MOVEMENTS OF TAGGED SUMMER FLOUNDER, Paralichthys dentatus, OFF SOUTHERN NEW ENGLAND

by

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INTRODUCTION

Adult summer flounder are found in Atlantic coastal waters from Cape Cod to Florida. They are most abundant in the Middle Atlantic Bight, the coastal concavity between Cape Cod and Cape Hatteras, where there are intensive commercial and recreational fisheries for them (Figure 1). From late spring to fall they are sought by recreational and commercial fishermen in coastal areas; from December to April they are fished by otter trawl- ers along the outer continental shelf edge. Vessels from New Jersey to Virginia fish this species in the southern part of the bight; those from New York and New England fish the areas from Long Island to south of Cape Cod.

The reported commercial catch of summer flounder in 1979 was 13,932 metric tons, of which 3,220 tons were taken within 3 miles (5.5 km) from shore and 10,712 tons were from waters beyond 3 miles but within the 200 mile (370 km) conservation zone (Pileggi and Thompson, 1980). The recreational catch for 1970, estimated from an angler survey, was 8,777 metric tons (Deuel, 1973).

There is evidence from marking and morphometric studies that there is a single population of summer flounder in the bight (Westman and Neville, 1946; Poole, 1962; Murawski, 1970; Wilk, et al., 1980). While there is some sporadic recruitment in the New York-New Jersey area, the principal nursery grounds are in estuaries and Bays of Virginia and North Carolina (Poole, 1966). The fish apparently disperse northward as they grow older and make up the stocks that are exploited in the northern part of the bight. Fish less than 25 cm in length are uncommon in New York waters (Westman and Neville, 1946). And in measuring samples from commercial otter trawl catches of this species

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from off southern New England in 1960-62 we found no fish less than 28 cm long in 18 trips from offshore areas and 5 from inshore areas. This was not a result of the smaller fish being discarded at sea; the entire catch of summer flounder is saved by New England draggers, since there is a market for all sizes caught.

Marking studies off New York and New Jersey have shown the seasonal pattern of movement of this species in the fall from coastal areas there to the outer continental shelf winter grounds, and the return in the spring to the coast again (Westman and Neville, 1946; Poole, 1962; Murawski, op. cit). These studies also have shown that the tagged fish tended to be caught farther to the north, within the bight, with the passage of time.

To learn more about the seasonal and long-term movements of summer flounder off southern New England, we tagged 2,839 of these fish on both coastal and offshore grounds there in 1961-62. The results of this study are reported here.

TAGGING PROCEDURE

The summer flounder for tagging were caught with otter trawls. For the offshore tagging we used the Bureau of Commercial Fisheries R/V Delaware. For the inshore tagging we used commercial otter trawlers. Tow lengths varied from 30 to 60 minutes. On the Delaware the fish were held in tanks of running seawater until they were tagged, whereupon they were immediately released. On the commercial vessels the fish were tagged from the net as they were brought aboard and immediately released. Records of total length in millimeters, date, and tagging location were made for each tagged fish. All of the summer flounder caught were tagged, except for the small number, of various sizes, whose physical appearance indicated that they were moribund. Therefore the tagged population was considered representative of the catch.
The seasons when the tagging was done were chosen to minimize the loss of tagged fish to fishing before they had moved from release areas. Thus, the 1961 offshore tagging was done in early April which is near the end of the winter fishery, and the 1962 inshore tagging was done in September, near the end of the summer fishery.

Fish that we had just tagged sometimes were caught in subsequent tagging tows. Where these appeared lively, they were re-released. These tag numbers were so noted in the tagging records.

The mesh sizes in the nets used to catch the fish for tagging had a stretched mesh measure of about 90 mm. A mesh of this size will retain many of the flounders of 20 cm in length or so (Clark, et al., 1958; Lux, 1968). We caught no summer flounder smaller than 31 cm and therefore we assume that the entire population on the bottom was sampled in relation to its abundance and that none escaped through the meshes. In view of the scarcity of summer flounder less than 25 cm in length off New England, we believe this is a reasonable assumption.

The tags used were plastic Peterson disks 13 mm dia and fastened to the fish with a stainless steel pin through the dorsum. One disk was printed with return instructions; the other carried a serial number.

A reward of \$1.00 was paid for a returned tag alone, and \$2.00, for a tag with the fish. Bureau of Commercial Fisheries port samplers, who were stationed in ports of landing, received most of the tags returned by commercial fishermen. Fishermen often brought the fish to them as well so that sex could be determined and the length measured. Positions for recaptures by the commercial fleet usually were in the form of Loran bearings and depths. These generally were accurate to within 10 km or less.

Recreational fishermen usually mailed in their recovered tags. They frequently gave the recovery position in terms of landmarks, such as an inlet, bay, or point. These positions likely were at least as accurate as those from commercial fishermen.
Some tags were discovered in fish markets or processing plants, and there was no information on locality caught. In most cases it was possible to identify these as commercially caught. In addition, there were a few mailed-in returns for which we were unable to get any information. Altogether these returns made up 3.8% of the total tags returned. While of no value for charting fish movements, they were useful in measuring total return rates, and they are included in the results presented below.

RESULTS

1.) Offshore Tagging, April 1961.

The summer flounder in these releases were caught and tagged in depths of 80 to 145 m April 1-6 (Figure 1). Most of the 1,833 fish tagged were from between Hudson and Block Canyons in about 90 m depth, approximate position 39°55'N, 72°00'W (location 4, Figure 1). Recoveries were obtained until August 1963, at which time a total of 155 had been reported, 8.4% of those released.

To compare the length distribution of recaptured fish with that of the tagged ones we used the lengths taken at the time of tagging rather than lengths obtained at recovery. The size distributions, at tagging, of the fish released in 1961 and of those subsequently recought (Figure 2) show that most of the fish tagged were between 31 and about 50 cm in length, but with some ranging up to over 60 cm. The mean length was 38.8 cm. The lengths, at tagging, of the recaptured fish closely approximated those of the tagged ones, suggesting that there was no significant differential in tagging mortality with fish size and that the size of recoveries was representative of the tagged population. The mean length of recoveries also was 38.8 cm.
All except one of the recoveries from 1961 releases were from fish released at location 4 in Figure 1; therefore the following discussion applies to movement from this release point.

In April-June 1961 there were 67 recaptures, all with recapture positions. Of these, 37 were caught in April on offshore areas in the vicinity of tagging (Figure 3). In addition, 3 late April recoveries were caught on inshore areas of Long Island. The other 27 recoveries were caught in May and June on inshore grounds, primarily from the ocean side of Long Island. One, however, was from Long Island Sound, 3 were from the Rhode Island shore, and 2 were from Vineyard Sound (just south of Cape Cod). The returns during this quarter established the time of movement from offshore to inshore grounds as being in April and May, at least for the area dealt with in this report, i.e., north of 39°N. There were 47 summer recoveries (July-September 1961), 46 of which had return locations. They were caught mostly in bays and sounds from Long Island to southern New England (Figure 4). Many of these recoveries were from more easterly inshore areas than the spring ones, although there were several also from western Long Island and Long Island Sound. Six returns were from as far to the east as Vineyard and Nantucket sounds. There were no summer recoveries from south of Sandy Hook, New Jersey or from east of the elbow of Cape Cod.

There were just three recoveries in the fall of 1961 (October-December), for one of which no return area was given. The other two were from south of Martha's Vineyard and Nantucket, in an area intermediate between inshore and offshore grounds, suggesting that these fish were in the process of moving offshore for the winter (Figure 4). One of these was caught in October, the other, in December.
There were 28 recoveries during January-March 1962, all of which were from offshore, and 15 of them coming from the vicinity of release in the previous spring (Figure 5). In addition, 10 others were caught well to the east of this, near Veatch Canyon, suggesting that an eastward movement on offshore grounds had occurred. The other 3 fish were recaptured south of the release point, indicating that a small amount of southerly movement had taken place.

Of the five recaptures reported for April-June 1962, two were caught on offshore grounds in April and May and the other three were caught on Long Island inshore areas in May and June (Figure 5). While there were few returns in this calendar quarter, the pattern of return locations was similar to that of April-June in 1961 (Figure 3).

Following June 1962 only six additional tags were recovered from the 1961 releases: one each in July, September, and October 1962; one in May 1963; and two in August 1963. The locations of these recoveries followed a pattern similar to that described for the 1961 recoveries in these months.

The tagged fish in the 1961 releases were caught by both commercial and recreational fishermen, with commercial gear taking 71.6% of the recoveries versus 26.5% for recreational (Table 1). While we have no exact breakdown of catch by the various commercial gears, the vast bulk of returns were caught by otter trawls and a few additional ones, on inshore areas, by traps and seines. The recreational gear was primarily hook and line, although a few returns appear to have been taken with spears.

Some recoveries by commercial gear were made year-round, but most were caught in January-June with many being taken during the offshore fishery for this species in January-April (Table 1). The recoveries by recreational
fishermen all were obtained during the summer months, when the fish are inshore. Most of these latter returns were caught in the Long Island and Long Island Sound areas, although several also were taken along the southern New England shore.

The length, at tagging, of the tagged fish returned by the commercial fleet ranged from 32-56 cm, with a mean of 39.3 cm. The fish returned by recreational fishermen, on the other hand, had a length range, at tagging, of 31-42 cm and a mean of 37.5 cm. Thus it appeared that fish of the recreational catch were slightly smaller in size and that considerably fewer large summer flounder were caught by anglers.

The sex of 58 of the 1961 releases was obtained by internal examination when the fish were recaptured and returned for measurements. The length frequencies, by sex, of these fish (at time of tagging) are presented in Figure 6. While the numbers of fish here, 22 males and 36 females, are rather small, there are indications of modes at about 35 cm for males and 40 cm for females.

2.) Inshore Tagging, September 1962.

The 1962 inshore tagging comprised two experiments: one in Block Island Sound and one in Nantucket Sound. The summer flounder tagged in Block Island Sound were caught and released in an area 5.5-6.5 km south southwest of the Point Judith, Rhode Island lighthouse (approximately 41°18'N, 71°32'W) in 18-27 m of water September 6-8 (Figure 1). Tag recoveries from this group were obtained through March 1967. A total of 406 fish were tagged, and 203 of these were subsequently recaptured for a return rate of 50%.
The length distributions, at time of tagging, of the summer flounder released at this location and of those later recaptured (Figure 7) show that the tagged fish ranged in length from 31 to 76 cm and had a mean length of 46.3 cm. The lengths at tagging of the recovered fish were similar to those of the tagged ones, indicating that the recoveries accurately represented the tagged population (Figure 7). The mean length of these fish was 46.4 cm.

The summer flounder tagged in Nantucket Sound were released in two areas off southeastern Cape Cod about 12-15 km apart: 397 fish were released 10 km south of Point Gammon (approximately 41°33'N, 70°15'W) in 16-20 m depths September 6-7; and 203 fish were released 6.5 km south southwest of Monomoy Point (approximately 41°32'N, 70°05'W) in 7-10 m depths September 21. Since the two areas are close together they are shown as a single position, number 6, in Figure 1. Through January 1968, when the last return was reported, 244 of the 600 fish tagged in these releases were recaptured, for a recapture rate of 40.7%.

The size distributions, at time of tagging, of all the Nantucket Sound releases and of those later recaptured (Figure 8) show that the length range of the fish tagged here was narrow, running from 35-53 cm. The mean length was 43.1 cm. The lengths, at tagging, of the recaptured summer flounder of these releases was similar, having a length range of 35-52 cm and a mean length of 43.5 cm.

The patterns of tag returns for the Block Island and Nantucket Sound releases were very similar, and we have therefore combined these two groups in discussing fish movements. Charts of the tag return positions for these groups for September 1962 through December 1964, by calendar quarter, are presented in Figures 9-13.
During September 1962, the month of tagging, 36 returns, all with return positions, were recorded. These were caught in the immediate vicinity of the release points (Figure 9). In the last calendar quarter, October-December 1962, the 25 returns, all with return positions, showed clear evidence of fish movement to offshore wintering areas (Figure 9), with a few tags being recovered in October near the tagging sites and also on grounds intermediate between inshore and offshore areas. Two of the tagged fish were recaptured in October on intermediate grounds off the New Jersey coast, a straight line movement from the release point of about 335 km in just over a month's time. In November 1962 only two returns were reported, both from south of Nantucket. In December there were eight returns, seven from offshore grounds and one from intermediate grounds south of Nantucket (Figure 9).

In January-March 1963 there were 110 recoveries, 105 of which had return positions. These were caught over the outer shelf area from Veatch Canyon on the east to Baltimore Canyon on the southwest, with many recaptures coming from the vicinity of Block Canyon (Figure 10). The recaptures from these releases were spread over an area that extended considerably to the south of that recorded for recaptures from the 1961 offshore releases.

Of the 59 tag returns obtained during April-June 1963, 53 had return positions. These were from offshore, intermediate, and inshore grounds, showing the spring return of summer flounder to coastal areas (Figure 10). The 17 returns in April were from offshore grounds, while the 36 caught in May and June were from coastal areas. Two of these latter were from south of Nantucket, and the rest were from more inshore points from Long Island to Nantucket Sound; none were from the New Jersey shore or from inshore areas south of there.
There were 88 tag returns in July-September 1963, of which 83 had return locations. These were from inshore areas except for one which was recovered on intermediate grounds south of the eastern end of Long Island in September (Figure 11). The 82 inshore returns were almost entirely from waters to the east of Long Island, with many being caught near or at the locations of release in 1962. One, however, was caught far to the south just east of Cape May, New Jersey.

The 11 recoveries in October-December 1963, of which 8 had return locations, included three from inshore grounds in October, one from intermediate grounds in November, and four from offshore grounds southwest of Hudson Canyon in December (Figure 11).

The tag return locations for the 86 recoveries in 1964 are presented in Figures 12-13. While the numbers of recoveries were much smaller than in 1963, the recovery positions reflect much the same pattern as was shown in that earlier year (Figures 10 and 11).

From January 1965 through January 1968, when the last recapture was reported, an additional 33 tags were returned from the inshore releases: 22 in 1965, 7 in 1966, 3 in 1967, and 1 in 1968. The locations of these returns, while not plotted here, followed the general seasonal patterns of summer flounder migrations described above.

A breakdown of the tag recoveries by commercial and recreational fishermen from the inshore 1962 releases (Table 2) indicates that commercial fishermen caught about 95% of the recoveries. More than 95% of the commercial fishery returns were by otter trawl. A few were caught in traps, one, in a scallop dredge.
The recreational catch from these releases amounted to less than 4% of the total, all of which was caught by anglers. The proportion of returns caught by anglers for the Block Island Sound releases was 5.9% compared with 1.6% for Nantucket Sound fish, suggesting that the Block Island area releases were subjected to a somewhat greater angling effort. The mean length, at tagging, of all 16 angler-caught returns in these releases was 43.6 cm. This is slightly smaller than the 44.9 cm mean length of the commercial recaptures.

The data of Table 2 indicate that the entire recreational catch was caught from spring to fall, when the fish are close inshore. The commercial catch was taken in all months; but few fish were caught in October-December when they are moving offshore. The highest commercial catches generally were made in the January-March quarter.

The sex of 60 of the summer flounder tagged in Block Island Sound and 132 of those tagged in Nantucket Sound was determined from internal examination when the fish were recovered and returned for measurements. The length frequencies, by sex, of these fish (at time of tagging) are shown in Figure 6. The females clearly were larger than the males. For both areas there was a length mode at about 40 cm for males and one, less clear, at about 45 cm for females. There also appeared to be a secondary mode at about 45 cm for males from Block Island Sound.

DISCUSSION

From the 1,833 summer flounder tagged on offshore grounds in the Block Canyon area in March 1961 there were 155 recaptures, 8.4% of the total released. Recaptures were reported through August 1963, or 30 months following tagging.
From the 1,006 fish tagged on inshore grounds of Block Island and Nantucket Sounds in September 1962 there were 447 recaptures, 44.4% of the total released. These were recovered over a period of 65 months following tagging. The difference in the number of tag returns and the time-span over which they were caught is large, particularly when one considers that both groups of fish were exposed to roughly similar fishing efforts. We attribute this difference largely to a greater tagging mortality in the offshore releases. Those tagged offshore came from water about 90 m in depth, and they clearly were in less vigorous condition than those tagged inshore, which were from depths of 27 m or less. While the flounders have no gas bladders to cause decompression injury they may, nevertheless, have suffered damage from the rapid pressure change as they were brought from bottom to surface. Tow length may also have been a factor. The fish tagged offshore were caught in tows of 45-60 minutes duration and therefore may have suffered greater injury in the trawl compared with those on inshore grounds which were mostly caught in tows of 30 minutes. In addition, tows on the offshore grounds frequently contained considerable quantities of spiny dogfish, *Squalus acanthias*, whose rough skin and spines abrade other fish in the trawl.

There was evidence of some tagging mortality among inshore releases, also, based on the tag return rate of newly tagged summer flounder that were recaptured during later tagging tows and re-released. In the Block Island Sound tagging 23 of the tagged fish recaptured during tagging tows were re-released in apparently good condition. Of these only four subsequently were recaptured in the years following tagging, for a tag return rate of 17.4%. This is much lower than the 50% return rate for the Block Island Sound releases as a whole. In addition to this, two of the Block Island Sound releases, which never previously had been
recaught, were picked up dead and decomposed a few days after tagging in the trawl of the commercial vessel that had been used during tagging.

In the course of the Nantucket Sound tagging, 90 of the tagged fish were recaptured in later tagging tows and re-released. Of these 10 subsequently were recaptured for a total return rate of 11.1%. Again, this was much lower than the 40.7% return rate for Nantucket Sound releases as a whole.

It must be concluded from the above that a significant number of the summer flounder from inshore releases died from the catching and tagging operations. This mortality needs to be taken into consideration in estimates of population parameters of this species from the tag return data.

The summer flounder tagged in April 1961 on offshore grounds east of Hudson Canyon moved during the spring and summer in northerly directions (northwest, north, and northeast) to coastal areas; there was no movement to the south of the Sandy Hook, New Jersey area (Figures 3-5). During the fall the movement was back toward the offshore winter grounds near the outer shelf edge; in the winter all of the recaptures were from the offshore grounds with many of them coming from the vicinity of tagging, suggesting a homing tendency. Some of the offshore returns, however, were from areas up to about 220 km to the east of the release point, indicating that there also was some eastward movement on offshore grounds (Figure 5). None of the returns were from areas to the east of the Veatch Canyon area, and insofar as is known, this is about as far to the east that this species moves in any numbers although they occasionally are caught on Georges Bank (Bigelow and Schroeder, 1953).
Very few of the tag recoveries were from offshore areas southwest of the point of tagging, suggesting that there was limited travel in this direction. This is not a matter of there being little fishing effort in this area since the New Jersey vessels regularly fish offshore grounds south of Hudson Canyon in the winter (Widerstrom, 1959), and if tagged summer flounder had moved there in any numbers more would have been caught.

The general pattern of recoveries from these offshore releases indicated that the summer flounder that move as far north as the winter grounds north of Hudson Canyon become rather permanent residents of the northern part of the Middle Atlantic Bight.

The summer flounder tagged in September 1962 on inshore areas of Block Island and Nantucket sounds moved in the fall and early winter to offshore winter grounds from the vicinity of Veatch Canyon on the east to as far south as Baltimore Canyon (Figures 9-13). The returns from these inshore releases clearly moved farther south on the offshore grounds than did those from the 1961 offshore releases. There appears to be no reasonable explanation for this difference from the data at hand, although variations in the winter bottom temperature on offshore grounds may have altered fish distribution as was suggested by Nesbit and Neville (1935) for a number of Middle Atlantic Bight fishes.

The large cluster of winter returns from the vicinity of Block Canyon (Figure 10) may be regarded, at least partly, as a function of fishing effort in this intensively fished area. However, there also is a productive winter fishing ground for squid there (Lux, et al., 1974), an important summer flounder food. It is possible, therefore, that summer flounder to some extent aggregate in this area for feeding.
Recoveries during the spring and summer of 1963 and 1964 (Figures 10-13) show that the fish in these seasons moved back inshore to areas from Long Island to south of Cape Cod. Many were recaptured at points of release. The general tendency was for these returns to be made from areas farther to the east as the summer progressed. There were very few spring and summer returns from inshore areas south of Long Island, further indicating that those fish that had moved to New England waters did not move far to the south in subsequent years.

The results from the 1961 and 1962 tagging studies showed similar movement patterns to those found for fish tagged in inshore waters of New York and New Jersey (Westman and Neville, 1946; Poole, 1962; Murawski, op. cit.). The New York and New Jersey fish, however, moved farther south in the winter months and generally did not move as far north in the summer as the New England releases did. In all of these more southern studies there was a trend towards movement to the northeast with the passage of time. All of this coincides with the general view that the major nursery grounds for this species are in estuaries and bays from Virginia to North Carolina and that there is a northward drift of the fish as they grow older (Poole, 1966).

To provide more information on this apparent northward dispersal with age, Murawski (op. cit.), studying movements of tagged summer flounder in New Jersey coastal waters, compared the lengths of recaptures from north and south of the release areas to see if there was a difference in fish size with direction of movement. He found no consistent differences for those releases. As we mentioned here earlier some of the recaptures from our 1962 inshore releases were recaptured in 1963 and 1964 on winter grounds far south of the release areas (Figures 10 and 12). To examine the possibility that there might be a north-
south size difference in these offshore recaptures we calculated the mean
lengths, at tagging, for fish that were recaptured in January-March 1963 and
1964 north of 39°N and those caught south of this latitude. The results of
this, given in Table 3, suggest that the recaptures north of 39°N were about
2 cm longer. The small numbers of fish involved in these samples, however,
make it difficult to settle this question.

Most of the tag recaptures of our study were made during the January-
April offshore fishery and during the inshore season from June-September
(Tables 1 and 2). A large proportion of recaptures in any one whole year
was in the January-March quarter. In all cases these were by the commercial
fleet since this fish is not available to anglers in winter. Landings statistics
show that this quarter usually is the time of greatest commercial catches
of summer flounder for New England trawlers.

Few tag recoveries were obtained in October-December, indicating that the
fishing pressure on this species was at a low ebb then. This probably was re-
lated to the dispersed nature of the summer flounder population during the fall
migration to offshore areas. An advantage of a low fishing mortality at this
time is that the fish are relatively undisturbed during spawning, which occurs
during their offshore movement to winter grounds (Smith, 1973).

Who recaptures the tagged summer flounder depends to a large extent on
when and where the fish are tagged. Recreational fishermen recovered 26.5% of
our April 1961 offshore releases and only 3.6% of those in the September 1962
inshore series. Most of the angler recaptures from the 1961 tagging were from
Long Island bays, which are areas of great sport fishing activity. Angler re-
turns from the 1962 releases, on the other hand, were mostly from New England
waters, where the angler population is smaller.

Recoveries by recreational fishermen in all of our releases were much fewer than those from inshore releases in the New York-New Jersey area, where larger population centers lead to greater angler effort. In studies in Great South Bay, Long Island, for example, up to 60% or more of the tagged summer flounder were caught by anglers (Westman and Neville, 1946; Poole, 1962). And in tagging studies off New Jersey in 1960-67 sport fishermen caught 46-60% of summer flounder released in three experiments near Sandy Hook and 25-49% of the recoveries in fish of three tagged groups off Cape May (Murawski, op.cit.). A summer otter trawl fishery operating in the Cape May region apparently accounted for the difference in these two New Jersey areas.

Although no age studies have been done in conjunction with the tagging, some inferences about age composition and growth rate of summer flounder can be drawn from the size compositions, by sex, of the recaptured fish (Figure 6). In the fish tagged offshore in 1961 in April, about the time when growth starts for the year, the male modal length is about 35 cm, which is close to the length calculated from otoliths of 345 mm at age 3 given by Smith and Daiber (1977); likewise, the mode for females at about 40 cm is close to their calculated length at age 3 of 380 mm. For the fish that we tagged in September 1962 (Figure 6) there are modes for males at about 40 cm, which corresponds closely with the 397 mm calculated length at age 4 of Smith and Daiber. There are no clear modes in the size frequencies of females in the 1962 samples, although there is some sign of them at about 45 cm. Again, this is close to the 453 mm length calculated at age 4 by Smith and Daiber. Fish measured in September can be expected to have completed most of their growth for that calendar year, and their
lengths, generally speaking, would differ little from those at the time of formation of their next annulus.

As indicated earlier, small summer flounder, less than about 28 cm in length, are uncommon off New England. The size distributions of Figure 6, coupled with this fact, suggest that summer flounder do not arrive in New England waters in strength until they have reached age 3, although it seems likely that some of the faster growing 2-year-olds also make this migration.

The reason for describing the size and age composition in some detail here is for its potential value in measuring summer flounder recruitment. If modes in size frequencies taken in New England can be identified with age group 3, then it should be possible to get an estimate of recruitment of 3-group fish to the New England area by obtaining length frequencies by sex of summer flounder from limited special otter trawl surveys for this species. It would appear from the data of Figure 6 and from information on the pattern of seasonal distribution that a good time of the year to attempt such a survey would be in the late spring, when the fish have arrived on inshore New England grounds such as Block Island Sound, Vineyard Sound, and Nantucket Sound.
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Widerstrom, F. L., Jr.

Table 1. Recoveries of tagged summer flounder from 1961 offshore releases by season and fisherman type, April 1961-October 1963.

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Table 2. Recoveries of tagged summer flounder from 1962 inshore releases by season and fisherman type, September 1962-January 1968.

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<td></td>
</tr>
<tr>
<td>September</td>
<td>34</td>
</tr>
<tr>
<td>October-December</td>
<td>25</td>
</tr>
<tr>
<td>1963</td>
<td></td>
</tr>
<tr>
<td>January-March</td>
<td>110</td>
</tr>
<tr>
<td>April-June</td>
<td>57</td>
</tr>
<tr>
<td>July-September</td>
<td>79</td>
</tr>
<tr>
<td>October-December</td>
<td>9</td>
</tr>
<tr>
<td>1964</td>
<td></td>
</tr>
<tr>
<td>January-March</td>
<td>36</td>
</tr>
<tr>
<td>April-June</td>
<td>26</td>
</tr>
<tr>
<td>July-September</td>
<td>18</td>
</tr>
<tr>
<td>October-December</td>
<td>2</td>
</tr>
<tr>
<td>1965-68</td>
<td></td>
</tr>
<tr>
<td>January-March</td>
<td>11</td>
</tr>
<tr>
<td>April-June</td>
<td>7</td>
</tr>
<tr>
<td>July-September</td>
<td>9</td>
</tr>
<tr>
<td>October-December</td>
<td>1</td>
</tr>
<tr>
<td>All months</td>
<td>424</td>
</tr>
</tbody>
</table>

Percentage 95.1 3.6 1.3 100.0
Table 3.—Numbers of tag recaptures north and south of 39°N in January–March 1963 and 1964 from 1962 inshore releases, and mean lengths and length ranges, in centimeters, at time of tagging.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area</th>
<th>Number of recaptures</th>
<th>Mean Length</th>
<th>Length range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>North of 39°</td>
<td>84</td>
<td>45.4</td>
<td>36–60</td>
</tr>
<tr>
<td>1963</td>
<td>South of 39°</td>
<td>22</td>
<td>42.8</td>
<td>38–50</td>
</tr>
<tr>
<td>1964</td>
<td>North of 39°</td>
<td>20</td>
<td>44.6</td>
<td>40–52</td>
</tr>
<tr>
<td>1964</td>
<td>South of 39°</td>
<td>8</td>
<td>42.6</td>
<td>40–45</td>
</tr>
</tbody>
</table>
Figure 1.—Map of the Middle Atlantic Bight showing locations where summer flounder were tagged and released in 1961 and 1962.
Figure 2.—Length frequency distributions of summer flounder tagged in April 1961 on offshore grounds and of those subsequently recaptured. (All lengths are those obtained at the time of tagging.)
Figure 3.—Tagged summer flounder release positions for April 1961 releases (open squares) and recapture locations in April–June 1961 (circles).
Figure 4.—Tagged summer flounder release positions for April 1961 releases (open squares) and 1961 recapture locations in July-September (circles) and October-December (triangles).
Figure 5.—Tagged summer flounder release positions for April 1961 releases (open squares) and 1962 recapture locations in January-March (circles) and April-June (triangles).
Figure 6.—Length frequency distributions, at tagging, of male (—) and female (——) summer flounder recaptures from fish tagged in 1961 on offshore areas and in 1962 on inshore areas.
Figure 7.—Length frequency distributions of summer flounder tagged in September 1962 in Block Island Sound and of those subsequently recaptured. (All lengths are those obtained at the time of tagging).
Figure 8.—Length frequency distributions of summer flounder tagged in September 1962 in Nantucket Sound and of those subsequently recaptured. (All lengths are those obtained at the time of tagging.)
Figure 9.—Tagged summer flounder release positions for September 1962 releases (open squares) and 1962 recapture locations in September (circles) and October-December (triangles).
Figure 10.—Tagged summer flounder release positions for September 1962 releases (open squares) and 1963 recapture locations in January-March (circles) and April-June (triangles).
Figure 11.—Tagged summer flounder release positions for September 1962 releases (open squares) and 1963 recapture locations in July-September (circles) and October-December (triangles).
Figure 12.—Tagged summer flounder release positions for September 1962 releases (open squares) and 1964 recapture locations in January-March (circles) and April-June (triangles).
Figure 13.—Tagged summer flounder release positions for September 1962 releases (open squares) and 1964 recapture locations in July-September (circles) and October-December (triangles).