

INTRODUCTION

The field work that resulted in the present report was begun in 1912 when Lewis Radcliffe and the late William W. Welsh undertook a study of the anadromous clupeoids principally on the Potomac River and at the head of Chesapeake Bay. These studies were continued more or less intermittently until the winter of 1914-15, when the Fisheries steamer *Fish Hawk* was assigned to this work and the scope was enlarged to include a general biological and physical examination of Chesapeake Bay. This work, which was then under the supervision of Lewis Radcliffe, was interrupted by the World War. It was resumed in 1920 under the immediate supervision of Dr. R. P. Cowles, of Johns Hopkins University. In 1921 the general survey was supplemented by a special investigation of the fishes of Chesapeake Bay by the authors of the present report and was continued at intervals until the fall of 1922, when all the field operations pertaining to the Chesapeake Bay investigations were brought to a close.

Collections of fishes were made during the general survey, and especially many young fish were taken. The operations of the general survey were almost wholly in offshore waters and particularly in the "deep holes." These collections were supplemented by the special survey, chiefly with collections made in the shallow inshore waters. Much attention was given to the spawning and feeding habits of fishes, also to migrations, seasonal abundance, etc. Special attention was directed to the methods employed in the fisheries, manner of handling and marketing the catches, prices received by the fishermen, wholesale dealers, and retailers, etc.

Scientific descriptions and keys, made as nontechnical as is consistent with the purpose of the work in hand, have been introduced, all based upon specimens, so far as available, collected in Chesapeake Bay. For the species of which no specimens were at hand, the source of the account given is stated. An attempt was made in the descriptions drawn up directly from specimens always to discuss the various characters commonly described in the same sequence. It is hoped that this arrangement will prove to be a convenience to those who may have occasion to use the descriptions.

Preceding each description, and following the scientific name of the species, are one or more common names. Those that are of more or less local use only are placed inside quotation marks. Next follow certain references to literature. The first of these gives the exact name used by the discoverer of the species and a sufficiently complete reference to the work in which the species was described and also the type locality for the species. Then follow references to the local fauna and to the general work by Jordan and Evermann—namely, Bulletin No. 47 of the U. S. National Museum. For all references except the first one only the date of publication and the page number or numbers on which the particular species is discussed are given. Complete titles to the works referred to are found in the bibliography (pp. 358-366).

In the matter that follows the descriptions, the subheads mentioned below are discussed without naming them in the text in the sequence in which they are listed here.

(a) A brief statement of the number and range in size of the specimens upon which the description was based.

- (b) A mention of the chief diagnostic characters, naming those, so far as possible, that are readily noticed in the field.
- (c) Variations among individuals; variations with age; also sexual differences.
- (d) Food and feeding habits.
- (e) Spawning, embryology, larval development.
- (f) Rate of growth.
- (g) Relative and seasonal abundance in Chesapeake Bay; how taken.
- (h) Commercial importance.
- (i) Size attained.
- (j) Habitat—i. e., general range of distribution.
- (k) Previous Chesapeake Bay records.
- (l) Specimens in collection; individuals observed in the field; where, when, and how taken.

It is understood, of course, that for many species nothing is known relative to some of the subheads, and in others they do not apply. In such cases the subject or subjects are not mentioned or are passed over with the remark that little or nothing is known about them.

The scope of the work was fixed arbitrarily to include all fishes taken in the salt water of the bay as well as those taken in the mouths of streams, where the water was brackish to only slightly brackish. This arbitrary division resulted in bringing several species of "fresh-water" fishes within the limits of this report. Species not taken during the present investigation, but previously recorded from the bay or reliably reported by fishermen, also have been included.

In the arrangement of the orders and families Dr. David Starr Jordan's recent work, "A Classification of Fishes," has been followed. Jordan's "Genera of Fishes," too, has been consulted freely.

The collection of the specimens and data and the preparation of the report have extended over a long time, and so many persons have helped at one time or another to further the work that it will be impossible to give a complete list of all who have made contributions of one kind or another. The authors are particularly grateful to the former officers of the Bureau of Fisheries—namely, Dr. Hugh M. Smith, former commissioner, Dr. H. F. Moore, former deputy commissioner, and Dr. R. E. Coker, formerly in charge of scientific research, as well as to the officers succeeding them in the same positions. These gentlemen, of course, made the undertaking possible, have rendered advice and encouragement, and have been patient with us, as the preparation of the report (the writers claim because of other duties) appeared to progress very slowly.

The work was undertaken originally by Messrs. Radcliffe and Welsh, as stated elsewhere. We have had the collections and the notes of these workers, of which we have made use freely. Mr. Radcliffe had already prepared an indexed card catalogue of the various species of fishes known from the vicinity of Maryland and Virginia when the work of preparing the report was assigned to us, and this catalogue has been of great convenience. During the later stages of the work we also received specimens and helpful data from Dr. R. P. Cowles, of Johns Hopkins University.

We are especially indebted to the Buchanan brothers—John, Roland, and Richard—of Norfolk, Va., who allowed us full freedom of their fishery at James Siding,

as well as their unusually complete records of catches made since 1908. These records are of great value in indicating the trend of the fishery with respect to species commonly taken in pound nets. Tables and graphs have been prepared from these records and they appear elsewhere in this report. Thanks also are due to the Parker-son brothers, of Ocean View, for permission to take specimens from their 1,800-foot haul-seine catches and for records of the fish taken at their fishery during the autumn of 1922. We wish to acknowledge, too, the courtesy of Messrs. E. E. Bennett and H. W. Bennett, of Bennett's North Carolina Line, Norfolk, Va., in allowing us the use of their warehouse for storing equipment. Thanks are due the fishermen of Chesapeake Bay generally for their interest in this work and for their helpfulness in giving information and in securing specimens.

We wish to thank Dr. Edward Linton, of Augusta, Ga., for examining the contents of a large number of stomachs of various species of fishes. Much valuable assistance also was rendered by Thomas K. Chamberlain, now director of the United States Fisheries Biological Station at Fairport, Iowa, and by Isaac Ginsburg and Irving L. Towers, junior aquatic biologists with the Bureau of Fisheries. Mr. Chamberlain assisted us in arranging the collection and notes in order to make both readily accessible. Mr. Ginsburg made many of the preliminary identifications of specimens, as well as a large part of the measurements and scale and fin-ray counts, etc., used in the descriptions. Mr. Towers examined stomach contents, assisted in the preparation of many of the tables included in the report, and made the final drafts of nearly all of the graphs and several of the drawings of fishes appearing in the report.

LITERATURE ON FISHES OF CHESAPEAKE BAY

The most comprehensive work on the fishes of Chesapeake Bay is the List of Fish of Maryland, by P. R. Uhler and Otto Lugger, published by the Maryland Fish Commission in 1876 in the report of the commissioner of fisheries to the governor, on pages 83 to 208, and dated January 1, 1876. The second edition of the list appeared the same year, in a reprint, with few alterations, of the same report. The list in the reprint occurs on page 69 to 176. This work, however, is much more than a "list" of fishes of Maryland, for a description (often very inadequate) for every species is offered, together with a brief synonymy, common names, and notes on occurrence, abundance, habits, etc. Nor do the authors confine themselves merely to the fishes of Maryland. "A Catalogue of the Fishes of Maryland and Virginia" would have been a much more appropriate title for this work. This catalogue was supplemented in 1877 by Otto Lugger, through the addition of 29 species, and again in 1878 with 10 species.

Shorter lists, with notes on the fishes from various sections of Chesapeake Bay, were prepared by the following authors: Tarlton H. Bean, 1883; Barton A. Bean, 1891; Hugh M. Smith, 1892; and Barton W. Evermann and Samuel F. Hildebrand, 1910. Complete titles and references to the publications by these authors are given in the bibliography.

Several species of fishes from Chesapeake Bay also are mentioned in various lists by Henry W. Fowler. References to these lists will be found in the text under the particular species that this author mentions. Notes on the species propagated on

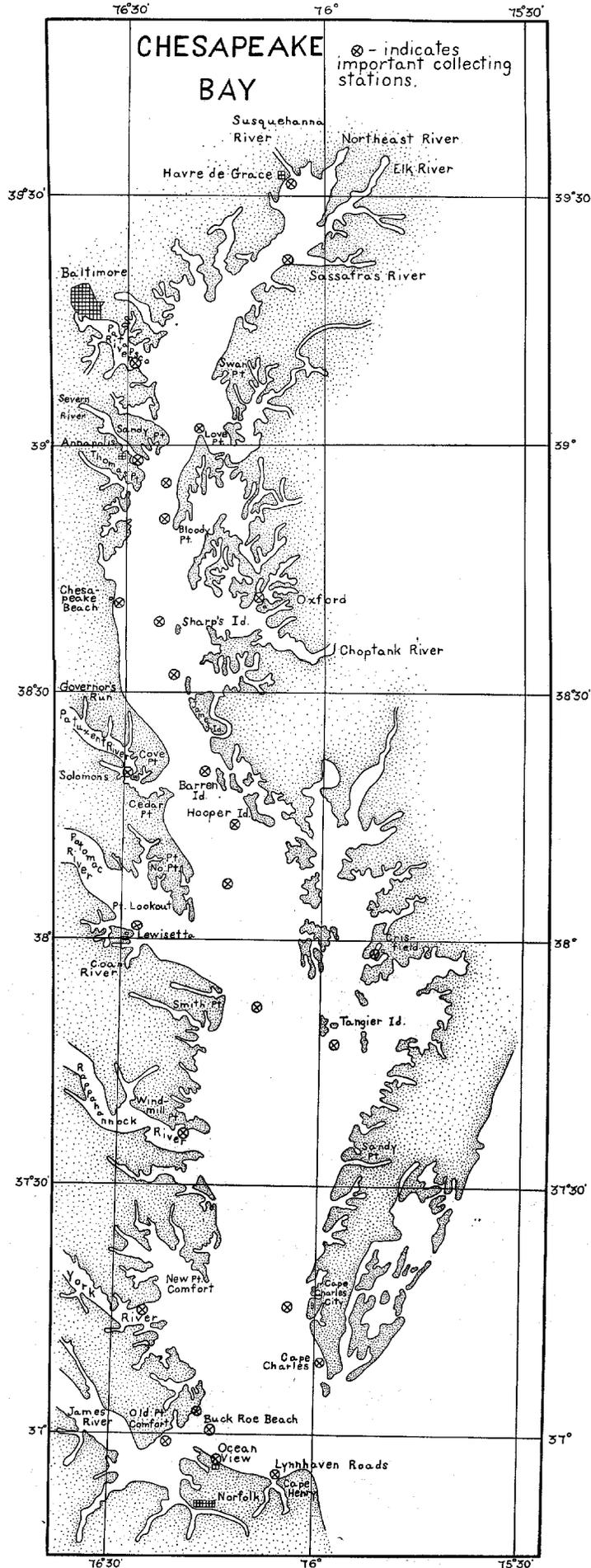


FIG. 1.—Map of Chesapeake Bay

Chesapeake Bay and tributary streams are scattered through the numerous reports of the United States Fish Commission and those of the fish commissions of Maryland and Virginia. Finally, various fishes from Chesapeake Bay are mentioned in an array of miscellaneous papers. Some of these are short and deal with a single fish, others are of a general nature, and one or more Chesapeake fishes are mentioned more or less incidentally. References to such publications occur in appropriate places in the text, and the complete titles are included in the bibliography.

GENERAL CHARACTER OF THE FAUNA

The fishes of Chesapeake Bay are not of a peculiar or distinctive type. It will be seen from the following table that of the 202 species described the great majority range both north and south of Chesapeake Bay. Present information indicates that the bay is the stopping point for 27 species of southern distribution, whereas only 12 species of northern distribution reach their southernmost range in Chesapeake Bay. One species, recently described, and four new species described in the present work, so far as known to date, are the only ones peculiar to Chesapeake Bay. We have included 44 species that do not appear to have been recorded previously from Chesapeake Bay. Other species undoubtedly will be taken, probably as stragglers, from time to time, as not a few coastwise species range both north and south of the entrance to Chesapeake Bay but have not been observed to date within the bay by a naturalist. Such species, of course, may stray past the capes and into the bay at almost any time.

The anadromous species, chief among which are the shad, alewives, and the striped bass, are especially numerous, and they constitute a very important part of the products of the fisheries of Chesapeake Bay. They are particularly important in that section of the bay lying within the State of Maryland, as many of the more strictly salt-water species common in the southern sections of the bay do not reach the Maryland waters in large numbers.

Distribution of species

[An X in the first column indicates that the species ranges both north and south of Chesapeake Bay; an X in the second column shows that it is found in Chesapeake Bay and southward, only; an X in the third column shows that it is found in Chesapeake Bay and northward, only; and an X in the last column shows that, to date, it has been taken only in Chesapeake Bay]

| Species | North and south | South only | North only | Chesapeake Bay only | Species | North and south | South only | North only | Chesapeake Bay only |
|-----------------------------|-----------------|------------|------------|---------------------|------------------------------------|-----------------|------------|------------|---------------------|
| Branchiostoma virginiae | | | | X | Paralichthys dentatus | X | | | |
| Petromyzon marinus | X | | | | Limanda ferruginea | | | X | |
| Ginglymostoma cirratum | | X | | | Pseudopleuronectes americanus | X | | | |
| Carcharodon carcharias | X | | | | Lophopsetta maculata | X | | | |
| Mustelus mustelus | X | | | | Etropus microstomus | X | | | |
| Carcharhinus milberti | X | | | | Etropus crossotus | | X | | |
| Scoliodon terraenovae | X | | | | Neotropus macrops gen. et sp. nov. | | | | X |
| Sphyrna zygaena | X | | | | Achirus fasciatus | X | | | |
| Sphyrna tiburo | X | | | | Symphurus plagiata | | X | | |
| Squalus acanthias | X | | | | Gasterosteus aculeatus | | | X | |
| Squatina dumeril | X | | | | Apeltes quadracus | | | | X |
| Pristis pectinatus | X | | | | Syngnathus fuscus | X | | | |
| Raja diaphanes | | | X | | Syngnathus floridae | | | | |
| Raja eglanteria | X | | | | Syngnathus louisiana | | X | | |
| Raja stiballiforis | X | | | | Hippocampus hudsonius | X | | | |
| Raja erinacea | X | | | | Fistularia tabacaria | X | | | |
| Torpedo nobiliana | X | | | | Menidia menidia | X | | | |
| Dasyatis centrura | X | | | | Menidia beryllina | X | | | |
| Dasyatis americana sp. nov. | X | | | | Membras vagrans | X | | | |
| Dasyatis say | X | | | | Mugil cephalus | X | | | |
| Dasyatis sabina | | X | | | Mugil curema | X | | | |
| Pteroplatea micrura | X | | | | Sphyræna guachancho | X | | | |
| Myliobatis freminvillei | X | | | | Sphyræna borealis | X | | | |
| Aetobatus narinari | | X | | | Polynemus octonemus | X | | | |
| Rhinoptera quadriloba | X | | | | Scomber scombrus | X | | | |
| Manta birostris | X | | | | Pneumatophorus collaris | X | | | |
| Acipenser oxyrinchus | X | | | | Scomberomorus maculatus | X | | | |
| Acipenser brevirostrum | X | | | | Scomberomorus regalis | X | | | |
| Lepisosteus osseus | X | | | | Sarda sarda | X | | | |
| Elops saurus | X | | | | Thunnus thynnus | X | | | |
| Tarpon atlanticus | X | | | | Trichiurus lepturus | X | | | |
| Clupea harengus | X | | | | Xiphias gladius | X | | | |
| Pomolobus mediocris | X | | | | Peprilus alepidotus | X | | | |
| Pomolobus aestivalis | X | | | | Poronotus triacanthus | X | | | |
| Pomolobus pseudoharengus | X | | | | Selar crumenophthalmus | X | | | |
| Alosa sapidissima | X | | | | Seriola dumeril | X | | | |
| Opisthonema oglinum | X | | | | Oligoplites saurus | X | | | |
| Brevoortia tyrannus | X | | | | Chloroscombrus chrysurus | X | | | |
| Dorosoma cepedianum | X | | | | Caranx hippos | X | | | |
| Anchoviella mitchilli | X | | | | Caranx crysos | X | | | |
| Anchoviella epsetus | X | | | | Caranx latus | | X | | |
| Anguilla rostrata | X | | | | Alectis ciliaris | X | | | |
| Conger conger | X | | | | Selene vomer | X | | | |
| Erimyzon sucetta | X | | | | Vomer setipinnis | X | | | |
| Minytrema melanops | X | | | | Trachinotus falcatus | X | | | |
| Catostomus commersonii | X | | | | Trachinotus glaucus | | X | | |
| Cyprinus carpio | X | | | | Trachinotus carolinus | X | | | |
| Notemigonus crysoleucas | X | | | | Pomatomus saltatrix | X | | | |
| Hybognathus nuchalis | X | | | | Rachycentron canadus | X | | | |
| Notropis hudsonius amarus | | | X | | Perca flavescens | X | | | |
| Notropis bifrenatus | | | X | | Boleosoma olmstedii | X | | | |
| Fellichthys felis | X | | | | Pomoxis annularis | X | | | |
| Amelurus catus | X | | | | Enneacanthus gloriosus | X | | | |
| Synodus foetens | X | | | | Lepomis gibbosus | X | | | |
| Esox reticulatus | X | | | | Micropterus dolomieu | X | | | |
| Esox americanus | X | | | | Micropterus salmoides | X | | | |
| Cyprinodon variegatus | X | | | | Morone americana | X | | | |
| Lucania parva | X | | | | Roccus lineatus | X | | | |
| Fundulus heteroclitus | X | | | | Mycteroperca microlepis | | X | | |
| Fundulus majalis | X | | | | Centropristes striatus | X | | | |
| Fundulus ocellaris | | X | | | Priacanthus aetnatus | X | | | |
| Fundulus diaphanus | X | | | | Pseudopriacanthus altus | X | | | |
| Fundulus luciae | X | | | | Labotes surinamensis | X | | | |
| Gambusia holbrooki | X | | | | Liathanus griseus | X | | | |
| Tylosurus marinus | X | | | | Orthopristis chrysopterus | X | | | |
| Tylosurus acus | X | | | | Haemulon plumieri | | | X | |
| Abiennes hians | X | | | | Bathystoma rimator | | | X | |
| Scomberesox saurus | X | | | | Stenotomus chrysops | X | | | |
| Hyporhamphus unifasciatus | X | | | | Stenotomus aculeatus | | X | | |
| Hemiramphus brasiliensis | | X | | | Legodon rhomboides | X | | | |
| Exocoetus heterurus | X | | | | Archosagus probatocephalus | X | | | |
| Pollachius virens | X | | | | Diplodus holbrooki | | X | | |
| Gadus callarias | X | | | | Kyphosus sectatrix | X | | | |
| Urophycis chuss | X | | | | Eucinostomus californiensis | | X | | |
| Urophycis regius | X | | | | Eucinostomus gula | X | | | |
| Merluccius bilinearis | X | | | | Leiostomus xanthurus | X | | | |

Distribution of species—Continued

| Species | North and south | South only | North only | Chesapeake Bay only | Species | North and south | South only | North only | Chesapeake Bay only |
|--|-----------------|------------|------------|---------------------|---|-----------------|------------|------------|---------------------|
| <i>Sciaenops ocellatus</i> | X | | | | <i>Gobiosoma bosci</i> | X | | | |
| <i>Larimus fasciatus</i> | X | | | | <i>Gobiosoma ginsburgi</i> sp. nov..... | | | | X |
| <i>Bairdiella chrysura</i> | X | | | | <i>Microgobius holmesi</i> | | X | | |
| <i>Stellifer lanceolatus</i> | | X | | | <i>Microgobius eulepis</i> | | X | | |
| <i>Micropogon undulatus</i> | X | | | | <i>Mugilostoma goblo</i> gen. et sp. nov..... | | | | X |
| <i>Pogonias cromis</i> | X | | | | <i>Echeneis naucrates</i> | X | | | |
| <i>Umbrina coroides</i> | X | | | | <i>Astroscopus guttatus</i> | X | | | |
| <i>Menticirrhus saxatilis</i> | X | | | | <i>Chasmodes bosquianus</i> | X | | X | |
| <i>Menticirrhus americanus</i> | X | | | | <i>Hypsoblennius hentz</i> | | X | | |
| <i>Menticirrhus littoralis</i> | | X | | | <i>Biennius fuorum</i> | | | | |
| <i>Cynoscion nebulosus</i> | X | | | | <i>Rissola marginata</i> | X | | | |
| <i>Cynoscion nothus</i> | | X | | | <i>Opsanus tau</i> | X | | | |
| <i>Cynoscion regalis</i> | X | | | | <i>Gobiosox strumosus</i> | | X | | |
| <i>Lopholatilus chamaeleonticeps</i> | | | X | | <i>Ballistes carolinensis</i> | | | | |
| <i>Chaetodipterus faber</i> | X | | | | <i>Monacanthus hispidus</i> | X | | | |
| <i>Chaetodon ocellatus</i> | X | | | | <i>Ceratacanthus schoepfi</i> | X | | | |
| <i>Hemirhamphus americanus</i> | | | X | | <i>Lactophrys trigonus</i> | X | | | |
| <i>Cyclopterus lumpus</i> | | | X | | <i>Lagocephalus laevigatus</i> | X | | | |
| <i>Prionotus evolans</i> | X | | | | <i>Tetraodon maculatus</i> | X | | | |
| <i>Prionotus carolinus</i> | X | | | | <i>Tetraodon testudineus</i> | X | | | |
| <i>Prionotus affinis</i> sp. nov..... | X | | | X | <i>Diodon hystrix</i> | X | | | |
| <i>Cephalacanthus voltans</i> | X | | | | <i>Chilomycterus schoepfi</i> | X | | | |
| <i>Tautoga onitis</i> | X | | | | <i>Lophius piscatorius</i> | X | | | |
| <i>Tautoglabrus adspersus</i> | | | X | | <i>Histrio histrio</i> | X | | | |
| <i>Scarus caeruleus</i> | | X | | | <i>Ogocephalus vespertilio</i> | | X | | |

GENERAL STATISTICS¹ AND REMARKS ON FISHERIES OF CHESAPEAKE BAY

Fishing in Chesapeake Bay is confined almost wholly to the period extending from about March 1 to November 1. Activities begin in the lower sections of the bay early in March, whereas the fishermen at the head of the bay usually do not set their nets until early in April. The first catches of the season consist of shad and herring, which arrive at the entrance about a month earlier than at the head of the bay. The first catches generally are small but remunerative, because they bring fancy prices, and therefore the nets are set early enough to intercept the earliest arrivals.

The biological fact that, exclusive of the rockfish, the white perch, the common eel, and a few other species of little importance, the commercial fishes leave the bay during the fall of each year and return the following spring is brought out in the discussions of the various species. This migration leaves the waters of the bay largely barren of fish during the winter months, and it is for that reason that nearly all fishing operations are discontinued by about the 1st of November and are resumed the following March or April, when the fish begin to return. The earliest to arrive, as already shown, are the shad and herrings, followed rather shortly by the croaker, kingfish, and several other species.

¹ The statistical data given here and elsewhere in this work, unless otherwise stated, are largely taken from the reports of the United States Commissioner of Fisheries. Since the statistics are given by counties in these reports, it was necessary to estimate the part taken within the bay proper for those counties not wholly on Chesapeake Bay. However, the original working sheets on which the data were compiled were available in the Bureau of Fisheries for our use for the statistics of 1920. These sheets contained the catches by localities, and for this year we were able to obtain fairly definite figures on the amount taken within the bay; and for those years where the amounts for certain counties had to be estimated, the relative proportion of 1920 was used in arriving at the estimated quantities taken within the bay itself. It is quite certain, however, that the figures are approximately correct. It will be noticed, also, that in some instances the figures given in the present report have been reduced to round numbers.

The quantity and value of each species of food fish taken in Chesapeake Bay during 1920 and apportioned between the States of Maryland and Virginia are given in the following table:

Value and weight of food fishes taken in Chesapeake Bay in 1920¹

| Common name | Scientific name | Maryland | | | | Virginia | | | | Entire Bay | | | |
|-----------------------------|---|------------|------|-----------|------|------------|------|-----------|------|------------|------|-----------|------|
| | | Pounds | Rank | Value | Rank | Pounds | Rank | Value | Rank | Pounds | Rank | Value | Rank |
| Alewives | <i>Pomolobus aestivalis</i> | 6,604,891 | 1 | \$163,544 | 3 | 16,381,267 | 1 | \$253,424 | 4 | 22,986,158 | 1 | \$416,968 | 2 |
| | <i>P. pseudoharengus</i> | | | | | | | | | | | | |
| Croaker | <i>Micropogon undulatus</i> | 1,130,590 | 2 | 31,693 | 6 | 13,039,795 | 2 | 361,479 | 2 | 14,170,385 | 2 | 368,162 | 2 |
| Shad | <i>Alosa sapidissima</i> | 1,816,346 | 3 | 344,110 | 1 | 7,257,987 | 3 | 1,138,184 | 1 | 9,074,332 | 3 | 1,452,294 | 1 |
| Squeteague | <i>Cynoscion regalis</i> | 678,470 | 5 | 43,143 | 2 | 7,240,243 | 4 | 345,953 | 3 | 7,918,713 | 4 | 390,101 | 4 |
| Rockfish | <i>Roccus lineatus</i> | 1,040,274 | 4 | 193,295 | 2 | 370,366 | 5 | 68,623 | 5 | 1,410,639 | 5 | 261,918 | 5 |
| Butterfish | <i>Poronotus triacanthus</i> | 15,062 | 14 | 603 | 15 | 1,263,666 | 6 | 42,000 | 7 | 1,278,628 | 6 | 42,603 | 6 |
| Spot | <i>Leiostomus xanthurus</i> | 51,692 | 8 | 3,133 | 9 | 786,163 | 6 | 60,000 | 6 | 837,845 | 7 | 63,136 | 7 |
| White perch | <i>Morone americana</i> | 316,915 | 6 | 32,026 | 5 | 218,165 | 12 | 19,898 | 9 | 534,983 | 8 | 51,914 | 8 |
| Spotted squeteague | <i>Cynoscion nebulosus</i> | 20,000 | 13 | 2,000 | 11 | 418,797 | 7 | 41,879 | 8 | 438,797 | 9 | 44,879 | 9 |
| Starfish | <i>Pepilus alepidotus</i> | 3,765 | 17 | 150 | 17 | 315,916 | 9 | 10,500 | 13 | 319,416 | 10 | 10,650 | 13 |
| Eel | <i>Anguilla rostrata</i> | 197,293 | 7 | 21,395 | 7 | 120,716 | 14 | 12,309 | 12 | 313,608 | 11 | 33,704 | 10 |
| Flounder | <i>Paralichthys dentatus</i> | 29,749 | 12 | 1,150 | 13 | 258,354 | 10 | 12,613 | 11 | 288,103 | 12 | 13,763 | 11 |
| Mullet | <i>Mugil cephalus and curama</i> | 35,837 | 10 | 1,801 | 12 | 246,683 | 11 | 8,346 | 14 | 282,020 | 13 | 10,207 | 14 |
| Hickory shad | <i>Pomolobus medocris</i> | 2,100 | 18 | 95 | 18 | 216,520 | 13 | 8,150 | 15 | 218,670 | 14 | 8,245 | 15 |
| Gizzard shad | <i>Dorosoma cepedianum</i> | 20,067 | 11 | 913 | 14 | 42,785 | 16 | 1,100 | 21 | 72,852 | 15 | 2,013 | 20 |
| Winter flounder | <i>Pseudopleuronectes americanus</i> | 40,119 | 9 | 4,012 | 8 | 13,600 | 21 | 1,360 | 20 | 53,719 | 16 | 5,372 | 17 |
| Bluefish | <i>Pomatomus saltatrix</i> | 14,989 | 15 | 2,112 | 10 | 36,979 | 16 | 4,925 | 16 | 51,968 | 17 | 7,037 | 16 |
| Hogfish | <i>Orthopristis chrysopterus</i> | | | | | 31,735 | 17 | 2,348 | 17 | 31,723 | 18 | 2,348 | 18 |
| Sturgeon (including caviar) | <i>Acipenser oxyrinchus</i> | 734 | 19 | 259 | 16 | 24,806 | 18 | 12,712 | 10 | 25,542 | 19 | 12,971 | 17 |
| Black drum | <i>Pogonias cromis</i> | 700 | 20 | 8 | 21 | 23,000 | 19 | 230 | 26 | 23,700 | 20 | 238 | 27 |
| King whiting | <i>Menticirrhus saxatilis, americanus, and littoralis</i> | | | | | 17,933 | 20 | 1,606 | 19 | 17,933 | 21 | 1,606 | 21 |
| Red drum | <i>Sciaenops ocellatus</i> | 4,835 | 16 | 76 | 18 | 12,730 | 23 | 204 | 27 | 17,565 | 22 | 280 | 26 |
| Spanish mackerel | <i>Scomberomorus maculatus</i> | 387 | 21 | 62 | 20 | 13,429 | 22 | 2,082 | 18 | 15,796 | 23 | 2,114 | 19 |
| Seup | <i>Stenotomus chrysops and aculeatus</i> | | | | | 7,165 | 24 | 582 | 22 | 7,168 | 24 | 585 | 22 |
| Sea bass | <i>Centropristes striatus</i> | | | | | 5,100 | 25 | 492 | 25 | 5,100 | 25 | 492 | 25 |
| Black bonito | <i>Rachycentron caudatus</i> | | | | | 3,808 | 26 | 368 | 28 | 5,000 | 26 | 368 | 25 |
| Whiting | <i>Merluccius bilinearis</i> | | | | | 3,000 | 27 | 60 | 34 | 3,000 | 27 | 60 | 34 |
| Tautog | <i>Tautoga onitis</i> | | | | | 2,000 | 28 | 20 | 32 | 2,000 | 28 | 20 | 32 |
| Pompano | <i>Trachinotus carolinus</i> | | | | | 1,650 | 29 | 230 | 24 | 1,650 | 29 | 230 | 24 |
| Bonito | <i>Sarda sarda</i> | | | | | 1,400 | 30 | 102 | 28 | 1,400 | 30 | 102 | 28 |
| Crevasses | <i>Caranx cryos and hippos</i> | | | | | 1,200 | 31 | 120 | 30 | 1,200 | 31 | 120 | 30 |
| Speckfish | <i>Chesodipterus faber</i> | | | | | 1,000 | 32 | 80 | 31 | 1,000 | 32 | 80 | 31 |
| Tripletail | <i>Lobotes surinamensis</i> | | | | | 1,000 | 33 | 80 | 33 | 1,000 | 33 | 80 | 33 |
| Sheepshead | <i>Archosargus probatocephalus</i> | | | | | 863 | 34 | 129 | 29 | 863 | 34 | 129 | 29 |
| Total | | 12,031,262 | | 846,635 | | 48,378,884 | | 2,412,338 | | 60,410,146 | | 3,258,973 | |

¹ Large quantities of white sand perch (*Bairdiella chrysura*) are caught in Chesapeake Bay, but only a small part of the catch is marketed. As the amount marketed can not be determined, this species is not included in the statistics for the bay.

² Estimated for 1921.

³ Estimated for 1922.

The total catch of fish taken in the salt and brackish waters of Chesapeake Bay in 1920, in round numbers, amounted to 60,000,000 pounds. Of this amount, 12,000,000 pounds, valued at \$850,000, were caught in Maryland and 48,000,000 pounds, worth \$2,400,000, were taken in Virginia. About 90 per cent of the entire catch consisted of alewives, croakers, shad, and squeteagues. According to the apparatus used, the catch may be divided as follows: Pound nets, 81½ per cent; gill nets, 7 per cent; seines, 6 per cent; fyke nets, 2 per cent; lines, 2 per cent; eel pots, one-half of 1 per cent; and miscellaneous, 1 per cent. The catch by States, expressed in per cent, according to apparatus used, may be divided as follows:

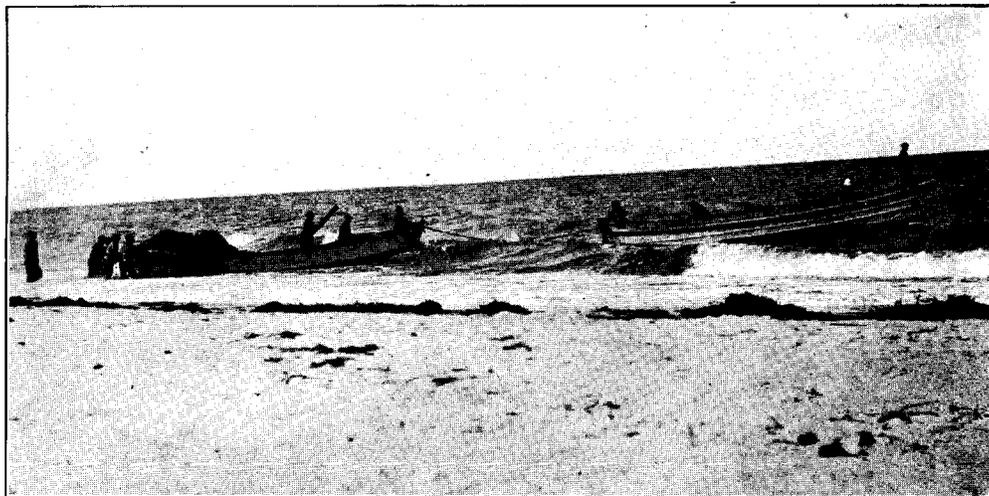


FIG. 2.—Haul-seining for spots and other fish at Ocean View, Va. The power boat towing the seine boat is about to leave the beach to pay out the 300-fathom seine

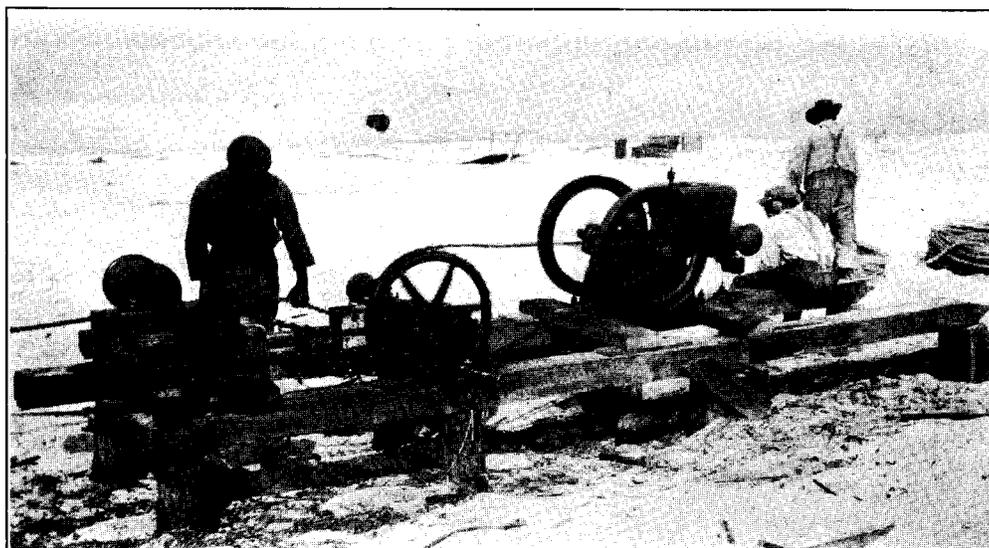


FIG. 3.—A winch, operated by a gasoline engine, is used for hauling in the seine in localities out of reach of electric power. Within Ocean View proper electric power is used. Note that only one person is required to manipulate the line as the seine is being drawn in. Later, as the seine approaches shore and man power supplants gasoline, 22 men are required

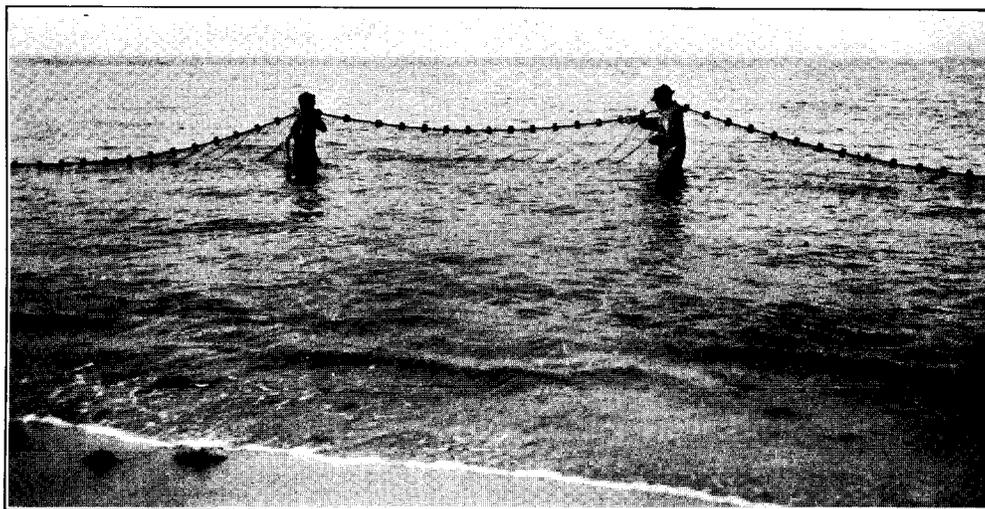


FIG. 4.—The bunt of the seine near shore. At this stage of a haul 2 or 3 men are required to foot the lead line and hold up the cork line of the bunt to prevent the fish from escaping



5.—The catch landed on the beach. In this instance the catch is small and can be drawn up on the beach in the seine. Frequently, however, when a large catch is made, the fish are bailed out with dip nets. Sometimes it requires an hour or more to remove the fish

| Apparatus | Mary- land | Virginia | Apparatus | Mary- land | Virginia |
|-----------------|-----------------|-----------------|--------------------|-----------------|-----------------|
| | <i>Per cent</i> | <i>Per cent</i> | | <i>Per cent</i> | <i>Per cent</i> |
| Pound nets..... | 68.0 | 65.0 | Lines..... | 0.5 | 2.5 |
| Seines..... | 18.0 | 3.0 | Elk pots..... | 1.5 | .2 |
| Gill nets..... | 10.0 | 4.5 | Miscellaneous..... | 1.5 | 1.0 |
| Fyke nets..... | 2.5 | 1.8 | | | |

The pound net, as shown by the data given in the preceding paragraph, is by far the most important apparatus employed in the fisheries of Chesapeake Bay. It is used throughout the bay, as well as in the lower parts of the larger tributary streams. The majority of the pound nets, particularly in the northern sections of the bay, are drawn up in midsummer, when fish, for a time, appear to be scarce, but are again operated during the autumn. Many nets are used only in the spring for catching striped bass, shad, and herrings. In the lower parts of the bay and in a few favorable localities elsewhere the nets are operated throughout the entire season—namely, from March to November. The principal species of fish taken in pound nets are indicated in tables and graphs that appear elsewhere in this report.

Seines rank next to pound nets in importance in the fisheries of Chesapeake Bay and are used almost everywhere. Seining, like pound-net fishing, is more profitable at certain seasons of the year than others. At Ocean View, Va., for example, where very large nets are used, operations do not begin until sometime in July, and large catches usually are not made until late in September or in October. Fair to large catches of spots, spotted and gray weakfish, striped bass, white perch, and occasionally bluefish and pompanoes, are taken. An unusually large catch of spots was obtained in an 1,800-foot seine at Ocean View, Va., in October, 1922, when 90,000 fish, weighing approximately 50,000 pounds, were taken in a single haul.

Gill nets appear to be somewhat less important than seines in the fisheries of the Chesapeake. They are used to a limited extent throughout the bay, however, and rather extensively in the lower Potomac, Rappahannock, and York Rivers; also in the vicinity of Love Point, Crisfield, and Cape Charles. The nets are used either as stationary nets or they are allowed to drift with the tide and current. Frequently fair to large catches of striped bass, croakers, weakfish, spots, kingfish, and bluefish are taken.

Fyke nets, too, are used almost everywhere in the bay. These nets are generally used in small coves and other places too small for pound nets and in places where pound nets are not permitted. Although the quantity of fish taken with fyke nets is comparatively small, many nets of this type are used. Nevertheless, the operation of the fyke net probably is quite remunerative, as the net itself is inexpensive and it can be fished by one man. Furthermore, the fyke net often is used far into the winter, when virtually all other methods of fishing have been abandoned. The fish caught at such times, of course, bring a fancy price. The species caught are chiefly winter flounders, white perch, yellow perch, croakers, and squeteagues.

Comparatively little hand-line fishing is done in Chesapeake Bay, because it does not appear to be as profitable as other methods. The only species that are taken almost exclusively with hand lines are the sea bass and the tautog, and of these

fish only small quantities are caught. In May and June, particularly at the mouth of the York River, croakers are caught with hand lines. This happens to be at a time when few of these fish are taken in pound nets. A limited amount of hand-line fishing for large squeteagues is done in the lower parts of the York and Rappahannock Rivers in October. About the same time many hand-line fishermen in small boats are seen off Ocean View fishing for spots, which appear to collect there, presumably preparatory to leaving the bay.

Eel pots are used throughout the Chesapeake region, but chiefly in the vicinity of the lower Choptank River and at the head of the bay. Virtually nothing except eels is caught in these traps.

In 1920 about 40,000 persons were engaged in the fisheries of Maryland and Virginia, and the shore property, boats, and gear employed (exclusive of the menhaden industry) were valued at about \$12,000,000. The property of the menhaden industry, including factories, boats, and gear, was valued at about \$5,000,000, and about 350,000,000 pounds of menhaden, worth about \$2,000,000, were caught in and near the mouth of Chesapeake Bay.

It may be of interest to make a comparison here of the catches of fish taken from Chesapeake Bay and Georges Bank, both intensively fished areas, the one protected by land and fed by numerous streams and the other in the open ocean. Chesapeake Bay and the brackish parts of its tributaries contain about 2,700 square miles and produced about 11 tons of fish per square mile in 1920, whereas Georges Bank, with an area of about 7,000 square miles, produced about 3 tons of fish to the square mile.

It is apparent from the statistics collected by the United States Bureau of Fisheries that, as a whole, no serious decline in the quantities of fish caught in Chesapeake Bay has taken place during recent years. The catch, however, probably is kept up to a certain extent through more intensive fishing and by the use of more efficient gear. It has been shown elsewhere that a much larger part (81½ per cent) of the total quantity of fish taken in Chesapeake Bay is caught with pound nets than with all other gear combined. Unfortunately, this apparatus is often very wasteful of young and undersized fish, especially if the operators are indifferent and careless. It may be said with great credit to some of the operators (as, for example, the Buchanan brothers, who run pound nets in Lynnhaven Roads, at James Siding, and others) that they are very careful to return to the water uninjured small and unmarketable fish. On the other hand, not a few pound-net operators empty the entire catch into their boats and later, at their leisure and after the fish are all dead, sort out the small fish and throw them overboard; it sometimes happens that only comparatively few fish of marketable size are contained in the catch. In fact, it is not unusual for some 5,000 young spots, croakers, or butterfish, all just slightly under marketable size, to be destroyed in one day at a set of two pound nets. Such a practice can not be condemned too strongly. Fishermen with forethought and with a sense of duty to the future will not do this, of course, but will cull their catch at the net (whenever weather conditions are not too unfavorable) and reduce the waste to a minimum.

BUCHANAN BROTHERS' FISHERY**LOCATION AND DESCRIPTION**

For over 50 years a fishery has been in existence in Lynnhaven Roads, Va., at a place now known as James Siding. This place is only about 3 miles west of Cape Henry. The fishery (herein called the Buchanan Brothers' fishery, because it is owned and has been operated during recent years by three brothers of that name), therefore, is near the entrance of Chesapeake Bay.

Pound nets and seines only have been used in this fishery, and they have always been operated in the same immediate vicinity and no evident physical changes have taken place during the period (1908 to 1922) for which statistics are available.

RECORDS OF THE FISHERY AND THE GEAR EMPLOYED

Records of the quantities of fish caught at this fishery have been kept for many years in the form of duplicate bills of lading. The amounts listed, therefore, are quite accurate, as the fish are shipped by rail directly from the fishery at James Siding to Norfolk. In general, if 10 pounds or more of any one species were included in the shipment, the species was listed separately. The only discrepancy that occurs is in small catches consisting of only a few pounds, for these were listed as "mixed" fish.

Through the courtesy of the Buchanan brothers we have had free access to the records, which are complete for most of the species (exclusive of 1911) since 1908. Subsequent to the close of the field work in 1922, the records of the shad caught in 1923 also were obtained.

Unfortunately for our purpose, the statistics from the fishery, for all the species taken, are not directly comparable for the entire period covered, as the gear was not uniformly employed. From 1908 to 1911 a set of two pound nets was operated from early March until about July 20, and for the remainder of the season, or until about the 1st of November, an 1,800-foot haul seine alone was used. From 1912 to 1917 a set of two pound nets was operated throughout the season, and in addition an 1,800-foot seine was used after about July 20. Finally, from 1918 to 1922 a set of two pound nets alone was used throughout the fishing seasons. Since the pound nets alone were used during the spring—that is, during the shad and herring runs—throughout the period of years covered by the records, the changes in apparatus do not apply to these species, and for them the data are directly comparable. Similarly, the data for the months of March, April, May, and June, for all the species, are directly comparable.

VALUE OF THE RECORDS

Tables and graphs (in so far as they seemed useful) have been prepared from the statistics in order to show the yearly fluctuations and the trend of the various species caught at this fishery. Regardless of the change in the apparatus employed, it seems probable that the tables serve the purpose not only of showing the trend in the abundance of the species commonly caught in pound nets in Lynnhaven Roads, but that, in a measure, they may reflect the general rise and fall in the abundance of these species over a series of years for the entire bay. We are unable to produce definite proof for the last-mentioned hypothesis as no statistics (exclusive of those

of 1909 and 1915 for the shad and herrings) covering the vicinity of the bay are available for comparison from 1908 to 1920. In comparing the Bureau of Fisheries statistics for 1908, 1909, 1915, 1920, and 1921, published in Appendix IX of the report of the United States Commissioner of Fisheries for 1922 (p. 85), for the shad and herrings, with those compiled from the records of the Buchanan brothers' fishery, it is seen that (disregarding changes in the gear used or in the number of men and boats employed in the fishery for the entire bay) the general downward trend for both shad and herrings is reflected in each group of statistics. For individual years, however, the statistics do not always agree; as, for example, the bureau's records show a larger catch for 1908 than for 1909. The records of the fishery under consideration, on the other hand, show that the larger catch there was made in 1909. Both sets of statistics, however, show that a very small catch was taken in 1915 and that better catches were made in 1920 and 1921. Nevertheless, the banner year (1921) at the Buchanan brothers' fishery is not reflected for the rest of the bay, as the bureau's report shows a larger catch for 1920 than for 1921.

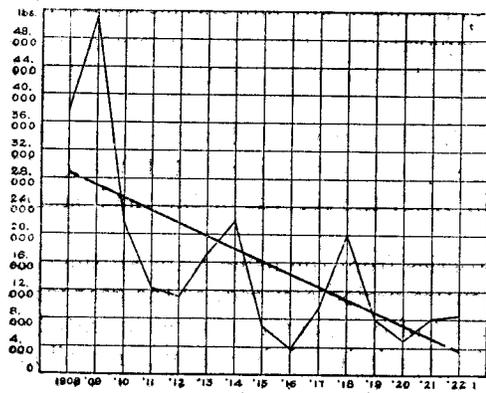


FIG. 6.—Graphic representation of the number of pounds of herrings (*Pomolobus pseudoharengus* and *P. setirostris*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by years. The straight, heavy line shows the general trend in the quantities caught

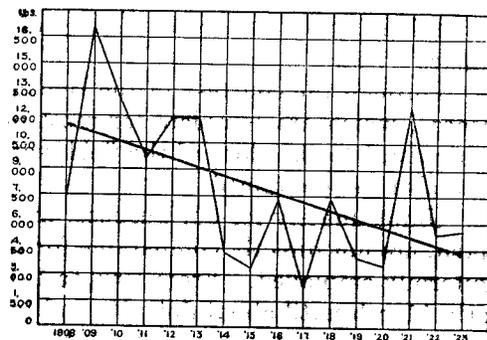


FIG. 7.—Graphic representation of the number of pounds of shad (*Alosa sapidissima*) taken from 1908 to 1922 at Buchanan Bros. fishery, arranged by years. The straight, heavy line shows the general trend in the quantities caught

For the herrings, as for the shad, when individual years are compared the banner years at the fishery do not always correspond with the better years for the bay generally; as, for example, the catch at the fishery in 1909 was larger than that for 1908. The bureau's statistics for those years, nevertheless, show a larger catch in 1908 than in 1909. A small catch in 1915 and a still smaller one in 1920 are indicated by both sets of statistics, and, similarly, both records show a larger catch for 1921 than for the preceding year. A further analysis of the records for the catches of shad and herrings at the fishery under discussion will be given in a succeeding paragraph.

It has been shown in the preceding paragraph that the general trend in the abundance of the shad and herrings for Chesapeake Bay appears to be reflected by the catches made at the Buchanan brothers' fishery, when statistics for a series of years are compared. No reason is evident to the writers why the same apparent fact should not hold for the other species, for which unfortunately insufficient records

are available to afford similar comparisons. Furthermore, it has been shown on page 13, as well as in the discussion of the various species, that most commercial species, including nearly all the fish that commonly are caught in pound nets, leave the bay upon the approach of cold weather in the fall and that they return the following spring. Because of the especially strategic position of the present fishery—almost within the mouth of the bay—it seems probable that a somewhat equal percentage of the entire body of migrating fish may be caught from year to year. The only exception that has been found to this supposition in the study of the records

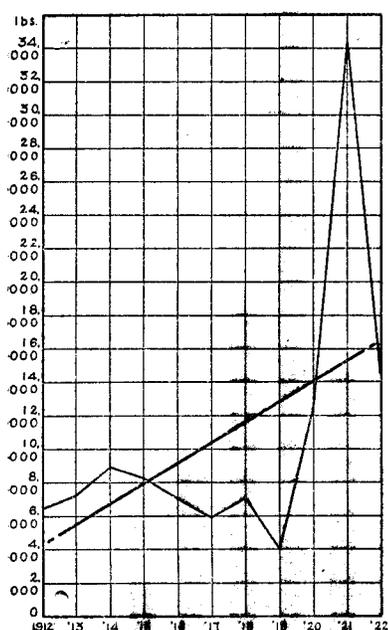


FIG. 8.—Graphic representation showing the number of pounds of summer flounders (*Paralichthys dentatus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by years. Note the apparent increase in the abundance of this fish. The straight, heavy line shows the general trend in the quantities caught

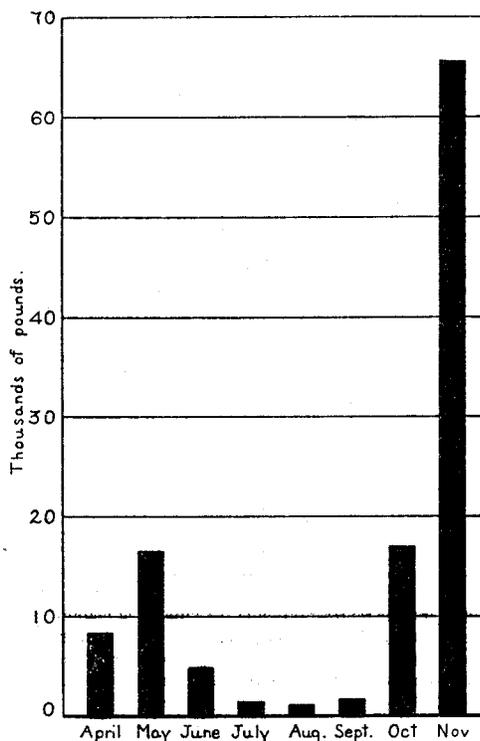


FIG. 9.—Graphic representation showing the number of pounds of summer flounders (*Paralichthys dentatus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by months

is brought about by exceptionally large catches sometimes made within the course of a day or two, when apparently large schools of fish are intercepted by the nets.

In addition to such value as the tables may have in showing the trend of the fishery, they also show at what time the various species appeared in Lynnhaven Roads in commercial abundance from year to year over the period covered by the records, and also when they again became scarce in that vicinity. These dates, in each instance, because of the location of the fishery, may be interpreted to show, in general, the time of arrival in and time of departure from the bay of the species listed.

FLUCTUATIONS IN YEARLY CATCHES

It is evident from the table and graphs that comparatively large yearly fluctuations in the catch of the various species take place. It is shown also that a species may decline seriously for a year or two and then return to occupy its previous place of importance. The common shad, for example, although suffering a general

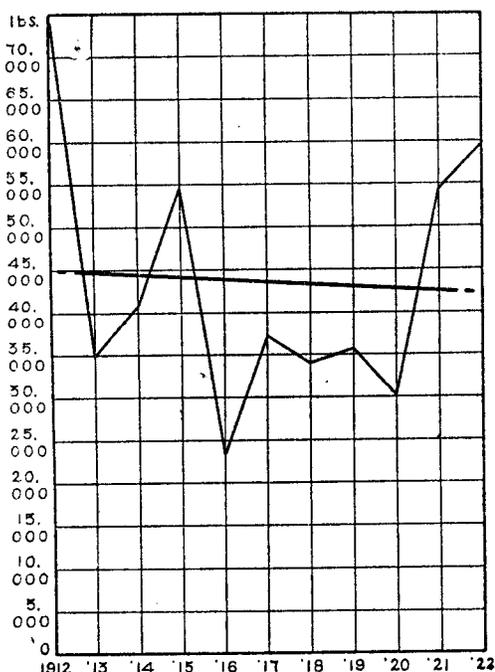


FIG. 10.—Graphic representation of the number of pounds of starfish (*Peprilus alepidotus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by years. The straight, heavy line shows the general trend in the quantities caught

decline over the series of years for which statistics are available, recovered from a new low mark (2,225 pounds) in 1917 to one of the largest catches (12,460 pounds) made in recent years in 1921. Similarly, the catch of branch and glut herring dropped to 3,800 pounds in 1916, but in 1918 it consisted of 20,020 pounds and it compared favorably with the catches made during the earlier years for which statistics are available. The next year a great decline (7,915 pounds) again took place. Somewhat similar fluctuations have taken place in the catch of nearly all the species commonly taken in pound nets in Lynnhaven Roads, and they are especially pronounced for the croaker and the kingfish.

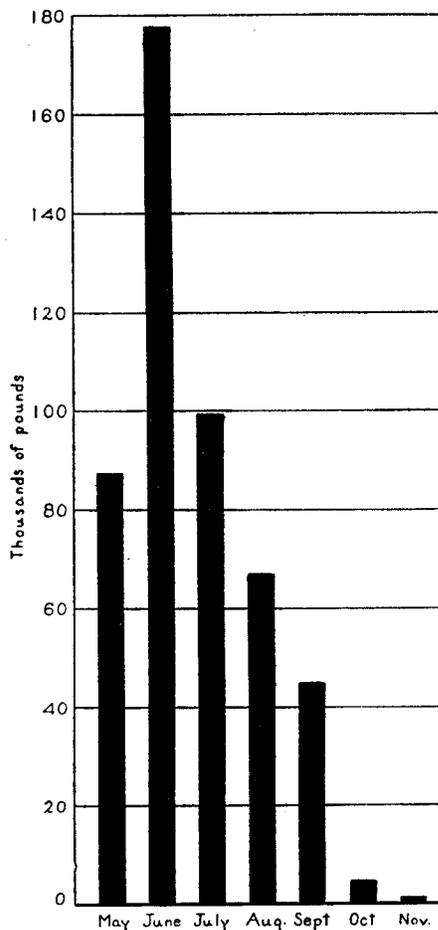


FIG. 11.—Graphic representation of the number of pounds of starfish (*Peprilus alepidotus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by months. This species is rarely taken later than the last of October

ANALYSIS OF THE DATA

Attention already has been called to the fact that, due to a change in the apparatus used, only the statistics for the shad and the herrings are directly comparable for the entire period covered. The operation of the pound nets was discontinued about July 20 and an 1,800-foot seine was used for the remainder of

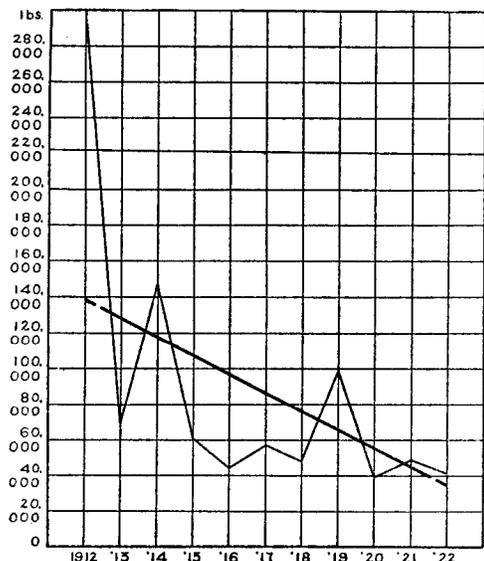


FIG. 12.—Graphic representation of the number of pounds of butterfish (*Poronotus triacanthus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by years. Although a seine, in addition to a set of two pound nets, was used from about July 20 to October, from 1912 to 1917, few fish were caught by this method, and this does not affect the final results greatly. Note the great abundance of this fish in 1912. This species was taken in large quantities throughout May and June of 1912, the largest single catch consisting of 19,400 pounds and was taken on June 25. The straight, heavy line shows the general trend in the quantities caught

the season from 1908 to 1911, because this gear, during that part of the fishing season, was thought to yield more profitable results. Then followed the period (1912 to 1917) when the pound nets were operated throughout the fishing season, and in addition an 1,800-foot seine was used after about July 20 until the close of the fishing season, and thereafter pound nets only were used. It is probable that a larger quantity of fish was caught with the seine than would have been taken with the pound nets during the same number of fishing seasons, and the annual catch undoubtedly was considerably increased for most of the species from 1912 to 1917 by the operation of both gears. The tables and graphs for all the species, exclusive of the shad and herrings, therefore, must not be interpreted too literally, as the

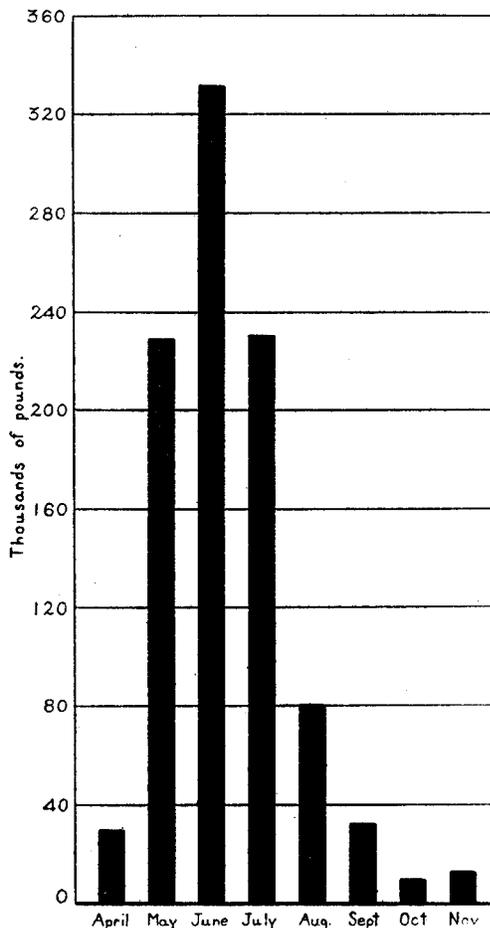


FIG. 13.—Graphic representation of the number of pounds of butterfish (*Poronotus triacanthus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by months

decline shown for those species for which the catch has diminished quite certainly is not as pronounced as indicated. On the other hand, in those species where an upward trend is shown, regardless of the discontinuance of the use of the seine, the increase very probably is greater than shown.

In summing up the statistics it may be concluded that an unmistakable and definite decline has taken place for the shad and herrings for the period covered. The decline, based on the average yearly catch for the first and second halves of the period covered by the statistics is 39.4 per cent for the shad and 60.2 per cent for the herrings. A very pronounced decline in the catch of shad took place in 1914 and 1915. After that time a partial recovery is shown, as averages (arrived at as

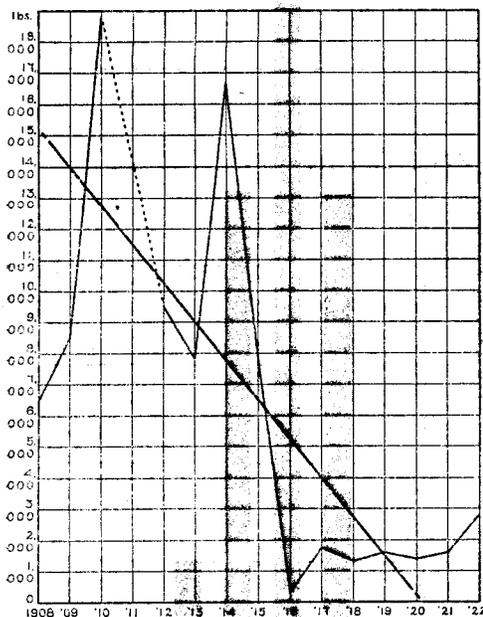


FIG. 14.—Graphic representation of the number of pounds of bluefish (*Pomatomus saltatrix*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by years. The straight, heavy line shows the general trend in the quantities caught.

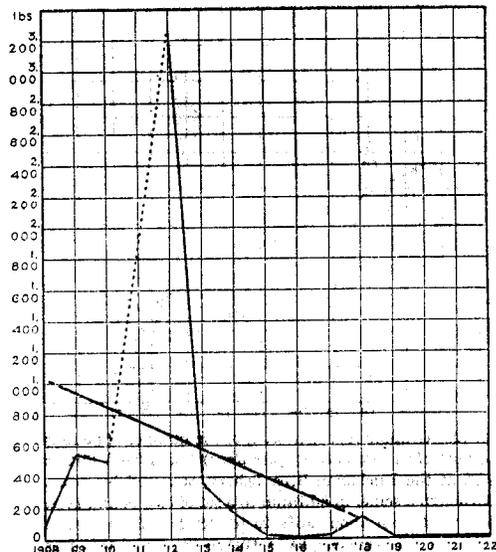


FIG. 15.—Graphic representation of the number of pounds of sheephead (*Archosargus probatocephalus*) taken at the Buchanan Bros. fishery from 1908 to 1922, arranged by years. During those years for which no catch is listed, a few, no doubt, were taken; but the daily catch consisted of less than 10 pounds and no separate record was made. The straight, heavy line shows the general trend in the quantities caught.

before) for 1914 to 1923 show an increase of 12.6 per cent. The first two years (1908 and 1909) for which data are available for the herrings appear to have been banner years and a large decline took place in 1910. The lowest mark, however, resulted in 1916. Excluding from consideration the large catches for 1908 and 1909, general averages show a decline of 34.5 per cent for the period 1910 to 1922, as compared with 60.2 per cent for the entire period. The species was rather stationary from 1915 to 1922, as only a slight increase is shown. It is at least somewhat encouraging that the shad has shown an upward trend and the herrings no further downward trend during recent years (that is, since 1915), as shown by the records of the fishery under discussion supported by the bureau's statistics for Maryland and Virginia for 1915, 1920, and 1921.

A really serious decline during recent years is shown by the records for the important commercial species known locally as the gray squeteague and the kingfishes. The squeteague was almost stationary from 1908 to 1918. Then occurred a sudden decline, which was not overcome during the next four years, or up to the end of the period for which statistics are available. The decline for the entire period (1908 to 1922) covered by the records, as shown by average yearly catches arrived at as in the preceding paragraph, was 35 per cent.



FIG. 16.—Graphic representation of the number of pounds of spots (*Leiostomus xanthurus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by years. The spot is caught in large quantities in seines during the autumn. Therefore, the smaller catches since 1918 (the seine was used in 1917, which evidently was a very poor year) do not necessarily indicate a decline in the abundance of the species. The straight, heavy line shows the general trend in the quantities caught

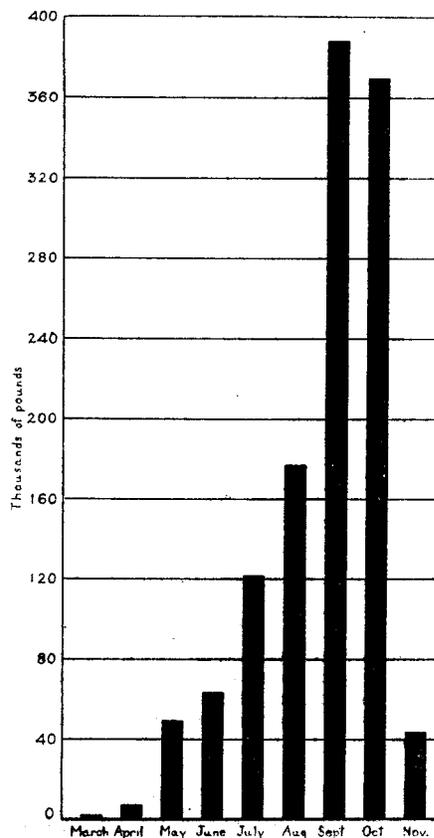


FIG. 17.—Graphic representation of the number of pounds of spots (*Leiostomus xanthurus*) taken from 1912 to 1922 at the Buchanan Bros. fishery, arranged by months. The first commercial catches of spots usually are made sometime in April. In 1920, however, the fish were caught in relatively large quantities in March

Large yearly fluctuations took place in the catch of kingfish from 1908 to 1917, the trend being upward until the banner year, 1912. Then followed a very greatly reduced catch in 1913 and another large catch in 1914. Thereafter the trend was strongly downward, the catch falling so low in 1918 that the species became of minor commercial importance in the fishery. The following year the catch was still smaller, and no recovery had taken place by the end of the period covered by the records (1922).

Very large catches of spot were made from 1912 to 1916, followed by much smaller catches, causing a decline of 55.8 per cent from 1912 to 1922, as shown by general averages. A recovery (amounting to an increase of 30 per cent) took place after the sharp decline of 1917, or from 1917 to 1922. Should these data be somewhat representative of the catches for the entire bay, some hope for the rehabilitation of the species remains.

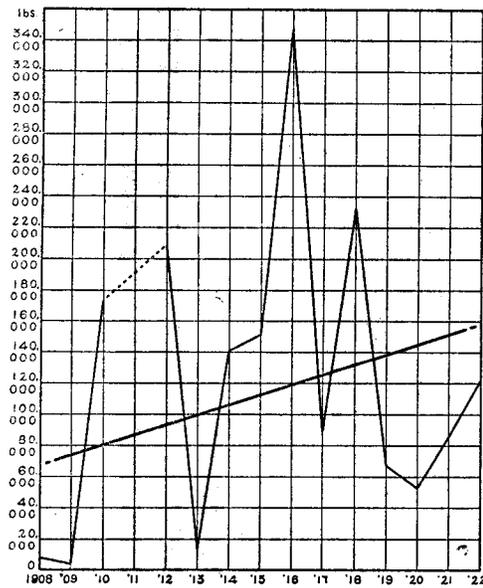


FIG. 18.—Graphic representation of the number of pounds of croakers (*Micropogon undulatus*) taken at the Buchanan Bros. fishery from 1908 to 1922, arranged by years. The straight, heavy line shows the general trend in the quantities caught

The decline for the butterfish (as shown by general averages, based on the total catch for each half of the period 1912 to 1922 for which data are at hand) is 51 per cent. This high percentage of decline is due in great measure to the enormously large catch of 1912. As this catch comes at the very beginning of the period for which we have records, it is impossible to know whether this was a much larger catch than had been taken during the preceding years and whether it should be regarded as an unusually large catch. Omitting the data for 1912 and calculating the decline for the remainder of the years by means of averages, it amounts to 27 per cent. From 1915 to 1922 an upward trend of 8.6 per cent took place, showing that during recent years no further decline has occurred in the catch at this fishery.

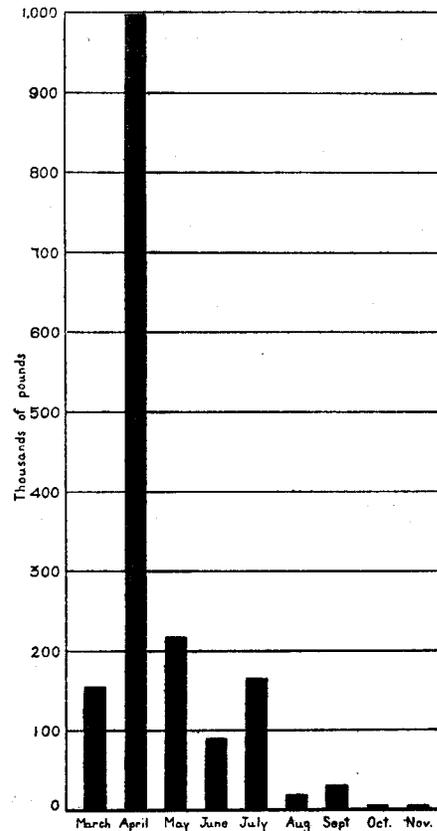
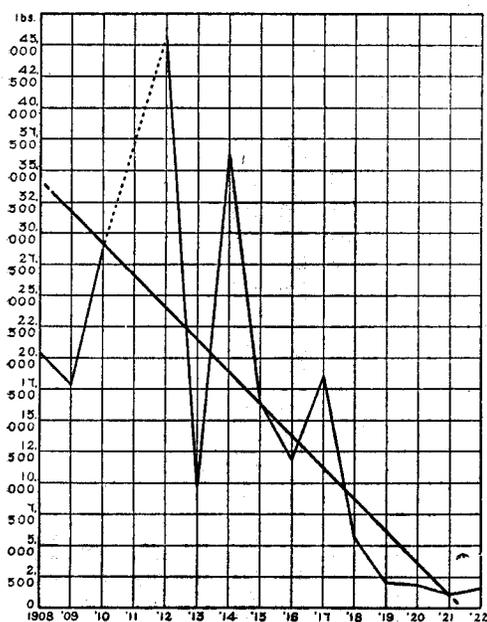


FIG. 19.—Graphic representation of the total number of pounds of croakers (*Micropogon undulatus*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by months. This graph should not be interpreted to signify that croakers are scarce or absent in the bay during the summer and autumn, for this does not appear to be true, as they are taken in fair numbers with hand lines at this time. A seasonal change in their habits is suggested

The starfish does not appear to have undergone a general decline. Comparatively large fluctuations have taken place, however. The largest yearly catch for the period 1912 to 1922, for which records are available, occurred in 1912. Here, as with the butterfish, it is impossible to know whether this is a "normal" catch as compared with immediately preceding years. The smallest catch for the entire period was made in 1916, and from the beginning of the period to that time the trend was decidedly downward, and thereafter it was definitely upward. A trend based on the average of the total catch for each half of the entire period shows a decline of 3.4 per cent. Determining a trend in the same way (omitting, however, the catch for 1912), an increase of 12 per cent is evident.



20.—Graphic representation of the number of pounds of kingfish (*Menticirrhus americanus*, *M. saxatilis*, and *M. littoralis*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by years. The quantities of kingfish caught in seines, when they were operated, was rather insignificant, and in any event did not affect the catches made during the spring, when the largest quantities were taken. A pronounced decline in the abundance of the kingfishes, therefore, is certain and undeniable. The straight, heavy line shows the general trend in the quantities caught

1916, and thereafter a decline took place. The increase for the entire period (1908 to 1922) for which statistics are at hand is 42.6 per cent, as shown by general averages of the catch arrived at as before.

The catch of summer flounders was quite stationary from 1912 to 1918. In 1919 a considerable decline took place. This small catch, however, was followed by large catches during the next three years. The increase of the catch of the second half over that of the first half of the period (1912 to 1922) for which records are at hand

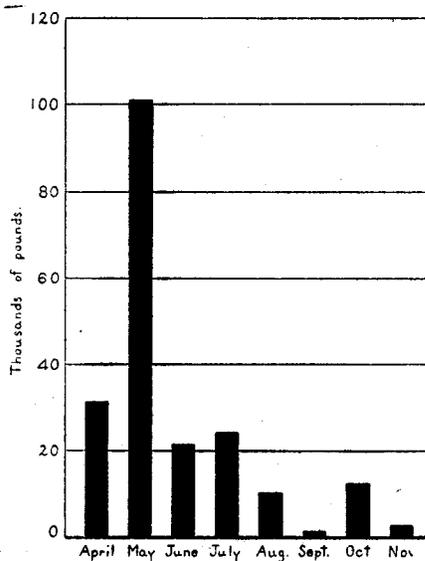


Fig. 21.—Graphic representation of the number of pounds of kingfish (*Menticirrhus americanus*, *M. saxatilis*, and *M. littoralis*) taken from 1908 to 1922 at the Buchanan Bros. fishery, arranged by months. This species usually is taken in commercial quantities first sometime during April.

Very large fluctuations have occurred in the catch of croakers. The catches for 1908, 1909, and 1913 were almost negligible. Later followed some very large catches, the largest being taken in 1916. An upward trend is evident from 1908 to