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## RESULTS OF HADDOCK TAGGING IN THE GULF OF MAINE FROM 1923 TO 1932<sup>1</sup>

By

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In the hope of throwing some light on their migratory habits 10998 haddock were tagged in the Gulf of Maine from 1923 to 1932 by the United States Bureau of Fisheries vessels *Halcyon* and *Albatross II*, during the course of cod marking experiments, made between the months of April and October. This paper gives an account of the recaptures reported from these tagged haddock, together with a brief discussion of rate of growth.

What little was known of the haddock's migrations in the Gulf of Maine up to 1924 is summed up by Bigelow and Welsh (1925) as follows: "Adult haddock roam from place to place in search of food like cod, and so constantly that where there is good fishing today, there may be none tomorrow. However, their movements seem mostly of short extent, from place to place on a given bank as food is locally exhausted or from some other cause. How much interchange of haddock there may be from bank to bank or between inshore and offshore grounds is unknown, but the fish that inhabit the coastwise belt carry out a local and irregular migration inshore in winter and early spring and offshore again in June or July. Certain bodies of fish may linger all summer in the deeper channels among the islands of Maine, on patches of suitable bottom."

<sup>1</sup>Published with the approval of the Director of the Fish and Wildlife Service, U. S. Dept. of the Interior.

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Needler (1930) discusses the migrations of haddock in the north-western Atlantic basing his conclusions on about 7000 fish tagged by the Biological Board of Canada and about 8000 fish which, up to that time, had been tagged by the U. S. Bureau of Fisheries. It is these latter 8000 haddock, together with some tagged later, that form the basis of the present report. Any discrepancies, as to numbers of fish tagged and recaptured between Needler's report and this one are due to certain changes in the records which I originally furnished to Dr. Needler and to additional data obtained since then. Perhaps the only important error in the figures is that of the 6000 haddock tagged by the Bureau of Fisheries in the vicinity of Mt. Desert, as stated by Needler (1930, p. 28), but which should have been about 4000.

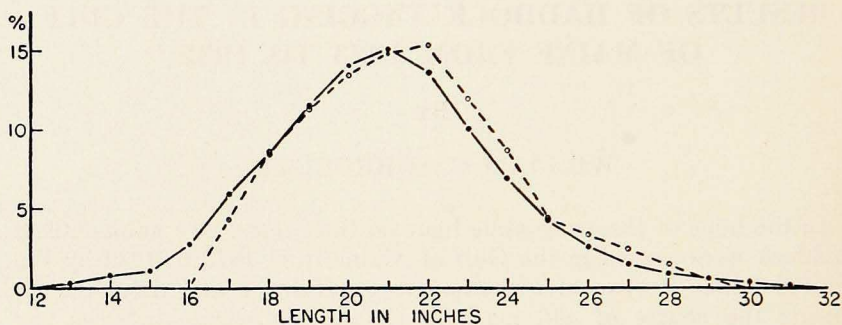


Figure 1. Length frequency distribution by percentages. Solid line: lengths of 10,998 haddock at time of tagging. Broken line: lengths of 210 recaptured haddock, at time of tagging.

Needler concludes from these haddock tagging experiments that the haddock population in the shallow waters along the New England coast does not mix with that of the Nova Scotia region. And none of the Nova Scotian tagged haddock were reported recaptured in the coastal waters or offshore banks of the New England coast hence there is no evidence of interchange between these regions.

The methods of tagging these haddock were identical to those used for cod by Schroeder (1930). In most cases metal tags were attached to the base of the tail dorsally. The tail of the haddock being rather tender many tags dropped off within the first 3 to 6 months, perhaps as many as 70 to 80 per cent. It is probably largely because of this that only 210 fish, or 1.91 per cent of the 10998 that were tagged were reported recaptured, a relatively small return as compared with about 12 per cent for cod marked on the same grounds.

Most of the haddock were tagged in the Nantucket Shoals region and in the vicinity of Mt. Desert, Maine. Smaller numbers were in-

cluded in the experiments in the shore waters between Cape Cod, Massachusetts, and Boothbay Harbor, Maine, and on the offshore banks (Platts Bank, Cashes Ledge, Browns Bank, and Georges Bank).

All of the fish were caught with hand lines and in size most of them fell between the lengths of 17 and 25 inches. Only 4.9 per cent of the catch was below 17 inches in length. No recaptures were reported from the smaller fish but beginning with those of 17 inches the size distribution of the recaptured fish agrees closely with the size distribution of all tagged fish (Figure 1).

#### NANTUCKET SHOALS REGION

TABLE I—RECORD OF HADDOCK TAGGED IN THE NANTUCKET SHOALS REGION, WITH SUBSEQUENT RECAPTURES

<i>Year</i>	<i>Number tagged</i>	<i>Local Recaptures</i>	<i>Distant Recaptures</i>	<i>No data</i>	<i>Total Recaptures</i>	<i>Percentage</i>
1923	410	4		2	6	1.46
1924	778	6	3	1	10	1.29
1925	1821	14	4		18	1.00
1927	481	2			2	0.42
1928	239	5	1	2	8	3.35
1929	132	3	1		4	3.03
1930	85		1		1	1.17
<i>Total</i>	3946	34	10	5	49	1.24

Nearly all these fish were tagged between Orion Shoal and Great Rip buoys; a few were tagged about 10 miles northeast of Orion Shoal on the "Chatham Grounds," and about 20 miles northeast, in South Channel. Recaptures of Nantucket Shoals region fish reported from any of these grounds are here classed as local. Precise recapture localities were seldom given by the fishermen, so it was not possible to trace with certainty a migration from Nantucket Shoals to nearby South Channel or vice versa.

Of the 34 local or nearby recaptures, 10 were taken in 20–100 days, 8 in 101–200 days, 6 in 201–300 days, 6 in 301–400 days, 3 in 401–500 days, and 1 in 601–700 days after tagging. The tagging vessels recaptured 3 fish 321, 330 and 377 days later, respectively. Thus, if it can be accepted that these few recaptured tagged haddock are at all representative of the bodies of fish of which they were a part, the indications are that a large proportion of the haddock population present at any given time in the Nantucket region remains localized for upwards of a year or more.

The 10 recaptures taken in distant localities prove that some of the haddock living in the Nantucket region carry out long journeys. Based on the total number of recaptures (49) and allowing that three of the "no data" fish were taken locally and two elsewhere, about one fourth of the Nantucket haddock migrated away. This is no doubt

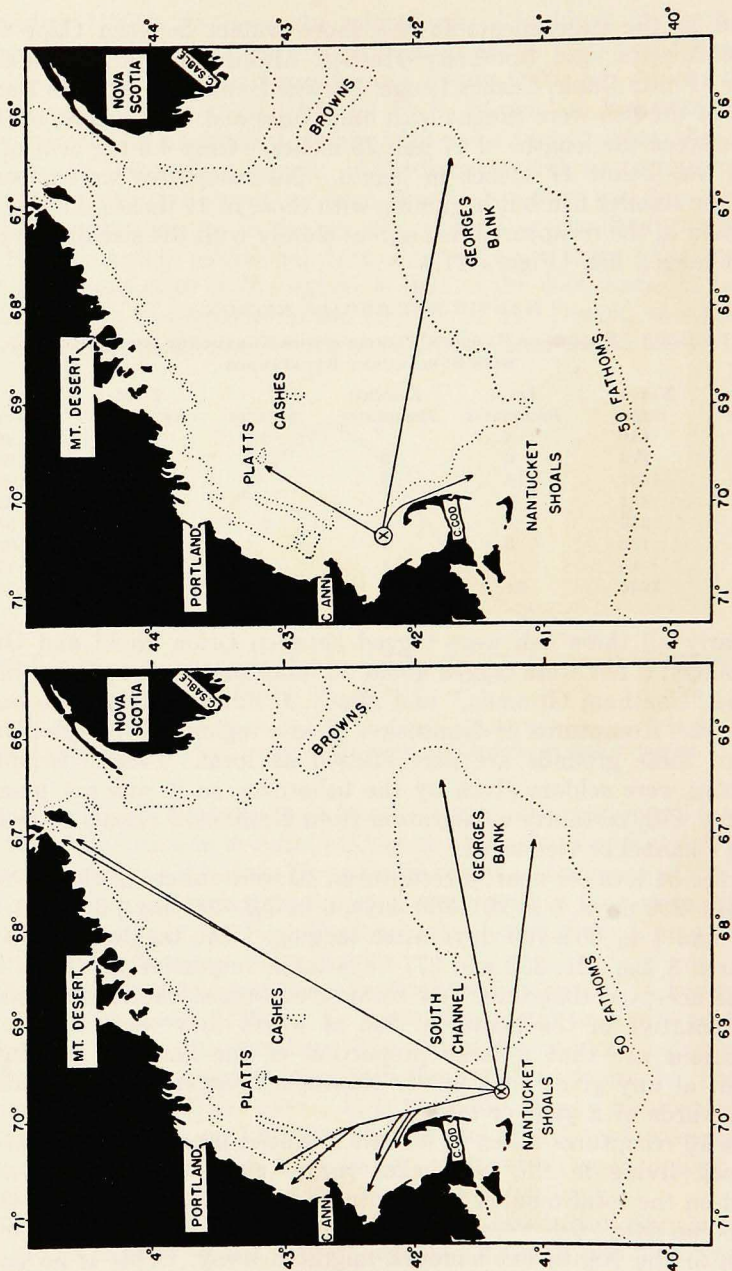


Figure 2. (Below.) Recaptures in distant localities of haddock tagged in the Nantucket Shoals region from 1923 to 1932.

Figure 3. (Above.) Recaptures of haddock tagged on Stellwagen Bank, from 1924 to 1928.

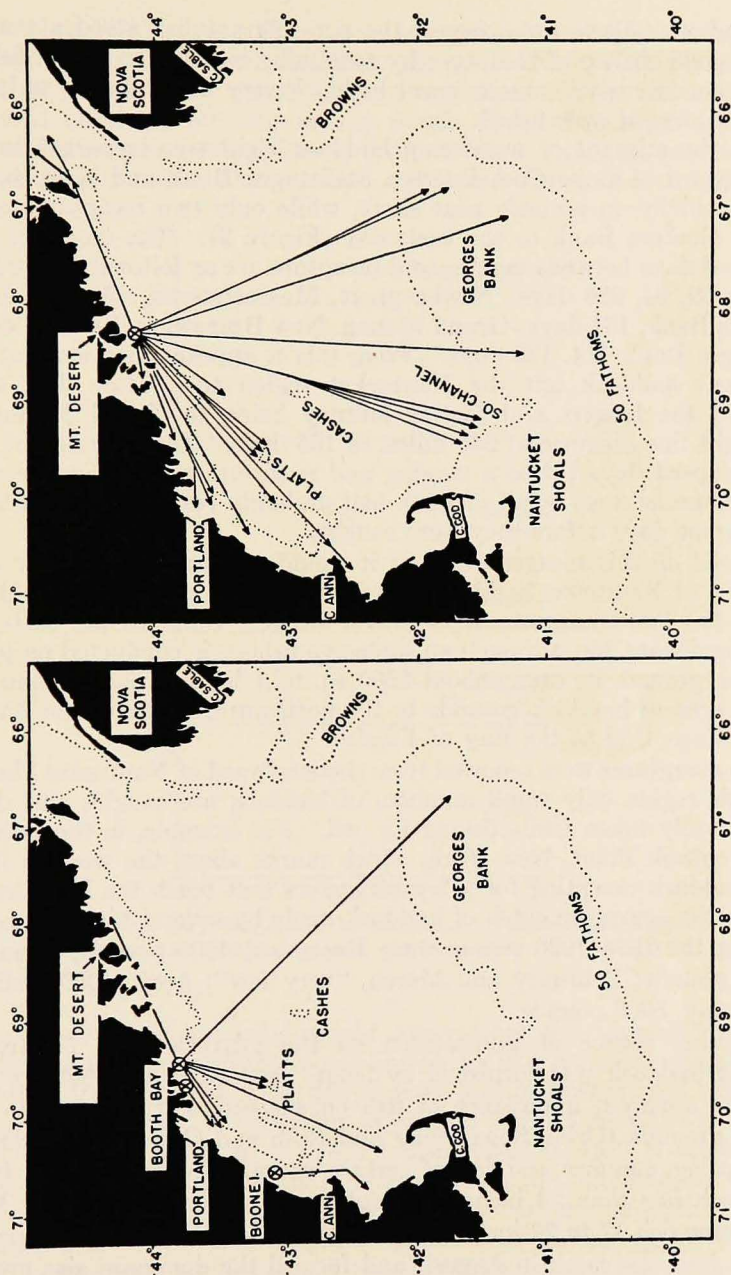


Figure 4. (Below.) Recaptures in distant localities of haddock tagged around Boone Island and Boothbay Harbor, Maine, from 1924 to 1930.

Figure 5. (Above.) Recaptures in distant localities of haddock tagged off Mt. Desert, Maine, from 1924 to 1932.

a minimum figure for, whereas the non-migrant fish stood a reasonably good chance of recapture by remaining in a region where fishing is rather intensive, some migrant haddock very likely moved to localities seldom if ever fished.

Of the migrant or wandering haddock eight were reported to the northward of Cape Cod, between Stellwagen Bank and New Brunswick, chiefly on grounds near shore, while only two recaptures came from Georges Bank to the eastward (Figure 2). The localities and elapsed days between tagging and recapture are as follows: Stellwagen Bank 69, 94, 286 days; Newburyport, Massachusetts, 158, 424 days; Platts Bank, 131 days; Grand Manan, New Brunswick, 105, 292 days; Georges Bank 114, 136 days. From this it appears that most of the migrant haddock left the Nantucket region soon after they were tagged the longest and fastest journey being to Grand Manan, a straight line distance of 240 miles, in 105 days. For the migrant fish the elapsed days between tagging and recapture can be considered a maximum as most or all of them had probably reached their destination some days before they were caught.

Based on this meager evidence it would appear that a larger proportion of Nantucket haddock go northward than go eastward. However, the two recaptures reported on Georges Bank to the eastward are significant for, although an intensive fishery is conducted on parts of this ground, its area (about 8500 sq. mi.) is much larger than the total area of haddock grounds to the northward of Nantucket Shoals from Cape Cod to the Bay of Fundy.

No recaptures were reported from the westward of Nantucket Shoals. In this region only small numbers of haddock are caught, and these are usually taken while fishing for cod. For example, in the vicinity of Montauk Point, New York, which marks about the western limit for haddock excepting for a few stragglers that reach the New Jersey coast, the aggregate catch of haddock made by several high line boats during the 1925-1926 season was: December, 4000 pounds; January, 2000 pounds; February and March, "very few"; April, 1000 pounds; and May, 8000 pounds.

Another source of information on the migrations of Nantucket Shoals haddock was furnished by length frequency distributions and by the apparent abundance of fish on successive trips made to the same grounds (Orion Shoal buoy and Rose and Crown buoy) during the spring, summer and fall of certain years. For example, in 1923, haddock less than 23 inches in length were virtually absent in May but some fish 17 to 22 inches long were taken in June, they comprised about half the catch in August, and formed the dominant size groups

in October (Figure 6). Thus there is good evidence that during the summer these 17-22 inch haddock moved to Nantucket Shoals, at least to that locality where tagging was done. From whence they came is unknown but the nearby South Channel grounds and the western part of Georges Bank, with a large haddock population, would seem to be a likely source. Whether many of the haddock

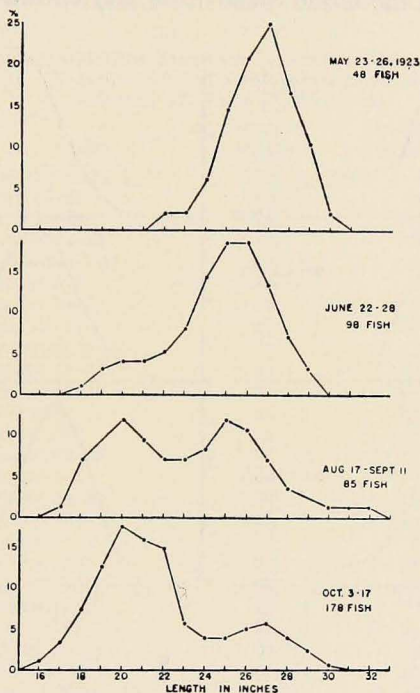


Figure 6. Length frequency distributions by percentages of haddock caught by the *Halcyon* on Nantucket Shoals during 1923. All length distributions are smoothed once by a moving average of three.

upwards of 23 inches long moved away from the tagging grounds during the summer of 1923 is not known for the reduced percentages of these larger fish taken as the summer and fall progressed may be due, at least in part, to the influx of smaller fish. Although the number of haddock taken on the four cruises made in 1923 is relatively small they were caught on many different days and are believed to be fairly representative of the small population that was present.

In 1924 evidence from length frequencies of the arrival of a new stock of haddock on Nantucket Shoals is not as striking as in 1923



for the dominant sizes showed relatively little change from July to October (Figure 7). However, the close resemblance of the July 1924 length distribution with that of October 1923, allowing for increased growth, gives some evidence that much of the population had remained localized during the interim.

In September 1924 it appears that some of the largest fish had moved away from the Orion Shoal-Rose and Crown section of Nan-

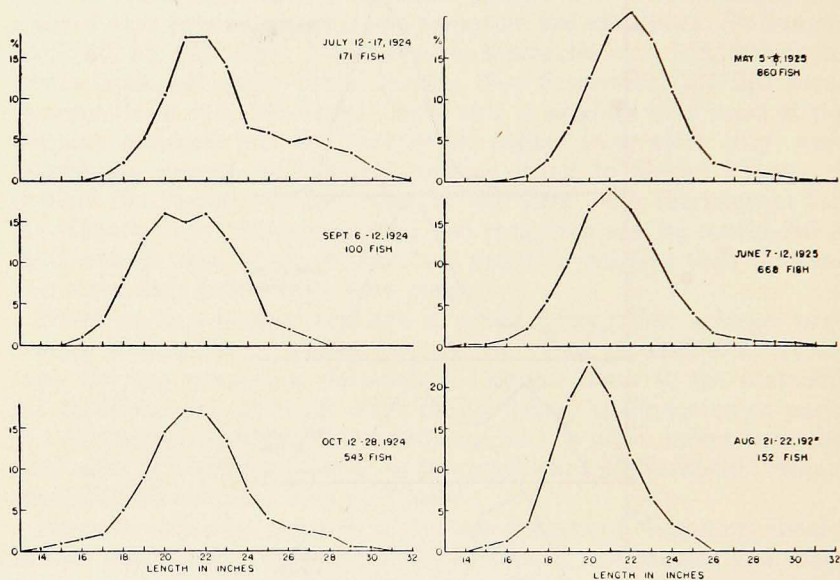


Figure 7. (Left.) Length frequency distributions by percentages of haddock caught by the *Halcyon* on Nantucket Shoals during 1924.

Figure 8. (Right.) Length frequency distributions by percentages of haddock caught by the *Halcyon* on Nantucket Shoals during 1925.

tucket Shoals and that possibly some smaller fish around 18-19 inches long had moved in. While in October the increased catch of haddock, per unit of effort, indicates that a fresh stock of fish, of about the same sizes as were present in September, had appeared on the tagging grounds.

In 1925 the frequency distributions again give evidence that many of the haddock present the previous fall (October 1924) remained over the winter, and that the large stock of fish then present had actually increased in numbers by May (Figure 8). In June haddock were

still plentiful but a shifting of the peak from 22 inches (in May) to 21 inches indicates that some of the larger haddock were leaving and this is still more apparent in August when the peak further retarded to 20 inches and haddock were found to be less abundant. There is little doubt but what most of the haddock present in the spring and summer had moved away by fall for in October 1925 they were found to be relatively scarce (Table II).

TABLE II—CATCHES OF HADDOCK MADE ON NANTUCKET SHOALS, IN THE VICINITY OF ORION SHOAL AND ROSE AND CROWN BUOYS, BY THE *Halcyon* AND THE *Albatross II*, FROM 1923 TO 1931

Year	Date	Hours of fishing	Number of haddock	Number per hour of fishing
1923	April 19—May 4	34	0	0.0
	May 23—28	48	48	1.0
	June 22—28	46	99	2.1
	August 16—23	42	36	0.8
	September 5—11	58	49	0.8
	October 3—8	41	129	3.0
	October 14—17	30	49	1.6
1924	July 13—17	47	177	3.8
	September 6—12	34	99	2.9
	October 16—22	29	174	6.0
	October 25—28	35	328	9.4
1925	May 5—8	35	859	24.5
	June 7—12	33	674	20.4
	August 20—25	31	236	7.6
	October 1—6	28	4	0.2
	October 24—30	10	48	4.8
1926	September 6—11	49	114	2.3
1927	May 4—7	17	17	1.0
	June 17—25	38	198	5.2
	September 1—3	29	194	6.7
	October 14—17	27	7	0.3
1928	July 14—21	35	186	5.3
	October 24—29	36	32	0.9
1929	June 10—14	33	119	3.6
1930	August 18—20	18	80	4.4
	October 18—22	27	5	0.2
1931	August 10—11	7	8	1.1

The catches of haddock per hour's fishing, as given in Table II, are based on factors which remained reasonably constant throughout. Thus the average number of hand lines which fished was about 6, the bait frozen herring, and the locality of fishing well marked by the proximity to Orion Shoal and Rose and Crown buoys. The relative abundance of haddock as found on these grounds (which are primarily cod-fishing areas) may not obtain for other parts of Nantucket Shoals, especially to the eastward where haddock are more plentiful. Nevertheless the comparisons given reveal periods of scarcity and abundance (as in May 1923 and May 1925) and show

that schools of haddock do move on to and away from this part of the Shoals.

## CAPE COD TO BOOTHBAY HARBOR

### STELLWAGEN BANK

On Stellwagen Bank, situated between Provincetown and Cape Ann, 192 haddock were tagged between the years 1924 to 1928. Four of these were reported recaptured, one on Platts Bank to the northeastward (506 days), one on Georges Bank to the southeastward (170 days), one off Chatham to the southward (101 days), and one which lacked sufficient data (Figure 3). These few records suggest that such Stellwagen haddock as migrate scatter in various directions.

### BOONE ISLAND TO BOOTHBAY HARBOR, MAINE

Between Boone Island and Boothbay Harbor, a distance of about 60 miles, 1104 haddock were tagged between 1924 and 1930. Of these only 11 were reported recaptured, 2 of them locally (33-48 days) and 9 in distant localities (84-503 days<sup>5</sup>) (Figure 4). All but one of these latter were recaptured to the southward of the tagging grounds to as far as Massachusetts Bay and Georges Bank. The remaining fish was caught to the eastward, off Prospect Harbor, 60 miles from Boothbay Harbor. Thus the indications are that most of the haddock found in the shore waters of this part of the coast of Maine are temporary residents and that, of those which move away, more of them go southward than go eastward. If an appreciable number of tagged fish had gone eastward, recaptures could have been expected off Mt. Desert and around the mouth of the Bay of Fundy where a rather intensive fishery is carried on.

### MT. DESERT REGION

Off Mt. Desert 4174 haddock were tagged from 1924 to 1932, most of them within a few miles of Bakers Island and Little Duck Island and off Petit Manan, in a depth of 10 to 15 fathoms, and a few at Mt. Desert Rock in 15 to 25 fathoms. The recaptures reported totaled 144 fish, or 3.45 per cent, of which 114 fish, or 2.73 per cent were taken locally (average 244 days), 25 fish, or 0.60 per cent in distant localities (average 299 days) and 5 fish, or 0.12 per cent, lacked sufficient data. Compared with the 1.24 per cent returns from the Nantucket Shoals tagging, the larger yield from the Mt. Desert experi-

<sup>5</sup> One fish was reported recaptured nearly three years after tagging but there is some doubt as to the accuracy of this record.

ment was probably due to the intensive fishing in that vicinity from May to October.

The returns would have been much larger had a more efficient tag been used throughout the experiments. For example, in the experiments of 1924-1930 when metal tags were used, 4078 fish produced 131 recaptures, or 3.2 per cent, whereas from the 1930-1932 experiments when celluloid disk tags were attached to the tail and some fish carried celluloid belly tags, the 96 fish thus marked yielded a return of 12.5 per cent.

The relatively large number of recaptures resulting from the Mt. Desert tagging experiments shows rather definitely that a large proportion of the haddock present there at a given time remain localized for from six months to a year, or more. The elapsed days for the local recaptures are as follows: 46 were taken in 12-100 days; 7 in 101-200 days; 21 in 201-300 days; 19 in 301-400 days; 18 in 401-500 days; and 13 in 500 days or more. Of these the tagging vessels *Halcyon* and *Albatross II* recaptured seven fish 49 to 62 days later, and one fish 309 days later. The records of some of the haddock at liberty for many days are not dependable as fishermen sometimes retained tags long after the capture, the date of which was forgotten. However, the haddock longest at liberty, 3 years and 253 days, carried a belly tag and its record is probably correct. The small number of recaptures made 101-200 days after tagging, as compared with the number reported 201-400 days later, is due to the fact that very little local fishing is done between December and March hence tagged haddock not caught locally by late fall would not be taken until at least the following spring. The experience of the fishery shows that in winter haddock move away from the grounds close to shore so it is probable that fish tagged one year and recaptured in the same vicinity the next made at least a short migration during the interim.

Localization of haddock off Mt. Desert is also indicated from the length frequency distributions of fish caught by the *Halcyon* and the *Albatross II*. Thus in the largest series of closely spaced experiments, from August 1924 to October 1925 the same body of haddock appears to have remained throughout (Figure 9). For example, in the September 29-October 5, 1924 cruise, the length distribution was essentially the same as in August, the slight change being what one might expect from two months growth, while in the summer and fall of 1925 the shifting of the dominant size group to 19-22 inches might also be attributed to the increased growth of the 17-19 inch August-October 1924 fish.

A slight retrogression of the dominant sizes occurred from May-

July to September, but they advanced again in October which was almost identical to July. This may have been caused by the arrival during the summer of a fresh stock of the smaller sizes or by the departure from the tagging grounds of more of the larger haddock than of the smaller. Furthermore, catches made by the local fishery probably accounted for more large fish than small for our experience has

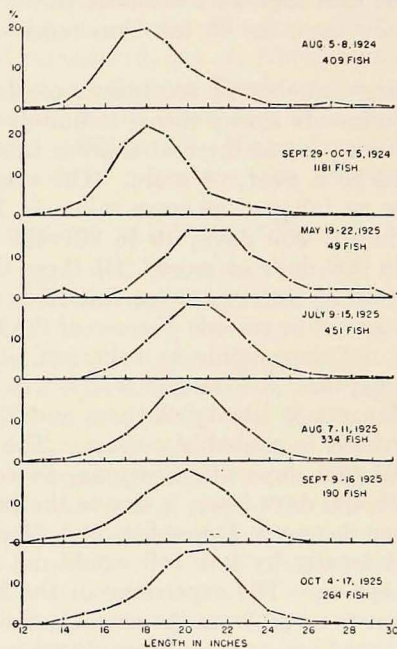


Figure 9. Length frequency distributions by percentages of haddock caught by the *Halcyon* off Mt. Desert, Maine, on cruises made from August 1924 to October 1925.

been that below a length of 17 inches hook and line fishing does not adequately sample the catch (Figure 1).

In localities distant from Mt. Desert 25 tagged haddock were reported recaptured (Figure 5). While this is a relatively small number compared with that taken locally (114) the chances of recapture after moving away must be much less than if the fish remained within the area of the intensively fished grounds close to shore. It appears quite certain that some of the emigrant tagged fish moved to localities where little or no fishing was done during the subsequent 6 or 12 months by which time many of them would have lost their tags. What proportion of the shore haddock emigrate within a year's time

cannot be determined from these experiments, but it is probably safe to say that at least one-half of them do so.

As 22 of the Mt. Desert migrant tagged haddock were recaptured between Penobscot Bay and the South Channel-Georges Bank region, compared with only 3 reported from the eastward (Grand Manan) the migratory tendency of haddock living along the coast of eastern Maine appears to be decidedly to the southward. Certainly if many of the fish went eastward more recaptures would have resulted from the intensive fishing around the mouth of the Bay of Fundy and southern Nova Scotia. The recapture localities and elapsed days at liberty for these migrants are as follows:

Grand Manan, N. B.	288	Monhegan	988
Dipper Harbor, N. B.	304	Jeffreys Ledge	260, 442
Bay of Fundy	265	Platts Bank	93, 119, 379
Penobscot Bay	280, 296	Cape Porpoise	259
Damariscove	318	Manchester	311
Portland	126, 434, 715	South Channel	130, 134, 224, 520
		Georges Bank	154, 226, 308, 326.

#### OFFSHORE GROUNDS

Negligible results were obtained from the haddock tagged on the offshore grounds. As these experiments were made primarily for cod, haddock were caught only incidentally and the total number tagged was relatively small. Furthermore, it is probable that many of the fish taken in deep water (20 to 50 fathoms), all caught with hand lines, failed to survive after liberation. And the offshore grounds, especially Georges Bank and Browns Bank, are relatively so large as compared with the shore grounds, that individual fish would seem to stand a better chance to elude capture there. The method of catching and handling fish on Georges Bank was no doubt partly responsible for the small number of tagged haddock reported from there (a total of 8 fish,—2 from Nantucket Shoals, 1 from Stellwagen Bank, 1 from off Boothbay Harbor, and 4 from Mt. Desert). Most of the commercial catch was taken with otter trawls so that a marked fish would stand very little chance of being detected until it reached the cleaning board, by which time its tag would likely be dislodged and, later, probably washed down the scuppers unnoticed.

Platts Bank, a small isolated plateau located about 30 miles southeast of Portland lightship might have provided some interesting results had the tagging experiments there yielded sufficient returns. However, from 1924 to 1930, out of 237 marked haddock only one was reported recaptured, a fish liberated in August 1928 and recaptured in June 1929 off Rockland about 60 miles inshore to the northeast.

On Browns Bank 747 haddock were tagged from 1927 to 1930, and only one was reported recaptured. This fish was tagged in August 1930 and recaptured on Browns Bank in February 1931.

No recaptures were reported from other haddock tagged offshore from 1926 to 1930, as follows: Georges Bank, 246; Cashes Ledge, 174; and Jeffreys Ledge, 53. Also, in 1928, 25 haddock were tagged off Cape Sable with no recaptures reported.

### AGE AND RATE OF GROWTH

During the course of these tagging experiments relatively little effort and study was given to the problem of the haddock's age and rate of growth. However, numbers of very small haddock were measured from time to time and enough records were obtained to

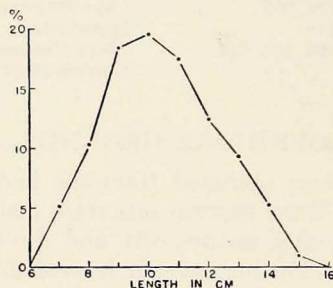


Figure 10. Length frequency distribution by percentages of 98 juvenile haddock taken on Georges Bank in miscellaneous catches from August 13 to September 25, 1925 to 1929.

give some indication of the size attained during the first year or two after spawning. Some of these young fish were taken on bottom in otter trawls, off bottom in plankton nets, and from cod and pollock stomachs, by the *Halcyon* and the *Albatross II*. Others were caught by otter trawlers operating on Georges Bank.

The smallest fish were caught from August 13 to September 15, during the years 1925 to 1929, when miscellaneous catches of 98 juvenile haddock were made on Georges Bank. These fish ranged in length from 6 to 15 cm. (Figure 10) most of them (76 fish) between 8 and 12 cm. ( $3\frac{1}{8}$ – $4\frac{3}{4}$  inches).

From February 9 to March 1, 1930 a large sample of young haddock (500 fish) was taken on Georges Bank by the trawler *Widgeon* and measured by Mr. Robert Smith, the wireless operator (Figure 11). They fall into two distinct age groups. The smaller fish (12–21 cm.) could easily have passed through the meshes of the net, but so many became trapped among the great mass of large fish landed on deck

that the samples can be considered fairly representative. These haddock very likely were spawned the previous spring and they had attained an average size of around 15–16 cm., or 6–6¼ inches, at about 10 months of age. Forty-eight fish taken on Georges Bank the following March 11–April 11 were of the same size range, with the dominant group also at 15–16 cm. This average length appears to obtain for fish about one year of age.

The 25 to 35 cm. haddock (165 fish) represent the smallest scrod that were taken (February 9 to March 1) and, while they are there-

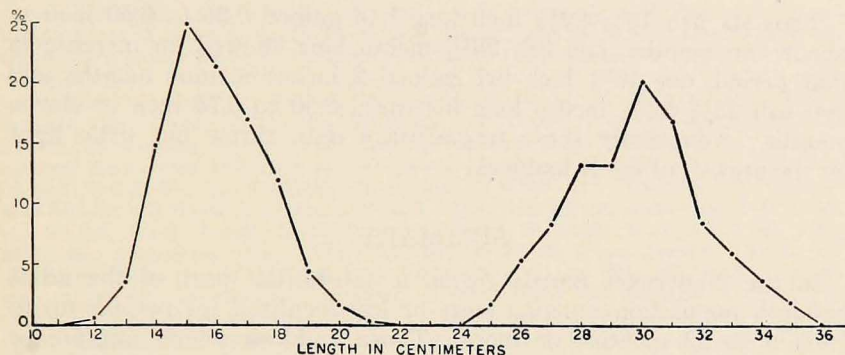


Figure 11. Length frequency distribution by percentages of young haddock caught on Georges Bank from February 9 to March 1, 1930 by the trawler *Widgeon*. Each curve represents 100 per cent.

fore not an unselected sample, nevertheless the dominant group at 30 cm. (12 inches) suggests that Georges Bank haddock are approximately this size when about two years old. A subsequent sample of 70 fish, taken March 11, also averaged about 30 cm. in length.

No attempt was made to study the haddock's rate of growth beyond the second year although scale samples were obtained from virtually all the fish that were tagged after 1923. And very few reliable records were received from recaptured fish, for in nearly every instance no remeasurement was made by the fishermen or, if the length was mentioned, it appeared to be incorrect. Following are the records of the ten fish recaptured by the *Halcyon* and the *Albatross II* arranged in the order of days at liberty:



<i>Tag No.</i>	<i>Date Tagged</i>		<i>Length</i>	<i>Date Recaptured</i>		<i>Length</i>	<i>Days at Liberty</i>
33018	June	26, 1925	22 ¼	August	13, 1925	22 ½	48
30843	May	21, 1925	21	July	9, 1925	21 ½	49
20474	August	8, 1924	18 ¼	October	3, 1924	18 ½	56
20237	August	8, 1924	17 ¼	October	5, 1924	17 ¾	58
19853	August	7, 1924	16 ¾	October	4, 1924	17	58
19797	August	5, 1924	18 ½	October	5, 1924	18 ¾	61
34139	July	14, 1925	26 ½	September	14, 1925	26 ½	62
24899	October	3, 1924	16 ¾	July	9, 1925	18 ¾	279
53459	September	1, 1927	24 ¼	July	19, 1928	25 ¼	321
18854	July	16, 1924	23 ¼	June	11, 1925	24	330

Thus six fish  $16\frac{3}{4}$ - $22\frac{1}{4}$  inch long had gained 0.25 to 0.50 inch in about two months, one fish  $26\frac{1}{2}$  inches long showed no increase in that period, one  $16\frac{3}{4}$  inch fish gained 2 inches in nine months and two fish  $23\frac{1}{4}$ - $24\frac{3}{4}$  inches long increased 0.50 to 0.75 inch in eleven months. Admittedly these fragmentary data throw but little light on the growth of adult haddock.

### SUMMARY

In the Nantucket Shoals region a substantial part of the adult haddock population remains more or less localized for periods up to from 6 to 12 months, or more. Those haddock which migrate or wander away from the Nantucket region appear to scatter to the northward of Cape Cod, alongshore as far as the Bay of Fundy, and also eastward to Georges Bank.

Haddock present along the southwestern coast of Maine, from Boone Island to Boothbay Harbor, appear to migrate to the southward to Massachusetts Bay and to as far as Georges Bank.

Along the northeastern coast of Maine, in the vicinity of Mt. Desert, many of the haddock remain localized for periods up to from 6 to 12 months, or more. Those fish which migrate go chiefly to the southward to as far as the South Channel region and Georges Bank. A small part of the population moves eastward to the Bay of Fundy.

Thus within the Gulf of Maine southern haddock tend to move northward and northern haddock tend to move southward.

The number of tagged fish recaptured was too small to reveal any seasonal migrations.

No information was obtained on the migratory habits of haddock living on Browns Bank and Georges Bank and on certain smaller grounds offshore as only two recaptures resulted from these experiments.

According to the length frequency distributions of young fish taken on Georges Bank, haddock in that region are about 6 inches long at one year of age and about 12 inches long at two years.

## LIST OF RECAPTURES OF TAGGED HADDOCK

*Explanation:* Each entry gives the data for one fish, the first item of the entry giving the date of release, the second item the place of recapture, the third item the date of recapture, and the fourth item (in italics) the number of days at liberty. VI.24.1923, South Channel VI.23.1924, 365; should thus read: released June 24, 1923, recaptured in South Channel June 23, 1924 after 365 days at liberty.

*Fish released on Nantucket Shoals*

VI.24.1923, South Channel VI.23.1924, 365; VI.24.1923, off Chatham IV.23.1925, 666; VI.25.1923, Unknown II.?.1924; IX.10.1923, Unknown IV.?.1924; X.4.1923, Nantucket Shoals VII.2.1924, 271; X.16.1923, Nantucket Shoals X.28.1924, 377; VII.16.1924, Nantucket Shoals VI.11.1925, 330; IX.12.1924, Stellwagen Bank XI.20.1924, 69; X.18.1924, S. E. Georges Bank II.9.1925, 114; X.18.1924, Stellwagen Bank VII.30.1925, 286; X.27.1924, Unknown III.?.1925; X.27.1924, South Channel VIII.17.1925, 294; X.27.1924, South Channel II.16.1925, 112; X.27.1924, South Channel VIII.6.1925, 283; X.28.1924, Nantucket Shoals VII.31.1925, 276; X.28.1924, South Channel VIII.18.1925, 294; V.6.1925, South Channel VIII.27.1925, 113; V.6.1925, South Channel VIII.2.1925, 88; V.6.1925, Nantucket Shoals VIII.27.1925, 113; V.6.1925, South Channel, VI.30.1926, 420; V.6.1925, Stellwagen Bank VIII.8.1925, 94; V.6.1925, Off Chatham VIII.9.1925, 95; V.7.1925, South Channel X.26.1925, 172; V.7.1925, Off Chatham VIII.25.1925, 112; V.7.1925, South Channel VII.25.1925, 79; V.8.1925, Off Chatham IX.12.1925, 127; V.8.1925, Nantucket Shoals VIII.16.1926, 465; VI.7.1925, Salisbury Beach, Mass. VIII.5.1926, 424; VI.7.1925, South Channel V.13.1926, 340; V.8.1925, South Channel VIII.27.1925, 81; VI.10.1925, Platts Bank X.19.1925, 131; VI.11.1925, Off Chatham VII.1.1925, 20; VIII.20.1925, Head Harbor, N. B. VI.8.1926, 292; X.6.1925, South Channel XI.12.1925, 37; V.3.1927, South Channel X.11.1927, 161; IX.1.1927, Nantucket Shoals VII.19.1928, 321\*; VII.13.1928, Newburyport, Mass. XII.18.1928, 158; VII.15.1928, South Channel X.6.1928, 83; VII.15.1928, South Channel X.15.1929, 457; VII.15.1928, Unknown 1933; VII.19.1928, Unknown 1930; VII.20.1928, Off Chatham VII.16.1929, 361; VII.20.1928, Off Chatham X.21.1928, 93; VII.20.1928, Nantucket Shoals X.14.1928, 86; VI.11.1929, South Channel X.15.1929, 127; VI.12.1929, Grand Manan, N. B. IX.25.1929, 105; VI.12.1929, South Channel II.15.1930, 246; X.22.1930, Georges Bank III.6.1931, 136.

*Fish released in South Channel*

VI.13.1929, South Channel VIII.22.1929, 70.

*Fish released on Stellwagen Bank*

X.16.1925, Unknown VII.?.1926; X.16.1925, Off Chatham I.25.1926, 101; X.16.1925, Platts Bank III.6.1927, 506; X.16.1928, E. Georges Bank IV.7.1929, 170.

*Fish released at Boone Island*

X.12.1924, Boston Lightship IV.22.1925, 192.

*Fish released off Portland*

VI.26.1925, Off Portland VIII.13.1925, 48\*; VII.22.1925, Off Portland VIII.24.1925, 33.

*Fish released at Seguin*

VII.31.1924, Off Portland VI.8.1925, 312.

*Fish released off Boothbay Harbor*

IX.22.1924, Portland Market IV.15.1927, 935; IX.22.1924, Platts Bank XII.15.1924, 84; IX.24.1924, Prospect Harbor, Me. IX.17.1925, 368; IX.24.1924, Platts Bank II.9.1926, 503; IX.25.1924, Portland I.12.1925, 109; VII.18.1925, Georges Bank X.10.1926, 449; IX.4.1925, Stellwagen Bank III.15.1926, 192.

*Fish released at Mt. Desert*

VIII.5.1924, Mt. Desert X.5.1924, 60\*; VIII.7.1924, Mt. Desert X.4.1924, 57\*; VIII.7.1924, Mt. Desert X.?.1924, 60; VIII.8.1924, Mt. Desert IX.27.1924, 50; VIII.8.1924, South Channel III.20.1925, 224; VIII.8.1924, Mt. Desert "Fall".1924, 60; VIII.8.1924, Mt. Desert X.5.1924, 58\*; VIII.8.1924, Mt. Desert "X-XI".1925, 400; VIII.8.1924, Mt. Desert "Fall".1924, 60; VIII.8.1924, Mt. Desert "V-VI".1925, 300; VIII.8.1924, Mt. Desert X.3.1924, 56\*; VIII.8.1924, Mt. Desert "Fall".1924, 60;

VIII.8.1924, Mt. Desert VII.?.1925, 330; VIII.10.1924, Mt. Desert "VI-VII".1925, 330; VIII.10.1924, Mt. Desert "V-VI".1925, 300; IX.30.1924, Mt. Desert "VI-VII".1925, 300; IX.30.1924, Mt. Desert "V-VI".1925, 270; IX.30.1924, Dipper Harbor, N. B. VIII.1.1925, 304; IX.30.1924, Mt. Desert Rock IV.14.1925, 196; IX.30.1924, Mt. Desert "Fall".1925, 65; IX.30.1924, Mt. Desert "V-VI".1925, 240; X.2.1924, Mt. Desert VIII.10.1925, 312; X.2.1924, Platts Bank I.29.1925, 119; X.2.1924, Mt. Desert "X-XI".1925, 390; X.2.1924, Mt. Desert V.19.1927, 949; X.2.1924, Mt. Desert X.?.1924, 30; X.3.1924, Mt. Desert "Fall".1925, 360; X.3.1924, Mt. Desert "Fall".1924, 30; X.3.1924, Jeffreys Ledge XII.22.1925, 442; X.3.1924, Mt. Desert VII.9.1925, 309\*; X.3.1924, Mt. Desert IX.?.1925, 350; X.3.1924, Mt. Desert VIII.?.1926, 660; X.3.1924, Mt. Desert VIII.?.1925, 300; X.4.1924, Mt. Desert "VI-VII".1925, 270; X.4.1924, Mt. Desert "Spring".1927, 940?; X.4.1924, Mt. Desert XII.8.1924, 65; X.5.1924, Platts Bank X.19.1925, 379; X.5.1924, Grand Manan, N. B. VII.21.1925, 288; V.19.1925, Mt. Desert VII.?.1925, 57; V.19.1925, Mt. Desert "VII-VIII".1925, 70; V.19.1925, Mt. Desert "VI-VII".1925, 60; V.20.1925, Mt. Desert VII.?.1925, 60; V.21.1925, Mt. Desert VII.9.1925, 49\*; V.22.1925, Mt. Desert VIII.?.1925, 80; VII.9.1925, Mt. Desert VIII.31.1925, 65; VII.9.1925, Mt. Desert VII.?.1925, 20; VII.9.1925, Portland? I.8.1927, 715; VII.9.1925, Mt. Desert VII.21.1925, 12; VII.10.1925, Mt. Desert "X-XI".1926, 465; VII.10.1925, Mt. Desert "X-XI".1926, 465; VII.10.1925, Mt. Desert "Summer" 1926, 365; VII.10.1925, Mt. Desert XII.?.1925, 170; VII.10.1925, Mt. Desert XI.30.1925, 143; VII.10.1925, Mt. Desert VIII.8.1925, 29; VII.11.1925, Mt. Desert, VII.25.1925, 14; VII.11.1925, Mt. Desert "X-XI".1925, 110; VII.11.1925, Mt. Desert VIII.20.1925, 40; VII.13.1925, Unknown II.?.1926; VII.14.1925, Mt. Desert IX.14.1925, 62\*; VII.14.1925, Mt. Desert "Spring" 1926, 270; VII.14.1925, Mt. Desert VIII.20.1925, 37; VII.15.1925, Mt. Desert "X-XI".1925, 110; VII.15.1925, Mt. Desert X.?.1926, 470; VII.15.1925, Mt. Desert "VII-VIII".1925, 30; VII.15.1925, Mt. Desert X.?.1926, 470; VII.15.1925, Mt. Desert "Fall" 1927, 790; VII.15.1925, Mt. Desert "VII-VIII" 1925, 30; VII.15.1925, Mt. Desert IX.?.1926, 400; VII.15.1926, Mt. Desert 1928?; VIII.7.1925, Mt. Desert "Spring-Summer" 1927, 700; VIII.8.1925, Platts Bank XI.9.1925, 93; VIII.8.1925, Mt. Desert, 360; VIII.8.1925, Mt. Desert "IV-V". 1926, 270; VIII.8.1925, Mt. Desert "Spring-Summer" 1927, 720; VIII.8.1925, Mt. Desert "Spring-Summer" 1927, 720; VIII.8.1925, Mt. Desert "X-XI".1925, 70; VIII.11.1925, Mt. Desert "Summer" 1926, 360; X.14.1925, Georges Bank III.17.1926, 154; X.15.1925, Mt. Desert XII.23.1926, 434; X.15.1925, Mt. Desert "IV-V".1926, 180; X.16.1925, Rockland Bay VIII.8.1926, 296; X.16.1925, Mt. Desert "X-XI". 1926, 365; X.16.1925, Mt. Desert "X-XI".1926, 365; X.16.1925, Mt. Desert "Summer" 1926, 270; X.16.1925, Mt. Desert "Summer" 1926, 270; VIII.21.1926, Mt. Desert IX.?.1926, 30; VIII.21.1926, Mt. Desert "Spring" 1927, 210; VIII.23.1926, Mt. Desert VII.20.1927, 332; VIII.23.1926, Bay of Fundy V.15.1928, 265; IX.26.1926, Mt. Desert "Fall" 1927, 365; IX.27.1926, Mt. Desert X.15.1926, 18; IX.27.1926, South Channel II.4.1927, 130; IX.27.1926, Mt. Desert "Spring-Summer" 1927, 270; IX.27.1926, Mt. Desert "Spring-Summer" 1927, 270; IX.27.1926, Mt. Desert "X-XI".1926, 40; IX.27.1926, Mt. Desert "X-XI".1926, 40; IX.27.1926, Mt. Desert "XII-I".1927, 100; IX.28.1926, Mt. Desert "Spring-Summer" 1927, 210; IX.28.1926, Mt. Desert "Spring-Summer" 1928, 600; IX.29.1926, Mt. Desert "X-XI".1926, 40; IX.29.1926, Mt. Desert "Spring-Summer" 1927, 210; VII.15.1927, Mt. Desert X.1.1928, 442; VII.15.1927, Mt. Desert VIII.15.1928, 395; VII.15.1927, Unknown 1928; VII.18.1927, Mt. Desert "Spring-Summer" 1928, 300; VII.18.1927, Unknown III.?.1928; VII.18.1927, Mt. Desert 1928, 250; VII.18.1927, Manchester, Mass. V.25.1928, 311; VII.18.1927, Mt. Desert VIII.?.1927, 30; VII.19.1927, Mt. Desert "Spring-Summer" 1928, 270; VII.19.1927, Cape Porpoise, Me. IV.4.1928, 259; VII.19.1927, Mt. Desert X.28.1927, 101; VII.20.1927, Mt. Desert VI.8.1928, 323; X.31.1927, Mt. Desert "X-XI".1929, 730; VIII.19.1928, Mt. Desert "Fall" 1928, 60; VIII.20.1928, Mt. Desert "X-XI".1929, 440; X.20.1928, Penobscot Bay V.27.1929, 280; VIII.20.1928, Mt. Desert IX.25.1929, 401; VIII.20.1928, Jeffreys Ledge V.7.1929, 260; VIII.20.1928, Mt. Desert "Spring" 1930, 620; VIII.21.1928, S. W. Georges Bank VI.24.1929, 308; VIII.22.1928, Mt. Desert "Fall" 1928, 60; VIII.22.1928, Mt. Desert VIII.19.1929, 362; VIII.22.1928, Mt. Desert X.1.1928, 40; VII.19.1930, Mt. Desert VIII.?.1930, 30; VII.19.1930, Mt. Desert IX.?.1930, 60; X.4.1930, Mt. Desert VI.14.1934, 1348; X.9.1930, South Channel III.?.1932, 520; VI.23.1930, Lat. 41° 20' N.; Long. 67° 10' W., 326; VI.23.1930, Damariscove, Me. V.7.1932, 318; VI.23.1931, Mt. Desert IV.?.1932, 300\*; VI.24.1931, Mt. Desert VIII.25.1931, 62; VI.24.1931, Georges Bank III.9.1932, 226; VI.24.1931, Mt. Desert VII.16.1931, 22; VI.27.1931, Mt. Desert VII.23.1931, 26; VI.27.1931, Boston Fish Pier V.?.1932; VI.27.1931, Mt. Desert I.18.1932, 203; VII.16.1932, 20 mi. S. E. Monhegan III.31.1925, 988.

*Fish released at Mt. Desert Rock*

IX.15.1925, Off Portland XI.24.1926, 434; IX.15.1925, Unknown VI.?.1929; X.27.1927, South Channel III.10.1928, 134; X.27.1927, Off Portland III.2.1928, 126.

*Fish released on Platts Bank*

VIII.18.1928, Rockland Bay, Me. VI.10.1929, 296.

*Fish released on Browns Bank*

VIII.2.1930, Browns Bank II.19.1931, 201.

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\*Recaptured by the *Halcyon* or the *Albatross II*.