NATIONAL RIVERS AUTHORITY
AWDURDOD AFONYDD CENEDLAETHOL

WELSH REGION
RHANBARTH CYMRU

Use of telemetric tracking to examine environmental influences on catch/effort indices. A case study of Atlantic Salmon (Salmo salar L.) in the R. Tywi, S. Wales

NRA

Guardians of the Water Environment
Diogelwyr Amgylchedd Dŵr

Use of telemetric tracking to examine environmental influence on catch effort indices. A case study of Atlantic Salmon (*Salmo salar* L.) in the R. Tywi, S. Wales.

Abstract

A case study of Atlantic Salmon runs into the R. Tywi (S. Wales) is presented.

Radio tracking of over 200 salmon in 1988 and 1989 has demonstrated that flow is an important factor in modifying both run timing and migratory success. Entry of salmon into the river is typically in response to flow events, and periods of low falling flows delay entry and may directly result in reduced runs into the river. Delayed entry may also increase the proportion of the run migrating after the end of both rod and net fishing seasons.

The implications of these results for net and rod catch and catch/effort data are discussed, using both statutory reported catch data and data from specific catch/effort studies. Flow is demonstrated to be a dominant factor in determining the within-season distribution of rod catch and catch/effort during low-flow years. Estuarial seine net catch and catch/effort tend to be controlled more by time of return than by flow, although low flows may delay runs. Annual reported rod catch is correlated with flow, which controls in season availability, catchability and consequently the amount of fishing effort. Use of catch or catch/effort data should take account of inter-year variations in flow and other environmental factors. Although catch and catch/effort are valuable indicators of fishery performance, they are inadequate to represent changing stock levels.

Authors - D. Clarke, W.K. Purvis and D. Mee (UK).

I. Introduction.

Data on salmonid fisheries is often restricted to reported catch or catch/effort data, primarily because of the cost and practical difficulty involved in direct sampling. While many authors have identified the limitations inherent in salmonid catch data (eg Harris, 1988; Shearer, 1988), in the absence of alternative information, catch/effort data is often accepted as a reliable indicator of relative stock abundance, both within and between years (Beverton and Holt, 1957; Ricker, 1975; Small and Downham, 1985; Prouzet and Dumas,1988). Since catch/effort is a function of both abundance and catchability (Gulland, 1969; Bunt, 1990), use of catch per effort in this way assumes constant catchability.

The influence of flow on upstream migration and catches of salmonids has long been recognised (Huntsman, 1948; Hayes, 1953; Millichamp and Lambert, 1966; Banks, 1969; Alabaster, 1970; Gee, 1980). These authors have examined catch and catch/effort statistics in relation to flow statistics, demonstrating significant effects of flow in most situations. However data has not been available which allows the mechanism of these relationships to be examined; in particular it has not been possible to distinguish between variations in abundance and catchability.

During the summers of 1988 and 1989, the National Rivers Authority (NRA) undertook a detailed behavioural study of salmonid migration within the estuary and freshwater reaches of the R. Tywi in South Wales, involving telemetric tagging and tracking of more than 200 Atlantic Salmon (*Salmo salar* L.). As part of this work, detailed catch and effort data have been recorded within both net and rod fisheries, and longer term catch data are also available from 1960. This paper examines the relationships between salmon behaviour and catch, particularly the availability of fish for capture within net and rod fisheries.

II. The Tywi system

(a) Freshwater

The R. Tywi (Fig. 1) rises at a height of 425m in an afforested an moorland region of mid-Wales. It is 111km in total length, and has a catchment area of 1335 km^2. Average daily flow for the Tywi at its mouth is $45m^3s^{-1}$, although in 1989 minimum flows were as low as $2m^3s^{-1}$. A regulating reservoir, Llyn Brianne, exists in the upper catchment and abstractions occur at Manorafon and Nantgaredig, the latter supplying Carmarthen and much of the Swansea area.

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

(b) The estuary

The estuary (Fig. 2) is shallow, well mixed and tidally influenced for an upstream distance of up to 20 km from the sea. The lower estuary is 2.5 km wide at the mouth, and is shared with the smaller Taf and Gwendraeth catchments. Further upstream the estuary narrows rapidly, and the upper estuary, upstream of Green Castle, is generally less than 50m wide at high water. Tidal range is large (6.6m on spring tides) and the tidal regime is asymmetric, with the flood tide period shorter than the ebb.

(c) Fisheries

The Tywi is a nationally important salmon and sea trout rod fishery, with an average declared salmon rod catch in excess of 900 per annum since 1983 and a declared annual sea trout (*Salmo trutta* L.) rod catch averaging more than 6000. The river also supports commercial salmon and sea trout net fisheries, with 8 seine nets licensed in the lower estuary and 9 coracle nets in the upper estuary (Fig 2).

III. Material and Methods

(i) Catch statistics.

Long term catch data were obtained for the period 1960 to 1988 from statutory returns. Within seasons, data were obtained from 2 sources :

(a) A specific angler census; the example given in this paper, for 1986, comprises data from 208 anglers who returned detailed logbooks reporting on 8257 fishing hours.

(b) Seine net catch per haul data for 1988 and 1989. This represents data from 239 hauls (60 fishing sessions) in 1988 and 729 hauls (213 fishing sessions) in 1989. These data were recorded by NRA staff as hauls were observed for tagging purposes.

(ii) Tagging and Tracking

(a) Tagging

Salmon were captured using either jumper nets or seine nets in the estuary downstream of Ferryside (Fig 2). Both these methods were used because they provide free-swimming, undamaged fish for tagging. Following the end of the normal fishing season on 31st August, a dispensation was obtained allowing two of the crews to catch fish for scientific purposes during the period September to December.

Salmon, undamaged by the capture process were selected for tagging, and immediately transferred to a handling bag where they were anaesthetised using 100 ppm 2-phenoxy ethanol. Once anaesthetised, the fishes sex and fork length were recorded, and a scale sample (2 scales) taken. Radio tags or Combined Acoustic and Radio Tags (CART) were then inserted into the stomach via the oesophagus, using methods similar to those described by Solomon and Storeton-West (1983). Fish were also externally tagged with orange Floy anchor tags. Following the tagging procedure, each fish was individually held until it was sufficiently recovered to maintain station and swim actively.

Both radio tags and CART's used were of standard Ministry of Agriculture Fisheries and Food (MAFF) design, operating on radio frequencies between 173.805 MHz and 173.850 MHz (Solomon and Potter, 1988). These tags are individually identifiable, and have a design life of 6-9 months, depending on pulse rate.

(b) <u>Tracking</u>

The tags were used in conjunction with 6 acoustic buoys and 36 Automatic Listening Stations (ALS) of MAFF design (Solomon and Potter, 1988). Estuarial acoustic buoys and ALS sites covered the upper estuary, the lowest unit being at Green Castle in 1988 and at Ferryside in 1989 (Fig. 2). In freshwater, ALS units were sited on major tributaries and at points roughly equidistant along the length of the main river.

To obtain information on the movement of fish between scanner sites, fish were actively located using a Yaesu FT290 receiver from a small inflatable dinghy. Tracking was conducted between Llandeilo and Carmarthen at least once per week between July and December inclusive. Less frequently, the area between Llandeilo and Llandovery was tracked. In addition active tracks were undertaken on 12th and 13th November 1988 and on 1st August, 18th and 20th November and 19th December 1989 from a small commercial aircraft. In this way, a large area, including major catchments outside the Tywi, was searched.

(iii) <u>Flow data</u>

Hydrological data used in this paper were obtained from Welsh Water/NRA gauging stations at Ty-Castell (1960 - 1982) and Capel Dewi (post 1982). These stations gauge approximately 90% of discharge to the estuary.

IV. Results

(i) Flows in 1988 and 1989

High rainfall throughout the summer of 1988 maintained abnormally high base flows during the period June-September (mean $46 m^3 s^{-1}$). These were followed by a period of unusually dry weather in the autumn and winter. In contrast drought conditions (mean flow $6.1\ m^3 s^{-1}$) prevailed until October 1989 (Fig 3.), with the exception of three small artificial freshets in July-September and a natural freshet in early September.

(ii) Behavioural data

(a) Sample size and bias

Behavioural data reported in this paper are based on 94 salmon tagged during 1988 and 111 in 1989, a total of 215. (Table 1). This is a relatively large number of fish for a behavioural study, allowing quantitative statistics to be calculated and patterns of migration to be identified. We must accept that both the sample as a whole and individual statistics may be biased toward fish whose behaviour makes them more susceptible to net capture. Estuarial time of travel may also be biased toward fish which enter rapidly, thus increasing their individual probability of survival to enter. Nevertheless consistent behavioural patterns are recognisable, both between months and years, and observed behaviour is consistent with catch patterns in both net and rod fisheries. Even if bias exists, inter-year comparisons are valid, since both years are based on similar experimental techniques and sampling regimes.

(b) Estuarial passage

Entry to freshwater was defined, for analytical purposes, to be movement above Carmarthen, as represented by detection above site TY1 (Fig. 2). Examination of individual tracks demonstrates that fish tagged during dry weather often remain at sea for long periods (sometimes months), and that subsequent entry is associated with freshet events (see for example figs 4a,4b).

Median time of travel from tagging to freshwater in June-August 1989 was found to be almost 4 times that observed in June-August 1988, when flows were high (Table 2). In contrast, during the period September-December, when flow levels were generally higher in 1989 than 1988, time of travel in 1989 is less than half that found in 1988.

Only 38% of fish tagged in 1989 entered freshwater in comparison to the 1988 figure of 65%. Detailed examination suggested that this was directly attributable to the effect of drought in 1989; comparison with 1988 showed that the probability of a fish tagged in June - August 1989 subsequently entering freshwater was greatly reduced, but that the figures were similar from September onward (Fig.5).

The reason for this apparent reduction in survival is not totally clear. Tag failure was precluded as a likely cause by comparison with a randomly selected control batch of 25 tags which were highly reliable, 24/25 (96%) still being operational after 4 months and 22/25 (88%) after 5 months (Mee and Ellery, 1990). Although occasional regurgitation of tags was evident in reported net and rod recaptures, this only represented 2/24 (8%) of recaptures with one tag regurgitation in each year. Tagging techniques were identical between years, with only one personnel change. We must therefore view the observed reduction in survival as real, rather than an experimental artefact.

(c) Migratory patterns

Most of the salmon entering the Tywi showed a three stage migratory behaviour (Fig. 4c ; Clarke and Purvis, 1989). Following the initial migration in from the estuary, a period of upstream movement occurred, lasting up to 20 days. Most rod recaptures were taken during this active entry phase (8/11), even though it comprised only a small part of within season in-river availability for capture. This was followed by a quiescent stage (during which time the fish were usually located in deep pools, were not stimulated to move by flow events, and were rarely captured by rods). Following this phase a further (secondary) migration often occurred, taking the fish into the spawning areas later in the year. At this time recapture data suggest that fish may become re-available for capture, although we must accept that the number of recaptures during this phase (3) are very small. A variation on this behaviour exhibited by a smaller number of fish was a stepped migration, with two or more quiescent phases, migrating up-river in a series of discrete movements (Fig.4d).

(iii) Rod catches, flow and rod catch/effort

The importance of flow in stimulating rod catches is illustrated in Figure 6. Although continuous, albeit varying effort occurred throughout the season, it is clear that both effort and catch/effort increased during and immediately following freshets in late July, August and early September.

The importance of flow is also reflected in longer term data, with significant correlations existing between long term catch data and corresponding flows (Fig. 7). Both June/July and August/September yielded correlations with flow (Table 3), despite the interfering effect of long term population changes and the relatively crude measure of flow adopted. Removal of a small number of obvious outliers (Table 3) increases the annual, June/July and August/September figures to a significance level >99%, and March/May to P>95%. The lower significance level in March/May is unsurprising; absolute numbers are small and there is evidence within the data of a long term reduction in catch with time.

(iv) Seine net catch per effort including dispensation period

The net catch per effort data presented here show similar overall trends and absolute values in both 1988 and 1989 (Fig 8.) Few salmon were caught prior to June, a peak in catches occurred in August/September, and a significant part of the run occurs outside the normal fishing seasons which end on 31st August. In 1989, the peak of the grilse run appears to have been delayed, maximum catch rates occuring in December, compared to October in 1988.

(IV) Discussion

(i) Seine net fisheries

Direct effects of river flow on seine net gear efficiency and effort are minimal, the method being dominated by tidal flow rather than freshwater discharge. However, behavioural data demonstrate that fish took almost four times as long to enter freshwater during the early summer period of 1989, when flows were low (Table 2). Delayed entry in low flows has also been qualitatively observed in other studies (Brawn, 1982; Potter,1988). Data for the Tywi show that fish in the lower estuary move with the tide during low flow periods, a result compatible with data reported for the Fowey (Potter, 1988) and for the Mirimichi (Stasko,1975). They may, therefore, pass through the fishery on a number of occasions, and are thus available for capture during a number of fishing sessions. In higher flows, entry is rapid, often effected within one or two tides, and availability of individuals within the netting zone is therefore reduced. Although increased estuarial passage time may not be directly proportionate to net catchability, because of non-random distribution of both fish and fishery within the estuary, it is clear that capture probability will be increased during lower flows. This is consistent with the observation of a higher overall net recapture rate in 1989 (6:1).

These results demonstrate an effective increase in catchability in 1989, and suggest that despite the apparently similar catch/effort values in each year, in-season abundance in 1989 may have been substantially lower than in 1988. However reduced in season abundance does not, automatically imply reduced levels of stocks returning to homewaters, since an increased catch/effort of late run one sea winter fish was also observed, presumably as a result of delayed entry in earlier periods of low flows.

This clearly illustrates the difficulty of interpreting catch statistics without detailed understanding of underlying factors; in this case salmon catchability within the seine net fishery is negatively related to flow, because of an increase in individual encounter time with the fishery at low flows.

(ii) Rod fisheries

(a) Catchability and availability

The importance of flow in determining rod catch and rod catch/effort has been demonstrated by many authors (Alabaster,1970; Banks, 1969; Gee 1980; Hayes, 1953; Huntsman,1948; Millichamp and Lambert,1966). However the mechanism of this relationship has not been fully examined, as most datasets do not allow even qualitative estimation of varying catchability.

Consistent with the above authors, behavioural data collected during this study show that during periods of lower flow, entry to the river is stimulated by freshet events. Although we must recognise the limited extent of recapture data, comparison of recaptures with availability in river suggests that rod catchability varies following entry, being initially high, declining rapidly as the fish enters it's quiescent period and then increasing again as the fish undertakes further activity in the autumn. Similar results have been reported by Solomon (1988) working on the Hampshire Avon. Peaks in catch/effort associated with freshets (either natural or artificial) therefore principally represent fish attracted into the river by the freshet, and the size and duration of the catch/effort peak will be related to the number of fish entering the river as a result of the freshet. This number will probably be defined by the availability of fish in the vicinity of the estuary and the size and duration of the freshet (ie it's ability to attract fish from farther afield).

Since total exploitation by rod within the Tywi is not high (recaptures rates in this project suggest less than 25% of available fish) this implies that much of the in-river stock is effectively unavailable for rod capture (excluding foul hooking). Thus, although a relationship between total in-river stock and catch/effort may exist, it will be weak, a result consistent with the observations of Mills et al (1986).

(b) Effect of drought

In particularly dry summers, with few freshets, as occurred in 1989, many fish may not enter during the fishing season, and the total rod catch will be drastically reduced. Unfortunately our data also suggest a significant reduction in successful entry to the river, which more than negates any beneficial effect of reduced rod exploitation on spawning escapement.

Although an increase in legal exploitation within the net fishery was observed, exploitation of salmon within the legal net fisheries is still at a low level, and cannot account for the > 75 % reduction in entry success observed from June-August 1989 as compared with 1988. No evidence of increased straying was found in aerial searches of other catchments; indeed, the proportion of missing fish relocated outwith the catchment was less than half that found in 1988, even though three times as much search time was input in 1989. We must therefore conclude that the result represents a high inshore mortality rate, either as a result of water quality related problems, predation or illegal take in drift and set nets which are fished off the estuary mouth.

(c) Longer term data

The effect of flow is also reflected in longer term (inter-year) results (Fig. 7). A high proportion of inter year variation in catch may be explained in this way, probably as a result of delayed entry, reduced run size, and increased effort when flows are high. The observed increase in effort during and immediately after freshets is worthy of particular note; fishing effort on many rivers is related to anglers expectation of catch, and increased availability of fish during high flows therefore results in increased effort and further catch increases.

(iii) <u>Interpretation of catch/effort data</u>

These results have important implications for the interpretation of both catch and catch/effort data. At least on the Tywi, substantial variations in both rod and net catchability are related to flow, and an important and varying proportion of the salmon run occurs outside the fishing season. These observations are behaviourally based, and are likely to be applicable to other systems. Variation in catchability, both between and within seasons could result in misleading data and conclusions if either catch or catch/effort are assumed to represent abundance. Variation in the proportion of fish running within the season may also result in misrepresentation of stock performance. While it can be argued that analysis of long term data using smoothing techniques will even out the influence of such factors, this will not be true if factors such as long term climatic change alter catchability or the proportion of the stock available within the fishing season. Long term changes in salmon:grilse ratio in Scotland have been associated with temperature change at sea (Martin and Mitchell, 1985).

Analysis of catch or catch/effort data for stock performance purposes should therefore include an assessment and correction for flow and changes in out of season runs. While catch and catch/effort data are obviously valuable indicators of <u>fishery</u> performance they are inadequate measures of stock performance.

Acknowledgements

We would like to thank the following people for their assistance with this work. Tony Morse, Tim Davies and Sally Crudgington for help with fieldwork. Guy Mawle, who instituted the Tywi anglers logbook scheme. The Tywi bailiffs, particularly Mike Todd and the hydrology section, in particular Jean Frost and Rhian Phillips for providing data concerning river flows throughout the year. Finally we would like to thank Dr. Alun Gee for his advice and support during the course of this work and Alan Winstone for valuable comments on the draft paper.

Disclaimer

Table 1. Numbers tagged in each month

Month	1988	1989
May	1	2
June	0	10
July	13	24
August	32	27
September	17	19
October	22	11
November	7	13
December	2	5
TOTAL	94	111

Table 2. Median time of travel from tagging to freshwater (hours)

	1988	1989
June - August	50hrs.	195hrs.
September - December	128hrs.	62hrs.

Table 3. Significance of flow/catch regressions

Period	Correlation coefficient R	Significance Level	Correlation coefficient R	Significance Level
March-May	0.207	n/s	0.398*	5%
June-July	0.614	1%	0.614**	>1%
Aug-Sept.	0.306	10%	0.501***	>1%
Annual	0.207	n/s	0.519****	>1%

Exclusions: * 1968, 1979, 1981 ** None
as outliers *** 1968, 1975 **** 1968, 1975, 1981

References

Alabaster, J.S. (1970), River Flow and upstream movement and catch of migratory salmonids, Journal of Fish Biology 2 p.1-13.

Banks, J.W. (1969), A review of the literature on the upstream migration of adult salmonids, Journal of Fish Biology 1 p.85-136.

Beverton, R.J.H. and Holt, S.J. (1957), On the dynamics of exploited fish populations, U.K. Min.Agric.Fish., Fish Invest. (ser,2), 19, 533 p.p.

Brawn, V.M., (1982), Behaviour of Atlantic Salmon (Salmo salar) during suspended migration in an estuary, Sheet Harbour, Nova Scotia, observed visually and by ultrasonic tracking, Can.J.Fish.Aquat.Sci. 39, p.248-256.

Bunt, D. (1990), Use of rod catch - effort data to monitor migratory salmonids in Wales, Paper presented to the Catch/Effort symposium, Humberside, 2-6 April, 1990.

Clarke, D.R.K. and Purvis, W.K., (1989), Migrations of Atlantic Salmon in the River Tywi system, South Wales, Paper presented at the Atlantic Salmon Trust Conference, Bristol, April 1989.

Gee, A.S., (1980), Angling success for Atlantic salmon (Salmo salar) in the River Wye in relation to effort and flows, Fisheries Management 11 (3), p.131-138.

Gulland, J.A., (1969), Manuel des methodes d'evaluation des stocks d'animaux aquations, Premiere partie - Analyse des populations, Manuel FAO de Science la Letique 4, 160 p.

Harris, G.S. (1988), The status of exploitation of salmon in England and Wales. In Atlantic Salmon, Planning for the future (eds. D. Mills and D. Piggins), London: Croom Helm, p.169-190.

Hayes, F.R., (1953), Artificial freshets and other factors controlling the ascent and population of Atlantic salmon in the La Have River, Nova Scotia, Burton, Fisheries Research Board of Canada (99), p.1-47.

Huntsman, A.G. (1948), Freshets and Fish, Transactions of the American Fish Society, 75, p.257-66.

Martin, J.M.A. and Mitchell, K.A. (1985), Influence of sea temperature upon the numbers of grilse and multi-sea winter Atlantic Salmon (Salmo salar L), caught in the vicinity of the River Dee (Aberdeenshire), Journal of Fish.Aquatic Sci., 42, p.1513-1521.

Mee, D.M. and Ellery, D.S. (1990 in prep)., The tag failure experiment, Regional Environmental Appraisal Unit Report, National Rivers Authority, Wales.

Millichamp, R.I. and Lambert, A.O. (1966), On investigations into the relationship between salmon catch and flow in the River Usk during the 1965 season, In symposium on River Management (Ed. P.C.G. Isaac), London: Mclaren, p.199-123.

Mills, C.P.R., Mahon, G.A.T. and Piggins, D.J. (1986), Influence of stock levels, fishing effort and environmental factors on anglers catches of Atlantic salmon (Salmo salar L) and sea trout (Salmo trutta L), Aquaculture and Fisheries Management, 17 (4), p.289-297.

Potter, E.C.E., (1988), Movements of Atlantic Salmon (Salmo salar L) in an estuary in South-West England, J. Fish. Biol.33 (Suppl.A), p.153-159.

Prouzet, P. and Dumas, J. (1988), Measurement of Atlantic salmon spawning escapement. In Atlantic Salmon: Planning for the Future (eds. D. Mills and D. Piggins). London : Croom Helm, p.325-343.

Ricker, W.E. (1975), Computation and interpretation of biological statistics of fish populations, Bull.Fish.Res.Bd. Can. 191, 382 p.p.

Shearer, W.M. (1988), Relating catch records to stocks, In Atlantic Salmon: Planning for the future (eds. D. Mills and D. Piggins), London: Croom Helm, p.256-274.

Solomon, D.J. (1988), Tuning in to Avon Salmon Trout and Salmon Magazine, November.

Solomon, D.J. & Potter, E.C.E., (1988), First results with the new estuarine tracking system, J.Fish.Biol.33 (Suppl.A), p.127-132.

Solomon, D.J. & Storeton-West, T.J. (1983), Radio tracking of migratory salominds in rivers, developments of an effective system, Fish.Res.Tech.Rep., MAFF Direct. Fish. Res., Lowestoft, No. 75,11 p.p.

Stasko, A.B., (1975) Progress of migrating Atlantic salmon (Salmo salar L) along an estuary, observed by ultrasonic tracking, J.Fish.Biol. 7 p.329-338.

Stoner, J.H., Gee, A.S. & Wade, K.R., (1984). The Effect of Acidification on the Ecology of Streams in the Upper Tywi Catchment in West Wales. Env. Pollution Ser. A. 35 p.125-127.

FIG.1 TYWI CATCHMENT

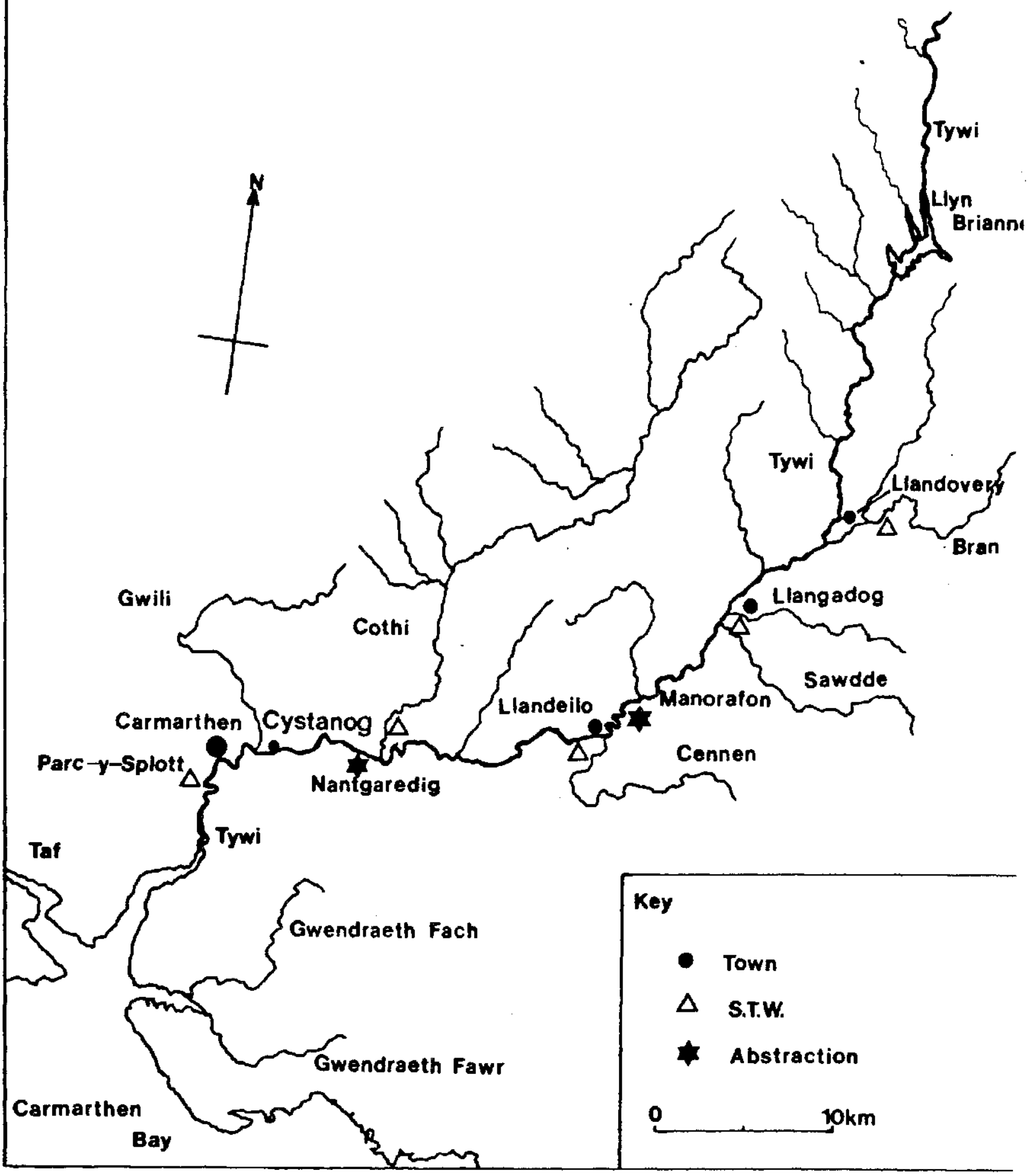


FIG.2 THE TYWI ESTUARY SHOWING TAGGING SITES AND MONITORING POINTS.

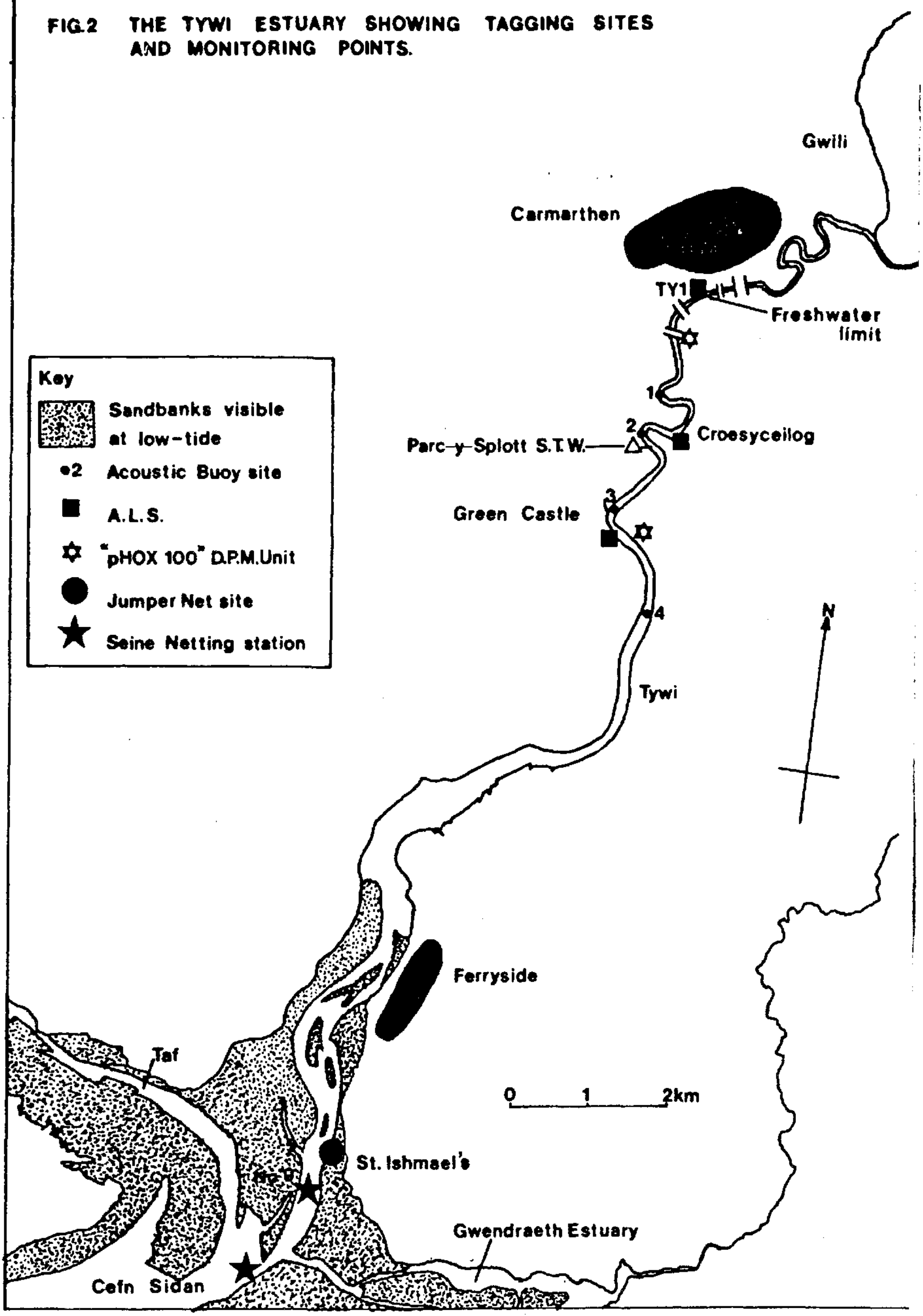
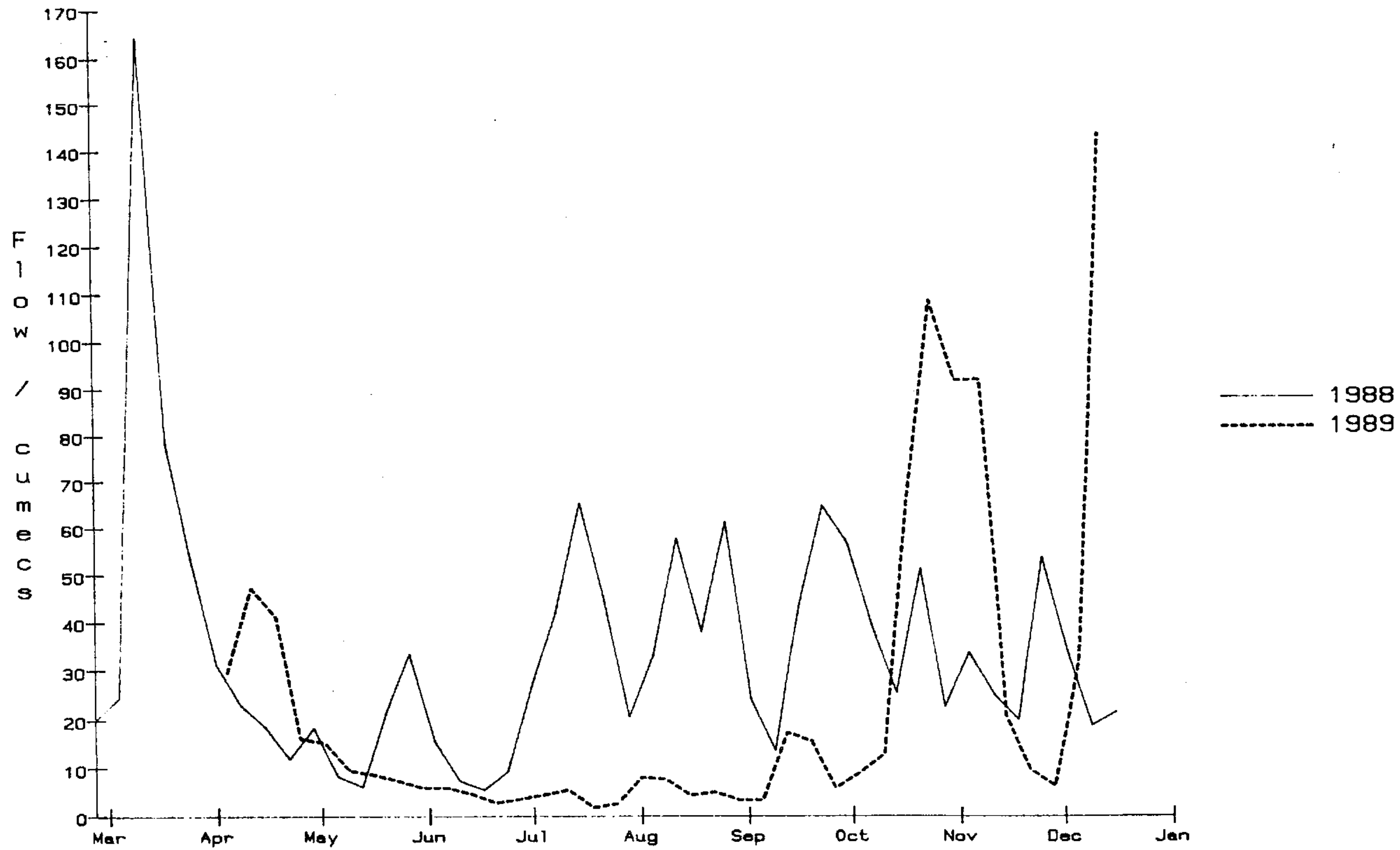


Fig 3. A comparison of the flow hydrographs (weekly mean values) for the years 1988 and 1989 .



Figs 4 (a) to (d) Examples of Salmon tracks

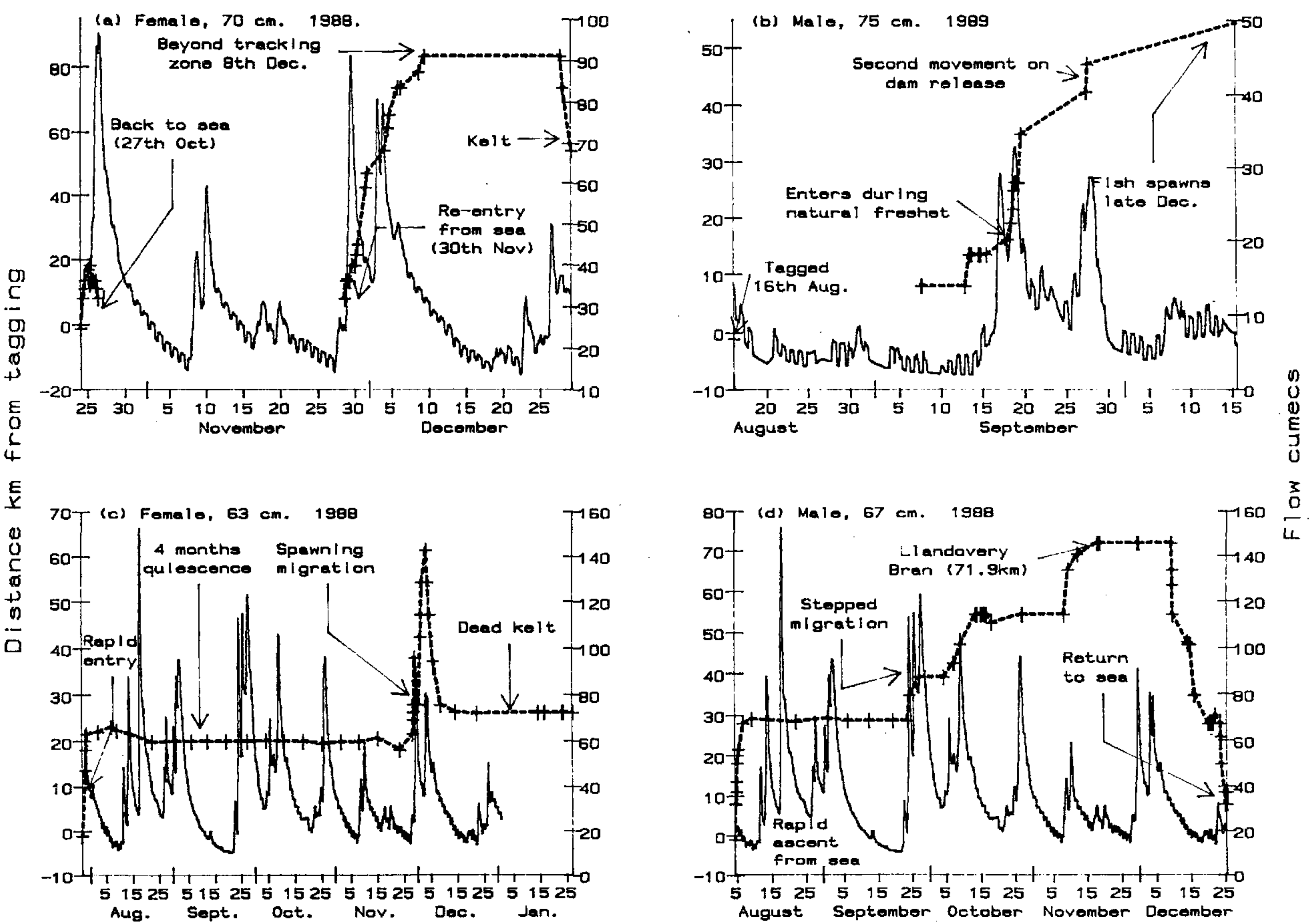


Fig 5. Monthly proportion of tagged fish detected in freshwater

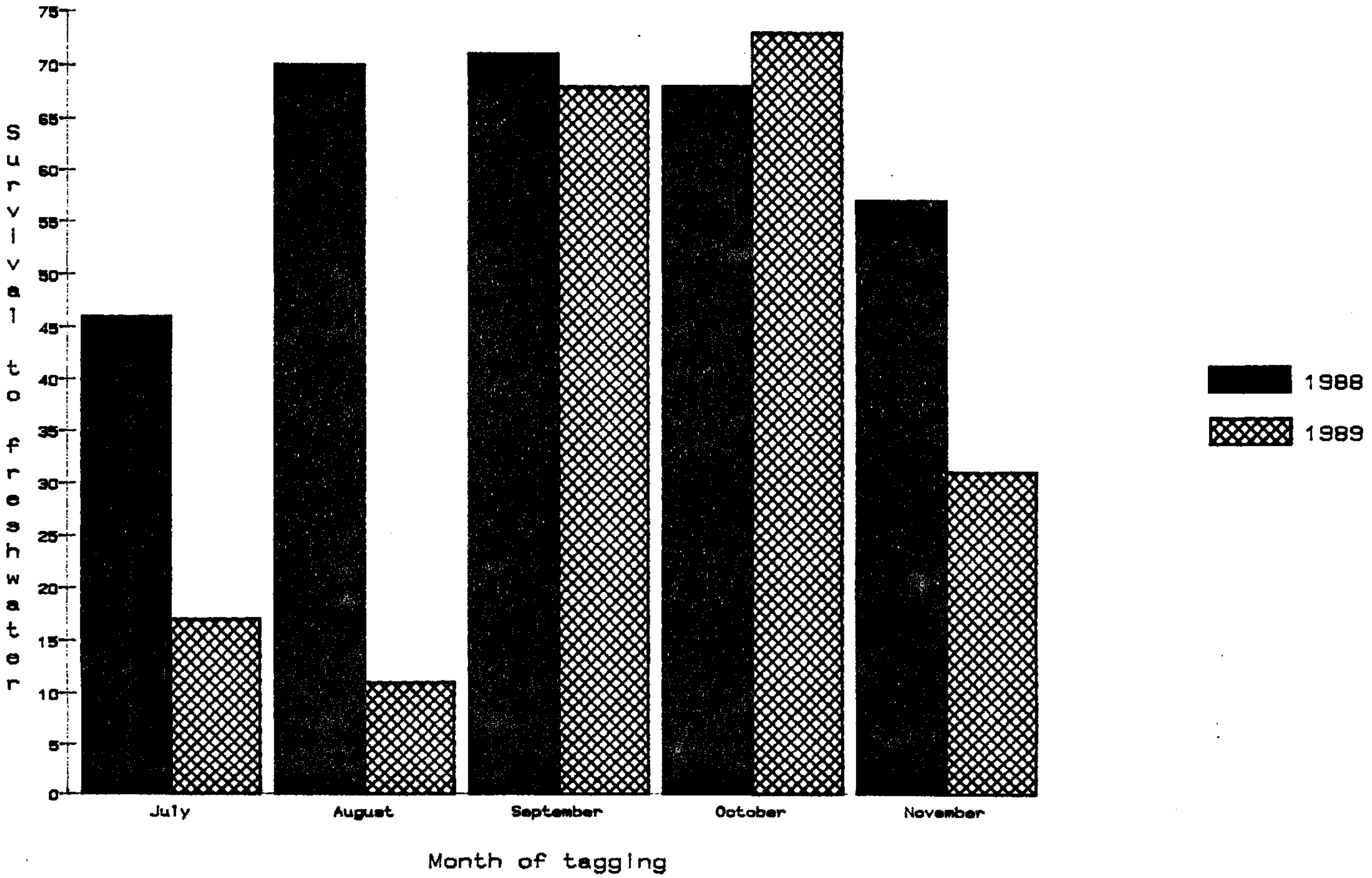


Fig 6. Rod catch/effort data for R.Tywi, 1986

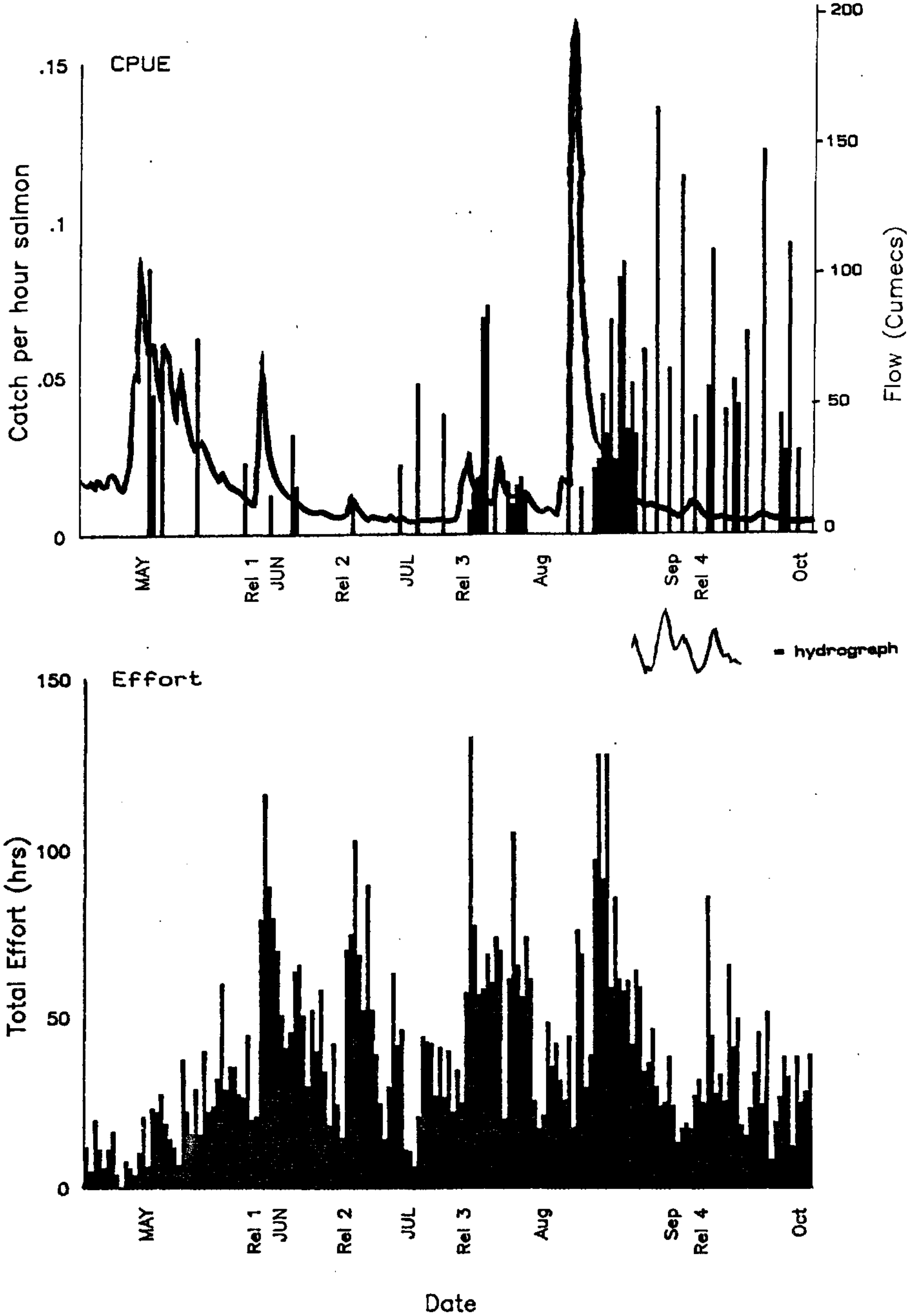


Fig 7. Catch of Salmon vs average monthly flows R.Tywi 1960-1989

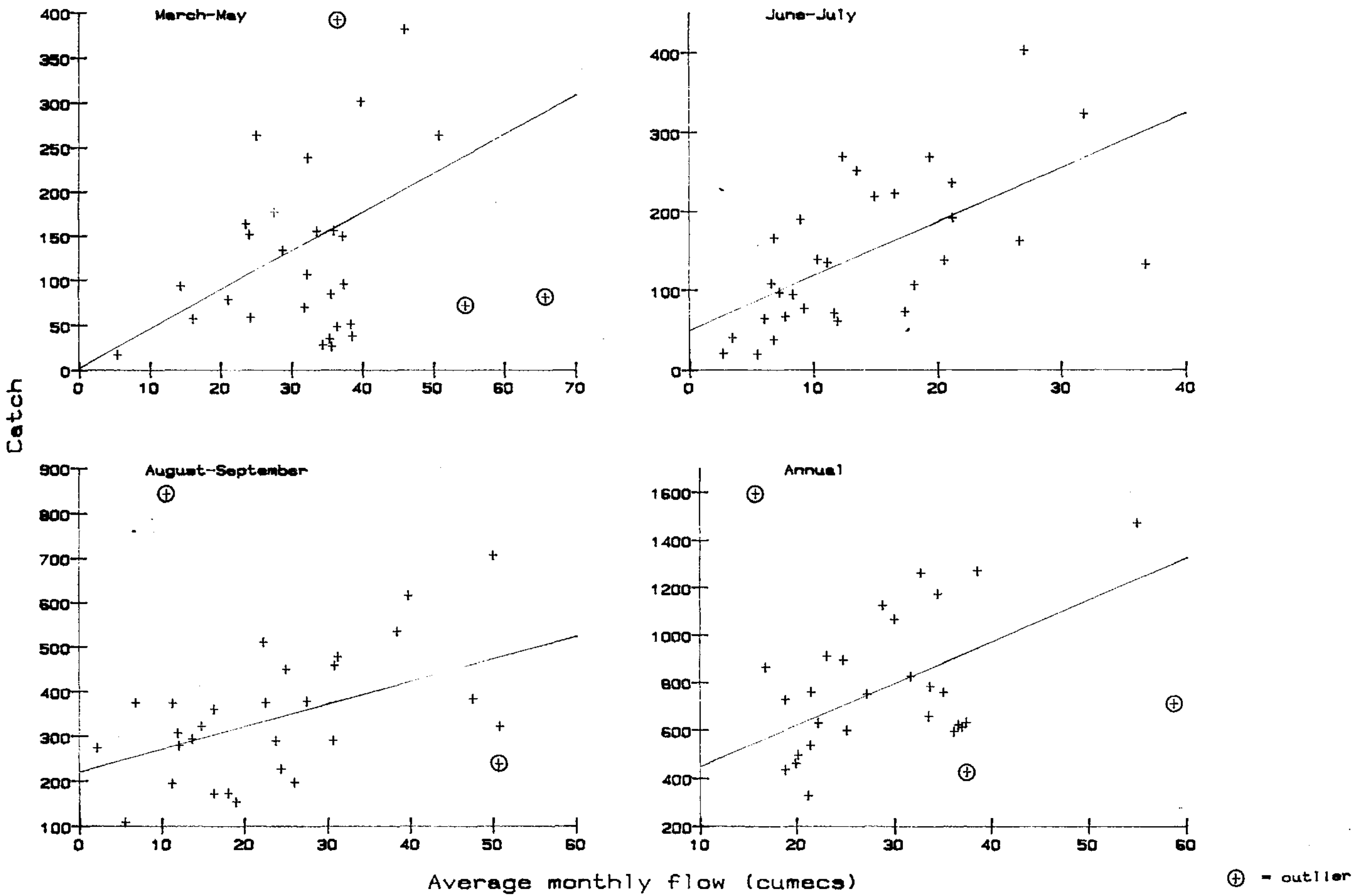
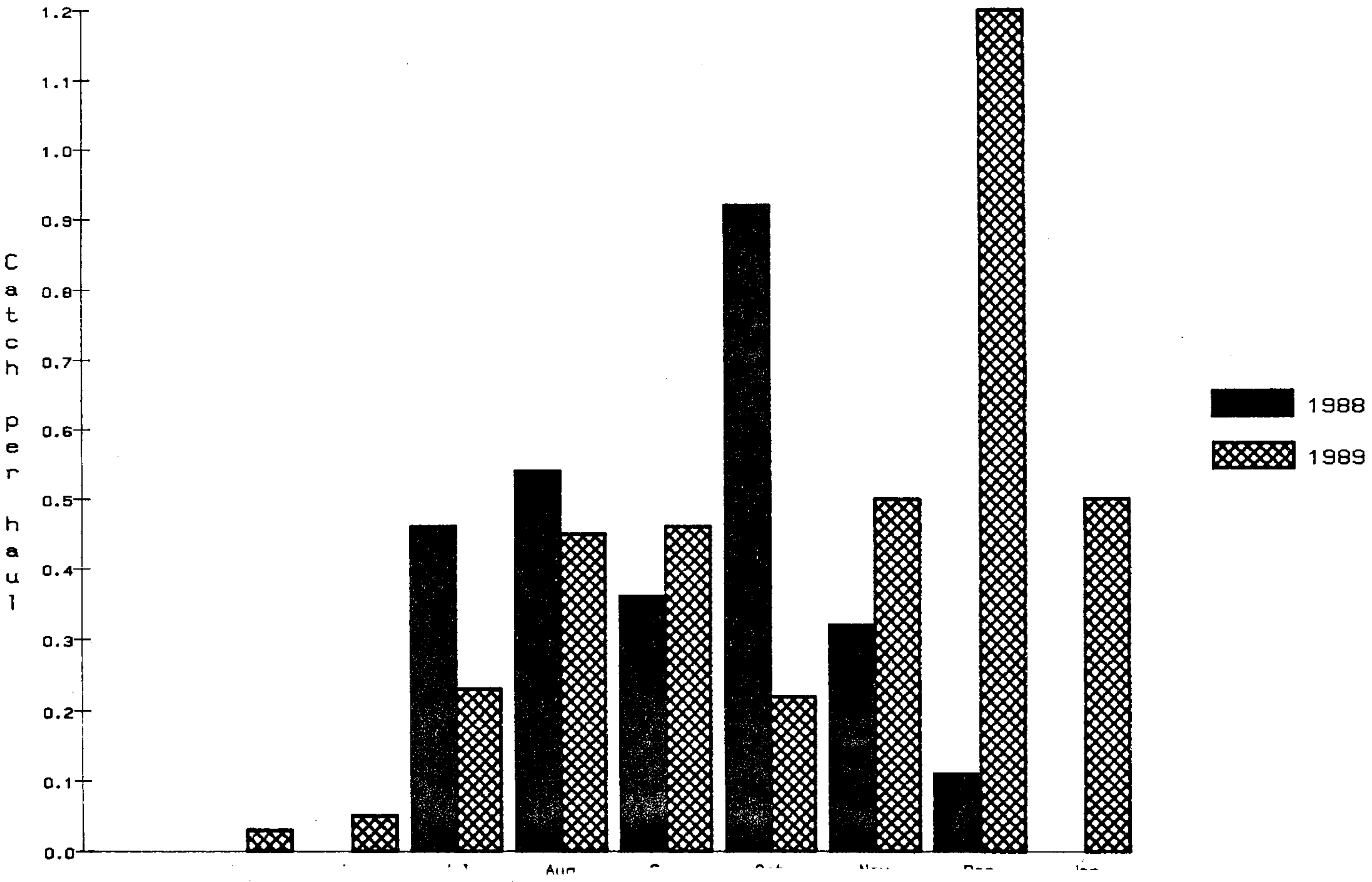


Fig 8. Catch per unit effort by seine nets in the Tywi Estuary



National Rivers Authority
Welsh Region

Awdurdod Afonydd Cenedlaethol
Rhanbarth Cymru

H.Q. / *PENCADLYS* ■
OFFICE / *SWYDDFA* ▲
LABORATORY / *LABORDY* ★
DEPOT / *DEPO* ●

NRA WELSH REGION
RIVERS HOUSE
ST MELLONS BUSINESS PARK
ST MELLONS
CARDIFF CF3 0LT
TEL. 0222 · 770088

NRA RHANBARTH CYMRU
PLAS-YR-AFON
PARC BUSNES LLANEIRWG
LLANEIRWG
CAERDYDD CF3 0LT
FFÔN 0222 · 770088