

**The use of Catch Statistics to Monitor Fishery
Change
Coarse Fish Study**

**Technical Report
W140**

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Coarse Fish Study

Technical Report W140

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Research Contractor:
SGS Environment, Liverpool

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Statement of use

This report is aimed at fisheries scientists who need to collate catch data from pleasure and competition coarse anglers.

Research contractor

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Amendments

Any corrections or proposed amendments to this manual should be made through the regional Agency representative on the Water Resources National Abstraction Licensing Group.

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EXECUTIVE SUMMARY

The overall objective of the R&D contract was to develop methods for estimating the stock size of migratory salmonids from catch statistics data and to examine new techniques for the collection of this data. However, due to the large degree of variation in the datasets for a range of underlying reasons, it became obvious that to achieve estimates of stock size would be a difficult goal to achieve. Therefore the project focused towards examining methods for accounting for the variability in the data sets and for estimating trends of runs of fish into rivers. This work was coupled with an examination of the temporal and spatial variability with and between river systems and the development of alternative data collection methods. As a result of the not being able to derive formulae to estimate of absolute stock size, it was agreed that the title of the project be changed. Outputs for the project are presented for migratory salmonids in R&D Technical Reports W27 and W139 and for coarse fish in R&D Technical Reports W140 and W141.

Compilation and examination of catch data sets for coarse fish were conducted during 1992-4. Few data sets were obtained for coarse fish other than those already known to exist from published sources of angling competition results.

Coarse angler survey methods, analogous to the creel census techniques widely used in the United States, were developed for recreational anglers. These surveys provided a high encounter rate with anglers who had caught fish allowing large data sets to be rapidly compiled. Problems in identifying, counting and measuring fish were encountered as a result of anglers not retaining fish in keepnets or because they refused to allow the survey officer to view their catch. It has been suggested that Agency survey officers should be given statutory powers to examine anglers' catches. Nevertheless acceptable data were collected for several lowland rivers and a detailed survey of the River Weaver and River Dane demonstrated that the method was cost effective in providing data.

A photographic method was developed to obtain a record of the anglers' catches. The size of the fish could be calculated using a GIS/CAD system and the species identified from the photographic record. This provided detailed qualitative data and a record of the exploitation of the stock which can be collected easily and effectively in mixed species coarse fisheries.

It is considered that coarse angler surveys have the potential to allow the establishment of a national database of coarse fish catches on large river systems and recommendations on how this could be achieved are made in the report. Results could be collected on a regional basis and submitted to a national centre. The collation of anglers' catch data should be established on the basis that long-term data sets will be required to determine trends within the fish stocks. Surveying techniques are also applicable to examining stillwater systems at a regional level.

Detailed catch data were obtained from angling competitions using the same photographic techniques as employed in the recreational angler surveys.

Individual angler catches were recorded and provided distribution data along the competition stretch of the river. These data also indicated that competition anglers have a higher catch rate than pleasure anglers although this may be biased towards particular species. This method was successfully on the River Weaver and Trent. As a result of a possible decline in the number of angling competitions on large lowland rivers, as the popularity of intensively stocked small stillwaters increases, the monitoring technique has not been recommended as a long term collection method for a national database. However, it has the potential for regional implementation and for specific surveys on rivers and stillwaters.

Both the surveys of pleasure and competition anglers could be used to obtain quantitative data using mark recapture techniques. However, it is not recommended as a regular method because of the time that would be involved and the difficulties in meeting the underlying assumptions of mark recapture models, therefore producing data of doubtful quality.

Long term qualitative catch data collected on a range of large lowland rivers are likely to be of greater value to the Agency especially when coupled with other techniques. This information should be stored on an easily accessible database that is available to fisheries staff in all regions.

KEY WORDS: Coarse Fish, Angling, Angler Surveys, Angling Competitions, Catch Rate, Population Monitoring

1.0 INTRODUCTION

1.1 OBJECTIVES

The specific objectives of R&D Technical contract W27 were to develop methods and techniques to estimate coarse fish stock size from anglers' catch statistics data. There are no suitable sampling techniques available at present for providing quantitative estimates of coarse fish stock size on large lowland rivers. At the start of the project it was quickly established that quantitative estimates of stock size for coarse fish would be an unattainable goal due to the complexities of the population dynamic of multi-species coarse fisheries. Long-term qualitative data have previously been used to identify the trends in coarse fish population abundance and species composition. However, the collection of catch data from coarse anglers has been relatively limited to specific studies on a regional basis. Therefore the objectives of the contract were changed to develop cost-effective methods for the collection of data from coarse anglers which would have the potential to be applied on a national basis. The development of the methods would seek to provide qualitative relative abundance data which would be of sufficient detail to enable the fishery manager to determine long-term changes in the coarse fish stocks and develop appropriate management strategies. The title of the project has been changed to reflect these changes in objectives and is now entitled 'The Use of Catch Statistics to Monitor Fishery Change'.

1.2 BACKGROUND

The collection of catch statistics to a nationally agreed standard from coarse or trout anglers in England and Wales has received little attention when compared to those collated for migratory salmonids. This is despite the fact that the majority of anglers pursue coarse fish for their sport (NOP 1994). The lack of data is probably a result of the difficulties of dealing with large numbers of species, anglers and the failure of many questionnaire surveys such as logbooks (Aprahamian pers comm.). Examinations of coarse fish populations have been based on the suite of standard sampling methods available to the fishery scientist. However, there are considerable difficulties associated with examining fish populations in large lowland rivers and lakes by standard sampling methods. As a result the Environment Agency (Agency), formerly NRA, current rolling stock assessment programme tends to concentrate its efforts on smaller waters where sampling is considered efficient.

The current sampling methods regularly employed are:

- Netting in its various forms
- Electric fishing
- Sonar acoustics
- Use of competition angling data

Quantitative estimates of the fish stock are possible on smaller waterbodies, such as canals and small rivers (usually less than 10 metres in width), using electric fishing and

seine netting (DOE 1983). However, inaccuracies to estimates may arise by sampling small areas due to the contagious distribution of fish.

These problems may be overcome by sampling long reaches or by undertaking many samples (Kell 1991), but this may not always be practical, particularly in more natural rivers than the Fens drain fisheries where Kell undertook his studies, and can be expensive in terms of resources.

The standard capture methods have in the past been combined with mark-recapture methods (Cooper & Wheatley 1981) in an attempt to provide an estimate of stock size on larger waterbodies. However, the basic assumptions of mark-recapture models are easily breached when sampling coarse fish populations (Hunt & Jones 1974) and the results of mark-recapture studies must be treated with some caution (Begon 1979).

Most long-term studies have been confined to the collection of angling competition records from large lowland rivers (Axford 1979, 1991, Cowx 1990, 1991, North & Hickley 1989). These studies have not provided quantitative characterisation of the fish stocks, but have been successful in using the relative abundance data to identify long term changes in species composition and the presence of strong year classes. There is no currently agreed national methodology for the collection of coarse angling catch statistics, yet such data are required for effective management of coarse fisheries. The present contract has pursued the development of methodologies for the collection of fish data which may be applied as both a national and regional sampling tool.

1.3 COARSE ANGLING IN ENGLAND AND WALES

Coarse anglers in England and Wales can be broadly classified under one of three groups:

- Recreational or pleasure anglers
- Competition (match) anglers
- Specialist anglers

Recreational or pleasure anglers represent the majority of coarse anglers in England and Wales (NOP 1980). Despite representing the majority of angler visits to fisheries, pleasure anglers have been generally ignored for the collection of catch data. This type of fishing may be characterised as general, with all species fished for and all legal angling methods employed. Competition coarse anglers, by comparison, fish in organised groups fishing over a fixed time period within a day in which each angler attempts to catch the greatest weight of fish. Specialist coarse anglers target a particular species of usually higher than average size and employ selective methods to achieve this. Specialist anglers' catch rates for numbers of fish may be low but the individual weights of fish are usually high for the target species.

Roving angler survey techniques are widely undertaken in the United States to survey their equivalent of pleasure anglers and are used to obtain economic, social and biological data from anglers (Guthrie *et al.* 1991, Pollock *et al.* 1994).

These methods have received very little attention in the UK with the exception of creel census studies undertaken on Yorkshire rivers (Axford 1991). However, it should be noted that these surveys have relied solely on anglers' recollections for the provision of data.

Therefore the main objective of the study was to test the applicability of survey techniques to pleasure anglers in England and Wales in an attempt to develop methods that could be used on a national basis to assess coarse fish stocks.

1.4 THE USE OF ROVING ANGLER SURVEYS IN THE UNITED STATES

Examination of the USA literature on roving angler (creel) surveys show that the provision of information on fish stocks for biological monitoring is only a small component of the census techniques (Gutherie *et al.* 1991, Pollock *et al.* 1994). Many surveys are undertaken for economic analysis of angler behaviour. The techniques have become highly developed in the USA, particularly the statistical techniques used for estimating survey bias and survey design on large waterbodies. The application of the American techniques to UK coarse anglers will differ in three main areas:

- The US fisheries surveyed are usually physically very large compared to the UK and may require a large team or several days to ensure complete coverage. Careful consideration needs to be paid to the planning and implementation of the roving angler survey to provide sufficient precision to assessments of effort and catch. UK coarse fisheries, by comparison, are relatively small and can normally be completely surveyed by a small team within one day.
- US anglers rarely adopt a catch and release policy. Fish are captured for the table, although attitudes towards this are gradually changing. UK coarse anglers nearly always operate a catch and release policy and therefore the fish caught by an angler may not be available for examination by a census clerk.
- UK pleasure coarse anglers regularly catch small fish and species as part of their sport (Cooper & Wheatley 1981). This contrasts with the pursuit of comparatively large sports fish (usually predatory), in the USA (Santucci & Wahl 1991).

Thus development of a coarse angler survey technique for use in England and Wales require that the differences in sporting practices in the USA and England are taken into account.

2.0 PRELIMINARY COARSE ANGLER SURVEY DEVELOPMENT

2.1 INTRODUCTION

The first year of the contract was used to develop a preliminary survey method and to test its suitability under field conditions. Initial surveying during 1992 was undertaken on a selective basis on a wide range of waterbodies in England and Wales to determine the level of information that could be collected.

2.2 METHODOLOGY

2.2.1 Survey form

A survey form was designed to collect information on both catch and angler behaviour (see Appendix 1).

The parameters identified as being of importance were:

1. Angler catch (number of each species and size distribution)
2. Angler effort (fishing time and seasonal effort (recollected))
3. Angler behaviour (location on the fishery)
4. Other information (e.g. willingness to participate in Agency logbook schemes)

2.2.2 Surveying

A single surveyor was sent to range of water bodies on a informal random basis during the summer period of 1992 (June-September). Surveys were undertaken on:

- North West Region: River Dane, River Weaver, Bridgewater Canal, River Ribble, Shropshire Union Canal and a range of stillwaters.
- Severn Trent Region: River Severn
- Thames Region: River Thames, River Wey, Wey Navigation canal and a range of stillwaters.

Surveying was undertaken by selecting a waterbody or stretch of a large river and interviewing all the anglers encountered on the fishery.

Anglers were approached on the fisheries by the surveyor who identified himself and, if the angler agreed, asked questions so as to ensure the survey form was completed (see Appendix 1 - for an example of a completed form). The angler's catch was assessed either by visual examination of the catch retained in a keepnet, or, if the fish were not retained or the angler would not permit examination of the catch, by recording the angler's recollection of the catch. The catch was examined for species composition and sizes of fish in 5cm categories. The majority of the fisheries were surveyed on a single occasion, except for the River Weaver and River Dane where repeat surveys were undertaken.

2.3 RESULTS OF PRELIMINARY SURVEY

A total of 656 interviews were undertaken with coarse anglers through the survey period of 27 interview days. The mean encounter rate with anglers was 24 anglers per survey day. A total of 5497 fish were captured by the anglers (from both examined and recollected catches) giving a mean catch of 9 fish.

2.3.1 Angler behaviour

The 1992 survey indicated that anglers demonstrate a clumped (contagious) distribution around access points to fisheries, on both linear and stillwater systems. Collated results for the anglers' location in relation to the access points on rivers and stillwaters are presented in Figures 1(a) and 1(b). 90% were located within 550 metres of an access point on rivers and canals. Still water fisheries also demonstrated this effect with 90% of anglers found within 400 metres of an access point.

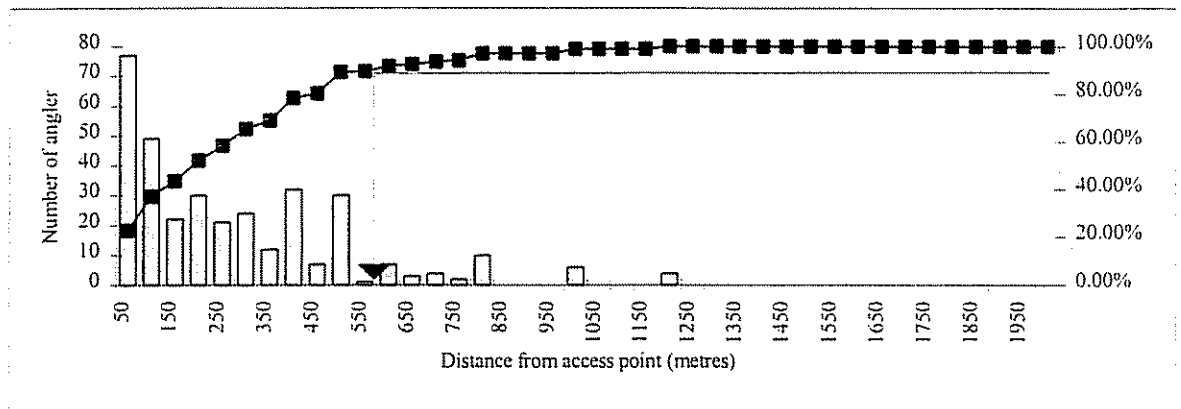


Figure 1(a): Distance from access points of anglers' fishing positions on riverine fisheries

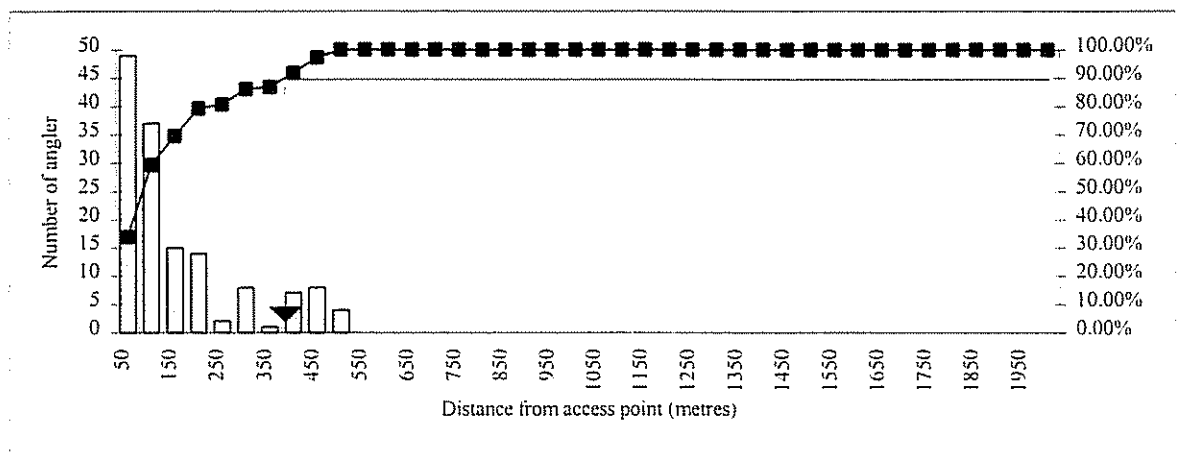


Figure 1(b): Distance from access points of anglers' fishing positions on stillwater fisheries

2.3.2 Angler catch

Results of examination of anglers' catches and anglers' recollections of their catches are presented as pie charts of species composition of the dominant species (Figures 2(a) to 2(f)) and 5cm grouped length frequency histograms by species for the River Dane and Weaver (Figures 3(a) to 3(b)). The species compositions from repeat surveys on the River Dane and River Weaver gave similar percentage values. The species composition of catches from a survey undertaken on the River Sever were similar to those obtained by Hickley *et al.* (1981) from an analysis of competition results on this river but there were differences observed in the result for short-lived species (e.g. gudgeon).

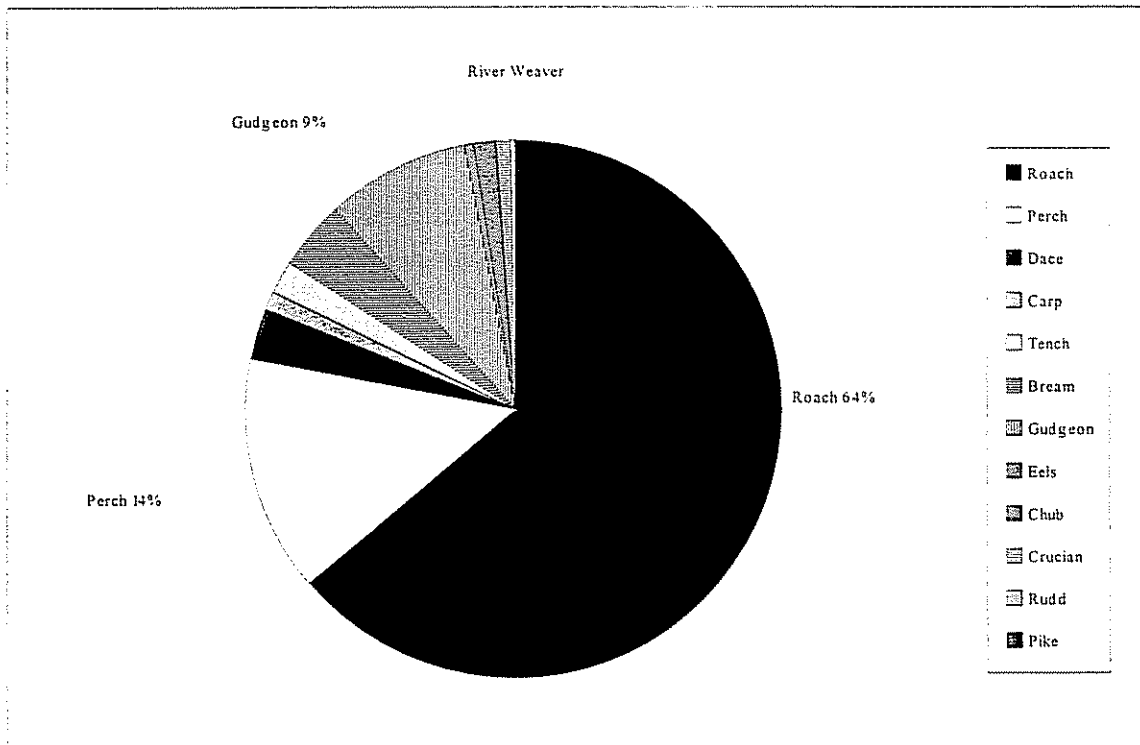


Figure 2(a): Species composition of anglers' catches based on recollected and examined catches for the River Weaver.

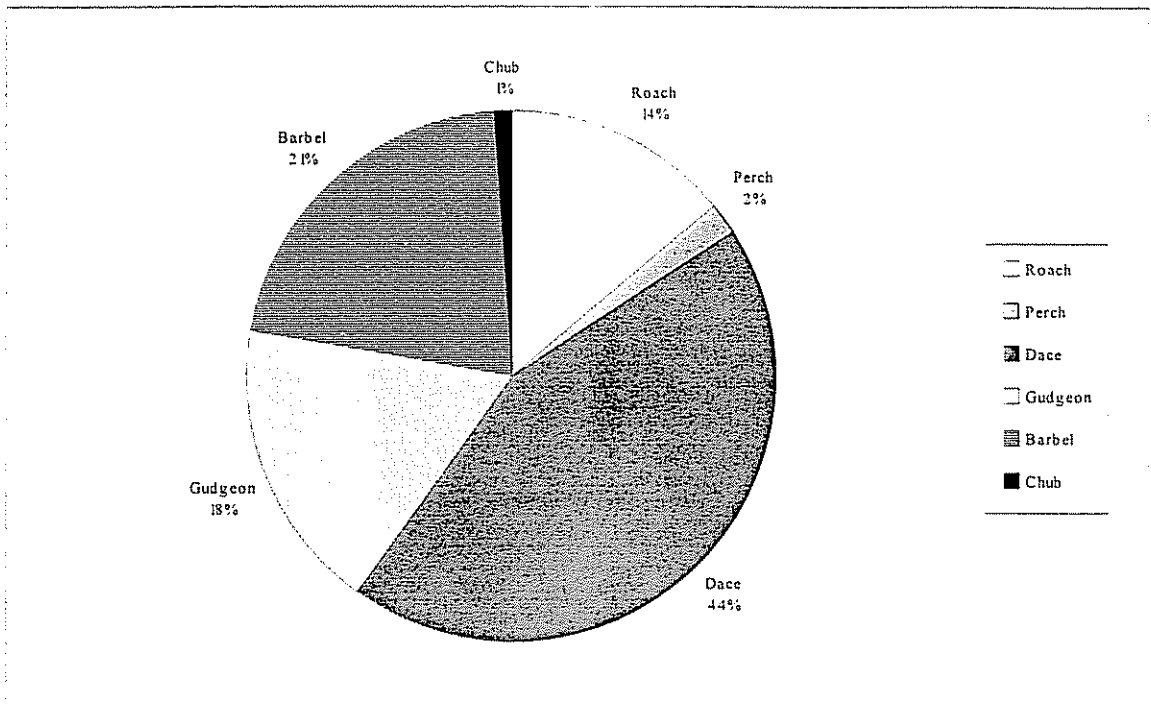


Figure 2(b): Species composition of anglers' catches based on recollected and examined catches for the River Dane

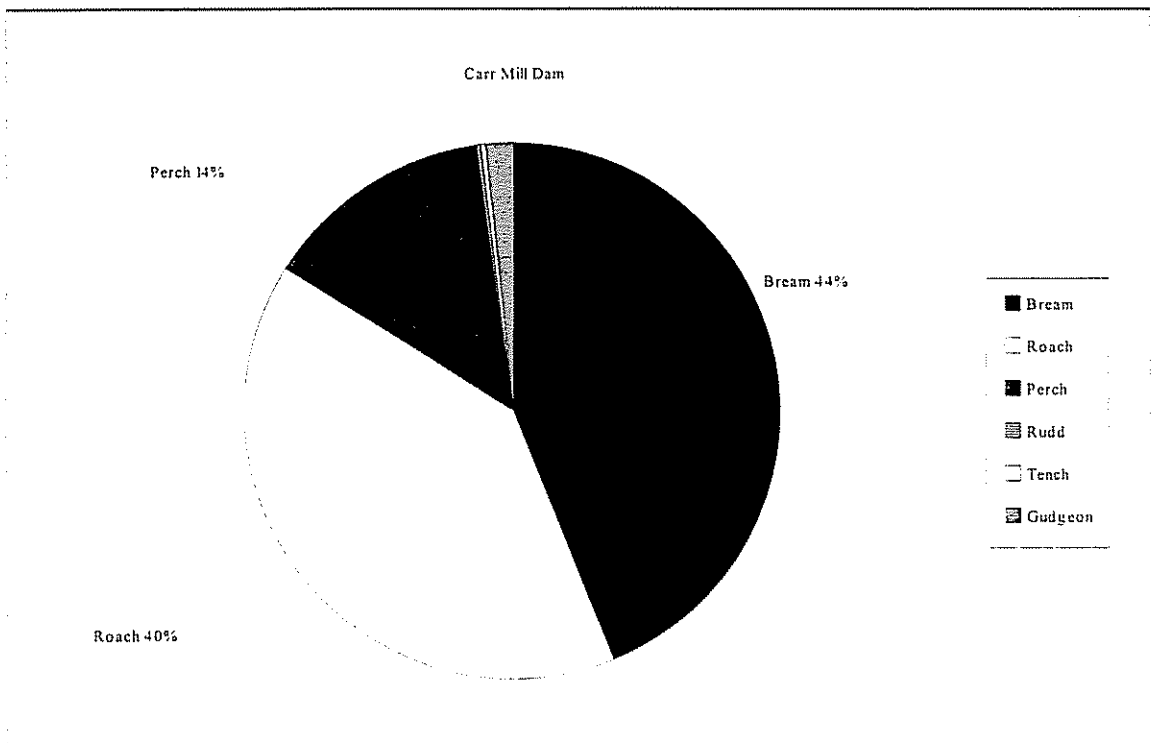


Figure 2(c): Species composition of anglers' catches based on recollected and examined catches at Carr Mill Dam lake.

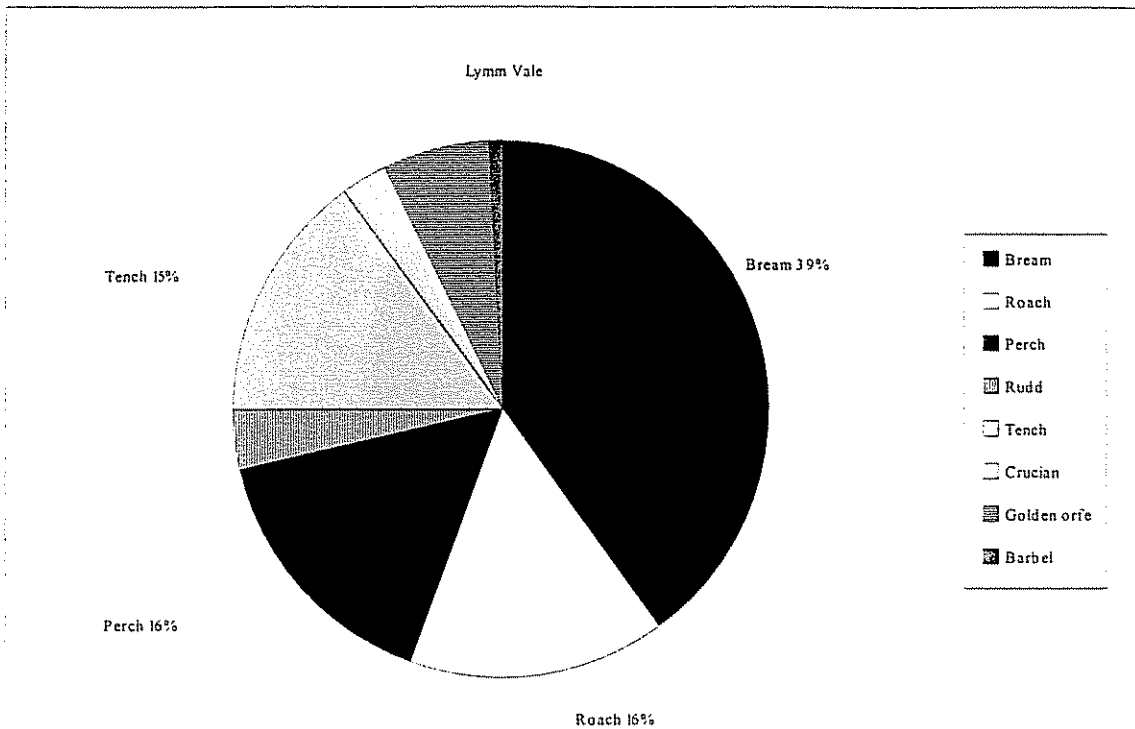


Figure 2(d): Species composition of anglers' catches based on recollected and examined catches at Lymm Vale Lake

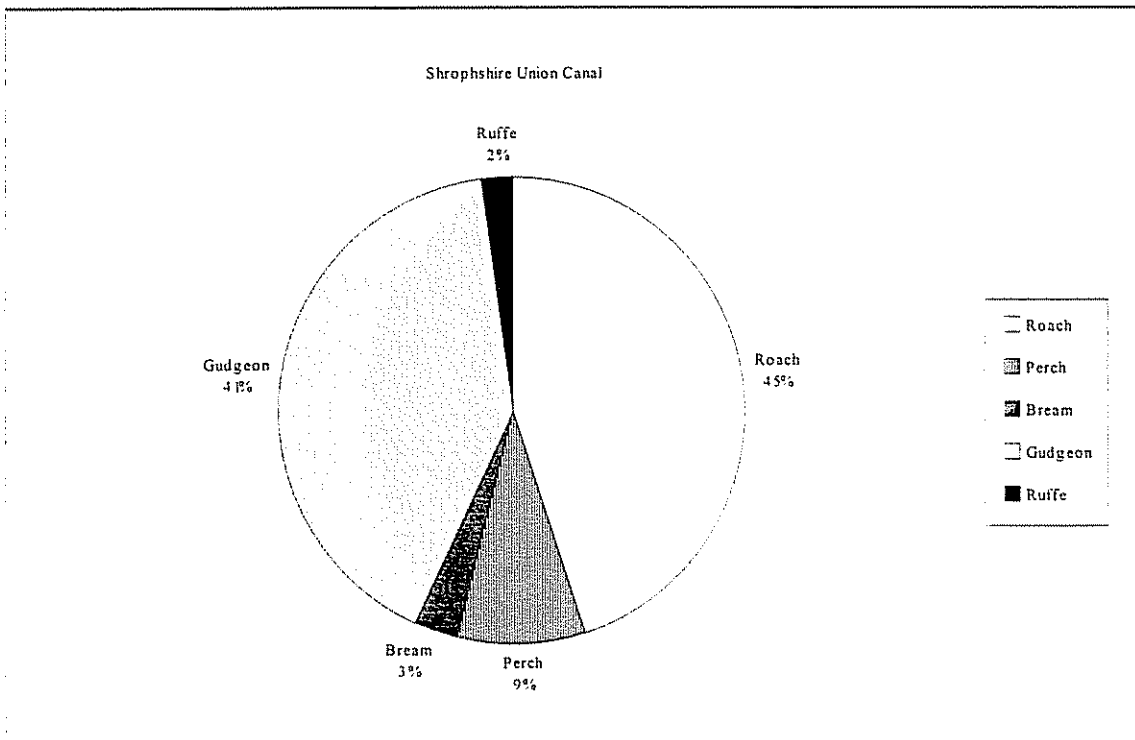


Figure 2(e): Species composition of anglers' catches based on anglers' catches based on recollected and examined catches for the Shropshire Union Canal.

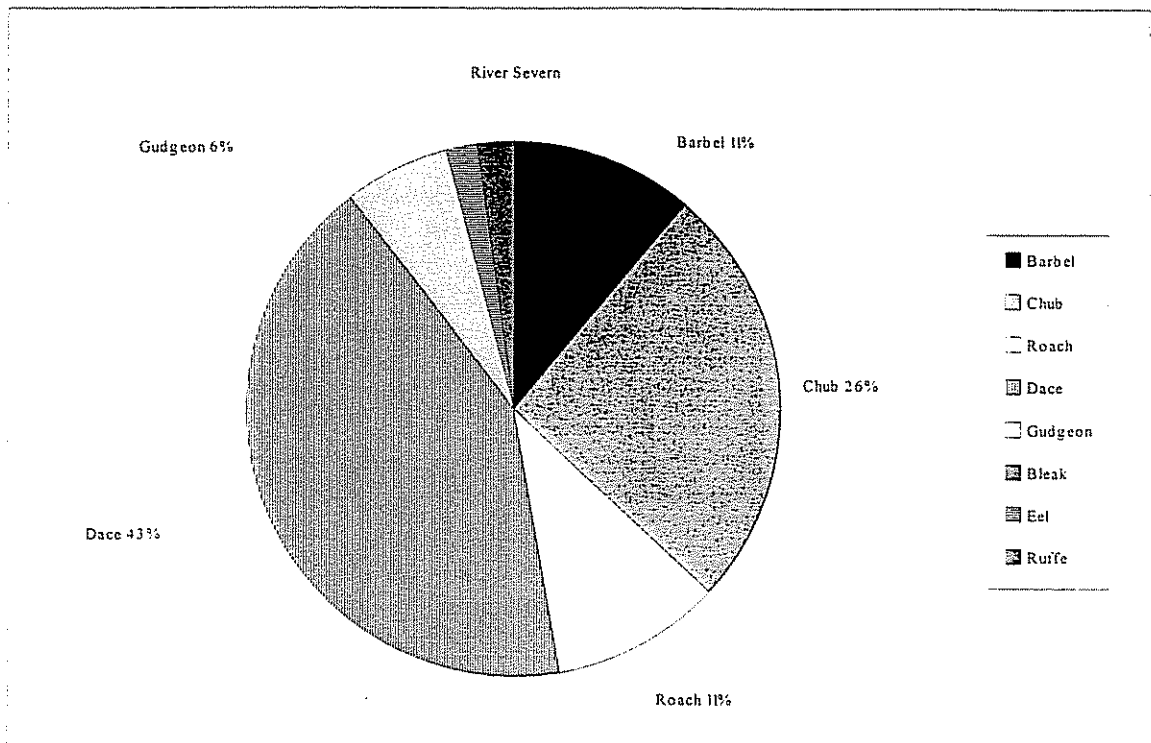


Figure 2(f): Species composition of anglers' catches based on recollected and examined catches for the River Severn.

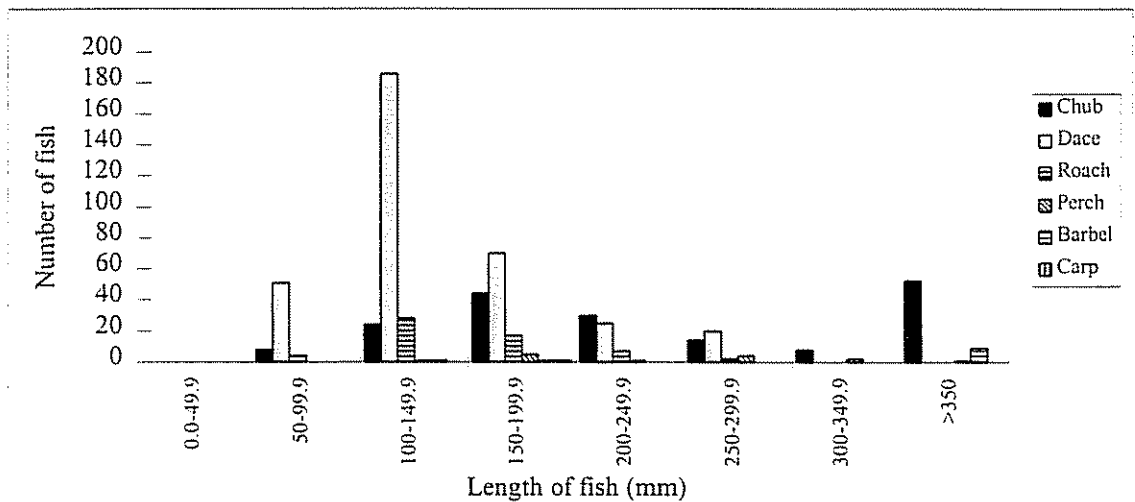


Figure 3(a): Number of fish caught by anglers in different size categories from the River Dane (combined survey results based on recollected and examined catches)

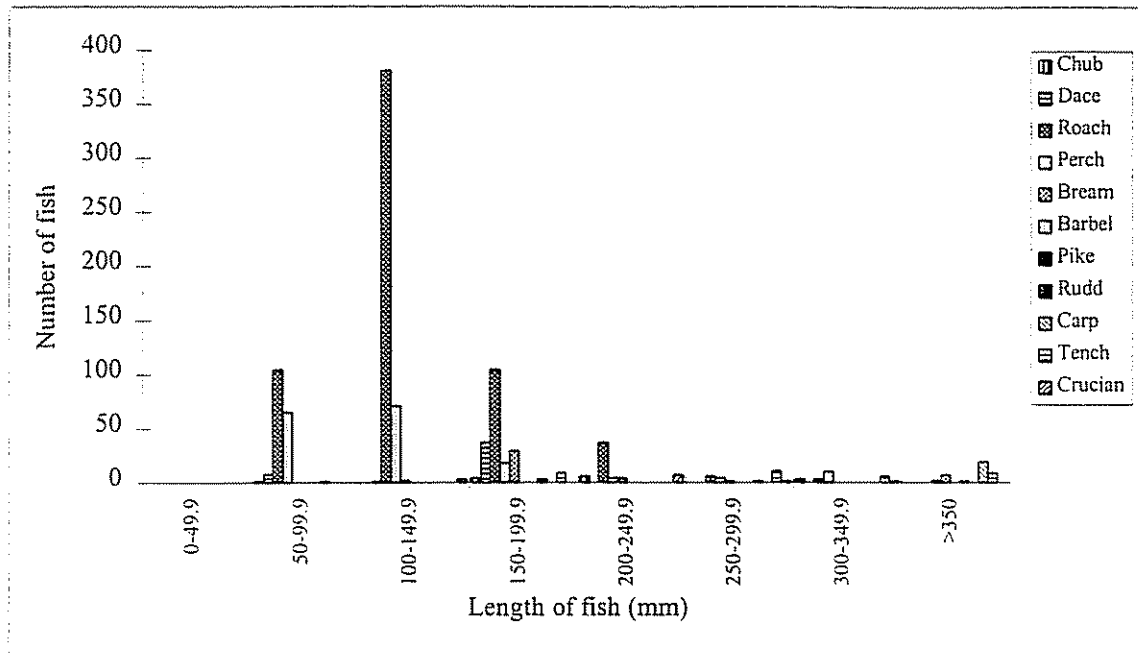


Figure 3(b): Number of fish caught by anglers in different size categories from the River Weaver (combined survey results based on recollected and examined catches)

2.3.3 Other information

Additional information collected during surveying included whether coarse anglers would be interested in participating in an Agency log book scheme for collection of coarse fish catch statistics. The response to this varied with Agency region.

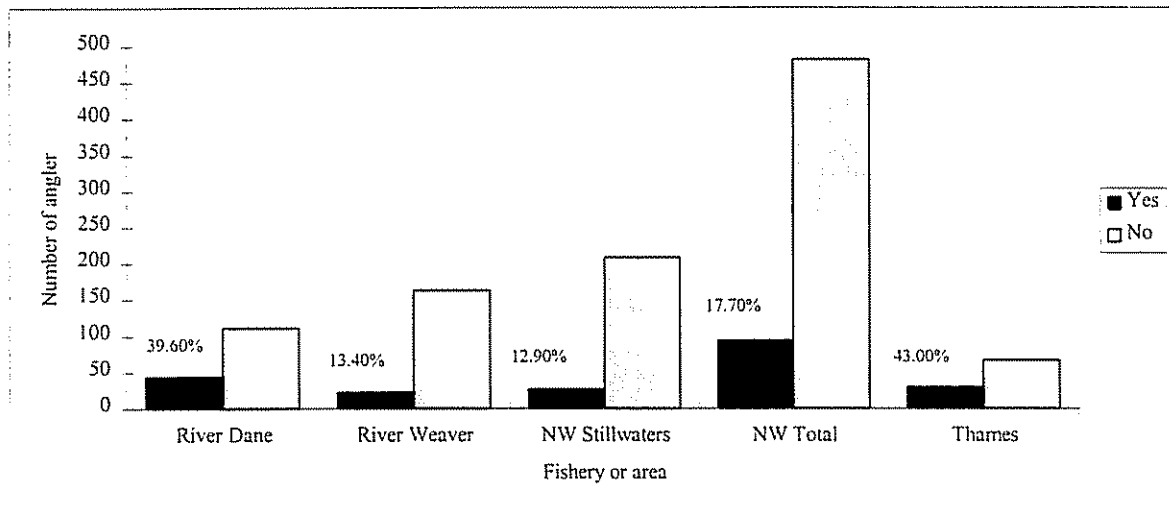


Figure 4: Number of anglers willing to participate in a log book scheme (% value indicates the percentage of anglers wishing to use logbooks)

2.4 DISCUSSION OF SURVEY RESULTS AND THE IMPLICATIONS TO THE SURVEY METHODOLOGY

Results of the initial study indicated that angler survey techniques could potentially be readily applied to coarse anglers in England and Wales. Recreational coarse anglers were found to be particularly suited to surveying methods due to the high encounter rate and their relatively high catch rates. In addition, the retention of the catch in keepnets by the majority of anglers provides a record of their catch (a formal assessment of keepnet usage by anglers was undertaken in the intensive survey of 1993 see section 4.0). Based on these average preliminary figures and on a twenty day working month it is estimated that it may be possible for a single surveyor to interview 480 anglers and examine a fish sample of 4320 fish.

The contagious distribution of anglers around fishery access points has implications for surveying. The majority of anglers using the fishery may be surveyed quickly with 90% being found within 550 metres of an access point to the fishery.

Examination of angler catches proved problematical in that many anglers would not allow examination of their catch, despite retention in a keepnet, and therefore only their recollection was recorded. This may have resulted from using a student surveyor rather than an Agency member of staff. Previous workers have found that anglers' recollection is generally poor (Cooper & Wheatley 1981). This was observed during surveying and when the recollected catch was compared to the actual catch with both mis-identifications of species and errors of judgement in the numbers and sizes of fish in the catch were confirmed. (A formal assessment of the anglers' recollection ability was undertaken for the 1993 survey (See Section 4)). Consistency was found in the species compositions of catches between survey occasions for the dominant species even though these data were based mainly on anglers' recollections of their catch. Large differences were observed in the species composition of stocks from different waterbodies suggesting that anglers catches were to an extent reflecting the composition of the stock. From the preliminary survey it was concluded that there was a need identified to develop a method which would allow simple, rapid, yet accurate recording of anglers' catches.

It is considered that logbooks for monitoring of coarse fisheries are unlikely to be successful due to the effort required in recording large multi-species catches of fish and the benefits gained from each entry are not readily apparent to the angler. Many anglers indicated a desire to use logbooks, but of approximately two hundred logbooks issued to coarse anglers by the North-West Region of the Agency only 3 were returned (Aprahamian pers comm.). Specimen anglers may be suitable for targeting for logbook schemes as they are usually dedicated to fishing for a certain species and may have a relatively low catch rate due to the methods they employ. In addition, specimen anglers often maintain a personal record of their angling sessions.

2.5 CONCLUSIONS

- 1) Angler survey methods are readily applicable to coarse anglers.
- 2) The relatively high encounter rate with anglers and their high catch rates on popular fisheries gives the potential to collect data on the exploited stock.
- 3) Anglers' recollection of their catch can not be relied upon due to inaccuracies.
- 4) The need to develop a rapid method of assessing the species and sizes of individual angler catches was identified.
- 5) Angler survey techniques provided additional data on angler behaviour and use of fisheries.
- 6) Logbooks are unlikely to be successful for obtaining catch data from coarse pleasure anglers due to number of fish and species caught, a lack of enthusiasm and a poor recollection of species.

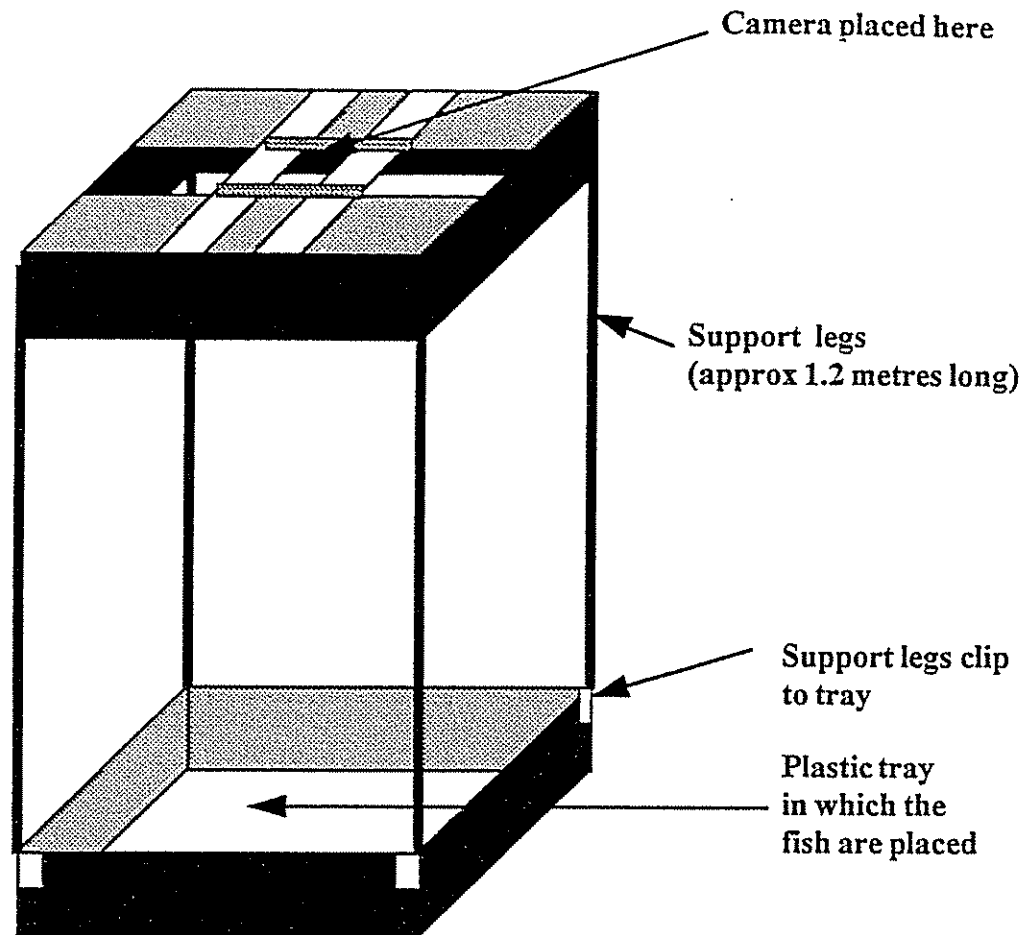


Figure 5(a): Diagrammatic representation of clip-on type stand for supporting camera during photographing of fish in a plastic tray.

Notes:

- 1) Experimentation will be required to determine the best frame design for a particular camera type.
- 2) The stand should be easily transportable and should therefore be both light and strong. It is recommended that the stand has locking collapsible legs for ease of transportation.
- 3) The camera should be supported directly above the centre of the tray. The resultant picture should be in focus and include the corners of the tray for analysis purposes. the support may therefore need to be clipped to brackets which extend out beyond the edges of the tray such that the corners of the tray are included on the photograph.

For fish which appear curved on the photograph the length can be estimated by selecting points a series of points along the length of the fish which are added by the computer to provide a total length.

4) On photographs of good quality, which can be achieved if the method was employed correctly, all species of fish were identifiable above 5cms in length when measured catches and their associated photographs were compared. This assumes that personnel undertaking the analyses are used to identifying coarse fish species. Juvenile common bream and silver bream could be identified separately from the photographs with care. Bleak, young dace and chub (above 5cms) were easily identified from the photographs. Some difficulties may be encountered with identification of cyprinid hybrids e.g. roach X bream hybrids.

5) During development of the technique on the River Weaver individually measured fish in catches were compared to individual estimated lengths from photographed catches. This was undertaken on every fifth catch in the development of the methodology for monitoring angling competitions. The relationship between estimated and actual measured individual lengths for 139 fish is presented in Figure 5(b). The technique provided an accurate method of estimating individual fish lengths from photographs.

6) The photographic technique may also demonstrate other advantages. For example, the photographic record will demonstrate any health problems, such as external lesions, that may be present in the fish stock. The technique may also be used for recording catches of fish stocks captured by standard sampling methods. This would potentially increase the number of sites that could be sampled in a day by reducing the time required to process the catches.

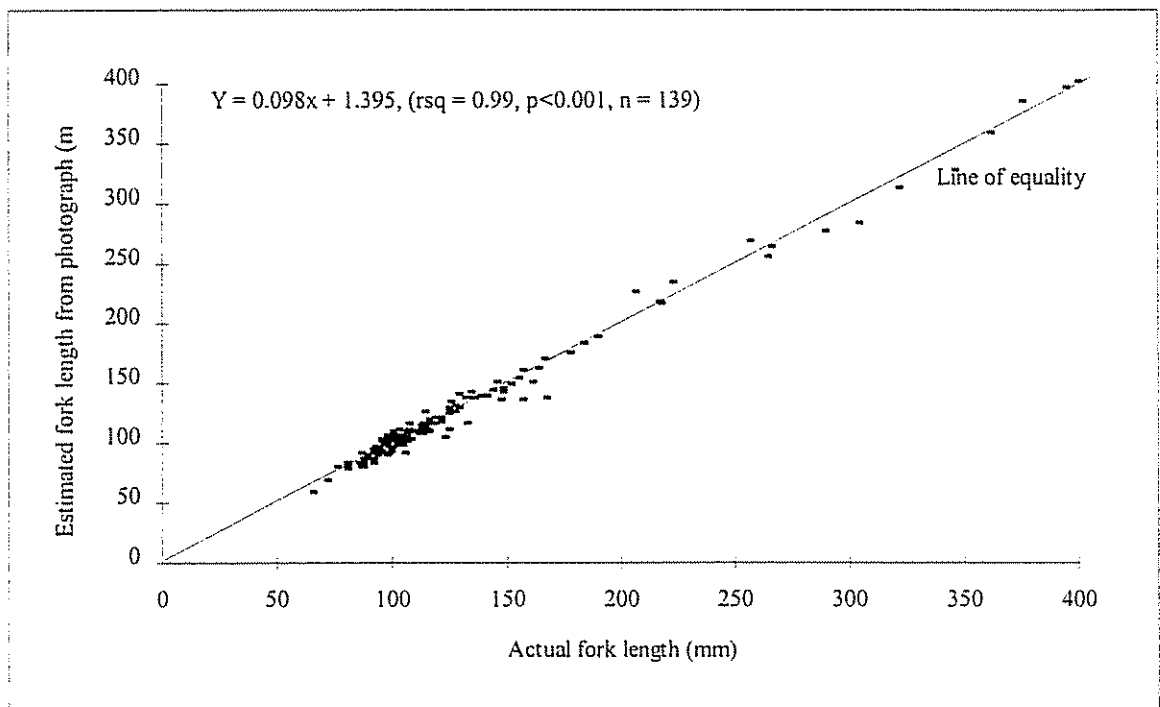


Figure 5(b) Regression of estimated individual fish lengths from photographs against actual measured lengths.

3.5 CONCLUSIONS

- 1) The tray photographic technique may be used to rapidly and accurately record anglers' catches.
- 2) Accurate fork length measurements and species composition may be determined from the photographed catches for all fish greater than 5cms.
- 3) The photographic technique may be used to show health problems in the stock such as the presence of external lesions.
- 4) The developed technique will have applications for the recording of samples of fish captured by standard sampling methods.

4.0 INTENSIVE ANGLER SURVEY DEVELOPMENT

4.1 INTRODUCTION

Following the preliminary study in 1992 it was decided to pursue an intensive survey of two selected contrasting rivers in North-West England during the summer period (June-August) of 1993 and in September and November 1993 and January 1994. The purpose of this exercise was to determine the level of information that could be collected by concentrating on particular fisheries. The intensive survey was combined with the developed photographic tray technique for recording of catches.

4.2 DESCRIPTIONS OF FISHERIES

4.2.1 The River Dane

The River Dane is a small river of approximately 10 metres width with varying depths resulting from its natural, sand and gravel bottomed riffle and pool habitat. Dense stands of *Ranunculus* sp. are present along with habitat features associated with a natural river including overhanging trees and natural instream structures. Weirs are present at several points along the river. The river supports a mixed coarse fishery dominated by riverine species including barbel. The sites selected for surveying were (see Map 1):

Cotton Hall Farm	(NGR SJ742677)
Byley Bridge	(NGR SJ715675)
Croxton Hall Farm	(NGR SJ698673)

4.2.2 The River Weaver

The River Weaver is a slow flowing, channelised river of approximately 35 metres width and a relatively uniform 4.5 metres depth in the central navigation channel. Marginal shelves are present along the majority of the channel with heavy macrophyte cover during the summer. The river has off-channel backwater areas and navigation locks. It supports a mixed coarse fishery including stillwater species such as tench, crucian carp and carp. The sites selected for surveying were (see Map 2):

Hartford Bridge	(NGR SJ647714)
Hartford Locks	(NGR SJ642705)
Bradford Mill	(NGR SJ652688)

4.3 METHODOLOGY

A new interview form was devised from that used in the preliminary survey (see Appendix 2) including minor alterations to facilitate ease of completion. The rivers were visited on a near daily basis through the summer period and early autumn (June-October) of 1993 by a single surveyor. No formalised randomisation or stratification of the survey design was made, as the purpose of the study was to determine the level of information that could be collected.

Each survey day was initially divided into two survey periods:

- 1) Period 1: 4am - 12 noon
- 2) Period 2: 12 noon - 8pm

However, it was found that few anglers were encountered during the first 2-3 hours of period 1 and the last two hours of period 2. Therefore surveying was operated between 8am and 6pm.

Anglers were approached on the fisheries by the surveyor who identified themselves and, if the angler agreed, were asked the relevant questions to allow the survey form to be completed. The angler was asked to recollect their catch, if permitted, for comparison with the photographed catch taken using the methodology described previously in Section 3.0.

If low numbers of anglers were encountered on a particular day, then both rivers were surveyed.

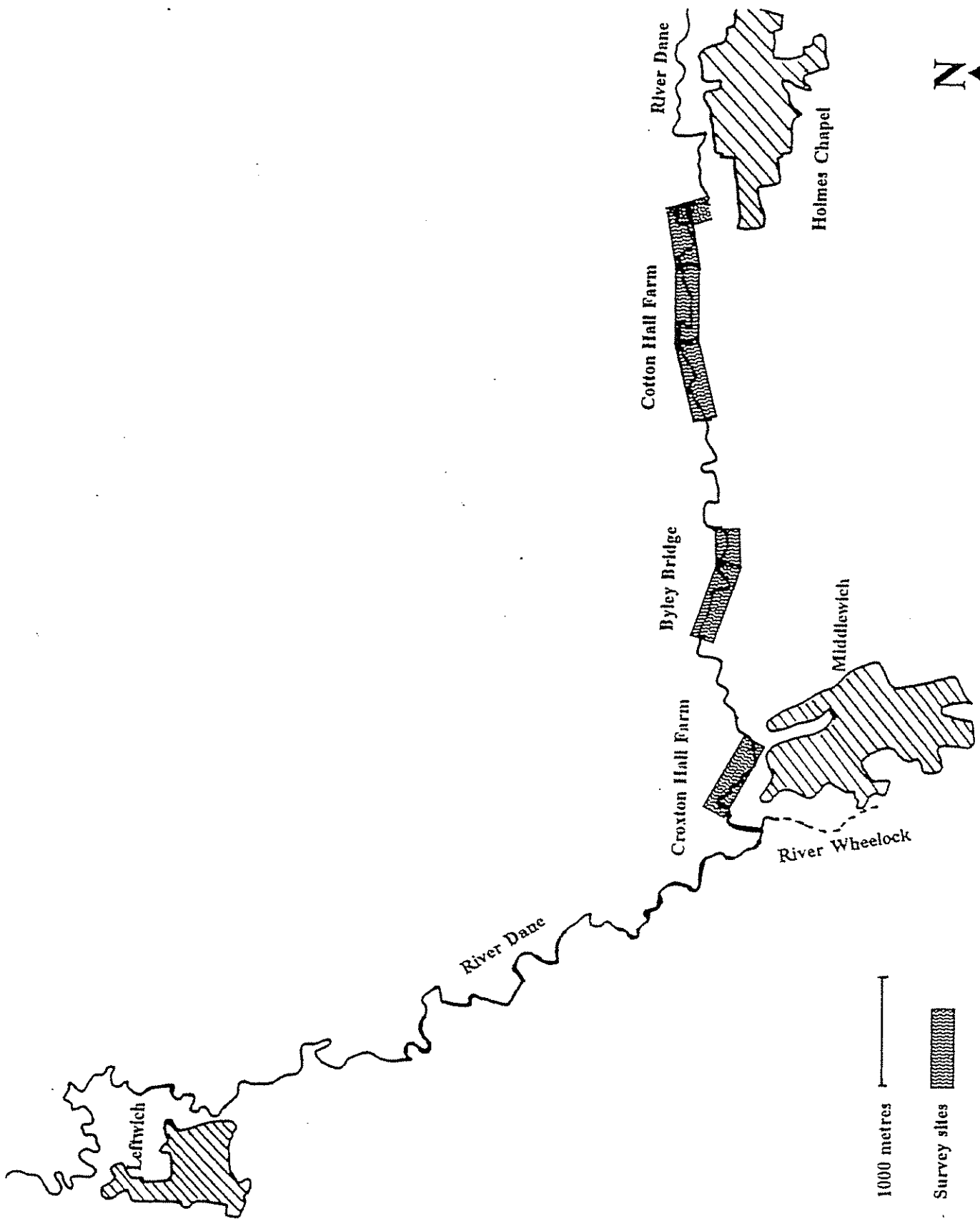
4.4 COMPARISON SAMPLINGS BY STANDARD TECHNIQUES

In order to examine how representative the anglers' catches were of the fish stocks and to compare results from different sampling methods, additional sampling was undertaken. On the River Weaver at Hartford Bridge there was a suitable site for seine netting. Netting was undertaken by using a large seine net (dimensions 150 metres long, 10 metres deep, mesh size. 16mm knot to knot). The seine netting was undertaken on the 25/5/93 as part of the development of the angling match monitoring methodology (see Section 11.3.3).

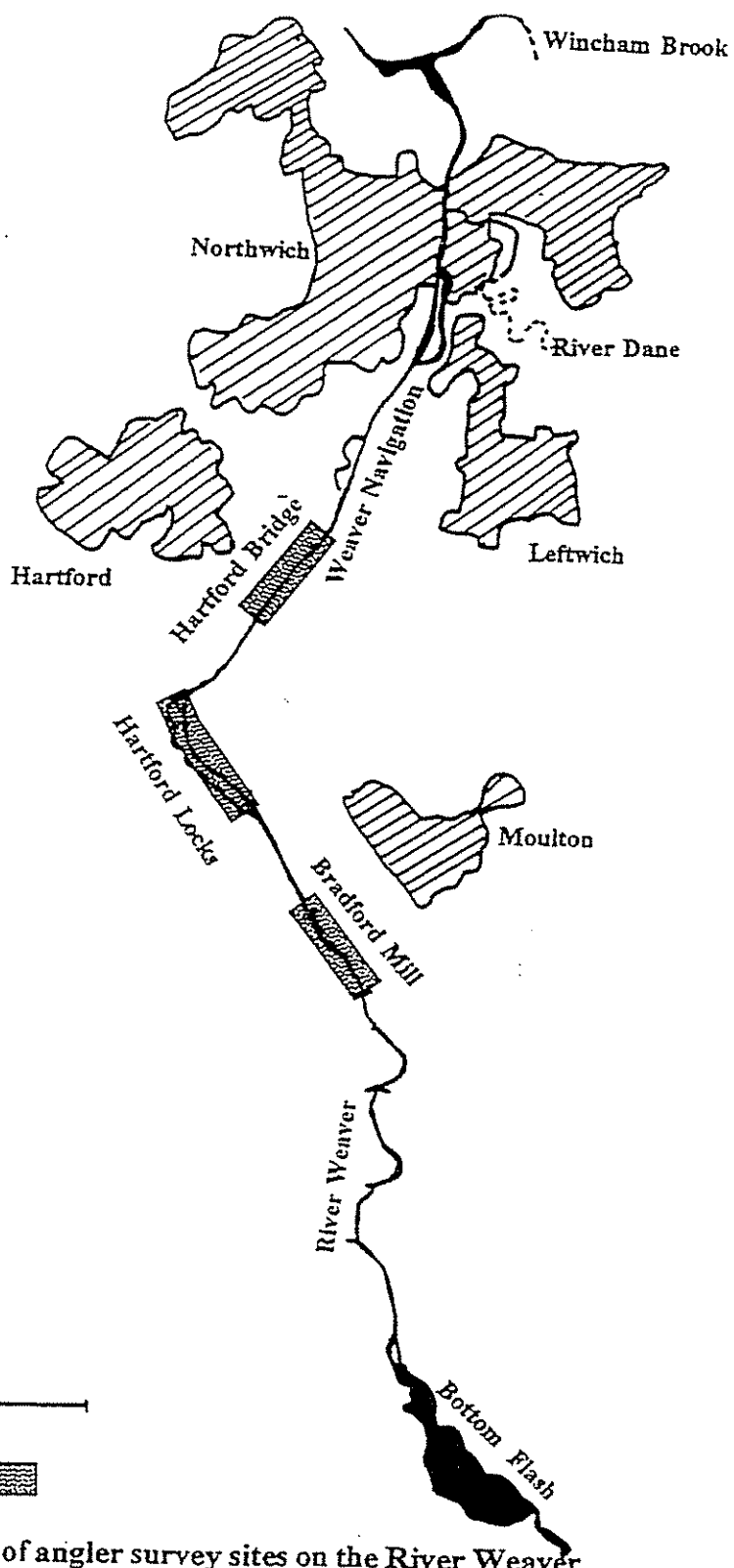
On the River Dane electric fishing surveys noting the species compositions were undertaken on two occasions. These comprised:

- An extensive electric fishing survey using 2 anodes Electrocatch apparatus from a boat on the 4th June 1993 from Holmes Chapel Weir (NGR SJ758678) to Byley Bridge (NGR SJ715675). The survey was conducted by noting the species of fish stunned at the anodes as the boat drifted downstream. No fish were measured during this survey.
- An electric fishing survey was carried out using 2 anodes from a boat at the Croxton Hall Farm fishery (NGR SJ698673) on the 18th October 1995. A stop net was used in attempt to reduce the number of fish avoiding capture. All fish stunned in this survey were captured and fork length measured to the nearest millimetre.

Difficulties were encountered during both surveys of the River Dane by electric fishing, with fish being noted to avoid capture. This problem was still observed with the use of a stop net in the latter survey. The sampling of fish on the River Dane proved to be relatively ineffective in the deeper pools.



Map 1: Location of angler survey sites on the River Dane



Map 2: Location of angler survey sites on the River Weaver

4.5 RESULTS OF INTENSIVE SURVEY

4.5.1 Basic survey statistics

The survey statistics for the intensive angler survey of the Rivers Weaver and Dane are presented in Table 1. A total of 500 angler interviews were undertaken on the River Weaver and 587 interviews on the River Dane in 59 surveying days. The mean encounter rate for anglers on both rivers (between June and August 1993) was 19 anglers per interview day with an average catch of 8 fish. Analysis of the encounter rate with anglers by month showed that June to August provided the highest rate (see Figure 6a). The highest catches of fish were also found through the same period (see Figure 6b). The use of keepnets by anglers and the numbers permitting examination of their catches are given in Figure 7.

	River Weaver	River Dane
Number of anglers encountered	500	587
Number of catches photographed	55	46
Number of man-days of angling effort encountered	229.5	337.5

Table 1: Basic survey statistics from 1993 intensive angler survey of the River Weaver and the River Dane

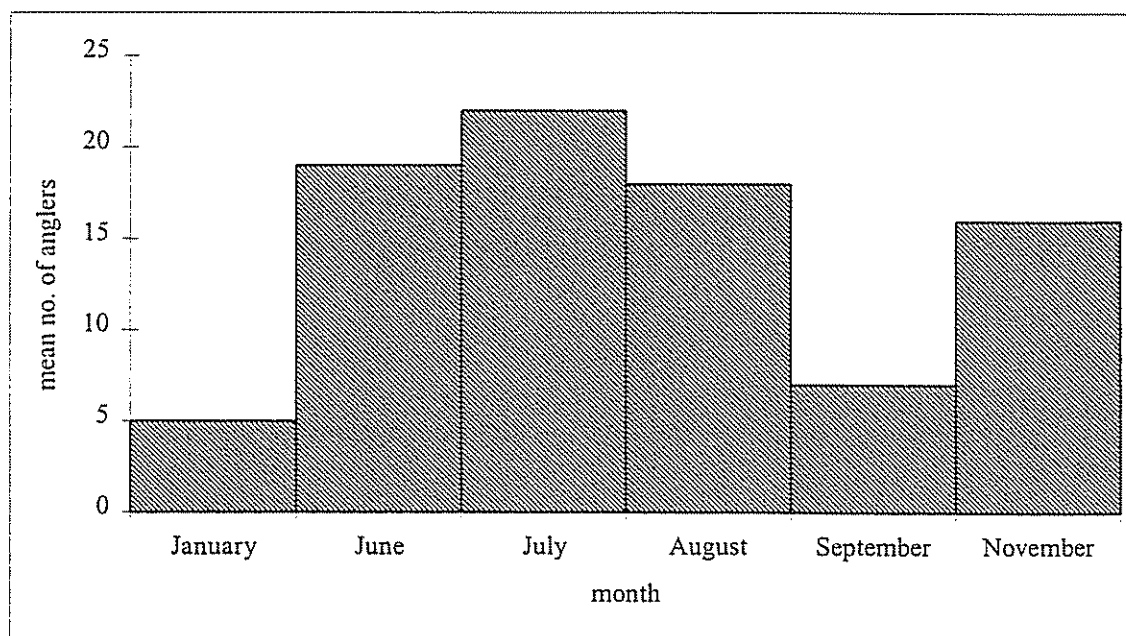


Figure 6(a): Mean number of anglers interviewed per survey day by month

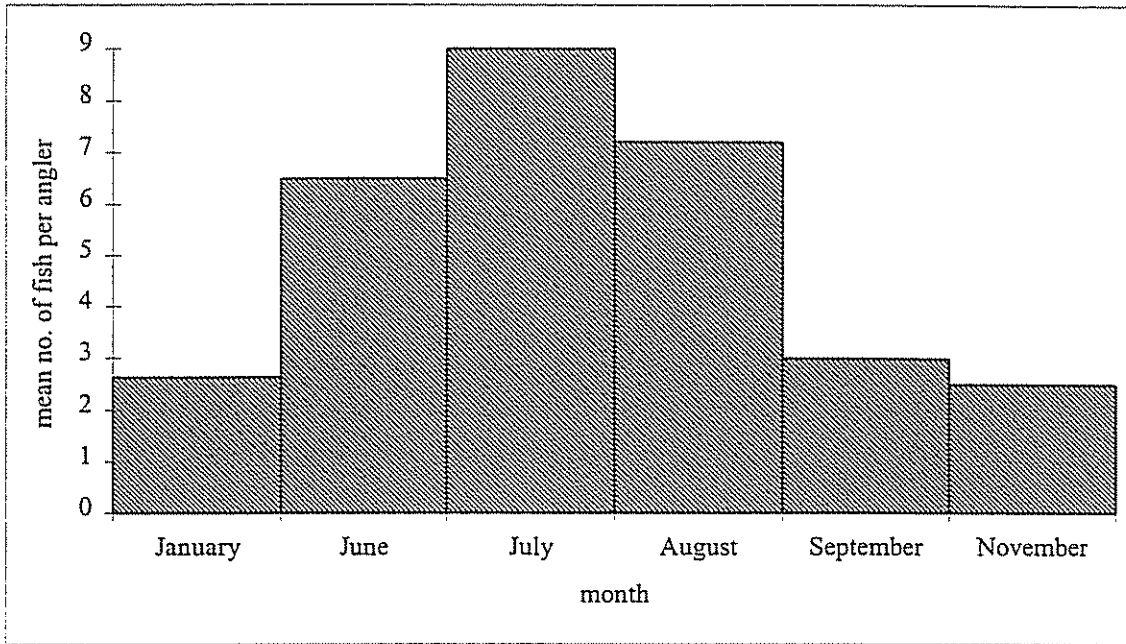


Figure 6(b): Mean number of fish caught per angler interviewed by month

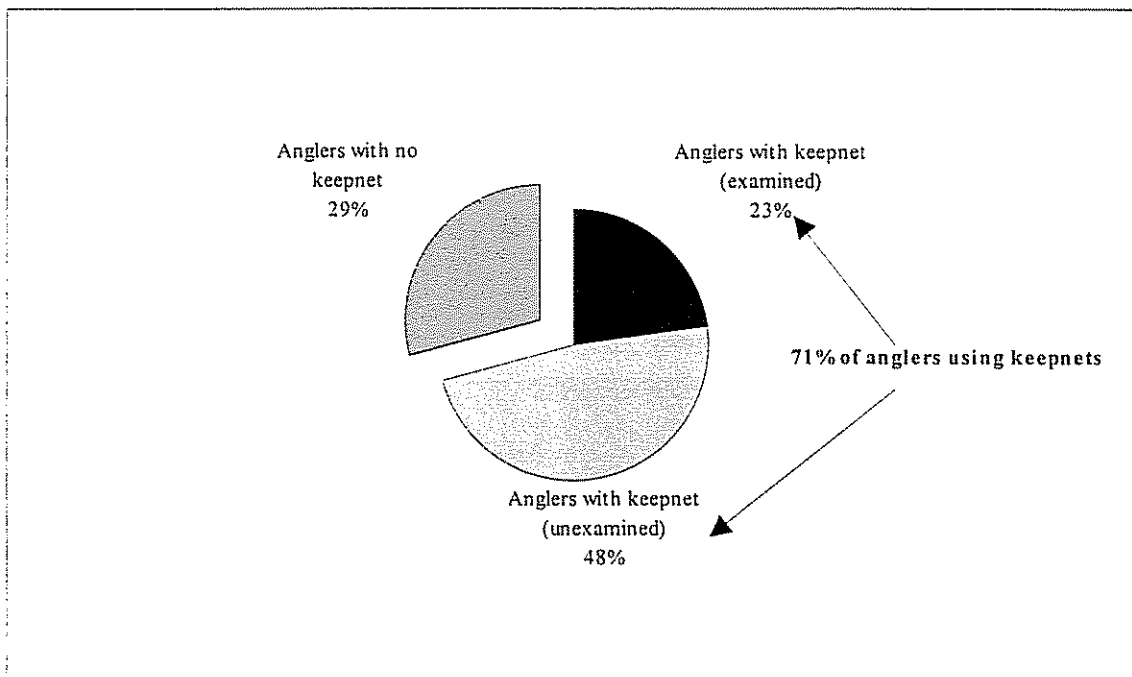


Figure 7: Use of keepnets and availability of catches for examination from the 1993 intensive survey.

4.5.2 Angler behaviour

The anglers' start and expected finishing time for each session was noted. The peak starting time of angling sessions on the River Weaver and Dane was 9:00 am with 90% of the anglers having started by 12:00 noon (see Figure 8(a) and 8(b)). The overall peak finishing time for angling sessions on the River Weaver was 4:30pm and 3:30pm on the River Dane (see Figure 8(c) and 8(d)).

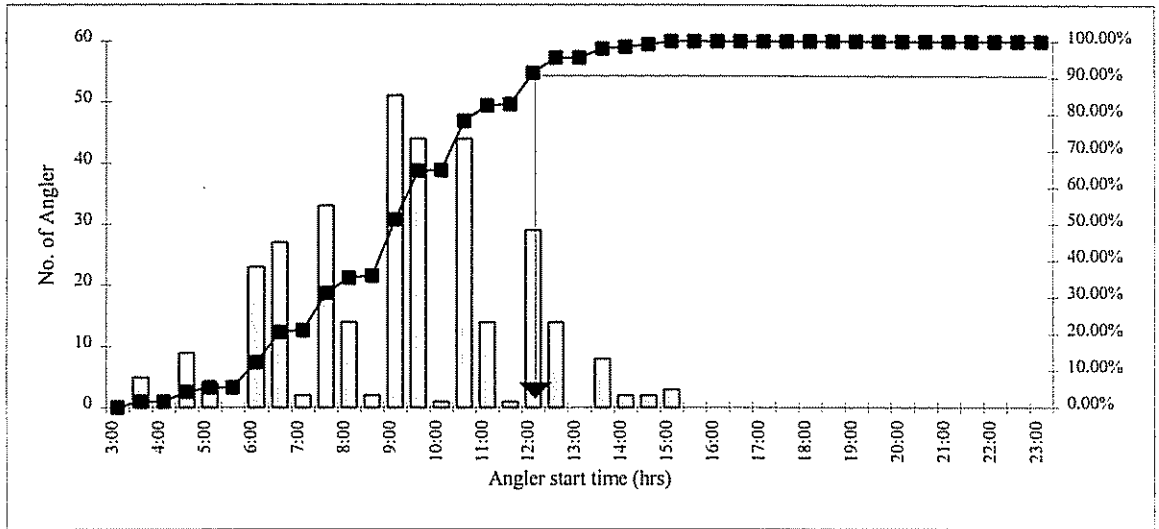


Figure 8(a): Angling session start times for the River Weaver

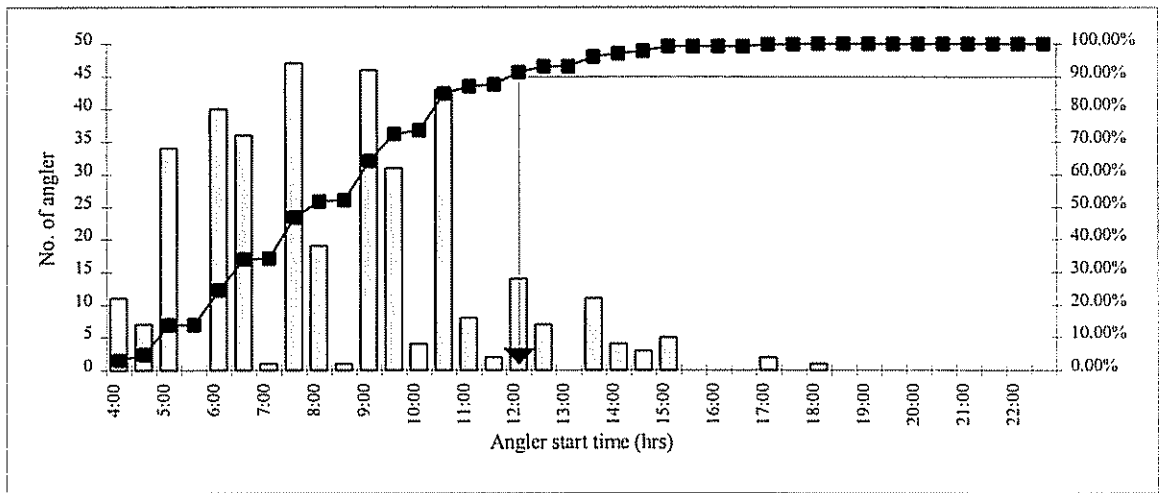


Figure 8(b): Angling session start times for the River Dane

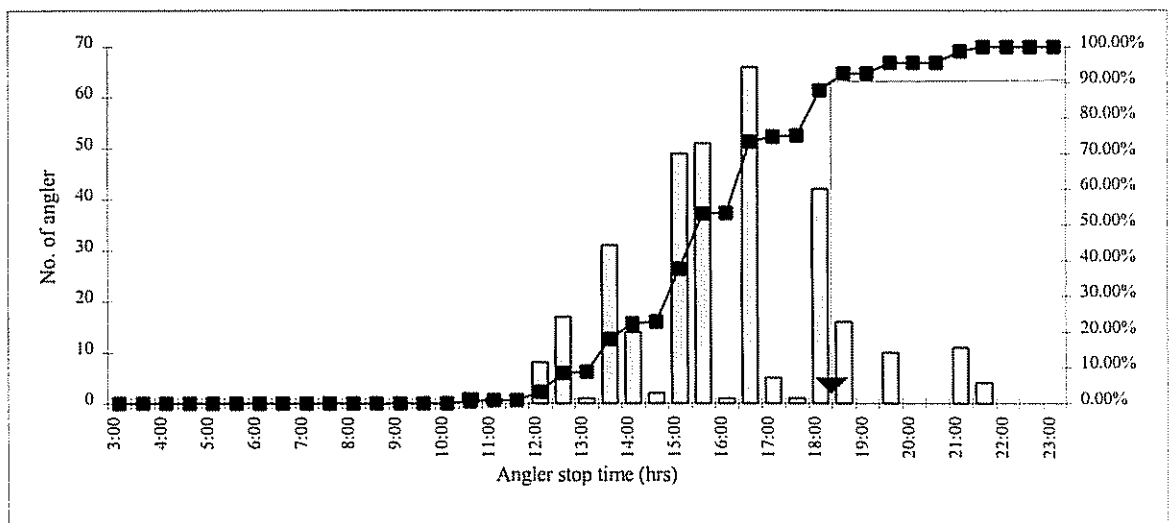


Figure 8(c): Angling session finishing times for the River Weaver

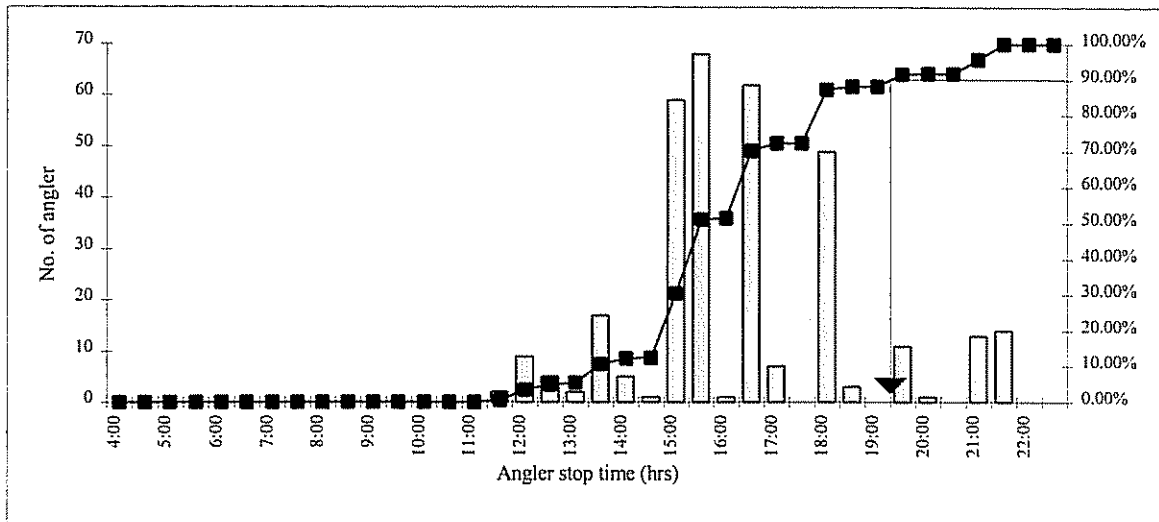


Figure 8(d): Angling session finishing times for the River Dane

The mean time periods for angling sessions on the River Weaver and Dane were 6 hours and 50 minutes and 7 hours and 20 minutes respectively.

Anglers were asked to recollect the number of days spent fishing through the different seasons of the year. Although this can only be used as a guideline, because it relies on recollection, the results indicate that the majority of visits take place during the summer period (June-September). Results of recollection of seasonal effort are presented in Figures (9(a) to 9(d)).

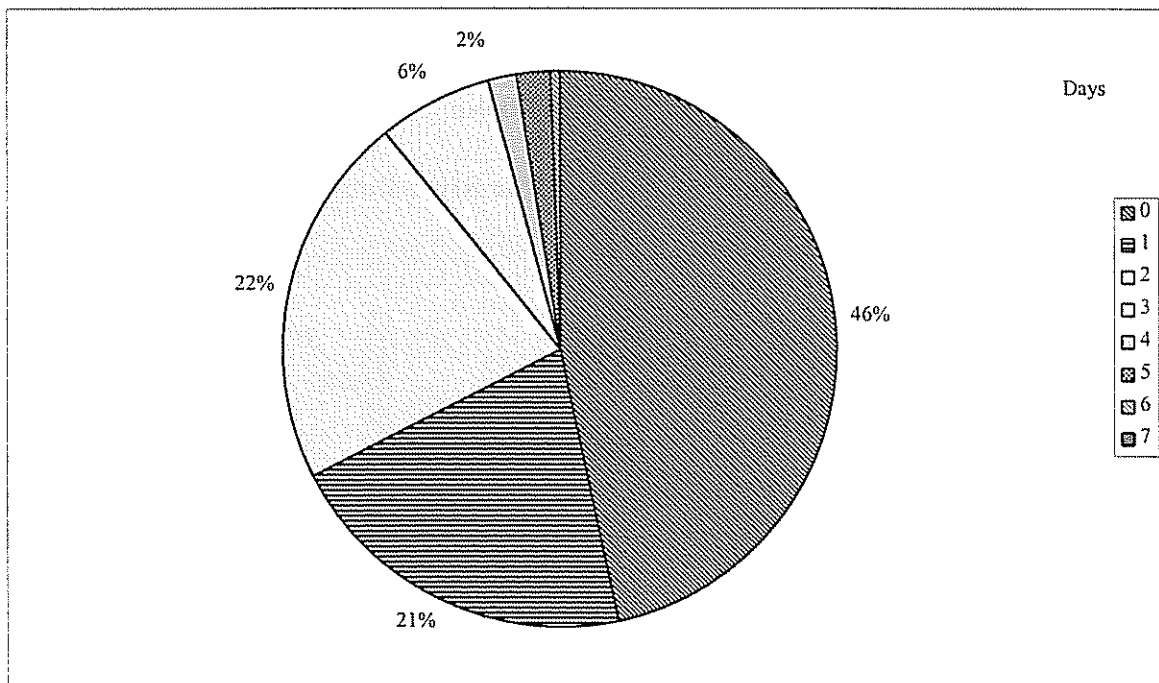


Figure 9(a): Anglers recollection of number of days fished per week in spring (March-June)

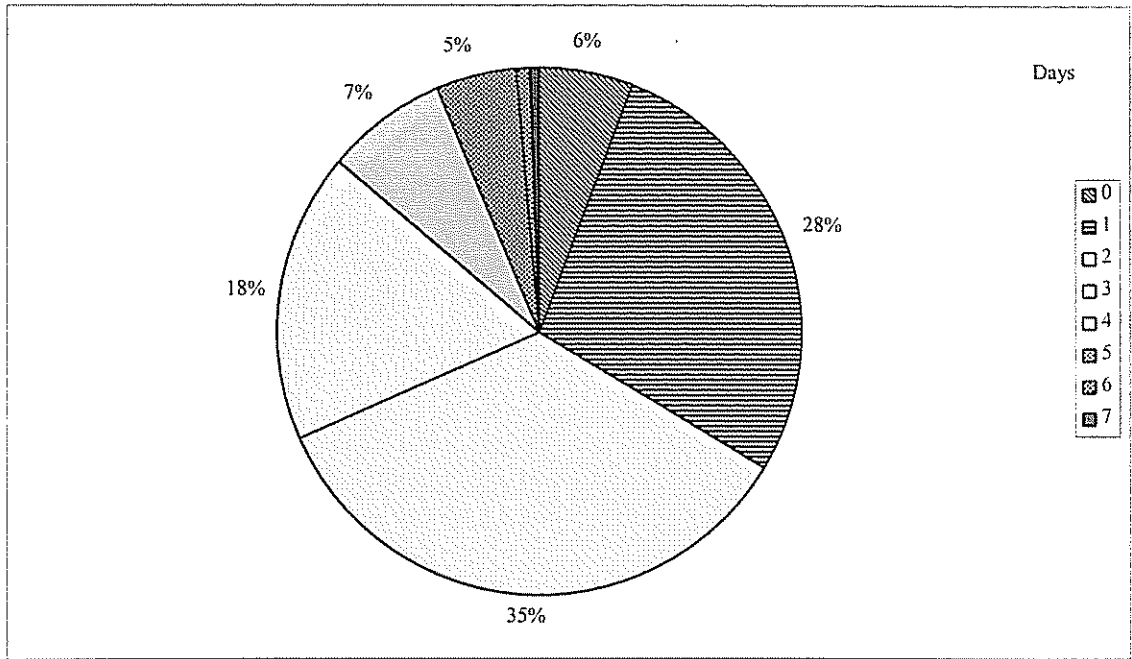


Figure 9(b): Anglers recollection of number of days fished per week in summer (June-September)

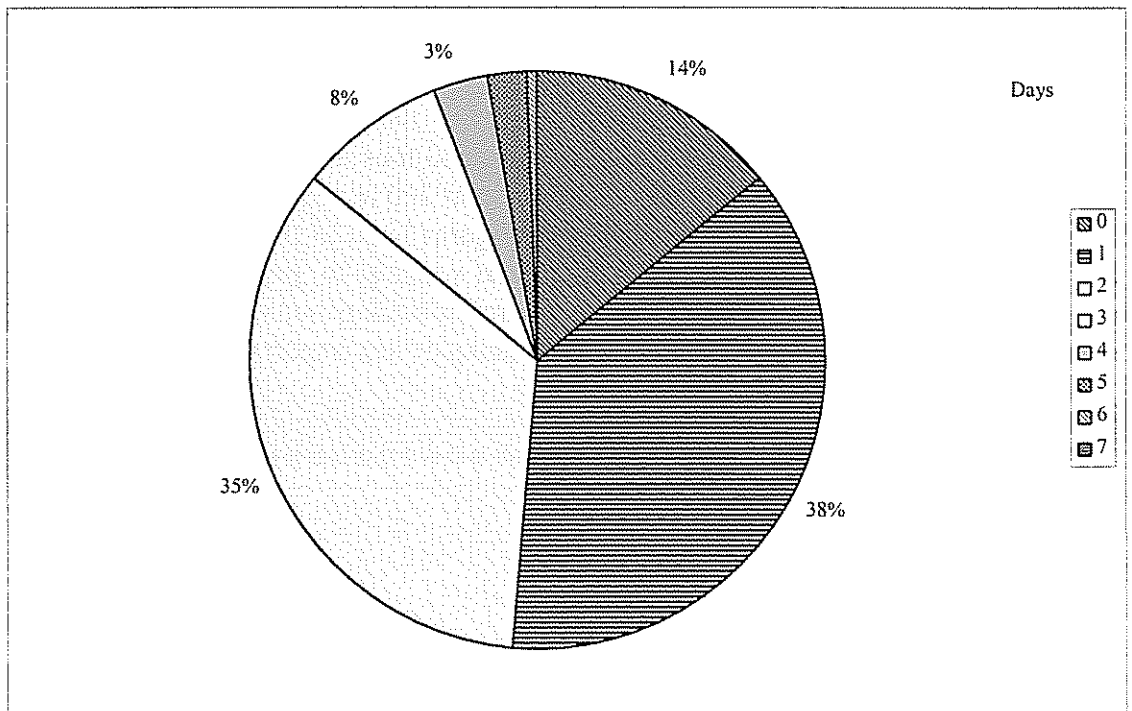


Figure 9(c): Anglers recollection of number of days fished per week in autumn (September-November)

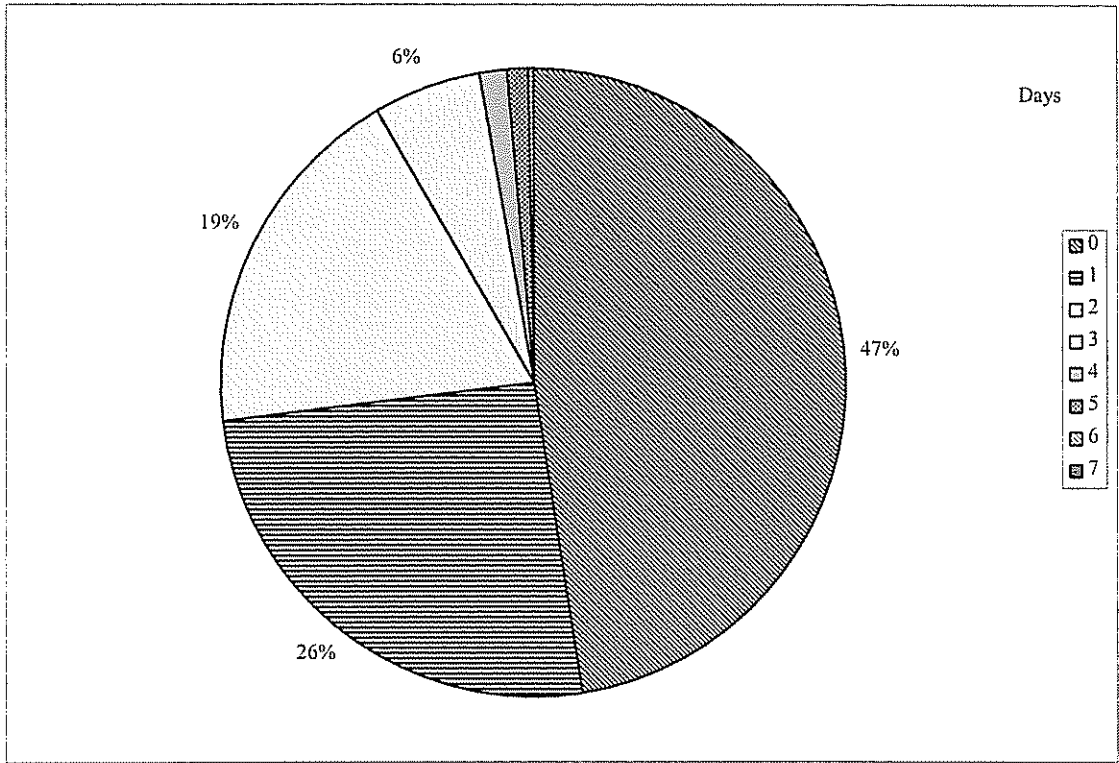


Figure 9(d): Anglers recollection of number of days fished per week in winter (December-March)

Analysis of the location of anglers with respect to the access points to the fishery demonstrated a contagious distribution of anglers, and thus effort, on both fisheries. On the River Weaver 90% of anglers were found within 200 metres of an access point and 90% within 550 metres on the River Dane (see Figures 10(a) to 10(b)). The difference is thought to be due to anglers on the River Dane walking to specific habitat features associated with good catches compared to the more homogenous habitat of the River Weaver leading to selection of fishing position being of less importance.

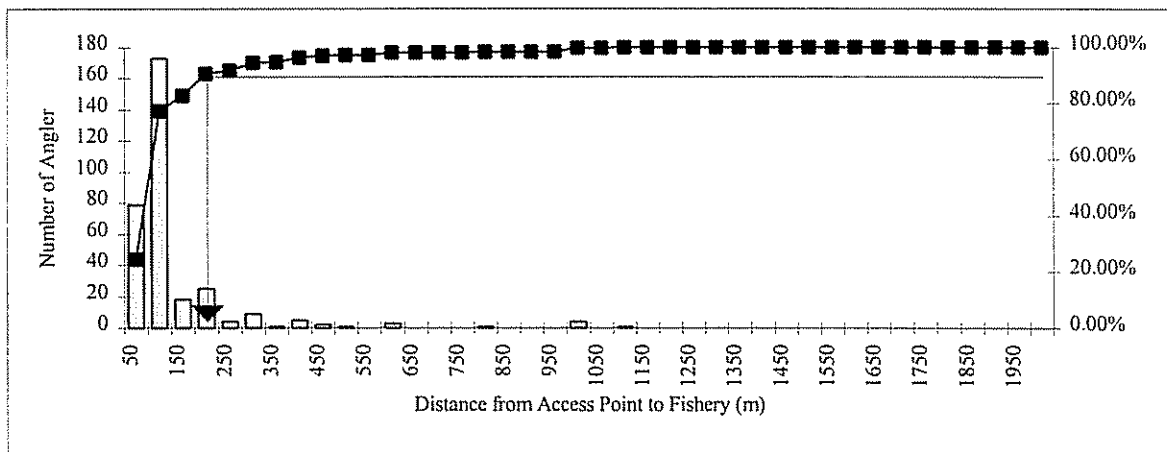


Figure 10(a): Distance of anglers from the nearest access point for the River Weaver

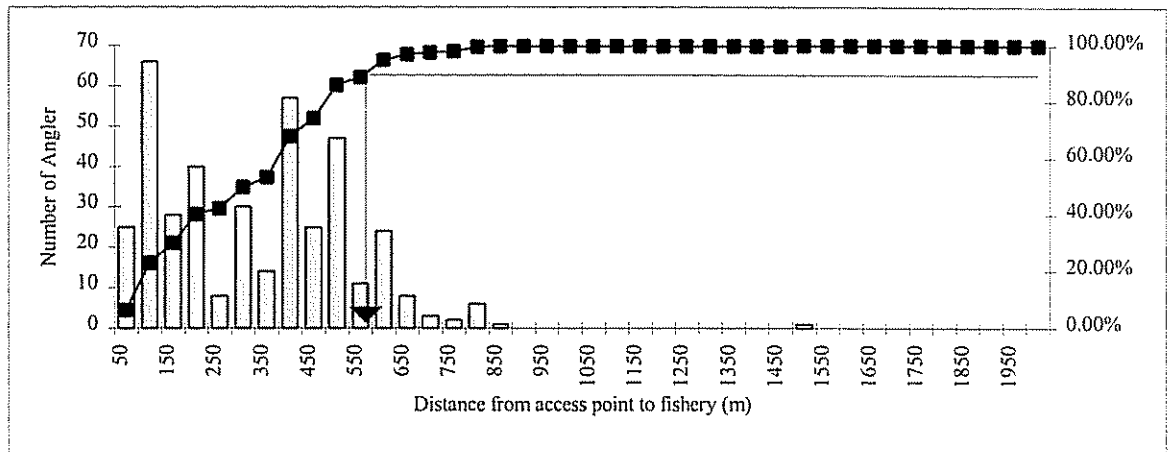


Figure 10(b): Distance of anglers from the nearest access point for the River Dane

4.5.3 Results of anglers' catches and comparison samplings

4.5.3.1 River Weaver

Anglers' recollection of their catches for the River Weaver are presented as a histogram in Figure 11(a). Species composition of anglers' recollected catches are presented in Figure 11(b). Analyses of the photographed catches by the GIS system showed that both species composition and fork length can readily be obtained. Length frequency histograms from the photographic record for the dominant species on the River Weaver are presented in Figures 12(a) to 12(d).

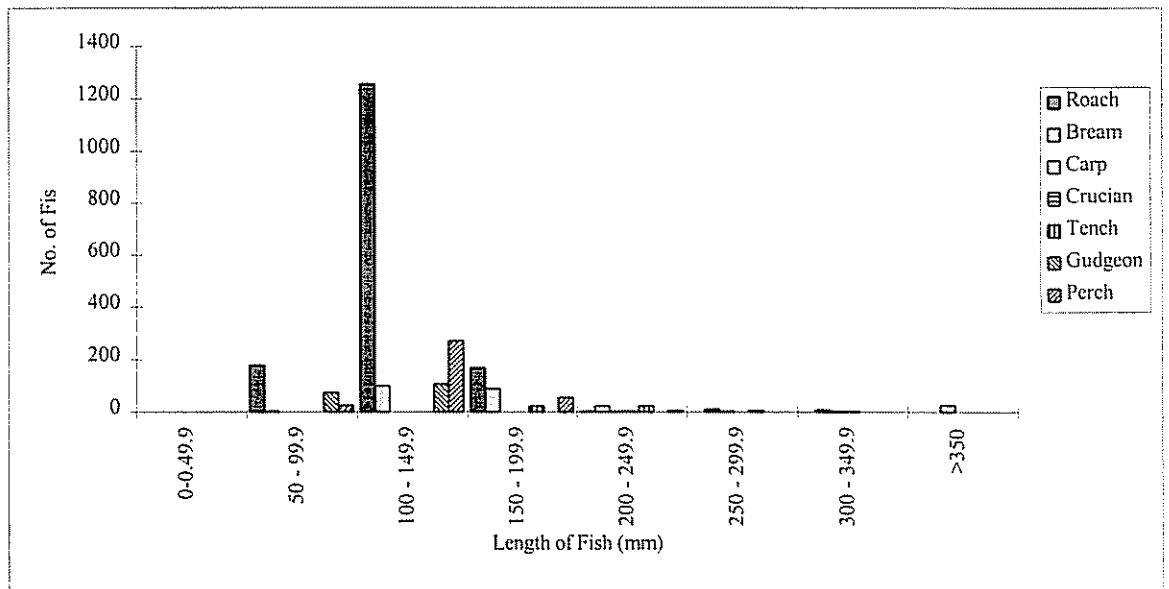


Figure 11(a): Total angler recollected catch by size and species for the River Weaver

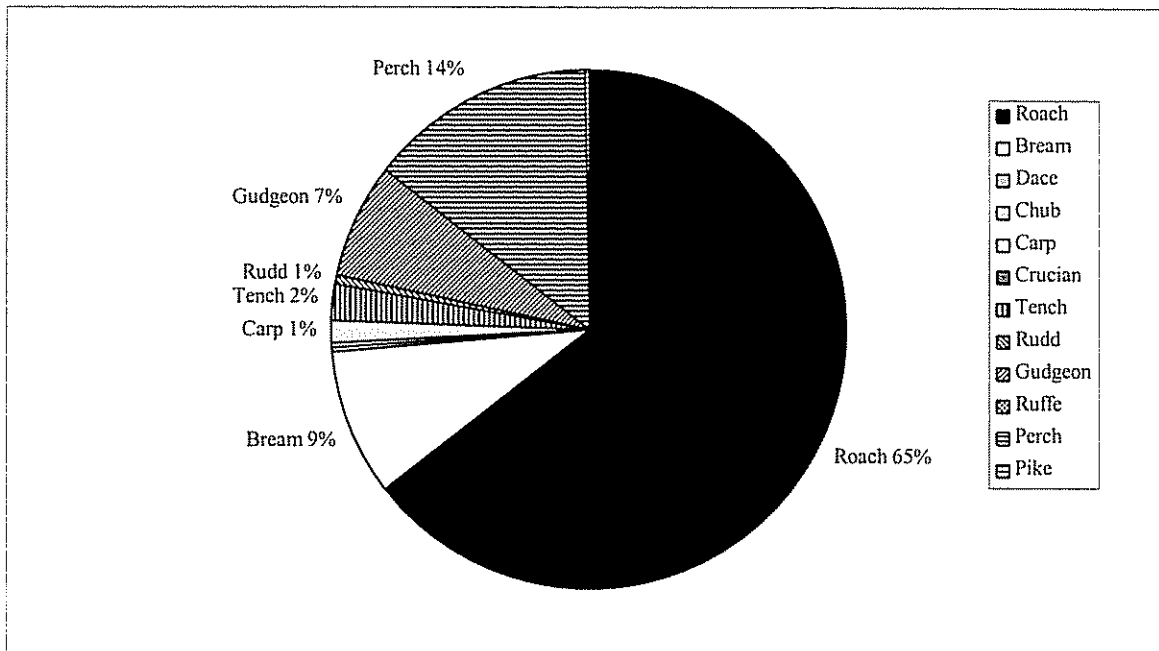


Figure 11(b): Species composition of recollected anglers' catches from the 1993 River Weaver survey

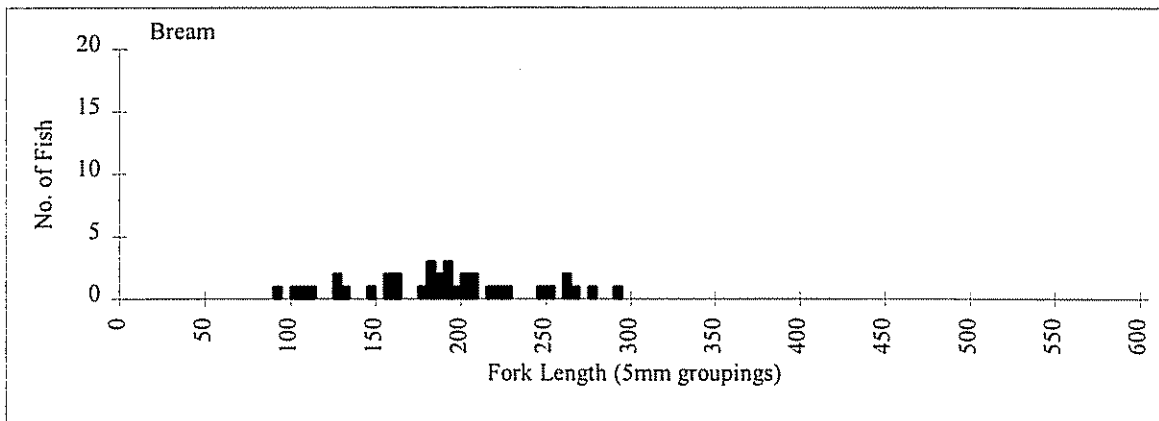


Figure 12(a): Length frequency histogram for bream from anglers' photographed catches from the River Weaver

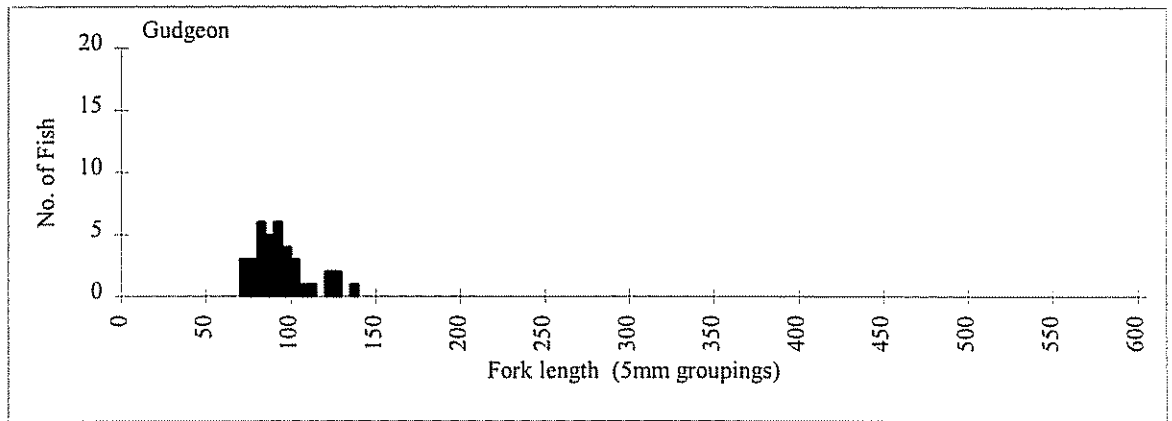


Figure 12(b): Length frequency histogram for gudgeon from anglers' photographed catches from the River Weaver

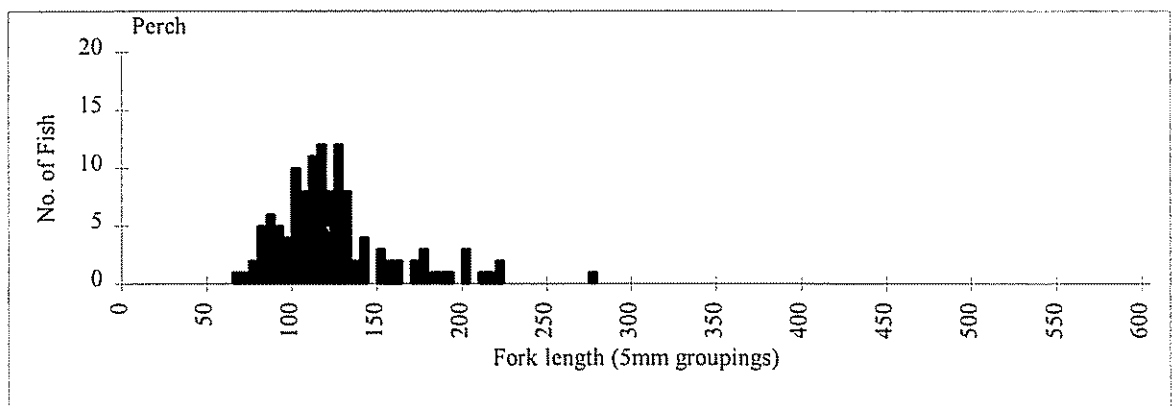


Figure 12(c): Length frequency histogram for perch from anglers' photographed catches from the River Weaver

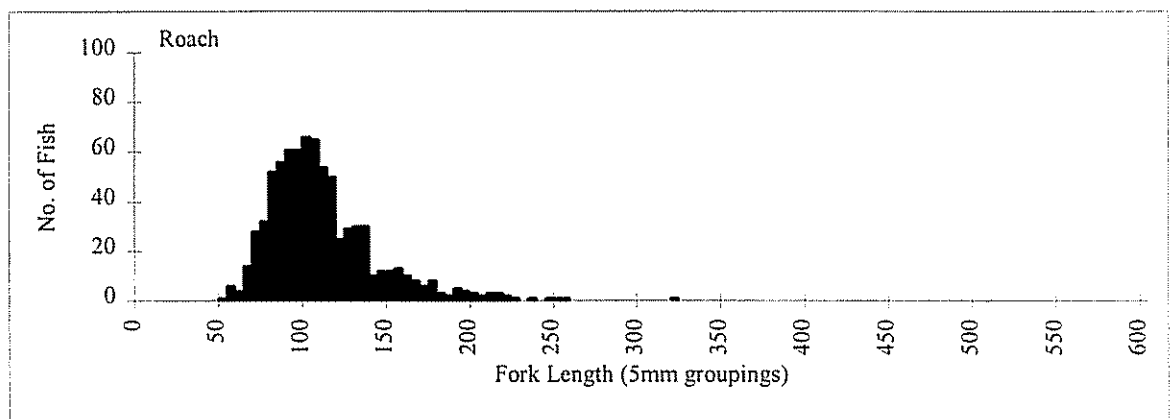


Figure 12(d): Length frequency histogram for roach from anglers' photographed catches from the River Weaver.

Species composition for all species for a River Weaver seine net sample is presented in Figure 13(a). The composition of the dominant species is presented Figure 13(b) to allow comparison with the dominant species in anglers catches (Figure 13(c)).

Length frequency histograms from seine netting results for the dominant species in the River Weaver are presented in Appendix 4, Figure numbers 19(a)-19(d), 20(a)-20(d), 21(a)-21(d) for comparison with those recorded from the anglers' catches.

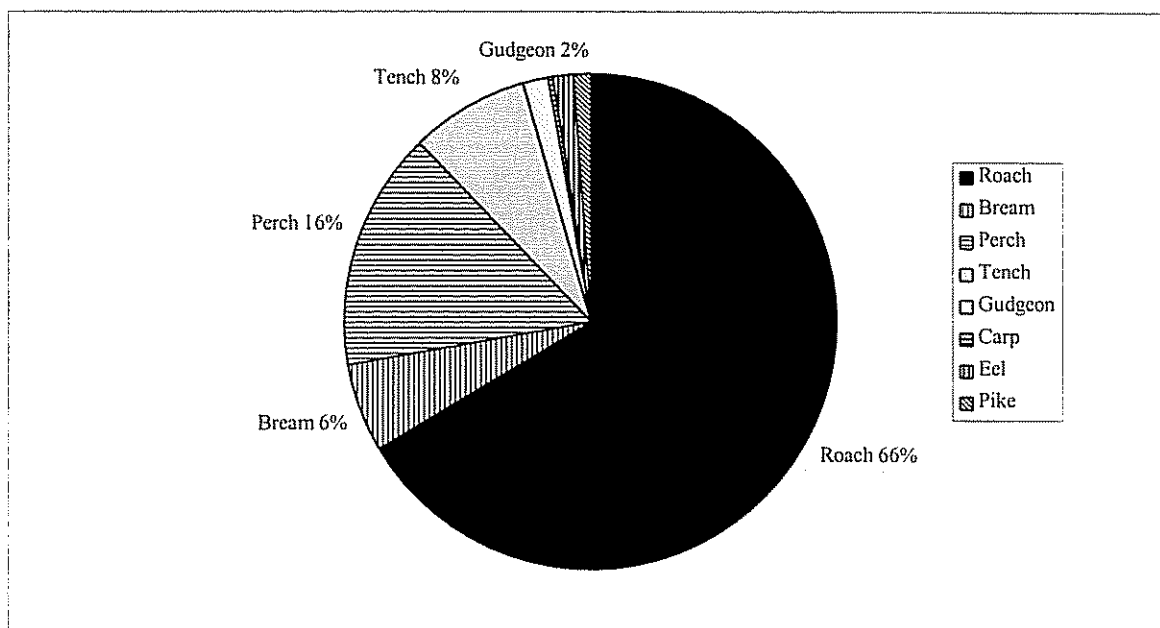


Figure 13(a): Overall species composition from a seine netting sample undertaken on the 25th May 1993 on the River Weaver

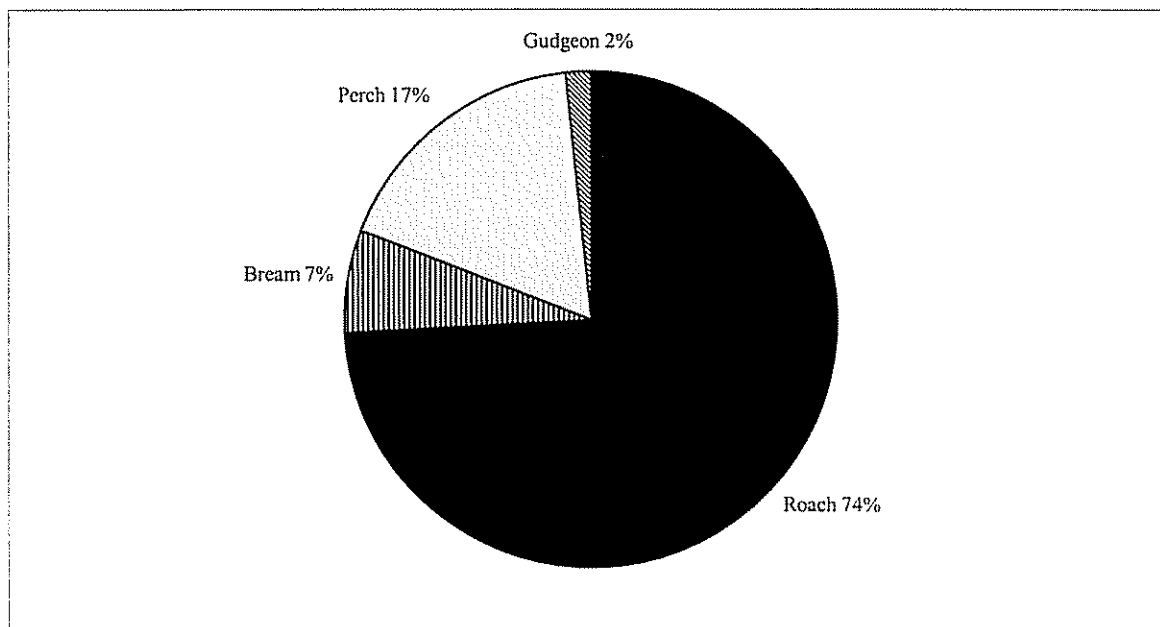


Figure 13(b): Species composition for the dominant species from a seine netting sample undertaken on the 25th May 1993 on the River Weaver

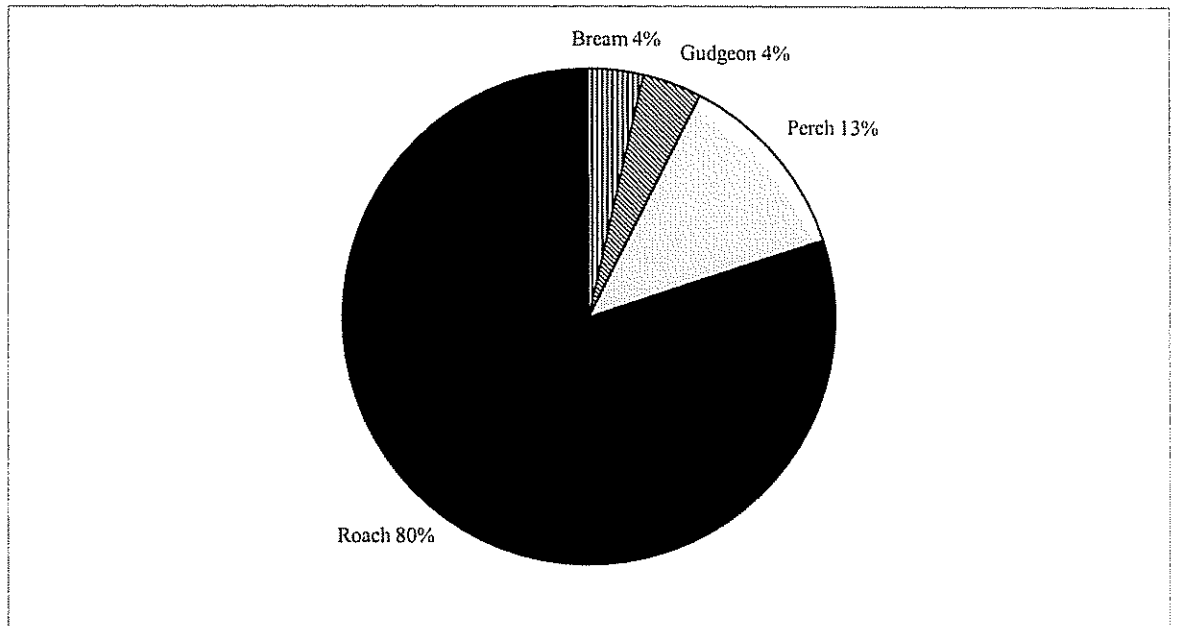


Figure 13(c): Species composition of the dominant species observed in photographed pleasure anglers catches on the River Weaver

4.5.3.1 River Dane

Anglers' recollection of their catches for the River Dane are presented as a histogram in Figure 14(a). Species composition of anglers' recollected catches are presented in Figure 14(b).

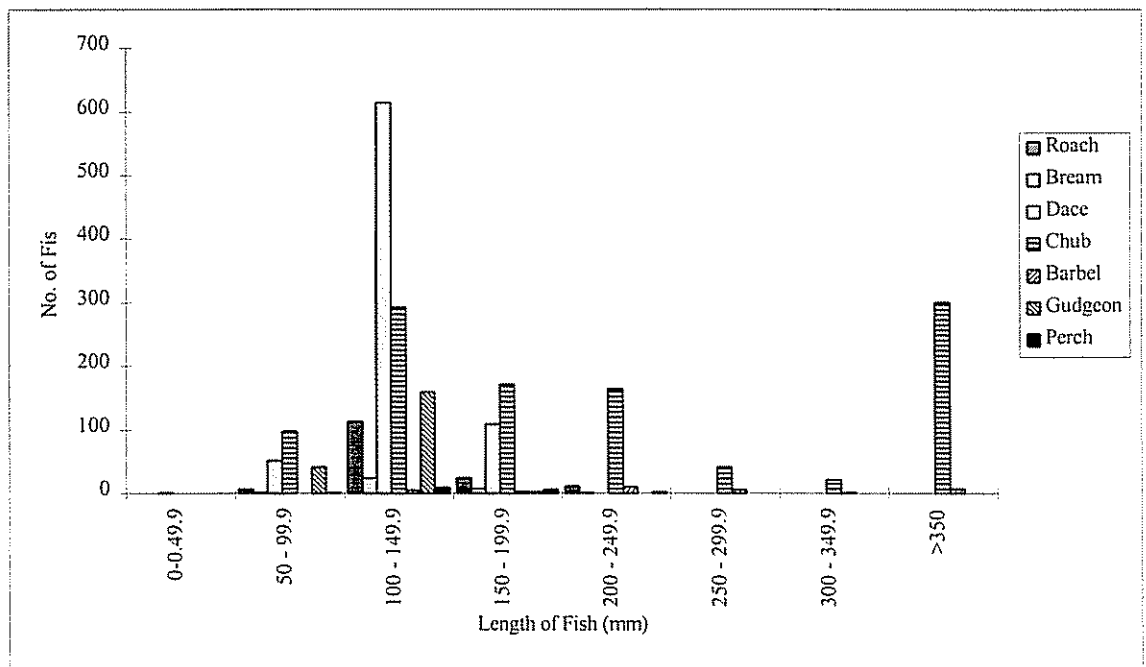


Figure 14(a): Total angler recollected catch by size and species in the River Dane

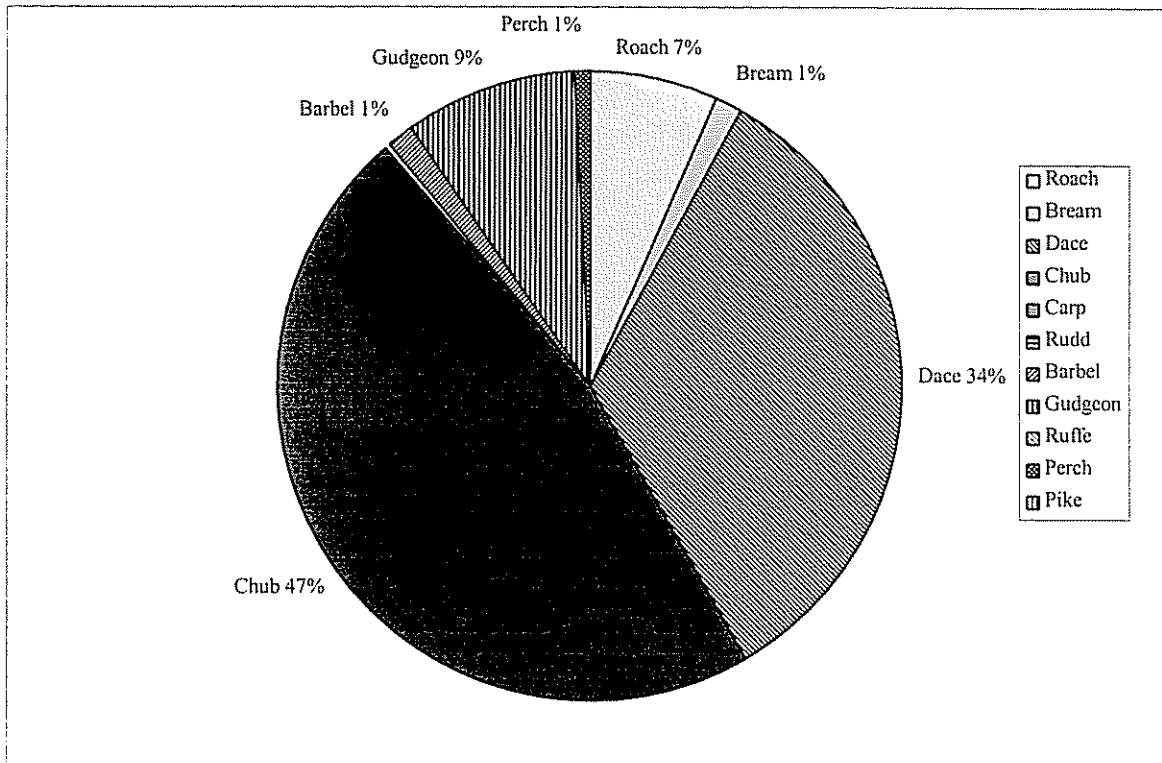


Figure 14(b): Species composition of recollected anglers' catches from the 1993 River Dane Survey

Length frequency histograms from the photographic record for the dominant species in anglers catches on the River Dane are presented in Figures 15(a) to 15(d) which may be compared to the results obtained from electric fishing surveys in Figures 16(a) to 16(d). These length frequency plots have been arranged to allow comparison of the results obtained from the photographing of the anglers' catches and electric fishing of the River Dane.

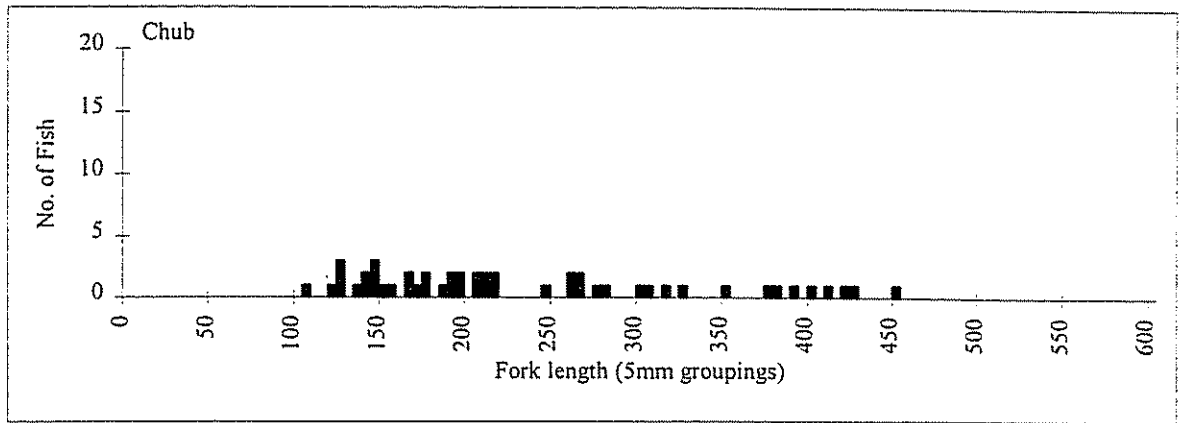


Figure 15(a): Length frequency histogram for chub from anglers' photographed catches from the River Dane.

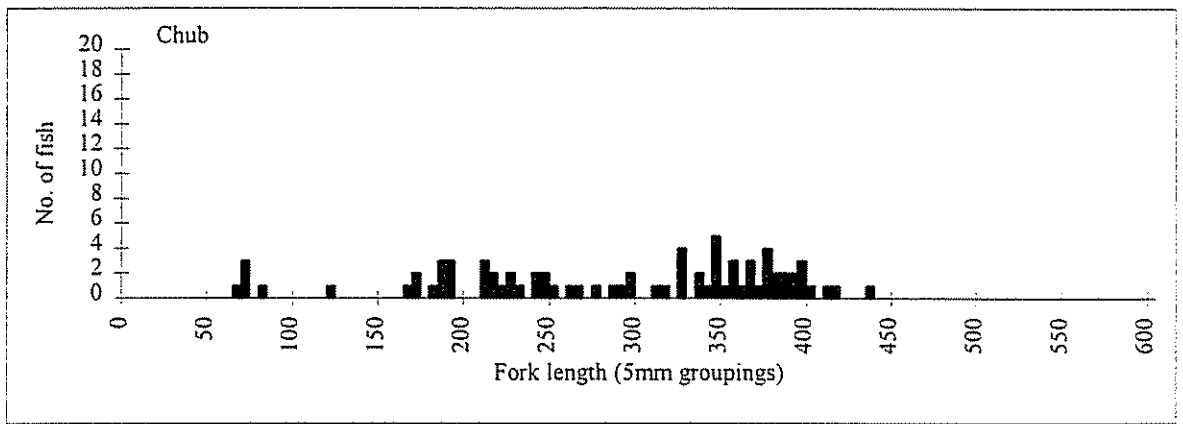


Figure 16(a): Length frequency histogram of chub captured in electric fishing survey of River Dane (18/10/93)

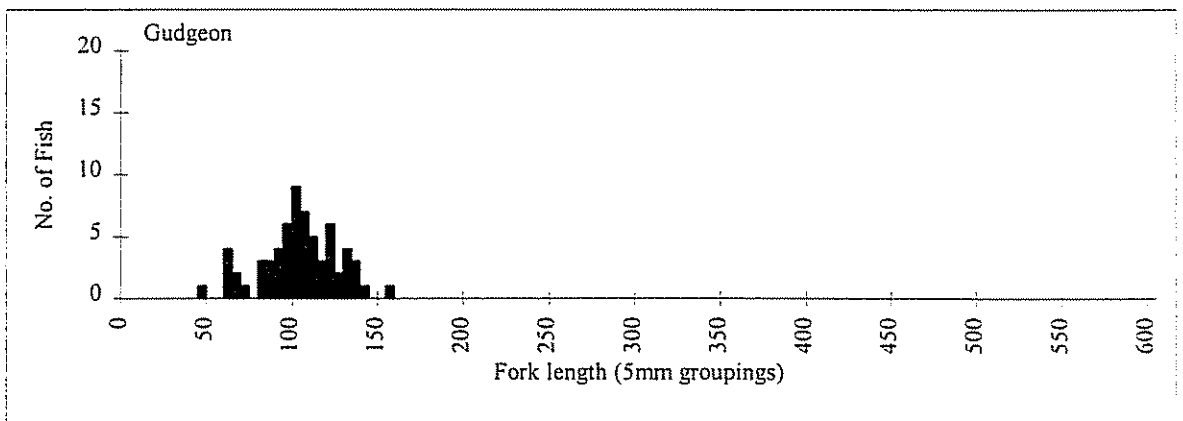


Figure 15(b): Length frequency histogram for gudgeon from anglers' photographed catches from the River Dane

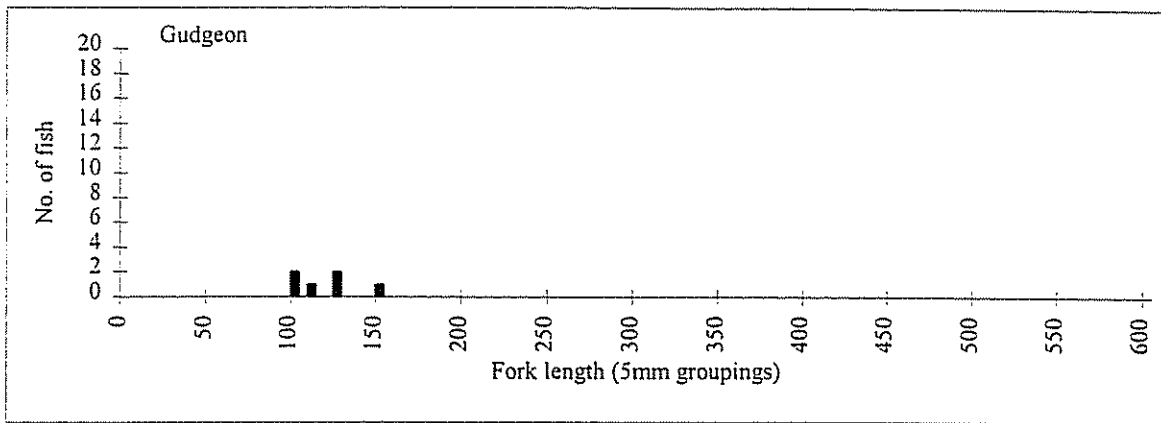


Figure 16(b): Length frequency histogram of gudgeon captured in electric fishing survey of River Dane (18/10/93)

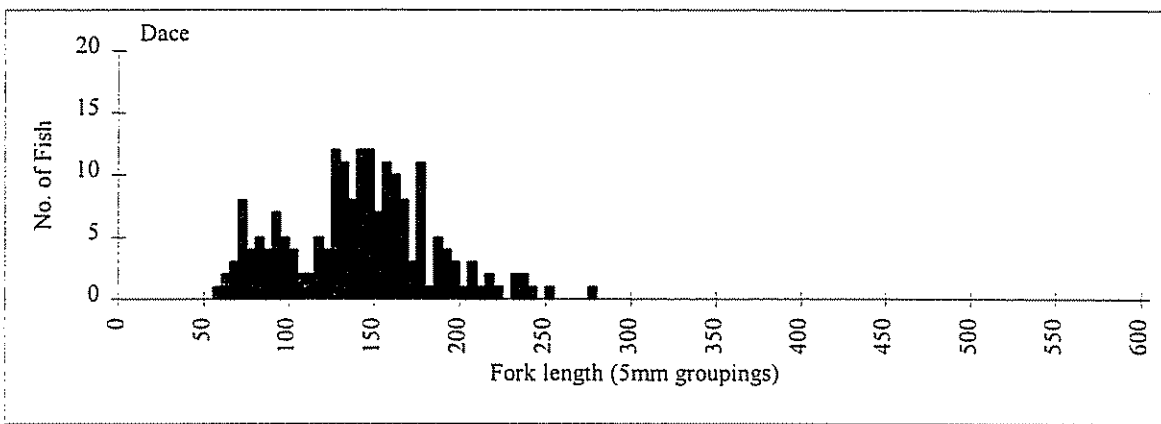


Figure 15(c): Length frequency histogram for dace from anglers' photographed catches from the River Dane

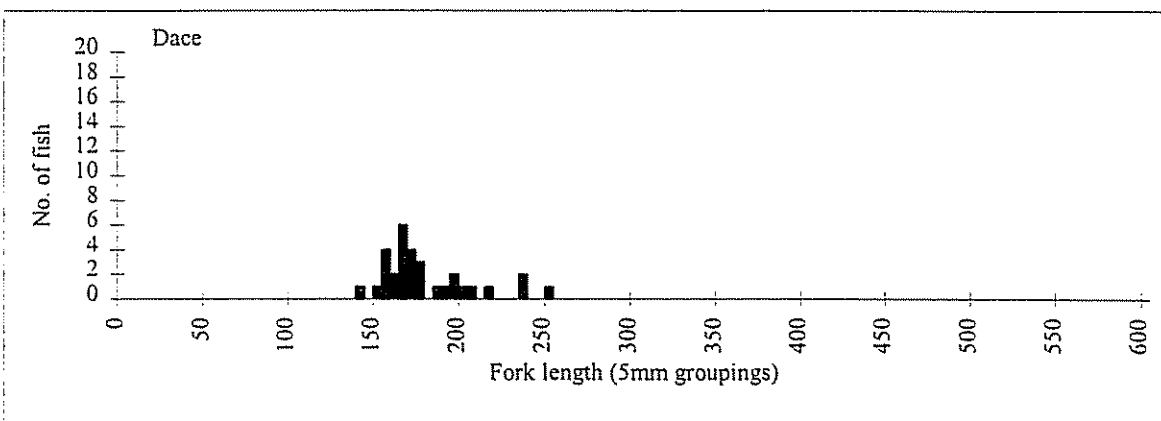


Figure 16(c): Length frequency histogram of dace captured in electric fishing survey of River Dane (18/10/93)

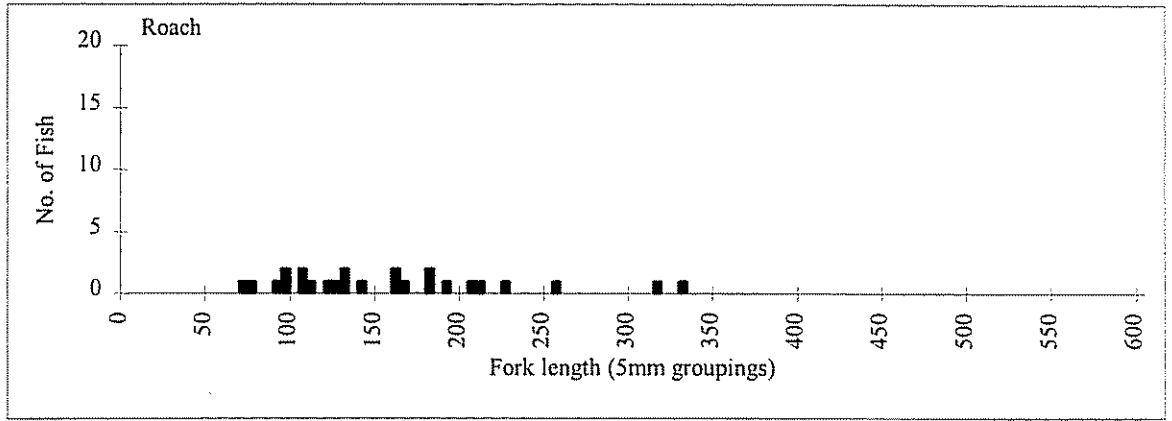


Figure 15(d): Length Frequency histogram for roach from anglers' photographed catches from the River Dane

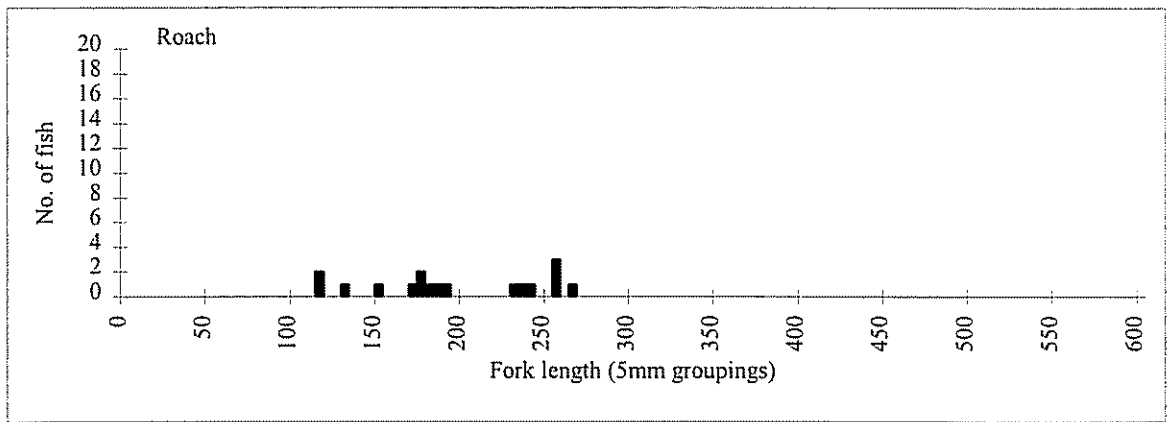


Figure 16(d): Length frequency histogram of roach captured in electric fishing survey of River Dane (18/10/93)

Species composition for all species from the electric fishing surveys for the River Dane (4th June 1993 survey) is presented in Figure 17(a) and for the dominant species in Figure 17(b). Species composition determined from the 18th October 1993 electric fishing survey are presented in Figure 17(c) and for the dominant species in Figure 17(d). The species composition for the dominant species recorded in anglers catches on the River Dane is presented in Figure 17(e) for comparison with the electric fishing data.

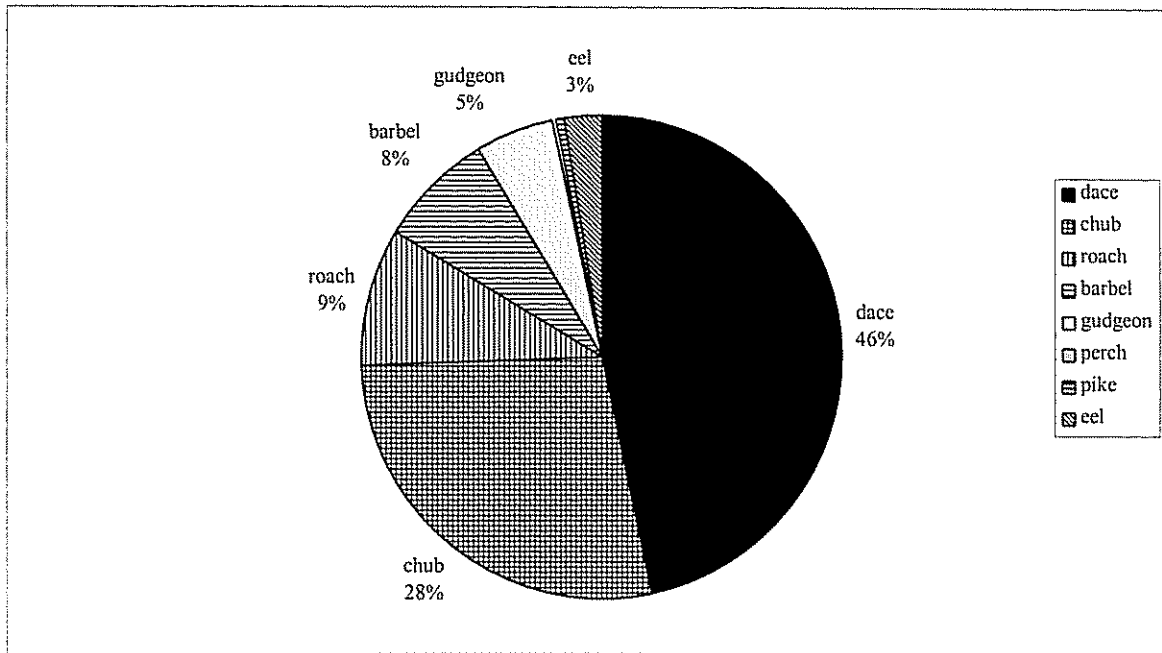


Figure 17(a): Overall species composition for electric fishing sample from the River Dane (4/6/93)

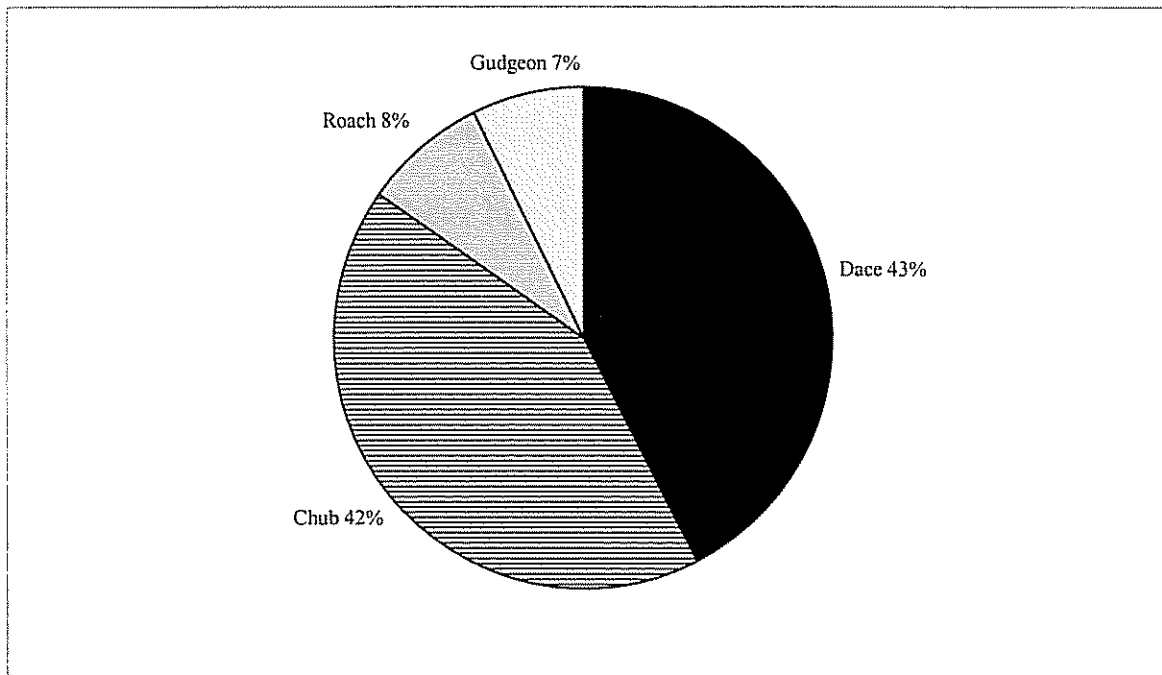


Figure 17(b): Species composition for the dominant species from an electric fishing sample from the River Dane (4/6/93)

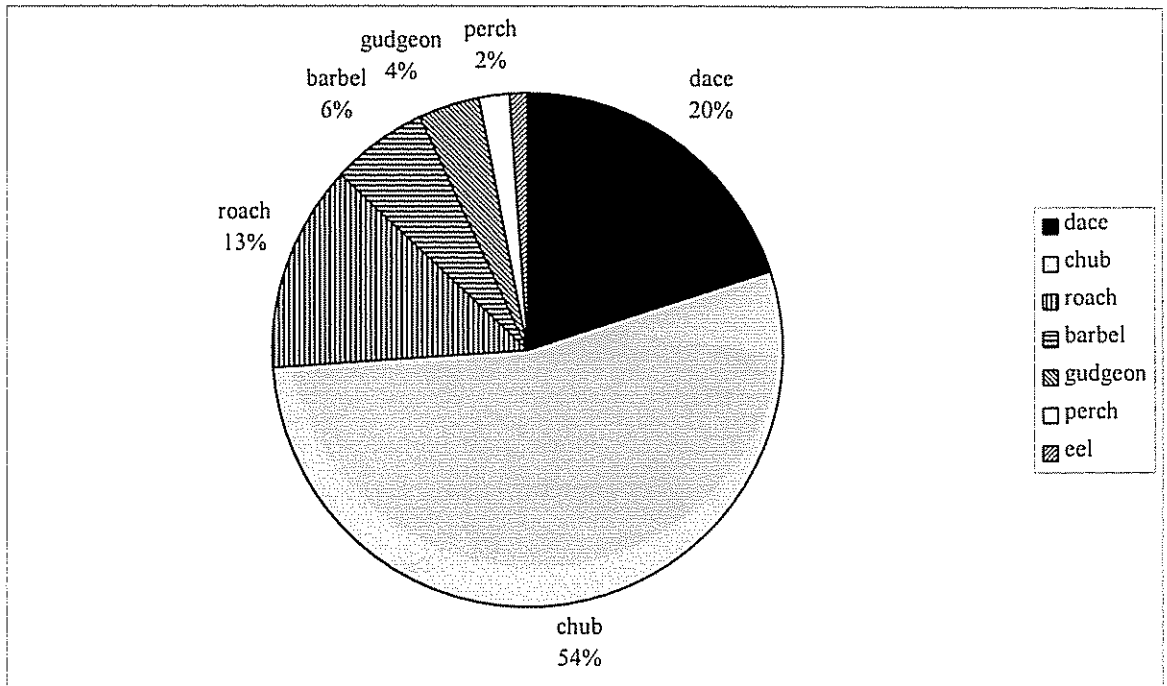


Figure 17(c): Overall species composition for electric fishing sample from the River Dane (18/10/93)

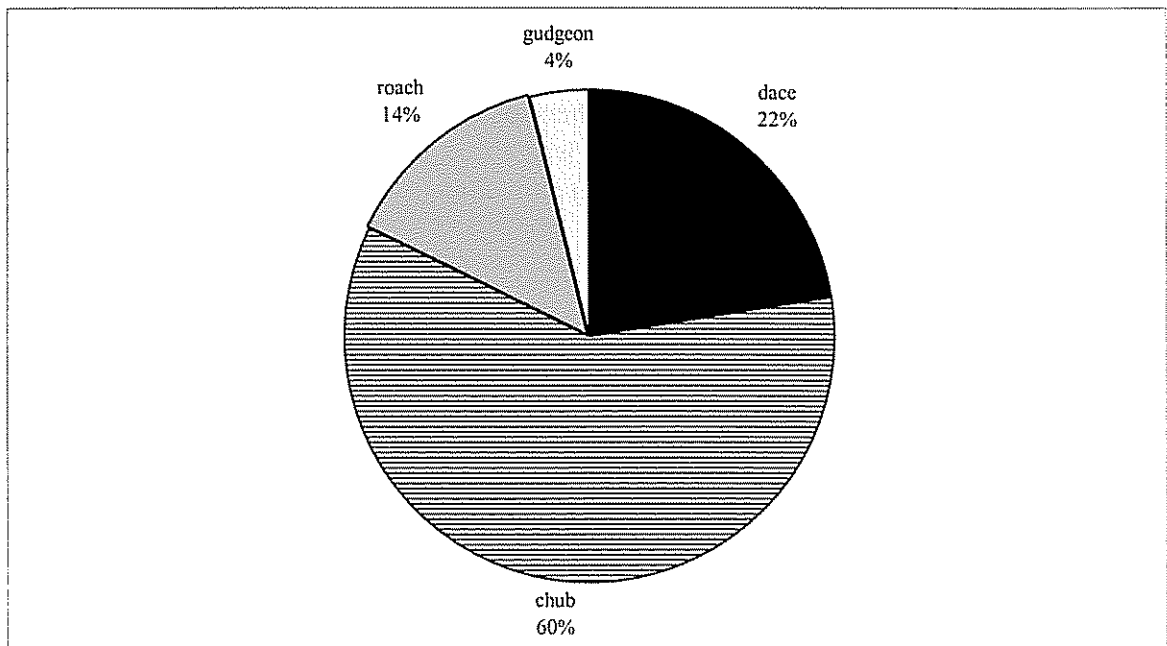


Figure 17(d): Species composition for the dominant species from an electric fishing sample from the River Dane (18/10/93)

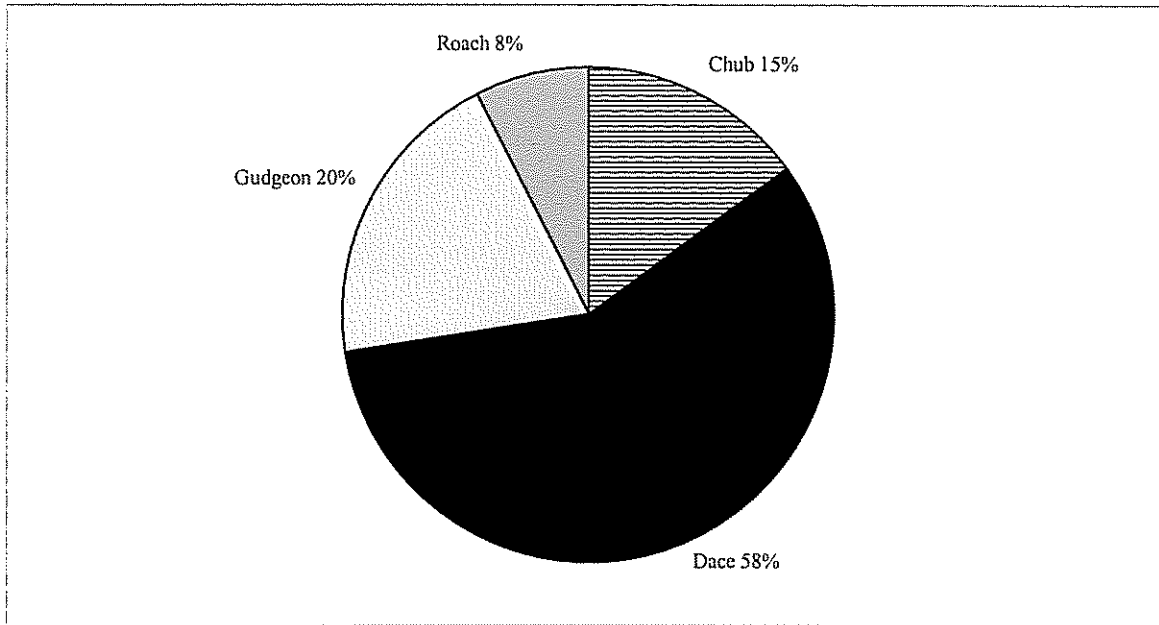


Figure 17(e): Species composition of the dominant species observed in photographed pleasure anglers catches on the River Dane

4.5.4 Results of analysis of anglers' recollection of their catches

The analysis of angler recollection of their catch compared to photographed and examined catches demonstrated that the recollection was generally poor. Anglers tended to over estimate both the size and numbers of fish caught (see Figure 18(a)). Mis-identification of juvenile cyprinid species was also a common error when anglers were asked to recall their catch (see Figure 18(b) and 18(c)-(e)).

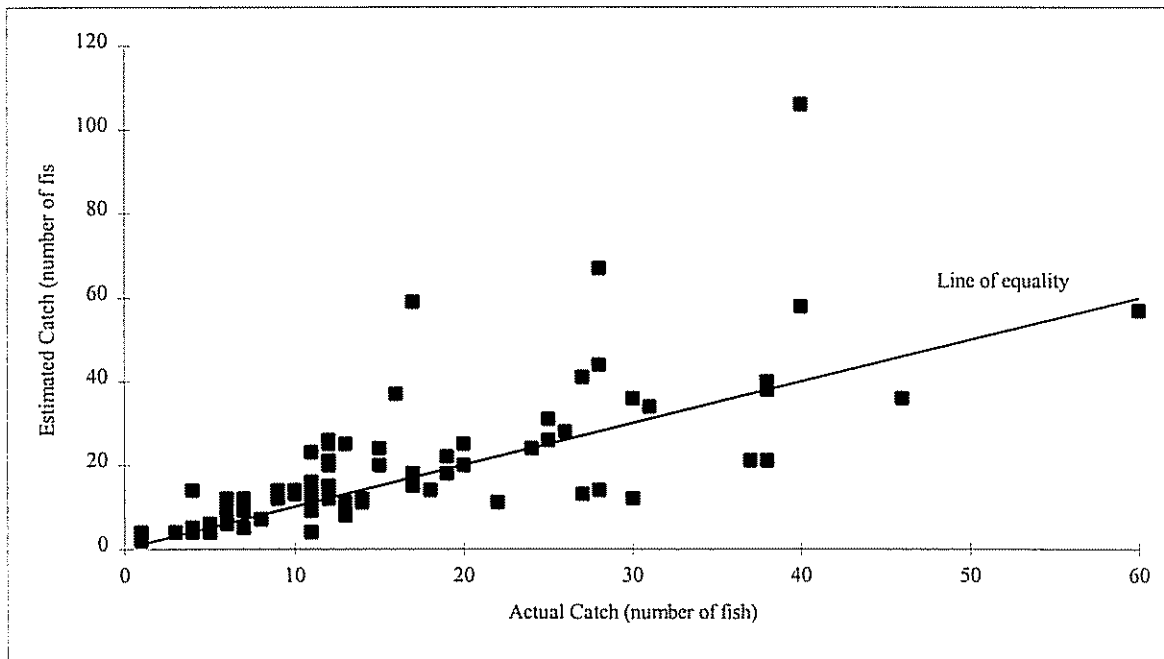


Figure 18(a): Anglers' recollected catch size compared to actual examined catch size

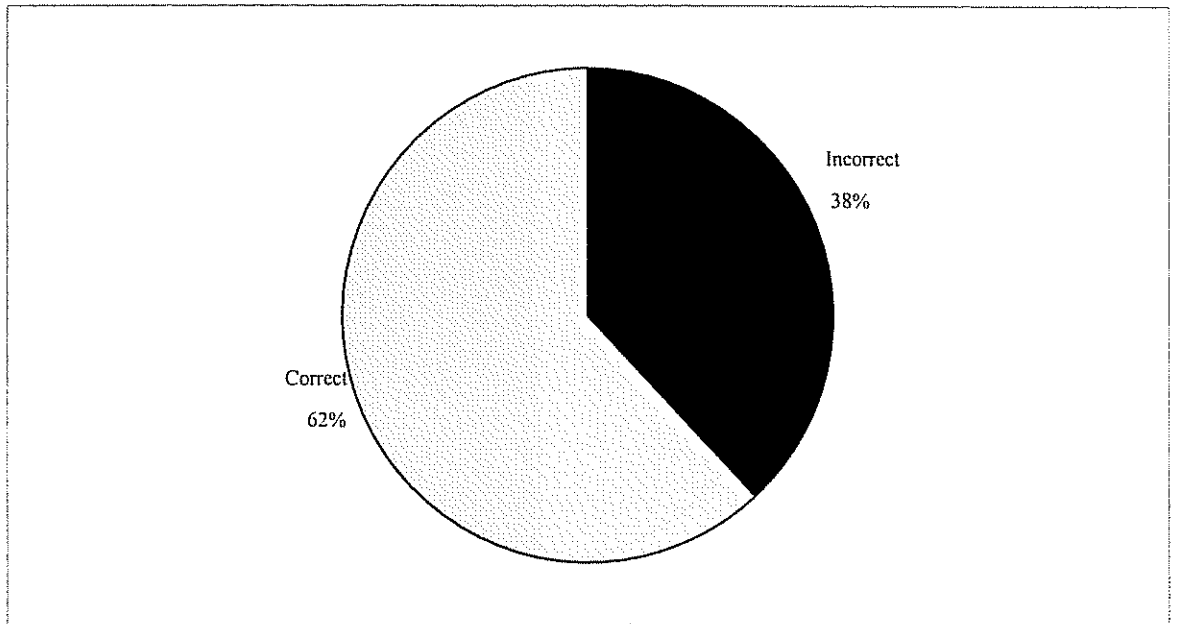


Figure 18(b): Proportion of anglers fishing the River Weaver who correctly recollected the species composition of their catches

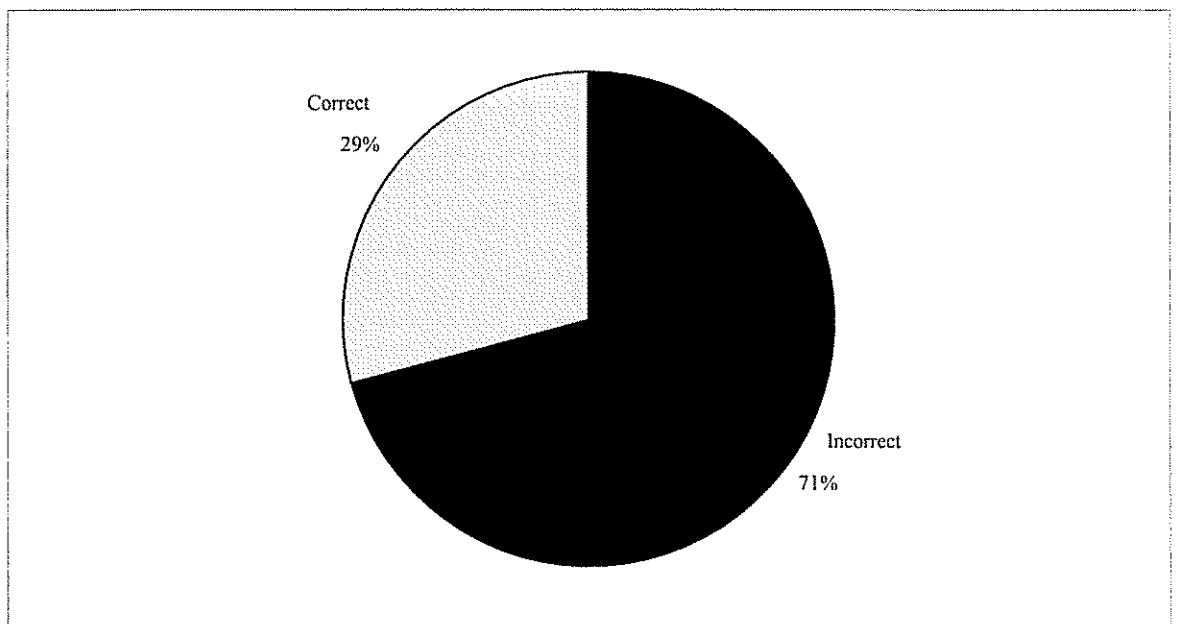


Figure 18(c): Proportion of anglers fishing the River Dane who correctly recollected the species composition of their catch

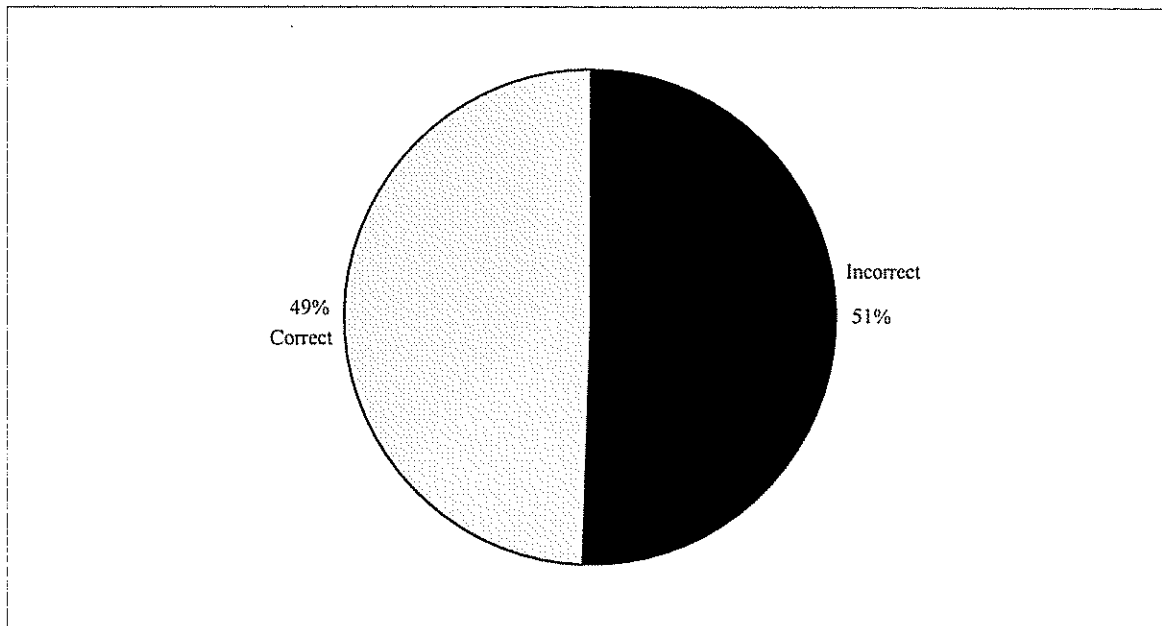


Figure 18(d): Proportion of anglers fishing the Rivers Weaver and Dane who correctly recollected the composition of their catch

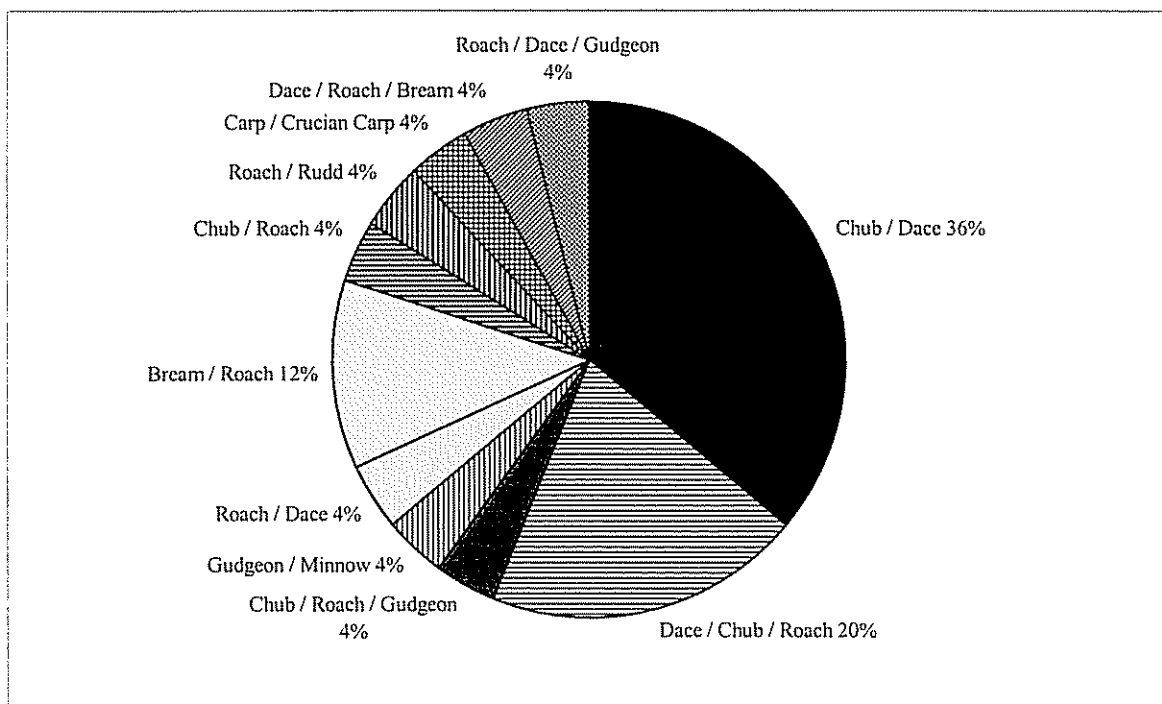


Figure 18(e): Common errors in mis-identification of species type by anglers on the Rivers Dane and Weaver

The catch results show that pleasure anglers catch a wide range of fish sizes and species. This is thought to result from the range of methods, bait and skill used by pleasure anglers. Many anglers are relatively non-selective in their catches as a result of the angling methods they employ. The majority of anglers were fishing for any of the species which were available (see Table 2(a) and 2(b)).

Target Species	% of anglers interviewed
Any	61.1
Chub	33.3
Barbel	1.83
Dace	0.5
Barbel / chub	2
Pike	0.18
Chub / dace	0.73
Roach	0.18

Table 2(a): Anglers' indicated target species for the River Dane

Target Species	% of anglers interviewed
Any	66
Roach	5.4
Tench	2.7
Bream	10.7
Carp	10.5
Pike / carp	0.7
Carp/ tench /eels	0.24
Roach / carp	0.37
Carp / tench	1.2
Bream / tench	0.24
Pike	1.95

Table 2(b): Anglers' indicated target species on the River Weaver

4.6 DISCUSSION

4.6.1 Survey timing (daily)

The results obtained on angler behaviour from the intensive survey have implications for the design of roving angler surveys. If a maximum encounter rate with anglers with catches is required, surveys should be designed accordingly. It was found that by starting surveying at 4am very few anglers were encountered and these had normally recently arrived at the fishery. Anglers encountered need to have been fishing for a least an hour to provide useful data, therefore the surveys were conducted between 9am and 6pm.

The behaviour of anglers may vary from the results described depending on the nature of the fishery. Neither fishery was noted as a specimen fishery and, although unexamined in the present study, consideration may need to be given to those anglers who may have fished through the night only and departed from the fishery early in the morning. In addition some fish species that show peak summer feeding activities at dawn and dusk.

4.6.2 Survey timing(seasonal)

The anglers' recollection of seasonal effort indicated that the majority of angler visits to the fishery are likely to occur through the summer period (see Figures 9(a)-9(d)). This was confirmed in the 1993 survey with the highest encounter rate with anglers found between June and August. The 1993 survey also demonstrated that the highest mean catch per angler was found between June and August. Therefore surveys conducted within this period are likely to provide the greatest quantity of data. The majority of fish should be actively feeding through the summer period, particularly species which feed under warm water conditions (e.g. tench and carp), thus allowing larger catches to be recorded during surveys and thus a larger sample of the fish population.

4.6.3 Anglers' location on fisheries

The majority of anglers may be rapidly surveyed by concentrating around access points to the fishery. Only limited catch data may be obtained from unpopular areas of the fishery distant from access points due to the low encounter rate with anglers. However, these areas may be important if examination of exploitation of the total stocks within the fishery is required.

The greater distance of anglers from access points on the River Dane is considered to result from anglers walking to natural habitat features on the river that are associated with good catches of particular species. These data indicate that the characteristics of angler behaviour may vary on different fishery types.

In America access point surveys are popular where the angler are interviewed whilst departing from the fishery with their retained catch. This method will not be applicable to UK coarse anglers, because their recollection is inaccurate and their catch is not retained.

4.6.4 Anglers' catches

As with the present study, Cooper & Wheatley (1981) have shown that anglers' recollection of their catch is generally poor. It is therefore a requirement either to photograph as many anglers' catches as possible or to identify the fish in the field. Problems were encountered in examination of catches. 71% of anglers encountered had retained their catches in keepnets but only 23% permitted examination of the catch by our surveyor. Anglers indicated that they would permit examination of the catch by official Agency personnel.

The length frequency histograms from photographed catches for species other than the dominant ones are rather limited. This resulted from insufficient anglers' catches being photographed. Examination and photographic recording of a greater proportion of the catches by Agency personnel would permit more detailed length frequency histograms to be constructed for the numerically less important species.

Care must be taken in combining the length data from photographs for length frequency histograms, as surveys are likely to be conducted over a minimum period of a month to allow sufficient data to be collected, during which time the fish will have increased in length. If the surveys are undertaken during the summer (the growth period for coarse fish species) combining the overall raw data is likely to lead to minor inaccuracies and a reduction in the separation of cohort peaks (i.e. fish from a particular cohort will be longer at the end of the surveying period than the start). Surveying should be combined with a scale sampling programme to determine growth rates so that the range of increase in length of a particular cohort during the summer period can be assessed and appropriate adjustments made to the data.

The photographic technique may be successfully applied to angler surveys as a rapid cost-effective method (see Section 5.5) of recording the catches. The technique may also have additional applications, for example, recording samples taken by standard techniques or for recording mortalities associated with fish kills.

4.6.5 Comparison samplings by standard techniques

Results obtained from the validation sampling of the River Weaver by seine netting and the River Dane by electric fishing have been compared to the results obtained from the angler surveys with regard to length frequency data and species composition. Differences were noted, which resulted from the selectivity towards certain species demonstrated by the sampling methods.

The sample taken by electric fishing on the River Dane (18th October 1993) indicates the selectivity of the method towards the capture of larger fish (see Figures 16(a)-16(d)). This will have partially resulted from the cold weather conditions on this date leading to fish shoaling in the deeper pools where electric fishing would have been less efficient, particularly for the small fish (i.e. less than 15cm).

Estimates of the personnel requirements and time allocation required for electric fishing, seine netting and angler surveys are:

- 1) Qualitative electric fishing of the River Dane required a four man team for one day (32 personnel hours) (4th June 1993). No fish were measured in this survey and only the numbers of each species type stunned were recorded. A total of 770 fish was observed. If the fish had been measured then it is estimated that a further five hours would have been required to measure the sample. Therefore the total personnel requirement would be 45 hours.
- 2) Seine netting was undertaken in association with the development of the monitoring of large angling competitions (see Section 11.2.1). A six man team worked for 7 hours (42 personnel hours) on the 24th October 1993 to record a total of 833 fish.
- 3) Based on an average encounter rate of 19 anglers per day with an average catch of 8 fish, it would require 5 survey days for one person (40 personnel hours) to record a sample of 760 fish.

It is estimated that the resultant catch photographs would require 1 personnel day for determination of fish lengths and species composition. Therefore the total time requirement would be 48 hours.

Electric fishing was observed to be relatively inefficient on the River Dane as fish could be observed avoiding capture. Additionally, standard electric fishing equipment has been demonstrated by other workers to be inefficient for fish below 10cm (Pygott et al. 1990).

Seine netting proved relatively cost-effective from a personnel requirement when compared to the other methods. However, only one site was sampled during this time. It has been shown previously that many sites would need to be sampled to provide a realistic assessment of coarse fish populations due to the contagious nature of their distribution (Kell 1991). It should be noted that seine netting was only effectively possible at one site on the River Weaver where the marginal shelves were absent. Therefore information of the distribution of the fish stocks could not be obtained by this sampling method on this fishery.

The angler survey method provided data on the exploited part of the fishery in addition to information on angler behaviour. Personnel time requirements for the survey compare favourably with the other standard sampling methods for a similar sample size of fish. The main advantage of the technique over existing sampling methods is its suitability for use on all waterbody types, including large rivers whilst being cost-effective in terms of equipment and personnel and sampling an extensive area. The technique may also provide information on the distribution of fish stocks and correlation of catches to specific habitat features. Angler surveys also will put the Agency in direct contact with one of their customers, the anglers. Such a customer focused approach should allow the Agency to gain a greater understanding of the requirements of coarse anglers from recreational fisheries.

4.7 CONCLUSIONS

- 1) Roving angler survey techniques can be applied to coarse anglers in the UK.
- 2) The method is suitable for use on fisheries which cannot be sampled effectively by the standard suite of sampling methods provided there are anglers regularly present.
- 3) A photographic technique can be successfully undertaken within the field.
- 4) The survey method developed can provide detailed relative abundance data on species composition and population structure of the stock.
- 5) Information on angler behaviour and use of a fishery is obtained from roving surveys.
- 6) Angler surveys may provide good contact between the Agency and anglers and thus can provide a useful public relations tool.

5.0 RECOMMENDATIONS FOR DESIGN OF ROVING ANGLER SURVEYS FOR THE UK

5.1 THE AMERICAN USE OF ANGLER SURVEYS

Angler surveys techniques are well developed in the United States and are routinely used on a state-wide basis to monitor fishery performance and collate data on angler behaviour. The Americans have demonstrated that the surveying of anglers should be kept as a separate activity from enforcement (i.e. licence and size limit checks) (Bayley pers comm.). Therefore although it may be considered that surveying could be undertaken as an additional duty of the Agency bailiffs, it is suggested that specifically employed survey clerks are used. Survey clerks should not be engaged in any enforcement activity, even if they are interviewing a person using illegal angling methods. This will achieve a better response from anglers being interviewed. The present survey has demonstrated that the majority of anglers would not present their retained catch for examination to a student surveyor. The Agency may need to provide clerks with the authoritative powers of a bailiff to provide a better response for examination of the anglers' catches. Alternatively, bye-laws could be made, coupled with a public information programme, to ensure that anglers present their catch for examination.

In America the surveyors undergo rigorous and precise training such that information collected is as standardised as possible (for example of Illinois training see Starske, Sobaski & Bayley 1993). Such training includes the precise nature of the information to be collected, the methods for approaching and questioning anglers and how to deal with difficult anglers. In addition, during interviews, surveyors are not allowed to enter into detailed discussions about the performance of the fishery and regulations associated with it.

Therefore it is recommended that, if roving coarse fish surveys are to be conducted by the Agency, these should ideally be undertaken by specially trained surveying clerks. These clerks will build up a good relationship with the local anglers and angling bodies if surveying are carried out over long time scales. The use of students for surveying will prevent establishment of these long-term relationships as they are likely to only be employed for a short period.

5.2 SURVEY DESIGN

The first step in the design of an angler survey is to establish the objectives of the study. These may include:

- To examine the status and composition of the fish community
- To analyse environmental effects on fish stocks and characterise their habitat
- To examine angler behaviour and the utilisation of fisheries

We suggest that the full benefits of the survey technique are only likely to be realised by the collection of long-term data. Therefore, before designing a roving angler survey the Agency needs to make long-term commitments to the study.

We suggest the surveys may be considered on two main levels:

- 1) A nationally applied survey tool to be incorporated into the rolling stock assessment programme of recreationally important rivers
- 2) A regionally applied technique to examine specific waterbodies and habitats. These could include rivers, streams, stillwaters and canals.

As part of a national programme, type rivers or important fisheries should be selected for surveying on a long-term basis. Surveys may also form part of regional Agency fisheries programmes to address specific problems in those areas or for routine monitoring of popular fisheries. However, it should be noted that fisheries displaying problems may not be well frequented by anglers. This would result in information of a limited nature being collected and supplementary surveys by other techniques may be necessary for problem solving management.

5.2.1 Selection of survey sites

For large river systems it is recommended that several sections of river are selected to allow randomisation of the surveying. To undertake a statistically robust survey there is a need for stratification and randomisation of the survey design, particularly for information on angler behaviour (Malvestuto 1991).

Stillwaters currently receive relatively little attention from the Agency regarding their performance as fisheries. However the preliminary angler survey in 1992 showed many stillwaters, particularly in urban areas are an important amenity resource and are well frequented.

There has also been a rise in recent years in the availability and popularity of intensively stocked coarse fisheries. The popularity of such fisheries results from good catch rates being achieved by high stocking densities. The performance and nature of the stock in such artificial fisheries is likely to be of little interest to the Agency. However, other information, such as that obtained in the NOP surveys, may be readily obtained from surveys of these popular fisheries. The main stillwater interests of the Agency are likely to lie with natural lake systems and their stocks. Such natural systems may, however have relatively low stock density, catch rates and numbers of anglers fishing. Therefore the extent of the data for use in management of the fishery that can be obtained from such waterbodies may be limited.

Consultation with the local controlling angling bodies is required to aid co-operation with the survey from the anglers. The surveying sections should ideally be permanently pegged to allow the relationships between habitat and catches of fish species to be elucidated. However, without such pegging, national grid references of angler location may be used.

Ideally, selected sites should, in co-operation with the angling club, be set up as monitoring sites where anglers are requested to retain their catches in keepnets and would expect a visit from a surveying clerk.

5.2.2 Survey forms

Survey forms should be based on the design used in the intensive survey (see Appendix 2). Information is required on angling effort, location of the angler, methods and baits employed (i.e. number of rods) and any additional information that is pertinent to the study objectives.

5.2.3 Stratification and randomisation

Randomisation of surveys would be required to obtain information apart from catch such as anglers' behaviour (see Malvestuto 1991). However, this is not considered essential for the recording of the anglers' catches as it is the exploited fish that are being examined. Based on the experience of the intensive survey it is recommended that the following strata are considered for surveying for other information than catch:

- Weekdays/weekend days
- Time of day (2 or 3 strata)
- Survey section
- Direction of surveying along fishery.

Randomisation of the above strata may be undertaken but consideration should be made such that sufficient data to meet the objectives of the survey can be collected from each monitoring site. Survey design must be carefully undertaken to ensure that the data requirements to fulfil the objectives of the survey are met. Therefore surveying frequency may vary from a once weekly visit to daily visits to the fishery.

Angler surveys for examination of the stock should be intensively undertaken through the summer period (June-August) when angling effort and catches of fish are generally greatest.

5.3 ANALYSIS OF SURVEY DATA

Data analyses can be undertaken in many ways depending on the purpose of the survey. We suggest that data could be analysed for three areas:

- **Composition and status of the fish community:** This may be considered in terms of long term changes of species composition and the construction of length frequency histograms to examine recruitment. Length with age data would need to be examined to allow adjustments for summer growth to be made to the fish length data. Specific CPUE in terms of numbers may also be calculate to assist in identification of long-term changes in composition.

- **Analysis of environmental effects on fish stocks and habitat characterisation:** Survey data may be used to determine the influence of environmental factors such as temperature and flow on fish populations and anglers catches. This may be important for baseline environmental assessment to determine the potential impacts of development schemes (e.g. small scale hydroelectric generation or discharges that affect the thermal regime). Catches of species may be correlated to habitat features to allow characterisation of specific coarse fish habitat requirements.
- **Angler behaviour and utilisation of the fishery:** Survey data may be used to determine angler behaviour and may provide an alternative to the NOP type surveys. The level of data collected is likely to be of a more detailed nature than that collected by telephone type market research.

6.0 RECOMMENDATIONS ON THE TRIAL IMPLEMENTATION OF A NATIONAL ANGLER SURVEY PROGRAMME

6.1 NATIONAL SURVEY PROGRAMME

The main objective for developing a national angler survey will be to provide countrywide long-term data on the status of coarse fisheries in England and Wales. For example, the data could be used to indicate the status of fisheries for 'The State of The Environment Report'. The collection of such baseline data are essential for the monitoring of fishery performance and the development of appropriate management and restoration strategies. This is particularly the case for large lowland rivers which cannot be sampled effectively by standard sampling methods.

The preliminary stage of establishing the National survey programme will be to undertake a small scale trial of the response of anglers to different types of surveying clerk. It is recommended that the following 3 clerk types are tested:

- Agency Bailiff
- Student surveyor
- Mature surveyor

These surveyors should be sent out on alternating days over a three month period (June -August). The response to the different types of survey clerk will determine the most appropriate personnel to employ and whether these staff would need to be provided with the authoritative status of an Agency bailiff.

It is recommended the surveys of anglers on a National basis are undertaken for a trial period of one year (with a further 6-12 months for analysis and report preparation) We recommend that this work could be set up as a 2 year R&D contract. This will allow the method to become established and any problems that may be encountered to be resolved. The programme could be established at a specialist centre, such as the scale reading centre at Brampton.

Surveying would also require establishment of a long-term national database in a similar way to the collation of catch returns for migratory salmonids has been pursued.

6.1.1 Staffing

- Survey staff should be specifically employed by the Agency . The employment of students for surveying is recommended during the first trial year. However, this may be dependant on the results obtained from the use of different surveyor types in the North West Region. These staff must present themselves to anglers as Agency officials to assist in examination and photography of the catches. The staff should be specifically trained for surveying and the production of a training manual should be developed for the pilot scheme.

- The employment of 5 staff for each of the 8 Agency regions is recommended for the National survey. Stratification of the staff allocation to different regions will be required due to differences in the size and availability of coarse fishing in each.
- Staff will be required to undertake analysis and report writing.

6.1.2 Survey Sites

- Survey sites should be selected which are popular as fisheries and which are difficult to sample by standard techniques.
- The sites should be chosen with a view to a long-term monitoring and may be different from any designated for a regional survey programme.
- Survey sites should ideally be set up as monitoring stretches where anglers are requested to use keepnets and retain their catch for examination. Surveyors must be provided with the authoritative powers of a bailiff or bye-laws passed which require anglers to present their retained catch when approached by a surveying clerk. The use of information boards on the fishery and liaison with the local angling club is recommended.
- Each surveyor should be allocated 4 survey sites on popular fisheries. Two sites should be surveyed on a daily basis for the first month of surveying and a further two in the second month of surveying. In this way 160 sites will be surveyed by the 40 surveyors with each site having be surveyed on approximately 20 occasions. Care will be required in combining survey results to allow for the growth of coarse fish cohorts over the survey period. Staff should be alternated between survey sites. Stratification and randomisation of the surveying programme may be considered in terms of starting times of surveying each site and the direction of travel along the fishery by the surveyor.

6.1.3 Timetabling

The following is a suggested timetable for the first year of a national survey programme:

March:	Select sites and allocate staff to regions
April:	Liaison with local angling clubs
May:	Recruit staff and design survey
June:	Staff training and surveying (surveying begins on 16th June for river fisheries)
July:	Surveying
August:	Surveying until mid-August
September:	Data analysis
October:	Data analysis
November:	Data analysis
December:	Reporting
January:	Meeting with local angling bodies to discuss the findings

February: Examine results and methodology to determine success of the survey. Undertake a cost-benefit analysis and compare to standard sampling methods.

6.2 REGIONAL SURVEY PROGRAMME

Angler surveys should also be run on a regional basis concurrently with the National programme. The objectives of a regional survey programme would be determined by each Agency Region to address specific problems which are not addressed by the National programme or NOP surveys. Regional based surveys may also be used to obtain information on angler behaviour to supplement the data provided by NOP surveys. Surveys would be set on specific fisheries where baseline data or a particular perceived problem requires addressing to meet the customers requirements. It is envisaged that the stillwaters would be included as part of the regional programmes.

6.2.1 Staffing

- Staffing of the regional programme will be dependant on the study requirements identified by each Agency region.

6.2.2 Survey Sites

- Selection of survey sites for the Regional programme will be based on different objectives to those set for the National programme.
- Similar criteria for the selection of survey sites should be required, as previously discussed for the National Programme (see Section 7.1).

6.2.3 Time tabling

- A similar time tabling to that described for the National programme, for the organisation of the regional programme, should be pursued.

7.0 RECOMMENDATIONS

- 1) It is recommended that angler surveys are implemented on both National and Regional Levels as an initial pilot study to allow an efficient surveying system to be established. The National programme may be set-up as a 2 year R&D Contract.
- 2) The employment of appropriate staff for surveying requires consideration and further testing. Staff employed for surveying should be specifically trained and the production of a training manual is recommended. The training manual should provide the surveyors with specific guidance on approaching anglers and collection of data to standardise the surveying method
- 3) The establishment of monitoring stretches of rivers where anglers are requested to use keepnets is recommended. Additionally, the generation of bye-laws to ensure that anglers present their catch to Agency personnel for examination should be considered.
- 4) The Agency should consider how the survey data are disseminated back to their customers to enhance public relations. Consideration should be given to the development of newsletters, information packs to feedback survey information in layman's terms to the anglers.

8.0 MONITORING OF ANGLING COMPETITIONS FOR THE PROVISION OF FISH STOCK DATA

8.1 INTRODUCTION

The Agency currently pursues a 3 year rolling programme of stock assessments for both migratory salmonids and coarse fish at selected riverine sites in England and Wales. Within this programme there are approximately 2000 sites surveyed by electric fishing and seine netting and 320 sites by angler census surveys. However, most stock assessments undertaken within this programme are from small rivers (DOE 1983), where effective samplings by standard techniques can be undertaken. The usefulness of some of the information presently collected for coarse fish management may be questioned since many of these selected sites may hold little direct value as recreational fisheries. A shift of emphasis towards an increased collection of coarse fish catch statistics and examination of fishery performance would potentially provide the Agency with data with which they may respond to the enquiries and complaints of one of their customers, the anglers. Such a shift in emphasis would require considerable commitment from the Agency because long-term data sets are required to identify changes in the fish stocks. This may be one of the main reasons why the collection of catch statistics for coarse fish has not been widely adopted. Additionally, analysis of coarse angling catches would allow examination of the exploitation of the fish populations. For the purpose of this contract exploitation has been defined as those components of the fish community which are vulnerable to capture by angling.

Angling competitions have previously been used to provide such catch statistics (e.g. North & Hickley (1981)), because these provide a source of potential data which can be relatively easily accessed compared with the collection of data from pleasure anglers.

8.2 BACKGROUND

8.2.1 Angling competitions

Angling competitions (or matches) are an important component of the sport of coarse angling in England and Wales. These matches are organised by the competing anglers drawing their fishing position (peg) at random and trying to win by catching the greatest weight of fish from that position over a fixed time period (normally 4-5 hours). Angling matches may vary in size from 10 anglers to over 500 anglers in major competitions. Often for competition purposes the fishery is divided into sections and prizes given to anglers accumulating the highest weight within their given section. Angling matches are fished on a wide range of waterbodies on a regular basis throughout the year. Data are potentially available from stillwaters throughout the year but only during the fishing season (June 16th -March 14th) on rivers.

8.2.2 Types of angling competition

There are two main types of angling match:

- Open Competitions
- League Competitions

Open matches are open to all anglers, but may be club based, and are won by the angler accumulating the highest individual weight of fish in the match period. Section winner prizes are also often available in this type of competition.

League matches are team based and the results of the team collated over a series of matches to determine the league winners. League matches are based on a combination of weight and points. Thus, in a poorly performing section in a league competition the capture of one small fish, assuming the other anglers have caught no fish, is important for obtaining points for the team.

8.2.3 Angling Tactics in Competitions

The aim of anglers fishing in a competition is to maximise the weight of fish caught from their position. The tactics employed by the anglers will be dependant on the type of waterbody, the species of fish present and the perceived numbers of fish available for capture. There are three basic tactics:

- To catch as many small fish as possible to provide the greatest weight
- To catch several large fish to provide the greatest weight
- To catch mainly small fish with the possibility of one or two large 'bonus' fish.

The decision on which tactic to employ will be dependant on whether the match is a league or open competition (team or individual event). Additionally, a combination of the angler's knowledge of the waterbody and the initial catches made at the start of the match are likely to be the main influencing factors on the methods used by the anglers through the match duration. However, the methods employed may vary during the match to maintain the catch rate.

The main point to note is that match anglers may be highly selective in catching specific components of the stock by employing certain tactics, methods and baits. Other workers have previously noted this bias towards the capture of certain species and size ranges of fish (Cooper & Wheatley 1981, Cowx & Broughton 1986).

9.0 DEVELOPMENT OF THE COLLECTION OF COARSE ANGLING COMPETITION CATCH STATISTICS

9.1 EARLY STUDIES

The collection and analysis of catch statistics collated from coarse angling competitions in the UK was originally developed as a response to being unable to sample large lowland rivers by standard methods (EIFAC 1974).

Early studies (e.g. Axford 1979, Hickley & North 1981) collated information on the following:

- percentage of anglers competing that caught fish
- CPUE expressed as grams/man/hour
- An indication of the species composition of the catch.
- Water temperature and catch rates of different species

This information was collected, following liaison with the local angling bodies, by means of a postal questionnaire. These methods have been successful in providing relative abundance information that allowed changes in species composition and the presence of strong year classes to be identified. From these data Relative Importance Indices have been calculated using the following formula:

$$RI = (\% \text{ relative abundance} + \% \text{ occurrence})$$

(after Cowx and Broughton 1986)

From these studies it was shown that angling match data could be used to provide relative abundance information on rivers that were considered difficult to sample. However, it was demonstrated that there were requirements for long-term data and good liaison and feedback to the participating anglers to maintain interest in the work (Hickley pers comm.). Although these studies provide a means of collecting cost-effective data, the information collected is limited in detail.

Analytical methods developed for analysis of competition catch data have also successfully been applied to match records collated from the angling press (Pearce 1983). The level of information achieved although suitable for a broad overview of the fishery does not provide the specific detail which may be required for successful management of the fishery.

9.2 FURTHER DEVELOPMENTS

The measurement of all fish captured in a series of matches on the River Trent provided information for the production of length frequency histograms (Cooper & Wheatley 1981).

Fish were collected from all anglers at the end of the competition and retained in a large aerated tank prior to processing. This study also included marking of captured fish and allowed exploitation rates, recapture rates and biomass to be estimated. It was concluded in this study that competition anglers, although selective, provided a better sampling tool than netting or electric fishing on the River Trent which is difficult to sample effectively by these standard techniques.

A further development in the collection of competition catch data was provided by Kell (1991). In a comparison of sampling techniques he collated match data and noted the number of bream captured at each peg. This confirmed the statistical contagion of bream distribution, and it was concluded that intensive sampling would need to be undertaken by standard sampling techniques to obtain a realistic estimate of the fish stocks. An important conclusion was that recording catches on an individual basis including the number of fish of each species, provided a method of identification of the distribution of fish stocks on linear systems.

9.3 CURRENT COLLECTION OF CATCH STATISTICS

Despite the value of these studies the collection of catch statistics from coarse angling competitions has not been widely adopted in England and Wales. Two Agency Regions, Severn Trent and Northumbria and Yorkshire, have routinely collected competition data from a limited number of venues on large lowland rivers (Axford pers comm.). More recently, the Thames Region has begun to collect catch statistics from the River Thames to provide baseline data on adult fish stocks associated with a proposed reservoir scheme.

However, the majority of Agency Regions appear to have a limited knowledge of large lowland river fish stocks because of the restrictions of standard sampling methods. The exception to this is the Anglian Region which is able to sample many of the region's lowland rivers because they are channelised and can be seine netted. However, these data are of questionable statistical validity as a result of the contagious distribution of coarse fish because only a limited number of sites can be logistically sampled (Kell 1991). It was concluded that a method needed to be developed which provided detailed data for each individual angler but which was economic in terms of personnel time input and costs for collection.

10.0 METHODOLOGY DEVELOPMENT

10.1 VARIATIONS ON EXISTING METHODOLOGIES

The objective of this work was to develop a method of recording and collating individual catches of anglers with respect to species composition and the size of individual fish.

Therefore the new methodology developments required were:

1. A method for rapidly recording each angler's catch yet capable of providing accurate data.
2. A method for retaining each angler's catch after the competition.
3. An assessment of the use of angling methods and tactics employed through the match duration. However, this is not considered an essential requirement.

10.1.1 Photographic record of catches

The development of the photographic tray method (see Section 3.0) for the recording of pleasure angler catches was selected for monitoring and recording of angling match catch data. The method presents a new dimension to monitoring techniques in that individual angler's catches along the match length can be recorded rapidly and accurately. This would enable very detailed information on the composition of catches, size distribution of catches and spatial distribution of captures of different species to be established.

10.1.2 Keepnets

To allow recording of individual catches, each competition angler was issued with a keepnet (North West Region of the Agency bought 150 keepnets for this purpose) into which the catch could be transferred after weighing at the end of the competition. The anglers were then free to go home leaving the fish to be identified and recorded at the end of the match. Each keepnet was embossed with an Agency rubberised logo to prevent theft and loss.

10.1.3 Angling methods

Ideally, the anglers competing would be asked to all use the same methods and baits through out the duration of the match to assist in standardising fishing effort. However, in practice this is unlikely to prove practicable. As an alternative the monitoring of angling methods through the competition period was pursued. Interviewing was undertaken on two or three occasions to provide an indication of the methods used by the anglers and the change in tactics through the duration of the match. It was considered that by comparing angling methods with individual catches that any bias imposed by particular tactics and baits may be revealed, although it was considered that long-term data would be required to achieve this. The collection of angling method data was undertaken to determine the logistics of obtaining the information during an angling competition.

10.2 METHODOLOGY

Details of the developed methodology are presented in Appendix 3

10.3 ADDITIONAL SAMPLING

Additional sampling may be considered as an adjunct or validation method for the angling competition monitoring. The methods employed will be dictated by the nature of the water body to be sampled. There are 3 basic sampling techniques available:

- Seine netting
- Electric fishing
- Sonar acoustics

These methods are used routinely within the Agency stock assessment rolling programme.

11.0 TRIAL ANGLING MATCH MONITORING

11.1 INTRODUCTION

The method developed was tested in conjunction with North-West Region of the Agency on the River Weaver at Hartford Bridge in Northwich (NGR SJ647714). In 1993 two matches were monitored. The first match (25th September 1993) was relatively unsuccessful in its provision of data but highlighted the logistical problems associated with the method. The match subsequently held that year on 24th October 1993 provided good data sets that are presented along with a further match held on the 23rd January 1994 . Further matches were attended and monitored in 1994. Two matches were monitored on the River Weaver on 16th July 1994 and 13th August 1994. Problems were experienced in the former match with the quality of the photographs and these data have not been presented.

An additional match was attended in 1994, the Division 2 National on the River Trent at Nottingham on 8/10/1994. This was undertaken to test the applicability of the method on a different type of river system.

11.2 METHODOLOGY

The methodology pursued within the monitoring of the trial matches was as described in Appendix 3. The following information was collected in each of the matches:

- A photographic record of individual anglers catches
- Interviews with anglers on fishing methods and tactics employed
- Additional sampling by seine netting, boom boat electric fishing and sonar acoustics was also carried out.

11.2.1 Additional sampling

The River Weaver is a large channelised river and is difficult to sample by standard methods. For this reason it was selected as the study site. The river is characterised by a central navigation channel (mean depth of 4.30 metres).

Testing of the new monitoring method was combined with:

- Boom boat electric fishing.
- Seine netting.
- Sonar acoustics.

Boom boat electric fishing

A boom boat electric fishing survey was carried out in conjunction with Hull International Fisheries Institute on the 25th September 1993. Catches of fish were made along the marginal shelves of the river but the method proved very inefficient when used along the centre navigation channel (Harvey and Cowx 1996).

The electric fishing technique was successful for species with a high length to depth ratio which are more susceptible to capture by this method, such as pike.

Sonar acoustics

A sonar acoustics survey was also undertaken before and after the 25th September 1993 competition. Problems were experienced with the functioning of the equipment. Only a very narrow beam angle was achieved resulting in very limited information being obtained. Because of this, and the poor quality of the photographic recording of anglers' catches in this match, this information has not been included in the present report. North-West Region of the Agency has been undertaking some sonar acoustics trials on the evening before angling matches to determine the relationship between fish density and anglers' catches. This work is still in progress.

Seine netting

Seine netting, using greatly over depth (dimensions' 150 metres x 15 metres (16mm mesh size knot to knot) nets, proved a successful method for sampling of the River Weaver. The method was limited by only being possible on only one site in the match length where no marginal shelves were present. Netting was undertaken within a 50 metre stop-netted section.

11.3 RESULTS

11.3.1 Results from photographic record of catches.

Analysis of the photographs of individual anglers' catches provided data on both species composition and individual fork length measurements. Results from the photographic record of catches are presented as:

- Length frequency histograms for the dominant species in the fishery
- Pie charts of species composition for dominant species
- Distribution plots of species along the match length by peg number for dominant species.

The length frequency histograms have been plotted with the same axes to allow the size of samples to be compared. These figures are presented in Appendix 4 and 5 for each of the following monitored matches:

River Weaver 24/10/93	Length frequency histograms :- Figures	19(a)-19(d)
	Pie charts :- Figure	19(e)
	Distribution plots :- Figure	19(f)
	(see Appendix 5 for catch distribution plots)	
River Weaver 23/01/94	Length frequency histograms :- Figures	20(a)-20(d)
	Pie charts :- Figure	20(e)
	Distribution plots :- Figure	20(f)

(see Appendix 5 for catch distribution plots)

River Weaver 13/08/94	Length frequency histograms :- Figures	21(a)-21(d)
	Pie charts :- Figure	21(e)
	Distribution plots :- Figure	21(f)
	(see Appendix 5 for catch distribution plots)	

River Trent 09/10/94 (Division 2 National Match)	Length frequency histograms :- Figures	22(a)-22(f)
	Pie charts :- Figure	22(g)-22(i)
	Distribution plots :- Figure	22(j) -22(k)
	(see Appendix 5 for catch distribution plots)	

11.3.2 Additional sampling

Length frequency histograms for the dominant species captured during seine netting on the River Weaver were constructed together with the species composition of the samples for the following matches:

River Weaver 24/10/1993	Length frequency histograms :- Figures	23(a)-23(d)
	Species composition :- Figure	23(e)
River Weaver 23/01/1994	Length frequency histograms :- Figures	24(a)-24(d)
	Species composition :- Figure	24(e)
River Weaver 13/08/1994	Length frequency histograms :- Figures	25(a)-25(d)
	Species composition :- Figure	25(e)

These figures are presented in Appendix 4 for comparison with the anglers' catches.

A sonar acoustic survey was undertaken during the first monitored match (25th September 1993) but was hampered by technical difficulties. Therefore no data are presented for this survey. An extensive boom boat electric fishing survey was also undertaken on the 25th September 1993. The efficiency of this sampling method appeared relatively low but the results have still been presented for comparison of the sampling techniques. The results of this survey are presented as length frequency histograms for the dominant species and an overall species composition:

River Weaver 25/09/1993	Length frequency histograms :- Figures	26(a)-26(d)
	Species composition :- Figure	26(e)

These Figures are presented in Appendix 4.

11.3.3 Results of angler interviews

Only a selection of the results of the angler interviews undertaken in the matches are presented. Results are presented for anglers' target species, bait use and angling methods for the following monitored matches:

River Weaver 24/10/1993

Target species
Angling methods

:- Figure 27(a)

:- Figure 27(b)

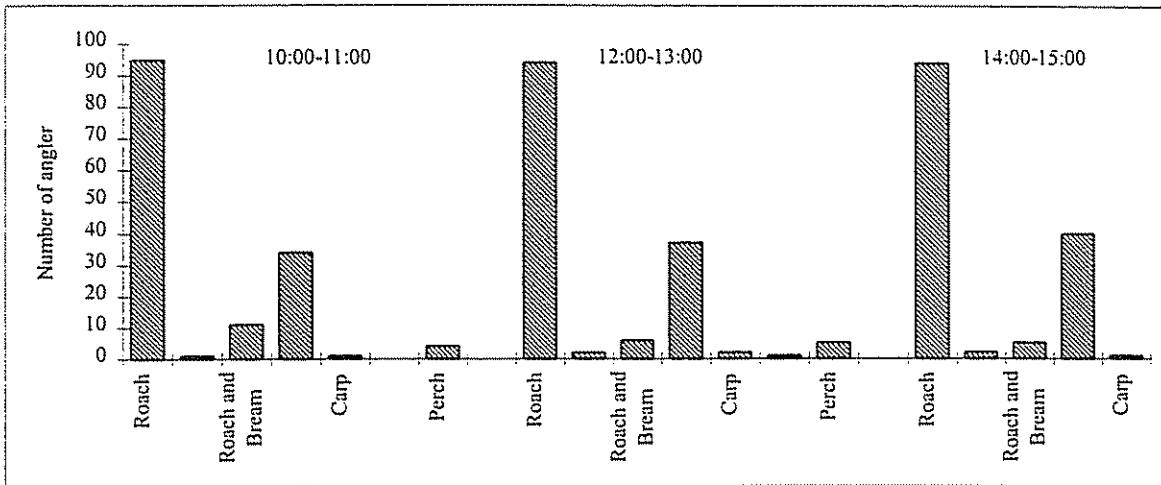


Figure 27(a): Target species of anglers during River Weaver match (24/10/93)

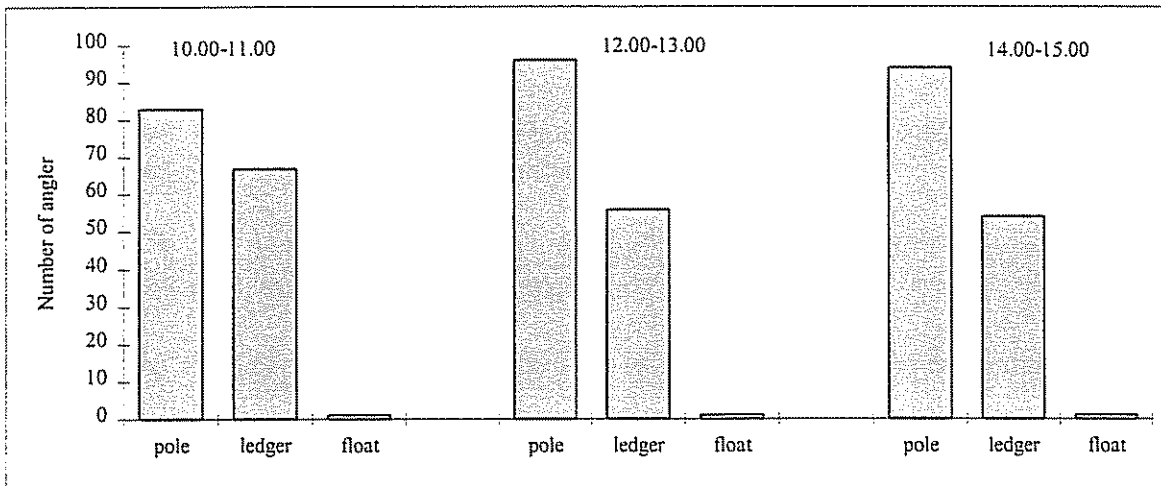


Figure 27(b): Use of angling techniques during River Weaver match (24/10/93)

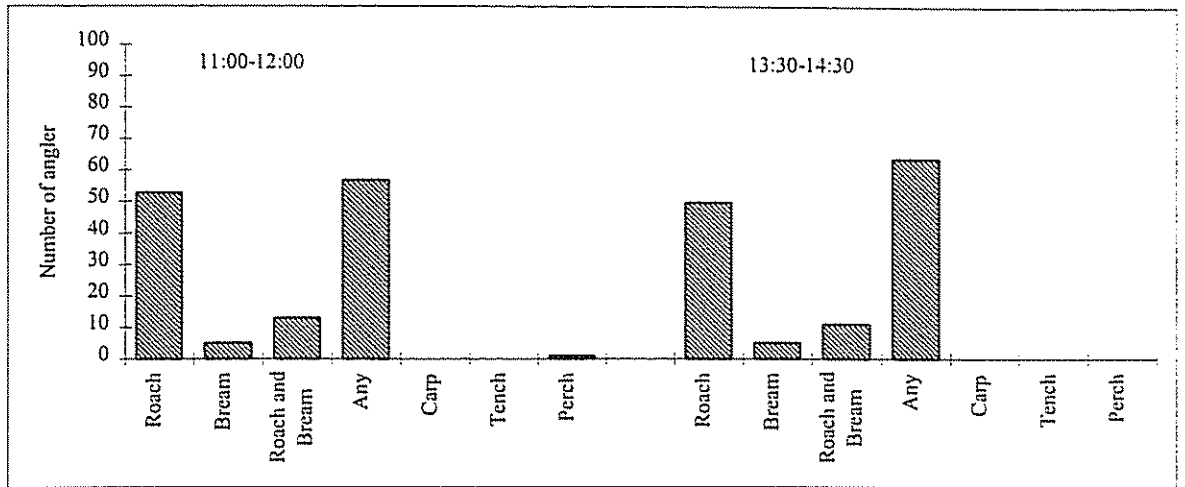


Figure 28(a): Target species of anglers during River Weaver match (23/01/94)

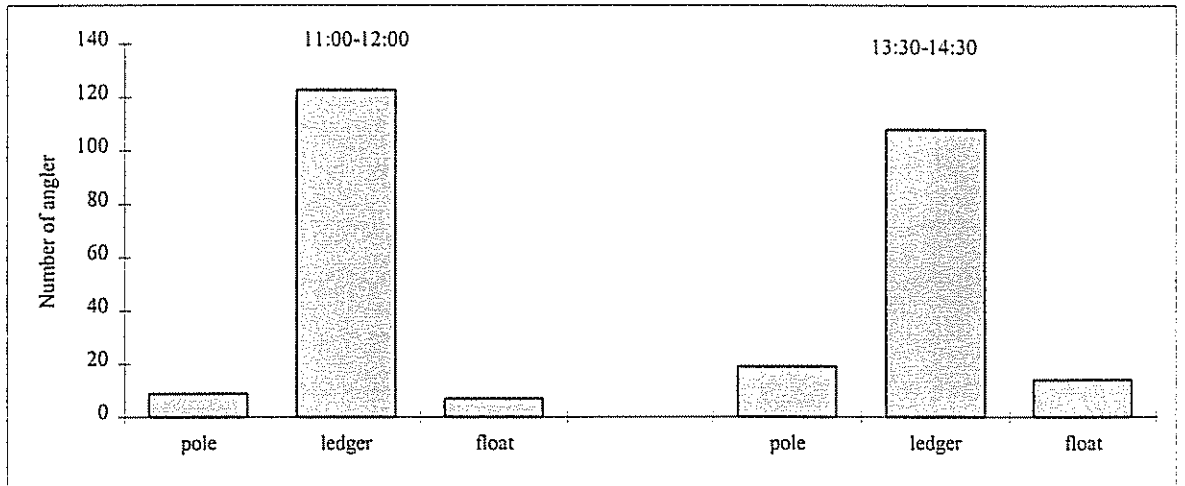


Figure 28(b): Use of angling techniques during River Weaver match (23/01/94)

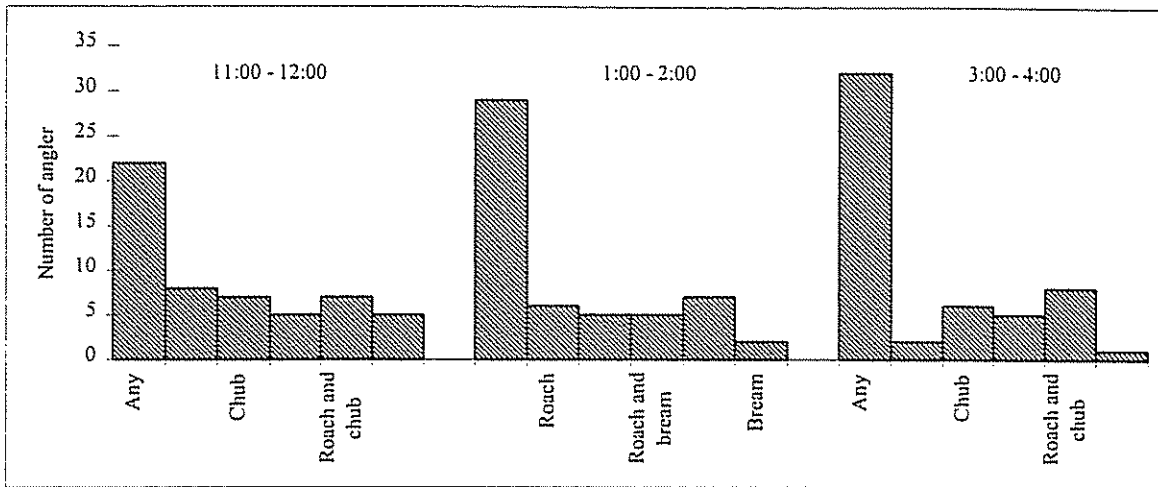


Figure 29(a): Target species of anglers during River Trent match (9/10/94)

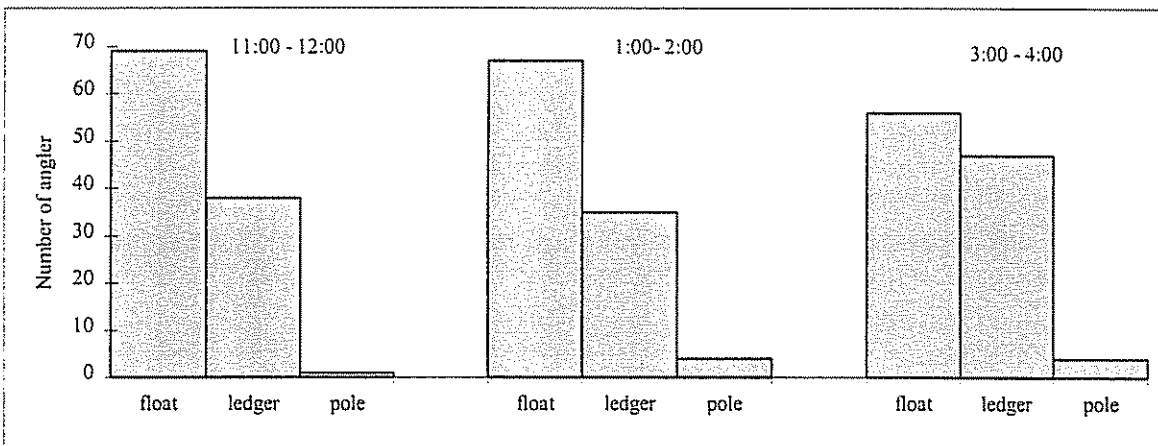


Figure 29(b): Use of angling techniques during River Trent match (9/10/94)

The data presented provide an indication of the type of information that may be collected if considered pertinent to the study. It can be seen that the tactics employed by anglers are variable and appear dependant on the conditions of the fishery. Tactics are probably adjusted according to waterbody type, season, flow and the angler's perception of the fish available for capture in front of his/her fishing position. The different tactics and baits employed would appear to affect the resultant composition of the catch. For example the angling tactics used and the size of the bream catch for the 24th October 1993 and 23rd January 1994 matches on the River Weaver may be compared. In the 24th October 1993 match 39% of anglers were ledgering (fishing with a static bait on the bottom) which resulted in a catch of 8 bream compared to 88% ledgering producing 46 bream in the 23rd January 1994 competition. This may indicate that ledgering leads to the capture of more bream in the anglers' catches.

11.4 DISCUSSION

11.4.1 Photography of Anglers' Catches

Photography of individual angler's catches allowed detailed information on the nature of the fish stocks to be obtained. The method allows rapid recording of catches and minimum handling of fish. The resultant photographs can be rapidly analysed using a CAD/GIS system. Length frequency histograms can be produced from this information for the dominant species. Length frequency histograms can be used to identify both recruitment and to monitor the growth of fish when combined with scale sampling programmes.

By recording the composition and sizes of individual catches it is possible to plot the distribution of the catches along the match stretch (see Appendix 5). The use of such plots, in combination with long-term data sets, may allow particular species to be correlated with certain habitat features within the fishery. These data, combined with CPUE data, may also allow areas of fishery that perform poorly to be identified. The development of such distribution information may provide additional data on the habitat requirements of different coarse fish species which could be used in rehabilitation or mitigation schemes. Collection of such data from Winter League matches may allow the movements and shoaling areas of fish in the winter period to be established.

By examining anglers' catches the investigator of the fishery is directly examining the exploited components of the fish community. This raises questions whether a cohort of a particular species may be over-exploited by the selective angling undertaken by competition anglers. This is not exploitation in its true sense as the fish are returned to the water, but the associated handling damage and scale loss, particularly for fish below 15cm, may raise the mortality rate above the natural level. This may affect the future performance and dynamics of the fishery.

Catch per unit effort (CPUE) analysis of the photographic data may be considered for the numbers of fish captured in different size categories for a particular species or in terms of weight. Therefore specific CPUE values may be calculated to assist in identifying trends or changes in the composition of the fish stocks. Weight information by peg number will be available from the match organisers.

The 24th October 1993 angling match (number of fish caught 4932, mean of 39 fish per angler) and 13th August 1994 angling match (number of fish caught 2579, mean number per angler 33) produced a far higher numbers of fish than the 23rd January 1994 competition (number of fish 817, mean of 7 fish per angler). In a similar way to the pleasure angler survey, it is considered that the most appropriate time to attend angling competitions is during the summer and autumn period when higher catches of fish are likely to be achieved. This results from all species of fish actively feeding under warmer water temperatures.

11.4.2 Angler interviews

Results from angler interviews on the use of methods and baits through the match period indicated that anglers adjusted their tactics according to river conditions and expected species. Differences between the matches can be clearly observed. It is considered that the tactics employed by the anglers will have an influence on the composition of the overall catch.

Analysis of the interview data indicates that different species respond to different tactics and bait under different conditions. If large long-term databases are generated to collate information it may be possible to ascertain the most productive method and bait used for each dominant species in the fishery under different environmental conditions. It may not be appropriate to divulge this information to the anglers as it may undermine the relationship between the Agency and the angling body. This would then allow clarification of the bias towards certain species in the catch under particular conditions and angler tactics.

The interviewing of anglers may not be that important from a practical side and considerable personnel costs may be saved but excluding it from the study. The anglers' catch results will indicate the exploited stock from the fishery .

12.0 USE OF ANGLING MATCHES BY THE AGENCY TO PROVIDE CATCH DATA

12.1 INTRODUCTION

Previous methods have required completion of a catch statistics form at the end of each match (e.g. Axford 1979, North & Hickley 1981). These forms are sent to the relevant fishery's officer for collation. The method developed within the present contract involves a greater personnel requirement than the postal methods. However the monitoring method provides better liaison between the Agency and the anglers. This is a favourable aspect of the methodology. Additionally, if the new method is compared to the personnel requirements of standard sampling techniques and the data obtained it can be considered favourable from a cost-benefit viewpoint (see Section 12.5). One of the main problems encountered from the developed methodology was the logistics of data collection.

12.2 ESTABLISHING OBJECTIVES

The first process in the organisation of an angling match monitoring programme is to determine the objectives of the study. The monitoring work may arise from either:

- a long term National rolling programme using coarse angling competition data for stock assessment purposes
- a short term study as a response to complaints over fishery performance.

12.2.1 National Programme

If a National programme is established then type rivers may have to be selected as monitoring sites or major, popular fisheries within each Region may be chosen. In preparation of a National monitoring programme, consideration should be given to the future potential changes in angling behaviour. Stillwaters receive little if any attention in the current rolling programme. The method will be applicable to natural stillwater fisheries, as long as catch rates in matches are high enough to supply sufficient data on the fish stocks. There is likely to be a general increase in the availability of specifically designed, high stock density match waters in the future. However the importance of stock assessment in this type of water is likely to be unimportant as long as catch rates remain at a level that is perceived to be satisfactory by the anglers. On this type of water survivorship and hook avoidance are likely to be more important issues. Large river fisheries will continue to act as important match venues for the future and it is on these large linear systems that the full benefits of the new methodology can be realised.

A problem which will be realised in implementation of a national programme is that the organisation of the matches is undertaken by the angling clubs and may vary between years. Therefore the monitoring programme must be tailored to the match schedule. The Agency may decide to offset this problem by liaison with the angling bodies to organise their own matches on the river systems under interest.

Objectives would need to be set for a National programme. The nature of the data collected in such a programme would be:

- Year class strengths and recruitment
- Species distribution
- Specific growth rates

12.2.2 Regional studies

Both short-term and long-term monitoring programmes may be established separately from the national programme at a regional level. These may be established as a response to complaints by anglers regarding the poor performance of a fishery. On such fisheries matches may need to be arranged as match bookings may be reduced with a decline in sport. Therefore a series of matches over a single year may be monitored to provide data on the fish stocks or longer term studies maybe required. This information would ideally be coupled with previous match records of individual peg weights. The Agency should therefore actively encourage all angling associations to maintain records of the match results. The development of a angling match database should be considered for collation of the match monitoring data.

The nature of the data collected at a Regional level may be:

- Distribution of fish at a habitat level
- Effects of water quality on distribution and recruitment
- Exploitation rates in different fisheries

However, the nature of the information collected will be dependant on the objectives set for the Regional studies. This information may complement that collected in the National monitoring programme.

12.3 LIASION WITH LOCAL ANGLING CLUBS AND MATCH SELECTION

The preliminary stage of monitoring large matches is to establish links with the local angling club who control the fishery of interest. The monitoring of matches may be a response by the Agency to an angling club request and to supplement match data that the Agency should encourage clubs to record. Information is required on the location, access, meeting area and timings of matches on the fishery under study. In addition it is important to establish who is responsible for running the competition on the match day as a brief introductory talk to the anglers is normally required to explain the purpose of the work. Selected match dates for monitoring should be agreed with the club's Committee.

There are two types of angling contest:

- 1) League Matches
- 2) Open Matches

In the former, teams of anglers compete in a league and will remain fishing throughout the duration of the match. This results from the matches being based on a combination of weight and a points system.

Often league matches are organised to take place in the winter months, although occasionally a small summer series is arranged. Open matches are open to all anglers, including non-club members. In this type of match if the angler has not achieved a reasonable catch then they may depart before the competition has finished. Therefore for this open type of match it is recommended that cash prizes are offered which can be won by a draw of all anglers who remained to the end of the match, even if they have not caught any fish. This was undertaken on the first pilot match and kept the majority (77%) of anglers on the bank.

Care must be taken in the selection of dates regarding time of year and day, as the majority of the work is undertaken at the end of the match. Therefore daylight may become a limiting factor. Generally the summer is considered the best period for monitoring as most species of fish will be actively feeding which potentially leads to higher catch rates. However, it should be considered that the major feeding activities of some coarse fish species in the summer may be confined to early morning and evenings. Therefore matches that are attended during the middle of the day (e.g. 11am-4pm) may demonstrate a reduced catch rate as a result.

Sites should be selected which ideally provide good bankside access, a central organisation point and be permanent pegged.

12.4 ORGANISATION OF MONITORING TEAMS AND STAFF ALLOCATION

Based on the experience gained from the matches monitored on the River Weaver it is recommended that a detailed logistics plan is produced to allocate staff time to different activities through the match. Staff involved in monitoring should have knowledge of both coarse fish and coarse angling methods. Many matches are also held at the weekends so staff may need to be available. For the full monitoring programme the monitoring team should comprise the following groups, each of which has clear instructions on their roles.

12.4.1 Monitoring team leader

A person should be appointed to manage the whole monitoring team. This person should be responsible for liaison with the angling club and the match organisers. The team leader should give the anglers a short talk before the match, during the draw for fishing pegs, to explain the purpose and methods that will be used. The importance of the retention of catches should be stressed during this briefing. The team leader will be responsible for collating all the data from the various teams, described below, at the end of the match. Ideally radio communications should be made available to allow contact to be maintained between the team leader and the monitoring team.

12.4.2 Interview team

A team should be appointed for collection of information on angling methods and baits employed by the anglers throughout the match period. The team should comprise of a team leader and a number of team members who have some knowledge of coarse angling methods. The team leader will be responsible for supply of data sheets and equipment to the team. Teams of two people are allocated 50 anglers for interviewing.

12.4.3 Keepnet distribution and collection team

Staff should be allocated for the distribution and collection of a keepnet to each angler. The keepnet should be distributed to each angling peg before the end of the competition. In open competitions it may be more appropriate to distribute the keepnets at the beginning of the match. This will allow any anglers who wish to depart before the end of the match to leave their catch. These anglers should inform the match organisers so that the leaving time may be noted for CPUE calculations. Keepnet distribution staff should also identify the persons responsible for undertaking the weighing of catches at the end of the match and inform them to ensure that each catch is transferred to an Agency keepnet following weighing. From the Weaver study the use of a boat for collection of keepnets, following examination, considerably reduced the collection time.

12.4.4 Photography team

A team should be deployed who are responsible for photographically recording each anglers' catch. A team leader will be responsible for supplying the equipment to the team. Teams of two people will be allocated 50 anglers for recording data on catch.

12.4.5 Additional Sampling team

A further team should be deployed for additional sampling of the water body, after the match has finished, using standard sampling techniques if such methods are applicable. The team deployed will be dependent on the scale and nature of any additional sampling.

It is possible for teams to perform two roles to save on personnel costs for example the interview team could be used for additional sampling or the photographic team could be used to distribute keepnets to the anglers. However, it must be remembered it may take staff a considerable time to walk their monitoring section of the match. For example if the final interviewing of angling methods is commenced 1 hour before the end of the match and if it takes 40 minutes to undertake the interviews and 20 minutes to walk back to the central organisation point, these staff could not be allocated to the duty of distributing keepnets. Costs of monitoring may also be reduced by requesting members of the monitoring team to arrive at the end of the match when the majority of work is undertaken.

The teams listed above are for the full monitoring suite. Partial monitoring in which only the anglers' catches are recorded may save considerably on costs yet still provide useful data.

The recording of angling methods is not considered essential to the success of the monitoring method but may be of additional interest in specific studies. Such likely costs for a 200 peg match using the full monitoring methodology are:

FULL MONITORING

Monitoring team leader	8 hours
Interview team (8 people at 5 hours)	40 hours
Photographic team (8 people at 3 hours)	24 hours
Additional sampling (8 people for 3 hours)	24 hours
Total manpower requirement	96 hours

This calculation assumes the photographic team distributes the keepnets

PARTIAL MONITORING

Monitoring team leader	8 hours
Photographic team (8 people at 3 hours)	24 hours
Total manpower requirement	32 hours

12.5 COST-BENEFIT ANALYSIS

These figures can be compared with the personnel requirements for standard fish sampling techniques. For this example it is assumed that standard sampling techniques are undertaken by a four man team (i.e. 32 hours working time for a single surveying day). Therefore the partial monitoring resource requirement is equivalent to a standard sampling team in the field for one day. The quantity of data generated is likely to be much greater from the match results. For example in the seine net samplings of the River Weaver (24/10/1994) a total of 833 fish were captured and measured by a six man team working for 5 hours (30 personnel hours) at one site. The data from the netting exercise may then take a further 2 hours to enter on to a computer spreadsheet. Therefore the total personnel requirements would be 32 hours. This may be contrasted with a total recorded anglers' catch of 4932 fish requiring 32 man hours to record. There would be an additional requirement of 2 days to analyse the photographed catches (16 man hours) and enter the data on to computer spreadsheets. Therefore the total personnel time required would be 48 hours.

Based on this data the processing time for the number fish per hour, including data entry, can be compared for the two methods:

Seine netting: 26 fish per hour

Photographic method: 103 fish per hour

A main benefit of the match monitoring method is that it provides an indication of the spatial distribution of the fish stocks. This information would be difficult to obtain by the standard sampling methods.

13.0 OVERVIEW

The method developed within this contract is an extension to the successful techniques previously developed by other works for coarse fish catch statistics (e.g. Cowx 1991, Axford 1991.). However, the developed methodology provides much more detailed information than previous methods. The important point is to determine the level of information required to meet the objectives of the study. The objectives should be considered in the context of the previous methods as these may provide sufficient data to meet the study's objectives.

The use of angling catch statistics from organised angling competitions can provide useful relative abundance data on fish stocks in fisheries that are difficult to sample by standard sampling techniques. The method is suitable for replacement of these techniques. Collated match data may also be used to supplement information collected by other sampling methods. However, in water bodies where few data may be obtained by standard sampling methods the monitoring of anglers' catches may provide the major source of data on the fish stocks.

Under its present organisation the Agency fishery departments are unlikely to have the staff resources to implement a full scale regular monitoring of large angling matches. However, it is considered that a large commitment by the Agency towards catch statistics will provide a better base knowledge of coarse fishery dynamics. This information will not only be important to respond to angling enquiries but will allow more accurate assessments of developments that may have an impact on a fishery to be understood. This will allow the Agency to provide a better response to their customers and will assist in public relations.

If a certain species within a fishery requires particular examination (e.g. pike or barbel) then specific matches may be organised. In such matches the anglers would be requested to target this species for capture. The timing of such matches must be carefully considered regarding time of year and day.

The present study has not allowed the derivation of formulae to estimate stock size for a coarse fishery. It has developed methods of collection of coarse fish catch statistics that will provide meaningful relative abundance information to the fishery manager. It may be possible to elucidate the relationship between catch and stock, in absolute terms on canal fisheries that can be quantitatively sampled by standard techniques. However, the extrapolation of this information to other waterbody types and species and the high degree of variability in catch depending on both water and temperature conditions will prove this a difficult aim to achieve.

It is considered that the correlation of regular catches of a particular species with certain habitat features may be a more appropriate way of examining a fishery, particularly for rehabilitation schemes or improving the potential of a fishery. Long-term data sets will be required to determine the habitat preferences of each coarse fish species regarding flow, temperature, substrate, depth, spawning/ nursery habitat and in-river features. However, once these data are obtained then practicable measures may be presented for improving a fishery or explaining the decline of a particular species.

Perhaps one of the most important components of the methodology described is to maintain the liaison between the angling club and the Agency. Of particular importance is the feedback of information to the angling club at the end of the study. This response may take the form of a short report written in layman's terms or through a general meeting between the Agency and the angling club. From our experience an organised meeting provides a good medium for dissemination of the information. Such meetings act as a general forum between the club and Agency and from a public relations side have many positive benefits. The Agency should also encourage angling clubs to keep records of angling competition catches on their waters for weight caught per peg and an indication of the dominant species in the catches.

14.0 RECOMMENDATIONS

- 1) It is recommended that the use of the collection of data from fishing matches should be assessed as a potential method for use on a national basis to provide cost-effective data on fish stocks.
- 2) The method has the potential for studying important rivers on a long-term basis. Key rivers should be selected or a programme established.
- 3) The method can be used in practice as a tool to assess fish distribution on linear systems in relation to habitat and water quality when used in conjunction with sonar surveys.
- 4) Manuals should be developed to provide a standard protocol for the monitoring of angling competitions.

15.0 REFERENCES

- Axford, S.N (1979) Angling returns in fisheries biology. Proc 1st Brit. Freshwater Fish Conf. University of Liverpool p.259-272
- Axford, S.N (1991) Some factors affecting angling catches in Yorkshire rivers. in Catch Effort Sampling Strategies. I.G Cowx (ed.) Fishing News Books. p.143-154
- Bayley, P.B., Austen, P.J. (1989) Fishery Analysis System: Data Management and Analysis for Fishery Management and Research. American Fisheries Society Symposium 6. p 199-205
- Begon, M. (1979) Investigating Animal abundance: Capture-Recapture for biologists. Edward Arnold, London.
- Cooper, M.J., and Wheatley, G.A (1981) An examination of the fish population in the River trent, Nottinghamshire, using anglers catches. J.Fish.Biol 19. p. 539-556
- Cowx, I.G., and Broughton, N.M (1986) Changes in species composition of angling catches in the River Trent (England) between 1969 and 1984. J. Fish Biol 28. p.625-636
- Cowx, I.G (1990) Application of creel census data for management of fish stocks in large rivers in the United Kingdom. in W.L.T van Densen, B. Steinmetz and R. Hughes (eds). Management of Freshwater Fisheries, Wageningen, Purdoc. p. 526-534
- Cowx, I.G (1991) Fishery problems in the River Trent. in Catch Effort Sampling Strategies. I.G Cowx (ed.) Fishing News Books. p.154-165
- Department of the Environment (DOE) Standing Committee of Analysts (1983) Methods for Sampling Fish Populations in Shallow Rivers and Streams 1983. HMSO
- EIFAC (1974) Symposium of methodology for the survey, monitoring and appraisal of fishing resources in lakes and large rivers. EIFAC Tech. Paper 23. Rome FAO, UN Publications.
- Gutherie, D., Hoing, J.M., Holliday, M., Jones, C.M., Mills, M.J., Moberley, S.A., Pollock, K.H., Talhelm, D.R (eds) (1991) Creel and angler Surveys in Fisheries Management. American Fisheries Society Symposium 12. p. 540
- Harvey, J., and Cowx, I.G. (1996) Electric fishing for the assessment of fish stocks in large rivers. in Stock Assessment in Inland Fisheries. I.G Cowx (ed.) Fishing News Books. p.11-27.
- Hickley, P., and North, E. (1977) The effects of reservoir releases upon angling success in the River Severn. Fish Mgmt 11. p. 1-9

- Hickley, P., and North, E. (1981) An appraisal of anglers' catch composition in the barbel reaches of the River Severn. Proc. of the 2nd British Freshwater Fisheries Conference. University of Liverpool pp 94-100.
- Hunt, P.C., and Jones, J.W (1974) A population study of *Barbus barbus* L. in the River Severn, England. *J.Fish Biol* 6. p. 255-278.
- Kell, L. (1991) A comparison of methods for coarse fish population estimation. in *Catch Effort Sampling Strategies*. I.G Cowx (ed.) Fishing News Books. p.184-201
- Malvestuto, S.P. (1991) The customisation of recreational fishery surveys for management purposes in the United States. in *Catch Effort Sampling Strategies*. I.G Cowx (ed.) Fishing News Books. p.201-214
- NOP (National Opinion Poll) (1980) National Angling Survey. Summary Report. Water Research Centre, Medmenham. pgs 19.
- NOP (National Opinion Poll) (1994) National Angling Survey. National Rivers Authority Report. Fisheries Technical Report 5. pgs 31.
- North, E., and Hickley, P. (1989) An appraisal of anglers' catches in the River Severn, England. *J.Fish Biol* 34. p. 299-306
- Pearce, H.G. (1983) Management strategies for British Coarse Fisheries: the Lower Welsh Dee, a case study. Proc 2nd Br. Freshwater Fish Conf. University of Liverpool. p.263-273
- Pollock, K.H., Jones, C.M., and Brown, T.L (1994) Angler survey methods and their applications in fisheries management. American Fisheries Society Special Publication 25
- Pygott, J.R., O'Hara, K., Cragg-Hine, D., and Newton, C. (1990) A comparison of the sampling efficiency of electric fishing and seine netting on two contrasting canal systems. in *Developments in Electric Fishing*. I.G. Cowx I (ed.) Fishing News Books. p.130-140
- Santucci (Jnr), V.J., and Wahl, D.H (1991) Use of creel census and electrofishing to assess Centrarchid populations. American Fisheries Symposium 12. Gutherie et al. (eds.) p.481-491
- Staske, D., Sobaski, S., Bayley, P.B. (1993) Manual for conducting Creel Surveys on Illinois lakes. Illinois Natural History Survey Centre for Aquatic Ecology (unpublished internal report)

Appendix 1: Survey form for preliminary coarse angler survey (1992)

The Use of Catch Statistics to Determine Stock Size:

ref:2360/c(W)

Questionnaire for Coarse Anglers (pleasure fishing):

VENUE: SHROPSHIRE WYVERN CLUB
MIDDLEWICH BRANCH GRID REF: 658586

DATE: 29/7/92

OWNERSHIP OF FISHING RIGHTS: BRITISH WATERWAYS

DISTANCE TO NEAREST ACCESS POINT: 20m.

TIME STARTED FISHING: 12.30 p.m.

FISHING METHOD: Float

PRESENT TIME: 1 p.m (expected leaving 5pm)

NUMBER OF HOURS FISHED: 0.5

BAIT USED: Maggot

NUMBER OF RODS USED: (1) 2 3

ARE YOU FISHING FOR ANY PARTICULAR SPECIES? Anything

FISH CAUGHT:

FORK LENGTH MEASUREMENT OF FISH (mm.)
(enter no caught in each size category)

SPECIES	0-49.9	50-99.9	100-149.9	150-199.9	200-249.9	250-299.9	300-349.9	>350
CHUB								
DACE								
ROACH		2						
PERCH								
BREAM								
BARBEL								
PIKE								
RUDD								
CARP								
TENCH								
CRUCIAN CARP								

* CATCH EXAMINED

OTHER SPECIES: (STATE NUMBERS CAUGHT)

GUDGEON 5

RUFFE _____

BLEAK _____

EELS _____

Are matches regularly fished on this stretch: (Yes) No

Do you Match Fish: (Yes) NO

Do you know the contact address and number for the club secretary?
(this may be indicated on the permit or day ticket)

Do you Match Fish _____

Name: N/A.

On's Stretch: Yes (NO)

Address: N/A

Postcode: _____

Tel: _____

**Appendix 2: Survey form for intensive coarse angler survey
(1993)**

The Use of Catch Statistics to Determine Stock Size

ref:2360/c(W)

Questionnaire for Coarse Anglers (pleasure fishing):

VENUE: SHROPSHIRE WYON CANAL
- MIDDLEBUNCH BRANCH GRID REF: 658586

DATE: 29/7/92

OWNERSHIP OF FISHING RIGHTS: BRITISH WATERWAYS

DISTANCE TO NEAREST ACCESS POINT: 20m.

TIME STARTED FISHING: 12.30 p.m.

FISHING METHOD: Float

PRESENT TIME: 1 p.m (expected leaving 5pm)

NUMBER OF HOURS FISHED: 0.5

BAIT USED: Maggot

NUMBER OF RODS USED: (1) 2 3

ARE YOU FISHING FOR ANY PARTICULAR SPECIES? Anything

FISH CAUGHT:

FORK LENGTH MEASUREMENT OF FISH (mm.)
(enter no caught in each size category)

SPECIES	0 - 49.9	50-99.9	100-149.9	150-199.9	200-249.9	250-299.9	300-349.9	>350	
CHUB									* CATCH EXAMINED
DACE									
ROACH		2							
PERCH									
BREAM									
BARBEL									
PIKE									
RUDD									
CARP									
TENCH									
CRUCIAN CARP									

OTHER SPECIES: (STATE NUMBERS CAUGHT)

GUDGEON 5

RUFFE _____

BLEAK _____

EELS _____

Are matches regularly fished on this stretch: Yes No

Do you Match Fish: Yes NO

Do you know the contact address and number for the club secretary?
(this may be indicated on the permit or day ticket)

Do you Match Fish

Name: N/A.

On this stretch: Yes NO

Address: N/A

Postcode: _____

Tel: _____

Appendix 3: Method statement for the photographic recording of anglers' catches and assessment of fishing methods during angling matches

1) Photographic recording of angler's catches

Equipment required:

- 1) Data recording sheets
- 2) Clipboards and Pens
- 3) 1 Keepnet and bankstick for each angler participating.
- 4) Measuring boards
- 5) Plastic crates to hold rest of catch during photography
- 6) Automatic cameras and film
- 7) Photographic trays
- 8) Post-it stickers (for peg numbers) and marker pens
- 9) Cloths
- 10) Hand nets

A) Introduction

At the end of the angling match an assessment is required of the species composition and size distribution of the anglers' catches. A photographic method, backed-up with length measurements of every 5th catch is used to record this information. In addition scale samples can be collected if required.

B) Method

1) A team leader for the assessment of the anglers' catches should be appointed before the match. It is the responsibility of this person to organise the photographic teams before the start of the match and to ensure that the appropriate equipment is provided.

2) Each photographic team should comprise two staff members with each team allocated 50 anglers to monitor. During the match a Agency keepnet with bankstick should be placed behind each angler participating in the competition. These keepnets must be in position before the weigh-in of catches at the end of the match. Staff involved in the photographic assessment must identify the person responsible for weighing of catches in their monitoring section. Staff must be in position to follow the weigh-in of catches in the section at the end of the match.

3) During the weighing of catches the anglers will transfer their catch from their own keepnet to the weighing basket. Having been weighed, the catch should be transferred to a Agency keepnet. The assessment team should follow the weigh-in through their monitoring section until completion. When this has been undertaken photographic recording of the catches may begin.

4) On arrival at each match peg the fish are transferred from the Agency keepnet into the photographic tray. A perspex sheet is placed over the fish and a peg number on a piece of paper ('Post-it' sticker) is placed on the perspex to identify the catch. Two photographs should be taken of each batch of fish. The best photographs may be achieved by:

a) If the angler has a large catch of small fish then the catch will need to be photographed in several batches. The catch should be placed in the plastic crate provided and removed in batches of 15-30 fish (depending on size) using the hand net for photography. After photographing, each batch of fish can be returned to the river or lake and another batch removed from the crate until the whole catch has been photographed. The photograph of each batch should be identified separately with a letter (i.e. Peg No. 476 (a), 476 (b), 476 (c), etc.). If the angler has a large catch of big fish, such as bream or barbel for example, then it is more appropriate to length measure the catch with measuring boards rather than attempt to photograph it. Eels are not suitable for photographic recording due to difficulties in retaining them within the photographic tray.

b) It is not necessary to be able to view every fish completely on the photograph as reasonable estimates can be made of the fork length of the fish if it is partly obscured by another.

c) The use of flashes should be avoided as this can cause problems in analysis of the photographs due to the reflective glare from the perspex sheet obscuring the catch. This may lead to problems during winter monitoring due to the restricted day length. However, it is considered that match monitoring is most successful if undertaken during the summer due to the higher catch rates (see Section 11.4.1).

d) The photographic tray should fill the photograph. However, it is important for analysis purposes that all the tray is visible in the picture. Care should be taken with photographing catches using automatic focus cameras that they are not taken too close (minimum 1.2 metres normally), as a loss of picture definition may result.

e) Photographs should be taken directly above the tray to reduce distortion and errors in estimating fish length. The use of a frame that clips to the corners of the photographic tray and holds the camera directly above the centre of the tray at an appropriate height is recommended. Development of the frame stand requires development but must be lightweight and portable. In this way the photographs will be standardised which will reduce the processing time and reduce distortion errors to a minimum.

f) The use of cameras with a dateback facility for marking the photographs with the date are recommended.

g) After several photographs fish scales, mucus and duckweed/ leaves will accumulate on the perspex sheet. This should be removed with the cloth provided to prevent the clarity of the photographs being obscured.

5) During interviewing there should be minimum disturbance to the anglers. Most of the information may be obtained by visual observation of methods and baits. It was found during the pilot matches that the second and third interviews are normally completed more rapidly than the initial one.

6) All completed data sheets should be collated by the team leader at the end of the match.

A completed data sheet is presented as an example.

Date: 08/10/1994

Venue: R. Trent

Angler Method Record Sheet

Peg No:

A52

		Time in Match (hours)				
		11.00-12.00	12.00-1.00	1.00-2.00	2.00-3.00	3.00-4.00
Method: (i.e float, ledger etc.)		Float	/	Swimfeeder (ledger)	/	Float
Area fished (distance from match bank)		Smetres	/	10metres	/	Smetres
Hook bait		Caster	/	Maggot	/	Worm
Attractant feed (e.g groundball, loose feed maggot etc)		Loose feed caster	/	Maggot in Swimfeeder	/	Chopped worm
Target species		Any	/	Chub	/	Any

Appendix 4: Length frequency histograms and pie charts from attended angling matches

(N.B. These figures have been arranged in the following appendix to allow comparison of the length frequency histograms from anglers' catches and seine netting samples from the River Weaver matches to be compared)

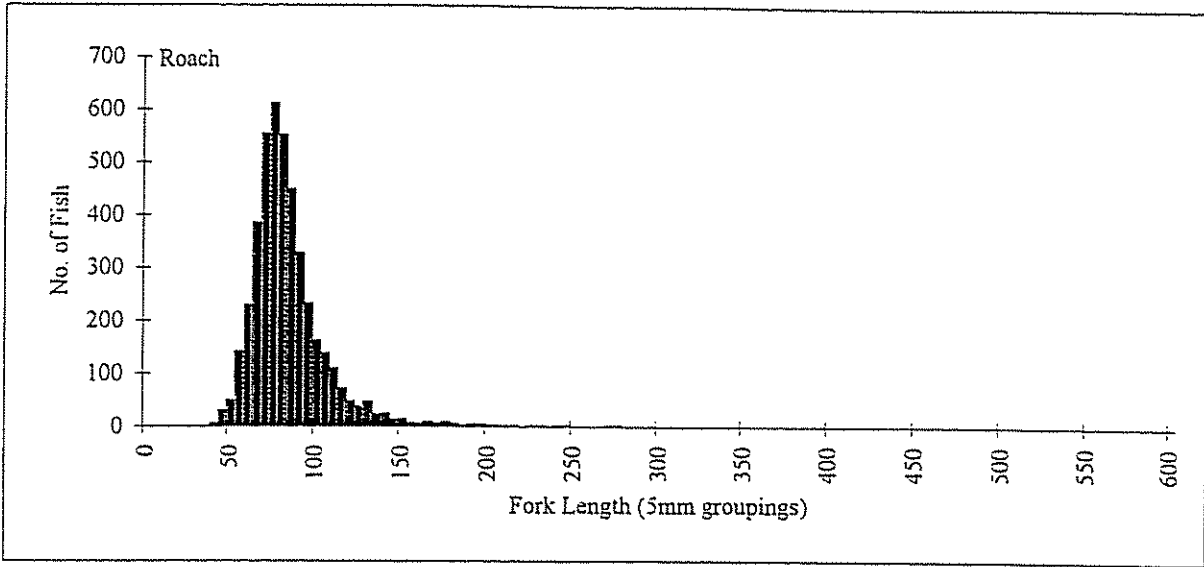


Figure 19(a): Anglers' catch of roach from River Weaver match 24/10/93

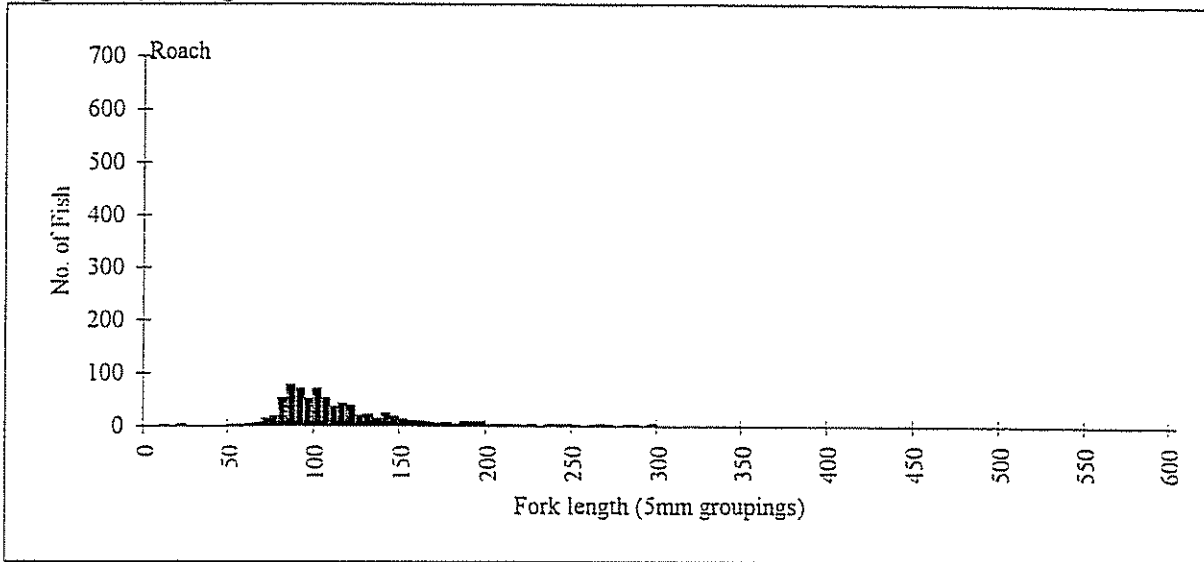


Figure 20(a): Anglers' catch of roach from River Weaver match 23/01/94

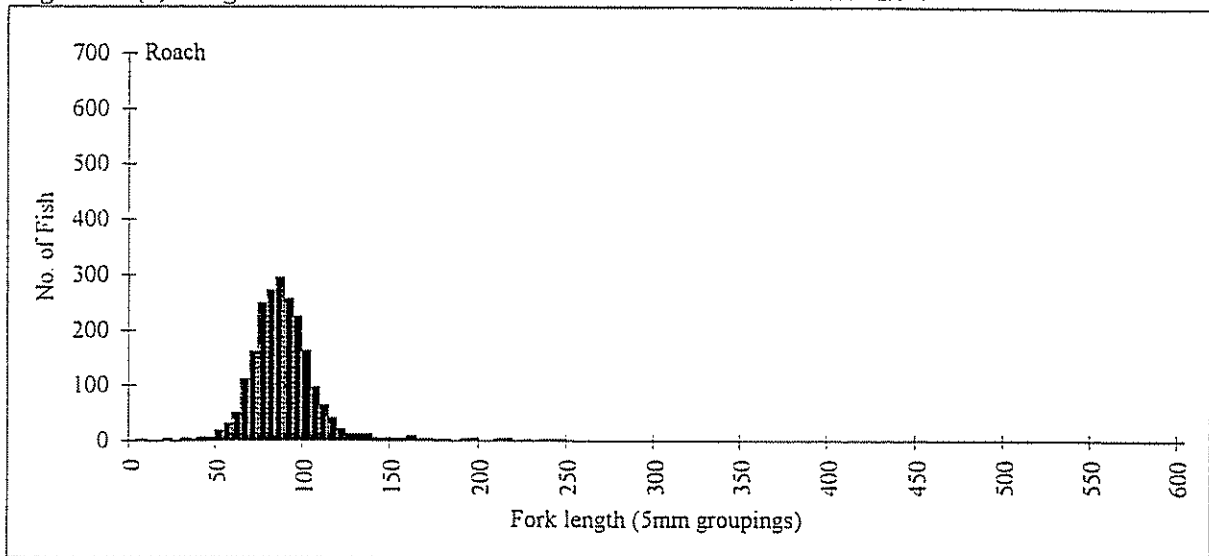


Figure 21(a): Anglers' catch of roach from River Weaver match 13/8/94

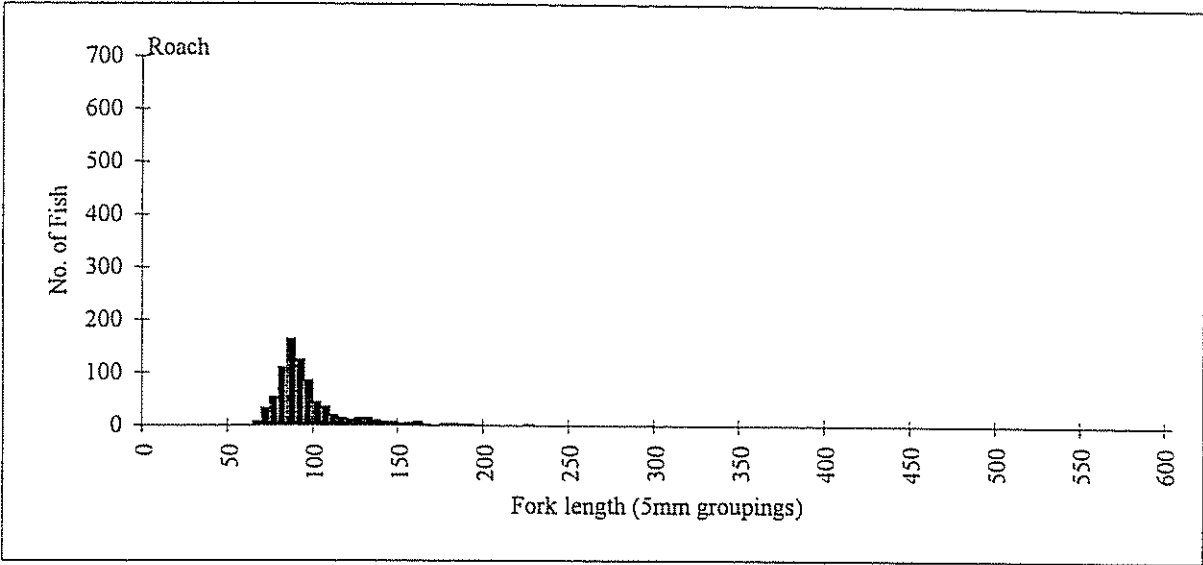


Figure 23(a): Seine netting sample of roach following River Weaver match 24/10/93

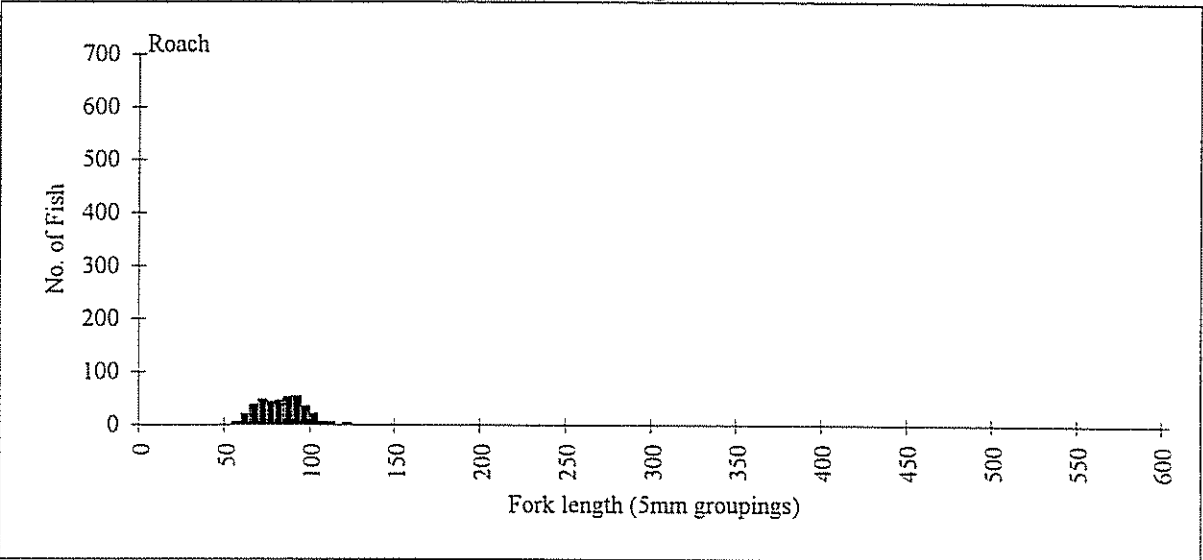


Figure 24(a): Seine netting sample of roach following River Weaver match 23/01/94

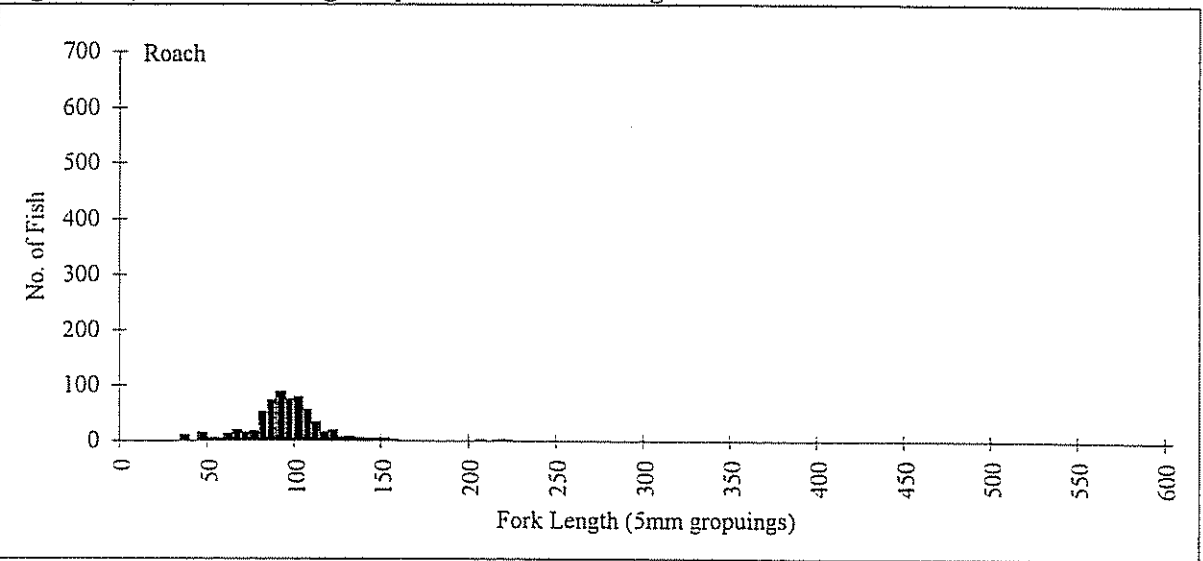


Figure 25(a): Seine netting sample of roach following River Weaver match 13/08/94

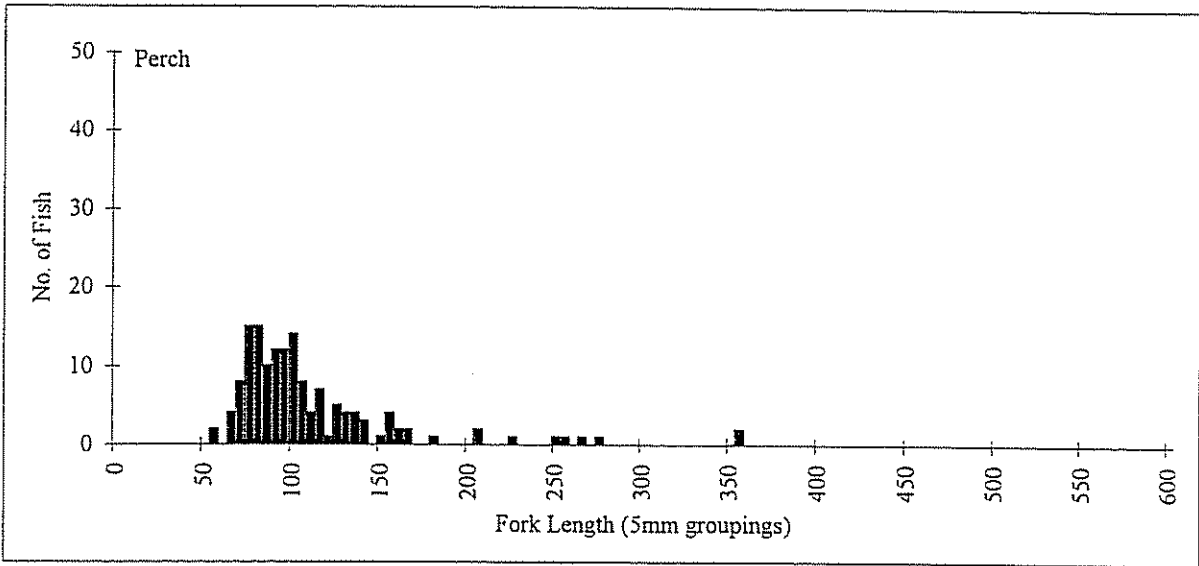


Figure 19(b): Anglers' catch of perch from River Weaver match 24/10/93

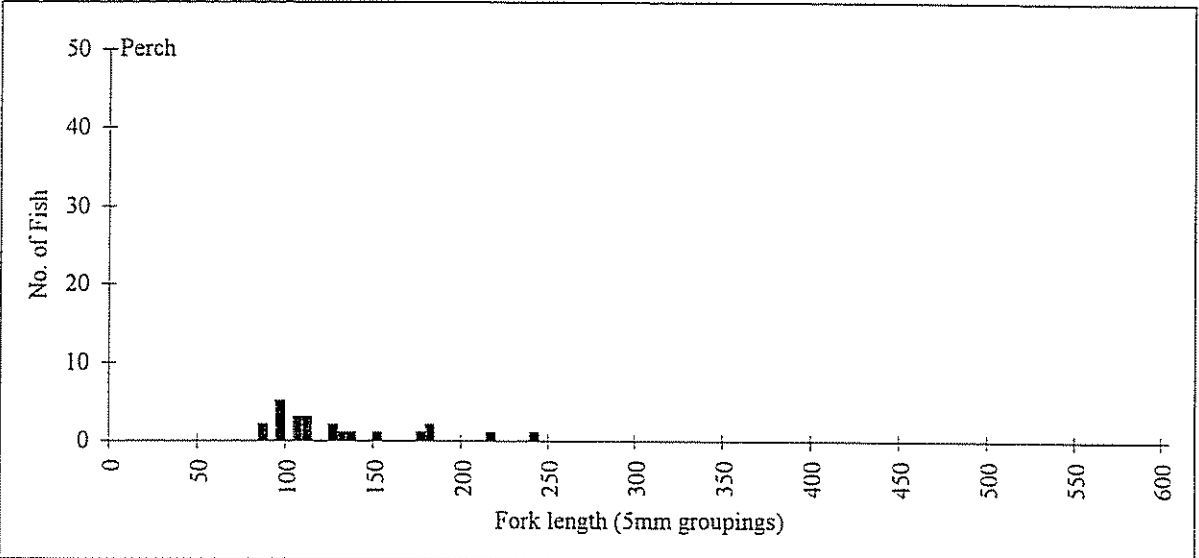


Figure 20(b): Anglers' catch of perch from River Weaver match 23/01/94

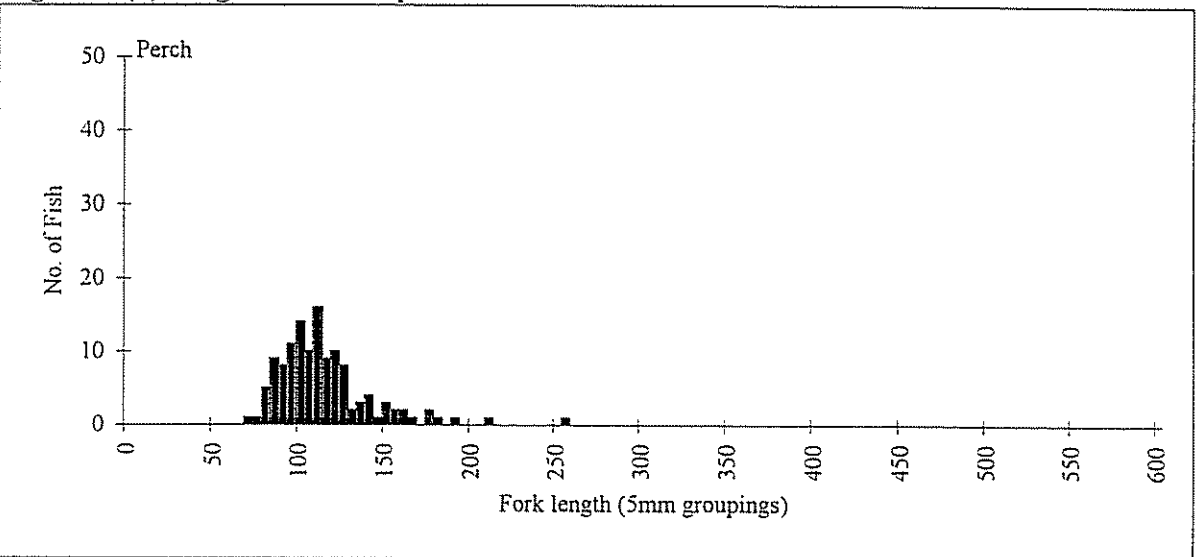


Figure 21(b): Anglers' catch of perch from River Weaver match 13/08/94

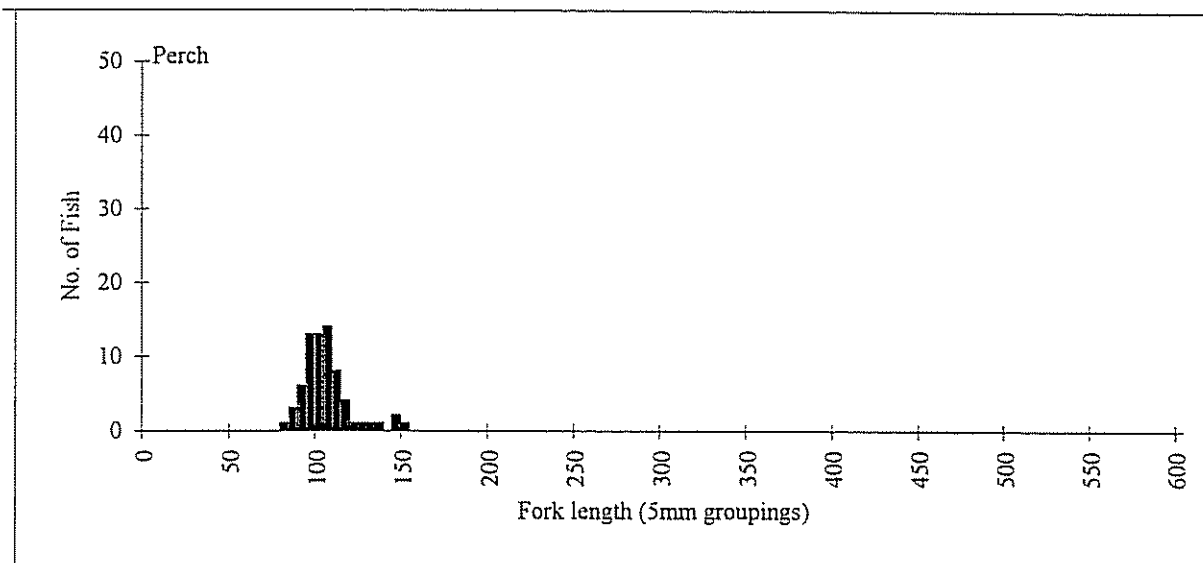


Figure 23(b): Seine netting sample of perch following River Weaver match 24/10/93

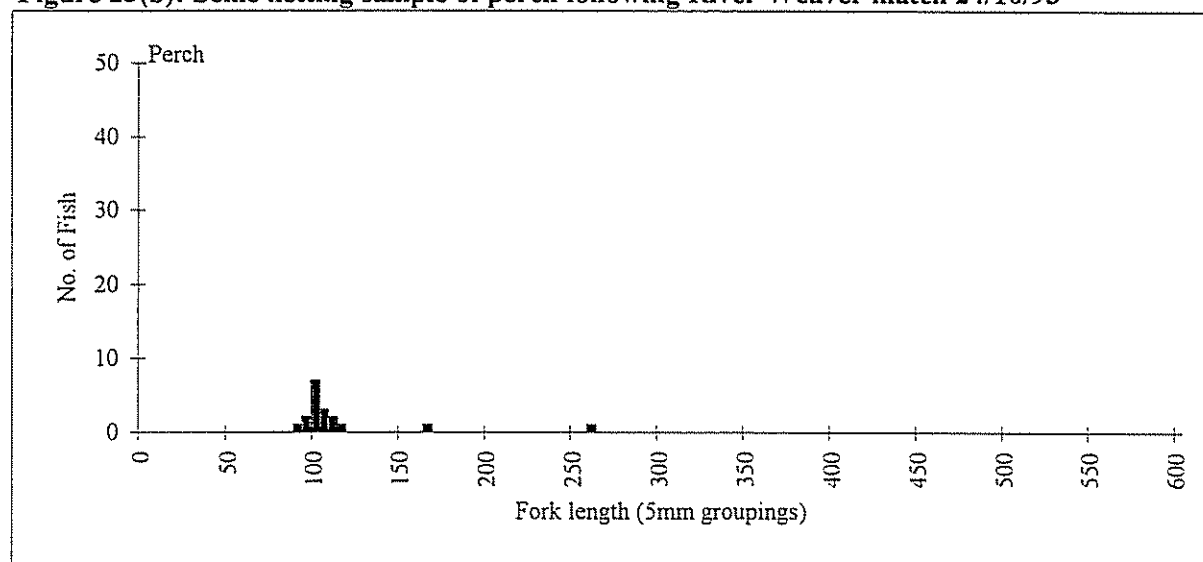


Figure 24(b): Seine netting sample of perch following River Weaver match 13/01/94

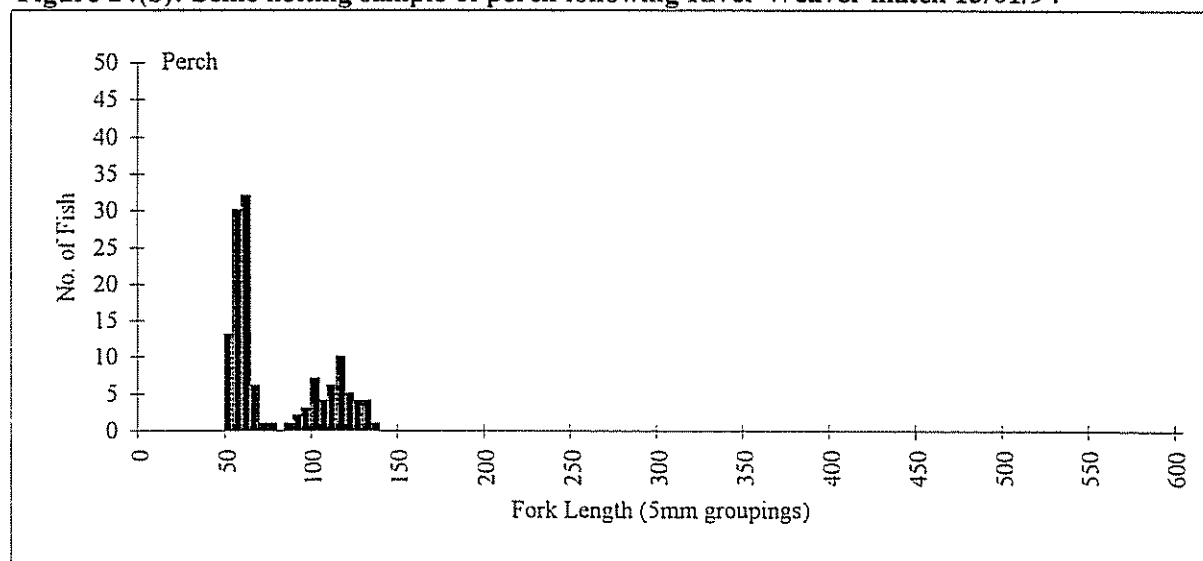


Figure 25(b): Seine netting sample of perch following River Weaver match 13/08/94

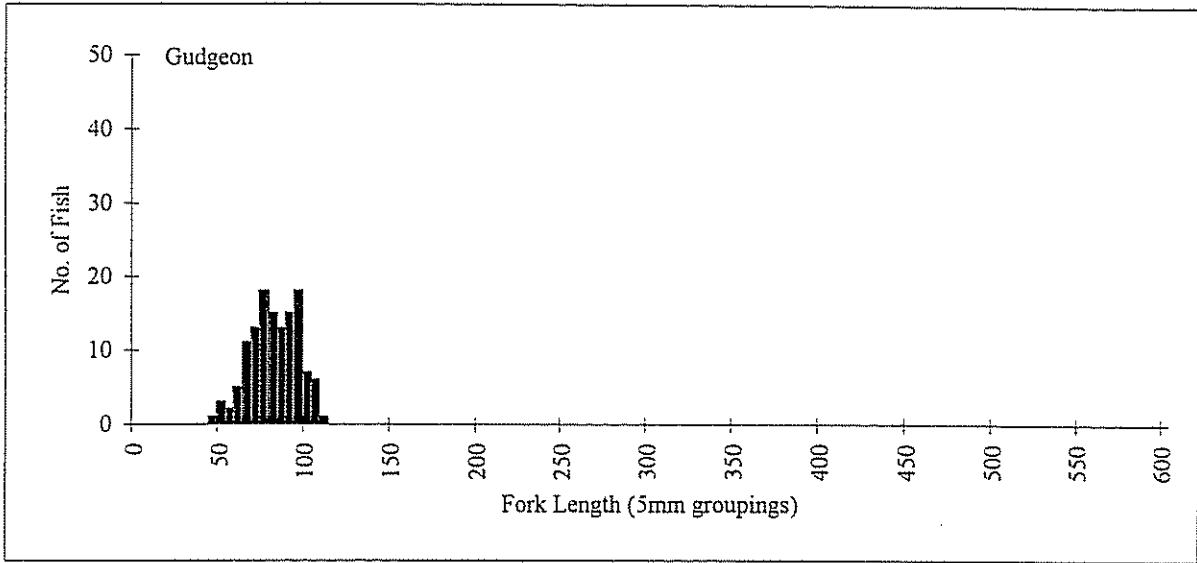


Figure 19(c): Anglers' catch of gudgeon from River Weaver 24/10/93

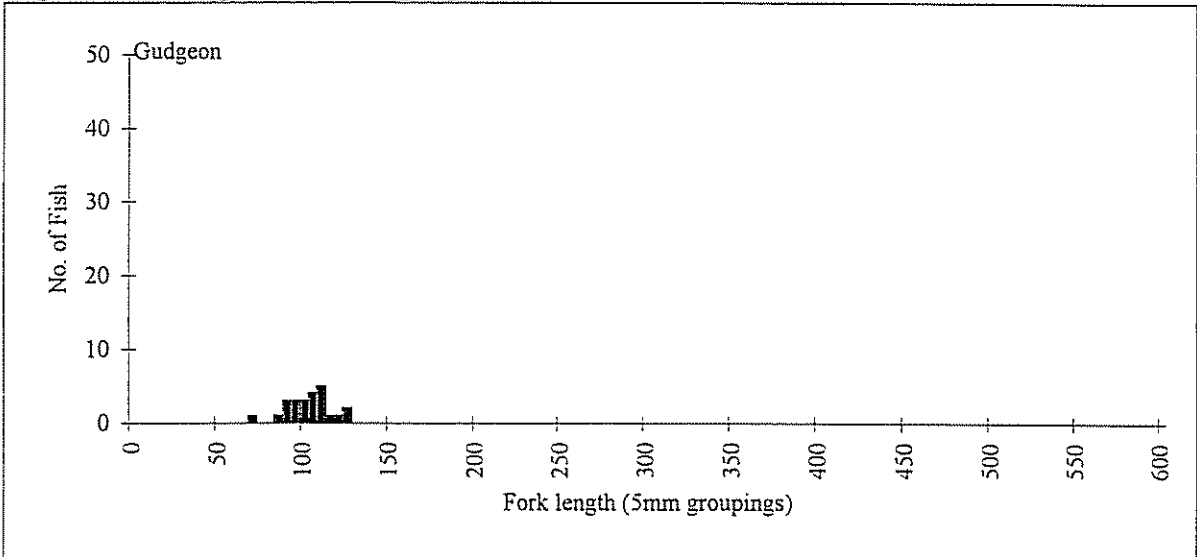


Figure 20(c): Anglers' catch of gudgeon from River Weaver 23/01/94

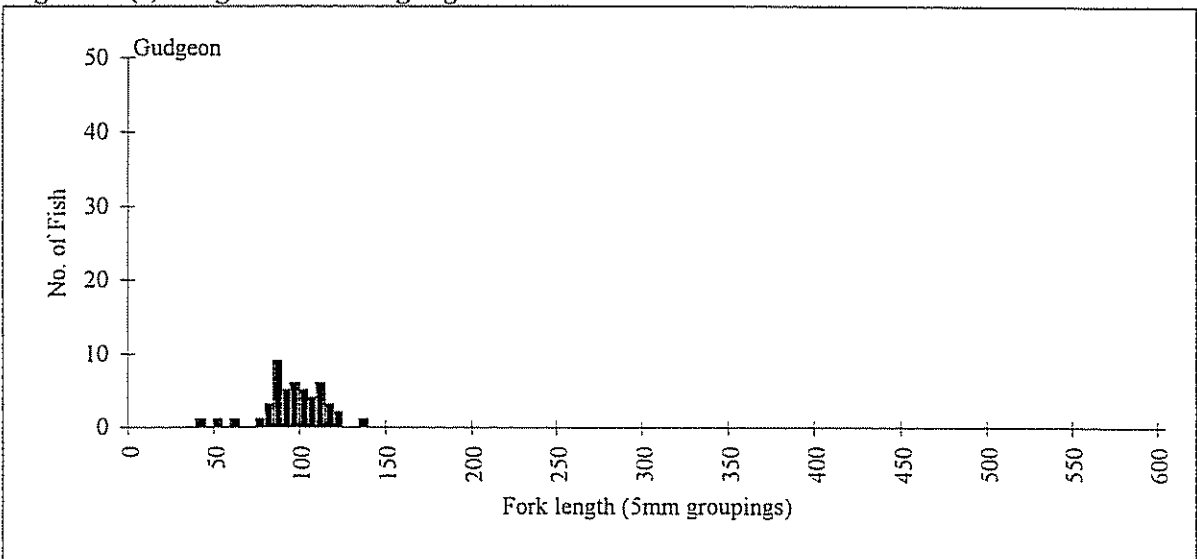


Figure 21(c): Anglers' catch of gudgeon from River Weaver 13/08/94

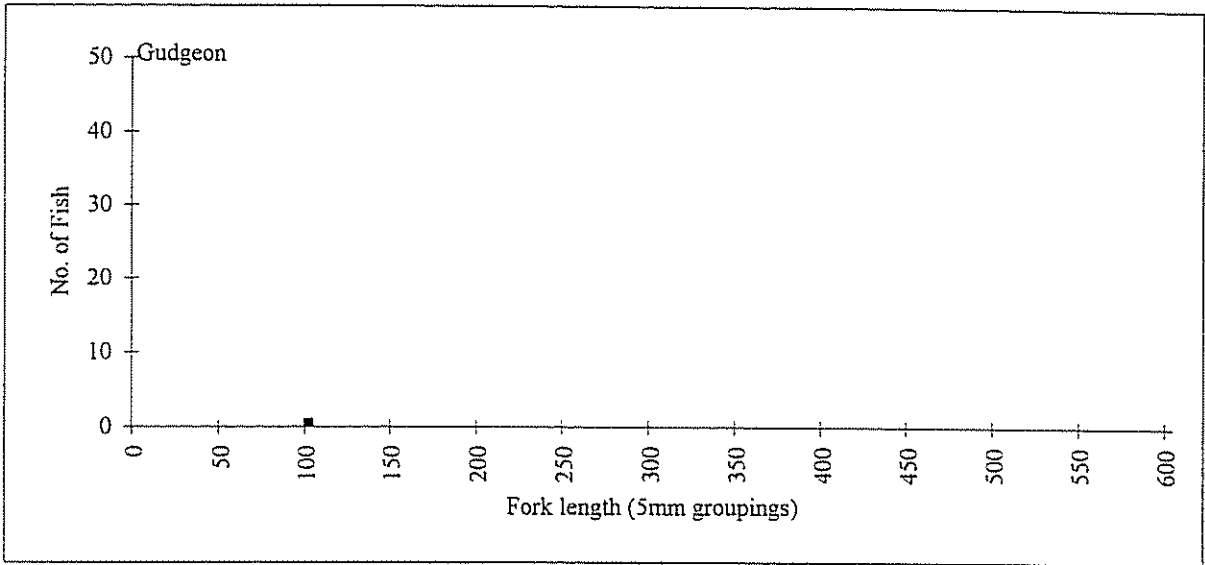


Figure 23(c): Seine netting sample of gudgeon following River Weaver match 24/10/93

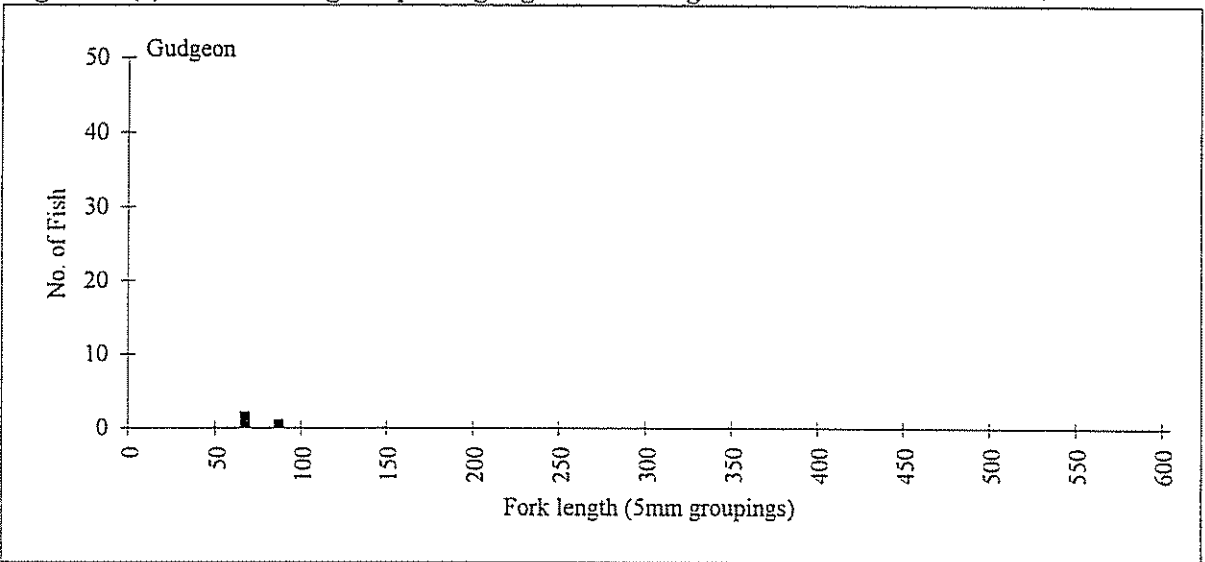


Figure 24(c): Seine netting sample of gudgeon following River Weaver match 23/01/94

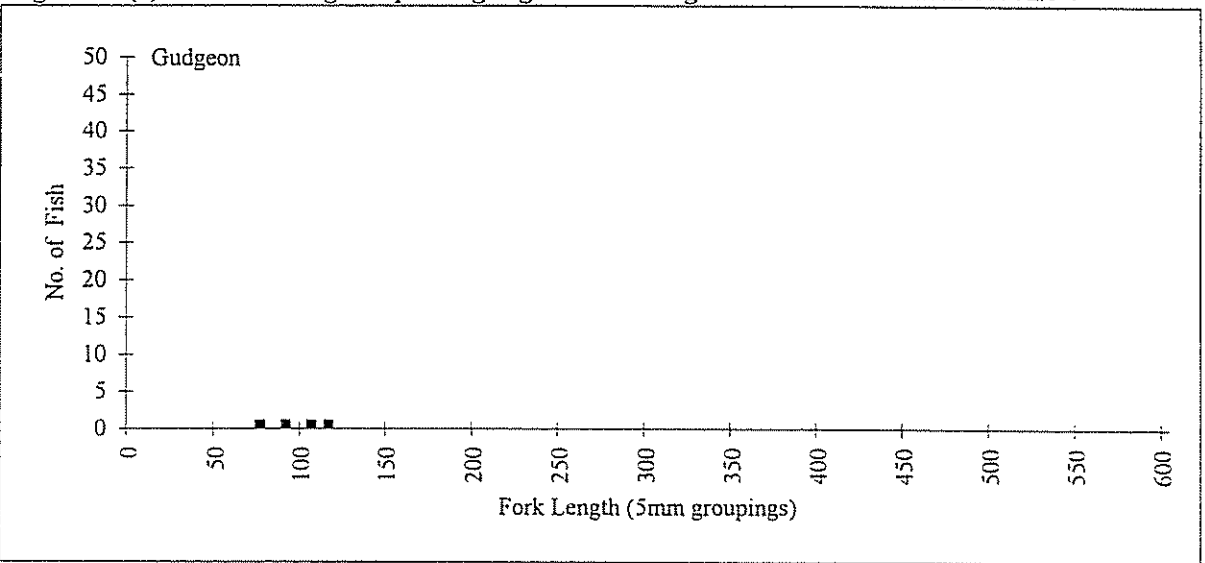


Figure 25(c): Seine netting sample of gudgeon following River Weaver match 13/08/94

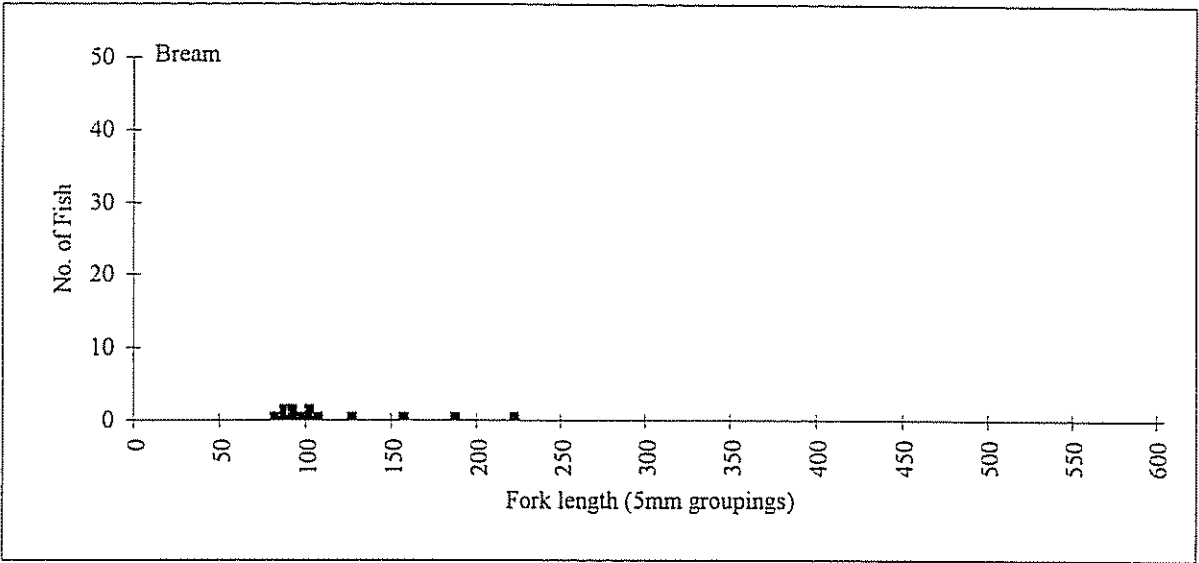


Figure 19(d): Anglers' catch of bream from the River Weaver match 24/10/93

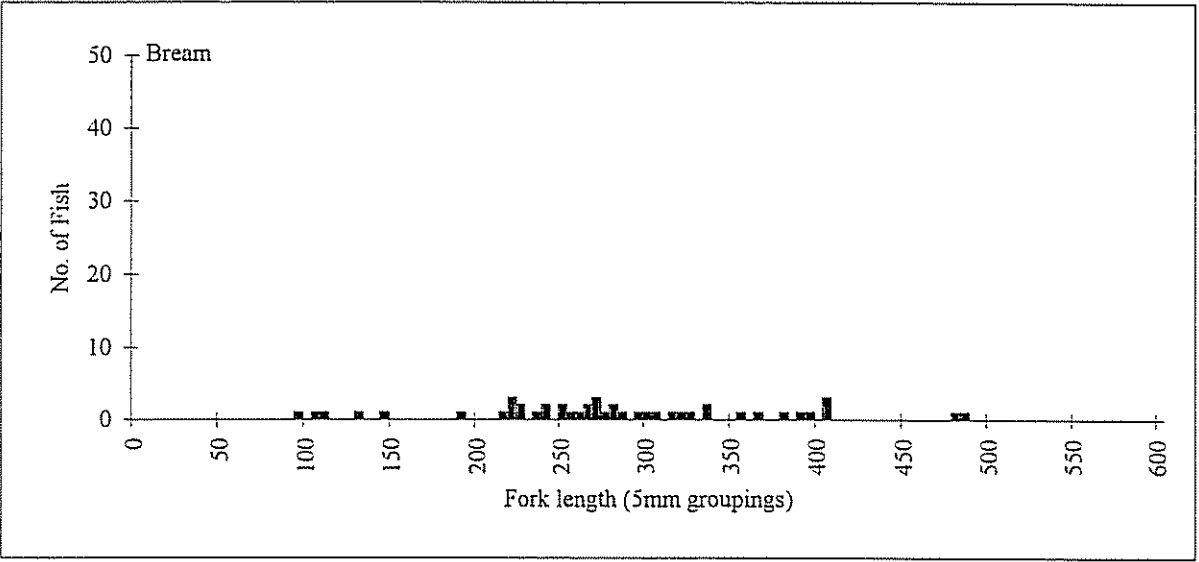


Figure 20(d): Anglers' catch of bream from the River Weaver match 23/01/94

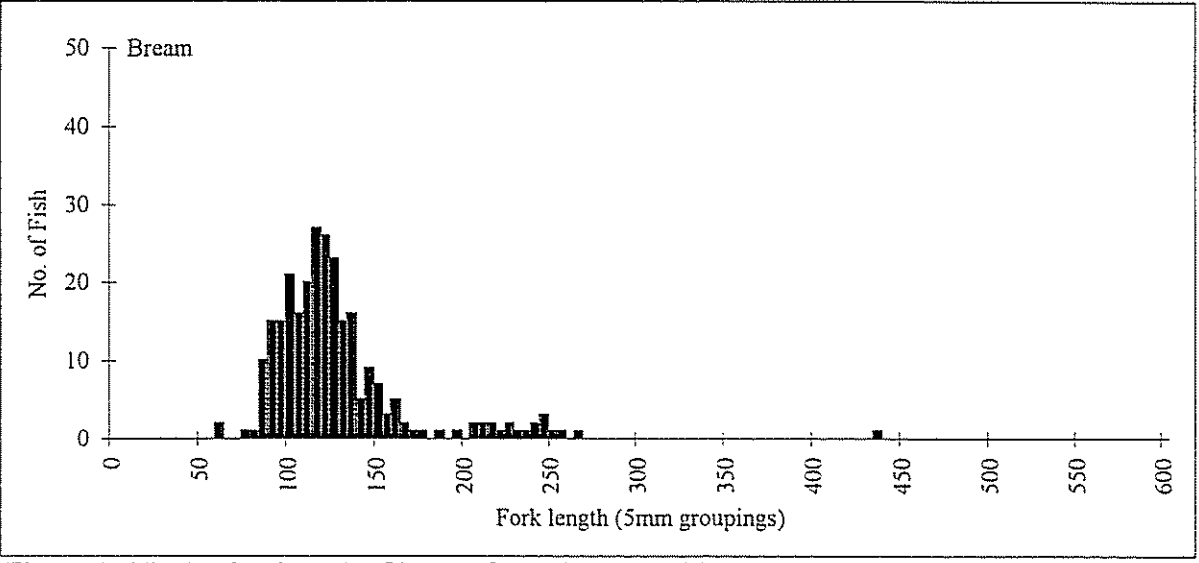


Figure 21(d): Anglers' catch of bream from the River Weaver match 13/08/94

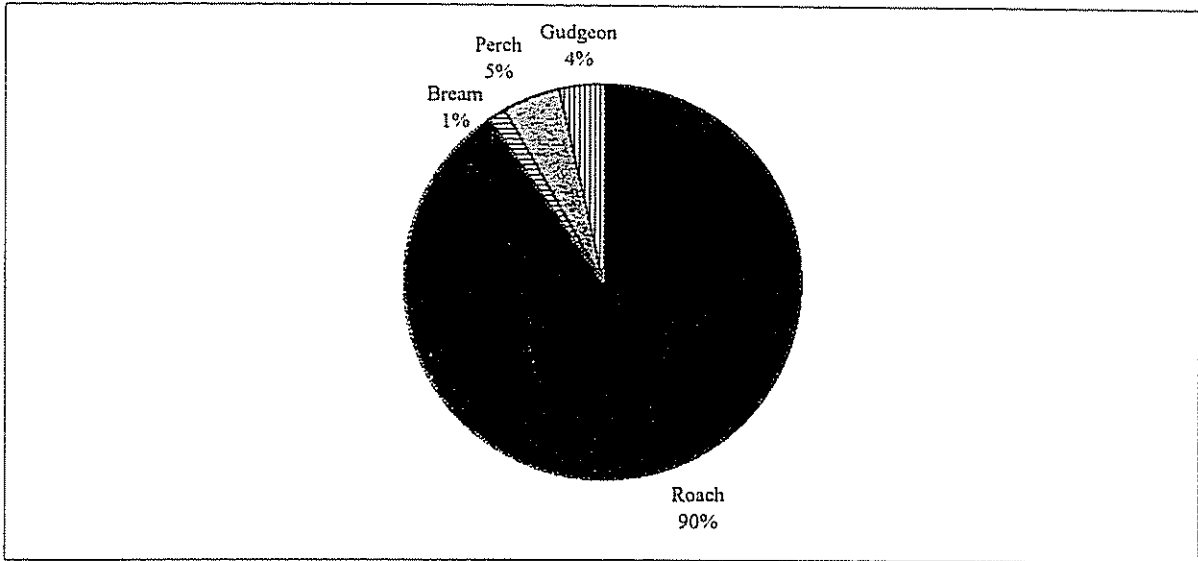


Figure 19(e): Species composition of anglers' catches from the River Weaver match 24/10/93

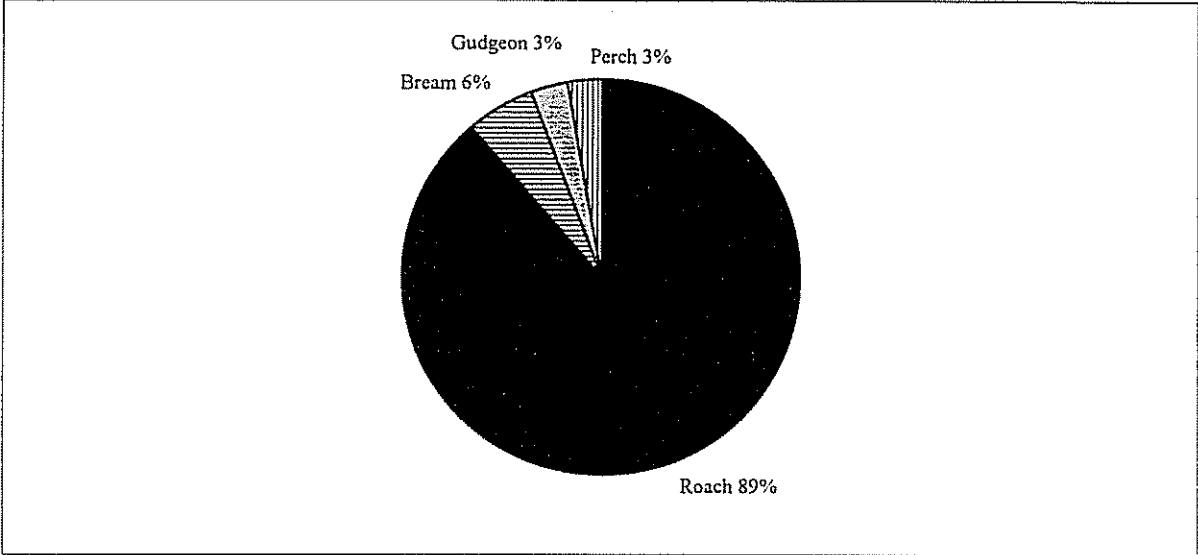


Figure 20(e): Species composition of anglers' catches from the River Weaver match 23/01/94

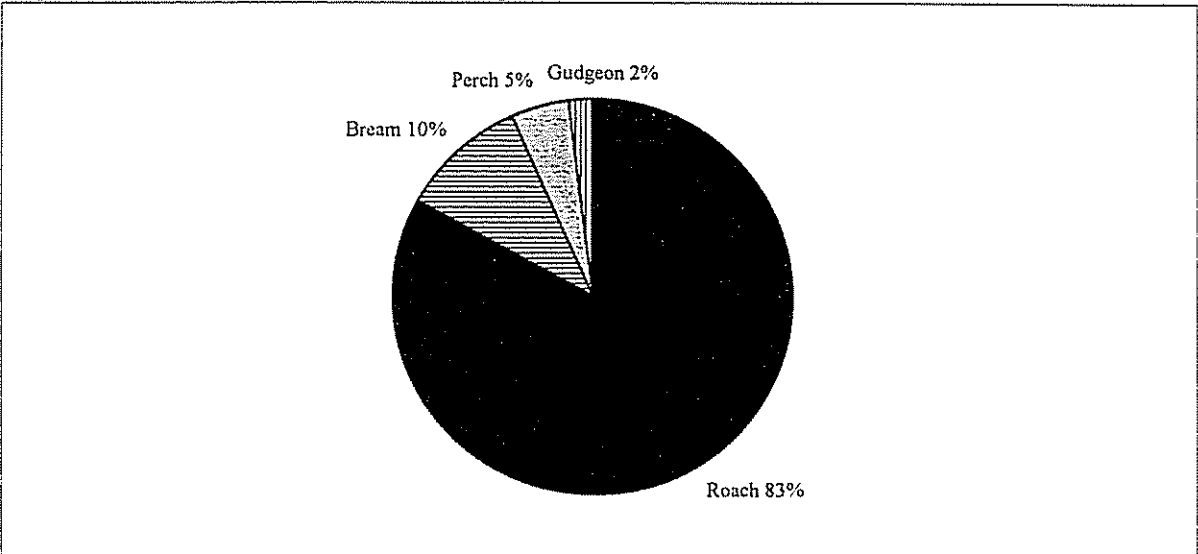


Figure 21(e): Species composition of anglers' catches from the River Weaver match 13/08/94

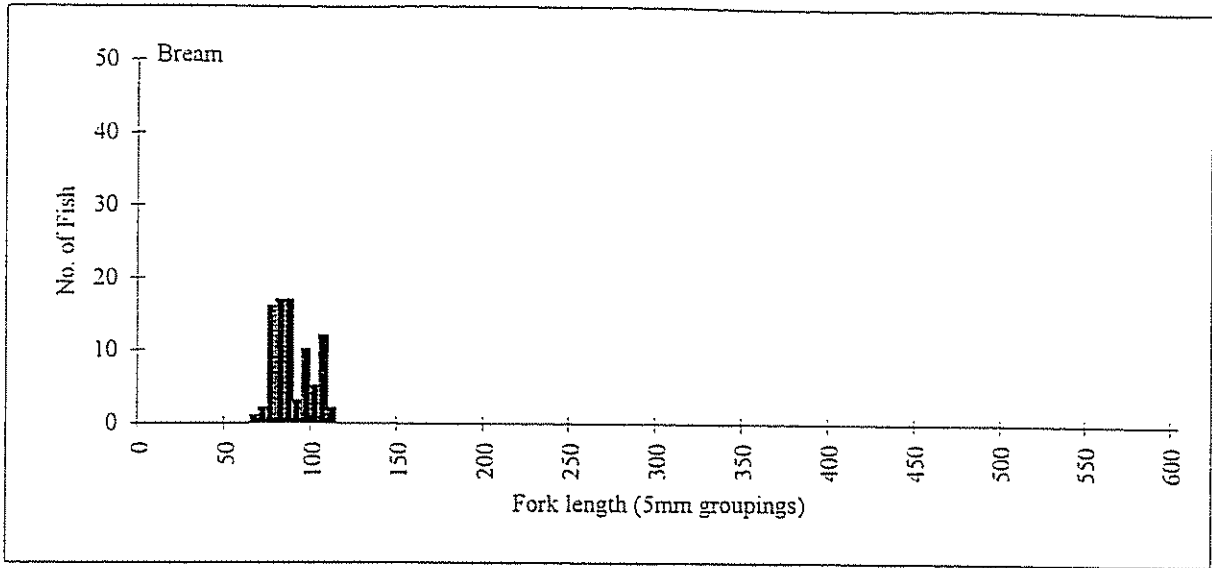


Figure 23(d): Seine netting sample of bream after River Weaver match 24/10/93

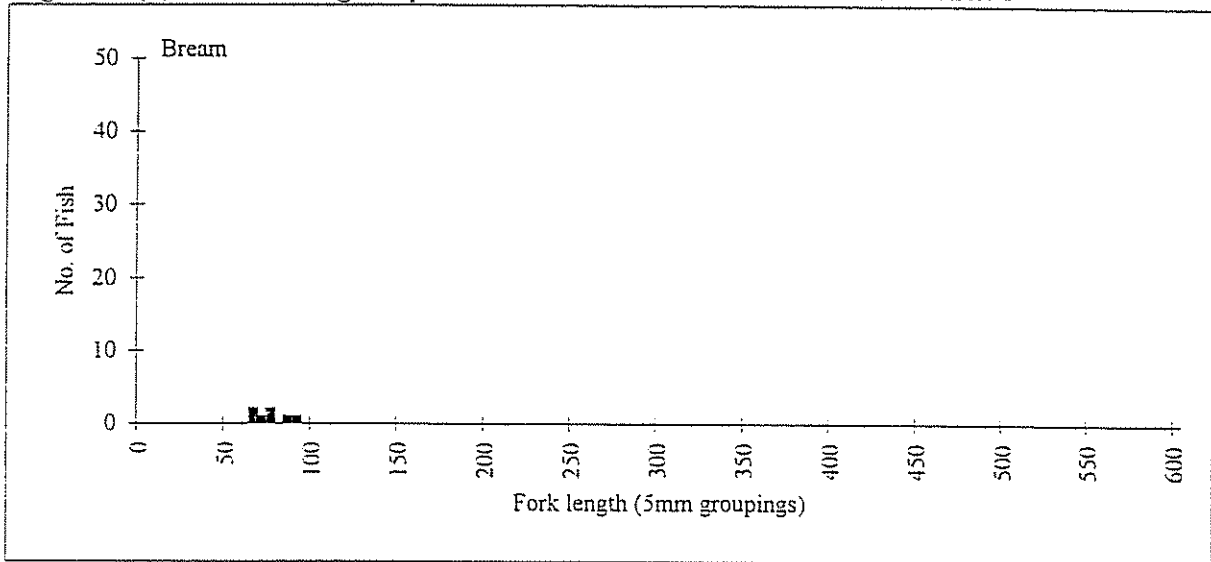


Figure 24(d): Seine netting sample of bream after River Weaver match 23/01/94

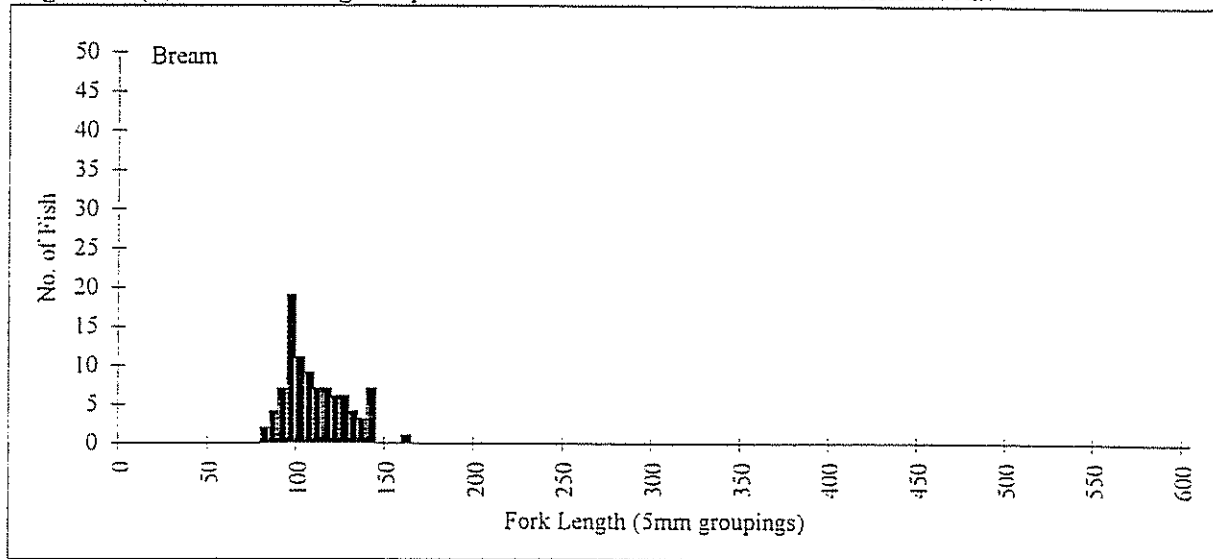


Figure 25(d): Seine netting sample of bream after River Weaver match 13/08/94

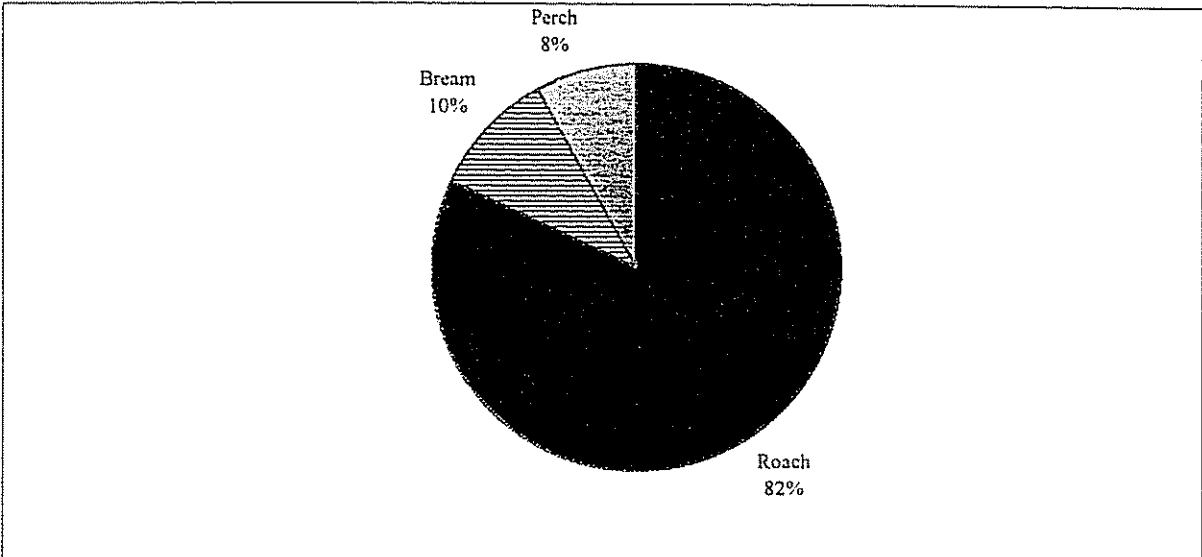


Figure 23(e): Species composition of seine net sample following the River Weaver match 24/10/

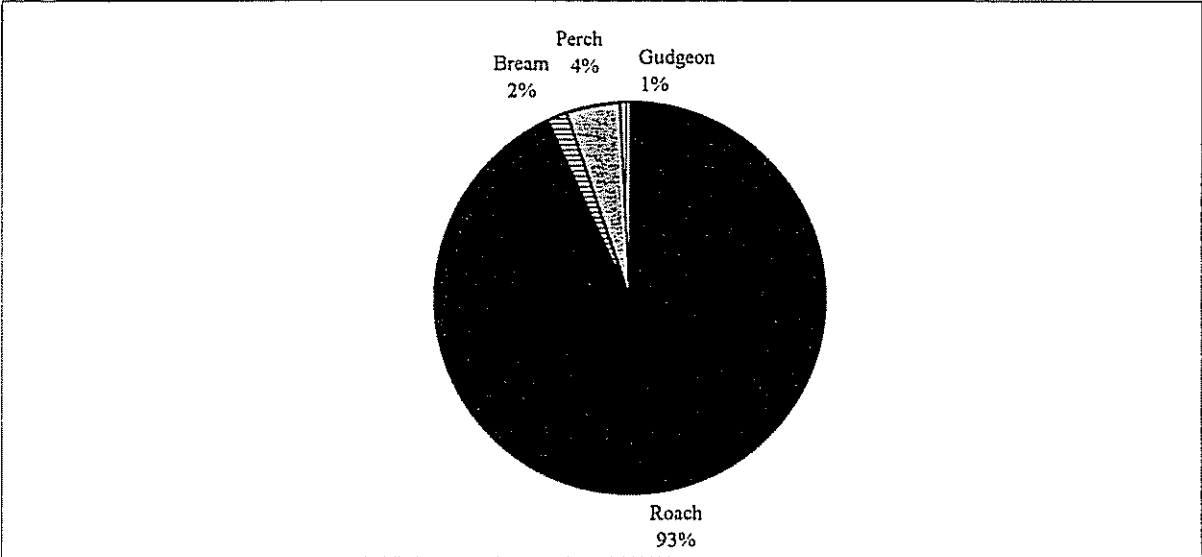


Figure 24(e): Species composition of seine net sample following the River Weaver match 23/01/

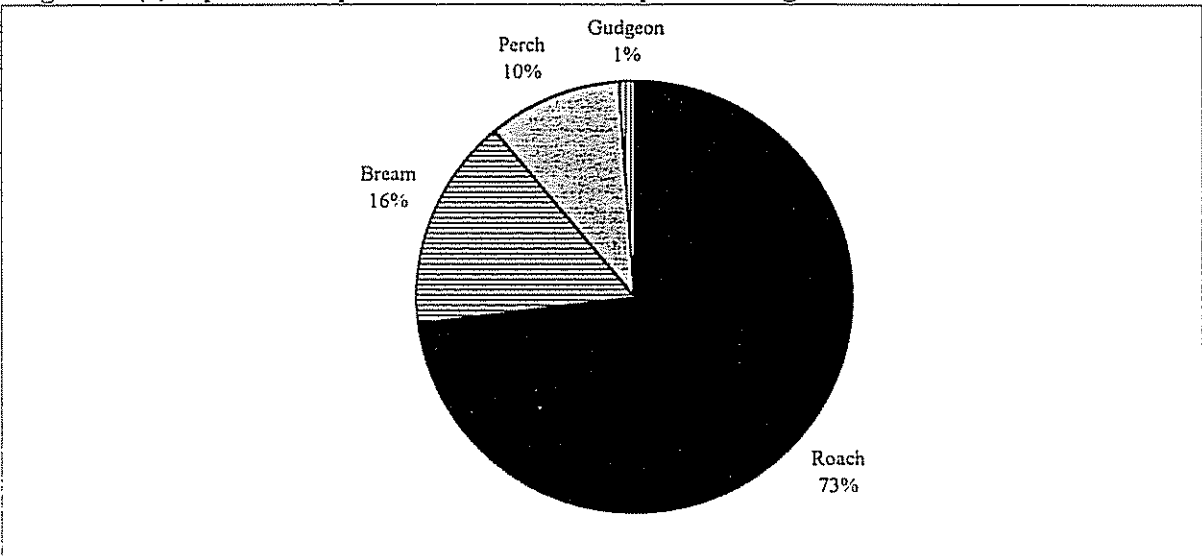


Figure 25(e): Species composition of seine net sample following the River Weaver match 13/08/

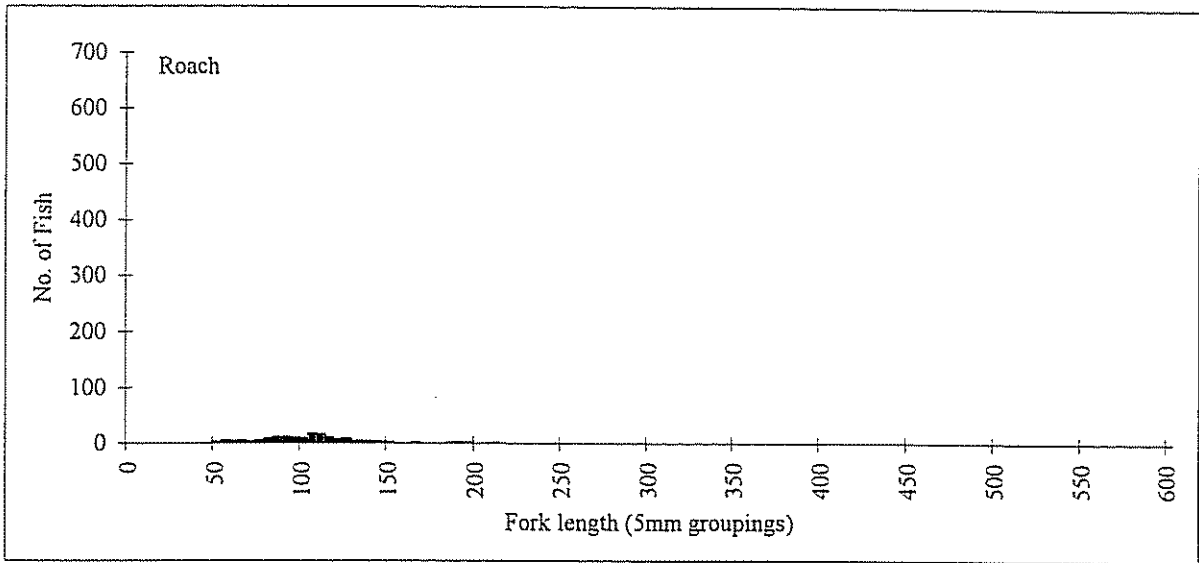


Figure 26(a): Boom boat electric fishing sample of roach from the River Weaver (25/9/93)

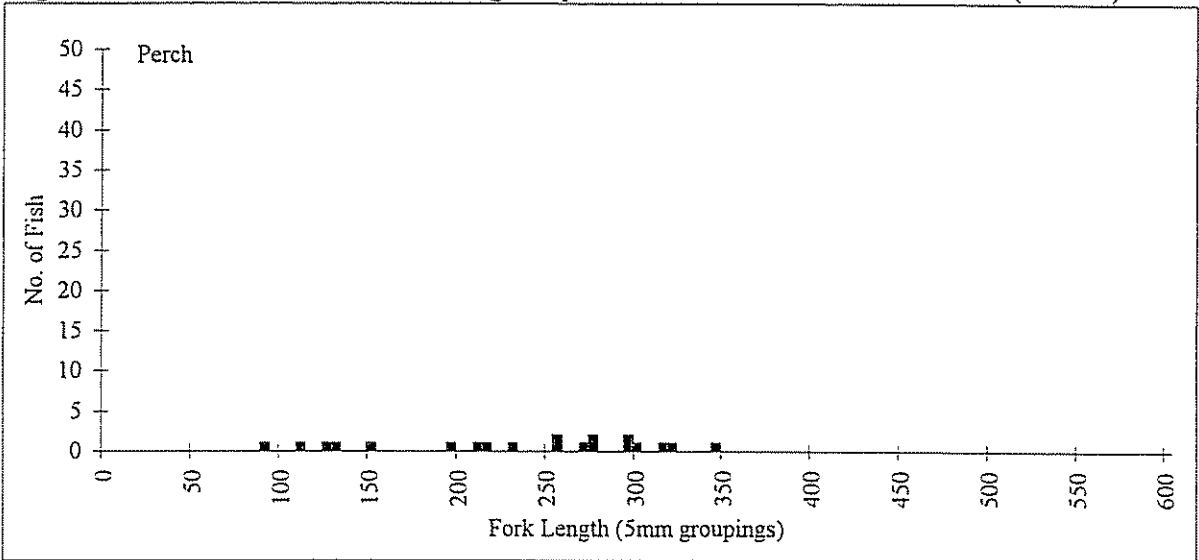


Figure 26(b): Boom boat electric fishing sample of perch from the River Weaver (25/9/93)

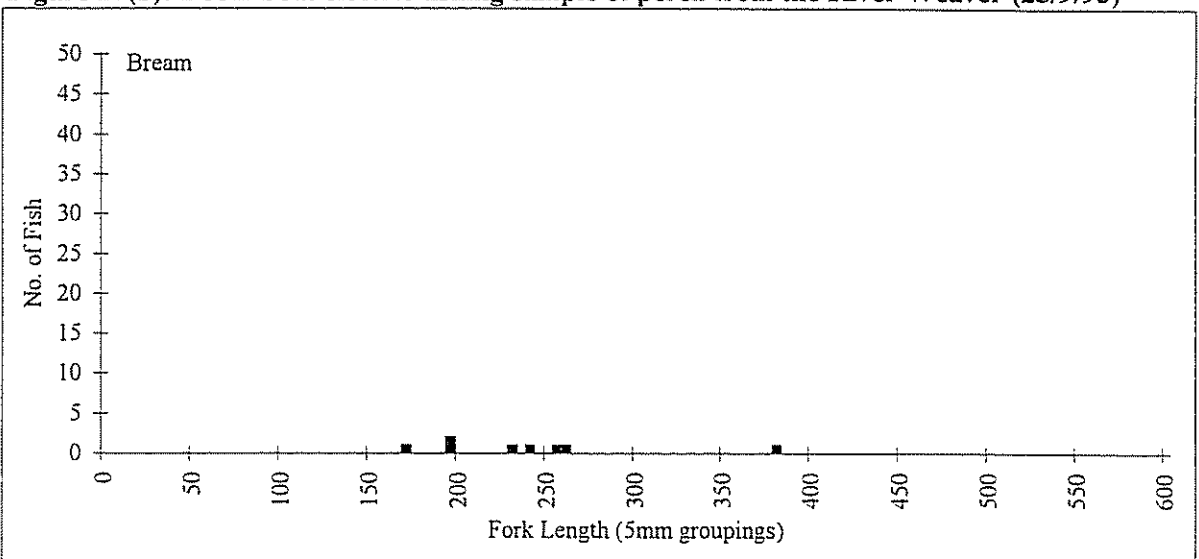


Figure 26(c): Boom boat electric fishing sample of bream from the River Weaver (25/9/93)

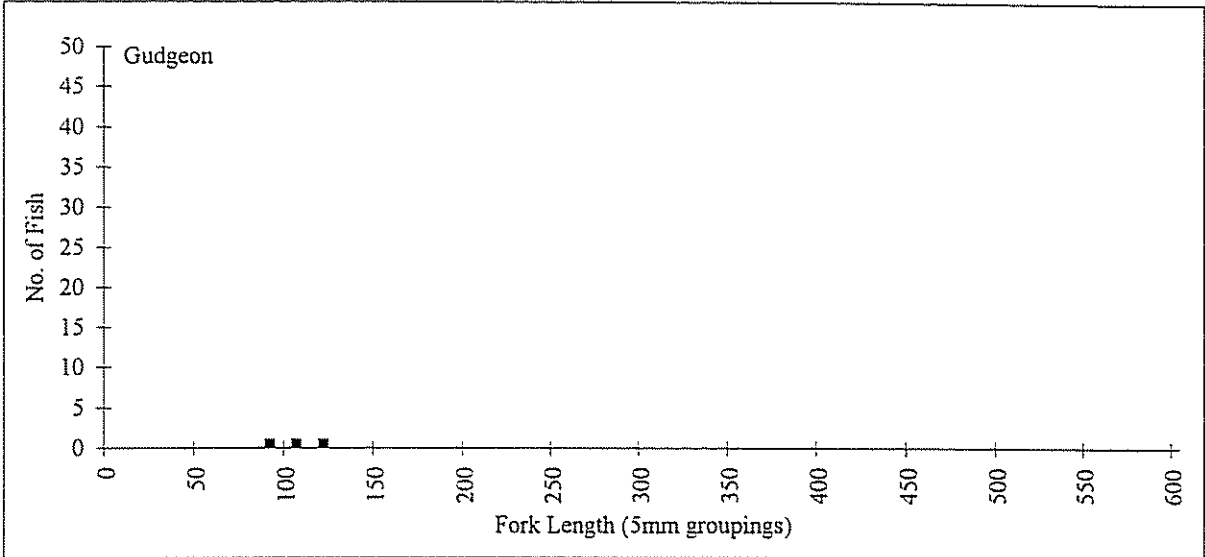


Figure 26(d): Boom boat electric fishing sample of gudgeon from the River Weaver (25/9/93)

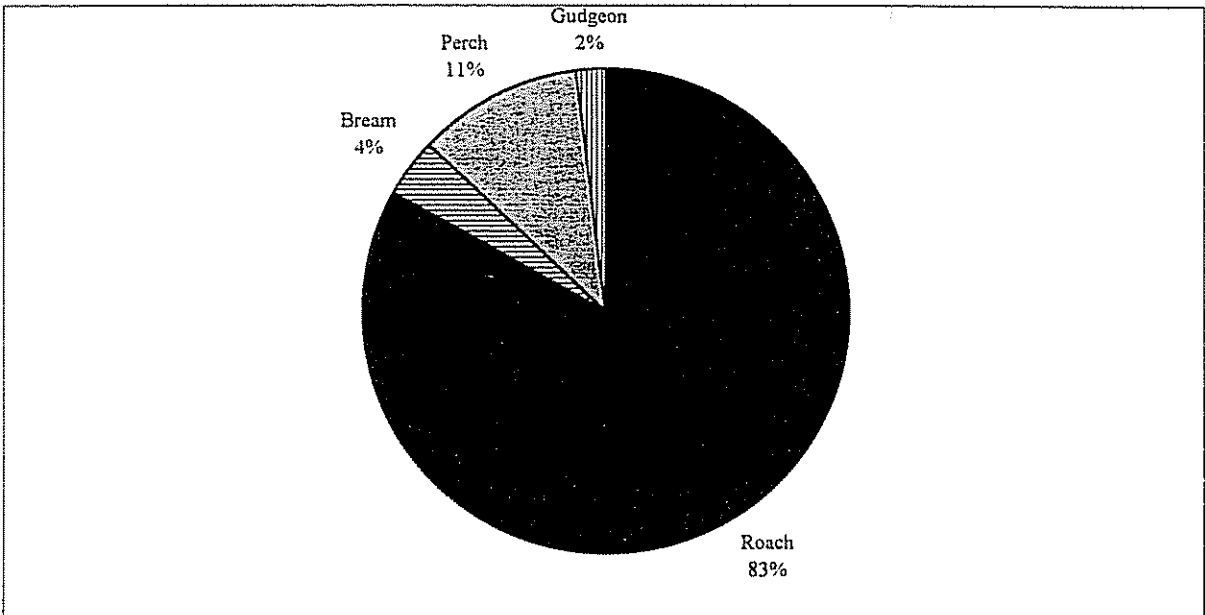


Figure 26(e): Species composition of boom boat electric fishing sample from the River Weaver

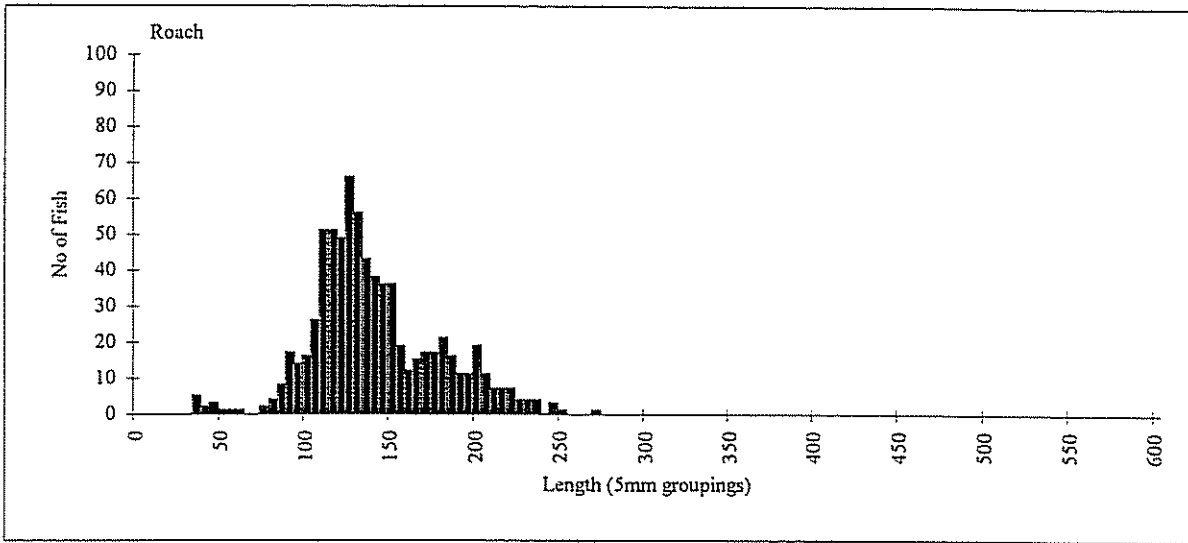


Figure 22(a): Anglers' catch of roach from River Trent match (9/10/94)

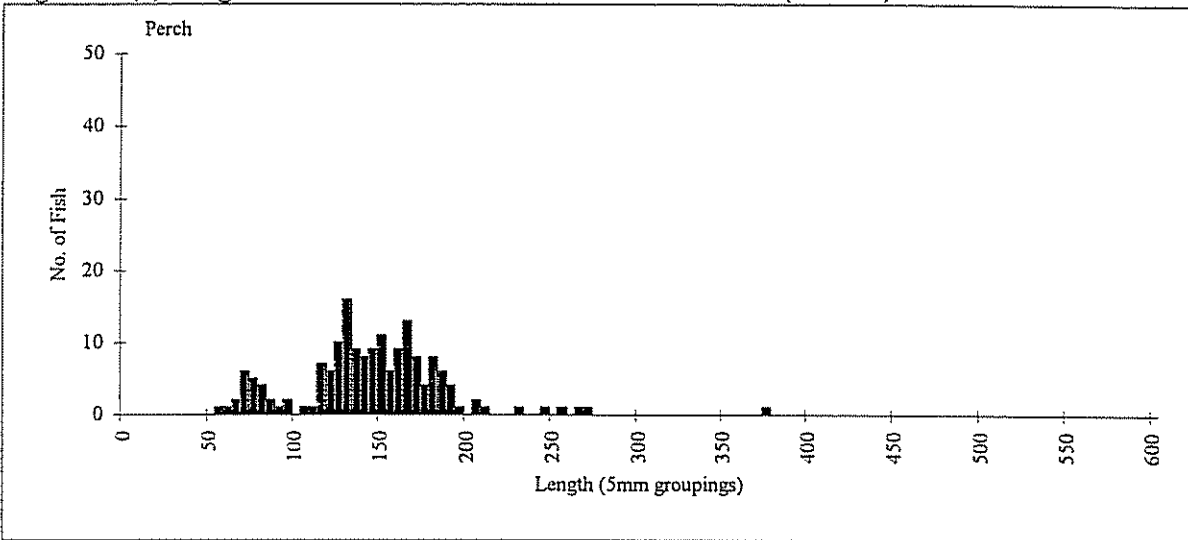


Figure 22(b): Anglers' catch of perch from River Trent match (9/10/94)

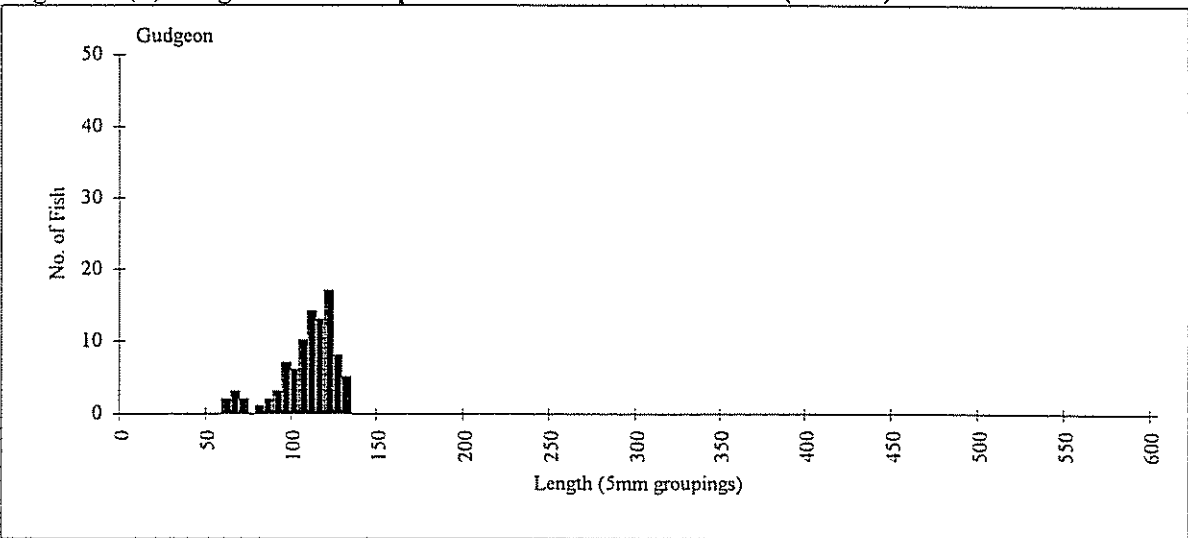


Figure 22(c): Anglers' catch of gudgeon from River Trent match (9/10/94)

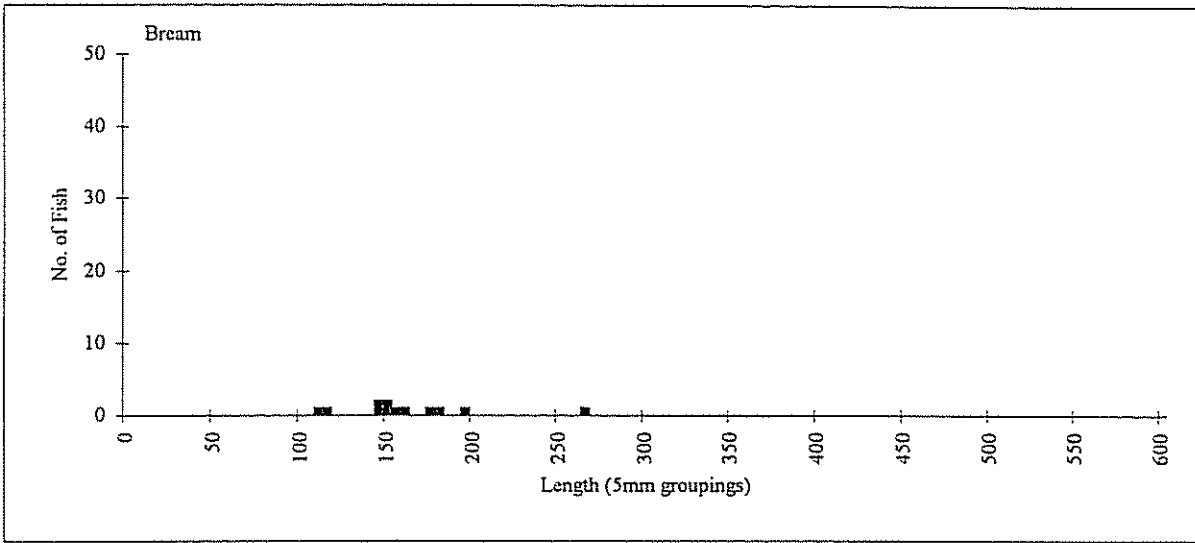


Figure 22(d): Anglers' catch of bream from River Trent match (9/10/94)

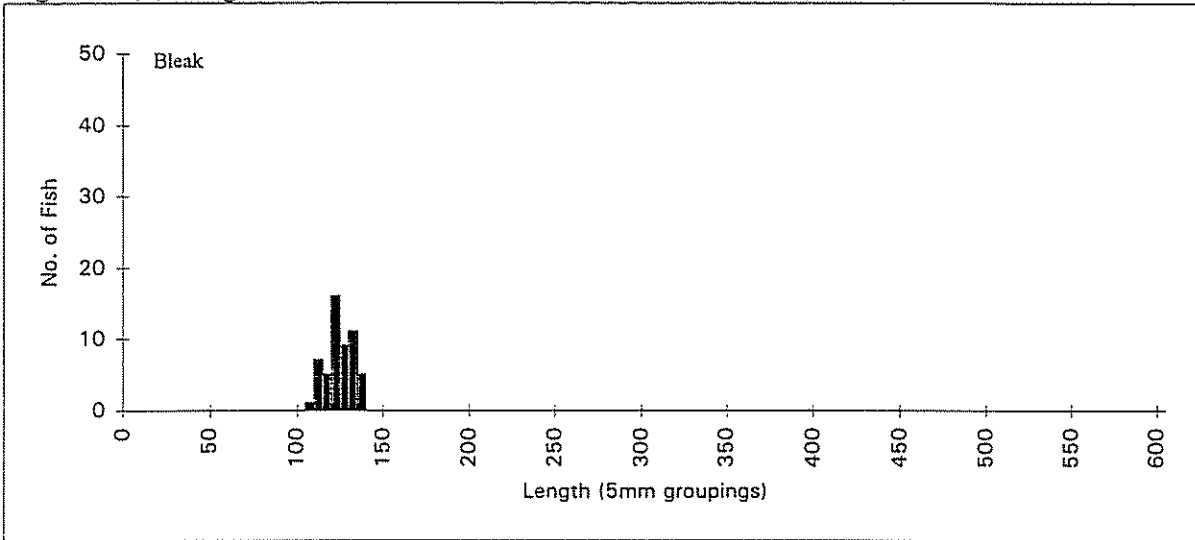


Figure 22(e): Anglers' catch of bleak from River Trent match (9/10/94)

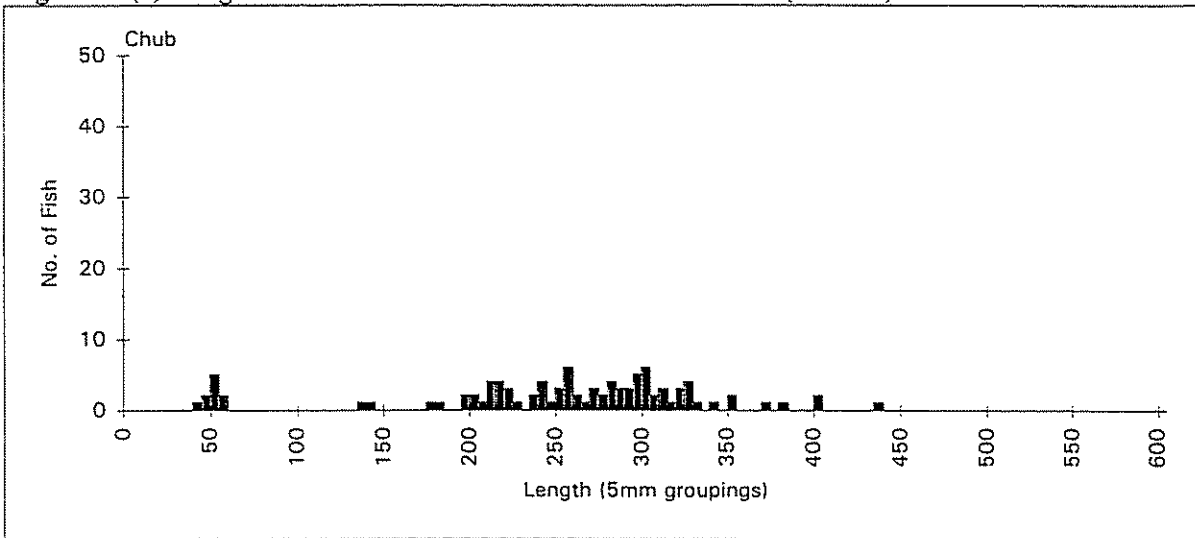


Figure 22(f): Anglers' catch of chub from River Trent match (9/10/94)

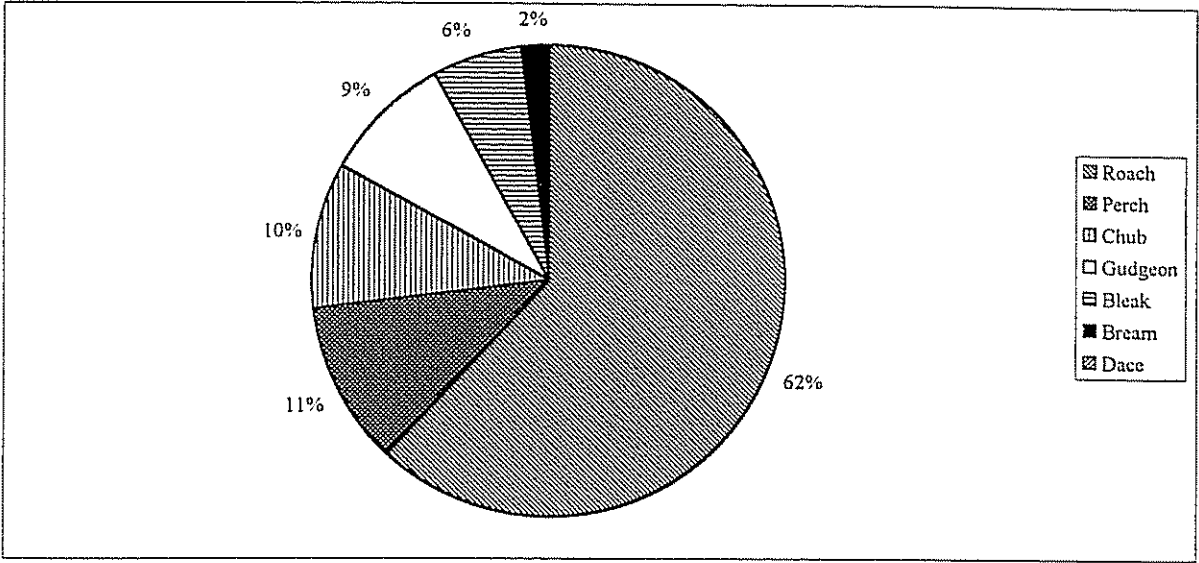


Figure 22(g): Species composition of anglers' catch from River Trent match (section A)

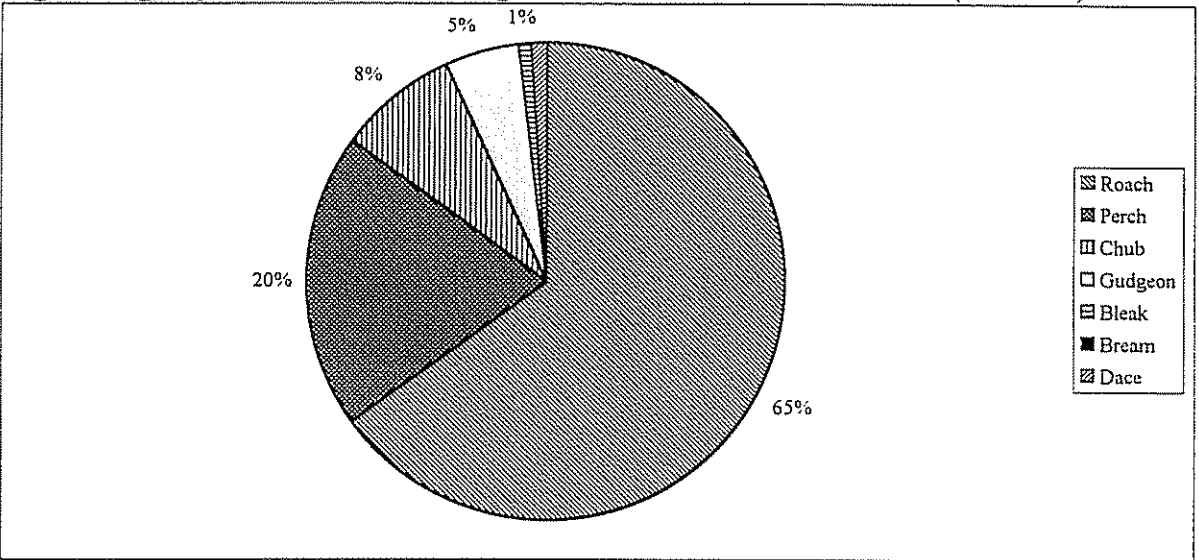


Figure 22(h): Species composition of anglers' catch from River Trent match (section B)

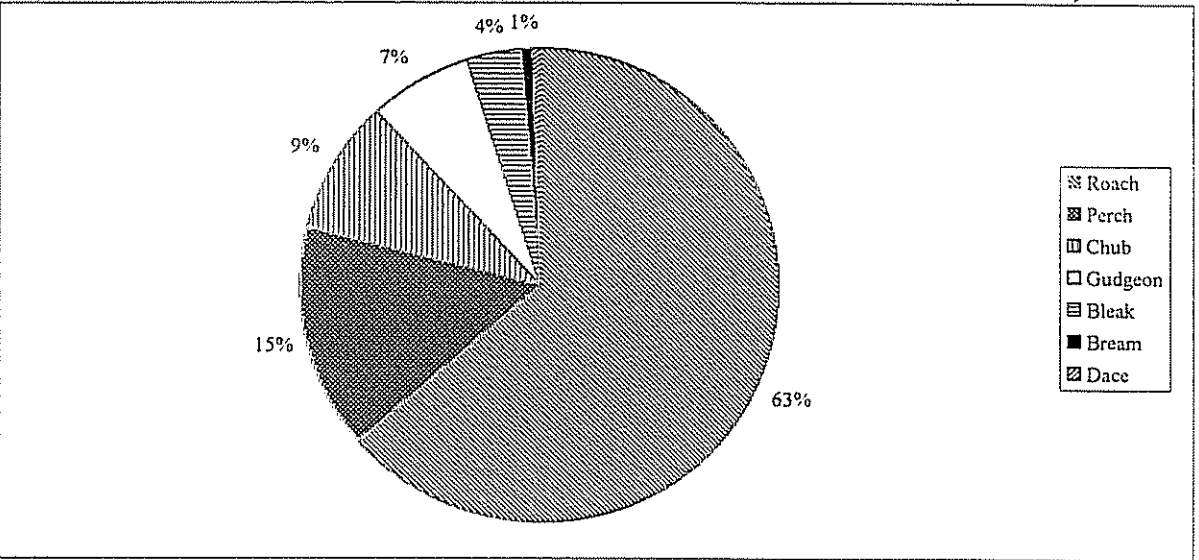


Figure 22(i): Overall species composition of anglers catches from River Trent match

Appendix 5: Catch spatial distribution plots for attended angling matches on the River Weaver and River Trent

Figure 19(f): Number of fish caught by peg number and species.
 River Weaver Angling Match (24/10/1993)

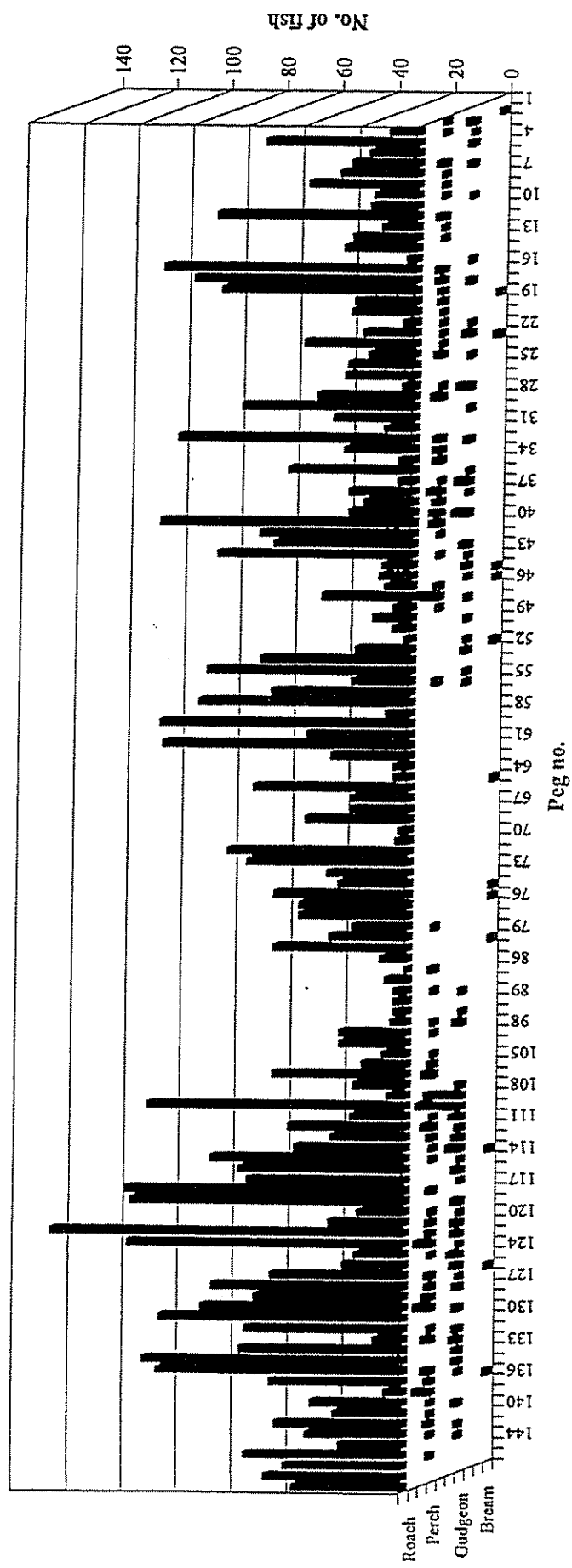


Figure 20(f): Number of fish caught by peg number and species.
 River Weaver Angling Match (23/1/1993)

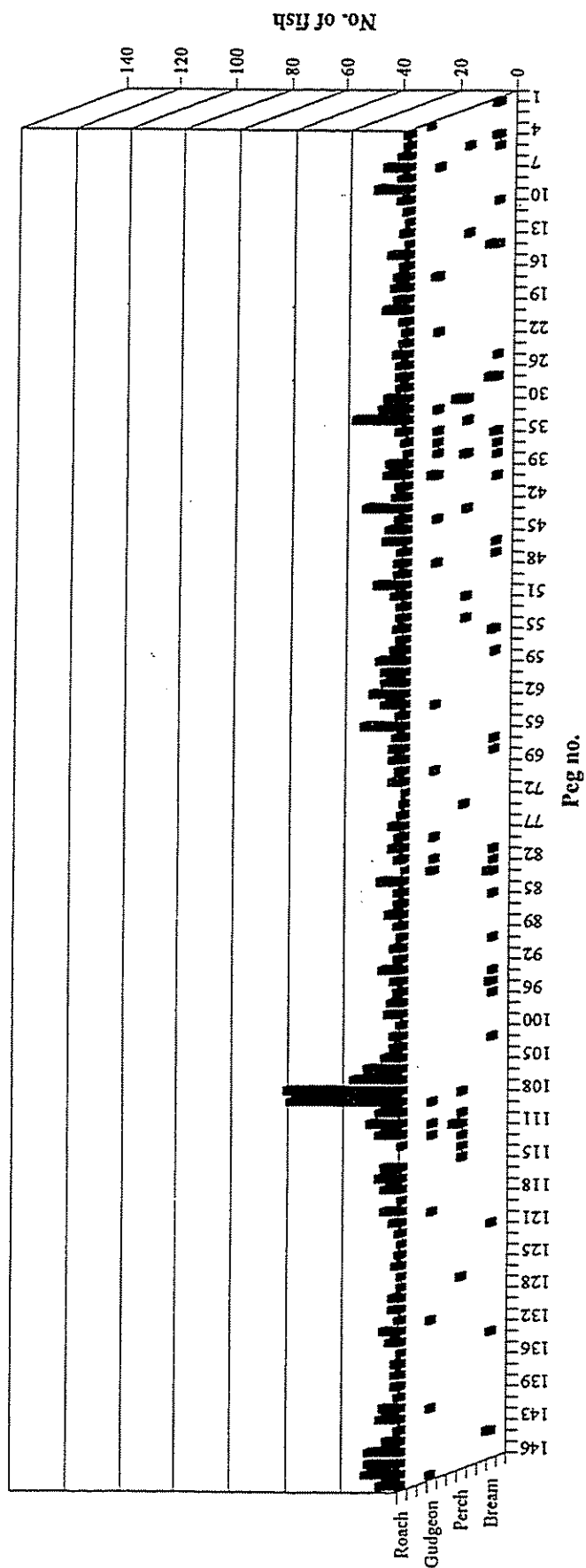


Figure 21(f): Number of fish caught by peg number and species.
 River Weaver Angling Match (13/8/1993)

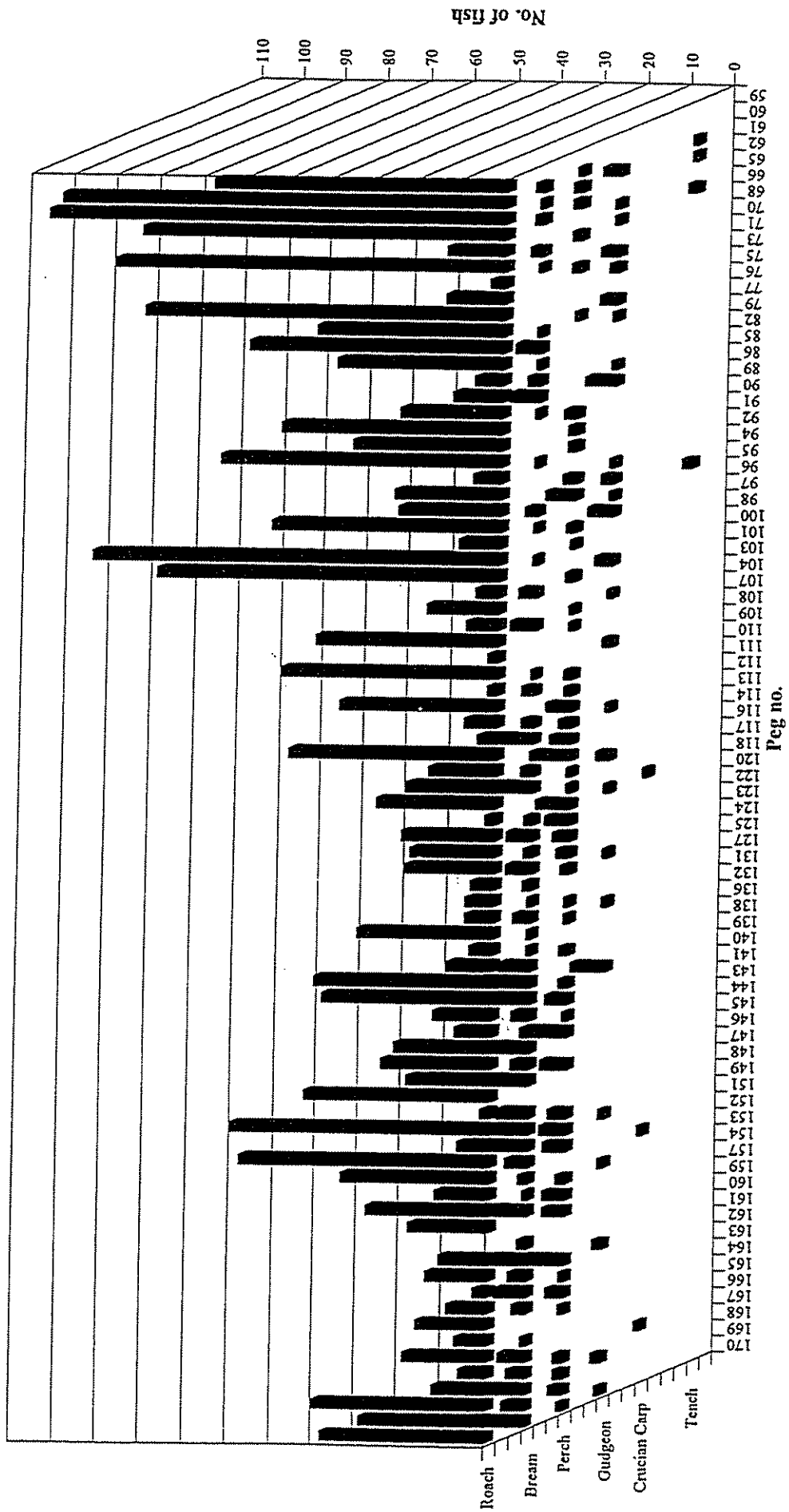


Figure 22(j): Number of fish caught by peg number and species.
 River Trent Angling Match (Section A) (9/10/1994)

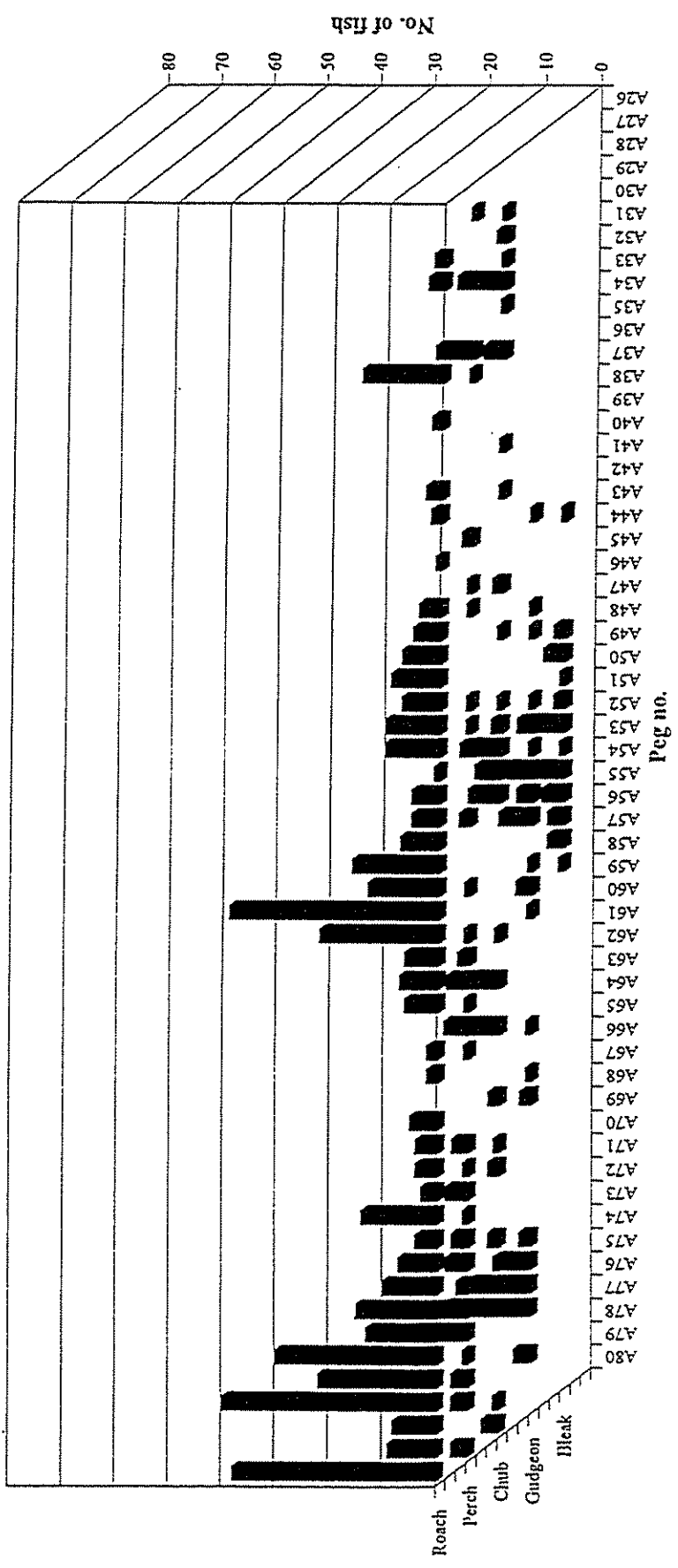
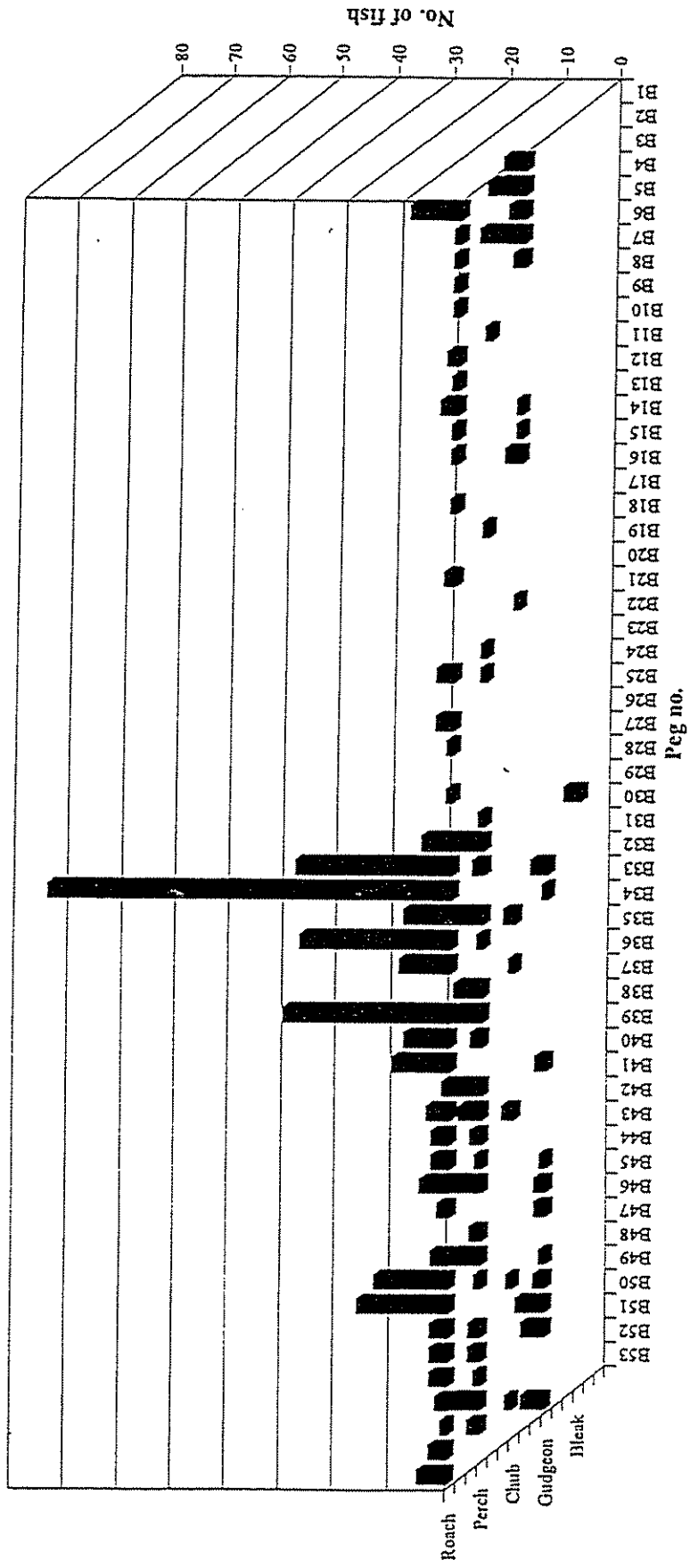


Figure 22(k): Number of fish caught by peg number and species.
 River Trent Angling Match (Section B) (9/10/1994)



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3) The plastic yellow tray has a reference scale of 25cms marked on the bottom. It was found that a yellow tray provided the best definition to the pictures when compared to other colours (red, white and green trays were also tested). Small black circles are marked on the internal corners of the tray to provide reference points during analysis of the photographs. Examples of photographs of anglers' catches are presented in Plate 1 and 2. An example of a poor quality photograph which was not suitable for analysis is presented in Plate 3.



Plate 1: Photograph of angler's catch from River Dane



Plate 2: Photograph of angler's catch from River Weaver



Plate 3: An example of a poor quality photograph of an anglers' catch

5) The catch of every fifth angler encountered should be fork length measured, as well as photographed, to provide validation to the photographic results. The length measurements should be recorded to the nearest millimetre. This data is entered on a data sheet supplied by the team leader.

6) On completion of recording of catches, all completed data sheets and films should be returned by the monitoring teams to the team leader. It is also the responsibility of the team leader to collect from the match organisers the match results of the total weight of fish captured by each angler.

Examples are presented of good and poor quality photographs (see plates 3 and 4).



Plate 3: Example of a good quality photograph of an anglers' catch



Plate 4: Example of a poor quality photograph of an anglers' catch

3.0 DEVELOPMENT OF METHOD FOR RECORDING ANGLERS CATCHES

3.1 INTRODUCTION

A need was identified because of resistance to examination of catches in keepnets and the need to keep expense to a minimum for the development of a method that would provide a rapid, accurate assessment of anglers' catches. The technique had to enable recording of the catch by species and lengths of individual fish, while involving minimum handling of the fish. A photographic method was chosen for these purposes to provide a cost-effective and simple method of recording the catches with lengths of fish extrapolated from the photographs using a CAD/GIS software system.

3.2 METHODOLOGY

Equipment required:

Shallow yellow plastic tray (length 60cms, width 40cms depth 10cms)

Perspex sheet cut to fit just inside the tray (2-3mm in thickness)

Automatic compact camera with date back facility

Clip-on camera stand (requires making) - see Figure 5(a)

Cloth

Identification numbers

Plastic crate and hand-net

Initial development of the methodology was undertaken in the laboratory with formalin preserved fish samples. Preliminary trials involved the use of a range of fish species in different tray types with different methods of retaining the fish in the tray. The method described in Section 3.3 was developed from laboratory tests.

3.3 PHOTOGRAPHING ANGLERS' CATCHES

1) The angler is asked to remove his catch from the keepnet and place it in the plastic crate which has been filled with water. Fish are removed from the crate in batches of 5-25 depending on the size of the fish and placed in the shallow plastic tray. The whole of each individual fish does not need to be visible, though it is preferred, as estimates of length can still be made. If a large catch of big fish is encountered then it is more appropriate to measure the fish with a measuring board. Eels were very difficult to retain within the tray and were not suitable for photography.

2) The fish in the tray are covered with a thin Perspex sheet (2-3mm thickness) to restrict their movements during photography. An angler identification number is then placed on the perspex so that the photographed catch can be referenced to the appropriate interview sheet during data analysis.

3) The plastic yellow tray has a reference scale of 25cms marked on the bottom. It was found that a yellow tray provided the best definition to the pictures when compared to other colours (red, white and green trays were also tested). Small black circles are marked on the internal corners of the tray to provide reference points during analysis of the photographs. Examples of photographs of anglers' catches are presented in Plate 1 and 2. An example of a poor quality photograph which was not suitable for analysis is presented in Plate 3.



Plate 1: Photograph of angler's catch from River Dane



Plate 2: Photograph of angler's catch from River Weaver



Plate 3: An example of a poor quality photograph of an anglers' catch

4) The camera used was a 35 mm compact automatic exposure and focus model with a date-back facility for ease of use. The use of flashes must be avoided, where possible, due to problems with the reflection of the flash on the perspex. The perspex sheet should be periodically wiped with a cloth to remove accumulated mucus scales and debris which can obscure the resultant photographs. Colour 200 or 400 ASA films was found to be ideal as they contend with lower light conditions yet still retain definition.

5) The use of a clip-on support frame which holds the camera perpendicularly above the centre of the tray is recommended (although this was not used in the study). All of the tray needs to be visible in the photograph for analysis purposes. To achieve this the camera could be sited on the frame at appropriate height above the tray depending on the lens type. A diagrammatic example of a frame design is presented in Figure 5(a). If no frame is used then the photographers must ensure that they are a sufficient distance from the tray to prevent loss of focus, usually a distance of least 1.2 metres. The photographs were taken from directly above the tray. If the photograph is not taken from directly above the tray then error in the length estimate may arise due to distortion. Two photographs must be taken of each tray of fish. The second repeat photograph should be taken as a back-up and for use during analysis to note which fish had been measured.

3.4 ANALYSIS OF PHOTOGRAPHS

1) Photographs were analysed using a Microstation Geographical Information Software (GIS) system supported by a digitising tablet with cross-hair mouse. The system used was a computer aided design system (CAD) which is used for producing scaled digitised designs and plans. Agency engineering departments have the hardware and software facilities to perform this type of analysis.

2) The marked internal corners of the tray on the photograph were selected with a cross-hair mouse and digitising tablet and defined as the corners (monument points) of a diagrammatic tray of scaled dimensions on the computer screen. This provided a scaling to the photograph such that any distance measured between two points on the photograph with the mouse, would be scaled accordingly.

The computer provided an error estimate to the scaling of the photograph which was usually less than 1% without the use of a camera support. This error arose from distortion if the photograph was not taken directly above the tray. The accuracy of the measured distance estimates were validated using the marked 25cm scale on the bottom of the tray.

3) The fork length of the fish was then determined by selecting the head and tail of the fish on the photograph with the mouse. In measuring mode the computer provided an estimate to the nearest millimetre of the distance between the two selected points (fork length) If the fish was not totally visible then an estimate was required of where the end of the fish was located below another and that point selected.

5) The catch of every fifth angler encountered should be fork length measured, as well as photographed, to provide validation to the photographic results. The length measurements should be recorded to the nearest millimetre. This data is entered on a data sheet supplied by the team leader.

6) On completion of recording of catches, all completed data sheets and films should be returned by the monitoring teams to the team leader. It is also the responsibility of the team leader to collect from the match organisers the match results of the total weight of fish captured by each angler.

Examples are presented of good and poor quality photographs (see plates 3 and 4).



Plate 3: Example of a good quality photograph of an anglers' catch



Plate 4: Example of a poor quality photograph of an anglers' catch

2) METHOD - Assessment of angling methods used through the match

Equipment required

- 1) Data recording sheets
- 2) Clipboards and pens.

A) **Introduction**

During angling matches notes should be made on the methods and tactics employed by the anglers through the duration of the match, although this is not considered essential. Anglers will tend to alter tactics through the match to achieve the highest catch return. The purpose of monitoring the method and tactics is to determine changes in fishing effort, and target species through the match period. This information may be required for specific studies but the main competition methodology developed was designed to examine the exploited stock regardless of their method of capture.

B) **Method**

1) A team leader for monitoring angling methods should be appointed before the match. It is the responsibility of this person to organise the teams before commencement of the match and ensure all the appropriate equipment is provided. The teams should ideally have some knowledge of coarse angling techniques.

2) Teams of two people will be allocated 50 anglers for monitoring. Monitoring should begin 1 hour after the start of the competition.

3) The interviewers should ask each angler for the following information that should be entered onto the sheet provided:

- a) The angling method used (float fishing, pole fishing, ledgering, etc.)
- b) The area fished within the channel from the bank the anglers are fishing and whether the angler is fishing to a particular habitat feature.
- c) The hook bait used (i.e. worm, maggot, caster, etc.).
- d) The attractant feed used by the angler (i.e. groundbait mixed with maggots, loose feed caster, hemp and chopped worm, etc.) The interviewer should also ask the frequency with which the feed is being introduced. Anglers may feed two separate areas at their fishing position at the start of the match and this should be noted.
- e) The target species of the angler.

4) The monitoring of angling methods should be undertaken on three occasions through the match period to allow an assessment of the changes in tactics by the anglers to be examined. The final monitoring interviews should be started at least 1 hour before the match is due to finish to allow the assessment to be completed.

This will allow time for personnel to be organised for the procedures following the end of the competition (e.g. photography of catches).

The Use of Catch Statistics to Monitor Fishery Change

Coarse Fish Study

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