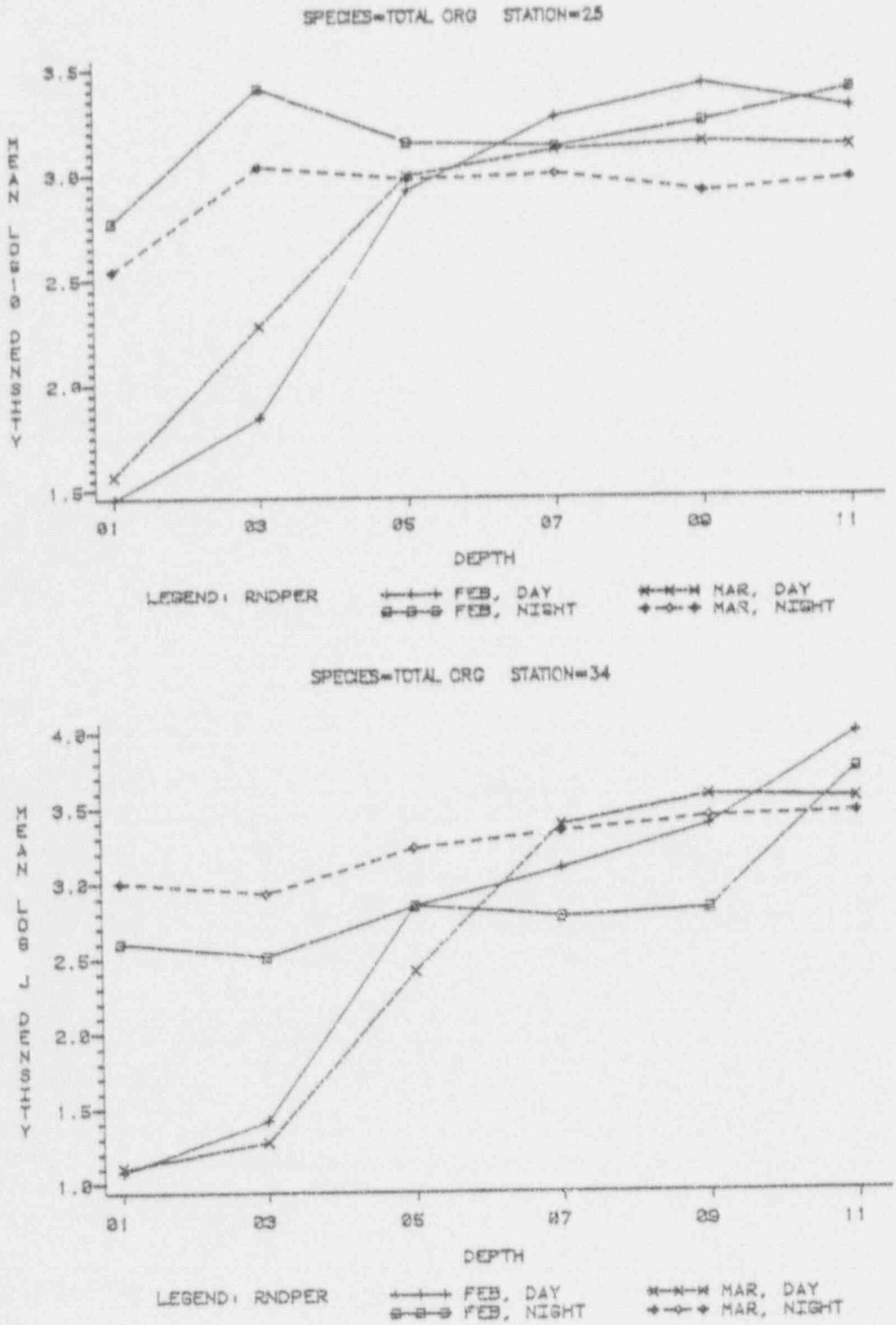
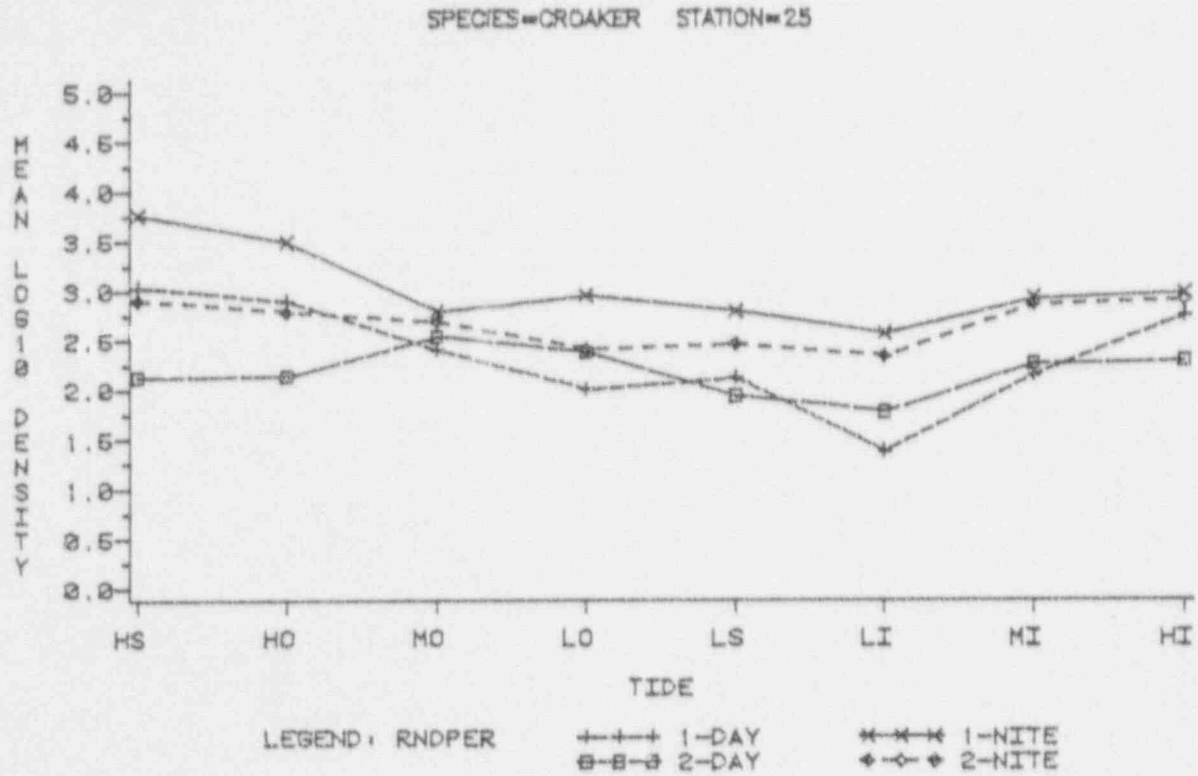


Figure 3.47 Discrete depth sampling density profiles, total organisms, 1982.



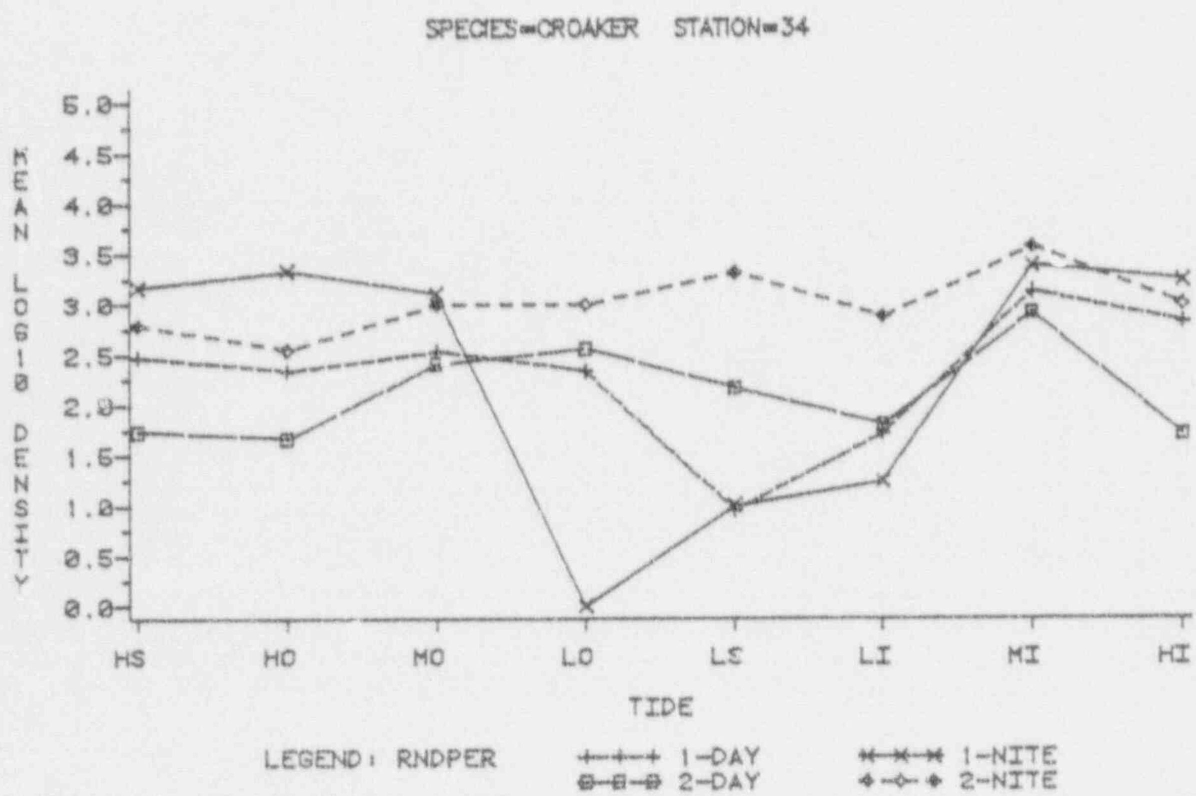
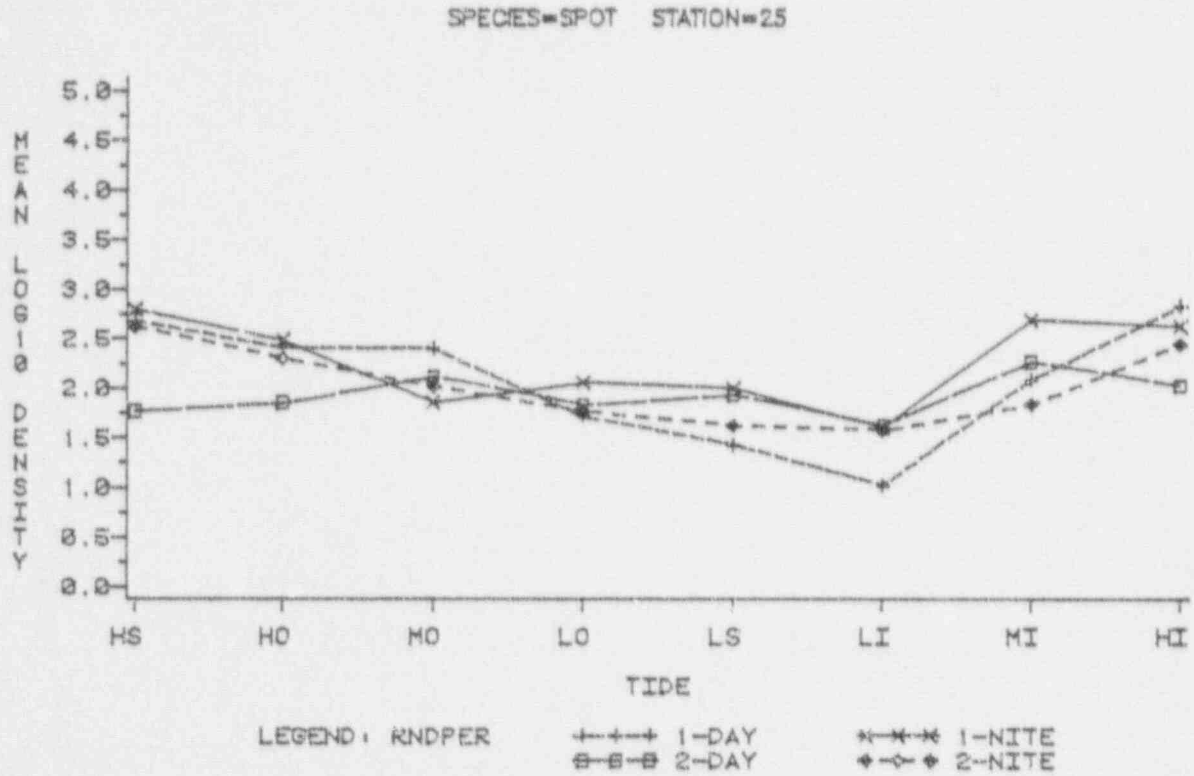


Figure 3.48 Discrete depth sampling density by tide profiles, croaker, 1982.



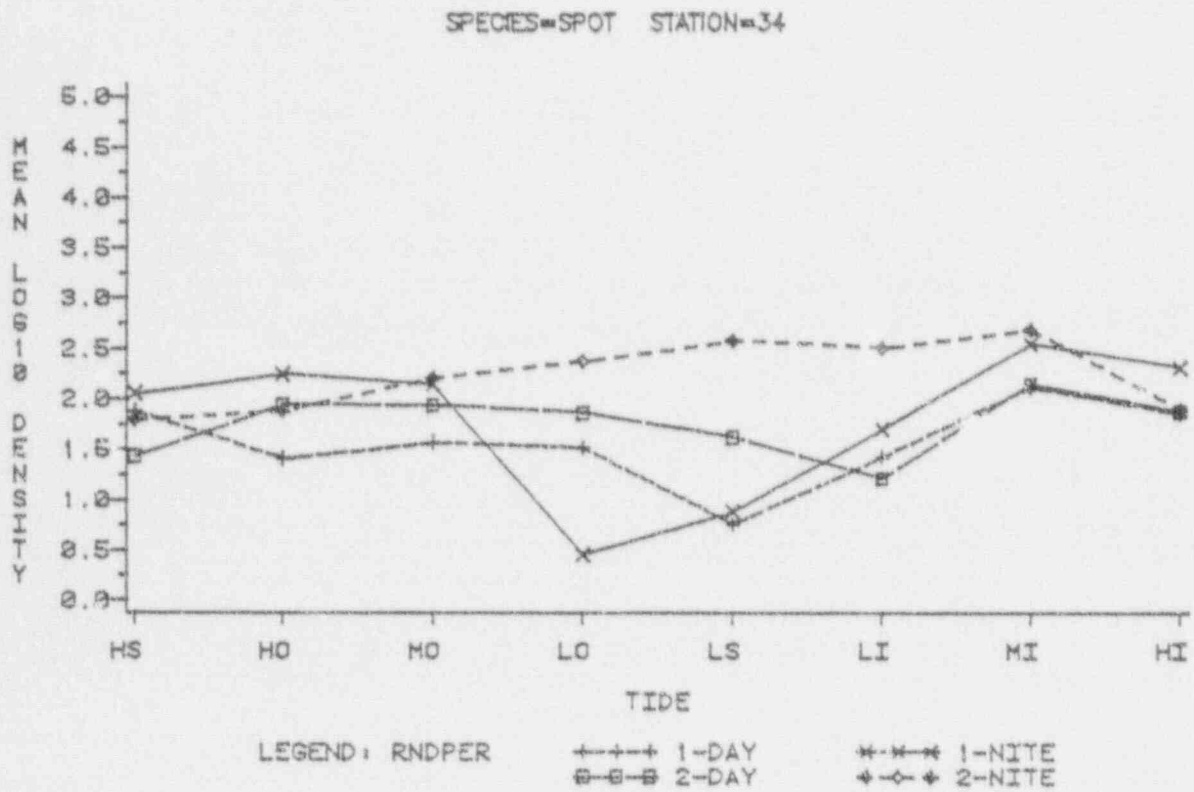
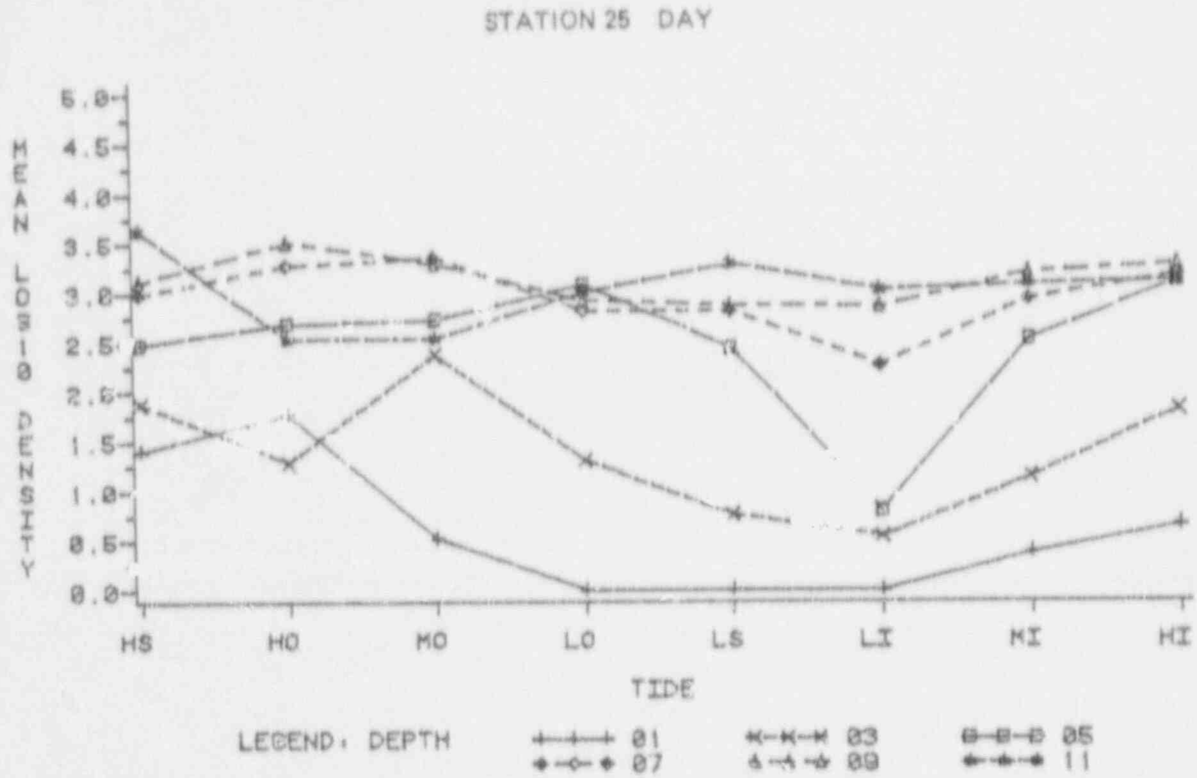


Figure 3.49 Discrete depth sampling density by tide profiles, spot, 1982.



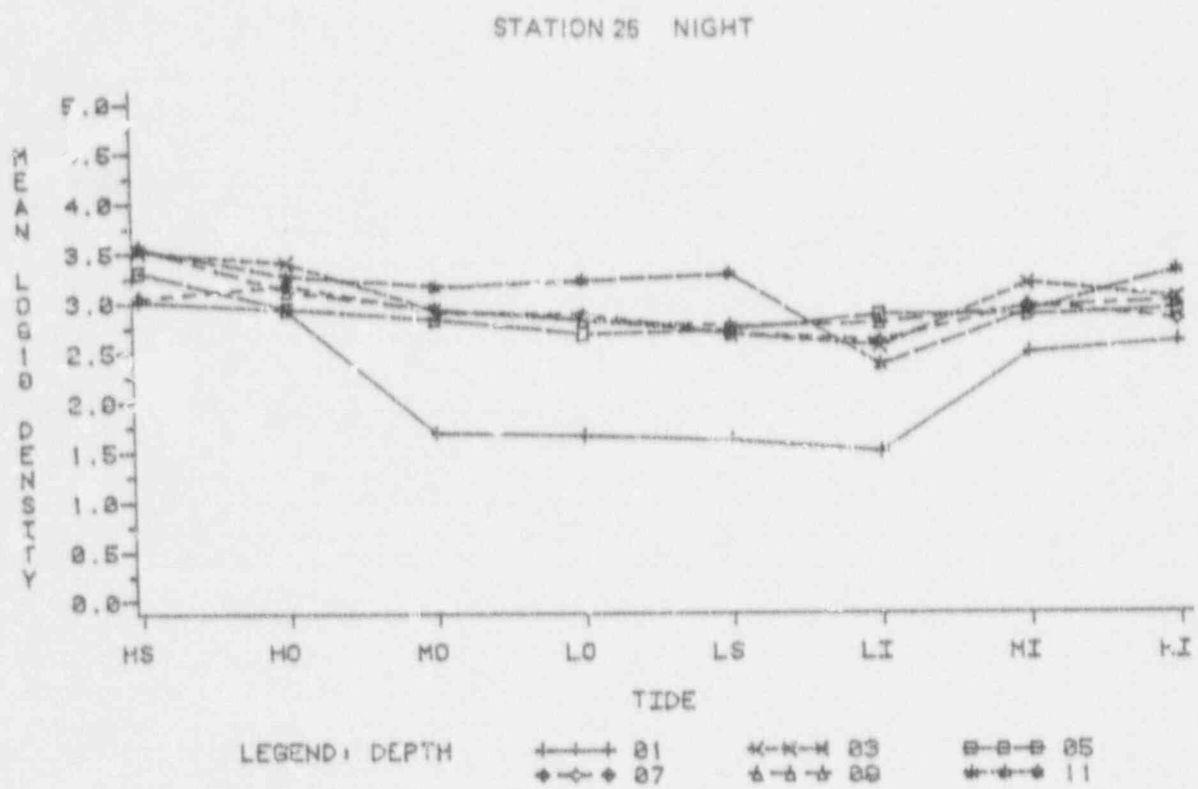
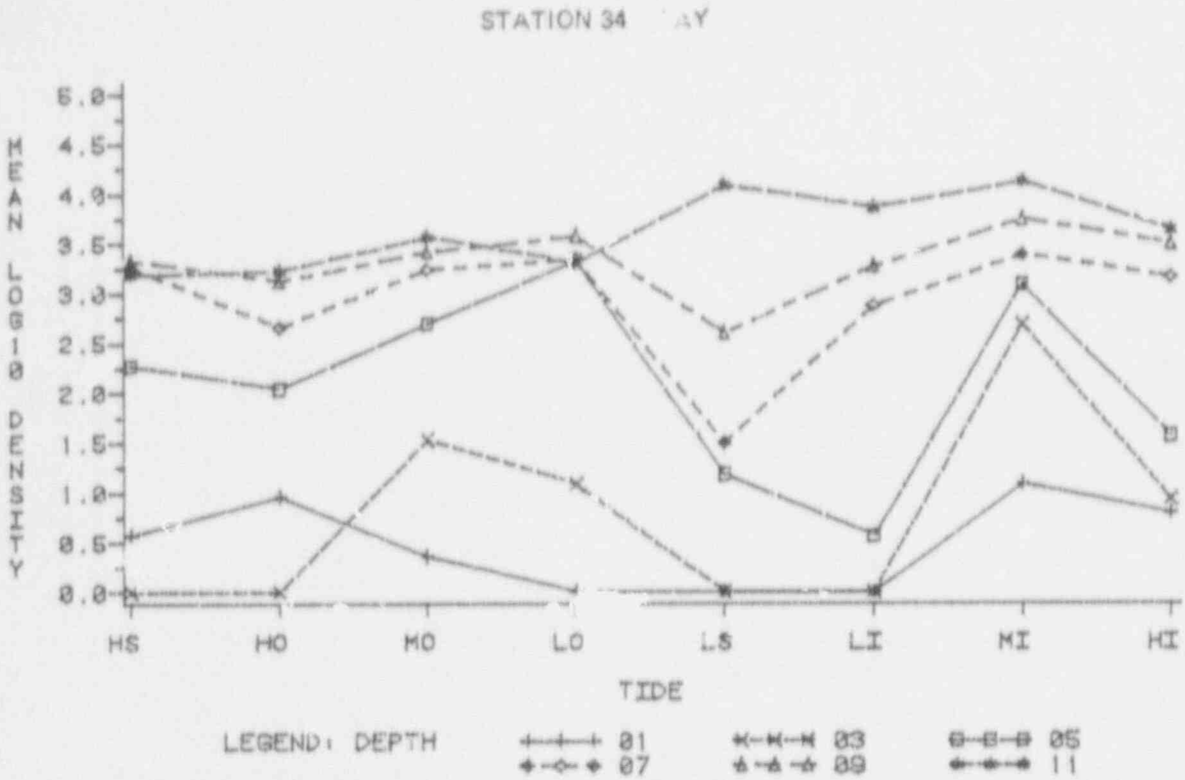


Figure 3.50 Discrete depth sampling density profiles, period by tide by depth, croaker, 1982 (Sheet 1 of 2).



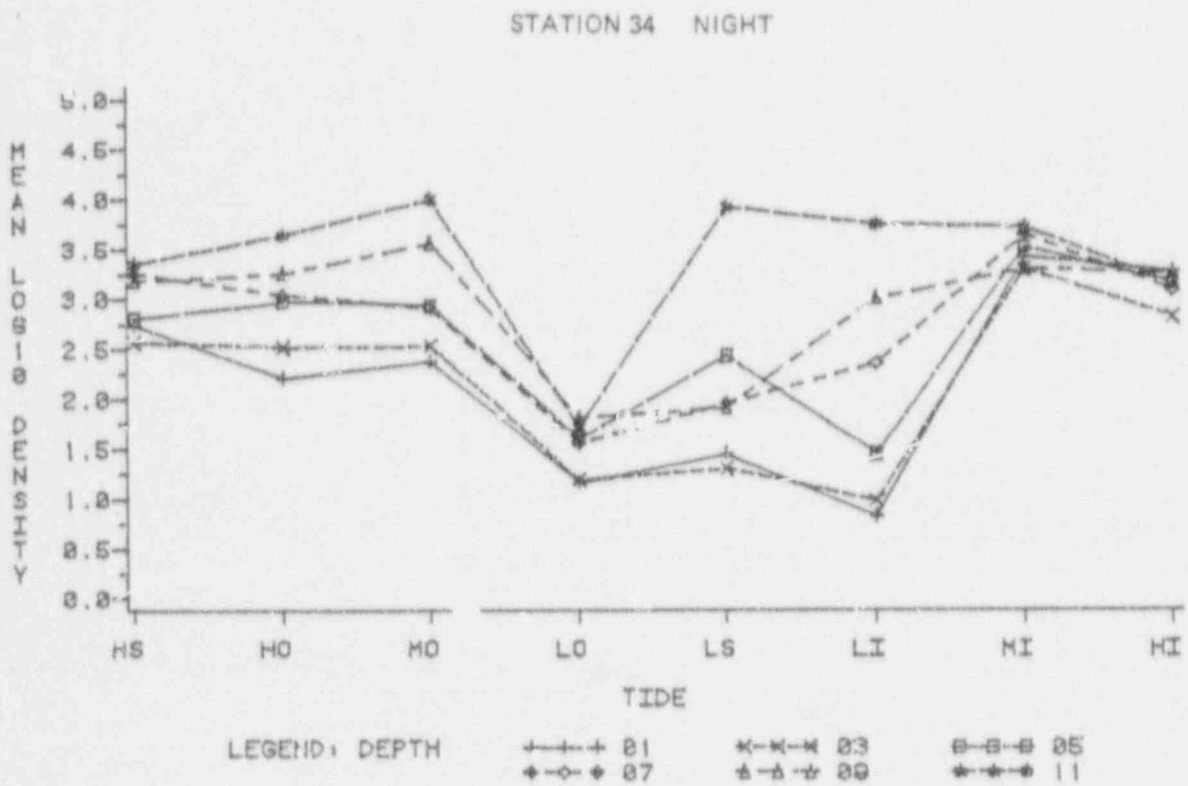


Figure 3.50 Discrete depth sampling density profiles, period by tide by depth, croaker, 1982 (Sheet 2 of 2).

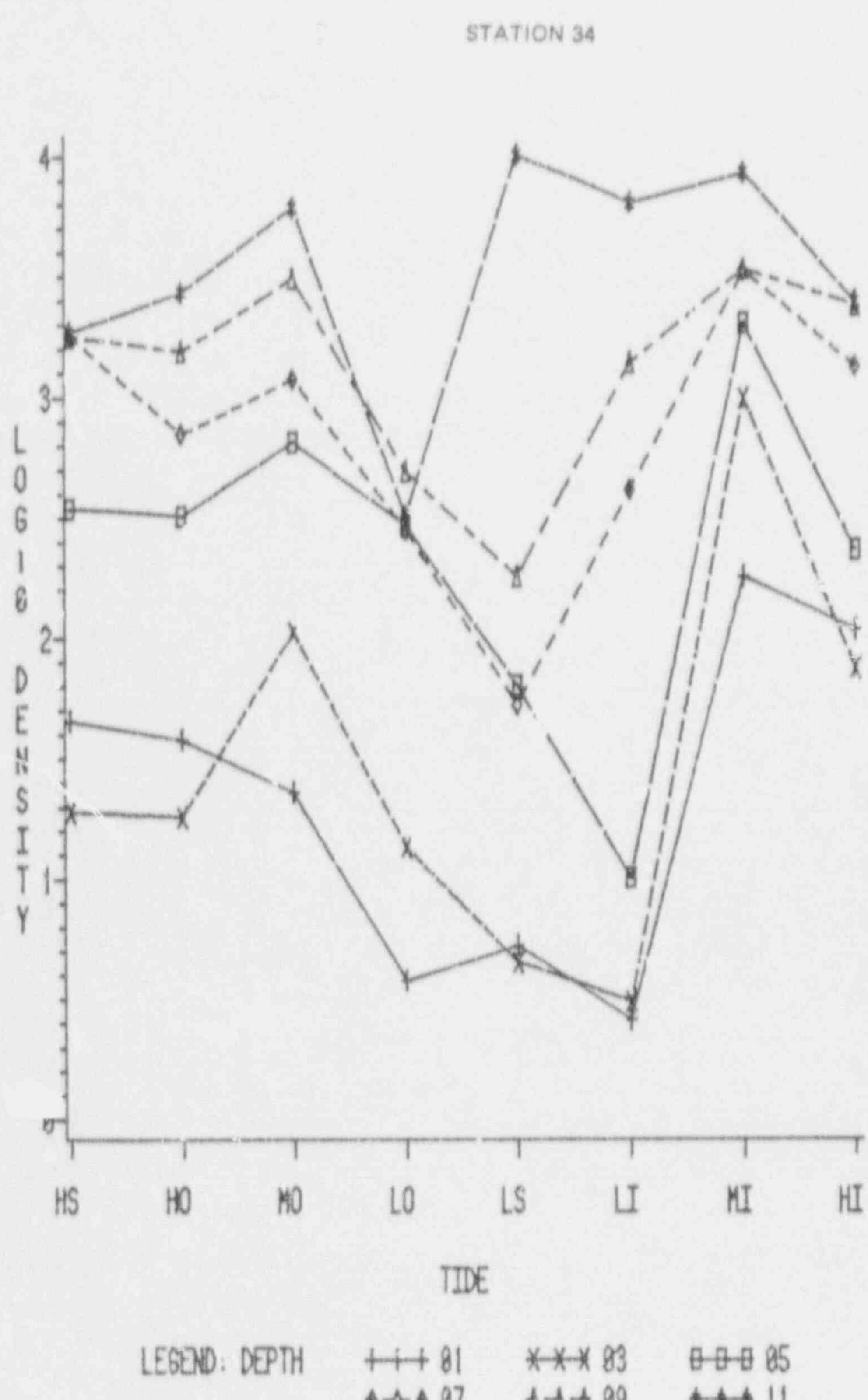


Figure 3.51 Discrete depth sampling density profiles, tide by depth, croaker, 1982.

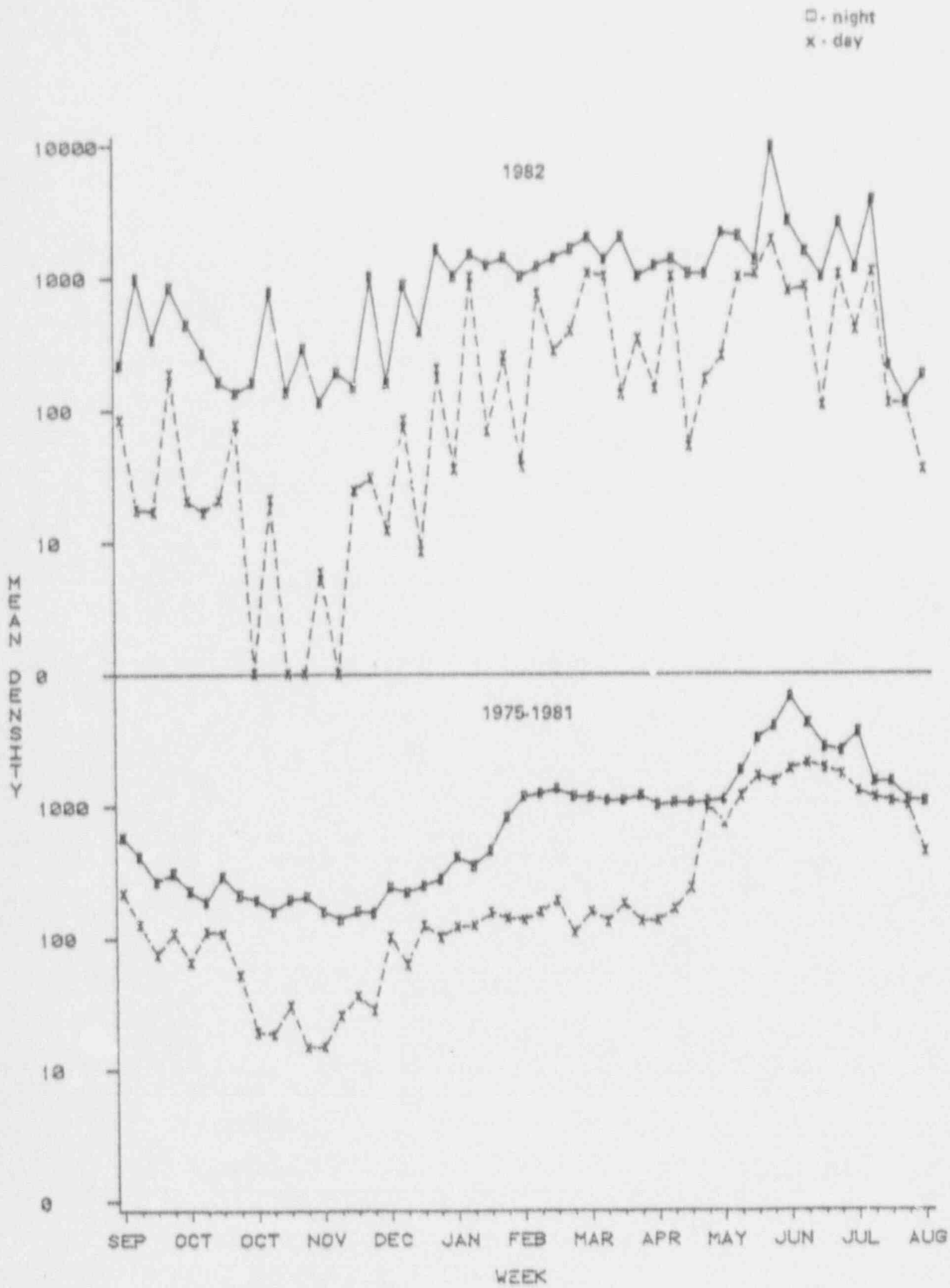


Figure 3.52 Entrainment day/night mean density for total fish, 1982 vs. 1975-1981 average.

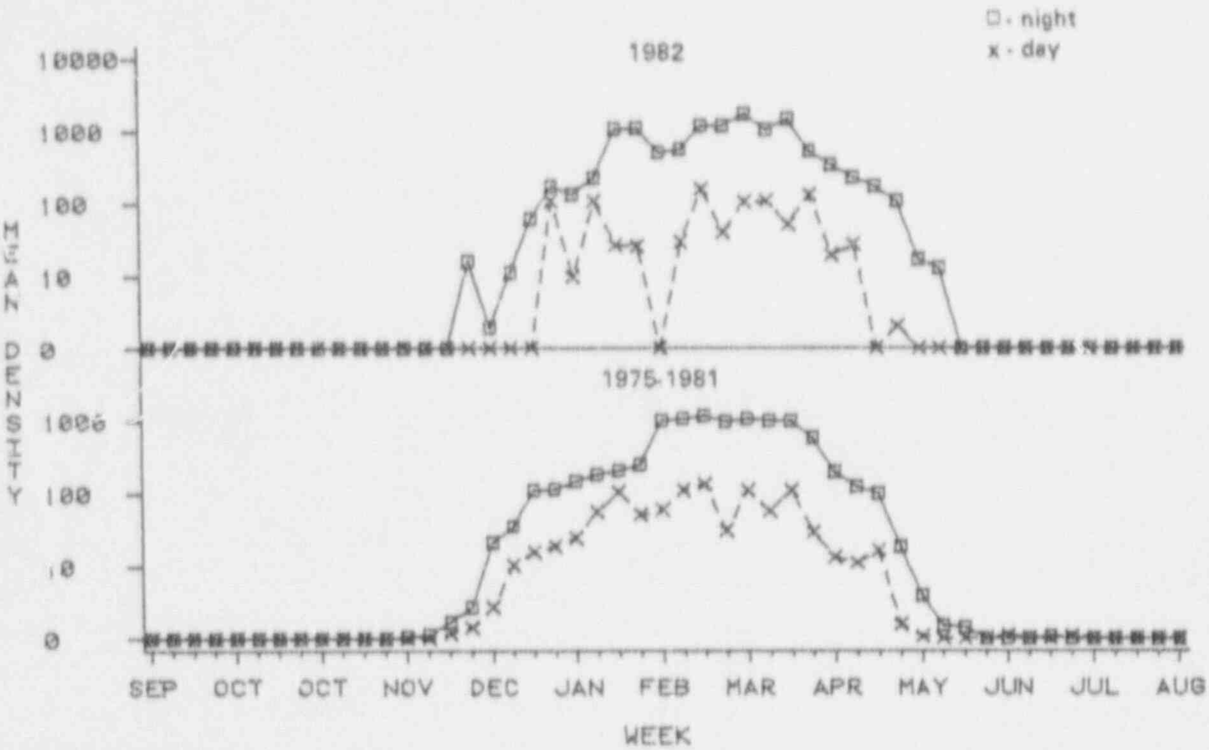


Figure 3.53 Entrainment day/night mean density for spot, 1982 vs. 1975-1981 average.

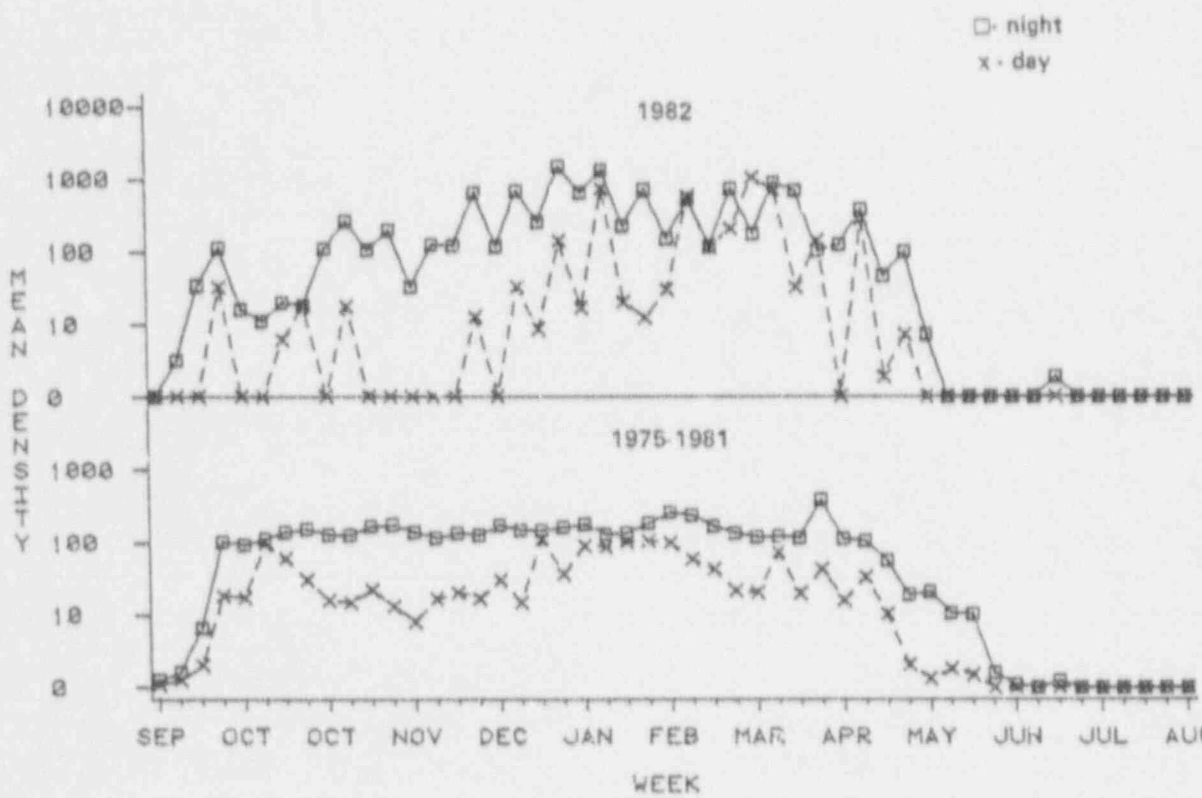


Figure 3.54 Entrainment day/night mean density for croaker, 1982 vs. 1975-1981 average.

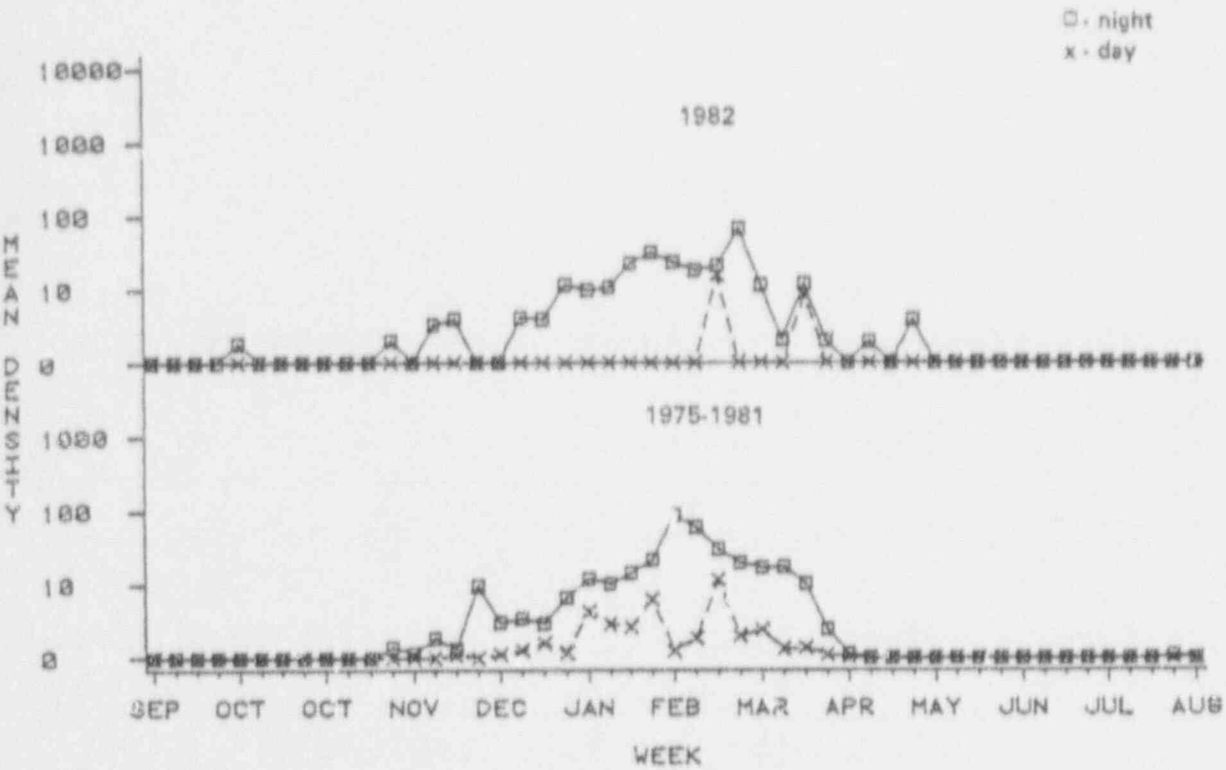


Figure 3.55 Entrainment day/night mean density for flounder, 1982 vs. 1975-1981 average.

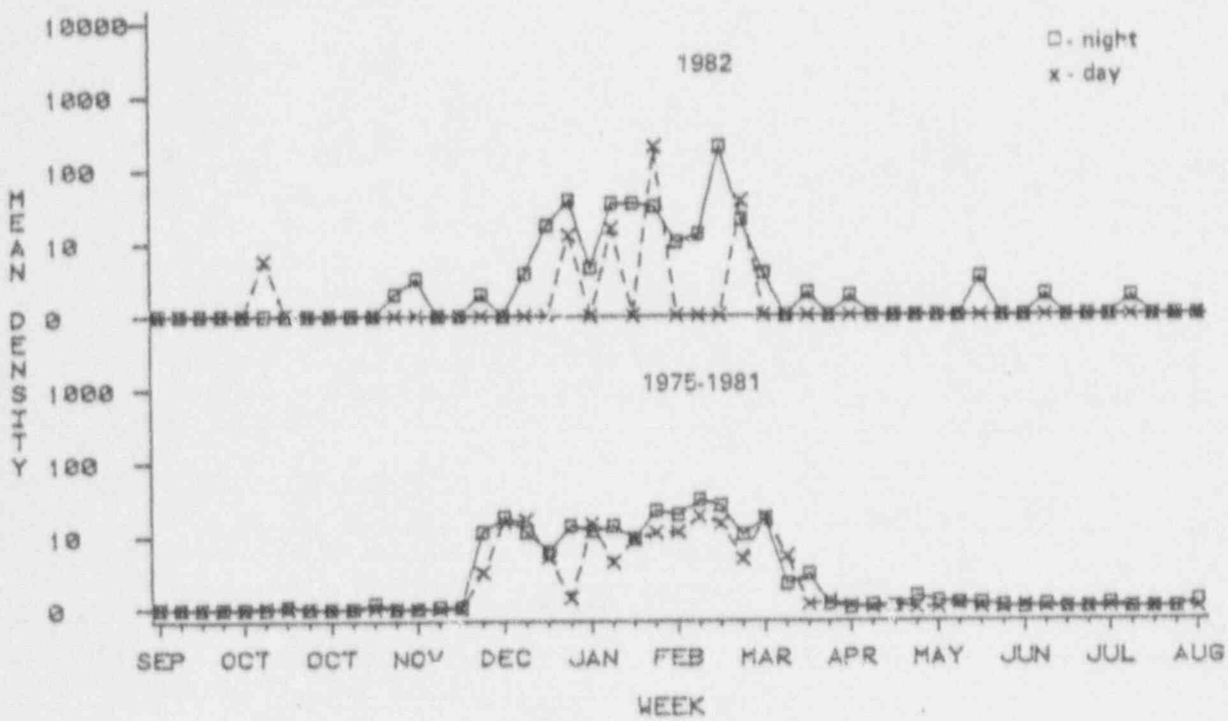


Figure 3.56 Entrainment day/night mean density for mullet, 1982 vs. 1975-1981 average.

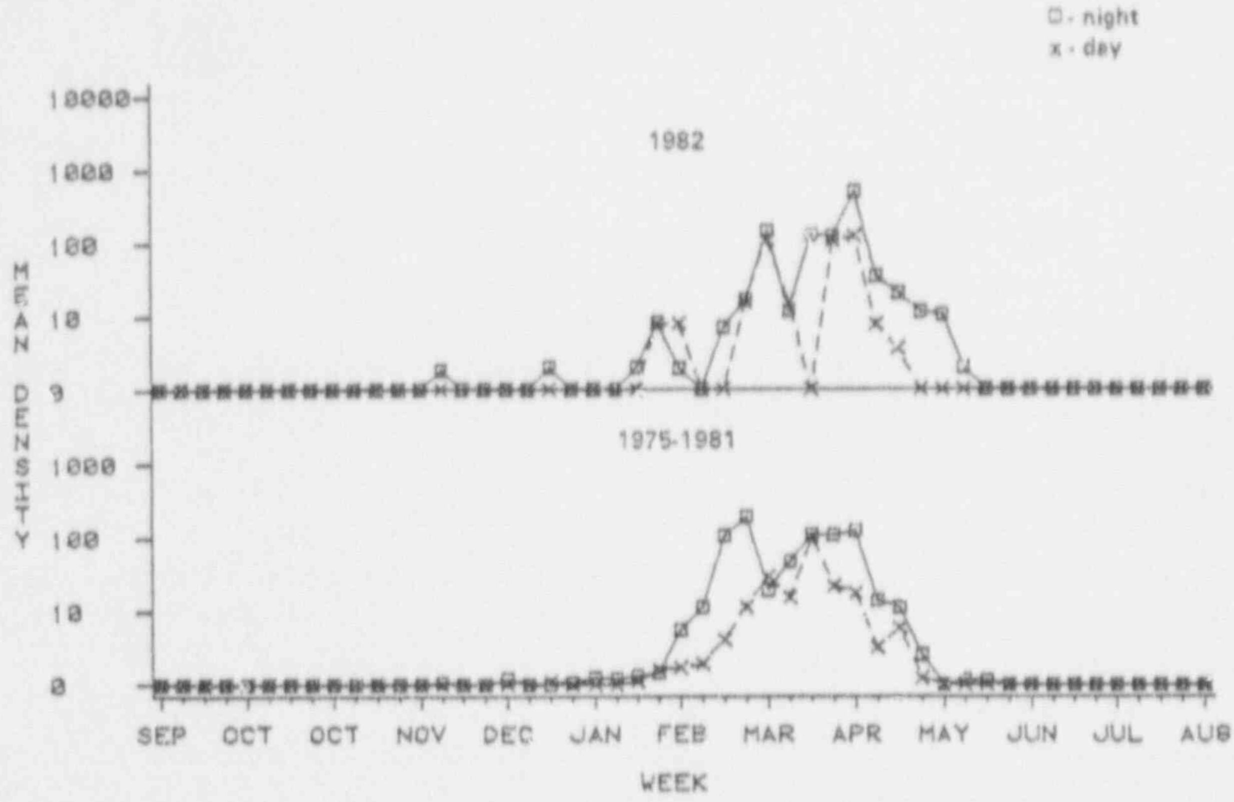


Figure 3.57 Entrainment day/night mean density for menhaden, 1982 vs. 1975-1981 average.

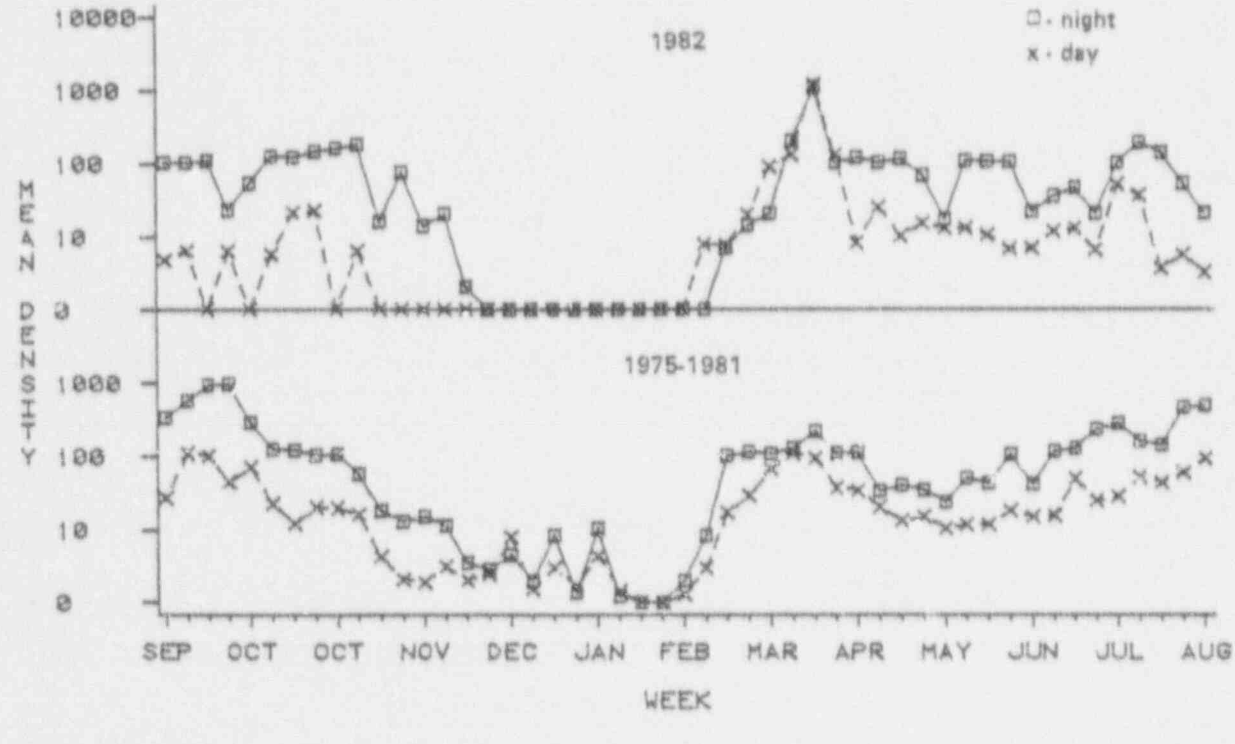


Figure 3.58 Entrainment day/night mean density for shrimp, 1982 vs. 1975-1981 average.

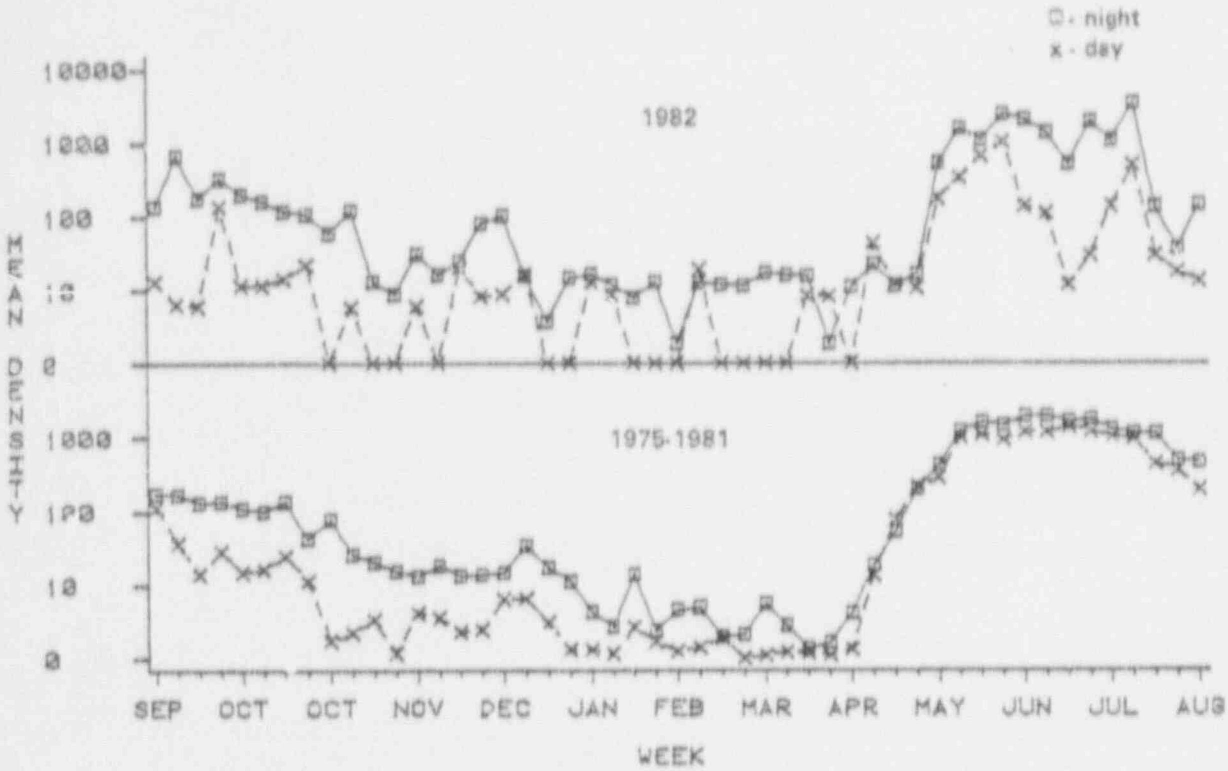


Figure 3.59 Entrainment day/night mean density for anchovies, 1982 vs. 1975-1981 average.

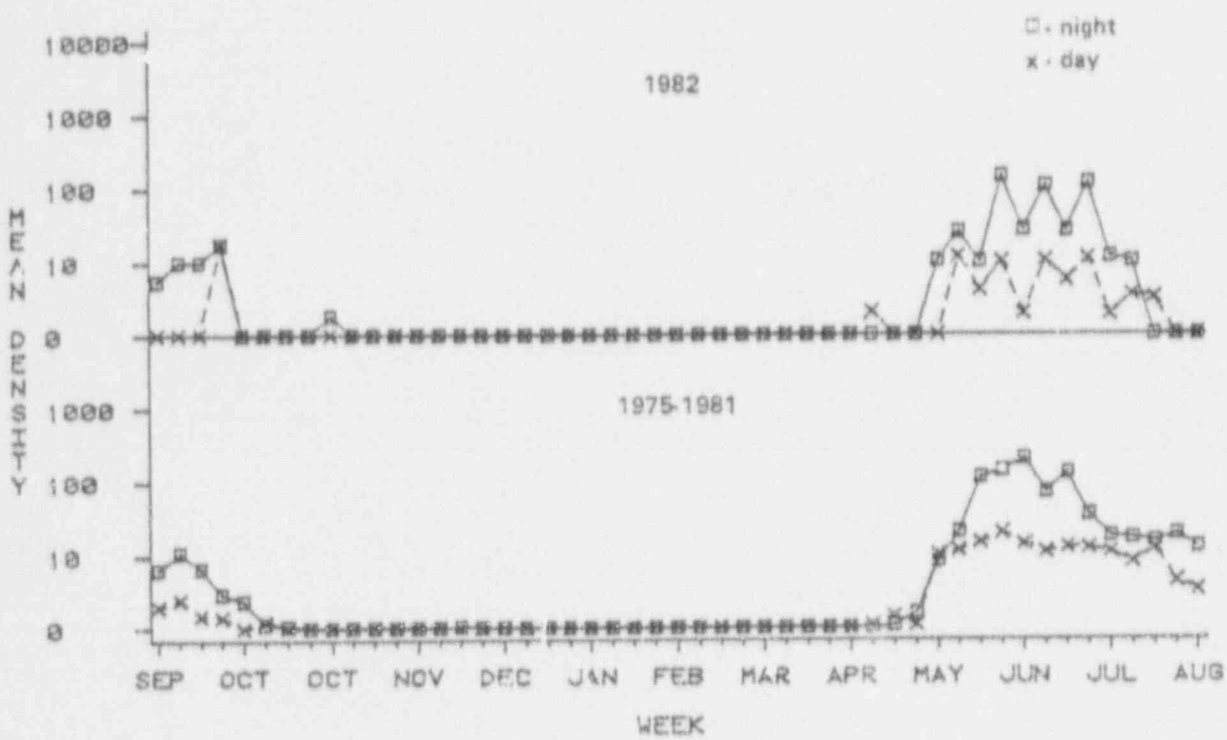


Figure 3.60 Entrainment day/night mean density for seatrout, 1982 vs. 1975-1981 average.

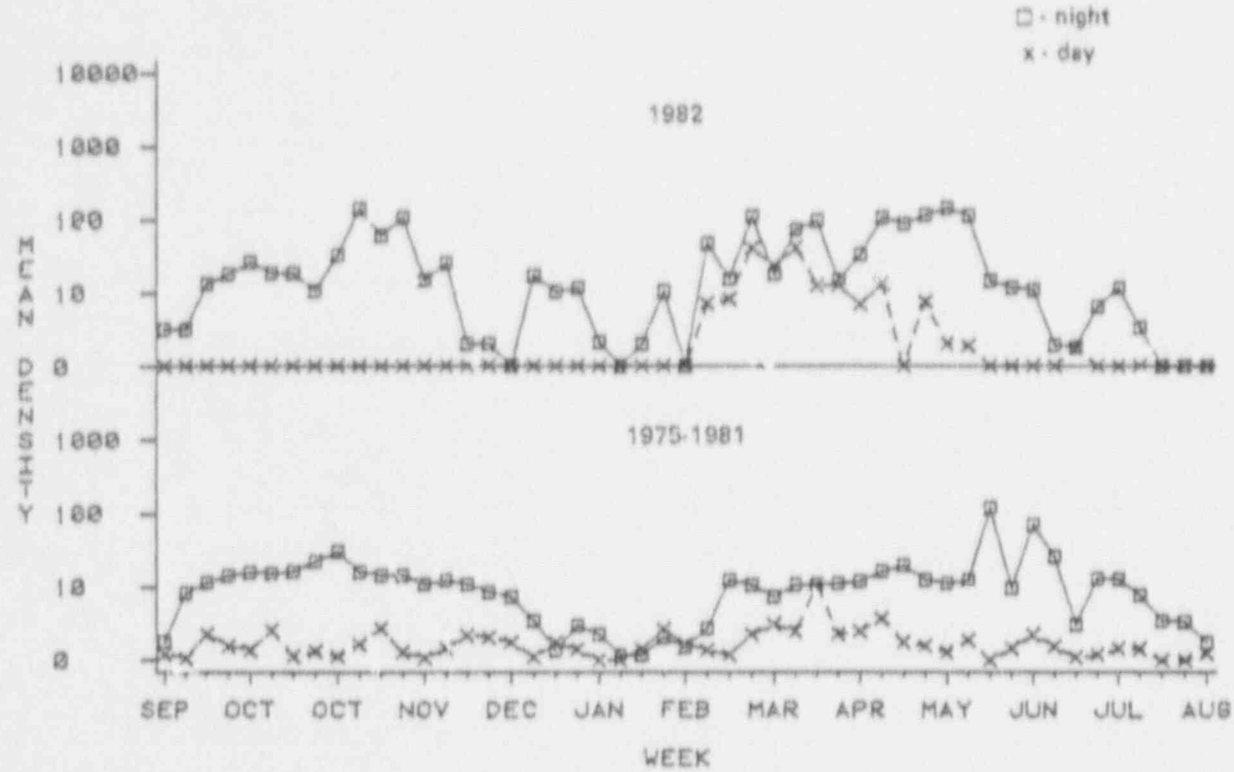


Figure 3.61 Entrainment day/night mean density for Gobionellus sp., 1982 vs. 1975-1981 average.

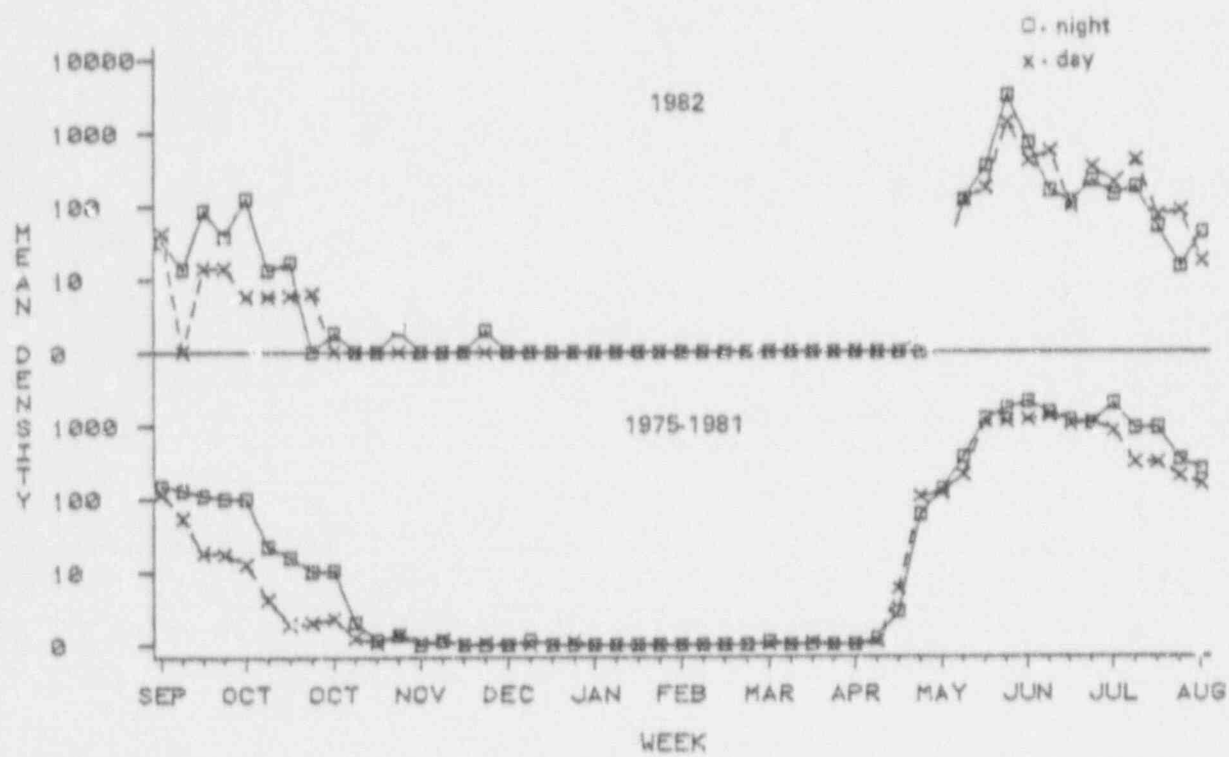


Figure 3.62 Entrainment day/night mean density for Gobiosoma spp., 1982 vs. 1975-1981 average.

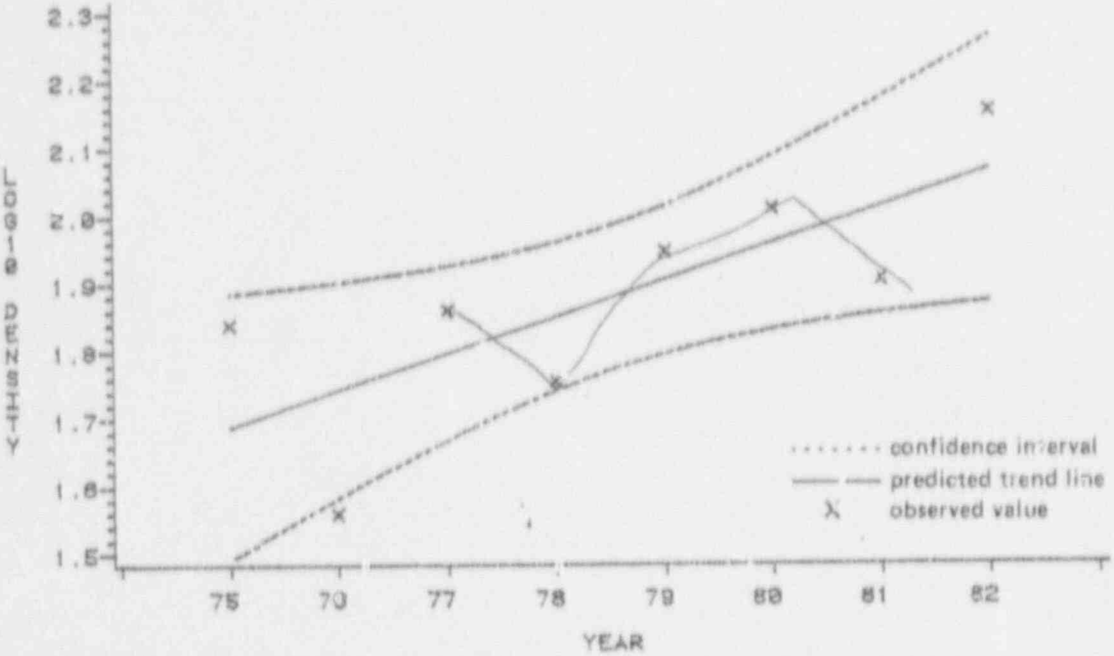


Figure 3.63 Entrainment linear trend analysis for spot, September 1974 to August 1982.

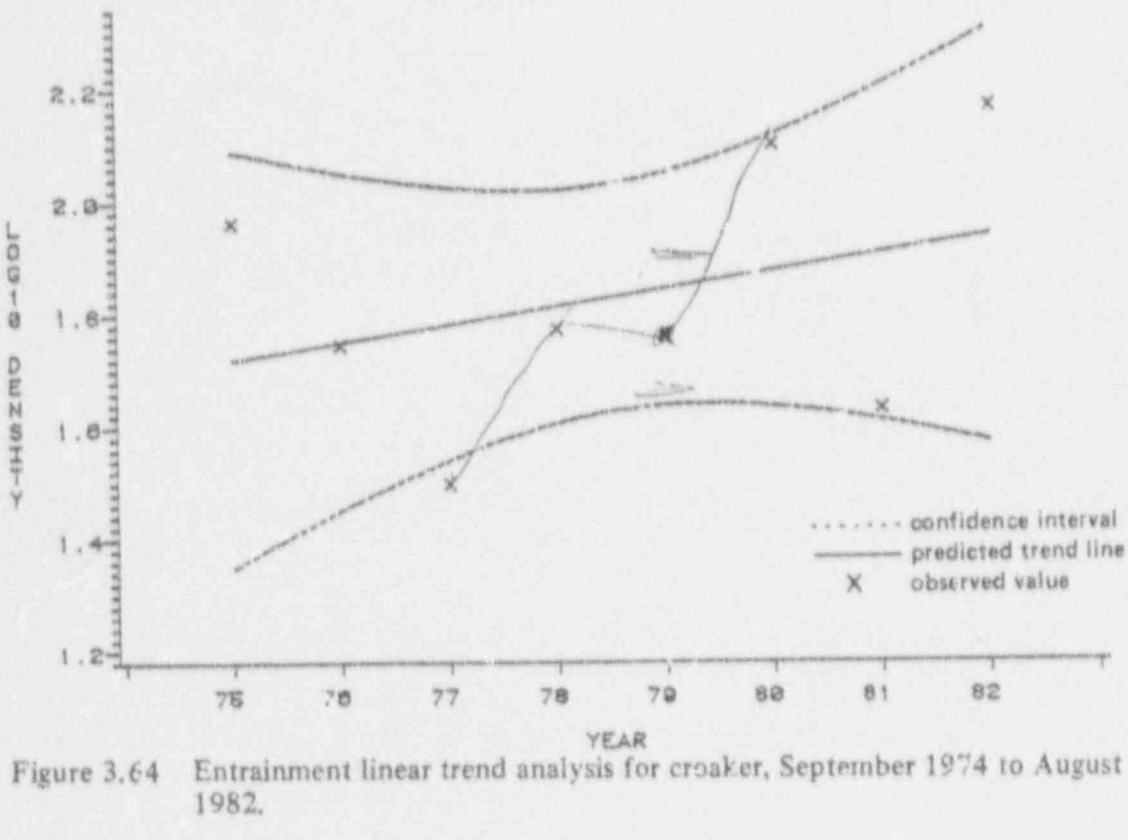


Figure 3.64 Entrainment linear trend analysis for croaker, September 1974 to August 1982.

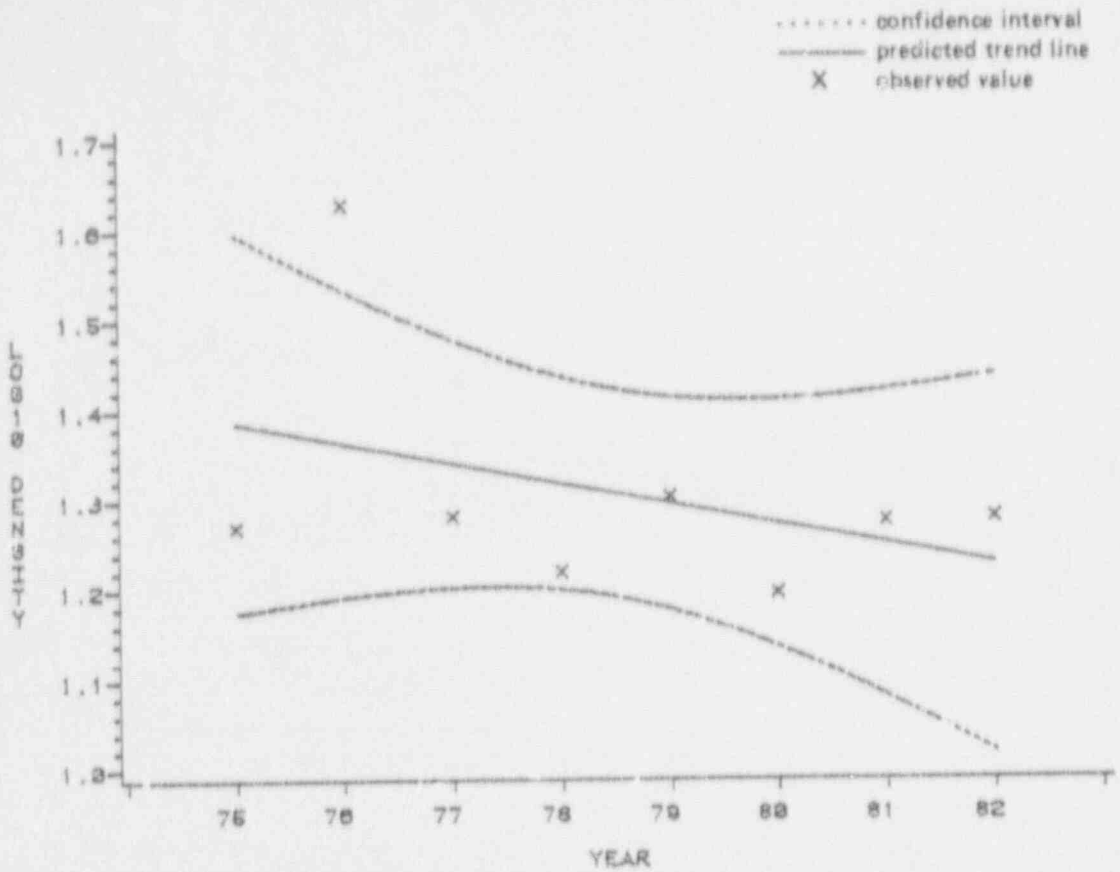


Figure 3.65 Entrainment linear trend analysis for seatrout, September 1974 to August 1982.

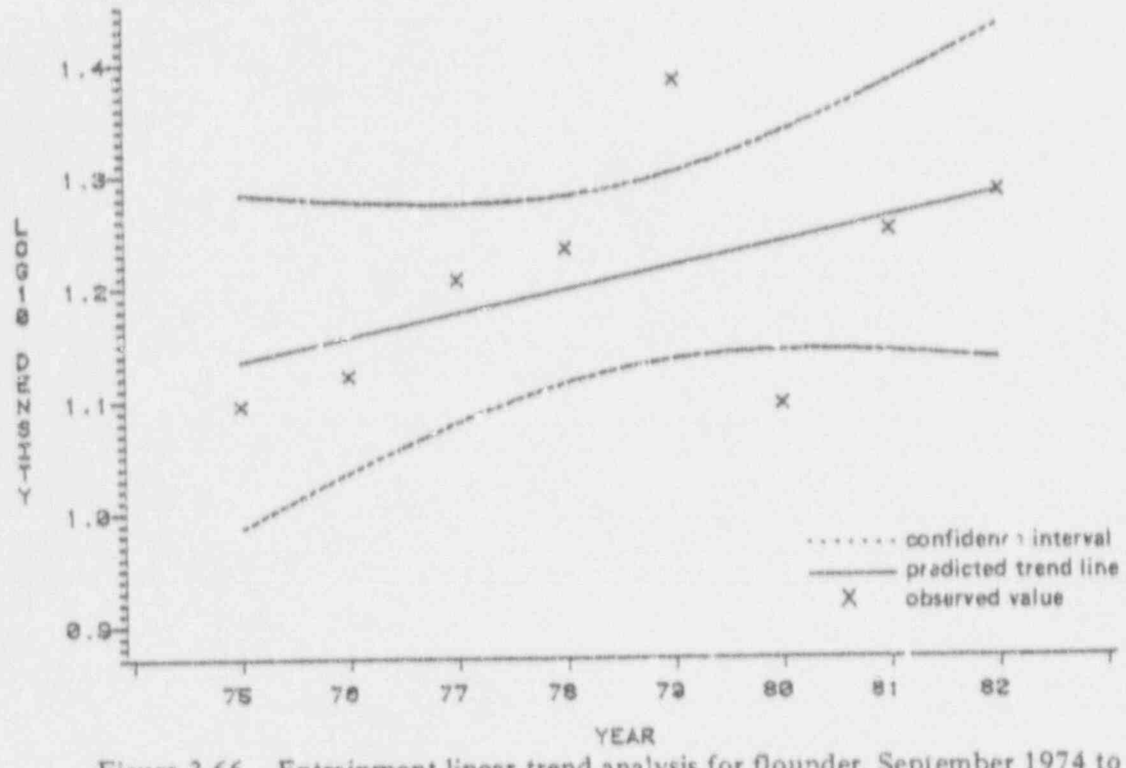


Figure 3.66 Entrainment linear trend analysis for flounder, September 1974 to August 1982.

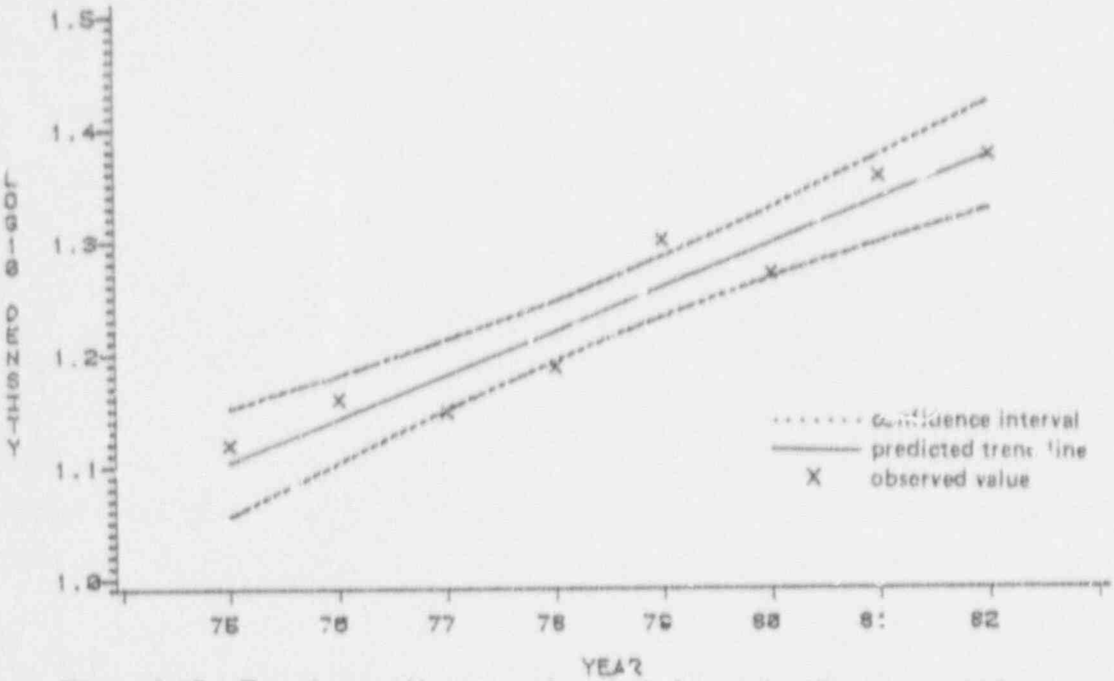


Figure 3.67 Entrainment linear trend analysis for mullet, September 1974 to August 1982.

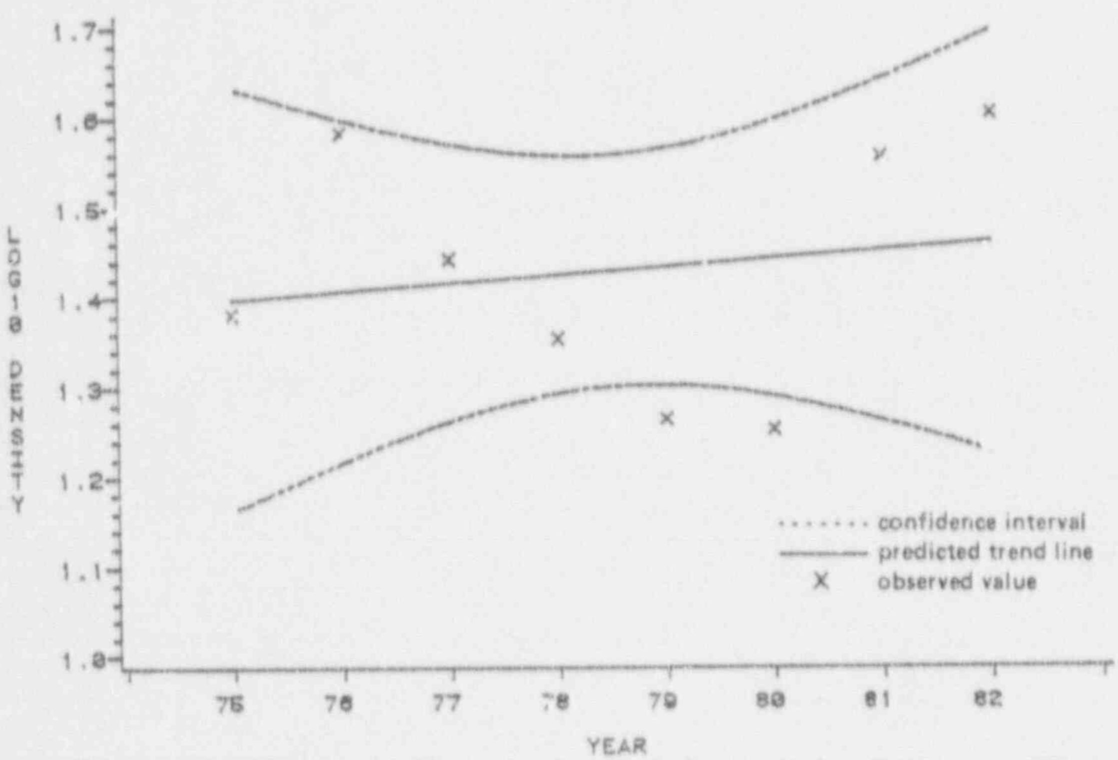


Figure 3.68 Entrainment linear trend analysis for menhaden, September 1974 to August 1982.

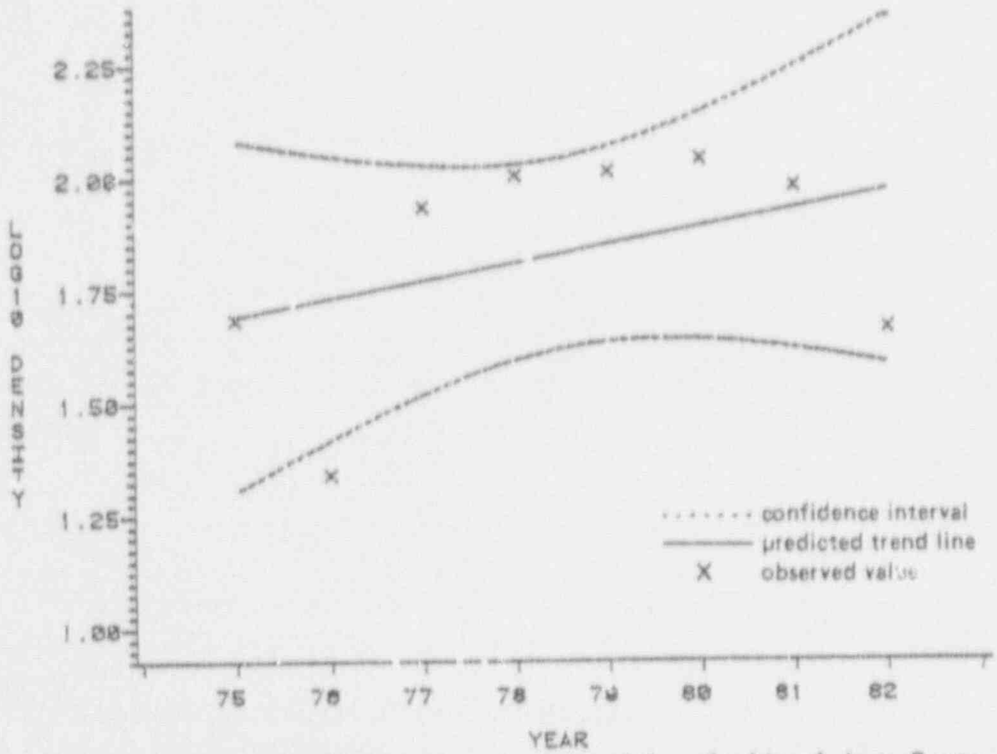


Figure 3.69 Entrainment linear trend analysis for pink and white shrimp, September 1974 to August 1982.

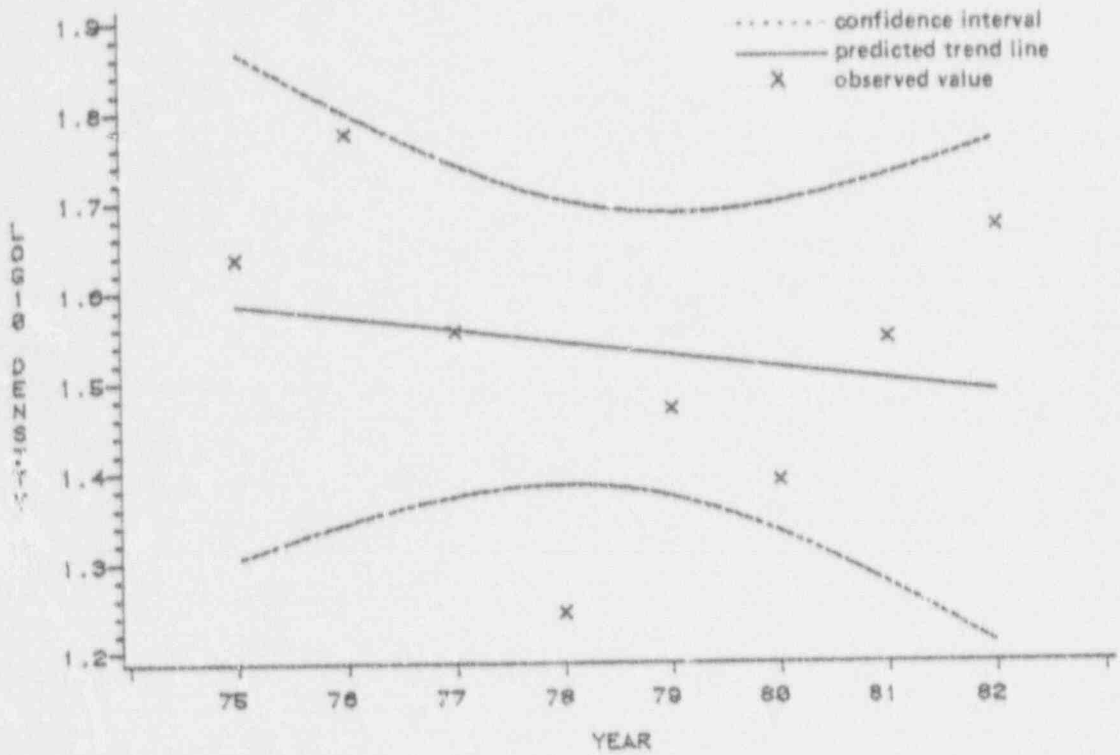


Figure 3.70 Entrainment linear trend analysis for brown shrimp, September 1974 to August 1982.

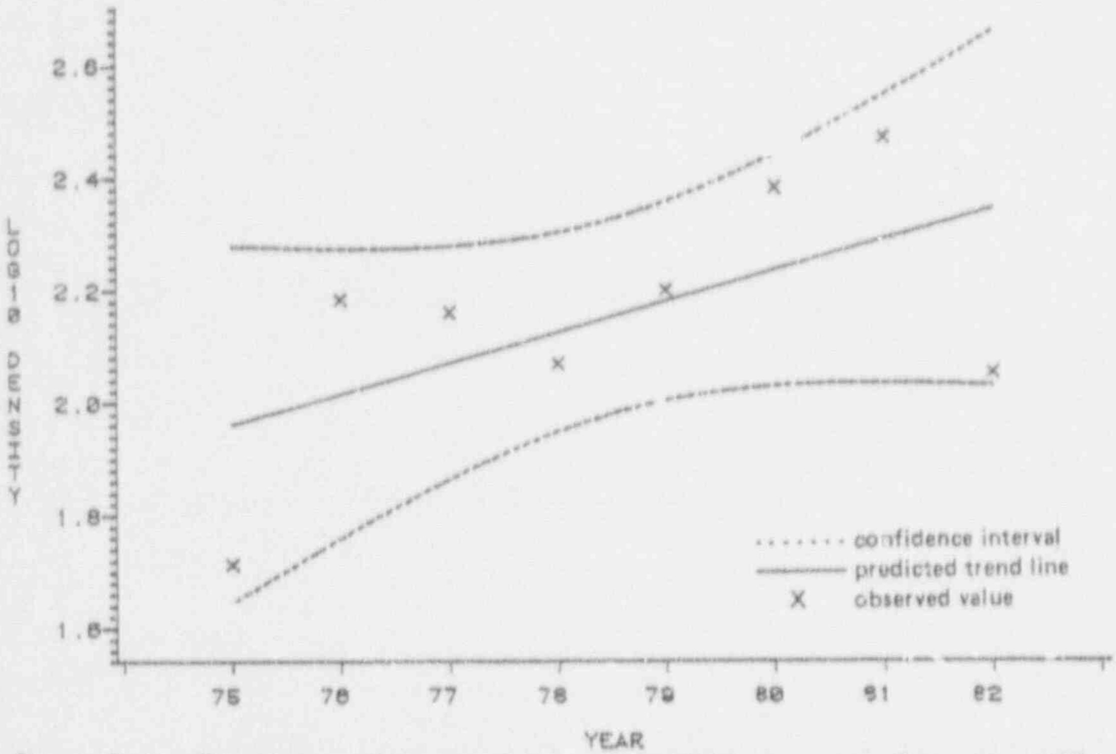


Figure 3.71 Entrainment linear trend analysis for Gobiosoma spp., September 1974 to August 1982.

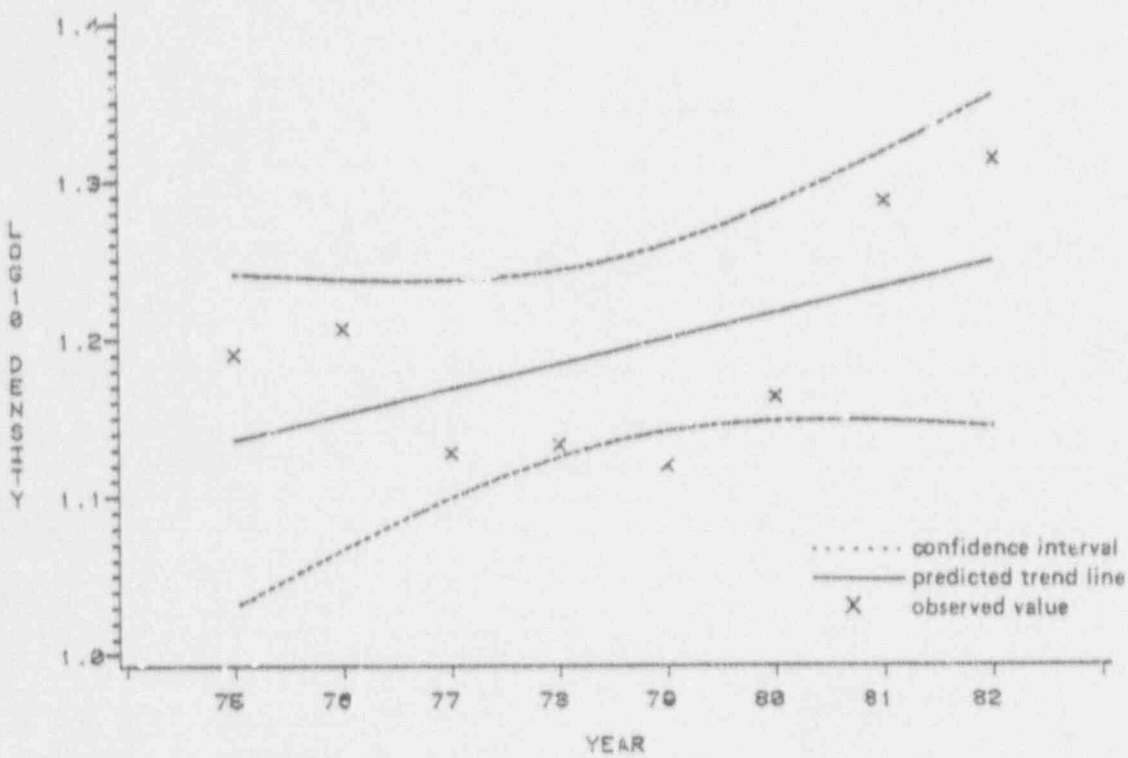


Figure 3.72 Entrainment linear trend analysis for Gobionellus spp., September 1974 to August 1982.

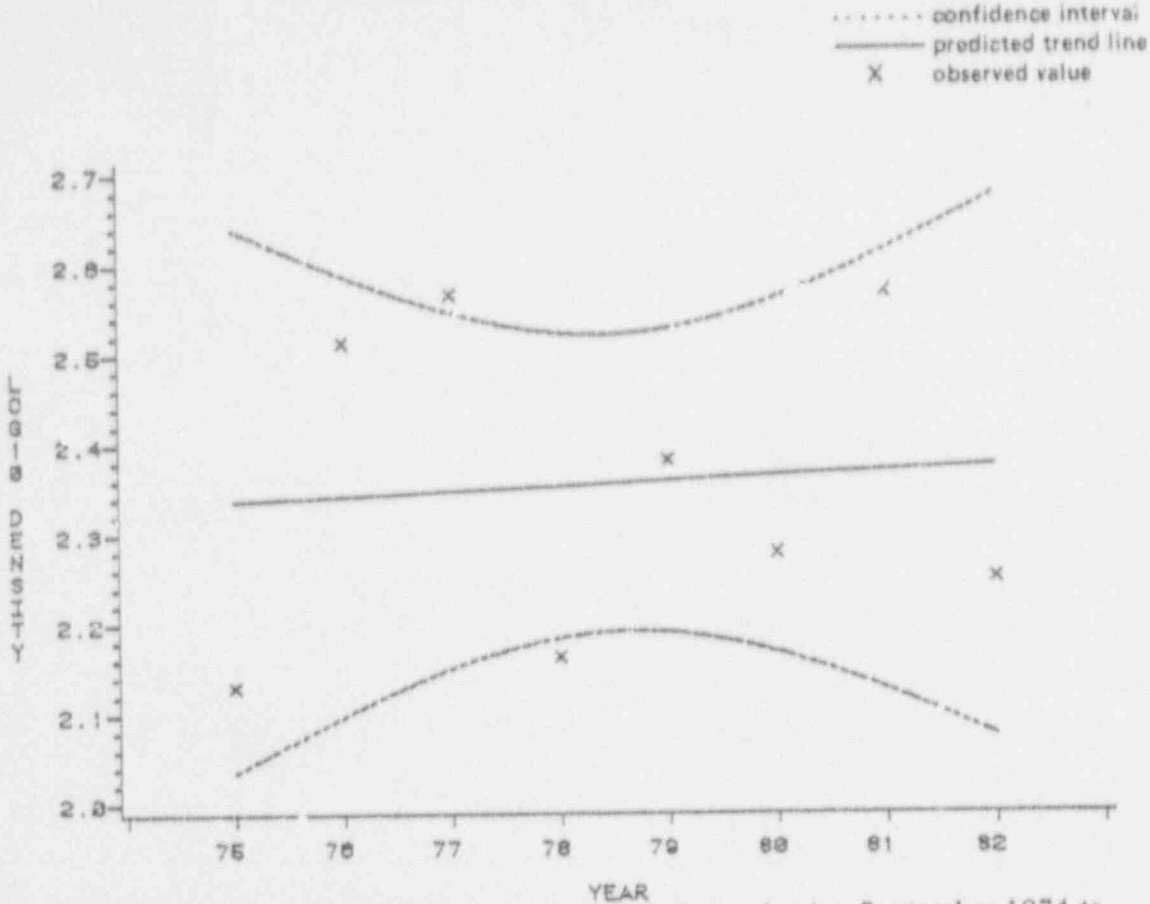


Figure 3.73 Entrainment linear trend analysis for anchovies, September 1974 to August 1982.

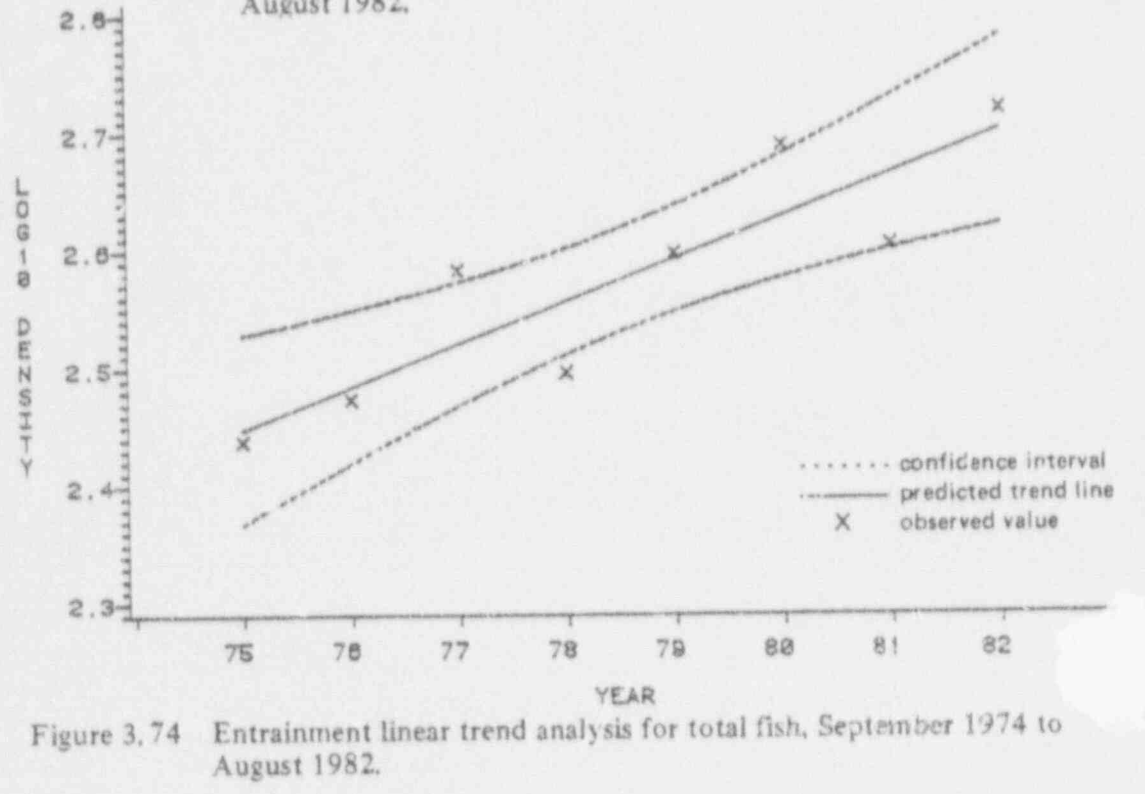


Figure 3.74 Entrainment linear trend analysis for total fish, September 1974 to August 1982.

TABLE 4.1 TOTAL CATCH AND PERCENT TOTAL OF ORGANISMS COLLECTED IN HIGH MARSH STUDY, 1982.

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TRAWLS CATCH	TRAWLS %	SEINES CATCH	SEINES %	ROTENONE CATCH	ROTENONE %
DASYATIDAE	STINGRAYS						
DASYATIS SABINA	ATLANTIC STINGRAY	1	0.00	0	0.00	0	0.00
MYLIOBATIDAE	EAGLE RAYS						
RHINOPTERA BONASUS	COWNOSE RAY	2	0.00	0	0.00	0	0.00
LEPISOSTEIDAE	GARS						
LEPISOSTEUS OSSEUS	LONGNOSE GAR	1	0.00	0	0.00	0	0.00
ELOPIDAE	TARPONS						
ELOPS SAURUS	LADYFISH	17	0.02	11	0.05	0	0.00
ELOPS SAURUS(LEPTOCEPHALUS)	LADYFISH(LEPTOCEPHALUS)	44	0.05	1	0.00	6	0.03
ANGUILLIDAE	FRESHWATER EELS						
ANGUILLA ROSTRATA	AMERICAN EEL	18	0.02	1	0.00	4	0.02
OPHICHTHIDAE	SNAKE EELS						
MYROPHIS PUNCTATUS	SPECKLED WORM EEL	2	0.00	0	0.00	1	0.01
MYROPHIS PUNCTATUS(LEPTOCEPHAL	SPECKLED WORM EEL(LEPTO.)	50	0.06	0	0.00	0	0.00
CLUPEIDAE	HERRINGS	1	0.00	0	0.00	0	0.00
ALOSA AESTIVALIS	BLUEBACK HERRING	1	0.00	2	0.01	0	0.00
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN	10,658	12.52	2,117	9.88	875	4.85
DOROSOMA CEPEDIANUM	GIZZARD SHAD	8,530	10.02	1,680	7.84	1	0.01
DOROSOMA PETENENSE	THREADFIN SHAD	3	0.00	0	0.00	0	0.00
ENGRAULIDAE	ANCHOVIES						
ANCHOA SP.	ANCHOVY UNID.(ANCHOA)	10	0.01	0	0.00	0	0.00
ANCHOA HEPSETUS	STRIPED ANCHOVY	27	0.03	8	0.04	0	0.00
ANCHOA MITCHILLI	BAY ANCHOVY	15,004	17.63	765	3.57	167	0.93
SYNODONTIDAE	LIZARDFISHES						
SYNODUS FOETENS	INSHORE LIZARDFISH	29	0.03	3	0.01	0	0.00
CYPRINIDAE	CARPS AND MINNOWS						
CYPRINUS CARPIO	COMMON CARP	1	0.00	0	0.00	0	0.00
ICTALURIDAE	BULLHEAD CATFISHES						
ICTALURUS CATUS	WHITE CATFISH	154	0.18	0	0.00	0	0.00
ICTALURUS PUNCTATUS	CHANNEL CATFISH	2	0.00	0	0.00	0	0.00
BATRACHOIDIDAE	TOADFISHES						
OPSANUS TAU	OYSTER TOADFISH	5	0.01	1	0.00	3	0.02
GOBIESOCIDAE	CLINGFISHES						
GOBIESOX STRUMOSUS	SKILLETFISH	0	0.00	0	0.00	1	0.01
GADIDAE	CODFISHES	4	0.00	0	0.00	0	0.00
UROPHYCIS FLORIDANA	SOUTHERN HAKE	2	0.00	0	0.00	0	0.00
UROPHYCIS REGIA	SPOTTED HAKE	13	0.02	1	0.00	0	0.00
OPHIDIIDAE	CUSK-EELS						
OPHIDION WELSHI	CRESTED CUSK-EEL	0	0.00	0	0.00	1	0.01
BELONIDAE	NEEDLEFISHES						
STRONGYLURA MARINA	ATLANTIC NEEDLEFISH	0	0.00	4	0.02	0	0.00
CYPRINODONTIDAE	KILLIFISHES						
CYPRINODON VARIEGATUS	SHEEPSHEAD MINNOW	1	0.00	7	0.03	0	0.00
FUNDULUS HETEROCLITUS	MUMMICHOG	352	0.41	3,825	17.85	8,547	47.41
FUNDULUS LUCIAE	SPOTFIN KILLIFISH	0	0.00	0	0.00	4	0.02

TABLE 4.1 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TRAWLS CATCH	TRAWLS %	SEINES CATCH	SEINES %	ROTENONE CATCH	ROTENONE %
FUNDULUS MAJALIS	STRIPED KILLIFISH	17	0.02	49	0.23	206	1.14
LUCANIA PARVA	RAINWATER KILLIFISH	0	0.00	1	0.00	0	0.00
POECILIIDAE	LIVEBEARERS						
GAMBUSIA AFFINIS	MOSQUITOFISH	15	0.02	5	0.02	2	0.01
ATHERINIDAE	SILVERSIDES	8	0.01	6	0.03	0	0.00
MENIDIA BERYLLINA	INLAND SILVERSIDE	11	0.01	37	0.17	8	0.04
MENIDIA MENIDIA	ATLANTIC SILVERSIDE	288	0.34	1,327	6.19	278	1.54
SYNGNATHIDAE	PIPEFISHES						
SYNGNATHUS FUSCUS	NORTHERN PIPEFISH	2	0.00	3	0.01	16	0.09
SYNGNATHUS LOUISIANAE	CHAIN PIPEFISH	7	0.01	1	0.00	5	0.03
PERCICHTHYIDAE	TEMPERATE BASSES						
MORONE SAXATILIS	STRIPED BASS	23	0.03	0	0.00	0	0.00
CENTRARCHIDAE	SUNFISHES						
LEPOMIS SP.	SUNFISH UNID.(LEPOMIS)	4	0.00	0	0.00	0	0.00
LEPOMIS GIBBOSUS	PUMPKINSEED	25	0.03	0	0.00	0	0.00
LEPOMIS MACROCHIRUS	BLUEGILL	6	0.01	0	0.00	0	0.00
LEPOMIS MICROLOPHUS	REDEAR SUNFISH	6	0.01	0	0.00	0	0.00
POMOXIS ANNULARIS	WHITE CRAPPIE	1	0.00	0	0.00	0	0.00
POMOXIS NIGROMACULATUS	BLACK CRAPPIE	57	0.07	0	0.00	0	0.00
PERCIDAE	PERCHES						
PERCA FLAVESCENS	YELLOW PERCH	2	0.00	0	0.00	0	0.00
POMATOMIDAE	BLUEFISHES						
POMATOMUS SALTATRIX	BLUEFISH	5	0.01	1	0.00	0	0.00
CARANGIDAE	JACKS						
CARANX HIPPOS	CREVALLE JACK	26	0.03	61	0.28	0	0.00
SELENE VOMER	LOOKDOWN	3	0.00	0	0.00	0	0.00
TRACHINOTUS FALCATUS	PERMIT	0	0.00	4	0.02	0	0.00
LUTJANIDAE	SNAPPERS						
LUTJANUS GRISEUS	GRAY SNAPPER	9	0.01	9	0.04	25	0.14
GERREIDAE	MOJARRAS	31	0.04	10	0.05	5	0.03
DIAPTERUS AURATUS	IRISH POMPANO	13	0.02	1	0.00	0	0.00
EUCINOSTOMUS SP.	MOJARRA UNID.(EUCINOSTOMUS)	47	0.06	13	0.06	4	0.02
EUCINOSTOMUS ARGENTEUS	SPOTFIN MOJARRA	216	0.25	226	1.05	20	0.11
HAEMULIDAE	GRUNTS						
ORTHOPRISTIS CHRYSOPTERA	PIGFISH	55	0.06	6	0.03	0	0.00
SPARIDAE	PORGIES						
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD	1	0.00	0	0.00	0	0.00
LAGODON RHOMBOIDES	PINFISH	459	0.54	122	0.57	65	0.36
SCIAENIDAE	DRUMS						
BAIRDIELLA CHRYSOURA	SILVER PERCH	191	0.22	16	0.07	2	0.01
CYNOSCION NEBULOSUS	SPOTTED SEATROUT	0	0.00	4	0.02	1	0.01
CYNOSCION REGALIS	WEAKFISH	7	0.01	7	0.00	0	0.00
LEIOSTOMUS XANTHURUS	SPOT	38,358	45.08	7,499	34.99	5,146	28.54
MICROPOGONIAS UNDULATUS	ATLANTIC CROAKER	5,691	6.69	159	0.74	278	1.54
POGONIAS CROMIS	BLACK DRUM	13	0.02	0	0.00	2	0.01

TABLE 4.1 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TRAWLS CATCH	TRAWLS %	SEINES CATCH	SEINES %	ROTENONE CATCH	ROTENONE %
SCIAENOPS OCELLATUS	RED DRUM	10	0.01	2	0.01	71	0.39
STELLIFER LANCEOLATUS	STAR DRUM	60	0.07	1	0.00	0	0.00
MUGILIDAE	MULLETS						
MUGIL SP.	MULLET UNID.(MUGIL)	2	0.00	0	0.00	0	0.00
MUGIL CEPHALUS	STRIPED MULLET	761	0.89	468	2.18	998	5.54
MUGIL CUREMA	WHITE MULLET	636	0.75	2,830	13.21	55	0.31
URANOSCOPIDAE	STARGAZERS						
ASTROSCOPUS GUTTATUS	NORTHERN STARGAZER	2	0.00	0	0.00	0	0.00
ASTROSCOPUS Y-GRAECUM	SOUTHERN STARGAZER	1	0.00	0	0.00	0	0.00
BLENNIIDAE	COMBTOOTH BLENNIES	1	0.00	0	0.00	2	0.01
CHASMODES BOSQUIANUS	STRIPED BLENNY	2	0.00	1	0.00	4	0.02
HYPLEUROCHILUS GEMINATUS / HYPSOBLENNIUS HENTZI	FEATHER BLENNY	1	0.00	0	0.00	0	0.00
GOBIIDAE	GOBIES						
BATHYGOBIUS SOPORATOR	FRILLFIN GOBY	0	0.00	0	0.00	1	0.01
GOBIONELLUS SP.	GOBY UNID.(GOBIONELLUS)	0	0.00	1	0.00	2	0.01
GOBIONELLUS BOLEOSOMA	DARTER GOBY	83	0.10	54	0.25	617	3.42
GOBIONELLUS HASTATUS	SHARPTAIL GOBY	42	0.05	0	0.00	11	0.06
GOBIONELLUS SHUFELDTI	FRESHWATER GOBY	235	0.28	26	0.12	7	0.04
GOBIOSOMA BOSCI	NAKED GOBY	55	0.06	4	0.02	338	1.87
GOBIOSOMA GINSBURGI	SEABOARD GOBY	1	0.00	0	0.00	12	0.07
MICROGOBIUS THALASSINUS	GREEN GOBY	0	0.00	0	0.00	9	0.05
STROMATEIDAE	BUTTERFISHES						
PEPRILUS ALEPIDOTUS	HARVESTFISH	3	0.00	0	0.00	0	0.00
PEPRILUS TRIACANTHUS	BUTTERFISH	0	0.00	1	0.00	0	0.00
TRIGLIDAE	SEAROBINS						
PRIONOTUS SP.	SEAROBIN UNID.(PRIONOTUS)	7	0.01	2	0.01	1	0.01
PRIONOTUS SCITULUS	LEOPARD SEAROBIN	7	0.00	1	0.00	0	0.00
PRIONOTUS TRIBULUS	BIGHEAD SEAROBIN	21	0.02	1	0.00	4	0.02
BOTHIDAE	LEFTEYE FLOUNDERS						
ANCYLOPSETTA QUADROCELLATA	OCELLATED FLOUNDER	2	0.00	1	0.00	0	0.00
CITHARICHTHYS SP.	WHIFF UNID.(CITHARICHTHYS)	13	0.02	0	0.00	0	0.00
CITHARICHTHYS SPILOPTERUS	BAY WHIFF	193	0.23	7	0.01	7	0.04
ETROPUS CROSSOTUS	FRINGED FLOUNDER	18	0.02	0	0.00	1	0.00
PARALICHTHYS SP.	FLOUNDER UNID.(PARALICHTHYS)	48	0.06	0	0.00	0	0.00
PARALICHTHYS DENTATUS	SUMMER FLOUNDER	22	0.03	2	0.01	41	0.23
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER	1,349	1.59	19	0.09	24	0.13
SCOPHTHALMUS AQUOSUS	WINDOWPANE	1	0.00	0	0.00	0	0.00
SOLEIDAE	SOLES						
TRINECTES MACULATUS	HOGCHOKER	809	0.95	0	0.00	0	0.00
CYNOGLOSSIDAE	TONGUEFISHES						
SYMPHURUS PLAGIUSA	BLACKCHEEK TONGUEFISH	180	0.21	25	0.12	140	0.78
BALISTIDAE	LEATHERJACKETS						
MONACANTHUS HISPIDUS	PLANEHEAD FILEFISH	4	0.00	1	0.00	12	0.07
TETRAODONTIDAE	PUFFERS						
SPHOEROIDES MACULATUS	NORTHERN PUFFER	1	0.00	1	0.00	0	0.00

TABLE 4.1 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TRAWLS CATCH	TRAWLS %	SEINES CATCH	SEINES %	ROTENONE CATCH	ROTENONE %
DIODONTIDAE	PORCUPINEFISHES						
CHILOMYCTERUS SCHOEPFI	STRIPED BURRFISH	2	0.00	0	0.00	0	0.00
	TOTAL FISH	85,096	100.0	21,430	99.9	18,029	100.0
PENAEIDAE	PENAEID SHRIMP	18	0.06	0	0.00	0	0.00
PENAEUS SP.(ADULT)	PENAEUS (ADULT)	9	0.03	0	0.00	0	0.00
PENAEUS SP.(POSTLARVAE)	PENAEUS (POSTLARVAE)	95	0.30	16	0.12	0	0.00
PENAEUS AZTECUS	BROWN SHRIMP	4,153	12.97	460	3.45	0	0.00
PENAEUS DUORARUM	PINK SHRIMP	1,050	3.28	138	1.03	0	0.00
PENAEUS SETIFERUS	WHITE SHRIMP	737	2.30	111	0.83	0	0.00
TRACHYPENEUS CONSTRICTUS	T-CON OR HARDBACK SHRIMP	108	0.34	8	0.06	0	0.00
PALAEMONETES SP.	GRASS SHRIMP	22,941	71.66	11,947	69.59	0	0.00
ALPHEUS SP.	SNAPPING SHRIMP	15	0.05	0	0.00	0	0.00
UPOGEBIA SP. AND CALLIANASSA S	MUD SHRIMPS	1	0.00	0	0.00	0	0.00
PORTUNIDAE	SWIMMING CRABS	332	1.04	58	0.37	0	0.00
PORTUNUS SP.	SWIMMING CRABS	1	0.00	0	0.00	0	0.00
CALLINECTES SP.	BLUE CRABS	2,518	7.87	600	4.50	0	0.00
LOLLIGUNCULA BREVIS	BRIEF SQUID	31	0.10	5	0.04	0	0.00
MALACLEMYS TERRAPIN	DIAMONDBACK TERRAPIN	2	0.01	0	0.00	0	0.00
CHRYSEMYS CONCINNA	RIVER COOTER	1	0.00	0	0.00	0	0.00
	TOTAL INVERTEBRATES	32,012	100.0	13,335	100.0	0	0.0
	TOTAL ORGANISMS	117,108		34,765		18,029	
	TOTAL EFFORTS	357		85		10	

Table 4.2 Results of analysis of variance and Duncan's multiple range test indicating statistical differences between creeks Log_{10} (CPUE + 1) for high marsh 1982.

Species	Gear	Creek	$\overline{Log}$	S^2	Trips Analyzed
Total organisms	Trawl	*** W M A B	1.936	0.374	1-17
	Seine	NS	2.137	0.292	1-17
Menhaden	Trawl	*** W A M B	0.662	0.560	2-10
Bay anchovy	Trawl	** M B W A	0.586	0.472	2-17
Mummichog	Seine	** W B M	0.649	0.618	3-15

NS Not significant - $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

B = Baldhead Creek
W = Walden Creek
M = Mott's Bay
A = Alligator Creek

Table 4.2 (continued)

Species	Gear	Creek	$\overline{Log}$	S^2	Trips Analyzed
Atlantic silverside	Seine	*** B W M	0.498	0.225	2-17
Spot	Trawl	*** W M B A	1.036	0.506	1-17
Croaker	Trawl	*** M A W B	0.306	0.177	1-17
Striped mullet	Seine	* W B M	0.394	0.250	1-17
White mullet	Seine	* W B M	1.12	0.526	7-14

NS	Not significant - $p > .05$	B	=	Baldhead Creek
*	$.01 < p \leq .05$	W	=	Walden Creek
**	$.001 < p \leq .01$	M	=	Mott's Bay
***	$p \leq .001$	A	=	Alligator Creek

Table 4.2 (continued)

Species	Gear	Creek	Log	S^2	Trips Analyzed
Flounder	Trawl	*** A M W B	0.317	0.158	1-9
Brown shrimp	Trawl	*** W M B A	0.758	0.359	7-12
Pink shrimp	Trawl	*** M W B A	0.367	0.136	6-17
White shrimp	Trawl	*** W M B A	0.377	0.231	7-16
Blue crab	Trawl	*** W A M B	0.601	0.207	1-17

NS Not significant - $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

B = Baldhead Creek
W = Walden Creek
M = Mott's Bay
A = Alligator Creek

Table 4.3 Salinity, temperature, and substrate organic preferences for selected species in high marsh study.

Species	Salinity (ppt)			Temperature (°C)			Organics (%)		
	0-10	11-20	21-30	3-13	14-24	25-34	<1-11	12-22	23-34
Atlantic menhaden	***	**	*	*	***	**	***	**	*
Bay anchovy	**	*	***	*	**	***	***	**	*
Mummichog	***	**	*	*	**	***	***	*	*
Atlantic silverside	*	**	***	*	**	***	***	*	*
Spot	***	**	*	**	***	*	**	***	*
Atlantic croaker	***	**	*	**	***	*	***	**	*
Striped mullet	***	**	*	*	*	***	***	*	*
White mullet	**	*	***	*	**	***	***	*	*
Flounder	***	*	*	**	***	*	**	***	*
Brown shrimp	***	**	*	*	**	***	***	**	*
Pink shrimp	**	***	*	*	***	**	***	**	*
White shrimp	***	*	**	*	**	***	***	**	*
Blue crabs	***	**	*	*	***	**	**	***	*

*** = Most abundant
** = Moderately abundant
* = Least abundant

Table 4.4 Spring standing crop estimates for high marsh 1982.

	Walden Creek		Baldhead Creek		Mott's Bay	
Species	No/m^2	No/Hectare	No/m^2	No/Hectare	No/m^2	No/Hectare
Total organisms	9.24	89643.36	12.80	127998.14	1.87	19142.50
Menhaden	0.13	1266.87	0.95	9358.56	0.36	3705.00
Bay anchovy	0.13	935.07	0.57	5681.00	1.16	11886.88
Mummichog	0.11	1023.30	10.69	105757.17	0.00	0.00
Atlantic silverside	0.01	52.93	0.00	0.00	0.01	61.75
Spot	6.80	65931.36	1.29	12747.94	1.16	11856.00
Croaker	0.00	0.00	0.00	0.00	0.10	1080.62
Striped mullet	0.32	3087.50	0.59	5804.50	0.09	895.38
White mullet	0.00	0.00	0.00	0.00	0.00	0.00
Flounder	0.07	723.36	0.01	54.88	0.04	370.50

	Walden Creek	Baldhead Creek	Mott's Bay
	Salinity	Salinity	Salinity
Upstream	4.0	20.0	6.0
Downstream	11.0	26.0	
	Temperature	Temperature	Temperature
Upstream	13.8	11.0	15.8
Downstream	15.0	12.0	
	Percent Organics	Percent Organics	Percent Organics
Upstream	1.5	0.9	2.8
Downstream	2.8	11.9	

Table 4.5 Fall stan-ling crop estimates for high marsh 1982.

Species	Walden Creek No/m^2	Walden Creek No/Hectare	Baldhead Creek No/m^2	Baldhead Creek No/Hectare	Mott's Bay No/m^2	Mott's Bay No/Hectare
Total organisms	0.83	8045.14	3.31	32754.94	0.76	7965.75
Menhaden	0.00	0.00	0.00	0.00	0.00	0.00
Bay anchovy	0.00	0.00	0.12	1235.00	0.14	1420.25
Mummichog	0.12	1164.43	0.99	9811.38	0.00	30.88
Atlantic silverside	0.00	0.00	0.38	3746.18	0.00	0.00
Spot	0.01	52.44	0.13	1248.73	0.01	61.75
Croaker	0.00	17.64	0.12	1235.00	0.46	4693.00
Striped mullet	0.41	4004.93	0.19	1893.68	0.02	185.25
White mullet	0.00	0.00	0.07	727.27	0.01	61.75
Flounder	0.00	17.64	0.01	96.06	0.00	0.00

	Walden Creek	Baldhead Creek	Mott's Bay
Salinity			
Upstream	4.0	23.0	12.0
Downstream	11.0	25.0	
Temperature			
Upstream	13.5	14.5	19.0
Downstream	15.0	15.8	
Percent Organics			
Upstream	1.5	0.9	2.8
Downstream	2.8	11.9	

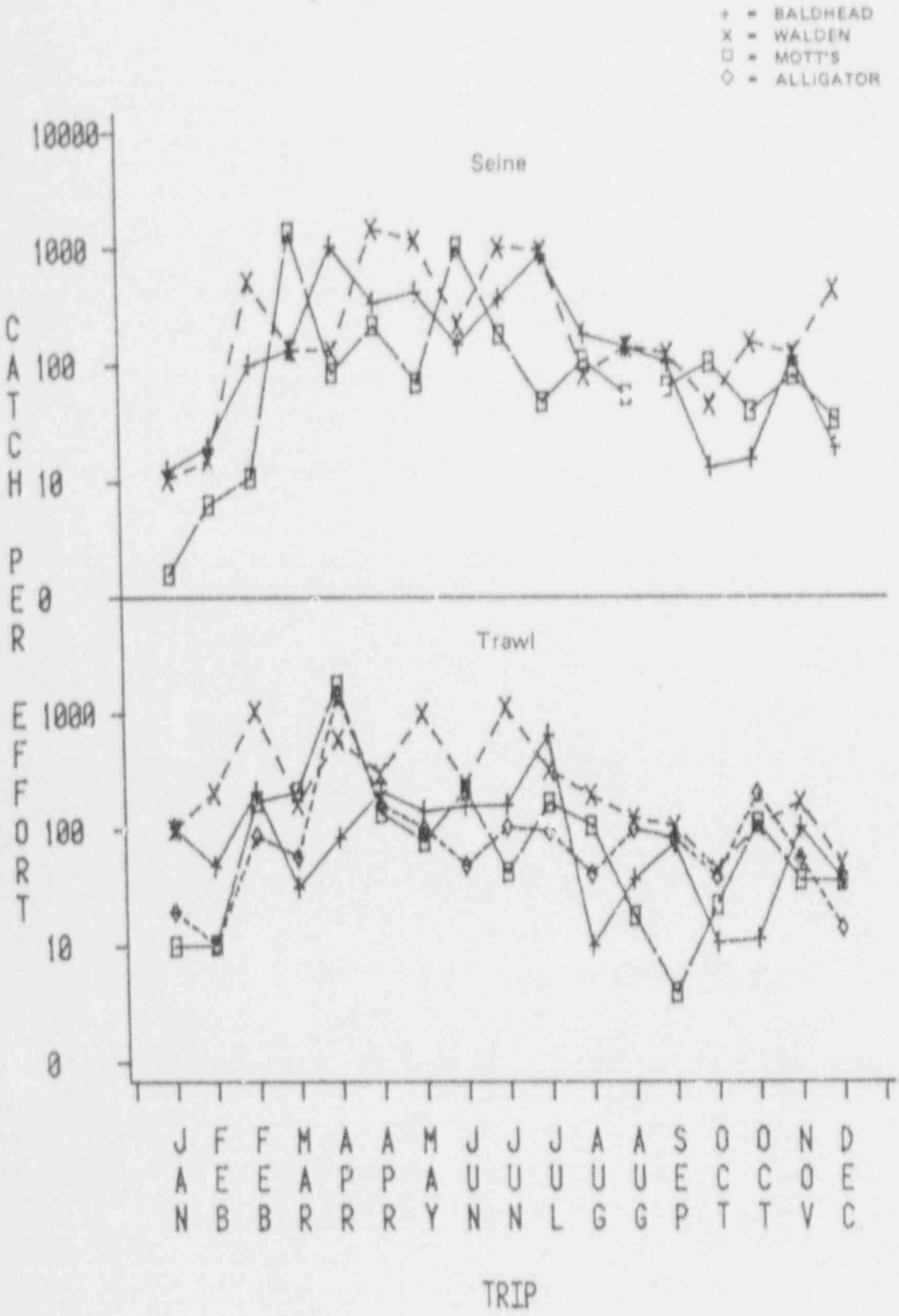


Figure 4.1 Mean CPUE of total organisms by creek for high marsh, 1982.

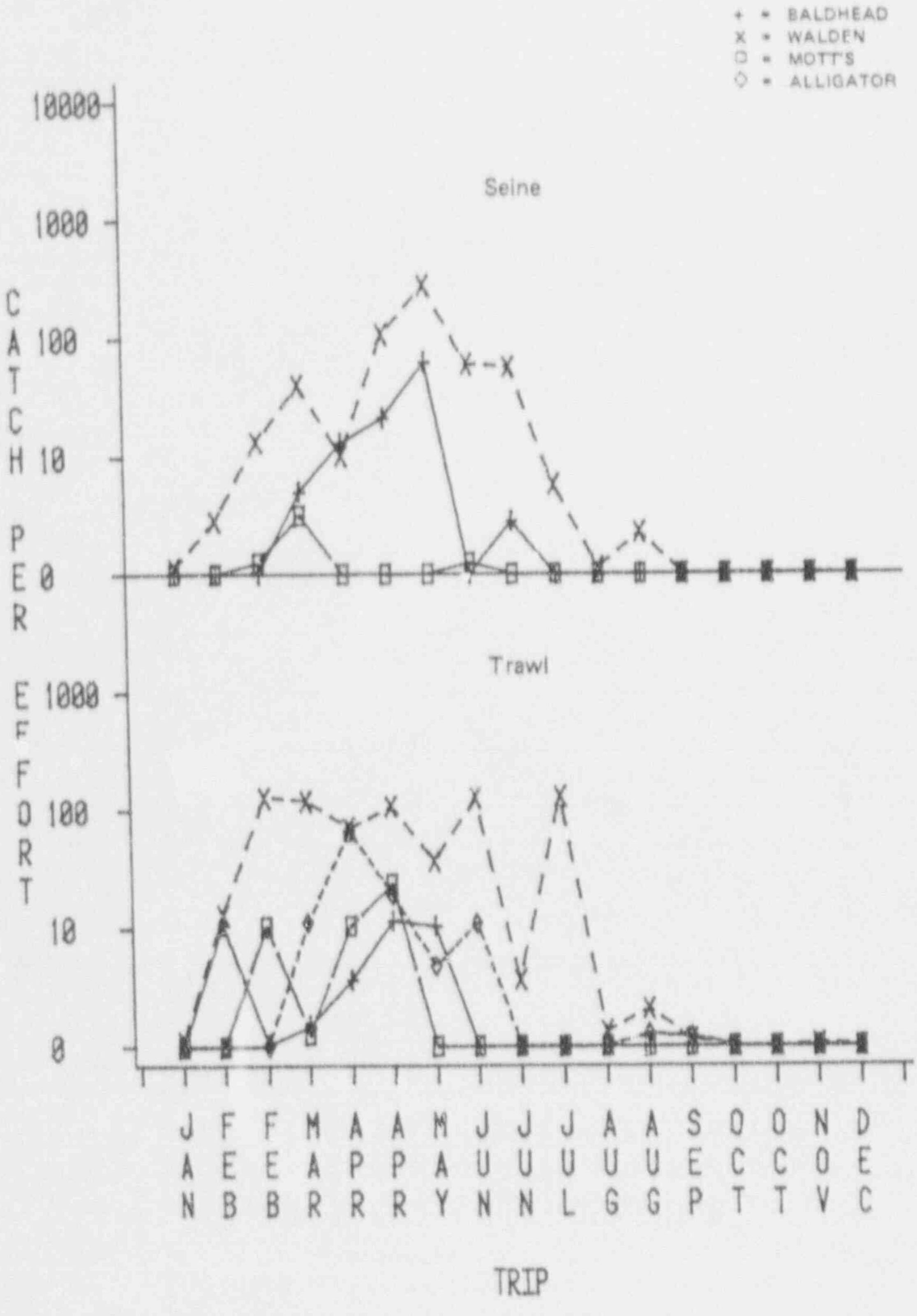


Figure 4.2 Mean CPUE of Atlantic menhaden by creek for high marsh, 1982.

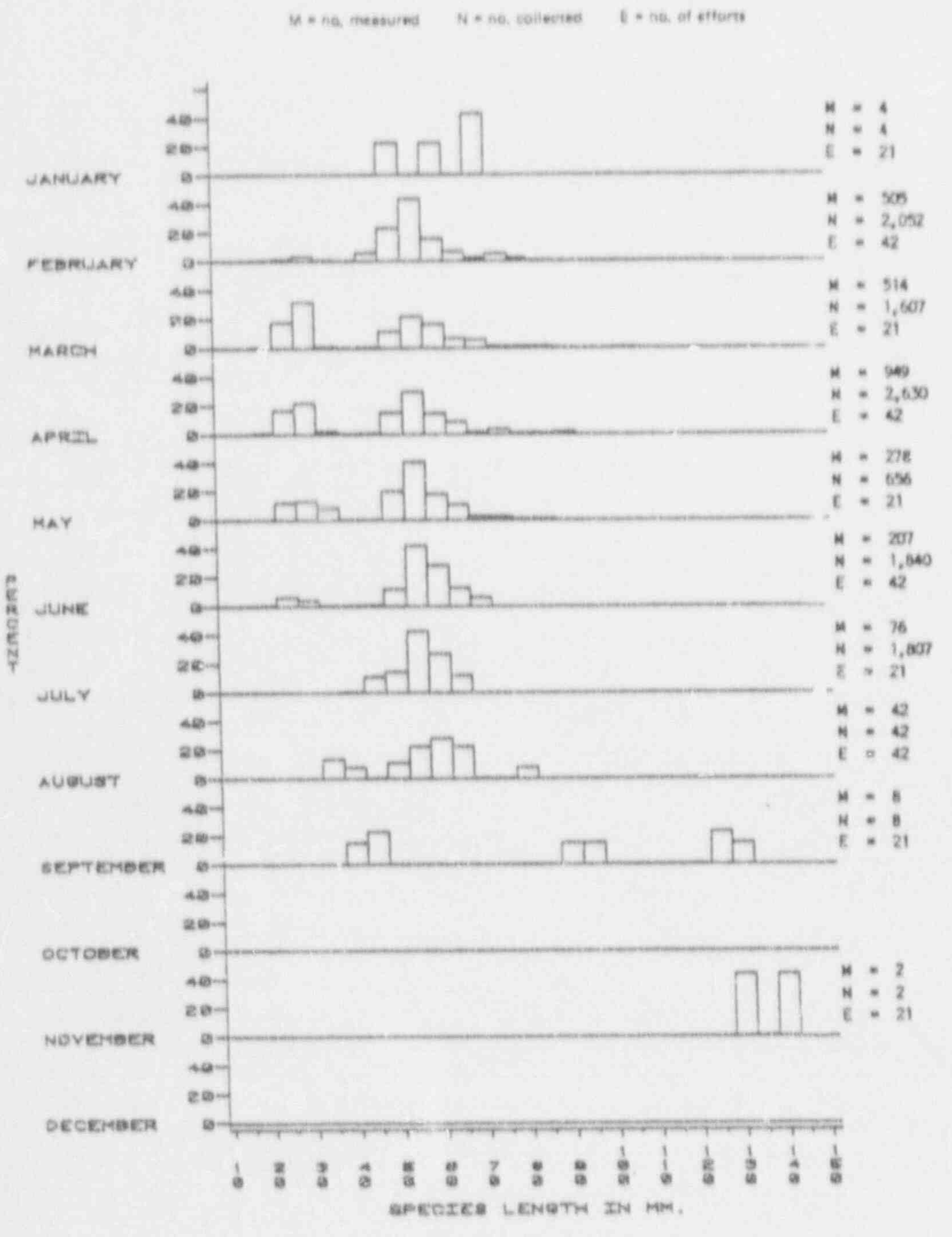


Figure 4.3 Length frequencies of Atlantic menhaden collected by trawls for high marsh, 1982.

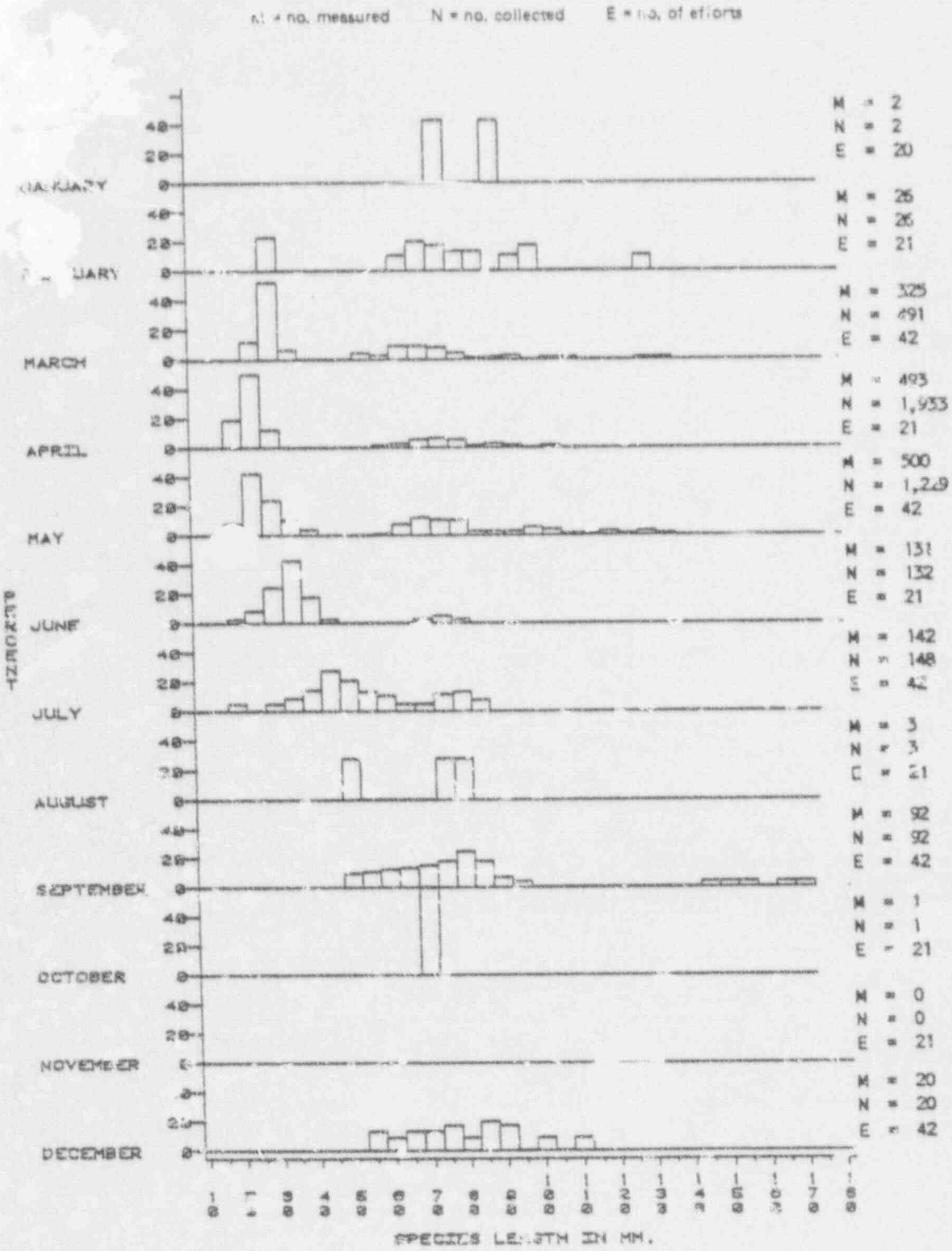


Figure 4.4 Length frequencies of Atlantic menhaden collected by trawls for high marsh, 1981.

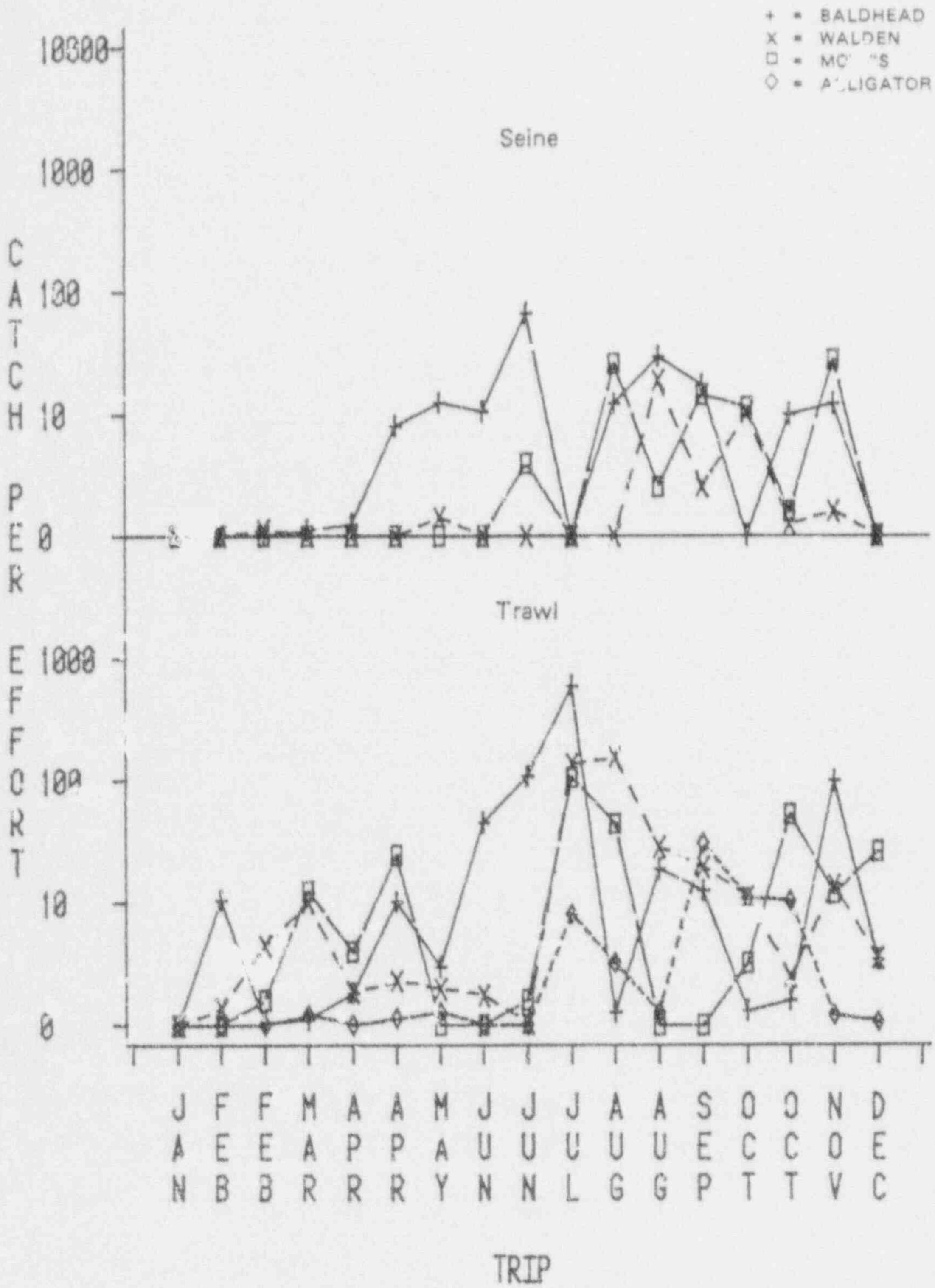


Figure 4.5 Mean CPUE of bay anchovy by creek for high marsh, 1982.

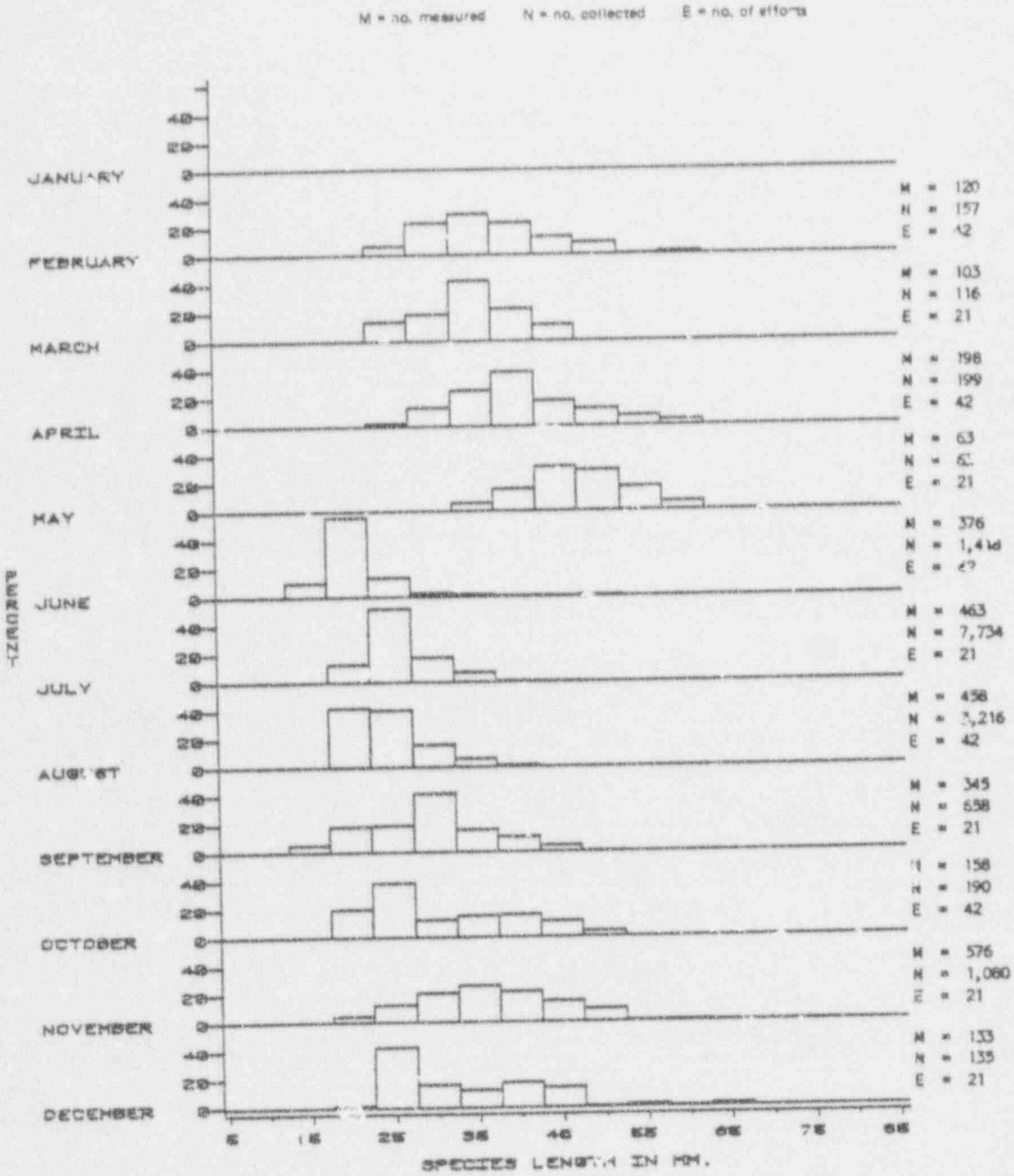


Figure 4.6 Length frequencies of bay anchovy collected by trawls for high marsh, 1982.

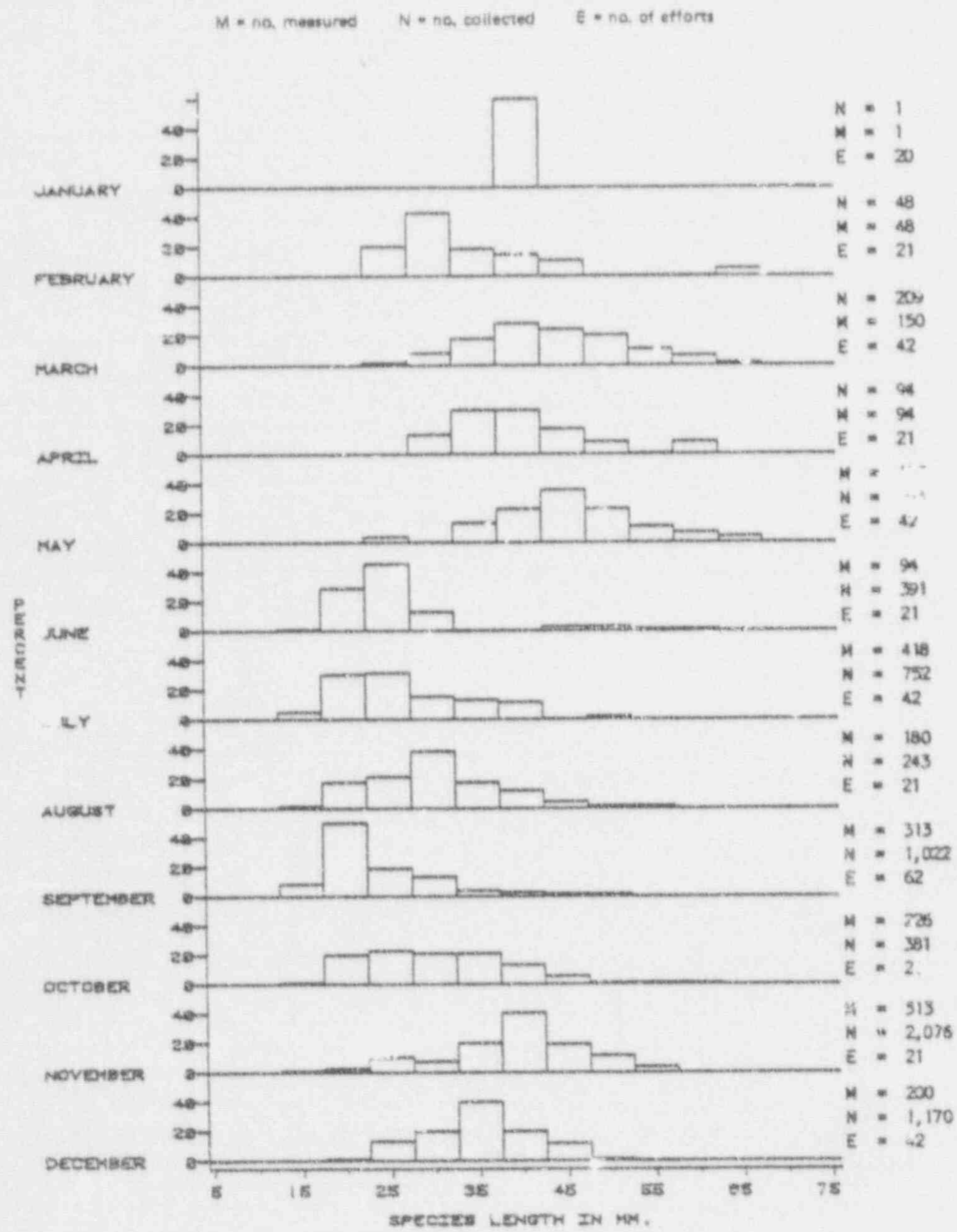


Figure 4.7 Length frequencies of bay anchovy collected by trawls for high marsh, 1982.

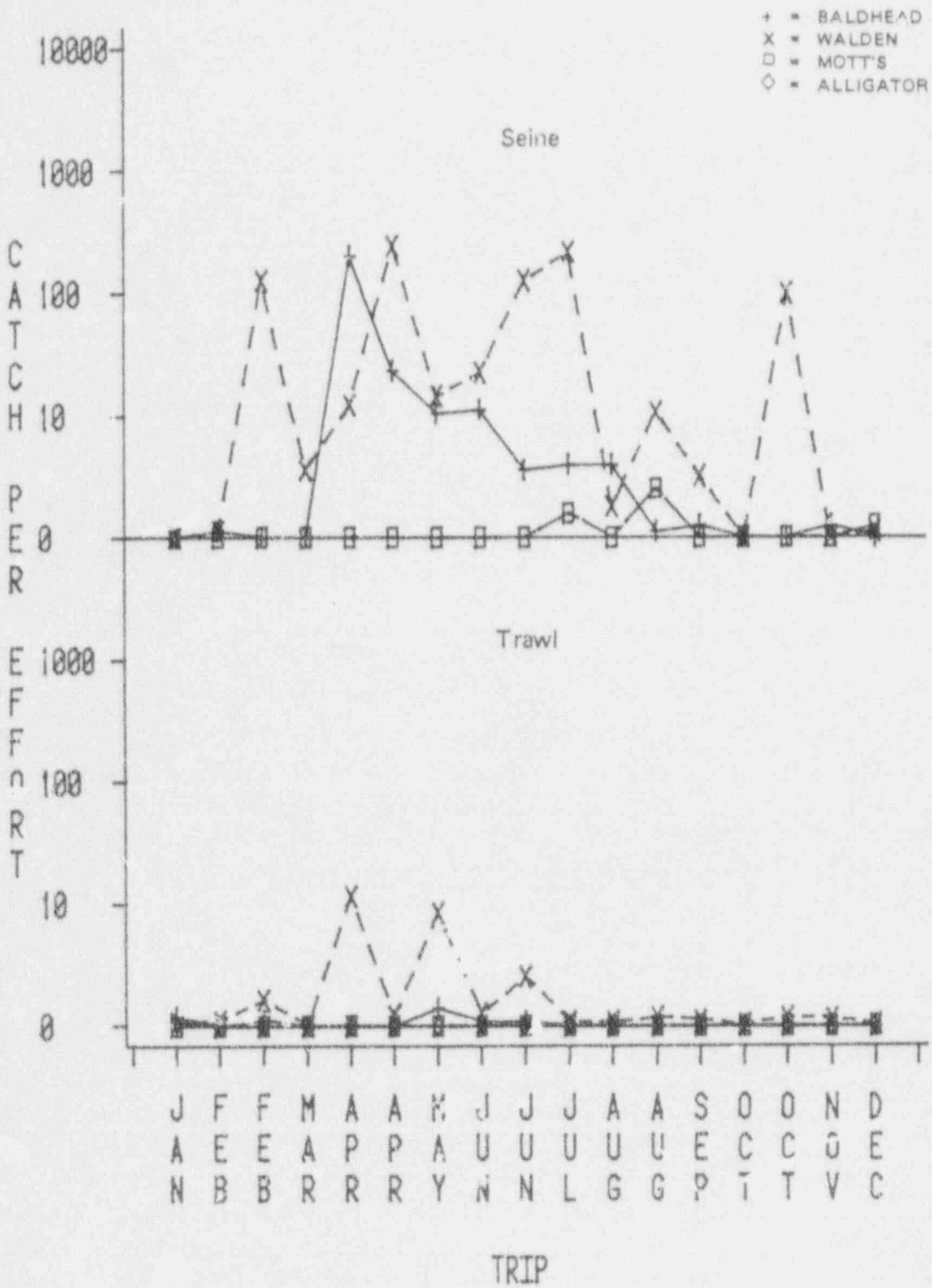


Figure 4.8 Mean CPUE of mummichog by creek for high marsh. 1982.

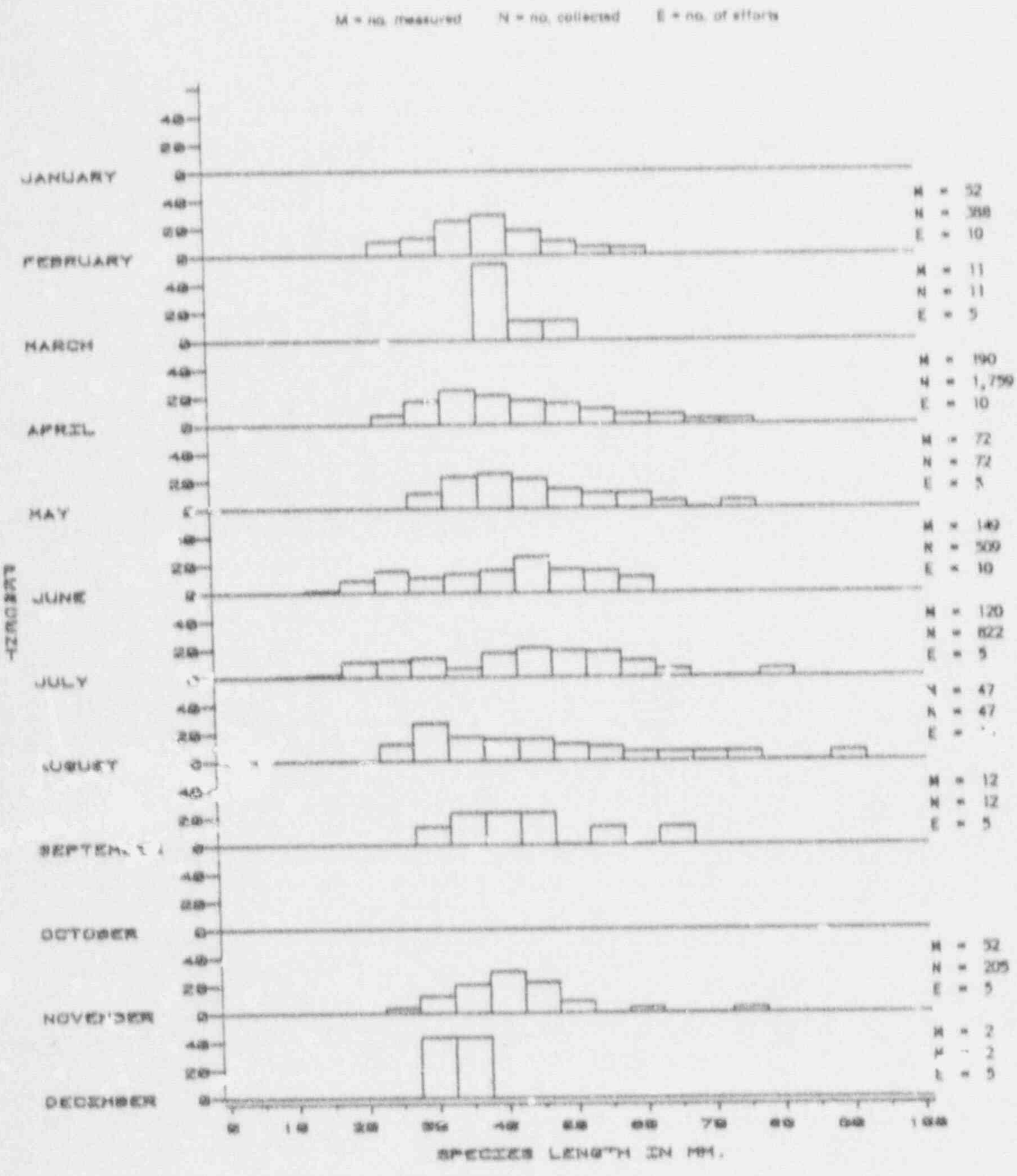


Figure 4.9 Length frequencies of mummichog collected by seines for high marsh, 1982.

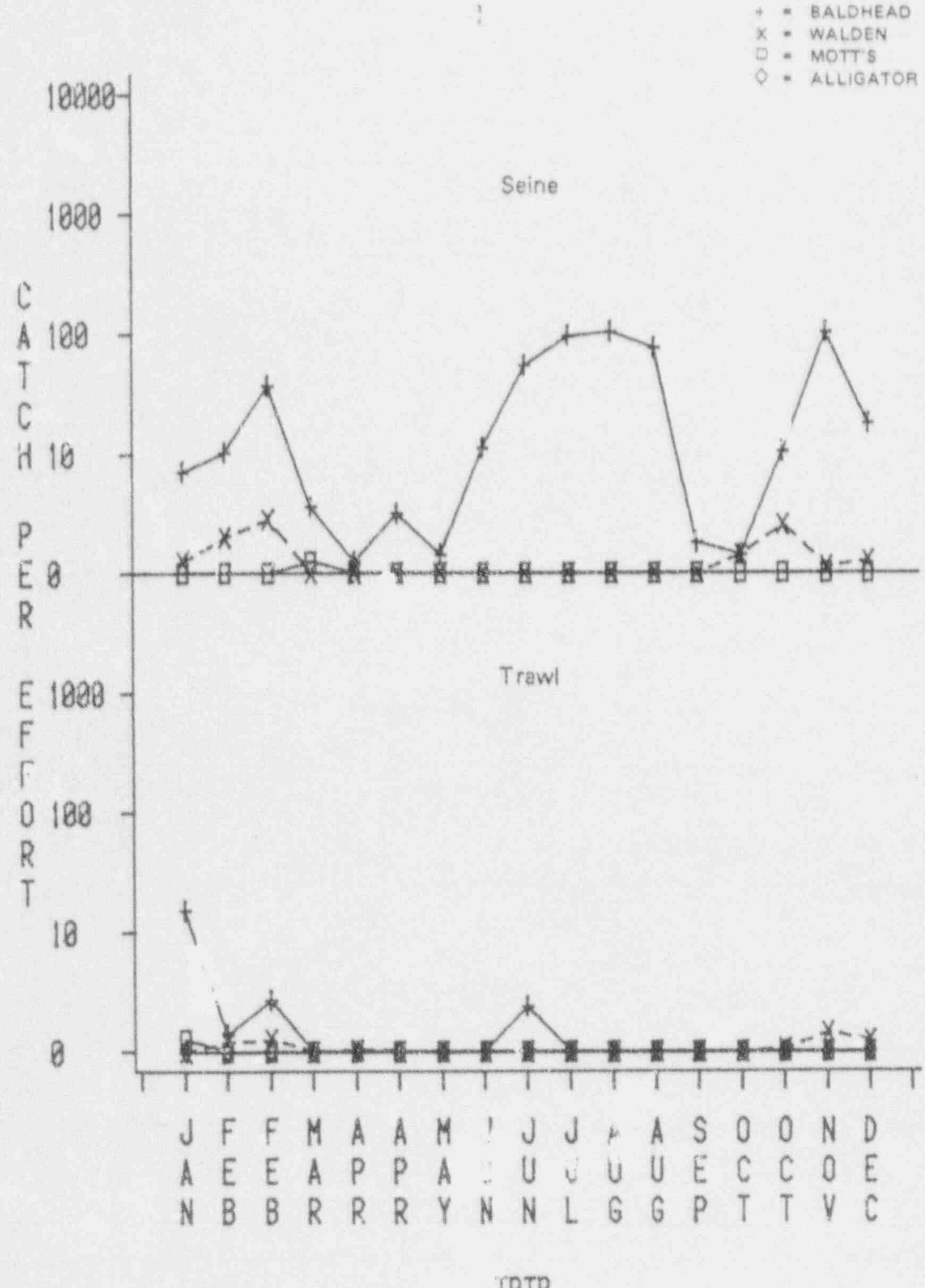


Figure 4.10 Mean CPUE of Atlantic silverside by creek for high marsh, 1982.

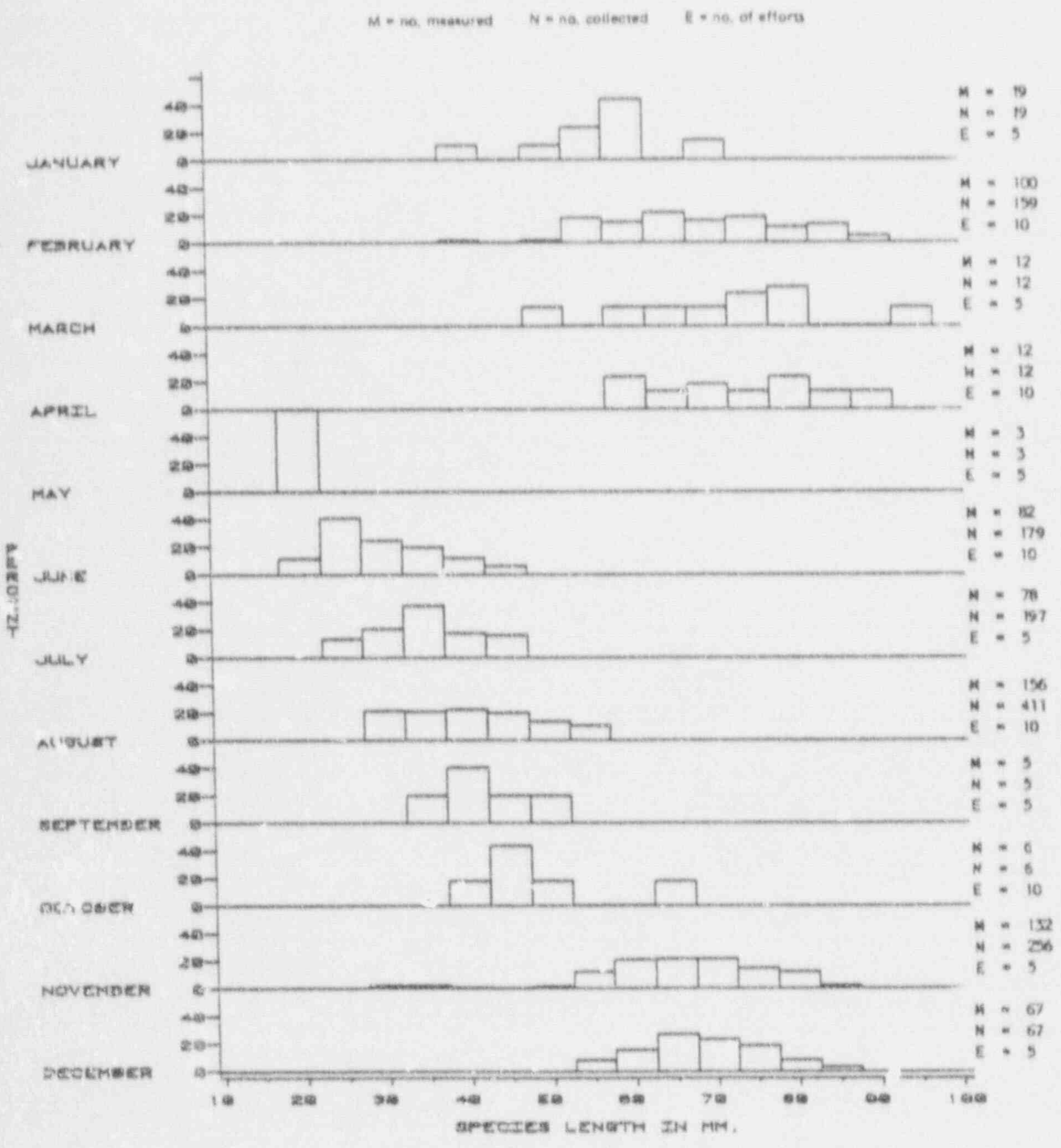


Figure 4.11 Length frequencies of Atlantic silverside collected by seines for high marsh, 1982.

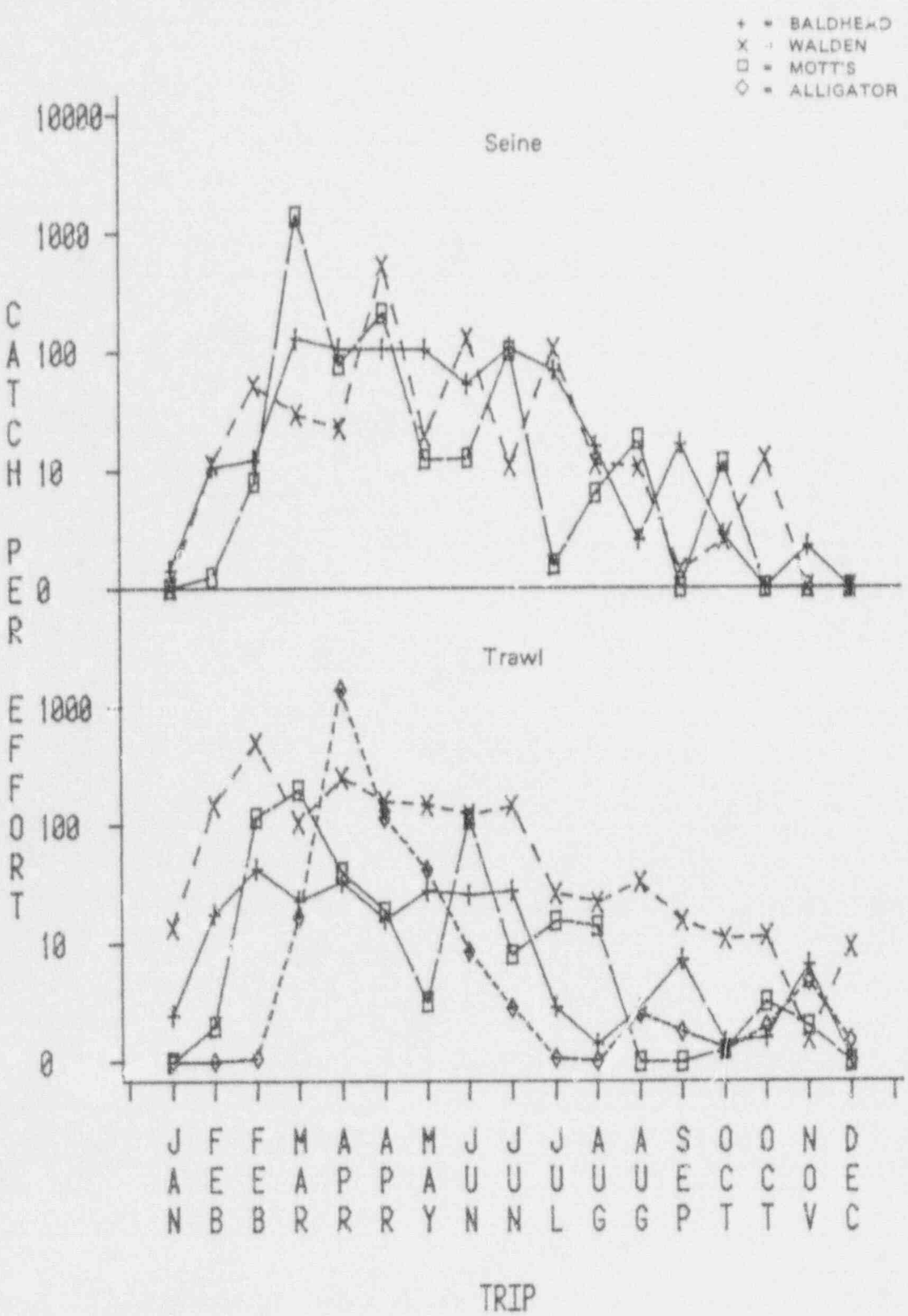


Figure 4.12 Mean CPUE of spot by creek for high marsh, 1982.

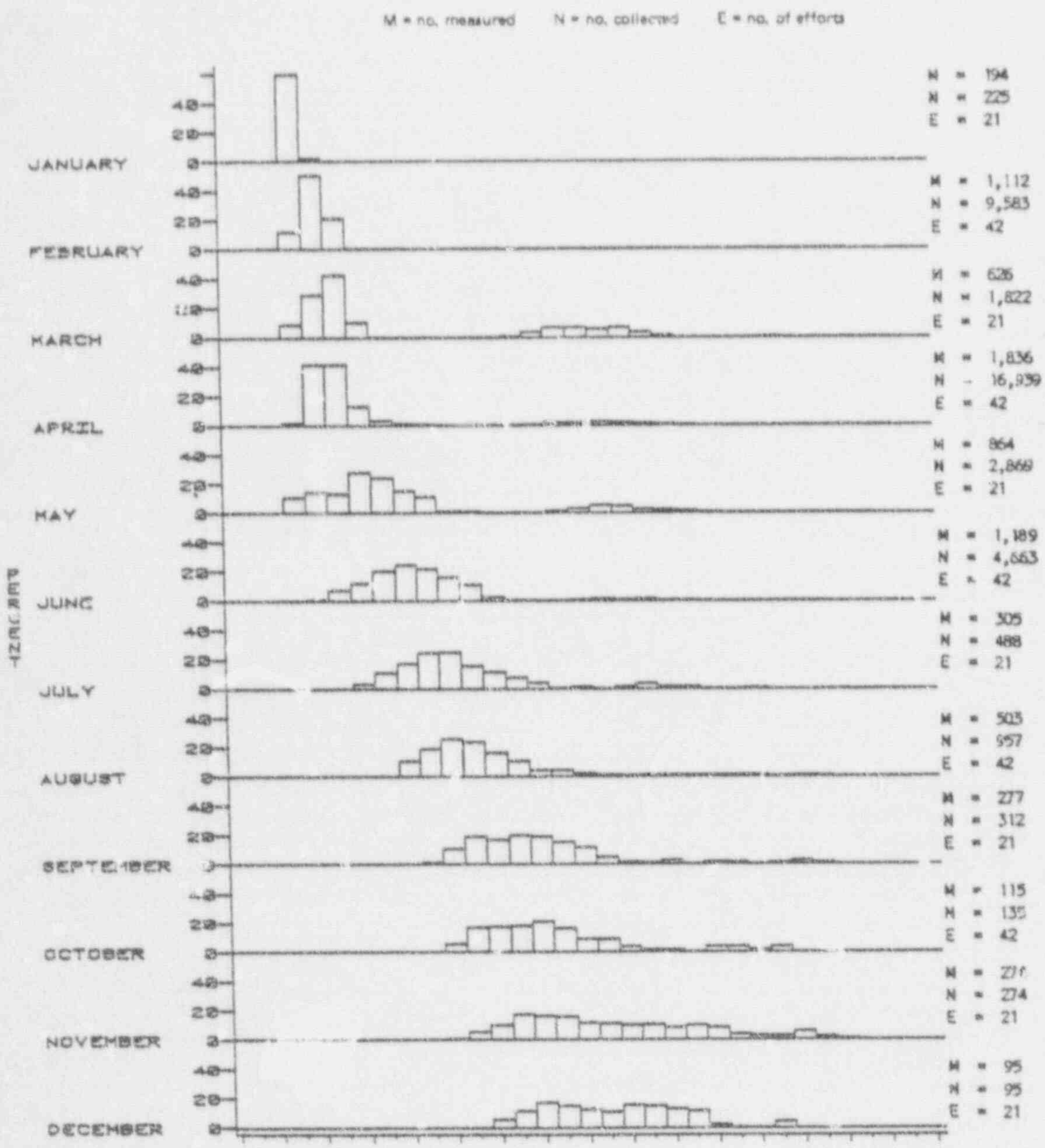


Figure 4.13 Length frequencies of spot collected by trawls for high marsh, 1982.

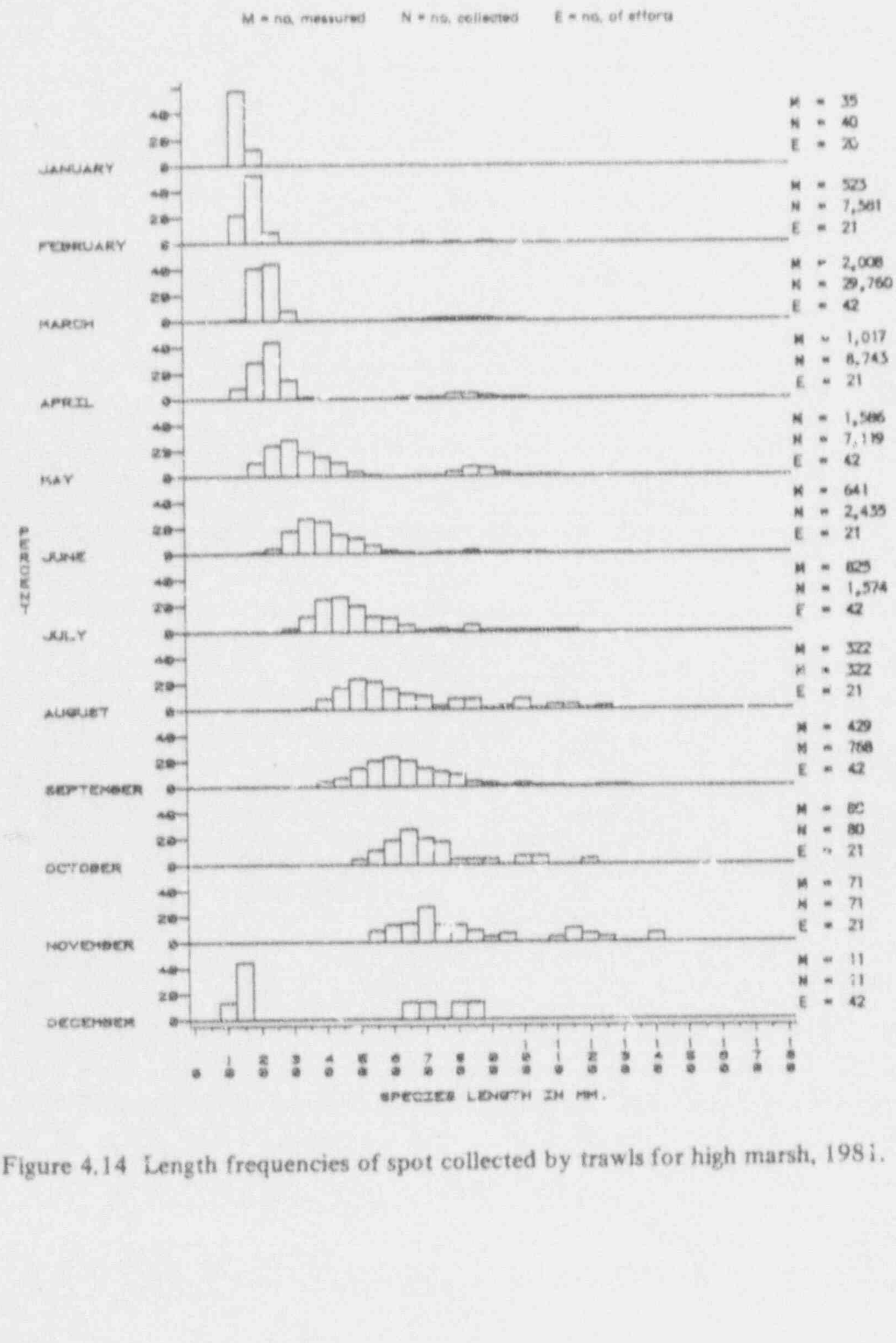


Figure 4.14 Length frequencies of spot collected by trawls for high marsh, 1981.

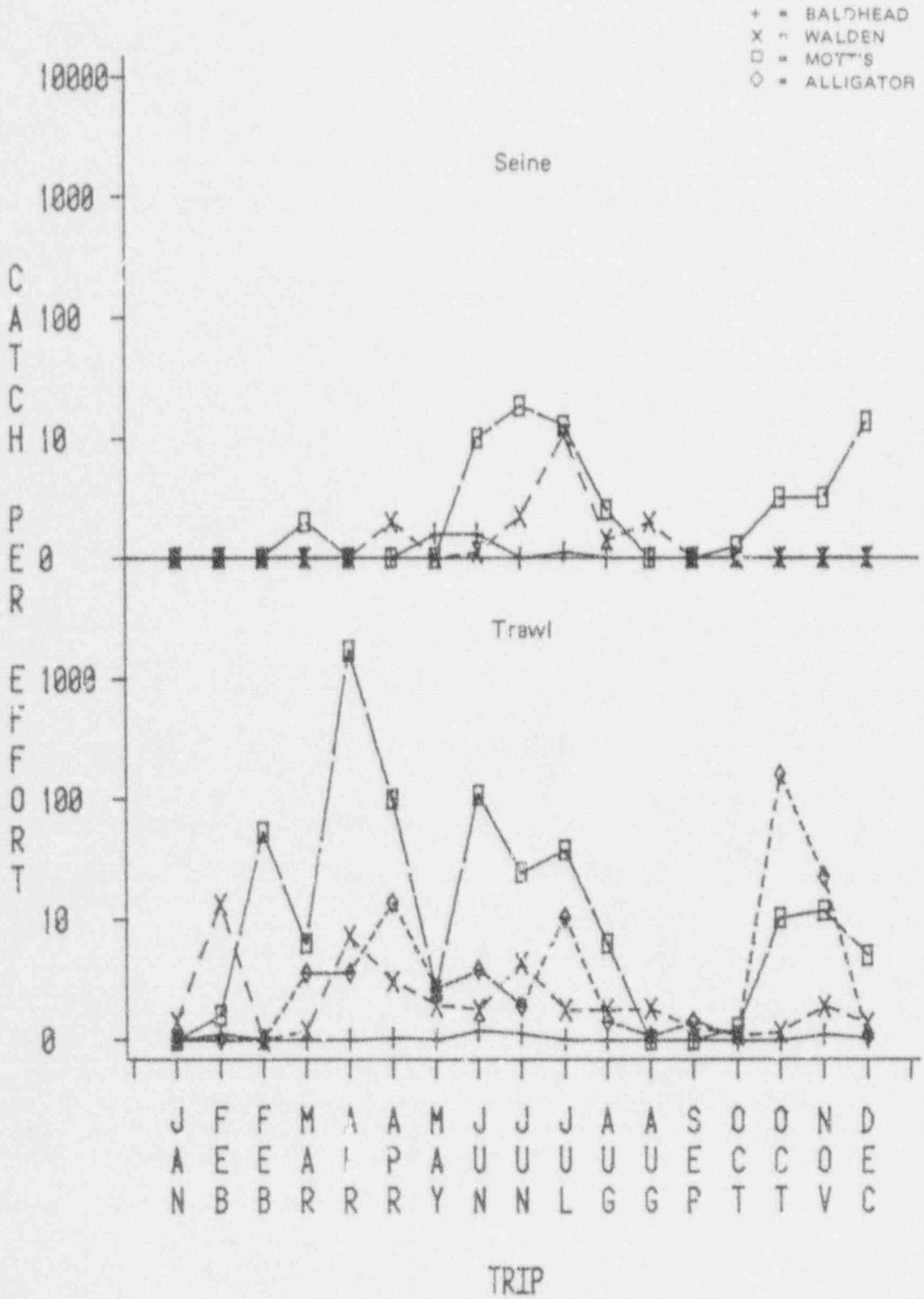


Figure 4.15 Mean CPUE of Atlantic croaker by creek for high marsh, 1982.

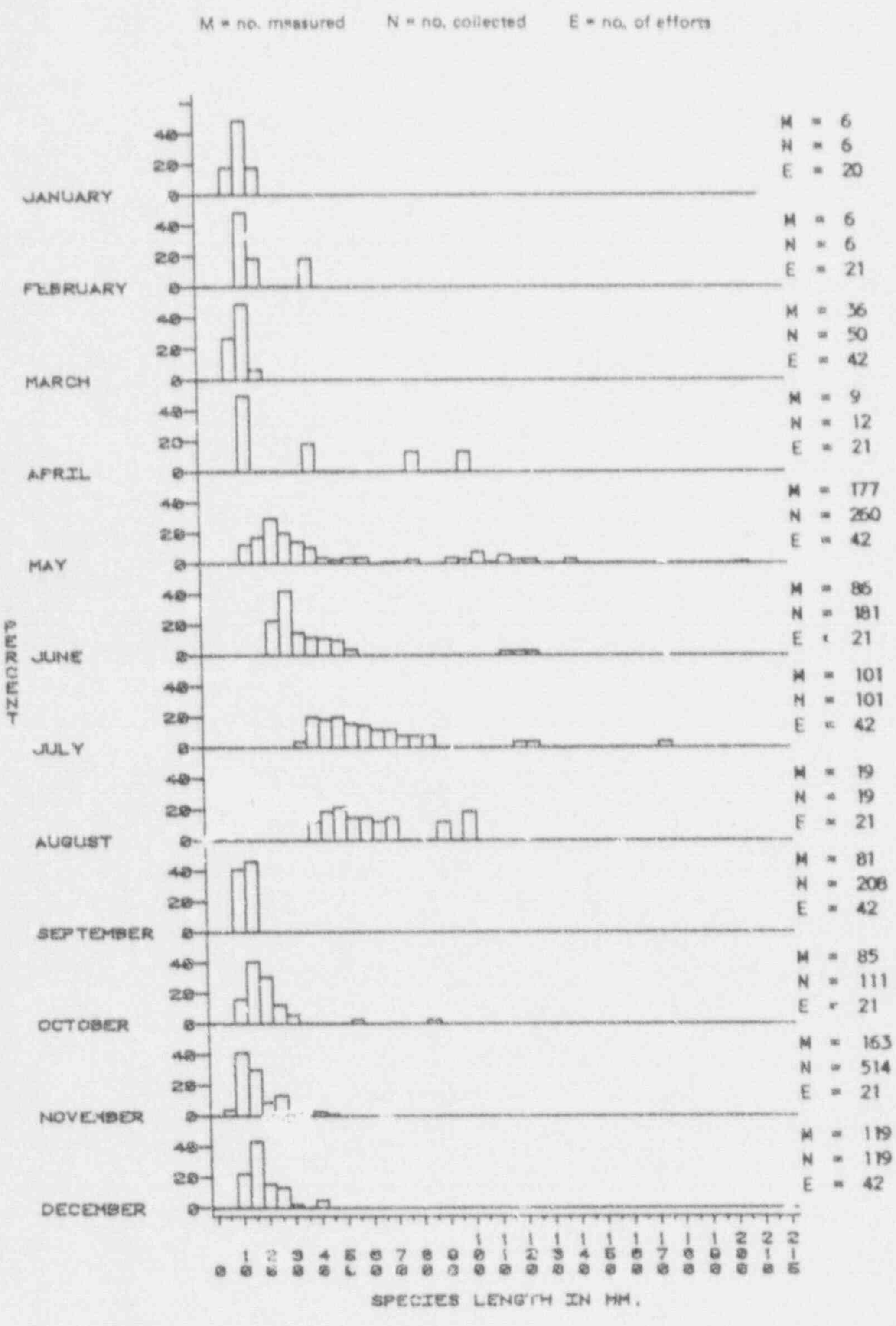


Figure 4.16 Length frequencies of Atlantic croaker collected by trawls for high marsh, 1981.

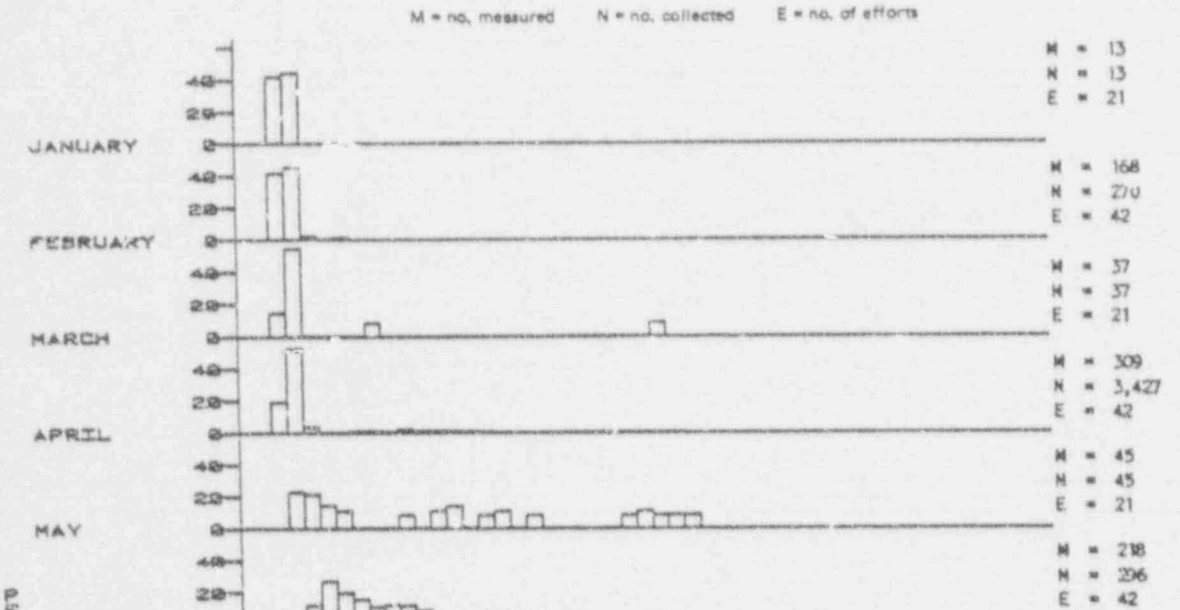


Figure 4.17 Length frequencies of Atlantic croaker collected by trawls for high marsh, 1982.

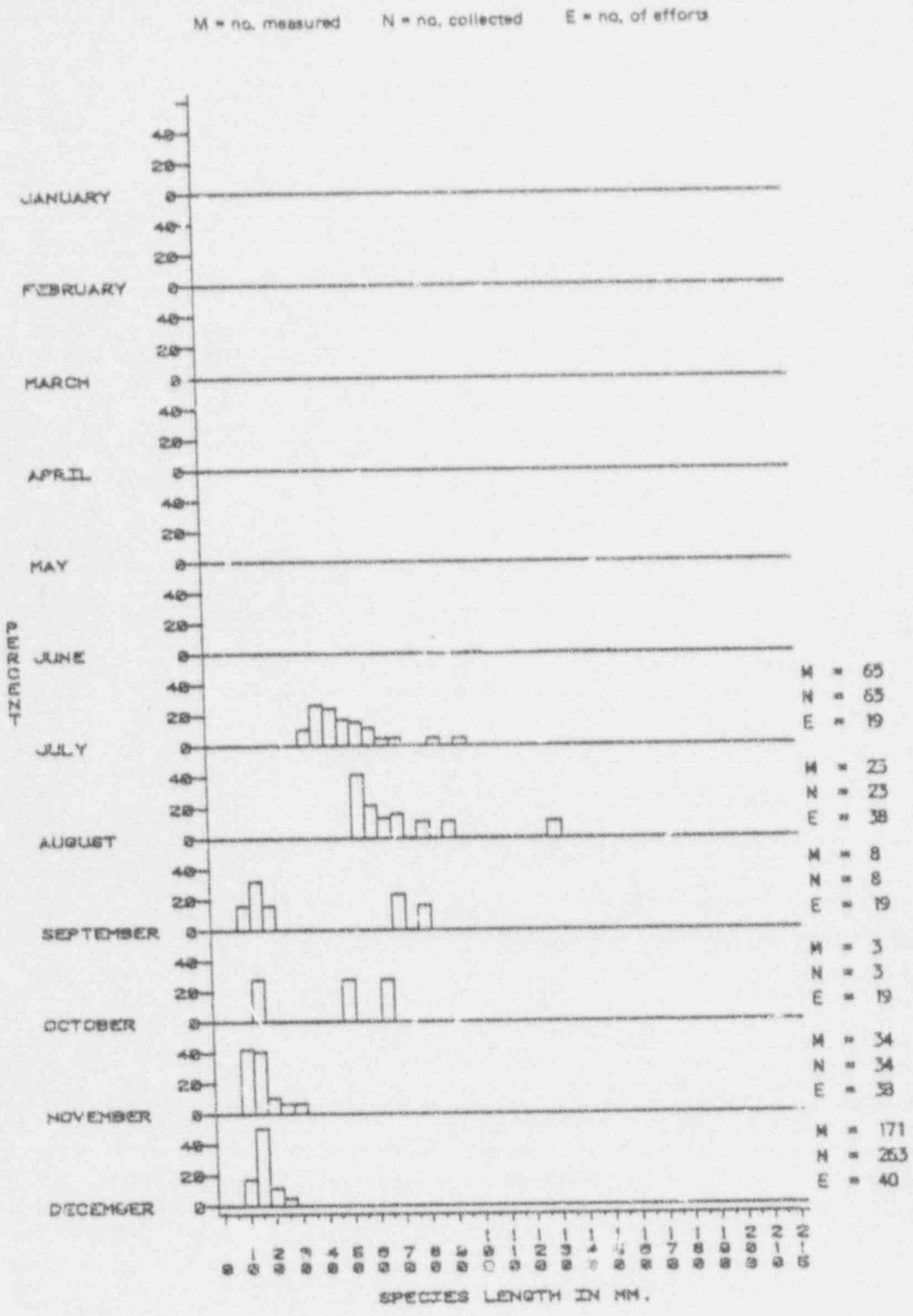


Figure 4.18 Length frequencies of Atlantic croaker collected by trawls for high marsh, 1980.

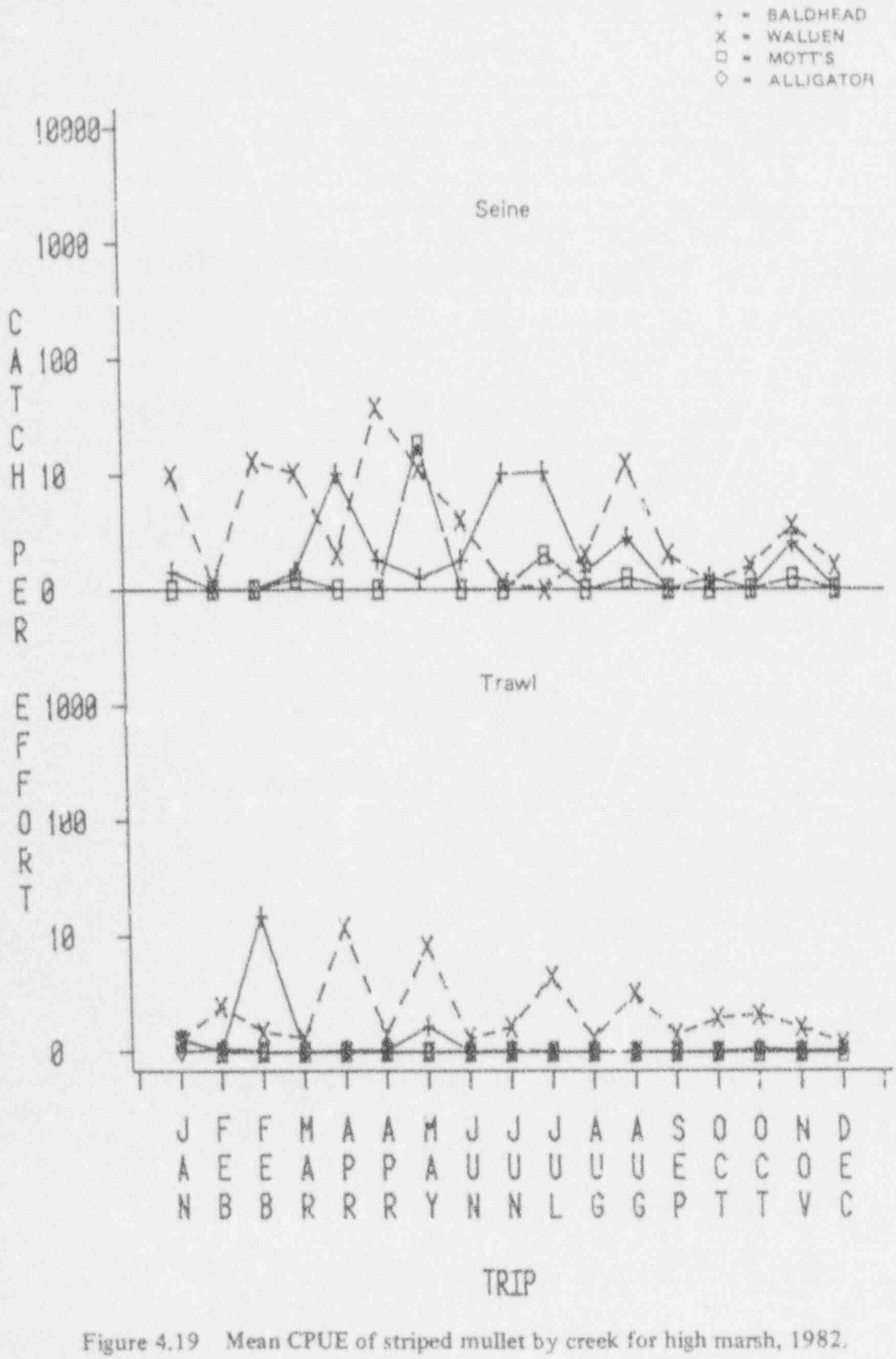


Figure 4.19 Mean CPUE of striped mullet by creek for high marsh, 1982.

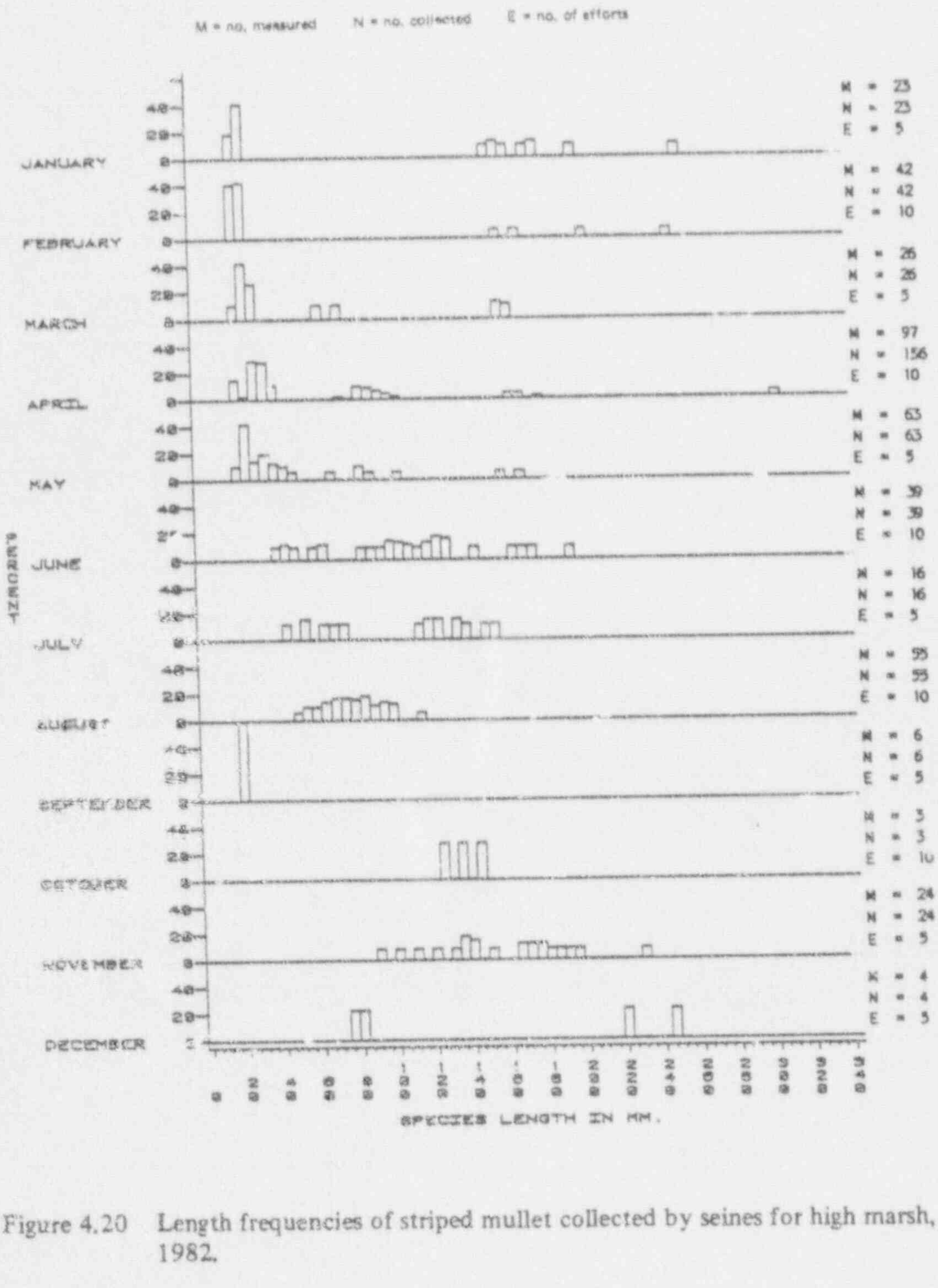


Figure 4.20 Length frequencies of striped mullet collected by seines for high marsh, 1982.

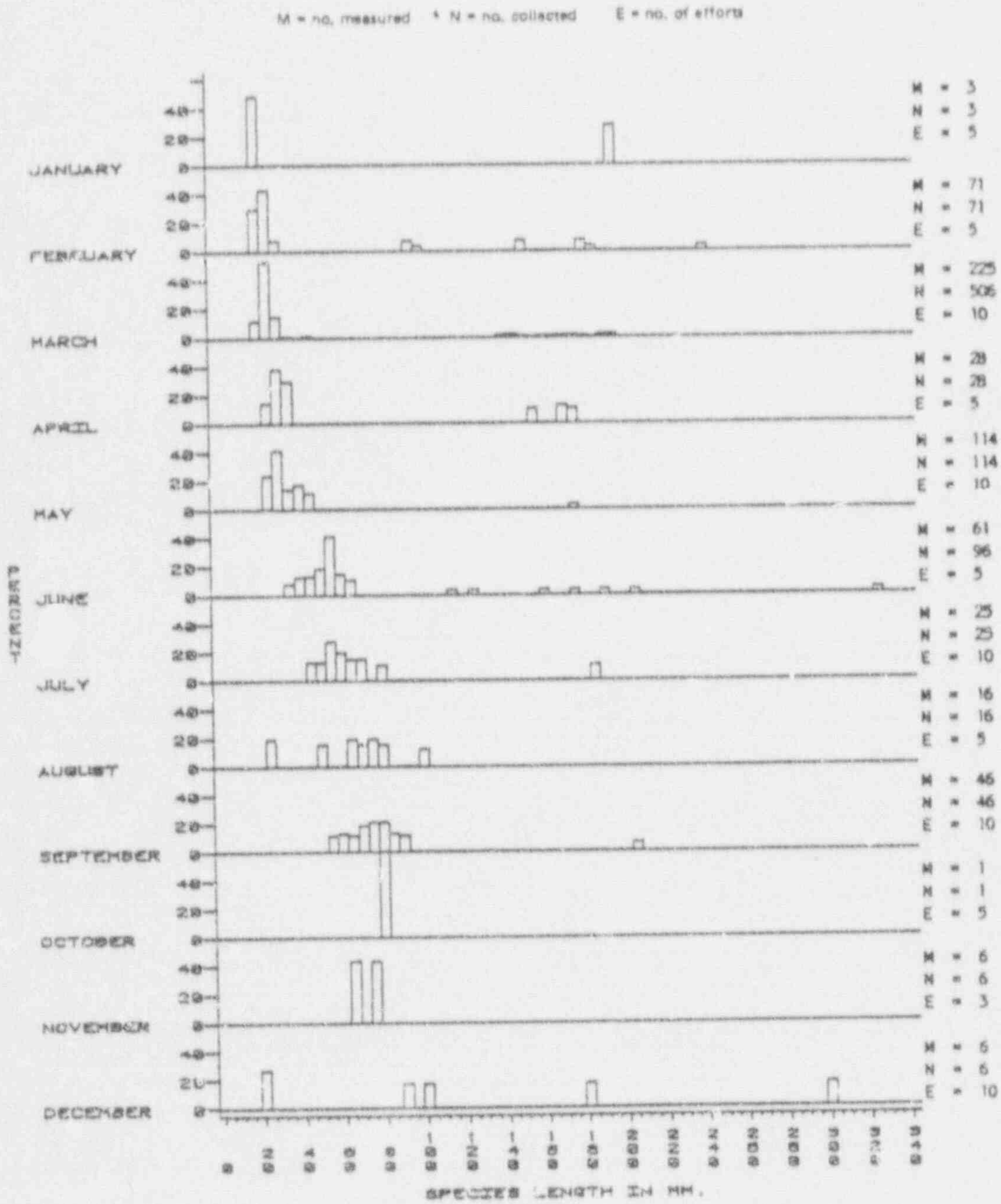


Figure 4.21 Length frequencies of striped mullet collected by seines for high marsh, 1981.

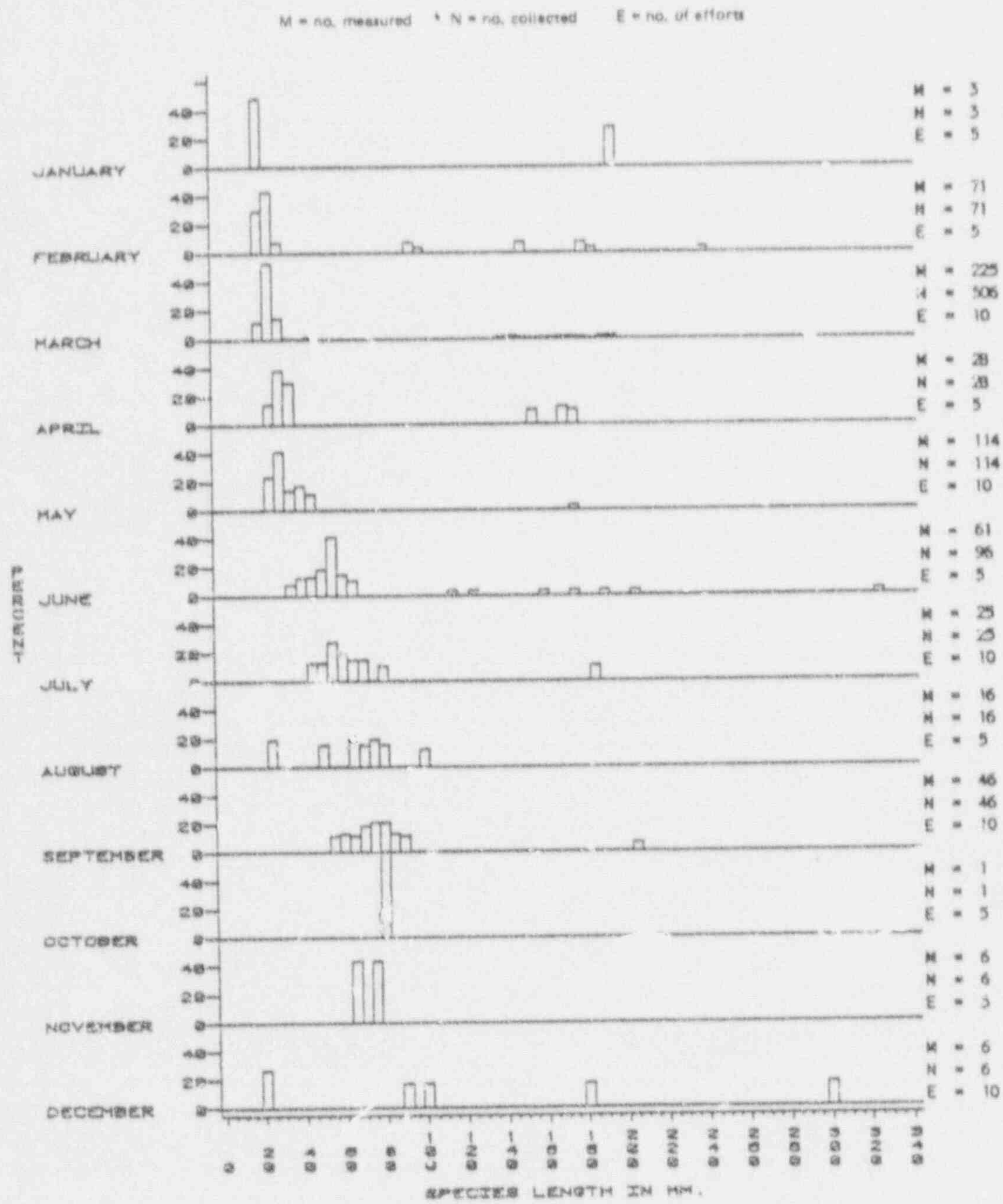


Figure 4.21 Length frequencies of striped mullet collected by sein., for high marsh, 1981.

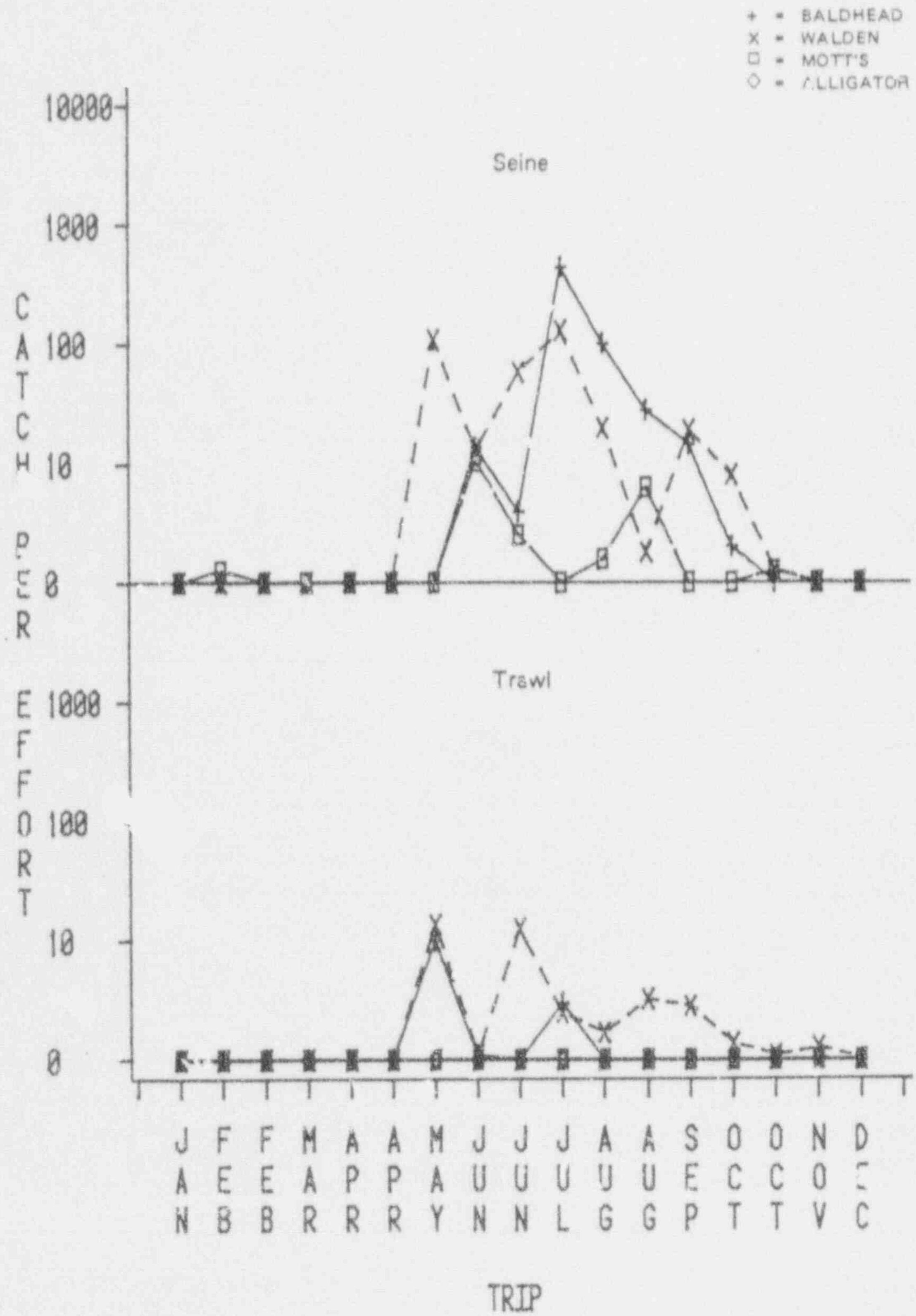


Figure 4.22 Mean CPUE of white mullet by creek for high marsh, 1982.

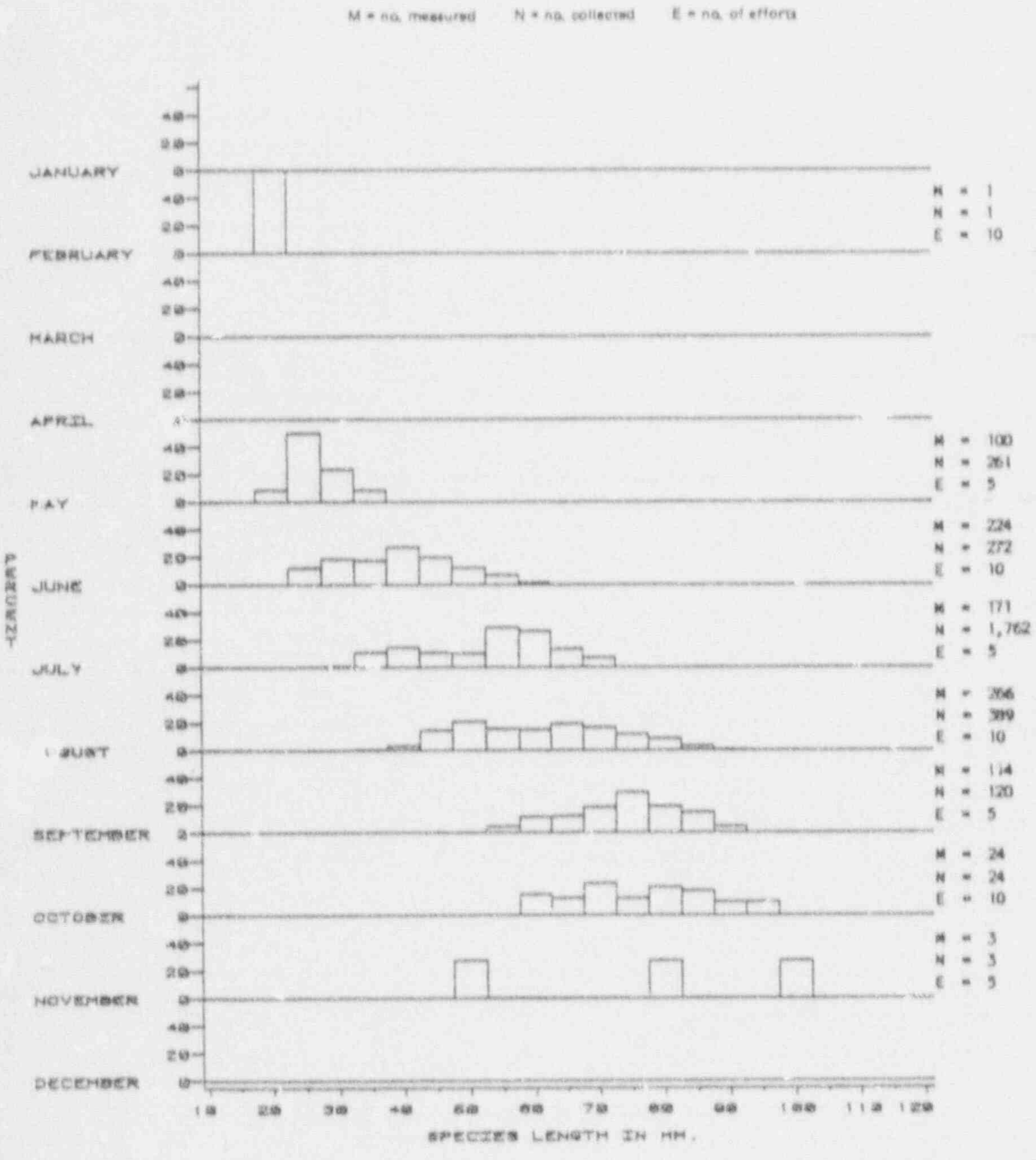


Figure 4.23 Length frequencies of white mullet collected by seines for high marsh, 1982.

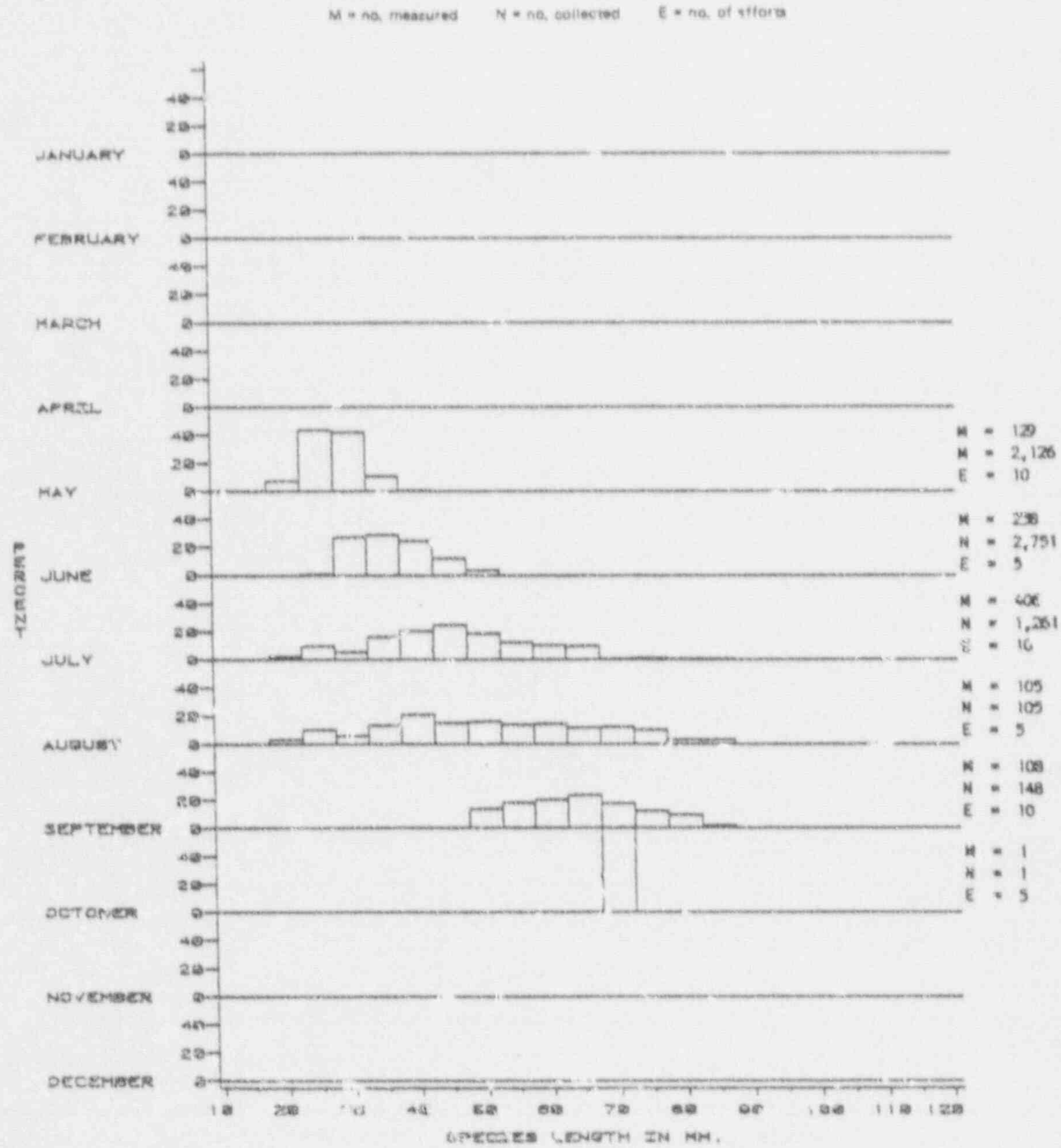


Figure 4.24 Length frequencies of white mullet collected by seines for high marsh, 1981.

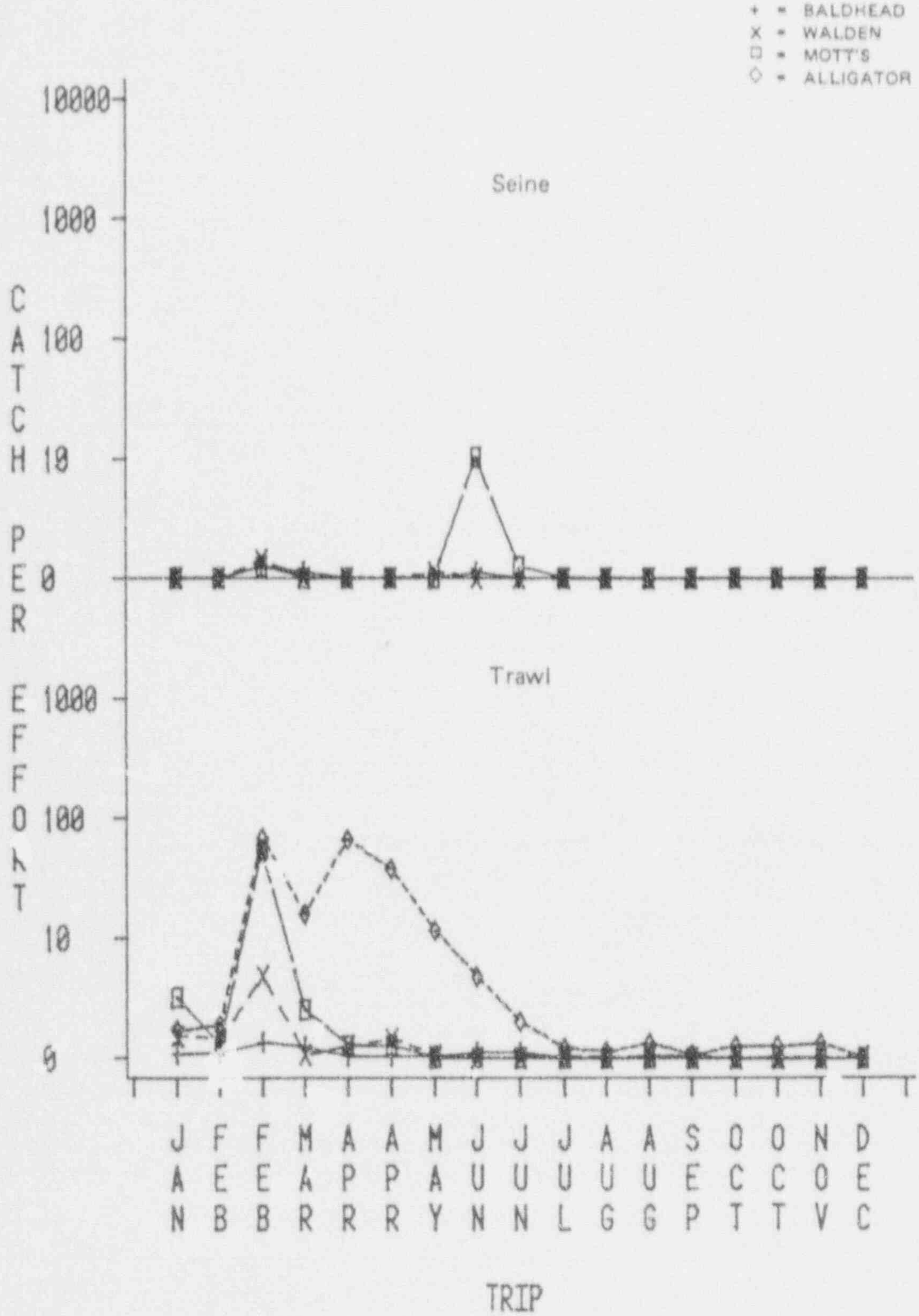


Figure 4.25 Mean CPUE of flounders by creek for high marsh, 1982.

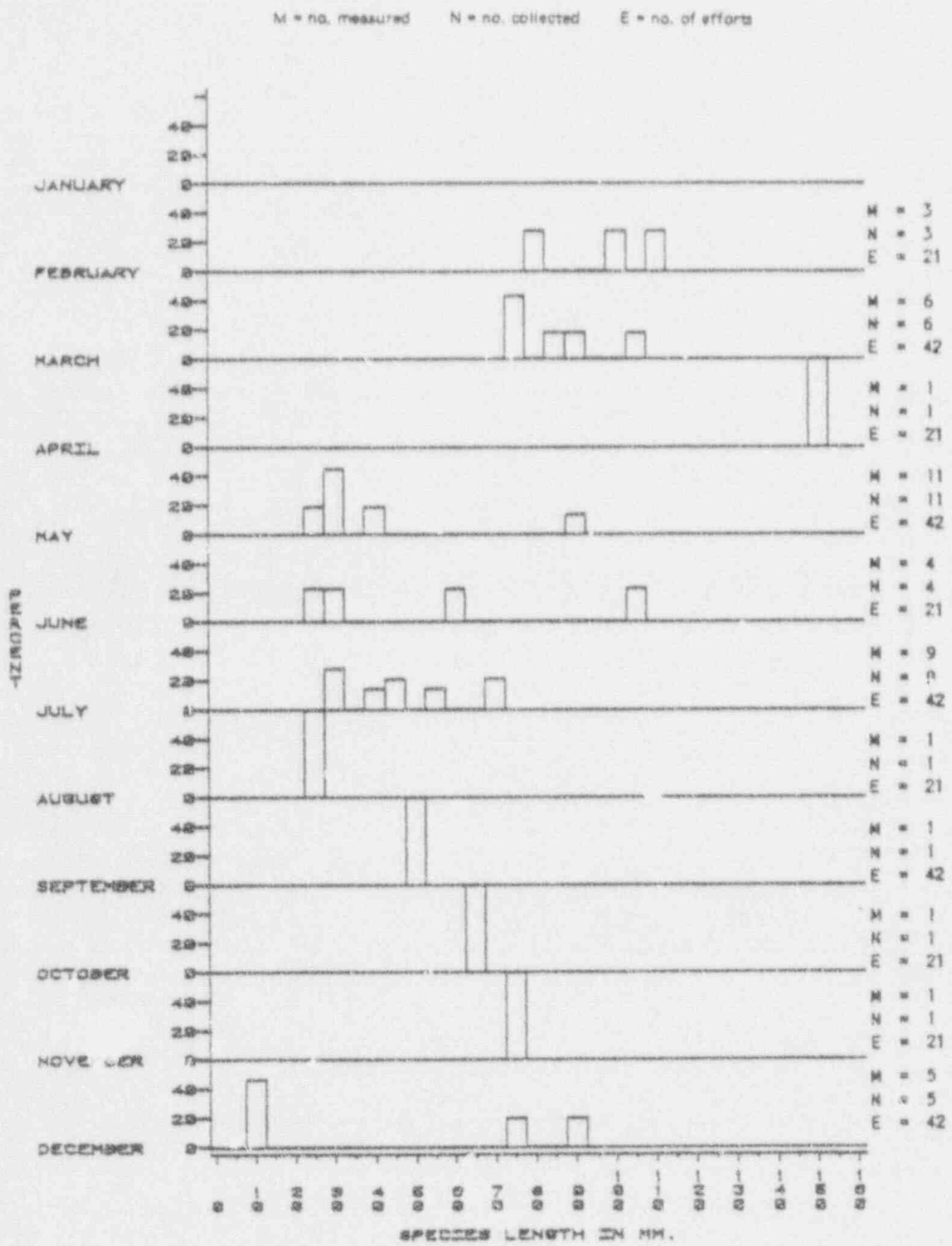


Figure 4.26 Length frequencies of southern flounder collected by trawls for high marsh, 1981.

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

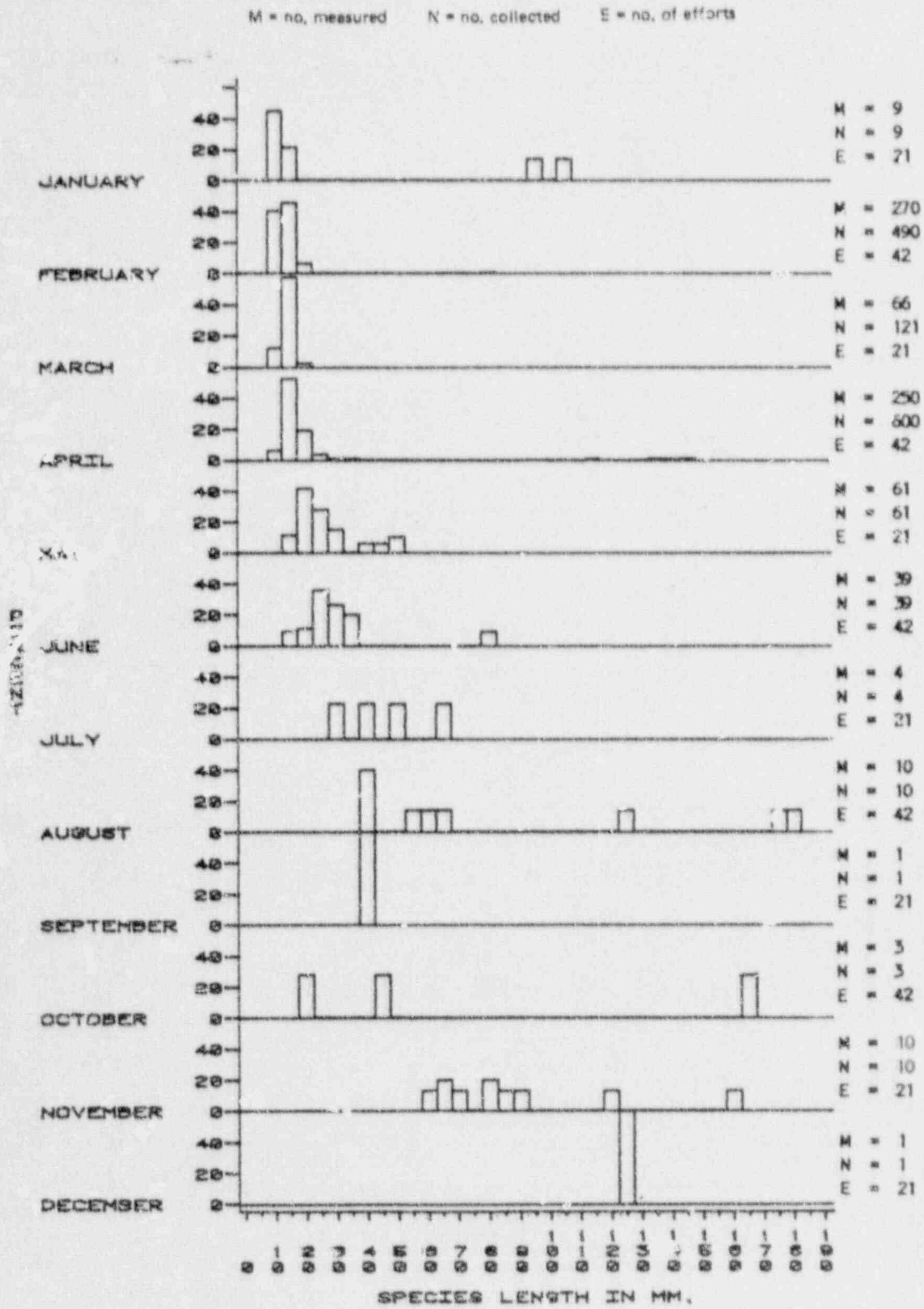


Figure 4.27 Length frequencies of southern flounder collected by trawls for high marsh, 1982.

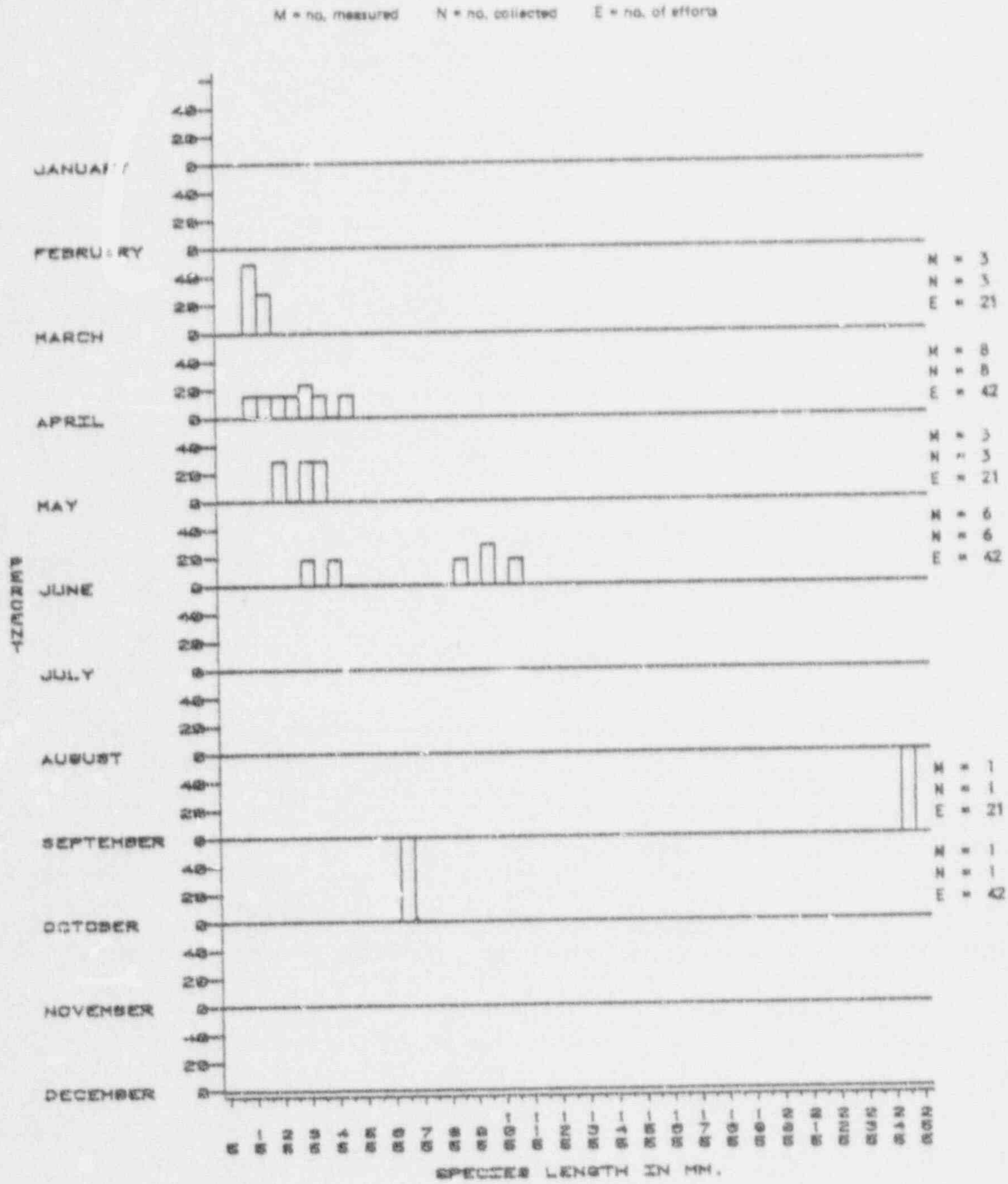


Figure 4.28 Length frequencies of summer flounder collected by trawls for high marsh, 1982.

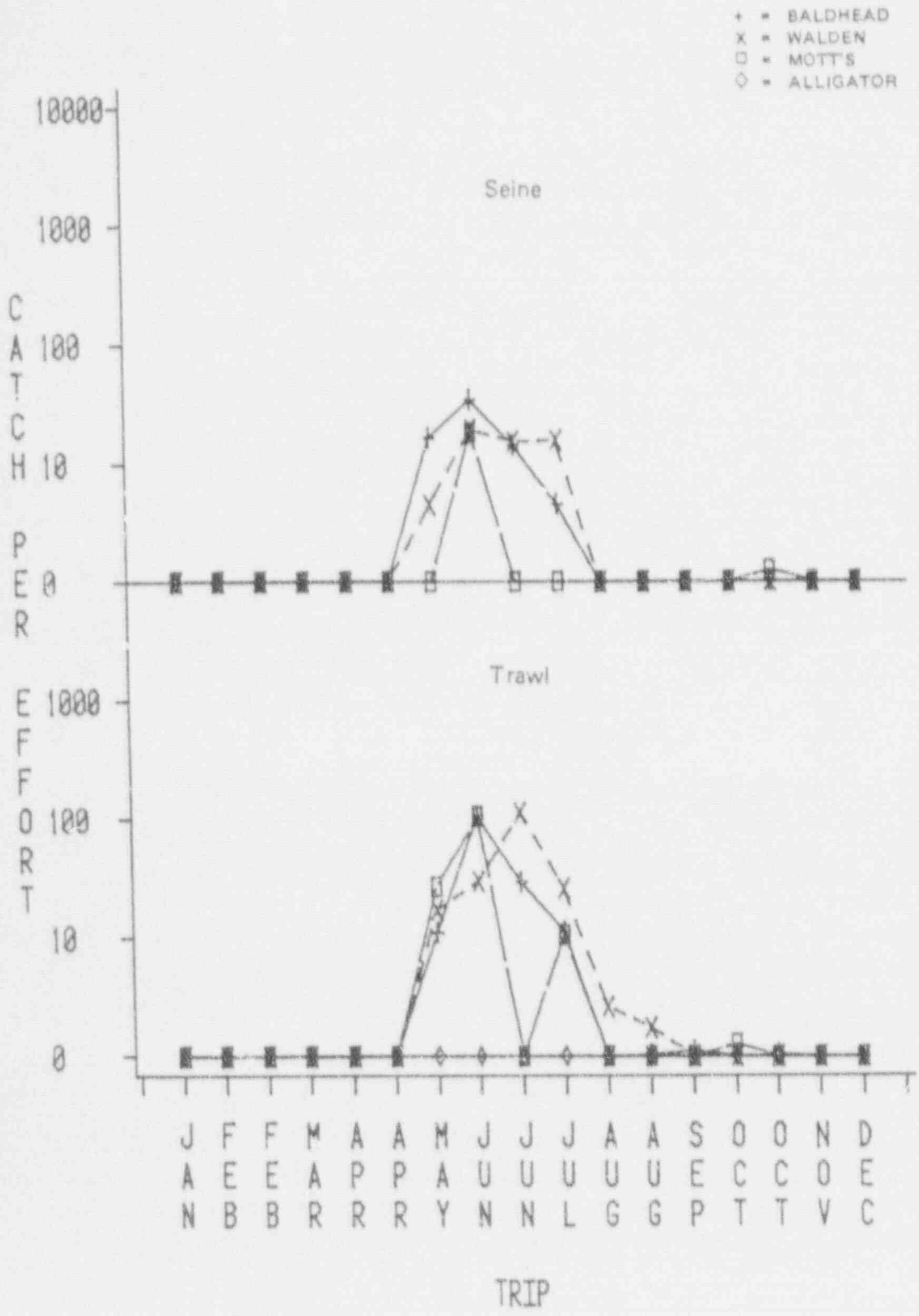


Figure 4.29 Mean CPUE of brown shrimp by creek for high marsh, 1982.

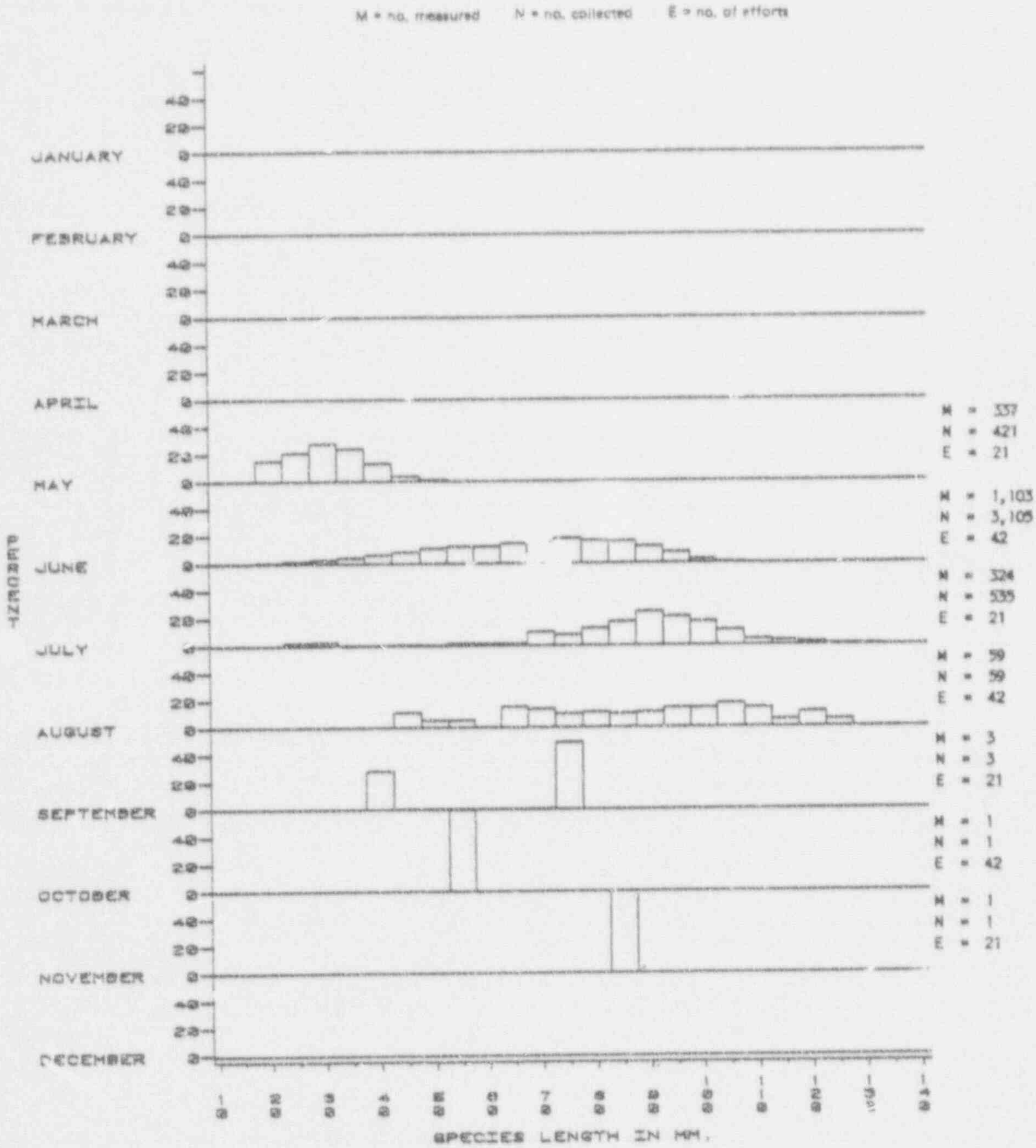


Figure 4.30 Length frequencies of brown shrimp collected by trawls for high marsh, 1982.

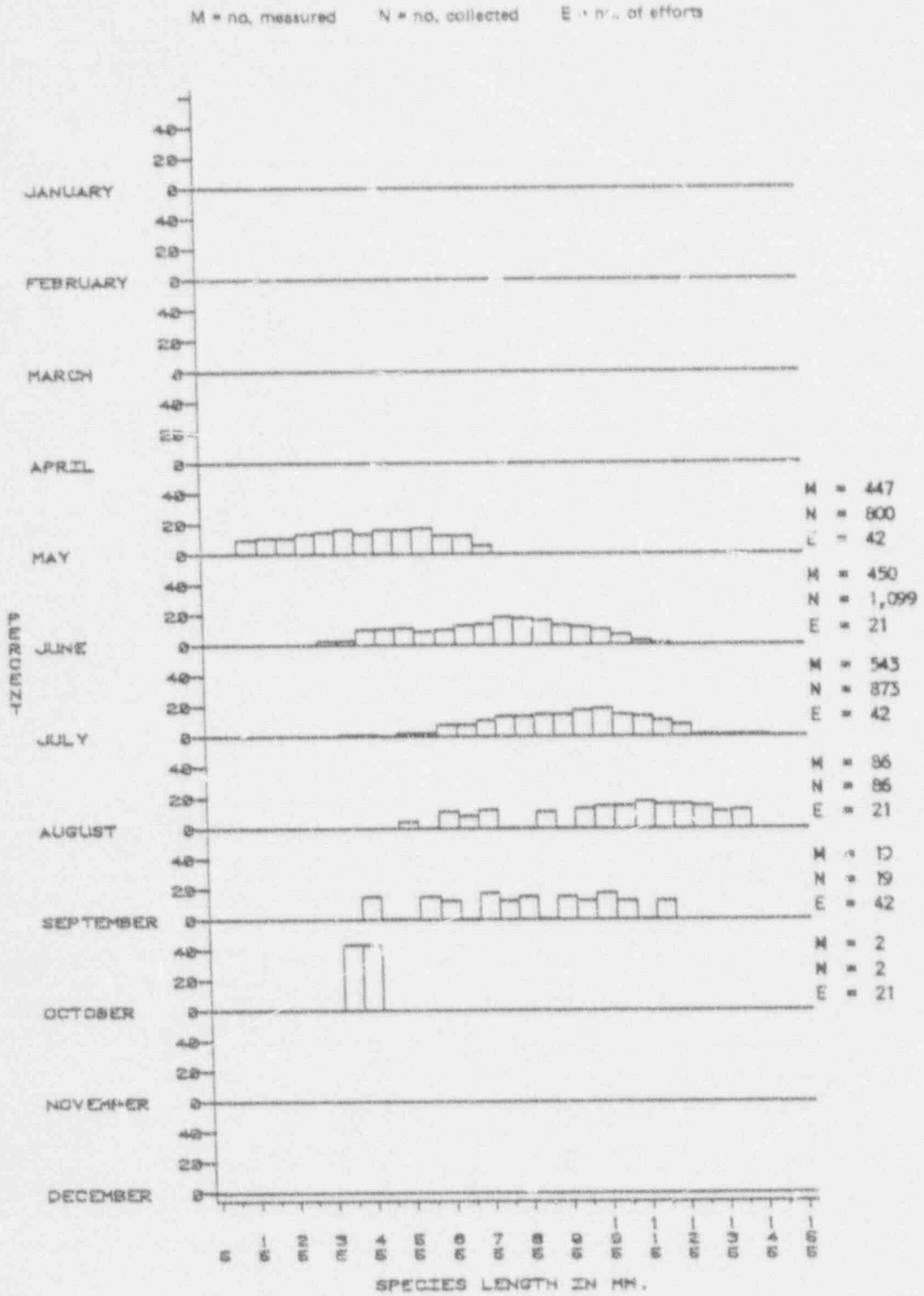


Figure 4.31 Length frequencies of brown shrimp collected by trawls for high marsh, 1981.

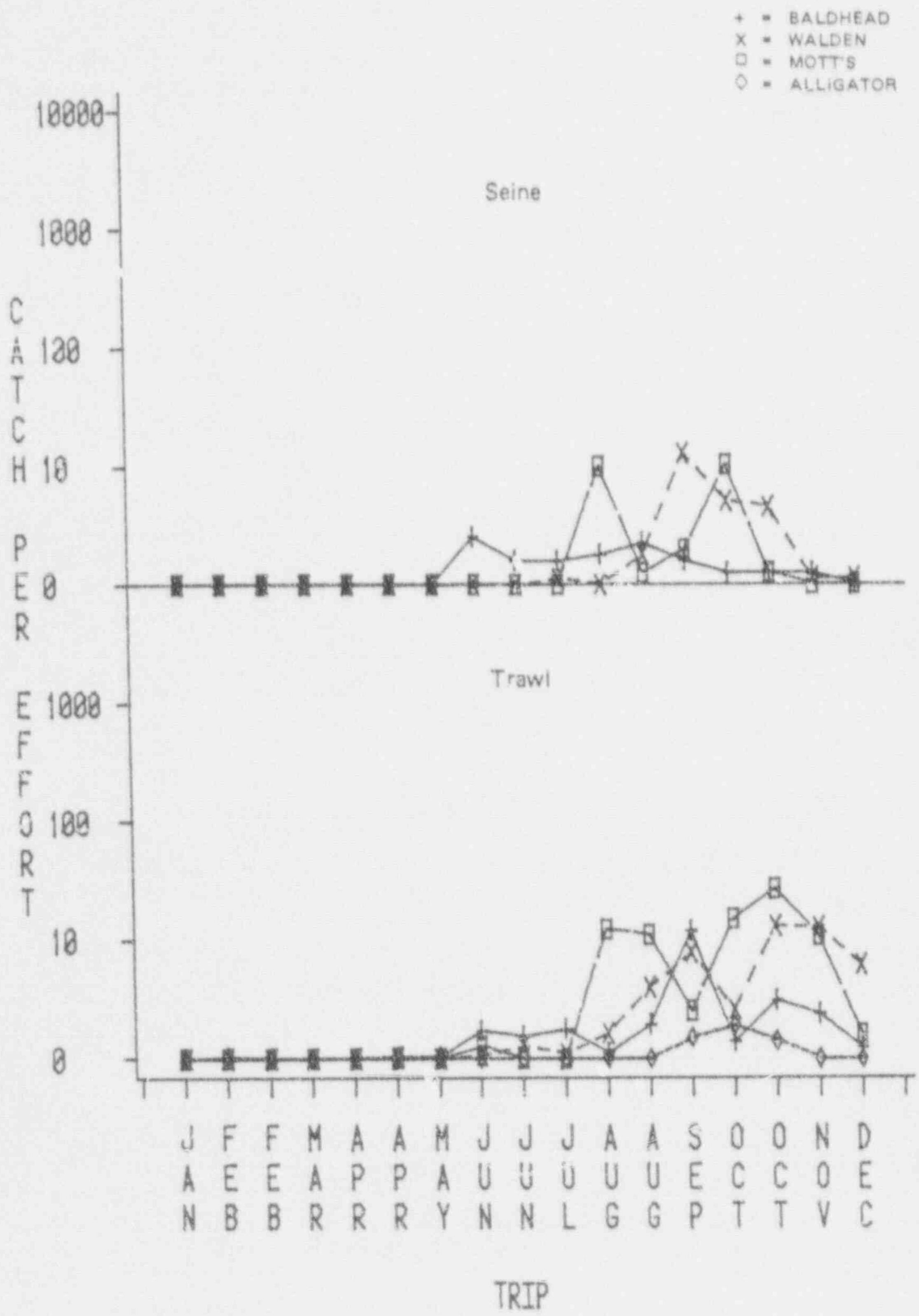


Figure 4.32 Mean CPUE of pink shrimp by creek for high marsh, 1982.

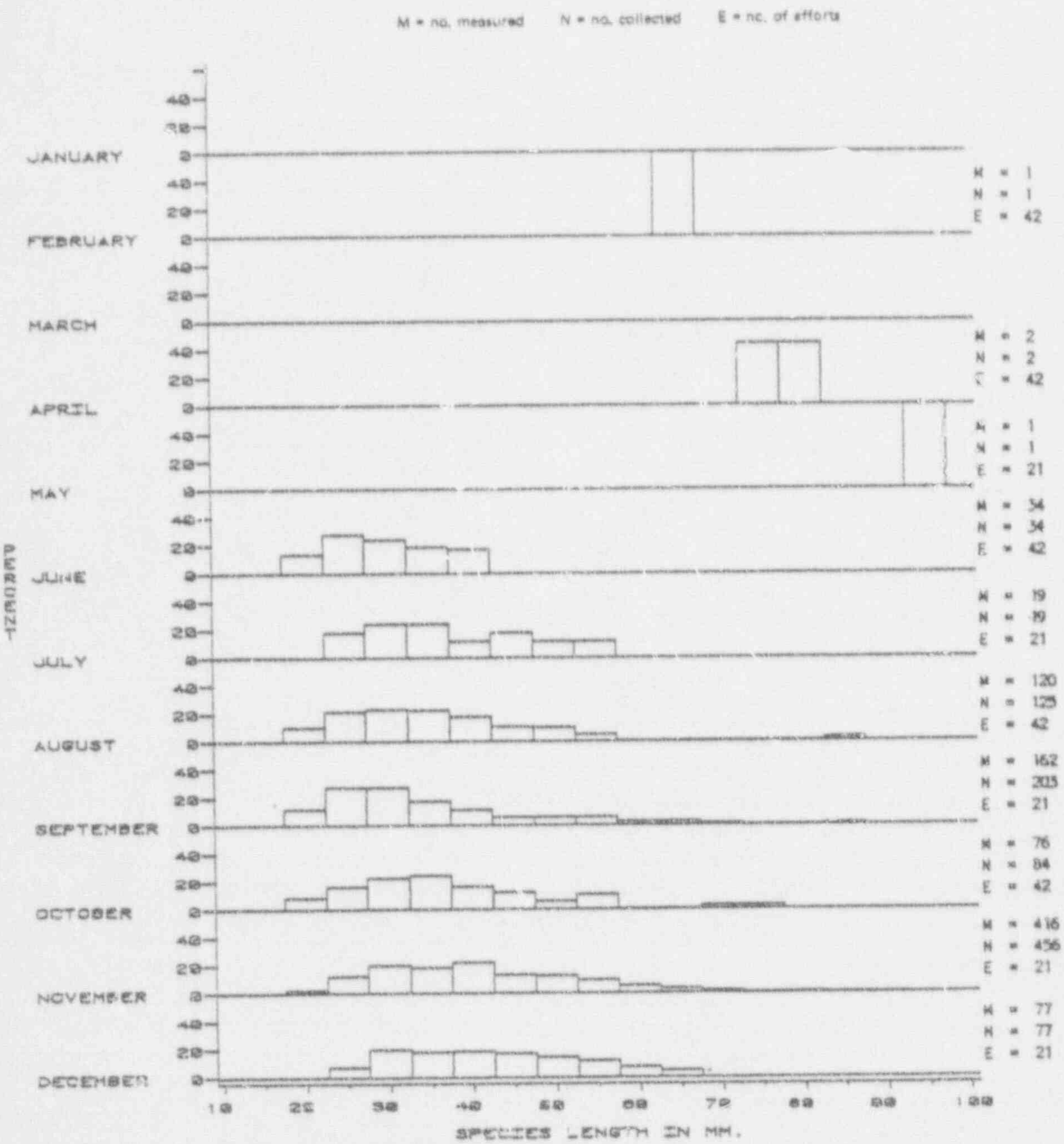


Figure 4.33 Length frequencies of pink shrimp collected by trawls for high marsh, 1982.

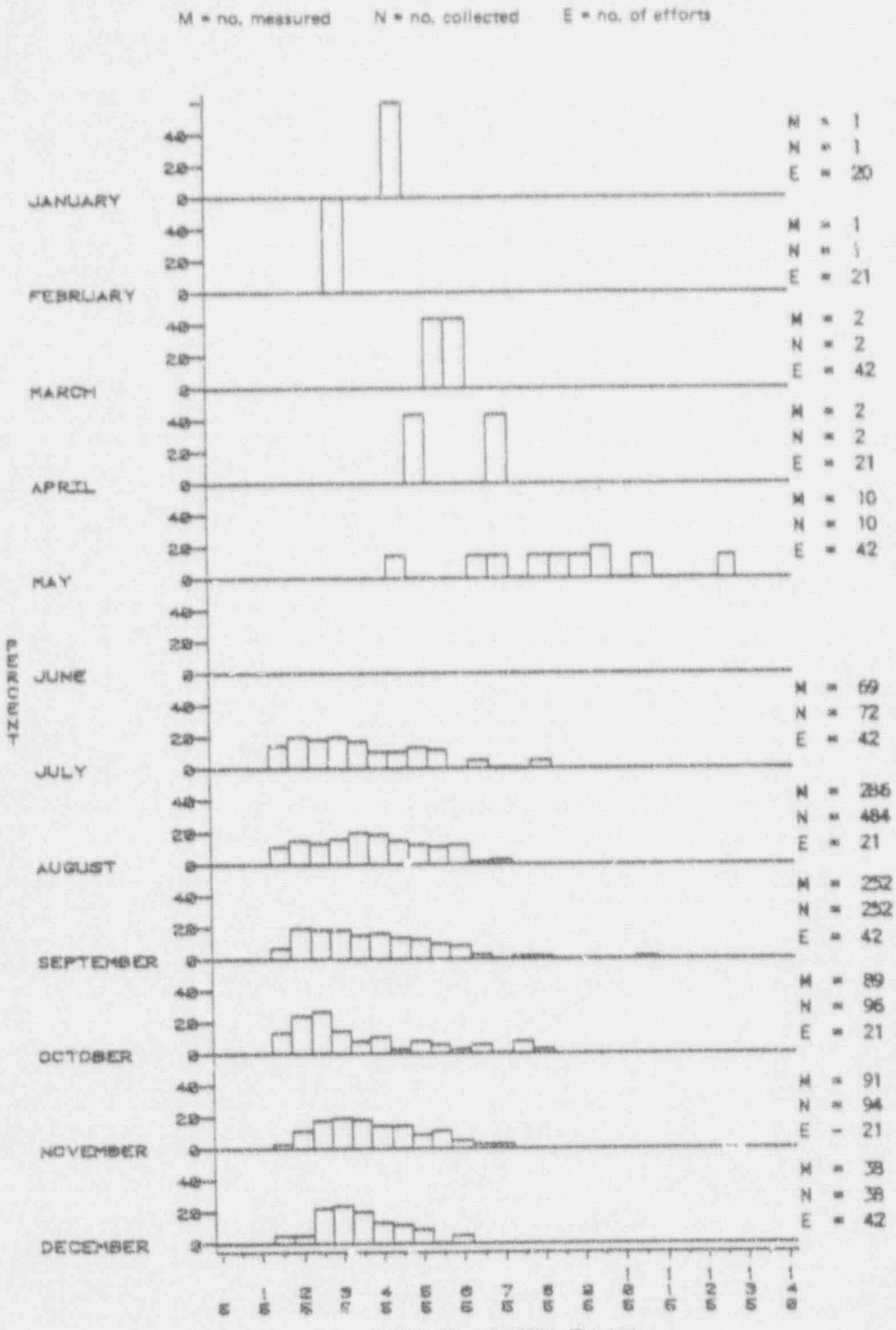


Figure 4.34 Length frequencies of pink shrimp collected by trawls for high marsh, 1981.

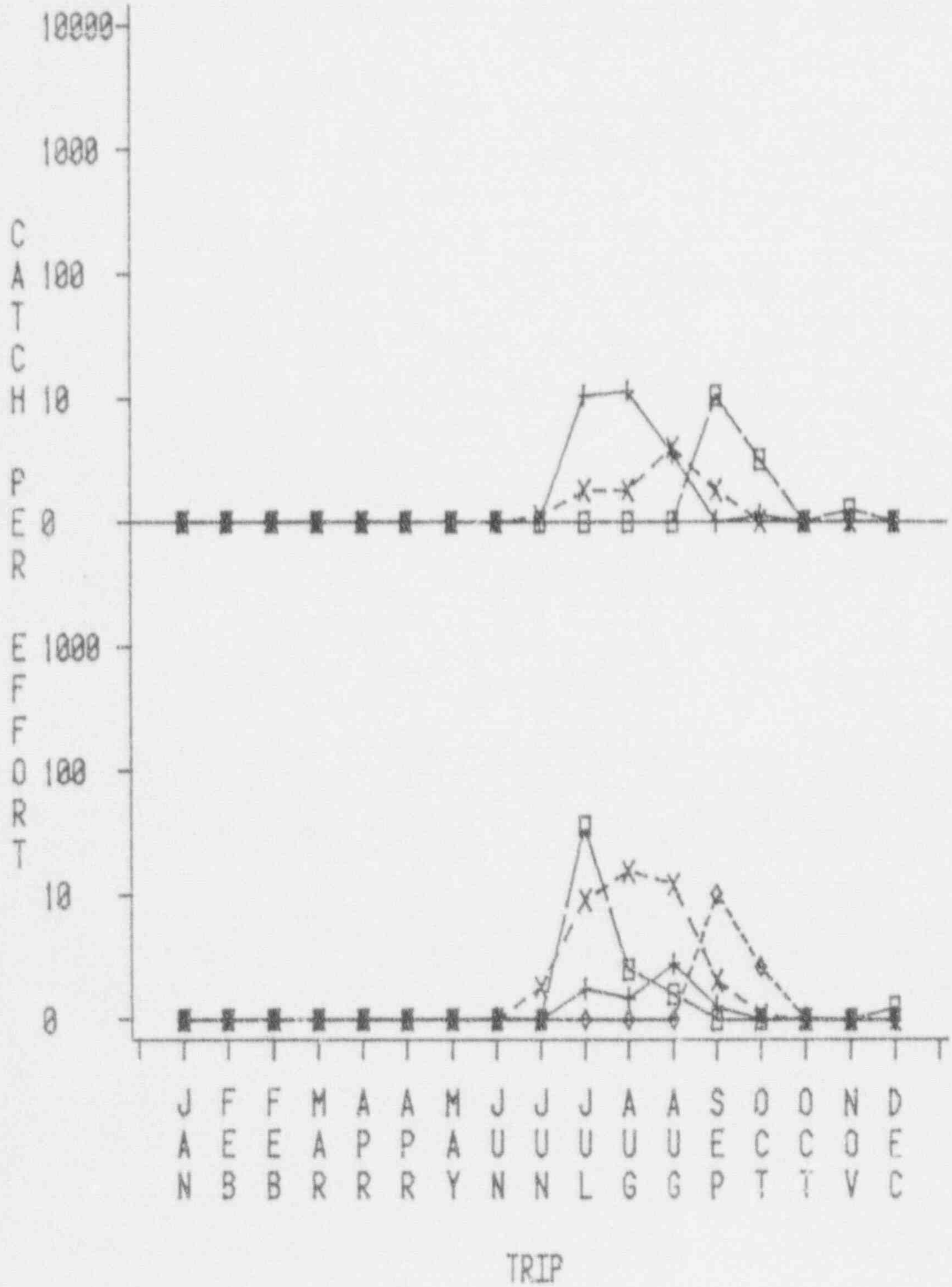


Figure 4.35 Mean CPUE of white shrimp by creek for high marsh, 1982.

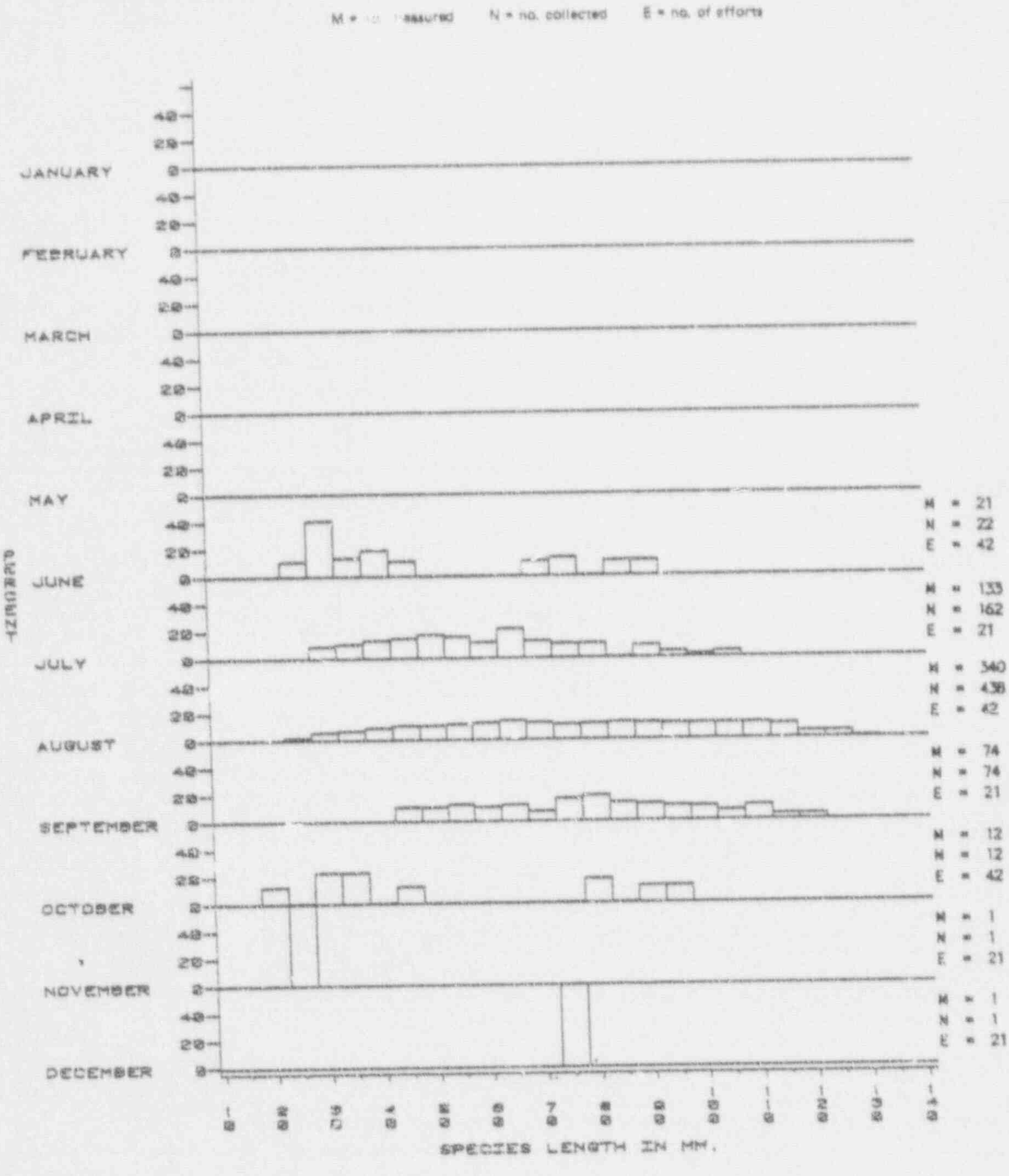


Figure 4.36 Length frequencies of white shrimp collected by trawls for high marsh, 1982.

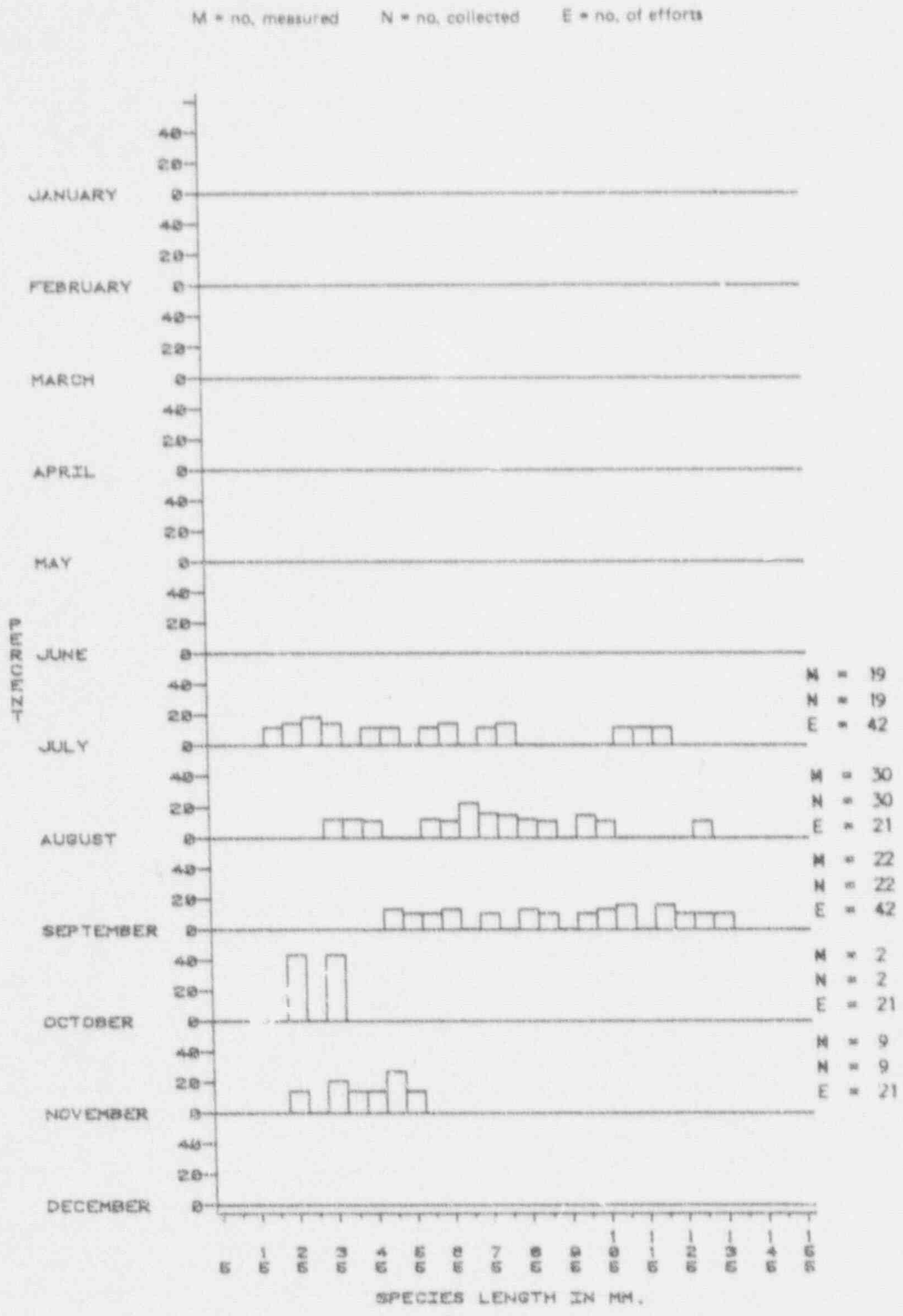


Figure 4.37 Length frequencies of white shrimp collected by trawls for high marsh, 1981.

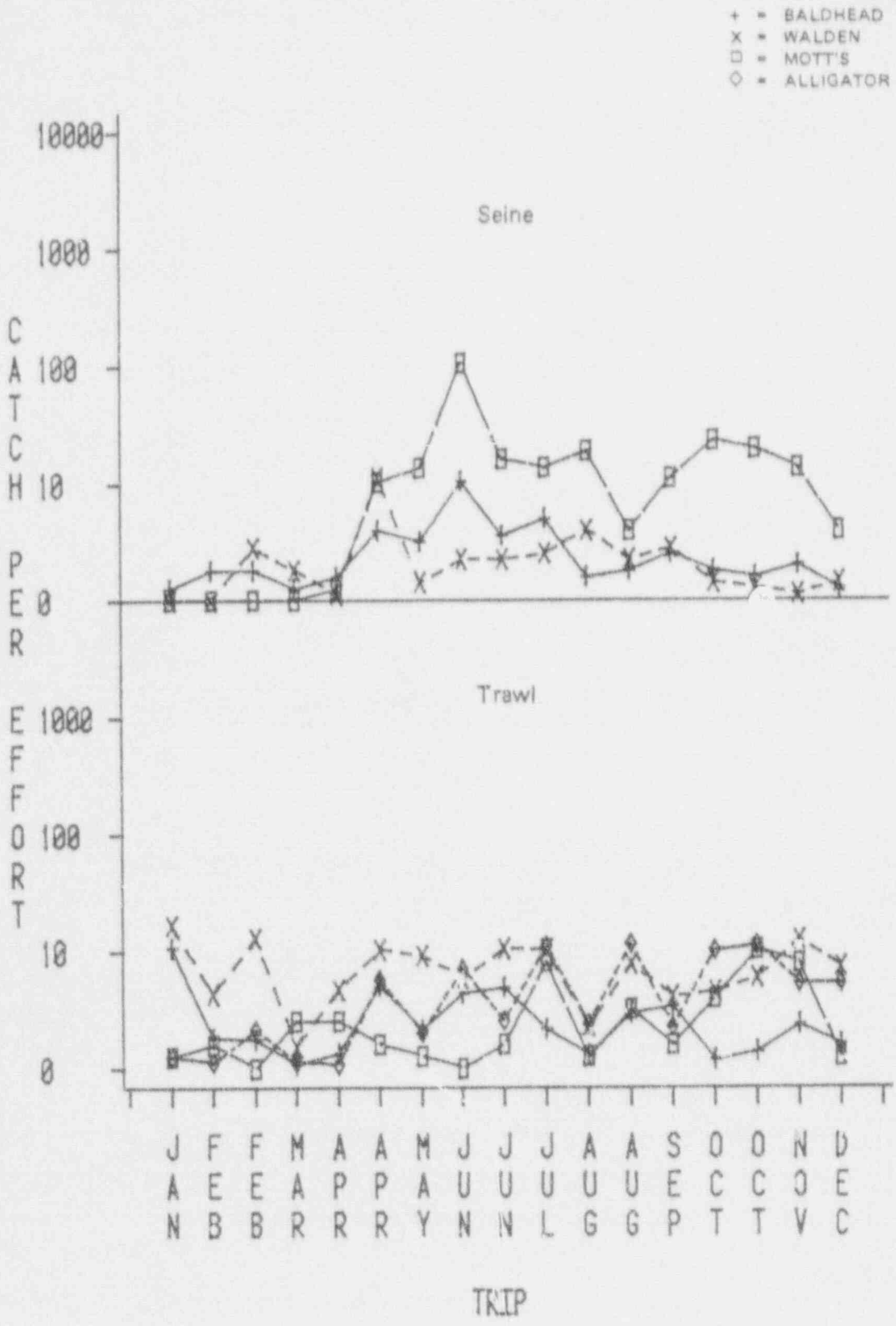


Figure 4.38 Mean CPUE of blue crabs by creek for high marsh, 1982.

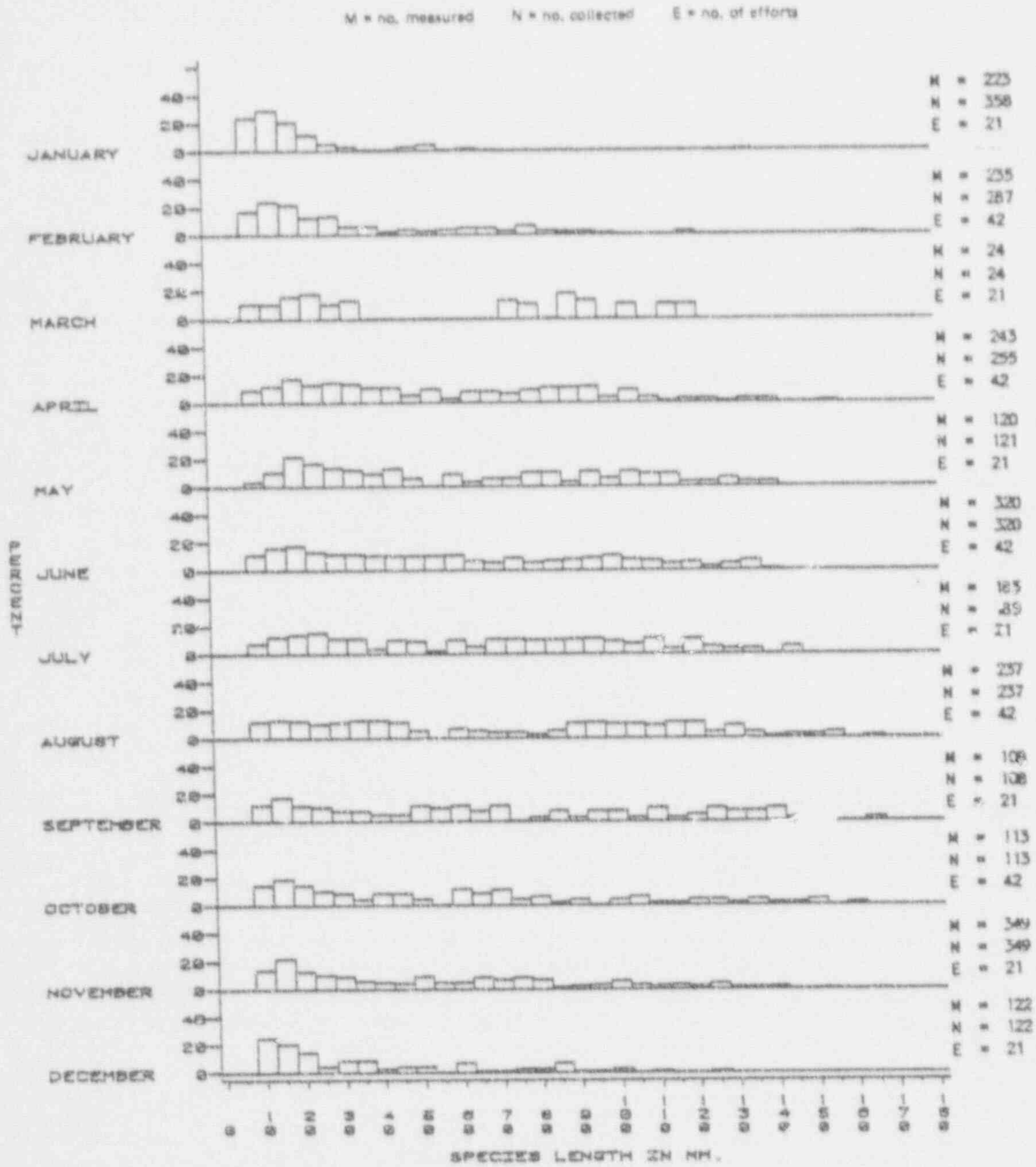


Figure 4.39 Length frequencies of blue crabs collected by trawls for high marsh, 1982.

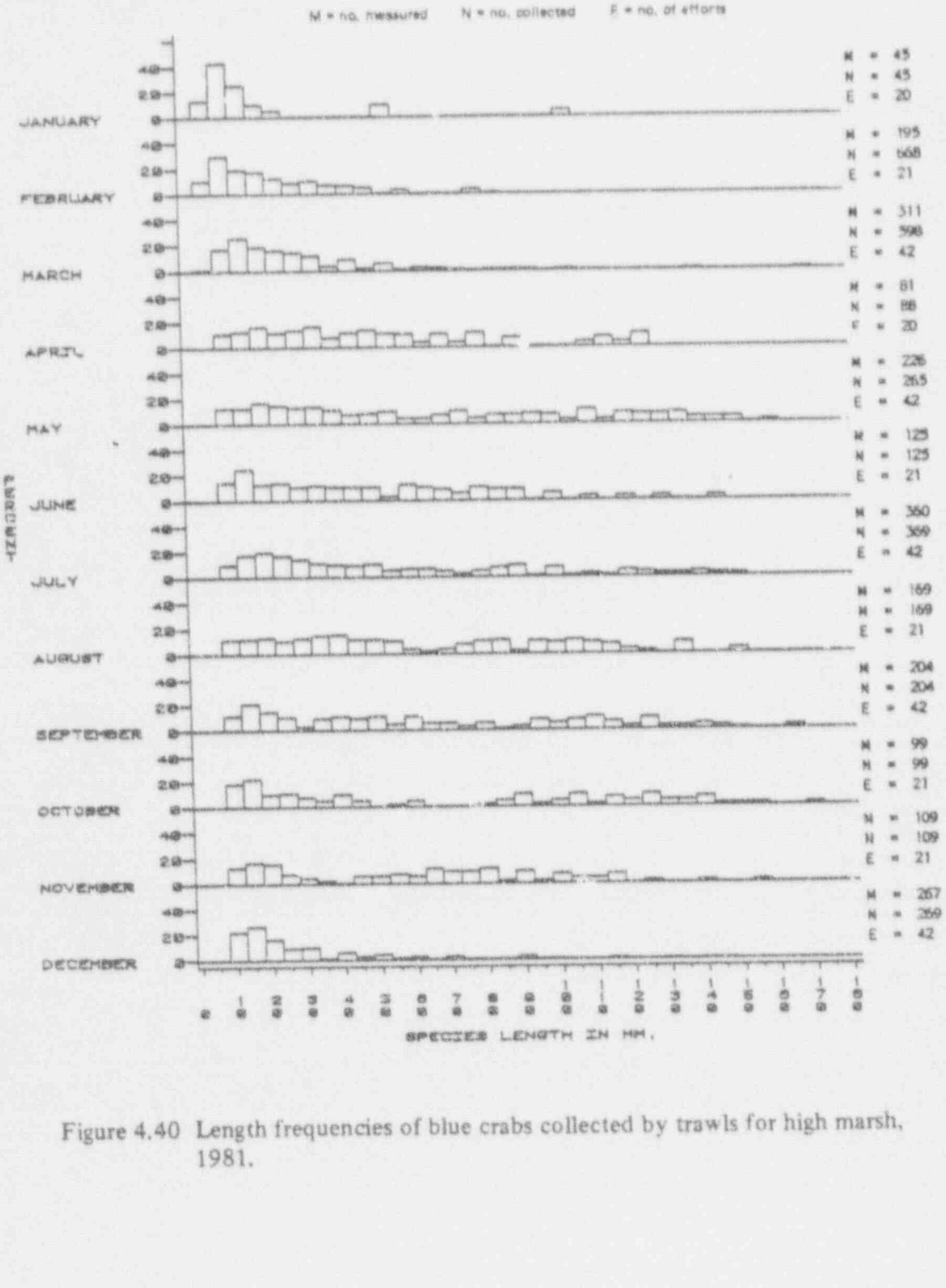


Figure 4.40 Length frequencies of blue crabs collected by trawls for high marsh, 1981.

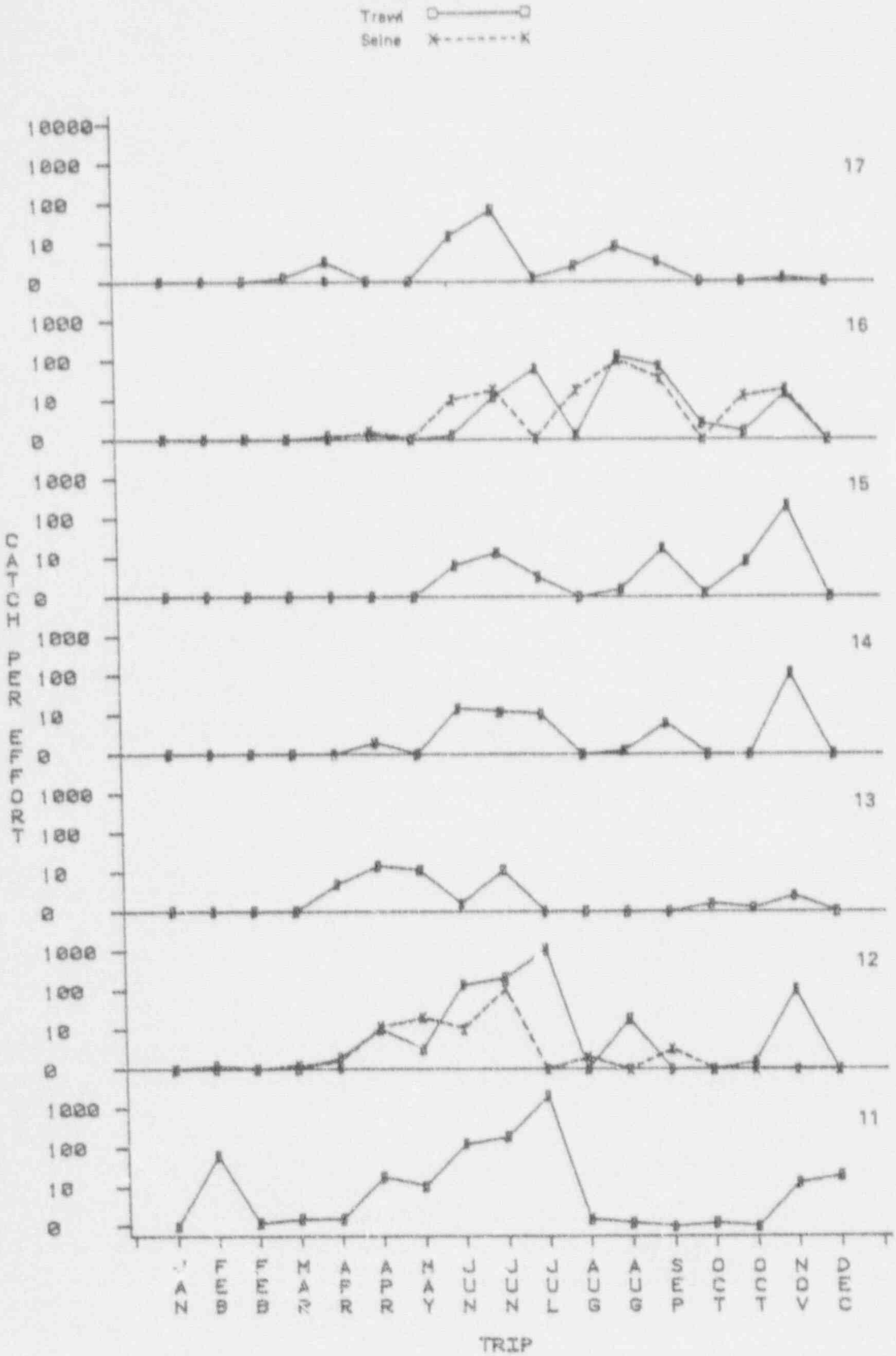


Figure 4.41 Mean CPUE of bay anchovy by station for Baldhead Creek, high marsh, 1982.

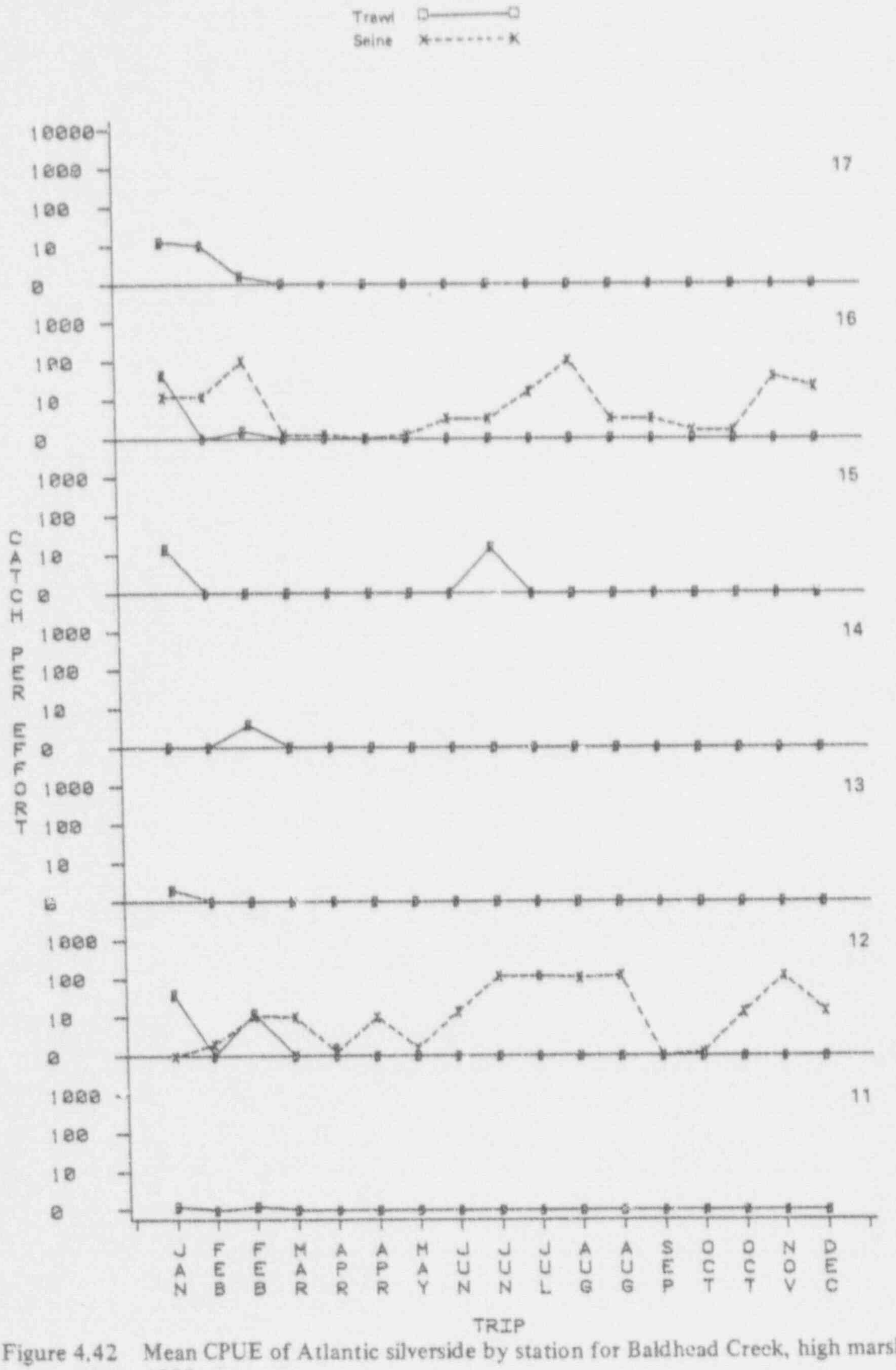


Figure 4.42 Mean CPUE of Atlantic silverside by station for Baldhead Creek, high marsh, 1982.

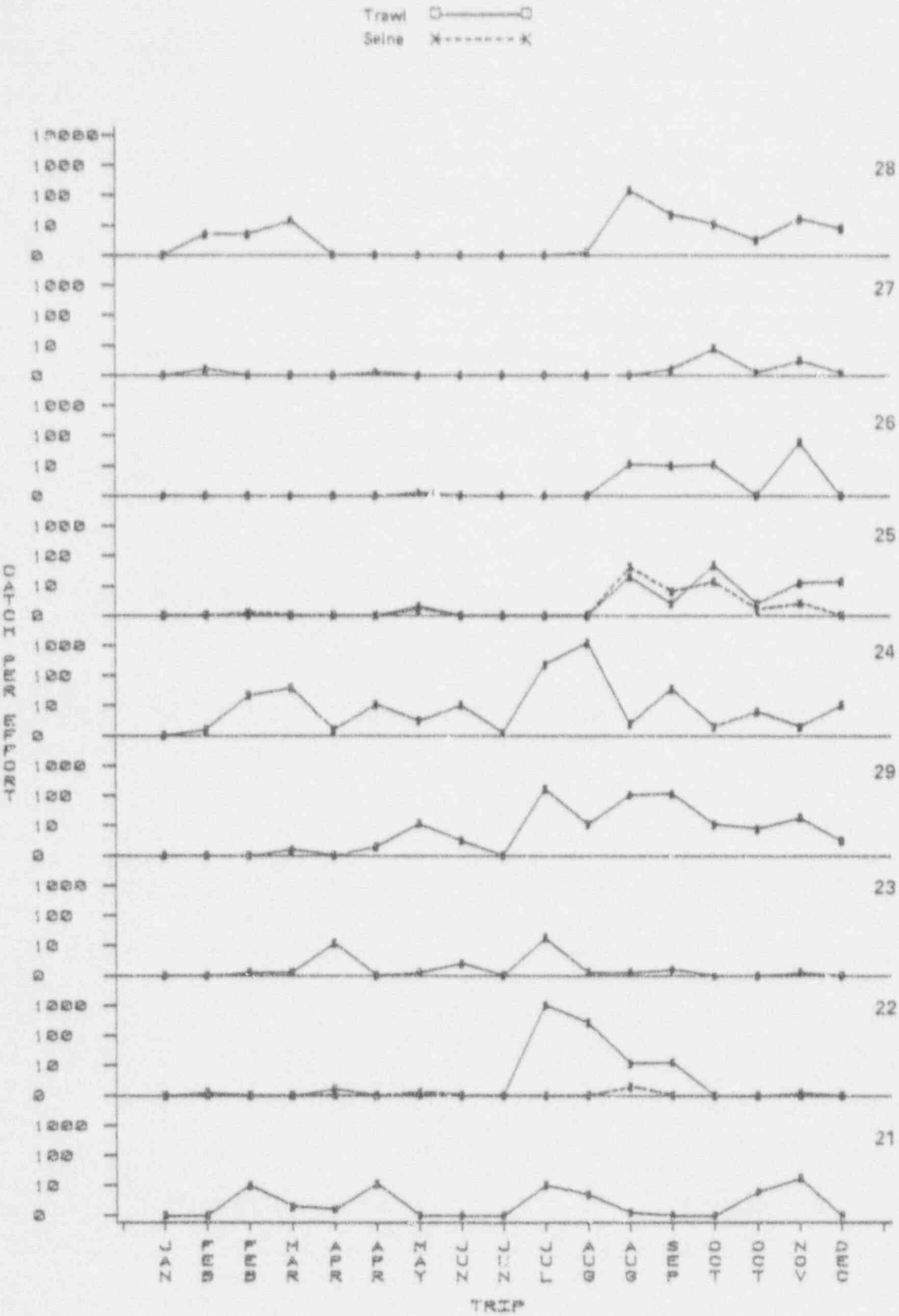


Figure 4.43 Mean CPUE of bay anchovy by station for Walden Creek, high marsh, 1982.

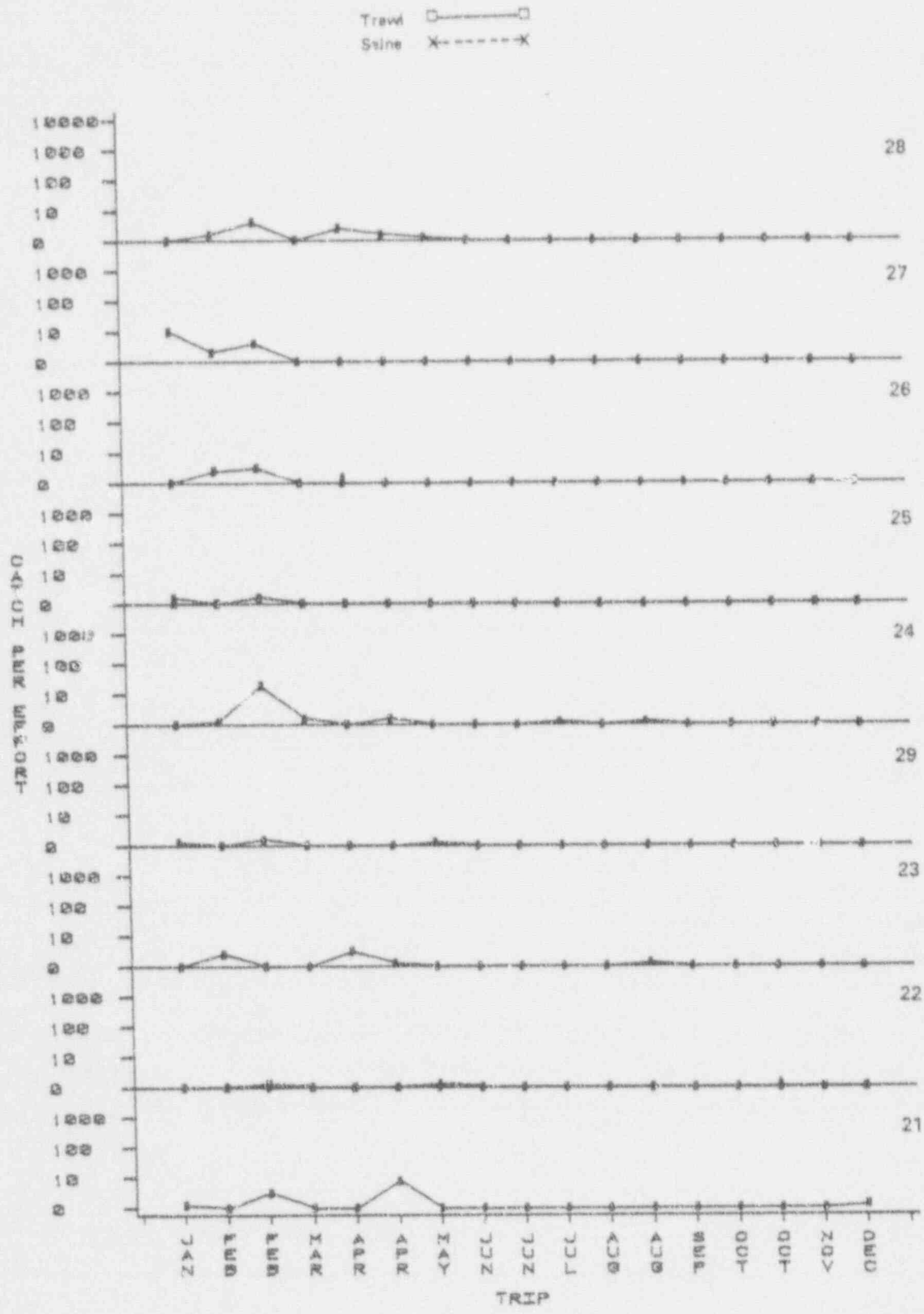


Figure 4.44 Mean CPUE of flounders by station for Walden Creek, high marsh, 1982.

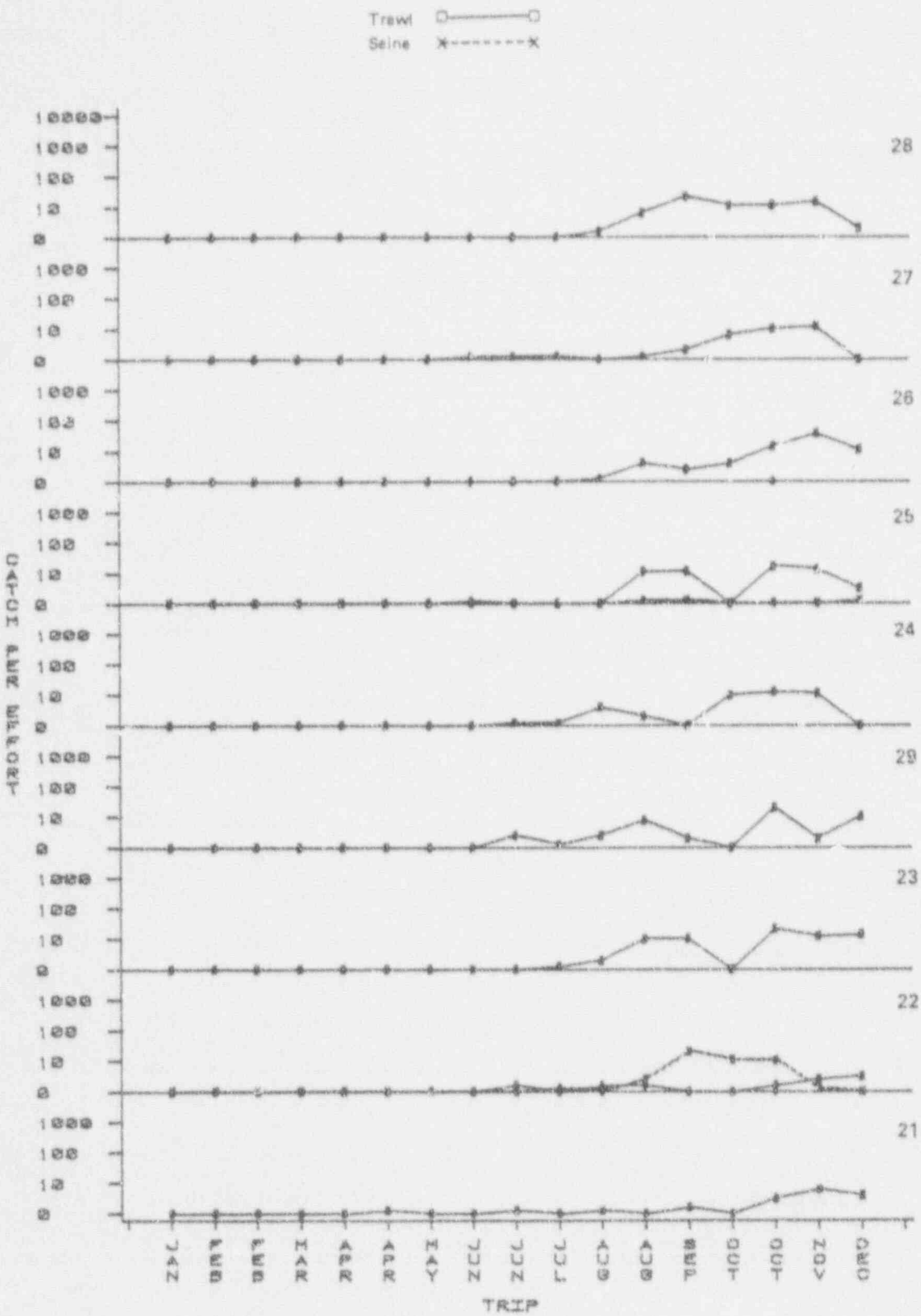


Figure 4.45 Mean CPUE of pink shrimp by station for Walden Creek, high marsh, 1982.

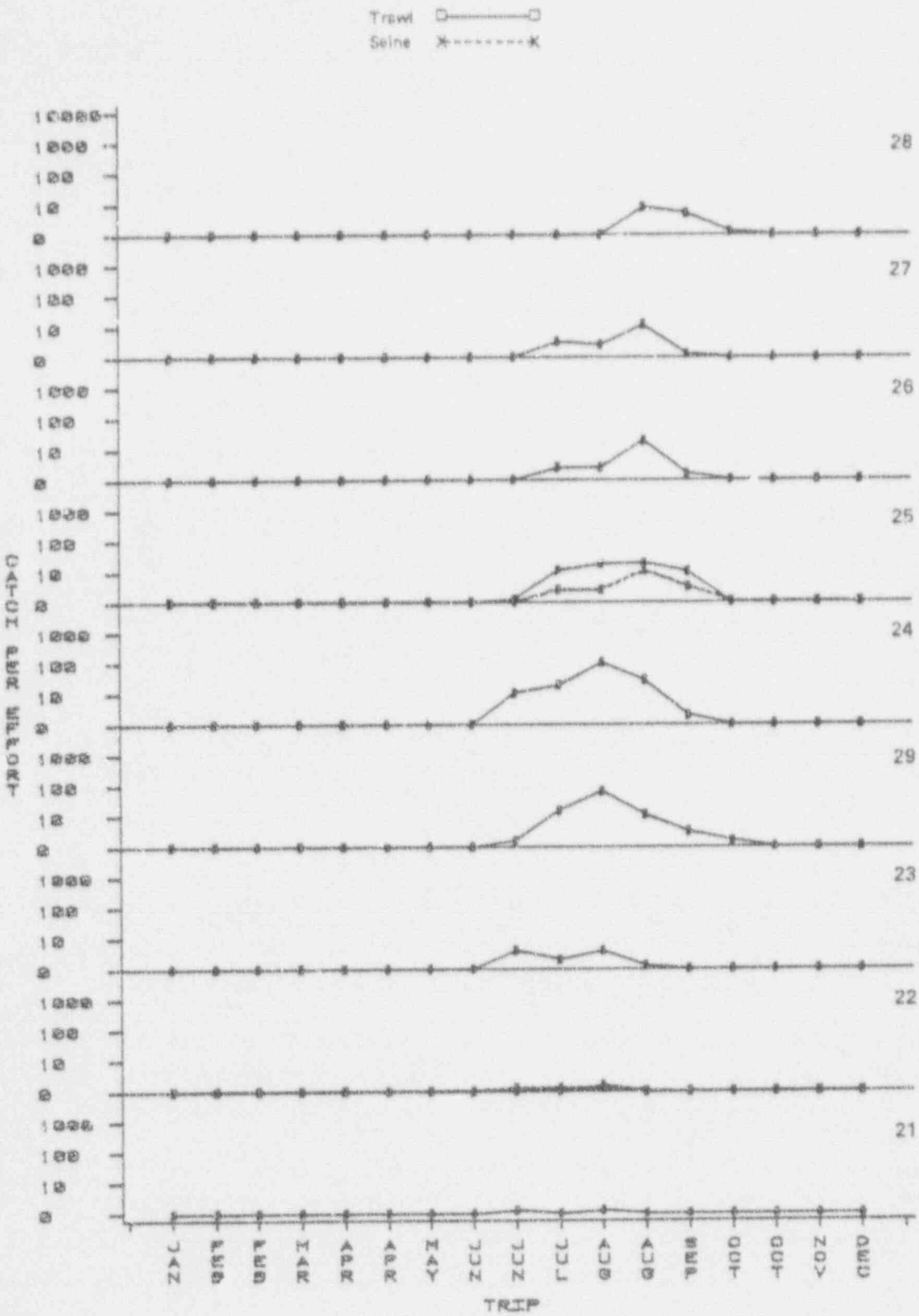


Figure 4.46 Mean CPUE of white shrimp by station for Walden Creek, high marsh, 1982.

TABLE 5.1 TRIP NUMBER, DATES, EFFORTS AND ANALYSIS WEEK FOR NEKTON SMALL TRAWLS, 1982.

TRIP	SAMPLE DATE	NUMBER EFFORTS	ANALYSIS WEEK
53	05JAN-06JAN	22	1
54	26JAN-27JAN	22	2
55	17FEB-19FEB	22	3
56	09MAR-10MAR	22	4
57	31MAR-01APR	22	5
58	20APR-21APR	22	6
59	11MAY-12MAY	22	7
60	02JUN-03JUN	22	8
61	21JUN-22JUN	22	9
62	13JUL-14JUL	22	10
63	04AUG-05AUG	22	11
64	23AUG-24AUG	22	12
65	14SEP-15SEP	22	13
66	05OCT-06OCT	22	14
67	25OCT-26OCT	21	15
68	17NOV-18NOV	22	16
69	07DEC-08DEC	22	17
70	21DEC-22DEC	22	18
	TOTAL	395	

TABLE 5.2 TOTAL NUMBER, TOTAL WEIGHT, MEAN NUMBER, MEAN WEIGHT, PERCENT TOTAL NUMBER, AND PERCENT TOTAL WEIGHT OF SPECIES COLLECTED IN NEKTON SMALL TRAWLS, 1982 (ADJUSTED FOR DURATION).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TOTAL NUMBER	TOTAL WEIGHT	MEAN NUMBER	MEAN WEIGHT	%TOTAL NUMBER	%TOTAL WEIGHT
LEPISOSTEIDAE	GARS						
LEPISOSTEUS OSSEUS	LONGNOSE GAR	2	4,319	0	11	0.00	1.10
ELOPIDAE	TARPONS						
ELOPS SAURUS	LADYFISH	1	51	0	0	0.00	0.01
ANGUILLIDAE	FRESHWATER EELS						
ANGUILLA ROSTRATA	AMERICAN EEL	54	6,517	0	16	0.04	1.66
CONGRIDAE	CONGER EELS						
CONGER OCEANICUS	CONGER EEL	1	183	0	0	0.00	0.05
OPHICHTHIDAE	SNAKE EELS						
MYROPHIS PUNCTATUS	SPECKLED WORM EEL	2	11	0	0	0.00	0.00
OPHICHTHUS GOMESI	SHRIMP EEL	1	30	0	0	0.00	0.01
CLUPEIDAE	HERRINGS						
ALOSA AESTIVALIS	BLUEBACK HERRING	6	144	0	0	0.00	0.04
ALOSA PSEUDOHARENGUS	ALEWIFE	1	211	0	1	0.00	0.05
ALOSA SAPIDISSIMA	AMERICAN SHAD	9	95	0	0	0.01	0.02
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN	6,512	40,261	16	102	4.57	10.26
DOROSOMA CEPEDIANUM	GIZZARD SHAD	188	394	0	1	0.13	0.10
DOROSOMA PETENENSE	THREADFIN SHAD	2	4	0	0	0.00	0.00
ENGRAULIDAE	ANCHOVIES						
ANCHOA HEPSETUS	STRIPED ANCHOVY	54	209	0	1	0.04	0.05
ANCHOA MITCHILLI	BAY ANCHOVY	50,902	34,959	129	89	35.70	8.91
SYNODONTIDAE	LIZARDFISHES						
SYNODUS FOETENS	INSHORE LIZARDFISH	21	874	0	2	0.01	0.22
ICTALURIDAE	BULLHEAD CATFISHES						
ICTALURUS CATUS	WHITE CATFISH	643	4,743	2	12	0.45	1.21
ICTALURUS FURCATUS	BLUE CATFISH	75	2,761	0	7	0.05	0.70
ICTALURUS PUNCTATUS	CHANNEL CATFISH	36	98	0	0	0.03	0.02
APHREDODERIDAE	PIRATE PERCHES						
APHREDODERUS SAYANUS	PIRATE PERCH	1	6	0	0	0.00	0.00
BATRACHOIDIDAE	TOADFISHES						
OPSANUS TAU	OYSTER TOADFISH	65	4,716	0	12	0.05	1.20
GOBIESOCIDAE	CLINGFISHES						
GOBIESOX STRUMOSUS	SKILLETFISH	10	29	0	0	0.01	0.01
GADIDAE	CODFISHES						
UROPHYCIS SP.	HAKE UNID. (UROPHYCIS)	1	1	0	0	0.00	0.00
UROPHYCIS FLORIDANA	SOUTHERN HAKE	39	469	0	1	0.03	0.12
UROPHYCIS REGIA	SPOTTED HAKE	931	9,848	2	25	0.65	2.51
OPHIDIIDAE	CUSK-EELS	1	2	0	0	0.00	0.00
OPHIDION WELSHI	CRESTED CUSK-EEL	30	95	0	0	0.02	0.02
CYPRINODONTIDAE	KILLIFISHES						
FUNDULUS HETEROCLITUS	MUMMICHOG	1	1	0	0	0.00	0.00
ATHERINIDAE	SILVERSIDES	1	0	0	0	0.00	0.00
MENIDIA BERYLLINA	INLAND SILVERSIDE	1	3	0	0	0.00	0.00
MENIDIA MENIDIA	ATLANTIC SILVERSIDE	39	137	0	0	0.03	0.03
SYNGNATHIDAE	PIPEFISHES						
HIPPOCAMPUS ERECTUS	LINED SEAHORSE	1	2	0	0	0.00	0.00
SYNGNATHUS FUSCUS	NORTHERN PIPEFISH	3	3	0	0	0.00	0.00

TABLE 5.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TOTAL NUMBER	TOTAL WEIGHT	MEAN NUMBER	MEAN WEIGHT	%TOTAL NUMBER	%TOTAL WEIGHT
SYNGNATHUS LOUISIANAE	CHAIN PIPEFISH	1	11	0	0	0.00	0.55
PERCICHTHYIDAE	TEMPERATE BASSES						
MORONE SAXATILIS	STRIPED BASS	4	3	0	0	0.00	0.00
SERRANIDAE	SEA BASSES						
CENTROPRISTIS PHILADELPHICA	ROCK SEA BASS	3	95	0	0	0.00	0.02
CENTROPRISTIS STRIATA	BLACK SEA BASS	1	6	0	0	0.00	0.00
CENTRARCHIDAE	SUNFISHES						
LEPOMIS SP.	SUNFISH UNID. (LEPOMIS)	1	1	0	0	0.00	0.00
LEPOMIS GIBBOSUS	PUMPKINSEED	18	1,248	0	3	0.01	0.32
LEPOMIS GULOSUS	WARMOUTH	3	438	0	1	0.00	0.11
LEPOMIS MACROCHIRUS	BLUEGILL	12	491	0	1	0.01	0.13
LEPOMIS MICROLOPHUS	REDEAR SUNFISH	7	259	0	1	0.00	0.07
POMOXIS NIGROMACULATUS	BLACK CRAPPIE	17	94	0	0	0.01	0.02
POMATOMIDAE	BLUEFISHES						
POMATOMUS SALTATRIX	BLUEFISH	13	358	0	1	0.01	0.09
CARANGIDAE	JACKS						
CARANX HIPPOS	CREVALLE JACK	8	12	0	0	0.01	0.00
CHLOROSCOMBRUS CHRYSURUS	ATLANTIC BUMPER	18	63	0	0	0.01	0.02
SELENE SETAPINNIS	ATLANTIC MOONFISH	4	22	0	0	0.00	0.01
SELENE VOMER	LOOKDOWN	60	470	0	1	0.04	0.12
LUTJANIDAE	SNAPPERS						
LUTJANUS GRISEUS	GRAY SNAPPER	4	181	0	0	0.00	0.05
GERREIDAE	MOJARRAS	1	1	0	0	0.00	0.00
DIAPTERUS AURATUS	IRISH POMPANO	3	38	0	0	0.00	0.01
EUCINOSTOMUS SP.	MOJARRA UNID. (EUCINOSTOMUS)	1	1	0	0	0.00	0.00
EUCINOSTOMUS ARGENTEUS	SPOTFIN MOJARRA	74	929	0	2	0.05	0.74
EUCINOSTOMUS GULA	SILVER JENNY	1	5	0	0	0.00	0.00
HAEMULIDAE	GRUNTS						
ORTHOPRISTIS CHRYSOPTERA	PIGFISH	7	88	0	0	0.00	0.02
SPARIDAE	PORGIES						
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD	25	723	0	2	0.02	0.18
LAGODON RHOMBOIDES	PINFISH	227	4,288	1	11	0.16	1.09
SCIAENIDAE	DRUMS						
BAIRDIELLA CHRYSOURA	SILVER PERCH	1,133	29,831	3	76	0.79	7.60
CYNOSCION NEBULOSUS	SPOTTED SEATROUT	15	837	0	2	0.01	0.21
CYNOSCION REGALIS	WEAKFISH	3,367	11,640	0	29	2.36	2.97
LEIOSTOMUS XANTHURUS	SPOT	46,905	139,689	119	354	32.90	35.60
MENTICIRRHUS SP.	KINGFISH UNID. (MENTICIRRHUS)	16	26	0	0	0.01	0.01
MENTICIRRHUS AMERICANUS	SOUTHERN KINGFISH	10	235	0	1	0.01	0.06
MENTICIRRHUS SAXATILIS	NORTHERN KINGFISH	1	2	0	0	0.00	0.00
MICROPOGONIAS UNDULATUS	ATLANTIC CROAKER	26,893	59,450	68	151	18.86	15.15
POGONIAS CROMIS	BLACK DRUM	9	835	0	2	0.01	0.21
SCIAENOPS OCELLATUS	RED DRUM	8	2,407	0	6	0.01	0.61
STELLIFER LANCEOLATUS	STAR DRUM	118	364	0	1	0.08	0.09
EPHIPPIDAE	SPADEFISHES						
CHAETODIPTERUS FABER	ATLANTIC SPADEFISH	3	17	0	0	0.00	0.00
MUGILIDAE	MULLETS						
MUGIL CEPHALUS	STRIPED MULLET	45	1,675	0	4	0.03	0.43

TABLE 5.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TOTAL NUMBER	TOTAL WEIGHT	MEAN NUMBER	MEAN WEIGHT	%TOTAL NUMBER	%TOTAL WEIGHT
MUGIL CUREMA	WHITE MULLET	10	244	0	1	0.01	0.06
URANOSCOPIDAE	STARGAZERS						
ASTROSCOPUS Y-GRAECUM	SOUTHERN STARGAZER	2	44	0	0	0.00	0.01
BLENNIIDAE	COMBTOOTH BLENNIES						
CHASMODES BOSQUIANUS	STRIPED BLENNY	1	4	0	0	0.00	0.00
HYPSOBLENNIUS HENTZI	FEATHER BLENNY	8	20	0	0	0.01	0.01
HYPSOBLENNIUS IONTHAS	FRECKLED BLENNY	15	69	0	0	0.01	0.02
GOBIIDAE	GOBIES						
GOBIONELLUS BOLEOSOMA	DARTER GOBY	32	14	0	0	0.02	0.00
GOBIONELLUS HASTATUS	SHARPTAIL GOBY	19	73	0	0	0.01	0.02
GOBIONELLUS SHUFELDTI	FRESHWATER GOBY	60	51	0	0	0.04	0.01
GOBIOSOMA BOSCI	NAKED GOBY	13	13	0	0	0.01	0.00
GOBIOSOMA GINSBURGI	SEABOARD GOBY	1	1	0	0	0.00	0.00
MICROGOBIUS THALASSINUS	GREEN GOBY	2	2	0	0	0.00	0.00
TRICHIURIDAE	CUTLASSFISHES						
TRICHIURUS LEPTURUS	ATLANTIC CUTLASSFISH	48	688	0	2	0.03	0.18
SCOMBRIDAE	MACKERELS						
SCOMBEROMORUS CAVALLA	KING MACKEREL	1	1	0	0	0.00	0.00
SCOMBEROMORUS MACULATUS	SPANISH MACKEREL	1	46	0	0	0.00	0.01
STROMATEIDAE	BUTTERFISHES						
PEPRILUS ALEPIDOTUS	HARVESTFISH	6	21	0	0	0.00	0.01
PEPRILUS BURTI	GULF BUTTERFISH	4	20	0	0	0.00	0.01
PEPRILUS TRIACANTHUS	BUTTERFISH	8	45	0	0	0.01	0.01
TRIGLIDAE	SEAROBINS						
PRIONOTUS SP.	SEAROBIN UNID. (PRIONOTUS)	47	23	0	0	0.03	0.01
PRIONOTUS SCITULUS	LEOPARD SEAROBIN	8	46	0	0	0.01	0.01
PRIONOTUS TRIBULUS	BIGHEAD SEAROBIN	163	285	0	1	0.11	0.07
BOTHIDAE	LEFTEYE FLOUNDERS						
ANCYLOPSETTA QUADROCELLATA	OCELLATED FLOUNDER	9	83	0	0	0.01	0.02
CITHARICHTHYS SP.	WHIFF UNID. (CITHARICHTHYS)	1	1	0	0	0.00	0.00
CITHARICHTHYS SPILOPTERUS	BAY WHIFF	112	301	0	1	0.08	0.08
ETROPUS CROSSOTUS	FRINGED FLOUNDER	123	482	0	1	0.09	0.12
PARALICHTHYS SP.	FLOUNDER UNID. (PARALICHTHYS)	1	1	0	0	0.00	0.00
PARALICHTHYS ALBIGUTTA	GULF FLOUNDER	1	1	0	0	0.00	0.00
PARALICHTHYS DENTATUS	SUMMER FLOUNDER	92	1,750	0	4	0.06	0.45
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER	352	14,969	1	38	0.25	3.81
SCOPHTHALMUS AQUOSUS	WINDOWPANE	43	841	0	2	0.03	0.21
SOLEIDAE	SOLES						
TRINECTES MACULATUS	HOGCHOKER	2,166	2,541	5	6	1.52	0.65
CYNOGLOSSIDAE	TONGUEFISHES						
SYMPHURUS PLAGIUSA	BLACKCHEEK TONGUEFISH	553	1,682	1	4	0.39	0.43
BALISTIDAE	LEATHERJACKETS						
MONACANTHUS HISPIDUS	PLANEHEAD FILEFISH	4	5	0	0	0.00	0.00
TETRAODONTIDAE	PUFFERS						
SPHOEROIDES MACULATUS	NORTHERN PUFFER	1	1	0	0	0.00	0.00
DIODONTIDAE	PORCUPINEFISHES						
CHILOMYCTERUS SCHOEPFI	STRIPED BURRFISH	2	1	0	0	0.00	0.00
	TOTAL FISH	142,579	392,379	361	993	99.95	99.95

TABLE 5.2 (CONTINUED).

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	TOTAL NUMBER	TOTAL WEIGHT	MEAN NUMBER	MEAN WEIGHT	%TOTAL NUMBER	%TOTAL WEIGHT
SQUILLA EMPUSA	MANTIS SHRIMP	35	103	0	0	0.07	0.06
PENAEUS SP.(POSTLARVAE)	PENAEUS (POSTLARVAE)	11	2	0	0	0.02	0.00
PENAEUS AZTECUS	BROWN SHRIMP	6,922	29,529	18	75	14.17	17.38
PENAEUS DUORARUM	PINK SHRIMP	1,155	3,040	3	8	2.36	1.79
PENAEUS SETIFERUS	WHITE SHRIMP	4,619	31,941	12	81	9.45	18.80
TRACHYPENEUS CONSTRICTUS	T-CON OR HARDBACK SHRIMP	658	201	2	1	1.35	0.12
MACROBRACHIUM SP.	FRESHWATER PRAWNS	7	16	0	0	0.01	0.01
PALAEMONETES SP.	GRASS SHRIMP	32,051	8,717	81	22	65.60	5.13
ALPHEUS SP.	SNAPPING SHRIMP	45	43	0	0	0.09	0.03
CRANGON SEPTEMSPINOSA	SAND SHRIMP	1	1	0	0	0.00	0.00
PORTUNIDAE	SWIMMING CRABS	13	9	0	0	0.03	0.01
PORTUNUS SP.	SWIMMING CRABS	7	8	0	0	0.01	0.00
CALLINECTES SP.	BLUE CRABS	3,135	80,843	8	205	6.42	47.58
LOLLIGUNCULA BREVIS	BRIEF SQUID	193	1,307	0	3	0.40	0.77
CHELYDRA SERPENTINA	SNAPPING TURTLE	1	6,750	0	17	0.00	3.97
MALACLEMYS TERRAPIN	DIAMONDBACK TERRAPIN	3	724	0	2	0.01	0.43
CHRYSEMYS CONCINNA	RIVER COOTER	3	6,679	0	17	0.01	3.93
	TOTAL NON-FISH	48,859	169,913	124	430	100.00	100.01
	TOTAL ORGANISMS	191,438	562,292	485	1,424		
	TOTAL EFFORTS		395				

Table 5.3 Ten most abundant fish caught in small trawls and percent of total number and weight, January to December 1982 and all years combined, 1979 to 1982 (adjusted for duration).

	All Years			1982		
Species	Rank	% Total Number	% Total Weight	Rank	% Total Number	% Total Weight
Bay Anchovy	1	35	8	1	35	9
Spot	2	32	37	2	22	36
Croaker	3	19	36	3	18	15
Menhaden	4	5	11	4	4	10
Weakfish	5	4	3	5	2	3
Blackcheek Tonguefish	6	1	1	10	<1	<1
Hogchoker	7	1	<1	6	2	<1
Star Drum	8	<1	<1			
Spotted Hake	9	<1	2	8	<1	2
Silver Perch	10	<1	1	7	<1	8
White Catfish				9	<1	1
		98%	99%		96%	85%

Table 5.4 Six most abundant non-finfish caught in small trawls and percent of total number and total weight, January to December 1982 and for all years combined, 1979 to 1982 (adjusted for duration)

	All Years			1982		
Species	Rank	% Total Number	% Total Weight	Rank	% Total Number	% Total Weight
Grass Shrimp	1	56	3	1	65	5
Brown Shrimp	2	19	23	2	14	17
Blue Crabs	3	7	56	4	6	48
Pink Shrimp	4	6	3	5	2	2
White Shrimp	5	5	9	3	9	18
Hardback Shrimp	6	4	<1	6	1	<1
		97%	94%		99%	[illegible]

Table 5.5 Mean number, mean weight, and percent total for all years of species collected in nekton small trawl, 1979-1982 (adjusted for duration)

Species	Number	Total	Weight	% Total
Bay Anchovy	112	38	97	9
Spot	90	31	430	38
Croaker	46	17	161	15
Menhaden	12	4	110	10
Weakfish	10	3	32	3
Southern Flounder	<1	.31	38	4
Brown Shrimp	20	17	114	20
Pink Shrimp	7	6	17	3
White Shrimp	9	7	64	12

Table 5.6 Results of ANOVA for nekton Log_{10} (CPUE + 1), small trawl, January 1979 through December 1982.

	Total Organisms	Menhaden Age I & Older
Week	***	***
Year	**	***
Week X Year	***	***
Station	***	***
Week X Station	***	***
Year X Station	*	***
Trips Analyzed	1-17	1-9
$\overline{Log}$	2.284	0.485
s^2	0.211	0.193

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.6 (continued)

Source	Bay Anchovy Age 0	Bay Anchovy Age 1 & Older	Weakfish Age 0
Week	**	***	***
Year	***	***	NS
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	*	***	***
Trips Analyzed	8-17	1-13	8-17
$\overline{Log}$	1.062	0.915	0.578
S^2	0.410	0.290	0.151

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.6 (continued)

Source	Spot Age 0	Spot Age 1 & Older	Croaker Age 0
Week	***	***	***
Year	***	***	***
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	***	***	***
Trips Analyzed	1-17	1-17	8-17
$\overline{Log}$	0.828	0.524	0.815
S^2	0.204	0.010	0.170

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.6 (continued)

Source	Croaker Age 1 & Older	Brown Shrimp	Pink Shrimp
Week	***	***	***
Year	***	***	***
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	***	***	***
Trips Analyzed	1-10	7-17	1-17
$\overline{\text{Log}}$	0.360	0.751	0.447
S^2	0.054	0.132	0.109

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.6 (continued)

	White Shrimp	Blue Crab
Week	***	***
Year	***	***
Week X Year	***	***
Station	***	***
Week X Station	***	***
Year X Station	***	***
Trips Analyzed	10-17	1-17
$\overline{Log}$	0.654	0.691
S^2	0.134	0.084

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.7 Results of ANOVA for nekton Log_{10} (CPUE + 1), January 1981 through December 1982.

	Total Organisms	Menhaden Age 1 & Older
Week	***	***
Year	NS	***
Week X Year	***	***
Station	***	***
Week X Station	***	***
Year X Station	**	*
Trips Analyzed	1-17	1-9
$\overline{Log}$	2.271	0.514
s^2	0.231	0.204

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.7 (continued)

Source	Bay Anchovy Age 0	Bay Anchovy Age 1 & Older	Weakfish Age 0
Week	***	***	***
Year	NS	**	NS
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	NS	NS	NS
Trips Analyzed	8-17	1-13	8-17
$\overline{\text{Log}}$	1.110	0.853	0.522
s^2	0.580	0.329	0.197

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.7 (continued)

Source	Spot Age 0	Spot Age 1 & Older	Croaker Age 0
Week	***	***	***
Year	***	***	***
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	***	***	***
Trips Analyzed	1-17	1-17	1-17
$\overline{\text{Log}}$	0.794	0.566	0.765
s^2	0.299	0.111	0.213

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.7 (continued)

Source	Croaker Age 1 & Older	Brown Shrimp	Pink Shrimp
Week	***	***	***
Year	***	NS	***
Week X Year	***	***	***
Station	***	***	***
Week X Station	***	***	***
Year X Station	***	***	***
Trips Analyzed	1-10	7-17	1-17
$\overline{\text{Log}}$	0.498	0.519	0.316
S^2	0.073	0.147	0.106

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.7 (continued)

	White Shrimp	Blue Crab
Week	***	***
Year	***	**
Week X Year	**	***
Station	***	***
Week X Station	***	***
Year X Station	***	***
Trips Analyzed	10-17	1-17
$\overline{\text{Log}}$	0.542	0.597
S^2	0.159	0.102

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.8 Results of ANOVA for nekton Log_{10} (CPUE + 1), 1982.

	Total Organisms	Menhaden Age 1 & Older
Week	***	***
Station	***	***
Week X Station	***	***
Trips Analyzed	1-18	1-9
$\overline{\text{Log}}$	2.274	0.637
S^2	0.154	0.171

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.8 (continued)

Source	Bay Anchovy Age 0	Bay Anchovy Age 1 & Older	Weakfish Age 0
Week	***	***	***
Station	***	***	***
Week X Station	***	***	***
Trips Analyzed	8-18	1-13	8-18
$\overline{\text{Log}}$	1.105	0.787	0.504
s^2	0.403	0.199	0.131

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.8 (continued)

Source	Spot Age 0	Spot Age 1 & Older	Croaker Age 0
Week	***	***	***
Station	***	***	***
Week X Station	***	***	***
Trips Analyzed	1-18	1-18	1-18
$\overline{Log}$	0.885	0.469	0.913
S^2	0.133	0.045	0.131

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.8 (continued)

Source	Croaker Age 1 & Older	Brown Shrimp	Pink Shrimp
Week	***	***	***
Station	***	***	***
Week X Station	***	***	***
Trips Analyzed	1-10	7-18	1-18
$\overline{\text{Log}}$	0.372	0.519	0.266
S^2	0.040	0.076	0.048

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

Table 5.8 (continued)

	White Shrimp	Blue Crab
Week	***	***
Station	***	***
Week X Station	***	***
,s Analyzed	10-18	1-18
$\overline{\text{Log}}$	0.720	0.553
S^2	0.108	0.070

NS $p > .05$
* $.01 < p \leq .05$
** $.001 < p \leq .01$
*** $p \leq .001$

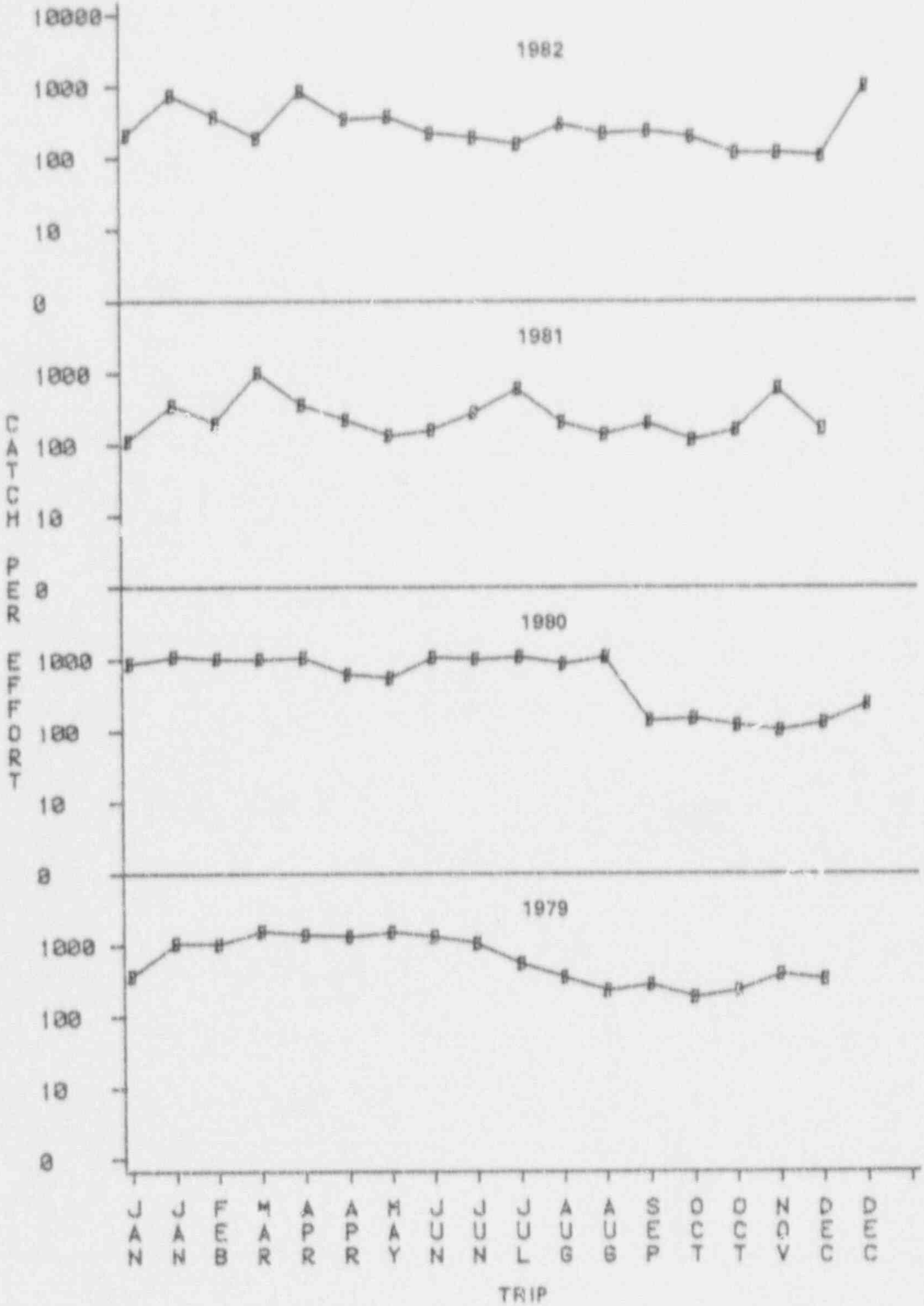


Figure 5.1 CPUE of total organisms collected in nekton small trawls, 1979 through 1982.

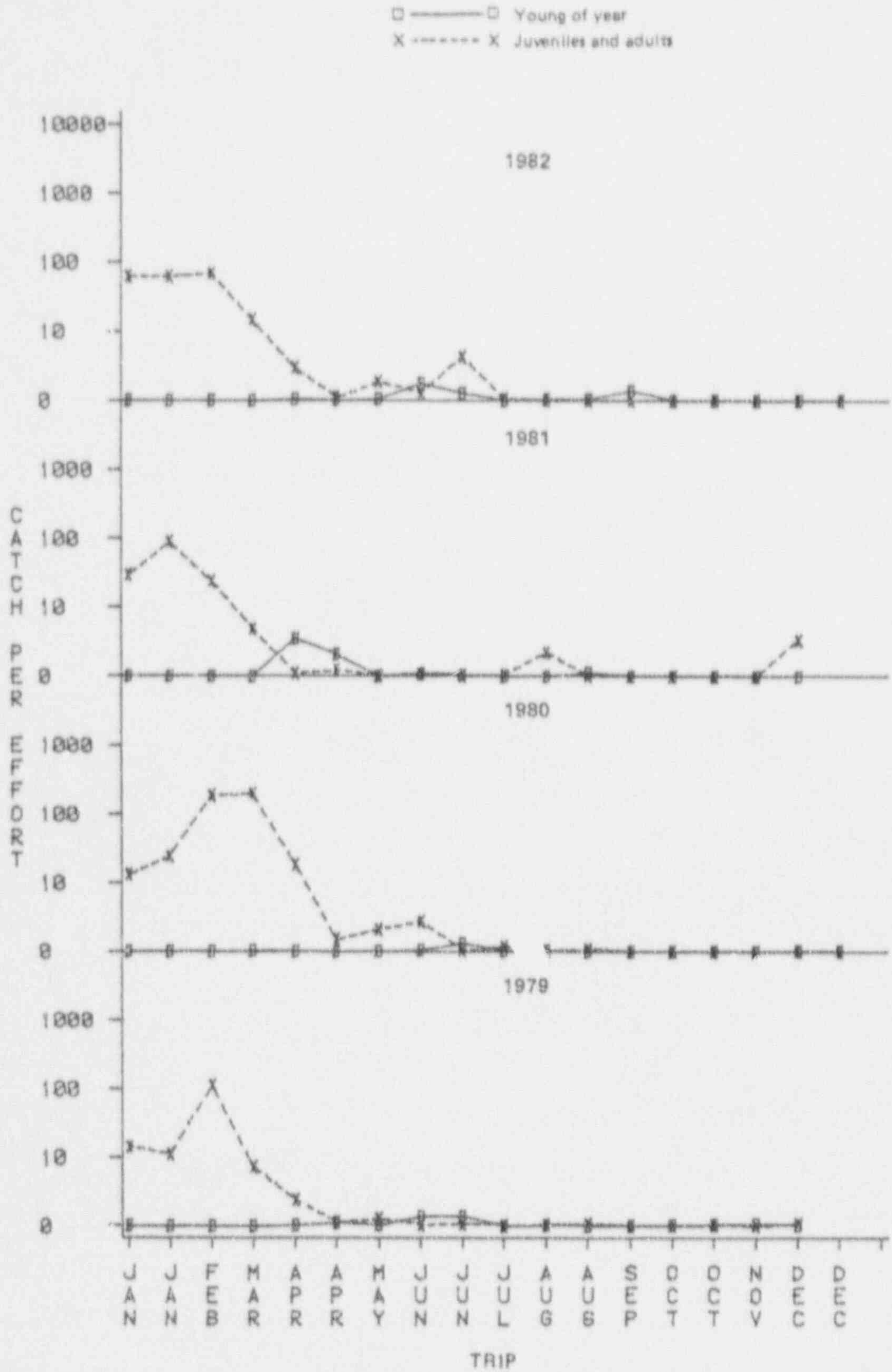


Figure 5.2 CPUE of Atlantic menhaden collected in nekton small trawls, 1979 through 1982.

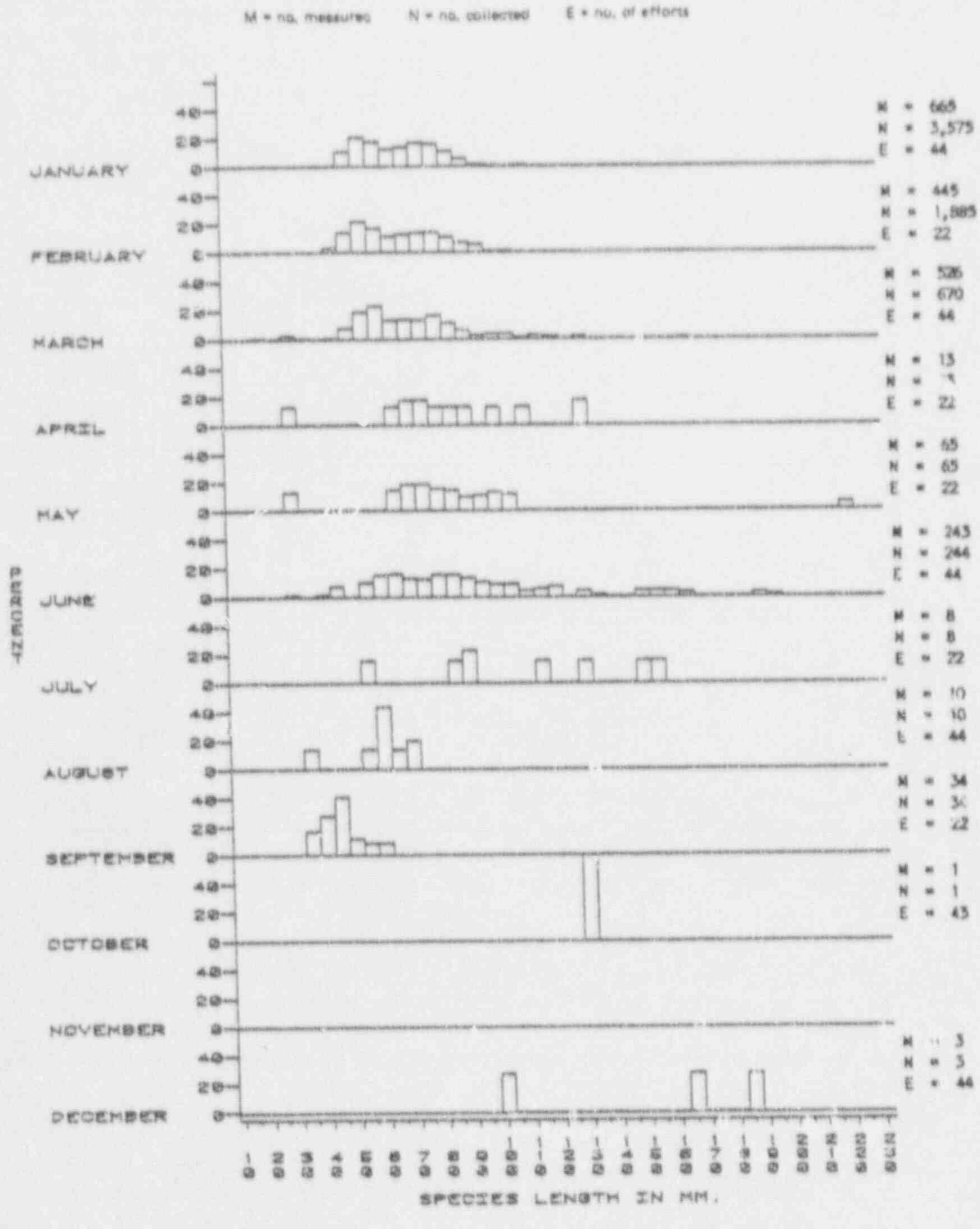


Figure 5.3 Length frequencies of Atlantic menhaden collected in nekton trawls, 1982.

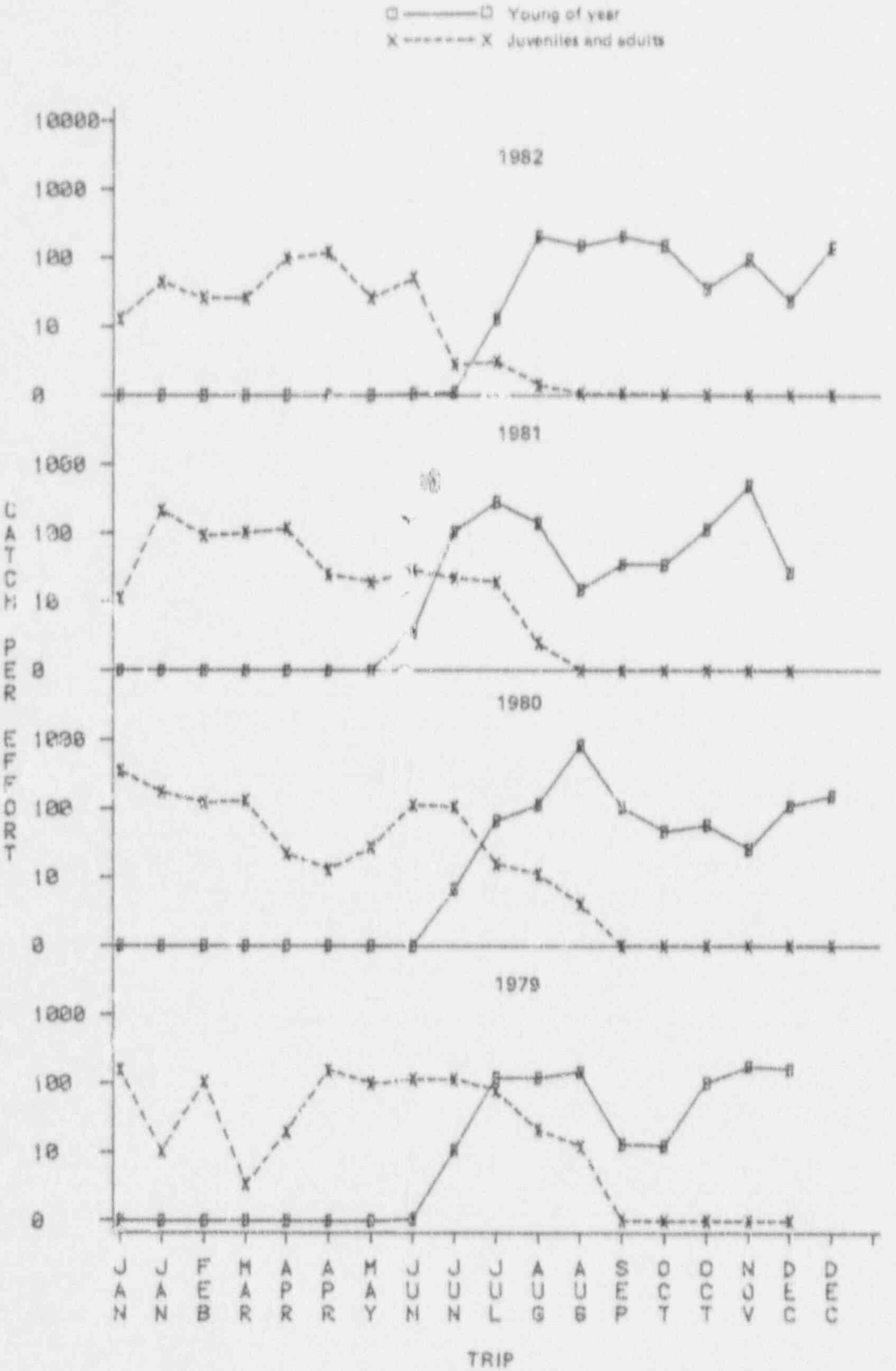


Figure 5.4 CPUE of bay anchovies collected in nekton small trawls, 1979 through 1982.

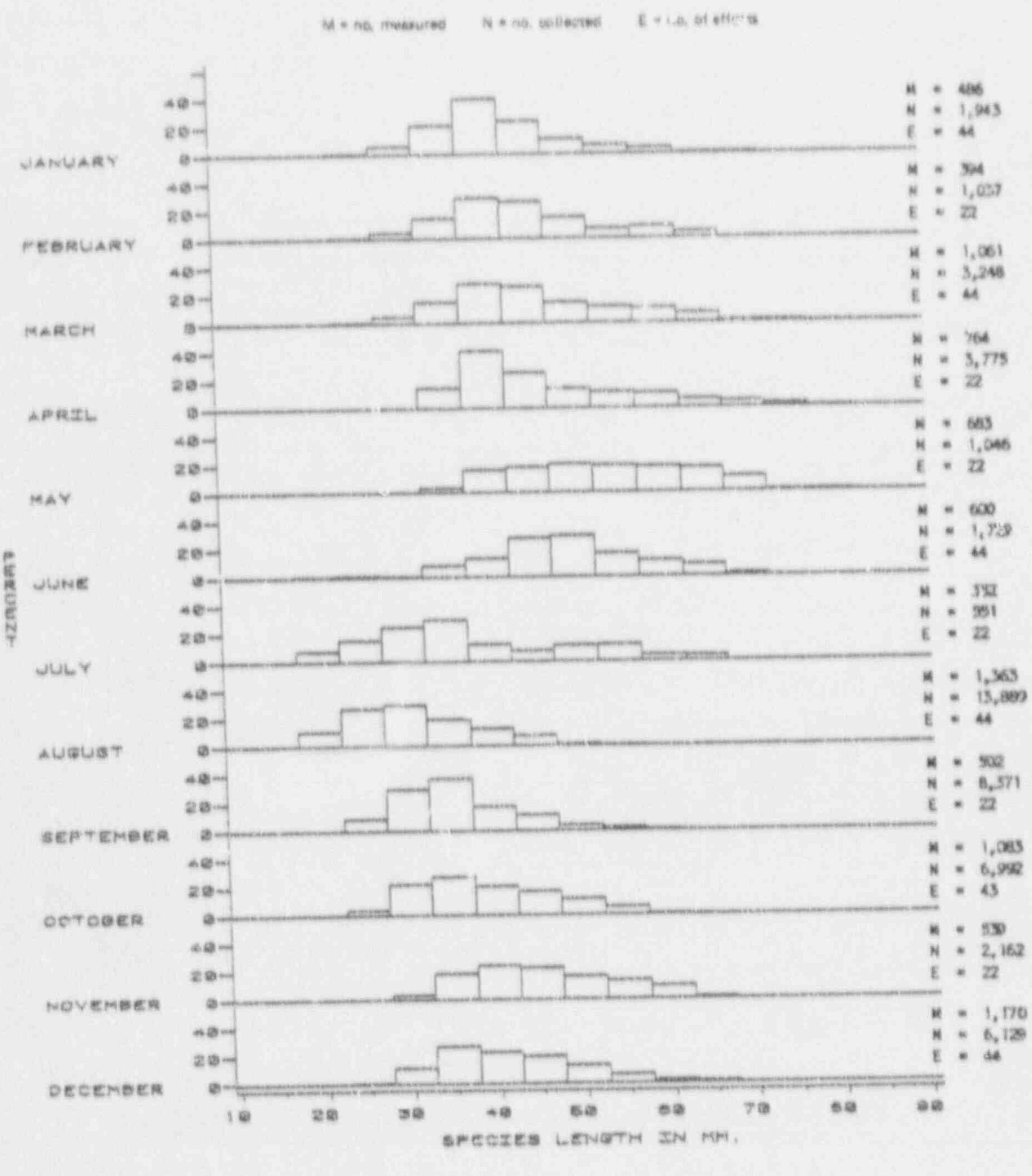


Figure 5.5 Length frequencies of bay anchovy collected in nekton trawls, 1982.

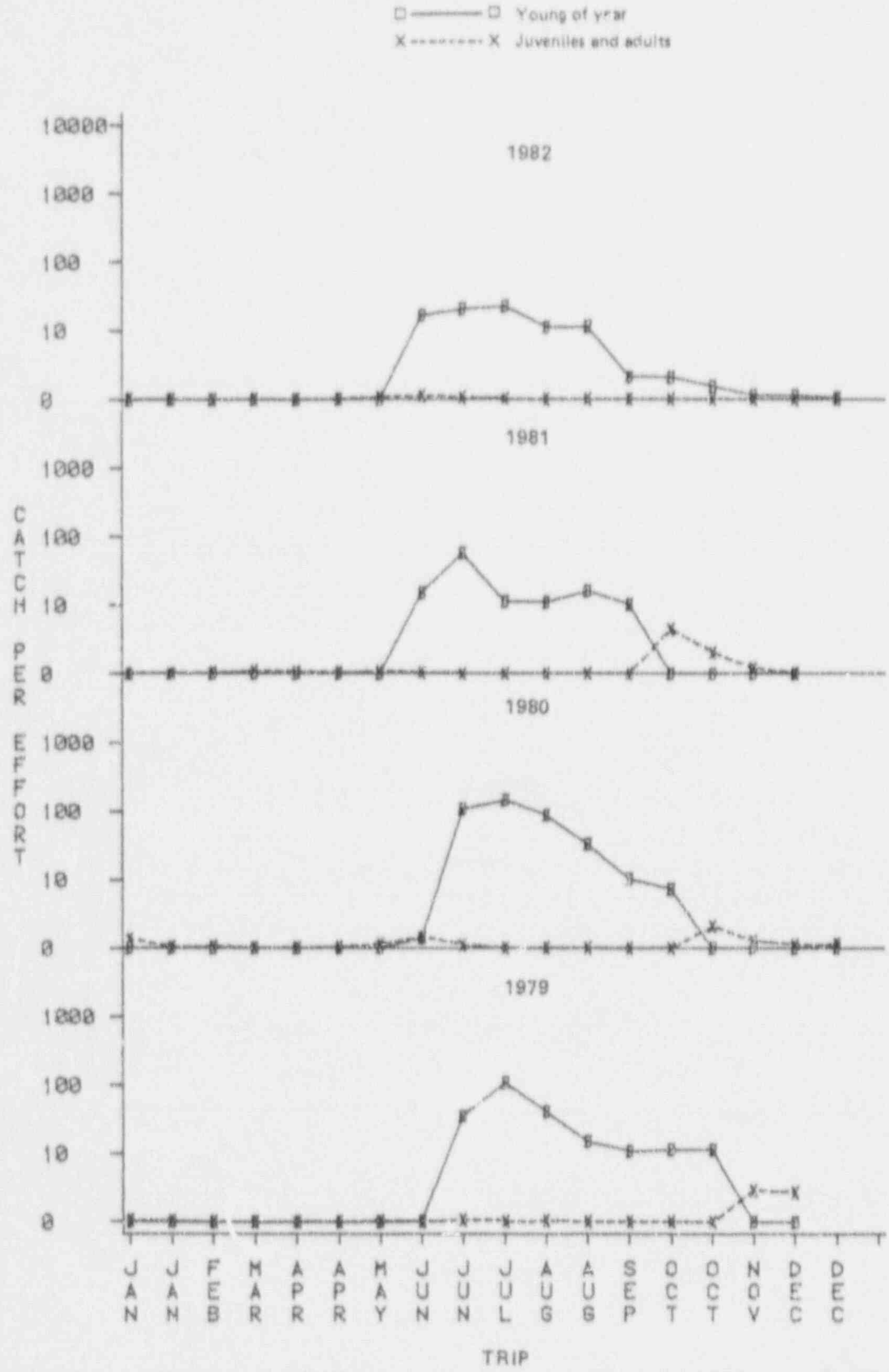


Figure 5.6 CPUE of weakfish collected in nekton small trawls, 1979 through 1982.

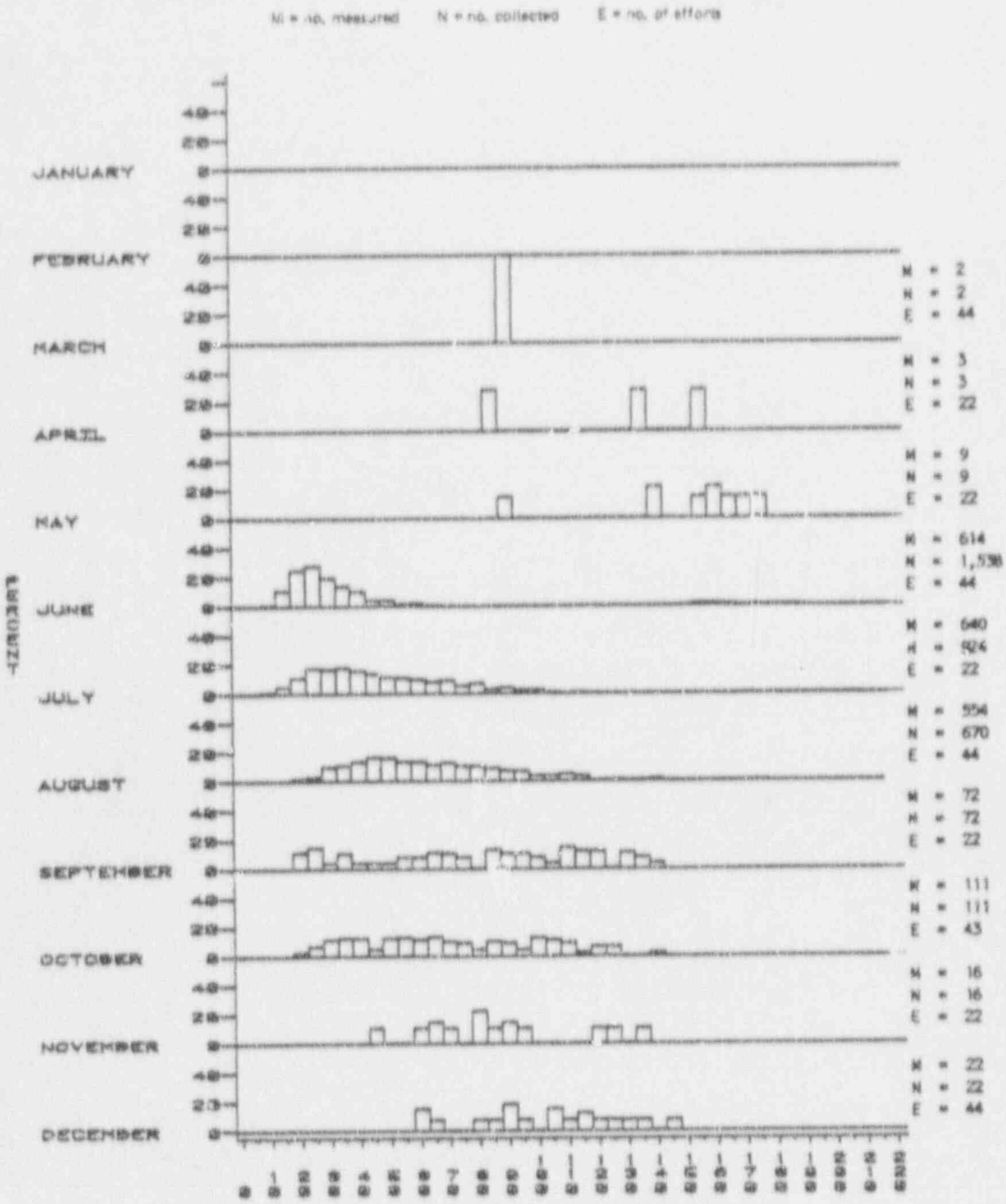


Figure 5.7 Length frequencies of weakfish collected in nekton trawls, 1982.

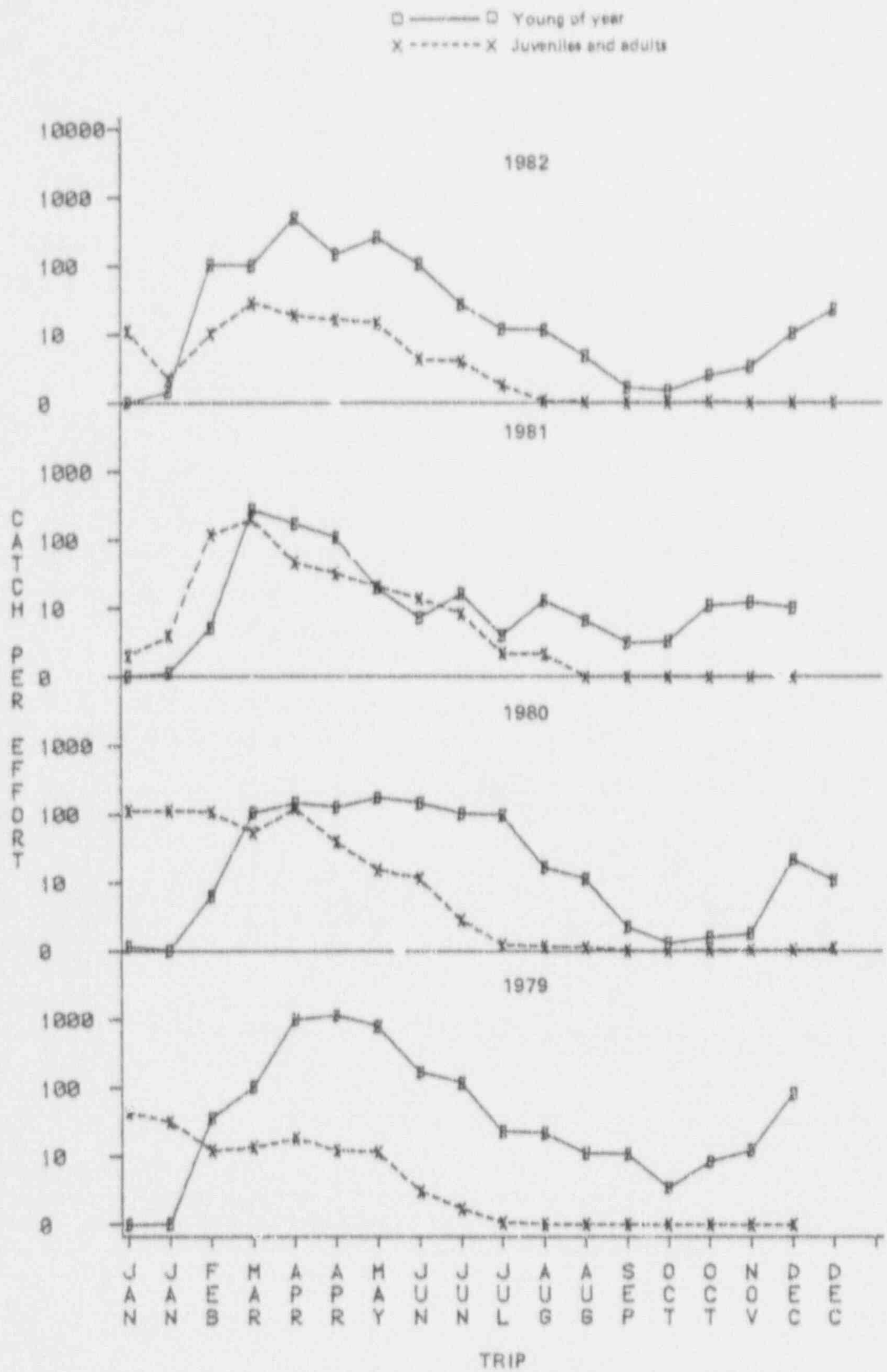


Figure 5.8 CPUE of spot collected in nekton small trawls, 1979 through 1982.

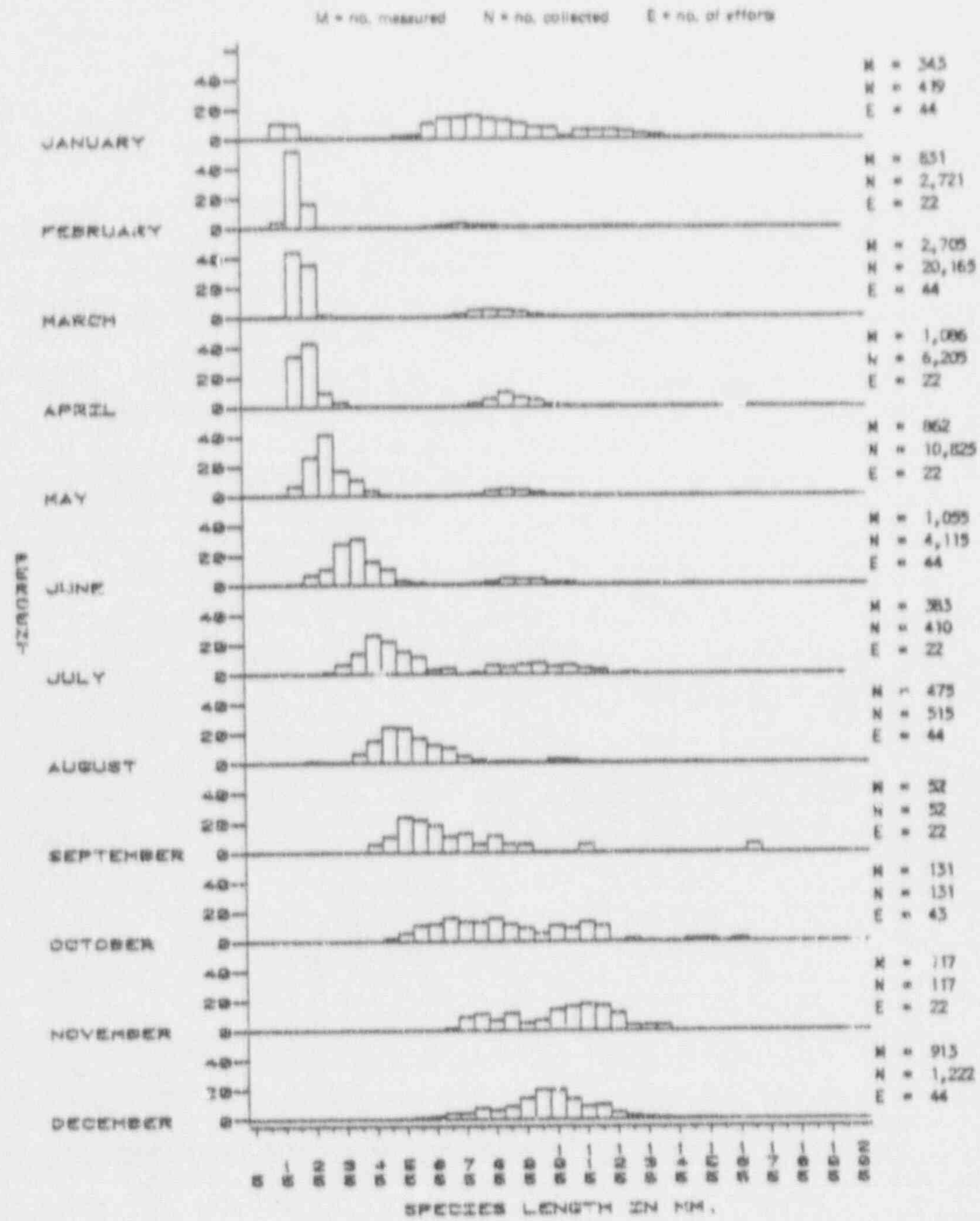


Figure 5.9 Length frequencies of spot collected in nekton trawls, 1982.

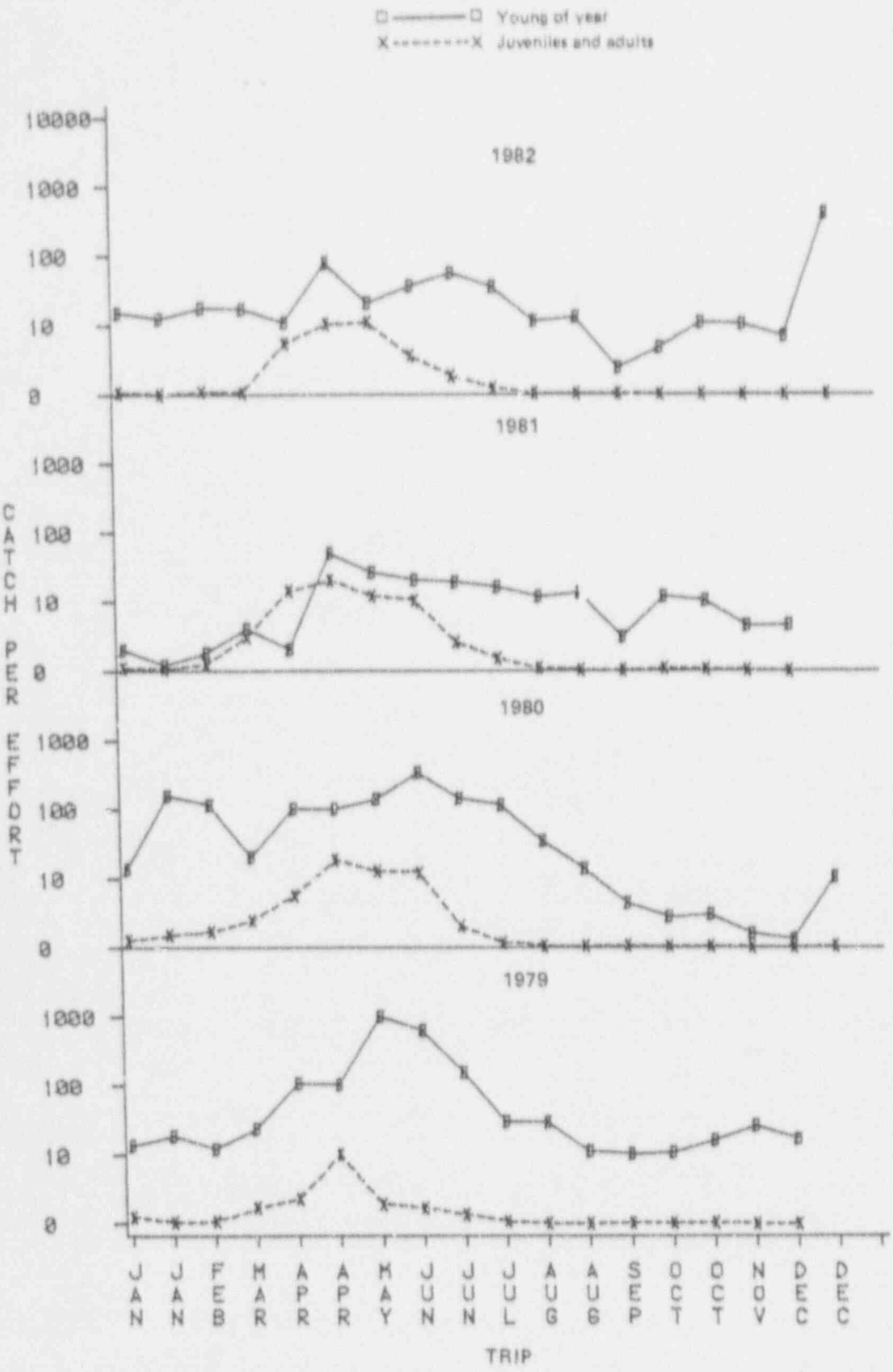


Figure 5.10 CPUE of Atlantic croaker collected in nekton small trawls, 1979 through 1982.

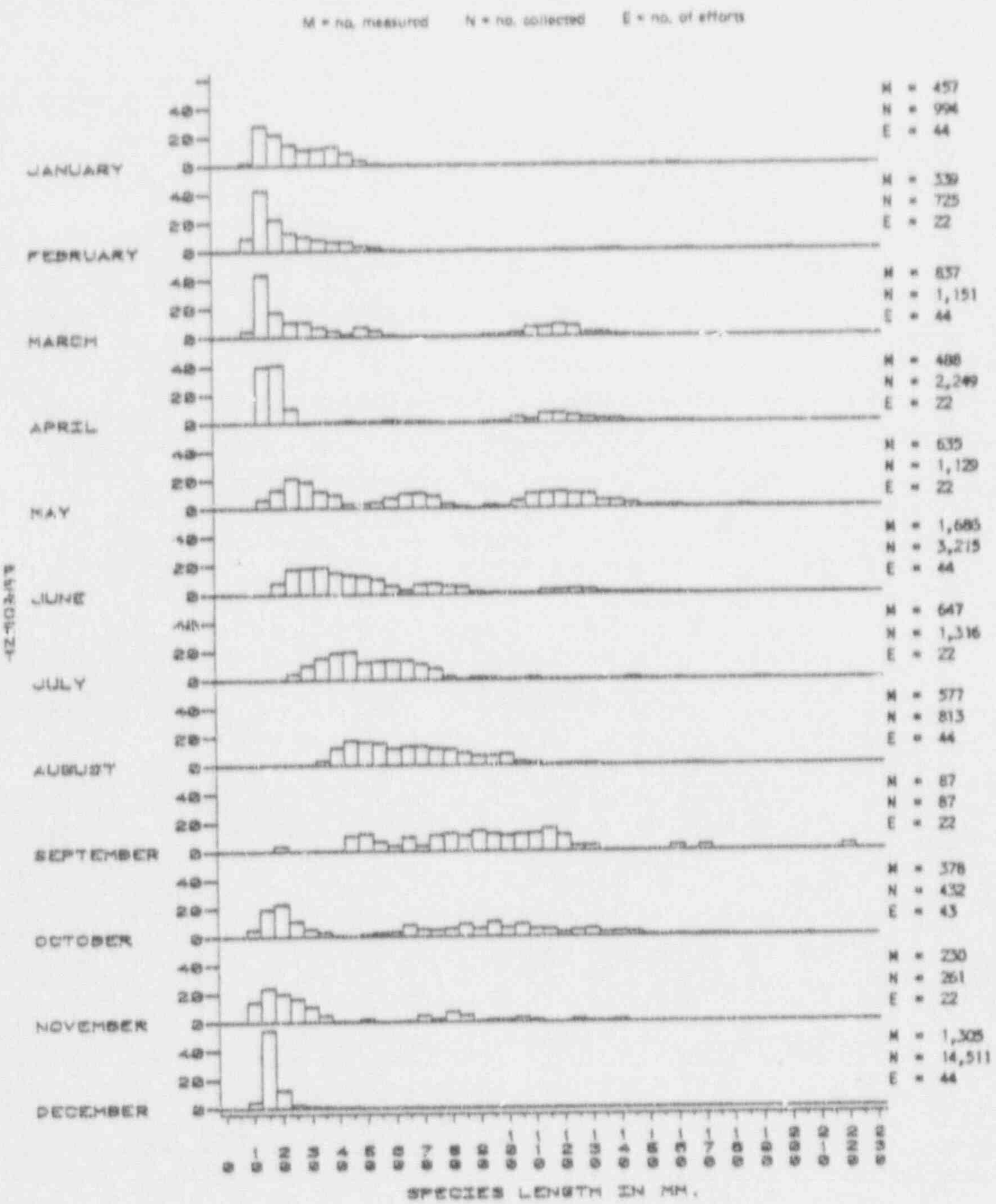


Figure 5.11 Length frequencies of Atlantic croaker collected in nekton trawls, 1982.

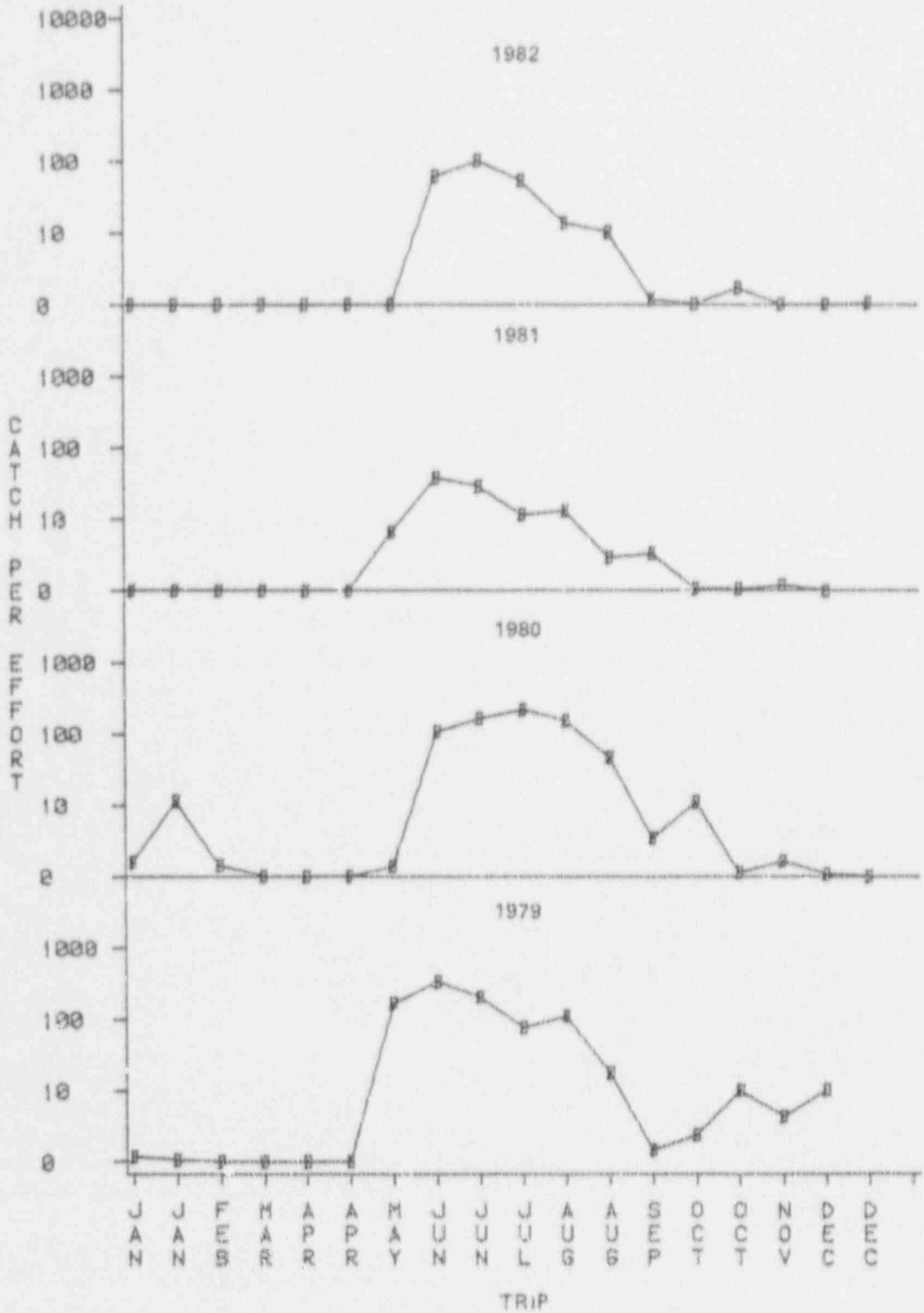


Figure 5.12 CPUE of brown shrimp collected in nekton small trawls, 1979 through 1982.

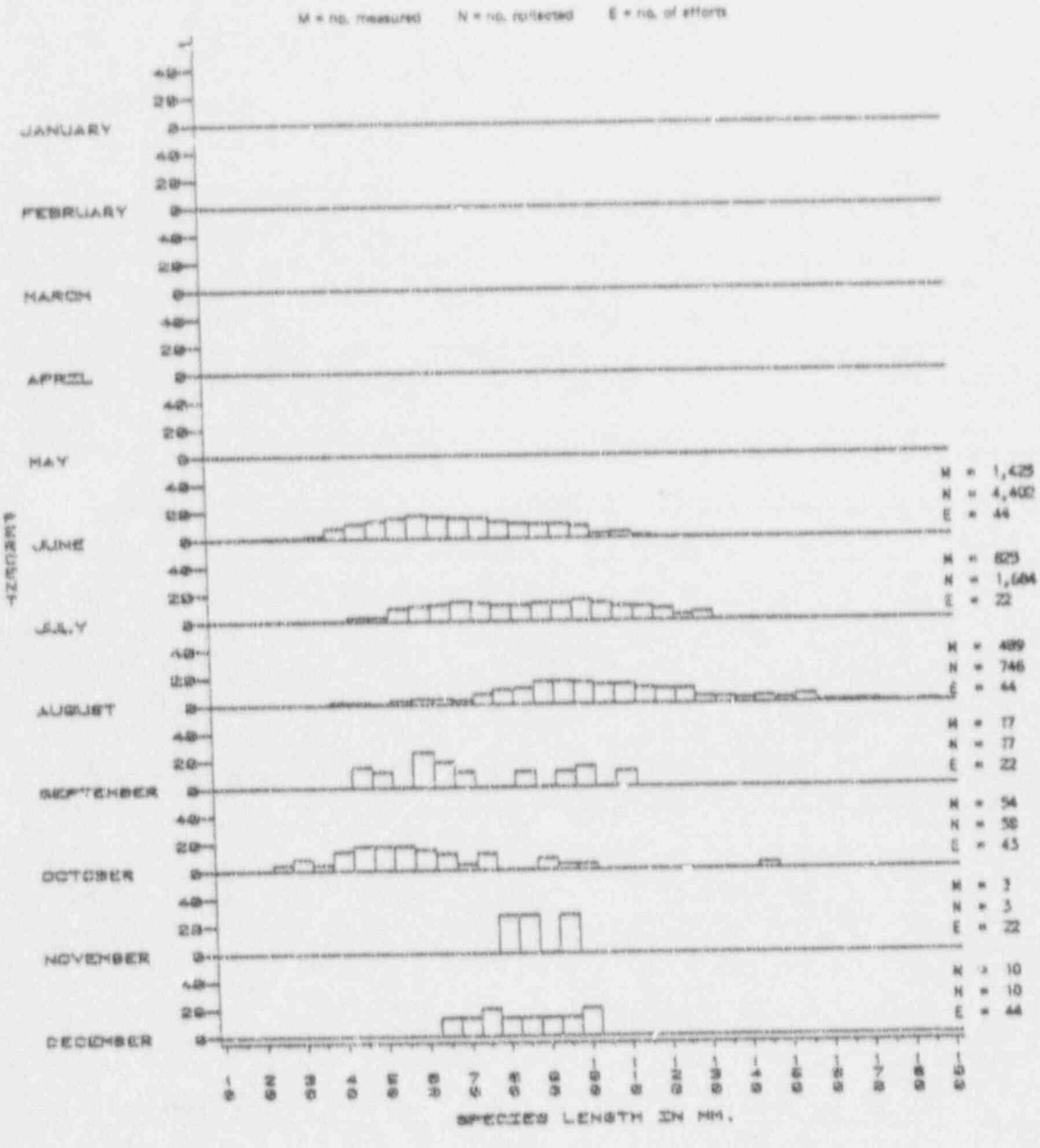


Figure 5.13 Length frequencies of brown shrimp collected in nekton trawls, 1982.

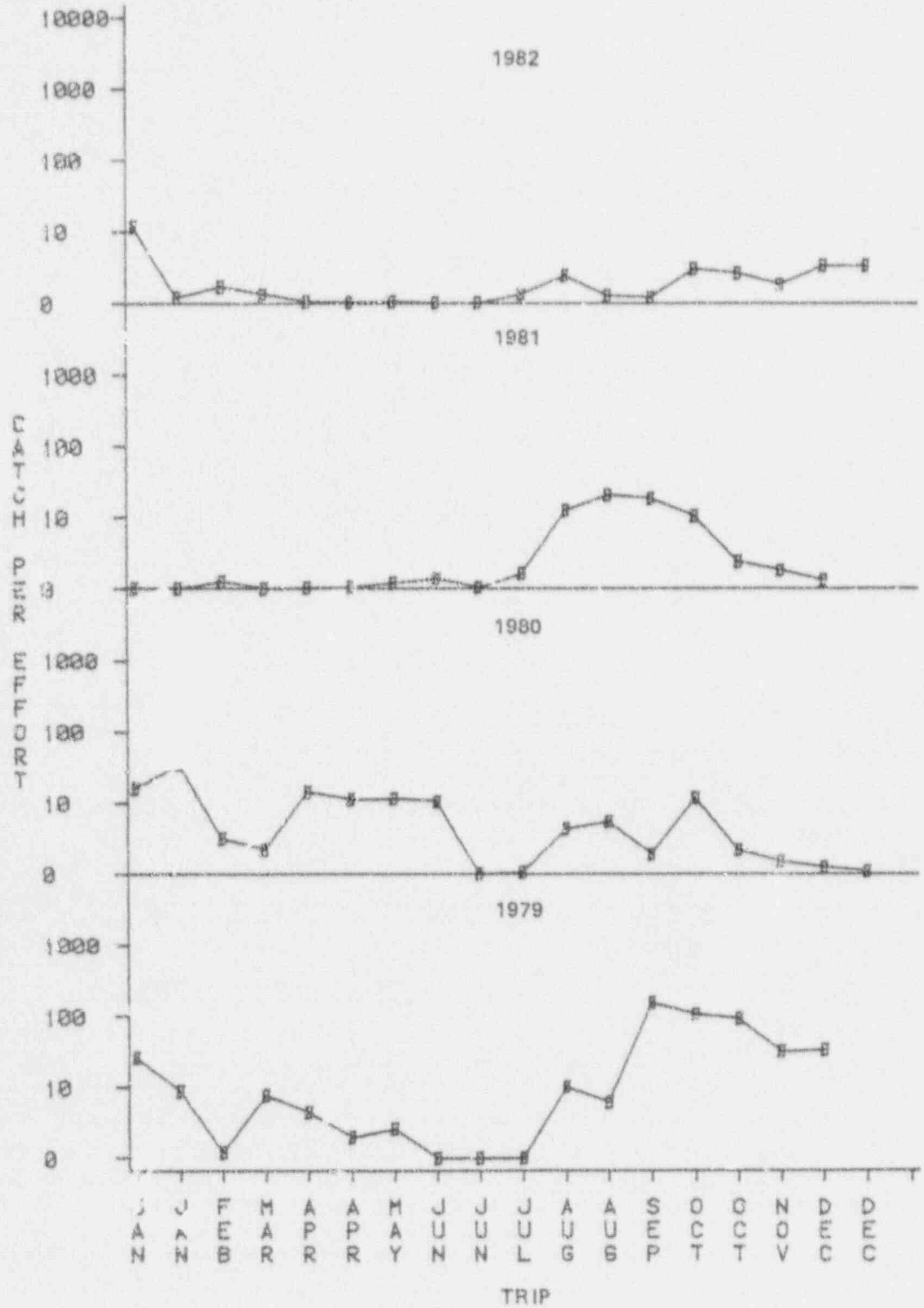


Figure 5.14 CPUE of pink shrimp collected in nekton small trawls, 1979 through 1982.

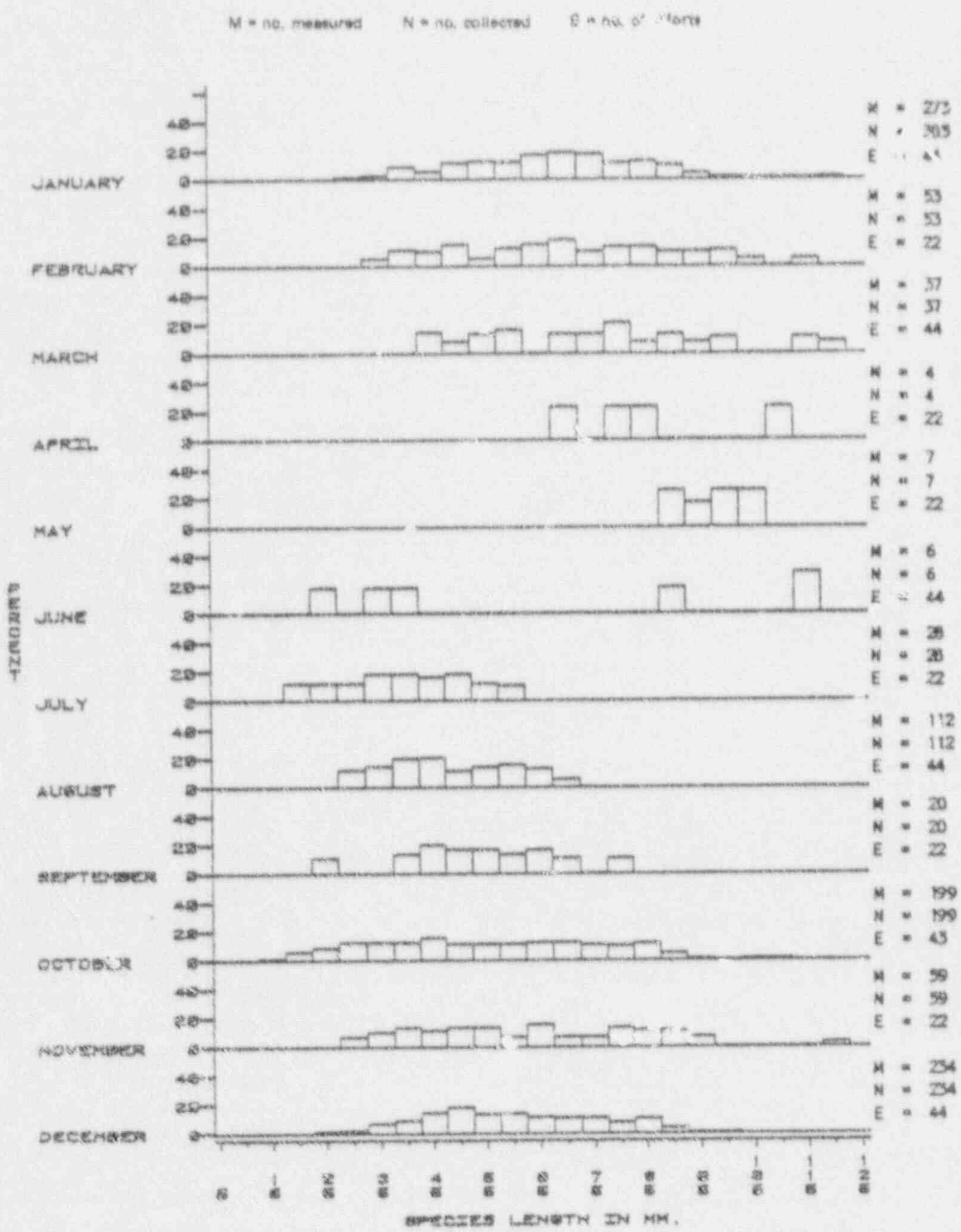


Figure 5.15 Length frequencies of pink shrimp collected in nekton trawls, 1982.

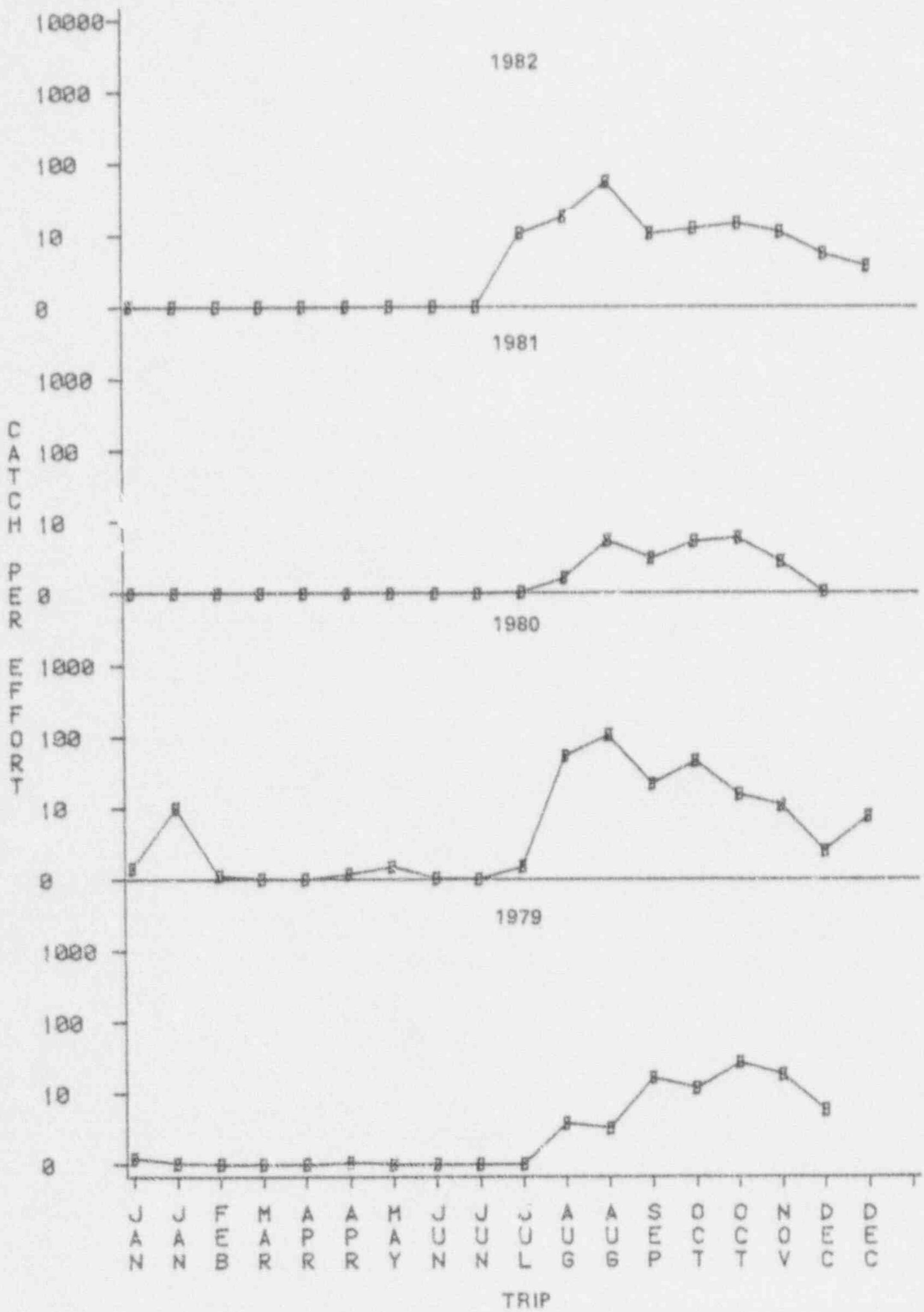


Figure 5.16 CPUE of white shrimp collected in nekton small trawls, 1979 through 1982.

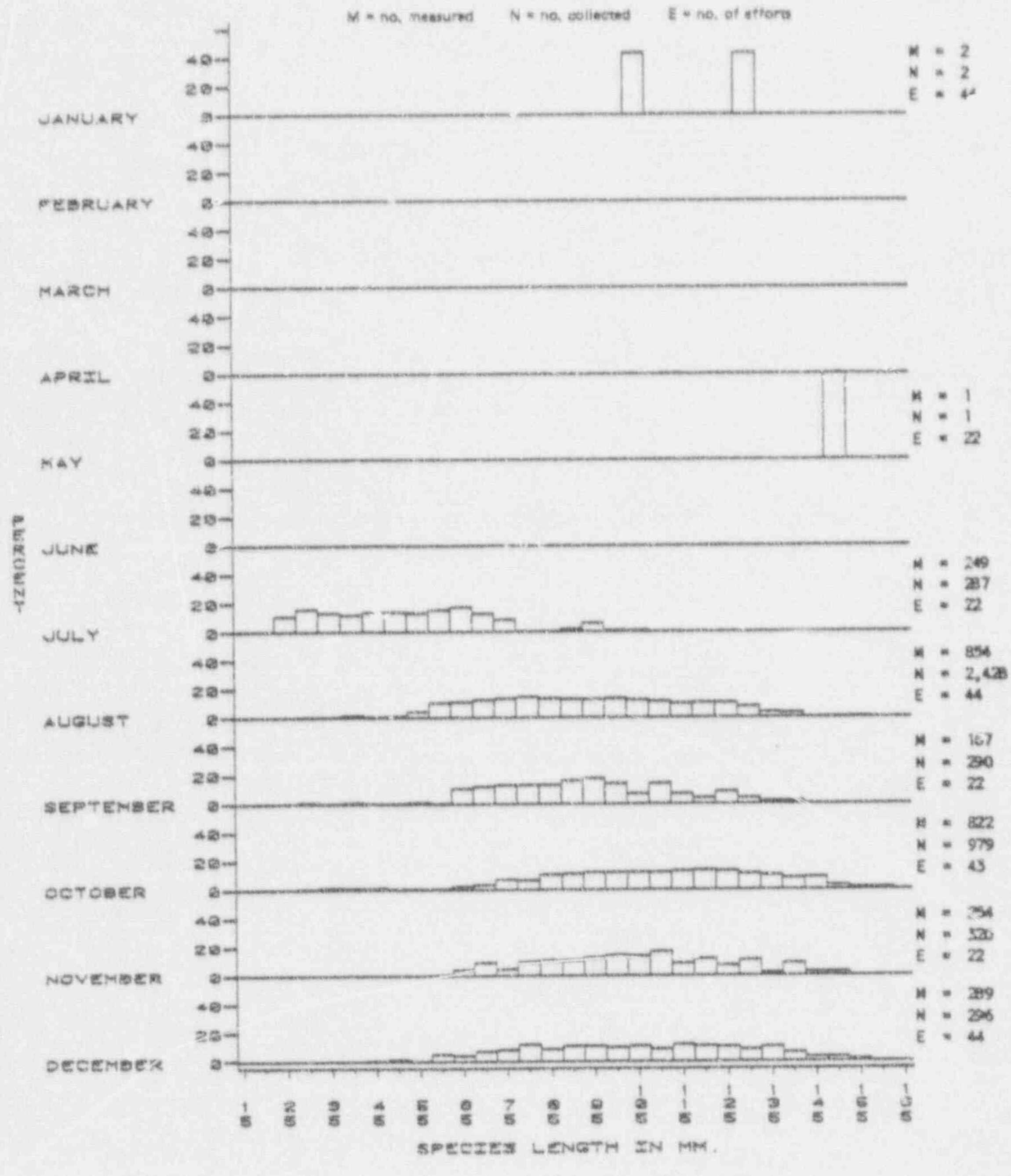


Figure 5.17 Length frequencies of white shrimp collected in nekton trawls, 1982.

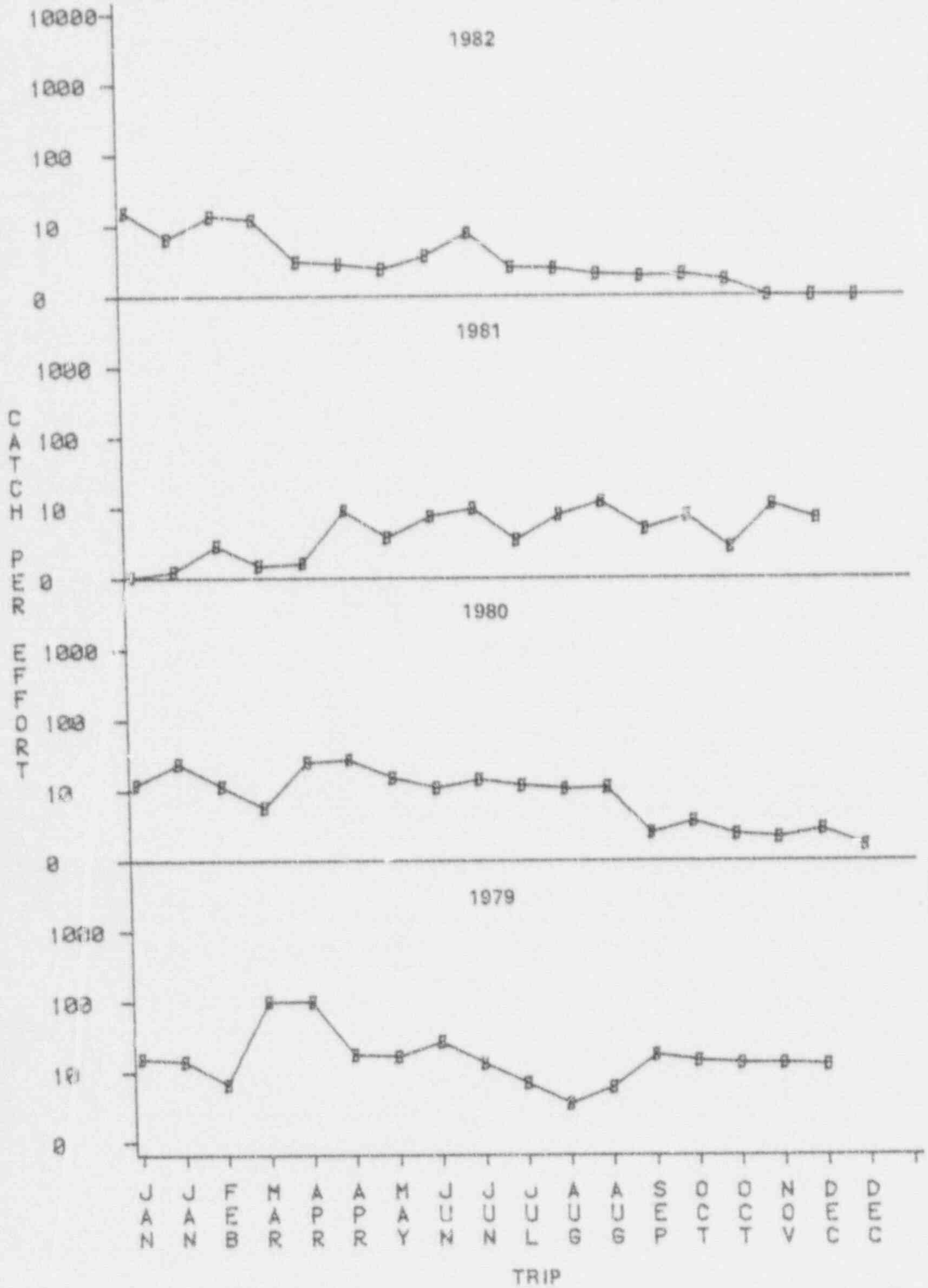


Figure 5.18 CPUE of blue crabs collected in nekton small trawls, 1979 through 1982.

Table 6.1 A summary of impingement at BSEP, January - December 1982.

Number of organisms	19,810,886
Weight (Kg)	76,494
Number of shellfish	1,223,006
Weight of shellfish	7,571
Number of finfish	18,584,058
Weight of finfish	68,839
Number of miscellaneous species	3,822
Weight of miscellaneous species	85
Total number of taxa	137
Total taxa of finfish	122
Species with 100 or fewer specimens	35
Species with 1000 or fewer specimens	81
Species representing more than 2% of total catch	4

Table 6.2 The ten most abundant species and percent of the total impingement catch, January - December, 1982.

Species Common Name	Percent
Atlantic menhaden	55.1
Gizzard shad	26.3
Bay anchovy	5.3
Blue crabs	2.6
Atlantic croaker	1.8
Spot	1.5
Brown shrimp	1.3
White shrimp	0.8
Grass shrimp	0.8
Spotted hake	0.7
Percent of total	96.2

TABLE 6.3 TOTAL NUMBER AND WEIGHT OF SPECIES IMPINGED AT BSEP, JANUARY - DECEMBER, 1982

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	NUMBER	WT(KG)
CARCHARHINIDAE	REQUIEM SHARKS		
RHIZOPR;ONODON TERRAENOVAE	ATLANTIC SHARPNOSE SHARK	62	8.9
DASYATIDAE	STINGRAYS		
DASYATIS SABINA	ATLANTIC STINGRAY	169	35.7
DASYATIS SAYI	BLUNTNOSE STINGRAY	39	4.2
ELOPIDAE	TARPONS		
ELOPS SAURUS	LADYFISH	154	8.3
ELOPS SAURUS(LEPTOCEPHALUS)	LADYFISH(LEPTOCEPHALUS)	15	0.0
ANGUILLIDAE	FRESHWATER EELS		
ANGUILLA ROSTRATA	AMERICAN EEL	181	26.5
OPHICHTHIDAE	SNAKE EELS	30	0.0
MYROPHIS PUNCTATUS	SPECKLED WORM EEL	1367	48.5
MYROPHIS PUNCTATUS(LEPTOCEPHALUS)	SPECKLED WORM EEL(LEPTO.)	15	0.0
OPHICHTHUS GOMESI	SHRIMP EEL	3764	160.1
CLUPEIDAE	HERRINGS		
ALOSA AESTIVALIS	BLUEBACK HERRING	41112	173.7
ALOSA PSEUDOHARENGUS	ALEWIFE	8	2.0
ALOSA SAPIDISSIMA	AMERICAN SHAD	743	7.3
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN	10926419	55976.8
DOROSOMA CEPEDIANUM	GIZZARD SHAD	5212020	?166.0
DOROSOMA PETENENSE	THREADFIN SHAD	980	3.1
HARENGULA JAGUANA	SCALED SARDINE	24	0.1
OPISTHONEMA OGLINUM	ATLANTIC THREAD HERRING	138	1.1
ENGRAULIDAE	ANCHOVIES		
ANCHOA SP.	ANCHOVY UNID.(ANCHOA)	572	6.0
ANCHOA HEPSETUS	STRIPED ANCHOVY	2744	10.7
ANCHOA MITCHILLI	BAY ANCHOVY	1044030	1245.2
ESOCIDAE	PIKES		
ESOX AMERICANUS AMERICANUS	REDFIN PICKEREL	8	1.0
SYNODONTIDAE	LIZARDFISHES		
SYNODUS FOETENS	INSHORE LIZARDFISH	738	3.5
CYPRINIDAE	CARPS AND MINNOWS		
NOTEMIGONUS CRYSOLEUCAS	GOLDEN SHINER	191	0.8
CATOSTOMIDAE	SUCKERS		
ERIMYZON OBLONGUS	CREEK CHUBSUCKER	286	25.6
ERIMYZON SUCETTA	LAKE CHUBSUCKER	8	1.5
ARIIDAE	SEA CATFISHES		
ARIUS FELIS	HARDHEAD CATFISH	31	3.5
APHREDODERIDAE	PIRATE PERCHES		
APHREDODERUS SAYANUS	PIRATE PERCH	141	0.4
BATRACHOIDIDAE	TOADFISHES		
OPSANUS TAU	OYSTER TOADFISH	9664	159.7
GOBIESOCIDAE	CLINGFISHES		
GOBIESOX STRUMOSUS	SKILLETFISH	4616	9.1
GADIDAE	CODFISHES	54	0.0
UROPHYCIS SP.	HAKE UNID.(UROPHYCIS)	113	0.1
UROPHYCIS FLORIDANA	SOUTHERN HAKE	620	1.8
UROPHYCIS REGIA	SPOTTED HAKE	139287	940.0
OPHIDIIDAE	CUSK-EELS		
OPHIDION WELSHI	CRESTED CUSK-EEL	3445	46.8

TABLE 6.3 (CONTINUED)

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	NUMBER	WT(KG)
EXOCOETIDAE	FLYINGFISHES		
HYPORHAMPHUS UNIFASCIATUS	HALFBEAK	34	0.3
BELONIDAE	NEEDLEFISHES		
STRONGYLURA MARINA	ATLANTIC NEEDLEFISH	549	0.9
CYPRINODONTIDAE	KILLIFISHES		
FUNDULUS HETEROCLITUS	MUMMICHOG	1837	4.9
FUNDULUS MAJALIS	STRIPED KILLIFISH	306	0.6
POECILIIDAE	LIVEBEARERS		
GAMBUSIA AFFINIS	MOSQUITOFISH	188	0.3
ATHERINIDAE	SILVERSIDES	39	0.0
MEMBRAS MARTINICA	ROUGH SILVERSIDE	7939	22.2
MENIDIA MENIDIA	ATLANTIC SILVERSIDE	54700	213.9
SYNGNATHIDAE	PIPEFISHES		
HIPPOCAMPUS ERECTUS	LINED SEAHORSE	160	0.1
SYNGNATHUS FUSCUS	NORTHERN PIPEFISH	1650	4.2
SYNGNATHUS LOUISIANAE	CHAIN PIPEFISH	981	4.7
SERRANIDAE	SEA BASSES		
CENTROPRISTIS PHILADELPHICA	ROCK SEA BASS	176	3.2
CENTROPRISTIS STRIATA	BLACK SEA BASS	94	3.9
CENTRARCHIDAE	SUNFISHES		
CENTRARCHUS MACROPTERUS	FLIER	78	0.3
LEPOMIS GULOSUS	WARMOUTH	194	2.7
LEPOMIS MACROCHIRUS	BLUEGILL	90	1.4
MICROPTERUS SALMOIDES	LARGEMOUTH BASS	90	0.2
POMATOMIDAE	BLUEFISHES		
POMATOMUS SALTATRIX	BLUEFISH	5302	38.2
RACHYCENTRIDAE	COBIAS		
RACHYCENTRON CANADUM	COBIA	216	1.2
CARANGIDAE	JACKS		
CARANX HIPPOS	CREVALLE JACK	15709	26.3
CHLOROSCOMBRUS CHRYSURUS	ATLANTIC BUMPER	1072	5.1
SELENE SETAPINNIS	ATLANTIC MOONFISH	56	0.0
SELENE VOMER	LOOKDOWN	11726	37.0
TRACHINOTUS FALCATUS	PERMIT	76	0.2
LUTJANIDAE	SNAPPERS		
LUTJANUS GRISEUS	GRAY SNAPPER	1045	10.0
GERREIDAE	MOJARRAS	119	0.1
DIAPTERUS AURATUS	IRISH POMPANO	217	2.4
EUCINOSTOMUS ARGENTEUS	SPOTFIN MOJARRA	629	3.2
EUCINOSTOMUS GULA	SILVER JENNY	8	0.1
HAEMULIDAE	GRUNTS		
ORTHOPRISTIS CHRYSOPTERA	PIGFISH	1115	1.9
SPARIDAE	PORGIES		
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD	1187	30.8
LAGODON RHOMBOIDES	PINFISH	27786	234.2
SCIAENIDAE	DRUMS		
BAIRDIELLA CHRYSOURA	SILVER PERCH	8078	102.5
CYNOSCION NEBULOSUS	SPOTTED SEATROUT	2522	176.5
CYNOSCION REGALIS	WEAKFISH	122674	178.1
LEIOSTOMUS XANTHURUS	SPOT	301179	1916.5

TABLE 6.3 (CONTINUED)

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	NUMBER	WT(KG)
MENTICIRRHUS SP.	KINGFISH UNID. (MENTICIRRHUS)	39	0.0
MENTICIRRHUS AMERICANUS	SOUTHERN KINGFISH	293	0.5
MENTICIRRHUS SAXATILIS	NORTHERN KINGFISH	36	0.1
MICROPOGONIAS UNDULATUS	ATLANTIC CROAKER	355036	921.9
POGONIAS CROMIS	BLACK DRUM	141	17.2
SCIAENOPS OCELLATUS	RED DRUM	2466	29.0
STELLIFER LANCEOLATUS	STAR DRUM	9229	34.0
EPHIPPIDAE	SPADEFISHES		
CHAETODIPTERUS FABER	ATLANTIC SPADEFISH	1161	2.2
MUGILIDAE	MULLETS		
MUGIL SP.	MULLET UNID. (MUGIL)	39	0.0
MUGIL CEPHALUS	STRIPED MULLET	23645	416.9
MUGIL CUREMA	WHITE MULLET	4160	29.8
URANOSCOPIDAE	STARGAZERS	46	0.0
ASTROSCOPUS SP.	STARGAZER UNID. (ASTROSCOPUS)	8	0.0
ASTROSCOPUS GUTTATUS	NORTHERN STARGAZER	55	0.5
ASTROSCOPUS Y-GRAECUM	SOUTHERN STARGAZER	116	1.1
BLENNIIDAE	COMBTOOTH BLENNIES		
CHASMODES BOSQUIANUS	STRIPED BLENNY	564	1.8
HYPLEUROCHILUS GEMINATUS	CRESTED BLENNY	15	0.0
HYPSOBLENNIUS HENTZI	FEATHER BLENNY	2654	11.5
HYPSOBLENNIUS IONTHAS	FRECKLED BLENNY	745	2.8
ELEOTRIDAE	SLEEPERS		
DORMITATOR MACULATUS	FAT SLEEPER	42	0.6
GOBIIDAE	GOBIES		
GOBIONELLUS BOLEOSOMA	DARTER GOBY	163	0.2
GOBIONELLUS HASTATUS	SHARPTAIL GOBY	654	2.4
GOBIOSOMA BOSCI	NAKED GOBY	184	0.1
TRICHIURIDAE	CUTLASSFISHES		
TRICHIURUS LEPTURUS	ATLANTIC CUTLASSFISH	10047	192.1
SCOMBRIDAE	MACKERELS	79	0.0
SCOMBEROMORUS MACULATUS	SPANISH MACKEREL	232	3.4
STROMATEIDAE	BUTTERFISHES		
PEPRILUS ALEPIDOTUS	HARVESTFISH	388	4.6
PEPRILUS BURTI	GULF BUTTERFISH	373	1.8
PEPRILUS TRIACANTHUS	BUTTERFISH	7442	8.4
TRIGLIDAE	SEAROBINS		
PRIONOTUS SP.	SEAROBIN UNID. (PRIONOTUS)	176	0.0
PRIONOTUS CAROLINUS	NORTHERN SEAROBIN	758	1.7
PRIONOTUS SCITULUS	LEOPARD SEAROBIN	324	1.1
PRIONOTUS TRIBULUS	BIGHEAD SEAROBIN	88204	150.6
DACTYLOPTERIDAE	FLYING GURNARDS		
DACTYLOPTERUS VOLITANS	FLYING GURNARD	15	0.0
BOTHIDAE	LEFTEYE FLOUNDERS		
ANCYLOPSETTA QUADROCELLATA	OCELLATED FLOUNDER	1797	17.0
CITHARICHTHYS SP.	WHIFF UNID. (CITHARICHTHYS)	202	0.2
CITHARICHTHYS SPILOPTERUS	BAY WHIFF	7877	61.7
ETROPUS CROSSOTUS	FRINGED FLOUNDER	19106	55.4
PARALICHTHYS SP.	FLOUNDER UNID. (PARALICHTHYS)	15	0.0
PARALICHTHYS ALBIGUTTA	GULF FLOUNDER	163	0.2

TABLE 6.3 (CONTINUED)

SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	NUMBER	WT(KG)
PARALICHTHYS DENTATUS	SUMMER FLOUNDER	8456	66.0
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER	5206	352.3
SCOPHTHALMUS AQUOSUS	WINDOWPANE	10171	42.0
SOLEIDAE	SOLES		
TRINECTES MACULATUS	HOGCHOKER	3750	31.7
CYNOGLOSSIDAE	TONGUEFISHES		
SYMPHURUS PLAGIUSA	BLACKCHEEK TONGUEFISH	50846	216.1
BALISTIDAE	LEATHERJACKETS		
ALUTERUS SCHOEPFI	ORANGE FILEFISH	70	0.0
MONACANTHUS HISPIDUS	PLANEHEAD FILEFISH	2175	2.4
TETRAODONTIDAE	PUFFERS		
SPHOEROIDES MACULATUS	NORTHERN PUFFER	169	0.3
DIODONTIDAE	PORCUPINEFISHES		
CHILOMYCTERUS SCHOEPFI	STRIPED BURRFISH	454	9.9
SQUILLA EMPUSA	MANTIS SHRIMP	9246	98.0
PENAEUS AZTECUS	BROWN SHRIMP	248202	964.1
PENAEUS DUORARUM	PINK SHRIMP	54216	124.4
PENAEUS SETIFERUS	WHITE SHRIMP	160570	642.9
TRACHYPENEUS CONSTRICTUS	T-COK OR HARDBACK SHRIMP	42151	25.2
MACROBRACHIUM SP.	FRESHWATER PRAWNS	30	0.0
PALAEMONETES SP.	GRASS SHRIMP	148583	61.4
ALPHEUS SP.	SNAPPING SHRIMP	33996	38.8
CRANGON SEPTEMSPINOSA	SAND SHRIMP	487	0.2
UPOGEBIA SP. AND CALLIANASSA SP.	MUD SHRIMPS	583	0.9
OVALIPES SP.	CALICO CRABS	260	0.4
PORTUNUS SP.	SWIMMING CRABS	1582	4.1
CALLINECTES SP.	BLUE CRABS	523587	5618.6
APLYSIA SP.	SEA HARES	6	1.9
LOLLIGUNCULA BREVIS	BRIEF SQUID	3662	34.7
LIMULUS POLYPHEMUS	HORSESHOE CRAB	8	35.0
MALACLEMYS TERRAPIN	DIAMONDBACK TERRAPIN	154	48.3

TABLE 6.4 EXPANDED MONTHLY IMPINGEMENT DATA, JANUARY - DECEMBER, 1982

SPECIES	JANUARY 1982 NUMBER	JANUARY 1982 WT. (KG)	FEBRUARY 1982 NUMBER	FEBRUARY 1982 WT. (KG)
BAY ANCHOVY	332067	346.4	215281	270.9
BLUE CRAB	7949	7.4	118583	379.3
CROAKER	211868	262.5	26830	32.3
FLOUNDER	243	31.3	1351	73.0
MENHADEN	8207785	41593.8	1051913	5218.9
MISC. SPECIES				
MULLET	18451	343.8	2327	12.4
OTHER FINFISH	136445	574.4	48830	275.5
OTHER SHELLFISH	34443	15.7	73906	43.1
SHRIMP	15773	47.7	615	2.5
SPOT	41578	608.4	[illegible]	104.7
TROUT	1872	159.5	[illegible]	0.9
TOTAL	9008474	43990.9	1587199	6413.5

SPECIES	MARCH 1982 NUMBER	MARCH 1982 WT. (KG)	APRIL 1982 NUMBER	APRIL 1982 WT. (KG)
BAY ANCHOVY	106090	117.3	123938	145.4
BLUE CRAB	161014	558.2	51338	298.4
CROAKER	14857	67.5	5048	31.9
FLOUNDER	1535	36.6	1305	3.0
MENHADEN	1237776	4998.5	48855	309.8
MISC. SPECIES	16	7.3	1485	33.1
MULLET	1015	17.2	668	16.9
OTHER FINFISH	157517	985.5	34170	200.1
OTHER SHELLFISH	43526	26.8	10405	8.8
SHRIMP	326	0.8	188	0.5
SPOT	114917	674.0	11603	39.7
TROUT	93	14.6	38	0.5
TOTAL	1838682	7504.3	289041	1088.1

TABLE 6.4 (CONTINUED)

SPECIES	MAY NUMBER	1982 WT. (KG)	JUNE NUMBER	1982 WT. (KG)
BAY ANCHOVY	152202	256.4	15237	18.6
BLUE CRAB	51065	587.9	42802	1249.3
CROAKER	35565	225.8	46423	167.4
FLOUNDER	3868	9.9	3278	69.3
MENHADEN	162789	874.0	189002	1936.4
MISC. SPECIES	179	9.2		
MULLET	426	20.1	1934	3.9
OTHER FINFISH	44173	379.1	5233234	4277.2
OTHER SHELLFISH	7844	4.9	8043	4.3
SHRIMP	4[illegible]	1.1	190225	586.6
SPOT	27916	161.5	49394	257.7
TROUT	620	31.6	99697	97.6
TOTAL	487128	2561.5	5879269	8668.3

SPECIES	JULY NUMBER	1982 WT. (KG)	AUGUST NUMBER	1982 WT. (KG)
BAY ANCHOVY	3254	3.4	1178	0.8
BLUE CRAB	25196	873.2	9409	255.0
CROAKER	5520	19.5	1651	19.0
FLOUNDER	555	31.0	527	31.9
MENHADEN	6484	246.0	4015	182.3
MISC. SPECIES	355	2.8	31	1.3
MULLET	355	1.1	132	0.9
OTHER FINFISH	25282	159.2	11107	68.6
OTHER SHELLFISH	4828	1.8	4425	2.0
SHRIMP	74692	337.9	48174	169.7
SPOT	4734	27.6	1837	12.2
TROUT	13060	13.6	3976	7.4
TOTAL	164315	1717.1	86462	751.1

TABLE 6.4 (CONTINUED)

SPECIES	SEPTEMBER 1982 NUMBER	SEPTEMBER 1982 WT. (KG)	OCTOBER 1982 NUMBER	OCTOBER 1982 WT. (KG)
BAY ANCHOVY	7738	3.8	11145	9.1
BLUE CRAB	12100	768.2	13733	387.4
CROAKER	2647	73.8	341	8.6
FLOUNDER	353	27.4	589	55.2
MENHADEN	3956	206.5	2829	109.3
MISC. SPECIES	526	11.0	1155	18.2
MULLET	155	2.7	1450	17.9
OTHER FINFISH	11714	121.7	15370	148.5
OTHER SHELLFISH	2827	3.0	16619	34.9
SHRIMP	74796	272.4	24266	102.5
SPOT	598	9.1	225	2.3
TROUT	4918	21.9	488	2.8
TOTAL	122328	1521.5	88210	896.7

SPECIES	NOVEMBER 1982 NUMBER	NOVEMBER 1982 WT. (KG)	DECEMBER 1982 NUMBER	DECEMBER 1982 WT. (KG)
BAY ANCHOVY	57052	53.4	18848	19.7
BLUE CRAB	13099	179.3	17299	75.0
CROAKER	1012	8.5	3274	5.1
FLOUNDER	30	15.5	206	34.4
MENHADEN	8489	228.9	2526	74.4
MISC. SPECIES	6	1.9	69	0.1
MULLET	488	2.8	443	7.0
OTHER FINFISH	28549	183.9	44123	182.9
OTHER SHELLFISH	12617	39.7	16948	35.8
SHRIMP	20449	123.5	13003	86.2
SPOT	169	4.4	687	14.9
TROUT	48	0.0	344	4.2
TOTAL	142008	841.8	117770	539.7

TABLE 6.4 (CONTINUED)

SPECIES	TOTAL 1982 NUMBER	WT. (KG)
BAY ANCHOVY	1044030	1245.2
BLUE CRAB	523587	5618.6
CROAKER	355036	921.9
FLOUNDER	13840	418.5
MENHADEN	10926419	55978.8
MISC. SPECIES	3822	84.9
MULLET	27844	446.7
OTHER FINFISH	5790514	7556.6
OTHER SHELLFISH	236431	220.8
SHRIMP	462988	1731.4
SPOT	301179	1916.5
TROUT	125196	354.6
TOTAL	19810886	76494.5

TABLE 6.5 NUMBER IMPINGED PER MILLION CUBIC METERS OF WATER ENTRAINED DURING EACH MONTH, JANUARY - DECEMBER 1982

MON	B ANCHOVY	MENHADEN	CROAKER	SPOT	FLOUNDER	MULLET	TROUT	BLUE CRAB	SHRIMP
JAN	2139.0	52870.1	1364.7	267.8	1.6	118.9	12.1	51.2	101.6
FEB	1637.1	7999.4	204.0	361.4	10.3	17.7	0.3	901.8	4.7
MAR	632.9	7583.8	88.6	685.5	9.2	6.1	0.6	960.5	1.9
APR	789.0	311.0	32.1	73.9	8.3	4.3	0.2	326.8	1.2
MAY	1530.3	1636.7	357.6	280.7	38.9	4.3	6.2	513.4	4.8
JUN	187.8	2330.1	572.3	609.0	40.4	23.8	1229.1	527.7	2345.2
JUL	35.2	70.1	59.7	51.2	6.0	3.8	141.1	272.3	807.1
AUG	12.2	41.7	17.1	19.1	5.5	1.4	41.3	97.7	500.1
SEP	77.7	39.7	26.6	6.0	3.5	1.6	49.4	121.4	750.6
OCT	79.0	20.1	2.4	1.6	4.2	10.3	3.5	97.3	172.0
NOV	428.0	63.7	7.6	1.3	0.2	3.7	0.4	98.3	153.4
DEC	179.9	24.1	31.2	6.6	2.0	4.2	3.3	165.1	124.1

TABLE 6.6 WEIGHT IMPINGED PER MILLION CUBIC METERS OF WATER ENTRAINED DURING EACH MONTH, JANUARY - DECEMBER 1982

MON	B ANCHOVY	MENHADEN	CROAKER	SPOT	FLOUNDER	MULLET	TROUT	BLUE CRAB	SHRIMP
JAN	2.2	267.9	1.7	3.9	0.2	2.2	1.0	0.0	0.3
FEB	2.1	39.7	0.2	0.8	0.6	0.1	0.0	2.9	0.0
MAR	0.7	29.8	0.4	4.0	0.2	0.1	0.1	3.3	0.0
APR	0.9	2.0	0.2	0.3	0.0	0.1	0.0	1.9	0.0
MAY	2.6	8.8	2.3	1.6	0.1	0.2	0.3	5.9	0.0
JUN	0.2	23.9	2.1	3.2	0.9	0.0	1.2	15.4	7.2
JUL	0.0	2.7	0.2	0.3	0.3	0.0	0.1	9.4	3.7
AUG	0.0	1.9	0.2	0.1	0.3	0.0	0.1	2.6	1.8
SEP	0.0	2.1	0.7	0.1	0.3	0.0	0.2	7.7	2.7
OCT	0.1	0.8	0.1	0.0	0.4	0.1	0.0	2.7	0.7
NOV	0.4	1.7	0.1	0.0	0.1	0.0	0.0	1.3	0.9
DEC	0.2	0.7	0.0	0.1	0.3	0.1	0.0	0.7	0.8

TABLE 6.7 NUMBER, WEIGHT AND PERCENT TOTAL BY PERIOD OF TOTAL ORGANISMS IMPINGED PER MILLION CUBIC METERS OF WATER ENTRAINED, 1982

	DAY		NIGHT		DAY		NIGHT	
MO	NUMBER	%	NUMBER	%	WT(KG)	%	WT(KG)	%
JAN	15402	26.54	42626	73.46	78.8	27.83	204.5	72.17
FEB	2325	19.26	9745	80.74	9.2	18.96	39.5	81.04
MAR	4096	37.34	6872	62.66	17.8	39.66	27.0	60.34
APR	637	34.64	1203	65.36	2.7	38.83	4.2	61.17
MAY	582	11.88	4316	88.12	3.9	15.21	21.8	84.79
JUN	50378	69.50	22104	30.50	59.3	55.52	47.5	44.48
JUL	674	37.95	1102	62.05	7.9	42.77	10.6	57.23
AUG	266	29.68	631	70.32	3.0	38.30	4.8	61.70
SEP	677	55.17	550	44.83	7.3	47.74	8.0	52.26
OCT	144	23.03	481	76.97	2.5	38.71	3.9	61.29
NOV	172	16.18	893	83.82	1.1	17.43	5.2	82.57
DEC	169	15.05	955	84.95	0.9	17.21	4.3	82.79

Table 6.8 Duncan's multiple range comparison for organisms impinged January 1975 through December 1982 by numbers and weight (kg)

Species	Number	Weight
Menhaden	78 77 82 79 80 81 76 75	78 77 82 80 79 76 81 75
Anchovy	79 76 80 77 75 78 81 82	79 76 77 80 78 81 75 82
Trout	77 79 78 76 75 81 82 80	78 77 76 79 75 82 81 80
Spot	79 77 76 78 80 81 82 75	77 81 76 78 79 80 75 82
Croaker	75 79 76 82 80 77 78 81	76 77 75 79 80 82 78 81
Mullet	77 81 80 79 75 78 82 76	75 81 77 78 80 76 82 79
Flounder	79 78 77 82 76 75 81 80	77 79 78 76 81 75 82 80
Shrimp	76 75 79 80 77 78 82 81	76 75 79 80 78 77 82 81
Blue crab	79 75 78 80 82 77 76 81	75 79 78 77 82 80 76 81

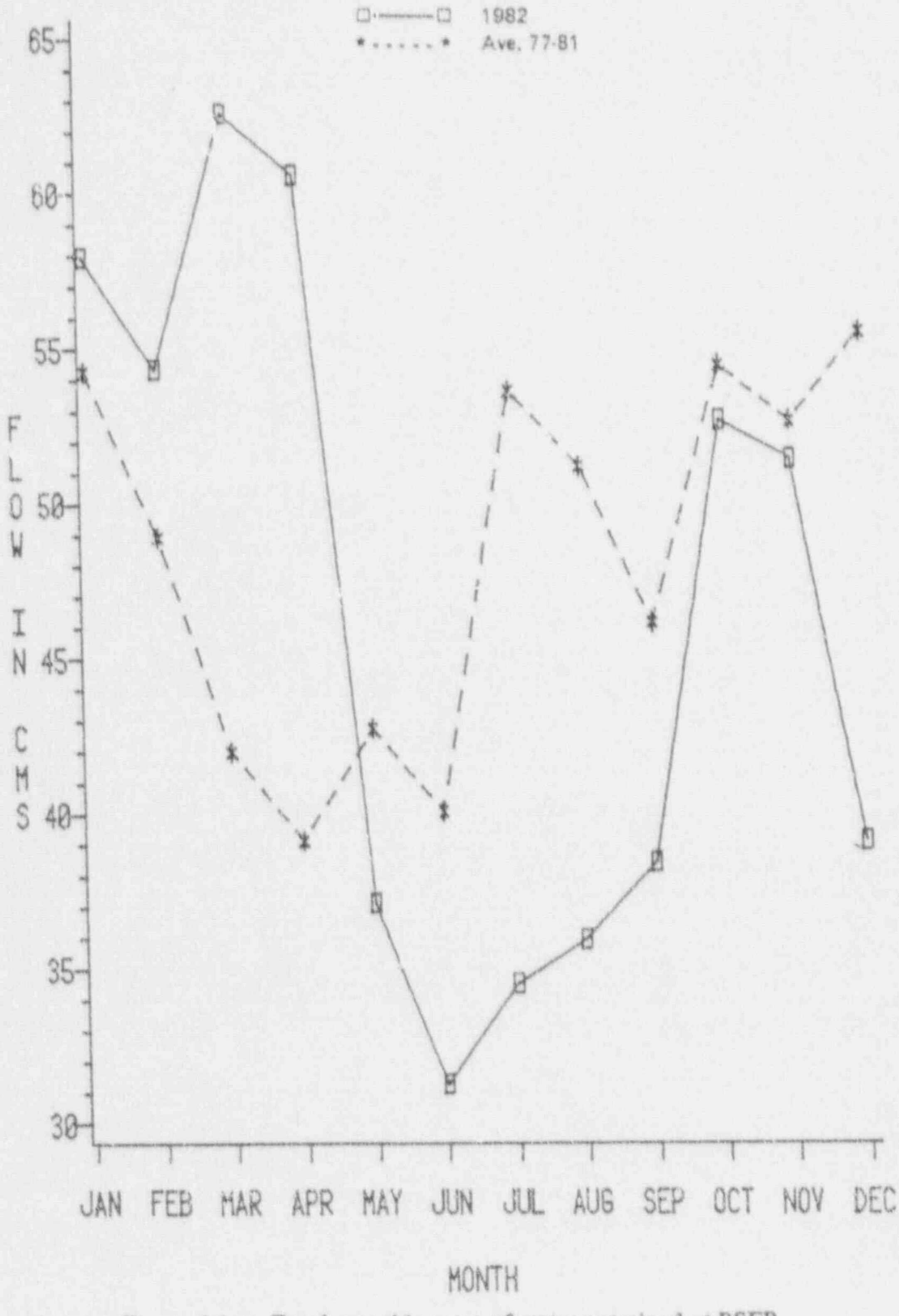


Figure 6.1 Total monthly rates of water entrained at BSEP.

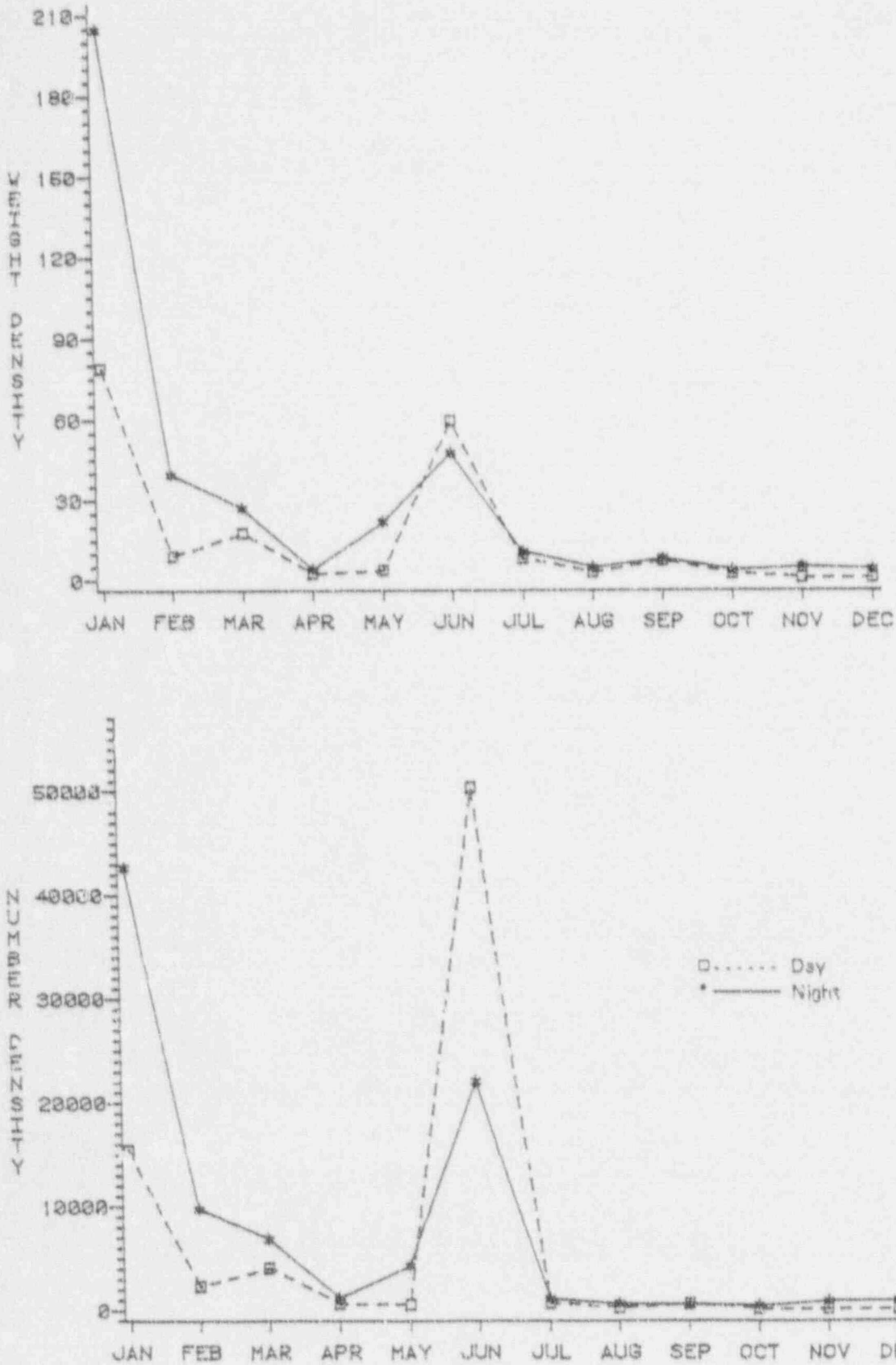


Figure 6.2 Monthly numbers and weights (kg) of organisms impinged day vs night, 1982.

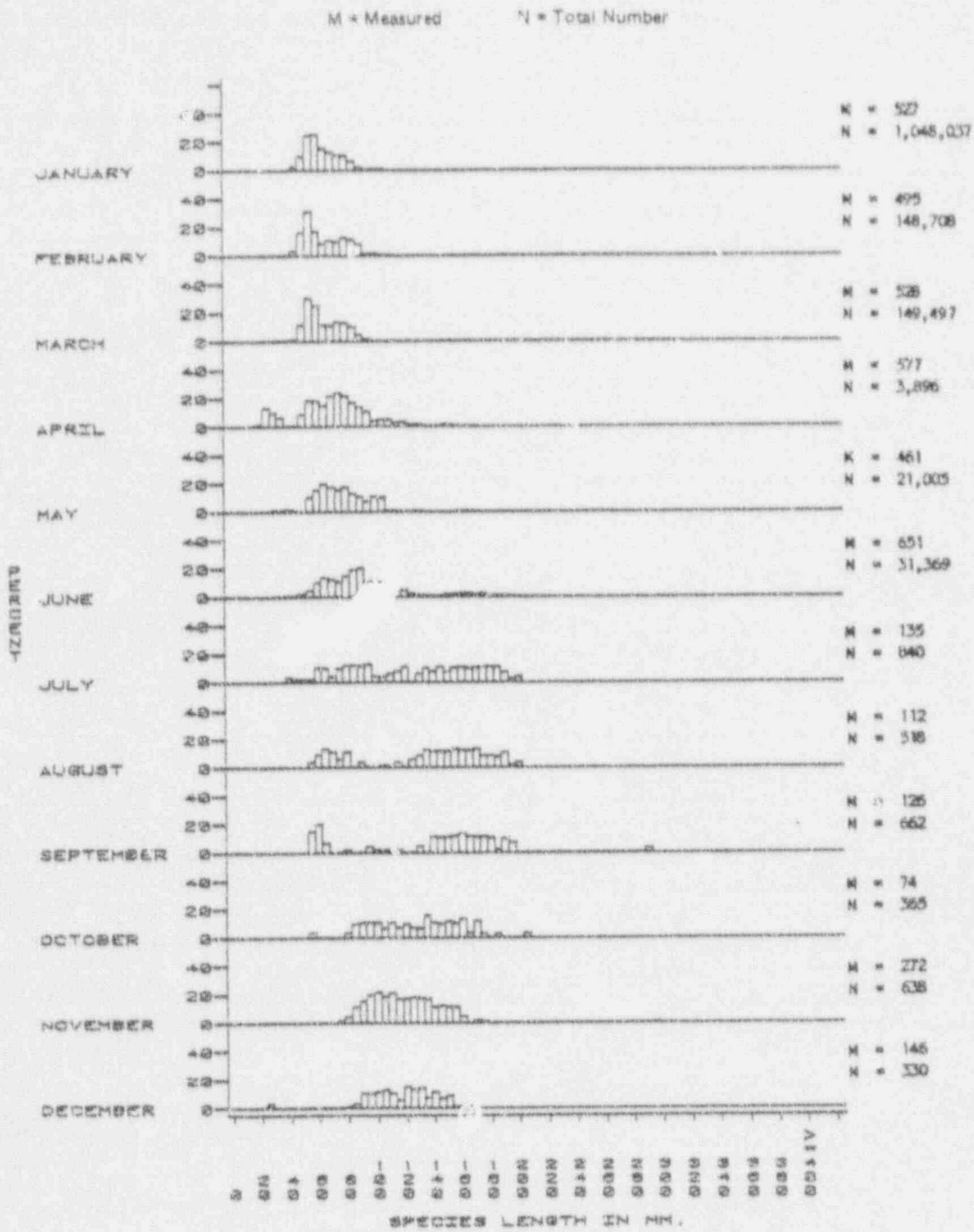


Figure 6.3 Length frequency of Atlantic menhaden impinged, 1982.

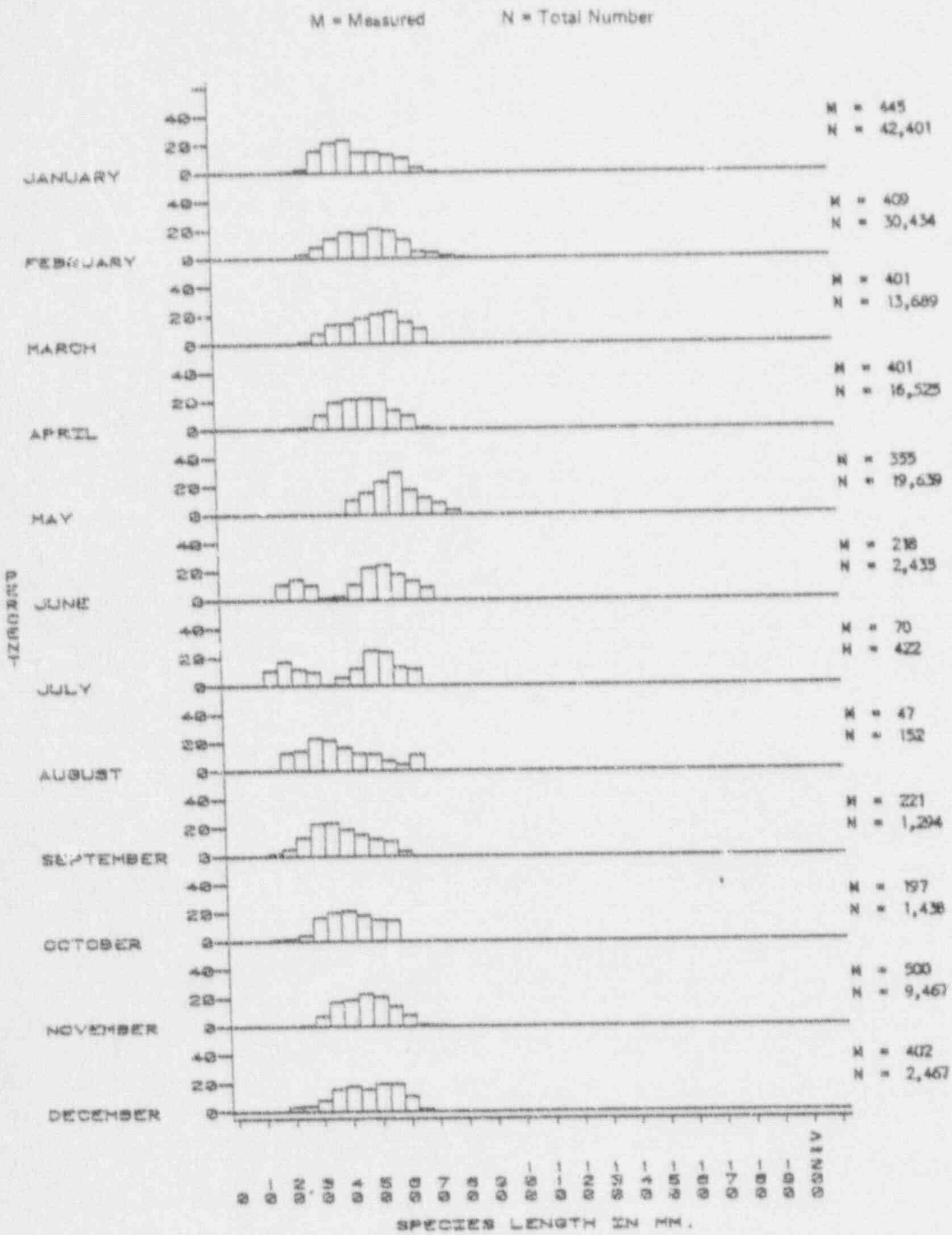


Figure 6.4 Length frequency of bay anchovy impinged, 1982.

M = Measured   N = Total Number

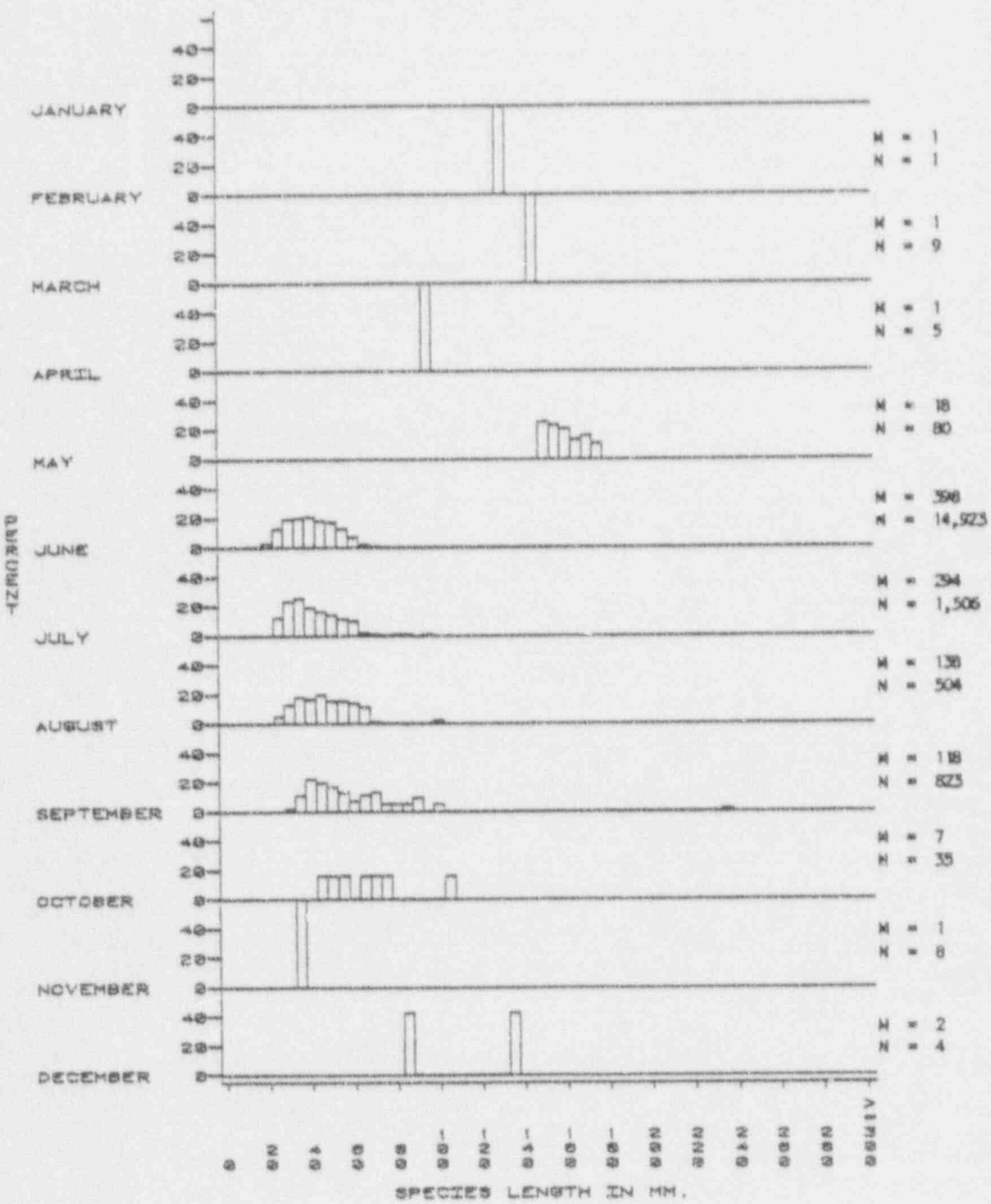


Figure 6.5 Length frequency of weakfish impinged, 1982.

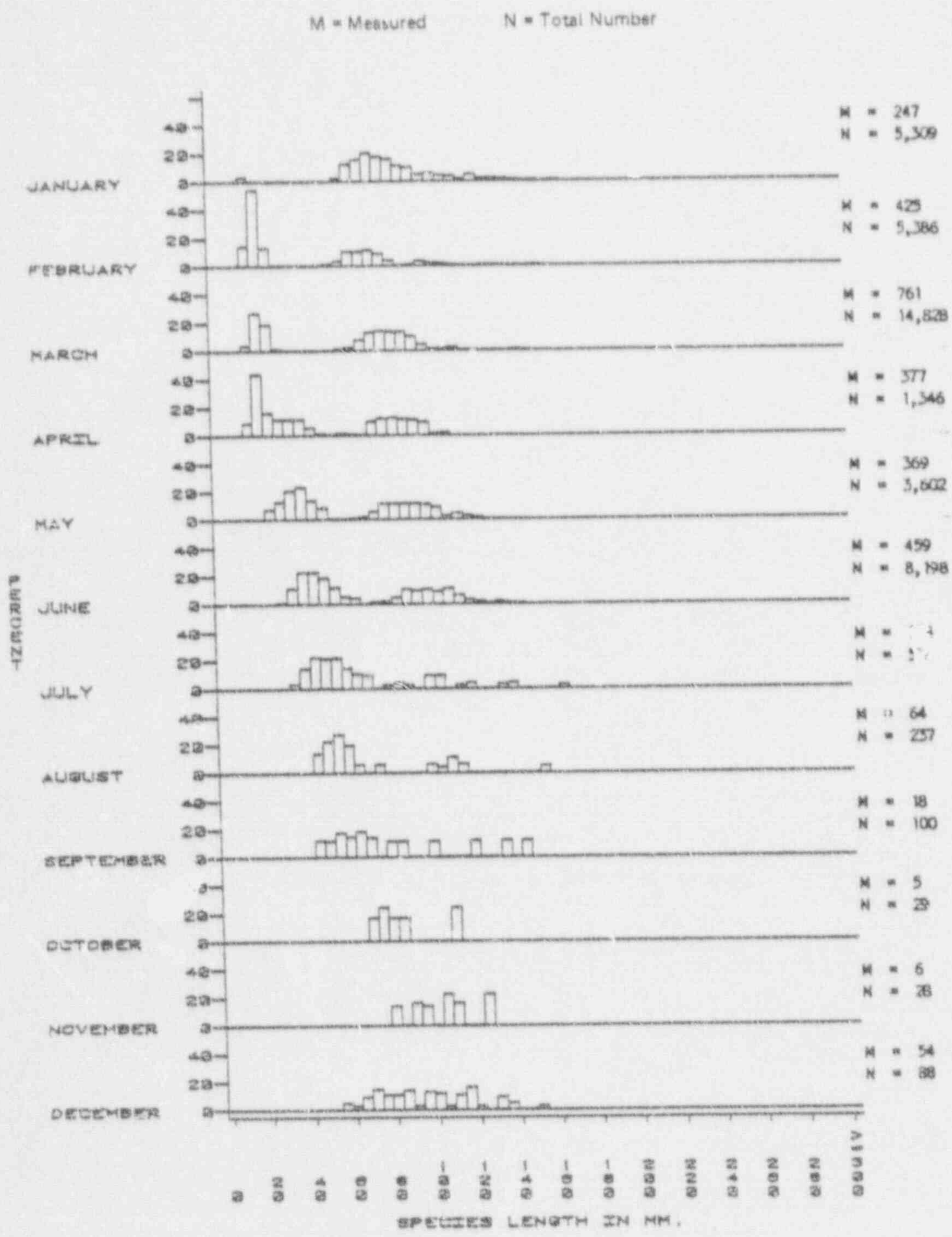


Figure 6.6 Length frequency of spot impinged, 1982.

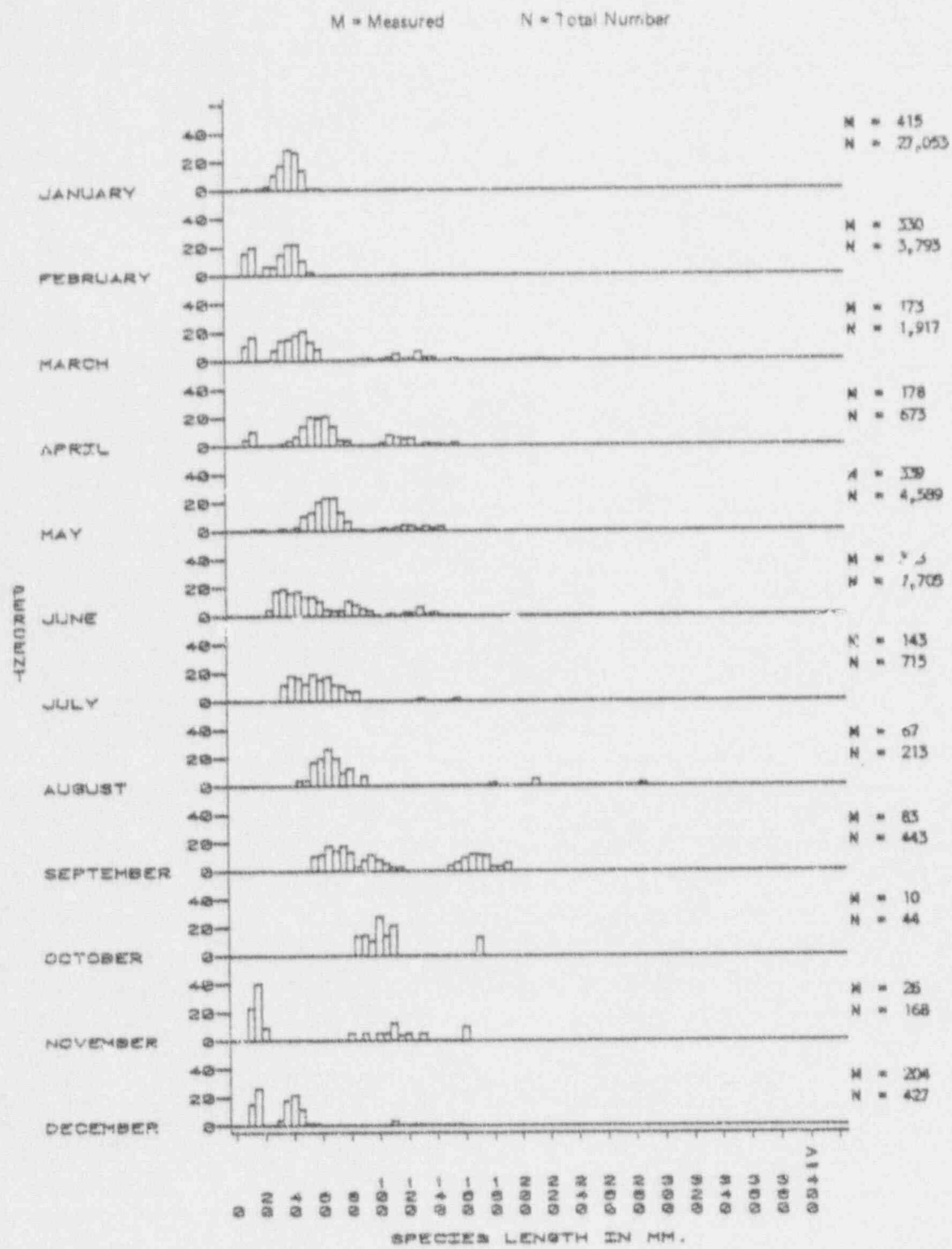


Figure 6.7 Length frequency of Atlantic croaker impinged, 1982.

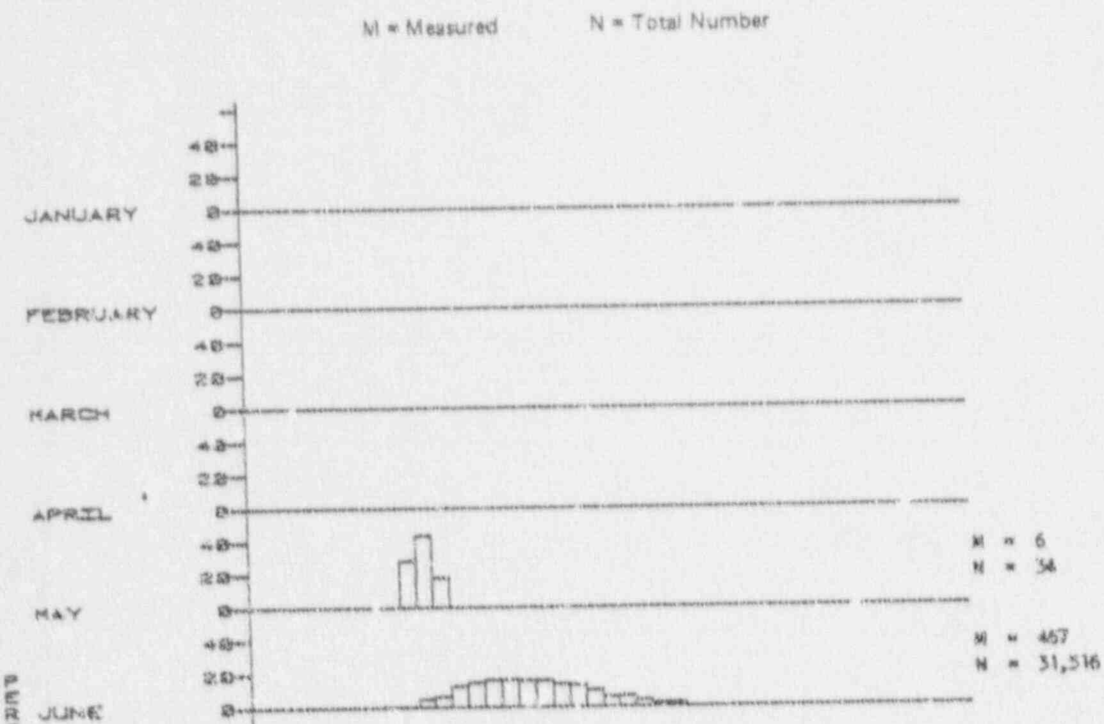


Figure 6.8 Length frequency of brown shrimp impinged, 1982.

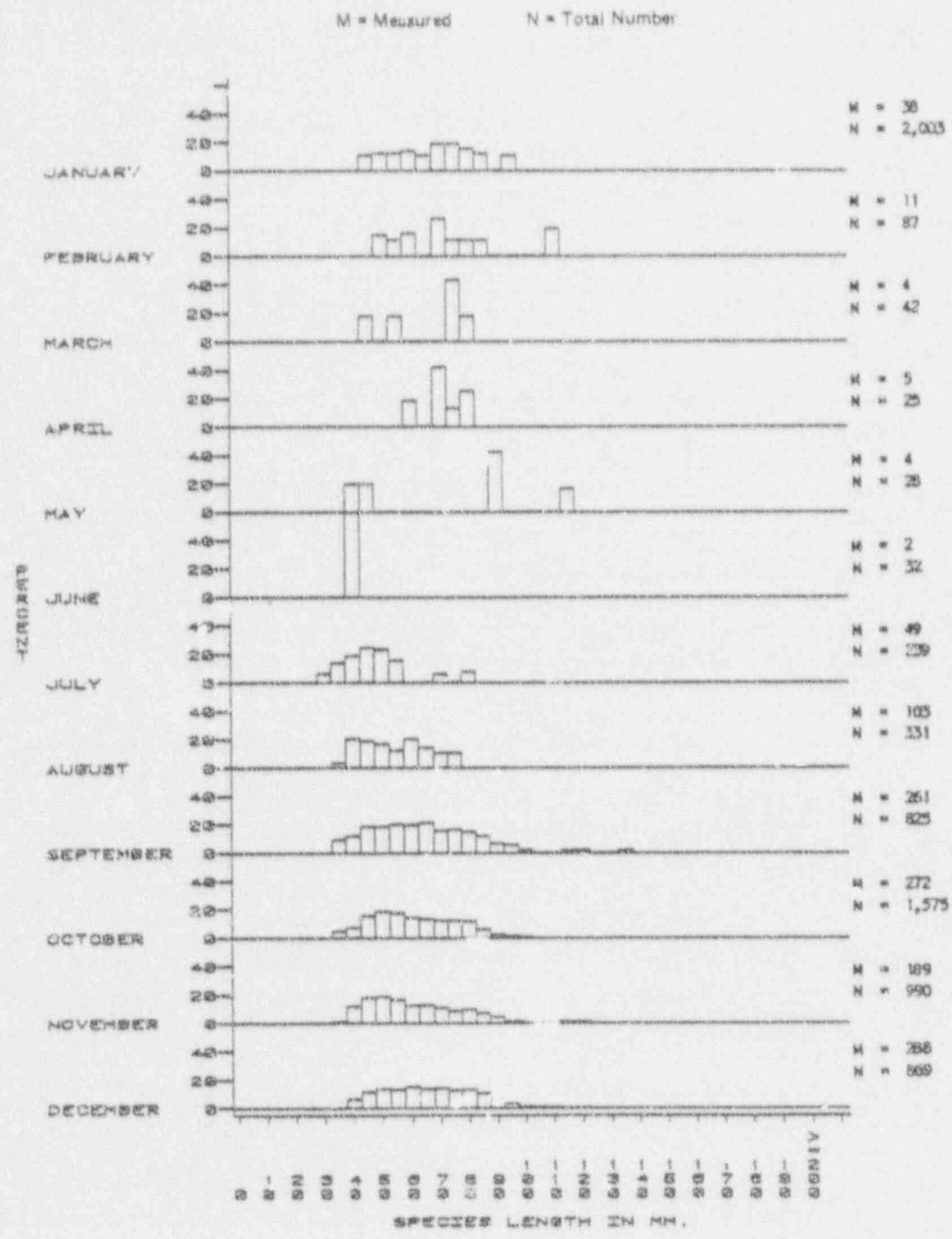


Figure 6.9 Length frequency of pink shrimp for 1982.

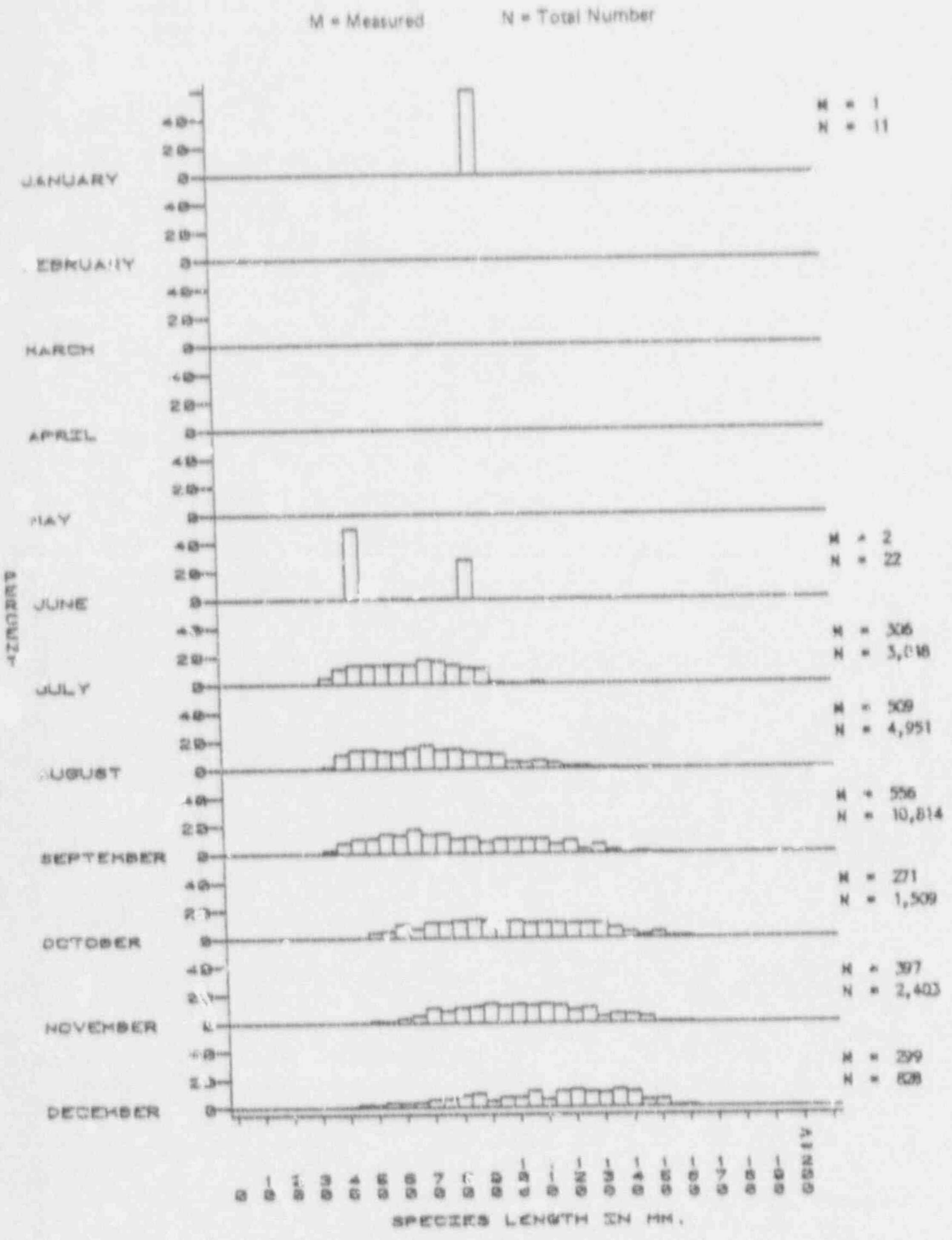


Figure 6.10 Length frequency of white shrimp inpinged, 1982.

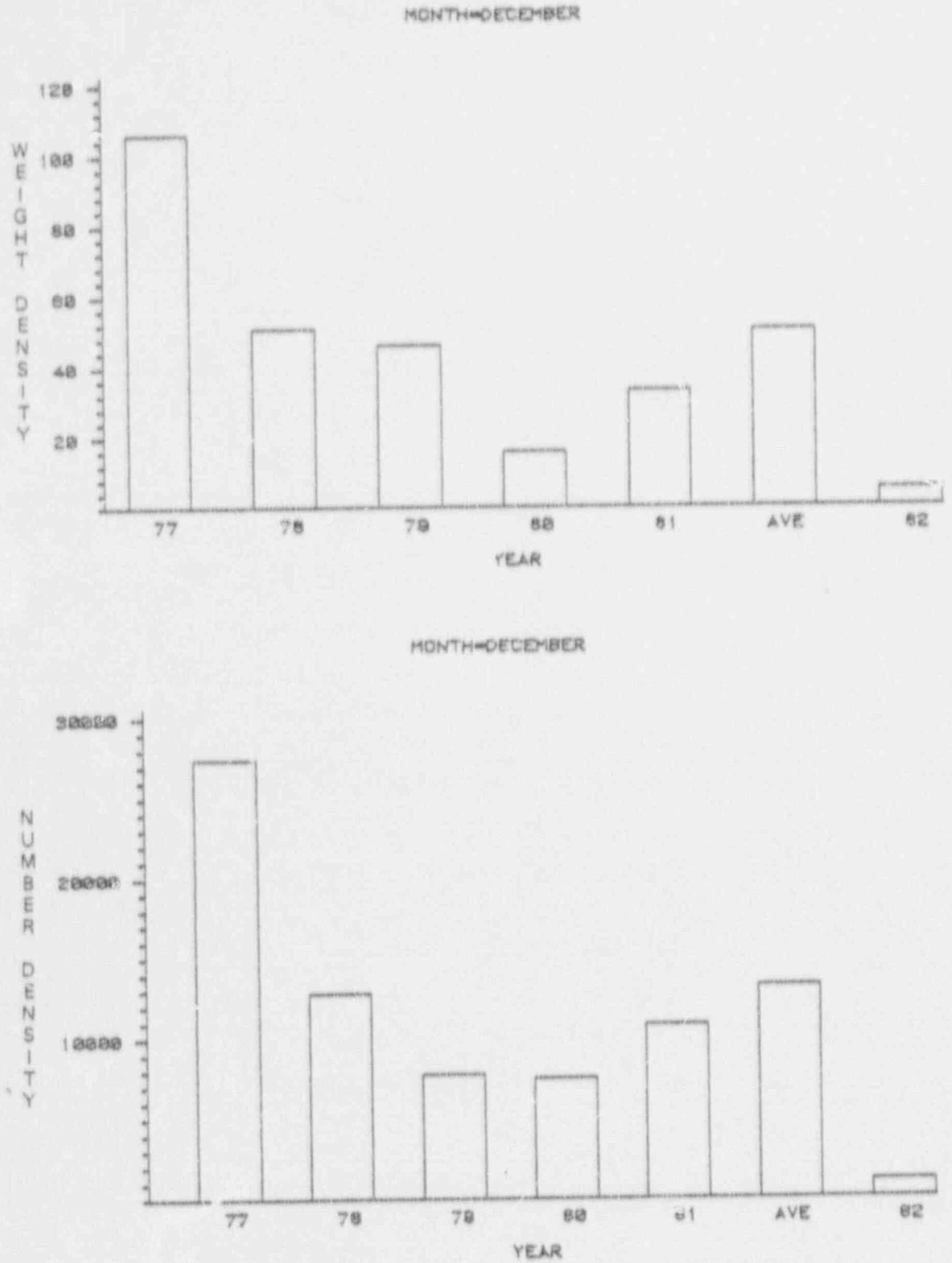


Figure 6.11 Number and weight of organisms impinged per million cubic meters of water entrained during the month of December, 1977-1982.