



Serial No. 950
(D.a.61)

Document No. 12

ANNUAL MEETING - JUNE 1962

United States Research Report, 1961

by Dr. Herbert W. Graham

Routine sampling of the landings of the major species was continued at the New England fishing ports. A detailed review of the interviewing and sampling procedures used at the fishing ports has been completed. As a result of this review, the sampling program has been expanded in some cases.

Concomitant with the improved interviewing and sampling program, we are developing a program to handle all of the data by automatic data processing equipment. As this program develops, we shall be able to work back into a large accumulation of historical records.

Research is also continuing to determine the optimum number and size of samples needed to obtain reliable estimates of the number of fish of each length and age taken from the Convention Area.

Haddock (*Melanogrammus aeglefinus* (L.))

The fishery.--In the first seven months of 1961, haddock abundance on Georges Bank exceeded that for 1960 and it was the highest since 1956 (table 1). A major part of this increase was attributed to the strong 1958 year class as 3-year-old fish (fig. 1). An important contribution to 1961 landings also was made by the 1959 year class (age group 2) which was about twice as large as the 1956 and 1957 year classes but only one-half as large as the 1958 year class.

Table 1.--Trends in the Georges Bank haddock fishery

Year	Landings (thousands of pounds)	Days fished	Average landings per day (pounds)
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	7,825	11,406
1958	68,655	7,836	8,761
1959	69,350	9,432	7,353
1960	79,470	7,669	10,362
1961*	53,293	4,476	11,906

* first seven months.

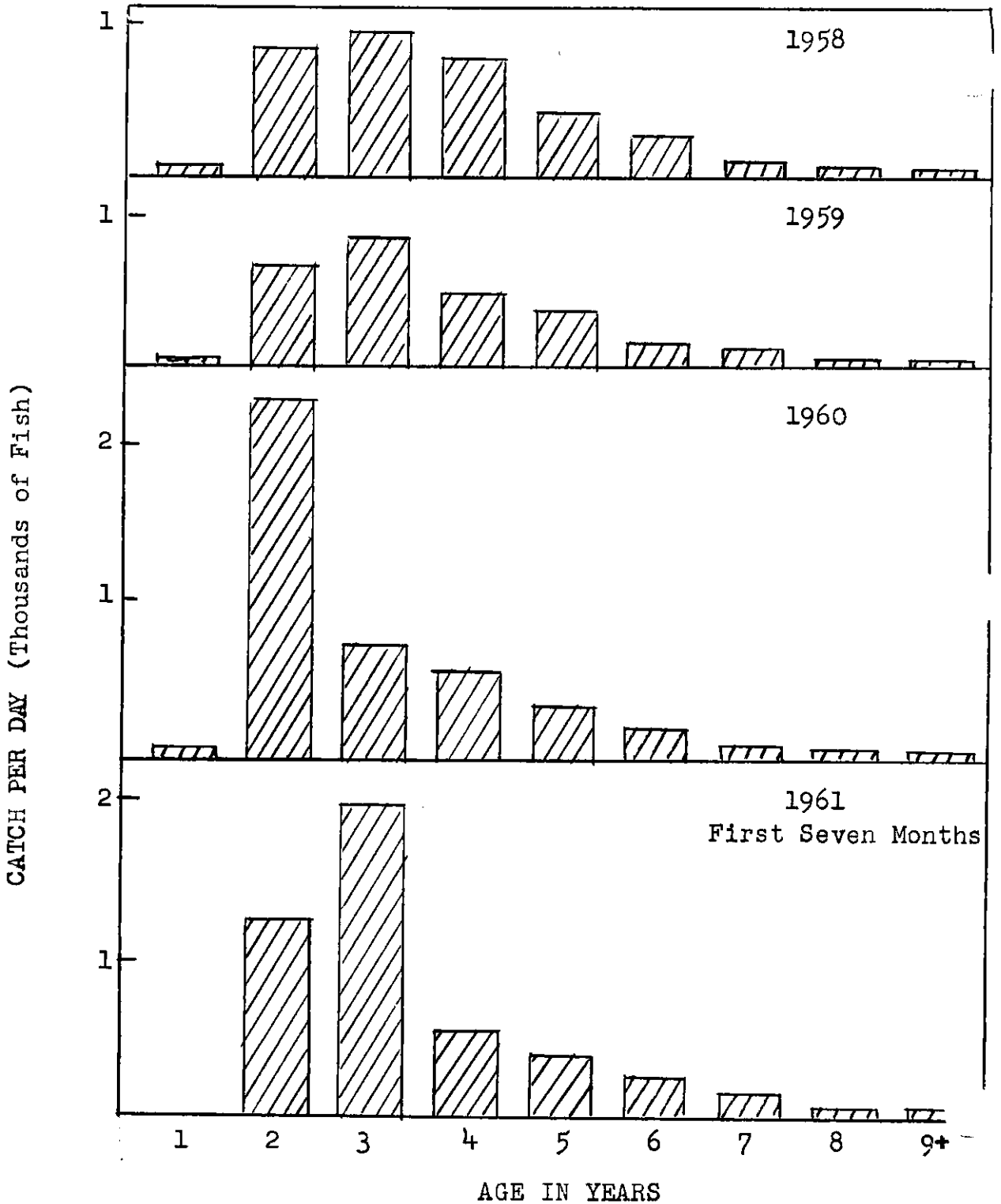


Fig. I.

Small catches of young-of-the-year haddock in the 1960 and 1961 fall survey cruises suggest that abundance may drop again in 1962 and 1963 when the 1960 and 1961 year classes enter the fishery as two-year-old scrod.

Predictions of year-class strength.--Distribution of young-of-the-year haddock on fall survey cruises was examined with respect to geographic location, depth and bottom temperatures. In the South Channel the largest catches of "zero" haddock consistently occurred in the depth range 50-100 fathoms, and at temperatures below 45° F. On the northern edge of Georges Bank this same relationship was observed in some years; but in other years equally high catches were made in shallower and warmer water. These data suggest that improvements in precision of year-class predictions may be obtained by appropriate stratification of grounds for survey purposes.

U.S.-Canadian 4X Program.--Substantial movement of haddock between subareas 4X and 5Y, as shown by Canadian tagging studies, makes it necessary to consider the stocks in these subareas jointly. The U.S.-Canadian cooperative exchange of data on Subarea 4X haddock was reviewed, and an agreement was made for its continuation. Essentially this consists of exchange of catch-effort statistics and size-age samples, with Woods Hole assuming primary responsibility for analyzing commercial landings. Work was begun on a backlog of 4X haddock otoliths after reviewing evidence supporting validity of otolith age readings.

Cod (Gadus morhua L.)

The fishery.--Total U.S. cod landings in 1961 reached a 10-year high of nearly 44 million pounds (table 2). Although each of the important New England ports reported increases in cod landings during the year, the largest increase--over 3 million pounds--was reported from Boston, Massachusetts.

Research.--Preliminary analysis of cod otoliths collected aboard the research vessel Delaware, revealed marked differences in the clarity of the hyaline zones for otoliths from different fishing grounds in the New England area. The zones in otoliths from fish collected in the offing of Cape Cod are not so sharply defined as those in otoliths collected in Ipswich Bay, north of Boston.

A critical study of scales and otoliths from the same fish is underway with material collected from 300 cod covering a wide range of sizes. Results of the study will be used to determine whether scales only, otoliths only, or a combination of the two will be used for routine age determination of commercial landings of cod.

Serological studies of cod blood were started in an effort to further delimit the groups or stocks of cod in New England waters. Results of the blood-group studies will be used to complement the extensive tagging study carried out in 1955-1958.

Table 2.--Trends in cod fishery

Year	Pounds landed (thousands)	large	Boston only market (thousands of pounds)	scrod
1952	42,401	7,022	11,872	2,910
1953	31,899	5,718	9,410	1,528
1954	35,239	7,291	7,234	2,006
1955	32,369	6,504	6,835	1,945
1956	32,760	8,165	8,019	1,334
1957	31,911	7,608	8,319	1,559
1958	37,784	5,194	6,612	4,377
1959	40,758	5,739	8,098	3,872
1960	40,381	4,774	8,078	2,695
1961 ^{1/}	43,700	(Data not yet available)		

^{1/} (N.B. weights of market categories:
 scrod -1-1/2 - 2-1/2 pounds
 market - 2-1/2 - 10 pounds
 large - 10-25 pounds)

Silver hake (Merluccius bilinearis (Mitchill))

The fishery.--The silver hake fishery in New England declined in 1960 due to the curtailment of the industrial fishery. In 1961 a drop in landings for food fish was due apparently to lowered availability and possibly abundance.

Table 3.--Trends in the New England silver hake fishery

Year	For Food	For industrial	For animal food	Total
1952	117	9	2	128
1953	85	16	3	104
1954	90	21	6	117
1955	111	23	10	144
1956	89	30	11	130
1957	117	38	16	171
1958	107	23	17	147
1959	110	26	20	156
1960*	103	4.6	20	127.6
1961	87	6.8	16	109.8

* preliminary estimates

Research.-- In the past year research on silver hake has included studies on behavior and selection (see section on mesh selection), and on availability and abundance. Although the data have not been fully analyzed at this time; a marked seasonal and secular change in availability of the population on different grounds is apparent in different years. Temperature appears to play a complex role in these local fluctuations in abundance.

Redfish (Sebastes marinus)

The fishery.--United States redfish landings for 1961 totalled about 131 million pounds, the lowest since 1944 and approximately half the amount landed in 1951, the peak year of the U.S. fishery.

Since 1955 fishing effort has varied between 7500 and 8000 boat-days fished annually with landings ranging between 134 and 157 million pounds. This fishing effort has been distributed in varying proportions among the four main fishing grounds, Gulf of Maine, Nova Scotia Banks, Gulf of St. Lawrence and the Grand Banks. Preliminary estimates indicate that the greatest portion of United States fishing effort in 1961 was expended on the Nova Scotian Banks with decreasing amounts in the Gulf of Maine, Grand Banks and Gulf of St. Lawrence, in that order. Fishing effort in the Gulf of St. Lawrence in 1961 was reduced to about 100 days, less than 5 percent of what it was 5 years earlier.

Table 4.--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	2,861.1	128.1	22.34
61	2,500*	--	--
<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	33,576.1	1038.2	32.34
61	31,400*	--	--
<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	79,958.5	3320.5	24.08
61	70,700*	--	--

Year	Landings (thousands of pounds)	Calculated fishing effort (days fished) Gulf of Maine	Catch per day (thousands of pounds)
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	25,036.7	2966.4	8.44
61	26,200*	--	--

* preliminary estimate - data for January-September 1961.

Research.--The results of tagging redfish on the opercle with Petersen discs were reported to the ICNAF Marking Symposium in May 1961. The effect of this tagging technique on the growth rate of the tagged fish was clearly shown. Growth was reduced to a very low value after the fish were tagged. This reduced rate of growth persisted for about 2-1/2 years, after which the rate increased gradually until it approached the pre-tagging rate at the end of 4-1/2 years.

Recent recaptures of Eastport redfish tagged with plastic dart spaghetti tags through the dorsum indicate that tagging in this manner has little effect on growth rate. Fish tagged with plastic darts on the dorsum grew an average of 31 mm. in 16 months, compared with the average of 1-2 mm. per year recorded earlier for Petersen discs on the opercle.

A small number of dart tags was recovered from fish that were tagged first with Petersen discs through the opercle and later were tagged with plastic darts through the dorsum. The fish grew an average of 17 mm. in 37 months while tagged with Petersen discs. When the Petersen discs were removed from the opercle and plastic darts were inserted in the muscle of the dorsum, the growth rate increased to an average of 23 mm. in 14 months. The difference in growth rate is thought to be mainly the result of the position of the dorsal tag, which did not interfere with feeding as did the opercle tag, rather than due to the difference in the type of tag used for tagging.

The pigmentation of pre-extrusion larvae of Sebastes from several locations in the western Atlantic was studied in relation to the morphometric measurement of the females. Variations in the caudal pigmentation were found to be more complex than that reported earlier by Templeman and Sandeman (1959). The number of caudal melanophores ranged between zero and four, and there was a relatively broad range in the number of melanophores found on the young from a single female. These variations indicate the value of counting the number of caudal melanophores as a possible racial characteristic rather than the less meaningful determination of the presence or absence of pigmentation reported earlier.

Flunders

The 5 species of flunders landed at New England ports, yellowtail (Limanda ferruginea) (Storer), winter flounder (Pseudopleuronectes americanus) (Walbaum), fluke (Paralichthys dentatus) (Linnaeus), American plaice (Hippoglossoides platessoides) (Fabricius),

and witch (Glyptocephalus cynoglossus) (Linnaeus), make up about 20 percent of the value of total fin fish caught in this region. Currently, biological studies are being carried out on the first 3 of these, which made up most of the flounder landings.

Yellowtail flounder (Limanda ferruginea)

The fishery.--Stock indentification studies of yellowtail indicate that there are 3 relatively distinct groups. Landings by ground and average landings per day of effort, 1950 - 1960, for the 2 groups which are of greatest importance in the catch, are given below. An examination of grounds where yellowtail are caught suggested that fishing effort could not be estimated on the basis of ground fished, alone, since a number of other species also are found in abundance on parts of these grounds. Landings per day was therefore based on trips landing 75 percent or more yellowtail.

Table 5.--Trends in the New England yellowtail fishery

Year	Southern New England ground		Georges Bank	
	Landings <u>1/</u>	Landings/day	Landings	Landings/day
1950	6,369	3.6	7,002	5.5
1951	3,787	3.8	7,913	5.5
1952	4,172	3.1	6,751	5.3
1953	3,255	3.4	6,356	5.3
1954	1,477	3.4	5,956	4.7
1955	2,919	3.3	6,049	5.4
1956	4,956	4.0	3,489	4.6
1957	9,586	5.4	5,074	6.7
1958	15,895	5.8	9,995	8.0
1959	13,294	3.8	9,106	4.7
1960	13,855	4.1	9,804	5.4
1961 ^{2/}	17,100		12,100	

1/ All figures for landings and landings per day are in thousands of pounds. Landings are those at Massachusetts ports. Landings per day are for trips by 26-50 ton draggers landing 75 percent or more yellowtail.

2/ Estimated.

Relative abundance has increased on both grounds in recent years, and it consistently has been highest on Georges Bank. Age composition studies show that strong year-classes in 1955, 1956, and 1958 have been principally responsible for the increase. The fish come into the catch at age 2 and they make their greatest contribution to landings at ages 3 and 4. The total New England landings from all grounds in 1961 were approximately 37 million pounds, the highest since 1948.

Preliminary information on the 1959 year class-suggests that it is of about average size. However, the landings during 1962 will probably remain at a high level because they will consist largely of fish from the strong 1958 year-class. Total catch very likely will be between 30 and 35 million pounds.

Research.--Research during 1961 was centred on studies of growth rate and age composition of fish from the 3 groups. Samples were obtained from 2 sources: (1) commercial vessels using large mesh (about 4-1/2 inches) trawls, and (2) research vessel catches using small mesh gear. Increased sampling with small mesh gear is planned for future studies in order to provide additional information on recruitment and discards.

Recovery information for yellowtail tagged in earlier studies have been recorded. These data, along with fishing effort and age compositions, will be used in mortality estimation.

Fluke (*Paralichtys dentatus*) (Linnaeus)

The fishery.--Fluke studies in 1961 consisted of (1) studies of time and place of spawning in New England waters, (2) study of abundance and distribution of 0 age group fish, (3) stock identification, and (4) preliminary age and growth studies of fish from commercial landings.

Research.--Spawning condition of fluke is being followed to determine when and where the fish spawn. Information so far collected suggests that spawning occurs in the fall during the migration from the summer inshore grounds to the winter offshore grounds.

A coastal water survey in the area from Long Island to Chesapeake Bay using a beach seine and otter trawl to collect young fish provided some information on distribution of 0-group fluke. It appears that Chesapeake Bay is an important nursery ground.

Tagging is being used to identify exploited groups. In a Bureau of Commercial Fisheries study 1,800 fluke were tagged on the offshore winter grounds southeast of Long Island in March and April, 1961. In a joint Bureau of Commercial Fisheries and New Jersey Conservation Department study 3,400 fluke were tagged in the summer months along the New Jersey coast by New Jersey biologists.

A study of the use of plastic impressions of fluke scales for age and growth assessment is in progress. Although interpretation of growth zones is difficult, it appears that scales can be used for this work.

Winter flounder (*Pseudopleuronectes americanus*) (Walbaum)

The fishery.--A biological investigation of the Woods Hole population of winter flounder has been undertaken. Sampling trips, using a small otter trawl, are being made in local waters at approximately weekly intervals. A study of food habits, with respect to season, time of day, and spawning condition is now underway. Data also are being collected for age, growth, and sex ratio studies. Information on animal communities, as sampled by the trawl, is being collected at the same time.

Industrial Fishery

The industrial trawl fishery remains a minor factor in harvesting fish on the New England grounds. The production of meal is negligible, of mink food moderate but slowly increasing, and of cat and dog food, also moderate but with the potential for a sharp increase in the near future. Pending resolution of the difficulties facing the fish flour producers, their production is also low and will remain so at least for the time being. In the past two years, 1960-61, less than 50 million pounds of industrial trawl fish have been landed each year to serve the needs of all of these fisheries.

There is little research being done at this time on these fisheries as specific entities. Routine sampling continues.

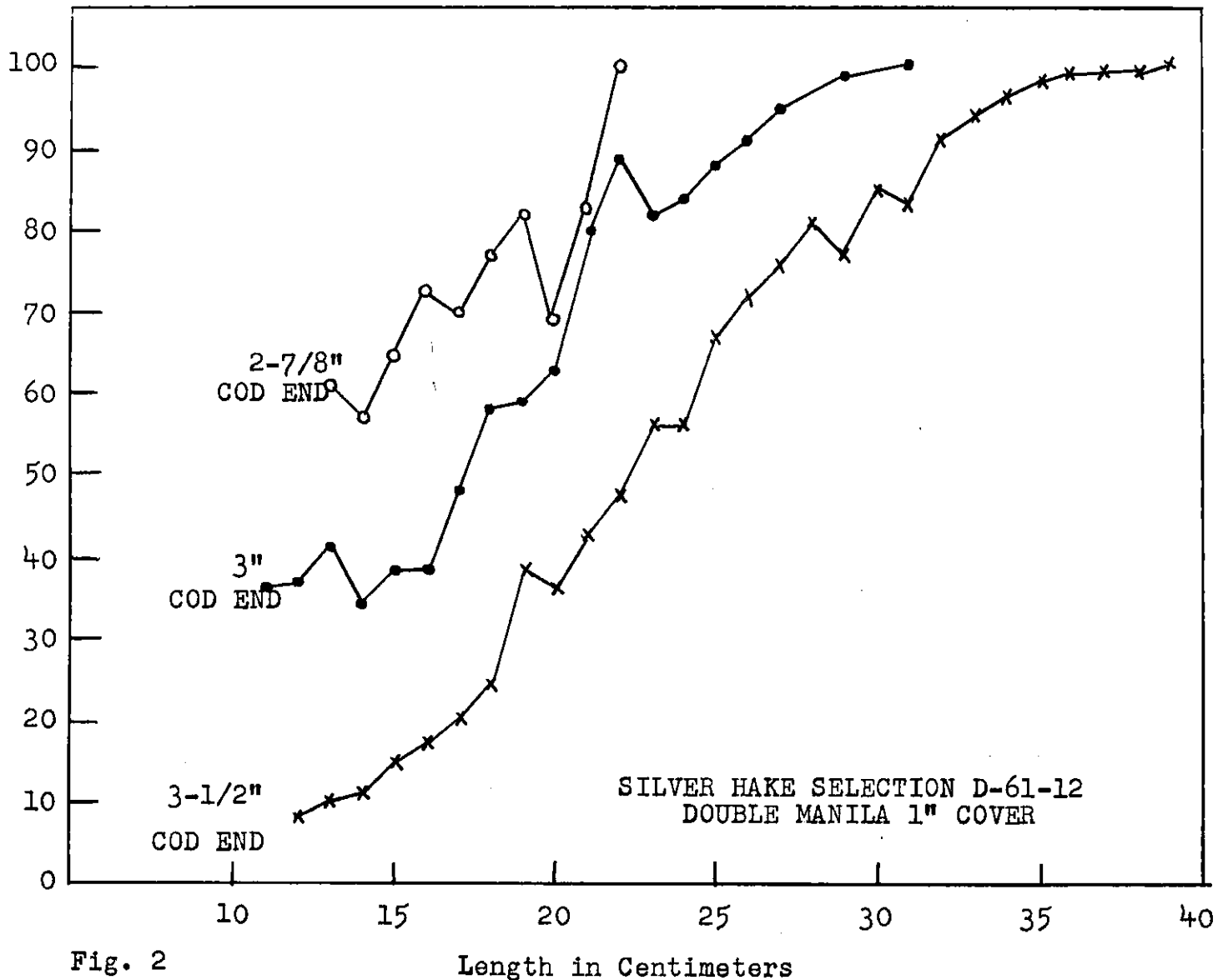


Fig. 2

Length in Centimeters

Mesh Selection

Extensive experimentation was carried out in August 1961, (Delaware cruise no. 61-12) by the Woods Hole Laboratory personnel on the possibilities of differentially selecting species as well as controlling the sizes retained.

Silver hake selection experiments were also carried out using 2-1/2, 3, and 3-1/2-inch double manila codends. For these experiments the basic net was a No. 36 Yankee of single manila 2-inch mesh twine. The lower half of the codend was lined with 1-inch cotton twine. The upper portion was covered with an additional loose bag (cover) of 1-inch cotton to retain those fish that escaped. All individuals of all species in both the cover and codend were measured, providing useful escapement data on all species captured in any number.

Silver hake appear to have reasonably sharp selection characteristics (fig. 2). There was some evidence that gilling might account for some of the minor irregularity at the upper end of the selection curve. Unfortunately, there were relatively few fish in the population between 18 and 22 centimeters in length, accounting for the scatter in the data for those lengths.

The differential selection experiments were interesting and revealing although no immediately useful technique was developed that would enable a commercial boat to selectively catch either silver hake or haddock, the two species of principal concern. Different species did behave quite differently in the net. It was possible to differentially select for approximately 70 percent of the silver hake and about 80 percent of the cod and haddock, and in addition, to control in the usual manner, the sizes retained of each of these groups. The variability of species selection was considerable, and further behavioral research will be required before this variability can be reduced to reasonable limits.

Groundfish Ecology

The program of study of the relationship of environmental conditions to the distribution and abundance of groundfish species was continued. An annual fall survey cruise (Delaware cruise no. 61-19) was conducted which extended from the Bay of Fundy southward to the Hudson Canyon to determine the distribution of groundfish species and the year-class strength of the young-of-the-year haddock (fig. 3). Sixty-five different species of fish were caught, counted and measured during the cruise.

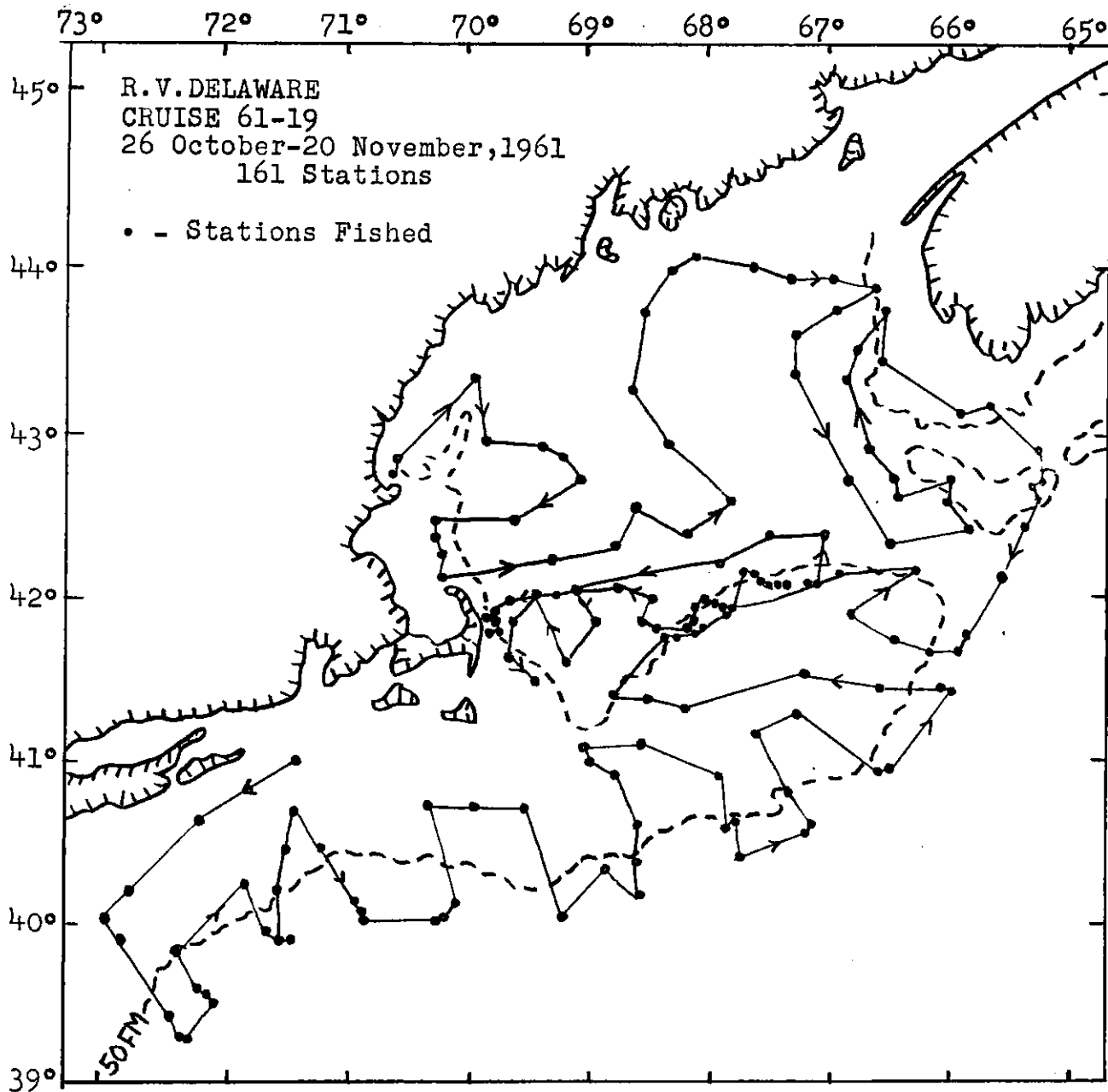


Fig. 3

Preliminary results showed that no haddock were caught south of 41°00'N. Lat., while haddock were caught at 81 percent of the stations fished north of this latitude. Catches for the northern part of the cruise showed that haddock were caught at all depths fished, but the greatest quantity were taken between 60 and 90 fathoms. These data also indicate that the larger size haddock inhabited the deeper waters.

The silver hake (Merluccius bilinearis), white hake (Urophycis tenuis), and the red hake (Urophycis chuss) were also found at all depths fished, but the silver hake were concentrated at depths greater than 90 fathoms, while the white hake were found between 60 and 120 fathoms, and the red hake between 60 and 90 fathoms.

The most frequently caught species on the northern half of the cruise were the silver hake, haddock, redfish, and dabs; while the silver hake, butterfish, scup, and red hake were the most frequently caught species on the southern part of the cruise.

Mesh Assessment

We have continued our studies of the effects on the yield of increasing the size of mesh in codends of trawl nets. These studies involve two different aspects: one is assessing the effectiveness of the current 4-1/2 inch mesh regulation for cod and haddock; the other is how increases in mesh size would effect the yields of other species.

The latter studies have been carried out in conjunction with the mesh assessment working group of ICNAF, and the initial results are summarized in Document 20 of the 1961 Annual Meeting of ICNAF. The important redfish, silver hake, and industrial fisheries in Sub-area 5 could not be sustained with a mesh as large as 4-1/2 inches; however the dynamics of the species involved are not well enough known to provide a precise estimate of the effects of various mesh sizes. These studies are continuing as further information becomes available.

We have tried, by several methods of analysis, to determine the effects of the current 4-1/2-inch mesh regulation on haddock yield-per-recruit. The results of these analysis have not been definitive. Only one complete year-class has passed through the fishery since the regulation has been fully implemented. Additional data from subsequent year-classes are needed for further analysis.

Sea scallop (Placopecten magellanicus (Gmelin))

The fishery.--United States landings of sea scallop meats from Subarea 5 in 1961 were greater than in 1960, the previous record year.

Table 6.--Trends in the sea scallop fishery

Year	Landings (millions of pounds)	Days fished	Average landings per day (pounds)
1952	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
61	23.6	8,655	2,724

Research.--One cruise was made to test the effect of various combinations of ring size and ring linkage on the size composition of the catch. Two survey cruises were made to collect data on the abundance of the fishable stock, and strength of the pre-recruit year-classes. Results of the analysis of these data are reported elsewhere in Commission documents.

An experiment was conducted in a large aquarium tank to see if the tag used in previously reported tagging experiments inhibited movement. Results show that tagged animals move about in the same manner as untagged animals, and that the small amount of dispersion of recaptured tagged scallops from the point of release can be regarded as typical of the untagged part of the population as well.

Two meetings were held during the year between Canadian and United States biologists interested in the sea scallop fishery to discuss and compare results of their programs of investigations. The reports of these meetings are to be found in other Commission documents.

Benthic Studies

Studies of bottom sediments, macroscopic benthic invertebrates, and food habits of groundfish were continued in 1961. A preliminary examination of bottom sediment samples recently taken from the central and northern sections of the Gulf of Maine indicate that silt and clay are the principal substrate components. However, in some shallow areas, such as Cashes Ledge and Jeffreys Ledge, mixtures of sand and gravel are predominant. Also, in certain deepwater areas near Browns Bank and in moderately shallow water between Browns Bank and the Lurcher Shoal region, sand and shell are the major sediment components.

Although haddock are exceedingly omnivorous feeders and were long considered to be non-selective in their choice of foods, recent information has been obtained which reveals selective feeding, at least in some localities. Haddock from the northeastern section of Georges Bank appeared to favor crustaceans and, to a lesser extent, echinoderms, over mollusks, annelids, and miscellaneous groups.

Table 7.--Comparison of haddock diet and available bottom food on northeastern Georges Bank

Group	Benthic fauna (% weight)	Haddock stomachs (% volume)
Mollusca	38	22
Echinodermata	10	13
Miscellaneous	34	27
Annelida	10	6
Crustacea	8	32
Total	100	100

A study of food habits of haddock from one locality throughout a one-year period has shown there are no important differences between males and females in the kinds of animals preyed upon or the quantities of food ingested. A moderately low feeding rate prevailed throughout the year except in June when feeding was intensified remarkably. Differences in diet composition were associated with haddock size and season of the year.

Environmental Studies

Bureau of Commercial Fisheries Studies

Plankton.--Analysis of the zooplankton samples collected in 1953 have been completed and the analysis of the 1955 samples is underway.

Hydrography.--Temperature norms for the area bounded by latitudes 39°00'N. and 45°30'N. and longitudes 64°00'W. and 72°00'W. are being computed by analysis of bathythermographic and hydrographic station data collected between 1940 and 1960.

Hydrography - by Dean F. Bumpus

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts

Hydrographic research by the U.S.A. in the Convention area was carried out by three agencies during 1961: the U.S. Coast Guard, 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 from the surface to 1,500 meters in 4 network surveys in the Grand Bank regions. The first survey, 2-15 April, covered waters over and immediately seaward of the southern and eastern slopes of the Grand Bank from just westward of the tail of the Bank northward to the latitude of Flemish Cap. The second survey, 29 April to 5 May, covered the area immediately seaward of the northeastern slope of the Grand Bank from Flemish Cap northwestward as far as, but not including, the Bonavista triangle. The third survey, 25 May - 5 June, covered an area similar to the first. The fourth survey, 14-22 June, covered an area similar to the second but included the Bonavista triangle. The post season cruise, 3-11 July, occupied the Bonavista triangle and the Labrador - Cape Farewell section to within 6 miles of Cape Farewell.

The season was characterized by an abnormal amount of sea ice on the east coast of Newfoundland and the eastern part of the south coast. Labrador Current water along the eastern slope of the Grand Banks was below normal and south of the latitude of Flemish Cap very nearly absent in early April. This was followed by a steady return toward normal conditions which were reached about mid-June. The cold subsurface temperatures in the Labrador Current were warmer than normal in early season and also returned to about normal values in June. On the post-season cruise both the Labrador Current off the South Wolf Island the West Greenland Current off Cape Farewell showed positive anomalies in volume and temperature.

The report in toto will be published in U.S. Coast Guard Bulletin No. 47.

B. The Bureau of Commercial Fisheries Biological Laboratory, at Boothbay Harbor undertook a number of temperature surveys at monthly intervals from Gloucester, Massachusetts, to off Eastport, Maine.

C. The Woods Hole Oceanographic Institution together with the Fisheries Research Board of Canada released 23,378 drift bottles in areas 4 and 5 throughout the year with approximately 10 percent return.

The examination of non-tidal drift at the bottom using Wood-head Sea Bed Drifters was commenced during the year in area 5.

The 13 lightship stations from Maine to Georgia equipped, at the end of 1955 as observation posts to collect surface temperature and salinity observations daily, bathythermograms daily and bottom water samples weekly, have continued in operation supplemented with surface water temperatures from several shore stations and Texas Towers 2 and 3. Many of the lightships also released drift bottles daily as part of the drift bottle program mentioned above.

Experimental Studies

The program of experimental studies has concentrated on the two major projects of racial stock identification and larval fish biology. The racial characterization of various geographically separate haddock populations has been undertaken using serological techniques. Specific erythrocyte precipitation (agglutination) reactions have been found using haddock sera (isoagglutinins) as well as miscellaneous fish, arthropod and rabbit anti-haddock sera (heteroagglutinins). Preliminary results show that while isoagglutinins are present in haddock their frequency and titre are low, and not useful for racial identification. Heteroagglutinins, on the other hand, show higher titres and a differential haddock cell response in several cases. These tools have not yet been applied on a large scale population analysis.

The work on larval fish biology has focused on a weekly survey of local waters to tabulate the numbers of species and individuals as a function of season. Eggs and larvae from the sampling have been used for laboratory growth and development experiments. Present information implies successful rearing of sculpin from pre-spawning adults through to month old larvae.

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