

DESTRUCTION OF UNDERSIZED HADDOCK ON GEORGES BANK, 1947-51

SPECIAL SCIENTIFIC REPORT: FISHERIES No. 96

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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United States Department of the Interior, Douglas McKay, Secretary
Fish and Wildlife Service, Albert M. Day, Director

DESTRUCTION OF UNDERSIZED HADDOCK ON GEORGES BANK, 1947-51

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CONTENTS

	Page
Methods	2
Estimated destruction, 1947-51	2
Annual	11
Seasonal	11
Areas	11
Analysis of discards, 1951	12
Pounds	12
Numbers	12
Estimated total destruction	12
Average weight	12
Size composition	18
Cull by fishermen	18
Age composition	23
Size composition of ages	27
Summary	32
Bibliography	32

ILLUSTRATIONS

FIGURE	Page
1. A Boston trawler, typical of those on which observations were made at sea	3
2. Checkers full of haddock immediately after one set of the net has been emptied on deck	4
3. Undersized haddock. - These fish were discarded as soon as the Fish and Wildlife Service observer measured them. Note measuring equipment in foreground.	5
4. Observer measuring a sample of discarded baby haddock by the punch strip method	6
5. Estimated monthly destruction (in pounds) of baby haddock discarded on Georges Bank by the Boston fishing fleet, 1947-51	9
6. Localities where haddock were discarded in the average year, 1947-51.	10
7. Distribution of fishing effort of Boston fishing fleet in the average year, 1938-49	13
8. Regression of average weight of discards against total pounds landed.	14
9. Size composition on the average Georges Bank trip observed in 1951	19
10. Haddock cull curve on the average Georges Bank trip observed in 1951	24
11. Cull by fishermen on the individual Georges Bank trips observed in 1951	25
12. Size composition of each age in catch on the average Georges Bank trips observed in 1951	28

THE DESTRUCTION OF UNDERSIZED HADDOCK ON GEORGES BANK, 1947-1951.

The destruction of undersized haddock on Georges Bank has been going on since the introduction of the otter trawl in 1905. This waste of small fish has been of great concern to the industry and to conservationists for many years. The Fish and Wildlife Service has been studying this fishery intensively since 1931, and has at various times urged the use of a larger-meshed net in order to curb the destruction of haddock too small to market (Herrington, 1932, 1935, 1936; Schuck, 1947, 1948; Royce and Schuck, 1950) but, since the banks lie in international waters, no legislation was ever enacted.

With the organization in 1951 of the International Commission for the Northwest Atlantic Fisheries, it became possible to control the fisheries of these banks, and appropriate regulations are now being promulgated by Canada and the United States to set the minimum size of mesh allowable for haddock fishing on Georges Bank and in the Gulf of Maine (subarea 5 of the Commission).

In connection with these regulations, it is necessary to have accurate information on the numbers and sizes of fish discarded at sea before and after the regulations are applied, in order to assess the effectiveness of the larger mesh in actual practice.

Extensive observations (61 sea trips) were made by Bureau of Fisheries observers (Alexander, Moore, and Kendall, 1915) in 1913-14, and from data collected it was possible to estimate the quantities of haddock discarded in these years. Herrington (1932, 1935, 1936) estimated the quantities of haddock discarded for the years 1930-32 by sampling at sea (20 trips) and by port interviews of vessels. The present report extends these data to include the results of port interviews for the years 1947 to 1951 and the samplings at sea for the year 1951.

The success of this study has been made possible by the wholehearted cooperation of the fishing industry. We wish to express our appreciation to all the fishermen interviewed and especially to the crews of the trawlers on which the observers shipped. An extra man on board may interfere with normal operations, but the observers have found the fishermen most willing to afford them an opportunity to collect the necessary data. The boat owners have been very cooperative in permitting the observers to sail on these trips.

Howard A. Schuck was in charge of haddock research when these studies were conducted. Credit is due him for supervising the sampling-at-sea program during its initial stages. The following persons collected data at sea: John R. Clark, Sterling L. Cogswell, David F. Hammack, George F. Kelly, John F. Shea, and the author. Port Interviews were conducted by James J. Miggins and David F. Hammack. Betty B. Murray and Sterling L. Cogswell assisted in the tabulation of the data.

METHODS

For many years, the Service has stationed a man at the Boston Fish Pier to collect biological information on the haddock landed there. This agent measures the lengths of a sample of each catch, collects scales for age determination, and interviews the captains of the vessels to obtain information on the area of capture. Since 1947 the interviewer has also obtained from the captains their estimates of the pounds of haddock discarded on each trip and the area in which the destruction occurred.

In 1951, a system was inaugurated for obtaining more detailed information on the fish discarded. In this program trained observers are sent to sea on commercial trawlers to count and measure the fish discarded and to collect scale samples for age determination. Similar data are collected from the retained portion of the catch. A trawler, typical of those on which observations were made, is shown in figure 1.

In normal fishing operations, the entire catch from a haul is dumped into one or more checkers (fig. 2). From these checkers the marketable fish are selected and separated according to species. The haddock are graded for size, then gutted and tossed into a wash box from which they are pitched below decks for icing. The biologist usually obtains his measurements and scale samples of the marketable fish before the fish are gutted.

The unmarketable fish remaining in the checkers are washed overboard through the scuppers. The biologist takes a sample of these just before they are discarded (see fig. 3). Lengths of fish are measured by the punch-strip method (see fig. 4). In this method, each fish is laid on an aluminum strip and its length recorded by punching the strip with an ice pick. The actual lengths are measured after return to the laboratory. The lengths of several hundred fish can be rapidly recorded in this way on a single strip by a single observer without use of notebook.

During 1951, seven trips were made by the sea sampling observers. The trips were made on the following trawlers: Barbara C. Angell, Crest, Drift, Michigan, Red Jacket, and Winchester. The dates and areas fished on these trips are listed in table 1. Most of the fishing was conducted on the Northern Edge, where a total of 326 sets were made. One hundred and ten sets were made on the Southeast Part, and 36 sets on the eastern side of South Channel.

ESTIMATED DESTRUCTION, 1947-51

The destruction of haddock on Georges Bank by the Boston fleet^{1/} for the years 1947 to 1951 is summarized in table 2.

^{1/} The estimates for the entire New England fleet are almost 50 percent greater than those reported here.



Figure 1.--A Boston trawler, typical of those on which observations were made at sea.



Figure 2.--Checkers full of haddock, immediately after one set of the net has been emptied on deck



Figure 3.--Undersized haddock. These fish were discarded as soon as the Fish and Wildlife Service observer measured them. Note measuring equipment in foreground.

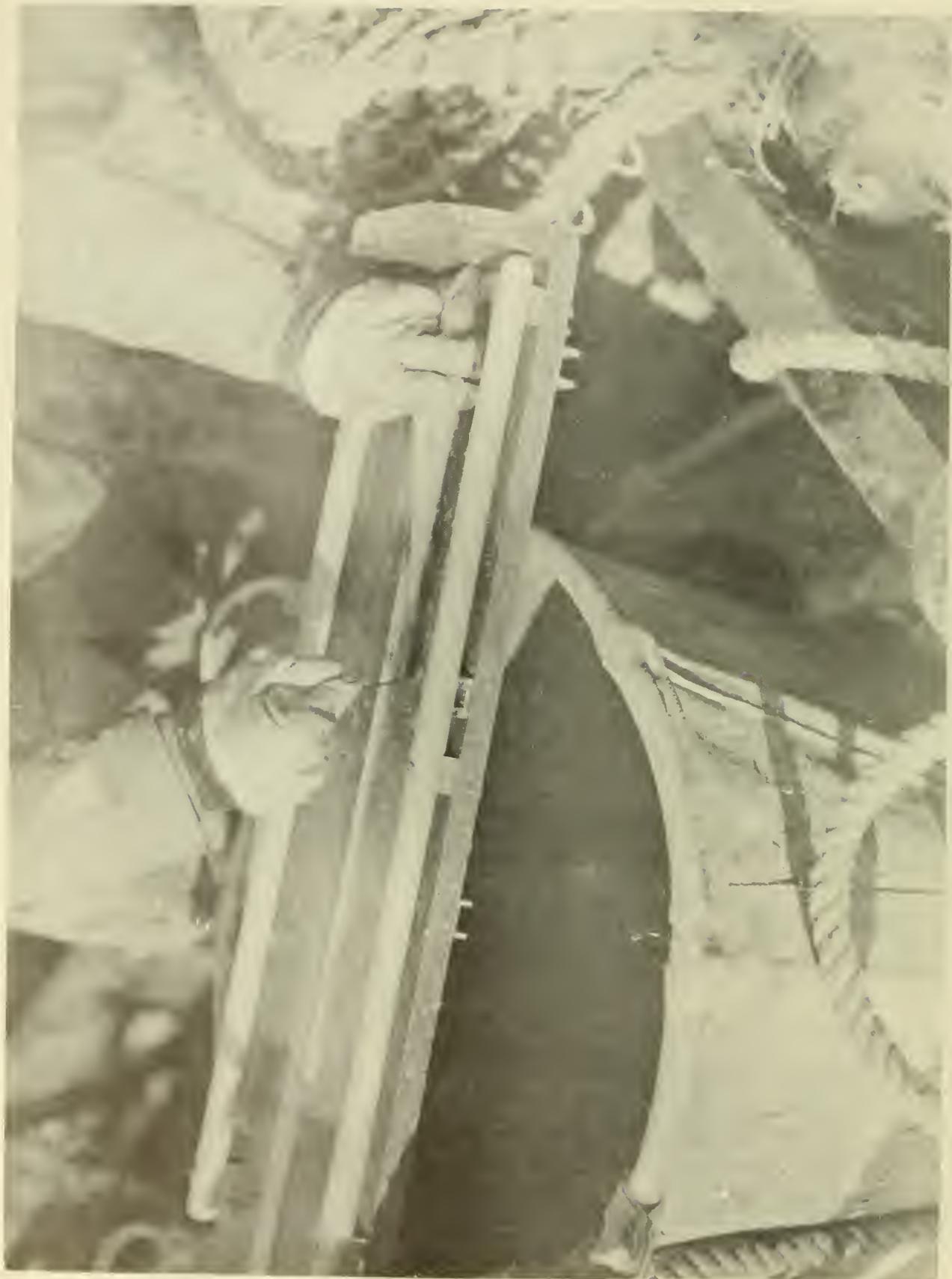


Figure 4.--Observer measuring a sample of discarded baby haddock by the punch strip method.

TABLE 2.--Destruction of haddock on Georges Bank
by the Boston fishing fleet, 1947-51
/in thousands/

Year-Month	Pounds			Numbers		
	Total catch	Discards	Percent discarded	Total catch	Discards	Percent discarded
1947-January	5,658	146	2.6	1,880	182	9.7
February	5,744	232	4.0	2,094	290	13.8
March	5,598	234	4.2	2,048	292	14.2
April	8,489	531	6.2	3,269	664	20.3
May	6,487	489	7.5	2,987	611	20.4
June	6,611	711	10.8	3,226	889	27.6
July	6,315	1,050	16.6	3,398	1,312	38.6
August	11,317	2,074	18.3	6,931	2,592	37.4
September	12,589	2,189	17.4	7,618	2,736	35.9
October	12,443	1,347	10.8	6,893	1,684	24.4
November	3,467	131	3.8	1,248	164	13.1
December	3,563	221	6.2	1,362	276	20.3
All months	<u>88,281</u>	<u>9,355</u>	<u>10.6</u>	<u>42,954</u>	<u>11,692</u>	<u>27.2</u>
1948-January	3,016	200	6.6	1,165	250	21.4
February	2,178	49	2.2	800	61	7.6
March	5,128	81	1.6	1,852	101	5.4
April	7,570	105	1.4	2,721	131	4.8
May	2,741	160	5.8	1,459	200	13.7
June	6,968	265	3.8	3,601	331	9.2
July	7,595	519	6.8	4,101	649	15.8
August	8,998	491	5.4	4,450	614	13.8
September	9,184	977	10.6	4,921	1,221	24.8
October	8,381	548	6.5	4,217	685	16.2
November	5,985	679	11.3	3,251	849	26.1
December	3,414	180	5.3	1,689	225	13.3
All months	<u>71,158</u>	<u>4,254</u>	<u>6.0</u>	<u>34,227</u>	<u>5,317</u>	<u>15.5</u>
1949-January	4,442	104	2.3	2,094	130	6.2
February	6,975	142	2.0	2,886	178	6.2
March	6,920	149	2.2	2,526	186	7.4
April	3,906	90	2.3	1,431	112	7.8
May	5,785	419	7.2	3,066	524	17.1
June	7,723	412	5.3	3,978	515	12.9
July	5,841	113	1.9	2,854	141	4.9
August	9,671	553	5.7	4,584	691	15.1
September	9,101	329	3.6	4,157	411	9.9
October	5,791	876	15.1	3,194	1,095	34.3
November	1,802	90	5.0	638	112	17.6
December	1,757	33	1.9	570	41	7.2
All months	<u>69,714</u>	<u>3,310</u>	<u>4.7</u>	<u>31,978</u>	<u>4,136</u>	<u>12.9</u>

TABLE 2.--Destruction of haddock on Georges Bank by the
Boston fishing fleet, 1947-51 continued
/in thousands/

Year-Month	Pounds			Numbers		
	Total catch	Discards	Percent discarded	Total catch	Discards	Percent discarded
1950-January	2,652	114	4.3	921	142	15.4
February	3,978	140	3.5	1,337	175	13.1
March	3,025	120	4.0	1,029	150	14.6
April	1,744	77	4.4	600	96	16.0
May	5,288	290	5.5	3,061	362	11.8
June	5,745	836	14.6	3,695	1,045	28.3
July	7,683	1,053	13.7	4,896	1,316	26.9
August	10,299	810	7.9	6,837	1,012	14.8
September	8,608	307	3.6	5,480	384	7.0
October	7,568	268	3.5	4,816	335	7.0
November	5,728	332	5.8	3,441	415	12.1
December	4,500	74	1.6	2,574	92	3.6
All months	<u>66,818</u>	<u>4,421</u>	<u>6.6</u>	<u>38,687</u>	<u>5,523</u>	<u>14.3</u>
1951-January	4,103	44	1.1	2,332	55	2.4
February	8,263	139	1.7	3,065	174	5.7
March	4,218	26	0.6	1,524	32	2.1
April	2,239	27	1.2	821	34	4.1
May	6,397	53	0.8	3,548	66	1.9
June	6,216	327	5.3	3,641	409	11.2
July	7,217	241	3.3	4,129	301	7.3
August	12,189	292	2.4	6,252	365	5.8
September	11,056	188	1.7	5,612	235	4.2
October	7,732	834	10.8	4,455	1,042	23.4
November	4,359	293	6.7	2,048	366	17.9
December	<u>3,190</u>	<u>324</u>	<u>10.2</u>	<u>1,591</u>	<u>405</u>	<u>25.4</u>
All months	<u>77,179</u>	<u>2,788</u>	<u>3.6</u>	<u>39,018</u>	<u>3,484</u>	<u>8.9</u>

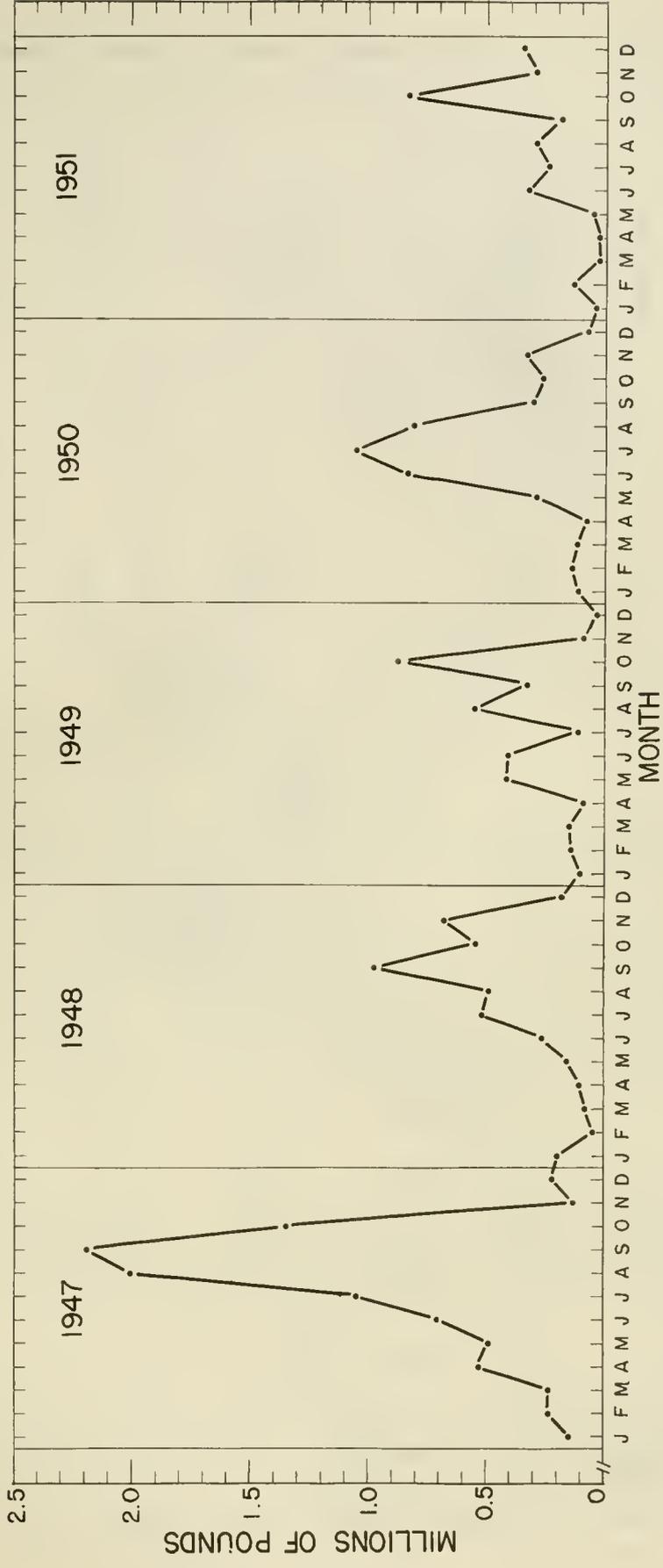


Figure 5.--Estimated monthly destruction (in pounds) of baby haddock discarded on Georges Bank by the Boston fishing fleet, 1947-51.

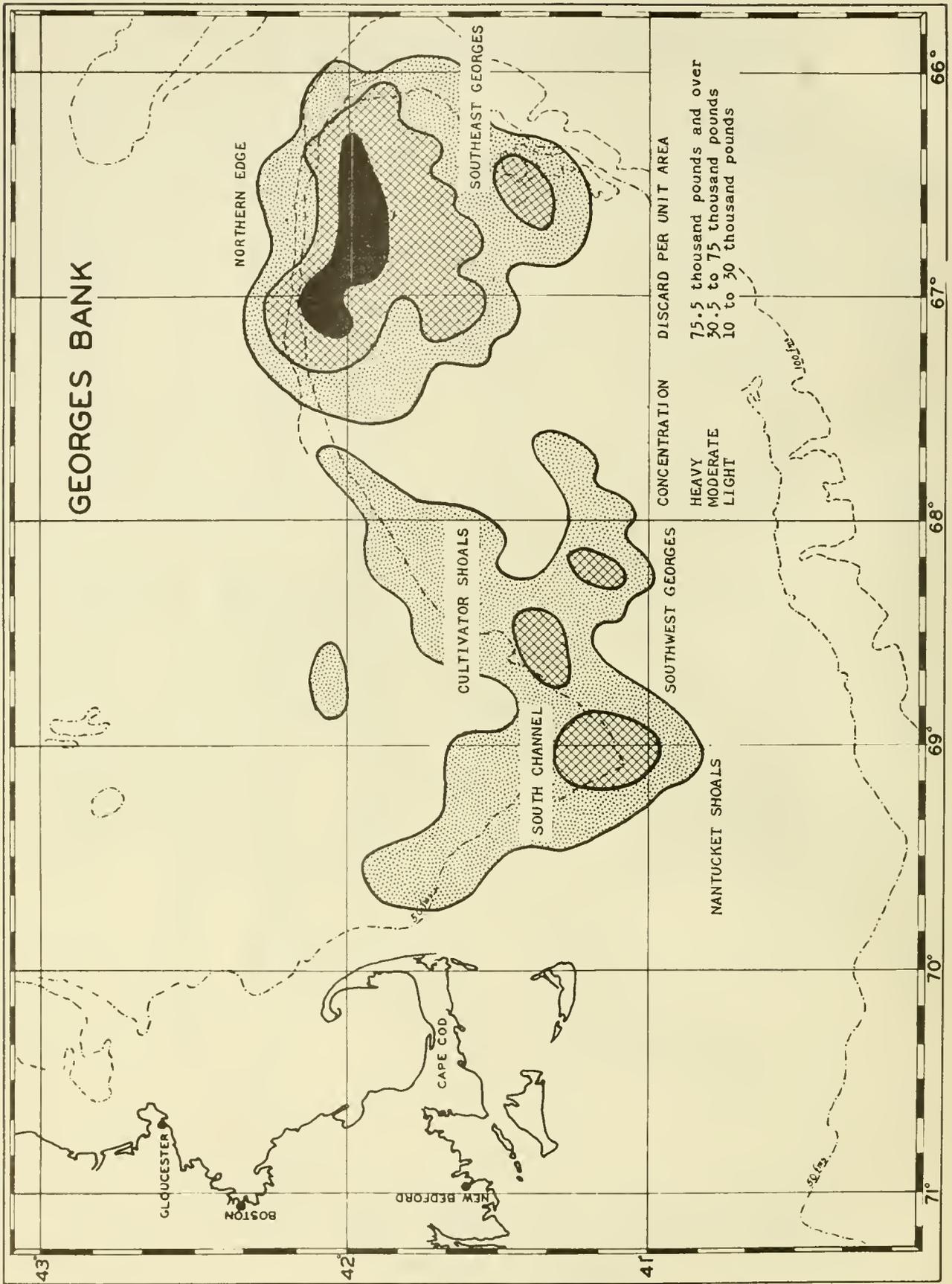


Figure 6.--Localities where haddock were discarded in the average year, 1947-51.

TABLE 1.--Dates and areas fished on the commercial trips observed in 1951

Trip Number	Date	Areas fished on Georges Bank
51-1	June 6-14	Northern Edge Southeast Part East side South Channel
51-2	July 18-25	Northern Edge
51-3	August 3-10	Northern Edge
51-4	August 7-14	Northern Edge Southeast Part
51-5	August 13-21	Southeast Part
51-6	August 29 - September 5	Northern Edge
51-7	September 22 - October 1	Northern Edge East side South Channel

Annual

The average quantity discarded annually during the 5-year period was over 4 1/2 million pounds, representing over 6 percent of the catch. In terms of numbers this quantity represented over 6 million individual fish or over 16 percent of the catch.

The greatest quantity discarded during this period was reported in 1947, when almost 11 percent of the total catch, by weight, was discarded at sea; this was equivalent to discarding 25 percent of the haddock caught. The least discard during this period was in 1951, when about 4 percent of the catch, by weight, was discarded; this amounted to 10 percent of the fish caught. The years 1948-50 were intermediate.

Seasonal

The destruction of baby haddock is definitely seasonal, as can be seen by a comparison of the monthly records (table 2 and fig. 5). Discards usually increased rapidly after June and declined after October. November to May were usually periods of relatively low destruction.

Areas

Discard by area was summarized by plotting the amounts of discard by units of 10' latitude by 10' longitude. The localities where haddock were discarded in the average year for the period 1947 to 1951 are shown in figure 6. The areas of greatest discard were the Northern Edge and

Southeast Part of Georges, with lesser quantities discarded along the 50-fathom contour on the western side and bottom of South Channel, extending northeastward to Cultivator Shoals.

Large discards in certain areas on Georges are not due entirely to the presence of large numbers of small fish, but in great part to the fishing effort expended in the area. The distribution of fishing effort in the average year is shown in figure 7 (Schuck, 1953). The similarity of the discard and effort concentration charts is immediately evident. The areas most heavily fished reflect, in most cases, the greatest discard.

ANALYSIS OF DISCARDS, 1951

Pounds

On the seven trips observed in 1951, a total of 46,608 pounds of baby haddock was discarded. This was an average of 6,658 pounds per trip, with individual trips ranging from 0 to 19,685 pounds (table 3). For all trips, about 7 percent of the total catch by weight was discarded, while on individual trips, percent discarded ranged from 0 to 17.

Numbers

These 46,608 pounds represented 61,802 individual fish, an average of 8,828 per trip. Numbers discarded ranged from 0 to 28,135 on the individual trips (table 4). Of the total numbers caught on these trips, about 17 percent was discarded, while on individual trips, the percentage discarded ranged from 0 to 39.

Estimated total destruction

Using the average discard per trip from the sea sampling data, it was possible to estimate the total destruction by the Boston fishing fleet for the period sampled (June to September). The estimate employing this method was 1,198,000 pounds.

Referring to table 2, we find that the destruction of haddock by the Boston fleet estimated on the basis of skippers' reports, during the 4-month period which parallels the sea sampling trips, was 1,048,000 pounds. The estimate by this method was 12.6 percent under that from sea sampling data.

Average weight

It is recognized that when haddock are scarce, fishermen tend to save fish of smaller sizes, whereas when plentiful, they discard larger fish. This explains the extreme variability in average weights in table 5. To show this more clearly, the average weight of discards was plotted against the total pounds landed for each of the trips on which fish were discarded (fig. 8).

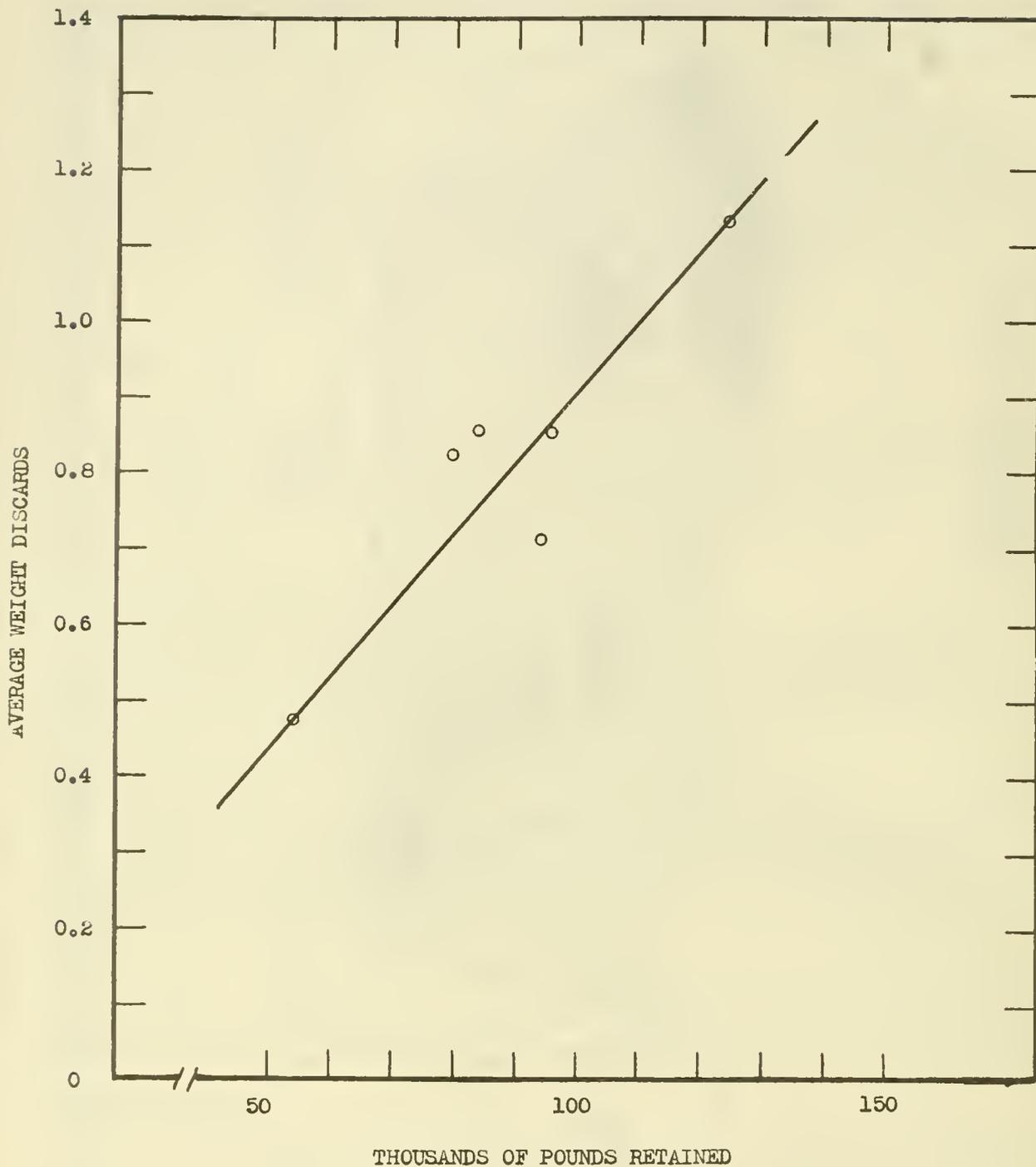


Figure 8.--Regression of average weight of discards against total pounds landed.

TABLE 3.--Percent of total haddock catch (in pounds) discarded on the commercial sea sampling trips to Georges Bank observed in 1951

Trip No.	Pounds caught	Pounds discarded	Percent discarded
51-1	58,900	4,900	8.3
51-2	79,000	0	0.0
51-3	82,010	2,010	2.4
51-4	104,155	7,755	7.4
51-5	114,385	19,685	17.2
51-6	134,225	9,525	7.1
51-7	86,733	2,733	3.2
Total	659,408	46,608	7.1
Average trip	94,201	6,658	7.1

TABLE 4.--Percent of total haddock catch (in numbers) discarded on the commercial sea sampling trips to Georges Bank observed in 1951

Trip No.	Number caught	Number discarded	Percent discarded
51-1	40,184 ^{1/}	10,514	26.2
51-2	33,331	0	0.0
51-3	41,744	2,463	5.9
51-4	59,639	9,073	15.2
51-5	72,186	28,135	39.0
51-6	74,055	8,404	11.3
51-7	44,728	3,213	7.2
Total	365,867	61,802	16.9
Average trip	52,267	8,828	16.9

^{1/} No samples of the landed portion of the haddock catch were taken at sea on this trip. To derive numbers from the total pounds landed, the average weight per fish was determined from port sampling at Boston (1.82 pounds per fish).

TABLE 5.--Average weight (in pounds) of haddock on commercial sea sampling trips to Georges Bank observed in 1951

Trip No.	Pounds caught	Numbers caught	Average weight per fish caught	Pounds discarded	Numbers discarded	Average weight per fish discarded	Pounds landed	Numbers landed	Average weight per fish landed
51-1	58,900	40,184	1.46	4,900	10,514	0.47	54,000	29,670	1.82
51-2	79,000	33,331	2.37	0	0	----	79,000	33,331	2.37
51-3	82,010	41,744	1.96	2,010	2,463	0.82	80,000	39,281	2.04
51-4	104,155	59,639	1.75	7,755	9,073	0.85	96,400	50,566	1.91
51-5	114,385	72,186	1.58	19,685	28,135	0.71	94,700	44,051	2.15
51-6	134,225	74,055	1.81	9,525	8,404	1.13	124,700	65,651	1.90
51-7	86,733	44,728	1.94	2,733	3,213	0.85	84,000	41,515	2.02
Total	659,408	365,867	1.80	46,608	61,802	0.75	612,800	304,065	2.02
Average trip	94,201	52,267	1.80	6,658	8,828	0.75	87,543	43,438	2.02

The average weights of individual fish taken on each of the seven trips are shown in table 5. The average weight of haddock caught on these trips was 1.80 pounds, with individual trips ranging from 1.46 to 2.37 pounds. The average weight of fish discarded for all trips was 0.75 pounds, while on individual trips it varied from 0.47 to 1.13 pounds. The average weight per fish landed was 2.02 pounds, while on individual trips it ranged from 1.82 to 2.37 pounds.

Size composition

The size composition of haddock on the average Georges Bank trip observed in 1951 is shown in table 6 and figure 9.

The size of haddock caught on these trips ranged from 0.1 to 8.4 pounds (6 to 30 inches) with over 90 percent from 0.5 to 3.1 pounds in weight (11 to 21 inches in length).

The size of fish discarded ranged from 0.1 to 2.2 pounds (6 to 18 1/2 inches), with about 90 percent from 0.3 to 1.0 pound in weight (9 1/2 to 14 inches in length).

The sizes in the landed portion ranged from 0.6 to 8.4 pounds (11 1/2 to 30 inches), with about 90 percent from 1.1 to 2.7 pounds in weight (14 1/2 to 20 inches in length).

Cull by fishermen

Of the total catch, about 16 percent by number (7 percent by weight) was discarded, while 84 percent by number (93 percent by weight) was landed.

A major consideration in selecting a mesh size for regulation of the Georges Bank fishery has been the selection of a mesh which would release most of the sizes of haddock at present discarded at sea. Therefore, it was of considerable importance to determine the numbers of each size discarded, relative to the total numbers of that size caught.

The data pertinent to these determinations are included in table 6. The numbers caught, as well as the numbers landed and discarded of each size, also are shown in figure 9. From this figure certain percentage discard points can be determined. The 50 percent point, that is, that size at which the same number are discarded as are landed, is 0.94 pounds (about 13 3/4 inches). This is the point where the line representing discards crosses the line representing landings. From this point downward,

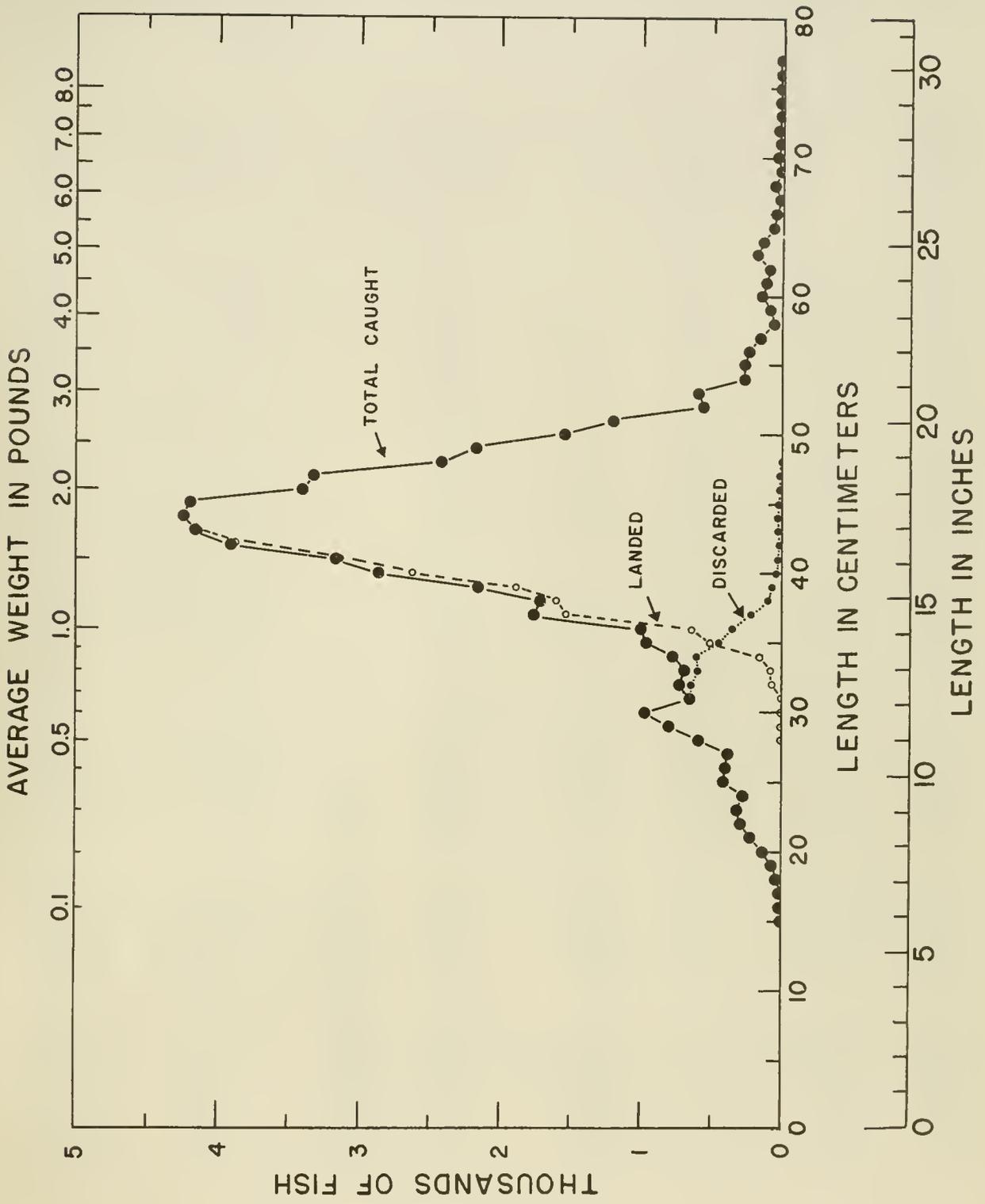


Figure 9.--Size composition on the average Georges Bank trip observed in 1951.

TABLE 6.--Size composition of fish caught, fish landed and fish discarded.
Average of observed trips in 1951. A sample of the landed portion
of the catch was taken on 6 of the 7 trips. Derivation of numbers
landed is based on 6 trips, while numbers discarded is based on 7
trips.

Length in cms.	Inches	Average weight (gutted) in pounds	Numbers caught	Numbers discarded	Numbers landed	Percent discarded	Percent landed
16	6.3	0.10	5	5		100.0	0.0
17	6.7	0.12	8	8		100.0	0.0
18	7.1	0.14	40	40		100.0	0.0
19	7.5	0.17	62	62		100.0	0.0
20	7.9	0.19	135	135		100.0	0.0
21	8.3	0.22	219	219		100.0	0.0
22	8.7	0.25	282	282		100.0	0.0
23	9.1	0.29	348	348		100.0	0.0
24	9.4	0.32	306	306		100.0	0.0
25	9.8	0.36	443	443		100.0	0.0
26	10.2	0.40	393	393		100.0	0.0
27	10.6	0.45	382	382		100.0	0.0
28	11.0	0.50	583	583		100.0	0.0
29	11.4	0.55	801	789	12	98.5	1.5
30	11.8	0.61	962	959	3	99.7	0.3
31	12.2	0.67	650	650		100.0	0.0
32	12.6	0.73	726	650	76	89.5	10.5
33	13.0	0.79	686	601	85	87.6	12.4
34	13.4	0.87	777	616	161	79.3	20.7
35	13.8	0.94	960	451	509	47.0	53.0
36	14.2	1.0	993	351	642	35.3	64.7
37	14.6	1.1	1,748	221	1,527	12.6	87.4
38	15.0	1.2	1,700	107	1,593	6.1	93.9
39	15.4	1.3	1,946	66	1,880	3.4	96.6
40	15.8	1.4	2,661	39	2,622	1.5	98.5
41	16.1	1.5	3,161	33	3,128	1.0	99.0
42	16.5	1.6	3,899	15	3,884	0.4	99.6
43	16.9	1.7	4,156	25	4,131	0.6	99.4
44	17.3	1.8	4,235	25	4,210	0.6	99.4
45	17.7	1.9	4,189	11	4,178	0.3	99.7

Length in cms.	Inches	Average weight (gutted) in pounds	Numbers caught	Numbers discarded	Numbers landed	Percent discarded	Percent landed
46	18.1	2.0	3,389	9	3,380	0.3	99.7
47	18.5	2.2	3,310	4	3,306	0.1	99.9
48	18.9	2.3	2,403		2,403	0.0	100.0
49	19.3	2.4	2,156		2,156	0.0	100.0
50	19.7	2.6	1,544		1,544	0.0	100.0
51	20.1	2.7	1,192		1,192	0.0	100.0
52	20.5	2.9	549		549	0.0	100.0
53	20.9	3.1	588		588	0.0	100.0
54	21.3	3.2	262		262	0.0	100.0
55	21.7	3.4	262		262	0.0	100.0
56	22.1	3.5	230		230	0.0	100.0
57	22.4	3.7	152		152	0.0	100.0
58	22.8	3.9	62		62	0.0	100.0
59	23.2	4.1	77		77	0.0	100.0
60	23.6	4.3	141		141	0.0	100.0
61	24.0	4.5	112		112	0.0	100.0
62	24.4	4.7	91		91	0.0	100.0
63	24.8	4.9	171		171	0.0	100.0
64	25.2	5.2	126		126	0.0	100.0
65	25.6	5.4	55		55	0.0	100.0
66	26.0	5.6	49		49	0.0	100.0
67	26.4	5.9	20		20	0.0	100.0
68	26.8	6.1	55		55	0.0	100.0
69	27.2	6.4	16		16	0.0	100.0
70	27.6	6.7	28		28	0.0	100.0
71	28.0	6.9	9		9	0.0	100.0
72	28.3	7.2	24		24	0.0	100.0
73	28.7	7.5	8		8	0.0	100.0
74	29.1	7.8	14		14	0.0	100.0
75	29.5	8.1	7		7	0.0	100.0
76	29.9	8.4	2		2	0.0	100.0
Total			54,560	8,828	45,732	16.2	83.8

TABLE 7.--Cull by fishermen on the individual Georges Bank trips observed
in 1951 ^{1/}

Length in centimeters	Average weight (gutted) in pounds	Percent of total catch landed				
		Trip number				
		51-3	51-4	51-5	51-6	51-7
Under 28	0.50 and under	0.0	0.0	0.0	0.0	0.0
29	0.55	0.0	0.0	0.0	24.6	0.0
30	0.61	0.0	3.5	0.0	0.0	0.0
31	0.67	0.0	0.0	0.0	0.0	0.0
32	0.73	0.0	0.0	5.1	12.1	8.5
33	0.79	55.1	1.7	0.0	0.0	17.7
34	0.87	0.0	15.0	0.0	19.8	36.2
35	0.94	62.7	23.4	31.9	34.1	66.8
36	1.0	74.8	59.8	51.8	29.7	89.8
37	1.1	93.5	73.6	82.2	72.1	96.0
38	1.2	96.0	89.0	97.3	87.0	96.3
39	1.3	98.8	94.8	99.4	88.1	97.3
40	1.4	99.5	97.2	100.0	95.2	98.8
41	1.5	100.0	97.8	100.0	96.9	99.7
42	1.6	100.0	99.5	100.0	98.6	100.0
43	1.7	100.0	99.6	100.0	97.6	100.0
44	1.8	100.0	100.0	100.0	97.2	100.0
45	1.9	100.0	99.9	100.0	98.8	100.0
46	2.0	100.0	100.0	100.0	98.9	100.0
47	2.1	100.0	100.0	100.0	99.5	100.0
48 and over	2.3 and over	100.0	100.0	100.0	100.0	100.0

^{1/} Trip No. 51-1 - No sample of landed portion of catch.
Trip No. 51-2 - No discard reported.

progressively larger percentages were discarded, until at sizes below 0.5 pound (11 inches) all were discarded. Conversely, going from the 50 percent point upward toward larger sizes of fish, the percentage of discard decreased, until at the size of 2.3 pounds (19 inches) none were discarded.

This culling by the fishermen is shown more clearly by the "cull curve" (fig. 10) in which the size of fish is plotted against the percentage of catch landed.

The sizes discarded and landed varied from trip to trip as indicated previously. The cull curves for each applicable trip are presented in figure 11; the data are given in table.7.

Age composition

The age composition of haddock on the average Georges Bank trip observed in 1951 is presented in table 8. The percentage of each age discarded is given in table 9.

In 1951, the 1948 year class (3-year-olds) dominated the fishery; over 70 percent of the haddock caught were from this one year class. Next in importance was the 1949 year class (2-year-olds), which contributed about 18 percent to the total catch. All other year classes were relatively less important.

Most of the discarded haddock (66 percent) were from the 1949 year class (2-year-olds). The 1950 year class (1-year-olds) was next in importance, contributing about 27 percent of the numbers discarded. The rest of the discarded fish (about 7 percent) were from the 1948 year class (3-year-olds).

Of the landed fish, about 83 percent were from the 1948 year class (3-year-olds), 9 percent from the 1949 year class (2-year-olds), and the rest (8 percent) from other year classes.

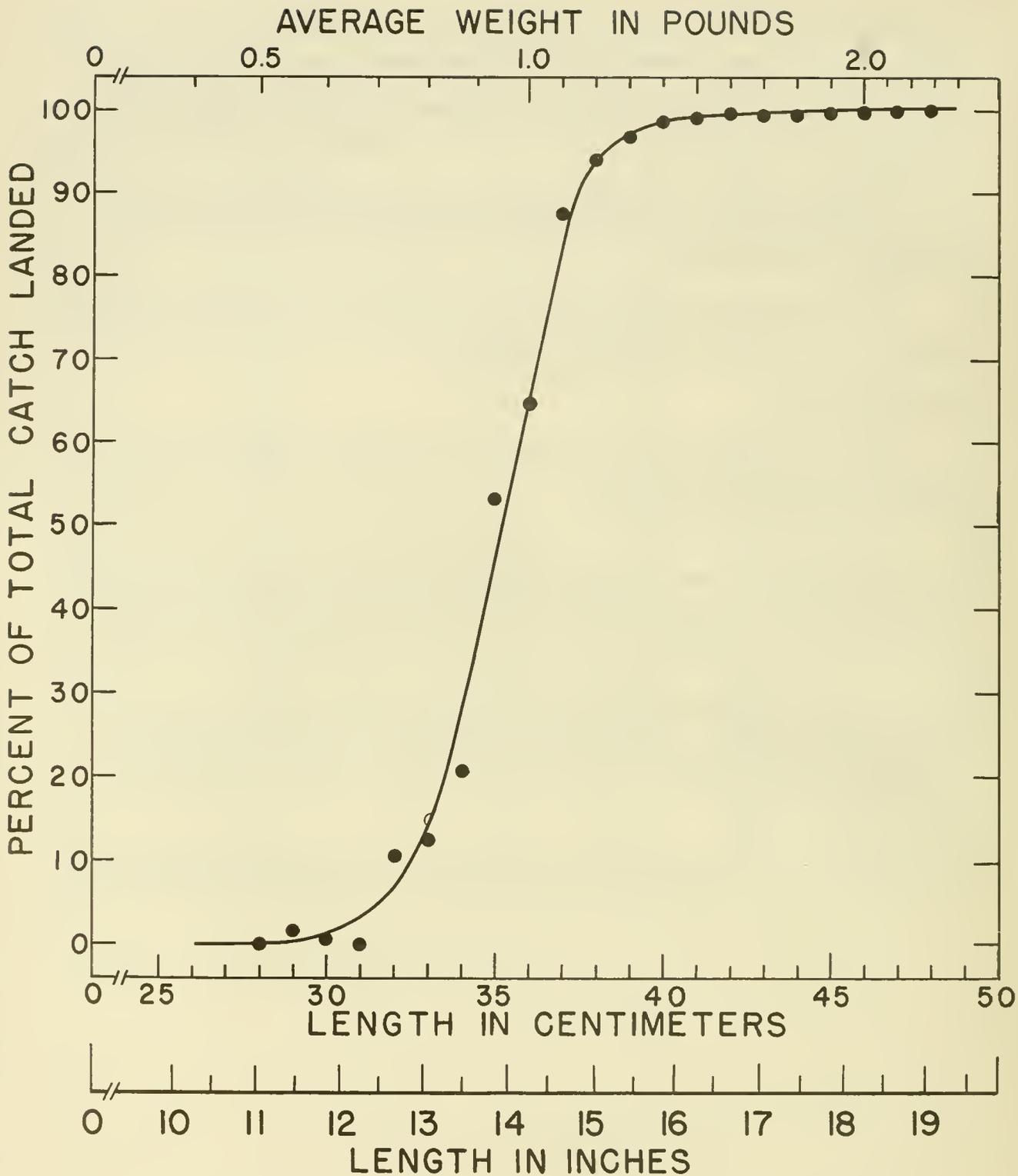


Figure 10.--Haddock cull curve on the average Georges Bank trip observed in 1951.

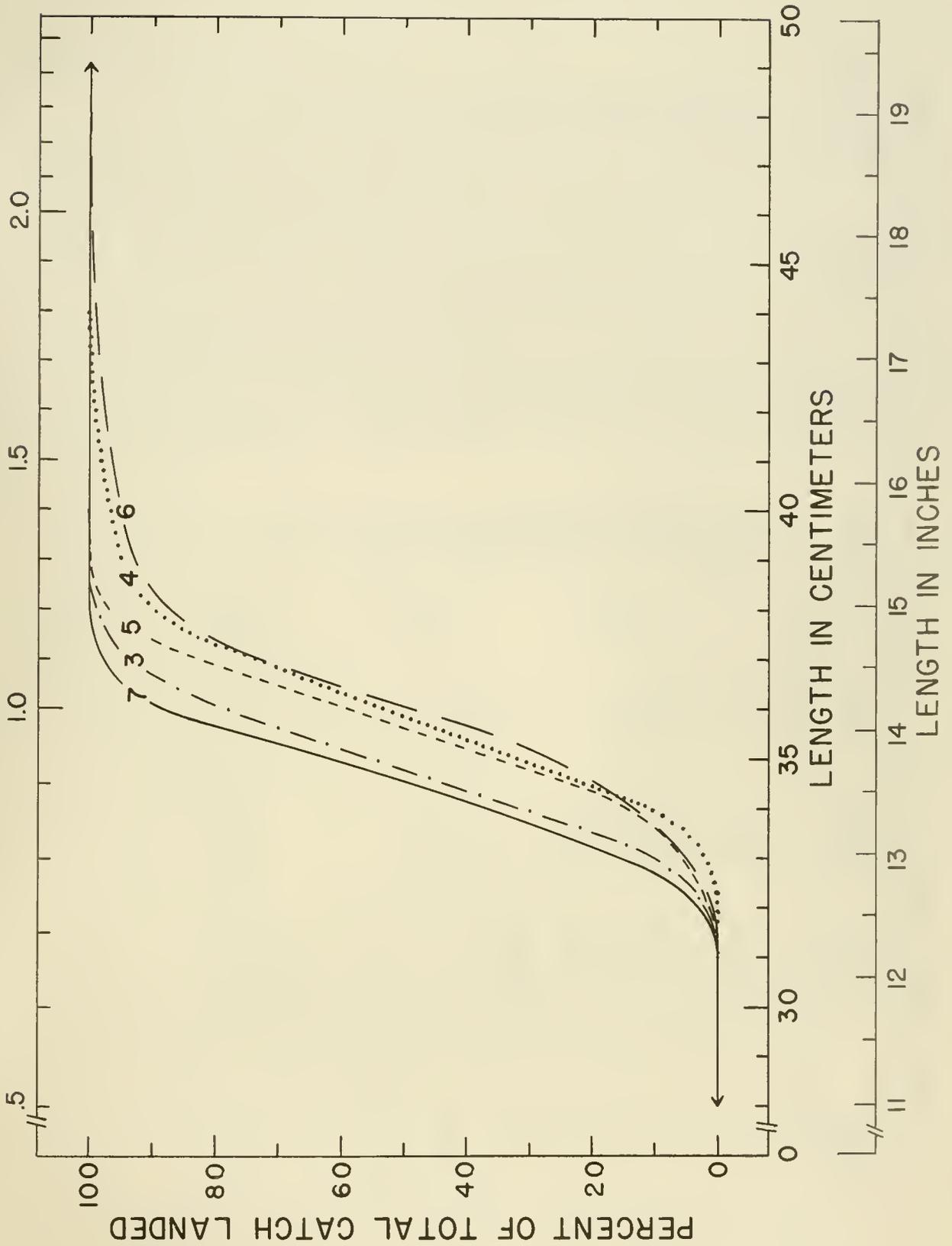


Figure 11.--Cull by fishermen on the individual Georges Bank trips observed in 1951.

TABLE 8.--Age composition of haddock on the average Georges Bank trip observed in 1951

Age in years	Year spanned	Numbers caught	Percent of total catch	Numbers discarded	Percent of total discard	Numbers landed	Percent of total landings
1	1950	2,395	4.4	2,394	27.1	1	----
2	1949	9,991	18.3	5,803	65.7	4,188	9.2
3	1948	38,476	70.5	631	7.2	37,845	82.7
4	1947	2,011	3.7	0	0.0	2,011	4.4
5	1946	1,358	2.5	0	0.0	1,358	3.0
6+	1945 and earlier	329	0.6	0	0.0	329	0.7
Total		54,560	100.0	8,828	100.0	45,372	100.0

Size composition of ages

The effect of culling on the different ages of haddock is shown more graphically by the size composition of the ages in the discarded and landed portions of the catch. These size compositions are presented in table 10 and figure 12. Referring to figure 12, the dominance of the 1948 year class in the landings is strikingly evident. Also clearly shown is the division of the 1949 year class between the discards and the landed fish, with the smaller of these being rejected and the larger included in the marketed group.

The size composition curve for the 1949 year class as shown for the total catch is markedly different from that of other year classes in that it exhibits two definite widely separated peaks. At first, it was thought that this might be due to sampling errors, but examination of this same year class a year later (in 1952) showed this same type of size distribution. The reason for this unusual size distribution of the 1949 year class cannot be explained at this time.

TABLE 9.--Percentage of each age discarded on the average Georges Bank trip observed in 1951

Age in years	Year spawned	Number caught	Number discarded	Percent discarded
1	1950	2,395	2,394	99.96
2	1949	9,991	5,803	58.08
3	1948	38,476	631	1.64
4	1947	2,011	0	0.00
5	1946	1,358	0	0.00
6+	1945 and earlier	329	0	0.00

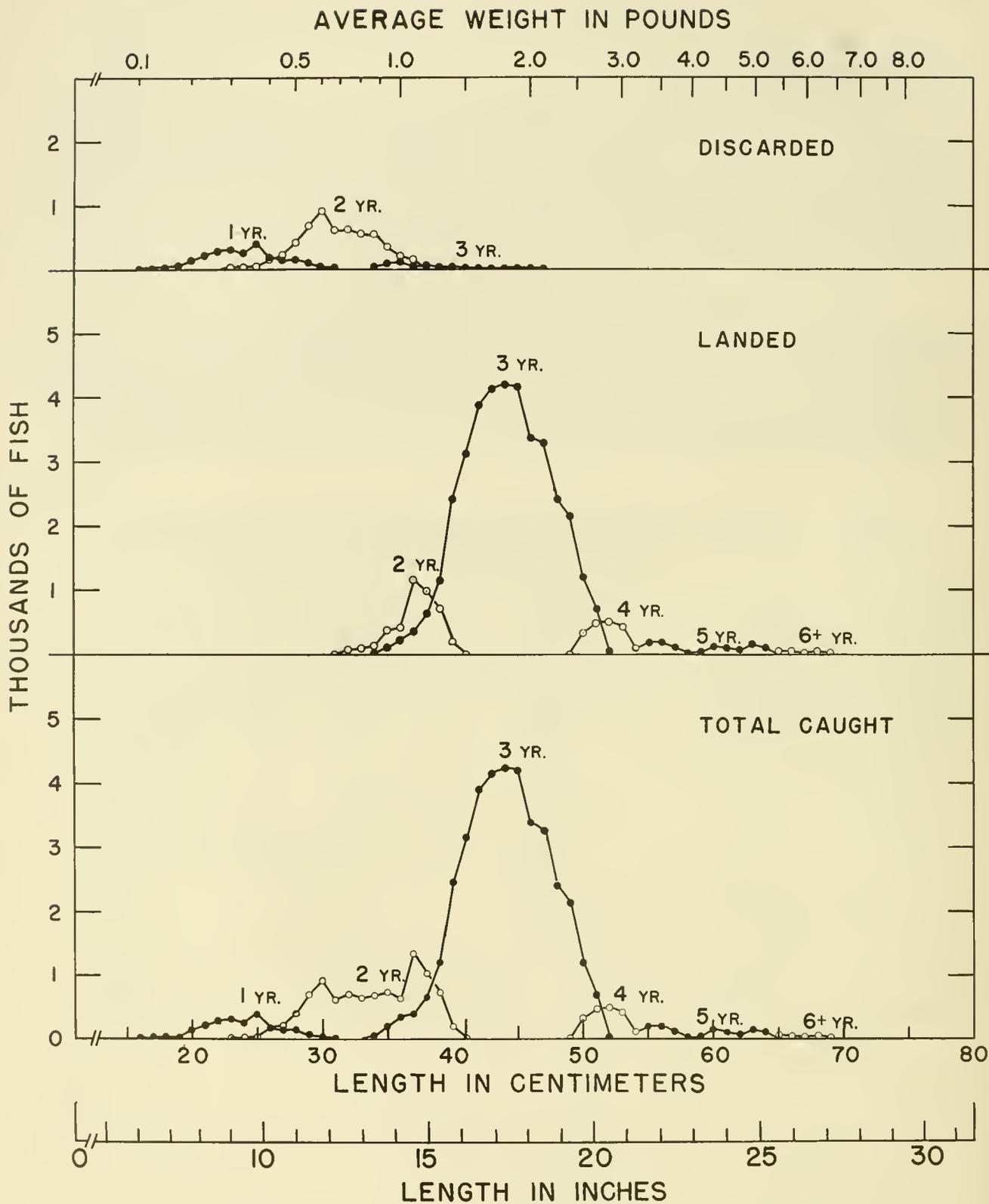


Figure 12.--Size composition of each age in catch on the average Georges Bank trip observed in 1951.

SUMMARY

1. During the period 1947 to 1951, the annual destruction of under-sized haddock on Georges Bank by the Boston fleet alone averaged over $4\frac{1}{2}$ million pounds (based on skippers' estimates as reported to port interviewers). This quantity represented over 6 million individual fish.

2. Most of the destruction occurred between the months of June and October during which time most of the 2-year-old fish, which were caught in great numbers, were under 1 pound in weight and unmarketable.

3. The areas of greatest discard were the Northern Edge and Southeast Part. Areas of lesser destruction were the western side and the southern end of South Channel. Areas of most intense discard coincided with areas of most intense fishing.

4. During 1951, observers went to sea on seven commercial trips to analyze the catch. Skippers' estimates of pounds discarded were found to be within 12 percent of estimates made by the Service observers at sea.

5. The size of fish discarded varies with the size of the catch. Smaller fish are saved when the catches are small. The 50-percent point on the average cull curve was $13\frac{3}{4}$ inches (0.9 pounds). Practically all fish of this size were 2 years old. The smaller fish discarded included many 1-year-olds while the largest individuals in the discards included many 3-year-olds.

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