

IRISH FISHERIES INVESTIGATIONS

SERIES A (Freshwater)

No. 18 (1979)

**An Roinn Iascaigh agus Foraoiseachta
(Department of Fisheries and Forestry)**

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EDWARD FAHY

**SEA-TROUT FROM THE TIDAL WATERS OF THE
RIVER MOY.**

Sea-trout from the tidal waters of the River Moy.

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ABSTRACT

Sea trout from the tidal waters of the River Moy are described on the basis of life data and scales from 1,269 specimens collected during 1974 and 1975. The mean smolt age was 2.30 years. Lengths ranged from 16.4 cm for one-year-old A type smolts to 23.9 cm for four-year-old B type fish. Two-year-old smolts increased in length by 67% in their first summer at sea. Sixteen age categories were identified and 82% of the first spawners were finnock. The proportion of 2.+ fish increased throughout the season. Correlation between mean age at first maturation and coefficient of total mortality in British and Irish sea trout stocks was demonstrated. Moy trout are short-lived in the sea and this factor is identified as the most important of those influencing the population which is a typically western seaboard Atlantic-feeding stock.

INTRODUCTION

A description of the sea trout, *Salmo trutta* L., of the River Forth, based on analysis of scale collections, was published by Menzies in 1920. Since that time substantially similar evaluations of some 80 stocks of the species in Britain and Ireland have been completed, the majority by Nall and Went of which Nall (1930) and Went (1962) were review works. More recent material has been provided by Harris (1970).

The material for each stock assessment hitherto completed consisted of scales from sea trout gathered from a particular area in one or two years. Life data (length, weight) were noted and lengths at age of pre-spawned fish calculated. The age profile of each collection was given. Occasionally more details were included but eight common statistics were suitable for comparing stocks (Fahy, 1978b).

From all of these studies of sea trout, controls on sampling were absent so that it was not possible to reach conclusions about the real structure of the populations concerned. However considerable and so far inexplicable differences between stocks (particularly in the riverine stage of the fish) have been revealed by the methods used. This evaluation of sea trout in the River Moy is a further contribution to a growing accumulation of data. The usual statistics are presented and the age at first maturation of the fish is examined in relation to the rate of mortality as suggested by the age structure of the samples. Figures similar to those used in the appraisal have been extracted from the earlier sea trout literature.

The river and its fishery

The River Moy is almost 100 km in length and its catchment of more than 2,000 km² contains two sizeable lakes, Conn (5,000 hectares) and Cullin (1,100 hectares). Compared with other Irish rivers its estuary is relatively long, tidal from upstream of Ballina to Killala Bay 10 km to the north. The estuary is, however, narrow being less than 1 km at the widest point with extensive mudflats at low tide. North of its debouchment to Killala Bay marine conditions prevail. The northern arms of Killala Bay (Kilcummin Hd and Lenadoon Pt) are 10 km apart. The latitude of the estuary is 54°10' and its longitude 9°9' west.

The Moy Fishery Company are owners of the several fishery in the tidal portion of the river where they operate draft nets and a salmon weir at the head of the tideway. During the period in which the sampling considered here took place there were three draft nets in operation. A bye-law (number 35 dated 21 May 1870) permits the Company to use a small mesh (3.2 cm knot to knot) presumably for the capture of sea trout.

Materials and terminology

In 1974 and 1975 a representative collection of sea trout was requested from the Moy Fishery Company. After the conclusion of the netting season in early August the collection of material continued, from rod fishermen.

Scales, length and weight measurements of sea-trout were collected by the Company between 20 June—2 August 1974 and 23 June—2 July 1975. Fish taken by rod between 2 and 31 August 1974 are included in the collections. In all, details of 1,428 fish were noted and 1,269 sets of scales were read, three back-calculations being made on each set.

The scale formula convention for sea trout begins with a figure describing the duration of the riverine (parr) phase of the fish in years (or more accurately winters, by the occurrence of winter growth bands on the scale). This figure is followed by a full stop and marine life is indicated by the succeeding figures, also expressed in years or post migration winters. SM indicates the presence of a spawning mark on the scale and a plus sign signifies growth which did not culminate in a winter band *i.e.* part of a year's growth.

Fish in their year of first migration to sea are known as finnock (post-smolts); having completed their first post migration winter (*i.e.* the winter of the year in which they first go to sea) they are known as adult sea trout.

A-type smolts migrate to sea at the end of the last parr winter before any growth has taken place in the year of migration. B-type fish grow in freshwater either prior to their migration or while moving downriver. Mean smolt age (M.S.A.) is calculated as:

$$\frac{(\% S1) + (\% S2 \times 2) + (\% S3 \times 3) \dots}{100}$$

100

where S₁, S₂ etc. are the smolt classes.

The mean age at first maturation is calculated as

$$\frac{(\% Y1) + (\% Y2 \times 2) + (\% Y3 \times 3) \dots}{100}$$

100

Where Y₁, Y₂ etc. are sea trout maturing at the second, third etc. post-migration winter, Y₀ represents the first post-migration winter, not included in the figures.

RESULTS

Progress of the Fishery

The progress of the Moy tidal fishery during the period of sampling is shown in Fig. 1. The sequence of events is interpreted on the basis of direct observations in the estuary and on the fish which were examined, the samples being the same approximate proportion of the total catch. The proportion of 2.+ fish increased throughout both seasons.

As a general rule salmonids must await the availability of adequate fresh water to migrate inland (Banks, 1969). During 1974, there was a continuous movement of sea trout up the Moy, high water was frequent during the period of sampling and so daily catches, in comparison with those of 1975, were relatively small. Because of dry weather the following year river levels remained low and the fish accumulated in the estuary where daily catches were larger.

The Collections

Analysis of the age structure in the collections is shown in Table 1 from which Table 4 is derived. Percentage length frequency distribution of the sampled material is shown in Fig. 2 and length at age data are contained in Fig. 3 and Tables 2 and 3. Lengths ranged from 16.4 cm for one year old A type smolts to 23.9 cm for four year old B type fish. Regarding growth at sea, two year old smolts in at least their second post migration summer had averaged 18.6 cm at migration and 31 cm at the end of the first post-migration winter (110 readings), an increase of 67% in length. Three year smolts in at least their second post-migration summer averaged 22.2 cm in length at migration and 30.3 cm at the end of the first post migration winter (20 readings), an increase of 36.4%.

DISCUSSION

The length frequency distribution of the fish is shown in Fig. 2, the occurrence of previously spawned fish being identified. This stock closely resembles that of the Gowla fishery reported by Went in 1949. The 1974 sample which consisted of 603 fish had a mean individual weight of 0.35 kg (0.78 lbs) and the 1975 collection of 666 fish an average of 0.37 kg (0.82 lbs). Previous spawners amounted to 5% of the 1974 fish and 6.3% of the 1975 sample. In Irish, Atlantic-feeding sea-trout stocks which have been investigated to date, the average weight of sea-trout in a sample displays a fairly constant relationship to the number of previous spawners represented (Fahy, 1978b) and the Moy collections conform to this correlation. (Further details of the relationship are contained in Fahy, 1978a).

E. Fahy: Sea trout from the tidal waters of the River Moy.

In Table 1 the results of analysis are set out. Sixteen age categories are recorded from the two collections of 1,269 fish. Williams' Index of species diversity (1947) was used to describe the relationship between the number of individuals and the number of age groups in a sample. For the Moy collections, both years combined, the value of the Index (α) is 2.2. For such a large sample this reading is very low—indeed it is the lowest diversity in age categories recorded to date. Went's Gowla samples (1949) contained 16 age categories only but these were represented by a mere 420 fish ($\alpha = 3.0$), the Ilen (Went, 1957) yielded 17 age categories in a sample of 186 ($\alpha = 3.5$) and the Argideen approximately 12 (Went, 1962) in 146 fish ($\alpha = 3.0$). The Mattock samples (Went, 1956a) contained 12 age categories among 160 individuals ($\alpha = 3.0$). In the case of the Moy the period of fishing is partly responsible for the small number of age groups. Larger fish (maiden and previous spawners) are known to migrate inland as early as April and May elsewhere (Nall 1930).

The Parr Stage

Details of freshwater life are summarised in Table 2. One-year smolts formed 3.4% of the total, two 64.5%, three 30.8% and four-year olds 1.2%. The M.S.A. is therefore 2.30 years, or within the range of figures recorded during the more recent stock-assessments in Ireland, the most recent calculations from other Irish systems being 2.16, Mattock (Went, 1956a), 2.39, Cashla (Went, 1956b), 2.26, Ilen (Went, 1957), 2.42, Foyle (Went, 1958), 2.33, Burrishoole (Piggins, 1961) and 2.10, Argideen (Went, 1962). Considering all stock assessments since Nall's work in the 1930s there appears to have been a progressive reduction in mean smolt age. Where comparison is made between successive calculations on the same system, for example Waterville (Nall 1931b, Went and Barker, 1943, Fahy unpublished), there is some—generally small—reduction in the time required for the parr stage. The earliest estimates from Nall's 1931b paper were as high as 2.81 (Owenduff), 2.76 (Ballinahinch) and 2.77 (Screebe).

For the 1930s the overall average value for the various M.S.A.s is 2.66 ($N = 10$ stock assessments) 1940s, 2.38 ($N = 4$) 1950s, 2.31 ($N = 4$) and the 1960s, 2.21 ($N = 2$). A third recording for this decade, from Went (1962) and for the Bundorragha River, is high (2.73) and this alone disturbs the trend. Comparable calculations are not possible for other regions of the British Isles in which similar census work has not been carried out over so long a period (Fahy, 1978b).

Migrating salmonids may not leave their rivers directly on completion of the final parr year but may continue growth into part of another year. Such B type smolts are found in all systems which have been investigated to date. The incidence of A type smolts in the Moy—at 28.3%—is marginally higher than in any other Irish river with the exception of the Burrishoole (Piggins, 1961). As was suggested by Allen (1944) B growth is a compensatory mechanism which brings the fish to a suitable size for migration. In the Moy the B growth increment is greatest in one-year smolts (30%) and progressively decreases to 16% in four-year olds.

In Fig. 3 the length frequency distributions for the two largest smolt classes are shown. Beginning with a relatively narrow base in the first year the size range becomes progressively greater. There is a slight variation in the mean point for each class in each year which is in the majority of cases significantly different (by *t* test $P < 0.05$) (Table 3). While the reasons for it are not understood it is nonetheless noteworthy that large and small parr alternated in successive years. Among three year old smolts the first and third year parr were larger in 1975 while second year parr were larger in 1974. Among two year old smolts one year parr were the larger fish in 1974 and the smaller in 1975. Finnock contributed the vast majority (85% of two year old smolts and 93% of the three year olds) to these figures.

Growth at Sea

Marine growth was calculated for the two largest categories of maiden sea-trout, the two and three-year smolt classes.

Where it has been possible to make comparison with this parameter in other stocks a lower increment by three- than two-year smolts is fairly general. Of the other Irish populations the Moy corresponds most closely with the increments in the Foyle sea-trout (Went, 1958) and is, again, within the range of measurements for Atlantic-feeding fish. The most notably different of the Irish fisheries is the Mattock (Went 1956a) where considerable marine increments are displayed (90% for 2 year smolts); these are thought to be a consequence of better feeding in the Irish Sea.

Maturation and Mortality

A divided migration and return chart is shown in Table 4. The year of hatching for the grouped age categories of each of the collections is set out. Traditionally in assessments of sea trout stocks it has been usual to compare ages at maturation of the number of previous spawners represented in the sample. Maturation is usually estimated as the average age at first spawning. The mean age at first maturation in the Moy was 0.14 post-migration winters, a low value which is approached only by the Carrowniskey River stock

described by Nall (1931b) in which 74% of the first spawners were finnock and the mean age at first maturation was 0.26 post-migration winters. In most other cases in Ireland this mean is less than 1.0 and it is frequently in the region of 0.90.

The coefficient of total mortality, c.t.m. (calculated according to Fahy 1978b) for the Moy Stocks was 1.312. The values most frequently encountered among British and Irish material range between 0.35 and 2.30. It can be shown that there is a good correlation between the survival of the stock and its "mean age at first maturation", the longer lived populations maturing at a later age. Average values for the c.t.m. and mean age at first maturation have been calculated from data provided in the following papers: Nall, 1925, 1926a and b, 1928 a, b, c and d, 1929, 1931a and b, 1932a and b, 1933a and b, 1934, 1935, 1936a, b and c, 1938a and b, Menzies, 1920, Harris, 1970, Went 1948 to 1962, Went and Barker, 1943.

Average values for the c.t.m. correspond with the mean age at first maturation as follows:

c.f.m.	first maturation	N
0.35	1.31	2
0.51	1.02	2
0.69	1.04	10
1.02	0.95	18
2.30	0.91	12

Reading from left to right in Table 4, it will be seen that the 1974 sample consisted mainly of fish which hatched in 1972; in the 1975 collection the majority of fish had hatched in 1973. From these peaks there was a rapid decline. Table 1 shows that 28% of .1+ fish had first matured as finnock and 85% of .2+ fish had spawned for the first time as .1+ fish.

In summary then, the Moy stocks, on the basis of the material examined here, are very short-lived, a factor which explains their characteristics, well known in other Irish sea-trout populations: small size, "early maturation" and poor representation of age categories.

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Table 1. Age category composition of the Moy sea-trout collections, 1974 and 1975.

Age category	1974	1975	Totals	%
1.+	12	6	18	1.4
2.+	341	318	659	51.9
3.+	150	193	343	27.0
4.+	10	4	14	1.1
1.1+	16	7	23	1.8
2.1+	33	77	110	8.7
3.1+	10	14	24	1.9
1.+SM+		1	1	0.1
2.+SM+	17	23	40	3.2
3.+SM+	6	15	21	1.7
2.2+		2	2	0.2
1.1+SM+	1		1	0.1
2.1+SM+	5	3	8	0.6
3.1+SM+	1		1	0.1
4.1+SM+	1		1	0.1
2.+2SM+		3	3	0.2
	603	666	1,269	

Table 2. Frequencies and mean length at migration of A and B type smolts and B type growth expressed as percentage of length at end of the last winter in freshwater (parr winter).

		Smolt Age Groups				Totals
		1	2	3	4	
Composition of the collections	B type smolts	78.6	78.0	60.5	50.0	71.7%
	A type smolts	21.4	22.0	39.5	50.0	28.3%
	Number of Smolts	18	771	367	14	1,170
Lengths of smolts at migration (cm)	B type smolts	16.9	20.5	21.5	23.9	
	A type smolts	16.4	18.9	20.9	23.1	
Amount of B growth (as % length at end of last freshwater winter)		30	21	18	16	

Table 3. Lengths (cm) of sea-trout at the end of each parr winter, back-calculated from the scales of all maiden fish in the Moy collections. Separate figures are presented for each sampling year. Figures in brackets are standard deviations. n.s. = not significant.

Two year smolts (n = 771)

Length at end of:	1	2 years of age
1974	7.6 (0.92)	17.5 (2.00)
1975	7.9 (0.91)	17.2 (2.23)
<i>P</i>	<0.001	n.s.

Three year smolts (n = 367)

Length at end of:	1	2	3 years of age
1974	6.0 (0.84)	13.1 (1.21)	18.8 (1.61)
1975	6.2 (0.84)	12.8 (1.33)	19.4 (1.72)
<i>P</i>	<0.05	<0.05	<0.005

Table 4. Divided migration and return figures for sea-trout in the Moy Collections—from the data in Table 1.

% Returned in 1974 as	% Hatched in the Year						Total
	1968	1969	1970	1971	1972	1973	
Finnock			1.7	24.9	56.6	2.0	85.1
Maiden sea trout			1.7	5.5	2.7		9.8
+ SMs	0.2	0.2	1.8	3.0			5.1
TOTAL	0.2	0.2	5.1	33.3	59.2	2.0	100.0 (n = 603)
% Returned in 1975 as	% Hatched in the Year				Total		
	1971	1972	1973	1974			
Finnock	0.6	29.0	47.7	0.9	78.2		
Maiden sea trout	2.4	11.6	1.1		15.0		
+ SMs	3.2	3.6			6.8		
TOTAL	6.2	44.1	48.8	0.9	100.0 (n = 666)		

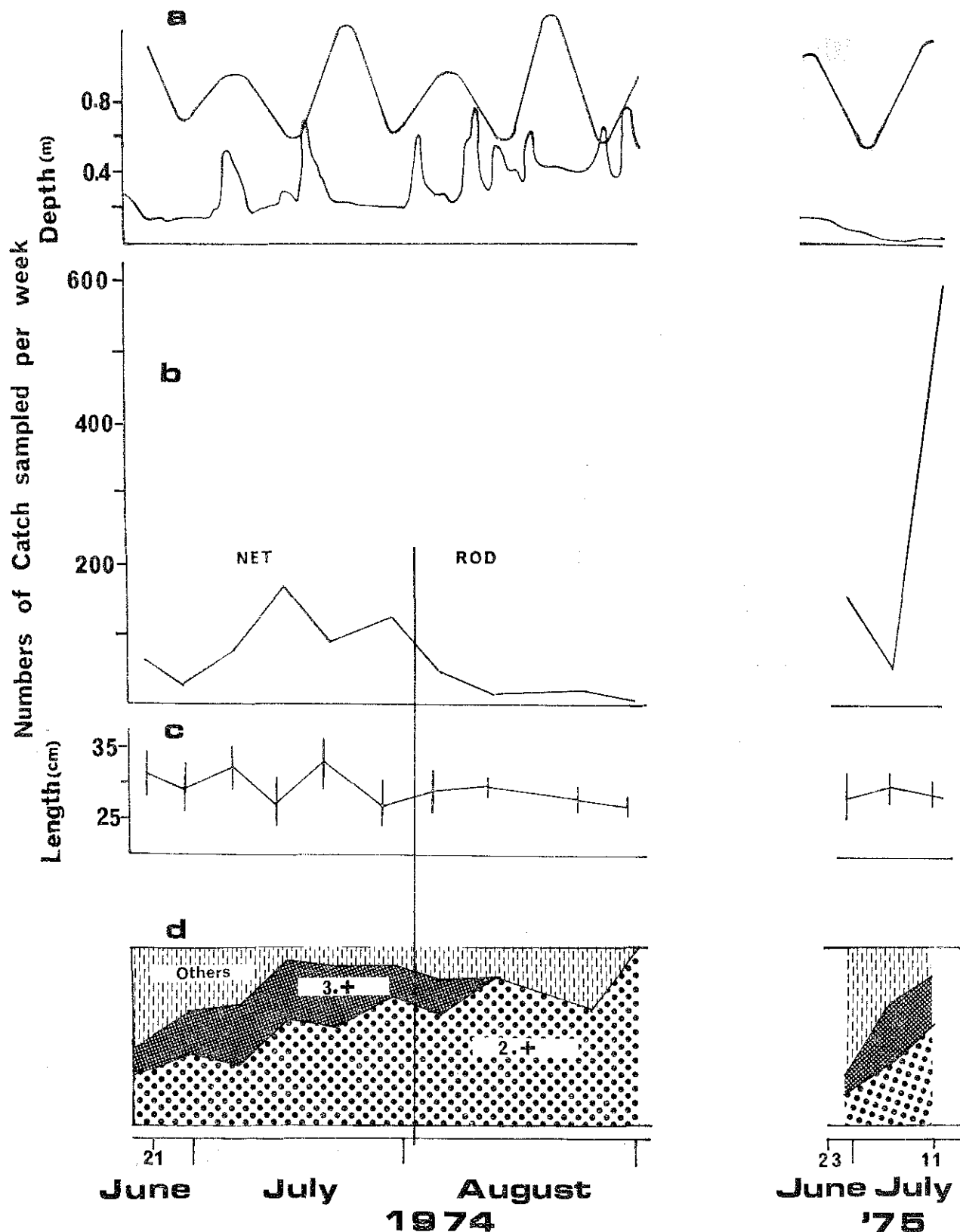


FIG. 1. Various parameters of the sampling periods :

- a: Upper line marks the tidal cycle (unscaled) as indicated by the maximum height of tide each day (from the Admiralty tide tables for Galway); below is the depth of water at the water level recorder at Rahan's House, the lowest on the Moy (Grid Reference, G. 244, 178; Zero = 5.770 m. O.D.).
- b: Numbers of sampled fish taken by net and rod each week of the sampling period.
- c: Average length of fish in sample each week. Standard deviations are shown as vertical bars.
- d: Age composition of samples; fish belonging to the largest smolt classes (the 2 and 3 year smolt finnock) are shown separately.

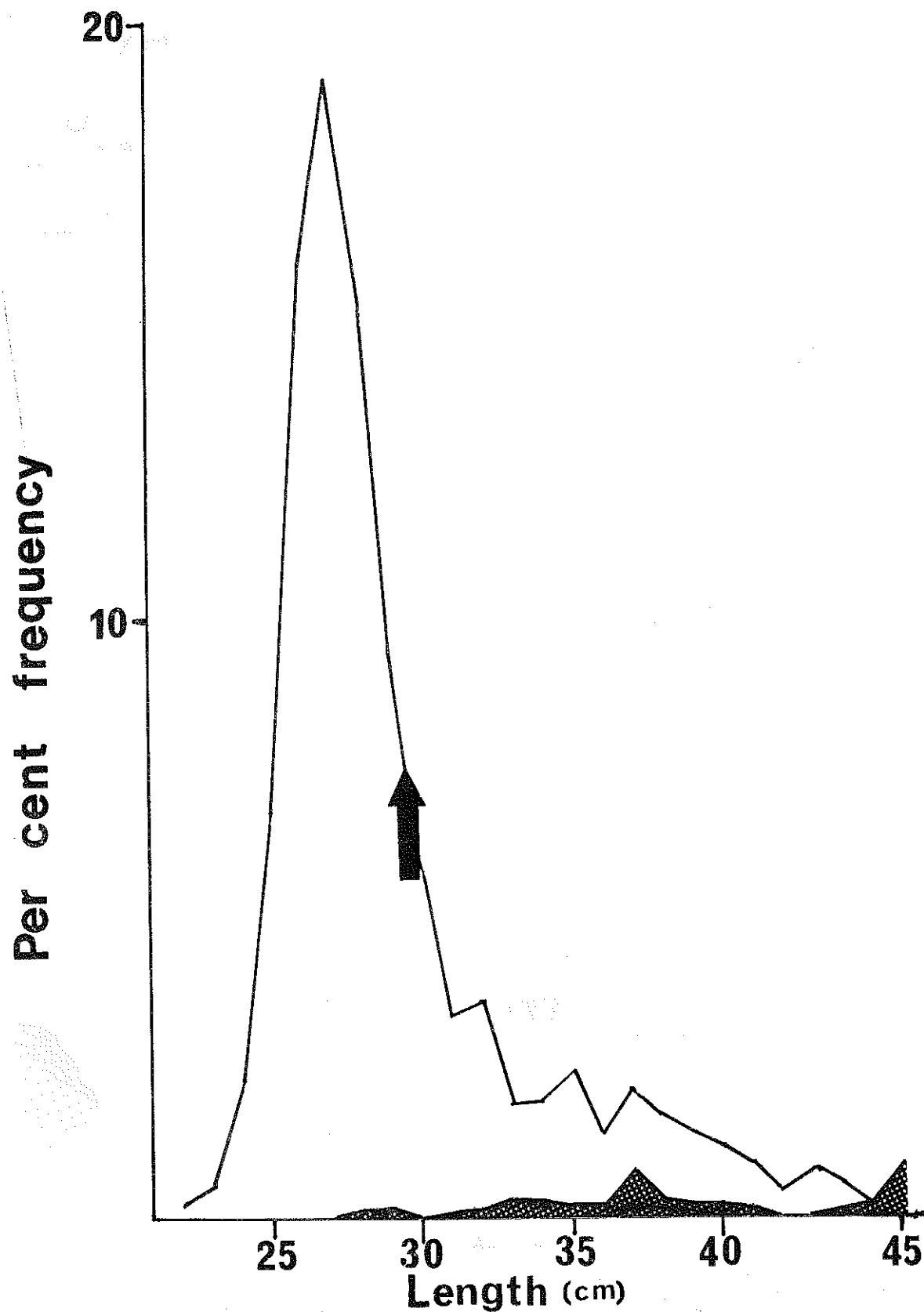


FIG. 2. Length frequency distribution of the Moy sea-trout (1974 and 1975) with previous spawners hatched. The mean length is indicated by the heavy arrow.

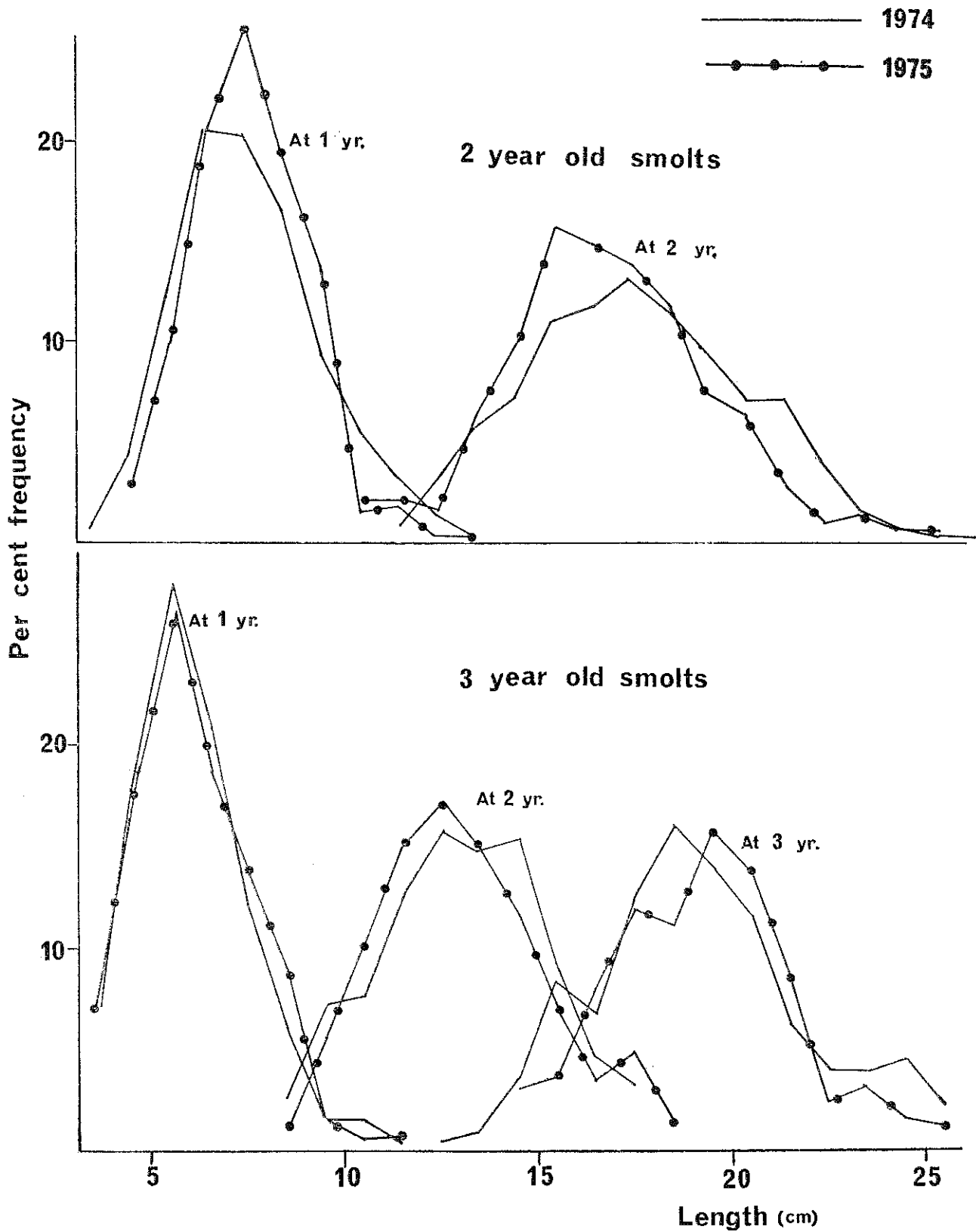


FIG. 3. Length distribution of age-groups of parr as back-calculated from scales of maiden fish with smolt ages of either two or three years.

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