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REVIEW OF UNITED STATES FISHERIES IN THE CONVENTION AREA

Contents

1. THE STATUS OF THE PRINCIPAL SPECIES

The major United States fisheries in the Convention Area depend upon groundfish. This is the term applied to the many species of fish which live on or near the bottom. In this area the important groundfish are rosefish and members of the cod, flounder, and closely related families. Haddock, cod, and rosefish have been the principal species during the past twenty years (Table 1). The emphasis, however, has shifted from year to year and in 1949 the rank in terms of total landings was rosefish, haddock, whiting, flounders, hake, cod, and pollock. Taken together, these groundfisheries far outrank the pelagic species, of which mackerel is the most important in the Convention Area. The other major fishery for a pelagic species in New England, that for sea herring, occurs almost entirely within territorial waters.

These fish are landed in the States of Maine, Massachusetts, Rhode Island, Connecticut, and New York. The major ports are Boston, Gloucester, New Bedford and Rockland. Substantial landings also are made in the Cape Cod area and at Portland, Point Judith, Stonington, and New York City.

A majority of the catch is taken in Subarea 5, (Table 2) and most of the balance in Subarea 4. Occasional catches have been made by United States vessels in Subarea 3 in recent years. The United States has only an historical interest in Subareas 2 and 1.

The United States catch of fish from the Convention Area has been increasing rapidly during the past thirty years. The landings at the principal New England ports during the first twenty years of this century averaged about 180 million pounds, dropped to a low point of 146 million in 1921 and have since risen to a high of 649 million pounds in 1949. This increase has been associated with the development of filleting and freezing techniques and with greatly expanded markets.

A fleet of about 600 otter trawlers catches most of the groundfish. In the average year since 1931 otter trawlers were absent from port 35,092 days, line trawlers, 6,595 days, and hand liners only 363 days. In the years since World War II fishing by line trawlers and hand liners has nearly disappeared.

Few species of groundfish have been proved to be overfished to the point of "depletion". True, many of them have become scarcer in certain localities, but this fact is not necessarily alarming, for in a new fishery some reduction in the catch usually occurs after the accumulated stocks are caught off.

Unfortunately, not enough facts are known about the biology of most of these fishes or about the changes in their populations, to provide the basis for good management. Yet it is growing increasingly clear that only by determining and using sound fishing practices will the fishing industry get the most that this resource can yield.

HADDOCK

Haddock is the mainstay of the United States otter trawl fishery and is the most valuable of all the Northeastern United States fisheries. At peak production in 1929 the haddock resource yielded nearly 260 million pounds. Owing to reduced abundance brought on by intensive fishing, the average catch since has been about 150 million pounds a year, worth about 12 million dollars at recent prices.

The haddock of the northwest Atlantic make up a complex of populations, of which at least three main groups are recognized, inhabiting, respectively, the New England banks (Subarea 5), the Nova Scotian banks (Subarea 4), and the Newfoundland banks (Subarea 3). The fish vary between groups as to growth rate, spawning time, migratory habits, and fluctuations in size of stock.

The haddock populations in Subareas 4 and 5 only have been important to United States fishermen. In the average year since 1931,

66.8 percent of the haddock landed at the principal ports have been caught in Subarea 5, 33.1 percent in Subarea 4, and only .1 percent in Subarea 3 (Table 4).

The Fish and Wildlife Service has carried on studies of the haddock resource for several years, chiefly on Georges Bank (Subarea 5). Here the catch increased to a high of 223 million pounds in 1929, and then declined to a low of 50 million pounds in 1934 (Table 5). Since then the landings have averaged 94 million pounds and never have exceeded 122 million pounds.

Two causes of reduced catches are known. First, the number of young haddock surviving to enter the fishery has fluctuated--with the landings of two year old haddock in the best year being about 38 times those of the poorest year. The causes of this varying production are not yet known. Second, the young rapidly growing haddock have been wasted in great numbers, either by being thrown overboard at sea, or by being landed at too small sizes. The effects of this waste and recommendations for preventing it are dealt with at greater length in Section 3 of this report.

COD

In the last century when salting was the only economical way of preserving fish for widespread distribution, the cod supported the largest fishery of the United States because it salts particularly well. The development of refrigeration and of the filleting industry, however, brought the haddock into prominence in the 1920's since haddock were more plentiful on the nearby grounds and more suitable for filleting than cod; and because the demand for salt fish was declining in this country, cod became less sought after by the United States fishermen. Today the annual catch is around 86 million pounds (Table 1).

Cod live in much the same depths and on the same type of bottom as haddock, but whereas the latter is the dominant species (in bulk at least) on Georges Bank, cod becomes increasingly dominant off Novia Scotia and exceeds any other bottom fish on the Newfoundland Banks and beyond. The United States landings since 1931 have been on the average, almost half from Subarea 4 and half from Subarea 5 (Table 6).

It is not known to what extent the cod populations found in the Gulf of Maine, on Georges Bank, and on the Eastern Banks are independent, but these fish are known to move about more than haddock. The catch per day's fishing has varied widely over the past 10 years (Table 7). It is not known whether these variations reflect changes in the population, migrations, or a shifting of the primary objective of the fishery between haddock and cod. An understanding of measures needed to obtain maximum utilization of this resource must await a study of the cod populations and the conditions which govern their yield.

POLLOCK

The pollock, often called Boston Bluefish, has been moderately important in recent years. Just before the war about 38 million pounds were caught annually and since 1945 the average has been 35 million pounds. Little is known about the biology of this species or the extent of the resource in American waters. The production, however, probably could be increased considerably if markets were available because frequently in recent years the price has been too low to encourage production.

ROSEFISH

The rosefish, redfish, or ocean perch supports a fishery which has grown spectacularly in recent years. Prior to 1934 only a few hundred thousand pounds were caught annually. In 1949, 237 million

pounds were landed which ranked it first in volume among New England fishes. This remarkable growth came as a result of the development of new markets and the utilization of the rosefish by the filleting industry.

Virtually the entire catch is taken by otter trawls in depths of 50 to 125 fathoms. Fishing is carried on throughout the year, but only during daylight hours, for the fish scatter or rise off the bottom at night.

Rosefish is one of the few commercial species giving birth to live young. The young are spawned from June to September and are abundant at or near the surface throughout the summer. The fish grow slowly at a rate of about an inch a year until around their eleventh year when they mature. Little is known about their migrations but there is some evidence that there are several independent stocks in Subareas 4 and 5.

The rapid expansion of the rosefish fleet and catch has resulted in a considerable decline in the yield from the nearby grounds as the accumulated stocks of older fish were caught. This is reflected in the total landings from Subarea 5 where the catch reached a peak of 118 million pounds in 1941 (Table 8) and has leveled off around an average of 90 million pounds for the last five years despite the discovery of some new fishing grounds in Subarea 5 which raised the catch in 1948 to 112 million pounds. A similar trend exists in the total catch from the southern part of Subarea 4 although here the fishery was interrupted by the war from 1942 to 1944 and the accumulated stock was caught off in 1945 and 1946. This has been followed by reduced landings. Still increasing is the catch from the central and northern parts of Subarea 4 which in 1941 produced less than 2 percent of the total United States catch but which in 1949 produced 52 percent of the total.

This vigorous and still expanding fishery is now exploiting almost all of the possible rosefish grounds within the range of the vessels. It seems certain that the production from these grounds must decline as the accumulated stock is caught. Indeed, the catch per day (Table 9) is generally declining in all areas, with some fluctuation in Subarea 5 due to the discovery of new grounds.

The Fish and Wildlife Service has recently begun a study of the effect of these developments on the productivity of the rosefish resource. It is working to determine practical measures which will protect the smaller fish and the maximum level of continuous yield for this fishery.

WHITING

Whiting or silver hake are taken commercially in Subareas 4 and 5. In the Gulf of Maine they are a summer fish, appearing first in the Cape Ann-Massachusetts Bay region in March and becoming increasingly abundant as the waters warm. South of Cape Cod they are common throughout most of the year, being taken offshore by otter trawlers from November through March, and inshore by pound netters from April through July. Otter trawlers, particularly of the Gloucester, Boston and Provincetown fleets have taken increasing amounts of whiting, and the catch has consequently risen from 8 million pounds in 1931 to 86 million pounds in 1949 (Table 1).

Nothing is known regarding the extent of the population, the rate of growth, or the size at maturity of whiting, nor are more than fragmentary data available regarding nursery grounds. Whiting spawn from June through September. The eggs and subsequently the larvae drift in the currents. The young fish descend to bottom probably when 1 to 1-1/2 inches long. Whiting are found on sandy and pebbly bottoms from the shoreline to a depth of about 300 fathoms.

Fishermen report that this fish is becoming scarcer, with former highly productive grounds now barely furnishing a day's fishing.

Hake is a name applied to several species of closely related fishes found from Newfoundland to Cape Hatteras. Two of these are taken commercially: the white hake, which, until very recently made up almost the entire catch, and the red hake, which had remained unutilized until wartime shortages created an unusual demand for fish in 1943 and 1944. Over 25 million pounds of hake were caught in 1945, principally with otter trawls. In that year fishermen took about 15 million pounds of red hake. In the following year the catch of this species declined to about one million pounds, but jumped again in 1949 as it was sought for reduction to fish meal.

White hake grows to 20 to 30 pounds, but the average sized fish landed is 5 pounds or less. Red hake average a pound to two, and though of good flavor, are so soft bodied they do not keep well. Very little is known of the biology of hakes or about the extent to which the supply is being utilized. The fishery for both of these species could probably be expanded if the market warranted.

FLOUNDERS

The flounder resource of the North Atlantic yields about 72 million pounds a year and ranks about fourth in volume in the New England catch. Until recent years it was hardly touched, for the small mouths of many of the species saved them from the hooks of line trawls and no considerable market existed for some of the most abundant species. In 1900, for example, only 4.5 million pounds were landed. The introduction of the otter trawl and development of the filleting industry stimulated growth of the flounder fishery. Today about 97 percent of the catch is taken with otter trawls, the balance chiefly with line trawls. Most of the flounder catch is utilized by the fillet industry.

Yellowtail is the most important of the North Atlantic flounders. Prior to about 1935 it was considered a trashfish and was landed in small quantities at very low prices. With the decline of the blackback fishery, the small otter trawlers turned to yellowtail fishing and the public learned of the excellent table qualities of this species. This led to the development of a flounder fillet industry at New Bedford and the expansion of the yellowtail fishery. In 1942 the landings of yellowtail were about 65 million pounds, surpassing those of all other flatfishes. Since 1942 this fishery has yielded progressively smaller catches. Fish and Wildlife Service studies indicate that the decline has been caused by heavy fishing and changing migratory habits. No remedies have been developed, but the landing of the young of this species for fish meal should be prohibited.

The blackback or winter flounder is the second most important of the North Atlantic flounders. The catch of this species had been 40 to 50 million pounds in the early 1930's, but has since declined steadily to less than 20 million pounds. This change can be attributed to a decline in the size of the blackback population and to a shift of portions of the fleet to the newly developed yellowtail fishery.

Blackback spawn in the winter and spring in depths of 1 to 3 fathoms. The eggs sink to the bottom and stick together in small clusters. The fish grow rapidly and become sexually mature at 8 to 10 inches and 3 to 4 years of age. The fish are relatively nonmigratory, moving only to cooler waters outside the bays in summer and back to inside waters in winter.

The rapid growth rate helps the blackback to persist under the intensive fishery. The nonmigratory habit, however, means that conservation measures must be more or less localized to fit local units of the blackback populations. To obtain better utilization of the existing supply of this resource, a minimum size limit of 10 inches has

been recommended for certain waters of Long Island, New York. Allowing the fish to grow before catching them will in itself increase fishermen's tonnages and also increase the number of spawning adults.

Lemon sole or Georges Bank flounder is a fish closely related to the winter flounder; indeed, it may be only a race of blackback flounder rather than a distinct species, though this is a matter of dispute. In any event, the trade uses the name lemon sole for individuals of both kinds which weigh over 2½ or 3 pounds. This size limit varies among dealers and among cities. About three million pounds sold under this name are caught annually. True lemon sole seem to be limited in their distribution to Georges Bank.

Gray sole is one of the deeper water flounders found principally on soft, muddy, and clay bottoms in 25 to 120 fathoms of water. About 3 million pounds are caught annually, most of it by the large otter trawlers incidentally with their catches of haddock, cod, and rosefish.

It is marketed almost entirely as fillet of sole. Practically nothing is known about this resource on which to base an opinion as to the possibility of increasing production.

Sea dab is a deep water flounder taken mostly on sandy bottoms in 15 to 60 fathoms by large otter trawlers as an incidental catch while fishing for cod and haddock. About 5 million pounds are landed annually. It is mostly filleted and marketed as fillet of sole. Virtually nothing is known of the biology of this fish, or of the production possibilities. Noteworthy, however, is the discovery by United States vessels of concentrations of this species on the Newfoundland banks in December 1950 from which more than 1 million pounds were taken during the month.

The North Atlantic halibut resource was fairly important 50 to 60 years ago, when it yielded around 13 million pounds annually.

At present less than a half million pounds are landed in a year (Table 10).

Some halibut are picked up incidentally by otter trawlers fishing for groundfish, but a greater part of the catch has been taken by a few line trawlers which specialize in halibut fishing on the edge of the continental shelf of the Nova Scotian Banks in 100 to 200 fathoms of water.

The halibut is the largest of our flat fishes. Present day specimens run from 20 to 200 pounds, but in former years individuals of over 700 pounds were taken. These huge fish are exceedingly voracious and their diet consists of various kinds of market and other fishes. If halibut are ever to be restored to the New England waters in anything like the numbers present in colonial days, it seems inevitable that a sizable share of the cod, haddock, whiting, and hake which now support important fisheries, will be required to feed them.

Table 1.—Total United States landings of certain species from the Convention Area.
(in millions of pounds)

Year	Haddock	Cod	Whiting	Pollock	Hake 2/	Rosefish	Mackerel	Flounders 3/	Halibut
1931	171	100	8	11	17	*	47	42	3
1932	146	94	7	11	17	*	60	38	2
1933	146	107	9	15	15	*	41	38	2
1934 4/	145	122	13	28	18	2	51	39	3
1935	177	122	17	33	27	17	62	39	3
1936 4/	163	114	35	42	26	66	47	43	3
1937	156	141	22	38	25	58	23	48	2
1938	154	129	25	40	24	65	39	47	2
1939	157	113	25	37	20	78	28	46	1
1940	137	86	41	37	15	85	36	58	1
1941 4/	165	102	44	39	13	152	41	68	1
1942	146	70	47	32	12	128	47	75	1
1943	126	70	54	22	17	115	53	66	*
1944	141	97	52	23	20	120	73	73	*
1945	155	145	78	38	32	132	57	74	*
1946	155	94	51	46	23	178	50	79	*
1947	166	67	62	21	26	147	47	68	1
1948	156	70	80	38	23	238	41	72	*
1949 4/	135	53	86	32	55	237	16	69	*

1/ Total New England and Middle Atlantic landings are used for haddock, cod, pollock, hake, rosefish, and halibut; total New England landings are used for flounder, mackerel, and whiting.
2/ Included are: red and white hake.
3/ Included are: gray sole, lemon sole, yellowtail, blackback, dab, and fluke.
4/ Partly estimated.
* Less than 500,000 lbs.

Table 2.--Landings at principal New England ports. 1/ (in thousands of pounds)

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Year	Convention Subarea					Total
	5	4	3	2	1	
1905	114,346	55,368	10,680	-	-	180,394
1906	111,494	40,917	15,865	173	-	168,449
1907	109,351	59,569	22,602	40	-	191,562
1908	108,489	56,756	16,214	-	-	181,459
1909	90,634	70,390	10,664	-	-	171,688
1910	105,699	64,987	9,858	-	974	181,518
1911	96,716	74,073	13,014	100	185	184,088
1912	112,607	63,346	5,042	888	14	181,897
1913	94,828	56,789	9,262	1,039	-	161,918
1914	94,239	54,131	12,309	741	-	161,420
1915	102,483	63,710	4,554	120	-	170,867
1916	113,640	62,215	8,181	56	-	184,092
1917	93,011	73,651	7,480	-	-	174,142
1918	128,876	64,992	5,427	-	-	199,295
1919	130,098	55,405	7,340	-	-	192,843
1920	129,780	38,677	6,841	-	-	175,298
1921	111,810	28,668	6,116	-	-	146,594
1922	105,779	47,024	6,863	-	-	159,666
1923	116,186	51,753	7,002	-	-	174,941
1924	128,299	43,336	11,259	5	-	182,899
1925	161,332	45,698	9,827	-	-	216,857
1926	173,393	51,984	12,896	21	-	238,294
1927	209,457	33,973	10,324	20	-	253,774
1928	228,839	29,810	21,098	46	-	279,793
1929	289,674	30,169	9,095	64	-	329,002
1930	290,501	53,286	9,402	60	-	353,249
1931	185,839	71,972	5,972	-	-	263,783
1932	187,629	60,313	3,620	-	-	251,562
1933	173,001	92,786	1,703	-	-	267,490
1934	143,633	167,767	1,315	-	-	312,715
1935	192,413	168,628	1,110	-	-	362,151
1936	264,213	150,657	369	-	-	415,239
1937	237,284	149,621	1,163	-	-	388,068
1938	270,756	149,471	800	-	-	421,027
1939	285,205	129,609	772	-	-	415,586
1940	307,473	101,335	223	-	-	409,031
1941	412,996	105,772	9	-	-	518,777
1942	394,079	36,210	28	-	-	430,317
1943	363,666	29,353	-	-	-	393,019
1944	354,853	75,153	-	-	-	430,006
1945	328,286	195,561	-	-	-	523,847
1946	394,530	145,337	79	-	-	539,946
1947	433,625	96,167	22	-	-	529,814
1948	462,620	176,933	1,886	-	-	641,439
1949	476,412	172,452	-	-	-	648,864

1/ Included are landings of all finfish and small quantities of other fishery products, such as scallops, lobsters, eels, etc.

Table 3.— Fishing effort by the New England fleet. 1/
(in days absent)

Convention Subarea	5	4					3	
Ground	New England	Nova Scotia			Gulf of St. Lawr.	Sum	Newfound-land	
		South	Central	North				
Statistical area	XXII	XXI So.	XXI Cent.	XXI No.	XIX	XIX & XXI	XVIII & XX	Total
Distance (in miles)	140	235	370	555	700	—	985	
Years								
1931	28,500	6,968	2,398	422	121	9,909	371	38,780
1932	26,169	5,450	2,694	467	159	8,770	270	35,209
1933	26,502	5,953	5,517	347	373	12,190	363	39,055
1934	21,046	4,826	10,383	1,804	345	17,358	349	38,753
1935	23,019	4,105	10,079	1,804	517	16,505	352	39,876
1936	27,445	6,484	6,109	1,772	505	14,870	134	42,449
1937	30,399	7,171	4,774	1,810	483	14,238	324	44,961
1938	27,662	6,854	4,672	1,329	236	13,091	291	41,044
1939	28,965	5,238	3,077	2,292	. . .	10,607	141	39,713
1940	31,255	5,247	2,253	1,903	. . .	9,403	71	40,729
1941	34,529	4,023	2,502	1,765	. . .	8,290	8	42,827
1942	32,905	2,278	641	321	7	3,247	29	36,181
1943	28,265	1,311	790	131	. . .	2,232	. . .	30,497
1944	23,742	1,553	2,698	321	. . .	4,572	. . .	28,314
1945	23,410	4,762	4,716	2,754	. . .	12,232	. . .	35,642
1946	42,894	3,610	6,729	848	. . .	11,187	7	54,088
1947	41,984	4,128	5,472	660	64	10,324	2	52,310
1948	45,099	3,876	5,151	4,482	. . .	13,509	150	58,758
1949	45,197	4,085	6,378	4,106	. . .	14,569	. . .	59,766
Total	588,987	87,922	87,033	29,338	2,810	207,103	2,862	798,952

1/ Otter trawlers, line trawlers, and hand liners landing at principal New England ports.

Table 4.- Haddock landed at principal New England ports.
(in thousands of pounds)

Year	Convention Subarea 5	4					3	Total
	New England	Nova Scotia South	Nova Scotia Central	Nova Scotia North	Gulf of St. Lawr.	Sum	Newfound-land	
1931	94,262	29,128	9,373	41	. . .	38,542	42	132,846
1932	91,124	19,177	9,754	2	. . .	28,933	61	120,118
1933	82,879	25,659	21,185	. ...	155	46,999	33	129,911
1934	46,472	16,581	63,581	7,766	68	87,996	214	134,682
1935	66,279	19,663	64,477	6,609	12	90,761	. . .	157,040
1936	78,513	20,130	39,486	5,742	5	65,363	6	143,882
1937	87,547	17,462	27,029	4,888	7	49,386	238	137,171
1938	83,158	24,717	24,861	2,004	. . .	51,582	79	134,819
1939	95,623	20,580	14,702	3,955	. . .	39,237	375	135,235
1940	88,837	14,368	11,745	5,447	. . .	31,560	57	120,454
1941	116,369	9,812	13,733	7,310	. . .	30,855	. . .	147,224
1942	96,727	9,142	2,855	1,073	. . .	13,070	. . .	109,797
1943	81,757	4,029	3,444	963	. . .	8,436	. . .	90,193
1944	64,706	10,055	13,539	1,151	. . .	24,745	. . .	89,451
1945	38,920	16,079	28,259	5,348	. . .	49,686	. . .	88,606
1946	85,413	7,946	16,674	2,884	. . .	27,504	53	112,970
1947	98,158	15,024	14,838	1,373	. . .	31,235	13	129,406
1948	83,970	16,125	15,330	2,867	. . .	34,322	1,527	119,819
1949	81,061	16,123	5,932	1,117	. . .	23,172	. . .	104,233
Total	1,561,775	311,800	400,797	60,540	247	773,384	2,698	2,337,857
Average	82,199	16,411	21,095	3,186	13	40,704	142	123,045
Percent	66.8	13.3	17.2	2.6	.01	33.1	.1	100.0

Table 5 -- Total landings and catch per days fishing for haddock from Georges Bank of Subarea 5

Year	Total catch Millions of pounds	Catch per days fishing Thousands of pounds
1917	27	25.8
1918	48	33.0
1919	76	35.0
1920	79	36.6
1921	58	32.5
1922	60	24.5
1923	64	18.4
1924	71	23.2
1925	80	32.2
1926	99	41.3
1927	143	43.8
1928	191	34.5
1929	223	22.4
1930	184	11.5
1931	115	8.9
1932	105	11.6
1933	82	9.7
1934	50	10.3
1935	79	12.3
1936	84	13.5
1937	95	11.6
1938	92	11.7
1939	105	13.0
1940	93	12.8
1941	122	16.6
1942	107	18.7
1943	90	18.4
1944	96	17.0
1945	78	16.0
1946	104	14.3
1947	105	12.8
1948	94	12.1
1949	82	11.4
1950	1/ 81	1/ 14.1

Source: Data (partly unpublished) from special haddock studies of the North Atlantic Fishery Investigations.

1/ Partially estimated.

TABLE 6. Cod landed at principal New England ports (in thousands of pounds).

	Convention Subarea							
		Nova Scotia						
Year	New England	South	Central	North	Gulf of St Lawr.	Sum	Nfld	Total
1931	40,619	14,028	6,166	119	864	21,177	13	61,809
1932	38,917	11,978	7,994	243	1,512	21,727	93	60,737
1933	42,056	15,649	13,507	190	4,858	34,204	159	76,419
1934	28,602	12,380	40,677	7,260	3,402	63,719	325	92,646
1935	35,584	10,472	30,837	9,227	4,090	54,626	102	90,312
1936	37,778	12,355	19,906	10,063	2,500	44,824	106	82,708
1937	49,790	11,544	22,059	16,638	2,036	52,277	295	102,362
1938	38,939	10,383	29,023	12,959	4,054	56,419	419	95,777
1939	28,557	12,024	20,045	19,732	-	51,801	221	80,579
1940	28,886	6,852	11,810	13,843	-	32,505	86	61,477
1941	32,899	7,332	17,364	17,473.	-	42,169	5	75,073
1942	29,326	3,832	6,641	3,469	11	13,953	5	43,284
1943	32,043	2,705	6,383	1,293	-	10,381	-	42,424
1944	29,747	4,337	25,573	4,128	-	34,038	-	63,785
1945	21,530	7,565	33,369	38,624	-	79,558	-	101,088
1946	40,694	4,102	17,103	5,667	-	26,872	-	67,566
1947	31,911	3,680	8,655	2,343	-	14,678	9	46,598
1948	32,971	3,283	7,605	4,771	-	15,659	97	48,727
1949	31,947	3,088	2,401	2,263	-	7,752	-	39,699
Total	652,796	157,589	327,118	170,305	23,327	678,339	1,935	1,333,070
Average	34,358	8,294	17,217	8,963	1,228	35,702	102	70,162
Percent	49.0	11.8	24.5	12.8	1.8	50.9	.1	100.0

Table 7.--Catch per day's fishing for cod in Subarea 5.

Year 1/	Thousands of Pounds per day
1932	5.4
1933	5.4
1934	4.6
1935	5.2
1936	6.6
1937	6.6
1938	5.0
1939	3.7
1940	5.3
1941	5.0
1942	4.6
1943	6.0
1944	5.9
1945	6.4
1946	4.9
1947	3.1
1948	2.4
1949	4.1

Source: Unpublished data on abundance of cod landed at Boston by a selected group of large otter trawlers from the Georges Bank area in 31 to 60 fathoms, compiled by North Atlantic Fishery Investigations.

1/ No data available for 1931.

Table 8.--Rosefish landed at principal New England ports.
(in thousands of pounds)

Year	Convention Subarea 5 New England		Convention Subarea 4 Nova Scotia South	Nova Scotia Central	Nova Scotia North	Gulf of St. Lawr.	Sum	Convention Subarea 3 Newfound-land	Total
1931	(1/)	120	. . .	. . .	. . .	. . .	. . .	. . .	120
1932	(1/)	57	. . .	. . .	. . .	. . .	. . .	. . .	57
1933	(1/)	250	. . .	. . .	. . .	. . .	. . .	. . .	250
1934	(1/)	1,841	. . .	. . .	. . .	. . .	. . .	. . .	1,841
1935		14,431	147	. . .	424	. . .	571	. . .	15,002
1936		48,359	14,788	454	386	. . .	15,628	. . .	63,987
1937		31,597	25,756	223	264	. . .	26,243	. . .	57,840
1938		44,587	17,071	120	225	. . .	17,416	. . .	62,003
1939		55,945	12,343	56	9,206	. . .	21,605	. . .	77,550
1940		57,914	22,880	62	2,781	. . .	25,723	. . .	83,637
1941		118,216	28,055	84	2,567	. . .	30,706	. . .	148,922
1942		117,554	4,265	122	. . .	. . .	4,387	. . .	121,941
1943		92,286	6,998	96	96	. . .	7,190	. . .	99,476
1944		93,885	6,356	1,335	188	. . .	7,879	. . .	101,764
1945		72,457	37,185	3,959	833	. . .	41,977	. . .	114,434
1946		79,603	30,791	10,652	33,609	. . .	75,052	. . .	154,655
1947		95,268	13,238	4,126	33,073	. . .	50,437	. . .	145,705
1948		112,180	22,411	13,205	89,213	. . .	124,829	. . .	237,009
1949		87,701	25,632	14,925	108,342	. . .	148,899	. . .	236,600
Total		1,124,251	267,916	49,419	281,207	. . .	598,542	. . .	1,722,793
Average		59,171	14,101	2,601	14,800	. . .	31,502	. . .	90,673
Percent		65.3	15.5	2.9	16.3	. . .	34.7	. . .	100.0

1/ Landings by area not available.

Table 9.--Catch per day's fishing for rosefish (in thousands of pounds)

Year	Subarea 5 New England	Subarea 4 Nova Scotia		
		South	Central	North
1935	14.6	-	-	-
1936	9.3	12.5	-	-
1937	9.6	9.9	-	-
1938	8.9	9.6	-	-
1939	10.0	12.5	12.9	-
1940	9.9	13.7	-	-
1941	13.0	16.7	-	-
1942	11.2	8.6	-	-
1943	11.8	18.8	21.8	-
1944	6.4	20.2	15.3	-
1945	9.9	16.9	12.0	-
1946	10.5	14.1	18.7	32.8
1947	9.9	7.6	10.0	20.3
1948	10.1	10.2	10.2	24.3
1949	7.2	8.5	10.6	19.5

Source: Unpublished preliminary data on rosefish landed by medium otter trawlers at principal New England ports compiled by North Atlantic Fishery Investigations.

Table 10.--Halibut landed at principal New England ports.
(in thousands of pounds)

Year	Convention Subarea 5	4					3	Total
	New England	Nova Scotia			Gulf of St. Lawr.	Sum	Newfound-land	
		South	Central	North				
1931	980	512	96	271	127	1,006	554	2,540
1932	847	291	299	523	26	1,139	366	2,352
1933	536	338	302	317	144	1,101	479	2,116
1934	255	390	599	316	16	1,321	315	1,891
1935	388	258	749	141	520	1,668	295	2,351
1936	233	429	419	590	305	1,743	235	2,211
1937	279	444	226	351	104	1,125	604	2,008
1938	205	427	232	331	108	1,098	277	1,580
1939	221	311	211	348	. . .	870	168	1,259
1940	218	203	135	320	. . .	658	77	953
1941	205	153	163	185	. . .	501	3	709
1942	182	85	28	143	11	267	23	472
1943	125	25	13	0	. . .	38	. . .	163
1944	84	31	30	1	. . .	62	. . .	146
1945	51	35	52	8	. . .	95	. . .	146
1946	149	16	36	5	. . .	57	22	228
1947	262	49	65	6	20	140	. . .	402
1948	196	43	60	15	. . .	118	1	315
1949	196	48	28	36	. . .	112	. . .	308
Total	5,612	4,088	3,743	3,907	1,381	13,119	3,419	22,150
Average	295	215	197	206	73	691	180	1,166
Percent	25.3	18.5	16.9	17.6	6.2	59.2	15.5	100.0

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3. RECOMMENDATIONS FOR PREVENTING WASTE OF SMALL HADDOCK IN SUBAREA 5

Fish and Wildlife Service research on the haddock of the Convention Area have been concentrated in Subarea 5. It has become evident that this species is not being utilized to full advantage, primarily because too large a proportion of undersized individuals is being taken. There is much evidence to prove, and no evidence to refute, that the poundage of haddock landed would be sharply increased if the immature individuals were permitted to escape as juveniles, and so be available to the fishery as adults.

REASONS FOR PROTECTING SMALL HADDOCK

The evidence at hand includes the following considerations:

(1) There are very large numbers of baby scrod caught each year, some of which are landed and marketed, while many more are discarded at sea (2) There is an intensive fishery, which results in a high percentage removal of the available stocks (3) There is a rapid rate of growth, especially during the early years (4) There is no substantial emigration of this species from Subarea 5 into other areas and (5) There is a low natural mortality rate, especially in the older age groups. If each of these considerations can be established, then there is adequate proof that the saving of the immature individuals will result in a substantial gain in the total poundage of haddock which may be removed from these grounds. The following evidence is presented in support of these assertions:

1. That very large numbers of immature haddock are landed is substantiated by the catch measurements of the Fish and Wildlife Service since 1931 at the important ports of landing. In addition large numbers of haddock, too small for economic use, are caught and discarded at sea. Because of the method of handling, all, or nearly all, of those discarded at sea are killed. Estimates of these losses are approximations, based

on the reports of the masters of the vessels at the ports of landing since 1947. Totals of immature haddock so removed from Subarea 5, as compared with the numbers of scrod and large haddock in the same years, are shown below:

CATCH IN NUMBERS OF INDIVIDUALS
(IN THOUSANDS)

YEAR	UNDER 1½ POUNDS LANDED	UNDER 1½ POUNDS DISCARDED AT SEA	TOTAL	OVER 1½ POUNDS LANDED
1931	3,836	63,000	66,836*	35,291
1932	2,579	Unkown		36,902
1933	4,043	"		26,851
1934	2,601	"		16,734
1935	4,416	"		27,887
1936	5,402	"		29,985
1937	4,260	"		32,274
1938	6,352	"		31,545
1939	5,419	"		38,426
1940	3,342	"		31,531
1941	10,341	"		45,262
1942	6,091	"		39,171
1943	4,727	"		32,702
1944	1,500	"		31,649
1945	2,700	"		23,852
1946	3,683	"		33,690
1947	8,942	33,000	41,892	32,853
1948	9,189	15,000	24,189	31,979
1949	5,479	12,000	17,479	27,956
1950	20,349	15,000	35,349	23,139

* From Herrington (1932)

2. Estimates of the mortality rate indicate the annual expectation of death for 3-year old haddock to be 0.44 (44%), and that a similar rate for 4-year olds existed during the period 1931-1948. These data are derived from indices of abundance which were computed for each age throughout this period by the Fish and Wildlife Service. Indirect evidence (Schuck 1949) indicates that the proportion of this total rate due to fishing probably is very high. In this study a

direct and statistically significant correlation between landings of 4 - to 9 - year-old haddock and the decline in size of the stock was demonstrated. The line fitting this relationship, extrapolated to the point of no removals by the fishery, demonstrated no decline in the stock. The validity of strict interpretation of such extrapolation is subject to question, but it does certainly indicate that fishing is causing all but a small part of the annual mortality at the levels of fishing which prevail.

3. Growth studies, demonstrate that the haddock have a rapid growth rate, especially in early years. The following averages represent weights of each age group as landed:

AGE GROUP	AVERAGE WT POUNDS	GRAMS	PERCENTAGE INCREASE BETWEEN YEARS
1	.40*	181	
2	1.55	703	288%
3	2.23	1012	44%
4	2.94	1334	32%
5	3.55	1610	21%
6	4.22	1914	19%

* selected sample, since only largest yearlings are landed.

From these data it is evident that the growth increment, especially between the first and second years, is of such magnitude as to insure a considerable increase in yield from the fishery if juveniles are permitted to survive for one or more additional years.

4. Studies of the stocks of haddock by American and Canadian biologists (Needler, 1930; Herrington 1944; Schuck and Arnold in press(through the use of growth rates, vertebral counts, and tagging indicate the emigration of haddock out of Subarea 5 is probably in-

significant. Thus haddock spared in one year will not migrate to another bank, but will be available to the fishery in succeeding years.

5. The fishery (see 2 above) is credited with causing very nearly all of the total mortality of the fully available ages, thus natural mortality must, under conditions of the heavy fishing, be very low. Natural mortality of the younger ages, while greater probably is low also.

If it be concluded that protection of small haddock is desirable, it remains to determine how best this might be accomplished. The methods may be closed seasons, closed areas, modifications of gear, minimum size limits or combinations of these. Each is considered in turn.

METHODS OF PROTECTION

Closed Seasons

The destruction of small haddock at sea, and the landing of undersized haddock (smaller than the lower limit of the recognized market category of scrod) are shown in each season in the following table. Values for destruction at sea are averages for the 1947-1950 period, values for landings are averages for the 1931-1948 period.

(In Thousands)

Season	Months	Number Destroyed at sea	Number Undersized landed
Spring	Feb.,Mar.,April	1,726	575
Summer	May,June,July	5,545	1,505
Fall	Aug.,Sept.,Oct.	9,443	1,893
Winter	Nov.,Dec.,Jan.	2,736	999
Total		18,750	4,972

Thus nearly half of the annual destruction occurs during August, September, and October. But the heaviest landings of large

haddock occur also during the fall season. The loss of the large fish probably would outweigh the gain in survival of small.

Closed Areas

Closure of the areas frequented by the small fish appears impractical because the areas are large and variable. A detailed analysis of fishermen's reports of the localities where small fish were discarded, and of Albatross III catches of small haddock, shows that small haddock have been found over much of Georges Bank in both shoal and deep water.

Modification of Gear

A method of preventing the capture of small haddock is the only effective way of preventing their waste. The use of larger mesh in the trawl is an effective way to accomplish this according to numerous experiments made by British and American biologists. Recommendations for larger mesh in the United States haddock fishery have been made by Herrington (1932, 1935, 1936, 1941); Schuck, 1947, 1948); Royce and Schuck (1950).

These recommendations have been made with the objective of preventing the capture of most of the haddock below 1.5 pounds, which size is the equivalent of 42 centimeters or 16.5 inches fork length. This size is attained by the average Georges Bank haddock at its third birthday after it has gone through its most rapidly growing period. Furthermore, according to the rules of the New England Fish Exchange at Boston, this is the minimum size for scrod haddock.

Unfortunately the mesh of a trawl net is not sharply selective. Thus it is necessary to compromise on a mesh which will permit the escape of most of the haddock below 1.5 pounds while retaining most of the larger haddock. From experiments conducted by British and Americans (summarized by Herrington, 1935) it is concluded that this could be accomplished with

a mesh opening of 4 5/8". This size opening will release about 75% of the 42 cm fish, 50% of the 46 cm fish and 25% of the 50 cm fish.

In order to state the mesh size in terms used by the fishing industry it is necessary to add the diameter of the knot to the size of the mesh opening. For a size of twine (4 thread manila, no. 1100 double) in common use the average knot diameter is about .57 inches. Thus the mesh size corresponding to a mesh opening of 4 5/8 inches would be about 5.19 inches. Also, because a regulation must specify a minimum mesh size which in practice must be exceeded, a minimum mesh size of 5 inches between knot centers as the net is stretched after use is recommended.

This larger mesh is necessary only in the top of the rear of the otter trawl net where the catch accumulates. This section of the net includes the cod end or bag and any extension piece which may be used between the belly and the cod end. It is recommended that the minimum mesh size shall apply to the top half of the net behind the belly.

Minimum size limits

A minimum size limit alone is of no great value for although landings of small fish would be curtailed these fish would still be caught, killed, and discarded at sea.

A minimum size limit as a supplement to a mesh regulation however, may be useful. If small fish are not salable there is less temptation to modify the net secretly or to concentrate on schools of small haddock which, when sufficiently abundant, are catchable even with a large mesh net.

RECOMMENDATION FOR STUDYING EFFECTS OF REGULATIONS

It is recommended that the effectiveness of any regulation which is adopted be the subject of further study and that provision be made to modify the regulation as may be proved necessary.

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Appendix I.--Explanation of Tables

Principal New England ports were Boston, Gloucester and Portland through 1944. New Bedford was added to the principal ports in 1945, Cape Cod in 1946, and Portland was omitted in 1947. The only exceptions are: In table 1 New Bedford landings were added from 1938, and Rockland from 1946 (otter trawl landings from Knox County); and in table 14 (rosefish) all Maine landings were included after 1947 (prorated into subareas on the basis of Gloucester landings). These changes have little effect on the comparative value of the data because the ports were added as they became important or omitted as they became less important.

Unless otherwise specified on individual tables, the sources of landing statistics used are those published by the Statistical Section of the Branch of Commercial Fisheries, United States Fish and Wildlife Service (formerly United States Bureau of Fisheries), and include: Fishery Statistics of the United States (formerly Fishery Industries of the United States), New England Fisheries, Massachusetts Landings, Maine Landings, and Middle Atlantic Fisheries. All tables were assembled by the North Atlantic Fishery Investigations of the United States Fish and Wildlife Service at Woods Hole, Massachusetts.

Landings of cod, haddock, pollock, hake and halibut are expressed in terms of drawn weight. Landings of whiting, rosefish, mackerel and flounders are in terms of round weight.

Medium otter trawlers are those of 51 to 150 gross tons, large otter trawlers are those of 151 gross tons or over.

Haddock as used herein refers to both market categories, large and scrod, combined.

The fishing grounds are the statistical areas defined by the North American Council on Fishery Investigations and revised in

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Development of Fishery Statistics in the North Atlantic, George A. Rounsefell, United States Fish and Wildlife Service, Special Scientific Report No. 47, 1948. They are as follows: New England, Area XXII; Nova Scotia South, Subareas N to S of Area XXI; Nova Scotia Central, Subareas D to M of Area XXI; Nova Scotia North, Subareas A to C of Area XXI; Gulf of St. Lawrence, Area XIX; Newfoundland, Areas XX and XVIII.

Conversion factors: 1 pound - 0.4536 kilos

1,000 pounds - 0.4536 metric tons

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Appendix II.—Common and Scientific Names of Species Referred to in the Tables.[1/]

Haddock	Melanogrammus aeglefinus
Cod	Gadus morhua
Whiting	Merluccius bilinearis
Pollock	Pollachius virens
Red Hake	Urophycis chuss
White Hake	Urophycis tenuis
Rosefish	Sebastes marinus
Mackerel	Scomber scombrus
Blackback Flounder	Pseudopleuronectes americanus americanus
Dab	Hippoglossoides platessoides
Fluke	Paralichthys dentatus
Gray Sole	Glyptocephalus cynoglossus
Lemon Sole	Pseudopleuronectes americanus dignabilis
Yellowtail Flounder	Limanda ferruginea
Halibut	Hippoglossus hippoglossus

1/ Common names are those used in statistical reports of the Fish and Wildlife Service; scientific names follow the list in Special Publication No. 1, American Fisheries Society, 1948.

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LIST OF TABLES

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