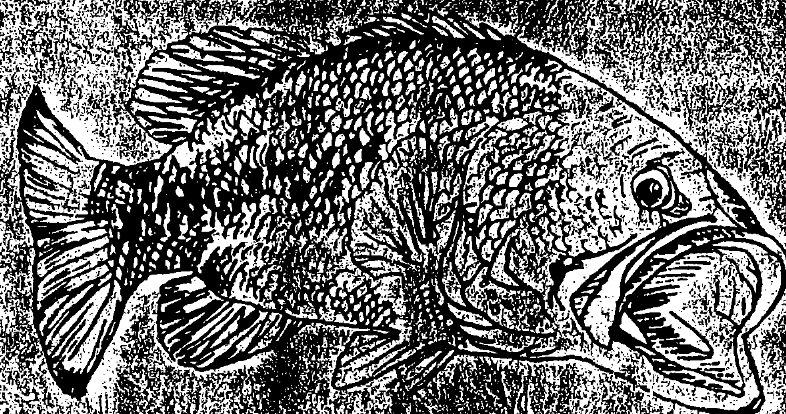
BACK BAY-CURRITUCK SOUND DATA REPORT



Fish Studies

COOPERATIVE STUDIES 1958 - 1964

BY: BUREAU OF SPORT FISHERIES AND WILDLIFE
NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
VIRGINIA COMMISSION OF GAME AND INLAND FISHERIES

BACK BAY - CURRITUCK SOUND DATA REPORT

Fish Studies; Volume 4

This data report is the fourth and final volume of data and preliminary analysis of data on the cooperative study of the ecology of Back Bay, Virginia, and Currituck Sound, North Carolina, from 1958 through 1964. The other volumes released this year were: Volume 1, Introduction and Vegetation Studies; Volume 2, Waterfowl Studies; and Volume 3, Environmental Factors.

Unlike the first three volumes, most of the material contained herein was prepared as Dingell-Johnson reports by each of the cooperating States; hence the organization differs. The Back Bay fish data are presented first; and the. latter half of the report presents the Currituck Sound fish data. Integration of all creel data, rotenone data, etc. 'would have required unjustified retyping, re-pagination, and cost and effort beyond the purpose of this assemblage of data.

This report is not a publication. A condensation of the four volumes will be prepared for publication satisfactory to the three agencies.

Hopefully; I speak for all in reiterating that the investigation of Back Bay and Currituck Sound was conducted without personal bias. The sole purpose was to determine important aspects of the ecology of the area so that the-knowledge could be applied to the most.effective management of waterfowl and fish. -The political and social ramifications that invariably shape policy decisions on desirable biological managementwerenot within the scope of this investigation.

June 1966

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Title: Rack Ray Fishery Investigations

Period Covered: July 1, 1959 - June 30, 1962

Objectives:

1. To investigate the current status and trends of the largemouth bass fishery at Rack Bay, Virginia.

2. To study the effects of increased salinities or other future waterfowl management proposals on largemouth bass and other fresh water fish found in the Back Bay area.

3. To investigate the productivity of bottom fauna in relation to various bottom types and turbidities.

Abstract:

A fishery investigation was initiated on Back Bay in 1959 to investigate the current status and trends of the largemouth bass fishery; to study the effects of increased salinities or other future waterfowl management proposals on largemouth bass and other fresh water fish found in the Rack Bay area; and to investigate the productivity of bottom fauna in relation to various bottom types and turbidities.

A creel census conducted during the period June-October in 1951 and 1959, and Hay-October, 1960 and 1961 indicated that largemouth bass and white perch are the most heavily harvested species by sport fishermen. Fishermen success was high during these four years. Natural bait fishermen caught fish more often than did artificial bait anglers, but the artificial bait angler, as a rule, caught more fish per trip than did the natural bait fisherman. In addition to catching more fish .per trip; the artificial bait anglers were also more successful in catching bass.

Nay and June are the peak months for bass fishing with approximately one-half of the bass harvest occurring in these two months. After June bass fishing success declines and is lowest in September and October. Fishing pressure follows a similar pattern.

At present the bass population appears to be expanding following a reportedly severe winter kill during the winter of 1958-59. The numerical harvest. of bass increased from approximately 12,000 in 1959 to about 24,000 in 1960 and 1961. Harvest of this species according to weight increased from slightly over 14,000 pounds in 1959 to 29,000 pounds in 1960 to over 30,000 pounds in 1961.

Total harvest of fish and fishing pressure have increased considerably since 1951. Harvest of all species has increased from 0.5 fish per acre in 1951 to 1.13 per acre in 1961. Harvest of bass has increased from 0.3 per acre in 1951 to 0.9 in 1961. Accompanying this increase in harvest; there was a corresponding increase in fishing pressure, from about one angler per acre in 1951 to over two fishermen per acre in 1961.

In order to gain some insight into the productive capacity of Back Bay, in terms of bass, total bass harvest figures were obtained from the U. S. Fish and Wildlife Service files pertaining to the commercial harvest of this species during the period 1901-1930. The commercial harvest of bass ranged from 75,000 pounds to over 300,000 pounds. Since then, several changes in the environment have taken place which undoubtedly have caused the bass habitat to deteriorate. The major influence appears to have been the introduction of silt from farm land drainage, causing considerable turbidity in Back Bay.

Aerial fishermen counts revealed that approximately 90 percent of the fishing pressure was confined to about 40-46 percent of Back Bay, This area of heavy fishing pressure was also the most productive area in terms of waterfowl food plants and lowest in turbidity. The areas of low fishermen utilization were also lowest in plant productionand most turbid.

During February and March, 1960 and 1961, 3,737 largemouth bass were tagged and released in various areas of Back Bay. During these tagging operations, the observed handling mortality, prior to tagging (24-48 hours), was light and seemed to be correlated with water temperatures. At water temperatures less than 46° F. mortality ranged from four to eight percent; while, at temperatures above 46° F. mortality was reduced to zero, No mortality was observed among tagged bass placed in a small pond.

Commercial fishing records were obtained for the years 1944-1960. These records indicate that the average-yearly harvest of commercial species from Back Bay was about 314,103 pounds (range - 109,567-498,396 pounds) valued at approximately $19,665 per year (range - $9,520-34,202). The predominant species taken was carp followed by perch (white and yellow), The effect of this commercial fishery on the management of Back Bay is probably minor; although, 'it may aid in the control of the carp population.

Bioassays were conducted to determine the tolerance of largemouth bass and bluegill sunfish to various concentrations of ocean water. These bioassays indicated that the 96-hour TLm was approximately 14,000 p.p.m. NaCl (43 percent of sea strength) for both bass and bluegill. Investigation also revealed that bass could survive for periods of at least 89 days in concentrations as high as 9,600 p.p.m. NaCl (30 percent of sea strength). Bluegill survived for a similar period at a concentration of 6,250 p.p.m. NaCl (19 percent of sea strength).

Analysis of bottom samples obtained during 1960-61, indicated that at least 14 orders of invertebrates were present in the Back Bay-Currituck Sound area; of which, eight orders were routinely collected in Back Bay. The most abundant organisms were the Amphipoda followed by Tendipedidae. Production of bottom fauna was noted to increase from north to south. Average production in Back Bay, from the October sample was 0.122 grams per square foot of bottom, while that from Currituck Sound was 0.414 grams per square foot. This increase in production of bottom fauna from north to south is accompanied by a higher production of aquatic vegetation and a more desirable nutrient balance which may be correlated with a progressive increase in salinity from north to south.

The effect of increased salinity on Back Bay may soon be known since a March (1962) storm caused ocean water to flow into Back Bay and Currituck Sound raising the salinity to 12-15 percent of sea strength. Studies are presently being conducted to evaluate the effects of this ocean water intrusion.

RESULTS

Description of the Area

Back Bay is located in Princess Anne County, approximately on the Virginia-North Carolina line.[1] It is the northern most of the series of inland waters which includes Currituck, Pamlico and Albemarle Sounds in North Carolina. It is separated from the ocean only by a narrow barrier beach varying in width from one-fourth mile to one mile.

Back Bay consists of approximately 27,000 acres of open water and marsh ponds. The largest body of open water within the area is Back Bay proper with an area of about 10,000 acres. The depth of the bay is, in general, shallow, averaging about three feet.

Wind is the major factor affecting the water levels of the bay. Persistent northerly winds may lower the water level as much as one to two feet; while, persistent southerly winds have the opposite effect. This wind action also has a pronounced effect on turbidity. Since the bay is so shallow wind action frequently causes the bottom to be stirred up to such an extent as to create considerable turbidity. This wind action probably has an effect on water temperatures by keeping the water in almost constant circulation. Weekly maximum-minimum water temperatures recorded from August 8, 1959 through June 6, 1960 indicate fluctuations of as much as 20° F. during a weeks time.

Temperatures and water levels of the bay could have a greet influence on the fish population. Extreme temperature and water level changes during the spawning seasons of bass and carp could severely reduce spawning success, although this has never been observed. Water levels appear to have a great influence on the distribution of the fish. Many of the ponds during low water are practically dry, which would concentrate the fish in deeper areas. This appears to actually be the case since during tagging operations bass appeared to be concentrated during low water and seine hauls of 25-300 bass could be made, while during periods of high water seine hauls of over eight-ten bass were seldom made.

The species of fish found in Back Bay, as recorded from rotenone samples, creel records and commercial fishing records are as follows :

Fresh water

Amiidae
Bowfin, Amia calva
Anguilladae
American eel, Anguilla rostrata
Centrarchidae
Largemouth Black Bass, Micropterus salmoides
Black Crappie, Pomoxis nigro-maculatus
Bluegill, Lepomis machrochirus
Pumpkinseed, Lepomis gibbosus
Bluespotted Sunfish, Enneacanthus gloriosus
Cyprinidae
Carp, Cyprinus carpio
Golden Shiner, Notemigonus crysoleucas
Cyprinodontidae
Eastern Banded Killifish, Fundulus diaphanus
Esocidae
Chain Pickeral, Esox niger
Redfin Pickeral, Esox americanus
Ictaluridae
Yellow Bullhead, Ictalurus natalis
Black Bullhead, Ictalurus melas
Channel Catfish, Ictalurus punctatus
White Catfish, Ictalurus catus
Lepisosteidae
Longnose gar, Lepisosteus osseua
Percidae
Yellow Perch, Perca flavescens

Salt-Brackish water

Atherinidae
Atlantic silversides, Menidia menidia
Tidewater Silversides, Menidia beryllina
Rough Silversides, Membras mertinica
Belonidae
Atlantic Needlefish, Strongylura marina
Clupeidae
Gizzard Shad, Dorosoma cepedianum - fresh water
American Shad, Alosa sapidissima - not verified
Alewife, Alosa pseudoharengus - not verified
Menhaden, Brevortia tyrannus
Elopidae
Ten pounder, Elops saurus

pressure from the docks, Y = total number of parties, and X = the number of parties which were checked at creel liveries. This ratio was 1.7 for all months of 1959 and varied from 2.0-4.2 in 1960 and from 1.7-4.3 in 1961. The estimate of total fishermen, fishermen hours and total catch was then determined by multiplying monthly ratios by the known number of fishermen; fishermen hours and catch. In order to use these ratios, it was assumed that persons using the creel liveries and those not using the creel liveries fished the same mean length of time per day and the same mean catch per hour. During September and October 1959, and October 1961, no aerial reconnaissance was conducted, thus the ratios obtained during September and October, 1960 were used to expand the data obtained during these months.

Comparison of the creel data obtained during 1951, 1959, 1960 and 1961. gives some indication to the present status and trend of the Back Bay largemouth bass fishery. Data secured in 1951, while taken during a previous project, was obtained in a similar manner and is thus comparable to data taken in 1959, 1960 and 1961 (Appendix 1, Table 1). Although no creel data is available for April and May, 1959; this data has been estimated (Table 1) in order to compare monthly and seasonal total numbers of fishermen? hours fished, total number of fish caught, total number of bass caught, and rate of catch, with that obtained for these months of 1960 and 1961. These figures were arrived at by determining the average portion of the totals that were made up by April and May, 1960 and 1961. These averages were then used to expand the 1959 data. While the 1959 expansions may not be entirely accurate, it is felt that they give a truer estimate of the 1959 season's total pressure and harvest than do the June through October estimate. The 1951 data has not been expanded; since, at that time a 10-inch size limit was in force and the season did not open until June 1. Thus the data appearing in Table 1 is probably a reasonably accurate estimate of the 1951 harvest and pressure.

Largemouth bass and white perch are the species most often caught in Back Bay (Appendix 1, Table 2). Although largemouth bass has the reputation of being the most sought after species in the bay, the catch of white perch quite often approximates that of bass, and occasionally exceeds it (1959). A partial creel census conducted in 1952 (Appendix 1, Table 3) also indicates that at least in the southern portion of the bay, the catch of white perch exceeded that of bass (bass, 31 percent of the total; white perch about 37 percent). The catch of white perch is probably directly related to their availability and excellent palatibility rather than to their sporting value. When abundant, catches of over 100 white perch per party have been recorded. Angling for this species is done, primarily, by local residents for table use. Other desirable species of lesser importance are bluegill, black crappie and the various species of catfish. With the exception of black crappie, angling for the above species is done by a relatively few anglers. Crappie fishing appears to be gaining in importance, particularly since this species is most easily caught early in the spring before bags fishing has started and at a time when anglers are anxious to start fishing after the long winter months.

During the four years for which creel data for the entire bay is available, angling success ranged from 75 percent in 1951 to 76 percent in 1959 to 79 percent in 1960 to 81 percent in 1961. Live or natural bait fishermen had a slightly higher rate of success than did artificial (one-six percent higher). Although more natural bait fishermen caught fish than did artificial bait fishermen, the artificial bait angler caught more fish per trip (Appendix 1, Table 4). Only in 1959 (June - October) did the angler using natural bait catch more fish than did the artificial bait angler (natural bait, 0.61 fish per hour; artificial bait, 0.36 fish per hour), During all years in which the creel census was conducted, the angler using artificial bait consistantly caught more bass than did the fisherman using natural bait. These figures are probably somewhat biased toward the artificial bait user, since a certain number of natural bait fishermen fished for species other than bass; thus, making the bass catch per hour on natural baits somewhat low. This is not thought to be too important since the number of anglers fishing for species other than bass is reportedly small.

Fishing pressure and harvest are highest in the spring and then begin to decline in June, becoming lowest by October (Appendix, Table 1). Rate of catch follows a similar pattern but does not decline as sharply during the summer months (June, July and August) as does pressure and harvest. The peak fishing month is May, with June the second top month. In May of 1960 about 800 more fishermen fished than in June, but the rate of catch was about the same for both months. Contrasting to 1960, approximately 500 more fishermen fished in May 1961 than in June, but the June rate of catch was considerably less than was May's.

At present the Back Bay largemouth bass fishery appears to be expanding following reportedly severe winter kill during the winter of 1958-59. The total numerical bass harvest has increased from 12,035 in 1959 to 23,890 in 1960 and then decreased slightly to 23,658 in 1961 (Appendix, Table 1). This increase accompanied an increase in fishing pressure. Approximately 3,000 more fishermen in 1960 harvested about 11,000 more bass than in 1959. About 1,000 additional anglers in 1961 harvested approximately 11,000 more bass than in 1959. Thus, 1961 was the most productive of the three years censused in terms of number of bass per angler. This may also be observed when rates of bass harvest for the three years are compared. The rate of bass harvest increased from 0.21 bass per hour in 1959 to 0.33 in 1960 and to 0.37 in 1961.

Although, the numerical harvest of bass decreased by about 200 bass from 1960 to 1961, the weight of bass harvested increased by over 1,600 pounds (Appendix, Table 5). This appears to have been brought about by an increasing number of larger bass being creeled in 1961. This may be illustrated by comparing the percent harvest of bass 13-18 inches in total length (Appendix, Table 5). During 1959 this group made up about 47 percent of the harvest; in 1960, 50 percent (three percent increase over 1959) and in 1961 they represented 60 percent of the catch (13 percent increase over 1959 and 10 percent over 1960). This increased catch of bass 13-inches and over in 1961 was accompanied by a decrease in the harvest of 10 and 11 inch fish,

Total harvest of fish and total fishing pressure have increased considerably since Roseberry's study (1952) on Back Bay in 1951 and 1952. Harvest of fish of all species increased from 0.51 per acre in 1951 to 0.94 in 1959, to 1.06 in 1960, and to 1.13 in 1961 (Appendix, Table 6). The harvest of bass exhibited a similar increase, from 0.30 per acre in 1951 to 0.45 in 1959, to 0.89 in 1960, and remained about the same in 1961 (0.88). Accompanying this increase in harvest there was a corresponding increase in fishing pressure, which except for 1961, approximated the increase in harvest. In 1961 the harvest of bass was about equal to that of 1960 'but pressure declined from 2.7 hours per acre in 1960 to 2.24 in 1961, indicating that fishing success was somewhat better in 1961.

In order to gain some insight into the productive capacity of Back Bay in terms of bass, total bass harvest figures were obtained from the U. S. Fish and Wildlife Service files pertaining to the commercial harvest for certain years during the period 1901-1930 (Appendix, Table 7). From table seven, it may be seen that under ideal conditions harvest of bass could be as high as 13-pounds per acre (1920 and 1921). However, since harvests such as these have occurred several changes in the environment have taken place which undoubtedly have caused the bass habitat to deteriorate. Bourn (1932) states the decline in bass harvest ai'ter 1921 was due to pollution in the form of salty-turbid water entering through the opened locks of the Chesapeake-Albemarle canal (which has since been closed), Other factors which have probably contributed to any reduction in bass habitat include farm land drainage which introduces considerable silt and resulting turbidity into the bay yearly; and wave action on island shorelines which also contributes to turbidity, Secchi disc readings for various areas of Back Bay from December, 1958 through February, 1960 are presented in table eight (Appendix) to illustrate the amount of turbidity in the bay, From this it may be seen that the limit of visibility is greatest in North Bay, followed in order by Shipps Bay, Buzzard Bay and Back Bay. The period March through May appears to be the period of greatest turbidity. This is probably caused by the increased frequency of northeast storms during March and often in April which have a tendency to keep the bottom stirred up almost continually during this period. Also, at this time of year water temperatures are low and viscosity of the water is high which would tend to keep silt #suspension during a longer period, The area of lowest secchi disc readings was Back Bay proper which comprises approximately 37 percent of the entire area, During pine months of the year the limit of visibility was less than 20-inches in this area, Thus, this low limit of visibility could be expected to have considerable effect on the productivity in general.

While analyzing aerial fishermen counts, it was noted that most of the anglers were concentrated on only a small portion of Back Bay (Figures 1 and 2, Appendix). This heavily fished area comprised the following areas : North Bay, Shipps Bay, Buzzard Bay, and Southwest Cove. During the entire creel period, 1,010 were counted on Back Bay during 1960 and 810 boats in 1961. Of these, 900 boats (89 percent) were found on 46 percent of the surface area of the entire bay in 1960 and 730 boats (90 percent) were found on 40 percent of the surface area in 1961. These areas of heavy fishing pressure consisted of approximately the same areas during both years. From this it is assumed that approximately 90 percent of the fish are caught in 40-45 percent of Back Bay annually.

It was also noted that these areas of heaviest utilization were also the most productive areas in terms of waterfowl food plants and lowest in turbidity. The areas of light fishermen usage were areas of poor plant production and also most turbid. The major difference between the two areas is in the amount of open water which is subject to prolonged wind action. The more productive areas consist of small ponds and coves and larger bays which are partially protected by surrounding land masses from strong winds and resulting turbidity, while in the less productive areas the reverse is true. Another important factor is the differing amount of bass habitat between the two areas. The heavily fished area, consisting of small ponds coves, and large bays has a greater amount of shore line per surface acre of water (40-feet per surface acre water) than does the lightly fished area (18-feet per surface acre of water). It also has numerous beds of submerged vegetation which produces an "edge" type habitat similar to that of shorelines, while the less used area is nearly void of vegetation. From personnel experience and from interviews with fishermen it appears that most of the bass are caught either at the shorelines during high water or in the vicinity of submerged vegetation during low water, Thus, it would seem that preferred bass habitat in Back Bay consists of shorelines and the edge of submerged vegetation beds, Tagging

During February and March, 1960 and 1961, 3,737 largemouth bass were tagged and released in various areas of Back Say (1,867 in 1960 and 1,874 in 1961). This took place as follows: 1960 - 279 in the False Cape-Cedar Island area, 754 in the Buzzard Bay-Southwest Cove area, 712 in the Buck Island Bay-Fishers Cove-Sand Bay area, and 66 in North Bay (Appendix, Figure 3). During 1961 the following were tagged: 538 in duck Island Bay, 579 in Shipps Bay, 507 in the Buzzard Bay-Southwest Cove area, 153 in the vicinity of Little Cedar Island, 41 in Bonney's Cove, 56 in the Otter Pond-House Cove area (Appendix, Figure4).

All bass were tagged by placing a serially numbered monel-metal jaw tag over the maxillary and premaxillary. After each fish was tagged the tag number and location where released were recorded, All tagged fish were released in the area where tagged, In addition total lengths were recorded for approximately one-half of the fish tagged in 1960 and for all of the fish tagged in 1961. During 1960, fisn were tagged and released immediately after being caught and it was noted that most of the fish were in a weakened condition when released (floated beliy-up for a few minutes before swimmina away), particularly when water temperatures were in the low 40's (°F.) Obscrvntions on fish placed in a small pond indicated that mortality was 10-28 percent depending on water temperatures. During 1961 fish were captured, held in a live car overnight, and tagged the following day. By following this procedure all fish released appeared in good condition (swam away immediately on being released), regardless of water temperature.

During 1960 number three tags were used on fish 10-15 inches in total length and number four tags on larger fish, At this time it was noted that number four tags did not allow the mouth of fish 18-inches and over to open to maximum width. Thus, in 1961, number three tags were used to tag fish 10-14.5 inches, number four tags for fish 14.6-17.5 inches and number five tags for fish 17.6-inches and larger, Number five tags appeared to be somewhat small for fish over 20-inches in total length; but, since fish of this size appeared in such small numbers (five), the fit of tags on these fish was not deemed important.

To aid in recover,- of tags posters describing the study were placed in conspicuous locations, news releases were put out to local newspapers and to one television station. Also, creel clerks were instructed to record tag numbers, total length, and area where caught, of all tagged fish checked, To determine the effects of tagging and handling at various water temperatures during the 1960 tagging operations, 56 tagged bass were placed in farm ponds and observations were made daily for indications of mortality. Thirty-six of these fish were released when the water temperature was 42° F. and 20 were released when the water temperature was 60° F.

Of the fishreleased when the water temperature was 42° F., ten fish (28 percent) were found dead within ten days after being placed in the pond. Of those tagged and released when water temperature was 60° F., two fish (10 percent) were found dead. Both groups of fish were caught by the same fishermen and in the same area. Tagging and handling after the fish were caught were the same. Thus, the ca-use of mortality was probably handling when water temperatures were low and at a time when the fish's metabolism was at a very low level. This mortality was probably somewhat higher than the actual tagging mortality on the bay, since the fish placed in the ponds were subjected to additional handling than were those tagged and released directly into the bay.

In 1961 bass were caught and held *in* a wooden boat shaped live-car approximately 10 feet in length, two feet deep, and three feet in width at the widest point, for 24-48 hours prior to tagging, After the fish were tagged all dead fish remaining in the live-car were counted, measured, and recorded along with the existing water temperature, Thus, mortality due to seining at various water temperatures was obtained. It is realized that some of this mortality may have been due to crowding the fish in the live-car but this was thought to have been negligable.

Mortality appeared to be highest at water temperatures below 44° F. (nine percent), except for those fish caught on February 7 (Appendix, Table 9). Fish caught on this date were exposed to a severe storm on the afternoon of February 8 of about six hours duration and winds up to 25 miles-per-hour, which is thought to have been responsible for the high mortality among this group of fish. As water temperatures rose from 44° to 46° F. mortality was reduced approximately 50 percent and no mortality was experienced at temperatures above 46° F.

From this, an indication of the mortality resulting from commercial fishing operations may be obtained. Thus, commercial fishermen may cause a mortality among bass of four to nine percent when fishing at water temperatures of less than 48° F. This mortality may be increased if bass are repeatedly caught in seines during these low temperatures. Above 48° F. commercial fishing probably causes little or no mortality, particularly as the water temperature continues to rise and the bass are caught increasingly less frequently as has been observed on frequent occasions.

On different occasions several fish were tagged and placed in a small pond to observe, tagging and handling mortality in addition to seining mortality. Daily observations, were made to detect dead fish and the pond was later seined and recovered fish were recorded and released in the bay, None of these fish were observed dead in the pond at any time.. Three seine hauls were made in the pond on each of three different days and tagged bass removed and tag numbers recorded (Appendix, Table 10). A total of 94 bass were placed in the pond and of these 81 (86 percent) were later recovered. Thus, the maximum possible mortality from handling while tagging was 14 percent. Since it is known that not all tagged bass remained in the pond (one tagged basa recovered from the bay); this mortality was probably much less and may have been close to zero since the last two groups of fish placed in the pond were exposed to only three seine hauls and recovery of bass exposed to all nine hauls was) in general, over 90 percent. During June it was reported that fishermen had removed several tagged bass from this pond, and on August 21 two additional seine hauls were made in the pond, No tagged bass were recovered from either of these hauls. At this time it was also noted that the screen used to block the outlet had worked loose enough to permit fish to escape from the pond. Thus, no further information was obtained regarding mortality due to handling of bass at the various water temperatures.

During 1961 a limited amount of information was obtained regarding the possible effects of tags on bass over several months time. While investigating tagging and handling mortality in the small pond, three bass were recovered which had been tagged the previous year. One bass was dead and in an emaciated condition and measured 0.7 inches less than when tagged. Of the remaining two, one was the same length as when tagged and the other measured 0.4 inches less than when tagged. These bass had all been tagged for approximately one year, During the summer of 1961 two additional tagged bass were recovered from the bay. One of these bass had been tagged for three and one-half months and was 0.3 inches longer than when tagged. The remainingbass had been tagged four months and was 0.4 inches shorter than when tagged and was in an emaciated condition. On the surface it would seem that the presence of the metal jaw tags interfered with feeding and growth and ultimately caused death. However, emaciated untagged bass similar to those tagged bass mentioned above have been occasionally observed from Back Bay and other waters indicating that emaciation and loss in length may not have been caused entirely by the presence of tags, but may have been related to natural mortality.

A total of 235 tagged bass were recorded as being caught in 1960 and 264 in 1961, of which 49 returns were from the 1960 tagging operations.

Of these, only 132 tags were returned to the Richmond office in 1960 and 136 in 1961 for the one dollar reward. The probable reasons for this low rate of return are: 1. Many fishermen probably did not think it necessary to send tags to Richmond since they had been recorded by creel clerks. This may account for a large portion of the low return since only 52 (33.5 percent) in 1960 and 74 (54.4 percent) in 1961 of the tags recorded at the creel check station were returned to Richmond, 2. A few tags were probably lost or mislaid. 3. Fishermen were either not interested in the program or not well enough acquainted with it.

If the ratio obtained during the creel census of boats checked at creel stations to total boats *on* the bay is applied to the tag returns recorded at the creel check stations, an estimate of the total number of tagged fish caught may be obtained. Thus, an estimated 317 tagged bass were recaptured in 1960 and 328 (of bass tagged 1961) in 1961, and the estimated rate of return of tags either to the Richmond office or by way of creel check stations was 74.1 percent in 1960 and 65.5 percent in 1961.

An estimate of the rate of exploitation of the bass population may be obtained by use of the formula $U = \frac{R}{M}$, where U = the rate of exploitation, R = the number of recaptured marks in the sample and M = the number of fish marked (Ricker, 1958; p 83). In order to use this estimate, the following assumptions have to be made: (1) that the tagged fish and untagged fish are equally vulnerable to angling; (2) that the tagged fish *are* mixed homogeneously with the untagged fish; and (3) that fishing pressure is equally distributed over the entire bay, Since, as has been demonstrated, fishing pressure on Back day is not equally distributed, the rate of exploitation for the entire bay cannot be readily calculated. However, it can 'be calculated for individual areas where fish were tagged and for all areas collectively (Appendix, Table 11). For all areas collectively, the estimated rate of exploitation was almost identical for both years (1960 - 17.4 and 1961 - 17.5) which would indicate a similar exploitation of the population for both years. However, the rate of exploitation for Shipps Bay (24.6) which is the most heavily fished area in the bay, tends to make the 1961 rate somewhat high when comparing the two different years, If only the same areas in which fish were tagged during both years are compared a much different picture is presented. The rate of exploitation for three areas in which fish were tagged during both years is 17.7 for 1960 and 14.0 for 1961, indicating that the bass population was less heavily exploited in 1961 than in 1960, although a similar number of bass were caught during both years (Appendix, Table 1). This would in turn indicate the presence of a larger population of bass in 1961. The rate of exploitation for the *entire* bay is probably in the vicinity of eight to twelve percent when it is considered that the estimated rate of 17.4 represents only about 40 percent of the total area (area fished by 89 percent of the anglers), In comparing the rate of exploitation for the various size groups of bass, certain size groups appear to be more vulnerable to angling than do others (kppendix, Table 12). This vulnerability does not appear to be associated with the number of fish tagged in the individual length groups nor on angler selectivity. If the number of tagged fish in each length group was a factor, the ll-inch group should have been harvested more heavily than the lo-inch group or the 14-inch group more than the 15-inch group or the 16-inch group more than the 17-inch group, yet the reverse is true. Angler selectivity is also not thought to have been important since many anglers expressed the desire to catch a tagged fish regardless of size. Thus, the only plausable explanation is that certain size groups of tagged bass were more vulnerable to angling than were others.

When data from this study is compared with that of Roseberry's (1952) this difference in size group angling vulnerability is again apparent, except that in the case of his data fish less than 13-inches in total length are exploited less than larger fish, while in the present study the smaller fish are as vulnerable as the larger fish. It is interesting to note that both in the 1951 study and the 1961 study the size group having the highest rate of exploitation is the 17-inch group. While certain groups larger then 17-inches have a higher rate of exploitation, the initial number of fish tagged in these groups is hot thought to be large enough to be representative.

A total of 156 tags returned in 1960, 194 tags in 1961, and 42 tags from fish tagged 1960 and returned in 1961, included adequate information to calculate the distances and direction traveled by individual fish.. Distances were measured on Coast and Geodetic Survey maps. all distances were measured from the point of release along the shortest route to the point of recapture and are minimum distances traveled. It is unlikely that the fish traveled by the most direct route. No large scale immigration of bass from the area was noted. Approximately 44 percent of all bass tagged moved less than one mile from their release site and 75 percent traveled three miles or less, (Appendix, Table 13).

If the 1960 group of tagged bass and the 1961 group are considered separately, the group tagged in 1960 appeared to move greater distances than did those tagged 1961. In 1960 the average distance traveled by tagged bass was 5.1 miles; while in 1961 the average distance traveled was only 3.2 miles (Appendix, Table 14).

Eighty-five bass moved one mile or less and SO-percent (155 bass) traveled three miles or less (Appendix, Table 13.) A greater movement of basa in 1960 than in 1961 is also indicated by the total distance traveled by individual fish, In 1960 three bass moved in excess of 15-miles, one of which traveled 23 -miles, and 15 bass (lo-percent) traveled in excess of nine miles, While, in 1961, no returns were received from a distance exceeding 15-miles and only six (three percent) from over nine miles. This reduced movement in 1961 is also evidenced by the 1961 recapture of bass which were tagged in 1960. These returns indicated that 95-percent (40 bass) of these fish traveled 12-miles or less. However, two bass from this group traveled distances of 25 and 64 miles. These maximum distances from release site to recovery site are similar to those reported for largemouth bass in Missouri (Funk, 1957) but are considerably less than those reported by Moody (1960) for the Florida largemouth (60-123 miles).

Although, the 1961 recaptures of 1.961 tagged fish and of 1961 returns of 1960 tagged fish indicate a reduced movement in terms of total miles traveled, they also indicate a tendency for fish to disperse over a larger area in 1961 than in 1960 (1960, 0-l mile; 1961, 0-3 miles). The 1960 returns indicate that 46 percent of the bass traveled 0-l mile and 16-percent traveled l-3 miles; while in 1961, 44-percent traveled 0-l mile and 36 percent moved l-3 miles. Thus, in 1961 there was an increase of 20-percent in the number of bass moving l-3 miles over 1960. The 1961 returns of fish tagged in 1960 indicate a similar tendency. This increased movement in 1961 was probably due to interspecific competition resulting from an expanding bass population.

Direction of travel and distance traveled varied considerably between fish tagged in 1960 and those tagged in 1961. In 1960 fish had a tendency to move south more than any other direction (all areas combined); while in 1961, tagged fish showed little preference regarding direction of travel, except that only a slight number of fish traveled west (Appendix, Table 14). Since most of the bass were tagged on the west side of Back Bay, little westward movement could be expected,. Average distances traveled by fish moving one or more miles also varied between the two years. Fish tagged in 1961 moved an average distance of 1.9 miles less than did those tagged in 1960 (Appendix, Table 14). During both years tagged bass tended to move a greater distance north than in any other direction. Most of the movement appeared to be from deep, open water areas, where bass congregate during winter months, to the shallow marsh ooves and ponds.

Differences in movement were also apparent between fish tagged in the northern area and those tagged in the southern area as well as between the two years. During 1960, fish tagged in the north end of the bay tended to move 'in a southerly direction an average of 5.1 miles; while in 1961, little difference with respect to north or south movement was noted, although fish tended to move a greater average distance south than in any other direction (3.7 miles south, 2.3 miles north), The greatest movement of fish tagged in this area in 1961 was east. Since a large number of fish were tagged on the west side of the bay, a pronounced easterly movement toward the marsh areas would be expected. In the south end of the area little difference in north or south movement was noted between years, although a slightly greater number of fish moved north in 1961 than south. In contrast to the northern area where tagged bass moved longer distances south than north, bass tagged in the southern area traveled a longer distance north than south, This difference is probably due to the large body of open water (10,000 acres) lying between the north and south areas. Fish traveling south from the northern area must cross Back Bay proper (approximately seven miles) to reach the marsh ponds of the southern area and fish moving north out of the southern area likewise have this large bay to cross to reach the marshes to the north.

Bass tagged in both 1960 and 1961 in the southern area tended to move greater distances north (7.6 and 6.2 miles respectively) than did those tagged by Roseberry (1952) in 1951 (1.3 miles); while those traveling south moved approximately the same distance during all three tagging periods,

According to size, the 14 and 15 inch groups of tagged bass tended to travel the longest distances (Appendix, Table 15). In general, these groups showed more of a tendency to move in excess of nine miles than did other groups. Bass 14 - 18 inches in length appeared to be the most mobile (traveled in excess of one mile) while those under 14 inches (except the 12 inch group) were the most sedentary, Among the 12 inch bass there was a variation between 1960 end 1961. Of those tagged in 1960 38 percent traveled over one mile; while in 1961 69 percent moved over one mile. The 16 inch group of bass appeared to be the most mobile with 75 percent moving in excess of one mile during both years. among other size groups, a maximum of 70 percent (usually less than 60 percent) moved over a mile from the tagging area, The number of bass tagged 18 inches and over and the returns of these groups are too small to be considered valid and, therefore, are not evaluated.

Population Sampling

During July, 1959, Population samples were obtained from 11.2 acres of water in Back Bay and from 12.2 acres in 1960 and 1961 by means of emulsifiable rptenone. This area consisted of the following ponds and coves with accompanying acreages: the pond adjacent to Landing Cove designated as area A (2.2 acres); the pond adjacent to House Cove, area B (5.0 acres); the pond adjacent to Buzzard Bay, area C (2.2 acres); the Dudley Creek Pond, area D (1.8 acres); end in 1960 and 1961 the eastern extremity of Deales Creek, area E (1.0 acres). Locations of these sampling areas are presented in the appendix, Figure 5.

During all sampling years, areas A, C, and E were completely blocked off from surrounding areas by means of block nets. Areas B and D were completely blocked only during 1960. In 1959 these areas were only approximately 60 percent blocked because insufficient net was available to completely block them. In 1961 these areas were blocked similarly as in 1959; since, the netting used in 1960 was lost in a fire and as in 1959 insufficient netting was available to oompletely block the areas. Incomplete blocking during 1959 and 1961 was not thought to have materially affected the results. These areas were well sheltered from the wind preventing drift of fish either in or out of the areas and it is thought that sufficient blocking was accomplished to prevent escape of larger fishes except possibly those which were in the opening. Rotenone concentrations were generally 1-2 p.p.m.

Fish were picked up on the day rotenone was applied and on the following day. Aerial reconnaisance on the third day revealed few dead fish remaining on the areas, therefore, no pick-up was made on the third day. All recovered fish were sorted to speoies divided into inch groups, counted, weighed, and recorded as suggested by Surber (1959).

Results from the population sample taken in area C in 1960, while being presented in table 28 are not included in the overall summaries because the sample was obtained during low water. Population samples obtained during low water levels are thought to differ from those obtained during high water, since adult largemouth bass are thought to desert the shallow marsh ponds at these times (Roseberry, 1952). All other samples were obtained during high water levels.

All areas exhibited a change in population composition and a reduction in total weight of recovered fish following the first sampling (Appendix, Table 16). With the exception of areas B and D, the reduction of total weight of fish is correlated with a reduced carp population following the first years treatment with rotenone. Areas B and D had few carp on the initial poisoning. Accompanying this reduced carp population the non-predatory sport fish populations (pumpkinseed, yellow perch and white perch) exhibited a progressive increase over all three years. In addition "to reduced carp populations the predatory food fish (longnose gar, bowfin, and white and channel catfish) appeared in reduced numbers in samples after the initial treatment. Largemouth bass, which could h&e been expected to increase with the increase in forage, remained about the same &ring all sampling years (average of all areas combined); Apparently the sampling area was too small to indicate the increase in the adult bass population which is indicated by the increased harvest of bass by anglers during the 1960 and 1961 seasons (Appendix, Tables 2 and 5). In addition to not revealing the apparent increase in bass, the sampling area was also not adequate to measure the black crappie population which is known to be relatively abundant in the bay.

From Tables **17** - 35, Appendix, F/C, A_t, Y/C, A_f, and S_f values were calculated. The at values were further broken down as follows: A_t^s, those fish normally harvested by anglers (sport fish) including largemouth bass, pumpkinseed, bluegill sunfish, yell& perch and white perch; A_t^c, those fish which are important commercial species, including striped mullet, American eel, carp, black and yellow bullheads, channel-and white catfish, bowfin and white and yellow perch; A_t^h, those fish which are harvested (sport and commercial); A_t^n, those fish which are of no importance either as sport or commercial species in the bay, including longnose gar, golden shiner, killifish, menhaden, needlefish, silversides, spot, bluespotted sunfish, alewife and miscellaneous minnows. Surber **(1959)** lists longnose gar as a commercial species, but since they are of little or no importance in the bay, they are considered here as a non-harvestable species. Spot, alewife and menhaden, while normally considered a commercial species do not reach a size here to be of importance commercially and are included in the non-harvestable group. The latter are placed in arbitrary size groups. In Order to give a more accurate evaluation of the bay as to the sport fishery and the commercial fishery white and yellow perch (equally important as sport and commercial species) are included in the calculation of both the A_t^s and A_t^c values, Thus, these values taken collectively will be somewhat greater than the At value, Although certain other species, i.e. channel catfish, white catfish, black and yellow bullheads are taken by sport fishermen, they are of most value as commercial species and are included in the A_t^c values.

At values were at all times within the range of balance as defined by Swingle- (1950), **33-90.** However, A_t^c values indicate that the sampling areas contained predominantly commercial species, most of which were carp, striped mullet, white perch, and yellow perch. Following the initial treatment with rotenone in each area, carp did not appear in abundance in succeeding samples , while the remaining species were either equally abundant or increasingly abundant during future years.

In addition to A_t values, Y/C values were also calculated. Y values included all forage which were 5.5 inches in total length or less, and C values included all predacious species which wore 4.6 inches long or longer. The value of these indices may be open to question since many species present in the area are marine species and are present in the area only during certain seasons. However, observations indicate that they are present during the major portion of the growing season and are thus considered a valuable source of forage. Y/C values for all areas combined and for individual areas indicated that the populations varied from being in balance to being overcrowded with forage species. However, since many of the forage species are not permanent residents, overcrowding by forage species is probably only a temporary condition. The fish populations of the sampling areas and probably in Back Bay appear to be reasonably well balanced. This contention that the Back Bay fish population is in balance is substantiated by the excellent bass fishing now in existance.

An additional observation, which is probably applicable to the entire study area, is the prediction of year class strength of the largemouth bass. On the basis of "estimates of abundance made from numbers during early and late brood stages and from numbers of fingerlings and I-annulus bass taken in bag-seine hauls", Kramer and Smith (1962) concluded that "relative strength of year classes was determined by the time that fingerlings were two weeks old". If these observations hold true for Back Bay, the year cl&s strength of bass may be estimated from these population samples (most bass were 6-10 weeks old at the time of sampling). Tables 17 through 20 indicate that the 1960 year class was strong, the 1959 year class somewhat weaker and the 1961 year class much weaker than that of either of the other two years, Future creel census data should give an indication as to the validity of these year class strength predictions. The intrusion of ocean water in March, 1962 may have had considerable effect on these year classes.

Commercial Fishery:

In the previous section, A_t values were discussed with respect to both the sport and the commercial fishery. Since the commercial fishery is of some importance to the management of the sport fishory and to the economy of the area, it is thought that this fishery should be further discussed.

Records containing approximately one-half of the yearly harvest and monetary value of various species of commercial fish from Back Bay from 1944-1960 (Table 35) were obtained. These records were completed only for carp and information for the years 1947, 1952, 1954, and 1955 oouid not be interpreted,

By obtaining the average weight and income from the available data on perch, catfish, striped bass and miscellaneous other fish, it was,, possible to obtain an estimate of the total weight and income for the above mentioned years. These adjusted total weights and monetary values are presented in Table 36. These adjusted weights and monetary values are not entirely accurate. After contacting the fisherman who recorded the data it appears that the figures axe low since carp figures for X944-1956 do not include dead carp sold. At times this amounted to . about 30 percent of the carp harvest. With this exception the figures are approximately correct.

The average estimated yearly total harvest of fish was about 314,103 pounds (range 109,567-498,286 3bs.) valued at approximately $19,665 per year, (range $9,520-$34,202). From 12 it may be seen that the carp is the predominant species taken,, and is of most importance economically to the commercial fishermen. The average yearly carp harvest has been approximately 228,015 pounds (73 percent of total), while yielding an average revenue of about $13,849 annually (59 percent of total).

The second most important species was perch (white and yellow) making up 22 percent of the total weight and 34 percent of the total Income. Carp and perch make up 94 percent of the total weight and yield 93 percent of the total income. Of the remaining six percent of the total weight and income, catfish (white and channel) contributed 3.4 percent of the total weight and 3.7 percent of the total income. Striped bass and miscellaneous species of herring contributed the remainder of the weight and income.

Commercial fishing probably has an effect on the management of the Back Bay fishery by aiding in the control of the carp population. Just how much control commercial fishing alone has on the carp population is questionable, since the average yearly carp removal is only approximately 9.1 pounds per acre. When considered with the previously mentioned possible natural control of reproduction it may be of importance. it should be noted (Table 35) that following years of high carp harvest (1944, 1948 and 1957) carp harvest was considerably less (1945, 1949, and 1958). These years of high harvest were probably a result of good to excellent reproduction during one or two preceding years, while the *following* low harvests may have been due to a reduced population caused by the commercial harvest and poor reproductive success.

The effect of fishing on the population of catfish and yellow perch is not known, but the harvest of these species makes up only a small portion of the total annual catch. The effect of the harvest of white perch, striped bass and the various species of herring present is likewise not known. Since these species are mobile the effect of fishing pressure in Back Bay can only be considered with the effect of fishing pressure and other natural limitations along their migration route.

In Back Bay five two-man crews probably do 90 percent of the commercial fishing and may derive about 90 percent of the income. This amounts to about $3,500 annually. This figure would be less after deducting expenses. Many of these fishermen farm most of the year and the fishing season occurs at a time of year (November-April) when little farm work can be done. The income from fishing provides an additional source of revenue during the slack period of the year.

Salinity Studies.

During present waterfowl investigations being conducted on Back Bay and Currituck Sound, a proposal has been made to introduce salt water into Back Bay in an attempt to improve the waterfowl habitat. Because of this proposal, studies were undertaken to determine the possible effects of varying salinities on largemouth bass and bluegill sunfish.

During February and March, 1959, sea water was introduced into six freshwater ponds to determine the effect of varying salinities on aquatic vcgetstion. At this time, largemouth bass, bluegill sunfish, black crappie and carp were held in live-cars in these ponds to determine their tolerance to varying salinities. Observations on these fish indicated that they could survive salinities of 12,750 p.p.m. NaCl, at least for short periods.

Because little information is available on survival of bass and bluegill in brines formed from sea water, it was decided to determine the TLm of largemouth bass and bluegill sunfish in various saline concentrations, using ocean water diluted with freshwater from Back Bay. Two containers were used for each series of tests. Five test fish were placed in each container. In most series, concentrations varied by 50-100 p.p.m. NaCl between the two containers. The series conducted on July 12 and September 22, however, varied by 700 and 400 p.p.m. for bass and by 400 p.p.m. in one concentration carried out for bluegill on September 22. Since suitable readily available glass containers for aquariums were not available, brown, nine-gallon plastic wastebaskets were used. Bass and bluegills used in the tests conducted on July 8 and 12, 1959 were obtained from private ponds adjacent to Back Bay. Fish used in the remainder of the tests were obtained from the fish hatchery at Stevensville, Virginia.

All bass used were 2-3 inches in total length and bluegill 3-4 inches, except for the first series, in which a few 5-inch bluegill were used.

For the bioassay tests, test fish were acclimatized to the various concentrations. Fish were placed directly into fresh water and salinities increased five percent every two hours until the desired concentrations were reached. On three occasions, test fish were introduced directly into concentrations of 10,850, 14,150, and 14,750 p.p.m. NaCl.

To obtain information on the survival of bass and bluegill for periods longer than 96 hours, test fish were placed in live-cars (18 inches on a side) and placed in 3,000 gallon neoprene tanks containing various saline concentrations.

Chemical analysis (Table 37) of the test solutions consisted of the following: salinity, determined by the Denny modification of the Mohr method; total alkalinity, by standard methods; pH, by means of a Beckman pocket pH meter except for one series in which a Hellige pH colorimeter was used; dissolved oxygen, by the Alsterberg modification of the Winkler method. Temperatures of test and control solutions were determined by the use of maximum-minimum thermometers.

Since Wood (1957) found that aeration of test solutions lowered their toxicity, aeration was kept to a minimum. At times when oxygen levels of the test solutions fell below 4.0 p.p.m., oxygen was bubbled into the test solutions for 15-20 minutes. Usually aeration was not necessary until after 48 hours had elapsed. The effect of the periodic aeration on the toxicity of these test solutions is not known, but it is probable that the toxicity was somewhat lowered.

Temperatures varied from 75°- 80° F. during bioassays conducted on July 8, 12, and September 8, 1959, and from 64° - 73° F. on those conducted on September 22. Total alkalinity was found to be higher in the saline concentrations than in the fresh water controls and pH was similar in both. It was found that during the course of the tests, pH decreased and total alkalinity increased over the 96 hour period that the bioassays were conducted.

During the period, July 8-13, 1960, bioassays were conducted on largemouth bass at concentrations ranging from 9,500 - 12,350 p.p.m. NaCl. The only mortality experienced at this time was a 20 percent mortality at the end of 24 hours in the series ranging from 11,650 - 12,360 p.p.m. Since this series was run for only 48 hours, two additional series were conducted on September 8, ranging from 11,500- 11,750 p.p.m. At the end of 96 hours, no mortality was observed and the test was terminated. On

September 22, 1959, bioassays were again conducted but at higher concentrations. In the series ranging from 13,650 - 13,700 p.p.m. a ten percent mortality was experienced at the end of 96 hours. Since mortality of less than 50 percent is not sufficient to determine the TLm, the concentrations were increased and ten new fish were introduced. This increased concentration ranged from 14,500 - 14,950 p.p.m. NaCl. At the end of 48 hours 20 percent of the 'bass had died; at the end of 72 hours 80 percent had died and at the end of 96 hours a 100 percent mortality was obtained,. The percent mortality and the concentrations used were plotted on semi-logarithmic paper and through interpolation the 96-hours TLm was found to be approximately 14,000 p.p.m. NaCl. No attempt was made to determine the 24-hour or the 48-hour TLm.

On September 7, 1959, ten bass were introduced directly into a saline concentration of 10,850 p.p.m. After 96 hours no mortality was observed. On September 24, 1959, ten bass were introduced directly into 14,150 p.p.m. and six into 14,750 p.p.m. After 24 hours, 50 percent of those in the 14,150 p.p.m. concentration had died and 73.4 percent of those in the 14,750 p.p.m. concentration had died. After 48 hours 70 percent of those 14,150 p.p.m. had died and all those in the 14,750 p.p.m. concentration had died. By the end of 72 hours no bass remained alive in either concentration. This indicates that tht acclimatization of bass increased their survival time approximately 24-48 hours.

Bioassays were also conducted with bluegill sunfish, using saline concentrations similar to those **used** for largemouth bass (Table 37). The 96 hour TLm for these fish was also found to be about 14,000 p.p.m. NaCl. The 24-hour TLm was approximately 14,600 p.p.m. and the 48 hour TLm about 14,000 p.p.m.

Although oxygen levels occasionally fall as low as 2.0 p.p.m. for short periods , it is not thought that this was directly- responsible for any mortality. All bass that died had developed a pop-eyed condition 12-24 hours prior to mortality, and many bluegill appeared to lose their sense of equilibrium and began to swim in a corkscrew fashion. While all bass which developed this pop-eyed condition died one of **the** bluegill which had lost its sense of equilibrium was still alive at the end of 96 hours. This pop-eyed condition and the loss of equilibrium was probably caused by increased internal osmotic pressures.

In plotting the various TLm's, it was noted that while both bass and bluegill had approximately the same 96-hour TLm, bluogili had achieved a 50 percent mortality in the 14,000 p.p.m. concentration by the end of 48 hours while bass experienced only a 20 percent mortality at the end of this period and did not achieve a 50 percent mortality at this concentration until the and of 72 hours. This delay of mortality among the bass may have been caused by laboratory diuresis and salt loss. This phenomenon has been found to occur in some species of fish by several investigtors (Brown, 1957, pp. 170). They found that after the fish are caught and put in aquaria they lose salts and water at an abnormally high rate. According to Brown (1957, pp. 176) Krogh noted lack of absorption of chloride concentrations, often for several days, at the boginning of his experiments, which suggests laboratory diuresis and salt loss.

To determine the ability of bass and bluegill to survive various salinities for ptriods *longer* than 96 hours several fish of each species were placed in live boxes which were placed in 3,000-gallon water tanks containing varying salinities. On August 2, 1959, ten bass and ton bluegill were placed in tanks having concentrations of 6,250 p.p.m. and 9,600 p.p.m. NaCl. Also, six bass and seven bluegill wore placed in a tank having a concentration of 1,600 p.p.m.. Fish remained in these tanks for 13 days with no mortality. At the end of 20 days, 60 percent of the bluegill were iost in the 9,600 p.p.m. concentration. Also, 42 percent of the bluegill and 33 percent of the **bass** were lost in the 1,600 p.p.m. concentration. These fish were apparently lost by being released by unknown individuals, since the opening in the live boxes, which had been wired closed was found open. Losses continued in the remaining tanks.

On October 30, 1959, these tanks were drained and all fish remaining therein removed, counted and condition noted. At this time the following fish were founds 1,600 p.p.m. - one bluegill and two bass; 6,250 p.p.m. - fivt bluegill and eight bass; 9,600 p.p.m. - three bass. Upon removing these fish from tanks, it was noted that all fish were in an extremely poor condition, apparently due to lack of food in the tanks. From this data it is apparent that largemouth bass can withstand salinities of 9,600 p.p.m. NaCl and that bluegill can withstand salinities of 6,250 p.p.m. for indefinite periods.

Although these fish can tolerate high salinities for indefinite periods of time, the effect of these salinities on spawning success is not known. To obtain this information the 3 ,000-gallon water tanks wore set up with the following salinities: 3,350 (Tank B); 5,000 (Tank C); 7,050 (Tank D) and a control tank (Tank A) containing only Back Bay water (salinity - 500 p.p.m.). All saline concentrations were formed by adding ocean water **to** Back Bay water. Sand was added to the tanks to provide nesting areas.

A pair of largemouth bass was placed in each tank on April 14, 1960. Periodic observations and chemical analyses were made on the tanks. During this study, test fish were fed live killifish periodically. Within a week after setting up the tanks, the control tank began to lose water and it was found that the tank had been punctured at the edge of the outlet.

Because of the location of the hole, it was not possible to repair the leak. An attempt was made to stop the leak by wedging rags into the hole. This, however, proved to be only a temporary solution, since after a short time water pressure in the tank caused the hole to become larger and finally all attempts to stop the leak became useless. No other tanks were available to use as control; thus, this portion of the study was conducted without the aid of a control.

Observations made on these tanks during the previous year indicated that salinities would remain fairly constant, Water lost through evaporation was replaced by- rainfall. This, however, was not the case during this spawning study. By May 15, salinities had increased as follows: 3,350 - 4,500 p.p.m.; 5,000 - 5,850 p.p.m., and 7,050 - 8,800 p.p.m. On May 15, the salinity in tank D was reduced from 8,800 to 6,700 p.p.m. because it was thought that this salinity was interfering with normal faeding and thus probably would prevent spawning.

The first indication of spawning was noted on May 11, when courtship behavior was observed in tank B. By May 30, no sign of young bass had been found. Because of a dense algae bloom in all of the study tanks prevented observations to be made on the nesting areas, the tanks were drawn down so that the nests could be seen. Close inspection revealed no young bass present nor were there any eggs present, although depressions were found in all tanks where the male had apparently fanned out a nest.

During May and June, 1961 the 3,000 gallon tanks were again set up in an attempt to get bass to spawn at salinities of 2,700 p.p.m. NaCl, 4,900 p.p.m. and fresh. No successful reproduction was noted. At the termination of the study all bass were examined for gonad development. Of the three females examined, two contained eggs and the third had lost her eggs. The gonads in the males had all been reduced to about the size normally found following the breeding season, indicating that reproductive failure was probably due to failure of male bass gonads to remain in a breeding condition.

In addition to these tanks, two saline ponds were also used to attempt to discover the maximum salinity at which bass would spawn. One pond, located in Saxis Marsh in Accomac County, was found to be unsuitable, since salinities could not be controlled and occassionally were found to be as high as 8,950 p.p.m. The pH was also found to be unsuitable (4.6 - 6.5).

During 1958 and 1959 a pond on the state waterfowl refuge at Hog Island (Surry County) was stocked with largemouth bass and bluegill fry. During the fall of 1459 a severe storm caused the James River to overflow into the pond raising the salinity to approximately 4,000 p.p.m. NaCl.

Following this, the salinity gradually decreased. On June 14, 1960 this pond was examined for reproduction. Four hauls with a 30-foot seine yielded 47 bass fingerlings measuring approximately 1½ inches in total length. At this time the salinity was 1,750 p.p.m. Salinities recorded on April 21, 1960 was 1,600 p.p.m. The salinity record for May was lost but the investigator who took it reported it to be about the same as that for April and June. Thus, it seems certain that bass spawned successfully at a salinity of 1,600 - 1,750 p.p.m. NaCl.

No young-of-the-year bluegill were found but examination of bluegill taken in the seine hauls revealed three females which had not spawned. This indicates that the absence of young-of-the-year bluegills was due to spawning not yet having taken place.

During the tank spawning study, it was noted that when salinities in tank D rose to 8,800 p.p.m., the bass apparently quit feeding. Forage fish introduced April 30 suffered no reduction in number by May 15, at which time the salinity was reduced to 6,700 p.p.m. Within a week following this reduction in salinity bass resumed feeding as evidenced by the disappearance of the forage fish.

Bottom Sampling.

In order to gain some insight into the productivity of Back Bay; 44 six-inch square 'bottom samples wore taken each in October, 1960 and February, May, and August, 1961, by means of a modified Eckman dredge. The Eckman dredge was mounted on A 2 by 2 inch pole, eight feet long, in order to penetrate the bottom through dense vegetation. Samples were taken approximately every 1,000 yards along transects previously established for taking vegetation samples and water chemistry (Appendix, figure 6). Samples were sorted and organisms were counted and weighed according to order. Weights were obtained by allowing organisms to air dry on blotter paper for two minutes and then weighed to the nearest .001 gram. Representatives of each order were sent to specialists for identification to genus and to species where possible. Bottom fauna occurring in the Back Bay - Currituck Sound area are as follows:

Amphipoda
- Corophium lacustre
- Gammarus sp.
- Leptocheirus plumulosis
- Monoculodes sp.

Coleoptera
- Berosus sp.

Diptera
- Tendipedidae
  - Collotanaypus sp.
  - Coelotanypus concinnuo (?)
  - Cryptochironomus sp.
  - Polypedilum sp.
  - Procladius sp.
  - Tendipes riparius (?)
  - Tendipes sp.
  - Tanytarsus sp.

Decapoda
Callinectes sapidus
Palaemonetas paludosus
Rhithropanopeus harrisii

Hirudinea
Hellobdella papillata
Myzobdella lugubris
Placobdella multilineata

Isopoda
Cyathura polita
Chiridotea almyra
Edotea triloba
Cassidinidea lunifrons
Probopyrus floridonsis
Leptochelia dubia (?)

Mollusca
Gyraulus parvus

Pelecypoda
Mulinia lateralis
Mytilopsis leucophaeta
Rangia cuneata - -

Ceraptopgonidae
Palpomyia sp.
Culcidae
Corethra sp.

Bemiptora
Corixa sp.

Odonata
Anax junius
Enallagma durum (?)
Ischnura verticallis (?)
Pachydiplax longipennis

Oligochaeta
Limnodrilus sp.

Polychaeta - mostly from Currituck Sound
Hypaniola florida
Hypaniola grayi
Amphicteis floridus
Amphicteis gunneri
Laeonereis culveri

Trichoptera
Oecetis sp. (?)
Triaenodes nr. tarda

Identifications of the above organisms have been verified by the following individuals: Oligochaeta by E. W. Surber; Diptera by Mr. E. W. Surber and Dr. W. W. Wirth; Decapoda, Isopoda, and Amphipoda by Thomas E. Bowman; Polychaeta by Marian H. Pettibone; Trichoptera by Oliver S. Flint; Odonata by Minter J. Westfall, Jr. All collections were analyzed by Mr. James Kerwin, biologist, U. S. Fish and Wildlife Service.

Although all of the above organisms occur in the area, very few were routinely collected in bottom samples. Those collected included: Amphipoda - all species; Diptera - Palpomyia, Corethra, midges were not tabulated to species; Isopoda - Cyathura polita; Mollusca - Gyraulus parvus; Odonata - organisms not tabulated to species; Oligochaeta - Limnodrilus sp.; Pelecypoda - organisms not tabulated to species: Polychaeta - organisms not tabulated to species and appeared in only one sample in Back Bay. Thus, of the 14 orders of invertebrates occurring in the area; only eight were routinely collected and not all representatives of those eight were present in collections. It, thus, appears that the sampling procedure was not adequate to sample all habitats or those organisms which were not abundant.

The former explanation seems to be the most reasonable; since, many bottom fauna species are often closely associated with rooted vegetation and no effort was made to sample plant inhabiting fauna.

The most abundant invertebrate, both numerically and by weight, was the amphipods. These organisms wore relatively abundant in all areas. The second most abundant was the Tendipedidae, in which were included Palpomyia (Ceraptogonidae) and Corsthra (Culcidae); which was also abundant in all areas. The remaining invertebrates, in order of numerical abundance were as follows: Oligochacta, Gastropoda, Isopoda, Odonata, and Pelecypoda; and by weight: Gastropoda, Oligochaeta, Isopoda, Odenata, and Pelecypoda.

in order to compare tho production of bottom fauna production of various areas of Back Bay; the weight of invertebrates from each sampling period were totaled and averaged. Average production of invertebrates from the various areas in order of abundance are as follows (highest to lowest): Buzzard Bay, Sand bay, Great Cove, Shipps Bay, Redhead Bay, North Bay, Fishers Cove, and Back Bay (Appendix, Table 38). It is interesting to note that Fishers Cove and Back Bay are rated last in the production of bottom fauna; particularly, since these two areas also have the lowest fishermen utilization of the entire area (appendix, figures 1 and 2). It has also been found during concurrent waterfowl investigations, that Back Bay proper is one of the least productive areas in the Back Bay area, in terms of rooted aquatic vegetation.

Data from the October sampling period, which also included Currituck Sound (Annual Progress Report on the Cooperative Studys of Back Bay, Virginia and Currituck Sound, N. C., 1961) indicates that the production of bottom fauna in Back Bay could be much higher. Production of invertebrates in Currituck Sound was considerably higher than that of Back Bay (Back Bay - .122 g./sq. ft.; Currituck Sound - .414 g./sq. ft.). This data also indicates a progressive increase, although somewhat erratic, in production from north to south as follows:

Transect — Grams per square foot

	A (north)	B	C	D	E	F	G	"1 (south)	Avcrage
Back Bay	.079	,252	.196	.070	,088	.088	.138	.094	.122

	I	J	K	L	M	N	O	P	Q	R	S	Av.
Currituck Sound	.200	.408	.116	.359	.160	.221	.241	.117	.449	1.25	1.15	.414

Data from the 1960 Annual Progress Report of the Back Bay - Currituck Sound Cooperative Study indicates that there may be an increase in productivity from north to south. Mr. John L. Sincock (coordinating biologist, U. S. Fish and Wildlife Service) in analyzing this data, hints that this increase in productivity may be due to nutrient balance; specifically, the calcium-magnesium-potassium-sulfate balance. He detected an increased calcium uptake by plants in the northern area where calcium, magnesium, potassium and sulfates were low and the reverse in the southern portion of the area. He attributed this to the action of higher concentrations of potassium and sulfates present in the south portion in suppressing calcium uptake and low amount of these elements in not suppressing calcium uptake in the north portion; and to the decreasing calcium/magnesium ratio from north to south. These observations were accompanied by progressively better field reting of plants from north to south. He quotes Lyon and Buckman (1950) " too much calcium may interfere with phosphorus and boron nutrition or may encourage chlorosis due to a reduction in the availability of the soil iron, zinc, or manganese". Other factors are also involved, but the above is thought to be the most important. This increase in productivity, in terms of more abundant bottom fauna, plant production and nutrients from north to south, is accompanied by increasing salinity, indicating that an increase in salinity may improve the productivity of Back Bay.

This question may shortly be answered. On March 7, 1962, a severe storm caused ocean water to flow accross the barrier beach, separating Back Bay from the Atlantic Ocean, and into Back Bay. The present salinity of Back Bay is 8-10 percent of sea strength (formerly 1-2 percent). Studies are continuing to evaluate the effects of this increase in salinity.

CONCLUSIONS

Under the existing fishing pressure, Back Bay seems to be producing sufficient numbers of bass to maintain a high quality of fishing and a harvest of at least 30,000 pounds of bass per year.

Aerial fishermen counts indicate that 40-46 percent of the area is producing most of the harvest while the remaining 54-60 percent of the area appears to be relatively unproductive. High turbidities are believed to be associated with the low productivity of the unproductive areas.

The introduction of a limited amount of salt water would tend to deflocculate the silt and reduce turbidities.

Results from the tagging study indicate that bass mortality can be expected when they are handled at wster temperatures of 46° F. or less.

Tag return information indicates that 26-35 percent of the tagged fish caught are never reported. This conclusion is based on a comparison between the actual number of returns and the calculated number of fish which were theoretically recaptured. These figures would probably be much higher than this were it not for the fact tnat creel clerks recorded tag information when checking anglers creels. In 1960 only 33 percent of the tags recorded 'by creel clerks were reported to Richmond and only 54 percent in 1961. -Tagging studies should be conducted in conjunction with creel studies where possible.

This study indicates that the bass population of Back Bay consists of two groups - a sedentary group of fish, moving one mile or less, and a mobile group, traveling in excess of one mile.

Salinity bioassay studies with largemouth bass and bluegill sunfish indicate that these species can withstand salinities of 43 percent of sea strength for short periods (96-hours) and salinities of 30 percent for bass and 19 percent for bluegill for approximately three months.

Bottom fauna studies in Back Bay also indicate that certain areas of the bay are much more productive than others. Those areas correspond closely witn the areas of low fishermen usage, low plant production, and high turbidities. It was also noted that bottom fauna production appeared to be about 75 percent less than that of Currituck Sound, immediately to the south. The low bottom fauna production of Back Bay is related to turbid water and low salinity, while Currituck Sound productivity is related to less turbid water and higher salinities. This indicates that an increase in salinity in Back Bay might increase the productivity of the bay. An introduction of a small amount of ocean water would have a tendency to defloculate suspended siits, thus reducing turbidity. It would also tend to increase the nutrients in the water, such as calcium, magnesium, and phosphorus, which would increase the primary production of the area and increase the production of sport fishes. Any salt water introduction should be controlled so as not to increase' the salinity of Back Bay to more than 10-12 percent of sea strength in order to be compatible with largemouth bass reproduction (as determined by studies of Borth Carolina biologists).

A preliminary evaluation of salt water introduction into Back Bay should be possible in the near future. On March 7, 1962, a severe storm caused ocean water to flow into Back Bay, raising the salinity of the bay to approximately 12 percent of sea strength. Some work should be continued to evaluate this salt water intrusion.

RECOMMENDATIONS

1. The construction of any additional farm-land drainage canals which would empty into Back Bay!, should be opposed by sport fishing interests.

2. If the introduction of salt water into Bach Bay is to be undertaken as a managment practice, salinities in the bay should be controlled to a maximum of about 10 percent of sea strength (3,200 p.p.m.).

3. Some work should. be continued to evaluate the effects of' salt water intrusion into Back Bay caused by the March, 1962 storm.

APPENDIX

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TABLE 1, A Comparison Total Fishing Pressure and Harvest of Fish From Back Bay - 1951 and 1959, (June - October), and April - October 1960 and 1961.

Month and Year	Amber of Fishermen	Hours Fished	Hours per Fishermen	Number of Fish	Number of Bass	Fish per Hour-	Bass per Hour
April							
1959	941	5203	5.5	2164	952	0.41	0.18
1960	2204	12051	5.5	5016	3971	0.42	0.33
1961	741	4010	5.3	1727	1057	0.43	0.26
May							
1959	2374	13487	5.8	6316	3380	0.46	0.24
1960	3196	18316	5.7	7160	6446	0.39	0.35
1961	3081	16571	5.4	8856	8102	0.53	0.49
June							
1951	1218	9562	7.8	5703	3654	0.59	0.38
1959	1838	11475	6.2	7104	1775	0.62	0.15
1960	2376	14434	6.1	5764	5078	0.40	0.35
1961	2552	13154	5.4	6480	5304	0-49	0.38
July							
1951	1108	7416	6.7	3553	2224	0.48	0.30
1959	1665	9078	5.4	3954	2224	0.43	0.24
1960	2418	12168	5.0	4498	3294	0.37	0.27
1961	2358	12496	5.3	6178	4062	0.49	0.32
August							
1951	864	4143	4.8	1867	994	0.45	0.24
1959	1586	7533	4.7	2529	1596	0.33	0.21
1960	1550	8473	5.5	3286	2811	0.39	0.33
1961	1332	6740	5.1	2656	2112	0.39	0.31
September							
1951	706	4239	6.0	1776	909	0.42	0.21
1959	882	4368	4.9	1222	882	0.28	0.20
1960	960	5170	5.4	1812	1621	0-35	0.31
1961	1031	5433	5.3	3543	2773	0.32	0.25
October							
1951	189	1068	5.6	771	130	0.72	0.09
1959	928	5342	5.7	2012	1226	0.39	0.23
1960	340	1856	5.4	878	669	0.47	0.36
1961	365	1705	4.7	798	248	0.46	0.14
Total							
1951	4.085	26428	6.5	13670	7911	0.50	0.30
1959	10214	56496	5.6	25301	12035	0.45	0.21
1960	13044	72468	5.6	28414	23890	0.39	0.33
1961	11460	60109	5.3	30238	23653	0.45	0.37

TABLE 2. REPORTED CATCH, BY SPECIES, FROM BACK BAY DURING THE PERIOD JUNE - OCTOBER, 1951 and 1959, and APRIL - OCTOBER, 1960 and 1961.

Species	1951			1959			1960			1961		
	Total Number	Percent Total Number	Catch per hour	Total Number	Percent Total Number	Catch per Hour	Total Number	Percent Total Number	Catch Per Hour	Total Number	Percent Total Number	Catch per Hour
Largemouth bass	5250	57.8	0.30	4074	44.2	0.20	10846	84.6	0.33	11033	78.4	0.36
Bluegill	*			429	4.6	0.02	146	1.1	0.004	317	2.2	0.01
Pumpkinseed	*			113	1.2	0.006	344	2.6	0.01	64	0.4	-
Perch**	3293	36.3	0.19	4161	45.1	0.21	961	7.5	0.03	1712	12.1	0.05
Black Crappie	*			241	1.6	0.01	160	1.2	0.004	452	3.2	0.01
Chain Pickeral	*			93	1.0	0.005	98	0.7	0.002	107	0.7	-
Catfish***	65	0.7	0.004	79	0.8	0,004	215	1.6	0.006	311	2.2	0.01
Striped bass	29	0.3	0.002	0	0.0	0.0	0	0.0	0.0	2	-	-
Others	431	4.7	0.02	17	0.1		38	0.2	0,001	74	0.5	-
Total	9068	99.8	0.51	9207	99.6	0.46	12808	99.5	0.39	14070	99.7	0.46

* Numbers of these fish not recorded.
** Mostly white perch with a few yellow perch.
*** Channel and white catfish, and brown and yellow bullheads.

TABLE 3

Harvest and pressure recorded at Bay Haven Farms (south portion of Back Bay) June - October, 1952.

Number of fishermen - 1601
Number hours fished, - 5583
Catch per hour - 0.67

Bass per hour - 0.33
Perch per hour - 0.40

Species	Number	Percent
Largemouth Bass	1843	30.8
Perch	2249	37.5
Catfish	58	0.9
Bluegill	90	1.5
Pumpkinseed	950	15.8
Pickeral	2	
Cra-ppie	15	0.2
Other	776	12.9
Total	5983	99.6

TABLE 4. Comparison of Fishing Success for Live and Artificial Bait 1959, 1960, and 1961.

	Number of Fishermen Live	Number of Fishermen Art.	Hours per Fisherman Live	Hours per Fisherman Art.	Number of Fish Live	Number of Fish Art.	Fish per Hour Live	Fish per Hour Art.	Number of Bass Live	Number of Bass Art.	Bass per Hour Live	Bass per Hour Art.
April*												
1959	-	-	-	-	-	-				-		-
1960	617	171	5.1	6.0	1,328	364	0.43	0.37	955	342	0.31	0.35
1961	327	45	5.5	4.3	749	79	0.42	0.41	451	78	0.25	0.41
May*												
1959			-	-	-	-						
1960	733	488	5.5	4.3	1,387	1,242	0.34	0.47	1,133	1,226	0.28	0.47
1961	388	786	5.5	5.2	929	2,617	0.43	0.64	700	2,552	0.32	0.62
June												
1959	535	365	6.5	5.7	2,963	638	0.84	0.31	488	453	0.13	0.22
1960	334	602	6.7	5.8	691	1,900	0.31	0.54	428	1,580	0.19	0.45
1961	305	696	5.4	5.5	824	1,884	0.49	0.49	463	1,819	0.29	0.47
July												
1959	374	610	5.9	5.1	1,240	1,253	0.55	0.40	300	1,077	0.13	u.35
1960	229	410	5.9	5.1	543	748	0.40	0.38	234	732	0.17	0.36
1961	319	659	6.0	4.8	1,209	1,424	0.63	0.44	503	1,328	0.26	0.41
August												
1959	214	448	5.2	4.6	524	634	0.46	0.30	203	520	0.18	0.24
1960	150	353	5.8	5.3	224	783	0.26	0.42	153	770	0.17	0.41
1961	175	386	5.5	4.8	316	833	0.32	0.44	189	722	0.19	0.39
September												
1959	182	106	5.1	5.5	294	208	0.31	0.35	168	190	0.18	0.32
1960	97	278	5.3	5.4	134	539	0.26	0.36	91	536	0.17	0.35
1361	118	299	5.7	5.3	197	521	0.29	0.33	104	483	0.15	0.30
October												
1959	104	53	5.9	4.8	200	162	0.30	0.60	100	134	0.20	0.50
1960	29	33	5-2	5.2	65	94	0.43	0.54	31	94	0.21	0.54
1961	57	11	4.5	5.4	130	13	0.50	0.22	33	13	0.13	0.22
Total (June-October)												
1959	1,409	1,582	6.0	5.1	5,221	2,895	0.61	0.36	1,219	2,374	0.14	0.29
1960	839	1,676	6.1	5.5	1,657	4,064	0.32	0.44	937	3,712	0.18	0.40
1961	974	2,051	5.6	5.1	2,676	49674	0.49	0.44	1,292	49365	0.24	0.41
Total (April-October)												
1960 / 1961	[illegible]	[illegible]	5.6	5.2	[illegible]	6,573	0.35	0.51	3,025	5,299	[illegible]	0.41
						7,370	0.46	0.49	2,443	6,995		0.47

* No Creel Obtained During April and May, 1959.

TABLE 5. Length (inches) and weight (pounds) distribution of largemouth bass creeled in Back Bay in 1951, 1959, 1960, and 1961.

Length	Percent of Total No. 1951	1959	1960	1961	Number of Fish 1951	1959	1960	1961	Average Weight of each fish	Total Weight 1951	1959	1960	1961
4	-	.03				4	-	-	-	-	-	-	-
5	-	.05	.04	-		6	9	-	0.04	-		-	-
6	-	.40	.21	.09		48	50	21	0.16		8	8	3
7	-	.05	.02	.04		6	5	9			-	-	-
8	-	1.7	2.1	.2		204	502	47	u.22		45	110	10
9		1.7	1.6	.6		204	382	142	0.36	-	73	137	51
10	8.4	11.4	11.8	6.5	666	1372	2819	1537	0.53	353	727	1494	815
11	11.8	12.6	10.8	8.6	935	1516	2580	2034	0.67	626	1014	1729	1363
12	20.0	21.5	21.3	20.9	1586	2587	5088	4944	0.65	1348	2199	4325	4202
13	9.1	14.2	15.2	17.8	721	1709	3990	4708	1.09	786	1863	3958	4590
14	16.3	16.7	16.7	19.9	1292	2010	1720		1.45	1873	2914	5785	6623
15	12.4	6.0	7.2	9.5	983	722		2247	1.73	1700	1249	2976	3887
16	8.6	6.7	7.2	8.6	682	806	1720	2034	2.06	1405	1660	3543	4190
17	4.8	3.6	3.4	4.3	380	433	812	1017	2.70	1026	1169	2192	2746
18	4.9	2.1	1.6	1.5	388	253	382	354	3.15	1222	797	1203	1115
19	1.8	0.6	0.4	0.6	143	72	95	142	3.96	566	285	376	562
20	1.4	0.3	0.2	0.2	111	36	48	47	4.35	483		209	204
21	0.3	0.08	0.6	0.1	27	10	143	23	5.09	137	151	728	117
22	0.005	0.14	u.2	0.01	4	17	48	2	5.91	24	100	284	12
23	0.005	-	-	-	4					27	-	-	
Total	99.8	99.8	100.5	99.4	7922	12015	24024	23519		11576	14313	29057.	30690

TABLE 6.

4 Summary of Fish Harvest and Fishing Pressure for Back Bay, April - October 1959, 1960, and 1961, and June - October, 1951.

	Year	Bass Harvest per acre	Fish Harvest per Acre	Fishermen Per Acre.	Fisherman Hours per acre
April	1959	.03	.08	.03	.19
	1960	.16	.22	.09	.47
	1961	.04	.06	.03	.15
May	1959	[illegible]	.23	.09	.50
	1960	.24	.28	.12	.68
	1961	.30	.33	.11	.62
June	1951	.13	.21	.04	.36
	1959	.06	.26	.07	.43
	1960	[illegible]	.24	.08	.53
	1961	.20	.24	.09	.49
July	1951	.08	.13	.04	.28
	1959	.07	.15	.06	.34
	1960	.12	.17	[illegible]	.45
	1961	.15	.23	.09	.47
August	1951	.04	.07	.03	.15
	1959	.05	[illegible]	.06	.28
	1960	.11	.13	.06	.32
	1961	.08	.10	.05	.25
September	1951	.03	.07	.03	.16
	1959	.03	.04	.03	.13
	1960	.07	.07	.04	.21
	1961	.10	.13	.04	.20
October	1951	,003	.03	.01	.04
	1959	.02	.03	.01	.08
	1960	.02	.03	.01	.07
	1961	.01	.03	.01	.06
Average	1951	.30	.51	.15	1.00
	1959	.45	.94	.38	2.11
	1960	.89	1.06	.49	2.70
	1961	.88	1.13	.43	2.24

TABLE 7

Commercial harvest of largemouth bass from 'Back Bay for 1901, 1904, 1920, 1921, 1923, 1924, 1925, and 1929.

Year	Harvest (pounds)	
1901	199,400	44,000*
1904	153,600	
1920	342,500	344,500*
1921	342,500	
1923	229,051	
1924	140,111	
1925	74,861	
1929	86,500	

* Data obtained from different sources.

TABLE 8

Quarterly averages secchi disc readings in (inches) for various areas of Back Bay - December, 1958 through February, 1960.

	Location			
Quarter	North Bay	Shipps Bay	Back Bay	Buzzard Bay
Dec., 1958 Feb., 1959	18	13	9	11
Mar.- May, 1959	12	10	7	8
Jun.-Aug., 1953	37	39	25	30
Sept.-Nov., 1959	40	43	19	31
Dec., 1959 - Feb., 1960	27	19	16	10

TABLE y

Mortality of largemouth bass Caught in a 250 yard haul seine and held in live-cars - February & March, 1961.

No. of Fish Caught	Date Caught	Date Tagged	Ida-tier Temp. (°F.)	Mortality	Percent Mortality
313[a]	Feb. 7	Feb. 9	46°	107	34.2
449[b]	Feb. 8 & 9	Feb. 9 & 10	41° & 46°	32	7.1
102	Feb. 11	Feb. 13	44°	9	8.8
237	Feb. 14	Feb. 15	46°	10	4.2
90	March 7	March 9		0	0.0
230	March 11	March 12	54°	0	0.0
163	March 13	March 14	60°	0	0.0
218	March 15	March 16	56°	0	0.0
41[c]	-	March 19	48°	0	0.0
59[c]					
39	March 18	March 19	50°	0	0.0
40[c]		March 28	58°	0	0.0
41[c]		March 28	58°	0	0.0

a Fish were exposed to a severe storm on the afternoon of February 8.

b Fish were caught and tagged over a period of two days. Both operations overlapped on February 9.

c Fish tagged on the same day, but caught by different fishermen and held in two different live-cars.

TABLE 10

Recovery of fish placed in small pond to obtain information on mortality due to handling during tagging operations,

No. of fish placed in pond on each occasion	Water Temp. (°F.)	No. Recovered	Percent Recovered	No. not Recovered	Percent not Recovered
30	39°	27	90.0	3	10.0
7	41°	5	71.4	2	29.6
12	44°	11	91.7	1	8.3
10	46°	10	100.0	0	0.0
13	54°	12	92.3	1	7.7
12	48°	9	75.0	3	25.0
10	58°	7	70.0	3	30.0
Total 94		81	86.2	13	13.8

TABLE 11. Percent harvest of largemouth bass for various areas of Back Bay based on known recaptures from fish tagged in these areas and on estimated recaptures calculated by means of the creel census ratio - 1960 and 1961*

Location	No. Tagged	No. Recaptures Known	No. Recaptures Estimated	Rate of Exploitation known	Rate of Exploitation Estimated
		1960			
Buck Island Bay	712	75	104	10.5	14.6
Buzzard Bay - S.W. Cove	754	119	164	15.7	21.7
Cedar Island	279	30	41	10.7	14.6
North Bay	66	5	7	7.5	10.6
Total or Average	1,811	229	316	12.6	17.4
		1961			
Shipps Bay	579	94	143	15.1	24.6
Buck Island Bay	538	50	76	8.7	14.1
Buzzard Bay - S.W. Cove	507	51	78	10.0	15.3
Cedar Island	153		14	[illegible]	9.1
Total or Average	1,777	204	311	11.4	17.5

* Does not include those released in Bonneys Cove or House Cove.

TABLE 12. Percent harvest for various length groups of bass, based on known recaptures. - 1951*and 1961.

Length (inches)	No. Tagged 1951	No. Tagged 1961	No. Recaptures 1951	No. Recaptures 1961	Rate of Exploitation 1951	Rate of Exploitation 1961
	374	65				
10	615		16	11	4.3	16.9
11		525	25	36	4.1	6.8
12	217	305	16	43	7.4	14.0
13	126	177	17	17	13.5	9.6
14	115	356	14	38	12.2	10.6
15	802	205	12	35	13.0	17.0
16	43	133	9	14	11.3	10.5
17		54	10	11	23-3	20.3
18	34	22	2	3	5.9	13.6
19	20	15	1	3	5.0	21.4
20	10	1	4	2	40.0	40.0
21	5		1	0	20.0	0
22	2	1	0	0	0	0
23	1	0	0	0	0	0
Total or av.	1734	1863	127	213	7.3	11.4

* Roseberry, 1952

TABLE 13.

Distances traveled by Lass tagged in 1960 and 1961.

Returns	Distances traveled (miles) 0-1	1-3	3-6	6-9	9-12	12-15	15-18	19	23	25	64	Total
1960												
Number	73	39	17	12	12	0	2	1	1	0	0	157
Percent	46	25	11	8	8	0	1	.6	.6	0	0	100
1961												
Number	85	70	22	11	3	3	0	0	0	0	0	194
Percent	44	36	11	6	1	1	0	0	0	0	0	99
1960 tags recovered in 1961												
Number	11	16	7	2	4	0	0	0	0	1	1	42
Percent	26	38	17	5	9	0	0	0	0	2	2	99

TABLE 14.

Direction and average distance traveled by largemouth bass tagged in various areas of Back Bay - 1960 and 1961.

Area where tagged	Direction Traveled	Number 1960	Number 1961	Average Distance Traveled 1960	Average Distance Traveled 1961
North End	North	7	23	2.2	2.3
	South	31	21	5.1	3.7
	East	3	35	2.9	2.0
	West	5	7	2.5	2.3
	Total or average	46	86	4.2	2.5
South End	North	23	17	7.6	6.2
	South	21	11	4.7	3.5
	East	4	4	3.0	3.7
	West	0	2	0.0	3.3
	Total or average	48	34		4.8
North and South ends combined.	North	30	40	6.3	4.0
	South	51	32	4.9	3.6
	East	7	39	3.0	2.2
	West	5	9	2.5	2.5
	Total or average	93	120	5.1	3.2

TABLE 15. Distances traveled (miles) by 80 largemouth bass tagged in 1960 (61 first year returns and 19 second year returns} and 194 tagged in 1961, according to size group.

Total Length*	Year	0-1	1-3	3-6	6-9	9-12	12-15	19	23	25	Total
10	1960-1st.yr. ret.	1	0	0	0	0	0	0	0	0	1
	1960-2nd. yr. ret.	2	1	0	0	0	0	0	0	0	3
	1961-1st. yr. ret.	5	5	0	0	0	0	0	0	0	10
11	1960-1st. yr. ret.	11	3	0	0	0	0	1	0	0	15
	1960-2nd. yr. ret.	2	1	1	0	1	0	0	0	0	5
	1961-1st. yr. ret.	20	8	1	3	0	0	0	0	0	32
12	1960-1st. yr. ret.	5	1	0	2	0	0	0	0	0	8
	1960-2nd. yr. ret.	0	3	0	0	0	0	0	0	0	
	1961-1st. yr. ret.	11	17	6	0	1	0	0	0	0	3:
13	1960-1st. yr. ret.	4	0	1	0	0	1	0	0	0	6
	1960-2nd. yr. ret.	1	2	1	0	0	0	0	0	0	4
	1961-1st. yr. ret.	8	6	0	2	0	0	0	0	0	16
14	1960-1st. yr. ret.	5	5	2	0	1	0	0	1	0	14
	1960-2nd. yr. ret.	0	0	0	0	0	0	0	0	0	0
	1961-1st. yr. ret.	18	14	2	3	1	1	0	0	0	39
15	1960-1st. yr. ret.	1	2	1	0	0	0	0	0	0	4
	1960-2nd. yr. ret.	0	1	0	0	0	0	0	0	1	2
	1961-1st. yr. ret.	14	13	5	1	1	1	0	0	0	35
16	1960-1st. yr. ret.	2	4	2	0	0	0	0	0	0	8
	1960-2nd. yr. ret.	0	0	0	0	0	0	0	0	0	0
	1961-1st. yr. ret.	3	3	5	1	0	0	0	0	0	12
17	1960-1st. yr. ret.	2	0	1	0	0	0	0	0	0	3
	1960-2nd. yr. ret.	1	0	0	1	0	0	0	0	0	2
	1961-1st. yr. ret.	4	2	3	1	0	0	0	0	0	10
18	1960-1st. yr. ret.	1	1	0	0	0	0	0	0	0	2
	1960-2nd yr. ret.	0	0	0	0	0	0	0	0	0	0
	1961-1st. yr. ret.	0	1	0	0	0	1	0	0	0	2
19	1960-1st. y-r. ret.	0	0	0	0	0	0	0	0	0	0
	1960-2nd. yr. ret.	0	0	0	0	0	0	0	0	0	0
	1961-1st. yr. ret.	1	1	0	0	0	0	0	0	0	2
20	1960-1st. yr. ret.	0	0	0	0	0	0	0	0	0	0
	1960-2nd. yr. ret..	0	0	0	0	0	0	0	0	0	0
	1961-1st. yr. ret,	1	0	0	0	0	0	0	0	0	3

* Total length when tagged - inch groups.

TABLE 16. Pounds of fish per acre by species obtained in population samples during 1959, 1960, and 1961.

Species	Area A 1959	Area A 1960	Area A 1961	Area B 1959	Area B 1960	Area B 1961	Area C 1959	Area C 1961	Area D 1959	Area D 1960	Area D 1961	Area E 1960	Area E 1961	Average 1959	Average 1960	Average 1961
Largemouth Bass	1.9	5.2	5.0	4.8	1.6	4.4	4.2	4.4	7.5	7.1	0.8	13.3	10.6	4.5	6.5	4.5
Pickeral*	0.0	0.5	Tr.	0.0			0.0	0.0	10.0	0.0 4.0	18 Tr.	0.0	0.0	0.0	0.0	Tr.
Sunfish**	8.0	15.0	15.4	3.6	0.0 1.4	[illegible]	9.7	17-3				22.2	17.4	8.9	10.6	13.7
Warmouth	0.0	0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Tr.	0.2
Yellow Perch	3.4	7.1	10.1	2.5	3.3	4.0	4.9	3.3	3.3	5.6	6.9	4.6	3.6	3.5	4.9	9.7
White Perch	9.7	3.8	8.6	8.7	3.3	6.4	4.5	1.5	6.9	6.6	22.0	19.3	23.2	744	8.3	9.7
Striped Mullet	1.3	0.0	0.0	0.2	0.0	1.8	Tr.	7.6	2.6	14.5	4.0	69.4	120.4	1.0	21.0	13.3
American Eel	1.9	0.4	0.4	0.2	Tr.	Tr	0.8	2.2	6.9	0.1	Tr.	1.3	2.9	2.4		
Carp	93.3	0.1	0.8	3.1	0.4	0.8	63.5	0.3	10.2	7.4	0.0	106.3	17.7	42.5	28.5 0.4	0.7 2.0
Bullheads***	0.5	1.7	0.4	0.5	0.4	0.1	2.4	0.1	1.0	0.2	Tr.	1.7	0.0	1.0	0.9	0.1
Longnose Gar	2.5	1.4	Tr.	2.2	Tr.	1.9	0.0	0.0	2.5	0.0	0.0	0.0	0.0	1.6	Tr.	0.7
Bowfinn	0.3	2.8	3.9	0.7	1.3	0.0	4.9	0.4	8.5	2.3	0.0	0.0	1.1	3.6	1.6	0.8
Channel Catfish	0.0	9.0	0.0	3.6	Tr.	0.0	Tr.	0.0	3.4	0.0	0.0	0.0	0.0	1.9	2.4	0.0
Golden Shiner	0.0	11.3	7.6	6.7	Tr. 0.7	0.5 6.1	2.6	0.5	0.3	1.4	1.0	3.0	Tr.	1.5	4.0	3.9
Spot	3.1	4.4	0.1				0.4	0.0	12.5	3.8	3.3	13.8	6.1	4.9	5.6	1.2
Others	Tr.	1.3	0.7	0.5	0.3	0.3	1.1	1.2	0.7	0.3	1.8	1.2	2.8	0.9	0.6	0.9
Total	125.9	64.2	54.0	40.3	12.7	34.1	99.0	38.8	83.7	53.3	53.1	256.1	205.8	85.6	95.4	61.4

* Chain and Redfin
** Mostly pumpkinseed with a few bluegill
*** Black and Yellow

TABLE 17 Summary of Fish Population data for all coves sampled in Back Bay (11.2 acres)-July, 1959

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Sport Fish									
Largemouth Bass	8.6	5	3.9	4.6-8.5	4	0.3	4.5	68	0.3
Total		5	3.9		4	0.3		68	0.3
B. Non-Predatory Sport Fish (Panfish)									
Pumpkinseed	5.6	1	0.1	3.6-5.5	143	6.5	3.5	247	1.9
Bluegill	5.6	4	0.4	3.6-5.5			3.5		
Yellow Perch	5.6	20	1.2			1.7	3.5	64	0.6
White Perch	5.6	7	2.0	3.6-5.5	270	4.3	3.5	111	1.1
Total		32	3.7		451	12.5		422	3.6
C. Non-Predatory Food Fish (Commercial Species)									
Mullet	9.6	1	1.0	5.6-9.5	0	0	5.5	2	Tr.
American Eel	15.6	3	1.3	8.6-15.5	14	1.1	8.5	5	Tr.
Carp	13.6	16	40.0	6.6-13.5	3	2.5	6.5	1	Tr.
Black Bullhead	6.6	3	0.7	4.6-6.5	0	0	4.5	4	Tr.
Yellow Bullhead	6.6	1	0.2	4.6-6.5	1	0.1	4.5	0	0
Total		24	43.2		18	3.7		12	Tr.

TABLE 17 (Continued)

Summary of Fish Population Data for all Coves Sampled in Back Bay (11.2 acres) -July, 1959

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number Per Acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
D. Predatory Food Fish (Commercial Species)									
Channel Catfish	9.6	Tr.*	1.6	4.6-9.5	0	0	4.5	Tr.	Tr.
White Catfish	9.6	Tr.	0.3	4.6-9.5	Tr.	Tr.	4.5		
Longnose Gar	25.6	Tr.	1.6	6.6-25.5	Tr.	Tr.	6.5	0	0
Eowfin	13.6	Tr.	3.3	4.6-13.5	Tr.	0.3	4.5	0	0
Total			6.8			0.3		Tr.	Tr.
E. Forage Fish									
Golden Shiner	5.6	14	0.7	3.6-5.5	25	d.8	3.5	7	Tr.
Killifish						-	3.0	76	0.2
Menhaden	9.6	0	0	3.6-9.5	32	0.6	3.5	5	Tr.
Needlefish	14.6	Tr.	Tr.	5.6-14.5	Tr.	Tr.	5.5	Tr.	Tr.
Silversides	-	-					3.0	75	0.2
Spot	-	-					5.9	117	4.9
Bluespotted Sunfish	-	-					3.0	21	0.1
Alewife	-	-					3.9	Tr.	Tr.
Misc. Minnows	-	-					3.0	5	Tr.
Total		14	0.7		57	1.4		306	5.4
Grand Total		75	58.3		530	18.2		808	9.3

*Trace - less than 1.0 (number) or 0.1 lb, (weight)

F/C-6.4; A_t-68.1; A_t^s-8.8; A_t^c-60.1; q-65.2; A_t^n-2.6; Y/C-0.8; A_f-64.1; I_f-23.7; S_f-12.1

TABLE 18 Summary of Population Data for the Landing Cove, House Cove, and Dudley Creek Cove - July, 1960

Species	Fish of Available Size: Minimum length (inches	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Game Fish									
Largemouth- Bass	8.6	4	2.9	4.6-8.5	6	1.2	4.5	104	0.6
Chain Pickeral	1 0	.Tr.*6	0.1	5.6-10.5	0.0	0.0	5.5	Tr.	Tr.
Total		4	3.0		6	1.2		104	0.6
B. Non-Predatory Game Fish									
Bluegill	5.6	1	0.2	3.6-5.5	13	0.5	3.5)		
Pumpkinseed	5.6	3	0.3	3.6-5.5	170	4.6	3.5)	799	1.2
Warmouth	5.6	Tr.	Tr.	3.6-5.5	1	Tr.	3.5		0.0
Yellow Perch	5.6	15	1.4	3.6-5.5	74	2.3	3.5	118	1.3
White Perch	5.6	22	2.3	3.6-5.5	55	1.9	3.5	105	c.4
Total		41	4.2		313	9.3		1,022	2.9
C. Non-Predatory Food Fish									
Mullet	9.6	2	4.8	5.6-9.5		0.0	5.5		0.0
American Eel	15.6	Tr.	Tr.	8.6-15.5	1	0.1	8.5	1	Tr.
Carp	13.6	1	2.4	6.6-13.5		0.0	6.5	4	0.2
Bullheads	6.6	1	0.7	4.6-6.5	1	Tr.	4.5	24	Tr.
Total		4	7.9		2	0.1		29	0.2

* Trace - less than 1.0 (number) or 0.1 lb. (weight).

TABLE 18 (Continued)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	0.5	6.6-25.5	Tr.	Tr.	6.5		0.0
Bowfin	13.6	1	2.1	4.6-13.5		0.0	4.5		0.0
Channel Catfish	9.6	1	3.0	4.6-9.5	1	0.3	4.5	6	Tr.
Total		2	5.6		1	0.3		6	Tr.
E. Forage Fish									
Golden Shiner	5.6	17	1.2	3.6-5.5	94	2.6	3.5	5	Tr.
Killifish							3.0	99	0.2
Needlefish	14.6		0.0	5.6-14.5	1	Tr.	5.5	1	Tr.
Silversides		-					3.0	31	Tr.
spot	5.6		0.0	3.6-5.5	2	0.3	3.5	78	2.7
Bluespotted Sunfish		-					3.0	26	Tr.
Menhaden	96		0.0	3.6-9.5		0.0	3.5	1	Tr.
Alewife					-	-	4.0	68	0.3
Total		17	1.2		97	2.9		309	3.2
Grand Total		68	21.9		419	13.8		1,470	6.9

F/C = 3.9; A_t = 51.4; A_t^s = 16.9; A_t^c = 39.2; A_t^h = 47.4; A_t^n = 4.0; Y/C = 0.6; E_f = 41.6; I_f = 38.5; S_f = 19.7

TCBLE 19 Summary of Population Data for all Areas Sampled, July, 1960

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Came Fish									
Largemouth Bass	8.6	6	4.4	4.6-8.5	10	1.4	4.5	108	0.7
Chain Pickeral	10.6	Tr.*	0.1	5.6-X.5	-	0.0	5.5	Tr.	Tr.
Total		6	4.5		10	1.4		108	0.7
B. Non-Predatory Came Fish									
Bluegill	5.6	5	1.6	3.6-5.5	13	0.6	3.5)		
Pumpkinseed	5.6	5	0.6	3.6-5.5	167	Tr. 5.5	3.5)	1,001	2.3
Warmouth	5.6	Tr.	Tr.				3.5		0.0
Yellow Perch	5.6	16	1.5	[illegible]		2.3	3.5	180	1.1
White Perch	5.6	35	4.0	3.6-5.5	6:81	3.0	3.5	231	1.3
				3.6-5.5					
Total		61	7.7		329	11.4		1,412	4.7
C. Non-Predatory Food Fish									
Mullet	9.6	11	21.0	5.6-9.5	Tr.	Tr.	5.5	Tr.	Tr.
American Eel	15.6	1	0.3	8.6-15.5	1	0.1	8.5	3	Tr.
Carp	13.6	8	28.3	6.6-13.5		0.0	6.5	4	0.2
Bullheads	6.6	1	0.9	4.6-6.5	Tr.	Tr.	4.5	20	Tr.
Total		21	50.5		1	0.1		27	0.2

* Trace - lass than 1.0 (number) or 0.1 lb. (weight).

TABLE 19 (Continued)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	Tr.	6.6-25.5		0.0	6.5		0.0
Bowfin	13.6	1	1.6	4.6-13.5		0.0	4.5		0.0
Channel Catfish	9.6	Tr.	'2.2	4.6-9.5	Tr.	0.2	4.5	'3	Tr.
Total		1	3.8		Tr.	0.2		3	Tr.
E. Forage Fish									
Golden Shiner	5.6	17	1.3	3.6-5.5	83	2.3	3.5	67	0.4
Killifish'						-	3.0	86	c.2
Needlefish	14.6		0.0	5.6-14.5	-1	Tr.	5.5	1	Tr.
Silversides		-	-	-		-	3.0	47	Tr.
spot	5.6		0.0	3.6-5.5	94	3.6	3.5	58	2.0
Bluespotted Sunfish		-	-	-	-	-	3.0	27	0.1
Menhaden	9.6		0.0	3.6-9.5		0.0	3.5	4	Tr.
Alewife							4.0	29	0.3
Topminnows					-	-	3.0	2	Tr.
Total		17	1.3		178	5.9		321	3.0
Grand Total		106	67.8		518	19.0		1,871	8.6

F/C - 8.0; A_t - 71.1; A_t^s - 12.8; A_t^c - 62.7; A_t^h - 69.7; A_t^n - 1.4; Y/C - 0.8; A_f - 70.1; I_f - 20.5; S_f - 9.3.

TABLE 20. COMBINED FISH POPULATION DATA FOR ALL AREAS SAMPLED - JULY & AUGUST, 1961.

Species	Fish of Available Size			Intermediate			Fingerlings		
	riinimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length inches	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	4	3.3	4.6-8.5	4.7	1.0	4.5	24	0.2
Pickeral*	10.6	0	0.0	5.6-10.5	0.2	0+	5.5	1	0+
Total:		4	3.3		4.9	1.0		25	0.2
B. Non-Predatory Game Fish									
Bluegill	5.6	3	0.6	3.6-5.5	1.7	0.5	3.5)	194	2.4
Pumpkinseed	5.6	8	1.2	3.6-5.5	145.2	8.5	3.5)		
Yellow Perch	5.6	16	1.6	3.6-5.5	89.7	3.3	3.5	33	0.3
White Perch	5.6	8	0.9	3.6-5.5	200.0	7.6	3.5	190	1.2
Warmouth	5.6	1	0.2	3.6-5.5	0.4	0+	3.5	0	0.0
Total:		36	4.5		437.0	19.9		417	3.9
C. Non-Predatory Food b'ish									
American Eel	15.6	Tr.	0.4	8.6-15.5	2.7	0.3	8.5	3	0+
Carp	13.6	Tr.	1.8	6.6-13.5	0.2	0.1	6.5	1	0.1
Bullheads **	6.6	Tr.	0.1	4.6-6.5	0+	0+	4.5	8	0+
Striped Mullet	y.6	8	12.6	5.6-9.5	'3.8	0.1	5.5	14	0.6
Total:		8	14.9		3.7	0.5		26	0.7

TABLE 20 (Continued) COMBINED FISH POPULATION DATA FOR ALL AREAS SAMPLED - JULY & AUGUST, 1961.

Species	Fish of Available Size: minimum Length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	0.7	6.6-25.5	0.2	0+	6.5	0	0.0
Bowfin	13.6	Tr.	0.7	4.6-13.5	0.2	0.1	4.5	Tr.	0+
Total:		Tr.	1.4		0.4	0.1		Tr.	0+
E. Forage Fish									
Golden Shiner	5.6	29	3.1				4.5	10	0.1
Killifish				4.6-5.5	19	0.7	5.5	39	0.2
Beedlefish	14.6	Tr.	0+	5.6-14.5	1	0+	4.0	Tr.	0+
Silversides								77	0.2
Spot	5.6	1	0.1	3.6-5.5	10	1.1	3.5	0	0.0
Bluespotted Sunfish							3.0	29	0.1
Menhaden	9.6	0	0.0	3.6-9.5	5	0.1	3.5	15	0.3
Total:		30	3.2		35	1.9		170	0.9
Grand Total:		80.3	27.3		480.7	23.4		639.5	5.7

* Chain and Redfin Pickeral
** Black and Yellow Bullheads

F/C - 6.0; A_t-50.5; A_t^s - 14.4; A_t^c - 34.8; A_t^h - 43.3; A_t^h - 7.2; Y/c - 4.9; A_f - 44.6; If - 44.0; S_f - 11.2

TABLE 20 (Continued) COMBINED FISH POPULATION DATA VW ALL AREAS SAMPLED - JULY & AUGUST, 1961.

Species	Fish of Available Size			Intermediate			Fingerlings		
	minimum Length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	0.7	6.6-25.5	0.2	0+	6.5	0	0.0
Bowf in	13.6	Tr.	0.7	4.6-13.5	-0.2	0.1-	4.5	Tr.	0+
Total:		Tr.	1.4		3.4	0.1		PC.	0+
E. Forage Fish									
Golden Shiner	5.6	29	3.1	4.6-5.5	19	0.7	4.5	10	0.1
killifish							4.0	39	0.2
Needlefish	14.6	Tr.	0+	5.6-14.5	1	0+	5.5	Tr.	0+
Silversides							4.0	77	0.2
Spot	5.6	1	0.1	3.6-5.5	10	1.1	3.5	0	0.0
Bluespotted Sunfish							3.0	29	0.1
Menhaden	9.6	-0-	-0.0-	3.6-9.5	5	0.1	3.5	15	0.3
Total:		30	3.2		35	1.9		170	0.9
Grand Total:		80.3	27.3		480.7	23.4		639.5	5.7

* Chain and Redfin Pickeral
** Black and Yellow Bullheads

F/C - 6.0; A_t-50.5; A_t^s - 14.4; A_t^c - 34.8; A_t^h - 43.3; A_t^h - 7.2; Y/c - 4.9; A_f - 44.6; I_f - 44.0; S_f - 11.2

TABLE 21

SUMMARY OF FISH POPULATION DATA FOR AREA A - 1959
(2.2 acres treated with 2.7 ppm. rotenone)

Species	Fish of Available Size: Minimum length (inches	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length inches	Number per acre	Pounds per acre
A. Predatory Sport Fish									
Largemouth Bass	8.6	2	1.3	4.6 - 8.5	2	0.4		31	0.2
Total		2	1.3		2	0.4		31	0.2
B. Non-Predatory Sport Fish (Panfish)									
Bluegill	5.6	12	1.5	3.6 - 5.5	2	0.1	3.5		
Pumpkinseed	5.6	6	0.2	3.6 - 5.5	73	3.4	3.5	201	2.8
White Perch	5.6		0.5	3.6 - 5.5	86	2.5	3.5 z	98	0.4
Total		3	1.1	3.6 - 5.5	602	8.5		9	0.1
		24	3.3		763	14.5		308	3.3
C. Non-Predatory Food Mullet (Commercial Species)									
American Eel	9.6	1	1.3	5.6 - 9.5	0	0	5.5	0	0
	7-23	7	1.9			-	-	-	-
Carp	13.6	34 Tr.	(0.1	8.6 -15.5	1	1.2	6.5	0	0
*Yellow Bullhead Total	6.6	42	95.4	4.6 - 6.5	3	0.4	.	0	0
					4	1.6		0	0
D. Predatory Food Fish (Commercial Species)									
Longnose Gar	25.6	Tr.	2.5	6.6 -25.5	0	0	6.5	0	0
Bowfin Total	13.6	0	0	4.6 -13.5	Tr.	0.3	4.5	0	0
		Tr.	2.5		Tr.	0.3		0	0

TABLE 21 (Cont'd). SUMMARY OF FISH POPULATION DATA FOR AREA A - 1959
(2.2 acres treated with 2.7 ppm. rotenone)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
E. Forage Fish									
Killifish	-	-	-	-	-	-	4.0	20	Tr.
Menhaden	9.6	0	0	3.6 - 9.5	0	0	3.5	5	Tr.
Needlefish	14.6	0	0	5.6 -14.5	0	0	5.5	Tr.	Tr.
Silversides	-	-	-	-	-	-	4.0	20	Tr.
Spot	5.6	10	0	3.6 - 5.5	-	-	3.5	107	3.1
Misc. Minnows	-	1		-			3.0	3	Tr.
Total								155	3.1
Grand Total		68	102.5		769	16.8		494	6.6

F/C - 44.8; A_t - 81.4; A_t^s - 3.6; A_t^c - 77.0; A_t^h - 79.4; A_t^n - 1.9; Y/C - 5.0; A_f - 81.4; I_f - 13.2; S_f - 5.2

Table 22 Summary of Fish Population Data for Area A - 1960

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in Length (inches	Number per acre	Pounds per acre	Fingerlings: Maximum length inches	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	3	1.9	4.6-8.5	14	2.9	4.5	132	0.4
Chain Pickeral	10.6	Tr.	0.4	5.6-10.5	-	—	5.5	1	0.1
Total		3	2.3		14	2.9		133	0.5
B. Non-Predatory Game Fish		2							
Bluegill	5.6	4	0.5	3.6-5.5	34	1.2	3.5)	2,000.0	2.2
Pumpkinseed	5.6		0.4	3.6-5.5	438	10.7	3.5)		
Warmouth	5.6	Tr.	0.1	3.6-5.5	3	0.1	3.5	0.0	0.0
Yellow Perch	5.6	17	1.5	3.6-5.5	126	3.9	3.5	336	1.7
White Perch	5.6	9	1.0	3.6-5.5	81	2.5	3.5	59	0.3
Total		32	3.5		682	18.4		2,395	4.2
C. Non-Predatory Food Fish							7.5		
American Eel	15.6	Tr.	0.2	7.6-15.5	1	0.2	6.5	3	0.1
Carp	13.6	0.0	0.0	6.6-13.5	0.0	0.0			
Black Bullhead	6.6	3	1.7	4.6-6.5	2	—	4.5	0.0	0.0
Total		3	1.9		3	0.2		4	0.1

TABLE 22 (Cont'd.)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	1.4	6.6-25.5	0.0	0.0	6.5	0.0	0.0
Bowfin	13.6	1	2.8	4.5-13.5	0.0	0.0	4.5	0.0	0.0
Channel Catfish	9.6	2	9.0	4.5-9.5	2	0.9	4.5	Tr.	-
Total		3	13.2		2	0.9		Tr.	0.0
E. Forage Fish									
Golden Shiner	5.6	58	3.8	3.6-5.5	282	705	3.5	0.0	0.0
Killifish			-		-	-	4.0	232	0.5
Silversides	14.6	[illegible]	0.0	5.6-14.5	Tr.	-	5.5	1	
Spot	5.6	0	0.0	-	-1	.	3.5	16	
Menhaden	9.6			3.6-5.5		0.1	3.5	133	4.3
		0	0.0	3.6-9.5	0.0	0.0		184	0.8
Total		58	3.8		283	7.6		566	5.6
Grand Total		99	24.7		984	30.0		3,098	10.4

F/C = 2.2; A_t = 37.9; A_t^s = 8.9; A_t^c = 24.9; A_t^h = 29.9; A_t^n = 8.0; Y/C = 0.5; A_f = 20.3; I_f = 57.8; S_f = 21.8

TABLE 23 Summary of Fish Population Data for Area A, July, 1961.

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	5.0	3.5	4.6-8.5	(3.6	1.3	4.5	36.8	0.2
Pickeral	10.6	0.0	0.0	5.6-10.5	0.0	0.0	5.5	2.2	0+
Total:		5.0	3.5		8.6	1.3		39.0	0.2+
B. Non-Predatory Sport Fish									
Bluegill	5.6	5.9	1.1	3.6-5.5	8.1	0.7	3.5)	478.1	5.2
Pumpkinseed	5.6	7.2	0.9	3.6-5.5	187.2	7.5	3.5)		
Warmouth	5.6	4.0	0.7	3.6-5.5	2.2	0.3	3.5	0	0.0
Yellow Perch	5.6	20.4	3.2	3.6-5.5	22g:o	6.6	3.5	72.2	0.4
White Perch	5.6	29.0	3.3	3.6-5.5	150.9	5.3	3.5	0.9	0+
Total:		66.5	9.2		577.4	20.4		551.2	5.6+
C. Bon-Predatory Food Fish									
American Eel	15.6	0.4	0.1	7.6-15.5	4.5	0.3	7.5	6.3	0+
Carp	13.6	3.0	0.0	6.6-13.5	0.4	0.4	6.5	3.1	0.4
Yellow Bullhead	6.6	0.4	0.4	4.6-6.5	~~0.0~~	0.0	4.5	1.3	0+
Total:		0.8	0.5		4.9	0.3		10.7	0.4+

TABLE 23 (Cont'd.) Summary of Fish Population Data for Area A, July, 1961

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length inches	Fingerlings: Number per acre	Fingerlings: Pounds per acre
D. Predatory Food Fish									
Long-nose Gar	25.6	0.0	0.0	6.6-25.5	0.1	0+	6.5	0.0	0.0
Bowfin	13.6	1.3	3.5	4.6-13.5	0.9	0.4	4	0.05	0.0
Total:		1.3	3.5		1.0	0.4+		0.0	0.0
E. Forage Fish									
Killifish Shiner	5.6	52.7	4.3	3.6-5.5	72.2	3.0	3.5	16.3	0.3
Needlefish	14.6	0.4	0.1	5.6-14.5	0.9	0+	3.0	30.0	0.1
		-	-		-	-	5.5	1.8	0+
Spot Bluespotted Sunfish	5.6	0.0	0.0	3.6-5.5	1.3	0.1	3.5	0.0	0.0
Menhaden	9.6	0.0					3.0	56.8	0.1
			0.0	3.6-9.5	0.0	0.0	3.5	19.5	0.2
Total:		53.1	4.4		74.4	3.1+		124.4	0.7
Grand Total:		126.7	21.1		666.3	25.5+		725.3	6.9+

F/C = 6.0; A_t 39.4; A_t^s = 17.7; A_t^c = 27.8; A_t^h = 31.2; A_t^n = 8.2; Y/C = 3.5; A_f = 31.6; If = 53.3; S_f = 15.0.

TABLE 24

SUMMARY OF FISH POPULATION DATA FOR AREA B - 1959
(5.0 acres treated with 1.2 ppm. rotenone)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Sport Fish									
Largemouth Bass	8.6	5	4.0	4.6-8.5	2	0.3	4.5	100	0.5
Total		5	4.0		2	5.3		100	0.5
B. Non-Predatory Sport Fish (Panfish)									
Bluegill	5.6	1	0.2	3.6-5.5			3.5		
Pumpkinseed	5.6	Tr.	Tr.	3.6-5.5	71	2.5	3.5	99	0.9
Yellow Perch	5.6	2	0.3	3.6-5.5	41	1.5	3.5	33	0.7
White Perch	5.6	9	2.5	3.6-5.5	198	1.9	3.5	435	4.3
Total		12	3.0		310	5.9		567	5.9
C. Ron-Predatory Food Fish (Commercial Species)									
Mullet	9.6	Tr.	0.2	5.6-9.5	0	0	5.5	0	0
American Eel	15.6	1	0.2	7.6-15.5	1	Tr.	7.5	6	Tr.
Carp	13.6	1	1.6	8.6-13.5	2	1.5	8.5	0	0
Brown Bullhead	6.6	1	0.4	4.6-6.5	0	0	4.5	5	Tr.
Yellow Bullhead	5.6	Tr.	Tr.	4.6-6.5	0	0	4.5	0	0
Total		3	2.5		3	1.5		11	Tr.

TABLE 24 (Cont'd.)

SUMMARY OF FISH POPULATION DATA FOR AREA B - 1959
(5.0 acres treated with 1.2 ppm. rotenone)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
3. Predatory Food Fish									
(Commercial Species)	9.6								
Channel Catfish	9.6	1	3.0	4.6	0	0	4.5	0	0
White Catfish	[illegible]	1	1.4	4.6	0				Tr.
Longnose Gar	25.6	Tr.	1.6	6.5	Tr.	0.0	6.5	Tr. 0	0
Bowfin	13.6	Tr.	0.7	4.6	0	0	4.5	0	0
Total		2	6.7		Tr.	0.6		Tr.	Tr.
E. Forage Fish									
Golden Shiner	5.6	55	2.7	3.6	21	0.9	3.5	6	Tr.
Killifish	-	-	-				4.0	30	0.1
Menhaden / Needlefish	14.6	Tr.	0.01	3.6	87	1.6	3.5	8	0.1
Silversides				5.6	1	Tr.	5.5	0	0
Spot							4.0	49	0.1
Bluespotted Surfish	-						6.0	135	6.7
		-	-			-	3.0	17	0.2
Total		55	2.8		22	0.9		245	8.9
Grand Total		77	19.0		337	9.2		923	15.4

$F/C = 2.5$; $A_t = 43.5$; $A_t^s = 16.0$; $A_t^c = 23.8$; $A_t^h = 33.4$; $A_t^n = 10.0$; $Y/C = 2.0$; $A_f = 26.4$; $I_f = 26.4$; $S_f = 47.1$.

TABLE 25 Summary of Population Data for Area B - 1960.

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	2	1.0	4.6-8.5	0	0.0	4.5	89	0.6
Total		2	1.0		0	0.0		89	0.6
B. Non-Predatory Game Fish									
Bluegill	5.6	Tr.	-	3.6-5.5	1	-	3.5)		
Pumpkinseed	5.6	0.0	0.0	3.6-5.5	22	0.8	3.5)	95	0.6
Yellow Perch	5.6	2	0.2	3.6-5.5	22	0.7	3.5	215	1.4
White Perch	5.6	6	0.5	3.6-5.5	65	2.2	3.5	146	0.6
Total		8	0.7		110	3.7		456	2.6
C. Non-Predatory Food Fish									
American Eel	15.6	0.0	0.0	7.6-15.5	1	-	7.5	0.0	0.0
Carp	13.6	0.0	0.0	6.6-13.5	0	0.0	6.5	6	0.4
Black & Yellow Bull.	6.6	Tr.	0.0	4.6-6.5	-	-	4.5	66	0.2
Total		Tr.	0.2		1	0.0		72	0.6

TABLE 25 (Cont'd.)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (Inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	0	0.0	6.6-25.5	Tr.	Tr.	6.5	0.0	0.0
Bowfin	13.6	1	1.3	4.6-13.5	0	0.0	4.5	0.0	0.0
Channel Catfish	9.6	0	0.0	4.6-9.5	0	0.0	4.5	13.0	Tr.
Total		1	1.3		Tr.	Tr.		13.0	Tr.
E. Forage Fish									
Golden Shiner / Killifish	5.6	0	0.0	3.6-5.5	0	0.0	5.5	14.8	Tr.
Needlefish	14.6	0		5.6-14.5			5.5	46.0	0.2
Silversides			0.0		1	Tr.	4.0	0.4	Tr.
Spot	5.6	0	0.0		-	-		20.2	0.1
Bluespotted Sunfish	-			3.6-5.5	5	0.7	3.5	0.0	0.0
							3.0	13.6	Tr.
Menhaden							3.5	3.2	Tr.
Total		0	0.0		6	0.7		98.2	0.3
Grand Total		11.2	3.2		114.8	4.4		728.4	4.1

F/C - 3.0; A_t - 37.6; A_t^s - 20.0; A_t^c - 258; A_t^h - 37.6; A_t^n - 0.0; Y/C - 2 [illegible] 6 A_f 10.2; If - 50.0; S_f - 39.7.

TABLE 26 SUMMARY OF POPULATION DATA FOR AREA B, JULY, 1961.

Species	Fish of Available Size			Intermediate			Fingerling		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	4	3.7	4.6-8.5	3	0.6	4.5	13	0.1
Total		4	3.7		3	0.6		13	0.1
B. Non-Predatory Game Fish									
Bluegill	5.6	Tr.	Tr.	3.6-5.5	0	0.0	3.5)	112	3.6
Pumpkinseed	5.6	1	0.1	3.6-5.5	81	4.1	3.5)		
Yellow Perch	5.6	7	0.6	3.6-5.5	67	3.2	3.5	22	0.2
White Perch	5.6	4	0.4	3.6-5.5	145	5.7	3.5	82	0.3
Total		12	1.1		293	13.0		216	4.1
C. Non-Predatory Food Fish									
American Eel	15.6	0	0.0	8.6-15.5	Tr.	0+	8.5	2	0+
Carp	13.6	Tr.	0.7	6.6-13.5	Tr.	0.1	6.5	Tr.	0+
Black Bullhead	6.6	Tr.	0.1	4.6-6.5	0	0.0	4.5	19	0+
Striped Mullet	9.6	1	1.8	5.6-9.5	0	0.0	5.5	0.0	0.0
Total		1	2.8		Tr.	0.1+		21	0+

TABLE 26 Continued

SUMMARY OF POPULATION DATA FOR AREA B, JULY, 1961.

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	Tr.	1.1	5.6-25.5	Tr.	0.8	6.5	0	0.0
Total		Tr.	1.1		Tr.	0.8		0	0.0
E. Forage Fish									
Golden Shiner	5.6	44	5.3	4.6-5.5	12	0.8	4.0	Tr.	0-t-
Killifish							4.0	47	0.2
Silversides								8	0+
Spot	5.6	1	0+	3.6-5.5	5	0.5		0	0.0
Bluespotted Sunfish							3.5	10	0+
Menhaden		-	-				3.0 4.0	6	0.1
Total		45	5.3		17	1.3		71	0.3
Grand Total		62.8	13.8		313.8	15.8		321.5	4.5

F/C = 44.1; A_t = 40.4; A_t^s = 14.0; A_t^c = 10.5; A_t^h = 21.7; A_t^n = 18.7; Y/C = 3.0; A_f = 32.3; If = 51.7; S_f = 15.8.

TABLE 27

SUMMARY OF FISH POPULATION DATA FOR AREA C - 1959
(2.2 acres treated with 1 ppm rotenone)

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Sport Fish									
Largemouth Bass	8.6	3	3.9	4.6-8.5	Tr.	0.1	4.5	45	0.2
Total		3	3.9		Tr.	0.1		45	0.2
B. Non-Predatory Sport Fish									
(Panfish)					1				
Bluegill	5.6	2	0.2	3.6-5.5	112	0.1	3.5	250	1.1
Pumpkinseed	5.6	0	0	3.6-5.5		4.4	3.5	53	0.9
Yellow Perch	5.6	13	1.3	3.6-5.5	102	2.9	3.5	74	0.7
White Perch	5.6	Tr.	0.1	3.6-5.5	177	4.1	3.5	0	0
Total		15	1.6		392	11.5		377	2.7
C. Non-Predatory Food Fish (Commercial Species)									
Mullet	9.6	0	0	5.6-9.5	0	0	5.5	3	Tr.
American Eel	15.6	2	0.8	8.6-15.5	3	Tr.	8.5	2	Tr.
Carp	13.6	24	58.2	6.6-13.5	5	5.0	6.5	5	0.3
+-Brown Bullhead	6.6	7	2.0	4.6-6.5	0	0	4.5	8	Tr.
*Yellow Bullhead	6.6	Tr.	0.4	4.6-6.5	0	0	4.5	0	0
Total		33	61.4		8	5.0		18	0.3

TABLE 27 (Cont'd.)

SUMMARY OF FISH POPULATION DATA FOR AREA C - 1959
(2.2 acres treated with 1 ppm rotenone)

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length inches	Number per acre	Pounds per acre
D. Predatory Food Fish (Commercial Species)									
Catfish	9.6	0	0	4.6-905	0	0	4.5	2	Tr.
Bowfin	13.6	2	4.1	4.6-13.5	1	0.8	4.5	0	0
Total		2	4.1		1	0.8		2	Tr.
E. Forage Fish									
Golden Shiner	5.6	2	0.2	4.6-5.5	77	2.2	4.5	23	0.2
Killifish	-	-	-	-	-	-	4.0	145	0.5
Menhaden	9.6	0	0	3.0	-	-	4.0	3	Tr.
Needlefish	14.6	0	0	5.6-14.5	1	Tr.	5.5	0	0
Silversides				0			4.0	122	0-4
spot							6.0	43	0.4
Bluespotted Sunfish	-						3.0		
Misc. Minnows							3.0	5	Tr.
Total		2	0.2		78	2.2		369	1.7
Grand Total		55.8	71.2	I	480.1	19.6		812.2	

F/C = 9.5; A_t = 74.3; A_t^s = 5.7; A_t^c = 79.0; A_t^h = 74.1; A_t^n = 0.2; Y/C = 2.6; A_f = 72.9; I_f = 21.5; S_f = 5.4.

TABLE 28 SUMMARY OF POPULATION DATA FOR AREA C - 1960

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	Tr.	0.2	4.6-8.5	0	0.0	4.5	127	0.8
Chain Pickeral	10.6	0	0.0	5.6-10.5	Tr.	-	5.5	0	0.8
Total		Tr.	0.2		Tr.	0.0		127	0.8
B. Non-Predatory Game Fish									
Bluegill	5.6	0	0.0	3.6-5.5	2	0.1	3.5)	279	3.0
Pumpkinseed	5.6	7	1.0	3.6-5.5	153	8.0	3.5)		
Warmouth	5.6	0	0.0	3.6-5.5	Tr.	-	3.5	0	0.0
Yellow Perch	5.6	0	0.0	3.6-5.5	29	0.9	3.5	28	0.1
White Perch	5.6	Tr.	0.0	3.6-5.5	9	0.4	3.5	150	0.9
Total		7	1.0		193	9.4		457	4.0
C. Non-Predatory Food Fish									
Mullet	9.6	0	0.0	5.6-9.5	0	0.0	5.5	18	0.7
American Eel	15.6	Tr.	-	7.6-15.5	6	0.4	7.5	7	-
Carp	13.6	0	0.0	6.6-13.5	0	0.0	5.5	43	1.4
Yellow Bullhead	6.6	1	0.4	4.6-6.5	3	0.2	4.5	12	-
Total		1	0.4		9	0.6		80	2.1

TABLE 28 (Cont'd.)

species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish									
Longnose Gar	25.6	0	0.0	6.6-25.5	2	-	6.5	Tr.	
Bowfin	13.6	0	0.0	4.6-13.5	1	0.5	4.5	0	0.0
Channel Catfish	9.6	0	0.0	4.6-9.5	0	0.0	4.5	3	-
Total		0	0.0		3	0.5		3	0.0
E. Forage Fish									
Golden Shiner / Killifish	5.6	0	0.0	3.6-5.5	28	0.7	3.5	23	0.1
Needlefish	14.6	0	0.0	5.6-14.5			4.0	84	0.6
Silversides		-	-		[illegible]	0.0	5.5	fr.	
Spot	5.6	0	0.0	-	0	-	4.0	1	
Bluespotted Sunfish	-			3.6-5.5		0.0	3.5	324	2.5
							3.0	29	0.2
Total		0	0.0		28	0.7		460	3.4
Grand Total		9.9	1.6		234.2	11.2		1,128.6	1U.3

F/C - 106.5;

TABLE 29 SUMMARY OF POPULATION DATA FOR AREA C, AUGUST, 1961.

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	4	3.2	4.6-8.5	1	0.3	4.5	34	0.6
Total		4	3.2		1	0.3		34	0.6
B. Non-Predatory Game Fish									
Bluegill	5.5	1	0.4	3.6-5.5	0	0.0	3.5)	177	1.8
Pumpkinseed	5.6	11	1.9	3.6-5.5	207	13.3	3.5)		
Yellow Perch	5.6	5	0.5	3.6-5.5	63	2.4	3.5	25	0.4
White Perch	5.6	Tr.	0.1	3.6-5.5	23	1.0	3.5	37	0.4
Total		17	2.9		293	16.7		239	2.6
C. Non-predatory Food Fish									
American Eel	15.6	1	0.9	8.6-15.5	7	1.1	8.5	3	0.2
Carp	13.6	0	0.0	6.6-13.5	0	0.0	6.5		0.3
Yellow Bullhead	6.6	0	0.0	4.6-6.5	Tr.	0.1	4.5	1	0+
Striped Mullet	9.6	3	6.9	5.6-9.5	5	0.7	5.5	0	0.0
Total		4	7.8		12	1.9		7	0.5
D. Predatory Food Fish									
Bowfin	13.6	Tr.	0.4	4.6-13.5	0	0.0	4.5	0	0.0
Total		Tr.	0.4		0	0.0		0	0.0
E. Forage Fish									
Golden Shiner	5.4	0	0.0	4.6-5.5	5	0.2	4.5	33	0.3
Killifish							4.0	50	0.5
Silversides							4.0	167	0.5
Bluespotted Sunfish							3.0	65	0.2
Total		0.0	0.0		5	0.2		315	1.5
Grand Total		25.3	22.7		312.3	19.1		596.8	5.2

F/C = 7.6; A_t = 37.0; A_t^s = 15.8; A_t^c = 14.3; A_t^h = 37.0; A_t^n = 0.0; Y/C = 6.1; A_f = 31.3; If = 55.1; S_f = 13.4.

TABLE 30

SUMMARY OF FISH POPULATION DATA FOR AREA D - 1959
(1.8 acres treated with 1.3 ppm. rotenone)

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Sport Fish									
Largemouth Bass	8.6	8	6.4	4.6-8.5	12	0.6	4.5	95.0	0.5
Total		8	6.4		12	0.6		95.0	0.5
B. Non-Predatory Sport Fish (Panfish)									
Pumpkinseed	5.6	Tr.	0.1	3.6-5.5	315	15.5	3.5	382.7	1.8
Yellow Perch	5.6	62	2.8	3.6-5.5	0	0	3.5	51.1	0.5
White Perch	5.6	15	4.2	3.6-5.5	103	2.7	3.5	2.7	Tr.
Total		77	7.1		418	18.2		436.5	2.3
C. Non-Predatory Food Fish (Commercial Species)									
Mullet	9.6	3		5.6-5.5	0	0	5.5	3.9	0.2
American Eel	15.6	4	2.4	7.6-15.5	52	4.5	7.5	13.3	0.2
Carp	13.6	4	8.0	6.6-13.5	3	2.2	6.5	0	0
Brown Bullhead	6.6	2	0.5	4.6-6.5	0	0	4.5	1.1	Tr.
Yellow Bullhead	6.6	2	0.5	4.6-6.5	Tr.	Tr.	4.5	0	0
Total		15	13.6		55	6.7		18C.3	0.4

TABLE 30 (Cont'd.) SUMMARY OF FISH POPULATION DATA FOR AREA D - 1959
(1.8 acres treated with 1.3 ppm. rotenone)

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
D. Predatory Food Fish (Commercial Species)									
*Channel Catfish	9.6	Tr.	3.4	4.6-9.5	0	0	4.5	0	0
Longnose Gar	25.6	Tr.	2.5	6.5-25.5	0	0	6.5	0	0
Bowfin	13.6	2	8.5	4.6-13.5	0	0	4.5	0	0
Total		2	14.4		0	0		0	0
E. Forage Fish (Non-Predatory)									
Golden Shiner	5.6	0	0	3.6-5.5	4	0.3	3.5	0	0
Killifish		-				-	4.0	108	0.3
Menhaden		-			40	0.7	4.0	28	0.2
Needlefish	14.6	0	3	3.6-14.5	0	0	5.5	Tr.	Tr.
Silversides		-				-	4.0	104	0.3
Spot		-				-	6.0	203	12.5
Bluespotted Sunfish	-	-				-	3.0	25	0.1
Alewife		-	-	-	-	-	-	-	
Total		0	0		44	1.0		468	13.4
Grand Total		103.	41.5		527.2	26.5		1018.4	16.6

F/C - 2.9; A_t - 49.0: A_t^s - 15.9; KC_t - 38.4; A_t^h - 46.0; A_t^1 - 2.9; Y/C - 1.9; A_f - 33.0; I_f - 41.3; S_f - 25.6.

TABLE 31 SUMMARY OF POPULATION DATA FOR AREA D - 1960

Species	Fish of Available Size: Minimum length (inches	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	7	5.7	4.6-8.5	4	0.7	4.5	90	0.7
Total		7	5.7		4	0.7		90	0.7
B. Xon-Predatory Fish									
Bluegill	5.6	0	0.0	3.6-5.5	3	0.2	3.5)	284	0.9
Pumpkinseed	5.6	5	0.5	3.6-5.5	50	2.4	3.5)		
Yellow Perch	5.6	25	2.5	3.6-5.5	74	2.3	3.5	139	Oe.8
White Perch	5.6	49	5.3	3.6-5.5	19	0.9	3.5	111	0.4
Total		80	8.3		146	5.8		534	2.1
C. Mon-Predatory Food Fish									
Mullet	9.6	7	14.5	5.6-9.5	0	0.0	5.5	0	0.0
American Eel	15.6	0	0.0		2	0.1	7.5	2	-
Carp	13.6	3	7.3	[illegible]			6.5	2	
Black Bullhead	6.6	Tr.	0.2	7.6-15.5 6.6-13.5	00	0.0	4.5	7	0.1-
Total		10	22.0		2	0.1		11	0.1
D. Predatory Food Fish									
Bowfin	13.6	1.7	2.3	4.6-13.5	0	0.0	4.5	0	0.0
Total		1.7	2.3		0.0	0.0		0	0.0

TABLE 31 (Cont'd.)

Summary of Population Data for Area D - 1960

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
E. Forage Fish									
Golden Shiner	5.6	10	1.2	36-5.5	Tr.	0.2	3.5	Tr.	
Killifish							4.0	19	
			-			-	5.5	1	-
Silversides Needlefish	-14.6	- 0	0.0	5.6-14.5	1	-	4.0	56	0.1
Spot	5.6	0	0.0	3.615.5	0	0.0	3.5	100	3.8
Bluespotted Sunfish	-						3.0	64	0.2
Menhaden		-	-					17	
Total		10	1.2		1	0.2		257	4.1
Grand Total		109.3	39.5		153.3	6.8		894.8	7.0

F/C - 4.7; A_t - 74.1; A_t^s - 26.3; A_t^c - 60.2; A_t^h - 71.8; A_t^n - 2.2; Y/C - 1.7; A_f - 71.7; If - 15.8; Sf - 14.3.

TABLE 32 SUMMARY OF POPULATION DATA FOR AREA D, AUGUST, 1961

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	Tr.	0.2	4.6-8.5	Tr.	0.2	4.5	29	0.4
Redfin Pickeral	10.6	0.0	0.0	5.6-10.5	Tr.	0+	5.5	0	0.0
Total		Tr.	0.2		Tr.	0.2		29	0.4
B. Non-Predatory Game Fish									
Pumpkinaeed	5.6	7	0.9	3.6-5.5	205	15.8	3.5	214	1.6
Yellow Perch	5.6	48	4.6	3.6-5.5	52	1.9	3.5	47	0.4
White Perch	5.6	Tr.	0+	3.6-5.5	471	15.6	3.5	909	6.4
Total		55	5.5		728	33.3		1170	8.4
C. Non-Predatory Food Fish									
American Eel	15.6	0	0.0	8.6-15.5	Tr.	0+	8.5	1	0+
Bullhead	6.6	0	0.0	4.6-6.5	0	0.0	4.5	1	0+
Striped Mullet	9.6	0	0.0	5.6-9.5	0	0.0	5.5	93	4.0
Total		0	0.0		Tr.	0+		95	4.0
E. Forage Fish									
Golden Shiner	5.6	12	0.9	4.6-5.5	2	0.1	4.5	0	0.0
Killifish							4.0	34	0.2
Needlefish	14.6	Tr.	0.1	5.6-14.5	3	0+	5.5	0	0.0
Silversides							4.0	301	0.7
Spot	5.6	0	0.0	3.6-5.5	66	3.3	3.5	0	0.0
Bluespotted Sunfish							3.0	17	0.1
Menhaden							4.0	35	0.8
Ten-Pounder							6.0	3	0+
Total		12	1.0		71	3.4		390	1.8
Grand Total		68.2	6.7		601.4	36.9		1684.1	14.6

F/C = 71.7; A_t = 11.5; A_t^s = 9.7; A_t^c = 7.9; A_t^h = 9.7; A_t^n = 1.7; Y/C = 12.8; A_f = 11.3; If = 63.9; S_f = 24.7.

TABLE 33 SUMMARY OF POPULATION DATA FOR AREA B. - 1960

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	11	8.8	5.0-8.9	21	2.2	4.9	12%	1.1
Total		11	8.8		21	2.2		122	1.1
B. Non-Predatory Game Fish									
Bluegill	5.6	iy	6.0	4.0-5.9	15	1.0	3.9)	1627	5.4
Pumpkinseed	5.6	12	1.6	4.0-5.9	159	8.2	3.9)		
Yellow Perch	5.6	18	2.0	4.0-5.9	48	2.2	3.9	31	0.4
White Perch	5.6	75	9.1	4.0-5.9	158	6.3	3.9	610	3.9
Total		124	18.7		380	17.7		2268	9.7
C. Non-predatory Food Fish									
Mullet	9.6	37	69.4	6.0-9.9	2		5.9	2	-
American Eel	15.6	3	1.1	8.0-15.9	2	0.2	7.9	8	-
Carp	13.6	30	106.1	7.0-13.9	0	0.0	6.9	4	0.2
Black Bullhead	6.6	2	1.7	5.0-6.9	0	0.0	4.9	5	-
Total		72	178.3		4	0.2		19	0.2
D. Forage Fish									
Golden Shiner	5.6	1	0.1	4.0-5.9	50	1.4	3.9	252	1.5
Killifish		-	-			-	3.0	47	0.2
Silversides	-	-	-			-	3.0	94	0.3
Spot	5.6	0	0.0	4.0-5.9	369	13.8	3.9	0	0.0
Bluespotted Sunfish	-	-	-			-	3.0	29	0.2
Topminnows		-	-		-	-	3.0	8	-
Menhaden		-	0.0	4.0-9.9	0.0	0.0	3.9	13	-
Alewife		-	-		-		4.0	72	0.5
Total		1	0.1		419	15.2		515	2.7
PC'/ - 28.0; Grand Total		208.0	205.9		822.6	35.3		2,925.4	13.7

A_t - 80.8; A_t^s - 10.8; A_t^c - 74.3; A_t^h - 80.8; A_t^n - 0.0; Y/C - 3.8; A_f - 81.1; If - 13.6; S_f - 5.1.

TABLE 34 SUMMARY OF POPULATION DATA FOR AREA E, JULY 1961.

Species	Fish of Available Size: Minimum length (inches)	Fish of Available Size: Number per acre	Fish of Available Size: Pounds per acre	Intermediate: Range in length (inches)	Intermediate: Number per acre	Intermediate: Pounds per acre	Fingerlings: Maximum length (inches)	Fingerlings: Number per acre	Fingerlings: Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	8	5.4	4.6-8.5	20	4.9	4.5	15	0.2
Pickeral*	10.6	0	0.0	5.6-1055	1	0.1	5.5	0	0.0
Total		8	5.4		21	5.0		15	0.2
B. Non-Predatory Game Fish									
Bluegill	5.6	18	5.8	3.6-5.5	3	0.3	3.5)		
Pumpkinseed	5.6	41	6.0	3.6-5.5	129	8.8	3.5)	4	0+
Yellow Perch	5.6	15	1.9	3.6-5.5	28	1.7	3.5	0	0.0
White Perch	5.6	11	1.1	3.6-5.5	461	21.3	2.5	193	0.8
Total		85	14.8		621	32.1		197	0.8
C. Non-Predatory Food Fish									
American Eel	15.5	3	2.3	8.6-15.5	5	0.6	8.5	3	0+
Carp	13.6	5	17.7	6.6-13.5	0	0.0	6.5	0	0.0
Striped Mullet	9.6	87	120.4	5.6-9.5	0	0.0	5.5	0	0.0
Total		95	140.4		5	0.6		3	0.0
D. Predatory Food Fish									
Bowfin	13.6	1	1.1	4.6-13.5	0	0.0	4-5	2	0+
Total		1	1.1		0	0.0		2	0+
E. Forage Fish									
Golden Shiner	5.6	0	3.0	4.6-5.5	0	0.0	4.5	7	0+
Killifish							4.0	4	0+
Needlefish	14.6	0	0.0	5.6-14.5	1	0+	5.5	0	0+
Silversides							4.0	4	0+
Spot	5.6	7	0.7	3.6-5.5	86	5.4	3.5	0	0.0
Bluespotted Sunfish							3.0	11	0+
Menhaden							4.0	141	2.8
Total		7	0.7		87	5.4		167	2.8
Grand Total		197.8	162.4		735.7	43.1		383.9	3.8

*Chain and Redfin Pickeral

F/C - 16.9; S_{f_t} - 77.5; A_t^s - 9.6; A_t^c - 69.0; A_t^u - 77.2; A_t^n - 0.3; y/c - 3.6; A_f -78.8;

TABLE 35

YEARLY HARVEST (POUNDS) AND MONETARY VALUE IN (DOLLARS) OF THE COMMERCIAL FISHERY OF BACK BAY AS RECORDED AT THE WARDEN HEADQUARTERS FISH POUND

Year	Carp Pounds	Carp Value	Yellow and White Perch* Pounds	Yellow and White Perch* Value	Catfish* Pounds	Catfish* Value	Striped Bass* Pounds	Striped Bass* Value	Miscellaneous 1 Pounds	Miscellaneous 1 Value	Total Pounds	Total Value
1944	139,546	$8,951									139,546	$8,952
1945	65,167	3,821									65,167	3,821
1946	129,930	5,488									129,930	5,488
1948	206,310	12,395									206,310	12,395
1949	102,574	62154									102,574	6,154
1950	106,491	6,389	33,931	$4,072	12,440	$995	1,290	$284	8,935	336	162,547	12,076
1951	86,657	5,199									86,657	5,199
1953	142,937	102756									142,937	10,756
1956	76,685	4.601					30				76,685	4,601
1957	158,971	11,464	10,200	1,318	2,532	205	499	8	112	4	171,845	12,999
1958	101,637	6,088	41,059	4,852	3,439	286		110	554	28	147,189	11,364
1959	53,252	3,195	51,098	5,857	3,150	278	523	114	1,544	76	109,567	9,520
1960**	49,665	2,208	14,604	1,747	1,111	82	338	74	1,135	52	66,853	49 163
				Estimated Total harvest and Total Monetary Value**								
1944	279,092	17,904									279,092	17,904
1945	130,334	72642									130,334	79642
J-946	259,860	10,976									259,860	10,976
1948	412,620	24,790									4129620	24,790
1949	205,148	12,308									2052148	12,308
1950	212,982	12,778	67,862	8,144	24,880	1,990	2,580	568	16,790	672	325,094	24,152
1951	169,186	10,150									169,186	10,150
1953	285,874	21,512									2852874	21,512
1956	'53,370	9,202									153,370	9,202
1957	317,942	22,928	20,400	2,636	5,064	410	60	16	224	8	3439690	259998
1958	2032 274	12,176	82,118	9,704	6,878	572	998	220	1,108	56	294,378	22,728
1959	106,504	3,808	102,196	11,714	6,300	556	1,046	228	3,088	152	219,134	199040
1960	99,330	4, A16	29,208	3,494	29222	164	676	148	2,270	104	133,706	8,326

* Records of catch not available for 1944-1949, and 1951-1956.

** Only January through April records included.

*** Approximately one-half of the fish were handled through the dock at Back Bay.

1 Includes small carp, bowfin and various species of the herring family.

TABLE 36

THE ESTIMATED TOTAL WEIGHT IN POUNDS AND THE VALUE IN DOLLARS OF COMMERCIAL FISH OBTAINED FROM RACK BAY.

	Recorded*		Estimated**	
Year	Total Weight	Value	Total Weight	Value
1944	182,379	$13,658	364,758	427,316
1945	1089000	8,527	216,000	17,054
1946	172,763	10,194	3459526	20,388
1948	249,143	179 101	498,286	349202
1949	145,407	109 860	290,814	219720
1950	162,547	12,076	325,094	24,152
1951	129,490	99905	258,980	19,810
1953	1859770	15,462	371,540	30,924
1956	119,518	9,307	2399036	13,614
1957	171,845	12,999	3439690	25,998
1958	1479189	119364	296,378	22,728
1959	1099567	9,520	219,134	19,040
1960	66,853	4,163	133,706	89326

* Estimatad from recorded data from warden headquarters fish pound.

** Adjusted from estimated harvest and values from entire bay.

TABLE 37

CHEMICAL ANALYSIS OF TEST SOLUTIONS USED IN SALINITY BIOASSAYS

Dilution p.p.m.	Total Carbonates (p.p.m.) Beginning	pH Beginning
Largemouth Bass		
9,500	26	7.8
9,650	26	
11,500	64	7.6
11,750	61	7.5
12,150*		7.7
12,850	72	8.1
12,900	68	8.1
13,650	70 72	8.1
13,700 14,500	72	8.1 8.1
14,950	78	8.1
Bluegill		
9,500	26	7.6
9,650	28	
11,750	64	7.6
11,800	64	7.7
12,150	61	
12,350	64	
	70	8.1
13,400	70	7.8
13,800	73	8.1
14,150	72	3.1
14,200	70	7.2
14,750	74	8.0

Note: Each dilution represents one aquarium containing five fish.

* Represents two aquaria having the same concentration.

TABLE 38 Average number and weight (in grams) of microscopic bottom fauna per square foot in various areas of Back Bay - October, 1960 and February, May, August, 1961.

Location	Number of Samples	Oligochaeta No.	Oligochaeta Wt.	Tendipedidae No.	Tendipedidae Wt.	Odonata No.	Odonata Wt.	Peleycypoda No.	Peleycypoda Wt.	Gastropoda No.	Gastropoda Wt.	Amphipoda No.	Amphipoda Wt.	Isopoda No.	Isopoda Wt.	Misc. No.	Misc. Wt.	Total No.	Total Wt.
North Bay																			
Oct., 1960	3	29	.057	15	.018			4	.016	5	Tr.							49	.091
Feb., 1961	3	11	.039	53	.069			1	Tr.	3	.008	24	.041	1	.015			93	.131
May, 1961	2											14	.012					14	.012
Aug., 1961	3	21	.025	21	.023							9	.035	1	.004			52	.087
Shipps Bay																			
Oct., 1960	5	1	.016	34	.041	2	.034	2	.005	9	.006	81	.146			1	Tr.	142	.248
Feb., 1961	5	[illegible]	.010	14	.018			2	Tr.	5	.013	62	.199	2	.026			91	.266
May, 1961	5			2	.003							3	.018					5	.021
Aug., 1961	5	1	.005	7	.007					1	.002	9	.022	1	.012			19	.048
Great Cove																			
Oct., 1960	2	10	.026	26	.022	4	.07[illegible]			Tr.	Tr.	12	.024				Tr.	52	.148
Feb., 1961	2	4	.006	38	.010					6	.046	42	.210			4	.118	94	.390
May, 1961	2			4	.030							2	.006					6	.036
Aug., 1961	2											6	.020					6	.020
Fishers Cove																			
Oct., 1960	2	14	Tr.	50	.026	8	.156			12	.012	16	.034			2	Tr.	102	.228
Feb., 1961	2	8	.024	2	.002					4	.014	13	.026			2	.008	29	.074
May, 1961	2			2	.002													2	.002
Aug., 1961	2																	0	.000
Red Head Bay																			
Oct., 1960	4	16	.011	14	.017							5	.012					35	.040
Feb., 1961	4	2	.003	23	.038					2	.007	19	.150					46	.198
May, 1961	4	6	.007	21	.025							12	.018					39	.050
Aug., 1961	4	7	.013	5	.013									2	.017			14	.043

TABLE 38 (Continued) Average number and weight (in grams) of microscopic bottom fauna -per square foot in various areas of Back Bay - October, 1960 and February, May, August, 1961.

Location	Number of Samples	Oligo-chaeta No.	Oligo-chaeta Wt.	Tendi-pedidae No.	Tendi-pedidae Wt.	Odonata No.	Odonata Wt.	Peley-cy-poda No.	Peley-cy-poda Wt.	Gastro-poda No.	Gastro-poda Wt.	Amphi-poda No.	Amphi-poda Wt.	Isopoda No.	Isopoda Wt.	Misc. No.	Misc. Wt.	Total No.	Total Wt.
Sand Bay																			
Oct., 1960	10	41	.020	59	,020	Tr.	Tr.			1	.004	43	,106	4	.015	Tr.	Tr.	148	.165
Feb., 1961	10	8	.00y	22	.005					4	.004	77	.277	2	.004			113	.299
May, 1961	10	10	.017	63	.021							28	.058					101	.096
Aug., 1961	10	8	.015	47	.022					3	.008	44	.077	3	.015	1	.012	106	.149
Back Bay																			
Oct., 1960	13	45	.022	19	.010	Tr.	Tr.					25	.013	Tr.	.004			89	.049
Feb., 1961	13	4	.014	17	.018					Tr.	Tr.	9	.029					30	,061
May, 1961	13	11	,009	17	.029					Tr.	Tr.	45	.047					73	.085
Aug., 1961	13	5	.015	21	.016							16	,034	Tr.	.003			42	.068
Buzzard Bay																			
Oct., 1960	5		.030	37	.015					6	.002	14	.029	2	.015			97	.088
Feb., 1961	5	38 6	.021	20	.043					89	.282	62	.253	2	.032	4	.010	183	.641
May, 1961	5	5	.002	50	,018			1	Tr.	6	.002	20	.026	1	.006			82	.054
Aug., 1961	5	8	.005	48	.018					12	.017	31	.022	2	.001			101	.063

TABLE 38 (Continued) Average number and weight (in grams) of microscopic bottom fauna per square foot in various areas of Back Bay - October, 1960 and February, May, August, 1961.

Location	Number of Samples	Oligo-chaeta No.	Oligo-chaeta Wt.	Tendi-pedidae No.	Tendi-pedidae Wt.	Odonata No.	Odonata Wt.	Peley-cypoda No.	Peley-cypoda Wt.	Gastro-poda No.	Gastro-poda Wt.	Amphi-poda No.	Amphi-poda Wt.	Isopoda No.	Isopoda Wt.	Misc. No.	Misc. Wt.	Total No.	Total Wt.
Sand Bay																			
Oct., 1960	10	41	.020	59	.020	Tr.	Tr.			1	.004	43	.106	4	.015	Tr.	Tr.	148	.165
Feb., 1961	10	8	.009	22	.005					4	.004	77	.277	2	.004			113	.299
May, 1961	10	10	.017	63	.021							28	.058					101	.096
Aug., 1961	10	8	.015	47	.022					3	.008	44	.077	3	.015	1	.012	106	.149
Back Bay																			
Oct., 1960	13	45	.022	19	.010	Tr.	Tr.					25	.013	Tr.	.004			89	.049
Feb., 1961	13	4	.014	17	.018					Tr.	Tr.	9	.029					30	.061
May, 1961	13	11	.009	17	.029					Tr.	Tr.	45	.047					73	.085
Aug., 1961	13	5	.015	21	.016							16	.034	Tr.	.003			42	.068
Buzzard Bay																			
Oct., 1960	5	38	.030	37	.015					6	.002	14	.029	2	.015			97	.088
Feb., 1961	5	6	.021	20	.043					89	.282	62	.253	2	.032	4	.010	183	.641
May, 1961	5	5	.002	50	.018			1	Tr.	6	.002	20	.026	1	.006			82	.054
Aug., 1961	5	8	.005	48	.018					12	.017	31	.022	2	.001			101	.063

Figure 1 - Areas of fishermen utilization of the Back Bay Area, April-October, 1960

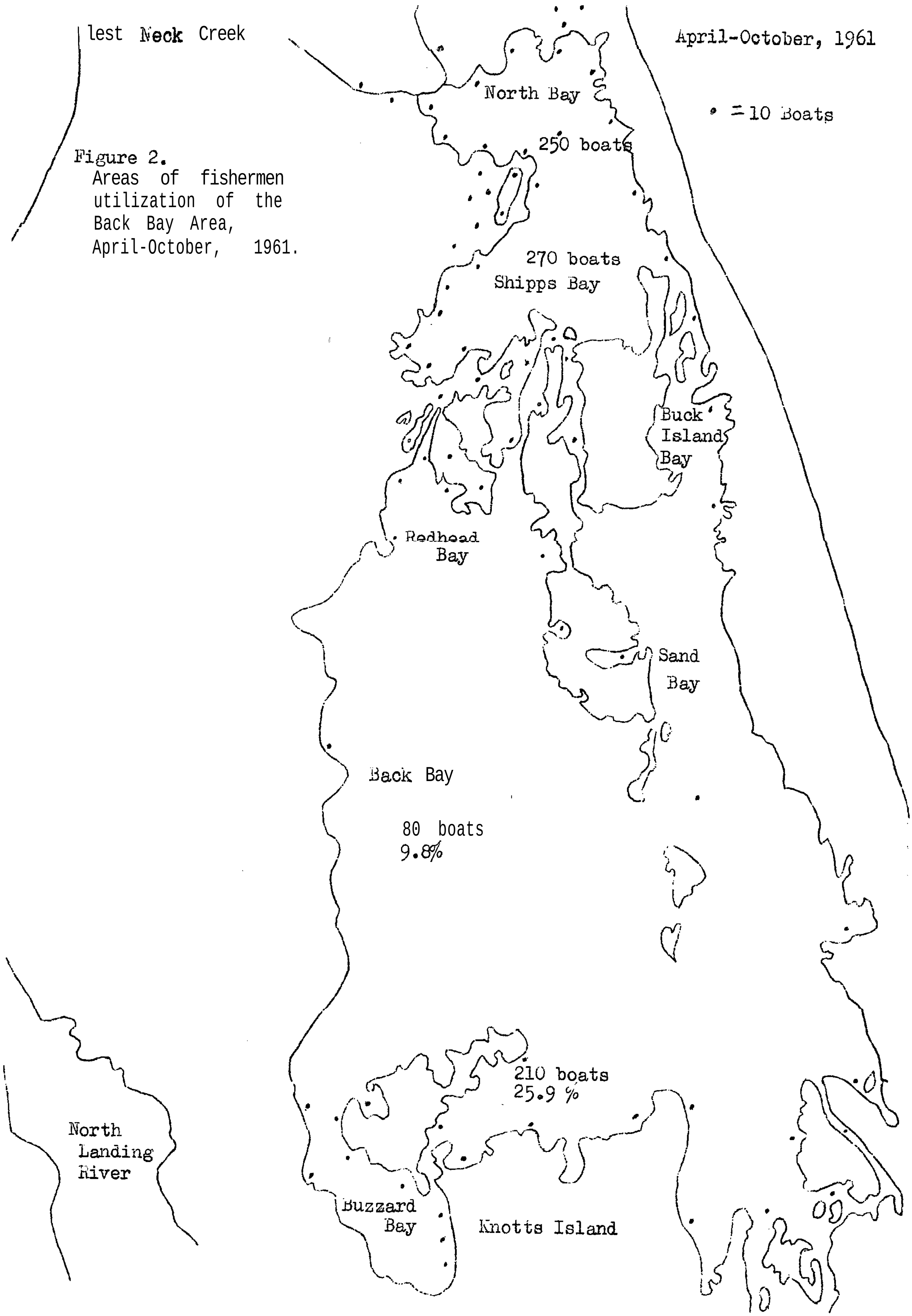
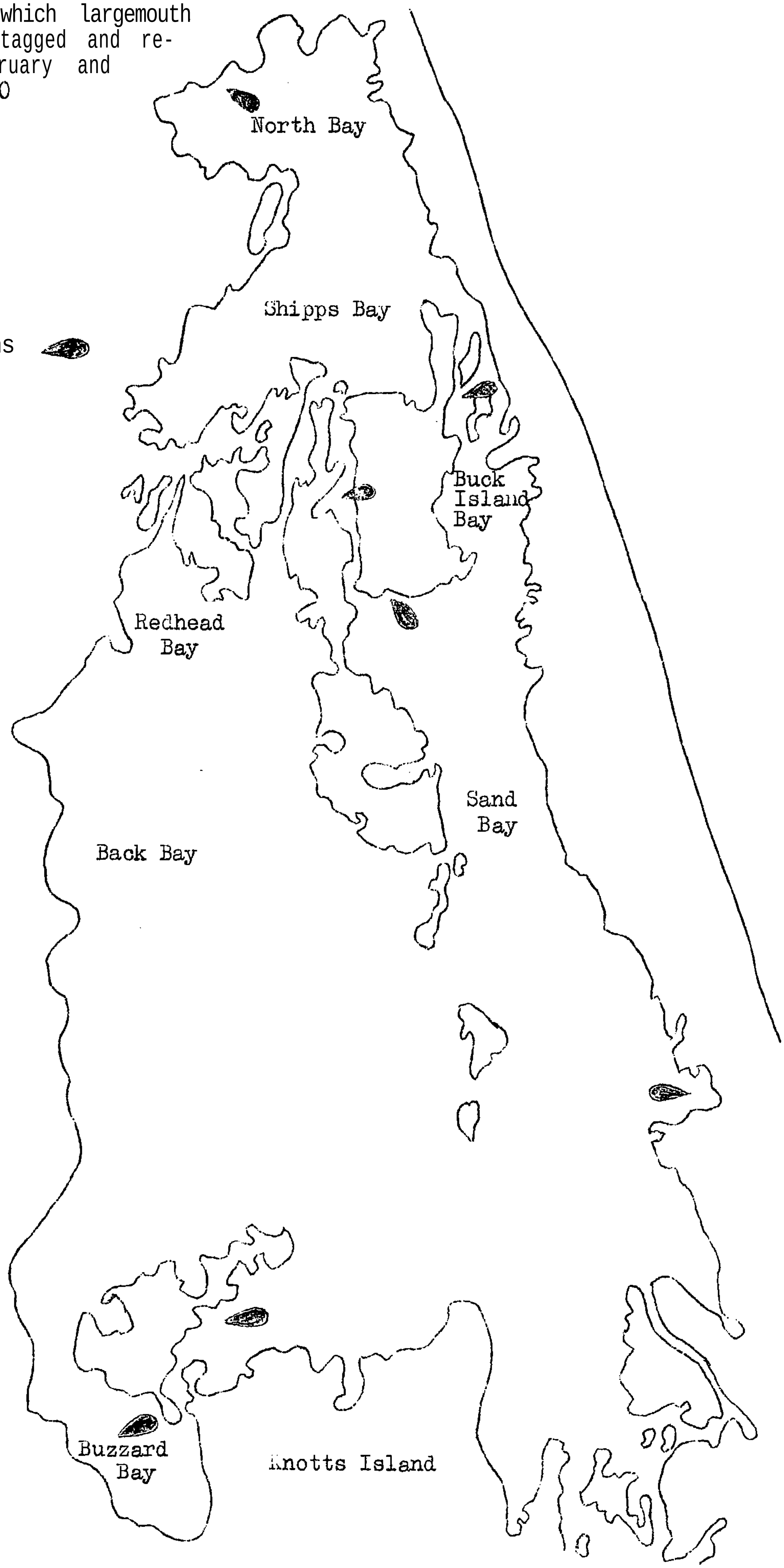


Figure 2.
Areas of fishermen utilization of the Back Bay Area, April-October, 1961.

Figure 3. Areas in which largemouth bass were tagged and released February and March, 1960

Tagging Locations



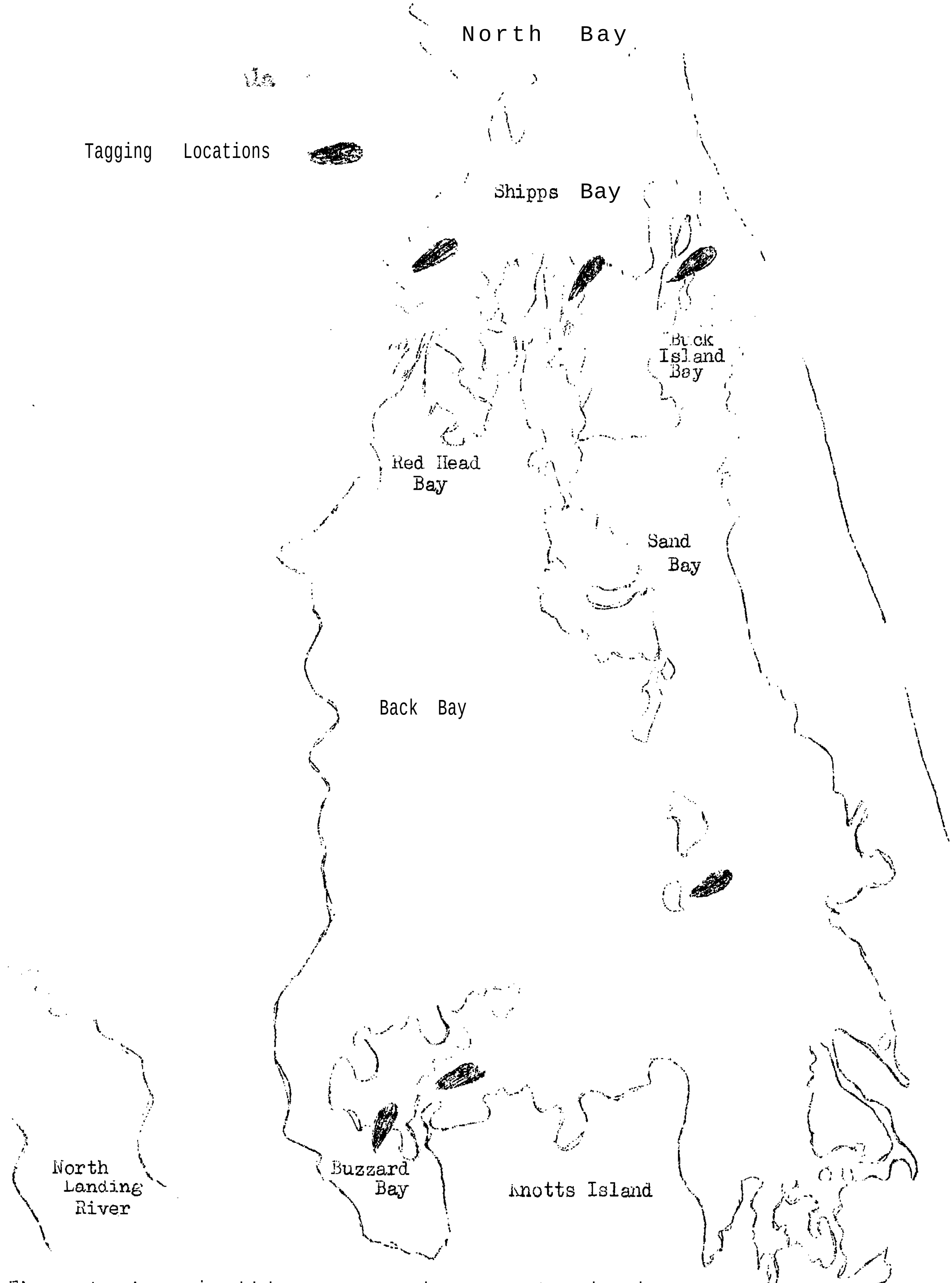
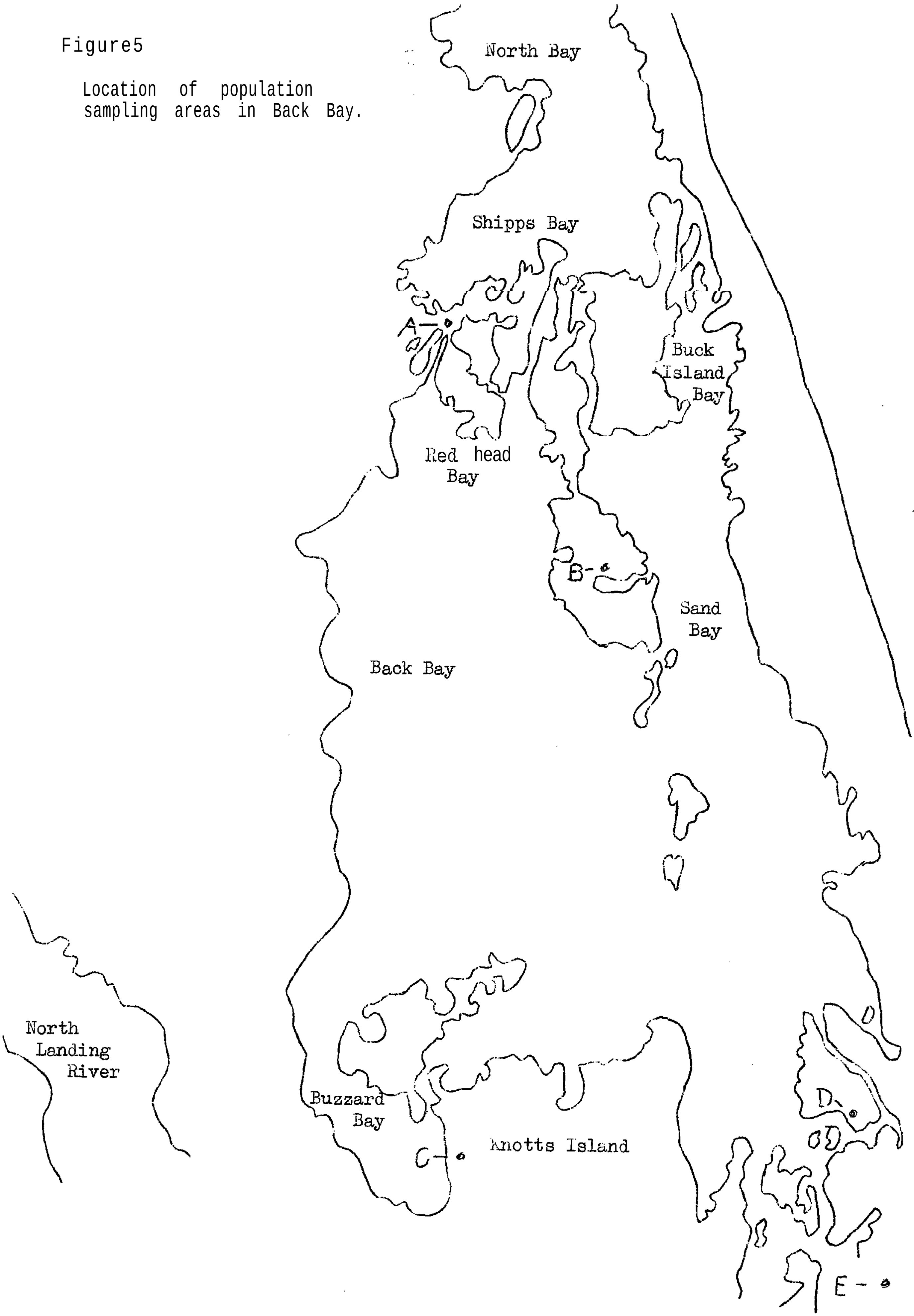


Figure 4 Areas in which largemouth bass were tagged and released February and March, 1961.

Figure5

Location of population sampling areas in Back Bay.



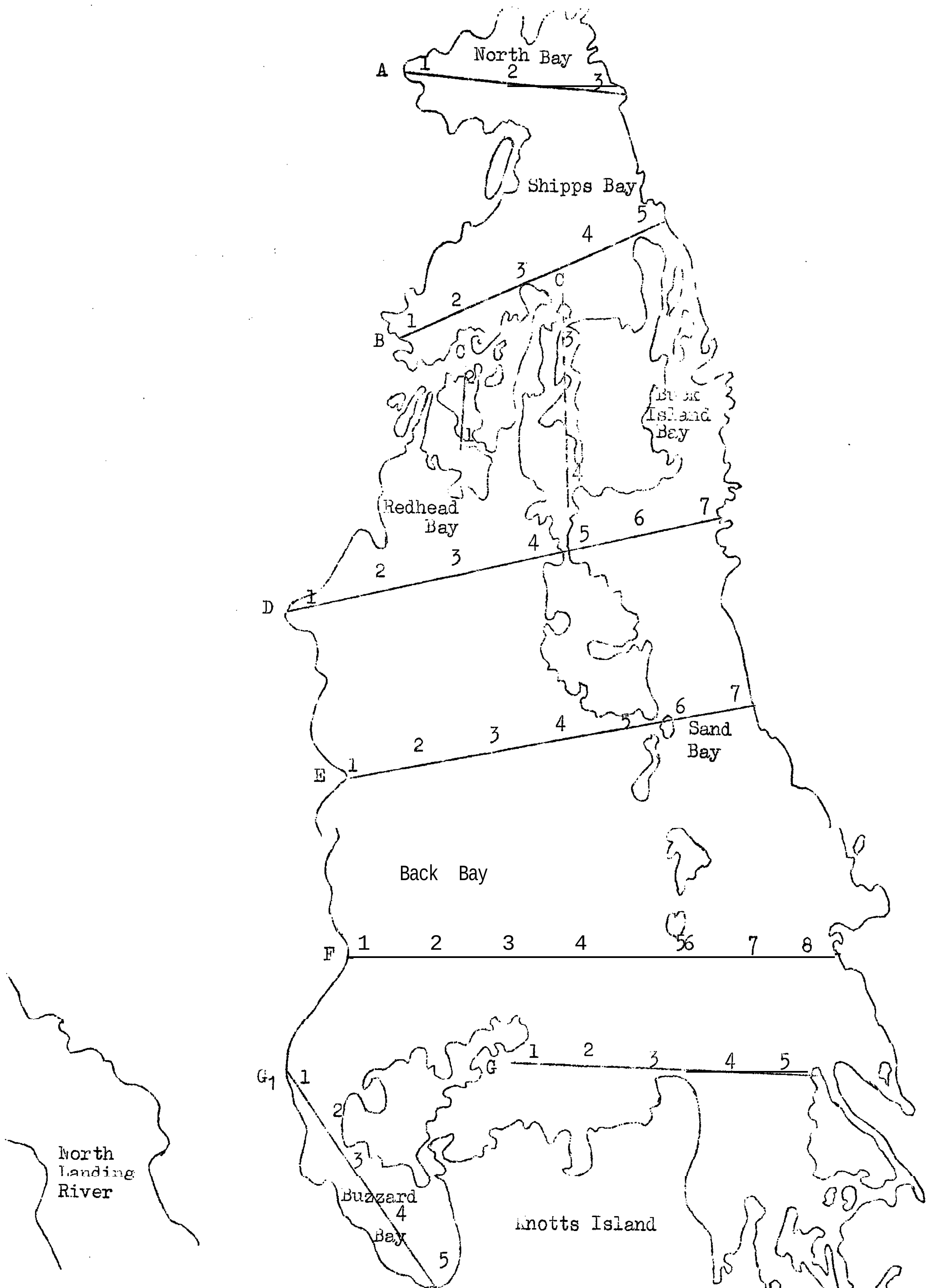


Figure 6 - Bottom sampling areas in Back Bay.

SUPPLEMENT TO FINAL REPORT

Title: Back Bay Fishery Investigations

Period Covered: July 1, 1962 - June 30, 1963

Objective:

1. To investigate the effects of a recent influx of salt water into Back Bay on the fish and fish food organisms and compare with similarly obtained data collected in 1959, 1960, and 1961, prior to the influx of salt water.

Abstract:

The effect of an invasion of ocean water, resulting from a storm on March 7, 1962, on the existing fresh water fish populations appeared to be minor. No effect, either beneficial or detrimental, could be detected on the harvest of largemouth bass or other fresh water sport species. Largemouth bass reproduction was low in two of the areas sampled and higher than any recorded in past years in one area. The two areas of low bass reproduction had salinities of 11 - 13 percent of normal sea strength; while the area having high reproduction had a salinity of 9 - 10 percent, This could indicate that salinities in excess of 10 percent may cause reduced spawning success of largemouth bass. This information is by no means conclusive since the low reproduction encountered in the two areas is comparable to other years of low reproduction in these same areas when. in a fresh water condition. Preliminary observations on the effect of the-increased salinities on bottom fauna indicate that bottom fauna were reduced immediately following the salt water influx. Amphipoda recovered their former abundance by July; while Tendipedidae and Oligochaeta continued to decrease, The brackish water clam (<u>Rangia cuneata</u>) and Polychaeta exhibited considerable increases following the influx of ocean water.

Introduction: *

"The March 7, 1962 storm which battered the Atlantic coast created eight major breaks, plus numerous small ones, in the dunes on the barrier beach along the study area. A major portion of the dunes were washed flat or seriously eroded.

* Taken from Quarterly Progress Report on the cooperative Study of Back Bay, Virginia and Currituck Sound, North Carolina for March through May, 1962.

Introduction (Continued)

Large quantities of sea water came over the beach and entered the study area, Concentrations as high as 75 percent sea water were recorded in Back Bay and 95 percent sea water in Currituck Sound the day after the storm. The sea water intrusion increased the average salinity in Currituck Sound from 3.26 percent sea water just prior to the storm to approximately 28 percent and raised the average salinity in Back Bay to approximately 15 percent by March 8, 1962.

A stratified layer of high concentrations of sea water developed in the deeper water areas. Variations as high as 10,950 ppm. (34 percent sea water) were noted between the surface and bottom samples taken in the deeper water areas. The wave action and wind tides mixed and diluted these concentrations and by March 23, 1962, the salinity was fairly uniform from the surface to the bottom.

There was considerable movement of the bodies of saline waters before they dispersed and diluted with the sound water. A gradual decrease in the average salinity was noted during the mixing process. After mixing, the average salinity for the study area remained fairly constant, Back Bay and Currituck Sound each had average salinities of 12 percent sea water during the last week of the quarter,

The barrier beach was eroded to the extent that sea water continued to enter the study area at several points after the storm during above normal tides. Civil Defense approved a Currituck County Commissioner's request for emergency repairs of the barrier dunes in Currituck County. Approximately twenty miles of the emergency repairs had been completed by the end of the quarter."

1. Creel Census:

To evaluate the effect of this ocean water intrusion on the Back Bay sport fishery creel census was resumed March 27, 1962. Fishing pressure showed a slight increase in 1962 (2.97 angler hours per acre) over the previous three years (low of 2.11 angler hours per acre in 1959) as shown in Table 1. Bass harvest also increased very slightly in 1962 (0.94 bass per acre) over 1960 and 1961 (1960-0.89 per acre, 1961-0.88 per acre) and was much higher than 1959 (0.45 per acre). These increases in pressure and bass harvest were progressive although slightly erratic. Total harvest of all species was higher in 1962 than in any previous year (1959-0.94 fish per acre; 1960-1.06; 1961-1.13; 1962-1.51), due to an increase in harvest of white perch, (Table 2). As with fishing pressure and bass harvest this increase in overall harvest was progressive

Considerable difference was noted between the comparison of numerical harvest and the catch in terms of weight between 1960 and 1962. The numerical harvest of bass increased only about three percent in 1962 (25,353) over 1960 (23,890) and 1961 (23,658); while, the weight of bass harvested was approximately 11.5 percent higher in 1962 (36,668 pounds) than in 1960 (29,057 pounds) and 1961 (30,690 pounds) as indicated in Figure 1 and Table 3. This was brought about by the harvest of larger size groups of bass in 1962 (Table 3). In 1960 59 percent of the bass creeled were 10-13 inches in total length, and 34 percent were 14-17 inches long. In 1962, the reverse is true; 39 percent were 10-13 inches long and 52 percent were 14-17 inches long. Thus, the average weight of bass creeled increased progressively from 1.19 pounds in 1959 to 1.20 in 1960 to 1.30 in 1961 and to 1.45 pounds in 1962, This is probably a result of an expanding population filling a void left by a natural catastrophe which occurred during the winter of 1957-58. This is probably similar to expanding populations encountered in newly impounded reservoirs.

From the data obtained-it appears that the increased salinity in Back Bay had no immediate effect, beneficial or detrimental, on the harvest of bass or other species.

2. Population Sampling:

During 1962, population samples were obtained from areas A, C, and E to determine the effect of the increased salinities on the reproduction of various species of fish. Young of the year fish were encountered for all species for which young of the year individuals are normally found. Tables 5-7).

Comparison of largemouth bass reproduction with salinity levels during the month of May (month Back Bay bass normally spawn), gives a slight indication that salinities over 10 percent of normal sea strength may reduce spawning success (Figure 2). Yield of young of the year bass from area C, which had a salinity of 9-10 percent during May was approximately five times greater than that of areas A and E which had salinities of 11-13 percent. This may well be a yearly fluctuation as indicated from results of previous years sampling (Figure 2).

Comparison of the weight (Table 8) of the various species of fish removed from the sampling areas indicated that little change, other than normal population fluctuations, had taken place in these areas since 1959 with the exception of carp. In all areas sampled, carp were found in reduced amounts following the initial sampling in each area..

3. Tagging:

During 1962, 88 tags were returned from bass tagged in 1961 and 19 from bass tagged in 1960. Of these,74 1961 returns and 17 1960 returns contained sufficient information to determine distances traveled (Table 9). From this it may be noted that in 1962 17 percent (two fish) of the returns of recaptures originally tagged in Buck Island Bay were taken within one mile of where tagged. In Shipps Bay and in the Buzzard Bay-Southwest Cove area 55 percent and 43 percent, respectively, of the returns of recaptured bass originally tagged in these areas were taken within one mile of where tagged. Thus, these second year returns of bass from the Buck Island Bay area indicated a tendency for these bass to be more mobile in 1962 than those from the other areas.

The probable reason for this increased mobility of Buck Island Bay bass was increased salinities caused by ocean water intrusion resulting from the March 7, 1962 storm. On March 8, salinities in the Buck Island Bay tagging area were approximately 75 percent of normal sea strength (24,300 p.p.m.). This concentration greatly exceeds the 96-hour TLm of 40 percent (14,000 ppm) for largemouth bass. Salinities on March 8 were only about one percent of sea strength (300-500 p.p.m,) in the Shipps Day and Buzzard Bay-Southwest Cove tagging areas, and never exceeded 19 percent (6,150 p.p.m.) in the Shipps Bay tagging area and 11 percent (3,700 p.p.m.) in the Buzzard Bay-Southwest Cove area, These salinities are well within the range which can be tolerated by bass.

Although this movement by bass tagged in Buck Island Bay could have taken place the preceding year, it does not seem likely when it is considered that these second year returns indicate that bass tagged in Shipps Bay and Buzzard Bay-Southwest Cove were much more sedentary (55 percent and 43 percent, respectively, moving less than one mile) than were Buck Island Bay bass. First year returns (both 1960 and 1961) also indicate a tendency for bass to be more sedentary in the north portion (Table 10). Second year returns from most tagging sites indicate a slightly higher percentage of returns from outside the tagging area than do first year returns, but none as pronounced as the second year returns from Buck Island Bay. Thus, it appears that this migration out of Buck Island Bay was caused by some outside force; and in this case high concentrations of salt water.

Reports accompanying two tag returns from the 1960 tagging operations (third year returns) were received which indicate that some tags are probably lost after the second year. These reports stated that the tags were nearly gone from the fish and remained attached only to the skin, These tags were originally attached around the maxillary and pre-maxillary of the fish. Numerous reports on second year tag returns were received stating that the skin of the fish had nearly grown over many tags, making them difficult to see. These reports indicate that tag returns received after the first year following tagging are of limited value from jaw tags applied as in this study because the tagsbecome inconspicuous or are lost. However, information regarding movement is probably valid.

4. Bottom Sampling:

In order to determine the effect of salt water intrusion on the bottom fauna of Back Bay, 44 six inch square bottom samples were taken each in April, July, and October, 1962. These samples have been sorted and sent away for analysis.

Preliminary observations of these samples indicate that an extensive reduction in bottom fauna occurred immediately following the salt water introduction on March 7, 1962. Amphipoda had recovered their former abundance by the July sample; while Tendipedidae and Oligochaeta appeared to continue to decline in number throughout the sampling periods. The salt or brackish water fauna appeared to increase considerably. The brackish water clam (Rangia cuneata) and Polychaeta appeared to be over 100 percent more abundant than in collections taken prior to the salt water invasion.

Summary:

1. Increased salinities appeared to have no effect on the harvest of largemouth bass or other sport species.

2. Increased salinities did not eliminate reproduction of fresh water sport species, but salinities in excess of 10 percent of normal sea strength could have reduced largemouth bass spawning success.

3. There is some indication that the invasion of high concentrations of salt water may have resulted in largemouth bass temporarily leaving these areas of high concentrations.

APPENDIX

Table 1. A summary of fish harvest and fishing pressure for Back Bay, April through October, 1959, 1960, 1961, and 1962.

Month and Year	Hours Fished	Hours per Angler	Angler Days	Angler Hours per Acre	Angler Days per Acre	Number Fish	Fish Harvest per Acre	Number Bass	Bass Harvest per Acre
April									
1959	5203	5.5	941	.19	.03	2164	.08	952	.03
1960	12501	5.5	2204	.47	.09	5016	.22	3971	.16
1961	4010	5.3	741	.15	.03	1727	.06	1057	.04
1962	16104	5.6	2856	.60	.11	6910	.26	5091	.19
May									
1959	13487	5.8	2374	.50	.09	6316	.23	3380	.13
1960	18316	5.7	3196	.68	.12	7160	.28	6446	.24
1961	16571	5.4	3081	.62	.11	8856	.33	8102	.30
1962	18856	5.7	3287	.70	.12	9126	.34	5603	.21
June									
1959	11475	6.2	1838	.43	.07	7104	.26	1775	.06
1960	14434	6.1	2376	.53	.08	5764	.24	5078	.19
1961	13154	5.4	2552	.49	.09	6480	.24	5304	.20
1962	14797	5.7	2570	.55	.09	7384	.27	4761	.18
July									
1959	9078	5.4	1665	.34	.06	3954	.15	2224	.07
1960	12168	5.0	2418	.45	.09	4498	.17	3294	.12
1961	12496	5.3	2358	.47	.09	6178	.23	4062	.15
1962	9662	5.2	1872	.36	.07	5664	.21	3223	.12
August									
1959	7533	4.7	1586	.28	.06	2529	.09	1596	.05
1960	8473	5.5	1550	.32	.06	3286	.13	2811	.11
1961	6740	5.1	1332	.25	.05	2656	.10	2112	.08
1962	5771	4.6	1264	.21	.05	4561	.17	1858	.07
September									
1959	4368	4.9	882	.13	.03	1222	.04	882	.03
1960	5170	5.4	960	.21	.04	1812	.07	1621	.07
1961	5433	5.3	1031	.20	.04	3543	.13	2773	.10
1962	9480	5.8	1640	.35	.06	4764	.17	3172	.12
October									
1959	5342	5.7	928	.08	.01	2012	.03	1226	.02
1960	1856	5.4	340	.07	.01	878	.03	669	.02
1961	1705	4.7	365	.06	.01	798	.03	248	.01
1962	4995	6.1	820	.19	.03	2120	.08	1645	.06
Total									
1959	56486	5.6	10214	2.11	.38	25301	.94	12635	.45
1960	72468	5.6	13044	2.70	.49	28414	1.06	23890	.89
1961	60109	5.[illegible]	11460	2.24	.43	30238	1.13	23658	.38
1962	79665		14309	2.97	.53	40529	1.51	25353	.94

Table 2 Reported Catch by Species from Back Bay during the period June-October, 1959, and April-October, 1960, 1961, and 1962.

Species	1959 Total Number	1959 Percent Total Number	1959 Catch per Hour	1960 Total Number	1960 Percent Total Number	1960 Catch per Hour	1961 Total Number	1961 Percent Total Number	1961 Catch per Hour	1962 Total Number	1962 Percent Total Number	1962 Catch per Hour
Largemouth Bass	4074	44.2	0.20	10846	84.6	0.33	11033	78.4	0.36	10440	61.2	0.31
Bluegill	429	4.6	0.02	146	1.1	0.004	317	2.2	0.01	191	1.1	0.005
Pumpkinseed	113	1.2	0.006	344	2.6	0.01	64	0.4	-	367	2.1	0.01
Black Crappie	241	1.6	0.01	160	1.2	0.004	452	3.2	0.01	436	2.5	0.01
Chain Pickeral	93	1.0	0.005	98	0.7	0.002	107	0.7	0.003	155	0.9	0.004
Perch-x	4161	45.1	0.21	961	7.5	0.03	1712	12.1	0.05	4854	28.5	0.15
Catfish**	79	0.8	0.004	215	1.6	0.006	311	2.2	0.01	508	3.0	0.01
Others%**	17	0.1	-	38	0.2	-	76	0.5	-	89	0.4	-
Total	9207	99.6	0.46	12808	99.5	0.39	14070	99.7	0.46	17040	99.7	0.51

* Mostly white perch with a few yellow perch.
** Channel and white catfish, and black, yellow, and brown bullheads.
*** Includes warmouth, striped bass, bowfin, eels, golden shiners, spot, and carp.

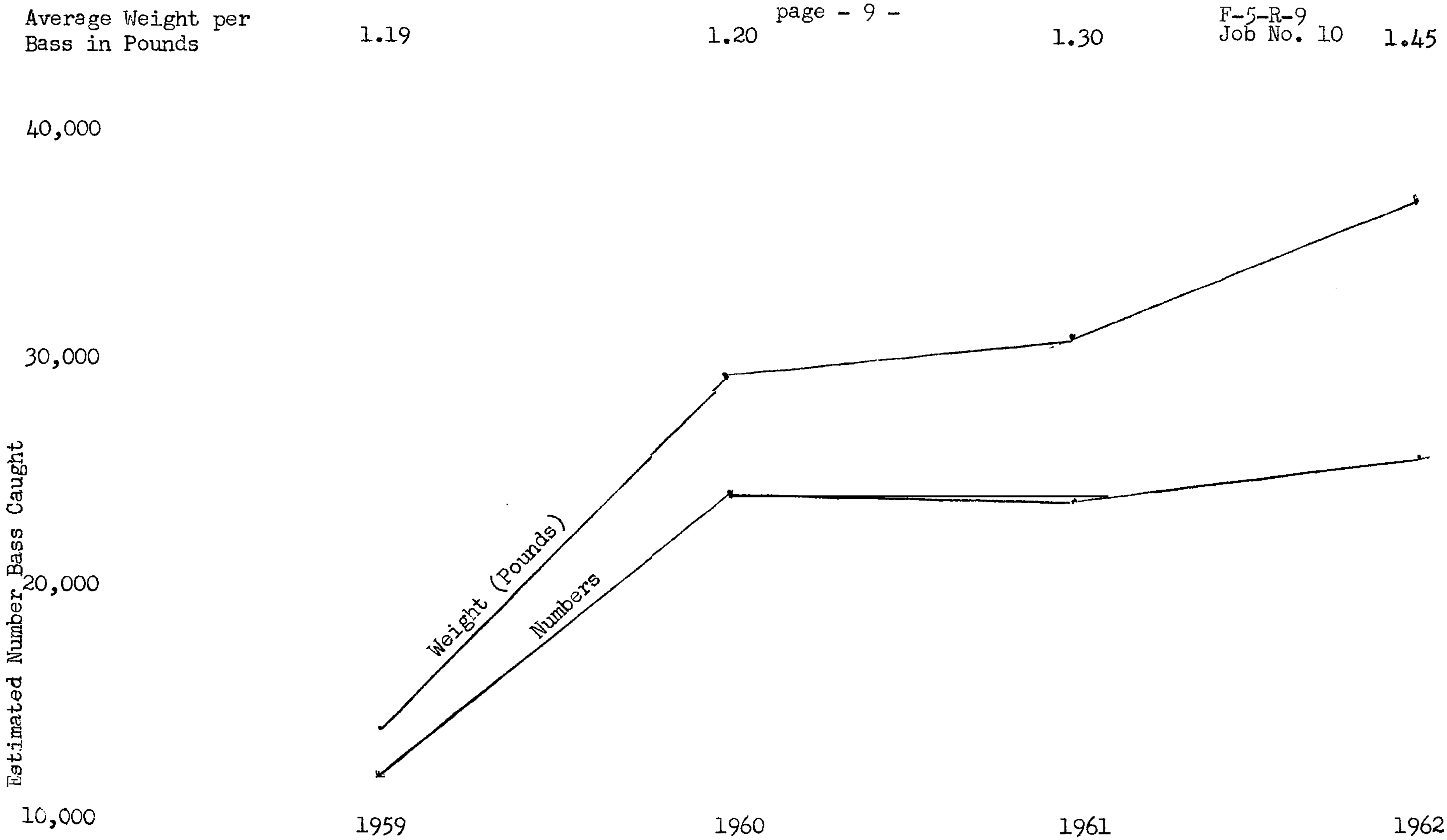


Figure 1 Number - Weight Relationship of Bass Harvest, 1959 - 1962

Table 3 Length and Weight Distribution of Largemouth Bass creeled in Back Bay in 1959, 1960, 1961, and 1962.

Length in inches	Percent of Total Number Caught 1959	1960	1961	1962	Number of Fish 1959	1960	1961	1962	Average Weight of Each Fish	Total Weight Caught in Pounds 1959	1960	1961	1962
4	.03				4								
5	.05	.04			6	9			0.04				
6	.40	.21	.09	.03	48	50	21	8	0.16	8	8	3	1
7	.05	.02	.04	.01	6	5	9	2					
8	1.7	2.1	.20	.17	204	502	47	43	0.22	45	110	10	9
9	1.7	1.6	.60	.23	204	382	142	58	0.36	73	137	51	21
10	11.4	11.8	6.5	3.9	1372	2819	1537	989	0.53	727	1494	815	524
11	12.6	10.8	8.6	8.7	1516	2580	2034	2205	0.67	1016	1729	1363	1477
12	21.5	21.3	20.9	15.3	2587	5088	4944	3879	0.85	2199	4325	4202	3297
13	14.2	15.2	17.8	11.4	1709	3631	4211	2890	1.09	1863	3958	4590	3150
14	16.7	16.7	19.9	22.2	2010	3990	4708	5628	1.45	2914	5785	6823	8161
15	6.0	7.2	9.5	10.9	722	1720	2247	2763	1.73	1249	2976	3887	4780
16	6.7	7.2	8.6	11.7	806	1720	2034	2966	2.06	1660	3543	4190	6110
17	3.6	3.4	4.3	6.9	433	812	1017	1749	2.70	1169	2192	2746	4722
18	2.1	1.6	1.5	2.1	253	382	354	396	3.15	797	1203	1115	1676
19	0.6	0.4	0.6	1.7	72	95	142	431	3.96	285	376	562	1707
20	0.3	0.2	0.2	0.45	36	48	47	114	4.35	157	209	204	496
21	0.08	0.6	0.1	0.27	10	143	23	68	5.09	51	728	117	346
22	0.14	0.2	0.01	0.06	17	48	2	15	5.91	100	284	12	89
23				0.06				15	6.83				102
27				0.01				2					-
Total	99.8	100.5	99.4	96.1	12635	23890	23658	25353		14313	29057	30690	36668

Table 4 Summary of Fish Population Data - Area A, Back Bay, Virginia - July 5, 1962

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum Length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	4	3.7	4.6-8.5	5	0.6	4.5	26	Tr.
Chain Pickerel	10.6	Tr.	0.1	5.6-10.5	1	Tr.	5.5	3	Tr.
Total		4	3.8		6	0.6		29	Tr.
B. Non-Predatory Game Fish					1				
Bluegill	5.6	7	1.8	3.6-5.5	133	Tr.		2	Tr.
Pumpkinseed	5.6	32	3.4	3.6-5.5	1	6.5	3.5	176	2.6
Warmouth	5.6	4	0.9	3.6-5.5	71	Tr.	3.5		
Yellow Perch	5.6	37	2.5	3.6-5.5		2.1	3.5	78	0.4
White Perch	5.6	12	0.9	3.6-5.5	179	2.7	3.5	13	Tr.
Total		92	9.5		385	11.3		269	3.0
C. Non-Predatory Food Fish									
American Eel	15.6	Tr.	0.2	7.6-15.5	7	0.5	7.5	4	Tr.
Carp	13.6			6.6-13.5	-	-	6.5	1	Tr.
Bullheads	6.6			4.6- 6.5	3	0.2	4.5	-	
Total		Tr.	0.2		10	0.7		5	Tr.
D. Predatory Food Fish									
Bowfin	13.6	Tr.	2.0	4.6-13.5	1	0.4	4.5	-	-
Channel Catfish	9.6	2	5.3	4.6-9.5	-	-	4.5	-	-
White Catfish	9.6	Tr.	1.7	4.6-9.5	-	-	4.5	-	-
Total		2	9.0		1	0.4		0.0	0.0

Table 4 Continued Summary of Fish Population Data - Area A, Back Bay, Virginia, July 5, 1962.

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number Per Acre	Pounds per acre	Maximum length (inches)	Number per Acre	Pounds Per Acre
E. Forage Fish							3.5		
Golden Shiner	5.6	5	0.4	3.6-5.5	34	0.8	3.0	11	0.1
Killifish								72	0.4
Needlefish	14.6	-					5.5		-
Silversides				5.6-J-4.5	2	Tr.	3.0	-6	0.1
spot	5.6	46					3.5	-	-
Bluespotted Sunfish			1.6	3.6-5.5	87	2.6	3.0	105	0.8
Menhaden	9.6	-					3.5	-	-
Alewife				3.6-9.5	106	1.7	3.0	1	Tr.
Total		51	2.0		229	5.1		195	1.4
Grand Total		149	24.5		631	18.1		498	4.4

Table 5 Summary of Fish Population Data - Area C - Back Bay, Virginia - July 17, 1962

Species	Fish of Available Size: Minimum length (inches)	Number per acre	Pounds per acre	Intermediate: Range in length (inches)	Number per acre	Pounds per acre	Fingerlings: Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	5	5.4	4.6-8.5	1	0.4	4.5	165	0.7
Total		5	5.4		1	0.4		165	0.7
B. Non-Predatory Game Fish									
Bluegill	5.6	1	0.4	3.6-5.5	2	0.3	3.5	Tr.	Tr.
Pumpkinseed	5.6	4	0.7	3.6-5.5	264	10.3	3.5	41	0.9
Warmouth	5.6	Tr.	0.2	3.6-5.5	Tr.	Tr.	3.5		
Yellow Perch	5.6	22	2.3	3.6-5.5	44	1.8	3.5	18	0.2
White Perch	5.6	13	1.5	3.6-5.5	71	2.6	3.5	22	0.5
Flyers	5.6	0		3.6-5.5	2		3.5	1	Tr.
Total		40	5.1		383	15.0		82	1.6
C. Non-Predatory Food Fish									
Mullet	9.6	1	1.5	5.6-8.5			5.5	5	0.2
American Eel	15.6			7.6-15.5	3	0.2	7.5	7	Tr.
Carp	13.6			6.6-13.5			6.5	23	0.2
Yellow Bullhead	6.6	Tr.	0.3	4.6-6.5			4.5		
Black Bullhead	6.6	Tr.	0.3	4.6-6.5	Tr.	Tr.	4.5	5	Tr.
Total		1	2.1		3	0.2		40	0.4
D. Predatory Food Fish									
Bowfin	13.6	3	6.6	6.6-13.5	-		6.5	-	
Total		3	6.6					-	-

Table 5 Continued Summary of Fish Population Data - Area C - Back Bay, Virginia - July 17, 1962.

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length {inches)	Number per acre	Pounds per acre
E. Forage Fish									
Golden Shiner	5.6	54	6.3	3.6-5.5	300	7.3	3.6	3	Tr.
Killifish				3.6-5.5	Tr.	Tr.	3.6		0.8
Needlefish	14.6			5.6-13.5	2	Tr.	5.6	234 4	Tr.
Silversides							3:0	40	0.2
spot	5.6			3.6-5.5	266	6.9	3.6	9	0.1
Bluespotted Sunfish							3.0	110	0.5
Brassy Minnow				3.6-5.5	2	Tr.	3.6	2	Tr.
Mosquitofish							3.0	Tr.	Tr.
Total		54	6.3		570	14.4		402	1.6
Grand Total		103	25.5		957	30.2		689	4.3

Table 6 Summary of Fish Population Data - Area E - Back Bay, Virginia - July 5, 1962

	Fish of Available Size			Intermediate			Fingerlings		
Species	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	13	7.9	4.6-8.5	4	101	4.5	33	0.4
Total:		13	7.9		4	1.1		33	0.4
B. Non-Predatory Game Fish									
Bluegill	5.6	23	8.8	3.6-5.5	36	2.2	3.5		
Pumpkinseed	5.6	58	9.1	3.6-5.5	2342	32.1	3.5	2*	2.6
Yellow Perch	5.6	15	2.2	3.6-5.5	14	0.7	3.5	2	Tr.
White Perch	5.6	38	6.4	3.6-5.5	110	4.5	3.5	134	2.2
Total		134	26.5		2502	39.5		138*	4.8
C. Non-Predatory Food Fish									
Mullet	9.6	73	106.1	5.6-9.5	4	1.3	5.5	6	Tr.
American Eel	15.6	1	0.8	7.6-15.5	7	1.2	7.5	14	0.1
Carp	13.6	3	12.0	6.6-13.5	6	6.6	6.5		
Bullheads	6.6	10	10.7	4.6-6.5			4.5	29	Tr.
Gizzard Shad	6.6	7	1.8	4.6-6.5			4.5		
Total		94	131.4		17	9.1		49	0.1
D. Predatory Food Fish									
Longnose Gar	25.6			6.6	3	1.6	6.5	4	Tr.
Bowfin	13.6	1	1.3	6.6			6.5		
Total		1	1.3		3	1.6		4	Tr.

* Exact number not available.

Table 6 Continued Summary of Fish Population Data - Area E - Back Bay, Virginia - July 5, 1962.

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum Length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
E. Forage Fish									
Golden Shiner	5.6	3	0.5	3.6	25	0.5	3.5	11	0.1
Killifish							3.0	57	0.1
Needlefish	14.6			5.6			5.5	4	Tr.
Silversides				2.6	4	0.1	2.5	48	0.2
Spot	5.6			3.6	279	9.3	3.5	220	4.1
Bluespotted Sunfish							3.0	24	0.2
Mudminnow							3.0	1	Tr.
Total		3	0.5		308	9.9		365	4.7
Grand Total		245	167.6		2834	61.2		589*	10.0

* Exact number not available.

Table 7 Summary of Fish Population Data - Areas A, C, and E - Back Bay, Virginia - July 5 - 17, 1962

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length inches	Number per acre	Pounds per acre
A. Predatory Game Fish									
Largemouth Bass	8.6	6	5.1	4.6-8.5	3	0.6	4.5	84	0.4
Chain Pickerel	10.6	Tr.	0.1	5.6-10.5	Tr.	Tr.	5.5	1	Tr.
Total		6	5.2		3	0.6		85	0.4
B. Non-Predatory Game Fish									
Bluegill	5.6	7	2.5	3.6-5.5	8	0.5	3.5	1	Tr.
Pumpkinseed	5.6	25	3.4	3.6-5.5	596	12.8	3.5	89*	1.9
Warmouth	5.6	2	0.4	3.6-5.5	1	Tr.	3.5		
Yellow Perch	5.6	27	2.4	3.6-5.5	49	1.7	3.5	39	0.2
White Perch	5.6	17	2.1	3.6-5.5	122	3.0	3.5	39	0.6
Flyers	5.6			3.6-5.5	1	0.1	3.5	Tr.	Tr.
Total		78	10.8		777	13		168	2.7
C. Non-Predatory Food Fish									
Mullet	9.6	14	20.2	5.6-10.5	1	0.2	5.5	3	0.1
American Eel	15.6	Tr.	0.2	7.6-15.5	5	0.5	7.5	7	Tr.
Carp	13.6	1	2.2	6.6-13.5	1	1.2	6.5	10	0.1
Bullheads	6.6	2	2.2	4.6-6.5	1	0.1	4.5	8	Tr.
Shad	6.6	1	0C.3	4.6-6.5			4.5		
Total		1.8	25.1		8	2.0		28	0.2
D. Predatory Food Fish									
Longnose Gar	25.6			6.6-25.5	1 Tr.	0.3	6.5	1	Tr.
Bowfin	13.6	1	3.7	6.6-13.5		0.2	6.5		
Channel Catfish	9.6	1	2.2	4.6-9.5			4.5		
White Catfish	9.6	Tr.	0.7	4.6-9.5			4.5		
Total		2	6.6		1	0.5		1	Tr.

* Not exact number

Table7 Continued Summary of Fish Population Data - Areas A, C, and E - Back Bay, Virginia - July 5-17, 1962

Species	Fish of Available Size			Intermediate			Fingerlings		
	Minimum length (inches)	Number per acre	Pounds per acre	Range in length (inches)	Number per acre	Pounds per acre	Maximum length (inches)	Number per acre	Pounds per acre
E. Forage Fish									
Golden Shiner	5.6	25	2.8	3.6-5.5	141		3.5	8	0.1
Killifish				3.6-5.5	Tr.	Tr.	3.5	135	0.5
Needlefish	14.6			5.6-14.5	2	Tr.	5.5	2	Tr.
Silversides				2.6-5.5		Tr.	2.5	28	0.1
spot	5.6	19	0.7	3.6-5.5	19:	5.6	2.5	44	0.8
Bluespotted Sunfish							3.0	92	0.6
Mudminnow							3.0	Tr.	Tr.
Menhaden	9.6			3.6-9.5	43	0.7	3.5		
Alewife							3.0	1	Tr.
Brassy Minnow				3.6-5.5	1	Tr.	3.5	1	Tr.
Mosquitofish							3.0	Tr.	Tr.
Total		4.4	3.5		384	9.7		311	2.1
Grand Total		148	57.2		1173	30.9		593*	5.4

-x Not exact number due to slight error of Pumpkinseed number

Figure 2 A Comparison of the Yearly Largemouth Bass Reproduction Found per Acre in the Sample Areas and the Various Salinities occurring in the Areas During the 1962 Spawning Season. Salinities are Expressed as Percent Sea Strength.

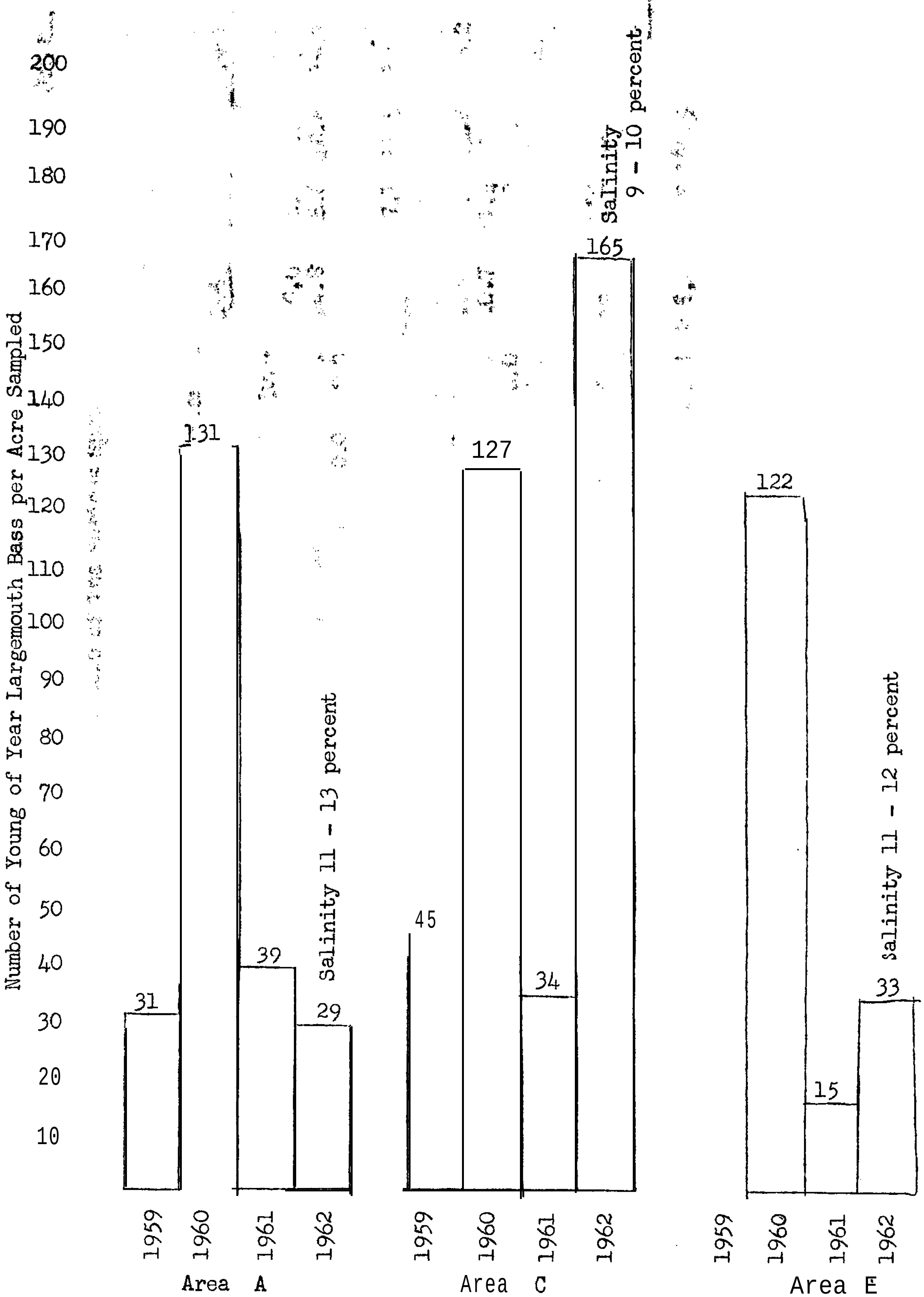


Table 8 Comparison of Yield in Pounds per Acre of the Various Species of Fish Obtained in Population Samples during 1959, 1960, 1961, and 1962.

	Area A				Area C			Area E			All Areas Combined			
Species	1959	1960	1961	1962	1959	1961	1962	1960	1961	1962	1959	1960	1961	1962
Largemouth Bass	1.9	5.2	5.2	4.3	4.2	4.4	6.5	13.3	10.6	9.4	3.0	9.2	6.0	6.0
Pickeral*	0.0	0.5	Tr.	0.1	0.0	0.0	0.0	0.0	0.0	0.0			Tr.	Tr.
Sunfish **	8.0	15.0	15.4	14.3	9.7	17.3	12.6	22.2	17.4	54.8	8.0	18.6	16.7	27.2
Warmouth	0.0	0.2	1.0	0.9	0.0	0.0	0.2	0.0	0.0	0.0	0.0	Tr.	0.3	0.4
Yellow Perch	3.4	7.1	10.1	5.0	4.9	3.3	4.3	4.6	3.6	2.9	4.1	5.8	5.6	4.0
White Perch	9.7	3.8	8.4	3.6	4.5	1.5	4.3	19.3	22.0	13.1	7.1	11.5	10.7	7.0
Striped Mullet	1.3	0.0	0.0	0.0	Tr.	7.6	1.7	69.4	120.4	107.4	0.6	34.7		36.3
American Eel	1.9				0.8			1.3	2.9	2.1	1.3	0.8	[illegible]	
Carp	93.3	0.4 0.1	0.4 0.8	0.7 Tr.	63.5	2.2 0.3	0.2 0.2	106.3	17.7	18.6	78.4	53.2	46.2	1.0 6.2
Bullheads ***	0.5	1.7	0.4	0.2	2.4	0.1	0.6	1.7	0.0	10.7	1.4	1.7	0.5	3.8
Longnose Gar	2.5	1.4	Tr.	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.2	0.7	Tr.	0.6
Bowfin	0.3	2.8	3.9	2.4	4.9	0.4	6.6	0.0	1.1	1.3	2.6	1.4	1.8	3.4
Channel catfish[1]	0.0	9.0	0.0	5.3	Tr.	0.0	0.0	0.0	0.0	0.0	Tr.	4.5		
Golden Shiner	0.0	11.3	7.6	1.3	2.6	0.5	13.6	3.0	Tr.	1.1	1.3	7.1	0.0 2.7	1.8 5.3
spot	3.1	4.4	0.1	4.2	0.4	0.0	7.0	13.8	6.1	13.4	1.7	9.1	2.2	8.2
Others[2]	Tr.	1.3	0.7	2.9	1.1	1.2	1.5	1.2	2.8	2.4	0.5	1.2	1.6	2.3
Total	125.9	64.2	54.0	45.2	99.0	38.8	59.3	256.1	205.8	238.8	111.8	159.5	98.0	113.5

* Chain and Redfin
** Mostly pumpkinseeds with a few bluegill
*** Black and yellow
1 Includes a few white catfish
2 Includes killifish, needlefish, bluespotted sunfish, mudminnows, fliers, mosquitofish, alewifes, and silversides.

Table 9 The Number of Tags Returned in the Second Year from Largemouth Bass Tagged in 1961 According to Distance Traveled in Miles from the Tagging Site. Note : The term percent in this table refers to the percent of actual returns and is not a percent of the number originally tagged.

Tagging Site	Number Tags Returned	0-l Nd.	0-l Percent	l-3 No,	l-3 Percent	3-6 No.	3-6 Percent	6-9 No.	6-9 Percent	9-J-2 No.	9-J-2 Percent	12-15 No.	12-15 Percent	19 No.	19 Percent
Shipps Bay	31	17	55	5	16	6	19			2	6			1	3
Buzzard Bay-Southwest Cove	21	9	43	5	24	2	9	3	14	1	5	1	5		
Buck Island Bay	12	2	17	2	17	5	42			3	25				
Little Cedar Island	1											1	-		
Bonneys Cove	6	1	17	2	33	2	33	1	17						
Lovitt Pond	2			2	-										
Total	73	29		16	1	15		4		6		2		1	

Table 10 A Comparison of the first Year Tag Returns for 1960 and 1961 According to Distance Traveled from Tagging Site in Miles.
Note: -The data is presented separately for the north portion and the south portion of the bay, The percent tags returned in this table refer to the percent of the original number tagged,

South Portion of Bay Percent Tags Returned		Distance Traveled	North Portion of Bay Percent Tags Returned	
1959	1960	Miles	1959	1960
44	36	0-1	52	50
17	11	1-3	34	42
10	29	3-6	7	
14	16	6-9	3	41
	2	9-12	1	2
12	4	12-15		
1	-	15-18	1	-
-	-	23	1	-

DISCUSSION OF THE BACK BAY-CURRITUCK SOUND CREEL CENSUS

The Back Bay-Currituck Sound Area has long been noted for its fresh water fishing, but as of the beginnings of the interagency study in 1958, there was little information available regarding the amount and quality of the sport fishing in the area. Since any management practice applied in the area could affect both fisheries and wildlife, it was necessary to evaluate the status of the sport fisheries as part of the overall study. To evaluate the status of the fishery, a creel survey was initiated on Back Bay in 1959 and conducted yearly through 1962. A creel survey was also conducted on Currituck Sound during the years 1960, 1962, and 1963.

Results indicate that fishing pressure in Back Bay was considerably higher than in Currituck Sound. In Back Bay it ranged from 2.11-2.97 angler hours per acre and in Currituck Sound from 1.52-2.14. The higher pressure in Back Bay was probably due to the close proximity of large municipalities such-as Norfolk, Portsmouth, and Virginia Beach. No such centers of high population are close to Currituck.

The overall harvest appeared to be directly related to fishing pressure in both areas. Harvest of bass, however, was not directly correlated with fishing pressure in Currituck. The catch per hour of bass in Currituck Sound appeared to decrease somewhat accompanying a sharply increased fishing pressure in 1962 and 1963. This decrease is probably not due to any decrease in the bass population but rather to an increase in fishing pressure for white perch.

The overall fishing success was considerably better in Currituck Sound (0.60-1.34 fish per hour) than in Back Bay (0.39-0.56 fish per hour). Most of the higher rate of success in Currituck can be attributed to the higher rate of catch of white perch in this area. The amount of fisherman effort expended catching white perch increased from approximately 5 percent of the total effort in 1960 to 20 percent in 1962 and 1963 in Currituck Sound. A similar increase was noted in Back Bay. This increased white perch fishery increased the average catch per hour for all fish from 0.60 in 1960 to 1.27 in 1962 and 1.34 in 1963 in Currituck Sound. The average increase in Back Bay was from 0.46 in 1961 to 0.51 in 1962 and 0.56 in 1963. This change in fishing preference was also noted on the plotted fishing pressure maps. A notable increase in fishing pressure occurred in the open water areas in the vicinity of the exposed oystershell beds and around deep water duck blinds.

The majority of the white perch fishing occurs during the slack period in midsummer when largemouth bass fishing has declined. This summer fishing for white perch adds greatly to the fishery resource in the area. The white perch fishery developed as a result of fishermen preference and not as a result of an increased population of white perch after the sea water intrusion. Population samples prior to the sea water intrusion showed good populations of white perch in the area. Similar samples taken after the storm, in 1962 and 1963, indicated no major change in the numbers of these fish.

Bass fishing success appeared to be similar in both areas. The rate of catch in Back Bay usually ranged from 0.31-0.37 bass per hour and in Currituck Sound from 0.28-0.41. No reduction in success was noted during 1962 and 1963 following the salt water intrusion. There may be reductions, however, in future years as a result of reduced spawning success during 1962. Population samples taken in 1962 indicate spawing success to be reduced.

After 1959 the average weight per bass appeared to be similar in both areas except for 1960 in Currituck Sound. At this time bass averaged about 0.25 pound larger than any average for Back Bay. In Back Bay the average weight per bass increased progressively due to an expansion of the population following a severe winter kill during the winter of 1958-59. This kill apparently did not extend into Currituck Sound, since no change in the population was noted during the creel survey.

The harvest of bass per acre indicates that both areas are probably considerably under-fished and could withstand a much higher pressure. The catch was somewhat higher in Back Bay (1.58 pounds per acre per year - maximum) than in Currituck Sound (1.09 pounds per acre per year - maximum). This harvest is far below average commercial harvests of about 5.6 pounds per acre, recorded in the early 1900's for Back Bay. Although the habitat has undoubtedly deteriorated since this time; it is conceivable that these areas could withstand a harvest of at least 3-4 pounds per acre with no damage to the population.

CONCLUSIONS

1. Under existing fishing pressure, Back Bay and Currituck Sound seem to be producing sufficient numbers of bass to maintain a high quality of fishing and harvest of at least 30,000 pounds or more of bass per year from Back Bay and 80,000 pounds or more in Currituck Sound.

2. Aerial fishermen counts indicate that 40-46 percent of the area is producing most of the harvest while the remaining 54-60 percent of the area appears to be relatively unproductive in Back Bay. Similar indications were noted from aerial counts in Currituck Sound.

3. High turbidities are believed to be associated with the areas of low fish production.

4. The March 7, 1962, sea water intrusion and associated fish-kill did not adversely affect the 1962 and 1963 sport fishery in Back Bay and Currituck Sound.

5. A substantial white perch fishery developed as a result of fisherman preference and the peak of the white perch fishing occurs during the slack period for largemouth bass, thereby filling the summer void in the fishery in Back Bay and Currituck Sound.

6. Currituck Sound and Back Bay can support a substantial increase in sport-fishing pressure without detrimental effects on the fish populations.

RECOMMENDATIONS

1. That any management practice or other activity which would change the habitat in Back Bay and Currituck Sound be considered, only, after sufficient safe guards have been incorporated in each proposed project to protect and maintain the high quality fishery now existing in Currituck Sound.

Back Bay and Currituck Sound Fish Populations

The water within Back Bay-Currituck Sound, under normal conditions, ranges from almost fresh in north Back Bay to slightly saline in south Currituck Sound. The fish population in the entire area is comprised of fresh- and brackish-water species with the bulk of the population being fresh-water species. Various marine species enter the area during the various seasons of the year and the area must be considered as an important nursery for some of the marine forms.

A good to excellent largemouth bass fishery exists throughout the Back Bay-Currituck Sound area with the greater populations located in the northern three-fourths of the area. Good largemouth bass reproduction normally occurs throughout the area and population samples taken during the study revealed a desirable size distribution for the largemouth bass population in both Back Bay and Currituck Sound. The largemouth bass population supports the major portion of the sport-fishing in the area,

Good populations of yellow perch, pumpkinseed, and white perch occur throughout the area. Bluegill are restricted to Back Bay and the northern one-half of Currituck Sound. Within the portion of the area where bluegills occur, their distribution is not uniform and good populations appear to be isolated to small sections of the area. Excessive salinity levels are possibly the limiting factor for bluegills in the southern portion of Currituck Sound, but other habitat requirements are limiting the bluegill in the remainder of the area as salinity levels do not reach the known limit in this portion of under normal conditions.

Comparison of Back Bay and Currituck Sound population samples reveals similar species composition with fresh-water forms slightly greater in Back Bay. The productivity of both areas is approximately the same with the average total number and weight of fish-per-acre being at corresponding levels in both areas. The fishing success and pressure studies also indicate that fisherman success is approximately the same in both areas.

The 1962 and 1963 population studies revealed no major change in the over-all species composition of the fishes in the area as a result of the sea-water intrusion, Fluctuations were noted but were considered annual variations similar to those experienced during preceding years. A wider distribution of various marine species were noted in Back Bay and northern Currituck Sound, This increase in distribution was due to the increase in salinity in the northern portion of the area following the sea-water intrusion, Salinity levels remained above normal in the northern portion through the summer of 1962. No change was noted in the distribution of the fresh-water species resident to the area. The areas along the eastern shore which received lethal quantities of sea water were re-occupied by a typical area fish population within a short period after the sea-water concentrations diluted to sub-lethal levels.

If the fish populations in the Back Bay-Currituck Sound area remain near their present level, they can support a substantial increase in sport-fishing pressure without detrimental effects on the fish populations.

JOB IV-B: Fishing Pressure Studies and Creel Census--Currituck Sound

To obtain a measure of fisherman use and fisherman success, a creel census and fisherman count was conducted on Currituck Sound during a 30-week period, April 3 to October 29, 1960. These 7½ months encompass most of the time when there is an appreciable count of fishing on the Sound.

The March 7, 1962, storm which battered the Atlantic coast introduced large quantities of sea water into the study area. Concentrations as strong as 93 percent sea water were recorded in eastern Currituck Sound on March 8, 1962. The sea water intrusions produced fish-kills along the east side of the Sound, Dead fish were observed from the Virginia-North Carolina line south to Duck, North Carolina. The creel census and fisherman count study was conducted again during 1962 and 1963 to determine and evaluate the possible effects of the sea water intrusion on fisherman success and pressure.

There are a number of landings on Currituck Sound where boats and the services of fishing guides are available. For those who have their own boats and do not 'desire a guide, there are also a number of landings available to the public, To obtain representation of both guided and non-guided fishermen in the sample, a creel clerk alternated between sampling points at Poplar Branch, an important guide landing, and the Coinjock Access Area where fishermen launch their own boats.

The 1960 30-week census period was stratified into five 6-week periods. Saturdays, Sundays, and one weekday were sampled each week. The starting weekday and week-end day sampled at each station was randomly selected and then rotated in order within each 6-week period. The creel checker was on duty from 8:00 a.m. till 8:00 p.m. each sample day and he counted, and weighed, by species the catch of each fisherman upon completion of the fishing trip.

Due to the size of the area (97,000 acres) and the vast amount of water which is intermingled with marsh, an airplane was selected as the fisherman count vehicle. A total fisherman count was set up to be conducted on one day of each week, alternating between weekdays and week-end days. The starting week-end day and weekday within each 6-week period was selected randomly and then rotated in order within each 6-week period. Each count required approximately two hours to complete. The starting hour for the first weekday and week-end days within each 6-week period was randomly selected, and the starting hour for the following days within each period were rotated in order by two-hour intervals. To further randomize the count, the Sound was arbitrarily divided into three sections. The starting section for the first count within each 6-week period was randomly selected and the remaining starting points followed in succession.

The 1962 and 1963 census were modified slightly from that conducted during 1960. The 30-week period was stratified into three lo-week periods instead of the five 6-week periods used in 1960. Weather conditions usually prevent a few of the aerial fisherman counts, and the modification was made to provide sample periods which contained sufficient data for proper analysis, The random selection of starting days, time, and location for the 1962 and 1965 census were made in the same manner as the random selection for 1960, except that it was employed on three lo-week periods instead of the five 6-week periods,

On the basis of this plan, there were two strata (week days and week-end days) and five 6-week periods within each stratum for the 1960 census. There were two strata with three IO-week periods within each stratum for the 1962 and 1963 census. The sampling unit was the catch for one day. The catch-per-hour for each period within a stratum was determined by summing the catch over-all days sampled and dividing by the sum of the hours fished.

Each count of fisherman was considered a random sample of the number of fishermen fishing in any given hour for that day. The sampling unit was the total hours fished per day, determined by multiplying the number of fishermen counted by the total possible fishing hours in the day. The total possible fishing hours was considered to be 13 hours for the period under study. The pressure, in total hours, for each period within a stratum was determined by multiplying the mean of the daily pressure by the total number of days within the period.

The projected total catch was determined by multiplying the total pressure by the average catch-per-hour for all fish, The total catch for each species was determined by dividing the projected total catch by the percent total number of all fish checked during the creel census.

RESULTS

1960

During the 30-week period, April-October, 1960, approximately 30,200 fishermen spent 148,000 hours catching 88,800 fish in Currituck Sound (Table __). The average trip was 4.9 hours and the average catch-per-hour was 0.60 fish. The fishermen averaged 3.0 fish per trip.

Largemouth bass, which comprised 68 percent of the catch at the two checking stations, were the primary target of the sport fishermen in Currituck Sound (Table __). The largemouth bass comprised almost 84 percent of the catch of the non-guided fishermen and 61 percent of the guided fishermen. The average catch-per-hour of largemouth bass was 0.37 at the Coinjock Station and 0.45 at Poplar Branch with an average of 0.41 (Table __). The fishermen averaged 2.0 largemouth bass per trip, weighing an average of 1.52 pounds each. This is a very conservative estimate since numerous limit catches of eight bass were observed and it. is known that when fishing is good, many fishermen release the smaller, but legal sized, bass captured, The peak fishing success for largemouth bass occurred during the second 6-week period (May 15-June 25). The average catch-per-hour of largemouth bass during this period was 0.57.

The sport- fishermen harvested approximately 19,450 white perch during the census period which comprised approximately 22 percent of the total catch. The fishermen expended approximately 5 percent of their total effort angling for white perch. The white perch averaged 0.50 pound each.

Other major species included in the fishermen's total creel were 3,550 pumpkinseed and bluegill; 5,460 striped bass with an average weight of 2.77 pounds each; 800 black crappie and 180 other fish.

Due to weather conditions, it was only possible to make 22 of the 30 scheduled aerial fisherman counts. There were insufficient count data during certain periods to make a complete analysis using the 6-week periods. Therefore, the count data were analyzed on the basis of two 15-week periods. The fisherman counts were also plotted on the three section quadrate maps of Currituck Sound to determine the distribution of the fishing pressure (Figure __).

The three sections, A (Point Harbor to Jews Quarter), B (Jews Quarter to Grandy), and C (Grandy to Virginia-North Carolina State line) have a distribution of fishing pressure in an approximately 1:2:4 ratio, respectively. Section B had approximately twice the number of fishermen as that found in Section A, and Section C contained twice the number as Section B. The major portion of the boat fishing, in all sections, was concentrated along the shore line and in the grass beds throughout the marsh areas of the Sound. The bank fishing was confined primarily to the Coinjock-Church's Island causeway in Section B, and Bell's Island and Knott's Island causeways in Section C.

1962

Approximately 29,744 fishermen caught approximately 237,390 fish during the period April 1 to October 27, 1962 (Table __). The fishermen expended some 187,390 hours and had an average catch-per-hour of 1.27 fish. The average fishing trip was 6.3 hours and each fisherman took home an average of 8.1 fish per trip.

Largemouth bass comprised 25.5 percent of the total catch at the two checking stations (Table __). An estimated total of 60,690 largemouth bass were caught during the 1962 study period, The fishermen took home an average of 2.1 largemouth bass, weighing an average of 1.26 pounds each, per trip. The average catch-per-hour for largemouth bass at the Coinjock station was 0.17 and an average catch-per-hour of 0.44 was recorded at Poplar Branch, The average catch-per-hour at the two stations was 0.32 (Table __).

White perch made up approximately 76 percent of the total catch at the Coinjock station, approximately 57 percent at Poplar Branch, and 65 percent of the total catch for both stations. Currituck Sound sport fishermen expended approximately 20 percent of their total effort angling for white perch and caught an estimated 154,890 white perch, averaging 0.34 pound each during the 30-week period in 1962. This was a sharp increase from the 5 percent effort and 19,450 white perch caught in 1960.

Sport fishermen harvested an estimated 2,820 striped bass weighing an average of 1.84 pounds each, 1,630 black crappie, 15,190 pumpkinseed, 1,150 bluegill, and 1,630 other fish during the 1962 'season.

The distribution of fishing pressure was obtained by plotting the 21 aerial fishermen counts on section quadrat maps of the Sound (Figure __). The bulk of the pressure was located along the shore line and marsh areas of the Sound. A decline in pressure was noted for the Tull's Creek, Knott's Island, and Pointer Hill Marsh areas of the Sound.

The increased white perch fishing was noted by a sharp increase in pressure in the deeper water areas of the Sound. The bank fishing continued to be concentrated along the Knott's Island, Bell's Island, and Church's Island causeways.

1963

The creel census was conducted in 1963 during the period April 7-November 2. An estimated 32,583 fishing trips were made on Currituck Sound during this 30-week period with the anglers catching approximately 279,430 fish. The average fishing trip was 6.4 hours with an average catch-per-hour of 1.34 fish. The fishermen took home an average of 8.6 fish per trip (Table __).

Largemouth bass made up 21 percent of the total catch during 1963 (Table __). Anglers caught an estimated 58,680 largemouth bass weighing an average of 1.32 pounds each. The fishermen caught an average of 1.8 bass per trip. The average catch-per-hour for largemouth bass during 1963 was 0.13 at Coinjock, 0.38 at Poplar Branch, and an over-all average of 0.28 (Table __).

The white perch fishery continued to increase during 1963 with approximately 30 percent of the angling effort expended in search of white perch. An estimated 194,210 white perch, weighing an average of 0.28 pound each, were caught by the sport fishermen during the 30-week period. The white perch comprised approximately 84 percent of the total catch at Coinjock, 58 percent at Poplar Branch, and 70 percent for both stations,

The sport fishermen caught an estimated 8,660 pumpkinseed, 560 bluegill, 8,100 striped bass averaging 1.33 pounds each,' and 9,220 other fish in Currituck Sound during the 30-week period in 1963.

DISCUSSION

The Back Bay-Currituck Sound area has long been noted for its fresh-water fishing, but as of the beginnings of the interagency study in 1958, there was no information available regarding the amount and quality of the sport-fishery in Currituck Sound. Since any management practice applied in the area could affect both fisheries and wildlife, it was necessary to evaluate the status of the sport fisheries as part of the over-all study,

The fishing pressure studies conducted in 1960 revealed that the major portion of the boat fishing was conducted along the shore line in association with a marsh habitat and in the rather shallow areas which contain a concentration of submergent vegetation" The majority of the fishermen use artificial bait when fishing the shore line and vegetation beds. Open-water fishing for largemouth bass is confined primarily to the numerous duck blinds and the "deep holes" in areas where the surrounding water is fairly shallow. Natural bait is normally used when fishing this type of area.

Fishermen seeking the white perch in Currituck Sound normally anchor over the exposed dead oyster shell beds located in the deep water areas of the Sound. Shrimp, fished just off the bottom, is the preferred bait of the white perch fishermen.

The major portion of the bank fishing is confined to the canals along the causeways to Knott's Island, Bell's Island, and Church's Island, The majority of the bank fishermen use natural bait and catch a greater variety of species than any other group of fishermen in Currituck Sound.

The 1960 creel census revealed that the largemouth bass were the primary target of the sport fishermen in Currituck Sound, Approximately 90 percent of the total fishermen effort was expended in search of the largemouth bass. An estimated 60,830 largemouth bass were taken home by 30,200 anglers during the 30-week census period in 1960. The average catch-per-hour was 0.41 bass and the average catch-per-trip was 2.0 bass. This is an indication of the quantity of the sport fishing in Currituck Sound but by no means reflects the true picture of the quality of the largemouth bass fishery. With regard to quality, the above figures must be considered very conservative as numerous limit catches of eight bass were recorded during the census and it is known that many fishermen release the smaller, but legal size, bass captured. During periods when fishing is good, catches as high as 365 largemouth bass, for a two-man party during a two-day period, have been recorded (fishing guide records, 1960). If the above party checked through a creel census station, only 32 of the bass (2 days limit) would be recorded in the creel data, The remainder were released after capture. Although the catch of 365 bass is the known extreme, catches of 50-60 largemouth bass, per two-man party, per day is common in Currituck Sound.

The peak in largemouth bass fishing in Currituck Sound usually occurs during mid-April to June. Success gradually tapers off during the summer months and usually experiences an increase during October.

The catch-per-hour data indicates the guided fishermen had greater success than the average non-guided fishermen. This emphasizes the fact that, in order to be consistantly successful, the angler must be familiar with the waters he fishes and the habits of the fish within these waters under varying conditions during the various seasons of the year.

A sharp reduction in the catch-per-hour rate of largemouth bass occurred at the Coinjock checking station during 1962 and 1963. Largemouth bass, which comprised 68 percent of the total catch at the two checking stations in 1960, made up only 25 percent of the catch in 1962 and 21 percent in 1963. These trends do not indicate, at it would appear, a notable reduction in the bass populations of Currituck Sound. The 1962 catch-per-hour of 0.44 largemouth bass at the Poplar Branch checking station was almost identical to that recorded in 1960 and the 0.38 bass-per-hour in 1963 is only a slight decrease. The number of largemouth bass-per-fisherman-trip remained approximately the same for 1960, 1962, and 1963 with 2.0, 2.1, and 1.8 bass per trip, respectively. The above trends do, however, reflect a change in fish preference by the anglers using the area. The white perch drew a greater expenditure of the fishermen's effort during 1962 and 1963 which, in turn, affected the catch composition.

The amount of fisherman effort expended catching white perch increased from approximately 5 percent of the total effort in 1960 to 20 percent in 1962 and 30 percent in 1963. The development of the white perch fishery is also emphasized by the projected total sport catch in Currituck Sound. The anglers harvested 19,450 white perch in 1960, 154,890 in 1962, and 194,210 white perch in 1963. The increased white perch fishery increased the average catch-per-hour for all fish from 0.60 in 1960 to 1.27 in 1962 and 1.34 fish in 1963. This change in fishing preference was also noted on the plotted fishing pressure maps. A notable increase in fishing pressure occurred in the open water areas of Currituck Sound in the vicinity of the exposed oyster shell beds. The majority of the white perch fishing occurs during the "slack period" in the summer when largemouth bass fishing has declined, This "summer fishing" for white perch adds greatly to the fishery resource in the area, The white perch fishery developed as a result of fisherman preference end not as a result of an increased population of white perch after the sea water intrusion. Population samples prior to the sea water intrusion showed good populations of white perch in the area, Similar samples taken after the storm in 1962 and 1963 indicated no major change in the numbers of white perch.

A comparison of these data with the available published creel records throughout the United States indicates that the Currituck Sound largemonth bass sport fishery is presently one of the best in North America. This fact is magnified by the numerous, legal size, largemouth bass which are caught and released by the fishermen after they have obtained their legal limit of eight largemouth bass.

The over-all fishing pressure in Currituck Sound must be considered very low with 0.33 angler and approximately 2.0 angler hours per acre. The area can support a very substantial increase in the fishing pressure without decline in fishing success.

CONCLUSIONS

1. The largemouth bass fishing in the Currituck Sound area is presently one of the best in North America.
2. The March 7, 1962, sea water intrusion and associated fish-kill did not adversely affect the 1962 and 1963 sport fishery in Currituck Sound.
3. A substantial white perch fishery developed as a result of fisherman preference and the peak of the white perch fishing occurs during the "slack period" for largemouth bass thereby filling the "summer void" in the fishery in Currituck Sound.
4. Currituck Sound can support a substantial increase in sport-fishing pressure without detrimental effects on the fish populations.

RECOMMENDATIONS

1. That any management practice or other activity which would change the habitat in Currituck Sound be considered, only, after sufficient "safe guards" have been incorporated in each proposed project to protect and maintain the high quality fishery now existing in Currituck Sound.
2. That a creel census be conducted during 1964 to evaluate the possible reduction in fisherman success due to the reduced largemouth bass reproduction in 1962 as a result of the sea water intrusion. The 1963 season will be the first season that the 1962 year class of largemouth bass will be available to the fishermen's creel,
3. That the 1964 creel census be modified to enable a complete analysis of the increased white perch fishery. (The modification should provide sufficient information on the largemouth bass fishermen and the white perch fishermen so that they may be separated and analyzed separately,)

TABLE

CATCH, BY SPECIES, AT THE CHECKING STATIONS ON CURRITUCK SOUND
DURING THE PERIOD APRIL 3, 1960 - OCTOBER 29, 1960

CREEL CENSUS
CURRITUCK SOUND - 1960

SPECIES	COINJOCK				POPLAR BRANCH				TOTAL			
	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR
Largemouth bass	305	445.2	83.6	.37	457	715.3	61.0	.45	762	1,160.5	68.5	.41
White perch	43	29.6	11.7	.05	198	92.5	26.9	.19	243	122.1	il.9	.13
Black crappie	6	2.4	1.6	.007	4	1.6	0.5	.004	10	4.0	0.9	.005
Pumpkinseed	6	0.6	1.6	.007	39	7.7	5.2	.04	45	8.3	4.0	.02
Striped bass	3	1.0	0.8	.004	40	118.3	5.4	.04	43	119.3	3.9	.02
Others	2	-	0.6	.002	0	0			2	-	0.2	.001
TOTAL	365	478.9		.44	748	915.4		.73	1,112	1,394.3		.60

TABLE

CATCH, BY SPECIES, AT THE CHECKING STATIONS ON CURRITUCK SOUND
DURING THE PERIOD APRIL 1 - OCTOBER 27, 1962

SPECIES	COINJOCK				POPLAR BRANCH				TOTALS			
	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR
Largemouth bass	394	476.9	13.6	0.17	1,277	1,634.5	35.0	0.44	1,671	2,111.4	25.5	0.32
White perch	2,195	736.7	75.7	0.96	2,072	716.1	56.8	0.72	4,267	1,452.8	65.1	0.83
Black crappie	44	14.3	1.5	0.02	--	--	--	--	44	14.3	0.7	0.008
Pumpkinseed	201	--	6.9	0.09	219	--	6.0	0.08	420	--	6.4	0.08
Bluegill	19	9.6	0.7	0.008	12	--	0.3	0.004	31	--	0.5	0.006
Striped bass	14	22.7	0.5	0.006	66	124.7	1.8	0.02	80	147.4	1.2	0.02
Others	43	--	1.5	0.02	--	--	--	--	43	--	0.7	0.008
TOTAL	2,901	1,260.2		1.27	3,646	2,475.3		1.26	6,556	3,725.9		1.27

TABLE

CATCH, BY SPECIES, AT THE CHECKING STATIONS ON CURRITUCK SOUND
DURING THE PERIOD APRIL 7 NOVEMBER 2, 1963

SPECIES	COINJOCK				POPLAR BRANCH				TOTALS			
	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR	NUMBER	WEIGHT	% TOTAL NUMBER	CATCH PER HOUR
Largemouth bass	278	378.7	8.5	0.13	1,300	1,808.9	30.7	0.38	1,578	2,187.6	21.0	0.28
White perch	2,742	761.8	83.8	1.25	2,470	699.2	58.4	0.73	5,212	1,461.0	69.5	0.93
Black crappie	2	0.5	0.1	-					2	0.5	-	
Pumpkinseed	158	47.2	4.8	0.07	75	28.0	1.8	0.02	233	75.2	3.1	0.04
Bluegill	13	5.1	0.4	0.01	3	4.3	0.1	-	16	9.4	0.2	-
Striped bass	15	18.6	0.5	0.01	193	258.2	4.6	0.06	208	276.8	2.9	0.04
-Others	63	28.9	1.9	0.03	la7	101.0	4.4	0.06	250	129.9	3.3	0.04
TOTAL	3,271	1,240.8	100.0	1,49	4,228	2,899.6	100.0	1.25	7,499	4,140.4	100.0	1.34

TABLE

CATCH AND CATCH RATE OF LARGEMOUTH BASS FROM CURRITUCK SOUND
BY SIX-WEEK PERIODS AT THE CHECKING STATIONS
DURING APRIL 3-OCTOBER 29, 1960

PERIOD	COINJOCK				POPLAR BRANCH				TOTALS			
	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH
I Apr. 3 - May 14	60	277	99	0.36	47	225	135	0.60	107	502	234	0.47
II May 15 - June 25	44	181	96	0.53	57	319	192	0.60	101	500	288	0.57
III June 26 - Aug. 6	36	162	53	0.33	31	164	57	0.35	67	326	110	0.34
IV Aug. 7 - Sept. 17	18	79	15	0.19	26	148	31	0.21	44	227	46	0.20
V Sept. 18 - Oct. 29	23	128	42	0.33	32	162	42	0.26	55	290	84	0.29
TOTALS	181	827	305	0.37	193	1,018	457	0.45	374	1,845	762	0.41

TABLE

CATCH AND CATCH RATE OF LARGEMOUTH BASS FROM CURRITUCK SOUND
BY TEN-WEEK PERIODS AT THE CHECKING STATIONS
DURING APRIL 1 - OCTOBER 27, 1962

PERIOD	COINJOCK				POPLAR BRANCH				TOTALS			
	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH
I Apr. 1 - June 9	172	1,096	258	0.24	184	1,383	784	0.57	356	2,479	1,042	0.42
II June 10 - Aug. 18	146	775	41	0.05	102	557	143	0.26	248	1,332	184	0.14
III Aug. 19 - Oct. 27	80	413	95	0.23	130	941	351	0.37	210	1,354	446	0.33
TOTAL	398	2,284	394	0.17	416	2,881	1,277	0.44	814	5,165	1,671	0.32

TABLE

CATCH AND CATCH RATE OF LARGEMOUTH BASS FROM CURRITUCK SOUND
BY TEN-WEEK PERIODS AT THE CHECKING STATION
DURING APRIL 7 - NOVEMBER 2, 1963

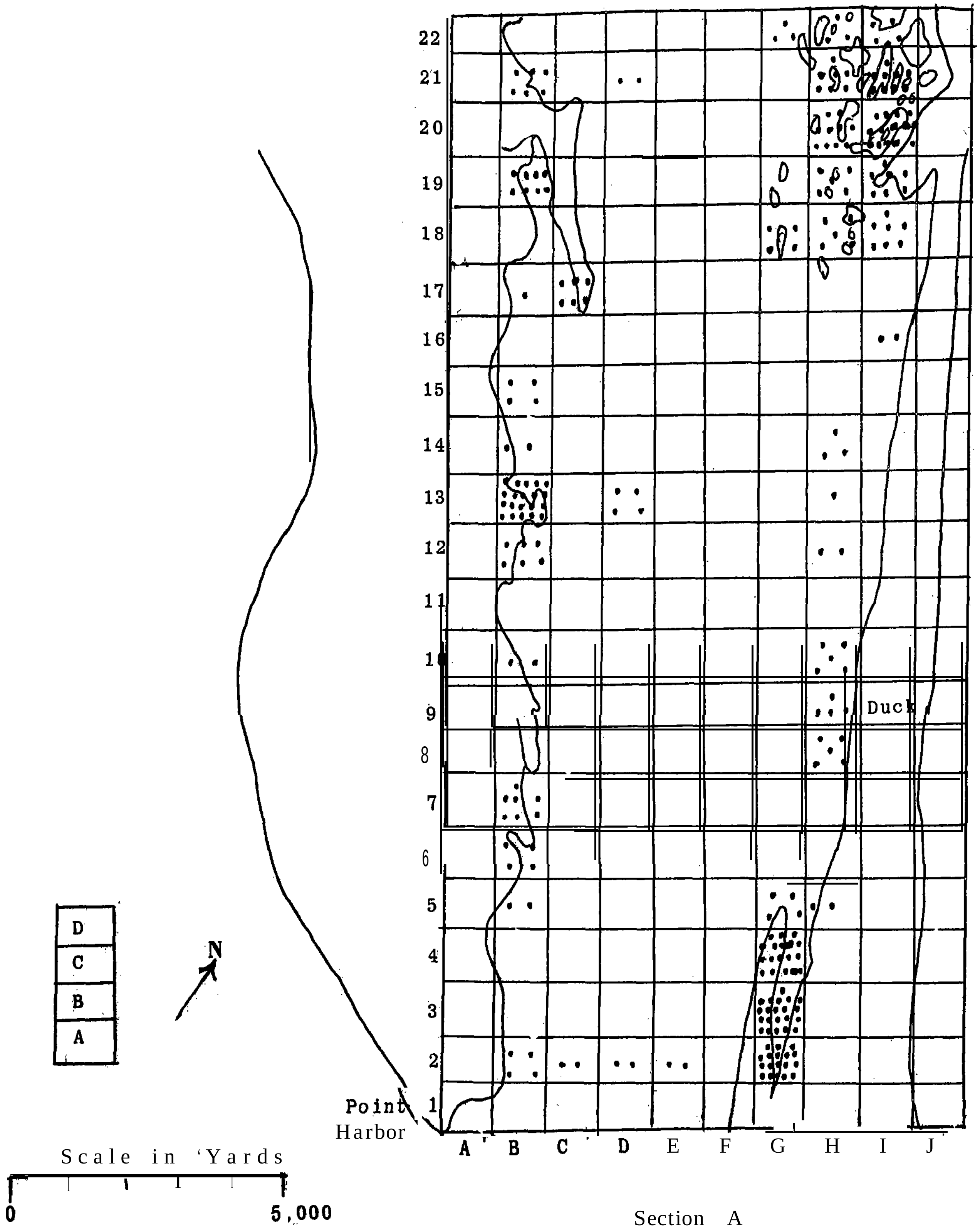
PERIOD	COINJOCK				POPLAR BRANCH				TOTALS			
	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH	NUMBER FISHERMEN	NUMBER HOURS	NUMBER FISH	CPMH
I Apr. 7 - June 15	154	801	167	0.21	212	1,421	815	0.57	366	2,222	982	0.44
II June 16 - Aug. 24	129	911	73	0.08	112	844	159	0.19	241	1,755	232	0.13
III Aug. 25 - Nov. 2	68	487	38	0.08	192	1,115	326	0.29	260	1,602	364	0.23
TOTAL	351	2,199	278	0.13	516	3,380	1,300	0.38	867	5,579	1,578	0.28

TABLE

PROJECTED TOTAL CATCH BY SPORT-FISHERMEN IN CURRITUCK SOUND
DURING 1960, 1962, AND 1963
EXPANDED FROM RESULTS OF CREEL CENSUS AND FISHERMEN COUNT STUDIES

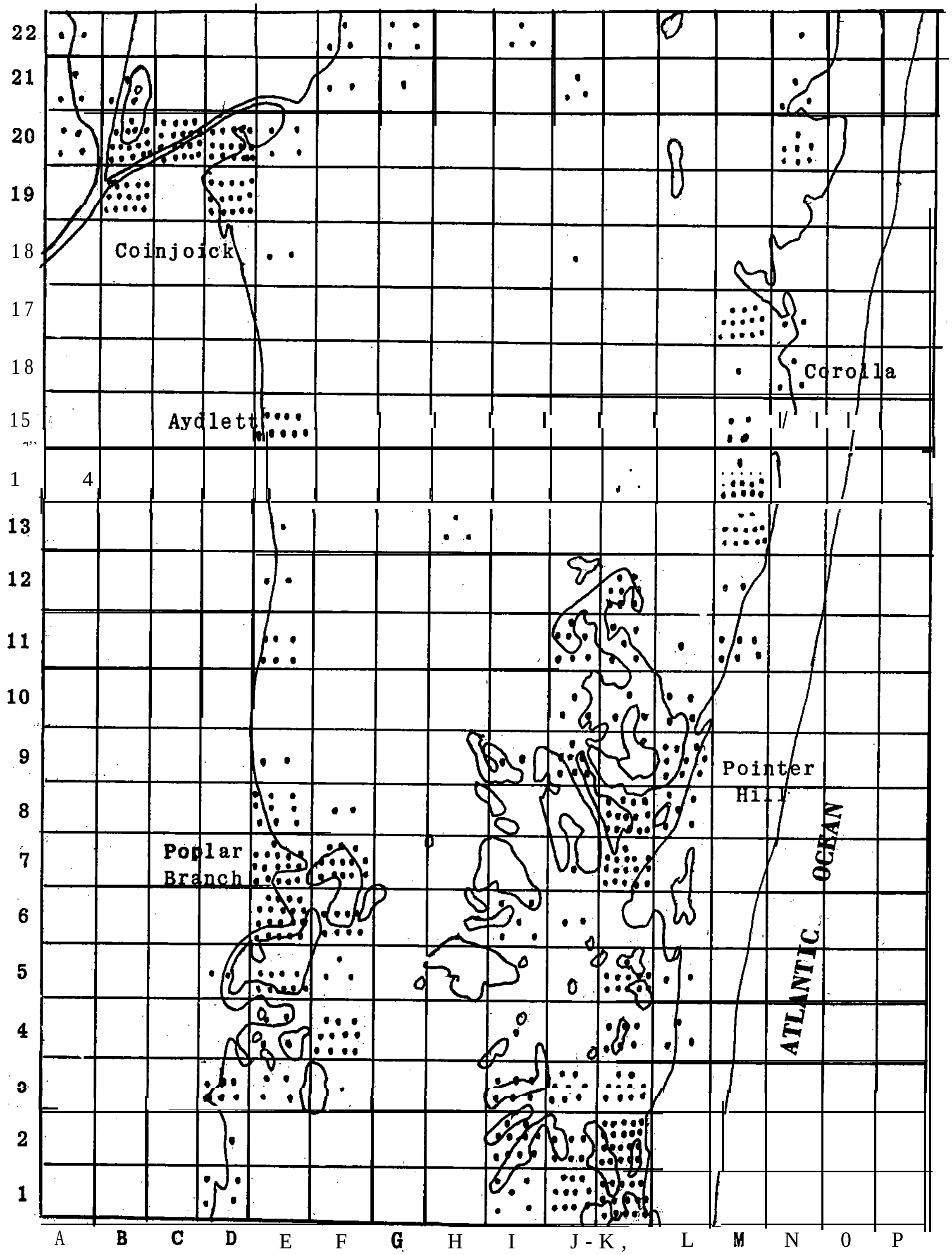
	1960	1962	1963
NUMBER OF FISHERMEN TRIPS	30,200	29,744	32,583
NUMBER OF FISHERMEN HOURS	148,000	187,390	208,530
AVERAGE NUMBER HOURS PER FISHERMEN TRIP	4.9	6.3	6.4
NUMBER OF FISH CAUGHT:			
Largemouth bass	60,830	60,690	58,680
White perch	19,450	154,890	194,210
Black crappie	800	1,630	70
Pumpkinseed	3,550*	15,190	8,660
Bluegill		1,150	560
Striped bass	3,460	2,820	8,100
Other fish	180	1,630	9,220
Total Number Fish	88,800	237,990	279,430
NUMBER OF FISH PER FISHERMEN TRIP,	3.0	8.1	8.6
NUMBER OF LARGEMOUTH BASS PER FISHERMEN TRIP	2.0	2.1	1.8
NUMBER OF WHITE PERCH PER FISHERMEN TRIP	0.6	5.2	6.0

* Includes Bluegill



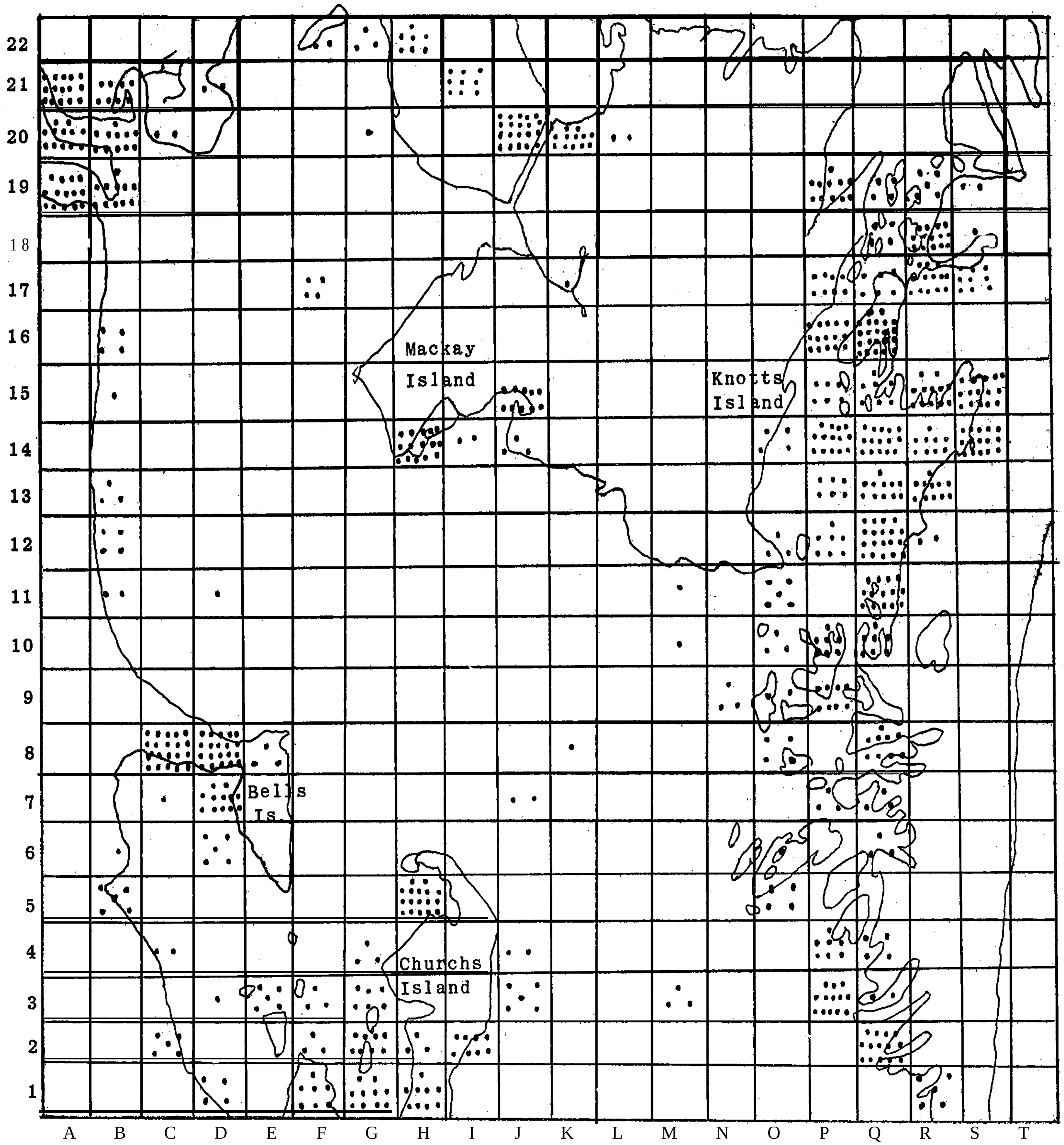
Section A

Figure ______. Distribution of Fishing Pressure in Currituck Sound During Twenty-twc Aerial Fishermen Counts April 3 to October 29, 1960; Each Dot Represents One Fisherman.



Section B

Figure _____ . (1960 Continued).



Section C

Figure ______ . . (1960 Continued).

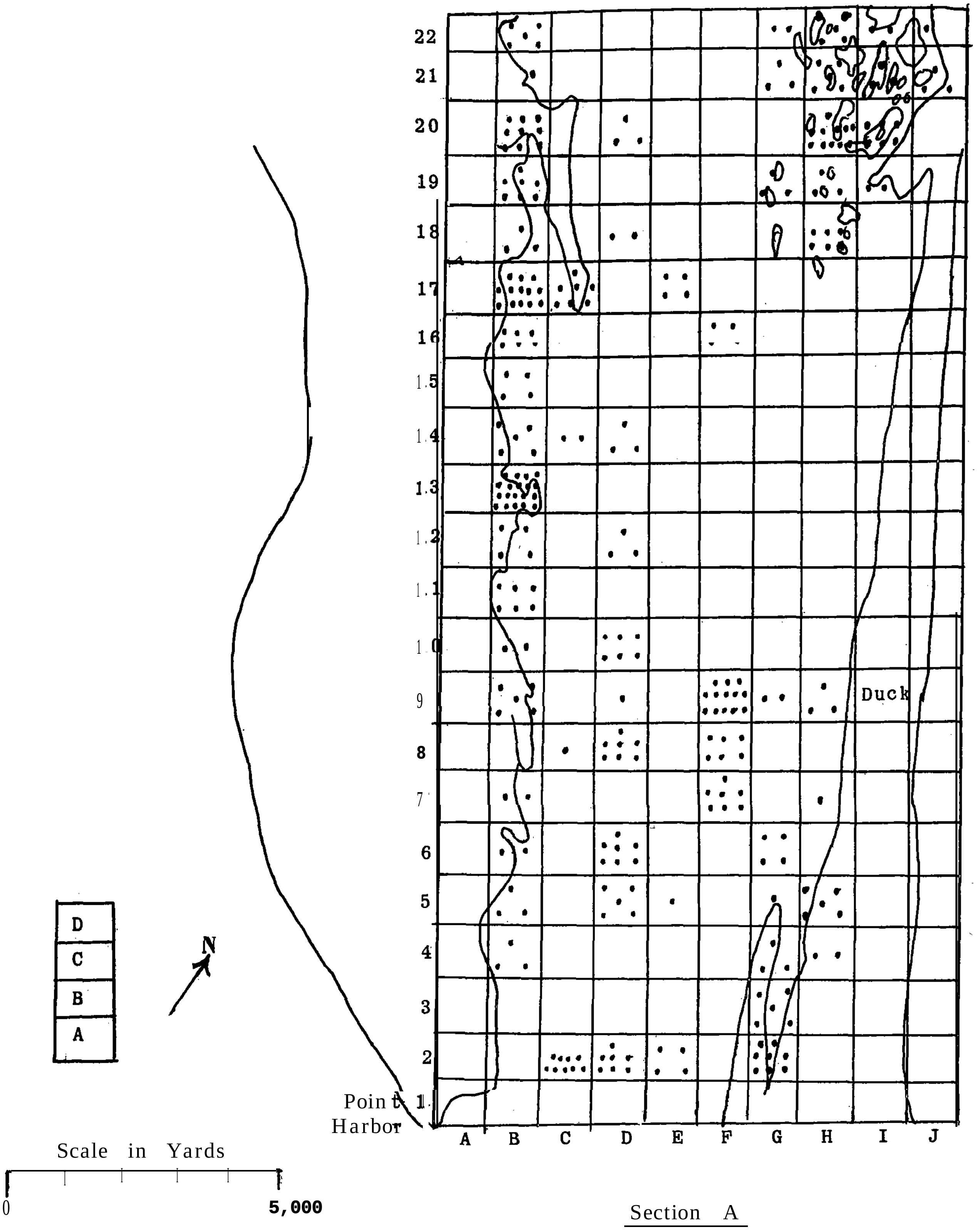
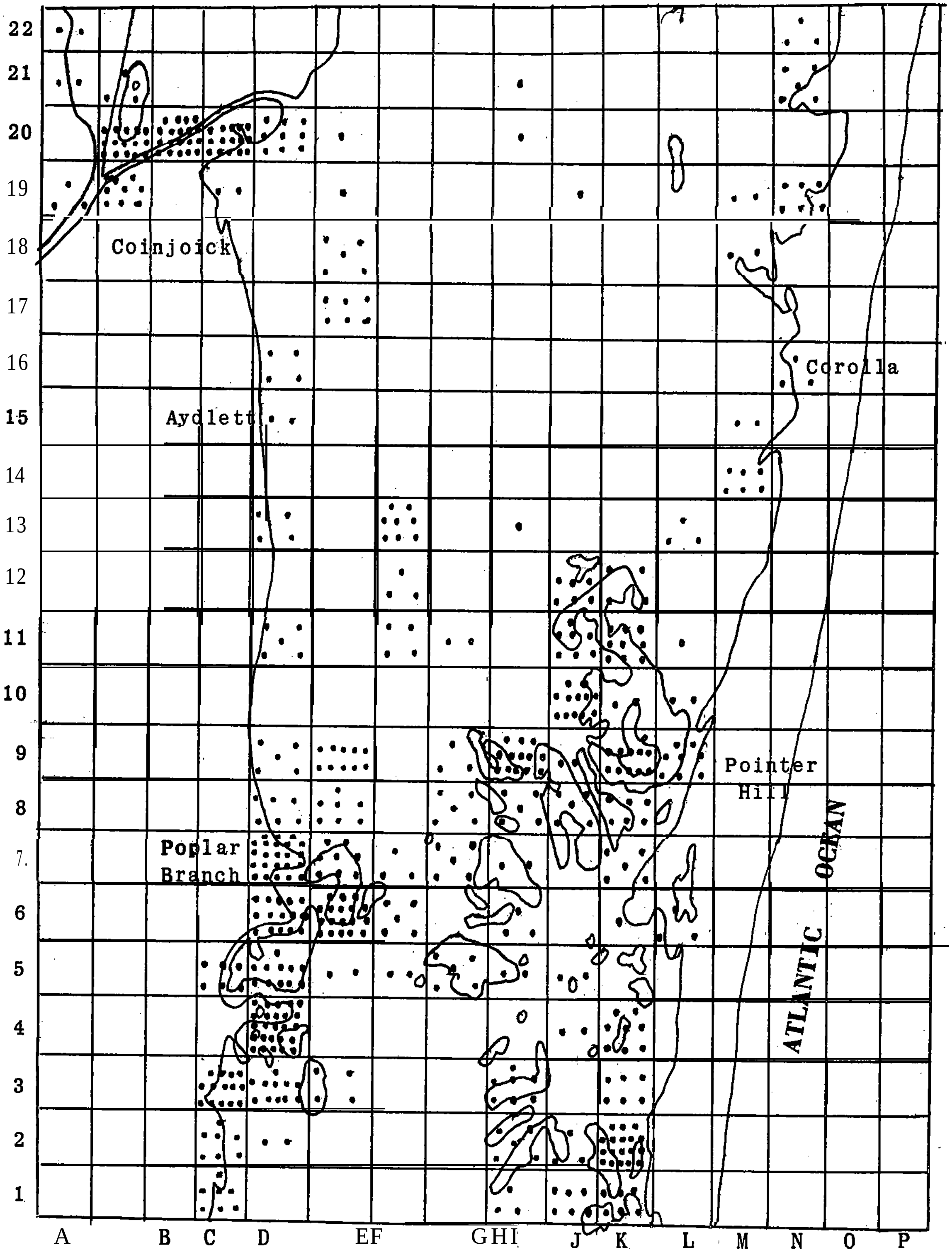
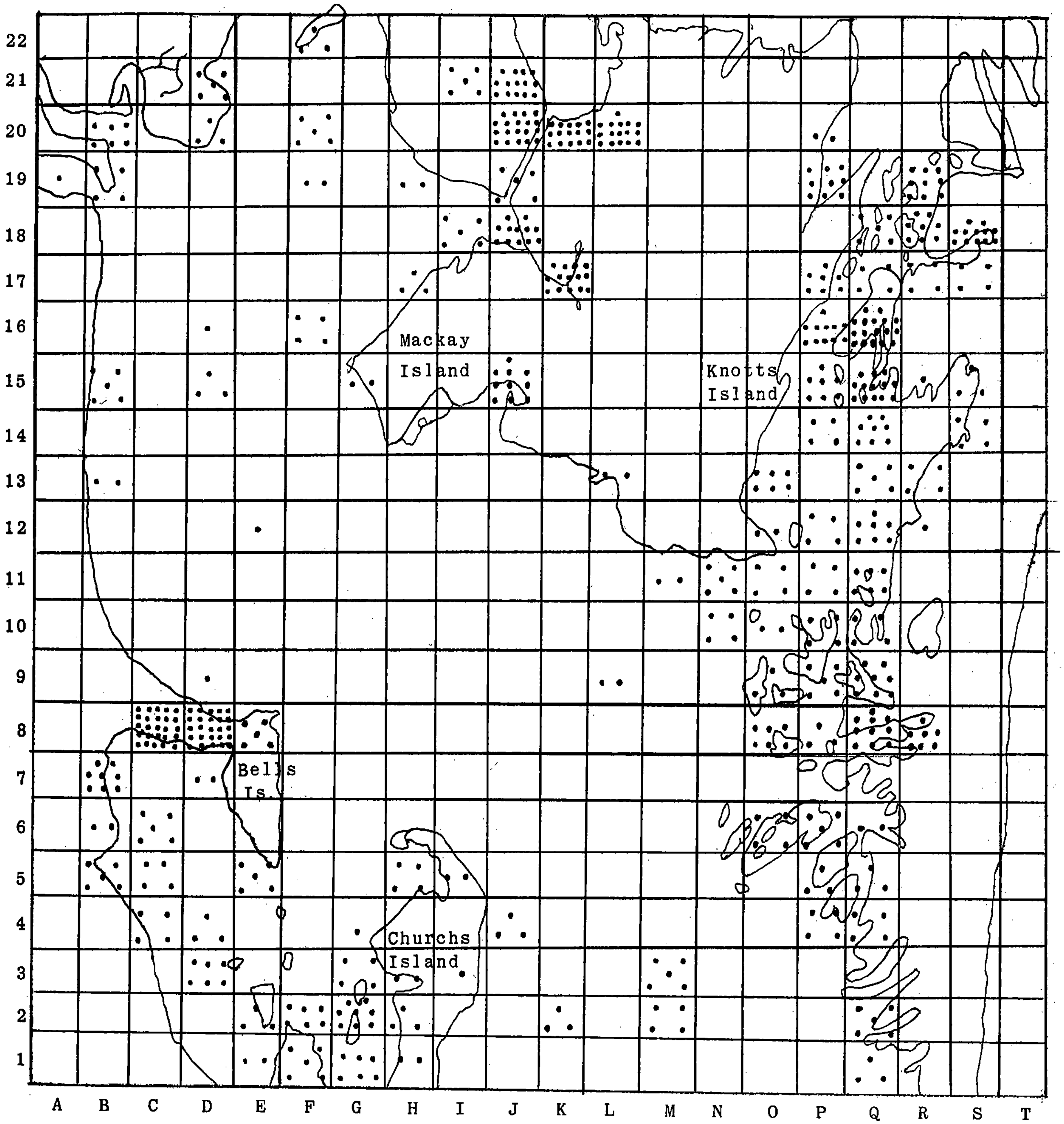


Figure ._____ Distribution of Fishing Pressure in Currituck Sound During Twenty-one Aerial Fishermen Counts April 1 to October 27, 1962; Each Dot Represents One Fisherman.



Section B

Figure . ______ (1962 Continued).



Section C

Figure ______. (1962 Continued).

JOB IV A: Fish Sampling with Rotenone in Selected Areas - Currituck Sound.

During the summer of 1958, nineteen rotenone samples were collected throughout Currituck Sound as a preliminary survey to obtain an index of the relative fish populations in the different portions of the study area, A series of samples, one-fourth to one-half an acre in area, were collected from each of the three portions of the Sound, Four of these sample sites were selected as representative areas for further intensive study to determine species composition, relative abundance, and to obtain a measure of reproduction success in the different'portions of the Sound,

The areas selected for intensive study were Knapp's Pond (Station A), Cedar Island Bay (Station B), Waterlily Bay (Station C), and Hog Quarter Creek (Station D). The size of the sample area at each site was increased to include a range of 2.0 to 3.5 surface acres. The four areas contain a similar cove habitat, bordered by marsh, an average depths of 2.5 to 3.0 feet, sand and silt bottom, and each contains a good growth of aquatic vegetation,

Fish population samples in each of the areas were collected with rotenone during July of 1959, 1960 and 1961. The four areas were sampled again during July, 1962 and 1963 following the March 7, 1962 storm to determine the effects of the sea-water intrusion on the species composition, distribution, and reproduction of the fish populations in the Sound. Two additional samples were collected in 1962--from coves having a habitat similar to that of the established sites--in Knott's Island Bay (Station E) and Sander's Bay (Station F) where the salinity remained relatively high throughout the spawning season. Station F was sampled again in 1963 to obtain a measure of the reproduction success in this area at lower salinity levels,

The salinity levels throughout the Sound were unstable following the March 7, 1962 sea-water intrusion, It was necessary to collect water samples from each of the population sampling sites at one- or two-week intervals, depending on the rate of change, prior to and during the spawning season to obtain sufficient data to evaluate the salinity levels in the sample sites. Prior to the sea-water intrusion and after the salinity levels stabilized following the storm, salinity determinations for each of the sample sites were made in conjunction with the regularly scheduled water quality study.

Five percent emulsifiable rotenone was applied in the sample areas at the rate of one gallon per three-acre-feet of water (an approximate concentration of .05 ppm active ingredient rotenone). Block nets were used, whenever possible, to prevent the escape or entrance of fish, In areas where block nets were impractical, a double curtain of rotenone was applied across the mouth of the cove immediately prior to the rotenone application in the area.

Fish were picked up on the day of application as long as they continued to surface and again on the following day, The fish were separated to species and the numbers and weights obtained. All largemouth bass and bluegill were sorted to one-inch size groups and individual lengths and weights obtained,

RESULTS AND DISCUSSION

The results of the rotenone sampling are presented in Tables ____ to ____. Game-fish species comprised an average 56 percent of the total number of fish collected in 1959, 47 percent in 1960, and 40 percent in 1961. Game-fish species made up 73 percent of the total weight for all samples in 1959, 71 percent in 1960, and 59 percent in 1961, Yellow perch, pumpkinseed, largemouth bass, and white perch were the dominant game species in the Sound.

A good to excellent largemouth bass fishery exists through the Sound, with the larger populations located in the northern two-thirds of the area. Bluegill are restricted primarily to the northern half of the Sound. Salinity may possibly be the limiting factor for bluegill in the southern portion of the Sound as sea-water concentrations in the southern portion normally increase beyond the known limit for successful reproduction during the summer months. Good populations of yellow perch, white perch, and pumpkinseed occur throughout the Sound. Small pumpkinseed and yellow perch, golden shiner, bluespotted sunfish, killifish, and menhaden comprise the major portion of the available forage in the Sound.

Sea-water intrusions, accompanying the March 7, 1962 storm,, produced fish-kills along the east side of the Sound. Dead fish were observed from the Virginia-North Carolina line, south to Duck, North Carolina. A severe fish-kill occurred in the Swan Island-Corolla portion of the Sound, Sea-water concentrations up to 94 percent produced a complete kill within this area, The kill was fairly light in the remainder of the affected area. During March, most of the largemouth bass were still in the deeper water areas. The marshy areas along the east side of the Sound which received the greater sea-water intrusions are shallow and did not contain concentrations of fish at the time of the intrusions, The sea-water intrustion increased the average salinity in Currituck Sound from 3.26 percent sea water, just prior to the storm, to approximately 28 percent. The salinity remained fairly high in some areas of the Sound through the summer of 1962,

The 1962 and 1963 fish population data revealed that there was no major change in the over-all species composition of the fishes in the Sound as a result of the sea-water intrusion, Game-fish species made up 46 percent of the total number of fish collected in 1962 and 60 percent in 1963. Game-fish species comprised an average 44 percent of the total weight in 1962 and 61 percent in 1963. The fluctuation of these data were considered annual variations similar to those experienced in the 1959, 1960, and 1961 data,, A wider distribution of various marine species, which enter the Sound during the summer months, was noted in the northern portion. This increase in distribution was due to the increase in salinity in the northern portion following the sea-water intrusion. Salinity levels remained above normal in the northern section through the summer of 1962. No change was noted in the distribution of the fresh-water species resident to the Sound. The areas along the eastern shore which received lethal quantities of sea water were reoccupied by the typical Sound fish population within a short period after the sea-water concentrations diluted to sub-lethal levels, The July, 1962 fish sample taken at Station E (Knott's Island) contained a typical Currituck Sound fish population after receiving large quantities of full strength sea water durin the March storm (Table____). The major portion of the sea water which entered the Sound in the Knott's Island area came through the cove at Station E.

Prior to the 1962 sea-water intrusions, good largemouth bass reproduction occurred at all stations, The 1962 fish population samples revealed reduced largemouth bass reporduction in the areas of Currituck Sound which contained sea-water concentrations greater than 11 percent sea strength with only a trace of bass reproduction found in those areas where a 'salinity exceeding 13 percent persisted throughout the spawning season (Table____).

Figure____ graphically expresses the amount of largemouth bass reproduction found in each sample area and the salinity in which the reproduction occurred, The 1962 largemouth bass reproduction in Stations A (Knapp's Pond), B (Cedar Island Bay), and D (Hog Quarter Creek) produced the same relative reproduction pattern as recorded during 1959, 1960, and 1961, The salinity in these areas did not exceed 11 percent during the 1962 spawning season, Station C (Water-lily Bay), however, contained the best relative bass reproduction during each of the three preceeding years, During 1962, the reproduction of largemouth bass in Station C was greatly reduced. The salinity range in Station C during the spawning season was 9 to 15 percent. The salinity dropped to 9 percent during a two-week period when the water temperature first reached the level where spawning might occur. The salinity remained at 13 to 15 percent during the remainder of the spawning season. Station F (Sander's Bay) contained sea-water concentrations of 15 to 16 percent until the last of May, 1962.

The salinity remained at 13 percent through June. Only one young-of-the-year largemouth bass was recovered from the 2-acre sample.

Bluegill reproduction was found for Stations A, B, and C during 1960 and 1961. Bluegill have not been recorded at Station D since 1959 (adults or young-of-the-year), when a few young-of-the-year were recovered in the sample. Only Stations A and B, of the six stations sampled in 1962, produced young-of-the-year bluegill, These two stations were the only areas with salinity levels below 10 percent during the spawning season.

The sea-water bioassays, conducted in the laboratory in 1961, indicated that the greatest concentration of sea water in which largemouth bass and bluegill can successfully reproduce lies between 10 and 15 percent. The 1962 and 1963 rotenone samples indicate that the limit is 10 percent sea-water strength.

CONCLUSIONS

1. Largemouth bass, yellow perch, white perch, and pumpkinseed are the dominant game-fish species in Currituck Sound with good populations of these species present through the Sound.
2. Bluegill populations are restricted to the northern one-half of the Sound with excessive salinity being the possible limiting factor in the southern portion,
3. The sea-water intrusions did not affect the over-all species composition of the fishes in the Sound.
4. The sea-water intrusions induced a wider distribution of various marine species which enter the Sound during the summer but, did not change the distribution of the fresh-water species resident to the area.
5. Sea-water concentrations exceeding 11 percent through the spawning season reduced the largemouth bass and bluegill spawning success and virtually

eliminated successful spawning in those areas with salinities in excess of 13 percent sea water.

6. In the event that sea water is introduced as a management practice, concentrations in excess of 10 percent sea strength cannot be tolerated by the fisheries.

TABLE___. Results of Rotenone Samples from Station A (Knapp's Pond) - Currituck Sound - 1959, 1960, 1961.

Area - 2.0 acres	1959				1960				1961			
Salinity	450 ppm.				750 ppm.				450 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No.	Total Wt.
Bluespotted sunfish	71	Tr.	10.5	Tr.	654	3.3	28.6	3.4	399	1.9	29.4	2.2
Yellow perch	299	1006	43.3	35.3	476	12.1	20.8	12.2				
Pumpkinseed	55	3.7	8.1	12.7	361	12.0	15.8	12.1	319	1801 7.0	23.4 9.8	218.3
Golden shiner	189	1.3	27.1	4.5	300	8.0	12.7	8.1	236	11.2	20.3	13.3
Largemouth bass	25	5.2	3.7	17.9	211	21.2	9.2	21.5	69	9.9	5.1	11.7
Bluegill	7	0.7	1.0	2.4	53	4.9	2.2	4.9	72	2.6	5.3	3.0
Eastern chain pickerel	10	3.1	1.4	10.5	31	5.6	1.3	5.6	18	4.6	1.3	5.4
Menhaden	Tr.	Tr.	-	-	30	0.1	1.3	0.1		-	-	-
Fundulus sp.					23	Tr.	1.0	-	-7	Tr.	0.5	-
White perch	8	0.2	1.1	0.7	22	1.1	0.9	1.0	4	0.2	0.3	0.2
Atlantic croaker				-	21	0.8	0.9	0.8				
Black crappie	-4	0.2	0.6	0.7	17	2.8	0.7	2.8	17	2.1	1.2	2.4
American eel					17	1.0	0.7	1.0	4	0.7	0.3	0.7
Brown bullhead	4	0.2	0.6	0.7	16	1.5	0.7	1.5	10	1.8	0.7	2.1
Notropis sp.	-	-	-	-	15	Tr.	0.6	-	2	Tr.	0.1	-
Warmouth	3	0.2	0.4	0.7	8	1.0	0.3	1.0	5	0.4	0.4	0.4
Bowfin	4	400	0.6	13.7	7	13.6	0.2	13.7	13	11.8	1.0	14.0
Carp					7	6.7	0.2	6.8	7	5.5	0.5	6.5
Cypress swamp darter					6	Tr.	0.2	-	-			
Goldfish	11	Tr.	1.6	-								
Redfin pickerel					3	0.2	0.1	0.2	Tr.	Tr.	-	-
Needlefish	-	-	-	-	2	0.2	0.1	0.2	1	Tr.	0.1	-
Longnose gar	-	-	-	-	2	Tr.	0.1	-	1	4.5	0.1	5.3
Madtom	-	-	-	-	2	Tr.	0.1	-				
Jumping mullet	-	-	-	-	1	1.8	-	1.8	2	1.1	0.1	1.3
Summer flounder					1	1.1	-	1.1				
Spot	Tr.	Tr.	-	-	1	Tr.	-	-				
Lake chubsucker									4	0.9	0.3	1.1
Yellow bullhead	-	-	-	-					1	0.3	0.1	0.4
Flier	-	-	-	-					Tr.	Tr.	-	-
Atlantic silversides	-	-	-	-	1	Tr.	-	-				
Pirate perch	-	-	-	-	Tr.	Tr.	-	-		-		
Total-/acre	690	29.4			2291	99.0			2047	84.6		

Tr. - Less than one fish and less than 0.1 pound.

TABLE __. Results of Rotenone Samples from Station B (Cedar Island Bay) - Currituck Sound - 1959, 1960, 1961.

Area - 3.5 acres	1959				1960				1961			
Salinity	800 ppm.				650 ppm.				500 ppm.			
Species	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.
Yellow perch	143	11.3	33.1	25.2	166	9.7	31.1	21.9	90	2.7	15.9	29.0
Pumpkinseed	27	1.6	6.2	3.6	112	5.2	19.9	18.2	37	1.4	6.6	14.9
Bluespotted sunfish	111	0.4	25.8	0.8	101	0.4	17.9	1.1	159	0.2	28.0	3.4
Golden shiner	37	2.4	8.6	5.4	72	2.1	13.2	6.6	7	0.4	1.2	4.9
Largemouth bass	19	8.2	4.4	18.4	29	8.3	5.1	26.7	13	2.1	2.3	22.6
White perch	11	0.8	2.5	1.7	28	1.9	4.9	6.2	21	0.7	3.8	7.0
Fundulus sp.	4	Tr,	0.9	-	16	0.1	2.7	0.1	181	0.3	32.0	3.7
American eel					11	0.8	1.9	2.5	13	0.5	2.3	5.1
Spot	-9	0.3	2.1	0.7	8	0.2	1.4	0.5				
Bluegill	2	0.6	0.5	1.3	1	Tr.	0.1	-	33	0.1	5.7	0.6
Notropis sp.					4	Tr.	0.7	-				
Menhaden	55	2.2	12.8	4.9	4	Tr,	0.7	-	1	Tr,	0.1	-
Brown bullhead	5	2.1	101	4.9	3							
Eastern chain pickerel	1	0.5	0.2	1.1	3	0.2 0.7	0.5 0.5	[illegible]				
Redfin pickerel					2	0.1	0.2	0.1	1	Tr.	0.1	-
Summer flounder	1	1.0	0.3	2.2	1	0.8	0.1	2.4	1	0.3	0.2	3.7
Yellow bullhead	3	0.4 9.8	0.3 0.7	21.1.0	1	0.2	0.1	0.7	1	Tr,	0.1	-
Carp					1	Tr.	0.1	-				
Jumping mullet					Tr.	0.3	-	0.8				
Bowfin	1	2.9	0.3	6.6	Tr.	0.2	-	0.7	1	0.5	0.1	5.1
Needlefish	1	Tr.	0.2	-	Tr,.	Tr.	-	-	Tr.	Tr.	-	-
Atlantic silversides									7	Tr.	1.2	-
Mosquitofish									2	Tr.	0.4	-
Total/acre	431	44.7			561	31.1			568	9.2		

Tr. - Less than one fish and less than 0.1 pound.

TABLE ___. Results of Rotenone Samples from Station C (Waterlily Bay) - Currituck Sound - 1959, 1960, 1961.

Area - 2.5 acres	1959				1960				1961			
Salinity	1500 ppm.				1050 ppm.				700 ppm.			
Species	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.
Bluespotted sunfish	365	1.3	40.1	1.9	1056	5.2	48.0	7.2	552	1.6	34.4	2.0
Pumpkinseed	130	10.3	14.3	15.1	402	21.9	18.2	30.7	348	23.0	21.7	28.6
Largemouth bass	37	21.8	4.1	32.1	237	12.9	10.7	18.1	70	7.9	4.3	9.8
Yellow perch	224	22.6	24.6	33.2	231	17.4	10.4	24.4	189	14.6	11.8	18.1
Golden shiner	75	202	8.3	3.2	99	4.8	4.4	6.8	176	8.8	11.0	11.0
Brown bullhead	8	1.4	0.9	2.1	53	0.6	2.4	0.8	24	4.1	1.5	5.1
Bluegill	4	0.2	0.5	0.2	26	1.8	1.1	2.5	50	2.4	3.1	3.0
Fundulus sp.	6	Tr.	0.7	-	24	0.1	1.0	0.1	30	Tr.	1.9	-
Eastern chain pickerel	6	0.8	0.7	1.2	16	1.6	0.7	2.3	22	1.0	1.4	1.2
American eel				-	14	0.4	0.6	0.1	48	2.0	3.0	2.5
Spot	19	0.6	2.1	0.8	12	0.7	0.5	0.9	Tr.	Tr.		
White perch	11	1.0	1.2	1.4	5	1.1	0.2	1.5	40	3.2	2.5	4.0
Needlefish	5	0.1	0.5	0.1	4	0.2	0.2	0.2	1	Tr.	0.1	-
Longnose gar	1	1.9	0.8	2.8	2	Tr.	0.1	-				
Menhaden					1	Tr.	0.1	-				
Bowfin	Tr.	0.4	-	0.6	1	1.5	0.1	2.1	4	5.8	0.2	7.1
Sumner flounder	1	0.6	0.1	0.8	1	0.5	0.1	0.7	1	0.4	0.1	0.5
Yellow bullhead	2	Tr.	0.2	-	1	0.2	0.1	0.3	12	2.8	0.8	3.5
Warmouth	2	-	-	-	1	0.1	0.1	0.1	4	0.8	0.2	0.8
Atlantic silversides	10	Tr.	1.1	-	1	Tr.	0.1	-	Tr.	Tr.	-	-
White catfish					Tr.	0.1	-	-	Tr.	1.2	-	1.5
Redfin pickerel	Tr.	0.1	-	0.1	Tr.	Tr.	-	-	8	0.2	0.5	0.2
Carp	2	2.6	0.3	3.9		-			14	0.1	0.9	0.1
Pirate perch	Tr.	Tr.	-	-					5	0.1	0.3	0.1
Channel catfish									5	004	0.3	0.5
Notropis sp.	2	Tr.	0.2	-	13	Tr.	0.6	-	1	Tr.	0.1	-
Lake chubsucker									Tr.	0.2	-	0.2
Black crappie									Tr.	Tr.	-	-
Mosquitofish	1	Tr.	0.1	-	-	-	-	-	-	-	-	
Total/acre	909	68.0			2200	71.1			1604	86.8		

Tr. - Less than one fish and less than 0.1 pound.

TABLE___. Results of Rotenone Samples from Station D (Hog Quarter Creek) - Currituck Sound - 1959, 1960, 1961.

Area - 2.5 acres	1959				1960				1961			
Salinity	3250 ppm.				3150 ppm.				1100 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ A144e	Wt./ Acre	% No.	Total Wt.
Bluespotted sunfish	44	0.2	12.4	0.6	453	3.0	36.4	3.2	129	10.4 0.4	16.8 15.0	14.9 0.6
Pumpkinseed	99	4.8	28.1	12.2	242	15.6	19.5	1606				
Atlantic croaker	-	-	-	-	140	308	1102	4.0	-	-	-	-
Yellow perch	70	8.2	20.0	20.9	106	13.2	8.5	14.1	72	7.2	8.3	11.0
American eel	5				72	4.6	5.8	4.9	225	4.0	26.2	5.7
Golden shiner	24	11.0.6.1.5		290.8	44	308	3.5	4.0	21	0.5	2.5	0.7
Largemouth bass					41	13.3	3.3	14.2	18	6.1	2.1	8.7
Atlantic silversides	8	Tr.	2.2	-	29	0.1	2.3	0.1	2	Tr.	0.2	-
White perch	57	1.0	16.3	2.5	26	3.2	2.1	3.5	52	4.6	6.0	6.7
Menhaden		0.9			22	Tr.	1.7	-	4	Tr.	0.5	-
Brown bullhead	2	Tr.	0.5	2.3	16	8.0	1.3	8.6				
Fundulus sp.	9		2.5	-	13	Tr.	1.0	-	36	5.3	4.1 1.1	7.6 -
Jumping mullet	1	0.6	0.3	1.5	12	14.5	0.9	1505	14	14Tr.;	1.7	20.8
Summer flounder	4	2.6	1.1	6.5	10	7.0	0.7	7.5	4	2.1	0.5	3.0
spot	15	0.5	4.2	1.3					116	4.5	13.5	6.5
Eastern chain pickerel	3	1.0	0.8	2.5	-4	1.5	0.3	1.5	1	0.1	0.1	0.2
Channel catfish					4	1.2	0.3	1.2	6	2.0	0.7	2.9
White catfish	4	7.0	1.1	17.7				-				
Needlefish	Tr.	Tr.	-	-	-4	0.2	0.3	0.2	2	Tr.	0.2	-
Bluegill	4	Tr.	1.1	-						0.5		
Longnose gar	Tr.	Tr.	-	-	1	Tr.	0.1	-	2	6.4	0.2	0.7
Carp					Tr.	0.2	-	0.2	2		0.2	9.1
Hog choker	1	0.1	0.3	002	Tr.	Tr,	-	-	Tr.	Tr.	-	-
Yellow bullhead	1	0.5	0.2	1.3					Tr.	0.1	-	0.2
Pinfish					Tr.	Tr.	-	-	-			
Black crappie					Tr,	Tr.	-	-				
Pirate perch	-	-	-	-	Tr,	Tr.	-	-				
Bowfin	-	-	-	-					Tr.	0.3	-	0.5
Total/acre	350	3994			1239	93.2			859	69.0		

Tr. - Less than one fish and less than 0.1 pound,

TABLE ____. Results of Rotenone Samples from Station A (Knapp's Pond) - Currituck Sound - 1962 and 1963.

Area - 2.0 acres	1962				1963			
Salinity	2300 ppm.				1100 ppm.			
Species	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.	No./ Acre	Wt./ Acre	% Total No.	% Total Wt.
Bluespotted sunfish	873	2.0	60.2	404	2375	5.9	38.3	3.5
Yellow perch	257	7.8	17.7	17.3	929	19.8	15.0	11.9
Golden shiner	65	2.7	4.5	6.0	723	28.4	11.7	17.1
Pumpkinseed	77	10.9	5.3	24.1	252	12.6	4.1	7.6
Menhaden	8	Tr.	0.6	-	452	1.8	7.3	1.1
Fundulus sp.	12	Tr.	0.7	-	316	1.3	5.1	0.8
Largemouth bass	84	9.5	5.8	21.0	269	11.1	4.3	6.7
Spot	2	Tr.	0.1	-	268	4.6	4.3	2.8
American eel	2	Tr.	0.1	-	219	15.2	3.5	9.1
White perch	8	1.5	0.6	3.3	99	14.2	1.6	8.5
Atlantic silversides	12	Tr.	0.8	-	89	0.1	1.4	0.1
Bluegill	12	0.4	0.8	0.9	32	2.2	0.5	1.3
Channel catfish	1	2.1	0.1	4.6	30	11.7	0.5	7.0
Notropis sp.	15	Tr,	1.0	-	27	Tr.	0.4	-
Madtom					24	Tr.	0.4	-
Black crappie					22	1.8	0.3	1.1
Brown bullhead	2	[illegible]	[illegible]	-	15	3.0	0.2	1.8
Chain pickerel	3	1.4	0.2	3.1	12	5.5	0.2	3.3
Jumping mullet					10	Tr.	0.2	-
Gizzard shad					9	3.2	0.1	1.9
Needlefish					7	0.1	0.1	0.1
Alewife					5	Tr.	0.1	-
Carp	10	Tr.	0.7	-	4	5.5	0.1	3.3
White catfish		-			4	1.0	0.1	0.6
Bowfin	4	6.9	0.3	15.93	2	9.7	0.1	5.8
Yellow bullhead					2	0.2	0.1	0.1
Mosquitofish	2	Tr,	0.1	-				
Warmouth					1	0.1	-	0.1
Longnose gar					1	7.3	-	4.4
Total/acre	1449	45.2			6198	166.3		

Tr. - Less than one fish and less than 0.1 pound,

TABLE ____. Results of Rotenone Samples from Station C (Waterlily Bay) - Currituck Sound - 1962 and 1963.

Area - 2.5 acres	1962				1963			
Salinity	4250 ppm.				1800 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No.	Total Wt.
Pumpkinseed	599	4808	38.7	43.7	388	18.1	16.7	21.4
Bluespotted sunfish	377	1.9	24.4	1.7	886	2.6	37.2	3.1
'Yellow perch	211	20.3	13.6	18.2	348	21.6	15.0	25.6
Golden shiner	137	9.3	8.9	8.3	58	2.4	2.5	2.8
spot	55				158	3.0	6.8	3.6
Bluegill	41	8.0	3.5?26	[illegible]	36	5.6	1.5	6.6
American eel	34	1.0	2.2	0.9	54	1.6	2.3	1.9
Largemouth bass	24	11.1	1.5	9.9	153	8.6	6.6	10.2
White perch	18	2.6	1.2	2.3	27	2.1	1.2	2.5
Fundulus sp.	18	Tr.	1.2	-	75	0.2	[illegible]	
Atlantic silversides	10	Tr.	0.6	-	60	Tr.	32.6 2	0.2 -
Warmouth	6	0.4	0.4	0.4	8	1.3	0.3	1.5
Brown bullhead	3	0.6	0.2	0.5	7	0.7	0.3	0.8
Summer flounder	2	2.5	0.1	2.2				
Chain pickerel	2	0.2	0.1	0.2	10	1.2	0.4	1.4
Yellow bullhead	2	0.2	0.1	0.2	3	0.7	0.1	0.8
Bowfin	2	2.5	0.1	2.2	3	7.6	0.1	9.0
Pirate perch	1	Tr.	0.1	-	3	Tr.	0.1	
Channel catfish	1	0.6	0.1	0.5	2	6.2	0.1	7 3
Bay anchovy	1	Tr.	0.1	-				
Longnose gar	1	Tr.	0.1	-	2	0.9	0.1	1.1
Menhaden	1	Tr.	0.1	-	9	Tr.	0.4	-
Carp	1	Tr.	0.1	-				
Mosquitofish	Tr.	Tr.	-	-	2	Tr.	0.1	-
Notropis sp.	Tr.	Tr.	-	-	9	Tr.	0.4	-
Madtom					39	Tr.	1.7	-
Needlefish					3	Tr.	0.1	-
Redfin pickerel					2	Tr.	0.1	-
Flier					1	Tr.	-	-
Silver perch					Tr.	Tr.	-	-
Ladyfish					Tr.	Tr.	-	-
Total/acre	1547	111.7			2323	84.4		

Tr. - Less than one fish and less than 0.1 pound.

TABLE ___, Results of Rotenone Samples from Station B (Cedar Island Bay) - Currituck Sound - 1962 and 1963.

Area - 3.5 acres	1962				1963			
Salinity	2950 ppm.				1400 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No,	Total Wt.
Bluespotted sunfish	294	0.5	27.8	0.9	22	0.1	2.0	0.3
Yellow perch	277	12.8	26.2	23.0	473	12.9	43.7	36.8
Fundulus sp.	143	0.4	13.6	0.7	137	0.4	12.6	1.1
Pumpkinseed	120	7.0	11.4	12.6	123	5.0	11.3	14.3
Golden shiner	89	7.0	8.4	12.6	31	1.9	2.8	5.4
Largemouth bass	55	10.5	5.2	18.9	102	4.5	10.1	12.9
White perch	25	2.1	2.4	3.8	35	4.3	3.2	12.3
Atlantic silversides	12	Tr,	1.1		36	Tr.	3.3	-
Spot	8	0.3	0.8	0.5				
American eel	5			1.4	55	0.9	5.0	2.6
Bluegill	5	0.8	0.5	0.5	3	0.5	0.3	-
Jumping mullet	3	0.1	0.3	0.2	3	Tr.	0.3	-
Bowfin	3	2.5	0.3	4.5	1	0.6	0.1	1.7
Brown bullhead	3	0.5	0.3	0.9				
Chain pickerel	3	7.5	0.3	0.9				
Channel catfish	2		0.2	13.4	1	3.1	0.1	8.9
Yellow bullhead	1	0.7	0.1	1.3	1	Tr.	0.1	-
Longnose gar	1	1.7	0.1	3.0	1	0.1	0.1	0.3
Summer flounder	1	0.5	0.1	0.9	1	0.2	0.1	0.6
Notropis sp.	1	Tr.	0.1					
Menhaden	1	Tr.	0.1		2	Tr.	0.2	-
Needlefish	1	Tr,	0.1		9	Tr.	0.3	-
Alewife	1	Tr.	0.1		2	Tr.	0.2	-
Carp	Tr.	Tr.	-		8	.		
Atlantic croaker					31	Tr./0.5	2.0/7.8	1.4
Madtom	-	-	-	-	6	Tr.	0.6	-
Bay anchovy	-	-	-	-	1	Tr.	0.1	-
Mosquitofish	-	-	-	-	Tr.	Tr.	-	-
Total/acre	1054	55.7			1078	35.0		

Tr. - Less than one fish and less than 0.1 pound,

TABLE____ Results of Rot&one Samples from Station D (Hog Quarter) - Currituck Sound - 1962 and 1963.

Area - 2.5 acres	1962				1963			
Salinity	3606 ppm.				2450 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	Total Wt.	No./ Acre	Wt./ Acre	% No.	Total Wt.
Bluespotted sunfish	306	1.6	25.3	0.9	690	1.9	21.6	2.7
Spot	273	7.7	22.6	4.5	285	4.7	8.9	6.7
Pumpkinseed	271	20.0	22.4	11.8	996	11.8	31.2	16.8
Yellow perch	110	16.6	9.1	9.8	66	8.5	2.1	12.1
White perch	98	7.7	8.1	4.5	57	5.2	1.8	7.4
Golden shiner	28	2.1	2.3	1.2	22	1.2	0.7	1.7
Carp	24	82.0	2.0	48.3	23	22.0	0.7	31.2
Largemouth bass	20	10.2	1.7	6.0	406	8.9	12.7	12.6
Atlantic silversides	16	Tr.	1.3	-	186	0.4	5.8	0.6
Menhaden	13	Tr,	1.1	-	78	Tr.	0.3	-
Fundulus sp.	10	Tr,	0.8	-	296	1.5 02	2.4 9.3	0.3
Brown bullhead	10	8.7	0.8	5.1				
American eel	8	2.0	0.6	1.2	23	0.8	0.7	1.1
Summer flounder	6	3.2	0.5	1.9	5	1.7	0.2	2.4
Ladyfish	4	Tr.	0.3	-	18	0.2	0.6	0.3
Jumping mullet	2	Tr.	0.3	-	13	0.6	0.4	0.9
Chain pickerel	2	1.2	0.2	0.7	Tr.	Tr.	-	-
Channel catfish	2	0.6	0.2	0.4				
Hogchoker	2	0.2	0.2	0.1	Tr.	Tr.	-	-
Bowfin	1	2.7	0.1	1.6	1		-	.
Yellow bullhead	1	0.1	0.1	0.1	3	Tr, 0.4	0.1	06 -
Longnose gar	1	Tr.	0.1	-	Tr.	Tr.	-	-
Bay anchovy	1	Tr.	0.1	-	2	Tr.	0.1	-
Needlefish	Tr.	Tr.	-	-	9	0.1	0.3	0.1
Pinfish	Tr,	Tr,	-	-	Tr.	Tr.	-	-
Silver perch	Tr.	Tr.	-	-	1	-.		
Mosquitofish					3	Tr. 01	0.-1	0.1 -
White catfish					1	0.2	-	0.3
Cypress swamp darter					1	Tr.	-	-
Four spine stickleback	-	-	-	-	Tr.	Tr.	-	-
Total/acre	1209	169.7			3193	70.4		

Tr. - Less than one fish and less than 0.1 pound.

TABLE ___. Results of Rotenone Samples from Station E (Knott's Island) - Currituck Sound - 1962

Area - 2.0 acres	1962			
Salinity	3600 ppm.			
Species	No./ 'Acre	Wt./ Acre	% Total No.	% Total Wt.
Spot	474	12.7	24.8	5.6
White perch	390	61.6	20.4	27.4
Pumpkinseed	378	38.1	19.8	16.9
Menhaden	189	4.1	9.9	1.8
Atlantic silversides	121	Tr.	6.3	-
Yellow perch	118	12.8	6.2	5.7
American eel	30	2.4	1.6	1.1
Bluespotted sunfish	30	Tr,	1.6	-
Largemouth bass	27	10.4	1.4	4.6
Brown bullhead	23	22.8	1.2	10.1
Jumping mullet	22	15.0	1.2	6.7
White catfish	22	12.6	1.2	5.6
Alewife	12	Tr,	0.6	-
Bay anchovy	11	Tr.	0.6	-
Mosquitofish	11	Tr.	0.6	-
Channel catfish	10	4.7	0.5	2.1
Bluegill	8	1.9		
Summer flounder	7	11.9	0.4	0.8 5.3
Gizzard shad	5	2.2		1.0
Carp	4	10.7	0.3 0.2	4.8
Needlefish	4	0.5		
Striped bass	4	0.4	0.2 0.2	0.2
Fundulus sp.	4	Tr.	0.2	-
Longnose gar	2	0.2	0.1	0.1
Ladyfish	2	Tr.	0.1	-
Yellow bullhead	1	Tr.	-	-
Golden shiner	1	Tr,	-	-
Redfin pickerel	1	Tr,	-	-
Total/acre	1911	225.0		

Tr, - Less than one fish and less than 0.1 pound, TABLE____ Results of Rotenone Samples from Station F (Sander's Bay) - Currituck Sound - 1962 and 1963.

Area - 2.0 acres	1962				1963			
Salinity	4950 ppm.				2500 ppm.			
Species	No./ Acre	Wt./ Acre	% No.	% Total Wt.	No./ Acre	Wt./ Acre	% No.	% Total Wt.
Pumpkinseed	463	18.4	40.4	23.7	791	5.1	26.1	23.4
Bluespotted sunfish	240	0.8	20.9	1.0	1095	1.4	36.1	6.4
American eel	117	11.6	10.2	14.8	11	[illegible]		
White perch	65	9.0	5.7	11.6	33	2.2	1.1	0.9
Fundulus sp.	67	0.3	5.9	0.3	394	0.8	13.0	3.7
Spot	57	5.0	5.0	6.4	37	1.0	1.2	4.6
Yellow perch	49	7.9	4.3	9.4	53	4.2		
Atlantic silversides	30	0.2	2.7	0.2	89	0.1	2.9 1.7	19.3 0.5
Menhaden	17	0.2	1.5	0.2			-	-
Largemouth bass	10	11.9	0.8	15.3	191	3.7	6.3	17.0
Gobius sp.	7	Tr.	0.7	-			-	-
Carp	5	Tr.	0.5	1.0	36	0.4	1.2	1.8
Mosquitofish	4	Tr.	0.3 0.5	-	133	Tr.	4.4	-
Fourspine stickleback					5	Tr.	0.2	-
Yellow bullhead	2	Tr.	0.2	3.5		-	-	-
Needlefish	2	3.9	0.1	-	-3	Tr.	-	-
Jumping mullet	1		0.1	4.9		-	-	-
Golden shiner	1	Tr,	0.1	-	6	0.7	0.2	3.2
Bowfin	1	2.5	-	3.2				
Summer flounder	1	2.0	0.1	2.6				
Longnose gar	1	Tr.	-	-				-
Brown bullhead	1	1.3	-	1.6	150	0.8	4.9	3.7
Channel catfish					1	1.3	-	5.9
Ladyfish	1	Tr.	-	-	2	Tr.	0.1	-
Cypress swamp darter	-	-	-	-	4	Tr.	0.1	-
Total/acre	1148	77.8			3034	21.8		

Tr. - Less than one fish and less than 0.1 pound.

TABLE.____ Young of Year Per Acre From the 1959, 1960, 1961, 1962 and 1963 Rotenone Samples in Currituck Sound,

Species	Largemouth Bass						Bluegill					
Area	A	B	C	D	E	F	A	B	C	D	E	F
YEAR												
1959	16	10	14	12	*	*	2	0	2	4	*	*
1960	173	18	213	22	*	*	16	1	10	0	*	*
1961	39	10	60	5	*	*	51	33	38	0	*	*
1962	67	48	11	6	15	0.5	10	6	0	0	0	0
1963	249	97	181	396	*	186	19	1	9	0	*	0

* Area not sampled.

TABLE____. Length Frequency Distribution From the 1959, 1960 and 1961 Rotenone Samples in Currituck Sound,

pecies	Largemouth Bass												Bluegill											
Area	A			B			C			D			A			B			C			D		
Inch	Year			Year			Year			Year			Year			Year			Year			Year		
Class	59	60	61	59	60	61	59	60	61	59	60	61	59	60	61	59	60	61	59	60	61	59	60	61
1													2									1		
2	17			31			36			3			1	17	90		3	114		26	94	9		
3	15	345	78	4	62	34		532	149	26	54	12		14	12				4					
4										1			2	26					4	11	5			
5		2						1					4	31	14					17	2			
6			8						1				3	9	9	1				5	6			
7	2	15	15	4	7	2		14	4		7	8	2	3	8	1			2	6	12			
8	5	21	6	2	10	4	7	20	5	4	24	6		2	8	5					4			
9	4	12	14	6		2	11	8	2	3	7	3		3	2						1			
10	2	7	2	3	5	2	5	7	1		3	1												
11	1	2	7	3			6		7	2	2	6												
12	1	9	6	5	5	1	7	3	2	7	7	2												
13	1			3	3		5	1	2	1	3													
14		2		1	6		3	1	2		1	4												
15	1	4	1	1		1	1		2		3	2												
16	1			1	1		4	1		5		1												
17				1	1	1	3	2	1	2														
18		1					1			1	1													
19							2			1														
20					1			2			1													
21		1					1																	
22																								

TABLE ______. Length Frequency Distribution From the 1962 and 1963 Rotenone Samples in Currituck Sound,

Species	LARGEMOUTH BASS												BLUEGILL											
Area	A		B		C		D		E		F		A		B		C		D		E		F	
Inch Class	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63	Year 62	63
o-2										*			19	39	15	4		17				*		
3	134	499	167	339	22	361	15	992	31		1	371		3			4	3						
4														8			15	3						
5													4	3			13	10			5			
6		1												3		1	24	31			4			
7	6	8		1		2								3		4	21	11			3			
8	4	11		3	12	4	11	1	2		1	4	1	3		1	21	11			2			
9	15	6	4	1	7	2	10	3	4		9	1		1	1		5	5			2			
10		6	1	3		1	1	1	6		1	1												
11	2'		3		6		1	4	3			1												
12	2	1	2	4	6	7	5	8	2															
13	4	3	4	2	3	2		2				2												
14		1	3	2	1		3	2	3		1	1												
15			2	1	3	1	1	2	2		1													
16			1			1	1	1			1													
17			1			1	1				1													
18	1	2	2	1		1	1		1		2													
19									1															
20			2		1						1													
21																								

* Area not sampled in 1963.

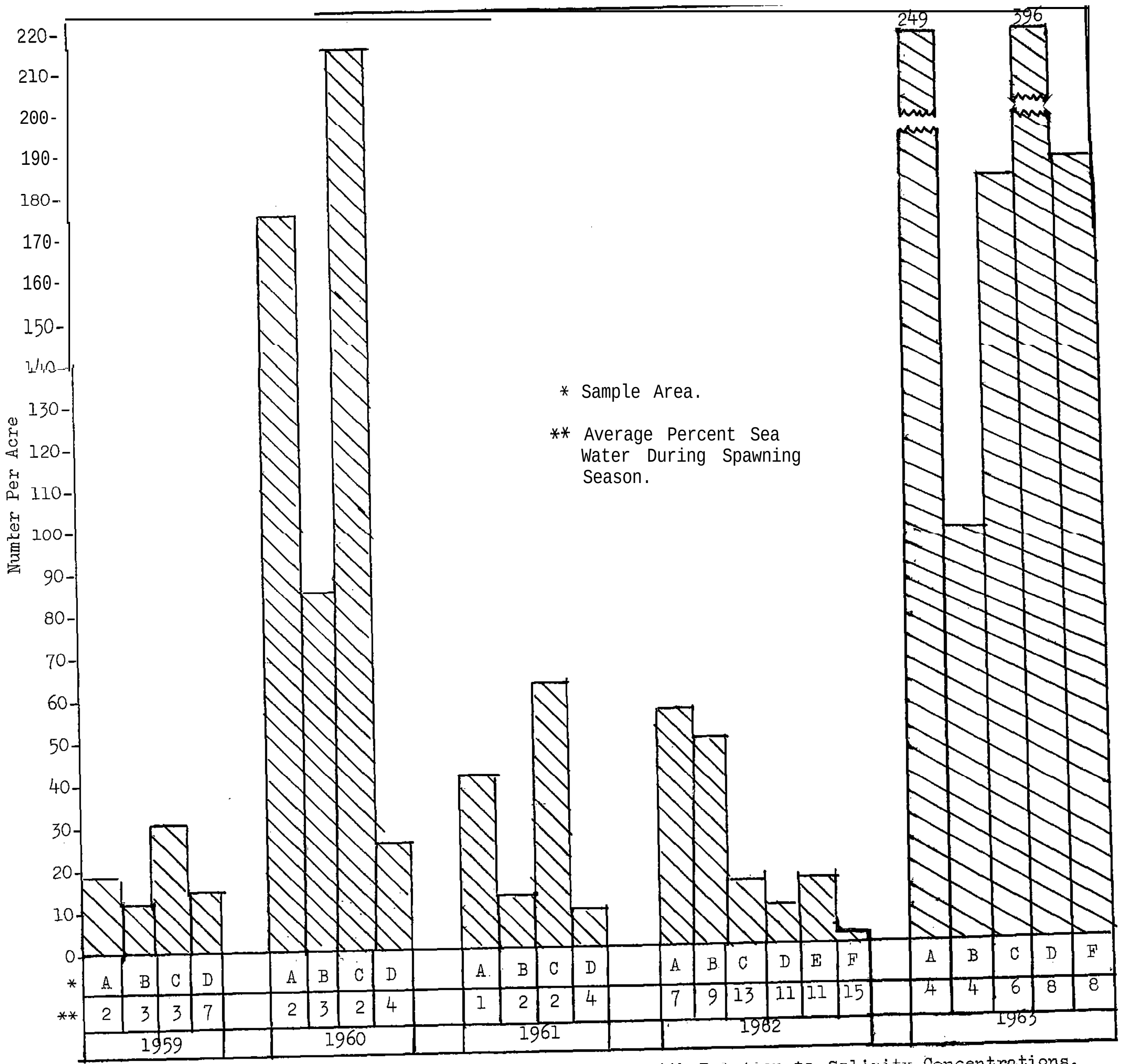


Figure-. Largemouth Bass Reproduction in Currituck Sound with Relation to Salinity Concentrations.

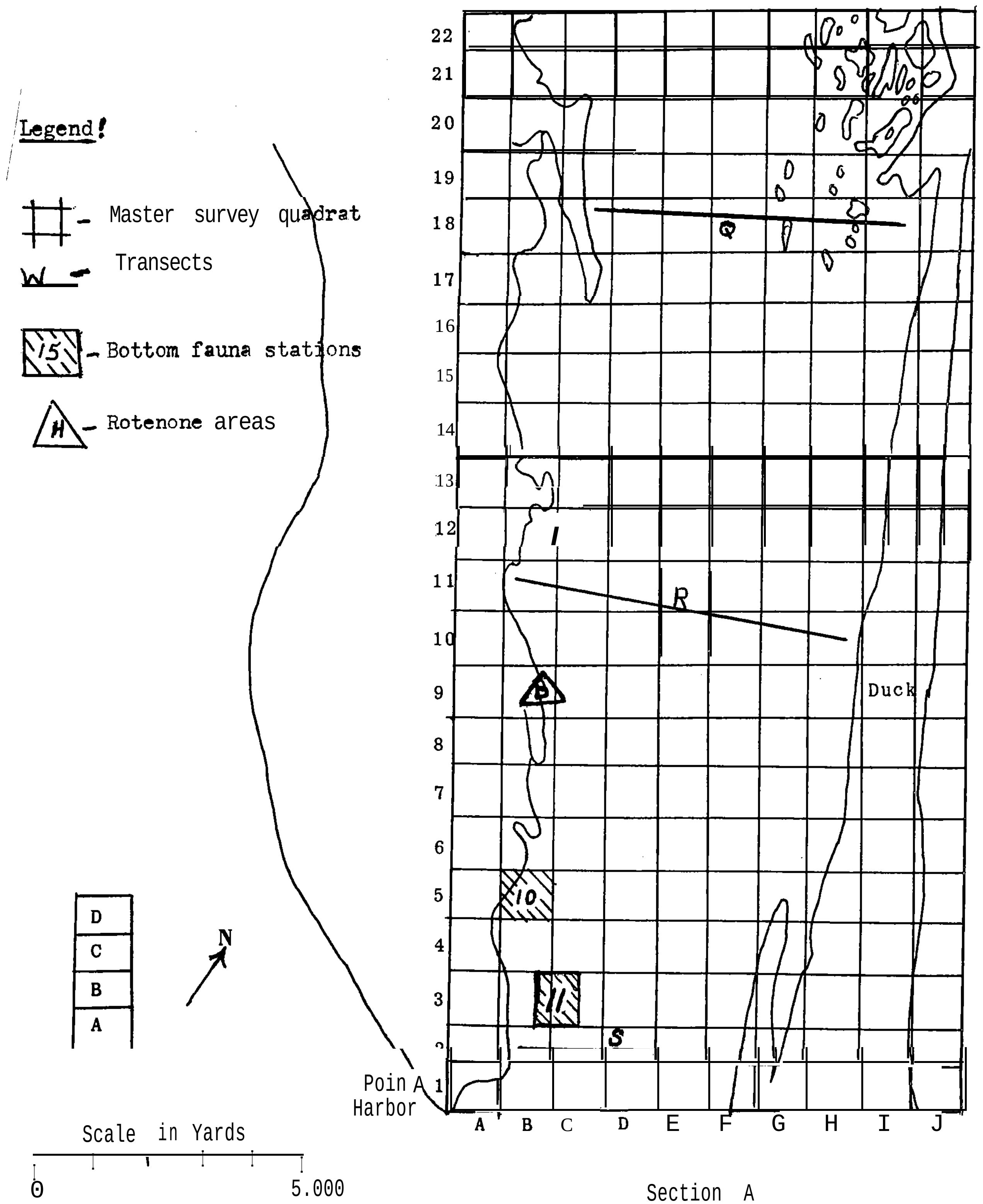
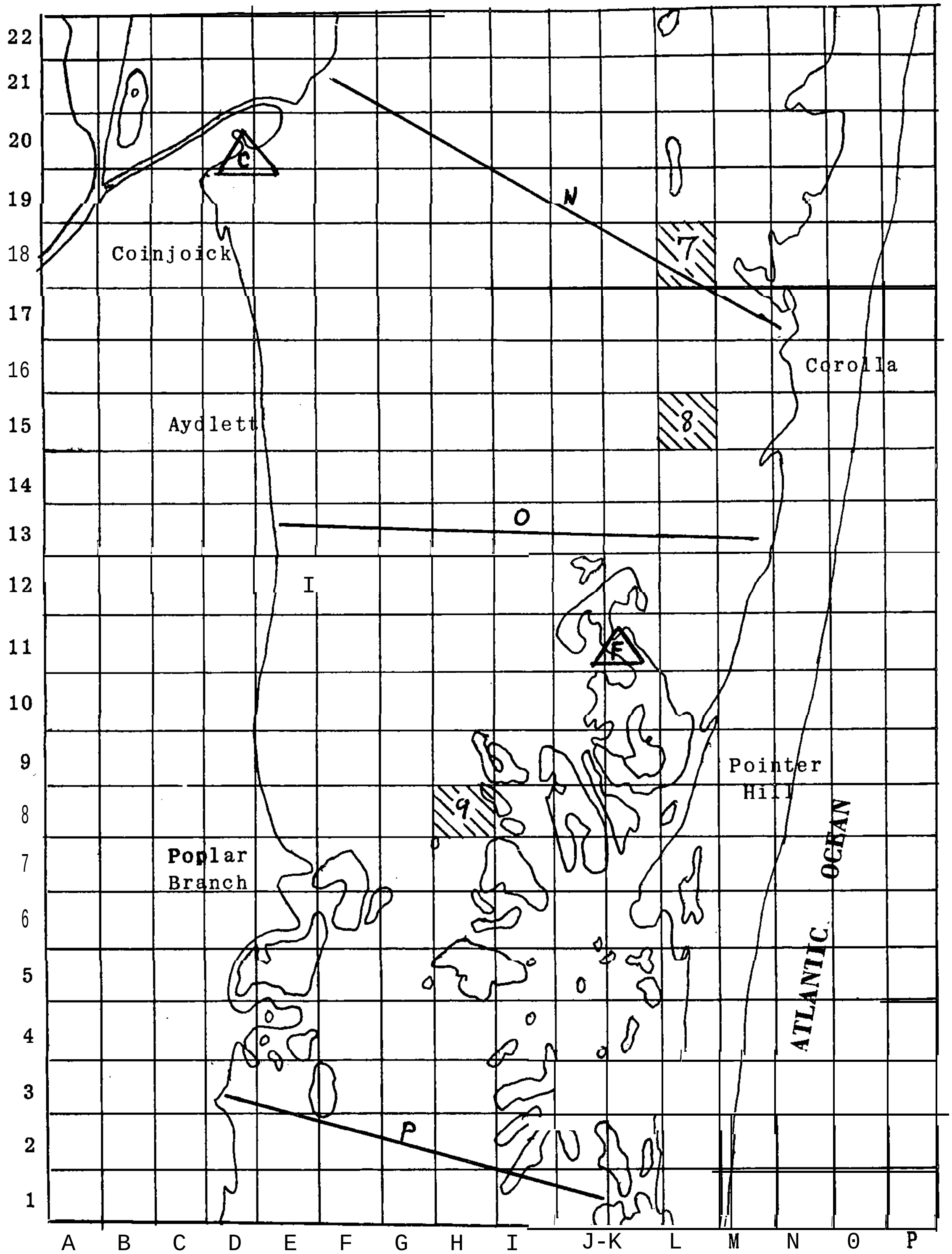
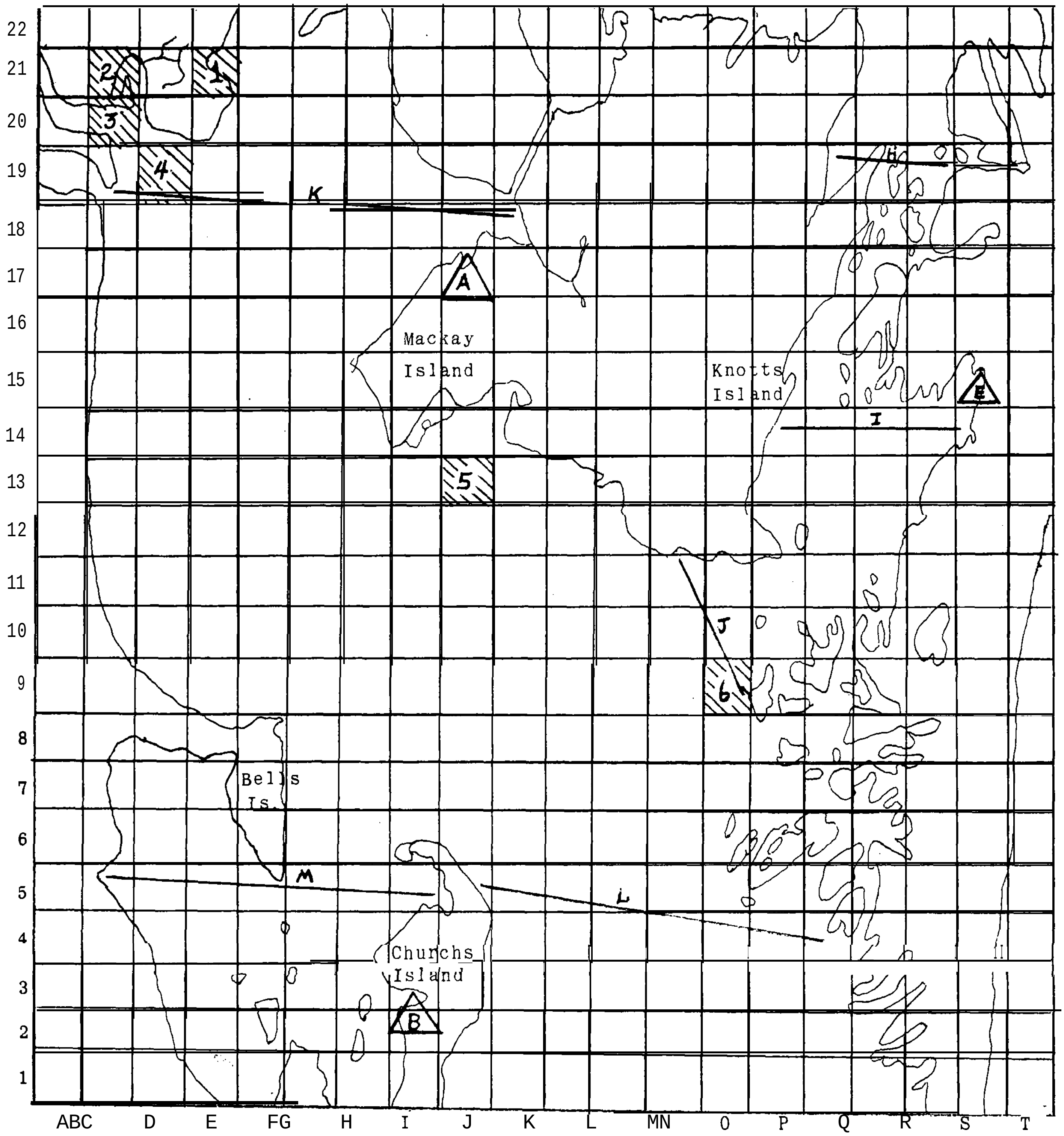


Figure ____. Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.



Section B

Figures ___. Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.



Section C

Figure ______ Location of Transects, Master Survey Quadrats, Bottom Fauna Stations and Rotenone Areas.

JOB IV-D: Trends and Status of Commercial Fishing in Currituck Sound,

In an attempt to establish the magnitude of the past and present status of the commercial fishing in Currituck Sound, commercial fishing records were obtained from the Bureau of Commercial Fisheries, U. S. Department of the Interior. Past records of commercial catches were available from 1929 to 1960,

The records indicate the volume and value of the various fish species landed or sold in Currituck County and includes those catches made outside of Currituck Sound that were landed or sold in Currituck County. There is no way to separate the outside fishery from the catches actually made in Currituck Sound or to estimate the volume of the outside catches and their influence on the evaluation of these data, Fisheries personnel who have worked in the area since 1952 feel that this outside influence was of little consequence during this period and diminished with each succeeding year. This insight on the magnitude of the outside fishery is strengthened by the absence of large quantities of several marine species, which do not frequently enter the coastal sounds, from the more recent catch data. Interviews with several older residents revealed that, in the past, several haul seines were operated in the Atlantic Ocean along the outer banks of Currituck County. The fishermen transported their catches by boat across the Sound to the mainland to be sold. No deterimentation could be obtained regarding the exact period when these seines were in operation and these haul seines were probably one of the sources of the large quantities of marine species reported in the early data.

Carp , catfish, striped bass, white perch, and eels make up the bulk of the commercial catch in Currituck Sound, Of the eighteen coastal counties in North Carolina reporting commercial catches, Currituck ranks number one in landings of carp, number four in white perch, and number five in catches of striped bass and catfish, There has been no major decline in the total pounds reported for Currituck County, with the exception of annual variations, since 1934. The price per-pound-of-fish, with the exception of a few species, has remained approximately the same or declined from the average value during the 1930's. The rise in the cost of living since the 1930's, with fishery values remaining approximately the same, has greatly decreased the tanagible value of the fishery resource in Currituck Sound, At present the commercial fishermen can be expected to harvest from 250,000 to 600,000 pounds of fish annually with a value of $20,000 to $30,000.

CONCLUSIONS

1. Carp, catfish, striped bass, white perch, and eels make up the bulk of the commercial fisheryin Currituck Sound.
2. There has been no major decline in the total pounds of fish taken by commercial fishermen in Currituck Sound, with the exception of annual variations, since 1934.
3. The price per-pound-of-fish, with the exception of a few species, has remained approximately the same or declined from the price during the 1930's.

TABLE.____ Commercial Catch Reported for Currituck County, North Carolina, 1929 to 1960*; Obtained From The Bureau of Commercial Fisheries, U. S. Department of Interior.

	1929		1930		1931		1934		1936	
Species	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Alewife	23,200	$ 561	16,900	$ 418	28,800	$ 56	2,000	$ 40	18,300	$ 259
Largemouth bass	81,600	11,969	89,213	12,965	55,872	5,586	1,500	75		
Bluefish	2,420	242	4,500	225	20,000	400	300	15	2,000	180
Bonito	400	20	1,000	30					-	
Bowfin	20,792	309	13,980	463	6,350	63	600	6	4,600	46
Carp					1-87,400	13,930	80,000	3,760	257,500	6,565
Catfish	464,39Q398	34,480	165,572	26,518 6,979	97,200	1,944	29,000	580	47,700	944
Crappie	112,330	70						-		
Croaker	77,770	2,858	65,000	1,300	27,500	275	7,200	72	39000	-30
Drum	1,500	75	1,000	40						
Eel	39,881	2,866	52,110	3,769	64,000	3,540	38,400	1,539	42,900	2,618
Flounder	10,224	660	13,250	947	10,000	400	4,400	198	3,000	150
Gizzard shad	10,640	J-38	11,991	210	14,600	146	12,000	110	30,500	305
Hickory shad	3,520	176	3,000	175	3,100	93			200	6
King whiting	61,800	3,172	7,500	375	28,000	840	7,000	280	4,200	105
Mullet	10,325	516	2,800	196	1,400	56	1,000	30	2,000	60
Pickerel	14,814	1,696	7,820	868	4,900	392	400	30	500	15
Shad, American	21,407	4,180	22,800	3,839	12,200	1,830	31,300	59345	42,000	6,720
Spanish mackerel	260	40	850	85	250	20	100	5		
spot	256,880	11,744	16,000	330	11,000	165	15,000	300	3,000	-60
Sea trout	46,313	4,179	36,000	2,600	27,000	1,145	12,000	890	11,000	450
Striped bass	30,591	5,785	61,822	11,999	56,760	6,621	47,500	4,750	34,900	3,435
Sunfish	28,827	425	7,597	158	7,200	144	100	1		
White perch	102,678	5,689	202,448	11,590	156,300	49739	92,700	3,608	55,300	2,675
Yellow perch	66,490	4,208	57,350	3,132	56,400	2,800	2,000	82	16,100	805
Total	1,490,600	$99,891	,213,192	$89,212	350,232	$45,185	384,500	$21,716	576,700	$25,716

*Years not listed during the period not available due to data not separated by counties.

TABLE____.(Contd.) Commercial Catch Reported for Currituck County, North Carolina, 1929-1960*; Obtained From the Bureau of Commercial Fisheries, U. S. Department of Interior,

Species	1937 Pounds	1937 Value	1938 Pounds	1938 Value	1945 Pounds	1945 Value	1950 Pounds	1950 Value	1955 Pounds	1955 Value
Alewife	6,200	$ 94	5,000	$ 56	21,500	$ 472	6,500	$ 130	15,000	$ 300
Bluefish					6,000	720	38,900	5,835		
Bowfin	1,100	11	1,000	10		-	14,800	296	5,000	300
Carp	111,800	2,236	84,800	1,406	150,000	4,500	336,900	20,214	232,600	11,630
Catfish	25,800	878	34,900	957	104,000	5,200	156,800	12,544	59,300	3,558
Croaker	2,200	33	3,000	47	75,000	6,000	53,600	3,680		
Drum		-			16,000	510			-	
Eel	64,200	1,664	80,000	2,275	61,000	3,050	1,200	36	9,400	-940
Flounder	2,100	105	2,300	115	6,000	520	8,700	1,305	3,200	384
Gizzard shad	23,000	230	27,100	271	8,000	160				
Hickory shad	500	15	300	10	17,000	1,360	54,700	2,635	5,100	255
King whiting	8,000	160	12,500	375	15,000	750	18,000	1,980	800	64
Mullet	1,100	33			2,000	160	15,500	2,325	12,900	1,290
Pickerel		-				-	4,100	867	1,000	120
Shad, American	24,800	3,835	25,700	4,112	25,000	4,400	23,300	7,456	5,000	1,250
Spot					10,000	500	46,000	1,980	200	20
Sea trout	2,200	78		-	20,000	3,200	21,400	6,287	200	60
Striped bass	83,500	8,532	96,600	9,660	64,000	12,900	162,100	26,120	62,500	9,375
Sunfish							12,300	369	2,500	75
White perch	48,900	1,920	40,000	1,610	70,000	8,400	268,700	26,870	101,900	8,152
Yellow perch	3,400	136	4,500	180	5,000	600	29,400	2,940	12,600	756
Total	408,800	$19,960	$410,700	0 8 4	676,000	$54,502	1,272,900	$122,879	529,200	$38,529

*Years not listed during the period not available due to data not separated by counties.

TABLE____.(Contd.) Commercial Catch Reported for Currituck County9 North Carolina9 1929 to 1960*; Obtained From the Bureau of Commercial Fisheries9 U. S. Department of Interior,

	1956		1957		1958		1959		1960	
Species	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Alewife	9,057	$ 91	1 6 ,	1 2 3	336,627	$39366	36,800	$ 368	12,000	$ 120
Bluefish	-	-	2,567	282	17	2			-	-
Bowfin	-	-	344	10	143,440	8			-	-
Carp	124,731	3,742	70,414	5,112	37,136	4,303	246,000	7,380	-039700	3,111
Catfish	25,834	2,067	42,252	3,380	[illegible]	2,971	114,000	9,120	55,200	49416
Croaker	130	8	656		8,328	666			-	-
Eel	3,516	155		47		596	23,200	-928	10,600	424
Flounder	29121	233	6,421	309	17,181	16			-	-
Hickory shad			411	24	40		-	-	-	-
King whiting	-		19154	103	3,678	33:			-	-
Mullet	6,684	-535	12,406	868	11,023	772	-	-	2,500	200
Sea trout	2,847	674	6,541	19559	524	29			-	-
Shad, American	5,361	1,340	3,092	876	1,561	400	500	125	800	200
Spot	12,473	873	349185	2,393	6,139	435				
Striped bass	23,436	3,750	16,885	2,533	22,387	4,029	19,852	39573	31,900	5,104
White perch	45,685	3,705	29,324	2,932	379756	3,776	47,800	4,302	42,700	4,270
Yellow perch	5,101	306	5,291	264	-	-	379600	2,632	12,600	756
Total	267,021	$17,479	348,251	$20,904	626,808	$21,702	522,782	$ 4 2 8	~72,000	$18,601

* Years not listed during the period not available due to data not separated by counties.

Job V E: Bioassays of the Toxic Saline Levels of Largemouth Bass and Bluegills (North Carolina).

To obtain a full understanding of the cause of the reduction in waterfowl populations in the Back Bay-Currituck Sound area, a determination of the adequacy, in terms of quantity and quality, of the aquatic food plants of the two areas was of primary importance.. Many sportsmen were of the opinion that a shortage of suitable food plants existed, and that this shortage was responsible for the reported decline in waterfowl populations.

Many sportsmen also felt that the introduction of salt water would enhance the production of waterfowl food plants. Information in the literature, and preliminary tank studies indicated that salt water might increase the production of certain plants indigenous to the area.

Therefore, early in the course of the cooperative studies, it became apparent that consideration must be given to the possibility of salt-water introduction for the purpose of improving the habitat for the production of desirable food plants. The implications of salt-water introductions for the very important fresh-water fishery for largemouth bass were obvious. The level of salinity which could be tolerated by the largemouth black bass at various stages in its life cycle was not known; however, in practical pollution work any effluent with an osmotic pressure above six atmospheres (salinity of approximately 7,000 ppm) is considered lethal to fresh-water fish (California Water Pollution Control Board, 1952; Young, 1923). This very general observation could hardly serve as a guide to the introduction of sea water into areas with fresh-water fisheries as important as those found in Back Bay and Currituck Sound.

The purpose of the studies reported here was to determine, using laboratory bioassay methods, the concentrations of sea water which are lethal to the eggs, fry and fingerlings of largemouth black bass and bluegill.

PROCEDURES

The bioassay studies were conducted at the warm-water fish hatchery of the North Carolina Wildlife Resources Commission located adjacent to highway 401, approximately 10 miles west of Fayetteville, North Carolina,

All experiments were conducted with ocean water hauled from the Carolina coast and diluted to the desired test concentration with well water from the tap at the hatchery. Depending on tide conditions and the point of collection, different loads of ocean water varied from approximately 90 percent to over 100 percent sea water. Calculations of percent sea water are based on a chlorinity of 19,538 ppm which is an average value for waters from the Atlantic Ocean (Olson, 1934).

Tap water at the hatchery is pumped from a shallow well, and, on October 4, 1961, had a pH of approximately 7.5, carbon dioxide content of 6.0 ppm, and a methyl orange alkalinity of 50 ppm. The tap water was analyzed with a Bausch and Lomb "Spectronic 20" colorimeter and had the following composition. All figures are in ppm.

Ammonia Nitrogen	0.08	Iron	0.08
Nitrate and Nitrite	0.24	Manganese	0.06
Ortho Phosphate	0.01	Silica	10.5
Meta Phosphate	0.20	Chromate	0.15
Copper	0.08	Sulfate	20.0
Fluoride	0.12		

All bioassays were conducted in an air-conditioned room where the air temperature was maintained at approximately 70° Fahrenheit. Water temperature in the test media was checked periodically and varied between 70° and 72° Fahrenheit.

Ten-gallon polyethylene open top containers were drilled at the base to receive a three-way hose connector to which two lengths of rubber tubing were attached. A short length of glass tube was inserted in the outer end of each rubber tubing and these glass tubes were inserted, through two-hole stoppers, into two 500 ml Erlenmeyer flasks which were suspended several feet below the polyethylene containers, The test solution was forced, by gravity flow, through the Erlenmeyer flasks containing the test specimens and the overflow was taken, by means of an additional length of tubing inserted in the other side of the two-hole stopper, to large battery jars on the floor of the laboratory. When a battery jar filled, the test solution was manually poured back into the polyethylene containers to repeat the cycle. Screw clamps were placed on the rubber tubing between the plastic baskets and the Erlenmeyer flasks, and the flow was maintained at approximately 12 to 15 ml per minute.

As pointed out by Prevost, 'et al (1958), the volume of solution per fish may affect the results of bioassay determinations. In the present experiments the volume ranged from approximately 3 to 5 pints per fish which, considering the small size of fingerlings used in the tests, is believed to be more than adequate.

Dissolved oxygen was determined by the unmodified Winkler method, and pH with a Taylor pH comparator. Chlorinity was determined by the Mohr method, as outlined in the Eleventh Edition of Standard Methods for the Examination of Water and Waste-water.

Dissolved oxygen, measured before, during and at the termination of all experiments, was never below 6.0 ppm and usually approached saturation. The pH of the test solutions varied from 7.5 to 8.1 with the higher pH in the more saline solutions. There was no discernible change in pH during the course of the experiments.

Fingerling bass and bluegill were obtained from ponds at the Fayetteville hatchery and were held in shallow sorting troughs in the hatchery building for a period of 24 to 48 hours before being used for experimentation.

Eggs and sperm for the hatching experiments were obtained from adult hatchery brood stock bass and bluegill. The brood stock were held in shallow concrete out-door pools until the eggs were mature. To induce ovulation in fish with mature eggs the females were injected with 1,000 units of chorionic gonadotrophin. The method used for injection of the hormone is described by Neal (1961). If the injected females could not be hand-stripped within 24 to 48 hours they were given a second injection of 1,000 units of hormone.

The eggs and sperm were stripped directly into beakers or Erlenmeyer flasks containing the concentration of sea water being tested. Thus, fertilization, incubation, and hatching took place in the test solutions.

RESULTS

Largemouth bass

Eggs:

Two 16-17 inch female largemouth bass brood fish were injected with hormone at a water temperature of 64" Fahrenheit and were held in the concrete out-door pools. At the end of 24 hours, eggs were easily stripped fromoneof these females and both eggs and sperm were stripped into beakers containing 40 ml of test solution. Within a few minutes the eggs were transferred to Erlenmeyer flasks which were included in the recirculating system described previously. Tests were run in duplicate at concentrations of 0, 5, 10, 15, 20 and 30 percent sea water. Hatching was complete within 48 hours from the time of fertilization, and after 168 hours from fertilization the yolk sac was absorbed and all fry were free-swimming.

None of the eggs held in 30 percent sea water hatched, and within 48 hours the yolk had deteriorated in most of them.

In the 20 percent sea water, by the end of 72 hours many of the sac fry were deformed and poorly developed. All of these fry were dead at the end of 236 hours.

At the end of 236 hours, there were 8 live fry left in the 15 percent sea water solution, These fry were poorly developed and appeared to be very weak. All fry in the 15 percent sea water were dead when the experiment was terminated at the end of 287 hours,

At the termination of the experiment (287 hours), in both the controls and the 5 percent sea water, there were 51 percent of the eggs surviving as fry (Table 1)。 In the 10 percent sea water, survival to the end of the experiment was only 24 percent, or approximately one-half the survival in the 5 percent and control solutions.

The high mortality in the 10 percent sea water occurred during the egg stage and survival of the hatched fry was very high (Table 1). The percent of eggs hatching in the 10 percent sea water was actually lower than the percent hatch in the 20 percent sea water, and was about equal to the hatch in the 15 percent sea water. The inconsistency in the hatching of eggs, as contrasted with the survival of hatched fry, in the different concentrations of sea water suggest that a factor other than sea water concentration (such as mechanical injury or poor fertilization) may have had an effect during the egg stage,,

In this experiment concentrations of sea water up to 20 percent did not prevent the successful fertilization and hatching of largemouth bass eggs. However, at concentrations of 15 percent sea water and above, many of the hatched fry were weak and deformed and were not capable of surviving. Therefore, it appears that the maximum concentration of sea water at which successful development of eggs and fry of largemouth bass can take place lies somewhere between 10 and 15 percent sea water.

Table 1. --Survival of eggs and fry of largemouth bass in different concentrations of sea water

	Concentration (Percen sea water)											
	0		5		10		15		20		30	
Number of eggs	72	84	49	57	58	49	71	85	67	60	123	95
Number hatched	46	47	33	29	15	13	16	22	24	37	0	0
Percent hatched	64	56	67	51	26	26	22	26	36	61	0	0
Percent surviving at end (287 hours)	56	46	55	47	24	24	0	0	0	0	0	0

Fingerlings:

To obtain an approximation of the salinity level which could be tolerated, the first test with bass fingerlings was run at a wide range of salinities. Using the graphical interpolation method of Doudoroff, et al (1951), the 96-hour TL_m was 38 percent sea water (Table 2).

In a second experiment, using a narrower range of salinities, the flasks were left unattended over night and the flow stopped in the controls and **33** percent solutions, and all fish died, The 70-hour TL_m for this experiment, in which the fish were somewhat smaller than those used in the first experiment, was **33** percent sea water (Table **3)**.

In the first two experiments, it appeared that there might be a difference in the reaction on the basis of size of the fish. Accordingly, additional experiments were run in two-gallon aquaria using different sizes of fish, The 96-hour TL_m for fingerlings **12-16** mm in total length was 31 percent sea water and for fingerlings 23-27 mm in total length was **35** percent sea water (Table 4).

The median tolerance limit at the end of **96** hours for largemouth bass fingerlings ranging in total length from 12 to 4.2 mm was from 31 percent sea water to 38 percent sea water, Within the range of size of fingerlings used in these experiments it appears that the smaller fish are less tolerant of salt water than are the larger fish,

Bluegill

Eggs:

Bluegill eggs were fertilized in six experiments conducted in duplicate at concentrations ranging from zero to 19 percent sea water. A good hatch was obtained in all flasks, and at the concentrations used there appeared to be no relationship between the concentration of sea water and the success of hatching.

When hatching was complete, all but **50** fry were removed from each flask and observations continued for eleven days **(264** hours). As determined by the

Table 2. --Survival of largemouth bass fingerlings in different concentrations of sea water. Experiment conducted in closed recirculating system

Concentration (as percent sea water)	Number of fish	Range in length of fish (mm)	Volume of solution per fish (pints)	Percent survival after 24 Hours	48 Hours	72 Hours	96 Hours
Control	12	35-42	5	92	83	83	75
9	12	36-42	5	100	100	100	100
19	12	34-41	5	100	100	100	100
28	12	35-42	5	100	100	100	100
34	12	35-41	5	100	100	92	92
42	12	34-42	5	100	67	8	0
69	12	34-42	5	0	0	0	0

96-Hour TL_m = 38% sea water

Table 3. --Survival -of largemouth bass fingerlings in different concentrations of sea water. Experiment conducted in closed recirculating system

Concentration (as percent sea'water)	Number of fish	Range in length of fish (mm)	Volume of solution per fish (pints)	pH °	Temperature Fahrenheit	Dissolved oxygen (ppm)	Percent survival after		
							24 Hours	48 Hours	70 Hours
Control	12	23-28	5	7.7	72	7.4	92	92	92
3208	12	22-27	5	8.0	72	7.2	100	50	50
35.8	12	22-27	5	8.0	72	7.2	100	50	33
39.2	12	22-27	5	8.0	72	7.2	100	17	8
43.0	12	22-26	5	8.1	72	7.1	0	0	0
46.6	12	23-28	5	8.1	72	7.0	0	0	0
65.8	12	23-25	5		72		0	0	0
70-Hour TL_m = 33%									

Table 4. --Median tolerance limits -i-n percent sea water of different size range largemouth bass fingerlings, Experiment conducted in 2 gallon battery- jars

Number of fish per container 10
Volume of solutioq per fish 1.6 pints
pH range 7.5 - 801

Size range of fish (mm)	48-hour TL_m	72-hour TL_m	96-hour TL_m
12-16	36	34	31
23-27	36	34	35

graphical interpolation method of Doudoroff, et al, the ll-day TL_m for the bluegill fry was 13 percent sea water (Table 5). This is within the range of tolerance found for the eggs and fry of largemouth bass.

Fingerlings:

Ten bluegill fingerlings were placed in control flasks and in flasks supplied with 17, 26, 34, 42 and 52 percent sea water. Duplicate flasks were set up at each concentration. The 96-hour TL_m, as determined by graphical interpolation, was 29 percent sea water (Table 6).

In an additional experiment over a narrower range of salinities, the 96-hour TL_m was 30 percent sea water (Table 7).

DISCUSSION

On the basis of the present bioassay studies, it appears that approximately 10 to 12 percent sea water is the maximum concentration at which bass and bluegill can successfully reproduce, Fingerling fish of these same species can survive, at least for short periods, in concentrations of from 29 to 38 percent sea water.

In connection with stream survey work on the downstream sections of the Neuse River in North Carolina, information was obtained on the distribution of various species of fish in relation to the salinity, Eighteen stations having concentrations ranging from 0 to 35 percent sea water were sampled. Sampling was with emulsified rotenone and, although not quantitative, an attempt was made to obtain representatives of all species present in the area sampled. In the family Centrarchidae, nine of twelve species were found only below 10 percent sea water. Bluegill were found at concentrations ranging from 0 to 10 percent sea water. Bass were present in areas having a range in concentration of from 0 to 29 percent sea water. The frequency of occurrence of largemouth bass dropped sharply above 10 percent sea water; and above 15 percent sea water they were rarely found in the

Table 5. --Survival of eggs and fry of bluegill in different concentrations of sea water

Concentration (as percent sea water)	Volume of solution	pH	Number of fry	Percent surviving at end of			
				5 days	7 days	9 days	11 days
Control	8 gallons	7.9	100	100	100	100	100
4	8 gallons	7.9	100	100	99	99	99
7	8 gallons	8.0	100	100	100	99	99
11	8 gallons	8.0	100	100	100	99	99
15	8 gallons	8.0	100	98	25	1	0
19	8 gallons	8.0	100	95	15	0	0

11-day TL_m = 13%

Table 6. --Survival of bluegill fingerlings in different concentrations of sea water, Experiment conducted in closed recirculating system

Concentration (as percent sea water)	Number of fish	Volume of solution per fish (pints)	Range in length (mm)	pH	Percent survival after			
					24 Hours	48 Hours	72 Hours	96 Hours
Control	20	3.2	15-20	7.9	100	100	100	100
17	20	3.2	14-19	7.9	100	100	100	100
26	20	3.2	14-20	7.9	100	90	85	85
34	20	3.2	15-20	7.9	100	5	0	0
42	20	3.2	14-20	7.9	25	0	0	0
52	20	3.2	15-21	8.0	0	0	0	0
67	20	3.2	15-21	8.0	0	0	0	0

96-Hour TL_m = 29% sea water

Table 7. --Survival of bluegill fingerlingsin different concentrations of sea water, Experiment conducted in closed recirculating system

Concentration (as percent sea water)	Number of fish	Volume of solution per fish (pints)	Range in length (mm)	pH	Percent survival after			
					24 Hours	48 Hours	72 Hours	96 'Hours
Control	20	3.2	17-25	7.5	100	100	100	100
23.2	20	3.2	17-25	7.8	100	100	95	65
25.8	20	3.2	17-25	7.8	100	100	60	60
28.1	20	3.2	17-25	7.8	100	100	65	65
30.6	20	3.2	17-25	7.9	100	65	50	45
34.0	20	3.2	17-25	7.9	100	55	25	15
54.0	20	3.2	17-25	8.0	0	0	0	0
67.0	20	3.2	17-25	8.0	0	0	0	0
96-Hour TL_m = 30.0%								

samples. Brackish water species such as white perch, tidewater silversides, and rainwater killifish most frequently occurred in samples where the sea water concentration ranged from 10 to 30 percent.

On the basis of these distributional data, it appears that both bass and bluegill prefer habitat having a concentration of less than 10 percent sea water. This coincides rather closely with what we might surmise from the bioassay data. The occasional occurrence of largemouth bass in concentrations greater than 10 percent sea water is probably the result of foraging excursions by the largemouth into areas where salt water forage species (menhaden and alewife) are abundant.

Bioassay procedures for the determination of the toxicity of substances to aquatic life are fairly well standardized (Doudoroff, et al, 1951), and with proper care are reasonably simple to carry out. Major difficulties arise, however, in the interpretation of bioassay results for purposes of predicting what will occur under natural conditions.

Obviously, the level of an environmental factor at which a species can survive is not necessarily a measure of the level at which an optimum population can be maintained, In the present case we are dealing with a black bass fishery of considerable importance to the sportsmen, of North Carolina, Virginia, and neighboring states, and which additionally provides a major source of income for residents of the counties bordering the Currituck Sound-Back Bay area. Therefore, we are not interested in merely sub-lethal conditions but only in those conditions which are optimum. On the basis of creel census data reported in another section, it would appear that optimum conditions for the sport fishery may be'prevailing in Currituck Sound at the present time. Without a doubt, the sport fishery for black bass in Currituck Sound and Back Bay is presently one of the best in North America.

Because of the recreational and economic importance of the black bass fishery, and its present level of excellence, there are dangers inherent in any manipulation of the present environment, Salt water introduction should be considered only in the light of concrete evidence that: (1) Waterfowl food plants are a limiting factor in the abundance of waterfowl in the area and (2) that salt water introductions will actually result in a higher production of desirable food plants. Field and bioassay studies, presently available for the fishery, definitely preclude consideration of any sea water-introduction which would result in concentrations of sea water in excess of ten percent.

References Cited

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JOB IV-C: Survey of the Distribution and Relative Abundance of Macroscopic Bottom Fauna.

A bottom sampling program was instituted in March, 1961 to inventory the existing macroscopic bottom fauna in relation to bottom types and prevailing salinities. The sampling stations were selected with the use of soil classification maps derived from the bottom sediments obtained during the 1960 master survey. Following the March 7,1962 storm, the study was conducted again to determine the effects of the sea-water introduction on the distribution and species composition of the macroscopic bottom fauna. The soil classifications were based upon particle size and organic matter as determined by the U. S. Soil Conservation Service, Plant Industry Station, at Beltsville, Maryland.

The identification criteria for each soil classification:

1. Loam - Loam soils contain 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand, Moderate cohesion of soil particles; sand can be detected when soil is worked between fingers.

2. Silt - Particle sizes range in diameter between the upper size of clay, (0.002 mm.), and the lower size of very fine sand (0.05 mm.), A silt soil contains 80 percent or more of silt and less than 12 percent of clay. Silt is a fine, light soil without the cohesion characteristics of clay and without detachable sand,

3. Sand - Particle size of 0.5 mm, to 2.0 mm. A sand soil contains 85 percent coarse particles and not more than 10 percent of clay. Coarse particle size is apparent by touch and sight, Virtually no cohesion of particles and relatively heavy soil can be obtained.

4. Clay - Particle size less than 0.002 mm. in diameter. As a soil textural class, clay contains 40 percent or more of clay, less than 45 percent of sand, and less than 40 percent of silt. This soil has great cohesion of

particles, a greasy feeling when rubbed between fingers, and it is easily recognized by blue-grey coloration. In addition, it forms a characteristic cloud when suspended in water,

5. Muck - A highly decomposed organic soil which contains plant remains not identifiable. This soil resembles a loam soil but may be differentiated by the lighter weight, dark brown coloration, and moderate cohesion,

6. Peat - Unconsolidated soil material consisting largely of undecomposed, or only slightly decomposed, organic matter. Over 50 percent undecomposed organic matter present.

Stations were established randomly in areas of the above soil types--the exact locations are shown in Figures __, __, and __. Three stations were selected in silt soil, three in sand soil, two in loam soil, and one each in clay, peat, and muck soils (Table __). All samples at each station were collected within a thousand-yard-square from an unanchored boat to avoid resampling the same area, Three one-quarter-square-foot samples were taken at each station at monthly intervals with an Ekman dredge attached to a ten foot wooden handle calibrated for depth,

Each sample was washed in a 30-mesh screen at the time of collection to remove the soil. The material remaining in the screen was put in a labeled container and, when time did not permit immediate sorting, the material was preserved in 70 percent alcohol, All organisms were identified as to species whenever possible, measured, and counted. Displacement volume also was determined in a graduated centrifuge tube.

The results of the bottom fauna study were projected to obtain an estimate of the total volume of bottom organisms in Currituck Sound. The projections were made using the soil type distributions obtained during the 1960 master survey study,

RESULTS AND DISCUSSION

Prior to the introduction of sea water into Currituck Sound, the groups of macrobenthos in order of abundance were Crustacea, Diptera, Polychaetes, Oligochaetes, Mollusca, Odonata, Ephemeroptera, and Trichoptera (Table __ and Figure __). The average number of organisms per-square-foot was 89.1 with an average volume per-square-foot of **0.49** ml. (Table __). After the introduction of sea water, the groups in order of occurrence were Crustacea, Diptera, Molldsca, Polychaetes, Oligochaetes, Odonata, Ephemeroptera, and Trichoptera (Tables __, __, and __). The average number increased to 171.2 per-square-foot, with an average volume of **0.69** ml. per-square-foot (Table __). This increase was in total number of organisms and did not significantly alter the species composition. The silt and sand soil which produced the largest number of organisms prior to the intrusion of sea water continued producing large numbers of organisms after sea-water intrusion. In connection with the above soil types, the vegetated areas also continued to produce the greater numbers of organisms with the non-vegetated areas still producing fewer organisms per-square-foot.

Crustacea:

Numerically and volumetrically the Crustaceans are the most dominant group of organisms, Five orders and fourteen species have been identified with Amphipoda and Isopoda being the most common, The data indicated that Crustaceans are more numerous in vegetated areas over a sand and silt substrate, The lowest occurrence of this group was associated with muck soil. The increased salinity caused by the March 7, **1962** storm brought about an increase in the total number of Crustaceans but did not change the over-all composition (Table __). Higher salinities seem to be beneficial to the growth and distribution of the Crustaceans. The most probable reason for this being the fact the Crustaceans present in the sound are predominantly brackish-water forms.

This group undoubtedly makes up a large portion of the available fish food in Currituck Sound. During both high and low periods of salinity the higher number of Crustacea are recorded in the winter months and the smallest amount during the spring.

Diptera:

These small organisms were very abundant under pre-storm conditions, appearing in 93 percent of the samples from all stations (Table __). Biologically some of this group have successfully invaded a brackish-water habitat from fresh water. Two species in particular appear to withstand higher salinities than any other. They were Procladius sp. and Cryptochironomus sp. In the northern stations where low salinities prevail, there was a greater variety of species present.

Under post-storm conditions, when increased salinities were encountered, the only group of macrobenthos that decreased to a noticable extent were the Diptera. As the salinities returned to normal, however, the Diptera began to return to normal, appearing in **89** percent of the samples from all stations. The total number of species found decreased at the norhtern stations where previously the greatest variety of specie:: were found.

Polychaetes:

These organisms are chiefly marine and brackish-water species. The polychaetes as a group seem to prefer silty soil and high salinity. The variation in numbers was so erratic between samples that seasonal distributions could not be established. Prior to the intrusion of sea water, Polychaetes were found in **50** percent of the samples taken-- from which three different species were identified. After the intrusion of sea water, the percent of occurrence increased to **73** percent. This increase was not sound wide. The largest increase being recorded at station nine and ten. These two stations are in silt soils which tend to support more Polychaetes than do sandy soils. A wider distribution of this group was also noted at the northern stations.

Oligochaetes:

The aquatic Oligochaetes of the United States are not well known. One species from Currituck Sound was identified as Limnodribus sp., but not yet confirmed by authorities. Quantitatively, the numbers reported mean very little for many were small enough to crawl through a 30-mesh sieve. In any event, this group comprises only a minor fraction of the total volume of organisms recovered in the study. The data concerning Oligochaetes were too scanty to indicate any seasonal trends for this group. As a group, they show some preference to soils with vegetation. The increase in salinity showed no marked change in this group but since Oligochaetes are chiefly fresh-water species there was probably some decrease,

Mollusca:

Prior to the introduction of sea water into the sound this group was found in only 17 percent of the samples and occurred with greater frequency at the more southern stations. An occasional large Rangia cuneata (Gray) was picked up in the samples; but, because of their size, were not included in the volume determinations. Smaller members of this species were common at stations 10 and 11 where salinities are relatively high.

After the introduction of sea water into the sound, this group was found in 73 percent of the samples. There was an increase in Molluscans at all eleven stations, in areas of high salinity as well as in areas of relatively low salinity, Congeria leucophaeata (Conrad), a small brackish-water mussel attaching to vegetation, was very numerous. A wider distribution of the clam, Rangia cuneata was also recorded. In addition, one snail, Lymnoea sp., was frequently encountered. This snail was seldom found prior to the salt water intrusion of March 7, 1962.

Insects (Odonata, Ephemeroptera, and Trichoptera):

Each order was represented by only one species. The Odonata were the most common of the three orders. They appeared in only 14 percent of the samples from all stations under pre-stormconditionsand in 14 percent under post-storm conditions. Vegetation appeared to be the most important factor determining their distribution rather than the increase in salinity.

The Ephemeroptera was represented by one species and was collected only at the northern stations of lcw salinity and in only 3 percent of the samples under pre-storm conditions, Under post-storm conditions, Ephemeroptera were collected in 8 percent of the samples at the same stations.

Trichoptera were collected in only 3 percent of the samples from all stations under pre-storm conditions and in 3 percent of the samples from all stations under post-storm conditions. These two groups are relatively unimportant in the over-all macrobenthos population of the sound. The **small** number of organisms collected makes it impossible to determine seasonal trends or the soil preference of these three orders of insects.

Miscellaneous:

A few representatives of the Hydracarina and Coleoptera were obtained from various samples. The number of these recovered, however, were insignificant in the over-all benthos population.

Projection of the average volume per-square-foot of all organisms in each soil type reveals an estimated 27,563 thousand-liters of bottom organisms in Currituck Sound under pre-storm conditions (Table __). Following the sea-water intrusion, the estimated total volume increased to 28,915 thousand-liters. It should be noted that these estimates are based on a yearly average volume for each soil type and any evaluation of these data regarding waterfowl and fisheries utilization should take into account the seasonal variations. Waterfowl populations occur in the area during the period (November-February) of peak bottom fauna production and the estimated total volume of organisms present during the waterfowl season would be approximately twice the above estimates or approximately 55,000 thousand-liters (pre-storm) and 58,000 thousand-liters (post-storm) of available bottom fauna. Major fisheries utilization occurs during the period (March-October) of least production and total volume estimates of available bottom organisms would be approximately one-half the yearly average. It should also be noted that the data obtained during the bottom fauna study occurred under existing fish and waterfowl populations and is not an estimate of total production, but rather an estimate of the bottom fauna occurring with fish and waterfowl utilization.

The following checklist of the various species of macmbenthos that have been identified to date admittedly is not complete, but it does include the majority of the benthos present in Currituck Sound:

Checklist of Macrobenthos of Currituck Sound, N. C.
-- April, 1961 to April 31, 1963 --

OLIGOCHAETA Limnodrilus sp.
POLYCHAETA (Identified by: Dr, Marion H. Pittibone, University, New Hampshire)
  Nereidae Laeonereis culveri (Webster)
  Spionidae Scolecolepids viridis (Verrill)
  Ampharetidae Hypaniola Florida (Hartman)
CRUSTACEA
  Amphipoda (Identified by: Dr. Thomas E. Bowman, U. S. Natural Museum)
    Corophium lacustre (Vanhoffen)
    Monoculodes edwardsi (Holmes)
    Leptocheirus plumulosus (Shoemaker)
    Gammarus fascuatus (Say) (Identified by: Dr. E. L. Bousfield, National Museum, Canada)
    Gammarus tigrinus (Sexton)
    Haustorium sp.
  Isopoda (Identified by: Dr. Thomas E. Bowman, U. S. National Museum)
    Cyathura polita (Stimpson)
    Edotea triloba (Say)
    Cassidinidea luniforms (Richardson)
    Probopgrus floridensis (Richardson) parasitic
  Decapoda
    Callinectes sapidus (Rathbun)
    Palaemonetes paludosus (Gibbs)
  Cumacea Almyracuma proximoculi (Jones) parasitic
  Tanaidacea Leptochelia dubia (Kroyer)
INSECTA
  Ephemeroptera (Identified by: Dr. B. D. Burks)
    Hexagenia munda (Eaton)
  Odonata
    Ischnura sp.
    Enallaga sp.
  Trichoptera (Identified by: Dr. Oliver S. Fling, Jr,, U. S. National Museum)
    Oecetis sp.
  Diptera (Identified by: Dr. W. H. Anderson, Beltsville, Maryland)
    Palpomyia sp.
    Chironomus sp.
    Procladius sp.
    Cryptochironomus sp.
    Pentaneura sp. (Identified by: Dr. W. H. Anderson, Beltsville, Maryland)
    Chaoborus punctipennis (Say)
    Det. A. Stone
MOLLUSCA
  Pelecypoda (Identified by: Dr. Joseph P. E. Morrison, U. S. National Museum)
    Rangia cuneata (Gray)
    Congeria ieucophaeta (Conrad)
    Pisidium sp.
    Sphaerium sp.
  Gastropoda Lymnaea sp.

Full credit is due those individuals who have aided in the identification of the organisms. It is interesting to note that Currituck Sound has provided the first records of Trichoptera larvae (genus Oecetus) taken in brackish water in North America, Another find was the extension of the range of Almyracuma proximoculi (Jones) which heretofore had been reported only from the Pocasset River, Cape Cod, Massachusetts.

SUMMARY

A total of 659, one-fourth-square-foot samples were collected over a two-year period. The samples were collected from eleven stations. These stations included six different bottom types with vegetation being present at some stations and absent from others. The salinity at these stations ranged between 0.47 and 55.35 percent sea water. The number of organisms in each family and their displacement to volumes were determined for each sample.

There is little to indicate that the productivity of macrobenthos differs greatly between the silt and sand soils of Currituck Sound. Prior to the intrusion of sea water, sand had an average of 154.1 organisms per-square-foot with an average volume of 0.73 ml- Silt had 146.6 organisms per-square-foot with a volume of 0.83 ml. Loam, muck, clay, and peat soils followed in order of decreasing importance. In order of abundance, the groups ranked as follows: Crustaceans, Diptera, Polychaetes, Oligochaetes, and Mollusca. The insects, Odonata, 'Ephermeroptera, and Trichoptera,were an insignificant group.

Following the intrustion of sea water, sand had an average of 160.4 organisms per-square-foot with an average volume of 0.59 ml. Silt had 301.0 organisms per-square-foot with a volume of 1.13 ml. Loam, clay, muck, and peat soils followed in order of decreasing importance. In order of abundance, the groups ranked as follows: Crustacea, Diptera, Mollusca, Polychaetes, Oligochaetes,

and Odonata. The insects Ephemeroptera and Trichoptera were of insignificant numbers,

There was very little variation in species composition during the two sampling periods. The only significant change was in total numbers of organisms and a wider distribution of all species. Apparently, silt and sand bottom soil types with vegetation are the most productive habitats in the sound, Throughout the study, peat soil was a consistently low producer of organisms.

The data collected during this study indicated that an increase in salinity up to 8 to 10 percent sea-water strength throughout the sound would not cause any detrimental effects to the existing macrobenthos population. The data also indicated that salinities of this strength did induce a wider distribution of several species. Likewise, further increases in the existing macrobenthos populations would accompany any increase in vegetation.

There is a slight indication that the annual influx of marine fishes into Currituck Sound during the summer months decreases the macrobenthos population.

CONCLUSIONS

1. The majority of the macrobenthos present in Currituck Sound are brackish-water species.
2. Silt and sand bottom types support the greatest development of macrobenthos.
3. An increase in salinity up to 8 to 10 percent sea-water strength, uniformly throughout the sound, would cause no detrimental effects to the existing macrobenthos populations.
4. Salinities of 8 to 10 percent sea water induced greater production and a wider distribution of several species of macrobenthos.
5. An increase in the existing populations of macrobenthos would probably accompany an increase in vegetation,

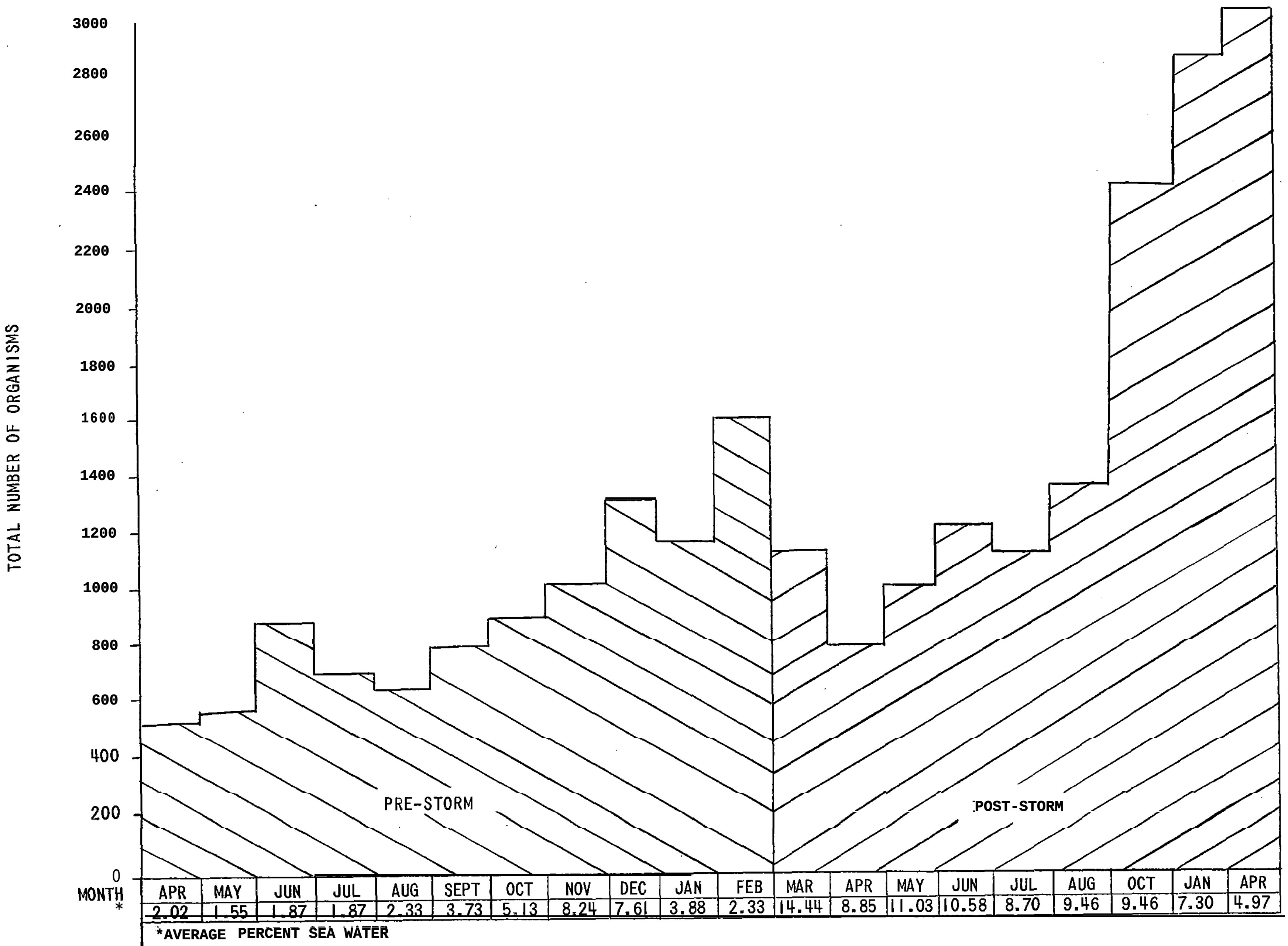

Figure Total Number of Organisms in Relation to Salinity - Currituck Sound, April, 1961 to April, 1963

TABLE ___. General Data of Bottom Sample Station--Currituck Sound--April, 1961 to April, 1963.

Pre-Storm

April, 1961 - February, 1962

Station No.	Map Section	Quadrat	Soil Type	Vegetation	Total Number of Organisms*
1	C	21-D	Silt	Absent	228
2	C	21-B	Muck	Absent	469
3	C	20-B	Peat	Absent	247
4	C	19-C	Clay	Absent	466
5	C	13-I	Loam	Absent	612
6	C	9-N	Sand	Present	1547
7	B	18-L	Sand	Absent	817
8	B	15-L	Loam	Present	880
9	B	8-H	Silt	Present	1622
10	A	5-B	Silt	Absent	1778
11	A	2-B, 2-C	Sand	Absent	1450

*Based on 363 Ekman samples (3/4 sq. ft.)

Post-Storm

March, 1962 - April, 1963

Station No.	Map Section	Quadrat	Soil Type	Vegetation	Total Number of Organisms-z
1	C	21-D	Silt	Absent	592
2	C	21-B	Muck	Absent	755
3	C	1 0-B	Peat	Absent	593
4	C	19-C	Clay	Absent	992
5	C	13-I	Loam	Absent	1337
6	C	9-N	Sand	Present	849
7	B	18-L	Sand	Absent	1333
8	B	15-L	Loam	Present	1576
9	B	8-H	Silt	Present	3470
10	A	5-B	Silt	Absent	2042
11	A	2-B, 2-C	Sand	Absent	1067

*Based on 297 Ekman samples (3/4 sq. ft.)

TABLE ____. Monthly Salinity Data- Currituck Sound--
April, 1961 to April, 1963.

Pre-Storm

April, 1961 - February, 1962

Date	Salinity Range- Low	High	NaCl* ppm	Sea Water* %	Total Number of Organisms
April	1.24	4.04	650	2.02	517
May	0.47	3.73	500	1.55	577
June	0.78	3.42	600	1.87	875
July	0078	3.42	600	1.87	694
August	1.09	4.04	750	2.33	631
September	1.87	7.76	1200	3.73	782
October	1.55	12.11	1600	4.97	908
November	2.95	14.30	2650	8.24	993
December	2.02	13.05	2450	7.61	1291
January	1.55	8.38	1250	3.88	1148
February	0.78	4.82	750	2.33	1575

*Average

Post-Storm

March, 1962 - April, 1963

Date	Salinity Range Low	High	NaCl* ppm	Sea Water* %	Total Number of Organisms
March	2.64	55.35	6300	19.58	1101
April	4.66	15.52	2850	8.85	758
May	6.68	16.61	3550	11.03	963
June	7.76	13.68	3400	10.58	1184
July	4.66	12.74	2800	8.70	1072
August	6.52	12.89	3050	9.46	1315
October	5.44	12.42	3050	9.46	2375
January	3.11	14.60	2350	7.30	2815
April	2.95	6.99	1600	4.97	3023

S-Average

Table ___. Results of Bottom Fauna Samples*--Currituck Sound--April 1, 1961 to February, 1962.

Pre-Storm

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
	Station 1 (Silt)											Station 2 (Muck)											Station 3 (Peat)										
April	3				1			10		14	0.2	13						2	31		46	0.5	13		1					9		23	0.2
May	3							9		12	0.2	4							5		9	0.1								9		9	0.2
June	5							10		15	0.1	4							82		86	0.6								4		4	0.1
July	1							13		14	0.1	23							48		71	0.2	3						1	7		11	0.1
August	4							14		18	0.1	1							1		-- 2	0.1	9				1					10	0.1
September	7							49		56	0.2	24							10		43	0.2								21		21	0.1
October	10							3		13	0.1	16							2		26	0.1	3							7		10	0.1
November	8				1			9		18	0.1	20	1						23		44	0.2	15		1					7		23	0.2
December	8							18		26	0.1	24							28		52	0.3	11							11		22	0.1
January	7		I					17		25	0.1	11						2	27	1	41	0.2	5							43		48	0.2
February	1							16		17		10							37		49	0.3	9							57		66	0.6
	Sta ion 4 (Clay)											Station 5 (Loam)											Station 6 (Sand)										
April								19		19	0.2	10							42		52	0.3	8							34		42	0.3
May								23		23	0.1	5							24		29	0.3	15					2		35		52	0.2
June	2							47		49	0.3	1					1		50		52	0.2	22				8	1		59	4	94	0.3
July	7							62		69	0.2	1							33		35	0.1	3					3		40	1	47	0.2
August	1							35		36	0.2	1							25		27	0.1	20			1	5	9		108		143	0.4
September	9							23	1	33	0.2	7							46		53	0.3	2							161	1	164	0.8
October	12		1					27	1	41	0.2	27							8		35	0.3	3			2	4			254	18	281	0.9
November	15							17		32	0.1	17							53		70	0.3	30				7	3	3	104	8	155	0.5
December	14							27	1	42	0.2	32					1		50		83	0.2	30			2	5			199		235	1.1
January	12				1			37		50	0.4	35							33		68	0.4	25				3	4		140	1	173	1.0
February	17							55		72	0.6	37				1	7		63		108	0.7	11				4	10		133	2	161	0.7

*Based on three Ekman (¾ sq. ft.) samples per month

Table ___. (Contd.) Results of Bottom Fauna Samples*--Currituck Sound--April I, 1961 to February., 1962.

Pre-Storm

Station 7 (Sand)

Month	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
April	3		2			17		48		70	0.6
May	4					1		13		113	0.4
June	11					6		39		56	0.2
July						5		11		16	0.1
August	12				4			31	1	48	0.2
September	42					3		35	1	81	0.4
October	15				2			15		32	0.2
November	21					2		18		41	0.2
December	17				2	3		09		131	0.6
January	17					3		09	1	130	1.0
February	9			1	2	3		88	1	104	0.5

Stat on 8 (Loam)

Month	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
April	22			1		7		40		70	0.3
May	34					8	1	77		120	1.0
June	20					2		17	2	41	0.2
July						3		35		38	0.1
August	13					14		63		90	0.2
September	10					1		36		47	0.2
October	15			2	1	2		40		60	0.5
November	22	1			1	3		53		80	0.3
December	19					2		70		93	0.5
January	14					2		05		123	0.7
February	16				1	10		92		118	0.7

Station 9 (Silt)

Month	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
April	39					13		38		90	0.4
May	32					3		51		86	0.4
June	4			3	1	9		75		92	0.3
July	3					22	1	78		104	0.3
August	27			1		21		68		117	0.4
September	62			2	1	9		76		151	0.8
October	73				2	8		72		155	0.7
November	61	1		3	10	6		57		138	0.7
December	100			4	5	15		191		315	1.8
January	23			4	1	1		125		154	1.0
February	71			1	3	11		133		220	1.5

Station 10 (Silt)

Month	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
April	6				8	38	5	11		68	0.3
May	7					13	17	63		100	0.6
June	11					98	12	112		235	0.8
July	6					31	4	120		161	0.4
August	12					1		95		108	0.3
September	52					10		33		95	0.4
October	50				1	29	5	22		107	1.0
November	45				7	20	5	101		178	1.0
December	32					10	2	91		135	0.7
January	88					96	51	99	1	345	2.3
February	87					74	11	74		246	2.5

Station 11 (Sand)

Month	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
April	4					10		19		33	0.2
May								19		19	0.2
June						12		140		164	0.3
July	3					80	2	44		129	0.3
August	7					10		15		32	0.1
September	1					30		7		38	0.2
October	17			2		69	7	53		148	0.7
November	1					89	5	118	1	214	1.3
December	45					7		105		157	0.8
January	14					11	7	60		92	0.8
February	6			2		81	8	216	1	414	2.8

*Based on three Ekman (¾ sq. ft.) samples per month

Table ___. Results of Bottom Fauna Samples*--Currituck Sound--April 1, 1962 to April 31, 1963.

Post-Storm

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
Station 1 (Silt)											
March	12				6			20		38	0.1
April	2	1						8		11	0.1
May	12					1		41		54	0.2
June	5						15	78		98	0.5
July						2	20	55		77	0.7
August	1				3	1	13	57		75	0.3
October	4						9	62		75	0.2
January	4					3	21	59		87	0.3
April	3					19	25	32		79	0.2
Station 4 (Clay)											
March	8					4		26		38	0.2
April	8					12		79		99	0.3
May	12					24		88		124	0.3
June	5					8	13	90		116	0.4
July							38	62		100	0.9
August	1					2	13	66		82	0.6
October	11						25	99		135	0.5
January	5					12	16	98		131	0.7
April	9					11	101	44		165	1.2

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
Station 2 (Muck)											
March	4							46		50	0.3
April	11		1					7		19	0.2
May	10		1					107		118	0.3
June	1						2	142		145	0.3
July							14	92		106	0.4
August	1		1				5	29		36	0.2
October	16						11	95		122	0.3
January	5			1		2	8	101	1	118	0.8
April	2					16	10	13		41	0.2
Station 5 (Loam)											
March	42				20	109		23		194	0.3
April	20					25		109		154	0.3
May	11					14		112		137	0.3
June	1					24	21	107		153	0.5
July	2					21	31	84		138	0.7
August	26					14	15	117		172	0.6
October	8						3	102		113	0.5
January	8				3	37	5	104		157	1.1
April	9					19	48	43		119	0.4

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
Station 3 (Peat)											
March								8		8	0.1
April	4						1	27		32	0.2
May	1							50		51	0.2
June	1						1	79		81	0.2
July	2						19	117		138	0.5
August	1						1	31		33	0.3
October							21	96		117	0.4
January				1		1	10	63		77	0.4
April								55		55	0.2
Station 6 (Sand)											
March	11					14		65		89	0.5
April								57		57	0.4
May	2					3		35		40	0.2
June	3			1				12		16	0.1
July	1						12	30		43	0.2
August	6			5	3	5		32		51	0.2
October	3			4		4	51	82		144	0.6
January	4			2	4	20	72	159		261	1.3
April	4				3	16	40	85		148	0.6

*Based on three Ekman (3/4 sq. ft.) samples per month

Table ___. (Contd.) Results of Bottom Fauna Samples*--Currituck Sound--April 1, 1962 to April 31, 1963.

Post Storm

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
	Station 7 (Sand)										
March	6					3		63		72	0.4
April	6	1				1		92		100	0.6
May						15		18	5	38	0.1
June	2						2	46		50	0.2
July	1					17	19	26		63	0.5
August	20			8	3	20	19	71	1	142	0.7
October	2					10	38	72		122	0.3
January	5					52	52	106		215	0.9
April	6		3		1	69	45	405	2	531	1.6
	Station 10 (Silt)										
March	41					43	46	62		192	2.0
April						14	10	31		55	0.4
May	18					6	75	47		146	0.8
June	16						34	69		119	0.6
July	12					2	6	62		82	0.4
August	37					31	7	95		170	0.6
October	21			1		16	6	5		49	0.2
January	70			6	4	76	4	21		577	1.9
April	43		1			145	271	190	2	652	1.5

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
	Station 8 (Loam)										
March	9				1	18		64		92	0.4
April	7					4		61		72	0.3
May	2					14		27		43	0.2
June	2					18	1	31		52	0.2
July	3					29	26	44		102	0.6
August	21				1	43	56	118	1	240	1.1
October	2					13	64	99		178	0.6
January	3				1	5	20	136		165	0.6
April	8					32	104	487	1	632	1.9
	Station 11 (Sand)										
March	9				1	15	4	37		66	0.3
April						28	2	14		44	0.2
May	1					20	95	52	1	169	0.8
June	1					5	8	162		176	0.4
July	1					6	6	54		67	0.3
August	5				1	14	17	70	6	113	0.3
October	9					4	6	41		60	0.2
January	7					12	1	26	1	47	0.4
April	14		1			155	22	132	1	325	0.3

	Diptera	Trichoptera	Ephemeroptera	Odonata	Oligochaetes	Polychaetes	Mollusca	Crustacea	Miscellaneous	Total Number	Total Volume
	Station 9 (Silt)										
March	64				6	19		173		262	1.1
April	37				4	2		72		115	0.5
May	14			2		2	3	22		43	0.7
June	10					3	29	138		180	1.1
July	55			1		18	6	78		158	0.9
August	28			4	3	32	16	118		201	1.9
October	72			1		14	14	1157		1258	1.0
January	25			11	11	195	187	550	1	980	2.4
April	1	1	1		.2	65	77	129		273	1.3

*Based on three Ekman (3/4 sq. ft.) samples per month

TABLE ___. Total Number of Organisms*--Currituck Sound--April, 1961 to April, 1963.

ORDER	April 1961	May 1961	June 1961	July 1961	ug. 961	ct. 1961	an, 1962	otal No.	pril 962	ay 962	me 962	uly 962	ug. 962	ct. 962	Jan. 1963	pril 963	otal No.
DIPTERA	121	104	80	50	107	241	251	954	95	83	47	77	147	148	136	99	832
TRICHOPTERA	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	3
EPHEMEROPTERA	3	0	0	0	0	1	1	5	1	1	0	0	1	0	0	6	9
ODONATA	1	0	3	0	2	6	4	16	4	2	1	1	17	6	21	0	52
OLIGOCHAETES	1	1	10	0	10	18	5	44	0	0	0	0	14	0	19	6	39
POLYCHAETES	85	27	129	144	55	108	117	665	86	99	58	93	162	63	815	547	1923
MOLLUSCA	5	18	12	8	0	12	61	116	13	173	126	197	162	248	396	743	2058
CRUSTACEA	301	428	635	491	455	503	695	3508	557	599	952	704	804	910	1423	1615	8564
MISCELLANEOUS	0	0	6	1	2	19	14	42	0	6	0	0	8	0	5	6	25
TOTAL	517	577	875	694	631	908	148	5350	758	963	184	072	315	375	2815	3023	3505

*Based on thirty-three Ekman (3/4 sq.ft.) samples per month.

TABLE-. Comparison of the Total Number of Macrobenthos in Currituck Sound--April, 1961, to April, 1963

Date	Total Number Organisms 1961 - 1962	Total Number Organisms 1962 - 1963	Percent Increase in Total Numbers
April	517	758	46.6
May	577	963	67.2
June	875	1184	35.3
July	694	1072	54.5
August	631	1315	108.4
October	908	2375	161.5
January	1148	2815	145.2

Note - An April, 1963 sample produced a total number of 3023 organisms, this was an increase of 299.5 percent over April, 1962 and an increase of 486.7 percent over April, 1961.

TABLE____. Percent Frequency of Occurrence of Macrobenthos--Currituck Sound--April, 1961 to April, 1963.

Pre-Storm

April, 1961 - February, 1962

Station No. Soil Type Vegetation	1 Silt Absent	9 Silt Present	10 Silt Absent	7 Sand Absent	6 Sand Present	11 Sand Absent	5 Loam Absent	8 Loam resent	4 Clay .bsent	2 Muck Absent	3 Peat Absent	All Stations
Diptera	100	100	100	91	100	82	100	91	82	100	73	93
Trichoptera	0	9	0	0	9	0	0	9	0	9	0	3
Ephemeroptera	9	0	0	9	0	0	0	0	9	18	18	6
Odonata	0	64	9	9	27	18	0	18	0	0	0	14
Oligochetes	18	64	27	36	64	9	9	27	9	18	9	27
Polychaetes	0	100	100	82	64	91	27	100	0	0	0	50
Mollusca	0	9	82	0	9	46	0	9	0	18	9	17
Crustacea	100	100	100	100	100	100	100	100	100	100	91	99
Miscellaneous	0	9	9	36	64	18	18	27	27	9	0	20

Post-Storm

April, 1962 - April, 1963

Station No. Soil Type Vegetation	1 Silt Absent	9 Silt "resent	10 Silt Absent	7 Sand Absent	6 Sand 'resent	11 Sand Absent	5 Loam Absent	8 Loam Present	4 Clay ıbsent	2 Muck Absent	3 Peat Absent	All Stations
Diptera	89	100	89	89	89	89	100	100	89	89	56	89
Trichoptera	11	11	0	11	0	0	0	0	0	0	0	3
Ephemeroptera	0	11	11	11	0	11	0	0	0	33	0	8
Odonata	0	56	22	11	44	0	0	0	0	11	11	14
Oligochetes	22	56	11	22	33	22	22	33	0	0	0	22
Polychaetes	56	100	89	89	67	100	89	100	78	22	11	73
Mollusca	67	78	100	67	44	100	67	67	67	67	67	73
Crustacea	100	100	100	100	100	100	100	100	100	100	100	100
Miscellaneous	0	11	11	33	0	44	0	22	0	11	0	12

Table ___. Estimated Total Volume in Thousand-Liters of the Bottom Fauna in Currituck Sound with Relation to Soil Types--1961 to 1963.

Soil Type	Total Number Square Feet	Pre-Storm 1961-62		Post-Storm 1962-63	
		Average Volume Sq./Ft.	Thousand-Liters of Organisms	Average Volume Sq./Ft.	Thousand-Liters of Organisms
Sand	2,538,921,471	0.73	18,534	0.59	14,980
Silt	379,771,447	0.83	3,152	1.13	4,291
Loam	1,105,177,582	0.49	5,415	0.78	8,620
Clay	110,944,468	0.32	355	0.79	876
Muck	25,602,569	0.34	87	0.45	115
Peat	8,534,190	0.24	20	0.39	33
Total*	4,168,951,727		27,563		28,915

*Does not include 98,143,183 square feet of shell bottom type.

TABLE____ Average Number and Volume (cc.) Per Square Foot of Bottom Organisms--Currituck Sound--April, 1961 to April, 1963.

Pre-Storm

April, 1961 - February, 1962

No. of Stations	Silt 9		Sand 9		Loam 6		Clay 3		Muck 3		Feat 3	
	No	Vol.	No	Vol.	No.	Vol.	No.	Vol.	No.	Vol.		Vol.
Apr.	76.4	0.40	64.4	0.49	81.3	0.40	25.3	0.56	61.3	0.66	3 %	0.26
May	88.0	0.71	84.0	0.35	99.3	0.86	30.6	0.13	12.0	0.13	12.0	0.26
June	152.0	0.53	139.5	0.31	60.6	0.26	65.3	0.40	114.6	0.80	5.3	
July	124.0	0.35	85.3	0.26	48.6	0.20	92.0	0.26	94.6		14.6	0.13 0.13
Aug.	108.0	0.35	99.1	0.31	78.0	0.26	52.0	0.26	2.6	0.26 0.13	13.3	0.13
Sept.	134.2	0.62	125.8	0.66	66.6	0.33	44.0	0.26	57.3	0.26	28.0	0.13
Oct.	122.2	0.80	204.9	0.80	63.3	0.53	54.6	0.26	34.6		13.3	0.13
Nov.	148.4	0.80	182.2	0.89	100.0	0.40	42.6	0.13	58.6	0.13	30.6	0.26
Dec.	211.5	1.20	232.4	1.01	11703	0.46	56.0	0.26	69.3	0.40	29.3	0.13
Jan.	232.9	1.55	175.5	1.24	127.3	0.73	66.6	0.53	54.6	0.26	64.0	0.26
Feb.	214.6	1.82	301.8	1.73	150.6	0.93	96.0	0.80	65.3	0.40	88.0	0.80
Yr. Av.	146.6	0.83	154.1	0.73	9003	0.49	56.8	0.32	56.8	0.34	29.9	0.24

Post-Storm

March, 1962 - April, 1963

No. of Stations	Silt 9		Sand 9		Loam 6		Clay 3		Muck 3		Peat 3	
	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.
Mar.	218.6	1.46	100.9	0.53	190.6	0.46	50.6	0.26	66.6	0.40	10.6	0.13
Apr.	80.4	0.47	89.3	0.53	150.6	0.40	132.0	0.40	25.2	0.28	42.8	0.28
May	108.0	0.76	109.7	0.49	136.4	0.30	165.2	0.40	157.2	0.40	68.0	0.28
June	176.5	1.12	107.6	0.31	136.6	0.48	154.8	0.52	194.8	0.40	108.0	0.28
July	143.6	0.88	76.8	0.45	174.0	0.85	137.2	1.20	141.2	0.52	184.0	0.68
Aug.	198.3	1.24	136.0	0.53	274.6;	1.14	109.2	0.80	48.0	0.28	44.0	0.40
Oct.	611.5	0.63	J-44.9	0.49	193.2	0e74	182.8	0.68	162.8	0.40	146.0	0.68
Jan.	726.1	2.04	232.5	1.11	214.6	1.14	180.0	0.92	157.2	1.08	102.8	0.52
Apr.	446.1	1.33	446.1	0.90	500.8	1.52	220.0	1.60	54.8	0.28	73.2	0.28
Yr. Av.	301.0	1.13	160.4	0.59	219.0	0.78	148.0	0.79	112.0	0.45	86.6	0.39

Table Thousands of Founds of **Macroscopic Bottom** Fauna on Each Transect Area on Back **Bay, Virginia, and** Currituck Sound; **North** Carolina;- as Determined by-the October 1960 Transect **Survey.**

-Transect	**Oligochaeta**	Polychaeta	Tendipedidae	**Odonata**	Pelecypoda	Gastropoda	**Amphipoda**	Isopoda	**Misc.**	Total **Weight**
A-	6	0	1	0	1	0	o -	@	0	a
B --	3	0	a	7	1	1	31	2	Tr.	53
C	2	0 . .	4	19	0	1	5	0	0	31
D	5	0	a	1	0	0	I0	0	0	24
E	17	0	7	0	0	0	20	1	0	45
F	6	0	7	0	0	2	17	11	0	43
G	6	0	2	0	0	0	27	I	0	36
G_1	4	0	2	0	0	Tr.	'4	2	0	12
Total Back Bay	49	0	39	27	2.	4	114	17	Tr.	252
H	4	0	4	0	0-.	11	5	0	3	27
I	1	0	5	0	0	0	37	3	2	48
J	3	0	14	5	0	34	74	9	0	139
K	37	0	25	0	0	0	75	41	0	178
L	26	41	56	a	0	0	448	47	1	627
M	7	0	11	1	0	3	54	9	2	a7
N	4	26	24	0	0	0	67	30	1	152
P	24	11	19	2	5	3	149	13	3	229
Q	25 55 266	3	24 6	00	00	00	34	17 6	01	371 3
R -	1	1,040	13	0	2.0	0	68	9	97	1,248
s	0	551	6	0	52	0	1	8	0	618
"Total Currituck-Sound	la7	1,938	207	16	77	51	1,039.	192	110	3,817
Grand Total	236	1,938	246	43	79	55	1,153	209	110	4,069

Tr. equals less than **500** pounds..

Table . . Average number of Bivalves Per Square Foot Found on Each Transect Area of Back Bay, Virginia, and Currituck Sound, North Carolina; as Determined by Each Transect Survey on Which They Were Measured.

Transect	1962 November	1963 May	1963 August
A	.36	.31	.24
B	.73	1.08	.42
C	.86	.94	.19
D	.54	.43	.11
E	.47	.56	.00
F	.57	.30	.03
G	.98	.88	.00
G_1	2.19	1.96	.31
Average Back Bay	.76	.73	.13
H		.69	
I		1.50	
J		2.36	
K		2.09	
L		.53	
M		2.60	
N		1.76	
O		.67	
P		.29	
Q		.55	
R		.23	
S		.05	
Average Currituck Sound		1.12	

Table ___. Generic Index of Existing Crustacea in the Back Bay Area of Virginia and the Currituck Sound Area of N. C. - 1963.

*Scientific Name	Order
Palaemonetes paludosus (Gibbes)	Decapoda
Probopyrus floridensis (Richardson)	Isopoda (parasitic)
Callinectes sapidus (Rathbun)	Decapoda
Rhithropanopeus harrisii (Gould)	Decapoda
Cyathura polita (Stimpson)	Isopoda
Chiridotea almyra (Bowman)	Isopoda
Edotea triloba (Say)	Isopoda
Cassidinidea lunifrons (Richardson)	Isopoda
Leptocheirus plumulosus (Shoemaker)	Amphipoda
Gammarus sp.	Amphipoda
Monoculodes sp.	Amphipoda
Leptochelia dubia (Kroyer) ?	Isopoda
Corophium lacustre (Vanhoffen)	Amphipoda

*Identifications by Thomas E. Bowman, U.S. National Museum.

Generic Index of Existing Crustacea in the Back Bay Area of Virginia and the Currituck Sound Area, North Carolina Taken From Waterfowl Gizzards Collected - 1904 - 1927.

Scientific Name	Order
Cyathura carinata	Isopoda
Gammarus sp.	Amphipoda
Gammarus fasciatus	Amphipoda
Hyalella sp. (Probably H. azteca)	Amphipoda
Palaemonetes sp.	Decapoda
Palaemonetes exilipes	Decapoda
Talorchestia megalopthalma	Amphipoda

Generic Index of Existing Polychaeta in the Currituck Sound Area of North Carolina - 1960.

*Hypaniola florida (Hartman)	Ampharetidae
Laeonereis culveri (Webster)	Nereidae

*Identifications by Marian H. Pettibone, U.S. National Museum.
*Includes:
Hypaniola grayi (Pettibone) 1953.
Amphicteis gunneri (Sars) 1951.
Amphicteis floridus (Hartman) 1951.

Generic Index of Existing Polychaeta in the Currituck Sound Area. North Carolina Taken from Waterfowl Gizzard Analyses. 1904 - 1927.

Nereis	Nereidae

Table.____ Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pm-Waterfowl Utilization Period Oct. 5-19. 1960.

(Weight in Grams)

Transect	Soil Type	Water Depth	Veg.	Oliochaeta	Polychaeta	Tendipedidae	Odonata	Pelecypoda	Gastropoda	Amphipoda	Isopoda	Misc.	Total Weight
A-1	sand	40"	Abs.	.013		.006		.006	Tr.				.026
2	Loam	57"'	Pres.	,020		Tr.							.020
3	Sand	23"	Pros.	.010		.003							,013
E l	Silt	43"	Pros.	,006		.006	.039	Tr.			.005	.002	.059
2	silt	62"	Pres.	Tr,		.003	.003			.022			.029
3	Loam	64"	Pres.	.006		,020			Tr.	.064			.091
4	Sand	37"	Pros.	,001		.005			.007	.045	,001		.059
5	Sand	32"	Pres.	,007		.010		.006		● 051	.004		,078
c-1	Silt	41"	Pres.			.007	.038		Tr.	.006			.052
2		35"	Pros.	,013		● 4				.006			.023
3	Loam	37"	Pres.	Tr.		[illegible]	.033		Tr.	.013		Tr.	,059
4	Silt	26"	Pros.	Tr.		,006	.045		,006	,004			,062
D-l	Silt	51"	Abs,	,001						.012			.013
2	Silt	65"	Abs,	Tr.		Tr.							Tr.
3	Silt	72"'	Pros.	,010		.010							.020
4	Silt	69"	Pros.			.007							.007
5	Silt	55"	Pres.	.003		.003	Tr.						.007
6	Silt	55"	Pres.	.008		.011	.003			.001			.023
7	Sand	17"	Pros.	,003		.010				,039			.052
E l	Sand	50"	Abs.	Tr.		Tr.							Tr.
2	Silt	73"	Abs.	Tr.		.006							.007
3	silt	75"	Abs.	.005		.002							.007
4	Silt	75"	Abs.										.000--
5	Silt	72"	Pres.	,026		.007				,013			.046
6	sand	66"	Pres.	.020		● 3				.039			.062
7	Sand	31"	Pres.	.007		.007				.017	.002		,033
F-l	Clay	36"	Abs.			Tr.							Tr.
2	silt	72"	Abs.	.004		.006							,010
3	Silt	74"	Abs.	.008		.005							,013
4	Silt	74"	Pres.	.001		[illegible]							.007
5	Sand	47"	Pres.	.007						,025	,013		.046
6	Loam	73"	Pres.	Tr.		.001			Tr.	.020	● 4		.026
7	Loam	71"	Pres.	Tr.		.002			.010				.013
8	Sand	31"	Pres.	.004		.007			Tr.	,022	,028		.062

Table ____(cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl Utilization Period Oct.5-19.1960.

(Weight in Grams)

Transsect	Soil Type	Water Depth	Veg.	Oliochaeta	Polychaeta	Tendipedidae	Odonata	Pelecypoda	Gastropoda	Amphipoda	Isopoda	Misc.	Total Weight
G-l	Sand	48"	Abs.	.015		Tr.				.004			.020
2	Silt	82"	Abs,										.000--
3													
4	Sand sand	42" 46"	Pres. Pres.	.001 .006		.002			Tr.	Tr. 001			.094
5	Sand	34"	Pres.	.007		.007			Tr.	,033	,004	Tr.	,052
G1-1	Loam	40"	Pres.	.010		.006			Tr.	.010	.015		.042
2	Silt	34"	Pres,	Tr.		● 3			.003				.007
3	Loam	43"	Pres.	,001		.009				,013			,023
4	Loam	43,"	Pres.	.001		.001			Tr.	● 4			● 7
5	Loam	34	Pres.	,025		Tr.			Tr.	1009	,004		,039
Back Bay - 44 Samples													
Avg.Wt./*Ekman:				.006		.005	.004	<.001	.001	.013	.002	<.001	.030
Avg.No./Ekman:				8.3		8.1	0.2	0.1	0.9	7.2	0.5	0.7	25.3
Avg.Wt./Occupied Ekman:				.006		.005	.023	.004	.002	.023	.008	.001	.031
Avg.No./Occuppied Ekman:				9.4		8.7	1.3	1.7	2.5	12.7	2.2	LO	26.5
1									Tr.				
2	Sand	26"	Pres.	.007		.004			.029	● 017			.029
	Silt	48"	Pres.	● [illegible]		.007				.006		● [illegible]	.059
3	Sand	24"	Pres.	.001		,007			,023	,001		,007	,039
I-l	Sandım	35"	Pres.	● OC2		.007						.007	.016
2		30"	Pres.			.008				.039	.002		.049
3	Sand		Pres.	Tr.		Tr.				,078	,006		,085
J-1	Silt	28"	Pres.	.002		.020			.065	,032	.004	Tr.	.124
2	Loam	34"	Pres.	.004		.007	,010		,010	.123	.004		.159
3	Sand	33"	Pres.	,001		.003				.006	.012		,023
K-l	silt	102"	Abs.	● 04		.002				.007	.020		.033
3	Loamıd	90"		.011		.002				.007	,003		,023
4	Sand	96"	Abs.	.002		.002				.007	.002		.013
		85"	Abs.	.011		.002				.029			.042
5	Silt	100"	Abs:	.010		,013				,026	.016		.065
6	silt	92"	Abs.	.004		.007				.004	.005		.020
7	Clay	48"				.001				● 005	.001		.007

*Ekman- 1/4 sq.ft.

Table (cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl Utilization Period Oct.5-19. 1960.

(Weight in Grams)

Transect	Soil Type	Mater Depth	Veg.	Olio-chaeta	Poly-chaeta	Tendi-pedidae	Odonata	Pelecy-poda	Gastro-poda	Amphi-poda	Isopoda	Misc.	Total Weight
L-1	sand	27"	Pres.	.002		.003				.020		• 001	.026
2	sand	70"	Abs,	.006		Tr.				,022			.029
3	Silt	84"	Abs,	.007		.025				.033	.026		.091
4	sand	37"	Pros.	Tr.	.016	.008				.035	.005		.065
5	Sand	24"	Pres.	.007	.013	.012				.007			.039
6	Sand	30"	Pres.	Tr.	.006	Tr.	,007			,266	,009		.289
M-1	Loam	54"	Pres.	,010		Tr.	.002		.006	,025		.005	.049
2	Loam	64"	Pres.	Tr.		.016				.042			,059
3	sand	19"	Pres.	Tr.		Tr.				.028	.004		.033
4	Loam	71"	Abs.	.005		.008				.020	.004		.033
5	Sand	26"	Pros.							,005	,013		.026
N-1	Sand	30"	Pres.	• 5		.005				.020	.006		.036
2	Sand	34"	Pres.	.006		.004				.072	.025	.004	.111
3	Silt	90"	Pres.		,013	.006				.007			.026
4	Silt	94"	Pres.		.020	.010				.015	Tr;		.046
5	Silt	102"	Pres.		.010	,013				.013	.003		.039
6	sand	89"	Pres.	Tr.	.038	,013				.026	.029		.107
7	Sand	61"	Pres.			Tr.				Tr.	Tr,		Tr.
8	Loam	37"	Pres.	.003	.003	• 4				.058	.023		.091
9	Silt	57"	Pres.	Tr,		.023				,006	.012		,042
O-1	Sand	26"	Pres.	,001		.003				.007			• 010
2	sand	55"	Pres.	.035	.004	.007				• 020	.006		.072
3	sand	80"	Pres.	.001	• 3	.007				,028			.039
4	Sand	66"	Pres.		.010	,010				,016	,003		.039
5	Silt	43"	Pres.			.002				.032	.002		,036
6	Loam	26"	Pres.	.012	Tr.	• 4				.100	.007		.124
7	sand	37"	Pres.		• 4	.004	.004	.010		.064	• [illegible]	Tr.	.094
8	Sand	27"	Pres.	,002	.003	.002			.007	.044	,003	.007	.068

Table ___(Cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl Utilization Period Oct.5-19. 1960.

(Weight in Grams)

Transect	Soil Type	Water Depth	Veg.	Oliochaeta	Polychaeta	Tendipedidae	Odonata	Pelocypoda	Gastropoda	Amphipoda	Isopoda	Misc.	Total Weight
P-1	Sand	45"	Pres.	.003	.004	.002		Tr.	Tr.	.008	.001	.001	.020
3	silt	78"	Pros.	Tr.		.026				.015			.042
4	Sand	75"	Abs.	.010		.003				.004	.003		[illegible]
	[illegible]	38"	Pres.	.026	Tr.	Tr.		Tr.		.010	.002	Tr.	.039
5	Loam	32"	Pres.	Tr.		.006				.016	.003		.026
Q-1	Sand	65"	Abs.	.004		.002				.001			.007
2	Sand	96"	Abs.	.004	.006	.002					.001		.013
3	Sand	96"	Pres.	.020	.230	.004		Tr.		.022	.009		.286
4	silt	60"	Pres.	.003	.005	.003					.009		.020
5			Pros.	.031	.006	Tr.		Tr.		.010	.004		.052
6	Sand	34"	Pres.	.038	.234		Tr.	Tr.		.016	.007		.296
R-1	Silt	55"	Pres.	Tr.	.006	.0		.010		.102	.004	.146	.289
3	Sand	66"	Abs.	.002	.059			.020		.001	.003		.085
4	Sand	111"	Abs. Abs.		.396	Tr.				Tr.	.006		.403
	sand	104"			.344								.345
5	Sand	102"	Abs.		.553								.553
6	sand	44"	Abs.		.207	Tr.					Tr.		.208
S-1	Sand	60"	Abs.		.194	Tr.							.195
2	sand	120"	Abs.		.240	.012		.020		Tr.			.273
3	Sand	113"	Abs.		.409	Tr.		.084			Tr.		.494
4	Sand	120"	Abs.		.436			.016			.016		.468
5	sand	45"	Pres.		.002	.001				.002	.002		.007
Currituck - 66 Samples.													
Avg. Wt./*Ekman:				.005	.053	.005	<.001	.003	.002	.025	.005	.003	.098
Avg.No./*Ekman:				9.3	6.2	7.9	0.1	1.1	1.2	17.3	2.1	0.3	45.5
Avg.Wt Occuppied*Ekman:				.007	.109	.006	.005						.098
Avg.No/Occuppied*Ekman:				12.8	12.8	8.7	1.2	.015	9.6 .018	.029	2.9	.015	45.5

*Ekman = 1/4 sq.ft.

Table._____ Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pm-Waterfowl Utilization Period - Oct. 5-19, 1960,

(Number of Organisms)

Transect	Soil Type	Water Depth	Veg.	Oligochaeta	Polychaeta	Tendipedidae	Odonata	Pelecypoda	Gastropods	Amphipoda	Isopoda	Misc.	Tote.1 Organism Ekman
A-1	Sand	40"	Abs.	13		1							14
2	Loam	57"	Pres.	3		3		3	4				13
3	Sand	23"	Pres.	26									33
B-1	Silt	43"	Pres.	2		8	1	1			1	1	14
2	Silt	62"	Pres.	1		3	1	1		J 2			18
3									1				37
4	sanLoam	64"37"	Pres.	2 2		11 6			4	24	1		37
5	Sand	32"	Pres.	9		15			6	43	2		74
				5		9				3			
2	Loamt	35"	Pres.	6		4	2		1	3			15
													12
3	Loam	37"	Pres.			12	1		1	7		1	28
4	Silt	-26"-	Pres.	1		13	3		5	1			23
D-1	Silt	51"	Abs.	1		1				5			6
2	Silt	65"	Abs.	1		8							2
3													
5	Silt	7269"	Pres.	14		2 3	1						22 2
6	Silt Silt	55"	Pras.	5		16	1			1			9
		55"	Pres.	5		25				26			23
7	Sand	17"	Pres.	3									54
E 1	Sand	50"	Abs.	3		2							5
2	Silt	73"	Abs.	1		7				8			8
4	Silt	75"	PrAbs.	584		1				14	1		73 0 5
6	Sand	66"	Pres.	33		13							67
3	Sand	31"	Pres,	7		39							61
F-1	Clay	36"	Abs.			1							1
2	Silt	72"	Abs.	7		8							15
3	Silt	74"	Abs.	14		5							19
4	silt	74"	Pres.	2		8							10
5	Sand	47"	Pres.	12		4				31	1		48
6	Loam	73"	Pres.	1		8			1	11	1		22
7	Loam	71"	Pros,	2		5			4				11
8	Sand	31"	Pres.	14		23			1	16	4		58

Table (cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl Utilization Period-Oct.5-19.-1960

(Number of Organisms)

Transect	Soil Type	Water Death	Veg,	Oligochaeta	Polychaeta	Tendipodidae	Odonata	Pelecypoda	Castropoda	Amphipoda	Isopoda	Misc.	Total Organisms Ekman
E 1	Sand	48"	Abs.	16		1				2			19
2	Silt	82"	Rbs.	9									0
3 / 4	sand / Sand	46" / 42"	Pres. / Pres.	5 / 32		3			1	1			14
5	Sand	34"	Pres.			5				38			48
						22			1	15	6	1	78
G_1-1 / 2	Loam / Silt	40" / 34"	Pres.	12		19			4	3	1		36
			Pros.	2		10							16
3 / 4	Loam / Loam	43" / 43"	Pros. / Pres.	1 / 1		13				7			21
5	Loam	34"				3			2	2			8
Pres.				31	1				1	6	2		41
BACK BAY-Avg. no. *Ekman:					0		0.2	0.1	0.9	7.2	0.5	0.7	25.3
No. Samples: 44				88.3	0	93.2	15.9	11.4	36.4	56.8	22.7	6.8	95.5
H-1	Sand	26"	Pros.	33		22			1	15			71
2	Silt	48"	Pres.	14		10			32	2		3	61
3 / I-1	Sand / Loam	24" / 39"	Pres.	7		20			10	3		2	42
		35"	Pres.	1		3						2	6
2	Sand	30"	Pros.			15				33	2		50
3	Sand		Pres.	1		3				42	1		47
J-1	Silt	28"	Pros.	3		15							
2	Loam	34"	Pres.	7		16			18	8	6	1	51
3	Sand	33	Pres.	1		18	1		13	39	6		82
K-1	Silt					8				4	3		18
3	sand	100" / 96"	Abs.	18		4				4	2		32
4	Sand Loam	96" 85"	Abs. Abs	22						3	1		30
5			Abs.	5		3				5			15
6	Silt	100"	Abs.	24 / 33		12				22			49
										14			62
	Silt	92"	Abs.	9		8				2	3		22
7	Clay	48"	Abs.			1				8	1		10
E1	Sand	27"	Pres.	4		7				16		2	29
2	Sand	70"	Abs.	6		2				16			24
3	Silt / Sand	84" / 37"	Abs.	9		20				24	5		58
4			Pros.	13	4 / 3	7 / 15				26	2		52
5	Sand	24"	Pros	19						6			43
6	Sand	30"	Pros:	1	1	2	1			86	3		94

Table (cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl Utilization Period-Oct. 5-19, 1960.

(Number Of Organisms)

Transect	Soil Type	Water Depth	Veg.	Oligochaeta	Polychaeta	Tendipedidae	Odonata	Pelecypoda	Gastropoda	Amphipods	Isopods	Misc.	Total Organisms Ekman
N-31	Loam	64"	Pres.	8		2	1		1	10		1	23
4	Sand	19"	Pres.	11		9				23			33
						5				31	3		40
5	Loam	71"	Abs.			12				15	4		32
	Sand	26"	Pres.	18						14	5		37
N-1	Sand	30"	Pres.	9		10		2		13	1		33
3	Sand	34"	Pres.	2j		9				41	8	1	84
5	silt	90"	Pros.		3	9				12			24
6	Silt Sand	102"	Pres.		15	19				23	2		54
		89"	Pres.	2	21	20				11	6		60
7 8	sand	61"	Pres.			1							5
9	Silt Loam	37" 57"	Pres.	28	1	3				123	1		31
			Pres.			13				8	3		28
O-1	Sand	26"	Pres.	2		9				5			16
3	Sand	55"	Pres.	56	1	20				27	1		105
4	Sand sand	66" 80"	Pres.	1	1	12				1%			32
5		43"	Pres.		5	12				20	3		40
6	Silt Loam	26"	Pres.			7				31	2		37
7	Sand	37"	Pres.	39	1	9				169	11		227
8			Pres.		2		2	1		47	8	1	70
P-1	Sand sand	27"	Pres.	8	1	5			1	38	2	1	61
		45"	Pres.	14	1	6		1	1	9	2	1	37
2	Silt	78"	Pres.	33		28				6			45
3	Sand	75"	Abs.			5					2		27
4	Sand	38"	Pres.		1	17		1		11	4	1	68
	Loam	32"	Pros.	1		4				12	2		19
Q-1	sand	65"	Abs.	8		10				1			19
2	Sand	96"	Abs.	6	1	7					1		15
3											3		
4	Sand Silt	96" 60"	Pres.	34	174	1		6		33	6		213
5	Sand	47"	Pres.	29	5	2		3		29	2		70
6	Sand	34"	Pres.	25	30		1	2		23	2		83

Table (cont'd). Back Bay-Currituck Sound Macroscopic Bottom Fauna-Pre-Waterfowl. Utilization Period-Oct.5-19, 1960

(Number of Organisms>

Transect	Soil Type	Water Depth	Veg.	Oligochaeta	Polychaeta	Tendipedidae	Odonata	Pelecypoda	Castropoda	Amphipoda	Isopoda	Mis.	Total Organisms Ekman
		55"		1									
R-1	Silt	66"	Pres.	9	4	12		4		48	3	2	74
2	Sand		Abs.		1			2		1	2		15
3													14
5	Sand Sand	111" 104"	Abs. Abs.		12	1				1	1		26
6	Sand sand	102" 44"	Abs. Abs.		16 8						1		16
						4							13
						5							
S-1	Sand	60"	Abs.		10	8							18
								2					
3	Sand	120"	Abs.		14			42		2			25
4	Sand sand	120" 113"	Abs. Abs.		28	1					11		76 18
5	Sand	45"	Pres.		1	2				4	1		8
Currituck sound - Avg.No.*Ekman:				9.3	6.2	7.9	0.1	1.1	1.2	17.3	2.1	0.3	45.5
% Frequency:				72.7	48.5	90.9	9.1	18.1	12.1	86.4	72.7	19.6	100
No, Samples: 66													

*Ekman = 1/4 Sq.Ft.