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# NRA

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Biological Characteristics
and Exploitation of Sea Trout
in the River Tywi during 1989.

PL/REAU/90/10

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SUMMARY

This paper presents results from the first year (1989) of a two year project intended to assess the biology and legal exploitation of the R. Tywi sea trout stock. The study is an opportunistic exercise, taking advantage of significant sampling effort undertaken to provide both salmon and sea trout for radio tracking.

Data were obtained from estuarial commercial seine nets, and from trap nets run by NRA staff. Catch per unit effort data were collected from direct observation of 213 seine net sampling tides (729 hauls) and from 160 trap net tides. A total of 934 sea trout were recorded during sampling operations, morphometric data were obtained from 398 fish and 369 were externally tagged with floy tags.

Based on these data, age structure, condition, length/weight relationships and timing of entry of various sea age classes are described, ranging from 2.0+ maiden fish to 2.2+4SM+, with mean lengths of 320mm to 820mm respectively. Average sea age and size declined as the season progressed, with peak runs of previous spawners in April, and of maidens (mainly sea age 1+) in May.

Fish returning after one winter at sea (1+) were most abundant in the sample, and a comparison with literature values showed that Tywi sea trout are amongst the fastest growing in Britain. However it is important to recognise that 0+ and SM+ groups are under-represented in both age structures and morphometric data because of mesh selection.

1989 provided data for a year of extremely low flows. A total of 31 tagged sea trout were reported recaptured from the legal seine, coracle and rod fisheries, indicating an overall exploitation rate of 8.4% (95% confidence limits 5.7%-11.9%). Under-reporting of tags by commercial nets is not considered to be a major problem within this study; a high proportion of seine net hauls were observed directly, and radio tracking showed few unreported disappearances of tagged fish within the coracle net fishery. However tagging was biased toward large fish which are most vulnerable to commercial netting. For this reason, the exploitation estimate is considered to be a maximum value for legal exploitation on the overall stock, even though it does not take account of possible tag loss.

## 1. INTRODUCTION

Sea trout (Salmo trutta L.) occur widely in rivers and around the coast of Wales and are exploited by both commercial and recreational fisheries. The R. Tywi is nationally one of the premier game fisheries, supporting an average rod catch of over 6,000 sea trout, the largest declared catch of sea trout in any rod fishery in the United Kingdom. In addition, the fishery supports 9 seine net licences in the lower estuary and 9 coracle licences operating in the upper estuary.

Despite this importance, minimal information exists on which to base management of the Tywi sea trout stock, the only data on adults being reported commercial and recreational catches, and a sample of 350 fish described by Harris (1970). No reliable description of contemporary biological characteristics, stock abundance, or exploitation rates exists.

As a by-product of a current radio tracking studies (The Tywi Tracking Programme, Clarke and Purvis, 1989; Clarke, Purvis and Mee, 1990a; Clarke et al.,1990b.), significant numbers of sea trout have been available for examination and tagging at minimal cost. An opportunistic study was therefore undertaken to describe biological characteristics of the stock and to examine exploitation by existing legal fisheries. This report describes results from the first year of this study.

## 2. SITE OF STUDY

The R. Tywi (Fig. 1) rises at a height of 425m in an afforested and moorland region of mid Wales. It is 111 km in length, has a catchment area of 1335 $km^2$, and the head waters are regulated by Llyn Brianne. Average daily flow for the Tywi at its mouth is 45 $m^3 s^{-1}$, although in summer 1989 this fell to $2m^3 s^{-1}$. Major abstractions occur at Manorafon and Nantgaredig, the Nantgaredig abstraction supplying Carmarthen and much of the Swansea area.

Water quality is generally good (NWC class 1A), the only notable exception being the headwaters of the upper catchment (above Llandovery) which suffer from acidification (Stoner, Gee and Wade, 1984).

The Tywi estuary is 2.5km wide at its mouth in Carmarthen Bay, which is shared by the Taf and Gwendraeth rivers (Fig.2). In the lower estuary, large areas of sand are exposed at low water. Upstream the estuary rapidly narrows and, with the exception of high spring tides and high freshwater flows, the river in the middle and upper estuary is confined within well-defined banks.

The tidal regime is asymmetric, with a shortened flood period and an extended ebb period (Jonas, 1979). Tidal range at the estuary mouth is large (mean spring 6.6m, neap 3.7m), decreasing to 2.6m and 0.4m respectively 16km inland.

## 3. MATERIALS AND METHODS

### 3.1 Fish Capture

All the sea trout studied during the survey were caught in the estuary using seine and jumper nets. These are described below.

#### (a) Seine netting

The seine nets were operated by professional licensed netsmen during the 2-3 hour period of slack low water between the ebb and flood tides, from April-December. A total of 213 tides were fished in 1989 and 729 hauls examined and recorded. A 100-200m net of 10.2 cm mesh was released from the rear of the boat in a semi-circle from a fixed point on shore and carefully hauled inshore, and its contents examined for suitable fish, i.e. those which were not visibly stressed or suffering scale loss or net damage. From April - 31st June a mesh size of 10.2 cm was used on the bunt end but after this period a smaller mesh size of 5 cm was used to reduce the proportion of fish damaged by meshing and to retain smaller fish. Tagging sites are shown in Fig 2.

(b) Jumper netting

Jumper nets are fixed nets, which retain free swimming fish for removal as the tide drops away. The nets consist of a triangular trap net 2.5m high and 8m long held in position by tensioned ropes attached to timber and scaffold poles. The trap is divided into compartments angled to lead fish into a final compartment where they are retained, unable to locate the exit. The fish are lead to the trap net by a 30-50m long, 4m high wall of netting suspended between poles which stand vertically when covered by the tide.

Two or three jumper nets were used in series on the estuary bank at St Ishmael's (Fig 2), operating as a string at right angles to the tidal flow. The two uppermost nets were made of 10 cm mesh whilst the lower net was composed of a 5cm mesh.

The jumper nets were operational at all states of the tide except near low water when they became exposed. Jumper nets were used from May to August, and a total of 160 net tides were fished (one net tide being one net fished for one tide).

## 3.2. Fish handling

The fish were tagged externally under anaesthetic using 55mm plastic Floy tags. The length (mm), weight (g) and sex of all tagged fish were recorded on site. Prior to release, 2 scales were removed from an area above the lateral line near the dorsal fin to allow age estimations to be made at a later date. The presence of parasites and/or damage (e.g. wounds) were also recorded.

Fish were released after tagging by placing them facing upstream into the tidal current until they revived and swam off.

### 3.3 Scale reading and nomenclature

Ageing of fish was carried out by scale reading, following the convention Z.C+ , where Z refers to the smolt age and C is the number of post-smolt winters (which may be occupied by one or more spawning marks). The + sign denotes an incomplete year's growth (Fahy, 1978).

Thus a scale with the formula 3.0+ denotes a fish which has spent three years in the river before migrating to sea, and is returning in the same year to freshwater. This sea age class (post-smolts) is known as Whitling in Wales but elsewhere has a variety of names including; Finnock, School Peal, and Shegalls.

As a second, and more complicated example, a scale with a formula of 2.1+2SM+ denotes a fish which has spent two years in freshwater before emigrating to sea and one winter at sea before returning as a maiden fish to spawn in each of the next two winters, returning to the sea after each spawning migration. At capture it would be attempting to return for a third spawning.

In order to check reliability of scale readings, sub-samples of 25 scales were supplied to Andy Walker (DAFS, Pitlochry) and Graeme Harris (Welsh Water), who kindly agreed to check read the scales blind for us. Despite the fact that this sample included a high proportion of 'difficult' scales, good agreement was obtained, particularly for sea age where , in both instances, agreement was obtained in 24/25 cases. Following these trials, we believe our scale reading to be reliable.

## 4. RESULTS

### 4.1 Sample sizes

In the course of the sampling season, April 1989 - December 1989, a total of 934 sea trout were recorded having been captured by either seine or jumper nets (Table 1). 398 of these fish were examined in detail and sets of scales were taken. 369, (39.5% of the total catch recorded) were floy tagged.

### 4.2 Gear selection

Comparison between the two methods used demonstrates that the length distribution for all sea trout sampled were generally similar for both methods of capture (Fig.3). The increased overall proportion of fish > 55cm in the overall seine net sample reflects sampling patterns, with a higher proportion of seine net effort early in the run, when average fish size was larger. In the absence of gear-related differences between the two sampling methods, age and length data were combined for further analysis.

### 4.3 Age structure

From the 398 sets of scales, 366 were successfully deciphered for sea age, and 216 for river age, with 19 different age categories being recorded (Table 2). Maiden fish made up the greatest proportion (69.9%) while previous spawners comprised 30.1% of the sample.

Only two and three year old smolt age groups occurred in the sample, out of a total of 216 scales readable for river age. 2 year old smolts predominated (63.4%) while 3 year old smolts comprised 36.6%. The mean smolt age (MSA) was greatest for post-smolts (0+) at 2.60 while 1+ and 2+ sea maidens were the youngest with a MSA of 2.2 (Table 3). The overall MSA for the sample was 2.37.

The age at which sea trout first became mature, as indicated by the presence of one or more spawning marks upon the scales, is shown in Table 4. 68.1% of previous spawners were one sea winter maidens while 26.4%

spawned in the year of their smolt migration. The number of spawning marks on the scales showed that 76.4% of previous spawners had spawned only once and less than 6% survived a third spawning.

4.4 Abundance

The most complete set of data available to us as a measure of relative seasonal abundance is that for the seine net fishery (Fig. 4a). Relative abundance of sea trout, as indicated by catch per unit effort (CPUE) was greatest in April and May, declined sharply to a relatively low level in June, July and August, then increased again in September. A similar trend was seen in the jumper net catch data (Fig.4b, Table 5). Initially high in May, jumper net CPUE dropped rapidly until the small meshed net was introduced, subsequently showing wide fluctuations from week to week as a result of variation in post smolt (0+) catch.

Overall CPUE for both methods masks quite complex variations in abundance of individual stock components. Maidens (primarily sea age 1+) and previous spawners (mainly 1+SM+ and SM+) comprised the main early run in April, May and early June (Table 2, Fig. 5). The proportion of these age classes decreased after June, and 0+ post smolts comprised the bulk of the catch in July and August. There were approximately equal catches of the three categories in September and October. Few scales were taken after the end of floy tagging, when no attempt was made to analyse the age composition of the late run of fish in November and December.

4.5 Length/Age/Weight relationships

Previous spawners of a given sea age were noticeably shorter than maidens of the same age (Table 6). Mean length increased rapidly with age.

Weights were taken from 117 fish. The regression of log weight on log length is shown in Fig. 6, where :

$\log W = 3.128 \log L - 5.267. \quad r^2 = 0.92$

The condition factor K, for the various sea age categories (Table 7) showed there was no significant difference between the maiden and previous spawning groups of sea trout.

## 4.6 Exploitation

A total of 369 sea trout were floy tagged from 13th April to 15th October 1989 of which 31 were subsequently recaptured, an overall exploitation rate (u) of 8.4%. Treating the number of recaptures (R) as a Poisson variable, 95% confidence limits may be placed on this estimate by substituting lower and upper limits of R into the calculation of u (Ricker,1975). This gives 95% limits on the overall figure of 5.7 - 11.9 %. Although the number of recaptures is relatively small when divided on a monthly basis, monthly exploitation rates have been calculated for each method and for all methods combined (Table 8), with confidence limits calculated for the combined method figures. Despite the small numbers of recaptures, a clear trend emerges, with the highest recapture rates (15.6% and 17.5%) occurring on fish tagged in April and May. Low exploitation rates were recorded from fish tagged in June, July and August.

# 5. DISCUSSION

## 5.1 Gear selection and sample bias

Comparison of catches pre- and post-introduction of small mesh bunts into seine nets indicates that the legal size of 4" stretched knot to knot of seine nets enables fish of less than 450mm (1.1 kg) to escape. The catch of fish smaller than 450mm increased after the introduction of small meshes in both jumper and seine nets (Fig.5), although fish of this size were predominantly sea age 0+ post-smolts, many of which do not enter the river until after July (Pratten & Shearer, 1983; Harris, 1970; Piggins, 1975).

## 5.2 Abundance

Peak CPUE occurred in April and May, then declined in June and July despite increased effort (Figs. 4,5). This drop in estuarial catch was probably exacerbated by low, falling flows and subsequent drought conditions throughout the summer (Clarke, Purvis and Mee, 1990a). The early peak of these data suggests that a part of the run may have entered the river prior to commencement of sampling.

The timing of the run of sea trout in the Tywi is earlier than that reported in previous studies. Harris (1970) found few fish were caught in March and April and sea trout did not enter the Dyfi in appreciable numbers until May, the run building up to a peak in July and August and then slowly declining. Runs in the North Esk (Pratten & Shearer, 1983) and sea trout in the Burrishoole systems (Piggins, 1975) follow a similar pattern to Harris' results. This may reflect a relatively low proportion of post-smolts in our data; possibly as a direct result of drought, or as a result of gear selection.

The increase in sea trout catch/effort recorded by the seine nets operating for experimental purposes after the normal netting season is particularly interesting. The majority of these fish were fresh run, 'silver' fish, although kelts and diseased fish, apparently leaving the river, were also present. Whilst it is possible that this may partly reflect delayed entry, as a result of the dry summer, similar results were observed in the wet year of 1988 (NRA, unpublished data), thus suggesting that a late run of 'fresh' sea trout does occur.

## 5.3 BIOLOGICAL CHARACTERISTICS

### 5.3.1 Age Structure

A total of 19 age categories were present in the sample (Table 2), considerably less than the 28 reported by Harris (1970), although Harris' sample was taken over three seasons. The great majority of the fish sampled were maiden sea trout which had spent two or three years in freshwater followed by an additional year at sea. The dominant sea age groups were the 0+,1+, and 1+SM+ groups. Although the data indicate that sea age 1+ are most abundant, it is likely that the post-smolt (0+ sea age) group were undersampled and that these could be the dominant sea year group in the Tywi.

Only fish which had smolted as two and three year olds were found in the sample, with a mean smolt age of 2.37. This is significantly higher than that of 2.03 quoted for Welsh stocks (Fahy, 1978) and that found in the R. Morlais, Afan and Ogmore (FTUS, 1983) although almost identical to the value of 2.31 reported for the Tywi by Harris (1970).

The evidence from fish which exhibited multiple spawning marks suggests that once maturity is reached Tywi sea trout spawn annually, a result consistent with studies of other stocks (Lamond, 1916; Nall, 1930; Pratten & Shearer, 1985).

The proportion of the sample which bore spawning marks was 30.1% whilst 69.9% were maidens. Few sea trout survived a third spawning (less than 5.5% of previous spawners were returning for the fourth time) a value significantly lower than the 14.7% for the Tywi observed by Harris (1970). Although this may reflect a decline in spawning/sea survival since 1970, the result could also reflect sampling bias if a significant proportion of large multiple spawners entered prior to commencement of sampling. The proportion of previous spawners is however similar to that quoted for other rivers in Wales (Harris, 1970; FTUS, 1983), and is comparable with recent data for other systems. In Scotland, Walker (1984) and Shearer and Pratten (1983) found that only 5.1% and 2.7% respectively of samples from the Findhu Glen and North Esk survived for a third spawning. In Ireland, Fahy and Nixon (1982), and Fahy (1984) found values ranging from nil to 10.5%.

5.3.2 <u>Growth rates</u>

When compared to published data on European sea trout stocks (Went, 1957; Pratten & Shearer, 1983; Harris, 1970; Nall, 1930; Fahy & Nixon, 1982), Tywi sea trout are among the largest and are comparable with those of the Tweed which are noted for their fast growth (Table 6). Although the average size attained is initially greater for post smolts and 1+ maidens in the Tywi, 2+ maidens are of similar size to those in the Dyfi, Coquet and Tweed. Care should however be taken when comparing these figures. Harris (1970) found that the average length of sea trout in the Dyfi had increased since Nall's study 40 years earlier and it is quite possible that growth rates have again changed in the past 20 years. Unfortunately more recent data from investigations in South West Wales on the Marlais, Afan and Ogmore

(FTUS, 1983) categorises the mean lengths of fish into sea years ,combining data from maidens and previous spawners and makes comparisons of sea growth impossible.

It can be seen that early maturation reduces the maximum 'attainable' size of the fish, i.e. if a fish matures later in life it is more likely to attain a greater size (Fig. 7). Nall (1930) found 'the retarding influence of spawning on growth' to be far less marked, only "a few ounces to half a pound" over three winters, in most Scottish rivers. The marked decrease in length of fish maturing earlier in the Tywi could be attributed to the high growth rates of maiden fish over the first and second winters at sea.

5.3.3 Length/Weight

In comparison to other studies (Fahy, 1984; Pratten & Shearer, 1985) Tywi sea trout were found to be relatively heavy for a given length. This is reflected in the condition factor (Table 2), and in the length/weight regression (Fig. 6).

5.3.4 Sex ratios

A notable feature of the sea trout sample was the dominance of females, producing an overall sex ratio of 1 male : 2.9 females. This characteristic has been noted in most populations of sea trout, and may be a result of differential migration tendencies between the sexes, only a small proportion of males migrating to the sea, (LeCren, 1985; Pemberton, 1976) or a higher mortality rate at spawning (Campbell, 1977).

The figure for the Tywi obtained in this study is significantly higher than that found by Harris (1970) of 1 male : 2.012 females. The probable cause for this was the different methods employed for sex determination. As fish were returned unharmed to the estuary, the sex of the fish was determined on external features i.e. head shape. It was however impossible to determine the sex of post-smolts as secondary sex characteristics had not formed and these fish were classed as not known. There is a tendency for male migrants to return at a younger age than females, and the sex ratio of post-smolts to be similar i.e. 1:1 for a number of Welsh and Scottish stocks (LeCren,1985). It is therefore likely that the overall sex ratio of the Tywi sea trout is less than that measured in this sample.

## 5.4 Tagging and Exploitation

The figures cited here refer to reported exploitation; we cannot know from floy tagging the proportion of unreported recaptures. However evidence from radio tracking suggests that reporting rates are high within the coracle fishery, with few fish disappearing in this zone without being reported as recaptures (Clarke, Purvis and Mee, 1990a). Similarly catches from 213 man-tides and 729 hauls were directly observed in the seine net fishery, effectively ensuring high return rates. Recapture rates within the rod fishery cannot be directly examined, but positive efforts have been made to inform rod fishermen of the studies, and detailed letters are returned to all anglers returning tags, describing the fish's history.

From all tagged fish 8.4% (95% limits 5.7 - 11.9%) of the sample were reported as having been recaptured (Table 8). This overall figure hides monthly variation; exploitation was significantly higher on fish tagged in April/May, with a maximum of 17.5 % (upper 95% statistical limit 28%) in May. This monthly variation principally reflects variation in fishing effort by commercial nets, which, as might be expected, is maximised in May, when peak abundance of the larger fish occurs. This estimate is not corrected for tag loss and non-reporting of tags. However it is still probable that both overall and peak figures represent over-estimates of true exploitation, primarily because the majority of the run comprises small fish, which escape through the meshes of commercial nets. These fish were substantially under-represented in our tagging because of gear selection, thus increasing the proportion of larger more vulnerable fish in the tagged sample, and hence biasing the exploitation estimate upwards. The figures may therefore be viewed as 'worst-case' and are a safe basis for evaluating exploitation levels.

The fact that no commercial exploitation was recorded in July and August reflected the very low catches of sea trout and low river levels at this time. There was no evidence of increased exploitation by these licensed methods during low flows as only one recapture was reported from the last 65 fish tagged (28% of the sample) by nets.

As with the net exploitation the early run sea trout in April and May were exploited to the greatest extent by rods with few reported recaptures of fish tagged from June onwards. The average time between tagging and recapture by rods was 49 days with a maximum of 94 days. The overall exploitation figure of 3.0% is low and may reflect the angling conditions in the 1989 season. Most recaptures were of fish caught by fly fishing at night, a method known to work well in low water conditions. Piggins (1975) found in a five year appraisal of the Burrishoole system that rod exploitation was greatly reduced during warm weather with low flows.

Thus no evidence of over-exploitation by either legal net or rod fisheries in low flows was evident from this study. Evidence within season, together catch records, suggests that fishery success may in fact be reduced in salmonid fisheries, as a result of fish dropping back to sea, or not entering the estuarial fishery zone at all (Clarke et al, 1990b). However this could result in a substantial increase in exploitation or damage within offshore fisheries targetted at other species, a cause of some concern (Gardner, 1990).

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TABLE 1

NUMBER OF SEA TROUT SAMPLED 1989

| MONTH | SEINE CATCH | JUMPER CATCH | NUMBER TAGGED |
|---|---|---|---|
| April | 136 | 0 | 31 |
| May | 196 | 51 | 97 |
| June | 188 | 65 | 108 |
| July | 90 | 44 | 65 |
| August | 37 | 19 | 32 |
| September | 25 | 0 | 19 |
| October | 44 | 0 | 17 |
| November | 32 | 0 | 0 |
| December | 7 | 0 | 0 |
| Total | 755 | 179 | 369 |

TABLE 2

SEA AGE BY RIVER AGE

| RIVER AGE | 2 | 3 | UNREADABLE | TOTALS |
|---|---|---|---|---|
| Sea Age | | | | |
| 0+ | 21 | 31 | 37 | 89 |
| 1+ | 74 | 20 | 69 | 163 |
| 2+ | 4 | 0 | 0 | 4 |
| 1+SM+ | 25 | 9 | 27 | 61 |
| 1+2SM+ | 5 | 3 | 3 | 11 |
| 1+3SM+ | 0 | 2 | 0 | 2 |
| 1+4SM+ | 1 | 0 | 0 | 1 |
| 2+SM+ | 2 | 1 | 2 | 5 |
| 2+4SM+ | 0 | 0 | 1 | 1 |
| SM+ | 4 | 8 | 6 | 18 |
| 2SM+ | 0 | 5 | 4 | 9 |
| 3SM+ | 0 | 0 | 1 | 1 |
| 5SM+ | 1 | 0 | 0 | 1 |
| TOTAL | 137 | 79 | 150 | 366 |

TABLE 3

MEAN SMOLT AGE (MSA) FOR RETURNING ADULTS 1989

| SEA AGE | MSA |
|---|---|
| Post-Smolts (0+) | 2.60 |
| Maidens (1+, 2+) | 2.20 |
| Previous Spawners | 2.42 |
| Overall | 2.37 |

TABLE 4

AGE AT FIRST MATURITY

| AGE AT MATURATION | NUMBER | PERCENT OF SAMPLE |
|---|---|---|
| 0+ (=SM+) | 29 | 26.36 |
| 1+ | 75 | 68.18 |
| 2+ | 6 | 5.45 |
| TOTAL | 110 | 100.00 |

TABLE 5

MONTHLY CATCH AND CPUE FOR 1989 JUMPER NETS

| MONTH | NUMBER OF FISHINGS | CATCH | NUMBER OF NET TIDES | CATCH PER NET TIDE |
|---|---|---|---|---|
| May | 11 | 51 | 26 | 1.96 |
| June | 23 | 65 | 69 | 0.94 |
| July | 15 | 44 | 45 | 0.98 |
| August | 12 | 20 | 20 | 1.00 |

TABLE 6

SEA AGE CATEGORIES AND MEAN LENGTHS FOR 1989 SEA TROUT

| NUMBER OF SEA WINTERS | AGE CLASS | NUMBER | MEAN LENGTH MM | MAXIMUM | MINIMUM | STANDARD DEVIATION |
|---|---|---|---|---|---|---|
| 0 | 0+ | 89 | 320 | 430 | 210 | 39.28 |
| 1 | SM+ | 18 | 460 | 545 | 395 | 39.68 |
| | 1+ | 163 | 530 | 620 | 370 | 42.20 |
| 2 | 2SM+ | 9 | 550 | 605 | 505 | 31.67 |
| | 1+SM+ | 61 | 595 | 720 | 500 | 48.36 |
| | 2+ | 4 | 635 | 650 | 620 | 13.17 |
| 3 | 3SM+ | 1 | 590 | | | |
| | 1+2SM+ | 11 | 680 | 700 | 535 | 48.29 |
| | 2+SM+ | 5 | 680 | 725 | 610 | 43.16 |
| 4 | 1+3SM+ | 2 | 630 | 630 | 630 | 0.00 |
| 5 | 5SM+ | 1 | 660 | | | |
| | 1+4SM+ | 1 | 720 | | | |
| 6 | 2+4SM+ | 1 | 820 | | | |

TABLE 7

CONDITION FACTOR K FOR 1989 SEA TROUT

| SEA AGE GROUP | NUMBER SAMPLED | MEAN | STANDARD DEVIATION |
|---|---|---|---|
| Maidens | 52 | 1.042 | 0.147 |
| Previous | 51 | 1.030 | 0.105 |
| All sample | 117 | 1.039 | 0.127 |

Condition factor K = Weight/(Length **3 * 0.0118203)

TABLE 8

EXPLOITATION OF SEA TROUT 1989 FOR ALL METHODS

| MONTH | NUMBER TAGGED | COASTAL WADE NETS | SEINE NETS | CORACLE NETS | RODS | TOTAL % EXPLOTIATION 95% CONFIDENCE LIMITS |
|---|---|---|---|---|---|---|
| April | 31 | 0(0) | 1(3.2) | 2(6.5) | 2(6.5) | 15.6 ( 5.2 - 37.7) |
| May | 97 | 2(2.1) | 4(4.1) | 7(7.2) | 4(4.1) | 17.5 (10.2 - 28.0) |
| June | 108 | 0(0) | 1(0.9) | 3(2.7) | 2(1.9) | 5.5 ( 2.0 - 12.1) |
| July | 65 | 0(0) | 0(0) | 0(0) | 1(1.5) | 1.5 ( 0.2 - 8.6) |
| August | 32 | 0(0) | 0(0) | 0(0) | 2(6.3) | 3.1 ( 0.6 - 22.5) |
| September | 19 | | | | 0(0) | 0.0 ( 0 - 19.4) |
| October | 17 | | | | 0(0) | 0.0 ( 0 - 21.8) |
| Total | 369 | 2(0.6) | 6(1.8) | 12(3.6) | 11(2.98) | 8.4 ( 5.7 - 11.9) |

Figures in partheneses are percentages.

FIG.1 TYWI CATCHMENT

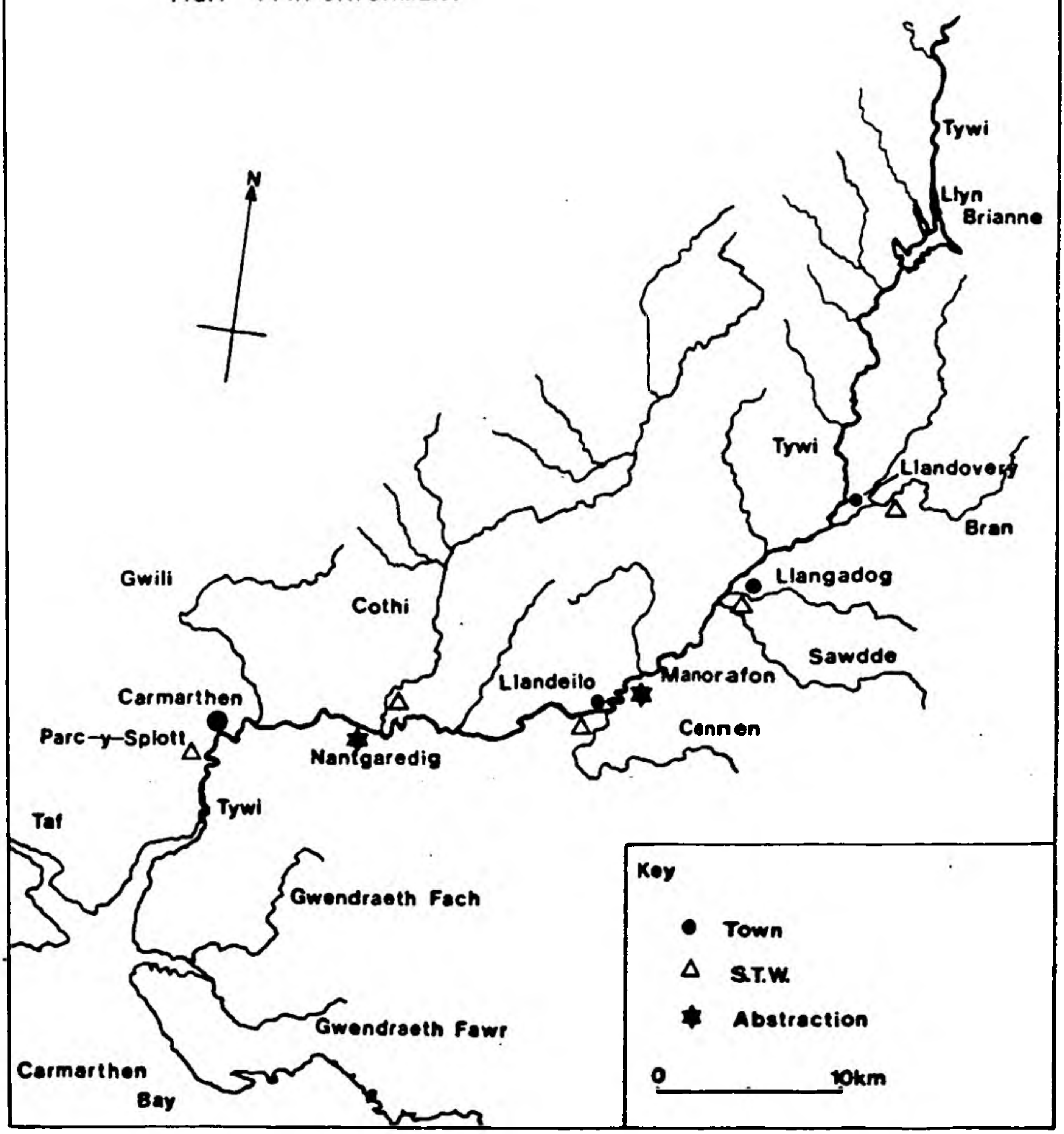

Fig 2.

# TYWI ESTUARY

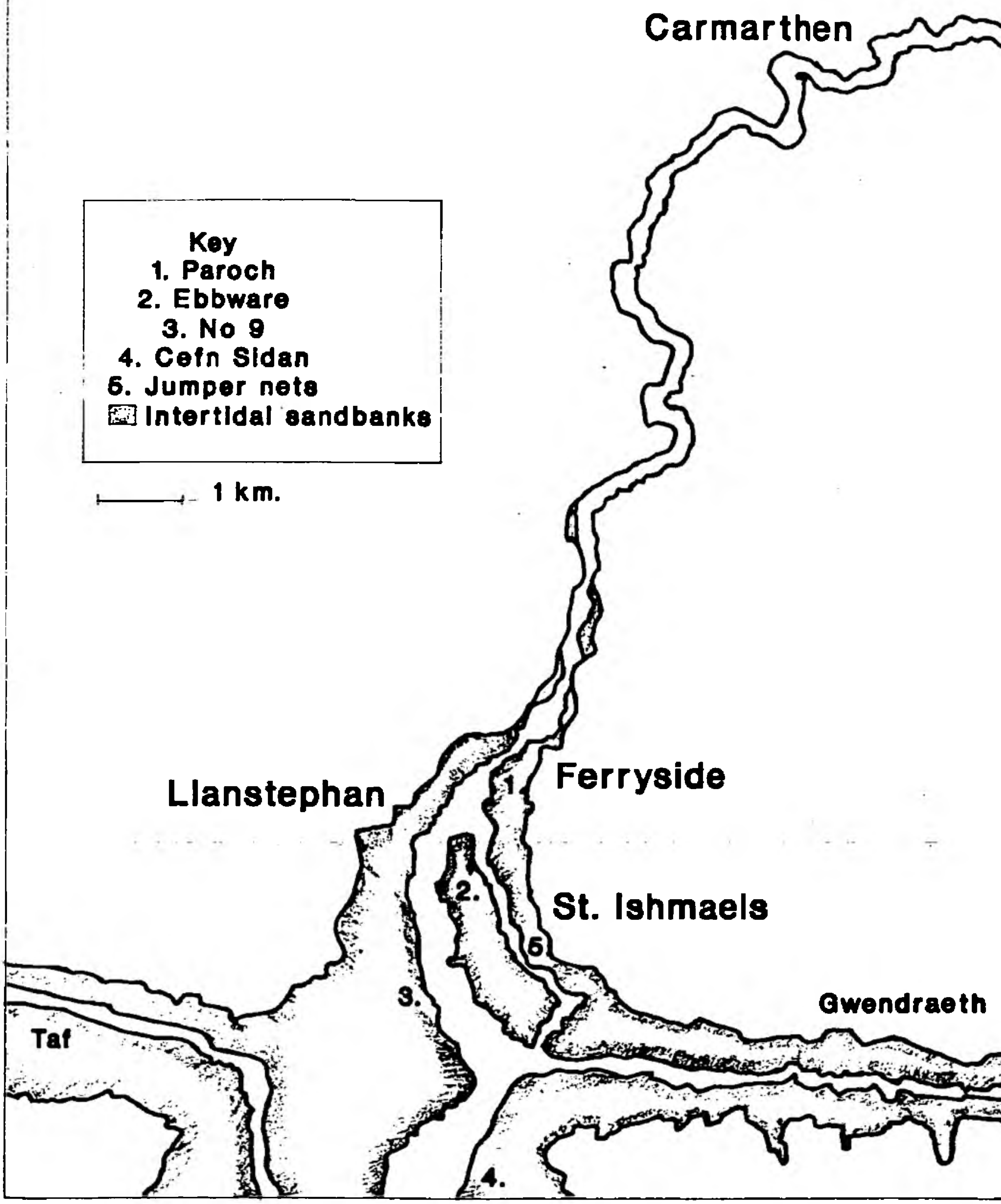

Fig 3. Length Distribution of Sea Trout for Seine and Jumper nets.

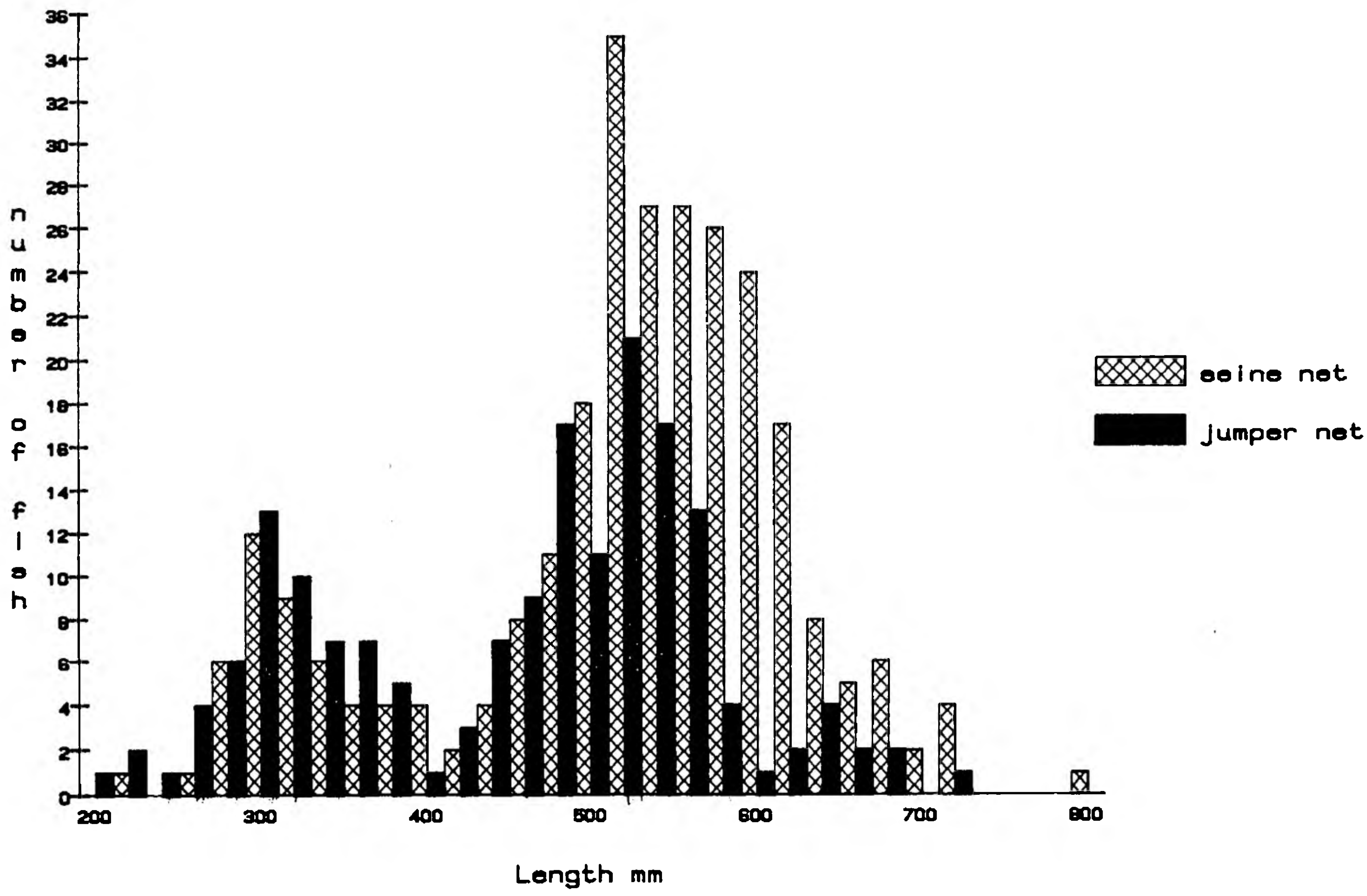

Fig 4a. Weekly CPUE for Seine Nets 1989

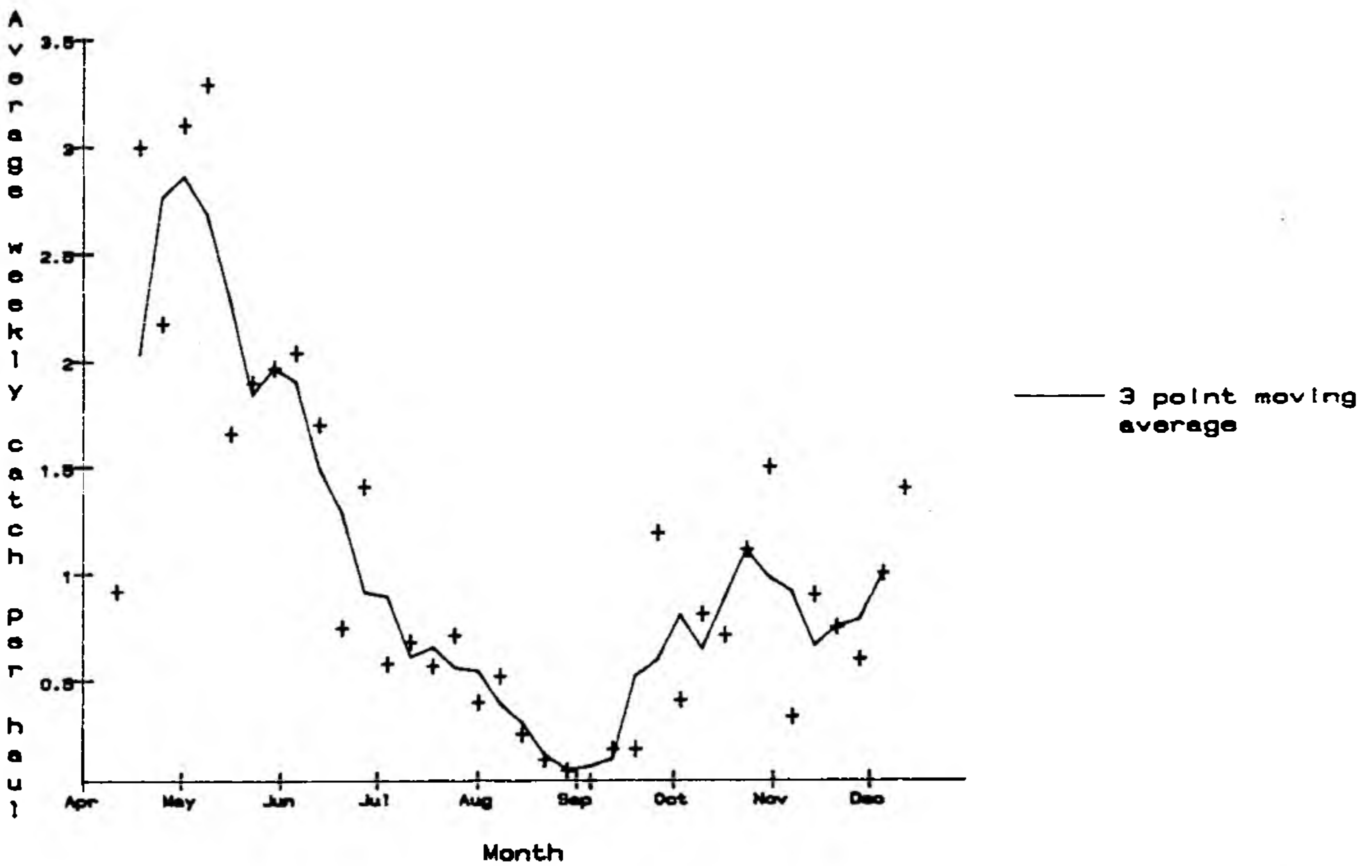


Fig 4b. Jumper Net Weekly Catch per Net Tide for Sea Trout.

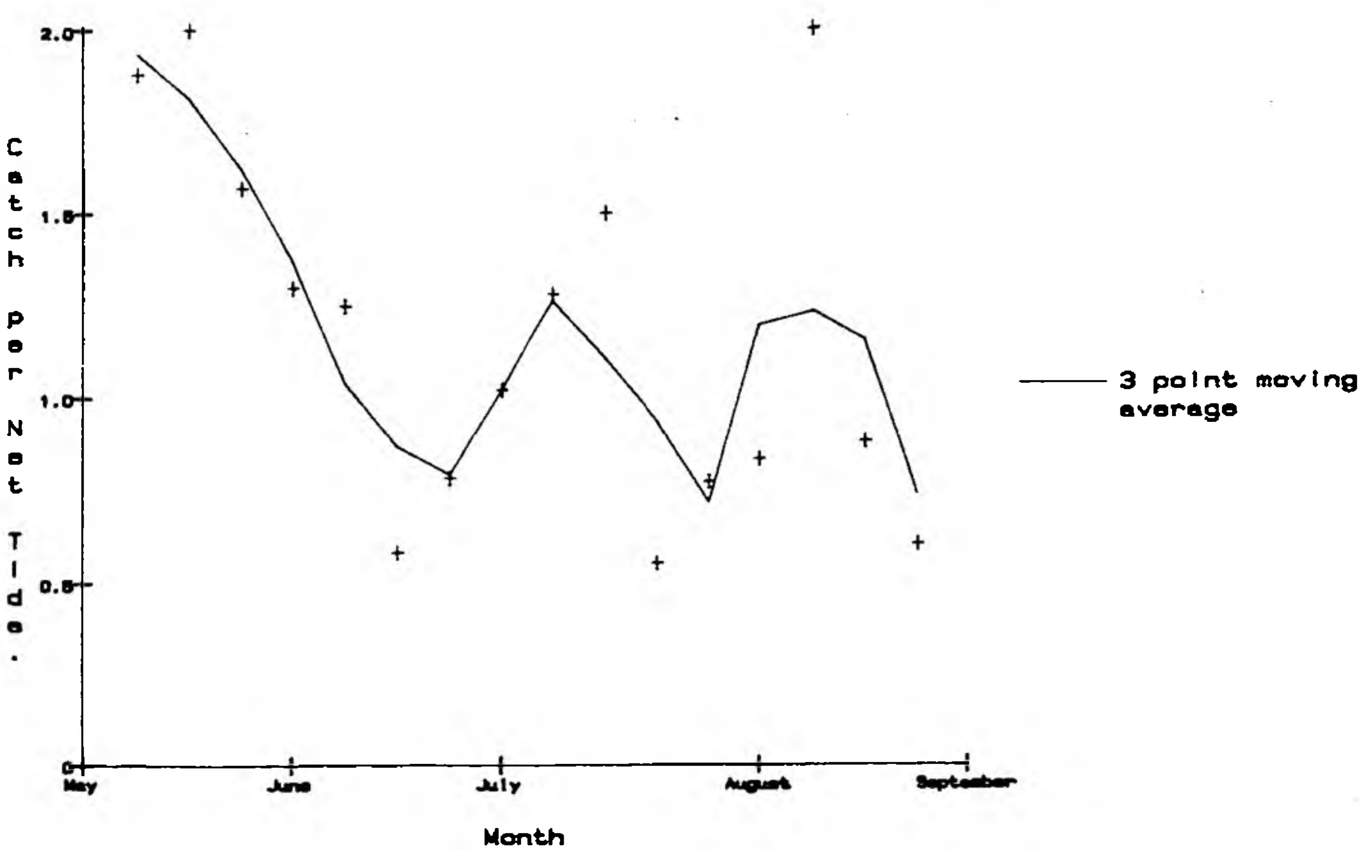

Fig 5. CPUE for Sea Age Categories from Seine Nets.

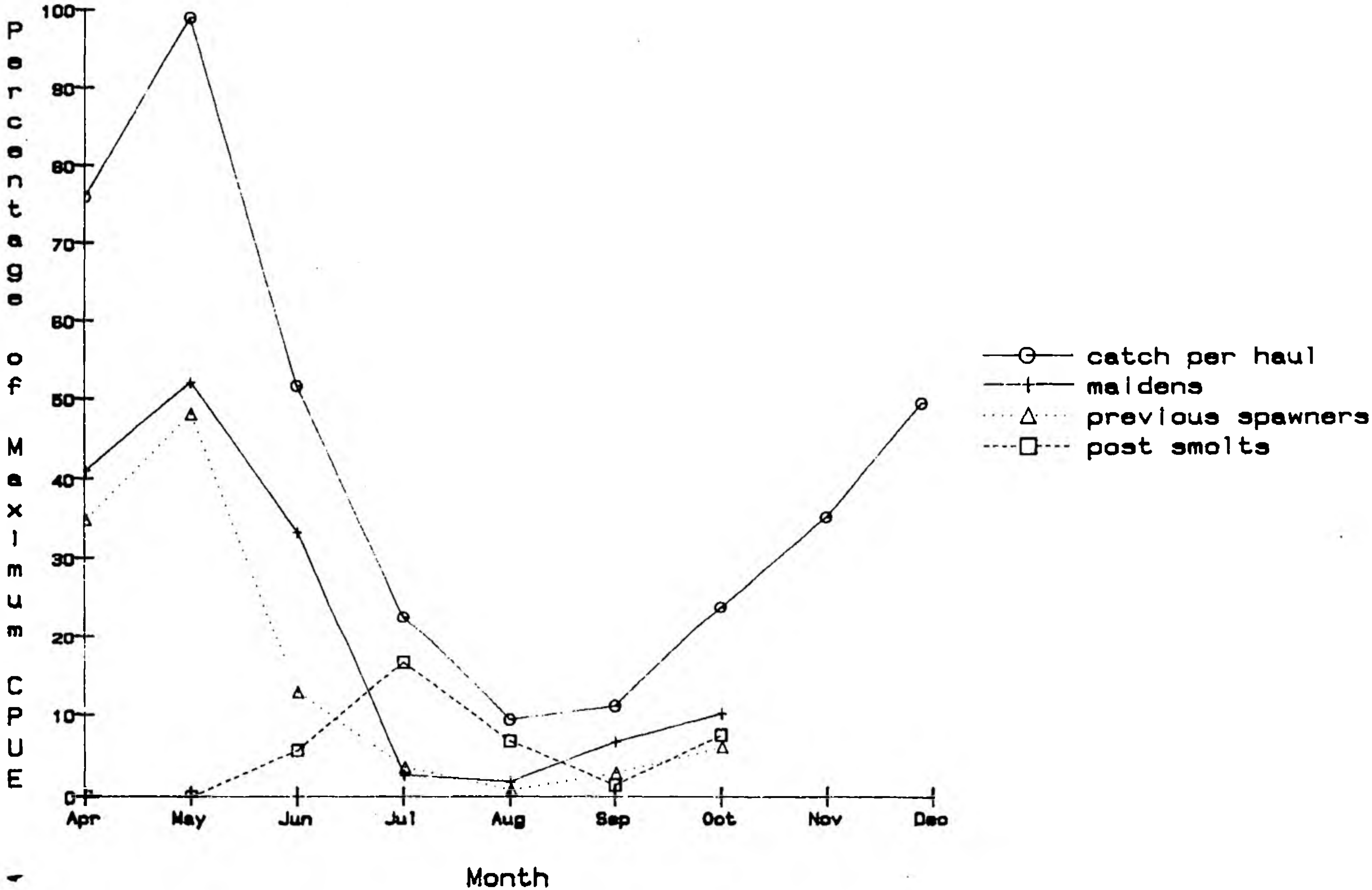

Fig 6. See Trout 1989 Log Length vs Log Weight

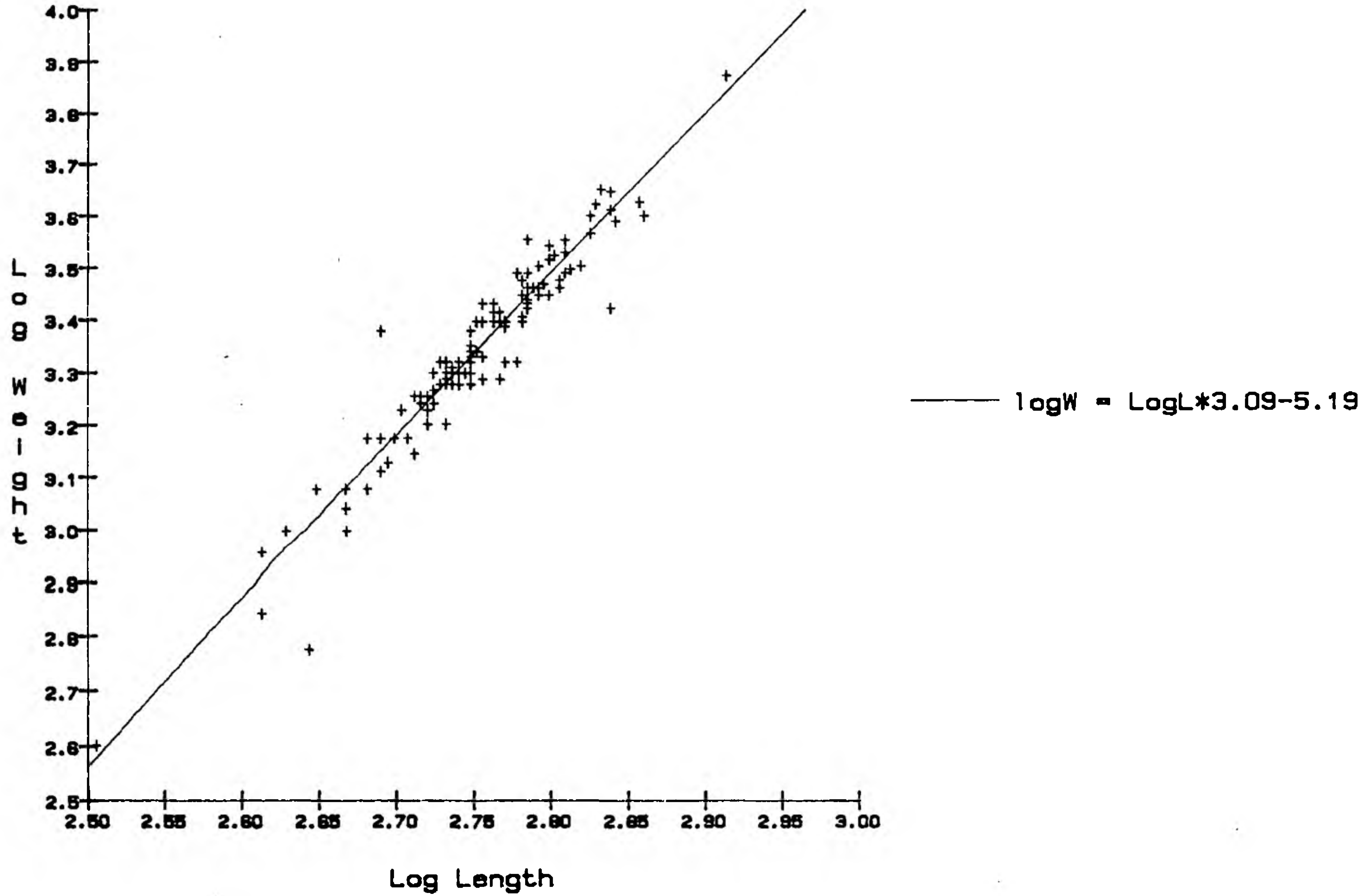

Fig 7. Effect of Maturity on Length at Age.