

EFFECTS OF INTRACOASTAL WATERWAY
DREDGING ON ICHTHYOFAUNA
AND BENTHIC MACROINVERTEBRATES

by

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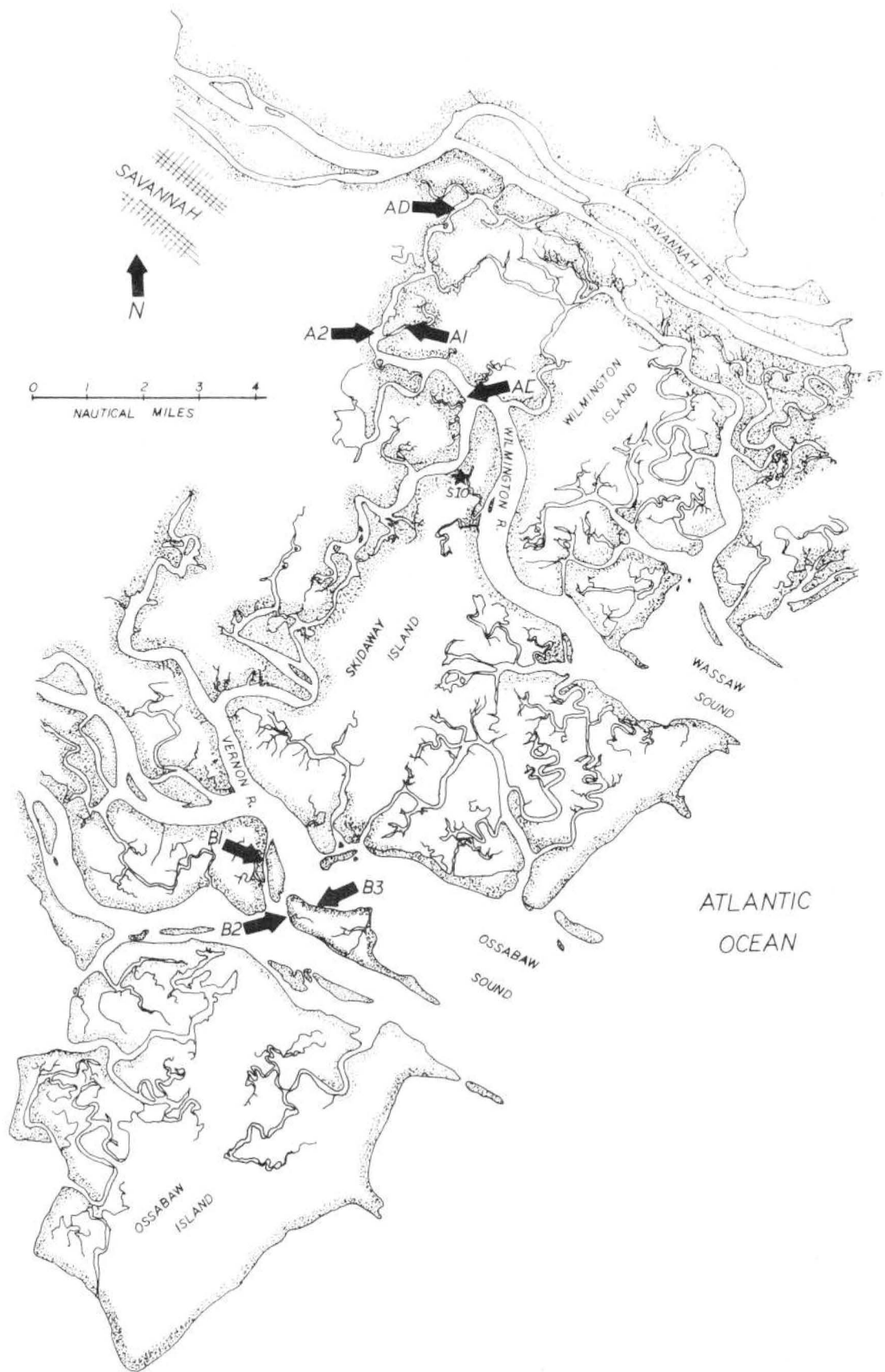
INTRODUCTION

The Intracoastal Waterway of the United States allows private and commercial boat traffic to traverse major portions of the Atlantic, Pacific and Gulf coasts while requiring only limited exposure to the open sea. The coastal region of Georgia, through which the Intracoastal Waterway passes, is composed of a system of islands, sounds, rivers and tributaries. The islands generally have sandy beaches on the seaward exposure with tidal salt marshes on protected sides. These salt marshes are dominated by the grasses Spartina alterniflora and Juncus sp.

The extensive Georgia estuarine system provides a nursery ground for the principal commercial marine organisms of the state; Penaeus setiferus (white shrimp), P. aztecus (brown shrimp) and Callinectes sapidus (blue crab). Detritus contributed each year when Spartina dies and decomposes provides the food base upon which these organisms and the myriad fish and other invertebrates present in the Georgia estuaries thrive (Odum and de la Cruz, 1963, 1967).

Georgia estuaries have characteristically high loads of suspended particulate silt and clay contributed from land runoff upstream. Much of this sediment load is deposited when fresh water enters brackish estuarine water. The sediments are also high in organic matter resulting largely

Figure 1. Map of the northern coastal region of Georgia showing stations sampled during this study. (SIO= location of Skidaway Institute of Oceanography).



from the decomposition of Spartina and other marsh plants as well as contributions from upstream terrestrial and aquatic vegetation.

Nearly 100 miles of Intracoastal Waterway meanders through the estuaries of Georgia. Continuous sedimentation results in shoaling of at least some portions of the waterway. The waterway is presently maintained through mechanical dredging to the depth of about four meters at mean low water. The United States Army Corps of Engineers has been charged with maintenance of the Intracoastal Waterway, and surveys are periodically made along the waterway by the Corps to determine when shoals occur. While some areas do not require dredging, others may become hazards to navigation in as little as two or three years following dredging.

Since the Intracoastal Waterway through Georgia was developed approximately 40 years ago, dredge spoils have been deposited largely on the surface of the marshes adjacent to dredging sites. It is often possible to identify original dredging spoil banks as hammocks of high ground surrounded by tidal marsh. The initial dredging spoil often contained high percentages of shell and sand which formed the high ground. Subsequent maintenance dredging has produced spoil material mainly of silt and clay size fractions. While the spoil may bury the Spartina initially on deposition, if the spoil is not piled so high as to place the surface of the mud above the tide range, Spartina will eventually recover. The depth of spoiling seems to be critical in determining

how long recovery will require (Herbert L. Windom, personal communication).

In some cases dikes are constructed around spoil banks to prevent spoil material from returning to the area from which it was dredged. These dikes prevent even spring high tides from flooding the high marsh, thus, the fact that an area is diked means the end of Spartina production whether or not spoil material is later added.

This study presents the results of part of continuing research which is examining the effects of dredging along the Intracoastal Waterway of Georgia on the biota, water chemistry, and geochemical equilibria. This report covers only the effects of dredging on fishes and benthic invertebrates.

MATERIALS AND METHODS

Seven sampling stations were occupied monthly from November or December 1970 through December 1971. Four stations were established near Savannah, Georgia on the Wilmington River (Figure 1). Station A1 is located within a small tidal creek adjacent to a marsh which received spoil during dredging activities in July, 1971. Station A2 lies in the Wilmington River in the Vicinity of where the creek on which station A1 is located enters the river. Across the river from station A2 is the town of Thunderbolt which has a series of seafood processing plants, shrimp docks and public marinas. Dredging was carried on within and around station

A2 during July, 1971. This station is undiked and considered to be polluted by domestic and processing wastes as well as spilled petroleum products associated with the marinas and shrimp boats. Station AD is located to the north of stations A1 and A2. Station AD represents a polluted area which has a diked spoil bank associated with it. This station was also dredged during July, 1971. Station AD receives polluted water from the Savannah River which contains municipal sewage, pulp mill wastes, acid and other industrial wastes. The water from the Savannah River can be followed through station AD and beyond at some times when acid wastes being flushed into the Savannah River result in reduced pH (Herbert L. Windom, R.R. Stickney, unpublished data). Station AC, located about two miles downstream from stations A1 and A2 was used as a control station. No dredging activities were carried out during 1971 at this station.

The remaining three stations were established in the vicinity of Ossabaw Sound in an area which is not presently polluted (Figure 1). Station B1, similar in many respects to station A1, was established in a tidal creek adjacent to the marsh on which spoil was deposited during the 1971 dredging activities. Station B2 was established in an area called Hell Gate which requires dredging at intervals of about two years. This station was dredged during July, 1971. Station B3 was used as a control station and was established over one mile from station B2 within Ossabaw Sound. While the general configuration and hydrology of station AC com-

pared closely with station A2 and to some degree with station AD, no area within the immediate vicinity of station B2 could be found in which similar conditions existed. Station B3 was arbitrarily set up as closely as possible to station B2 but beyond the influence of dredging.

Monthly samples included the determination of temperature, salinity and the collection of animals at each of seven sampling stations. Surface temperature was obtained through utilization of a mercury-in-glass thermometer. Surface salinity was determined by refractometry. Animals were collected on low tide in a 6.1 m wide at the mouth otter trawl constructed of 2.5 cm stretch nylon mesh. The trawl was towed behind a boat through each station for ten minutes each month beginning in November, 1970 at the Wilmington River sampling stations and beginning December, 1970 at the Ossabaw Sound sampling stations. Exceptions occurred during July, 1971 when trawls were made at each station immediately prior to, during and after dredging. No sample was obtained from station A2 during dredging however, as the position of the dredge and its pipeline precluded trawling. Samples were preserved in 10% formalin and returned to the laboratory for examination.

All animals were weighed to the nearest 0.1 g on a top loading electric balance. Standard lengths were obtained to the nearest mm on all fish. Shrimp (Penaeus sp.) were measured from the tip of the rostral spine to the base of the carapace. Blue crabs (Callinectes sapidus) were measured between the tips of the lateral carapace spines. Rostrum

length was recorded on stomatopods (Squilla empusa), while squid (Loliguncula brevis) were measured from the syphon to the posterior terminus of the mantel.

Station number, date, time, temperature, salinity, tide stage, family, genus and species of the organism, sex (if determined), length and weight were recorded on computer cards for each individual. Analyses of the data were carried out on a General Electric 225 digital computer through utilization of various programs compiled by Stickney and McMahon (submitted for publication).

In addition to species composition information, two diversity indices were run on the data. Diversity index one was based on the relationship presented by Odum (1953) which stated:

$$\text{Diversity} = \frac{\text{Number of species in sample}}{\text{Log of number of individuals}}$$

Diversity index number two was based on the relationship:

$$N = \sum p_i \ln p_i$$

where N is diversity and p_i is the frequency of occurrence of species i in the sample (MacArthur and MacArthur, 1961; Dahlberg and Odum, 1970).

Station A2, AD and B2 were dredged during different dates in July, 1971. The data are all reported in terms of monthly values except for July where separate collections were made immediately before, during and after dredging. The dates of these samples do not necessarily coincide for each station but fall within about two weeks of each other.

RESULTS AND DISCUSSION

Monthly temperature and salinity data including three determinations in July which correspond to dredging activities, are presented in Table 1. All water samples were taken at low tide from the surface, thus variations in salinity were generally slight throughout the sampling period at any particular station. Station AD was the least saline of all stations demonstrating influence of the Savannah River on this sampling station. No other large source of upstream freshwater was available to station AD (Figure 1). Low salinities were observed at all of the Wilmington River sampling stations during March and April due to freshwater runoff from precipitation. Salinities at the Ossabaw Sound sampling stations were generally higher than those of the Wilmington River stations since the former are located in closer proximity to the open ocean.

Temperature followed a typical seasonal pattern for southeastern coastal waters at all stations with coldest surface water temperatures occurring in February without exception. Rapid warming of the water occurred April and May with a period of rapid cooling occurring in October and November. During July, water temperatures were still increasing to their summer maxima (about 30 C at the Wilmington River stations, and up to 34 C during midday at the Ossabaw Sound stations). The cooler water temperatures associated with the samples taken during dredging at the Ossabaw Sound stations resulted from the fact that the sam-

ples were taken in the late afternoon following a thunder shower. Salinity was also lower than in other samples taken during July because of the precipitation.

Absolute numbers of organisms obtained in a non-duplicated 10-minute otter trawl sample cannot be heavily relied upon to give an accurate picture of the total population because of sampling bias which comes from selecting against large animals which can escape by outswimming the net and small animals which can escape through the webbing. pelagic animals are also selected against since the net fishes on the bottom. While absolute numbers of organisms obtained within a particular trawl set can give some idea of the size of the population, the percentage composition of the catch by biomass and quantity of each species present may give a more accurate picture of population dynamics. The percentage of total biomass and quantity contributed by each vertebrate and invertebrate species during each month of the study period are presented for each station in Tables 2 through 8. Also included in these tables are figures for the total number of organisms captured each month and the total weight (g) of each monthly sample. Fishes are listed in approximate phylogenetic order (American Fisheries Society, 1970); all animals having been identified to species. Some invertebrates were not classified to the species level, including a xanthid crab, a small gastropod mollusc and a paleomonid shrimp. These animals, which never contributed greatly either to total percentage biomass or quantity, are presented in the

tables as "others" in the section on invertebrates.

While many fish species were represented at each of the sampling stations, the families Sciaenidae and Engraulidae were especially widely represented. During some parts of the year, members of the family Bothidae also were well represented. Sciaenid fishes were more dominant in general at the Wilmington River sampling stations than at the Ossabaw Sound stations. Many samples were dominated by the invertebrates Penaeus setiferus and Callinectes sapidus. Penaeus aztecus became important (especially in terms of percentage quantity) at some stations during the summer. Each of these three invertebrates are commercially valuable and will be heavily stressed in the following discussion. Among the fishes of commercial and sport interest captured at one or more of the seven sampling stations were Brevoortia tyrannus (menhaden), Leiostomus xanthurus (spot), Cynoscion nebulosus (spotted seatrout), C. regalis (weakfish), Menticirrhus americanus (whiting), Micropogon undulatus (croaker), Scomberomorus maculatus (Spanish mackerel), Mugil cephalus (white mullet) and Paralichthys sp. (flounder).

Included in the data in Tables 2 through 8 are figures for percentage of total biomass and quantity contributed by each species from samples taken in July immediately before, during and after dredging. Most of the following discussion will be aimed at examination of data taken during the summer months, especially during July.

Station A1, while not directly exposed to dredging, did

receive runoff water from the spoil bank at its lower end (Figure 1). Penaeus setiferus dominated both percentage biomass and percentage quantity throughout the dredging period at station A1. The percentage biomass was less during dredging than either before or after (Table 2), while the percentage of total quantity contributed by P. setiferus steadily increased during July and into August, after which the number declined. While the percentage biomass of Penaeus setiferus was low during dredging (49.5% as compared with 64.8% before and 77.3% after dredging), the percentage biomass contributed by the blue crab, Callinectes sapidus, was much higher during dredging than either before or after (Table 2). This coincided with a low percentage of total quantity made up of blue crabs (2.3%) during dredging, due to the presence of several large C. sapidus in the sample obtained during dredging. They contributed greatly to total biomass while making up an insignificant fraction of total quantity. Bearing this in mind, there was no disruption in the general pattern of shrimp population increase associated with July samples.

Penaeus aztecus did not contribute greatly to the total biomass percentage or percentage quantity with the exception of June, 1971, when both values were greater than those of Penaeus setiferus. The trend as regards the shrimp population was for increasing P. setiferus as dredging approached and decreasing P. aztecus at the same time.

The number of organisms found at station A1 were low through May, 1971, after which an order of magnitude increase

was found in June (Table 2). The total number of organisms continued to increase into August after which a rapid decline occurred. The highest numbers of organisms captured were obtained in July (during dredging) and August. Total biomass of samples followed a trend similar to total numbers of individuals (Table 2).

Station A2 was directly within the area of dredging activities and should have reflected any effects on the biota that occurred. Unfortunately, it was not possible to obtain samples during dredging at station A2, thus the presence or absence of any particular species during that time is not known. Penaeus setiferus were present in relatively low biomass and quantity during June and in July before dredging. Following dredging the P. setiferus biomass and quantity reached their peaks after which the population declined (Table 3). The pattern was similar to that seen at station A1 (Table 2).

The percentages of both biomass and quantity contributed by P. aztecus at station A2 were greater than the contribution by this species at station A1. P. aztecus appeared for the last time in the sample made immediately before dredging at station A2.

Looking briefly at the vertebrate population at station A2, most species of fish which were captured immediately before dredging were present in the sample immediately after dredging. On a numerical basis, five species of vertebrates were present in July before, and five after dredging (Table 3).

The greatest number of organisms were captured in July before dredging with a decline following dredging. There was no peak in August at station A2 as compared with station A1. Total biomass figures reflected those of total numbers of individuals to a large degree.

Station AC was used as a control station. While it was undiked, it was also used as a control on station AD (the diked dredging station) because no other diked area could be found in the immediate vicinity. The patterns of Penaeus setiferus percentages of biomass and quantity at station AC were similar to those of the previously discussed stations (Table 4). The percentages of biomass and quantity were increasing throughout the dredging period and declined beginning in October, 1971. The decline in P. setiferus biomass at stations A1 and A2 appeared to begin somewhat earlier than October; however, the differences in both cases were apparently due to the fact that Callinectes sapidus percentage biomass increased to a large extent during September. The percentage quantity of P. setiferus figures for all three stations (A1, A2 and AC) were similar. As was the case at station A1, P. aztecus first appeared at station AC in June, 1971, and was absent after the July post dredging sample.

More species of fish were captured at station AC both before and after dredging in July (13 and 11, respectively) than were taken at station A2. During the total study period 27 species of vertebrates were taken at station AC and 21 at station A2.

The total number of specimens taken in the samples increased rapidly beginning in June at station AC and peaked in the sample taken in July following dredging. This pattern was similar to that seen at station A2, but differed from the one at station A1 where the maximum number of individuals in a sample occurred in August. Station A1 is located in a somewhat different hydrographic area than are either stations A2 or AC (tidal creek as opposed to the considerably larger Wilmington River). The two stations of similar hydrographic type showed the same general trends in population density although one was dredged and the other was not. The number of organisms taken immediately after dredging at station A2 was somewhat less than the number taken at station AC; however, the values for August were similar at both stations (Tables 3 and 4). It is possible that representatives of some species avoided the dredging area immediately following dredging, but the effects appeared to be short-lived. A large number of individuals (382) were taken at station AC during September, 1971, although more than 90 percent of these were P. setiferus.

Distinct differences between station AD and all of the other Wilmington River stations were noted (Table 5). The difficulty in interpretation comes from the fact that this station does not resemble any of the others in several respects. It is strongly influenced by inflow of the Savannah River as can be seen from its surface salinity at low tide (Table 1) and pH (Herbert L. Windom, unpublished data). In addition, the water flow at station AD is in the opposite direction from

stations A1, A2 and AC. Water from station AD ebbs by way of the Savannah River, whereas the other three stations ebb in the direction of Wassaw Sound (Figure 1).

Penaeus setiferus were absent from station AD from December, 1970 through June, 1971, whereas, at one or more of the other three Wilmington River sampling stations this species was represented each month during the period. P. setiferus never completely dominated total biomass percentage (Callinectes being dominant as regards percentage biomass during July and August when shrimp were dominant at the other stations discussed), although P. setiferus were numerically dominant in July after dredging as well as in September and October. No Penaeid shrimp of any species were captured during dredging. P. aztecus were captured only on one occasion (July prior to dredging), unlike the other stations in the Wilmington River.

The largest total number of individuals obtained in a sample occurred in July prior to dredging. At no time did the numbers reach levels as high as those obtained from the other three previously discussed stations. In July, during dredging, only 11 animals were captured, while both before and after dredging the numerical catch exceeded 100 (Table 5).

Callinectes sapidus dominated the sample obtained during dredging, both as regards biomass, and to a lesser extent, quantity. Six fish species were captured in July prior to dredging, and three after dredging. No fish were captured in August, it is possible that dredging activities at this station caused the dislocation of P. setiferus. Fish may or may not have

been at least temporarily affected. The number of organisms captured at station AD in months prior to July and after July were similar.

Small catches were characteristic of station AD. This may have been due to the presence of the dike, influence of Savannah River water, past dredging activities, or some combination of these. The marsh directly adjacent to station AD was largely removed from production due to the dike, and this may have resulted in the reduced numbers of animals present. Low tide sampling was undertaken to assure that all of the obligate swimming organisms would have moved from the marsh into the river. Since the area of marsh available near station AD is limited, the number of organisms which can be accommodated must also be limited. Further study of diked spoil areas is needed.

Thirty species of vertebrates were captured at station B1, 29 at station B2 and 35 at station B3 (Tables 6, 7 and 8). Station B3 (Table 8) seemed to differ from the other two Ossabaw Sound stations in that this station had more species associated with it which are normally associated with high salinity water. These included Sphyrna lewini, Rhinoptera bonasus, Lagodon rhomboides, and Monocanthus maculatus. Centropristis philadelphica and C. striatus both were captured at station B2 although C. striatus does not normally seem to penetrate far into the estuaries of Georgia (Table 7).

Station B3 also differed from the other B stations in substrate type. While the substrate at stations B1 and B2 was

mud rich in organic matter (similar to Wilmington River substrate), a sandy bottom was typical of station B3 except immediately adjacent to Spartina beds where some muddy areas were apparent.

Penaeus setiferus were captured at station B1 during all months of the study period with the exception of February 1971. The percentage of total biomass contributed by P. setiferus was never as high at station B1 as was seen during the late summer in the Wilmington River stations. This was due, in large part, to the fact that Callinectes sapidus often contributed greatly to percentage biomass, but not always to percentage quantity (Table 6). The period of greatest P. setiferus numbers (as revealed by percentage quantity in the samples) occurred during the period from July (during and after dredging) through November. The shrimp were apparently moving down the rivers during the fall and had largely evacuated the lower salinity waters typified by the Wilmington River stations (Tables 2 through 5), but were still present in the areas of the sounds during November. No great fluctuations in the percentage quantity contributed by P. setiferus were demonstrated at station B1 during the period of dredging or thereafter. Station B1 is situated adjacent to the spoil bank that was used during 1971; however, unlike station A1, the water running off the spoil bank did not enter the creek in which station B1 was placed, but on the opposite side of the island (Figure 1).

The highest number of organisms captured in any one trawl

at station B1 occurred during dredging in July. The general pattern was similar to that of previously described stations in that low numbers of individuals were captured during the period from December, 1970 through March, 1971, after which the numbers increased reaching peaks in July and September. The increased numbers in the catch began earlier at station B1 than at the Wilmington River stations (April as opposed to May in the latter case) and the high numbers in the catch continued through October, which was somewhat longer than occurred at the Wilmington River stations.

The seasonal pattern of P. setiferus was not the same at station B2 as it was at station B1. At station B2 shrimp were absent from December, 1970 through April, 1971 except for February when 10% of the small catch biomass was contributed by P. setiferus (Table 7). As was true at station B1, P. setiferus contributed relatively little biomass during the months that it was present with the exception of August, 1971, when this species represented 61.1% of biomass. The contribution of P. setiferus to percentage quantity was considerable during the period from July (during dredging) through November, 1971. Some reduction in percentage quantity of P. setiferus occurred in the sample taken during July after dredging as compared with July before dredging and August. High numbers of white shrimp were found during dredging at station B2 in contrast to results obtained from station AD. As was the case at station B1, P. aztecus, while present from June through July, contributed little either to biomass or quantity (Tables 6 and 7).

High total numbers of individuals were not obtained during any month of the study period at station B2. The strong currents associated with the area may have been important in limiting population size. The number of individuals taken during dredging was higher than before dredging to a limited degree and slightly over three times higher than that of the after dredging sample. The highest numbers of individuals were recorded during August, September and October, 1971, after the dredging activities were completed. Total biomass figures for samples taken in June and August were similar (Table 7). There appeared to have been no lasting effect of dredging at station B2, although a reduction in the number of organisms present may have occurred for a short period immediately following dredging.

While station B3 was supposed to be a control station on station B2, the shrimp population at station B3 was highly dissimilar to any of the other stations studied. Penaeus setiferus were absent in June and July, but occurred as the dominant species both by percentage biomass and quantity during August and September (Table 8). P. aztecus occurred during June, August, and October, 1971, always in low percentage quantity and biomass. Callinectes sapidus was largely absent during July, except in the sample taken during dredging when it was present at 7.1% of biomass. The July samples were dominated by fishes instead of invertebrates, in opposition to the results obtained at the other six stations.

Low numbers of individuals were captured from December,

1970 through April, 1971 (Table 8). In May and June the number captured increased to a few hundred during each month. July samples contained few organisms, whether taken before, during or after dredging. August and September samples contained the greatest numbers of individuals and were dominated by P. setiferus.

The pattern followed for total biomass was similar to that of total numbers of individuals except during May, 1971, when over 33,000 g represented only a few individuals. Most of this biomass (79.1%) was contributed by two large rays (Rhinoptera bonasus) and a horseshoe crab (Limulus polyphemus).

The location of station B3 was apparently outside of what may generally be recognized as including the nursery ground area of the Georgia estuaries. The lack of organic rich mud and limited amount of organic matter available as detritus may have contributed to the rather low standing crop seen at this station during most months.

Summarizing the data presented thus far, all stations, with the exception to station B3 showed high levels of Penaeus setiferus (as indicated by percentage of total quantity contributed by this species) during the period covered by dredging activities. At one of the experimental stations (station AD) this species was not found during dredging, but at no station did absolute numbers of organisms, percentage biomass or percentage quantity show reductions in August below values of June or July. No effects definitely attributable to dredging could be elaborated from the data. The variability

involved in sampling probably accounted for most of the variability in the data better than did any activities associated with dredging.

Values for diversity index one (Odum index) based on species numbers and number of individuals are presented in Table 9 for each sample taken at each station. No collections were made at the B stations during November, 1970, nor at station A2 during dredging in July as previously stated. Diversity based on the relationship between species number and number of individuals showed no distinct seasonal pattern at any single station or group of stations. Comparison of diversity within the Wilmington River samples during November and December, 1970 with diversity for those months in 1971 showed little relationship between the two years. The same result held when December diversity values from the two years were compared among the Ossabaw Sound stations.

Diversity at the Ossabaw Sound stations was somewhat higher on the average than that of the Wilmington River stations during the period May through August, 1971 (Table 9). During the remainder of the sampling period there appeared to be little difference in diversity between the two sampling areas.

Sampling during July, 1971 demonstrated that diversity was higher during than either before or after dredging at each station. With the exception of station B3 little change in diversity occurred when samples obtained just before dredging were compared with those obtained immediately after

dredging. At station B3, diversity was low just prior to dredging and high afterwards. No systematic changes in diversity which could be attributed to dredging effects occurred in the months subsequent to dredging at any station.

Diversity has been advanced as a means by which the relative health of communities may be examined. High diversity is regarded as being indicative of a healthy environment containing many niches occupied by a variety of species. Low diversity, on the other hand, is a sign of environmental stress on organisms and is characterized by few species, although these may contain high numbers of individuals. Stress imposed by dredging, if it occurred, should be reflected in reduced diversity or, if dredging led to an improved environment, diversity should increase. Neither event was reflected in the Odum diversity index (Table 9).

Because of their relationship to sources of industrial and domestic pollutants both in the immediate vicinity and from the Savannah River, the Wilmington River stations must be considered to lie within polluted water areas. Water quality data support this contention (Herbert L. Windom, unpublished data). The environmental stress placed on these stations by the pollution sources in the area did not appear to be reflected in diversity. During the summer when water temperatures were highest and the maximum stresses were placed on the oxygen holding capacity of the water the average diversity for these stations was slightly lower than for the Ossabaw Sound stations, but these effects occurred at all

stations, not only at experimental stations.

The diversity indices calculated from diversity index number two (based on proportionality of each species in a sample) are presented for each station and sample in Table 10. While few generalities can be drawn from these data, station B3 did appear to exhibit consistently higher diversity than did any other station except in July prior to dredging when diversity at station B3 was very low (0.2510). Station AD, on the other hand, demonstrated consistently low diversity throughout most of the sampling period. Exceptions occurred in June and November, 1971. Since station AD is presumably stressed by pollution, low diversity was to be expected. This diversity index seemed to demonstrate this effect to a greater degree than did the previously discussed diversity index.

Diversity at station A2 as determined by diversity index number two showed a lower value in July after dredging than before, whereas diversity increased in the same two sampling periods at stations A1 and AC. Station AD, like station A2, an experimental station, showed a fairly steady diversity pattern in and around the period of dredging. Diversity at the control station (station AC) fell following July and remained relatively low throughout the remainder of the sampling period. This station was well outside the influence of dredging activities.

The diversity values obtained for diversity index two from the Ossabaw Sound stations varied more highly at the two

stations not directly under the influence of dredging (stations B1 and B3 than did diversity at the station located within the dredging site (station B2). Values obtained for this diversity index at stations B1 and B2 in the months following dredging were similar.

SUMMARY

Collections of fishes and invertebrates made by otter trawl during the period November, 1970 through December, 1971 from stations within the Georgia coastal estuarine system were evaluated in terms of effects of hydraulic dredging activities associated with the Intracoastal Waterway on the biota collected. The patterns of seasonal occurrence and dominance of specific organisms appeared to be consistent regardless of whether or not dredging occurred in the area sampled. Variability among the stations seemed to be associated with natural hydrographic and physiographic characteristics as well as sampling variability. Some changes in population structure or standing crop may have been associated with dredging, but these effects were transient, lasting no longer than one or two months following dredging.

Diversity was obtained through the utilization of two indices. The data obtained from the diversity indices failed to demonstrate any long-term effects of dredging. In fact, control stations often showed more variability in diversity during the period immediately before, during and after dredging than did the experimental stations.

If dredging of the Intracoastal Waterway in Georgia has

any effect on the vertebrate and invertebrate organisms captured by otter trawling, the current investigation was not able to demonstrate them. The organisms collected were highly motile without exception, thus, they could leave and return to the dredging area at will. The effects of dredging did not, apparently, preclude their rapid return to the dredged areas, if indeed, they every did evacuate. Studies have been initiated to consider the effects of dredging on benthic infauna, organisms which cannot demonstrate an effective avoidance pattern.

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TABLE 1

Temperature and salinity data for each sampling station for the period November, 1970 through December, 1971. (Upper number = temperature (C), number in parentheses = salinity (‰), BD = Before Dredging, DD = During Dredging, AD = After Dredging)

Station	Nov 70	Dec 71	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71	Jul 71	Jul 71	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
A1	18 (ND)	15 (22)	ND (15)	8 (15)	15 (8)	20 (10)	26 (16)	28 (16)	26 (18)	29 (ND)	30 (18)	28 (13)	27 (14)	22 (16)	16 (14)	16 (14)
A2	ND (ND)	16 (22)	ND (16)	9 (11)	16 (6)	20 (10)	26 (13)	29 (14)	26 (18)	NC (NC)	29 (20)	28 (12)	27 (15)	23 (16)	18 (14)	16 (14)
AC	18 (23)	16 (24)	ND (22)	8 (14)	14 (8)	19 (8)	25 (16)	28 (16)	26 (20)	29 (ND)	30 (20)	29 (26)	27 (17)	23 (21)	18 (16)	16 (14)
AD	ND (ND)	15 (17)	ND (8)	8 (7)	15 (4)	18 (8)	26 (8)	27 (10)	26 (12)	27 (10)	28 (12)	28 (7)	27 (13)	23 (12)	18 (11)	ND (ND)
B1	NC	14 (31)	12 (18)	10 (19)	14 (26)	20 (20)	25 (25)	29 (28)	30 (29)	27 (20)	31 (24)	33 (24)	28 (19)	22 (22)	15 (20)	16 (17)
B2	ND	13 (29)	12 (18)	10 (16)	13 (25)	20 (21)	26 (24)	29 (27)	29 (27)	27 (20)	31 (24)	30 (20)	28 (17)	23 (18)	17 (15)	15 (12)
B3	ND	14 (30)	11 (25)	10 (23)	14 (28)	20 (21)	26 (24)	28 (25)	29 (29)	27 (26)	31 (24)	34 (25)	28 (15)	23 (24)	17 (22)	16 (22)

ND = No Data

NC = No Collection

TABLE 2

Percentage of total biomass and quantity contributed by each species at station A1 during the period November, 1970 through December 1971. (Top Number = percentage of total biomass, bottom number = percentage of total quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging)

Classification	Nov 70	Dec 70	Jan 70	Feb 70	Mar 70	Apr 70	May 70	Jun 70	Jul 70 BD	Jul 70 DD	Jul 70 AD	Aug 70	Sep 70	Oct 70	Nov 70	Dec 70
Lepisosteidae																
<u>Lepisosteus platostomus</u>	-	-	-	-	-	-	-	-	-	-	-	31.5 (0.1)	-	-	-	-
Clupeidae																
<u>Brevoortia tyrannus</u>	-	30.5 (32.1)	-	-	-	-	-	21.6 (6.1)	5.6 (2.1)	-	-	-	-	21.1 (2.6)	-	-
Engraulidae																
<u>Anchoa hepsetus</u>	-	-	-	-	-	-	-	0.3 (4.5)	-	-	-	-	-	-	-	-
<u>Anchoa mitchelli</u>	-	-	-	-	-	-	-	-	-	-	<0.1 (0.4)	-	0.2 (2.0)	-	-	-
Ariidae																
<u>Arius felis</u>	-	-	-	-	-	-	8.3 (3.1)	-	-	-	-	1.1 (0.1)	-	-	-	-
Batrachoididae																
<u>Opsanus tau</u>	-	-	-	-	-	-	-	0.8 (0.4)	-	-	-	-	-	-	-	-
Carangidae																
<u>Chloroscombrus chrysurus</u>	-	-	-	-	-	-	-	-	-	-	-	-	0.3 (0.7)	-	-	-
Sciaenidae																
<u>Bairdiella chrysura</u>	89.5 (82.8)	14.3 (15.4)	-	-	74.6 (66.7)	-	6.4 (12.5)	13.2 (4.5)	19.8 (20.8)	4.5 (9.3)	0.9 (0.9)	1.9 (0.9)	26.0 (14.2)	9.6 (7.8)	86.8 (72.7)	18.5 (33.3)

[illegible]

TABLE 2 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 72
Soleidae																
<u>Trinectes maculatus</u>	-	-	-	-	-	-	-	-	-	0.2 (0.1)	-	-	-	-	-	-
Cynoglossidae																
<u>Symphurus plagiusa</u>	-	-	-	-	-	-	-	-	2.3 (0.1)	-	-	-	-	-	-	-
INVERTEBRATES																
Loliginidae																
<u>Loliguncula brevis</u>	-	-	-	-	-	-	-	-	-	-	0.1 (0.1)	-	-	-	-	-
Penaeidae																
<u>Penaeus setiferus</u>	1.3 (3.4)	1.9 (5.1)	-	-	-	-	0.1 (3.1)	2.8 (27.5)	64.8 (74.0)	49.5 (82.5)	77.3 (95.6)	60.3 (97.8)	30.4 (78.4)	38.6 (85.6)	2.4 (9.1)	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	-	21.8 (38.9)	5.9 (1.4)	1.0 (0.6)	-	-	-	-	-	-
Portunidae																
<u>Callinectes sapidus</u>	1.7 (3.4)	31.4 (28.2)	-	-	9.8 (13.3)	100.0 (100.0)	77.0 (37.5)	29.0 (2.4)	-	41.6 (2.3)	20.6 (2.3)	4.5 (0.2)	43.1 (4.7)	29.7 (3.3)	10.5 (18.2)	16.8 (33.3)

TABLE 2 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Others	<0.1 (3.4)	-	-	-	-	-	0.1 (0.4)	-	1.7 (4.1)	-	-	-	-	-	-	-
Total Number of Specimens	29	39	2	0	30	3	32	247	288	857	700	1075	148	153	11	3
Total Biomass (g)	665.5	1982.5	12.0	0.0	957.3	133.2	1787.0	3107.0	—18612.1—	—	—	10475.9	2198.2	1877.8	169.1	83.2

TABLE 3

Percentage of total biomass and quantity contributed by each species at station A2 during the period November, 1970 through December, 1971. (Top number = biomass percentage, number in parentheses = percentage quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging.)

[illegible]

TABLE 3 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Carangidae																
<u>Chloroscombrus chrysurus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5 (1.6)	-	-
Sciaenidae																
<u>Bairdiella chrysura</u>	29.1 (26.7)	-	20.9 (16.7)	-	8.9 (14.3)	-	3.6 (5.0)	-	-	-	3.4 (5.7)	1.2 (1.8)	7.5 (10.0)	-	5.7 (12.0)	46.7 (76.6)
<u>Cynoscion nebulosus</u>	7.7 (3.3)	-	-	-	-	-	32.7 (10.0)	-	-	-	-	-	-	-	-	1.1 (1.6)
<u>Cynoscion regalis</u>	3.8 (3.3)	-	-	-	-	-	-	1.0 (2.9)	0.3 (0.4)	-	2.6 (2.1)	7.7 (7.6)	-	-	-	-
<u>Leiostomus xanthurus</u>	50.9 (43.3)	-	-	64.1 (33.3)	16.2 (14.3)	-	5.5 (35.0)	33.1 (45.5)	0.3 (0.4)	-	-	-	-	-	-	1.3 (1.6)
<u>Menticirrhus americanus</u>	-	-	-	-	-	-	-	-	1.3 (1.6)	-	2.2 (0.7)	-	-	-	-	-
<u>Micropogon undulatus</u>	-	-	-	-	-	-	7.0 (5.0)	2.1 (1.7)	-	-	-	-	-	-	-	-
Mugilidae																
<u>Mugil cephalus</u>	-	-	12.3 (16.7)	-	-	-	-	-	-	-	-	-	-	-	-	-
Bothidae																
<u>Citharichthys spilopterus</u>	1.1	-	-	-	-	-	-	<0.1 (0.3)	0.1 (0.2)	-	1.3 (0.7)	-	-	-	-	-

TABLE 3 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Bothidae (cont'd)																
<u>Etropus crassostus</u>	-	-	-	-	-	-	-	-	-	-	-	0.3 (0.6)	6.2 (2.9)	0.6 (2.8)	0.2 (4.0)	-
<u>Paralichthys lethostigma</u>	-	-	-	-	22.0 (14.3)	-	-	-	-	-	-	2.0 (0.6)	-	-	-	-
Soleidae																
<u>Trinectes maculatus</u>	-	-	-	-	-	-	-	-	1.2 (1.4)	-	-	-	-	-	-	-
Cynoglossidae																
<u>Symphurus plagiusa</u>	3.9 (6.7)	-	-	-	15.4 (23.8)	-	1.7 (5.0)	-	-	-	-	-	-	-	-	-
INVERTEBRATES																
Loliginidae																
<u>Loliguncula brevis</u>	0.8 (3.3)	-	-	-	-	-	-	-	0.2 (0.2)	-	0.5 (10.0)	-	-	-	-	-
Penaeidae																
<u>Penaeus setiferus</u>	2.4 (6.7)	-	0.9 (16.7)	9.8 (33.3)	-	-	-	0.1 (1.7)	8.9 (22.6)	-	70.7 (68.6)	47.3 (79.4)	11.2 (68.5)	6.2 (53.1)	1.4 (20.0)	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	-	16.5 (34.1)	78.4 (70.3)	-	-	-	-	-	-	-
Portunidae																
<u>Callinectes sapidus</u>	0.3 (3.3)	100.0 (100.0)	62.6 (16.7)	-	22.1 (23.8)	100.0 (100.0)	21.6 (20.0)	19.2 (4.4)	8.9 (2.0)	-	12.4 (1.4)	33.7 (4.7)	71.7 (17.1)	92.2 (35.9)	85.9 (60.0)	49.8 (17.2)

TABLE 3 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Squillidae																
<u>Squilla empusa</u>	-	-	-	-	-	-	-	-	0.3 (0.8)	-	-	0.2 (0.6)	-	-	-	-
Total Number of Specimens	30	32	6	3	22	4	20	342	487	NS	131	170	70	64	25	64
Total Biomass (g)	888.0	1078.0	117.5	46.0	734.0	174.0	586.4	5685.6	—	12281.1	—	2205.8	1986.4	4664.2	1743.3	2100.8

NS = No Sample Obtained

TABLE 4

Percentage of total biomass and quantity contributed by each species at station AC during the period November, 1970 through December, 1971. (Top number = biomass percentage, number in parentheses = percentage quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging.)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
VERTEBRATES																
Clupeidae																
<u>Alosa sapidissima</u>	-	-	-	-	-	-	3.4 (1.6)	-	-	-	-	-	-	-	-	-
<u>Brevoortia tyrannus</u>	-	-	-	-	62.4 (52.6)	-	-	1.5 (0.5)	-	-	2.9 (0.4)	-	-	-	-	-
Engraulidae																
<u>Anchoa mitchelli</u>	-	-	-	4.0 (25.0)	0.3 (2.6)	-	39.6 (84.4)	1.4 (10.6)	-	0.1 (0.7)	0.1 (0.7)	0.1 (1.0)	0.1 (0.5)	-	-	-
Synodontidae																
<u>Synodus foetens</u>	-	-	-	-	-	-	-	-	-	0.7 (0.4)	0.2 (0.1)	-	1.6 (0.3)	2.7 (0.6)	-	-
Ariidae																
<u>Arius felis</u>	-	-	-	-	-	-	19.5 (1.6)	17.9 (9.1)	5.9 (1.0)	-	0.4 (0.1)	-	-	-	-	-
Serranidae																
<u>Centropristis philadelphica</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	2.0 (0.6)	-	-
Carangidae																
<u>Chloroscombrus chrysurus</u>	-	-	-	-	-	-	-	-	-	<0.1 (0.2)	-	-	1.0 (0.8)	-	-	-
<u>Selene vomer</u>	-	-	-	-	-	-	-	-	-	-	0.1 (0.1)	-	-	-	-	-

TABLE 4 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Sparidae																
<u>Lagodon rhomboides</u>	-	-	-	-	-	-	-	-	0.1 (0.2)	-	-	-	-	-	-	-
Sciaenidae																
<u>Bairdiella chrysura</u>	7.3 (9.5)	-	-	-	5.0 (5.3)	-	-	0.7 (0.5)	1.8 (0.4)	0.1 (0.4)	3.3 (0.7)	5.5 (3.1)	8.6 (3.4)	-	-	10.4 (27.3)
<u>Cynoscion nebulosus</u>	-	-	-	-	-	-	-	-	-	6.8 (4.1)	-	-	-	-	-	-
<u>Cynoscion regalis</u>	-	-	-	-	-	-	-	0.9 (1.9)	0.3 (0.4)	-	3.9 (1.9)	1.0 (0.5)	-	-	-	-
<u>Leiostomus xanthurus</u>	50.4 (28.1)	100.0 (100.0)	-	-	13.8 (7.9)	82.7 (33.3)	3.1 (3.1)	57.5 (54.8)	37.0 (30.7)	1.9 (2.0)	0.4 (0.4)	-	-	-	-	0.6 (1.8)
<u>Menticirrhus americanus</u>	-	-	-	-	-	-	-	-	0.2 (0.2)	0.4 (0.2)	-	-	-	-	-	-
<u>Micropogon undulatus</u>	-	-	-	-	-	10.1 (37.5)	11.4 (13.1)	-	3.1 (1.6)	2.6 (0.7)	1.2 (0.5)	-	-	-	-	-
Ephippidae																
<u>Chaetodipterus faber</u>	-	-	-	-	-	-	-	-	0.2 (0.4)	-	-	-	-	-	-	-
Mugilidae																
<u>Mugil cephalus</u>	-	-	-	-	-	-	-	-	-	6.3 (1.1)	-	-	-	-	-	16.7 (7.3)
Scombridae																
<u>Scomberomorus maculatus</u>	-	-	-	-	-	-	-	-	-	-	-	3.4 (2.1)	-	-	-	-

TABLE 4 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Stromateidae																
<u>Peprilus alepidotus</u>	-	-	-	-	-	-	-	2.4 (0.5)	-	-	-	-	-	-	-	-
Triglidae																
<u>Prionotus evolans</u>	-	-	-	-	0.8 (2.6)	-	-	0.1 (0.5)	-	-	-	-	-	-	-	-
Bothidae																
<u>Ancyclopsetta quadrocellata</u>	-	-	-	80.0 (50.0)	3.2 (7.9)	-	3.9 (3.1)	-	1.1 (0.2)	-	-	-	-	-	-	-
<u>Citharichthys spilopterus</u>	11.5 (19.0)	-	-	-	-	-	-	0.2 (1.0)	0.5 (0.6)	0.5 (0.2)	-	-	-	-	-	-
<u>Etropus crassotus</u>	-	-	-	-	-	-	-	-	3.9 (6.1)	0.4 (0.5)	0.3 (0.4)	-	1.4 (1.0)	13.5 (11.7)	3.0 (16.7)	0.4 (5.5)
<u>Paralichthys lethostigma</u>	-	-	-	-	-	-	-	-	1.1 (0.2)	-	-	-	-	-	-	-
Cynoglossidae																
<u>Symphurus plagiusa</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8 (0.6)	-	-
Tetraodontidae																
<u>Sphoeroides maculatus</u>	-	-	-	-	-	-	-	-	<0.1 (0.2)	-	-	-	-	-	-	-
Diodontidae																
<u>Chilomycterus shoepfi</u>	-	-	-	-	-	-	-	-	-	1.2 (0.4)	0.5 (0.1)	-	-	-	-	-

TABLE 4 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
INVERTEBRATES																
Loliginidae																
<u>Loliguncula brevis</u>	28.7 (38.1)	-	-	-	-	-	9.0 (3.1)	1.7 (5.3)	-	<0.1 (0.2)	4.1 (3.7)	-	-	0.7 (1.2)	-	-
Penaeidae																
<u>Penaeus setiferus</u>	2.1 (4.8)	-	-	-	0.8 (2.6)	1.7 (4.2)	-	-	3.3 (9.6)	61.1 (83.6)	69.4 (87.3)	79.6 (91.8)	79.9 (93.2)	16.2 (80.4)	13.8 (33.3)	-
<u>Penaeus duorarum</u>	-	-	-	-	0.8 (2.6)	1.0 (4.2)	-	-	-	-	-	-	-	-	-	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	-	15.5 (15.4)	24.6 (39.3)	4.6 (3.2)	3.0 (1.8)	-	-	-	-	-
Portunidae																
<u>Callinectes sapidus</u>	-	-	-	16.0 (25.0)	12.9 (15.8)	4.4 (16.7)	-	-	16.3 (7.3)	12.7 (1.3)	9.4 (0.8)	10.5 (1.5)	7.3 (0.8)	64.1 (4.9)	83.2 (50.0)	71.8 (58.2)
Squillidae																
<u>Squilla empusa</u>	-	-	-	-	-	-	-	-	0.7 (1.6)	0.4 (0.5)	0.7 (0.9)	-	-	-	-	-
Others	-	-	-	-	-	0.1	-	-	-	0.2	-	-	-	-	-	-
Total Number of Specimens	21	23	0	4	38	24	64	108	480	549	838	195	382	163	6	55
Total Biomass (g)	671.0	697.0	0.0	12.5	653.5	513.0	333.4	2793.3	—	17552.9	—	204.5	3967.5	2397.7	93.0	2824.5

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
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[illegible]

TABLE 5 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Gerreidae (cont'd)																
<u>Eucinostomus argenteus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2 (7.7)	-
Sciaenidae																
<u>Bairdiella chrysura</u>	6.1 (11.1)	100.0 (100.0)	-	-	13.5 (17.5)	44.7 (50.0)	3.5 (1.3)	17.3 (16.7)	-	-	0.3 (1.0)	-	-	-	11.2 (23.1)	-
<u>Cynoscion nebulosus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	24.6 (1.3)	-	-
<u>Cynoscion regalis</u>	-	-	-	-	-	-	-	1.1 (4.2)	20.8 (0.3)	4.6 (18.2)	-	-	-	-	-	-
<u>Leiostomus xanthurus</u>	4.6 (11.1)	-	-	42.2 (65.0)	-	-	44.0 (77.9)	9.2 (16.7)	5.2 (4.2)	1.0 (9.1)	-	-	-	-	-	-
<u>Micropogon undulatus</u>	-	-	-	-	16.5 (71.3)	-	26.0 (9.1)	3.4 (8.3)	3.3 (1.3)	-	-	-	-	-	-	-
Mugilidae																
<u>Mugil cephalus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4 (1.7)	-	-
Scombridae																
<u>Scomberomorus maculatus</u>	-	-	-	-	-	-	-	-	-	2.2 (9.1)	-	-	-	-	-	-
Bothidae																
<u>Citharichthys spilopterus</u>	-	-	-	-	-	-	-	-	-	-	0.7 (1.0)	-	-	-	-	-
<u>Etropus crassostus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8 (1.3)	-	-

TABLE 5 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Bothidae (cont'd)																
<u>Paralichthys dentatus</u>	-	-	-	12.7 (2.5)	-	-	-	0.2 (2.1)	-	-	-	-	-	-	-	-
<u>Paralichthys lethostigma</u>	-	-	-	36.7 (2.5)	15.4 (3.7)	-	14.7 (1.3)	-	2.1 (1.6)	-	-	-	-	-	-	-
Soleidae																
<u>Trinectes maculatus</u>	-	-	-	0.3 (2.5)	-	-	-	1.4 (6.2)	1.2 (1.0)	-	1.3 (1.9)	-	-	-	0.5 (7.7)	-
Cynoglossidae																
<u>Symphurus plagiusa</u>	-	-	-	-	-	-	-	-	0.6 (0.3)	-	-	-	-	-	-	-
INVERTEBRATES																
Penaeidae																
<u>Penaeus setiferus</u>	3.5 (22.2)	-	-	-	-	-	-	-	33.8 (73.3)	-	27.7 (83.7)	10.0 (40.0)	59.7 (87.8)	56.3 (88.2)	0.8 (7.7)	-
<u>Penaeus duorarum</u>	-	-	-	-	-	-	-	0.7 (4.2)	-	-	-	-	-	-	-	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	-	-	11.0 (11.4)	-	-	-	-	-	-	-

TABLE 5 (cont'd)

Classification	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Portunidae																
<u>Callinectes sapidus</u>	81.0 (22.2)	-	100.0 (100.0)	8.1 (27.5)	5.6 (3.7)	55.3 (50.0)	11.6 (9.1)	55.8 (31.2)	42.0 (6.5)	92.1 (63.6)	70.0 (12.5)	90.0 (60.0)	29.9 (6.1)	31.1 (7.2)	79.2 (38.5)	-
Total Number of Specimens	9	6	4	40	80	2	77	48	306	11	104	10	49	152	13	0
Total Biomass (g)	361.0	474.0	71.5	1317.0	776.4	51.5	678.2	1279.5	—	3814.7	—	148.7	299.1	1520.0	328.1	0.0

TABLE 6

Percentage of total biomass and quantity contributed by each species at station B1 during the period November, 1970 through December, 1971. (Top number = biomass percentage, number in parentheses = percentage quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging.)

[illegible]

TABLE 6 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Batrachoididae															
<u>Opsanus tau</u>	-	-	-	-	-	-	1.9 (2.6)	0.7 (1.5)	0.8 (0.2)	4.2 (0.6)	-	0.7 (0.1)	-	-	-
Gadidae															
<u>Urophycis regius</u>	-	1.0 (5.0)	17.7 (11.5)	5.3 (4.4)	2.1 (0.6)	-	-	-	-	-	-	-	-	-	-
Atherinidae															
<u>Menidia menidia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.1 (0.6)	-
Sciaenidae															
<u>Bairdiella chrysura</u>	0.3 (2.4)	1.1 (5.0)	23.5 (42.3)	-	-	0.8 (1.8)	1.2 (1.1)	2.3 (2.9)	-	0.3 (0.7)	0.4 (0.1)	4.2 (3.3)	0.2 (0.3)	-	-
<u>Cynoscion nebulosus</u>	-	20.8 (5.0)	8.8 (3.8)	-	-	-	-	-	-	0.4 (0.2)	-	0.5 (0.1)	-	-	3.8 (5.0)
<u>Cynoscion regalis</u>	-	-	-	-	-	-	0.1 (1.1)	-	<0.2 (0.2)	-	0.3 (0.3)	-	-	-	-
<u>Leiostomus xanthurus</u>	18.0 (11.9)	19.0 (10.0)	-	31.5 (17.6)	-	1.6 (4.5)	15.9 (37.9)	5.3 (19.1)	5.1 (2.0)	1.0 (0.4)	0.1 (0.1)	-	-	1.5 (0.6)	10.5 (5.0)
<u>Micropogon undulatus</u>	-	-	-	0.4 (2.9)	0.6 (1.3)	4.9 (10.9)	1.9 (6.8)	3.3 (10.3)	1.9 (0.6)	-	0.8 (0.3)	-	-	-	-
<u>Stellifer lanceolatus</u>	-	-	-	-	-	-	-	-	-	0.2 (0.1)	-	-	-	-	-
Ephippidae															
<u>Chaetodipterus faber</u>	-	-	-	-	-	-	-	-	-	<0.1 (0.1)	-	-	-	-	-

TABLE 6 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Soleidae															
<u>Trinectes maculatus</u>	-	-	-	-	-	1.6 (4.5)	0.2 (1.1)	-	6.7 (2.9)	0.7 (0.6)	0.6 (0.4)	-	-	-	-
Cynoglossidae															
<u>Symphurus plagiatus</u>	-	-	-	-	-	2.6 (2.7)	-	-	-	-	-	-	1.5 (1.1)	1.4 (1.7)	-
Diodontidae															
<u>Chilomycterus shoepfi</u>	-	-	-	-	-	-	0.1 (0.5)	0.2 (1.5)	-	0.6 (0.1)	-	-	-	-	-
INVERTEBRATES															
Loliginidae															
<u>Loliguncula brevis</u>	0.2 (4.8)	3.7 (20.0)	-	1.2 (4.4)	0.4 (0.6)	4.1 (7.3)	0.5 (3.7)	0.3 (4.4)	-	0.3 (0.6)	1.7 (1.9)	0.3 (0.8)	2.0 (4.1)	0.1 (0.6)	-
Penaeidae															
<u>Penaeus setiferus</u>	33.6 (50.0)	12.4 (25.0)	-	36.0 (51.5)	28.7 (20.5)	13.3 (18.2)	0.6 (0.5)	1.1 (1.5)	48.5 (85.3)	31.9 (82.1)	69.9 (71.0)	50.5 (90.6)	59.8 (80.5)	25.3 (72.1)	3.4 (45.0)
<u>Penaeus duorarum</u>	-	-	-	-	-	3.3 (4.5)	-	-	-	-	-	-	-	-	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	1.4 (6.8)	1.2 (5.9)	9.0 (5.7)	11.9 (1.1)	-	-	-	0.1 (1.2)	-

TABLE 6 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Portunidae															
<u>Callinectes sapidus</u>	46.2 (11.9)	39.4 (15.0)	3.3 (3.8)	-	36.5 (2.6)	62.5 (18.2)	69.8 (21.1)	82.3 (27.9)	20.9 (2.5)	45.6 (9.2)	15.4 (1.4)	42.7 (3.1)	31.9 (3.9)	71.0 (20.6)	81.7 (40.0)
Squillidae															
<u>Squilla empusa</u>	-	0.4 (5.0)	-	-	-	0.2 (0.9)	1.5 (7.9)	2.7 (19.1)	-	1.5 (2.5)	0.5 (0.8)	-	1.0 (0.9)	0.1 (0.3)	-
Others	-	0.3 (5.0)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Number of Specimens	42	20	26	68	156	110	90	239	1208	802	723	1031	636	344	20
Total Biomass (g)	717.9	234.8	135.7	1003.5	1184.5	2226.2	6863.7	— 1812.4 —			5418.1	10972.2	8267.1	9528.3	820.9

TABLE 7

Percentage of total biomass and quantity contributed by each species at station B2 during the period November, 1970 through December, 1971. (Top number = percentage of total biomass, bottom number = percentage of total quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging.)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
VERTEBRATES															
Clupeidae															
<u>Alosa sapidissima</u>	-	-	23.8 (14.3)	-	-	-	-	-	-	-	-	-	-	-	-
<u>Brevoortia tyrannus</u>	-	100.0 (100.0)	-	-	51.4 (28.1)	-	-	-	-	-	-	-	-	-	-
Engraulidae															
<u>Anchoa hepsetus</u>	-	-	-	-	-	-	-	-	1.3 (4.8)	-	-	-	-	-	-
<u>Anchoa mitchelli</u>	0.3 (5.6)	-	2.3 (14.3)	62.8 (83.3)	10.8 (59.4)	1.8 (13.2)	0.2 (3.4)	-	0.6 (8.6)	0.1 (1.8)	-	0.1 (1.0)	0.2 (2.8)	-	3.8 (26.9)
Ariidae															
<u>Arius felis</u>	-	-	-	-	-	-	-	-	1.5 (0.5)	14.8 (7.3)	5.3 (1.5)	-	-	-	-
Batrachoididae															
<u>Opsanus tau</u>	-	-	-	-	-	-	2.2 (1.1)	2.6 (1.4)	-	-	-	-	-	3.2 (0.5)	-
Serranidae															
<u>Centropristis philadelphica</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	1.8 (0.5)	-
<u>Centropristis striatus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7 (0.5)	-

TABLE 7 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Pomatomidae															
<u>Pomatomus saltatrix</u>	-	-	-	-	-	-	-	-	2.1 (1.1)	-	-	-	-	-	-
Carangidae															
<u>Chloroscombrus chrysurus</u>	-	-	-	-	-	-	-	-	0.2 (2.1)	-	0.1 (0.3)	-	-	-	-
<u>Selene vomer</u>	-	-	-	-	-	-	<0.1 (0.6)	-	0.9 (1.1)	-	0.9 (0.3)	-	-	-	-
Sciaenidae															
<u>Bairdiella chrysura</u>	-	-	-	-	11.5 (6.2)	-	1.4 (1.1)	-	5.8 (3.2)	11.7 (10.9)	8.8 (4.1)	2.9 (6.4)	0.4 (0.4)	-	7.0 (3.8)
<u>Cynoscion regalis</u>	-	-	-	-	-	-	0.1 (1.1)	-	-	2.7 (3.6)	0.9 (0.3)	-	-	-	-
<u>Leiostomus xanthurus</u>	-	-	-	-	-	2.6 (4.3)	17.6 (31.6)	15.7 (31.7)	0.8 (1.1)	-	0.7 (0.3)	-	-	-	24.4 (3.8)
<u>Menticirrhus americanus</u>	-	-	-	-	-	-	-	-	-	2.1 (3.6)	-	-	<0.1 (0.4)	-	-
<u>Micropogon undulatus</u>	-	-	-	-	-	1.2 (0.9)	11.2 (14.7)	11.4 (15.8)	8.8 (2.1)	1.8 (1.8)	2.9 (1.0)	-	-	-	0.6 (3.8)
Ephippidae															
<u>Chaetodipterus faber</u>	-	-	-	-	-	-	-	-	-	-	2.2 (1.8)	-	-	-	-
Scombridae															
<u>Scomberomorus maculatus</u>	-	-	-	-	-	-	-	-	0.8 (0.5)	-	-	-	-	-	-

TABLE 7 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Stromateidae															
<u>Peprilus alepidotus</u>	-	-	-	-	26.2 (6.2)	-	-	-	-	1.1 (3.6)	-	-	-	-	-
Triglidae															
<u>Prionotus tribulus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4 (0.5)	-
Bothidae															
<u>Ancyclopsetta quadrocellata</u>	-	-	-	-	-	3.2 (0.4)	-	-	-	-	-	-	-	-	-
<u>Citharichthys spilopterus</u>	-	-	-	-	-	1.8 (1.3)	0.2 (1.1)	0.2 (0.7)	0.2 (0.5)	-	-	0.2 (0.3)	0.3 (0.4)	0.2 (0.5)	-
<u>Etropus crassotus</u>	-	-	-	-	-	-	0.4 (2.3)	0.4 (2.9)	-	-	2.5 (1.0)	1.8 (3.2)	15.0 (25.7)	9.2 (21.6)	3.8 (11.5)
<u>Paralichthys dentatus</u>	-	-	-	-	-	0.3 (0.4)	-	-	-	-	-	-	-	-	-
<u>Paralichthys lethostigma</u>	-	-	-	-	-	-	0.6 (0.6)	0.7 (0.7)	-	-	5.4 (0.3)	-	-	0.9 (0.5)	-
<u>Scophthalmus aquosus</u>	-	-	-	21.1 (8.3)	-	-	-	-	-	-	0.2 (0.3)	-	-	-	-
Soleidae															
<u>Trinectes maculatus</u>	-	-	-	-	-	32.8 (53.4)	0.2 (0.6)	0.2 (0.7)	-	-	-	-	-	-	-
Cynoglossidae															
<u>Symphurus plagiusa</u>	-	-	-	-	-	0.4 (0.4)	0.8 (1.1)	0.1 (1.4)	-	-	-	2.9 (1.3)	3.1 (2.4)	0.5 (0.5)	4.4 (3.8)

TABLE 7 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Diodontidae															
<u>Chilomycterus shoepfi</u>	-	-	-	-	-	-	0.2 (0.6)	0.2 (0.7)	-	-	-	2.8 (0.3)	4.5 (0.4)	-	-
INVERTEBRATES															
Loliginidae															
<u>Loliguncula brevis</u>	0.4 (5.6)	-	-	-	-	-	0.1 (0.6)	-	0.8 (1.1)	0.1 (1.8)	0.3 (0.3)	1.3 (2.2)	-	0.1 (0.5)	-
Penaeidae															
<u>Penaeus setiferus</u>	-	-	10.0 (14.3)	-	-	39.6 (19.7)	1.1 (1.1)	0.1 (1.4)	17.9 (64.7)	7.7 (40.0)	61.1 (87.4)	39.8 (79.9)	33.0 (58.6)	38.9 (63.0)	3.0 (11.5)
<u>Penaeus aztecus</u>	-	-	-	-	-	-	2.6 (6.2)	1.7 (4.3)	2.0 (2.7)	2.7 (9.1)	-	-	0.2 (0.4)	-	-
Portunidae															
<u>Callinectes sapidus</u>	98.9 (83.3)	-	63.8 (57.1)	16.1 (8.3)	-	14.5 (3.8)	60.8 (30.6)	65.4 (36.7)	56.1 (5.3)	55.1 (14.5)	9.2 (0.8)	48.2 (6.4)	43.3 (8.0)	41.5 (11.1)	52.9 (34.6)
Squillidae															
<u>Squilla empusa</u>	0.4 (5.6)	-	-	-	-	1.9 (2.1)	0.1 (0.6)	0.1 (0.7)	0.1 (0.5)	0.2 (1.8)	0.2 (0.3)	-	0.1 (0.4)	0.2 (0.3)	-
Others	-	-	-	-	-	-	0.2 (0.6)	0.3 (0.7)	-	-	-	-	-	-	-
Total Number of Specimens	18	3	7	12	32	234	177	136	182	53	388	314	249	208	26
Total Biomass (g)	489.5	165.5	65.0	19.9	347.0	2503.9	4925.8	—	12876.8	—	4886.6	4274.9	3921.4	2676.3	357.9

TABLE 8

Percentage of total biomass and quantity contributed by each species at station B3 during the period November, 1970 through December, 1971. (Top number = biomass percentage, number in parentheses = percentage quantity, BD = Before Dredging, DD = During Dredging, AD = After Dredging.)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
VERTEBRATES															
Sphyrnidae															
<u>Sphyrna lewini</u>	-	-	-	-	-	-	-	-	-	-	3.6 (0.1)	-	-	-	-
Dasyatidae															
<u>Dasyatis sabina</u>	-	-	-	39.2 (1.9)	23.2 (2.5)	-	-	-	-	-	-	-	-	-	-
Myliobatidae															
<u>Rhinoptera bonasus</u>	-	-	-	-	-	59.2 (0.7)	-	-	-	-	-	-	-	-	-
Clupeidae															
<u>Brevoortia tyrannus</u>	-	5.3 (3.0)	-	2.5 (3.7)	-	-	-	-	-	-	-	-	-	-	-
Engraulidae															
<u>Anchoa hepsetus</u>	-	-	-	-	0.9 (7.6)	-	2.4 (7.9)	93.2 (93.1)	11.0 (17.2)	0	<0.1 (0.1)	-	-	-	-
<u>Anchoa mitchelli</u>	12.3 (66.7)	1.2 (15.2)	-	1.7 (25.9)	1.1 (41.8)	0.2 (18.1)	6.5 (38.1)	6.8 (6.9)	5.5 (62.1)	0.3 (6.2)	0.1 (1.9)	0.1 (1.2)	<0.1 (1.4)	-	-
Synodontidae															
<u>Synodus foetens</u>	-	-	-	-	-	-	0.9 (0.3)	-	-	-	0.2 (0.1)	-	-	-	-
Ariidae															
<u>Arius felis</u>	-	-	-	-	-	0.9 (5.4)	3.5 (1.5)	-	-	16.5 (15.6)	2.0 (0.6)	0.1 (0.2)	-	-	-

TABLE 8 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Batrachoididae															
<u>Opsanus tau</u>	-	-	-	-	-	-	-	-	-	-	-	-	6.8 (1.4)	-	-
Gadidae															
<u>Urophycis regius</u>	-	-	-	4.1 (7.4)	0.5 (1.3)	-	-	-	-	-	-	-	-	-	-
Cyprinodontidae															
<u>Fundulus heteroclitus</u>	-	-	1.4 (12.5)	-	-	-	-	-	-	-	-	-	-	-	-
Pomatomidae															
<u>Pomatomus saltatrix</u>	-	-	-	-	1.6 (2.5)	-	-	-	-	-	-	-	-	-	-
Carangidae															
<u>Chloroscombrus chrysurus</u>	-	-	-	-	-	-	-	-	-	-	<0.1 (0.1)	0.3 (0.8)	-	-	-
<u>Selene vomer</u>	-	-	-	-	-	-	0.1 (0.6)	-	-	-	-	-	-	-	-
Sparidae															
<u>Lagodon rhomboides</u>	-	-	-	-	-	-	-	-	-	-	-	0.4 (0.2)	-	-	-
Sciaenidae															
<u>Bairdiella chrysura</u>	79.8 (16.7)	5.7 (3.0)	0.5 (12.5)	-	-	0.1 (1.1)	2.7 (0.6)	-	55.0 (6.9)	54.7 (9.4)	0.5 (0.2)	2.6 (1.4)	-	-	-
<u>Leiostomus xanthurus</u>	-	62.6 (27.3)	-	9.1 (7.4)	4.1 (3.8)	3.9 (30.3)	43.7 (22.3)	-	7.5 (3.4)	2.0 (3.1)	0.4 (0.4)	-	-	-	-
<u>Menticirrhus americanus</u>	-	-	-	-	-	-	-	-	-	-	-	-	0.4 (2.8)	-	-

TABLE 8 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Sciaenidae (cont'd)															
<u>Micropogon undulatus</u>	-	-	-	0.3 (1.9)	-	0.2 (1.8)	15.7 (7.3)	-	-	12.2 (15.6)	0.2 (0.1)	-	-	-	-
Ephippidae															
<u>Chaetodipterus faber</u>	-	-	-	-	-	-	-	-	-	-	0.4 (0.7)	-	-	-	-
Mugilidae															
<u>Mugil cephalus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6 (1.0)	-
Scombridae															
<u>Scomberomorus maculatus</u>	-	-	-	-	-	-	0.5 (0.3)	-	13.9 (6.9)	3.3 (6.2)	-	-	-	-	-
Stromateidae															
<u>Peprilus alepidotus</u>	-	-	-	2.6 (1.9)	-	-	-	-	-	3.5 (9.4)	-	0.2 (0.2)	-	-	-
Triglidae															
<u>Prionotus evolans</u>	-	-	-	0.8 (3.7)	0.5 (2.5)	0.2 (1.8)	1.2 (0.3)	-	-	-	0.1 (0.2)	-	-	-	-
Bothidae															
<u>Ancyclopsetta quadrocellata</u>	-	0.7 (3.0)	2.0 (25.0)	13.1 (11.1)	4.4 (12.7)	0.2 (0.7)	-	-	-	-	-	-	-	-	-
<u>Citharichthys spilopterus</u>	-	-	-	0.9 (1.9)	0.2 (1.3)	< 0.1 (0.4)	-	-	-	-	0.3 (0.2)	-	-	-	-
<u>Etropus crassotus</u>	-	-	-	-	-	-	-	-	-	-	0.2 (0.4)	-	11.5 (28.0)	31.1 (44.2)	26.8 (50.0)
<u>Paralichthys dentatus</u>	-	-	-	-	-	-	0.3 (0.3)	-	-	-	0.2 (0.1)	-	-	-	-

TABLE 8 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Bothidae (cont'd)															
<u>Paralichthys lethostigma</u>	-	-	28.2 (12.5)	-	-	2.5 (1.4)	-	-	-	-	1.1 (0.4)	-	-	-	-
<u>Scophthalmus aquosus</u>	-	-	-	1.9 (9.3)	-	-	-	-	-	-	-	-	-	-	-
Soleidae															
<u>Trinectes maculatus</u>	-	-	-	-	-	0.1 (1.1)	-	-	-	-	-	-	-	-	-
Cynoglossidae															
<u>Symphurus plagiatus</u>	-	-	-	-	-	0.2 (1.1)	-	-	-	-	<0.1 (0.1)	0.2 (0.2)	-	-	-
Balistidae															
<u>Monocanthus maculatus</u>	-	-	-	-	-	-	-	-	-	-	<0.1 (0.1)	-	-	-	-
Tetraodontidae															
<u>Sphoeroides maculatus</u>	-	-	-	-	-	-	-	-	-	-	<0.1 (0.1)				
Diodontidae															
<u>Chilomycterus shoepfi</u>	-	-	-	-	-	-	0.4 (0.6)	-	-	-	<0.1 (0.1)	2.3 (0.3)	-	-	-
INVERTEBRATES															
Loliginidae															
<u>Loliguncula brevis</u>	-	-	-	1.2 (5.6)	-	1.5 (10.5)	11.9 (15.8)	-	-	7.4 (34.4)	0.7 (0.6)	0.4 (1.2)	-	0.4 (1.0)	-

TABLE 8 (cont'd)

Classification	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
Penaeidae															
<u>Penaeus setiferus</u>	-	2.1 (3.0)	3.8 (25.0)	2.1 (3.7)	0.1 (1.3)	3.9 (18.1)	-	-	-	-	74.9 (90.9)	89.8 (94.2)	25.7 (52.4)	37.2 (41.2)	4.0 (10.0)
<u>Penaeus duorarum</u>	-	1.3 (3.0)	-	-	-	<0.1 (0.4)	-	-	-	-	-	-	-	-	-
<u>Penaeus aztecus</u>	-	-	-	-	-	-	3.1 (2.3)	-	-	-	< 0.1 (0.2)	-	0.5 (2.8)	-	-
Portunidae															
<u>Callinectes sapidus</u>	7.8 (16.7)	19.0 (30.3)	64.2 (12.5)	20.5 (14.8)	63.4 (22.8)	6.7 (6.5)	6.6 (1.2)	-	7.1 (3.4)	-	14.7 (2.1)	3.6 (0.3)	48.4 (9.1)	30.6 (12.4)	61.6 (30.0)
Squillidae															
<u>Squilla empusa</u>	-	1.1 (3.0)	-	-	-	-	0.5 (0.6)	-	-	-	0.3 (0.6)	-	0.1 (1.4)	-	-
Xiphosuridae															
<u>Limulus polyphemus</u>	-	-	-	-	-	19.9 (0.7)	-	-	-	-	-	-	-	-	7.6 (10.0)
Others	-	0.9 (9.1)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Number of Specimens	6	33	8	54	79	277	341	29	32	32	1603	657	143	97	10
Total Biomass (g)	33.2	375.9	480.9	1301.6	4695.3	33781.6	3397.8	—	6049.0	—	23897.3	8858.2	3461.2	1548.2	140.6

TABLE 9

Diversity indices based on the relationship $\text{diversity} = \text{number of species} / \log_{10} \text{total number of individuals}$ for each sampling station during the period November, 1970 through December, 1971. BD = before dredging, DD = during dredging, AD = after dredging.

Station	Nov 70	Dec 70	Jan 71	Feb 71	Mar 71	Apr 71	May 71	Jun 71	Jul 71 BD	Jul 71 DD	Jul 71 AD	Aug 71	Sep 71	Oct 71	Nov 71	Dec 71
A1	1.4849	1.9107	2.8854	1.4427	1.1761	0.0000	1.7212	1.8151	1.2361	1.6288	1.2875	1.1461	1.0006	0.9939	1.2511	1.7297
A2	2.6461	2.8854	2.7906	2.7307	1.9708	0.0000	2.6705	1.7130	1.6133	NC	2.6638	1.9471	1.1769	1.2022	1.5533	1.2022
AC	2.2992	2.8854	NS	2.1640	2.4742	1.8879	1.6831	2.0609	2.7453	2.8486	2.3745	1.1379	1.1774	1.3742	1.6743	1.2477
AD	2.7307	1.1162	0.7213	1.3554	1.3692	2.8854	1.3813	2.8415	1.5715	1.6681	1.0766	0.8686	0.7708	1.3933	2.7291	NS
B1	NC	1.8728	3.3381	2.1485	2.3699	1.5842	3.1912	3.0493	2.8439	2.6989	2.6887	2.2785	1.1530	1.3942	1.7121	1.6690
B2	NC	1.3839	0.9102	2.0556	1.2073	1.1542	2.0164	3.6707	2.8372	4.5587	2.9945	2.5164	1.5654	1.9937	2.2482	2.4554
B3	NC	1.6743	2.8600	2.8854	3.5097	2.5175	3.0228	2.7435	0.5939	3.3216	2.3083	3.2522	1.6955	1.8135	1.0930	1.7372

NC = No Collection

NS = No Specimens in Sample

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TABLE 10

Diversity indices based on the relationship $H = \sum p_i \ln p_i$, where H = diversity and p_i is the frequency of species i for each station during the period January through December 1971. (BD = before dredging, DD = during dredging, AD = after dredging)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul BD	Jul AD	Jul DD	Aug	Sep	Oct	Nov	Dec
A1	0.6931	0.0000	0.9882	0.0000	1.3854	1.6597	0.7786	0.7067	1.2875	0.1426	0.7251	0.5725	0.7595	1.0986
A2	1.5607	1.0986	1.7413	0.0000	1.8033	1.3882	0.8992	NC	0.4801	0.8638	0.9536	1.0329	1.1403	0.7454
AC	NS	1.0397	1.5680	1.4299	0.7065	1.4525	1.6581	0.8288	2.3745	0.4037	0.3477	0.7219	1.0114	1.0916
AD	0.0000	0.9117	0.9398	0.6931	0.7996	2.0321	0.9933	1.0336	1.0766	0.6730	0.4567	0.5143	1.6924	NS
B1	2.0820	1.4770	1.5849	0.8334	2.1952	2.0135	2.0169	2.3861	0.7996	0.8881	0.4538	0.8290	0.8913	1.1752
B2	0.0000	1.1537	0.5661	1.0129	1.4312	1.9082	1.6576	2.4625	1.9502	0.6530	0.8435	1.1879	1.0968	1.7201
B3	2.8600	2.8854	3.5097	2.5175	3.0228	2.7435	0.2510	1.8881	1.8459	3.2522	2.6955	1.8135	1.0930	1.7372

NS = No Specimens in Sample

NC = No Collection