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United States Research in the Convention Area during 1960

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Market sampling of the major species landed from the Convention Area continued at all important ports. Research samples of bottom fish, samples of bottom fauna, and hydrographic observations were made on eight cruises of the research vessel Delaware and on two cruises of a charter vessel.

Haddock (*Melanogrammus aeglefinus* (L.))

The fishery. The abundance of haddock on Georges Bank and the landings in 1960 were higher than in the previous two years (Table 1). This was due largely to the abundance of the 1958 year-class which contributed heavily to the catch as 2-year-old scrod. Scrod comprised about 50 percent of the landings in 1960 compared to about 47 percent in 1959. The increase in landings occurred in spite of a drop in effort. The age composition of the landings for the last three years is shown in Figure 1.

Table 1. Trends in the Georges Bank haddock fishery

Year	Landings (thousands of pounds)	Days fished	Average Landings per day (pounds)
1951	91,508	6,490	14,098
1952	83,645	5,933	14,098
1953	69,476	6,511	10,671
1954	89,710	5,807	15,448
1955	78,942	5,059	15,603
1956	94,505	6,794	13,910
1957	89,251	8,050	11,087
1958	68,655	7,836	8,761
1959	69,350	9,432	7,353
1960	72,600*	6,368	11,461

*Preliminary - based on 9 months' data.

The fishery should improve in 1961 as the fish in the 1958 year-class grow to larger size. Fall survey cruises designed to assess the abundance of pre-recruit haddock showed low numbers of young-of-the-year (1960 year-class). Thus, it is expected that scrod landings will drop in 1962, which may possibly have an effect on total landings, depending upon the abundance of the 1958 year-class which will then be four years old.

Tagging. Tagging records were analyzed to determine the effect of the condition of the fish at time of tagging upon numbers of returns. Preliminary results indicated fewer recaptures of fish with evidence of scale loss or subcutaneous bleeding as compared with undamaged fish at time of tagging.

Another analysis was made to compare percentage return of different types of tags. Percentage returns were twice as high for spaghetti tags as for Petersen disc tags whether inserted in the dorsum or the operculum. These tagging experiments were conducted in Divisions 4X and 5Z.

Age determination. Age analysis of special collections of scales and otoliths from groundfish surveys and from routine port collections continues for comparative age and growth studies.

A critical review of the scale method for haddock age determinations was completed.

Cod (*Gadus morhua* L.)

The fishery. Total U.S. cod landings in 1960 were down about 4 million pounds from the 1959 landings, bringing the figure near the 1957 level of 32 million pounds.

Research. In 1959, we reported a study in which drift bottles were dropped from U.S. Navy airships (blimps) in the offing of New Jersey. Bottle recoveries to date have shown no clear pattern of surface currents in the area. Most of the bottles were recovered within about 25 miles or less of the drop station, but there have been three long-distance recoveries. One bottle stranded in the Azores, one in Bermuda, and one in Ireland.

U.S. cod studies were started only a few years ago and on a limited basis. The initial program comprised studies of the number of stocks, migrations, and growth rates. We have now started a study of the age composition of cod in Subarea 5. These data are essential to population studies of the fish in this subarea and should provide vital information on the effect of fishing.

Silver hake (*Merluccius bilinearis* (Mitchill))

The fishery. Landings of silver hake for 1960 from Subarea 5 decreased slightly from the previous year. Landings and catch per day of small and medium otter trawlers fishing out of Gloucester, Massachusetts, are shown in Table 2. The year 1957 was a peak year for both landings and abundance. The abundance figures show an irregular decline since then, but landings at Gloucester are still higher than in 1956. An analysis of the catch per day for each fishing ground showed some decrease in abundance on all grounds fished.

Research. Survey cruises were conducted to determine the winter distribution of the silver hake. The largest number was caught in depths greater than 100 fathoms, in temperatures ranging from 44°F to 52°F (6.7°-11.1°C) in the general area between Cape Cod and Cape Hatteras.

Table 2. Trends in the silver hake fishery, Subarea 5.
(Data for Gloucester, Massachusetts, only)

Year	Landings, Subarea 5 (thousands of pounds)	Catch per day OTS ^{1/}	Catch per day OTM ^{2/}
1956	90,090	25.8	58.9
1957	126,312	44.0	69.6
1958	106,650	33.5	47.6
1959	110,144	35.8	51.0
1960	104,785	32.9	39.9

^{1/} Otter trawl - small ^{2/} Otter trawl - medium

Redfish (*Sebastes marinus*)

The fishery. The U.S. redfish landings in 1960 were about 139.5 million pounds, an increase of approximately 2.5 million pounds over the 1959 value, but well below the annual average of 178 million for the fishery since 1946. About 30 million pounds were landed from the Gulf of Maine, 71 million from the Nova Scotian banks, 31 million from the Grand Bank, and 7 million from the Gulf of St. Lawrence.

Preliminary estimates for 1960 show the redfish catch per unit of effort to be approximately equal to, or slightly higher than, the 1959 values on all grounds fished by U.S. vessels.

Table 3. Trends in the redfish fishery.

Year	Landings (thousands of pounds)	Calculated fishing effort (days fished)	Catch per day (thousands of pounds)
<u>Gulf of St. Lawrence</u>			
1951	8,517	353.1	24.12
52	9,949	463.4	21.47
53	16,026	681.7	23.51
54	37,981	1517.4	25.03
55	76,586	2397.1	31.95
56	54,729	2024.0	27.04
57	40,385	1960.4	20.60
58	16,611	843.6	19.69
59	11,489	551.6	20.83
1960	7,000*	--	--
<u>Grand Bank</u>			
1951	29,900	445.5	67.12
52	45,129	818.6	55.13
53	73,593	1647.9	44.66
54	68,936	1785.9	38.60
55	29,555	1125.9	26.25
56	29,330	942.5	31.12
57	10,575	288.5	36.65
58	23,939	687.9	34.80
59	36,337	1093.8	33.22
1960	31,000*	--	--
<u>Nova Scotian Banks</u>			
1951	151,679	6922.8	21.91
52	83,933	5013.9	16.74
53	29,606	1837.7	16.11
54	46,065	1899.5	24.25
55	20,569	1099.9	18.70
56	35,963	1460.7	24.62
57	46,519	1895.6	24.54
58	67,830	2555.8	26.54
59	54,448	2391.2	22.77
1960	71,000*	--	--
<u>Gulf of Maine</u>			
1951	68,213	9814.8	8.95
52	47,128	6042.1	7.80
53	37,017	4459.8	8.30
54	28,633	3858.9	7.42
55	30,675	3089.1	9.93
56	31,720	3266.7	9.71
57	36,306	3862.3	9.40
58	35,725	3671.6	9.73
59	34,414	3599.8	9.56
1960	30,000*	--	--

* Preliminary estimate - data for January-September 1960.

Research. Studies are in progress on the definition of redfish stocks in the Gulf of Maine, directed toward an understanding of the population dynamics of this species. Records of catch and fishing effort, length composition, and parasite incidence collected since the start of the fishery in 1935 are being analyzed to delineate the smallest redfish groups that can be treated as units in population dynamics studies.

Field work was continued on the inshore stock of redfish at Eastport, Maine. Recapture of many tagged fish at the tagging site has permitted continuing observations of the effect of tagging on the growth rate. Other studies on the natural mortality of tagged fish and

estimation of population size are also in progress. Manuscripts on these subjects are in preparation for presentation at the ICNAF Marking Symposium in May 1961.

Yellowtail flounder (*Limanda ferruginea* (Storer))

The fishery. Landings of yellowtail flounder in recent years have increased greatly. Age composition studies show that much of the increase is due to large year-classes spawned in 1955 and 1956. In addition, a strong year-class was spawned in 1958 and fish from it entered the landings in 1960. These three strong year-classes will help to maintain yellowtail production at a high level during 1961.

Table 4. Trends in the U.S. yellowtail fishery

Year	Landings (thousands of pounds)
1951	18,430
52	16,987
53	13,716
54	12,763
55	14,373
56	14,643
57	22,445
58	33,325
59	29,000
1960	31,000*

* Preliminary

Research. Research during the past year has consisted of yellowtail stock identification, relative abundance, and age and growth rate studies. For stock identification, an analysis of recoveries from 1955 and 1957 tagging was used. In addition, information on exploited yellowtail groups was gained from meristic counts and from studies of the incidence of parasite infestation. Three yellowtail groups were identified. For relative abundance studies, average landings per day were computed for yellowtail trips from three fishing grounds. Yellowtail abundance was high in the early 1940's, dropped in the late 1940's and early 1950's, and rose in recent years. For age and growth studies, scales collected from commercial and experimental catches from 1957 to 1960 were used. Separate growth and age composition studies were made for each identified yellowtail group. These studies, while incomplete, show that growth rate varies according to area of catch. They have also provided information on strong and weak year-classes.

Sea scallop (*Placopecten magellanicus* (Gmelin))

The fishery. U.S. landings of sea scallop meats from Subarea 5 in 1960 were the highest in the history of the fishery even though fishing effort declined somewhat. This resulted from the extraordinary abundance of the year-class recruited to the fishery during 1959. On certain grounds the fishermen were able to catch as many sea scallops as they could shuck in a day with only a few hours dredging.

Research. One survey cruise was made to collect data on abundance of the fishable stock and strength of the pre-recruit year-classes. Data were also collected for the calculation of growth and mortality rates to be used in population dynamics studies. Results of the analysis of these data are reported elsewhere in Commission documents.

Data on the amount and size distribution of the landings, as well as the number of days spent on the grounds continue to be collected at all ports of landing. Copies of the catch and effort statistics compiled by area of capture have been sent monthly to Commission headquarters. A critical comparison of these data with quantitative abundance indices collected from research vessels has shown that the raw landings per day figure cannot be

Table 5. Trends in the sea scallop fishery

Year	Landings (millions of pounds)	Days fished	Average Landings per day (pounds)
1951	12.4	7,626	1,626
52	12.1	7,742	1,563
53	16.3	10,031	1,625
54	15.5	9,343	1,659
55	18.3	11,619	1,575
56	17.5	12,246	1,429
57	17.3	10,500	1,651
58	14.4	8,775	1,637
59	18.7	8,556	2,189
1960	21.9	8,039	2,725

used as a reliable index of abundance in this fishery. There is an upper limit to the number of scallops which the crew can shuck per day. Once the catch in numbers reaches this limit, the amount of the landings per day spent on the grounds depends strictly on the average size of scallop being shucked. On one ground, the average weight of the landings per day spent on the ground rose from 2200 pounds in June of 1959 to 3600 pounds in May of 1960. Research vessel samples showed that the population was reduced to one-sixth of its previous abundance in one year on that ground. The 63-percent increase in the landings per day was the result of growth.

Studies of the cycle of gametogenesis have shown that sexual products are rapidly regenerated during winter and early spring, but that the animals remain fully ripe for almost six months before spawning in the fall. Data on the seasonal and areal variation in the length-weight ratio have been collected and are being analyzed.

Industrial Fishery

The reduction of non-food trawl fish to meal and oil was almost completely stopped in September 1959 and was not resumed in 1960. Market sampling, of course, was terminated in the absence of landings. Previous data have been analyzed and the 1959 species composition report completed.

An analysis of the quantities and sizes of young haddock and other commercially important groundfish species taken by the industrial trawl fishery and its sister industry, the silver hake fishery, has been made. This study indicates that the small mesh industrial and silver hake fisheries may seriously influence the potential recruitment of haddock and other groundfish species. This research is continuing.

One of the important species in the industrial fishery is the red hake (*Urophycis chuss*). Some preliminary studies were initiated to determine the age and growth. Various structures were examined to determine which might be most suitable for age reading. The otoliths appear to be generally unsuitable but the scales show some promise.

Benthos Investigations

A study of relationships between bottom sediments, benthic invertebrate fauna, and the foods of groundfish is continuing. Results of an inventory of Georges Bank benthic fauna have revealed that pronounced differences in the haddock's diet from one locality to another are due largely to differences in available foods. Also, marked variations in species composition and quantities of benthic organisms were found to be correlated with sediment type. In this regard, benthic organisms were much more abundant in substrates composed of gravels and coarse sand than in fine-grained sediments.

Bottom sediments of Browns Bank and the southern Gulf of Maine are the subject of a

report now in preparation. Analysis of sediment samples from these areas indicates that gravels and coarse sands are the predominant component on Browns Bank, whereas in the southern Gulf, silts and clay are most prevalent.

Evaluation of Mesh Regulation

Studies of the effect of the mesh regulation in the Georges Bank haddock fishery continue. They show that the regulation has been beneficial in reducing the proportion of discards of small fish and in increasing the relative catch of larger fish. This results in easier handling of the catch on board the vessels and increases the efficiency of processing operations ashore.

Our principal concern is to demonstrate an increase in yield per recruit. Studies of this problem involve a comparison of the total yields of year-classes over their fishable life span. Year-classes after mesh change should yield more pounds of fish than year-classes of the same initial size before mesh change. Evaluation of regulation on this basis requires an accurate measure of the initial strengths of year-classes before and after regulation. Although values are available for many year-classes prior to regulation and values are available for post-regulation year-classes, the post-regulation values are not comparable to those for pre-regulation year-classes. To date, it has not been possible to find an entirely satisfactory

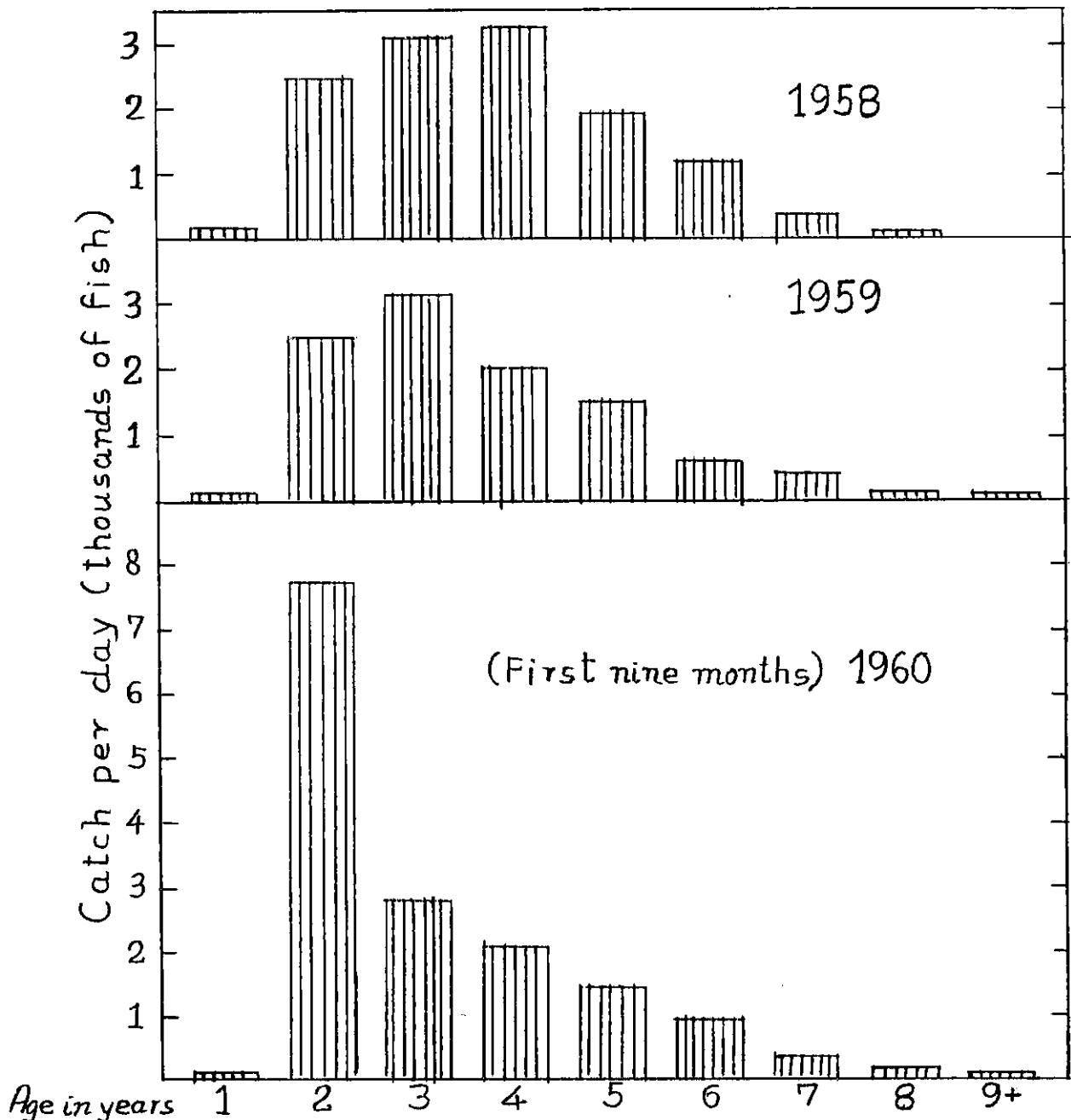


Figure 1. Age composition of Georges Bank haddock, 1958-1960.

method of adjusting the new values to make them comparable with the early ones.

As more large year-classes pass through the fishery more data will become available for this study. As data accumulate and more effort is devoted to developing new methods of evaluation, a more firm demonstration of the increase in yield per recruit should emerge.

B. by Dean F. Bumpus
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Hydrographic research by the U.S.A. in the Convention Area was carried out by four agencies during 1960; the U.S. Coast Guard, U.S. Coast and Geodetic Survey, the Bureau of Commercial Fisheries, and the Woods Hole Oceanographic Institution.

A. The U.S. Coast Guard, as the agency operating the International Ice Patrol, examined the temperature and salinity distribution in four network surveys in the Grand Banks region. The first survey, 1-17 April, in addition to covering the southern and eastern slopes of the Grand Banks extended south to Latitude 37°30' N. in order to cooperate with the "Gulf Stream '60'" survey (see below). The second survey, 1-9 May, covered the eastern and northeastern slopes of the Grand Banks. This was followed by an evaluation of the wind effect on iceberg movements. Parachute drogues were employed during this phase of the study. The third survey, 3-6 June, covered the Bonavista triangle and the fourth survey, 17 June-1 July, covered the area immediately seaward of the southern and eastern slopes of the Grand Banks from just westward of the Tail of the Banks to the latitude of Flemish Cap. A post-season cruise, 5-13 July, included occupation of the Bonavista triangle and a section across the Labrador Sea from South Wolf Island, Labrador to off Cape Farewell, Greenland.

The report in toto will be published in U.S. Coast Guard Bulletin No. 46.

B. The U.S. Coast and Geodetic Survey set up a bubbler-type tide gauge on Texas Tower #3 (on Nantucket Shoals) and ran 100 hours of simultaneous current observations at three depths at each of three buoys in the same general area. One hundred hours of current measurements were made off Point Judith.

C. The Bureau of Commercial Fisheries has collected a limited amount of temperature (bathythermograph) data in Subarea 5 in the course of the second cruise of the Delaware and along the coast of Maine during the latter part of the year through the efforts of the Biological Laboratory at Boothbay Harbor, Maine.

D. The twelve U.S.C.G. lightship stations from Maine to Georgia, equipped at the end of 1955 by the Woods Hole Oceanographic Institution under contract with the Fish and Wildlife Service, as observation posts to collect surface temperature and salinity observations daily, bathythermograms daily, and bottom water samples weekly, have continued in operation. Several of the lightships have also released drift bottles daily.

A cooperative study including the Fisheries Research Board of Canada, the Bureau of Commercial Fisheries, the Weather Bureau Atlantic Weather Project, the U.S. Coast Guard Ice Patrol, and the Woods Hole Oceanographic Institution has released 20,505 drift bottles in Division 4X and Subarea 5 during 1960 with over 7% returns to date.

The Atlantic Weather Project observers on board U.S. Coast Guard weather ships commenced during 1960 to release drift bottles in Subarea 3 following their departure from Cape Race for weather stations Bravo, Charlie and Delta.

A network of hydrographic stations, referred to as "Gulf Stream '60'", (T, S, dissolved O₂ - surface to bottom) in the area from the latitude of Bermuda to the continental shelf of North America between longitude 48°30' and 68°30' W, including the southern parts of Subareas 3, 4 and 5, was occupied during April by Atlantis, Crawford, Chain and Evergreen. Thus, for the first time, a three-dimensional description of the Gulf Stream System and its environment from surface to bottom over approximately one-half million square miles may be forthcoming.