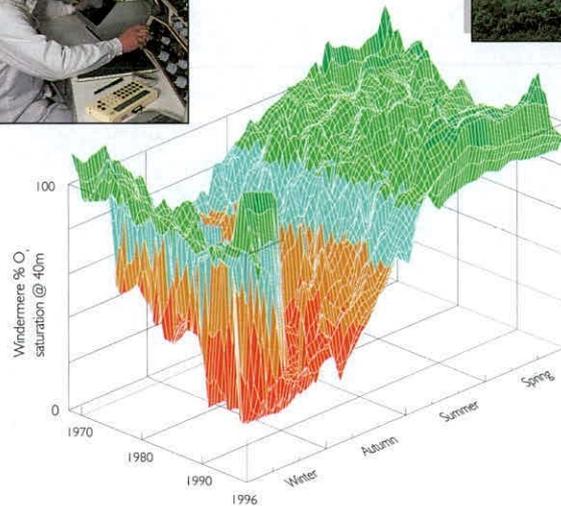


**1997 SURVEY OF THE COARSE FISH OF
THE RIVER TEES**

Interim Report

**J S Welton; J E G Masters; W R C Beaumont;
A C Pinder; and M Ladle;**

Report To: Environment Agency, North East
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**Institute of
Freshwater
Ecology**

**River Laboratory
East Stoke
Wareham
Dorset BH20 6BB**

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**J S Welton, BSc, PhD, CBiol, MIBiol
J E G Masters, BSc
W R C Beaumont, LMIFM
A C Pinder
M Ladle, BSc, PhD**

Sub Project Leader:	J S Welton
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REVIEW OF PROGRESS

The fry survey was carried out in June and covered the same sections as previously. These included areas affected by the barrage and areas upstream for comparison. Over 5000 fry were sampled and identified. The large numbers suggest that 1997 will be a good year class (assuming good conditions for growth and survival). Dace was the most common species accounting for about half the fry caught. Roach fry numbers were low, less than half the numbers in 1996 even though the total fry numbers caught were more than doubled. Chub were present in high numbers in contrast to 1996 when none was found. Gudgeon fry numbers were high, about 20 times the number found in 1996. Perch and grayling fry were new to the survey and were present in low numbers. A single (unconfirmed) Ide fry was found.

The distribution of fry was different to 1996 with good numbers of dace, roach and chub found in the lower sections (below Yarm), although the proportion of dace in these areas was still low (20% cf 10% in 1996) suggesting poorer spawning success than upstream. Most perch fry were found in Sections 1 and 2.

Dace fry again showed a bimodal length frequency distribution.

The adult survey was carried out in September 1997, mainly by boom boat electric fishing. Over 8600 fish of 15 species were caught. This is twice the number sampled in 1996. One third of these were young of the year, indicating that survival from the high fry numbers has been good.

Roach outnumbered dace for the first time in the history of the surveys. They had increased in number in the catch by 3000 individuals. Chub and dace numbers were also higher than last year. Common bream (mainly young of the year) were found for the first time in the September survey. Perch numbers had increased considerably.

Dace distribution was similar to that in 1996 but roach and chub densities in the lower sections had increased. All major species show high numbers of 2+ fish corresponding to the good 1995 year class. Large (older) fish were present in very low numbers compared to pre-barrage surveys.

Temperature records were collected for Barwick Farm in the area affected by the barrage and at Low Moor, above the influence of the barrage. In general the deeper slower water was warmer. There was a suggestion of stratification in the deep water in early August when the bottom temperature was relatively constant. The daily mean temperature for the surface and bottom at Barwick farm was the same suggesting that if stratification did take place it was for a relatively short period of time.

Angling catch data has continued to be collected. The mean catch per angler was not significantly different from the previous year. The significant change has been in the distribution of fish. They are no longer aggregated and can be found in almost all areas such that anglers normally expect to catch something. During pre-barrage matches, the number of blanks was higher and winning weights were possible from relatively few pegs. The general perception of anglers is that the fishing has improved.

1. SURVEY OF COARSE FISH FRY JUNE 1997

1.1 Introduction

This survey was planned for June and as previously, the timing was a compromise between sampling the dace before they left the margins and the appearance of all coarse fish species.

1.2 Methods

The fry survey was carried out between the 17 and 19 June 1997. Since the completion of the barrage, micromesh seining has been difficult due to the deep water. Few samples were obtained this year by this method. Most fry were sampled either by random point sampling or target sampling using battery powered back pack electrofishing gear. Target sampling was also performed using a standard FBA pond net. No attempt was made to quantitatively assess abundance.

A description of the method(s) used in each section is given in Appendix 1.

1.2.1 Electrofishing

Electrofishing apparatus designed for fry sampling was used. This is battery powered with the anode ring mounted on a telescopic pole so that it can be extended in front of the boat to sample fry with minimal disturbance. The shape and size of the anode allow point sampling, producing a high intensity field that stuns fry in a small area. At each sampling site, up to 10 point samples were taken over a 25 metre length of the river. The number of point samples depended on the number of fry caught. Point samples were either targeted at concentrations of fry or taken at random.

1.2.2 Micromesh seining

In addition to the electrofishing, a micromesh seine was used in areas where large congregations of fry were expected and where no snags were present. These were set and hauled in shallow marginal areas of the river, especially from beach gravel shoals.

1.2.3 Hand netting

Fry were often observed to be in shallow water (<5 cm) and hand netting was often found to be a more effective sampling technique. A standard FBA pond net was used to sample discrete shoals in these habitats.

1.3 Results

5426 fish fry of eleven species were sampled. This is over twice as many as were sampled in 1996 and is the highest number of fry caught since the closure of the barrage. Eight species were of angling importance. Species new to the survey were perch and grayling which were found in low numbers and a single individual identified as an ide. This identification has not been confirmed as there are no other specimens of fry available for comparison. The majority of the perch were found in Section 1 (Stockton) although individuals were found in Sections 2 and 21. Grayling fry were found in Section 20. Chub fry were found in all but 5 sections in 1997, unlike 1996 when chub fry were not found at all in June. Numbers of each species are shown in Table 1. The dace again showed a bimodal length frequency distribution indicating two separate spawning times. The numbers of dace were very much greater than in 1996 (2448 cf 932) whilst numbers of roach fry fell from 812 to 357.

Table 1. Number of fry of each species sampled in the R. Tees in June 1997

Species	Totals	
Barbel <i>Barbus barbus</i> (L.)	24	
Chub <i>Leuciscus cephalus</i> (L.)	702	748
Dace <i>Leuciscus leuciscus</i> (L.)	2448	
Grayling <i>Thymallus thymallus</i> (L.)	3	
Gudgeon <i>Gobio gobio</i> (L.)	903	917
Ide <i>Leuciscus idus</i> L.	1	
Minnow <i>Phoxinus phoxinus</i> (L.)	717	747
Perch <i>Perca fluviatilis</i> L.	8	
Roach <i>Rutilus rutilus</i> (L.)	357	
Stone loach <i>Barbatula barbatula</i> (L.)	232	234
Three spined stickleback <i>Gasterosteus aculeatus</i> L.	31	
Total	5426	5518

1.3.1 Distribution of fry

The distribution of fry was different from last year with good numbers of dace, roach and chub fry found in the lower sections although numbers were generally higher in upstream sections (Sections 15-25)(Table 2).

The species compositions of fry in each section are given in Figs 1a and 1b.

Numbers of dace fry were high, with this species forming almost 50% of the catch. Dace fry were absent from only one section (3). In 1996, about 20% of all dace fry were found in Section 13, this year, however, <20% occurred in the lower 16 sections. Approximately 60% of the fry came from Sections 17, 20 and 25 (Fig 2).

Roach fry numbers were unexpectedly low with only 357 fish being caught. This number is less than half that of 1996 which was, in turn, less than half that of 1995. They were caught in all sections except Sections 3 and 18 unlike in 1996 when they were present in only one section downstream of Section 13. As in the previous year, Section 5 contained a high percentage (30%) of the total roach fry caught (Fig 3). The size distribution was similar to both 1996 and 1995 so it is unlikely that the low numbers were due to late spawning.

Unlike the survey of June 1996 when no chub fry were found, this year chub fry were present in all but 4 sections. Sections 7 and 17 each contained around 15% of the fry caught (Fig 4). Few fry were found in the lowest sections (1-3) which are open and provide little overhead cover for adult fish.

Gudgeon fry were present in far higher numbers than in 1996, with nearly twenty times as many gudgeon caught this year. They were found in 15 sections over the whole length of the river but as in previous years, numbers were concentrated in and above Section 15, with Sections 15 and 17 containing over 85% of the fry caught (Table 2).

Only 24 barbel fry were caught in 1997 compared with 64 in 1996. They were found in 7 sections in the upper part of the study area with the majority being in Section 18 (Table 2).

Perch fry were found for the first time in the study in low numbers in three sections (Table 2). They were not unexpected given the increase in numbers of older fish in recent years and the huge increase in spawning habitat since the closure of the barrage.

Three grayling fry were found in Section 20, the first records for the survey.

One ide was found in Section 19. Although not a positive identification, it was definitely not a dace or a chub or any other species previously caught on the survey and was the same as an illustration of an ide fry in a Russian key.

Table 2. Number of fry of each species found in each section fished in the R. Tees in June 1997

Species\Section	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	25
Barbel												1			1		5	11	1	4		1	
Chub	17			62	65	41	115		26	15	25	31	15	33	17	52	112	11	20	6	61	24	
Dace	18	1		10	22	13	18	5	8	46	54	33	31	29	100	26	495	107	180	579	228	101	344
Grayling																							
Gudgeon		1		1	6	6				1	2			8	229	2	565	17	40	19	9		11
Idle																			1				
Perch	6	1																			1		
Roach	11	3		9	104	33	5	2	4	39	7	11	16	15	5	9	9		16	17	1	40	1
Minnow	3					30	1	18		7	3	1		25	7	18	123	161	108	55	14	14	159
Stone Loach				16	4	2	4	1	1	2	1	2		4	4		34	12	36	74	2		35
Three spined stickl	17											1					13						

1.3.2 Length frequency distribution

Length frequency histograms are shown for each species (Fig 5) and for dace, roach and chub in each section in Appendices 2-4.

The numbers of dace fry found in the downstream sections (below Section 15) were very low showing that historical dace spawning sites (eg Section 8 at Yarm) have been affected by the barrage (Table 2). Successful spawning apparently occurred only in areas where reasonable flow still exists.

As in 1996, dace fry showed a bimodal length frequency distribution (Fig 5). Both modal lengths were greater than last year, the lower modal length being 13 mm and the upper modal length being 21 mm compared with 11 mm and 18 mm respectively in 1996. From length frequency distributions at each site it appears that fish of the lower modal class were found in higher numbers in the upstream sections of the river including sections above the influence of the barrage (Appendix 2). Although individuals from both modal groups were found in 17 of the 22 sections sampled, 46% of individual samples within sections contained only one size group showing that the two modal groups are often separate. The fact that this bimodal pattern was not seen prior to the completion of the barrage leads to the conclusion that its construction has had an effect even though this pattern was seen in sections upstream of its direct influence. It is possible that there has been either a change in the timing of the migration to the spawning grounds because of changes in environmental conditions in areas where dace overwinter or that dace which would normally have spawned in the lower river move upstream when conditions at these former spawning sites fail to improve after they arrive and this delays their spawning.

The modal length of roach fry was 10 mm in most sections although it was higher in Sections 5 and 10-12. Numbers of fry were low in all sections (Fig 5, Appendix 3).

Chub fry had a very limited size range (7-11 mm) with the majority being between 8 mm and 10 mm and this is constant throughout the sections (Fig 5, Appendix 4).

Two distinct disparate size groups of perch fry were found although numbers were small. All the larger group (22-27 mm) were found in an ORSU in Section 1 and had grown fast compared with the other group of 7-9 mm (Fig 5).

2. SURVEY OF ADULT COARSE FISH SEPTEMBER 1997

2.1 Introduction

This is the seventh annual survey of the adult coarse fish and the third since the completion of the barrage. There had been an increase in aquatic macrophytes in some sections and filamentous algae were almost absent.

All sections of the river normally sampled were fished with the exception of Section 25. All sub-sections of Section 1 were fished. Section 1A now contains a water skiing course and fishing was delayed by this activity.

2.2 Methods

2.2.1 Electrofishing

All sites were sampled by electrofishing. Site 21 was waded (twin anode 200 v, 1.9 KvA), and all other sites were electrofished with the boom boat.

The boom boat used 200 v at 10 amps from a 7.5 KvA generator. Each section was fished twice, once along each bank. With the negligible flow there was no necessity to fish in any particular direction and fishing was conducted down one bank and up the other. Fish from both runs were retained in an oxygenated holding tank and processed as one catch. Fish were released at a distance sufficient to prevent their migration into the next study section before fishing commenced.

2.2.2 Processing

Length measurements were taken from each fish (fork length to the nearest 0.1 cm) and scales for ageing were taken from a representative sample (641).

2.3 Results

This year, over twice as many fish as last year were caught. Over 8600 fish of 15 species were sampled from the lower R. Tees, in addition, eel numbers were estimated. The numbers of each species caught are given in Table 3. 3322 (38%) were ≤ 8 cm which were considered to be young of the year. For the first time in this study, roach outnumbered dace comprising 43% of the catch compared with 28% for dace. The proportion of dace was the lowest found since the study started. In contrast, the roach proportion was the highest recorded. Although the proportion of dace was low, the number caught was relatively high, with 700 more caught than in 1996.

The number and proportion of chub was also high compared with previous years with nearly 2000 individuals caught. Gudgeon numbers were similar to 1996 but flounder numbers again fell.

Common bream were found for the first time in the September surveys. Young of the year were found in Section 1 and an older specimen (1+) was found in Section 21. Perch numbers had increased considerably from 9 in 1996 to 52 in 1997. Two adult salmon and 5 parr were caught this year as opposed to only 1 adult in 1996. In addition, a further 5 or 6

adults were seen but not caught. At least 6 sea trout, 3 of which were >50 cm in length were also caught. A further five salmonids were seen at the entrance to the fish pass below the barrage.

Table 3. Species list for the R. Tees and number of each species caught - September 1997

Species	Totals
Barbel <i>Barbus barbus</i> (L.)	11
Common bream <i>Abramis brama</i> (L.)	7
Chub <i>Leuciscus cephalus</i> (L.)	1937
Dace <i>Leuciscus leuciscus</i> (L.)	2427
Eel <i>Anguilla anguilla</i> (L.)	>150
Flounder <i>Platichthys flesus</i> (L.)	33
Grayling <i>Thymallus thymallus</i> (L.)	6
Gudgeon <i>Gobio gobio</i> (L.)	386
Minnnow <i>Phoxinus phoxinus</i> (L.)	42
Perch <i>Perca fluviatilis</i> L.	52
Pike <i>Esox lucius</i> L.	2
Roach <i>Rutilus rutilus</i> (L.)	3721
Salmon <i>Salmo salar</i> L.	7
Stone loach <i>Barbatula barbatula</i> (L.)	3
Three spined stickleback <i>Gasterosteus aculeatus</i> L.	17
Trout (brown and sea) <i>Salmo trutta</i> L.	21
Total (without eels)	8672

2.3.1 Distribution of fish

Species compositions at each site are summarised in Fig 6. Pie charts for each section are shown in Appendix 5

Quasi-quantitative information expressed as numbers of fish per 100 m of river for each section is given in Table 4. Comparisons between sections and years may be made only after due regard to the different efficiencies with which each section is fished. Sections are more comparable post-barrage as the variability of factors such as depth and state of tide has been substantially reduced or eliminated.

Table 4. Number of fish per 100 m found in each section in September 1997

Section	Dace	Roach	Chub
1A	3 15.0	2 16.9	2.3 1
1B	15 6.4	10 12.7	0.5 0
1C	16 15.8	29 47.0	12.5 7
1D	13 30.9	19 95.5	12.8 5
1E	11 12.7	31 47.5	22.8 22
2	33 21.4	47 55.4	21.6 21
3	19 9.6	41 15.7	18.8 13
4	17 9.6	26 25.9	9.4 13
5	33 14.3	40 9.3	6.8 21
6	12 8.7	4 2.3	2.1 5
7	24 18.4	16 10.8	18.5 31
8	75 13.9	35 2.1	7.5 13
9	5 11.2	1 6.1	4.8 1
10	51 11.9	31 3.6	4.4 40
11	19 13.7	8 8.3	5.2 13
12	16 11.9	3 11.2	9.2 8
13	76 14.0	22 21.7	11.7 41
14	25 6.6	14 7.6	12.5 38
15	37 6.5	18 5.7	8.9 37
16	3 7.5	0 3.7	17.3 2
21	21 11.2	39 8.3	6.4 26
	10	7	22

Dace were found in all sections fished and the pattern of density distribution was similar to that found in 1996. Notable exceptions to this were Section 1D where the density had doubled and Section 2 which had a density of dace 5 times that recorded in 1996. Peak dace densities occurred in Sections 1D, 2 and 7, all below Yarm in the slow deep water. In contrast, Sections 14-21 contained low dace densities. These latter sections include some that are only partially affected by the barrage and might be expected to be better habitats for dace. The length frequency distributions for each section (Appendix 6) show that the majority of the dace found in the lower sections are

small (young of the year). It is apparent that these sections contain prime nursery habitat.

Roach were present in all sections at similar densities to last year in Sections 5-16 (apart from a high value in Section 13 in 1997). The densities in the lower sections were many times higher than in 1996 with a maximum density of $95.5 \text{ } 100 \text{ m}^{-1}$ in Section 1D compared with $2.5 \text{ } 100 \text{ m}^{-1}$ in 1996. Again, these lower sections were good nursery areas for young of the year roach (Appendix 7). The high density of roach found in Section 21 in 1996 was absent in 1997.

A similar pattern is seen with chub. They were present in greater densities in the lower sections than last year but not to such a great extent as for roach.

2.3.2 Length frequency distribution

The length frequency distribution of each of the major species is presented in Fig 7 and for dace, roach, chub, and gudgeon this is also given by section (Appendices 6-9).

The large number of young of the year dace suggest that 1997 will be a good year class (Fig 7). They were caught in far larger numbers than older fish and were found in all sections although they were generally more abundant in the lower sections. This is in direct contrast to 1996 when few young of the year were found in the lower sections. Numbers of older dace were low upstream of Section 6 (Appendix 6).

Roach young of the year were caught in numbers which were orders of magnitude greater than those of older fish and as with dace, suggest that 1997 will be a good year class. They were very abundant in the lower sections (Appendix 7). The cohort of modal size 10 cm were common in Sections 3-5. Very few individuals > 15 cm were caught. These are possibly in deeper water outside the range of the electric fishing gear.

Chub young of the year were found in low numbers relative to older fish and were present in most sections. They were particularly abundant in Sections 1-4, and 13 and 14. The 10-15 cm size class was most abundant in Sections 1-4 and 7. Few fish > 20 cm were caught and these tended to be in the upper sections (Appendix 8).

Gudgeon young of the year were caught in larger numbers than older fish and in greater numbers than in 1996. The length frequency distribution shows poor numbers of 7-10 cm fish which correspond to the low numbers of young of the year in 1996 (Fig 7). Good numbers of larger fish were caught from the 1995 year class. Young of the year were concentrated in Sections 1-4 whilst few larger fish were found in these sections (Appendix 9).

Barbel and flounder numbers were lower this year than in 1996. The size range of flounder was similar to last year indicating that some fish are still entering the river (Fig 7).

Perch numbers had increased with the cohort of modal size 16 cm well represented (Fig 7). No small perch were found in the 1996 survey to correspond to these fish although it is possible that they were in areas not fished such as the ORSUs. Pike

numbers remained low although conditions appear to be good. This species should do well once a critical number has been built up to ensure successful spawning.

2.3.3 Year class strengths

The length frequency histograms for each age group of dace, roach, chub and gudgeon are shown in Figs 8-11. Although the same proportion of each age group was not necessarily aged, high numbers of a particular age group can be interpreted as an indication of a strong year class.

All dace caught were aged 4+ and younger except for one 6+ individual (Fig 8). The exceptionally strong 1995 year class was evident as 2+ individuals with the 3+ group also strong as expected. Although high numbers of 1+ dace were measured which does not reflect the poor numbers of 0+ found the previous year, the length frequency graph shows relatively few fish corresponding to this age (Fig 8). Very high numbers of young of the year in 1997 indicate a good year class for the future. As in 1996, large dace were virtually absent from the sections fished.

Eight age classes of roach were found although large individuals were few in number (Fig 9). Very high numbers of young of the year were found with >2000 individuals sampled. Good numbers of 2+ and 3+ were found corresponding to the strong 1+ and 2+ groups of the previous year.

In common with dace and roach few large chub were found (Fig 10). Although individuals up to the age of 11+ were recorded, numbers of fish older than 3+ were low. The pattern of year class strength for these young ages was similar to that of dace and roach.

Gudgeon were present in all ages up to 3+. High numbers of 2+ correspond with the good 1995 year class (Fig 11). Numbers of 1+ were low again as expected from the previous year's results. High numbers of young of the year indicate a strong year class.

3. TEMPERATURE

3.1 Introduction

Minilog data loggers were installed at Low Moor (Section 21) and Barwick Farm (Section 5) in June during the fry survey. At this latter site, loggers were positioned to record the water temperature 10 cm from the bed and 10 cm from the surface to investigate whether the river showed signs of stratification in the summer. The surface temperature was taken in the shade.

3.2 Results

Monthly means and monthly means of daily ranges of water temperature for June to September are given in Table 5. It should be noticed that values for June and September are not based on complete months. Continuous records are displayed in Figs 12. It can be clearly seen that there is less daily fluctuation in temperature near the bed at Barwick Farm where the water is deep than there is either at the surface or on the bed at Low Moor (a shallow site). In general, the water temperature at Low Moor (above the influence of the barrage) is lower than at Barwick Farm in the impounded section (Fig 12).

Results for a 5 day period in August are shown in detail to see if there was stratification at the Barwick Farm site (Fig 13). Daily fluctuations in temperature are seen from all three thermister probes. Daily variation in temperature was normally $<1^{\circ}\text{C}$ at Barwick farm (deep) compared with 4°C at the surface (Fig 13). The corresponding value at Low Moor, above the influence of the barrage, was 2°C . Whilst the results do not clearly demonstrate stratification, the relatively constant bottom temperature suggests that it may be taking place. During late August, the surface and bottom temperatures at Barwick Farm are almost the same (Fig 12). At this time the temperature of the incoming water (as recorded upstream at Low Moor) is colder and any stratification would have broken down. The temperature at the lower site is significantly higher due to the buffering effect of the large water body.

The monthly mean temperature for August for the surface and bottom at Barwick Farm are the same (Table 5) probably indicating that any stratification was of a short duration.

Table 5. Monthly means ($^{\circ}\text{C}$) and means of daily ranges in the R. Tees at Low Moor, and Barwick Farm.

	Low Moor		Barwick Farm (surface)		Barwick Farm (bottom)	
	Mean	Range	Mean	Range	Mean	Range
June	12.80	1.23	12.91	1.53	12.96	0.95
July	16.50	1.46	17.11	1.88	17.00	1.33
August	19.81	2.02	20.48	1.75	20.23	0.94
September	21.90	1.83	22.38	1.91	21.99	0.63

4. ANGLING DATA

4.1 Methods

The system set up for anglers to record data from matches has again been reasonably successful this year. Data on individual angler's catches continued to be collected. The total weight of each catch was recorded along with the composition in terms of numbers of each species of fish. Dace, roach and chub were split into large and small fish, large dace and roach being >6 oz and large chub being >1 lb. Match sheets now include gudgeon, perch and grayling. Also recorded were the position on the river (peg number), and a subjective assessments of the river and weather conditions.

Due to the fluctuations in numbers of anglers fishing each competition, and in particular due to the poor attendances in recent pre-barrage years, the anglers felt that the mean catch per angler was giving a result which was artificially high. The few anglers fishing were given what were expected to be the best pegs and comparisons with previous matches, where many anglers failed to catch anything, may not be valid. In order to address this, the mean catch per angler for the top ten catches in each match was calculated, in addition to the mean catch per angler for all competitors in each match. With the improved angling, the number of anglers attending matches has increased.

4.2 Results

4.2.1 Mean catch per angler

The mean catch per angler was calculated and appended to those of previous years (Fig 14, Appendix 10). The 1996/97 of mean catch per angler is not significantly different from those in any other post-barrage year but is significantly greater than the value calculated for the last full pre-barrage year. A similar pattern was seen for the mean catch per angler for the top ten results only (Fig 15). The values are still significantly lower than the peak in 91/92 but are better than the results from the years 93/94 and 94/95.

Despite the match results showing lower catch weights than at the peak in 91/92 and the subsequent year, the fact that results have improved since closure of the barrage has pleased the anglers.

4.2.2 Distribution of catch weights along the river

It is now apparent that the distribution of fish has altered. Before barrage construction, catches were influenced by the tide and fish were aggregated in specific areas such that blanks were common and relatively few pegs had any chance of producing winning weights regardless of the skill of the angler. Fish are now distributed over a larger area and it is relatively uncommon for an angler to fail to catch anything during a match except during February and March (Fig 16).

5. ANTICIPATED COSTS OF THE WORK IN THE PERIOD TO MARCH 1998

The anticipated cost of the work is expected to be in excess of £50,000.

6. PROGRAMME FOR THE NEXT REPORTING PERIOD

This is currently under review with the Project Officer.

7. FACTORS LIKELY TO AFFECT THE COMPLETION OF THE WORK

It is possible that adverse weather conditions may delay the sampling programme in the short term and whilst this has not been considered serious enough to affect the completion of the project in the past, this is not necessarily the case for next year. 1998 is the final year of the project and the final report will synthesize all data collected. This in itself will be difficult (if not impossible) to achieve in the very short space of time available but any delay in the last sampling will create a serious problem.

Figure 1(a) Species composition of fry in the R. Tees in June 1997 at various sites

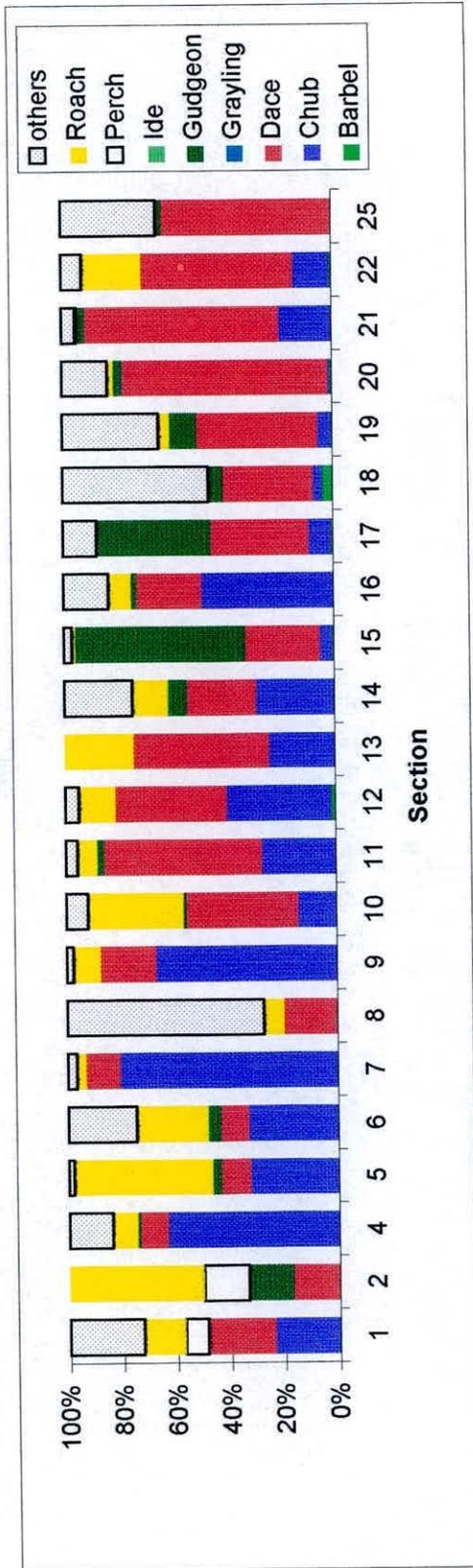


Figure 1(b) Species composition of fry in the R. Tees in June 1997 at various sites (minnows, stone loach and sticklebacks removed)

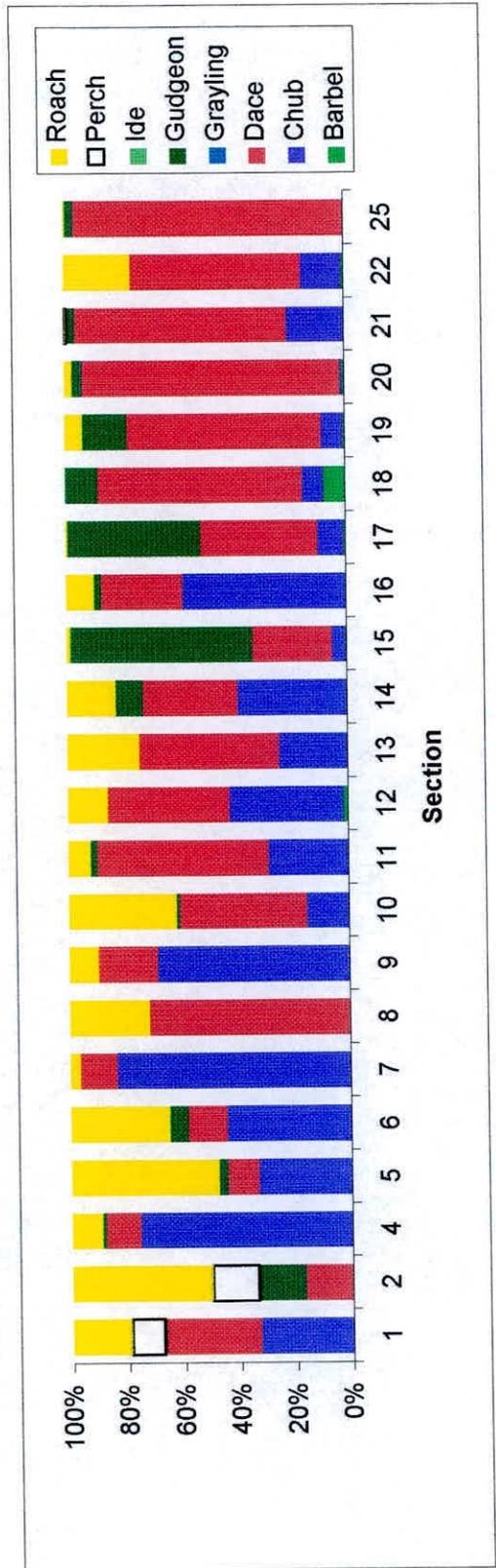


Figure 2. Percentage of dace fry at each site along R.Tees June 1997

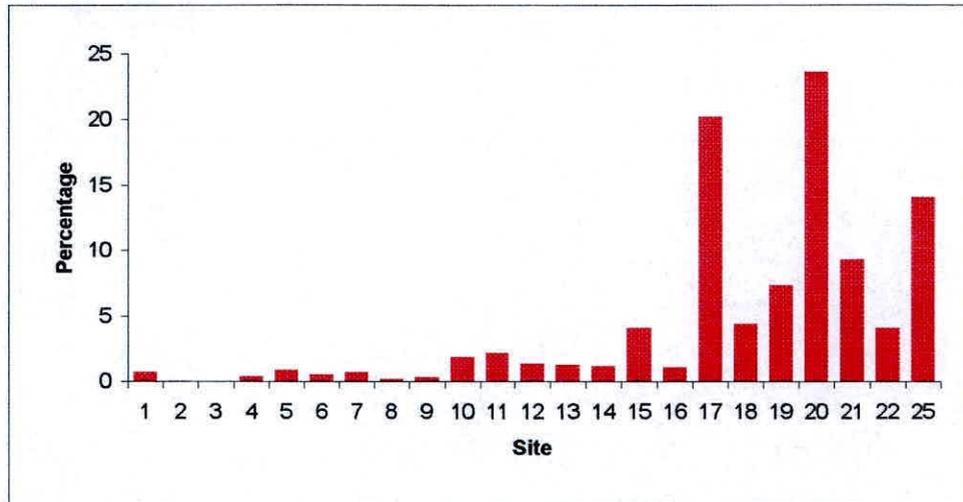


Figure 3. Percentage of roach fry at each site along R.Tees June 1997

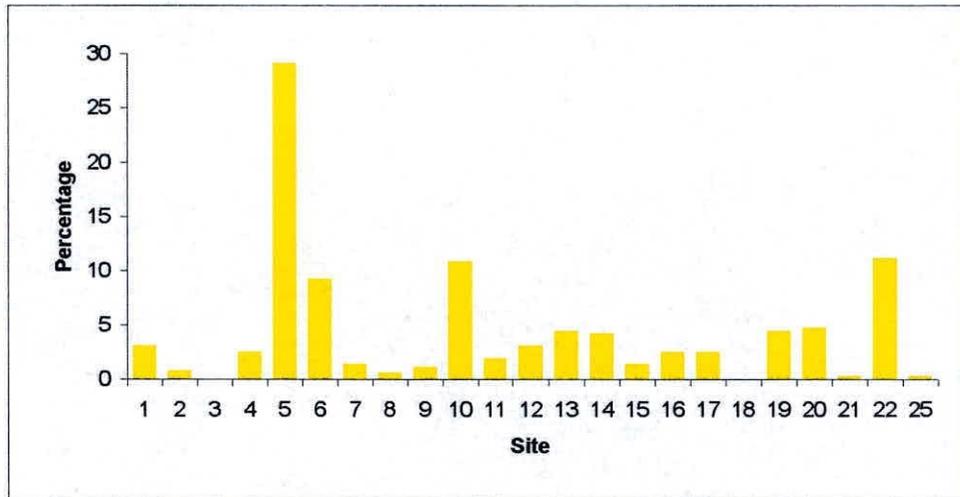


Figure 4. Percentage of chub fry at each site along R.Tees June 1997

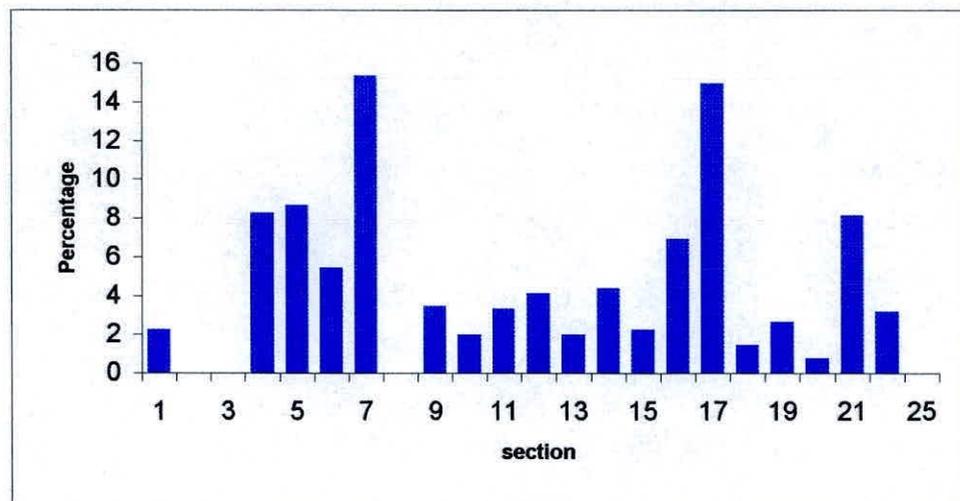


Figure 5. Length frequency histograms for each species of fry in the R. Tees in June 1997

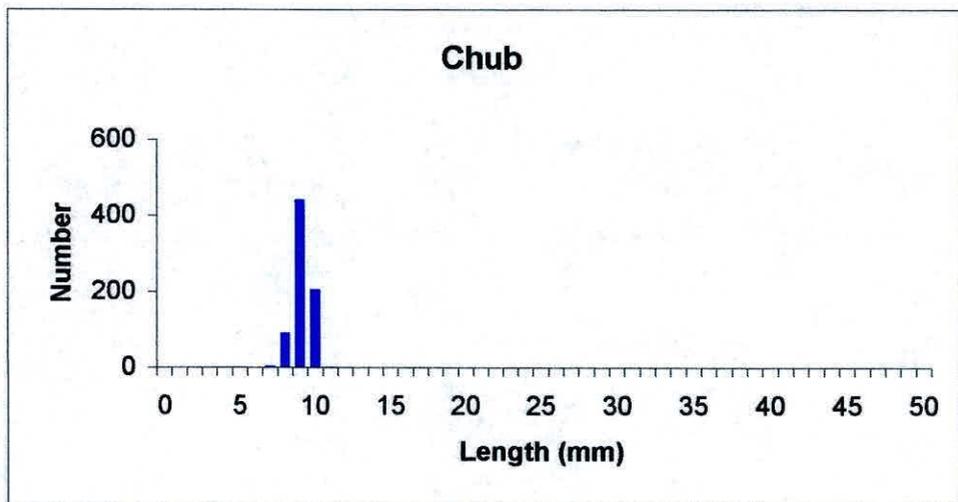
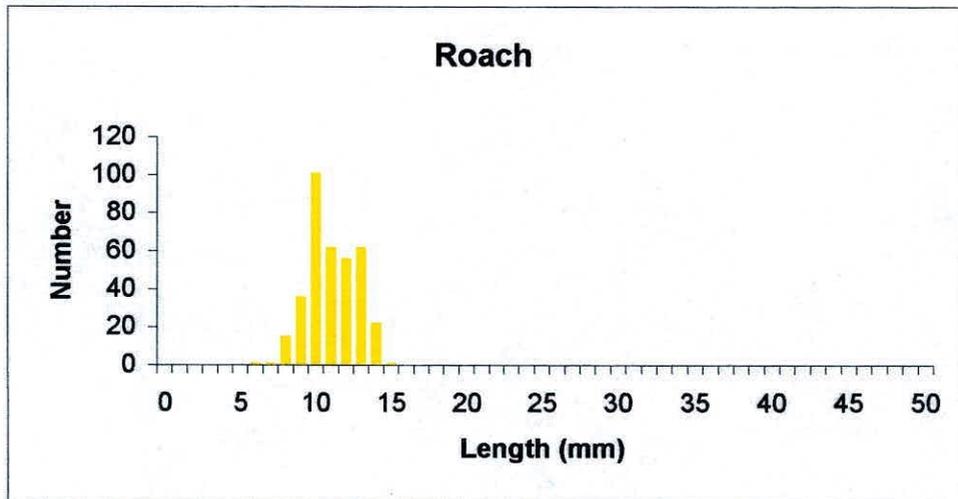
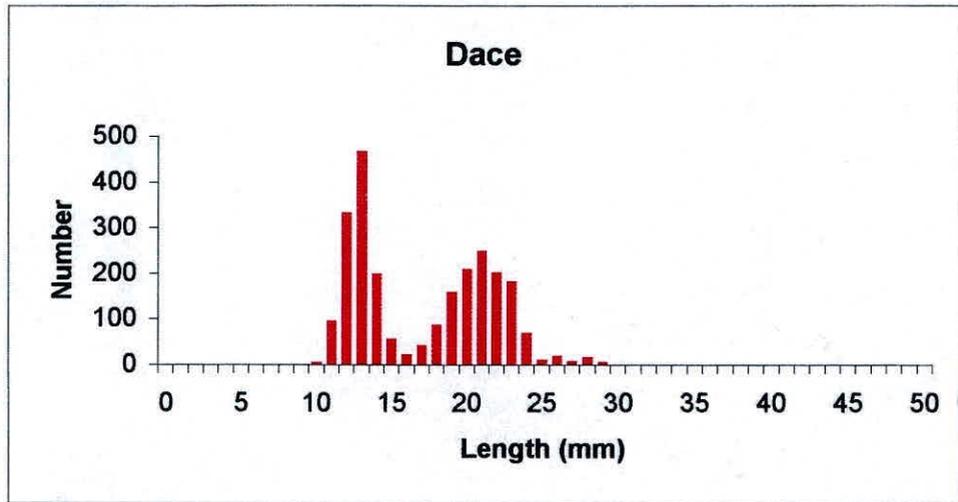


Figure 5 continued

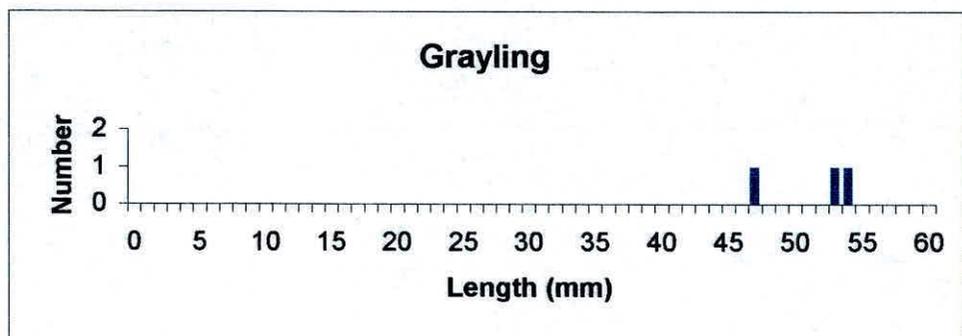
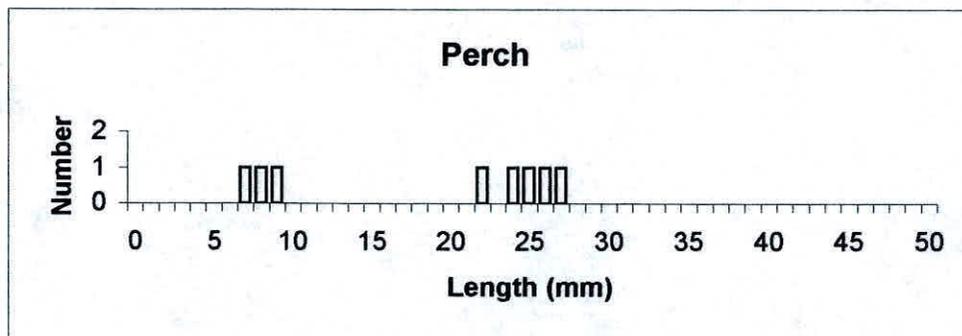
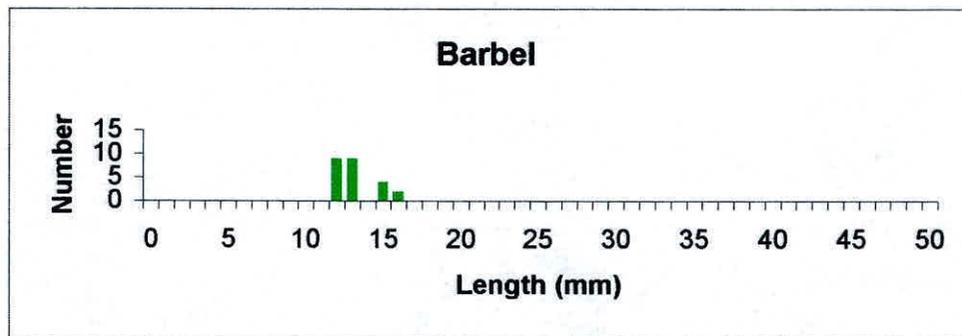
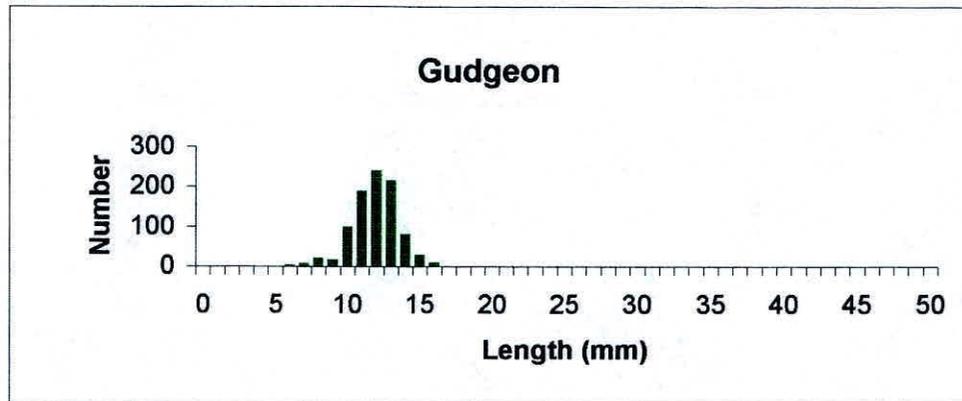


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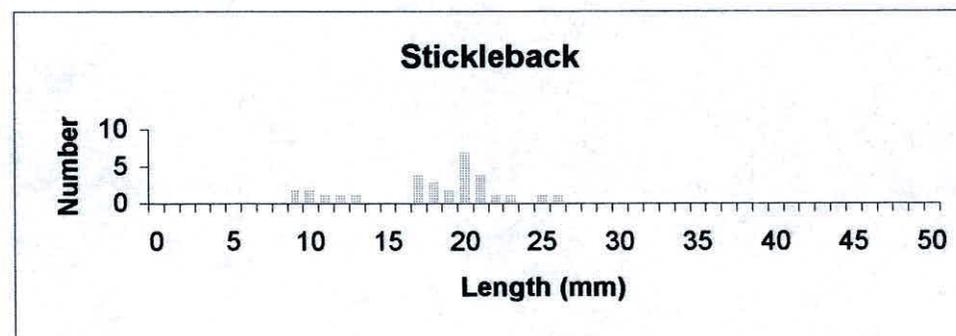
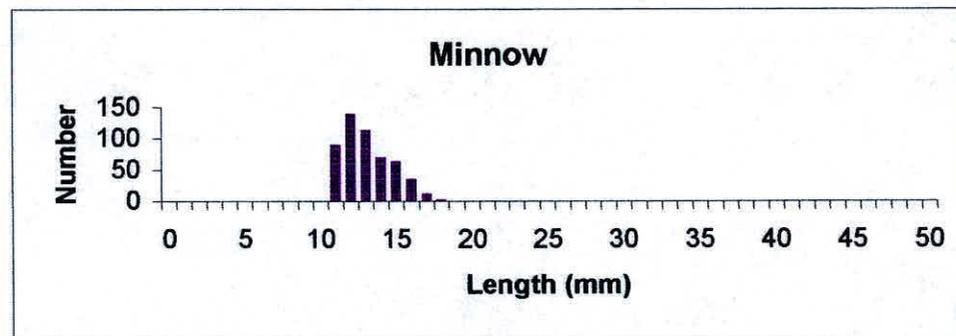
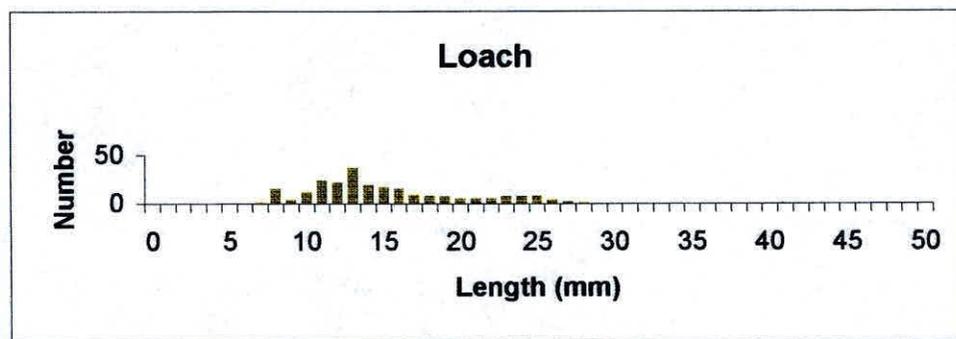
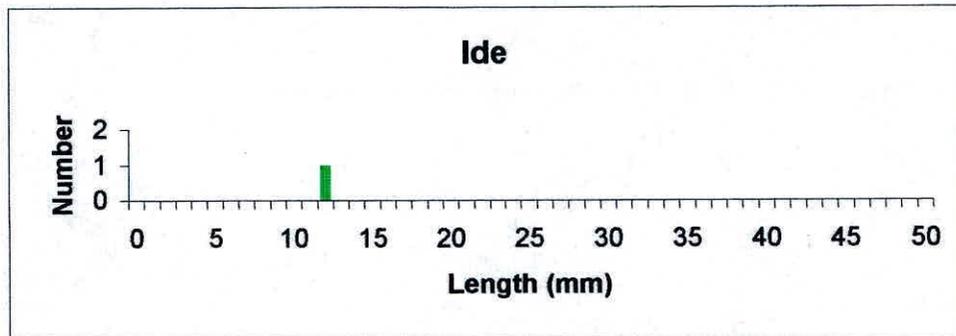


Figure 6 Species composition of fish in the R. Tees in September at various sites

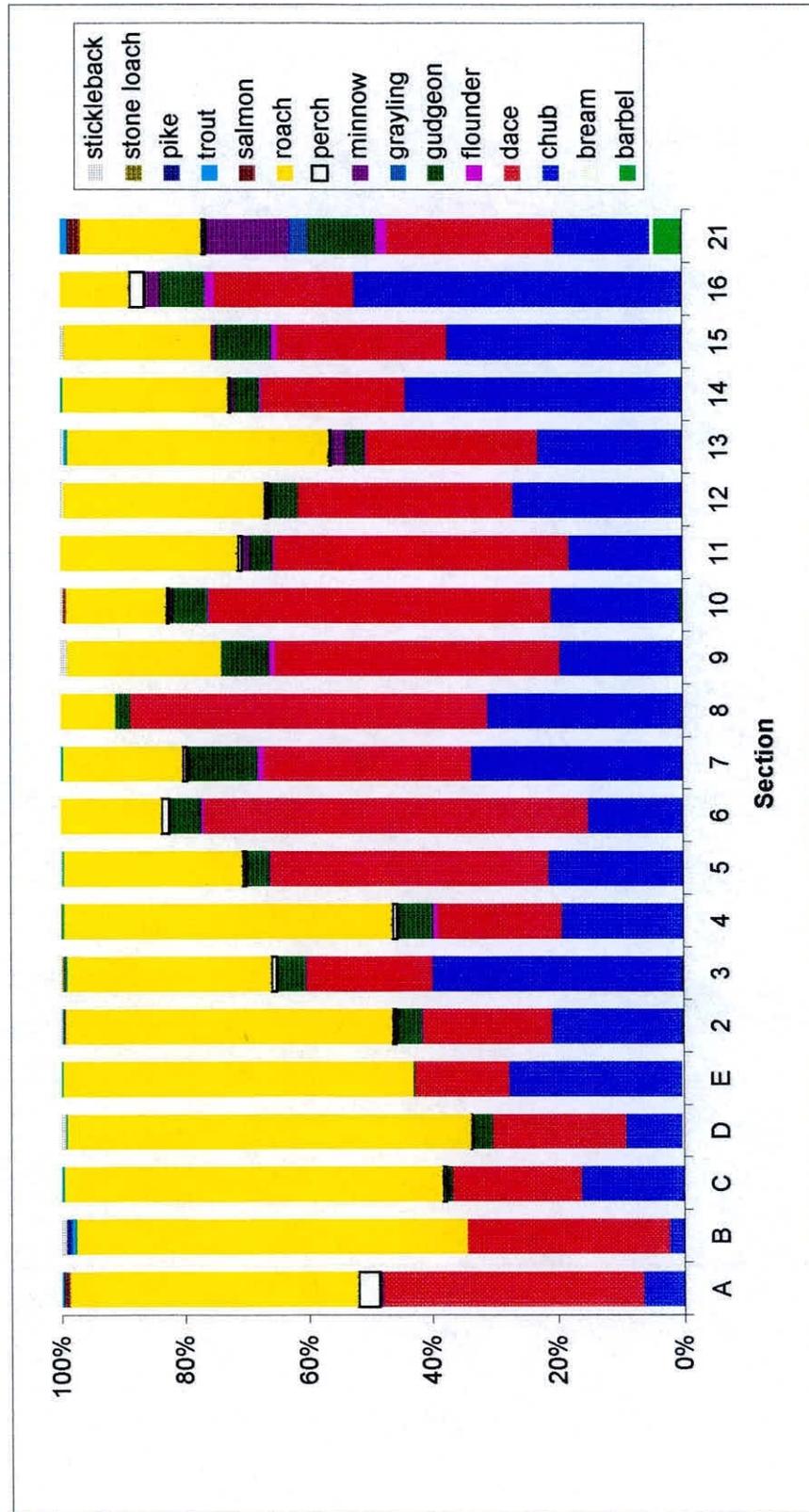


Figure 7. Length frequency histograms for each species of adult fish in the R.Tees in September 1997

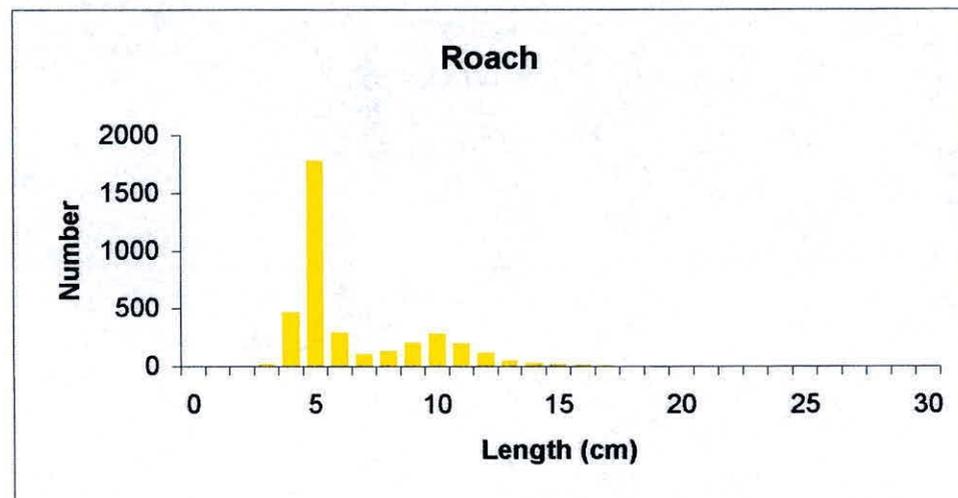
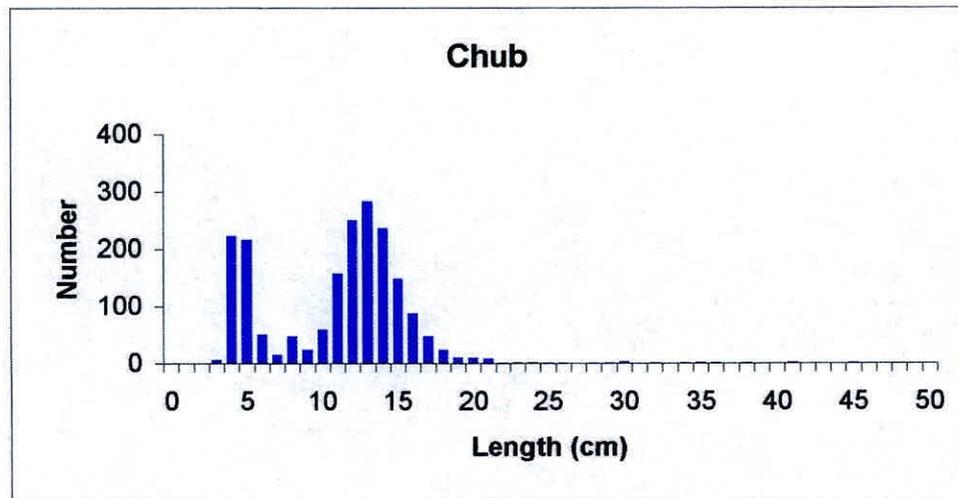
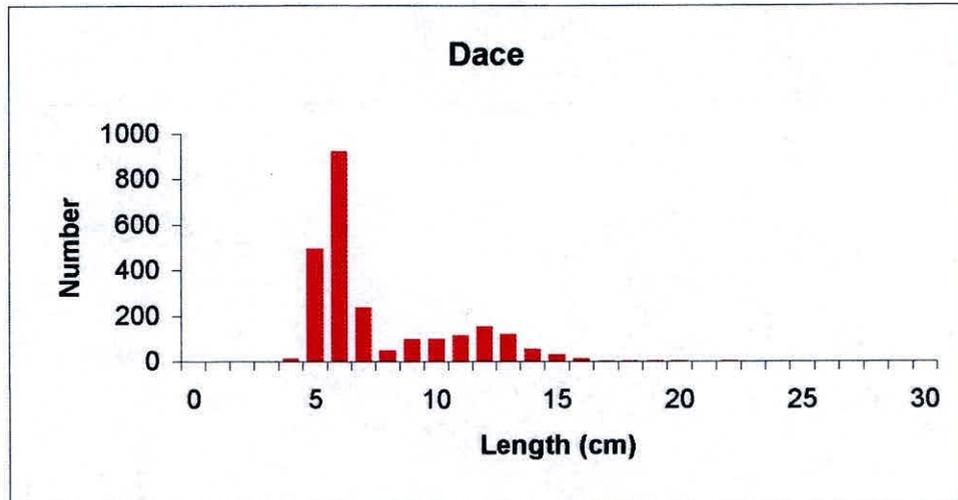


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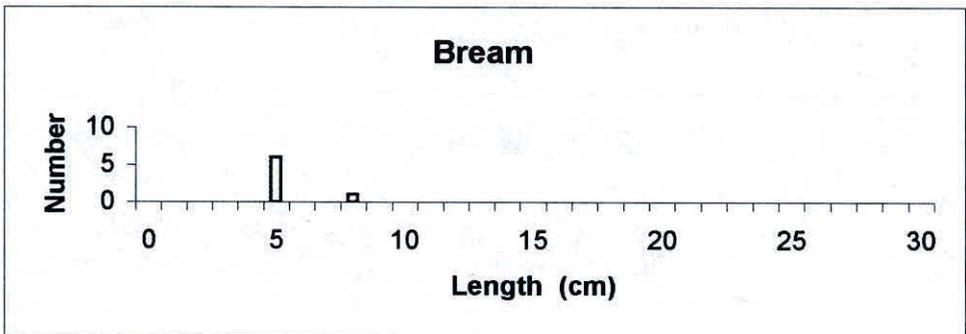
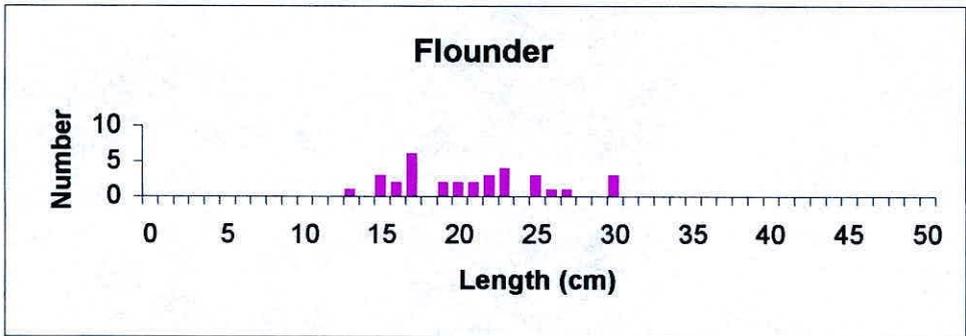
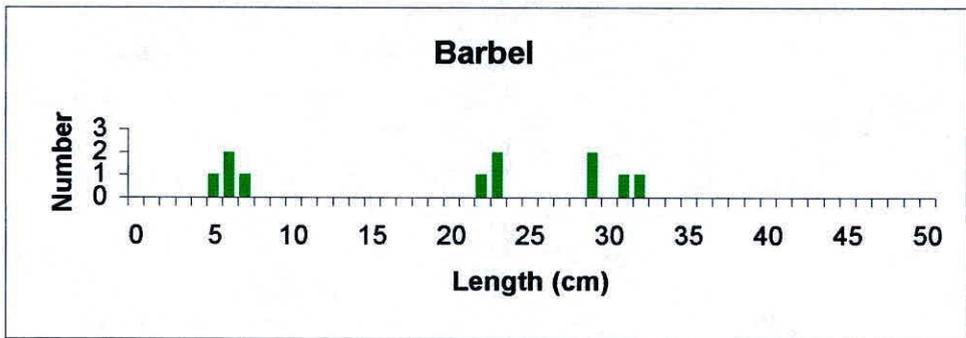
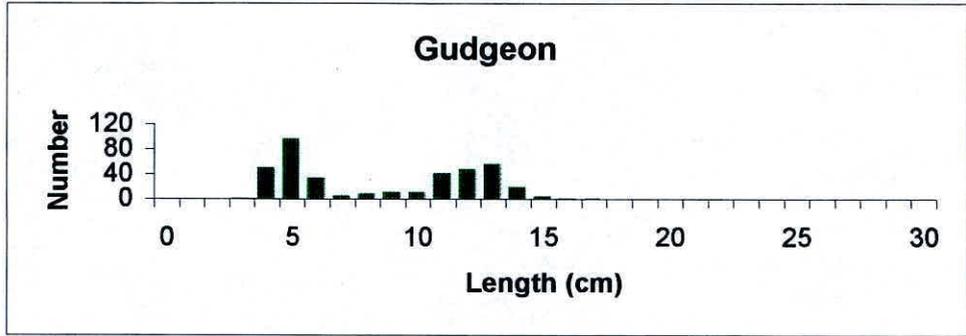


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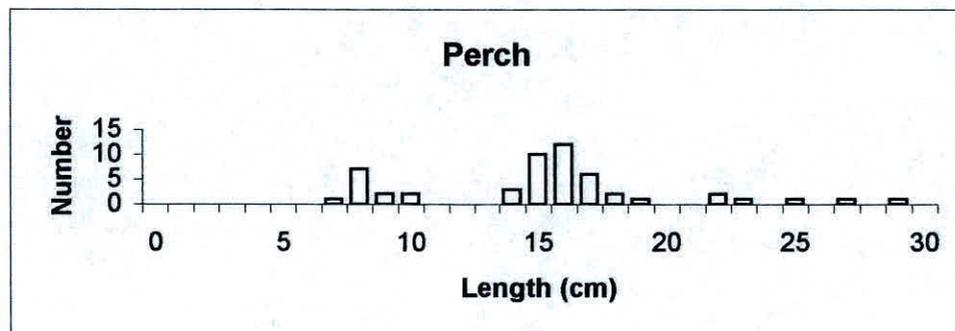
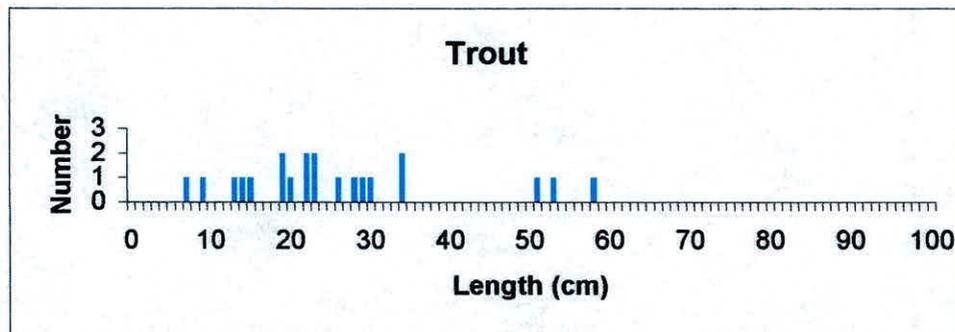
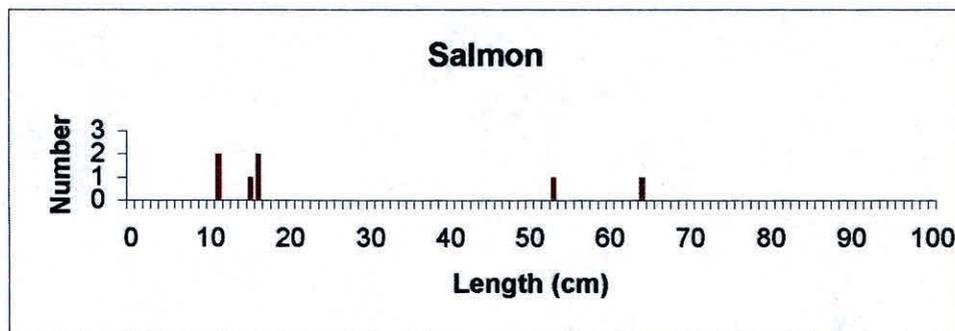
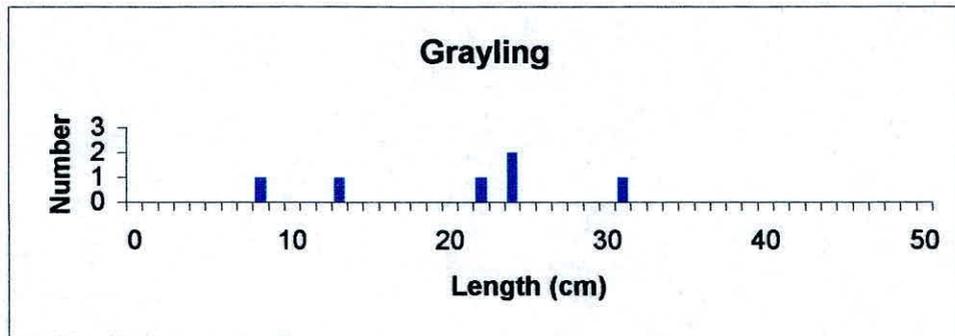


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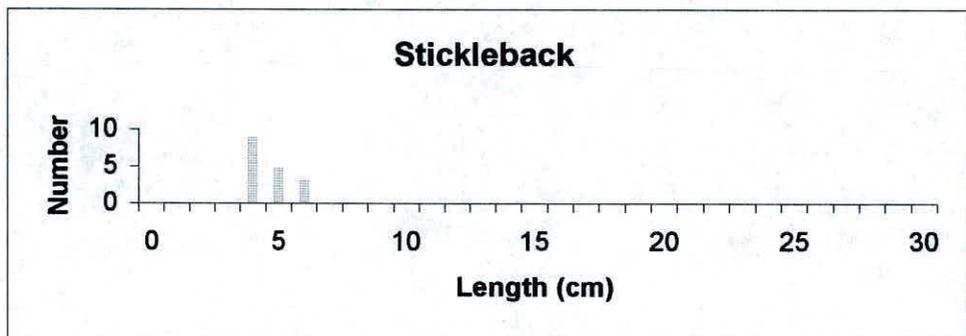
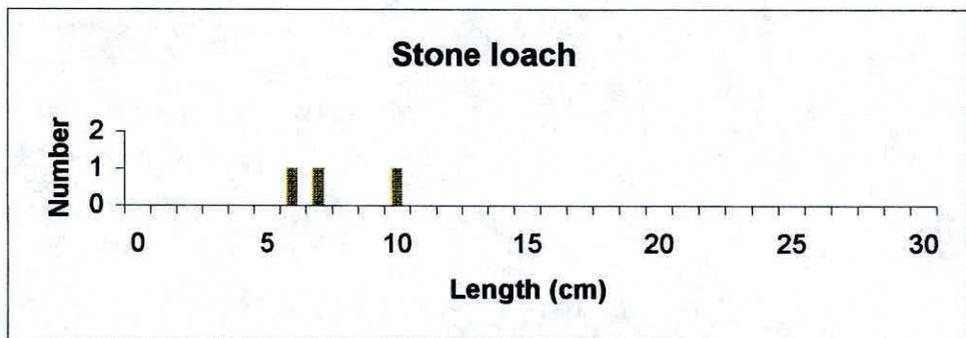
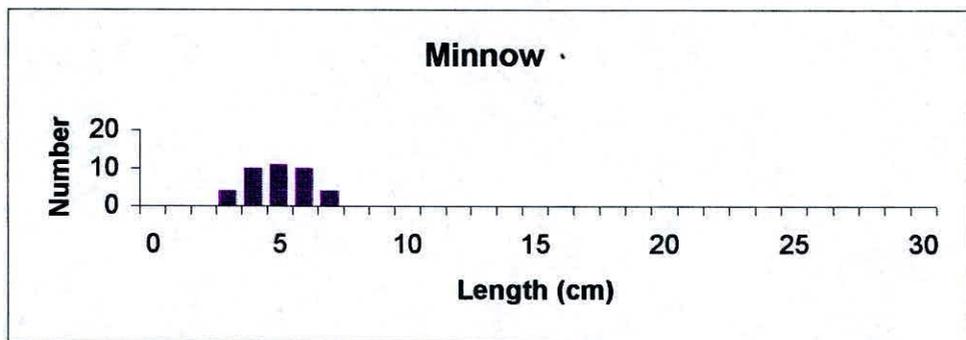
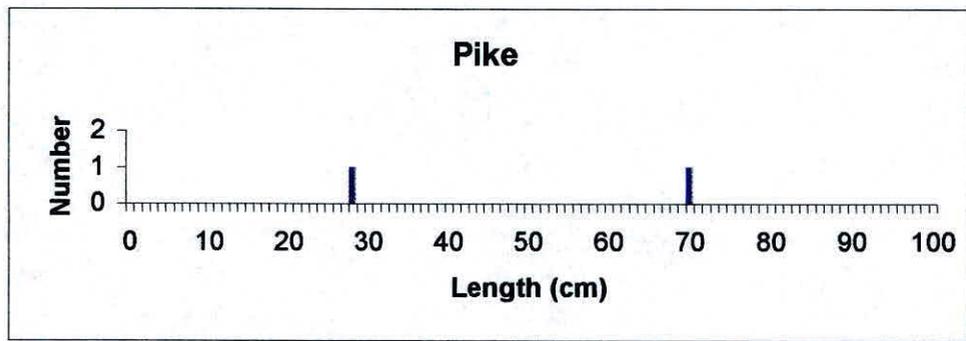


Figure 8. Length by age for dace in the R.Tees in September 1997

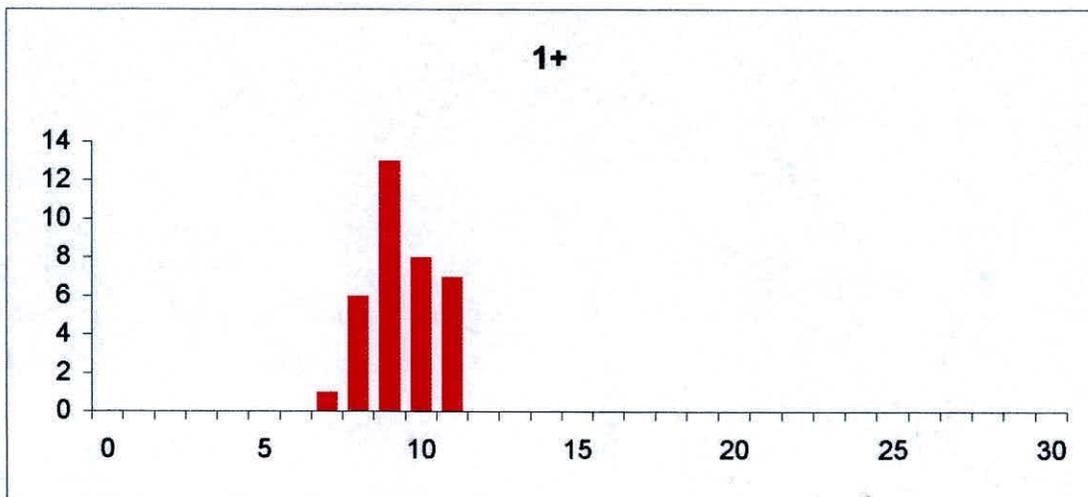
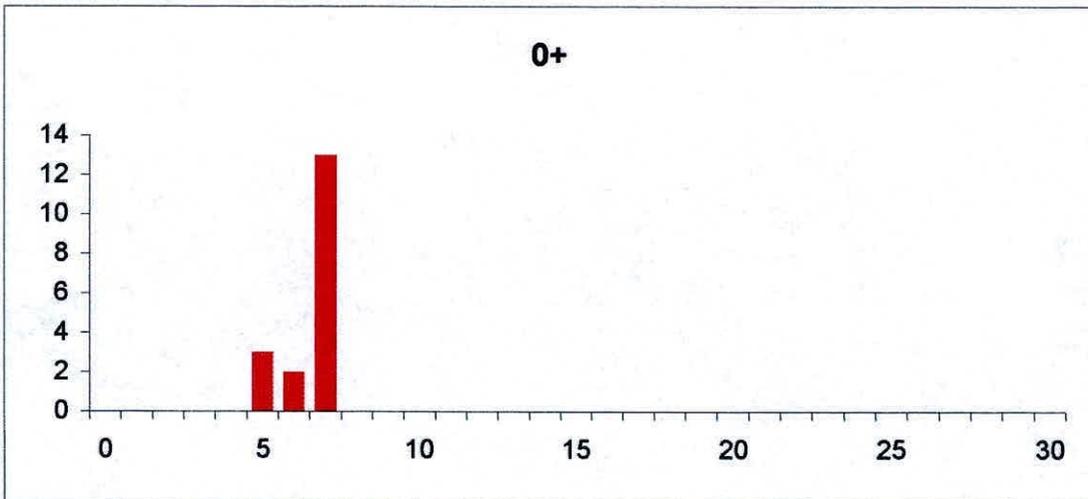
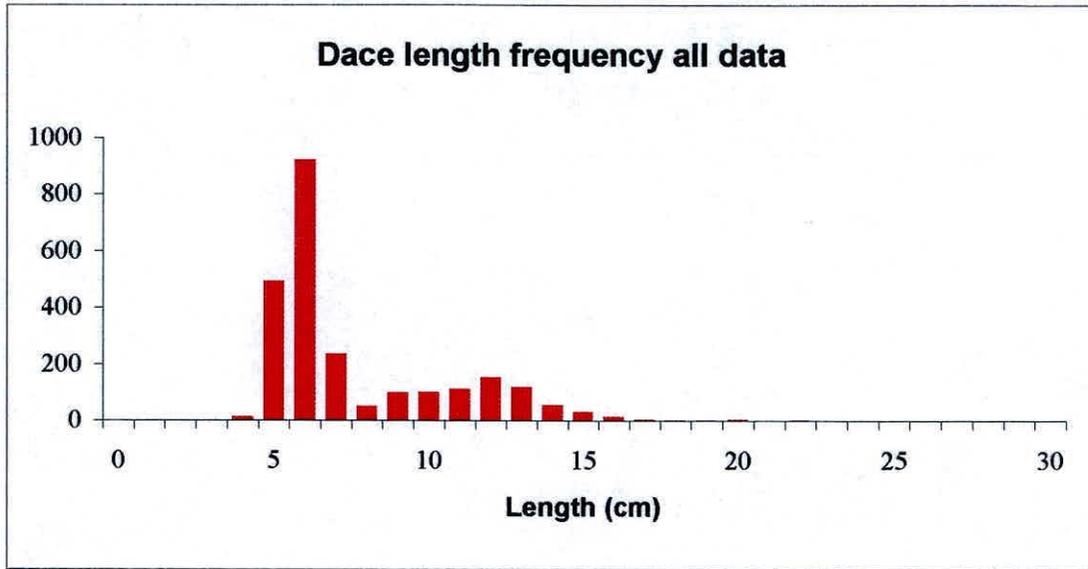


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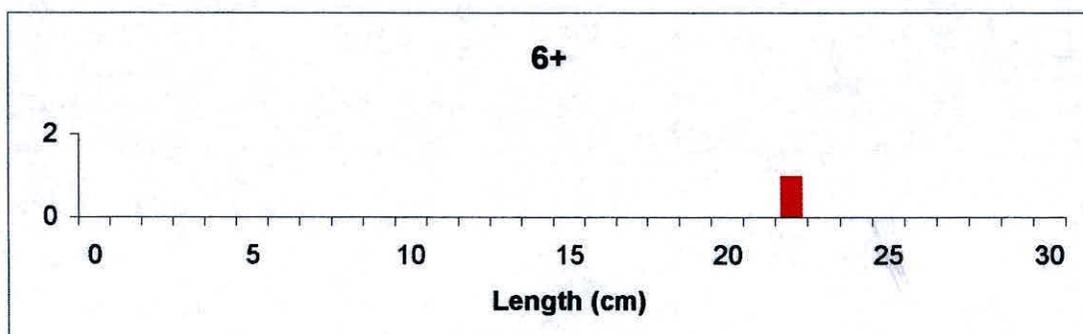
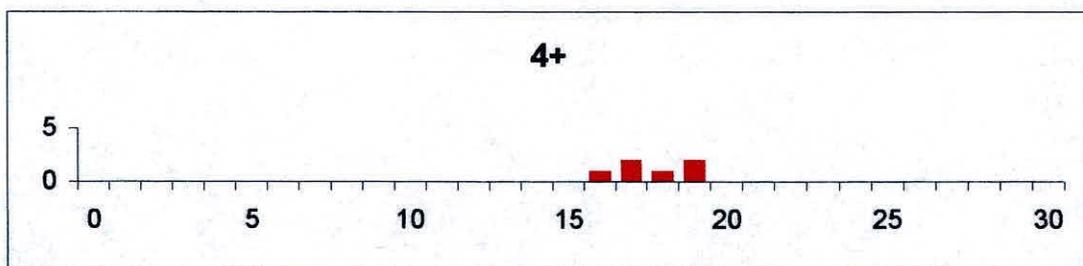
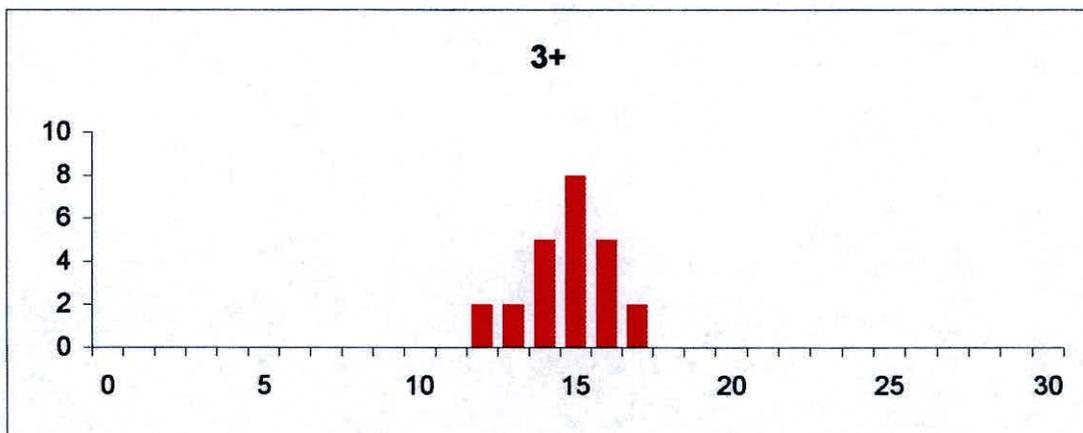
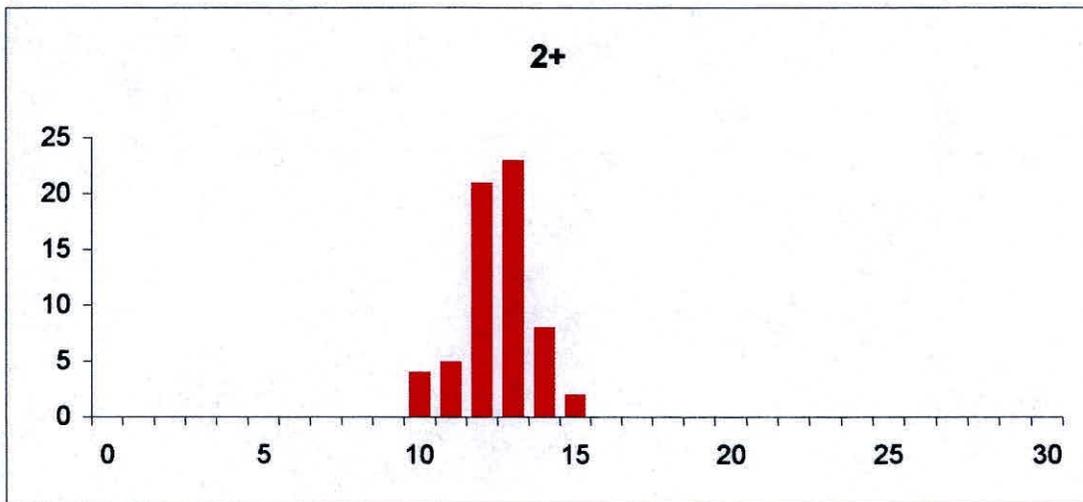


Figure 9. Length by age for roach in the R.Tees in September 1997

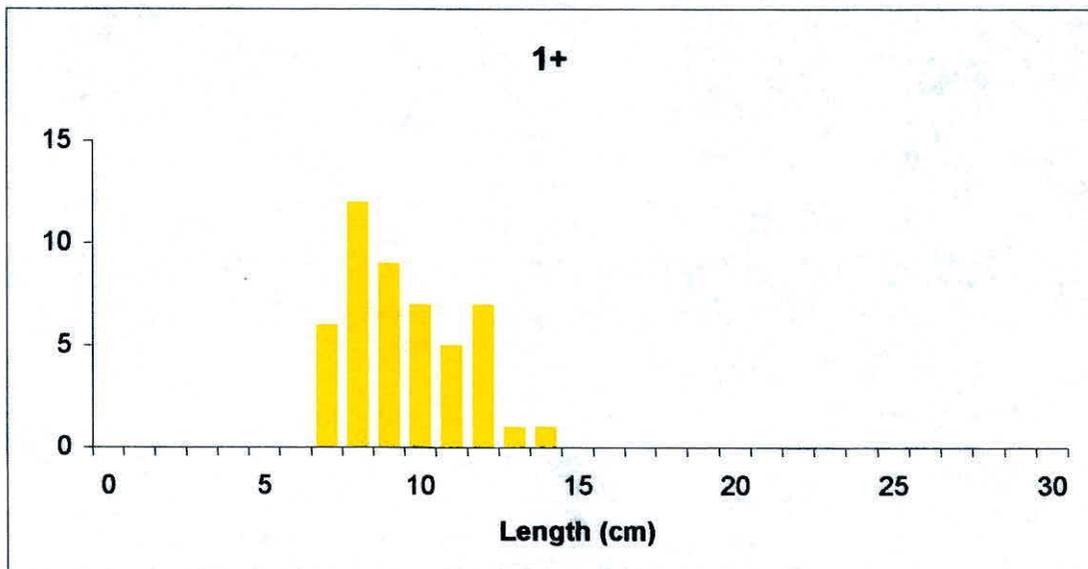
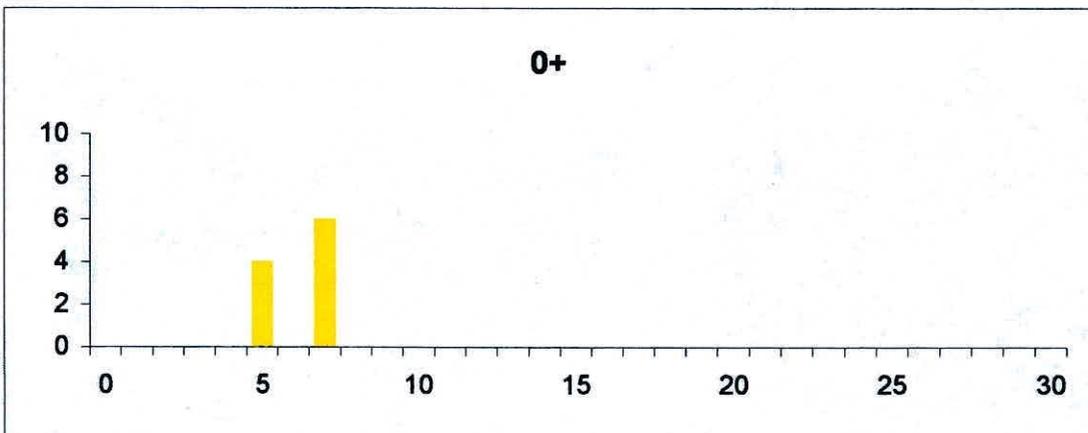
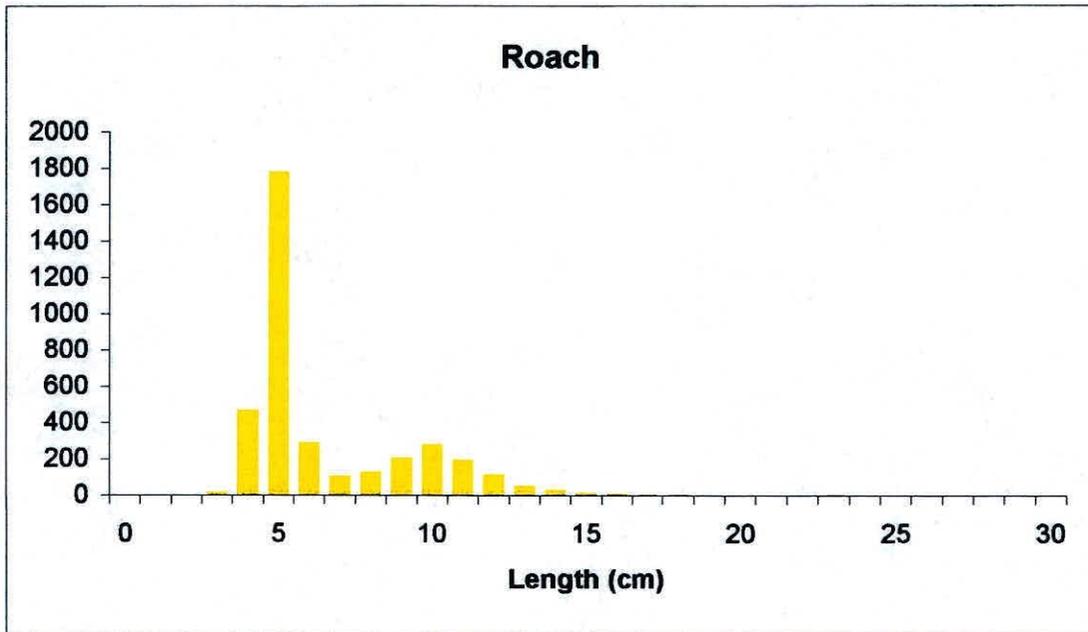


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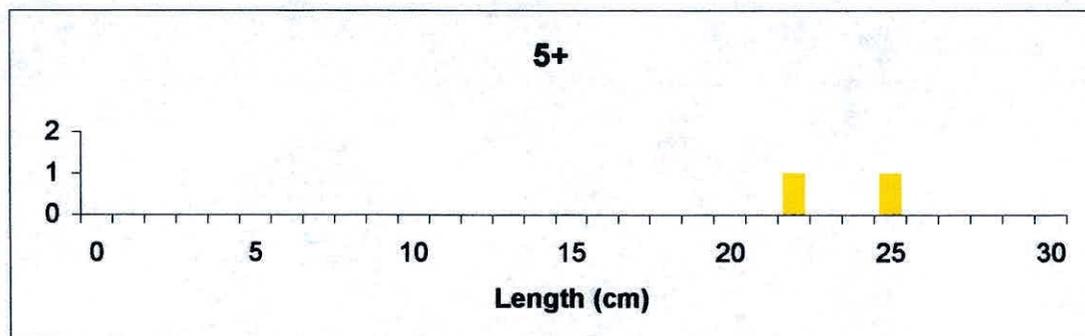
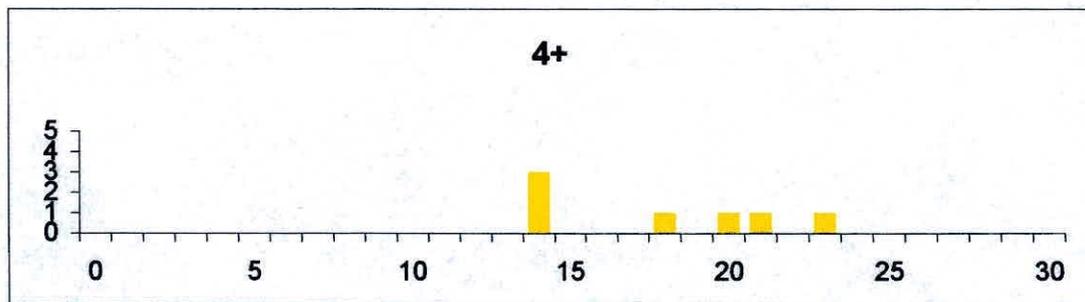
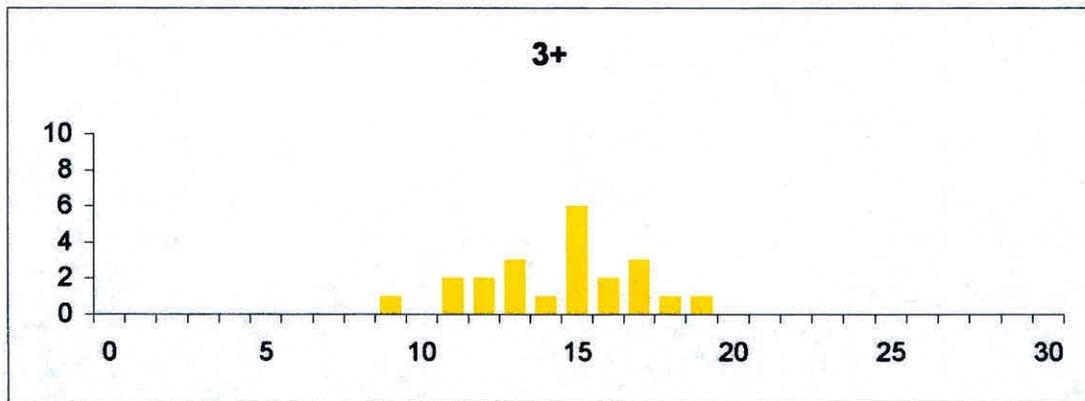
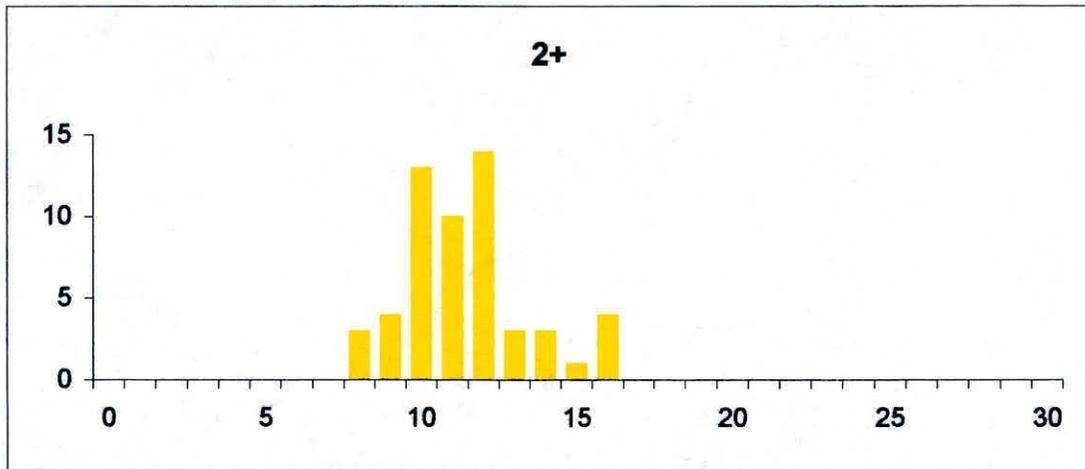


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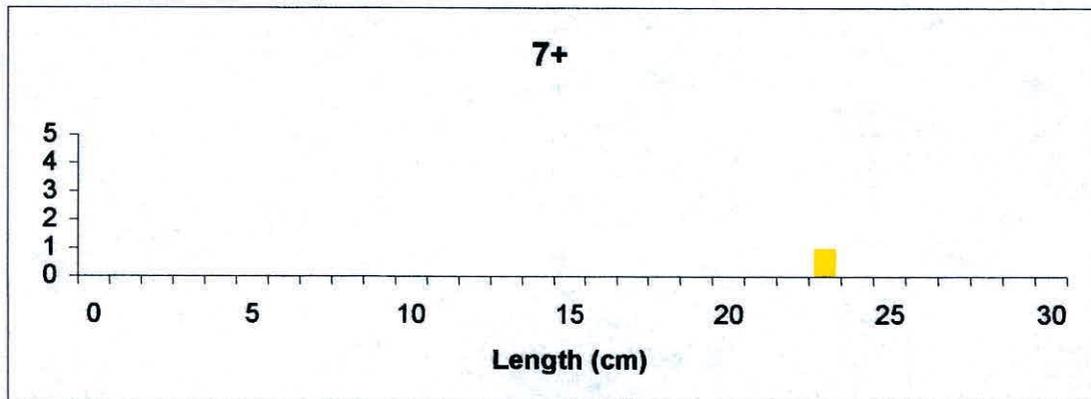
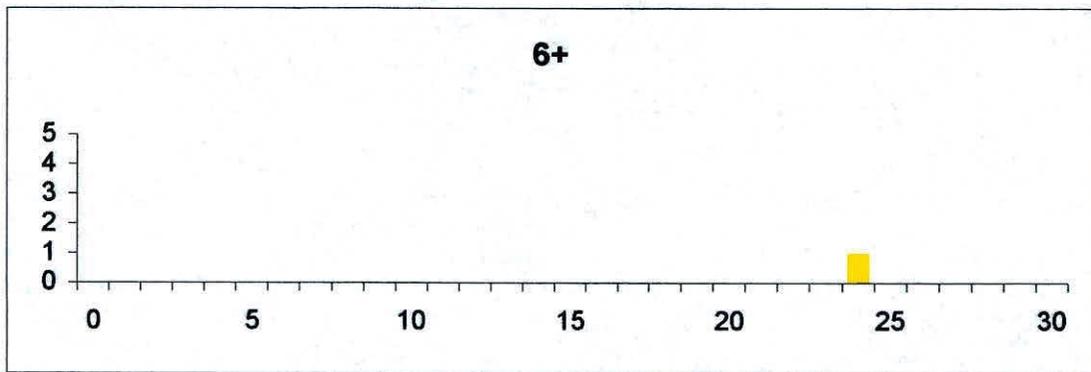


Figure 10. Length by age for chub in the R.Tees in September 1997

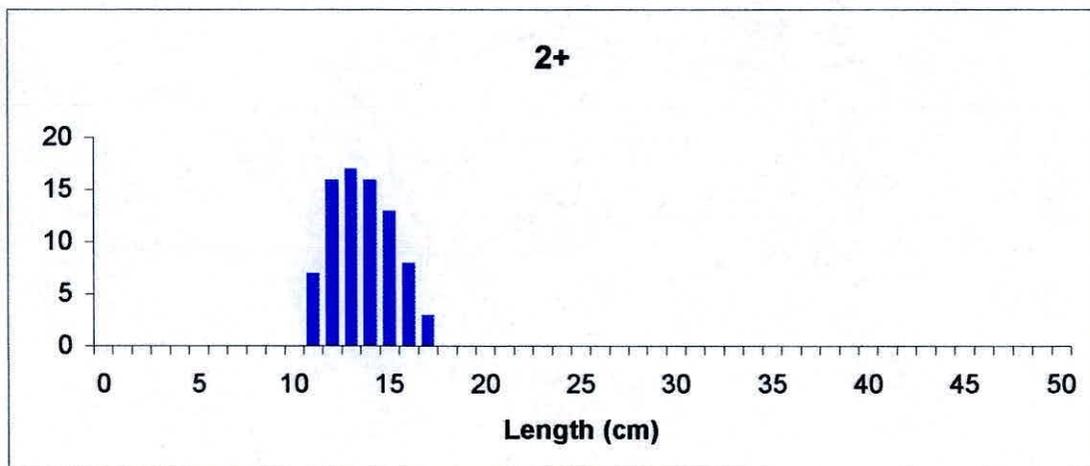
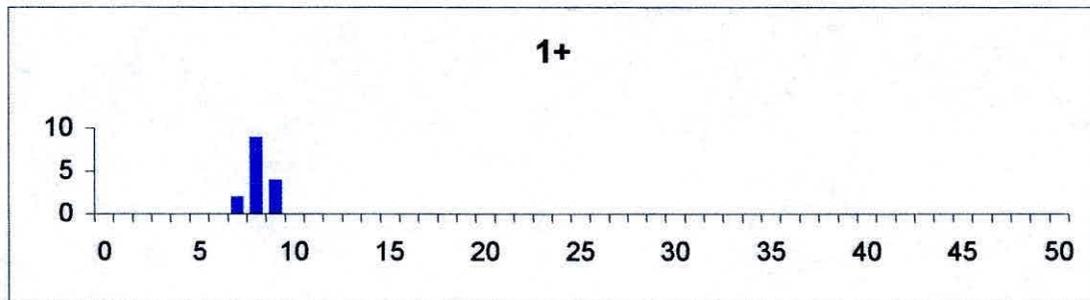
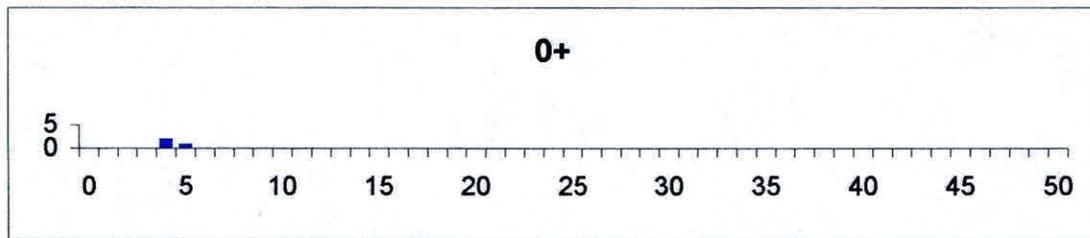
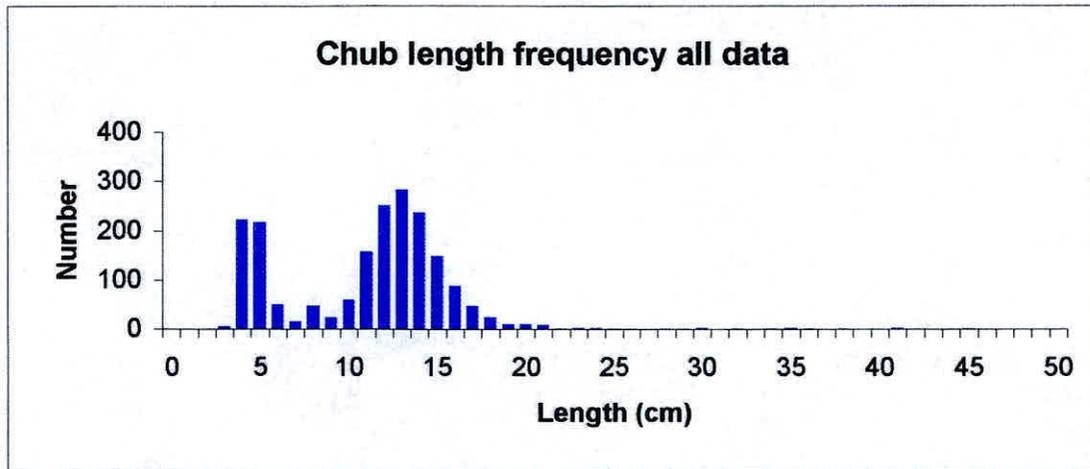


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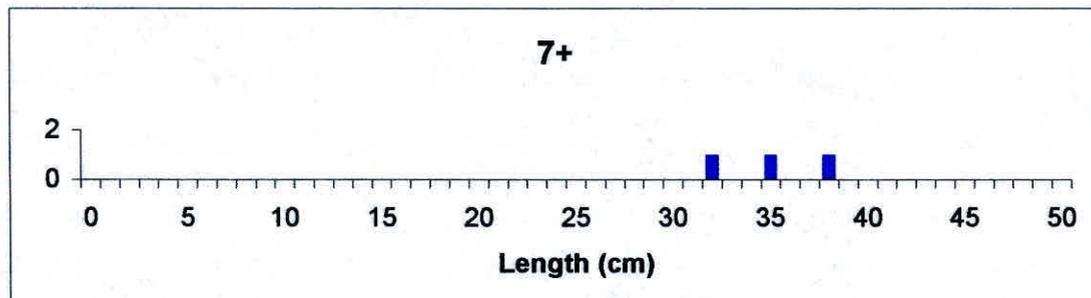
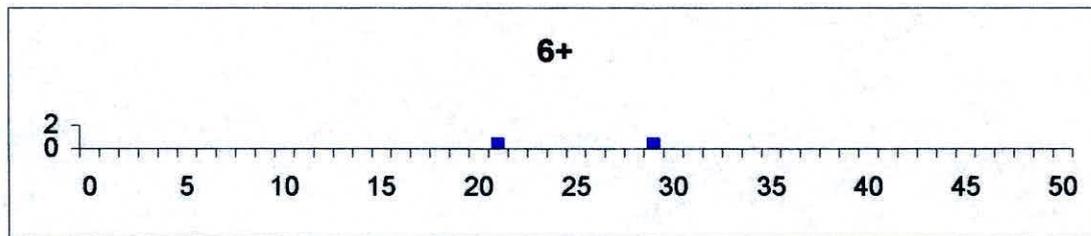
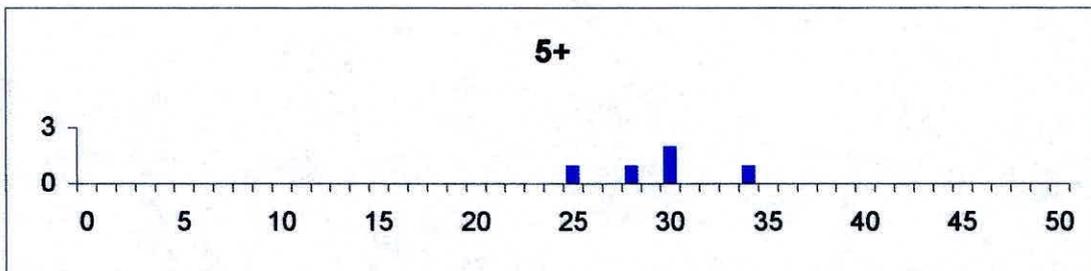
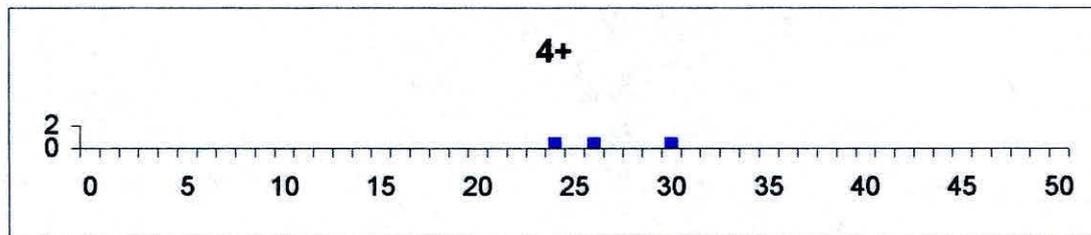
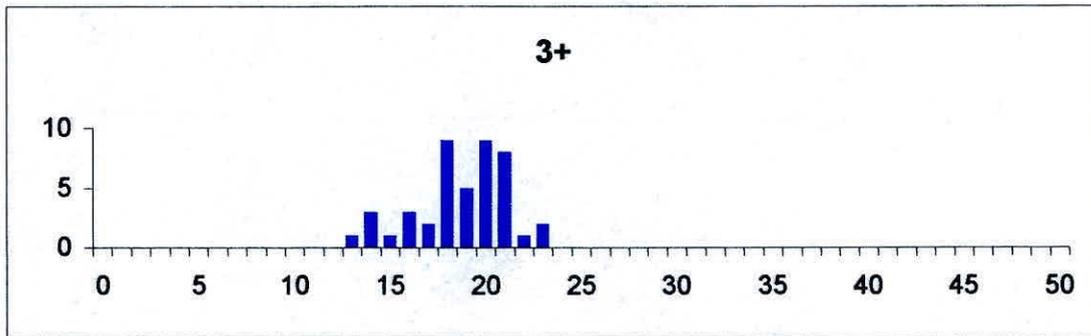


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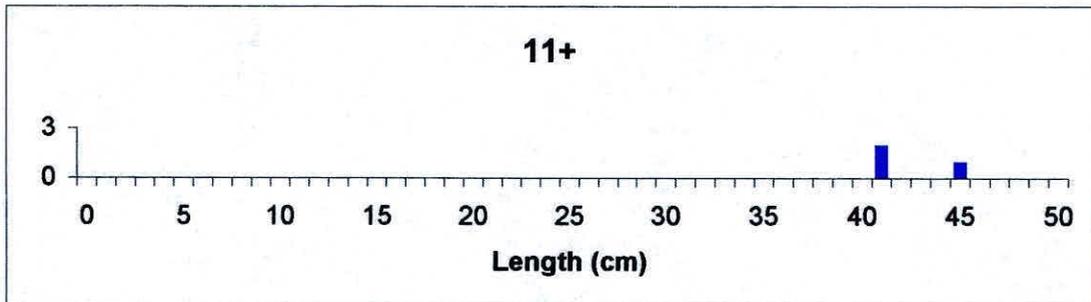
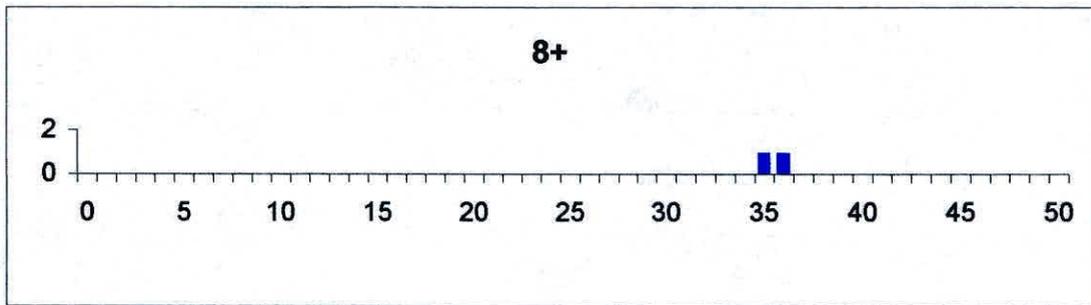


Figure 11 Length by age for gudgeon in the R.Tees in September 1997

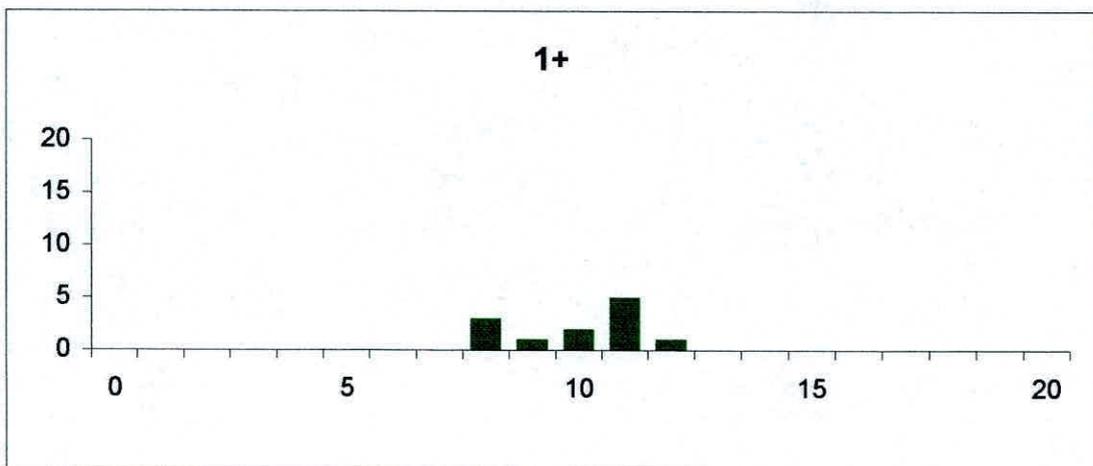
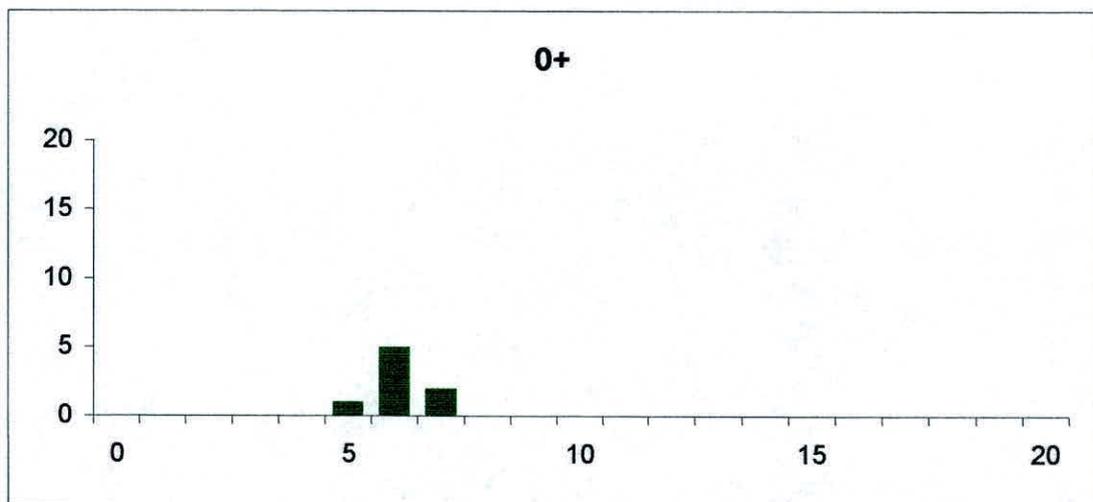
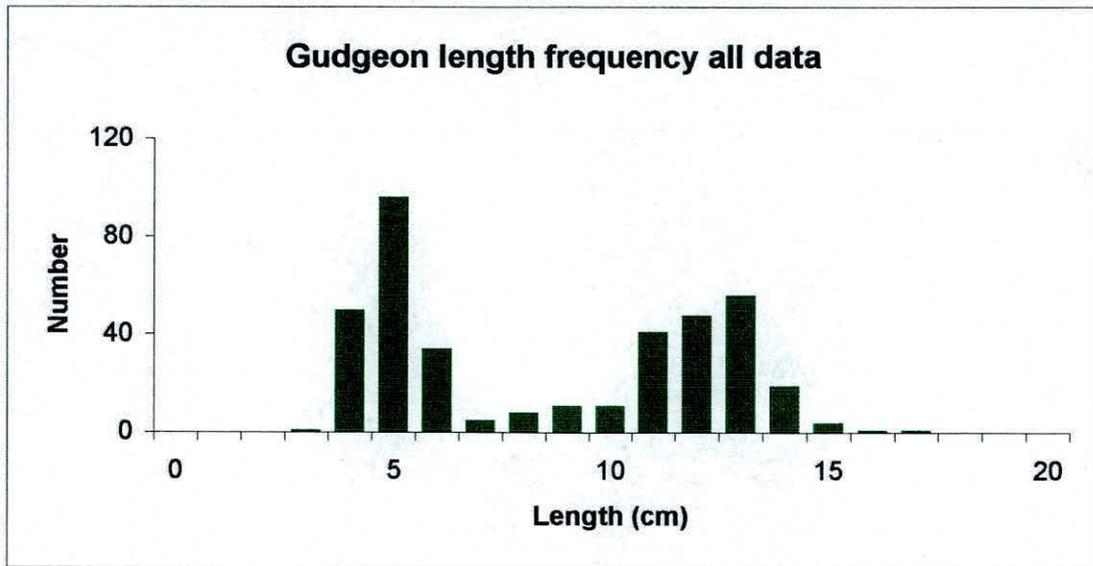


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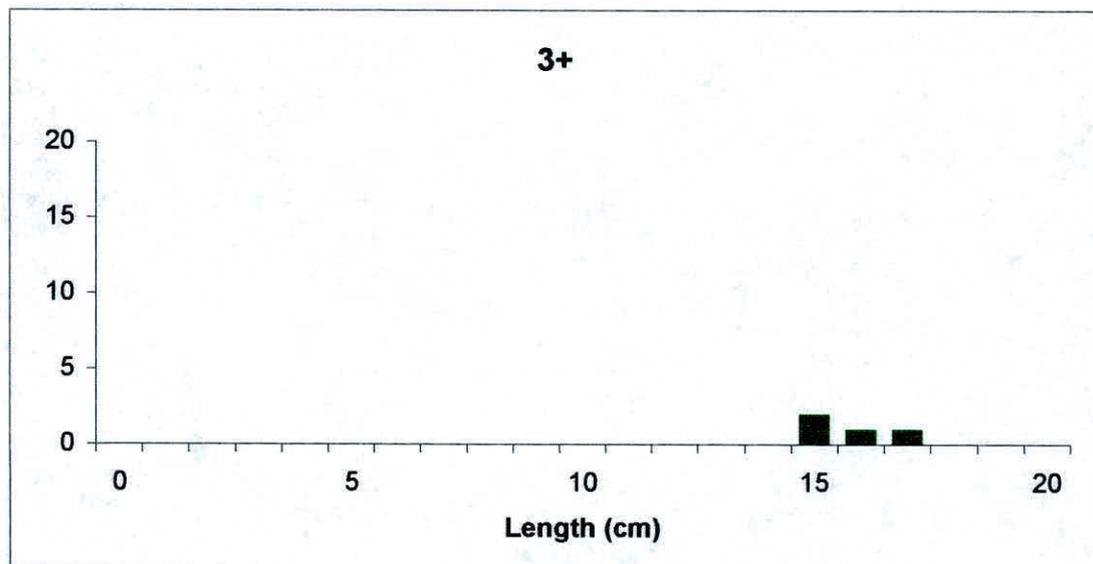
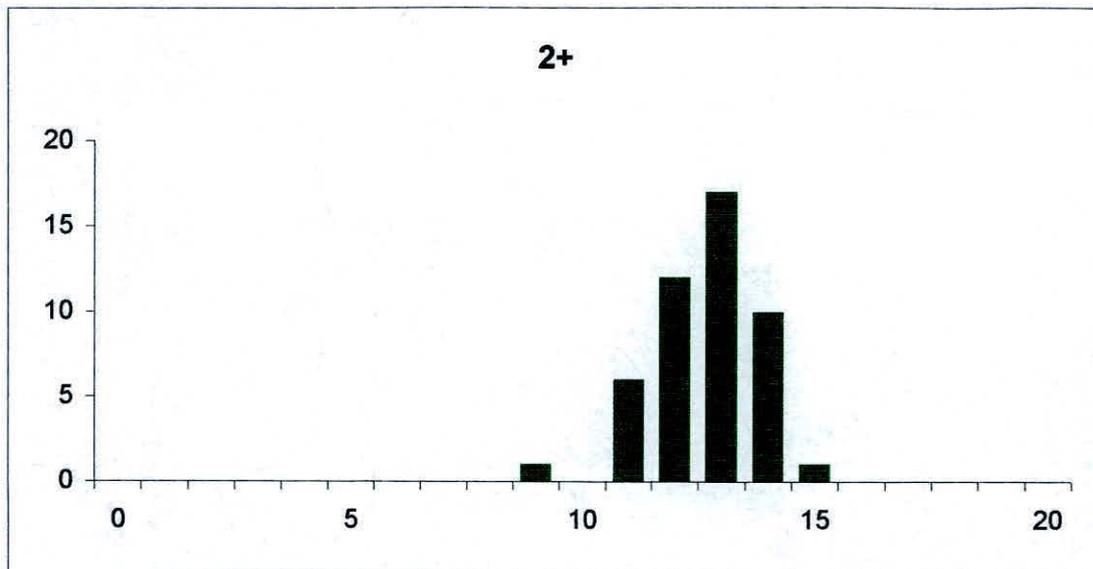
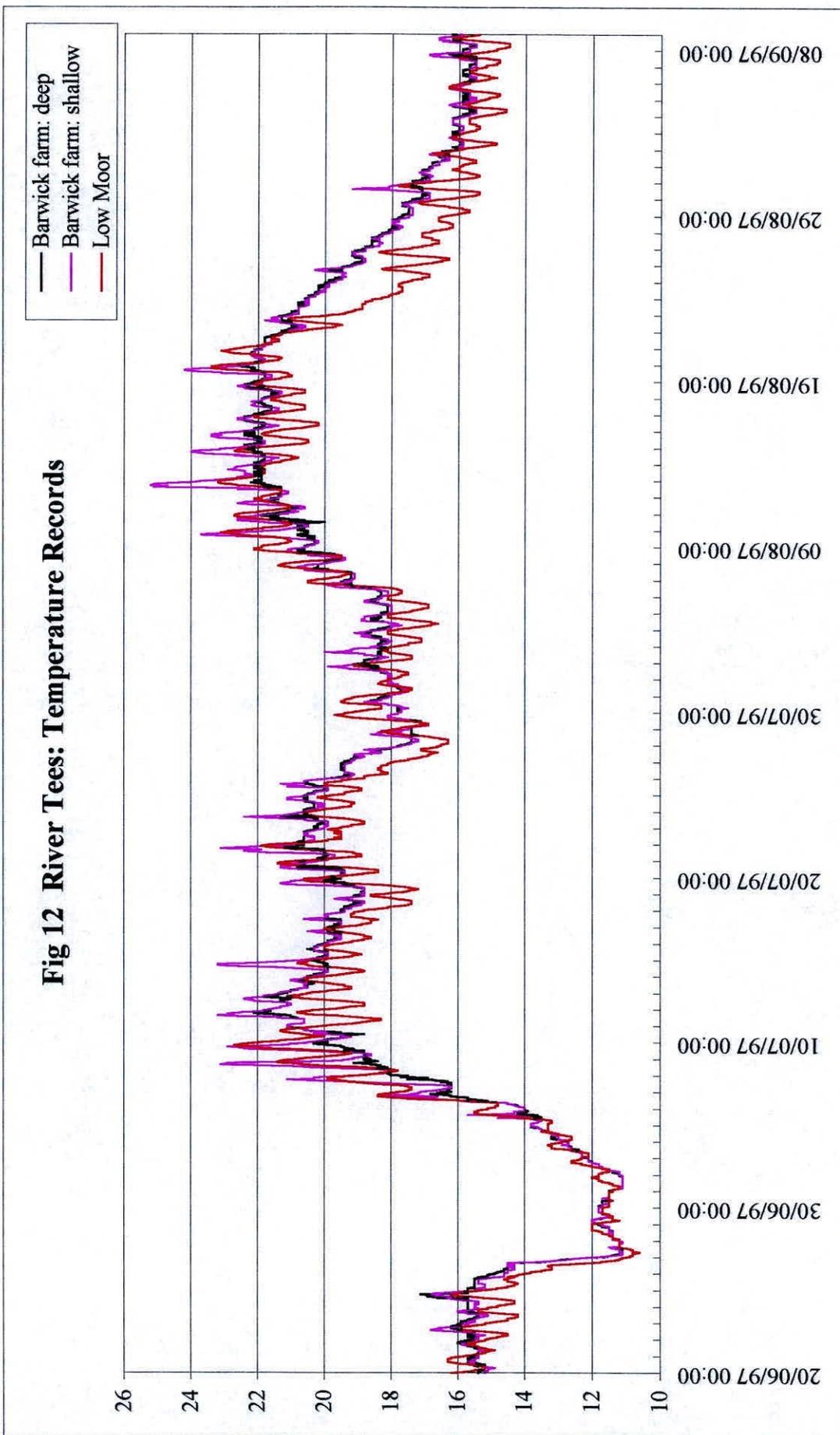


Fig 12 River Tees: Temperature Records



**Fig 13 River Tees: Temperature Records
9 August 1997 - 13 August 1997**

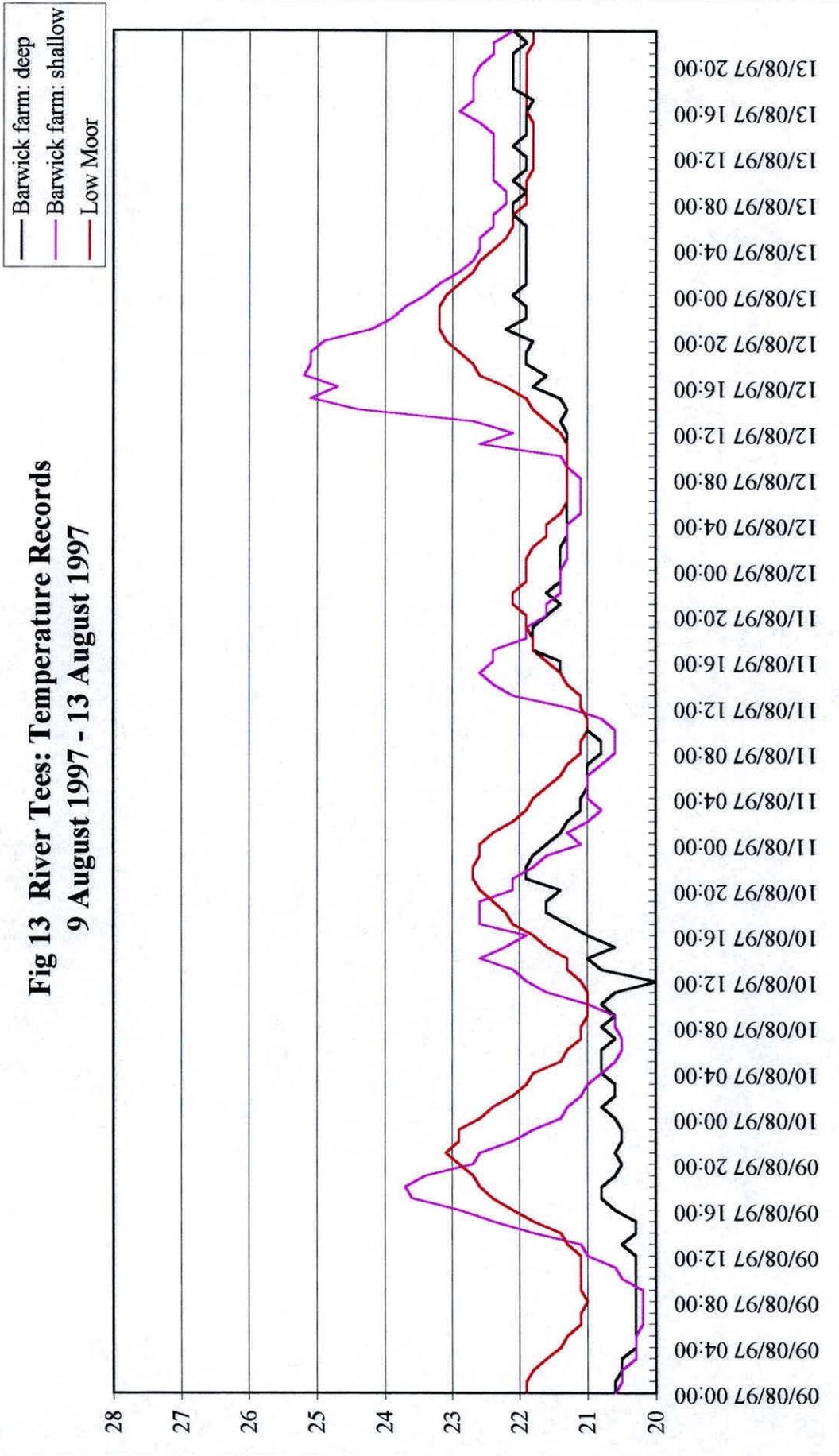


Figure 14 Mean (\pm 95% CL) catch weight per angler per match for each season in the study period.

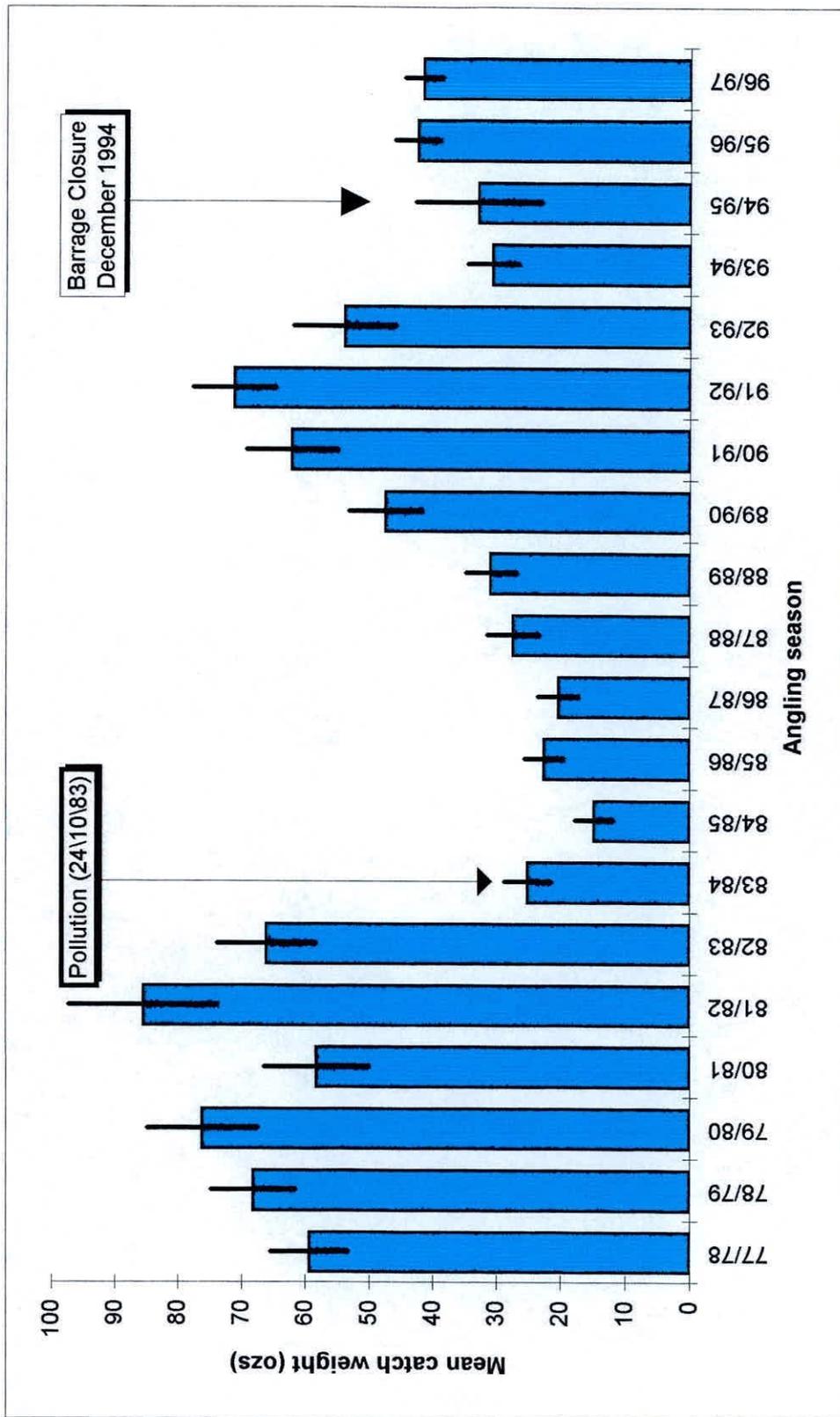


Figure 15 Mean (\pm 95% CL) catch weight per top ten angler per match for each season in the study period

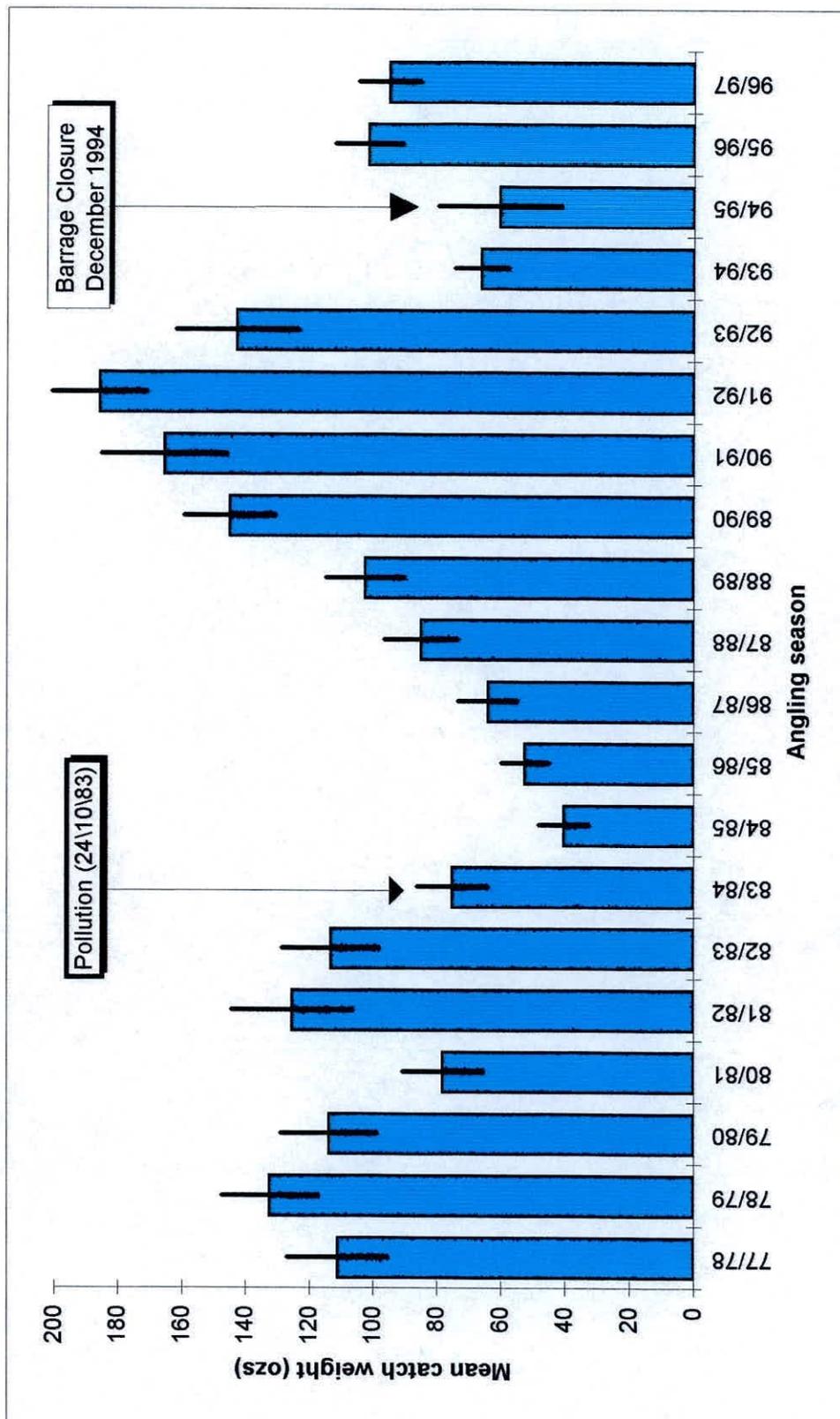


Figure 16 Post-Barrage distribution of catch weights in the River Tees from years 1994/1995 (post-barrage), 1995/1996 and 1996/1997

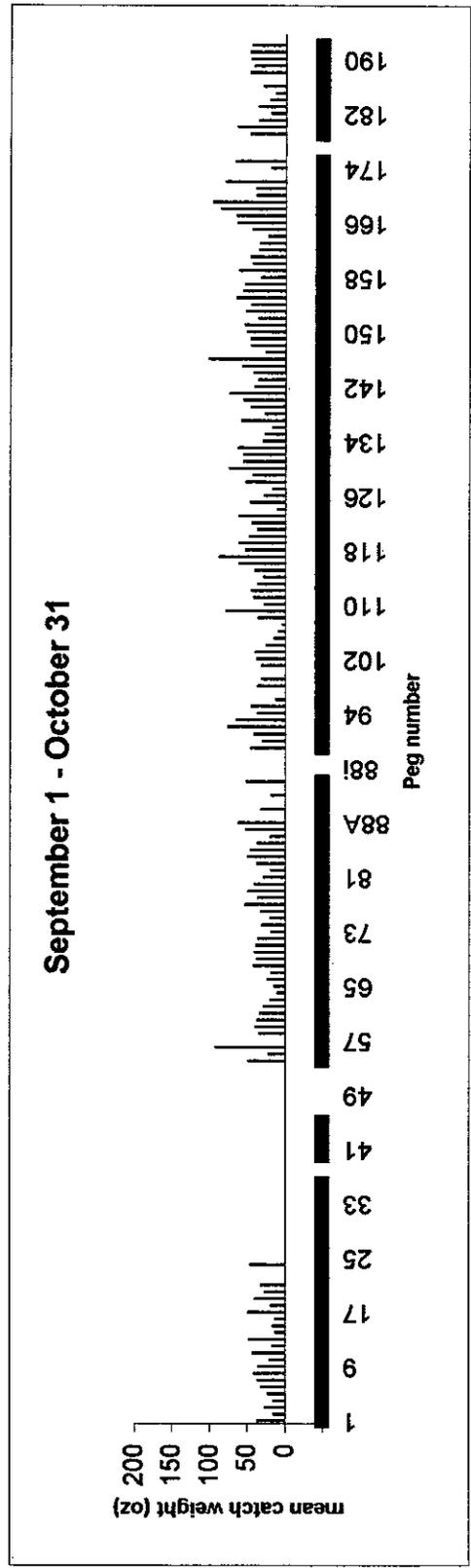
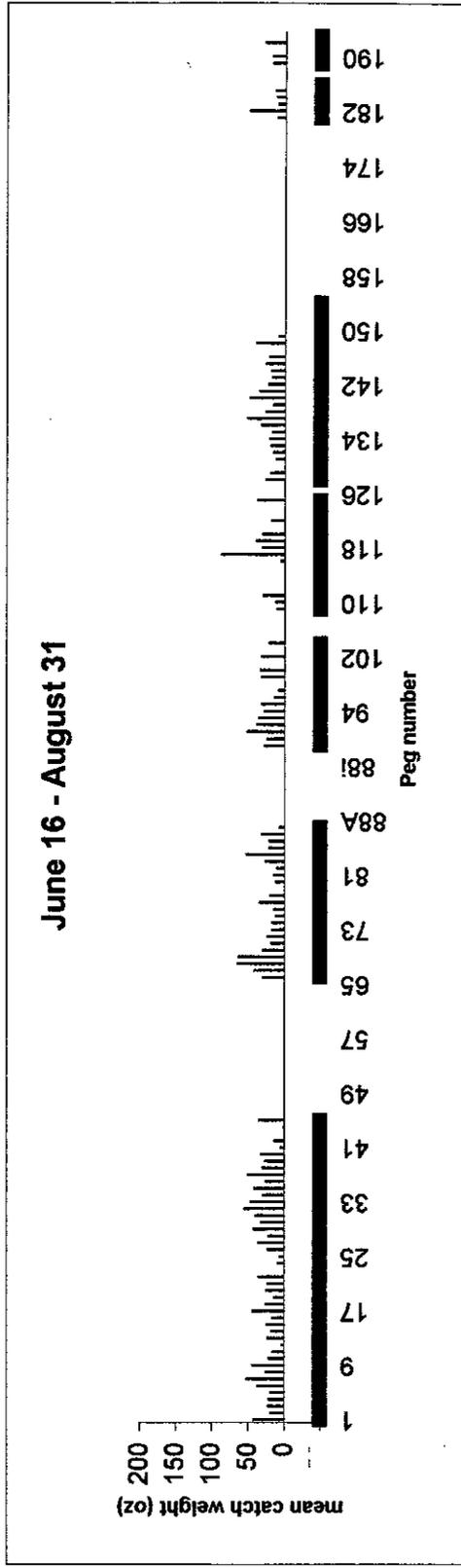
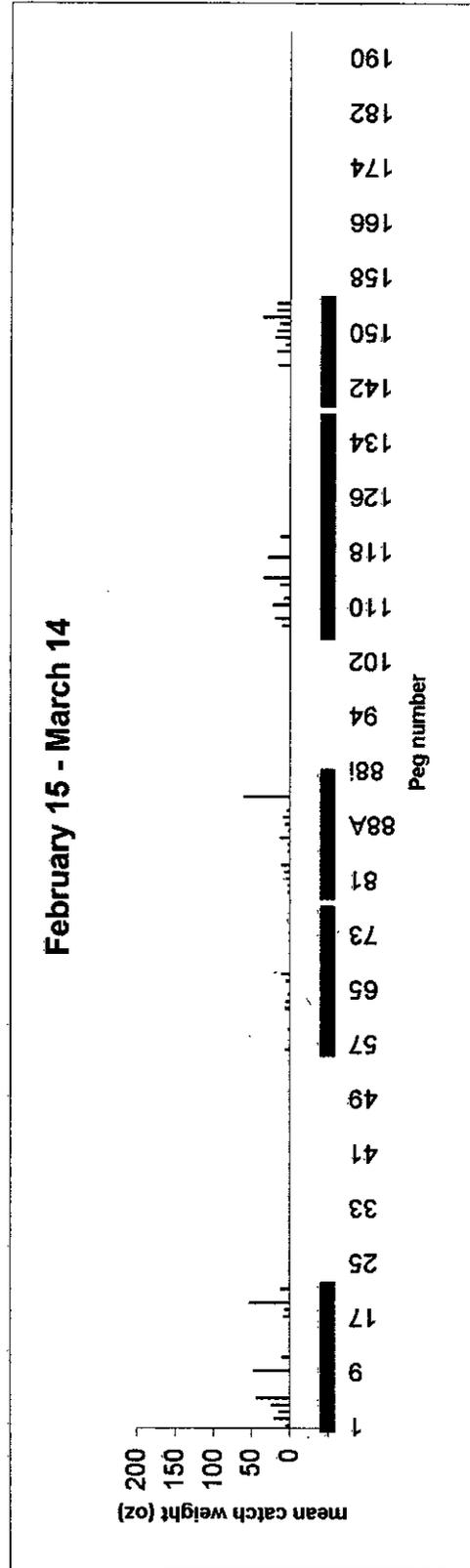
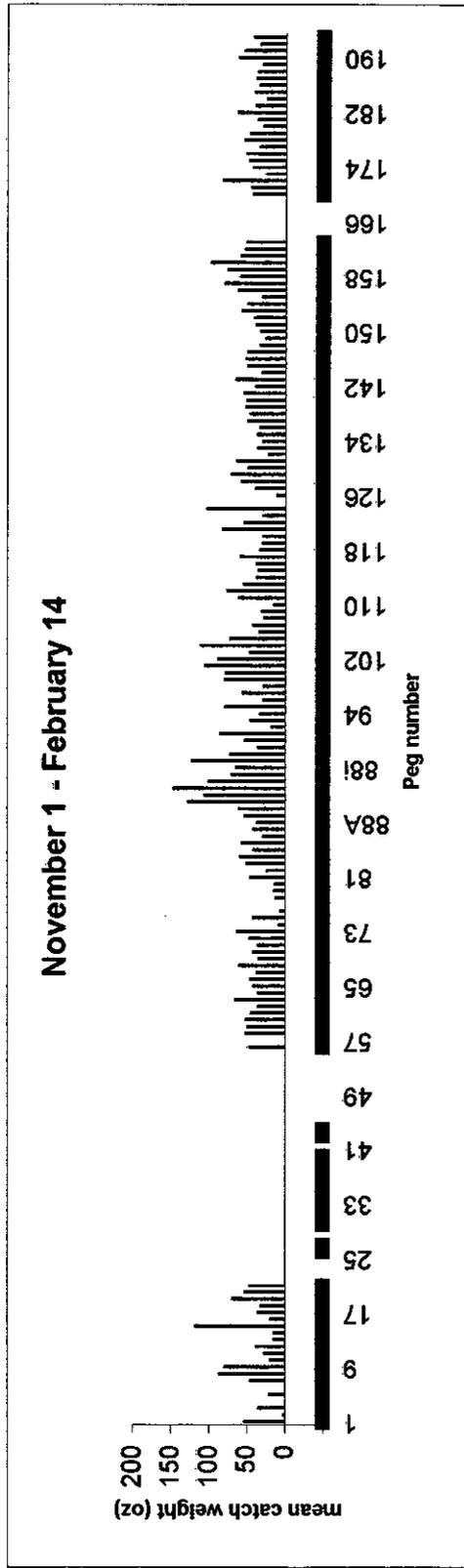


Figure 16 continued



S1 Seine net in ORSU. Depth =>1m Some floating Enteromorpha.

Section E . Not Sampled.

Section 1. The Holmes. 19 June 1997. 13:40 Hrs.

P1 Extensive PS search along right bank at apex of bend where a few pinheads had been seen earlier.

THE HOLMES ORSU

E1 Margins of The Holmes ORSU examined. No fry seen.

Section 2 Basaleton Wood 19 June 1997. 13:00 Hrs.

P1(10) Basaleton Beck.
Substrate: Marginal vegetation and emergent reeds - depth >1m. Shelving mud.

P2(10) North bank, shelving area of mud (cattle drink) 10 cm deep.
Non-fry caught = 1 adult stickleback.

Section 3 Pipe Bridge 19 June 1997. 12:45

P1(10) North bank. Emergent reeds and bays in reeds.
Depth >1m. No fry seen. 1

P2(10) South bank just downstream of pipe bridge. Emergent reeds. Depth >1 m.
Non-fry caught = 1 adult Stickleback.

Section 4 Preston Park 19 June 1997. 11:30 Hrs.

P1(5)/TN1 Random PS followed by two targeted net samples at fry shoal. Shelving mud with some emergent Phragmites.

TN2 Left bank, mud & sand substrate. Extensive search for fry, one net sample taken from each of the two shoals seen.

PRESTON PARK ORSU

P2 Preston Park ORSU. Shelving mud slope. No >0+ fish seen and few <0+ (including sticklebacks).

E1 Entire ORSU perimeter checked. No fish seen.

P3(10) South bank on inside of bend. Shallow shelving mud with emergent phragmites.

Section 10 18 June 1997 13:50Hrs.

- P1(5) South bank Steep mud bank with some roots / emergent vegetation.
- P2(5) South bank Shallow mud substrate with emergent Glyceria.
- P3(5) In Nellys' Beck. Deep with branches. Few fry seen and those that were were in sunny areas, Dace seemed to be close to the banks with roach further off.

Section 11 The Cabins 18 June 1997 13:30Hrs.

- TN1(5) North bank by Holme House slipway. Shelving concrete plus mud with emergent vegetation. Max depth 20cm.
- P1(5) North bank. Shallow marginal mud with some emergent vegetation.
- P2(5) South bank. Shallow bays in steep mud bank with emergent Glyceria . Depth <10cm.

Section 12 18 June 1997 12:50Hrs.

- P1(10) North bank (by wooden staging). Depth 30cm. Substrate mud with some emergent vegetation. Most fry found in Myriophyllum beds and shallow mud areas.
- P2(5) South bank. Shallow (>20cm) area in amongst emergent Glyceria. Substrate mud with emergent vegetation. b & 1->0+minnow.

Section 13 18 June 1997 12:30Hrs.

- P1(5) South bank. Deep water at margin. Mud and emergent vegetation.
- P2(5) North bank. Shallow marginal area with emergent vegetation.

Section 14 18 June 1997.

- P1(5) North bank. Steep bank with mud substrate & emergent vegetation..
- P2(5) South bank. Deep water with steep mud bank. Willow roots in margins.
- P3(5) North bank. Mud substrate with emergent vegetation. Depth =>10cm.

Section 15 18 June 1997 11:50Hrs.

- P1(5) North bank. Deep water with emergent reeds.
P2(5) In small beck on south bank. Deep water with mud substrate in margins.

Section 16 Low Worsall 18 June 1997 11:30Hrs.

- P1(5) South bank. Steep mud bank with little emergent vegetation - some roots.
N1(5) Random net samples in margin of deep water area. Some emergent / floating macrophytes present.

Section 17 18 June 1997 10:30Hrs

- TN1(5) Small pool with river connection (mini (natural) ORSU). Substrate = mud, depth < 10cm.
S1 Area 3x10m shelving muddy gravel, depth = 0.5 - 0m.

WORSALL ORSU

- TP1(5) Combined 5 random points plus targeted point at shoal of fry. Random Points in deep water with emergent reeds (few fry seen) Targeted Point in shallow muddy area.
P1(10) Large bay on left bank. Deep water with floating macrophytes and boulders.
P2(5) In small inlet on left bank, Substrate = margins and emergent / floating macrophytes.

Section 18. 18 June 1997 10:00Hrs.

- S1 Substrate shelving silty gravel, some Myriophyllum. Depth 0.5 - 0 m.
Area netted = 9m². Non-fry caught = 6->0+ dace, 1->0+ chub, 1->0+ gudgeon & c.50 >0+ minnows
P1(5) Left bank. Substrate steep mud bank with emergent reeds.

Section 22 Above Low Moor weir 17 June 1997 11:15Hrs.

Temperature logger exchanged

TN1(5) Left bank. In marginal area with Myriophyllum on silt bottom, depth 50 cm.

TP1(5) Left bank. In marginal emergent Sparganium, depth 20 - 50 cm Flow nil.
Plus 2->0+ roach and a post spawning (spent) female roach.

Section 23 Not Sampled

Section 24 Not Sampled

Section 25 Low Dinsdale 17 June 1997 9:30Hrs.

S1 Left bank under bridge. Slack on edge of flow. Substrate gravel. Area seined = 40m².

S2 In shallow marginal area including flowing water area and marginal bay area.
Substrate gravel / silt. Depth 0 - 20cm.

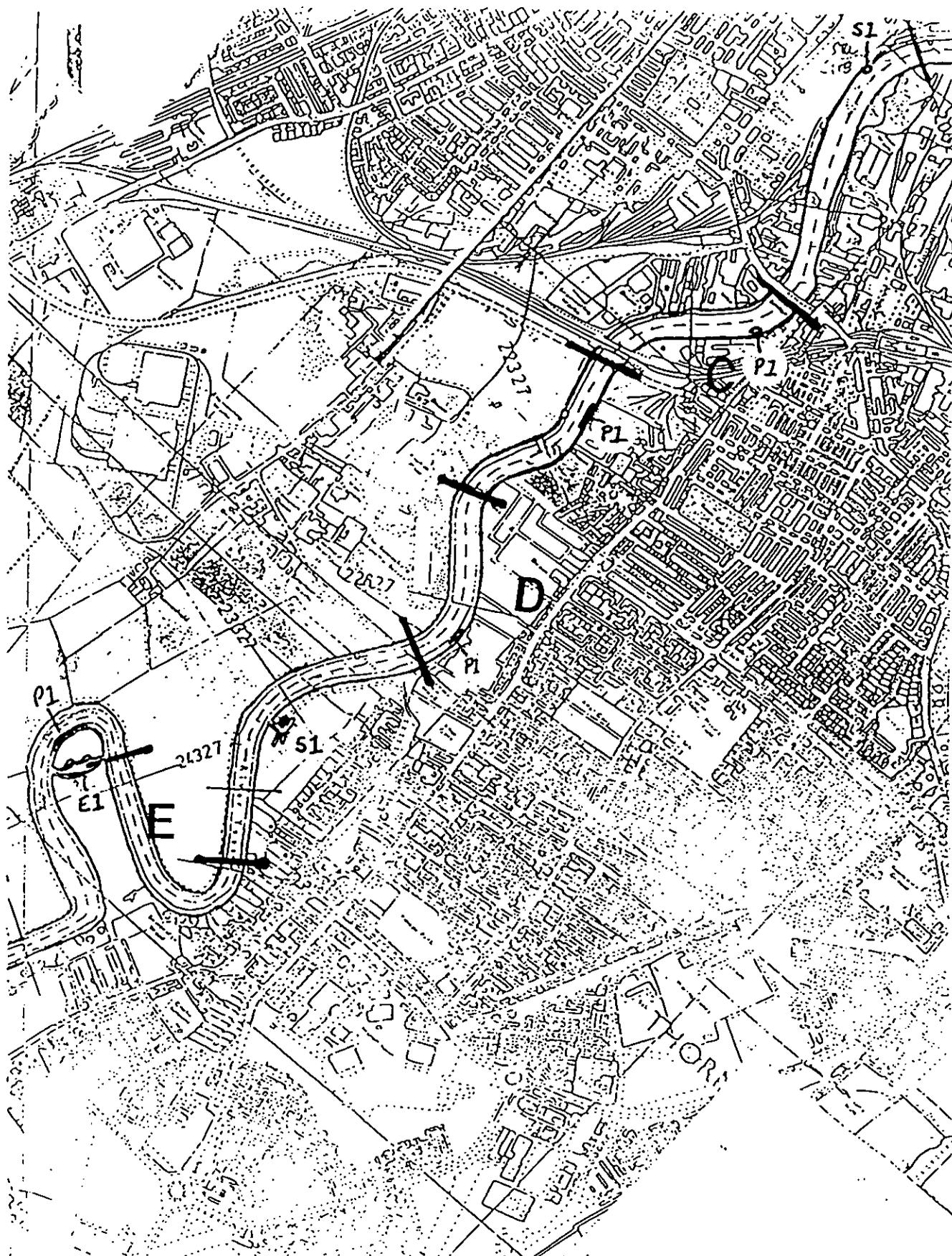
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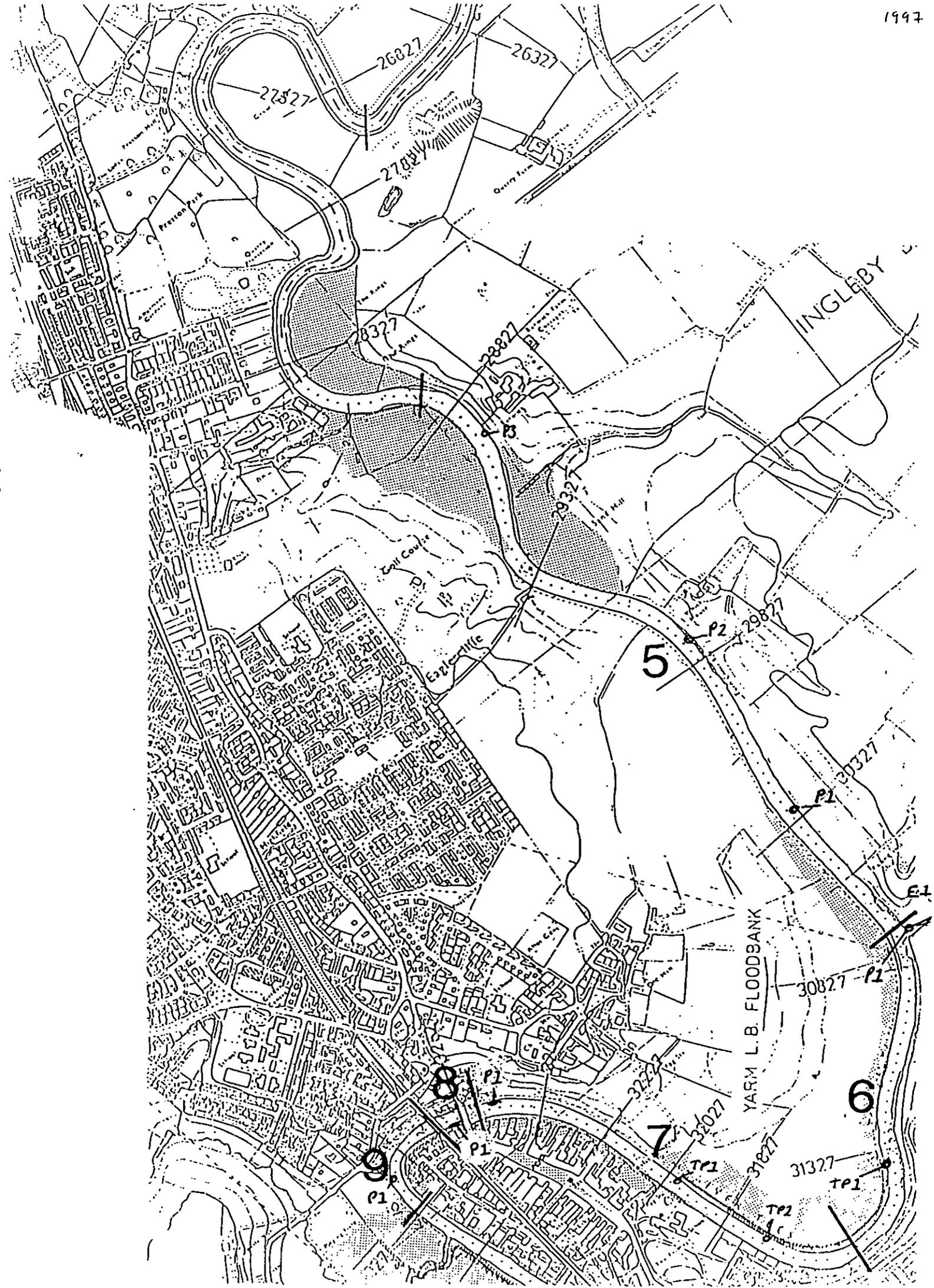
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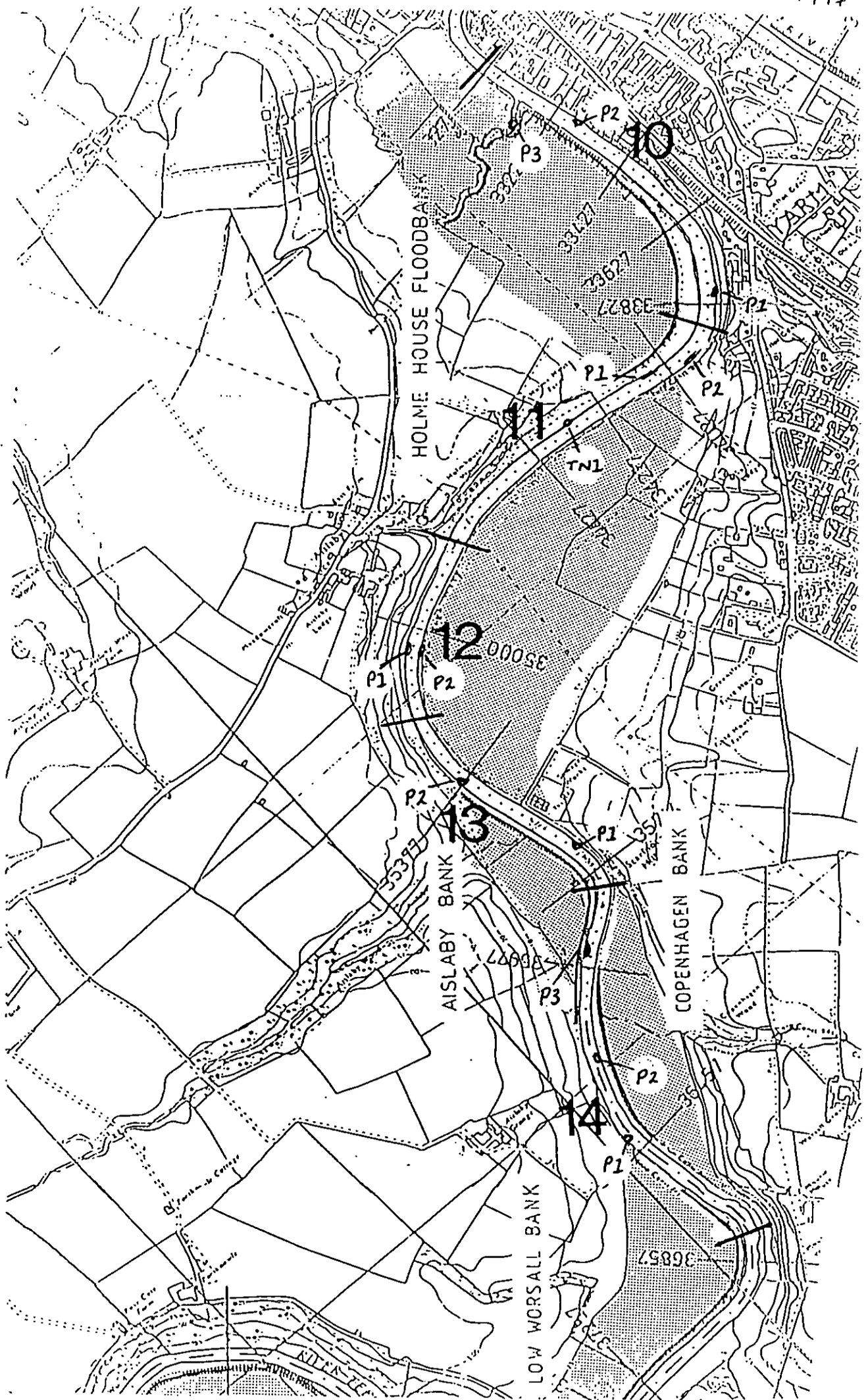
17-19 JUNE.

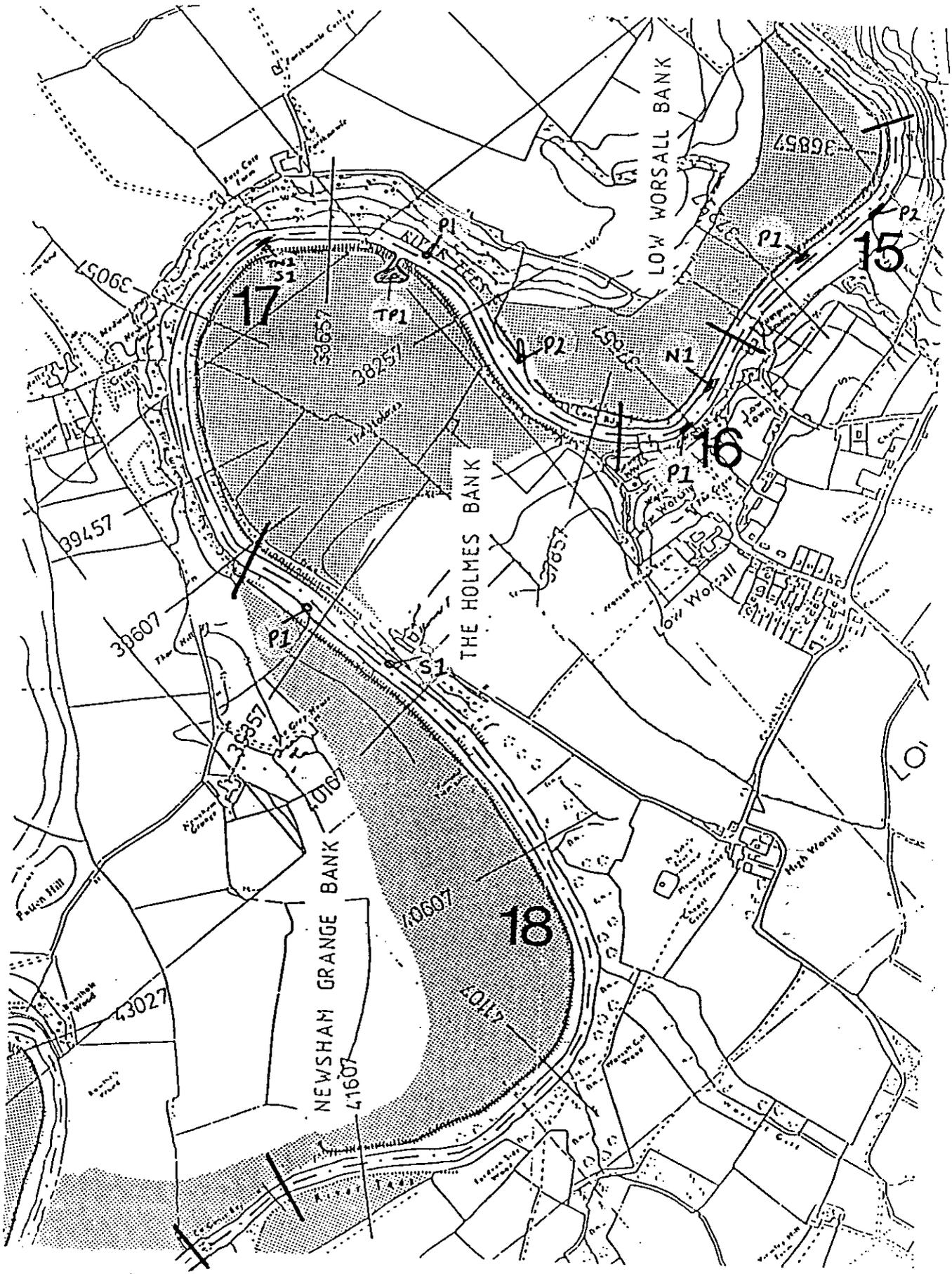


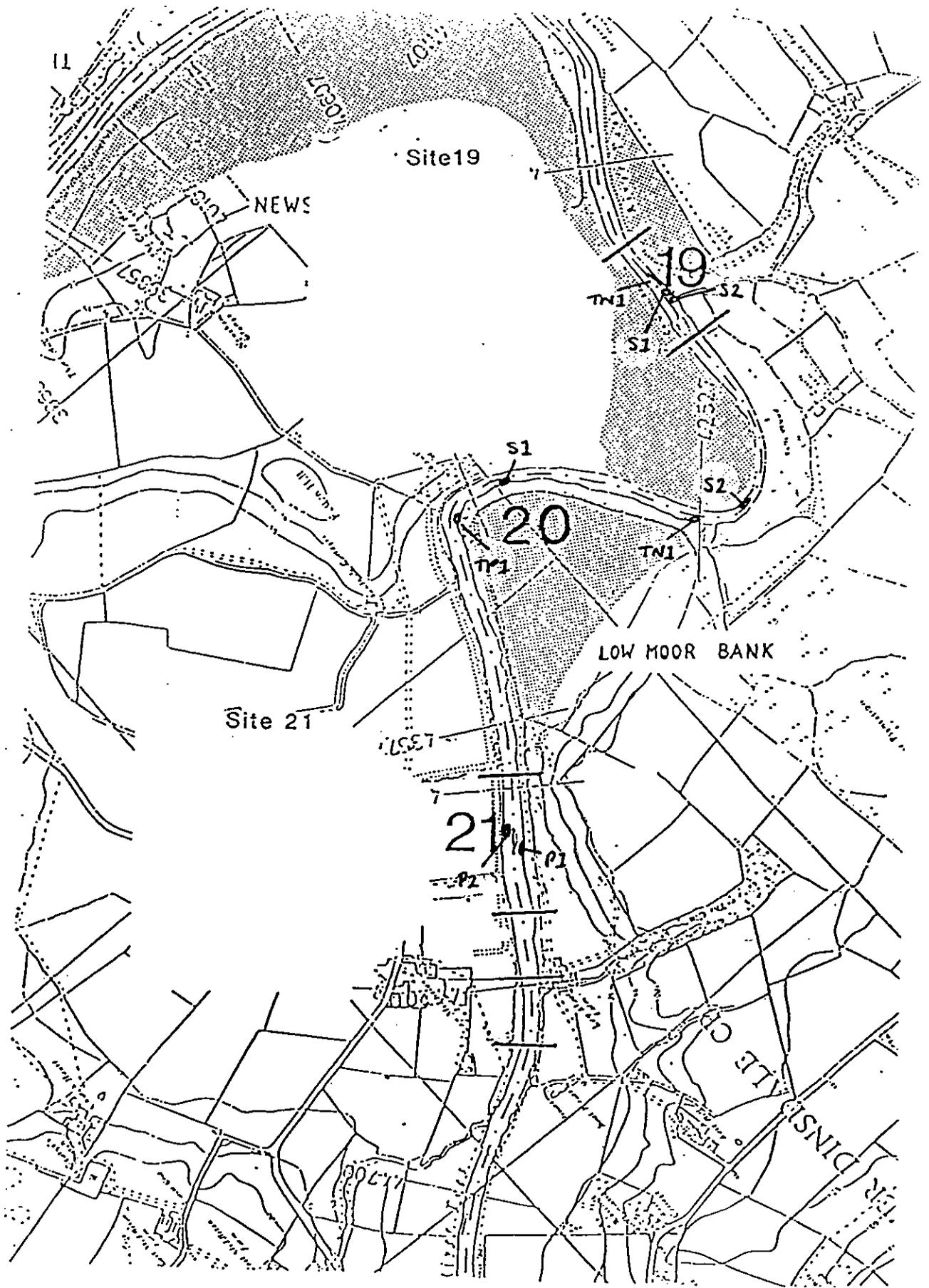
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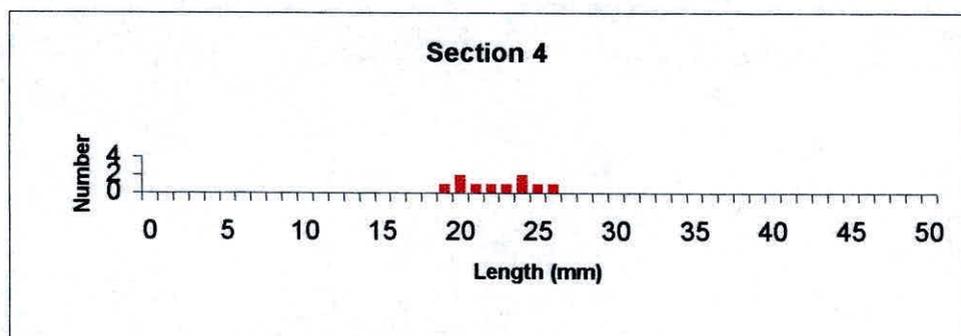
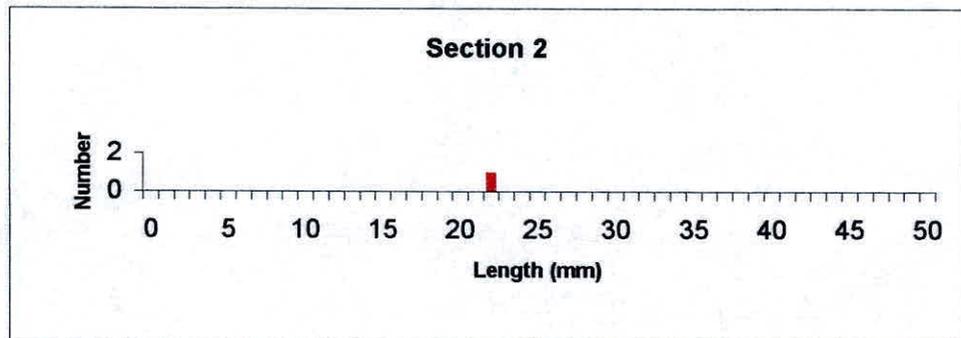
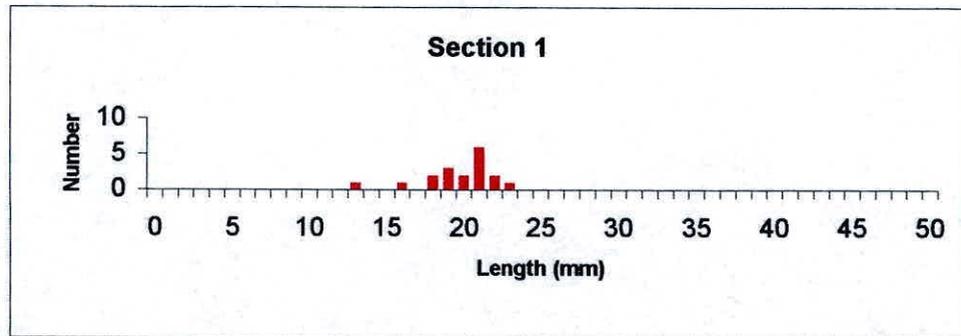
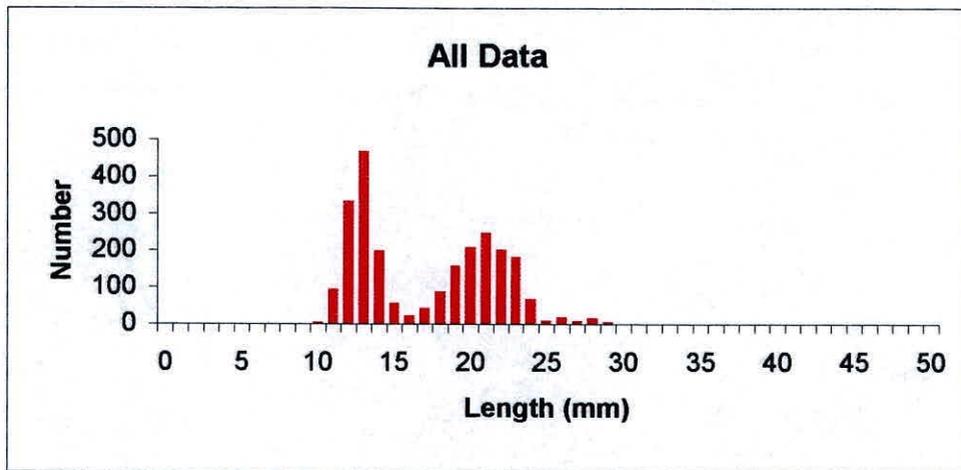




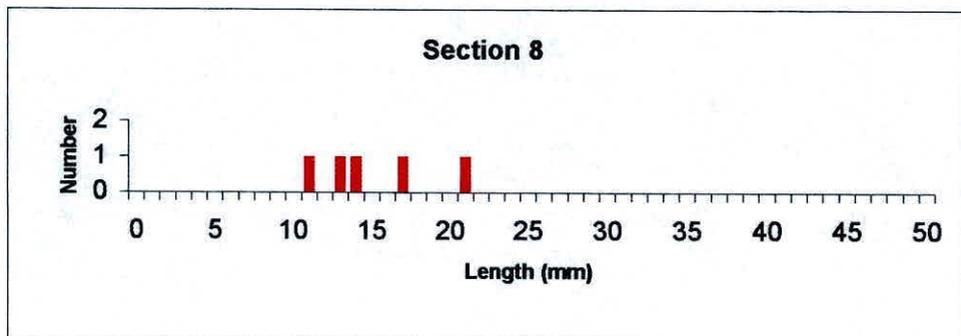
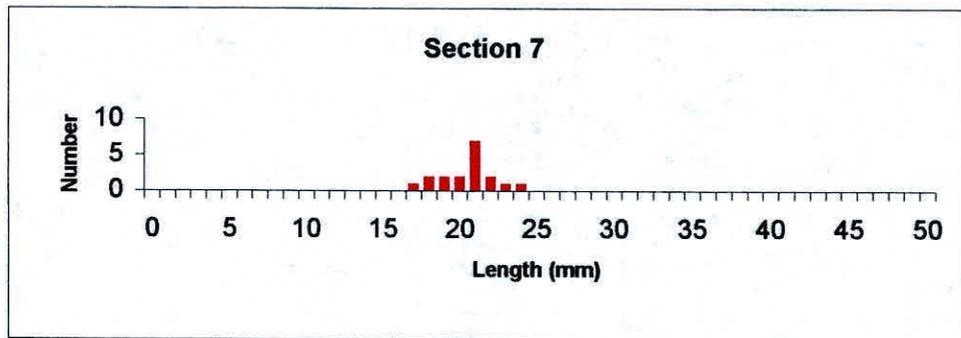
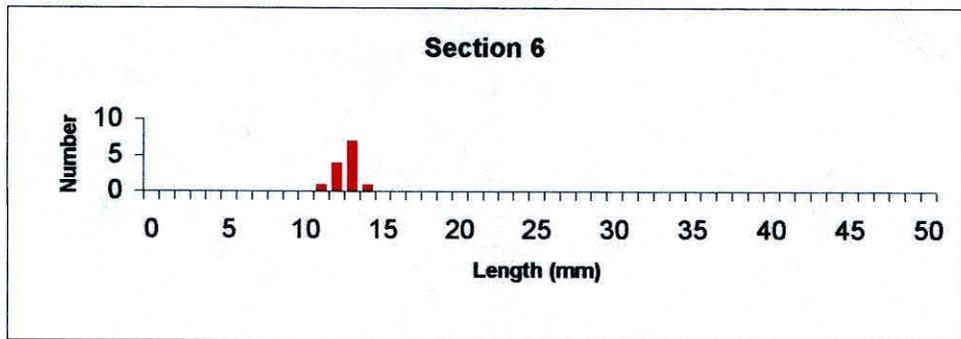
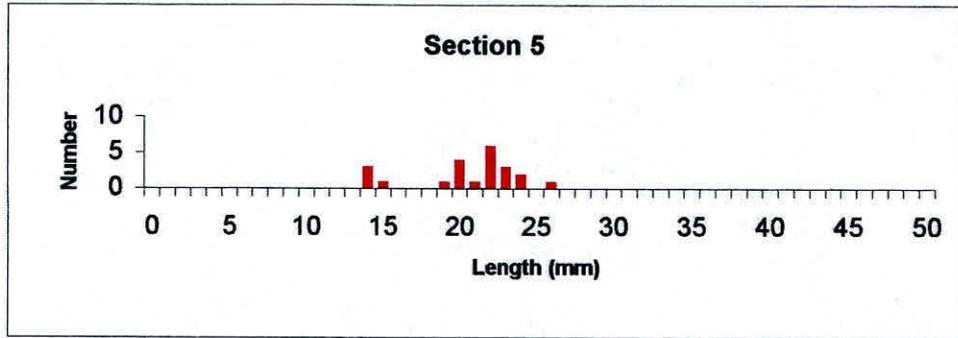




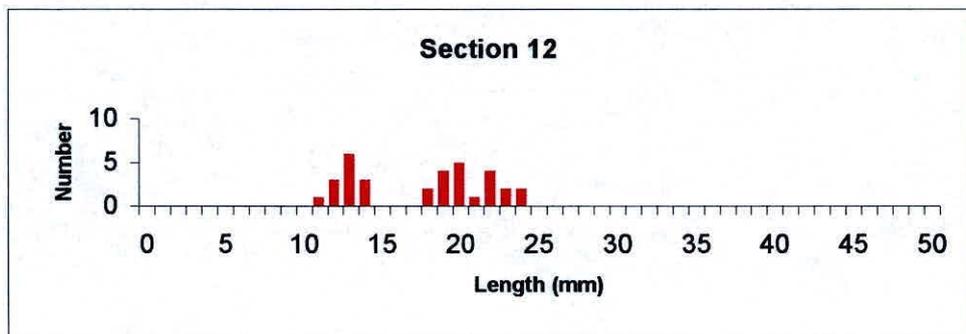
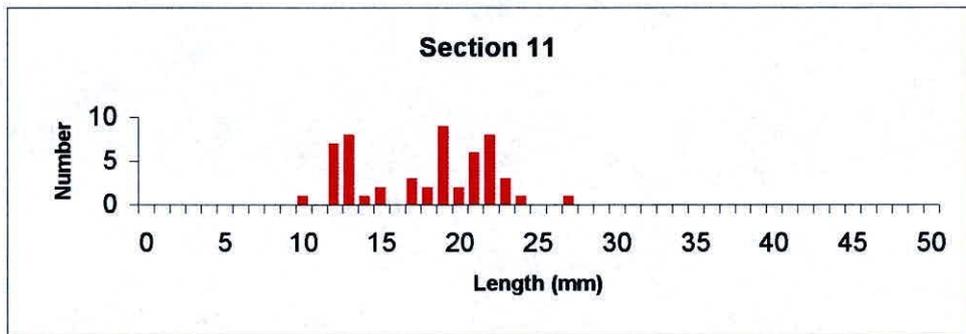
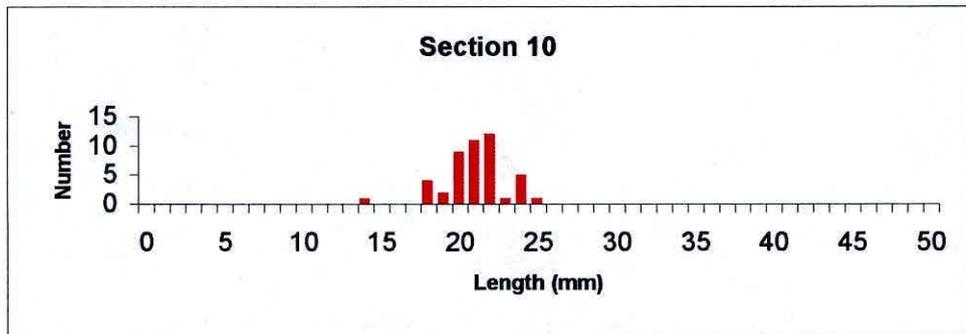
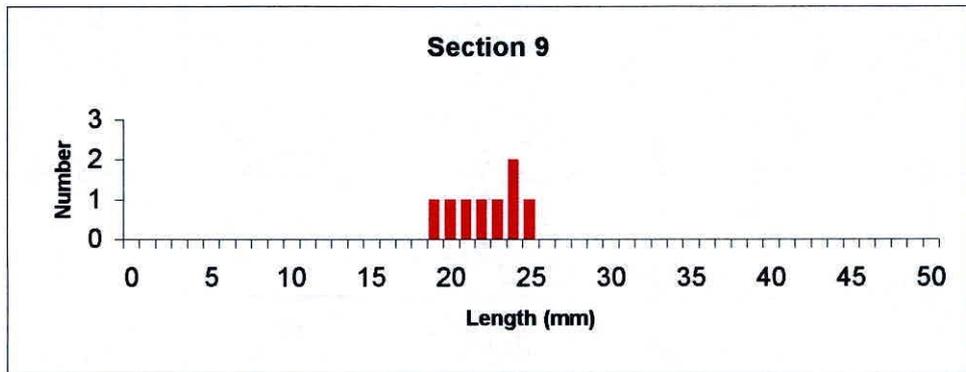
Appendix 2 Length frequency distribution of dace fry in each section of the R.Tees in June 1997



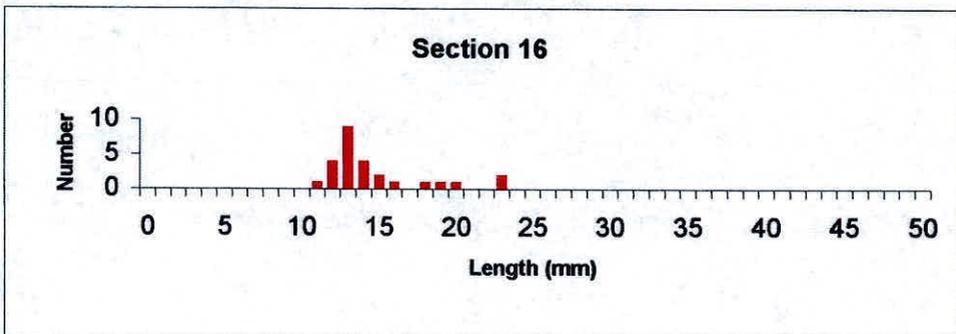
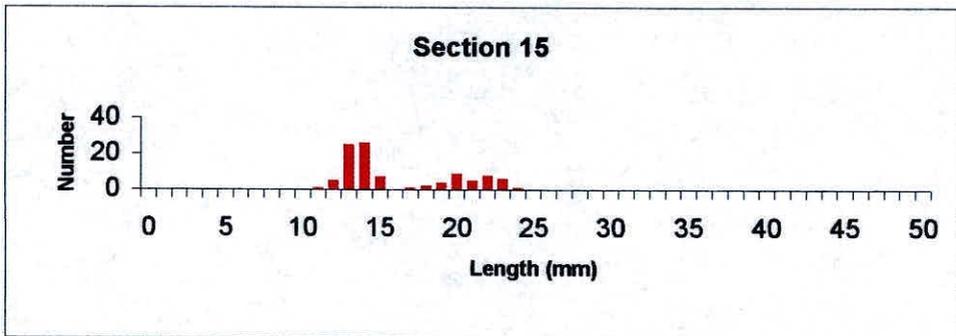
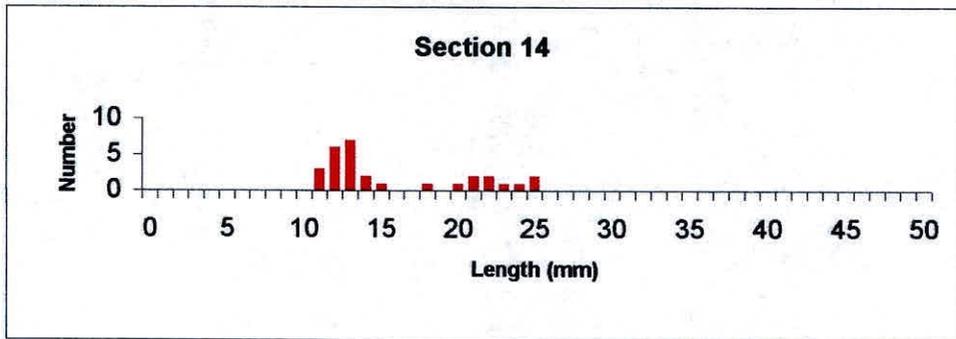
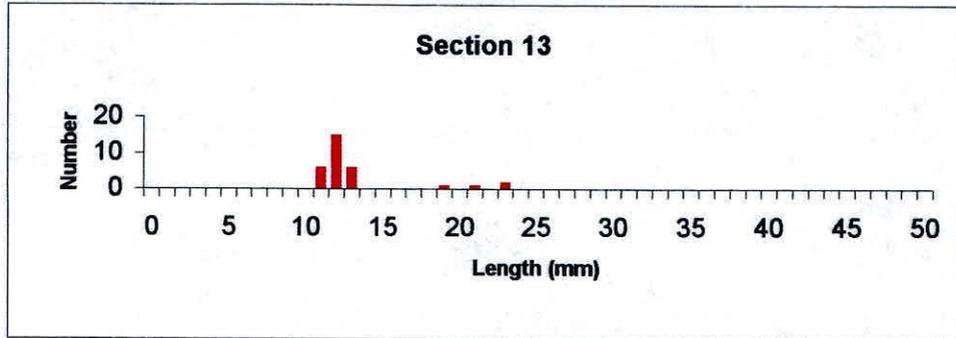
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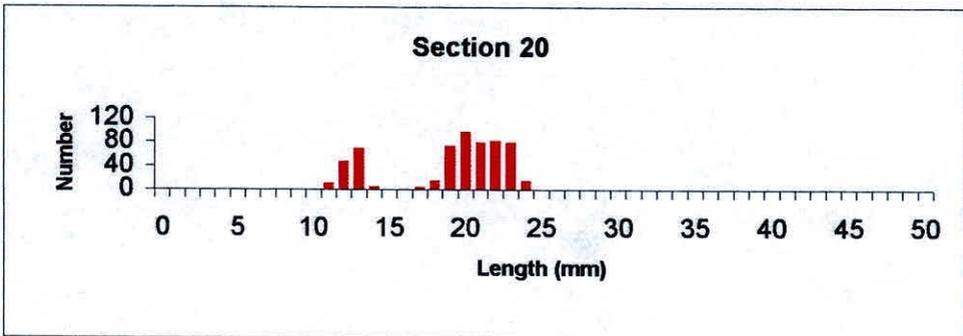
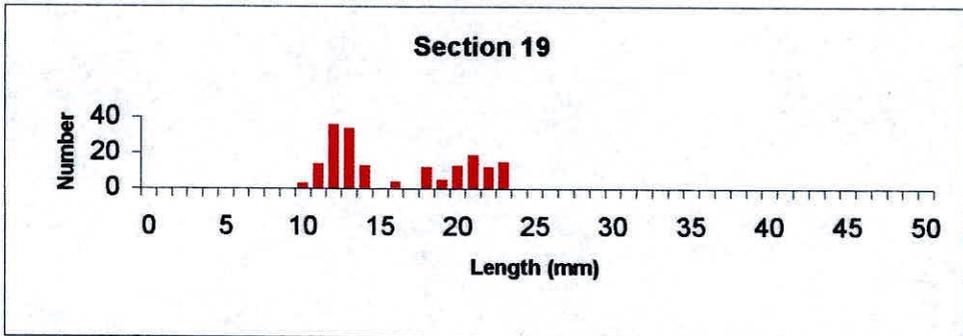
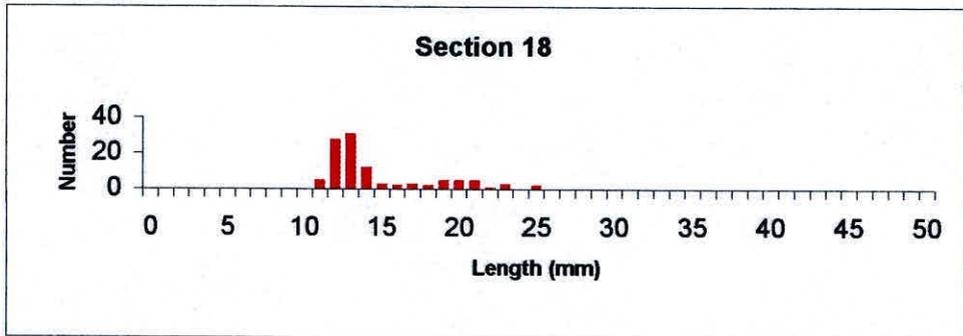
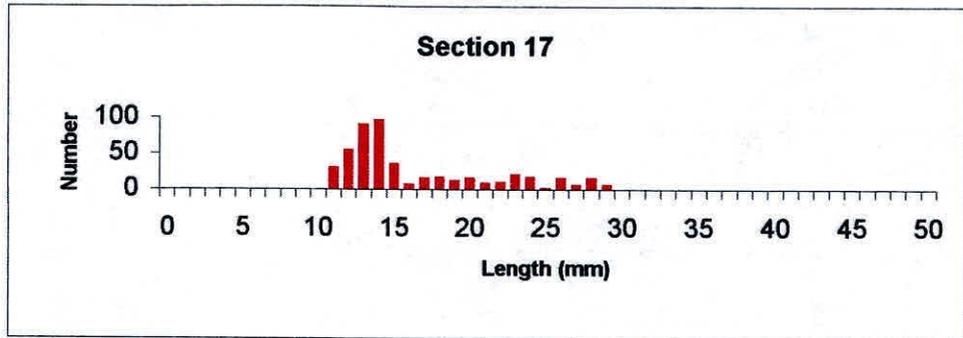
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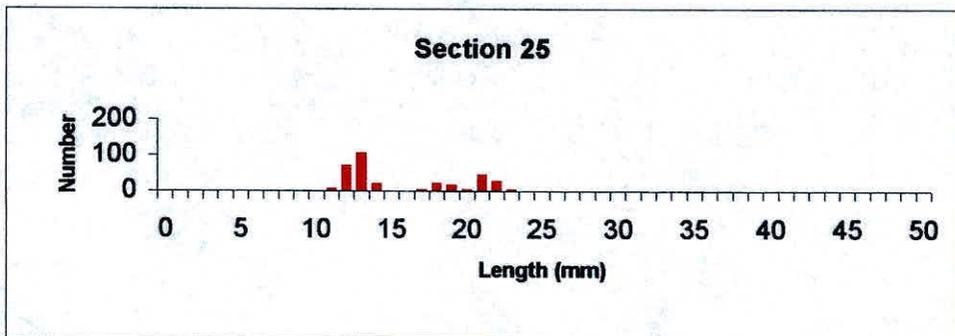
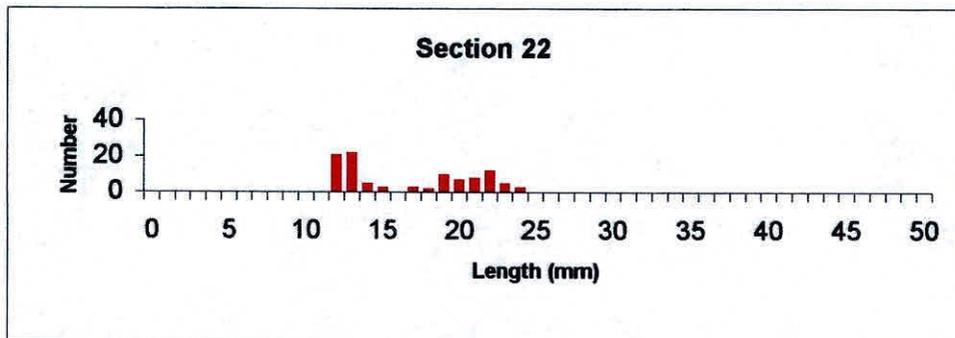
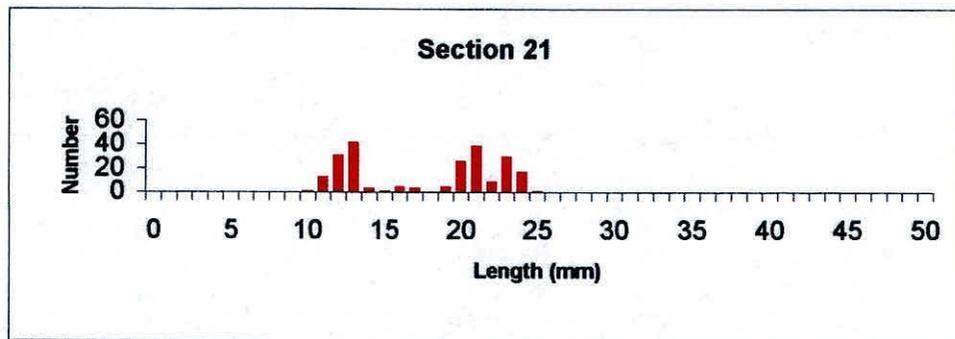
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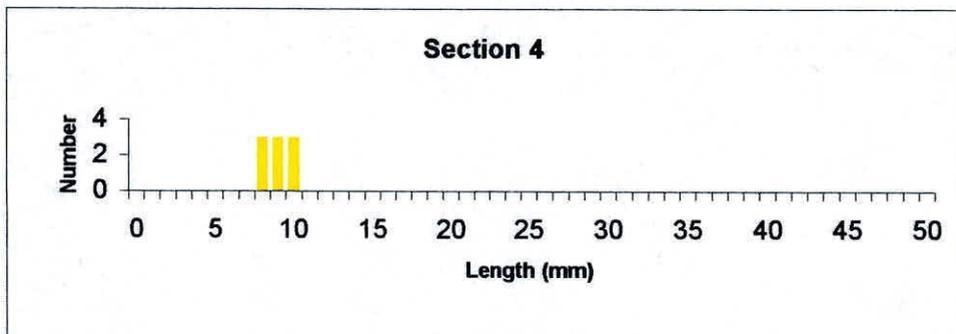
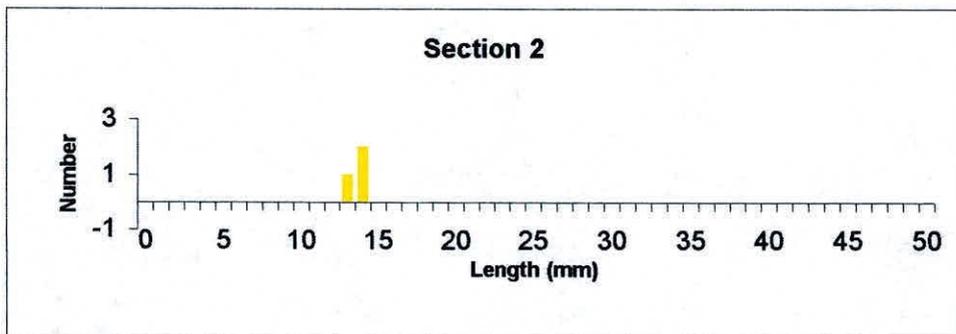
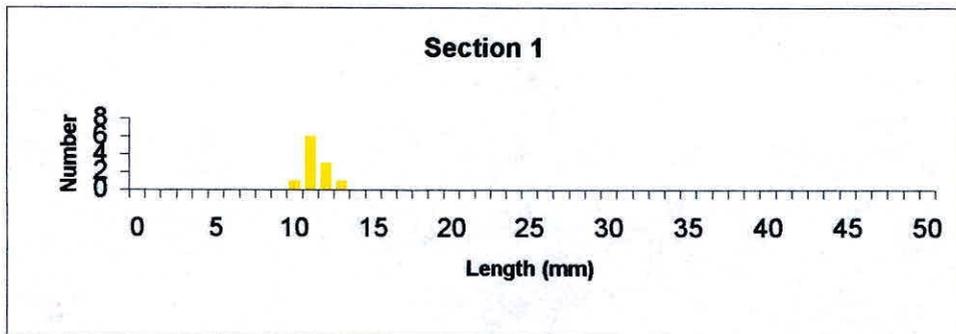
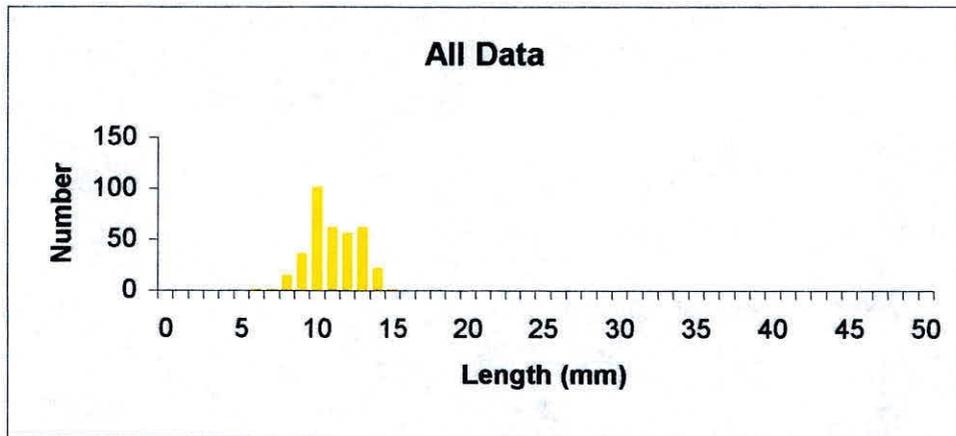
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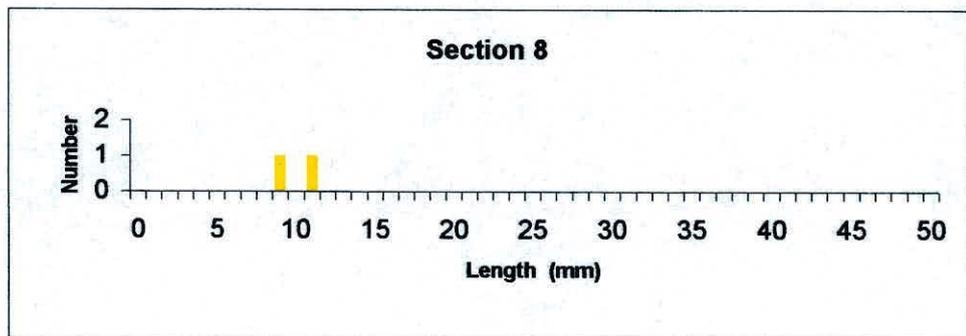
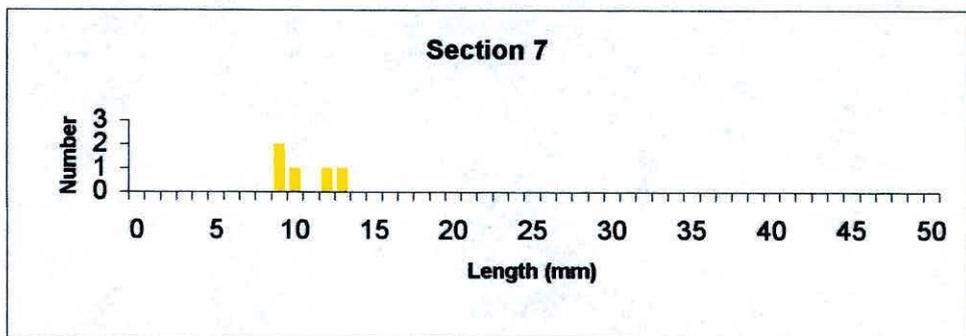
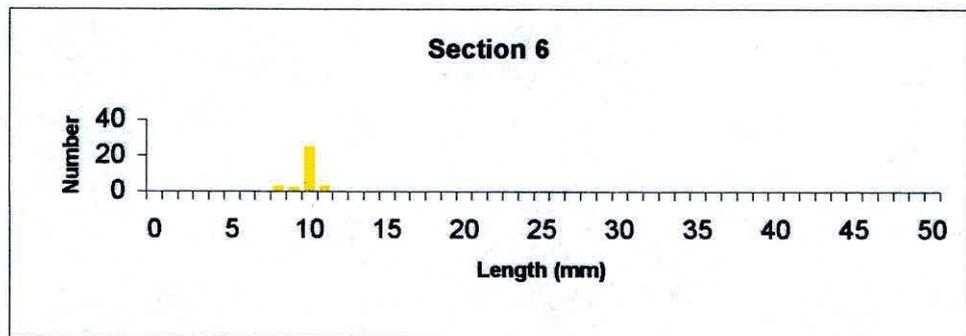
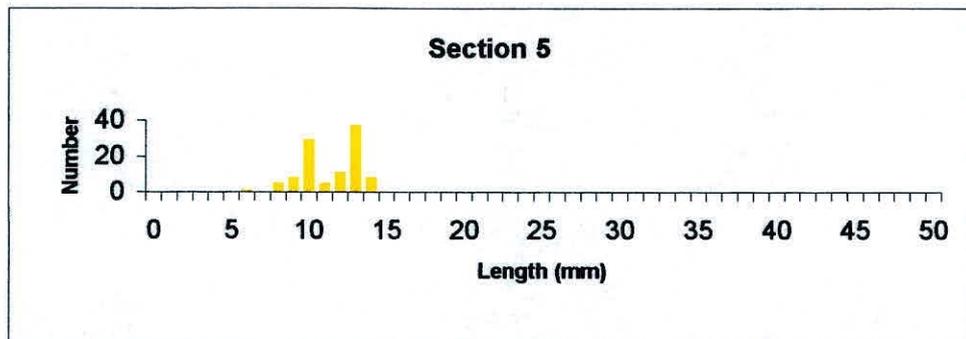
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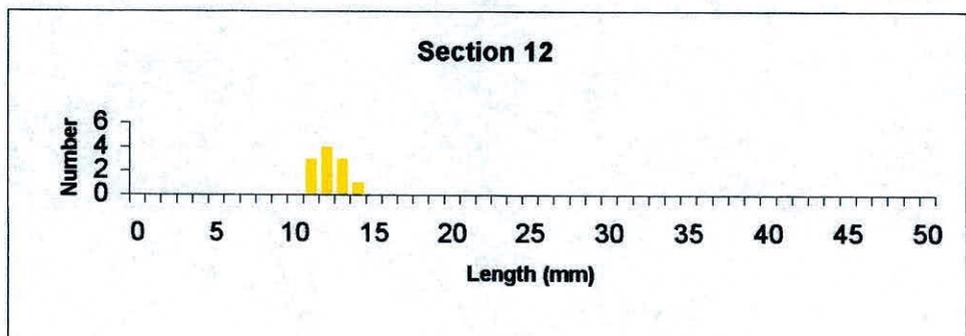
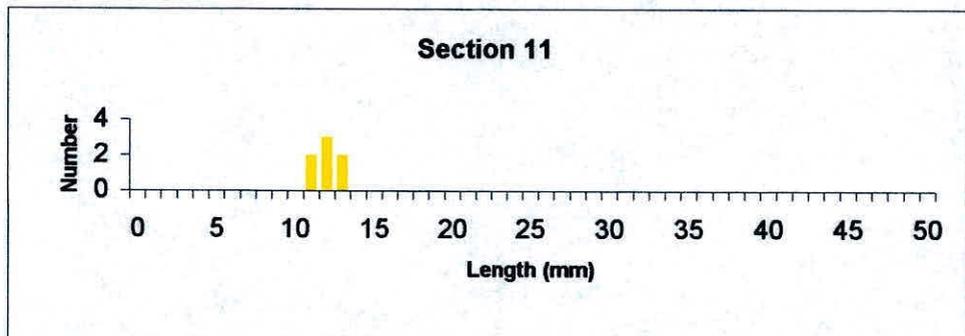
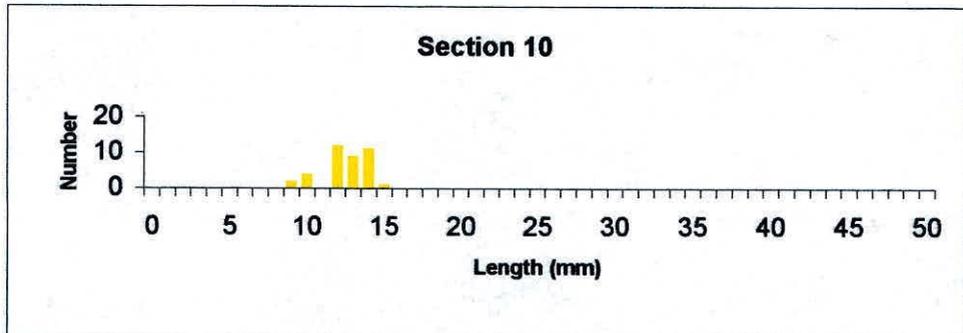
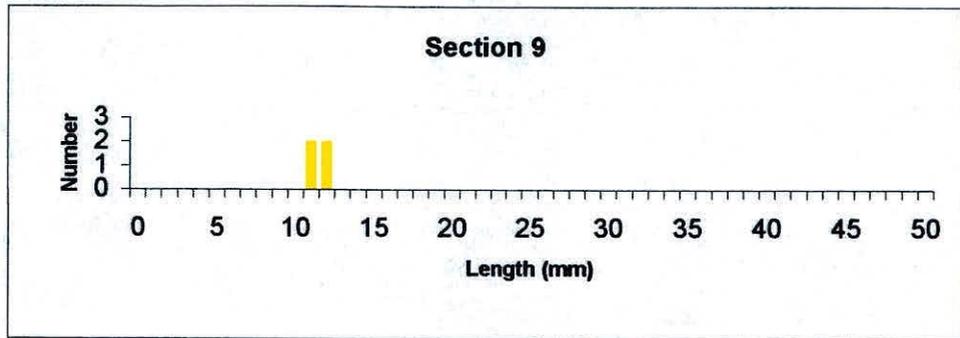
Appendix 3 Length frequency distribution of roach fry in each section of the R. Tees in June 1997



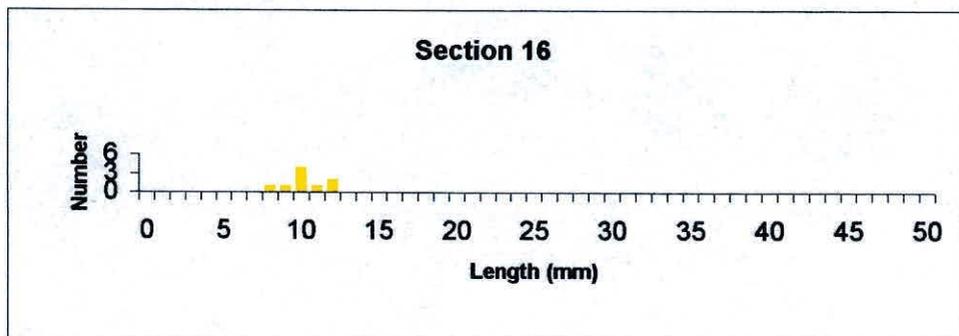
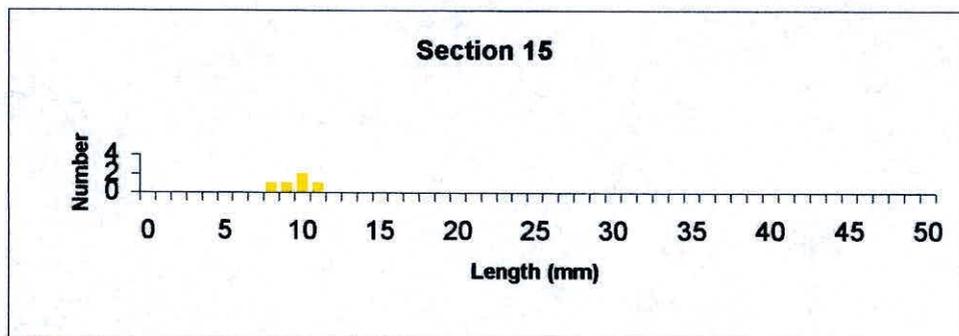
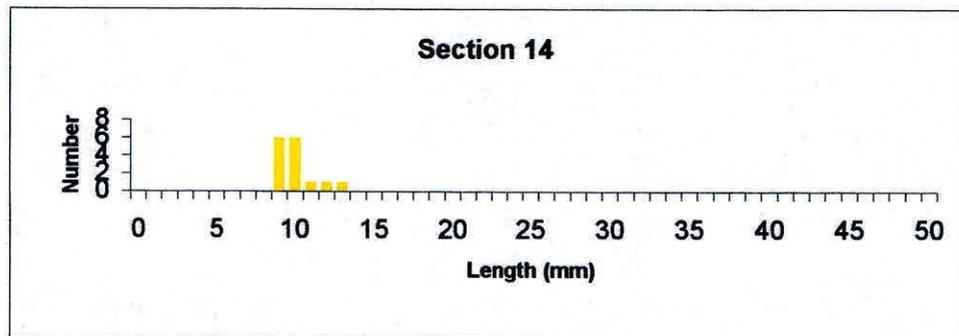
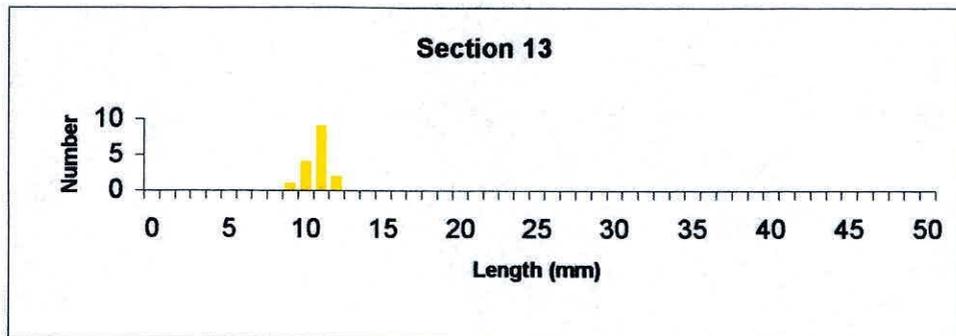
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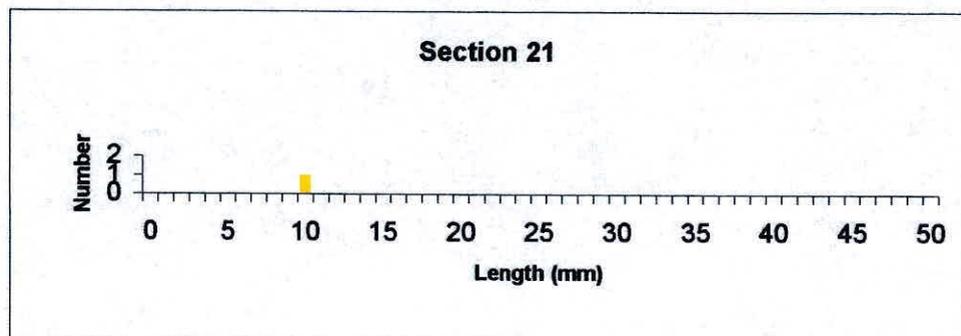
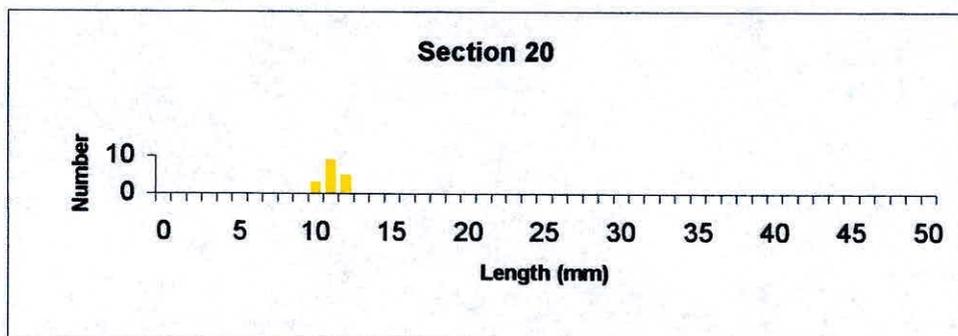
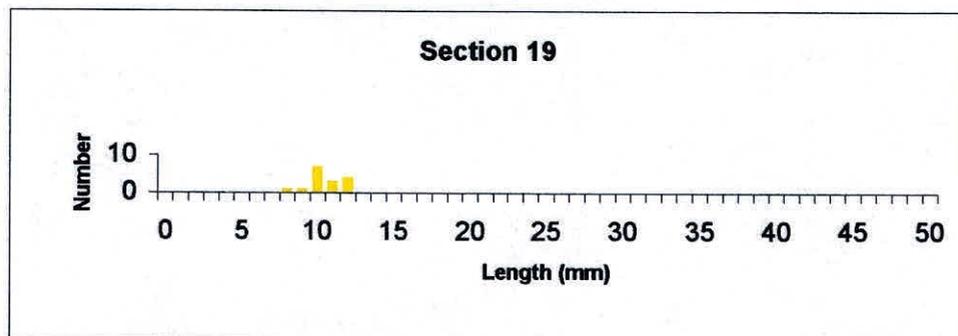
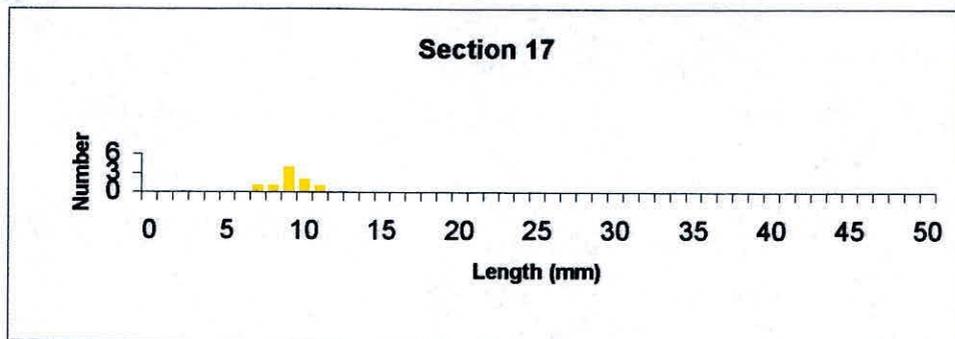
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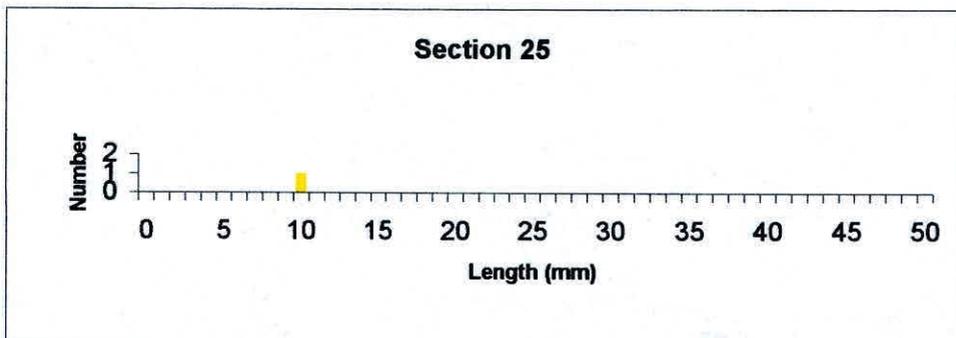
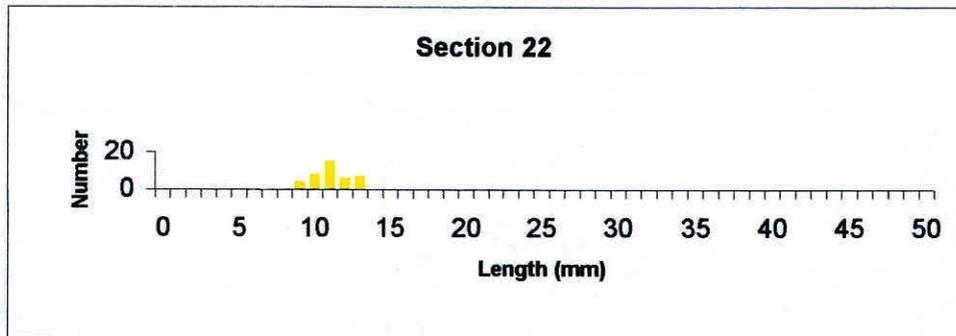
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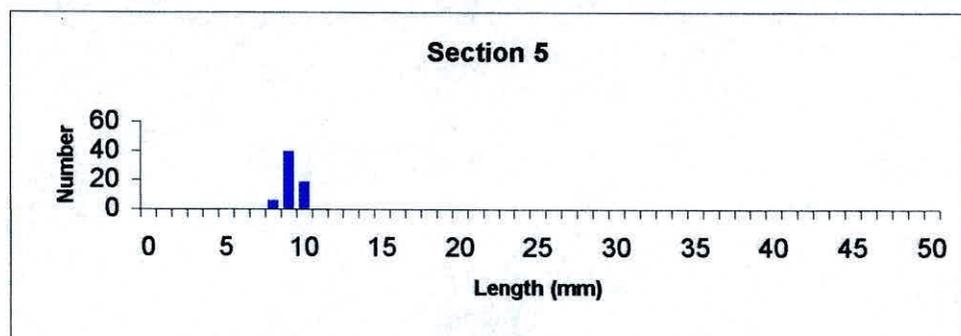
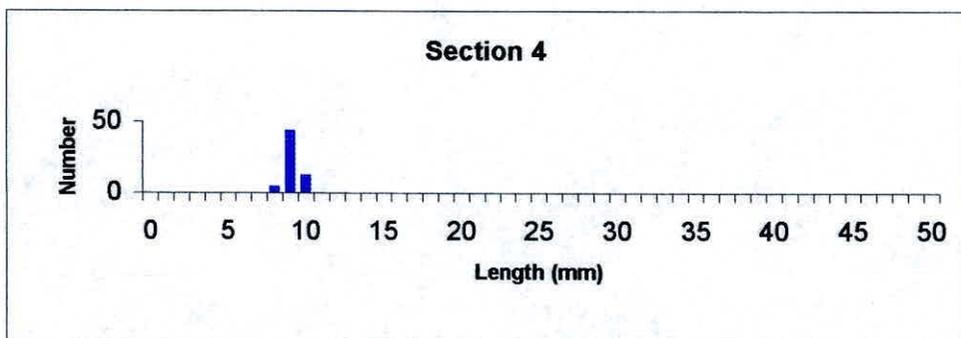
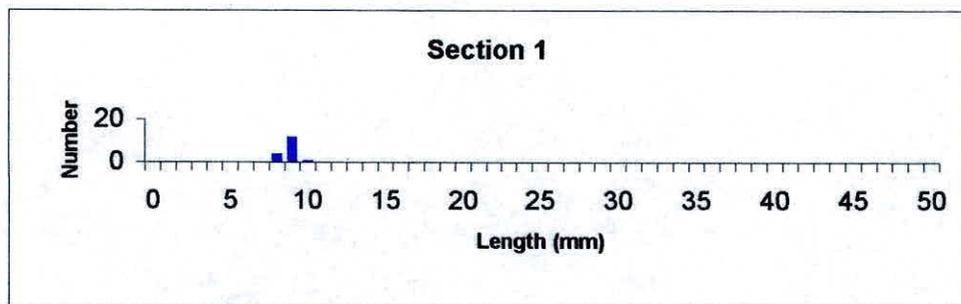
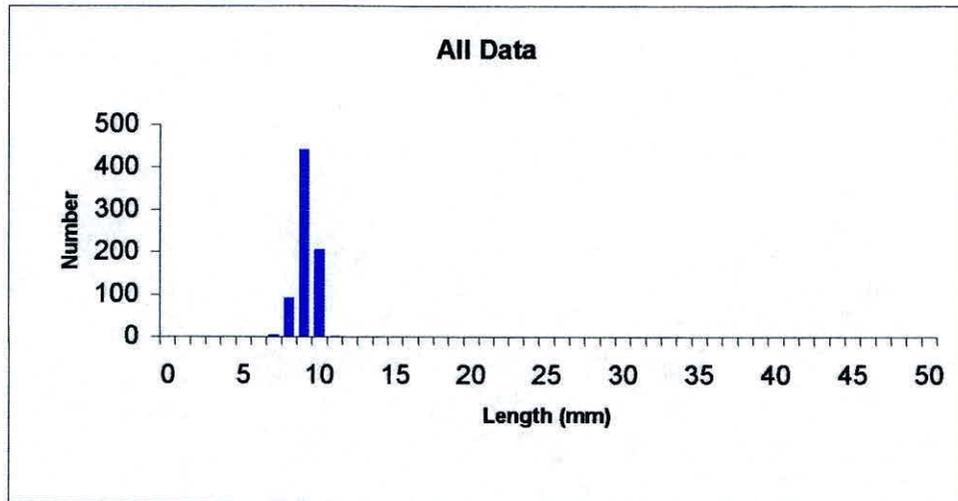
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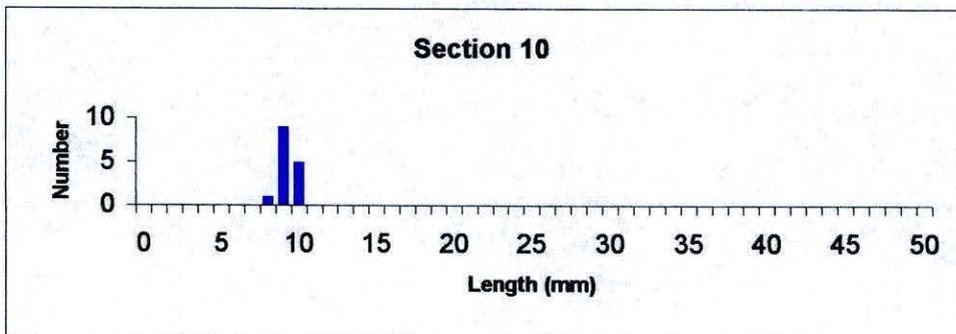
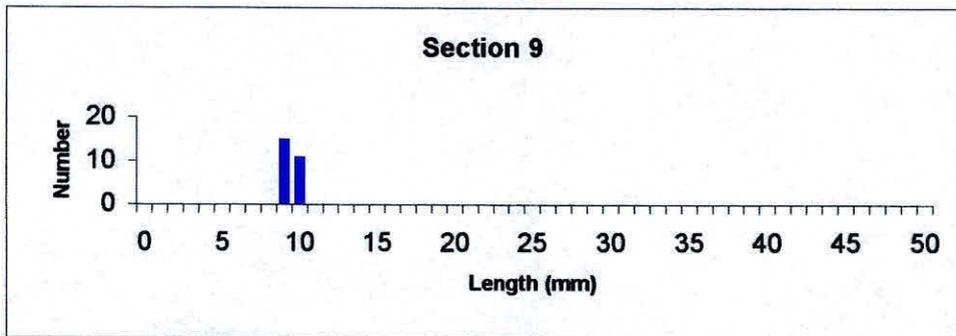
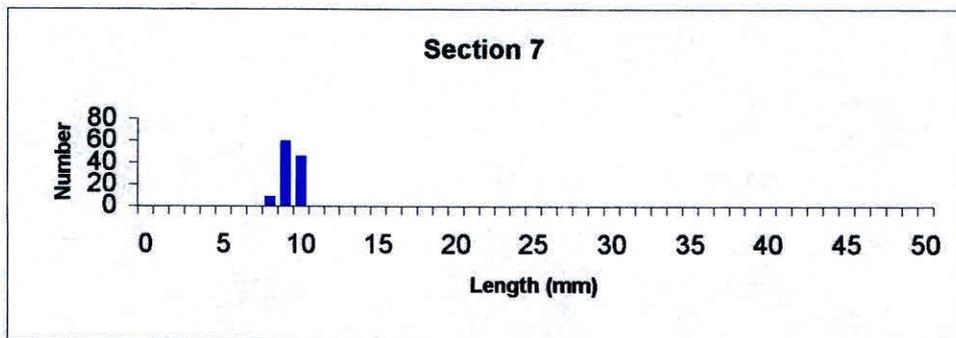
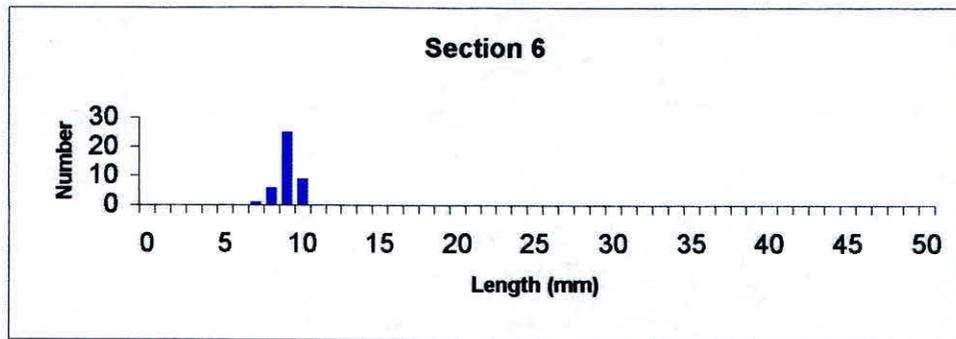
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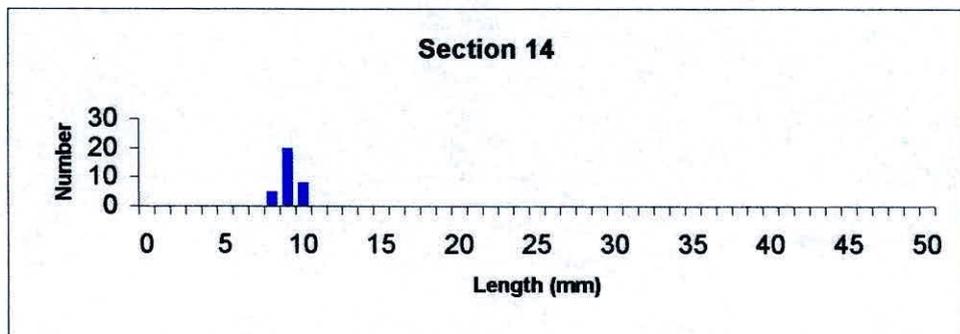
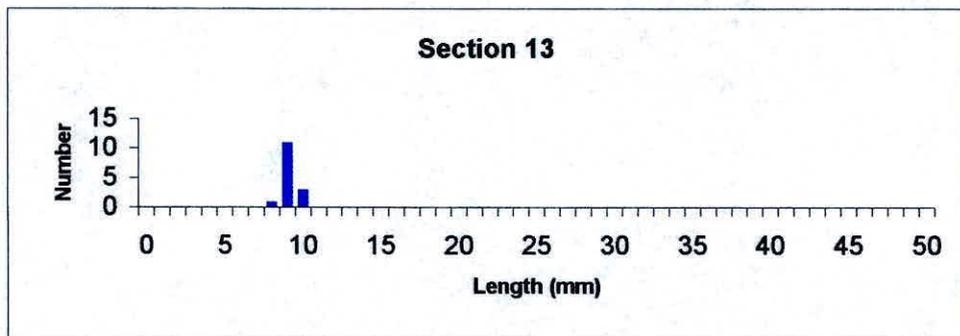
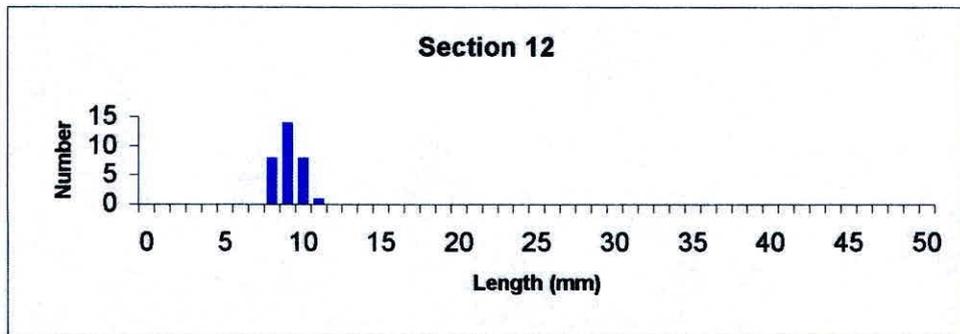
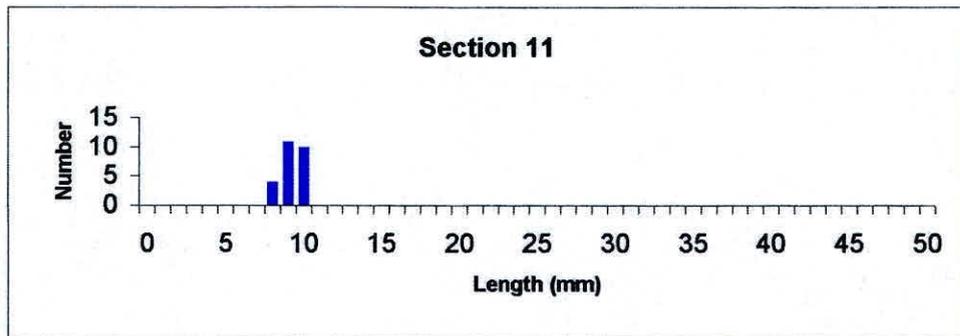
Appendix 4 Length frequency distribution of chub fry in each section of the R. Tees in June 1997



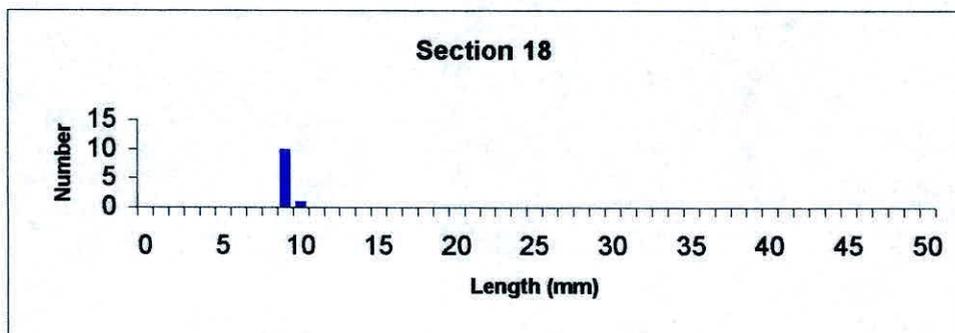
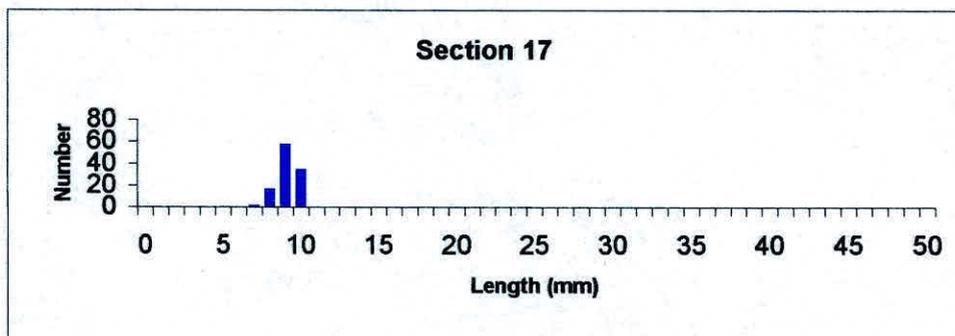
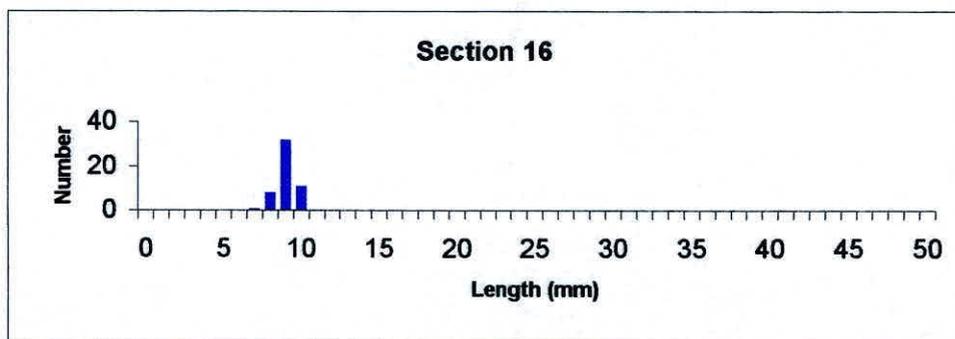
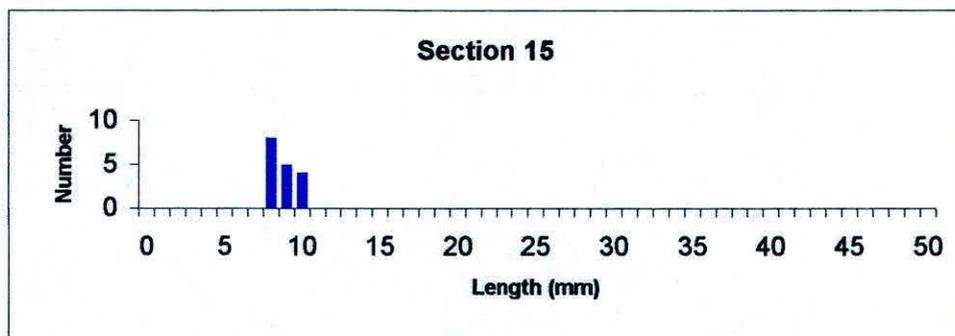
Appendix 4



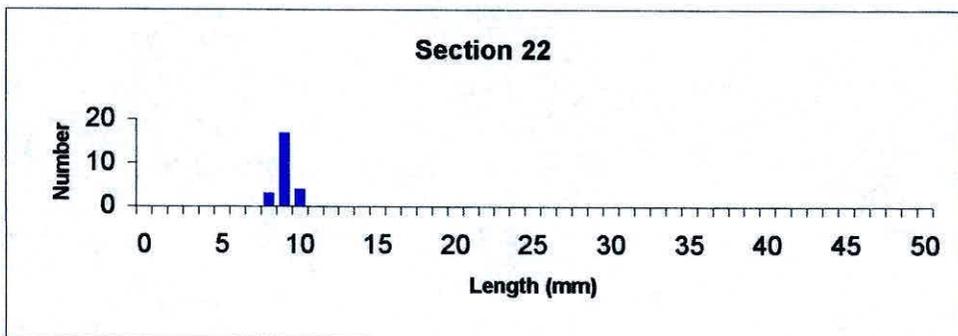
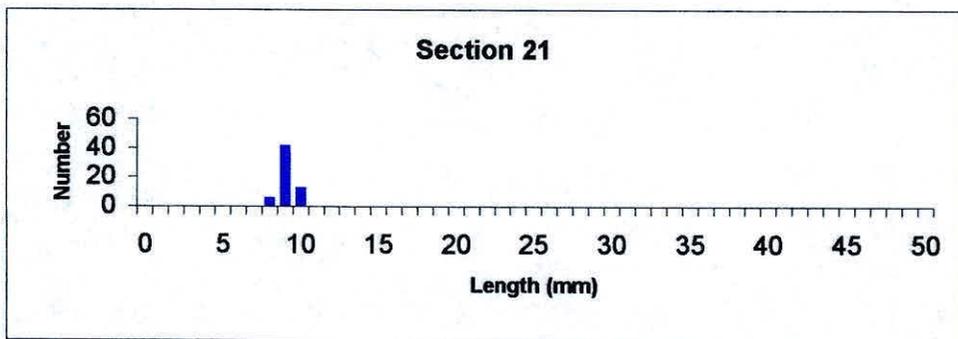
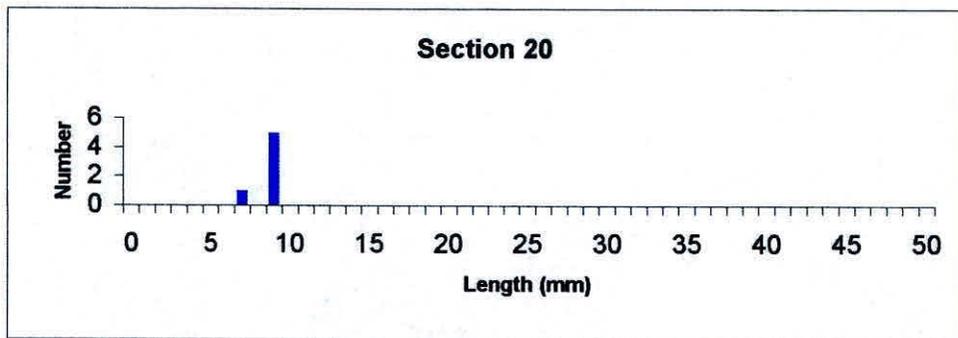
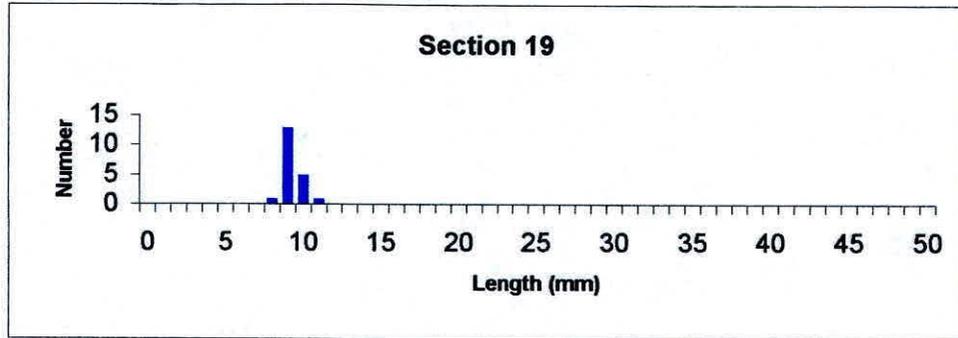
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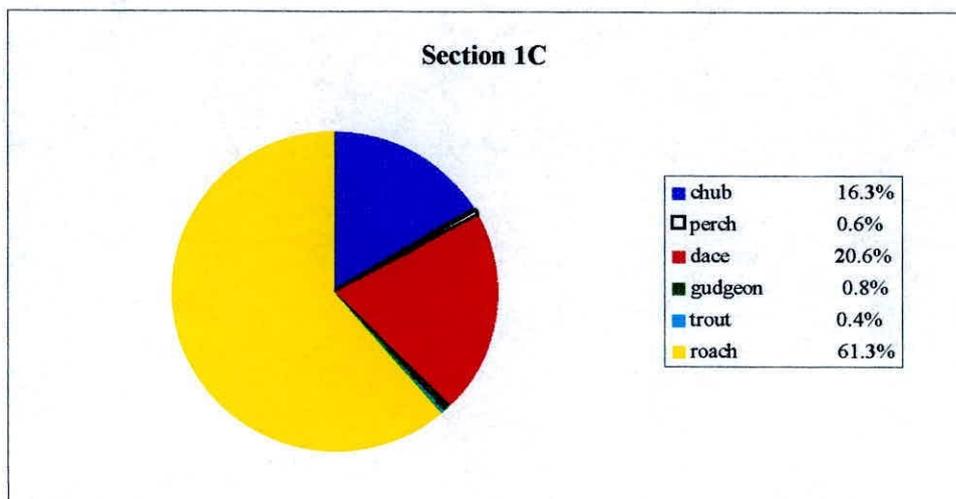
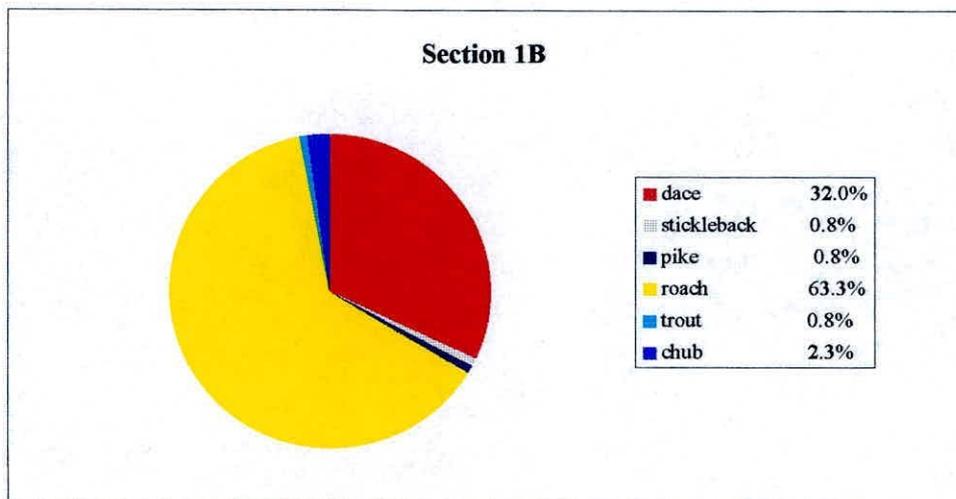
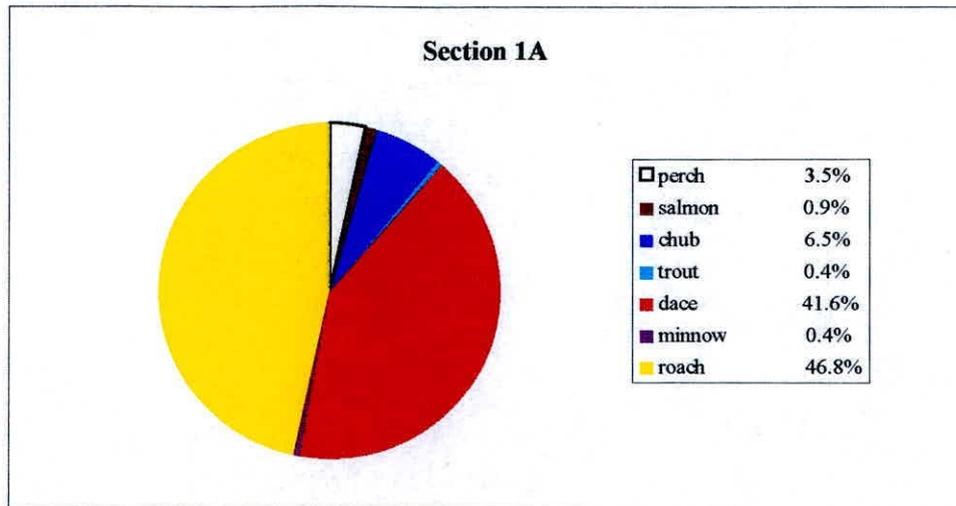
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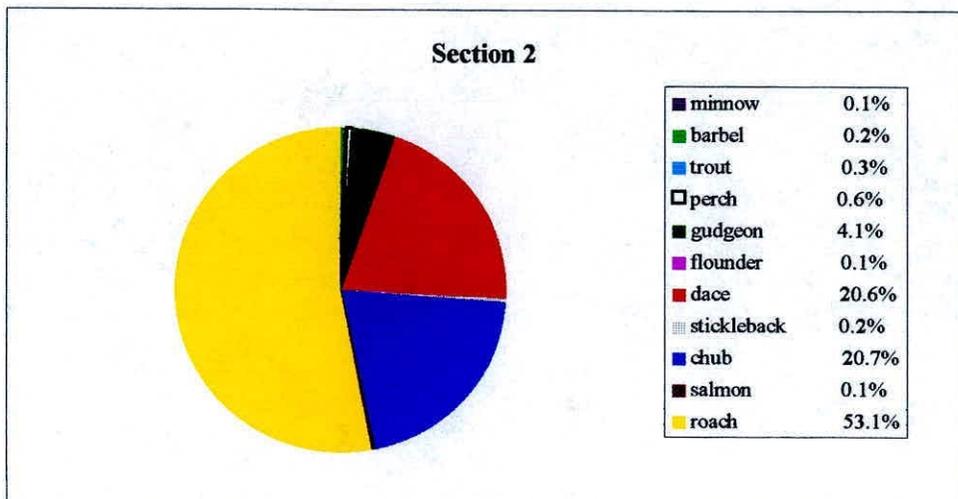
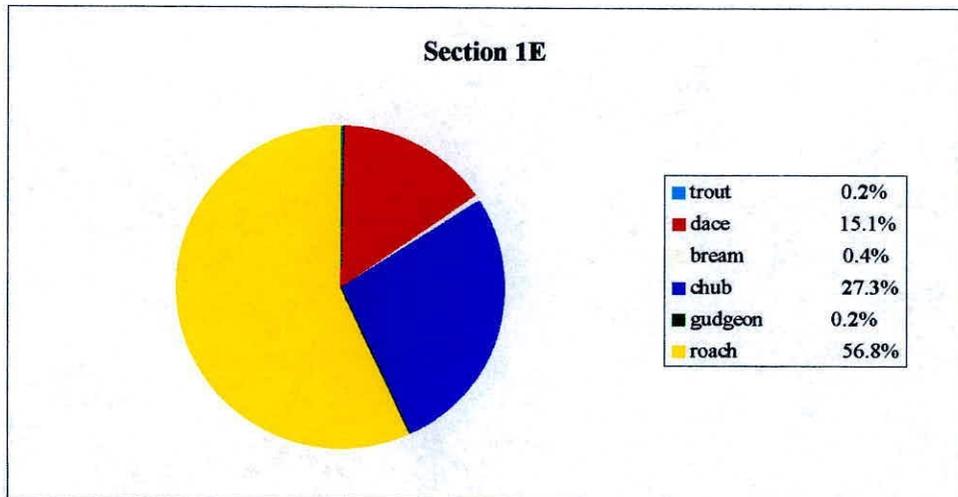
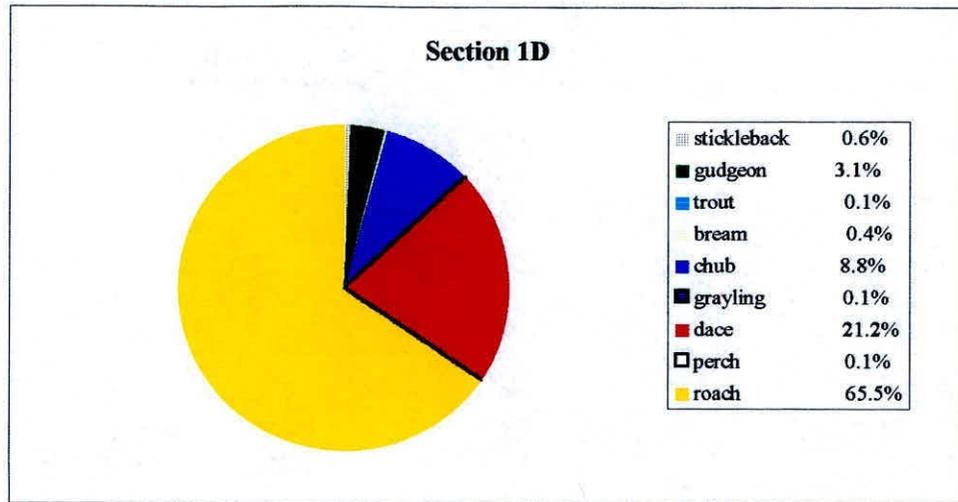
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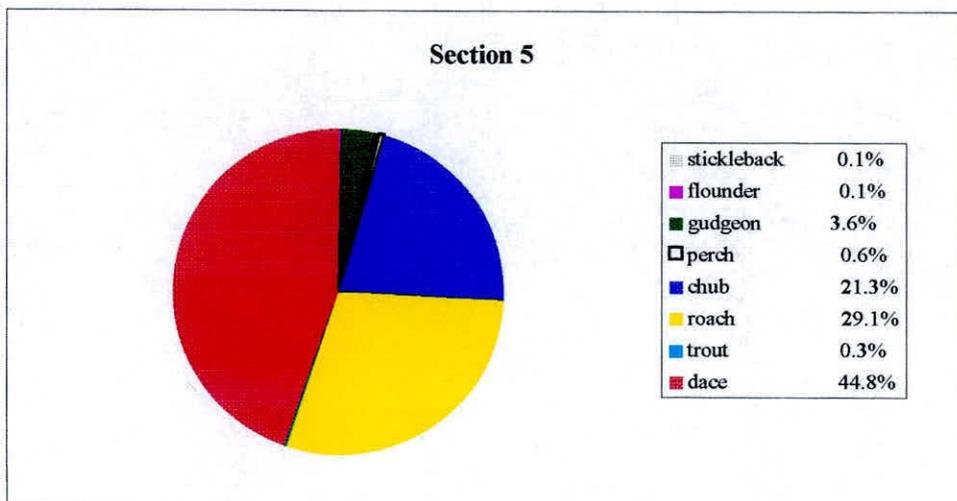
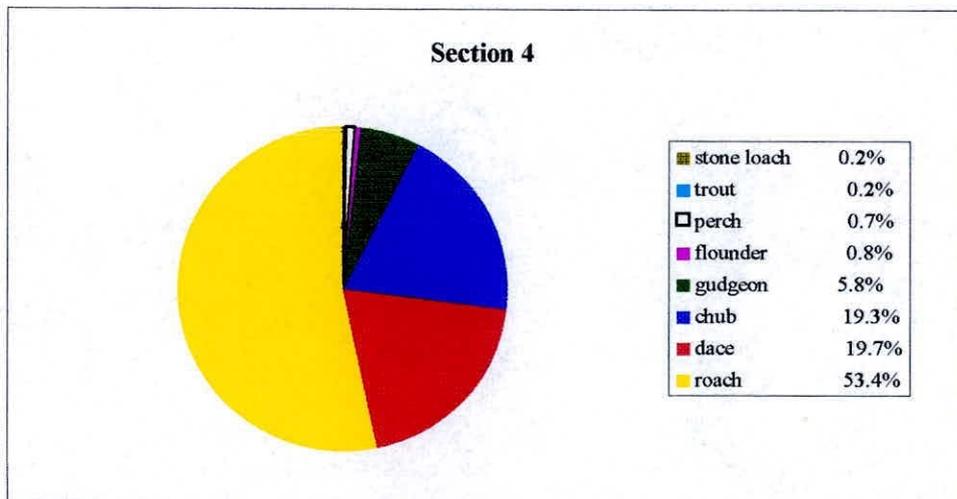
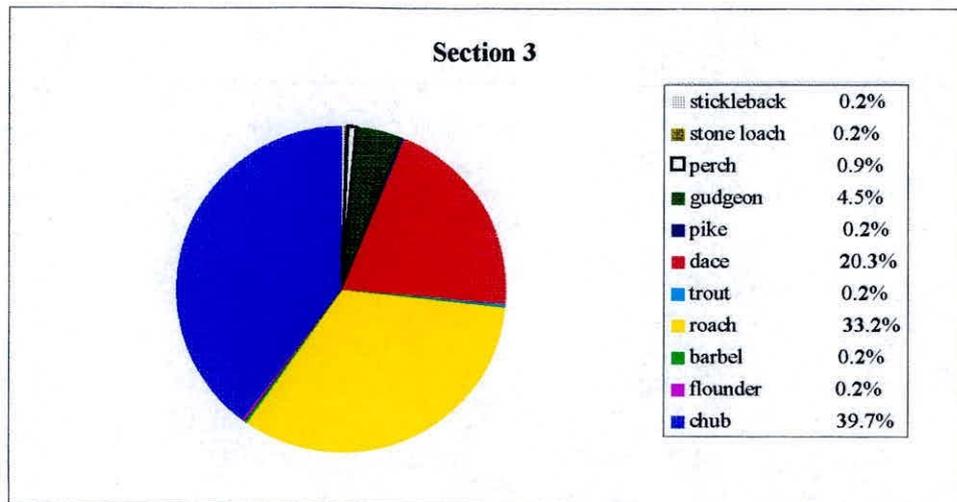
Appendix 5 Species composition of fish in each section in September 1997



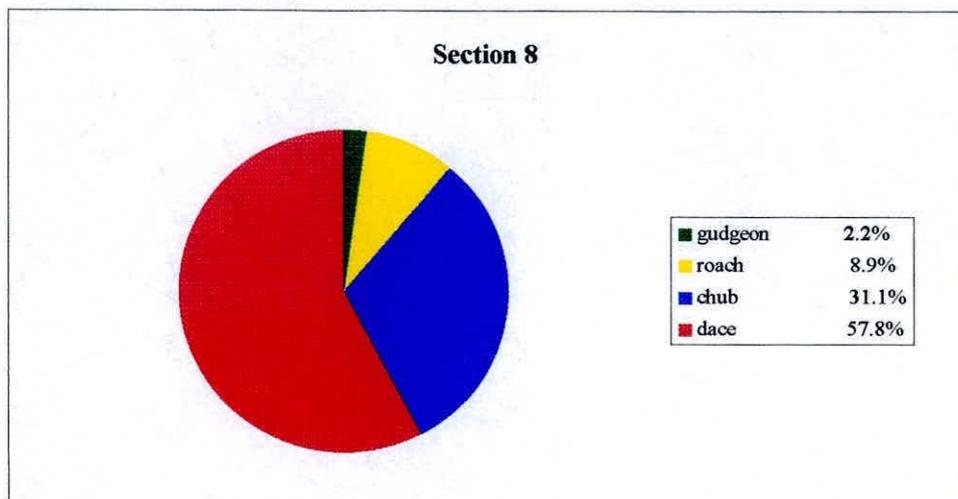
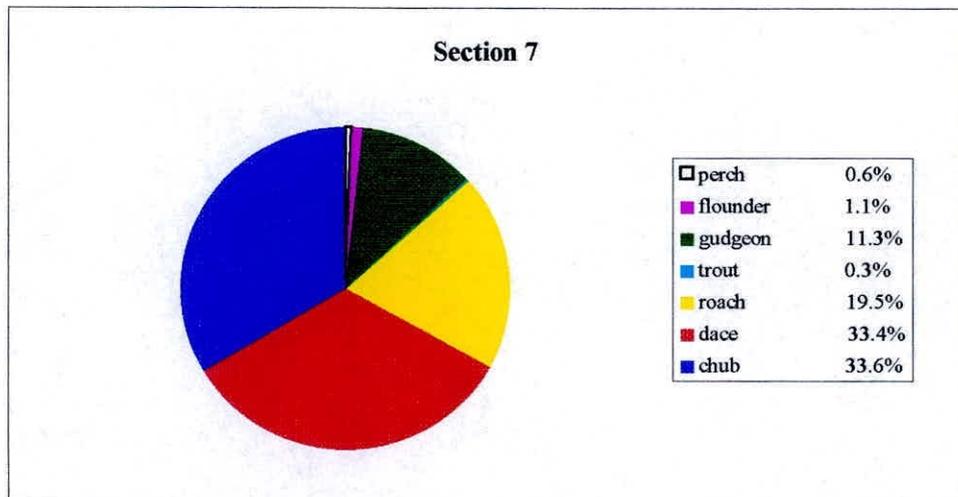
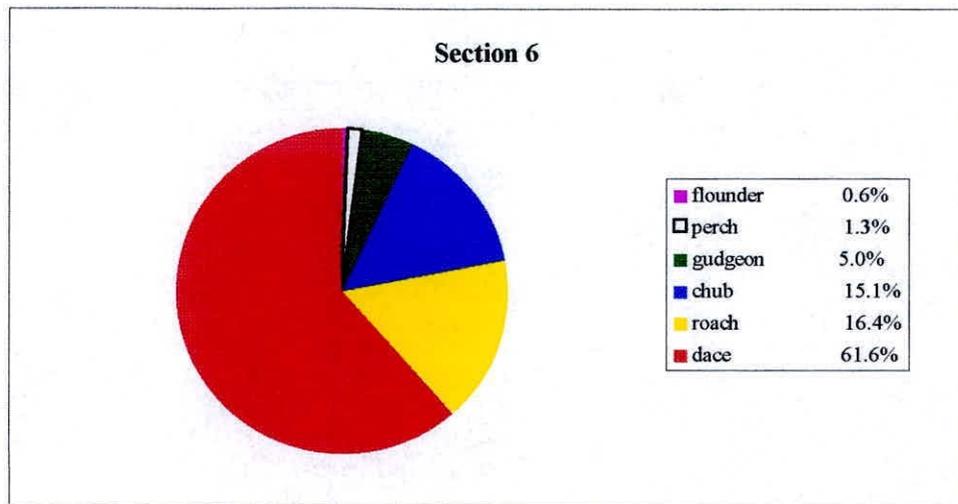
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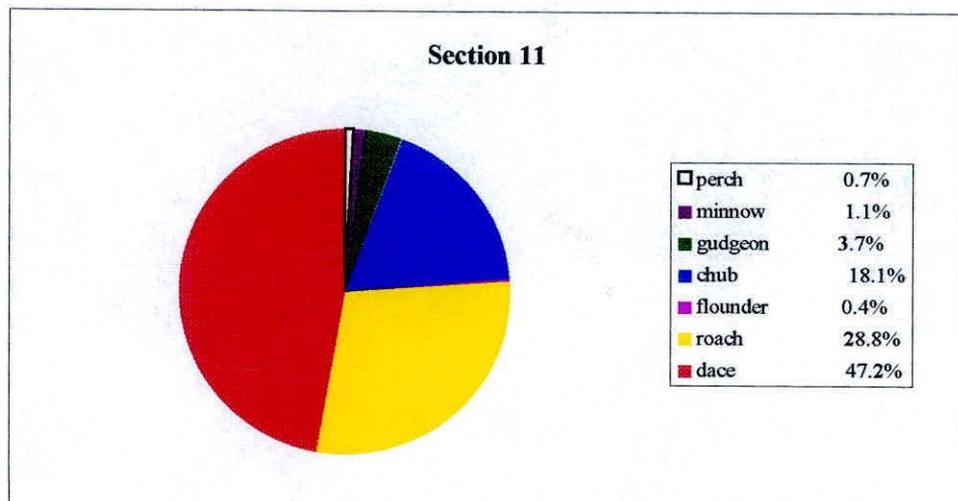
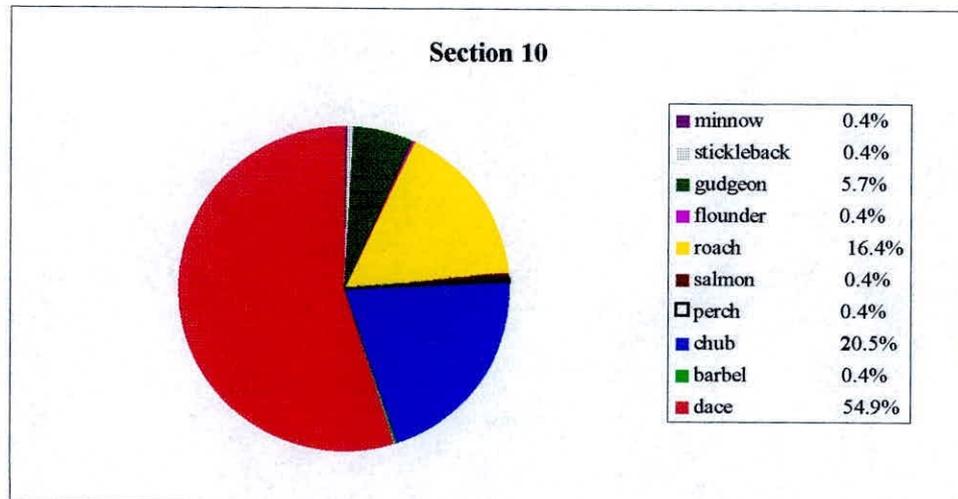
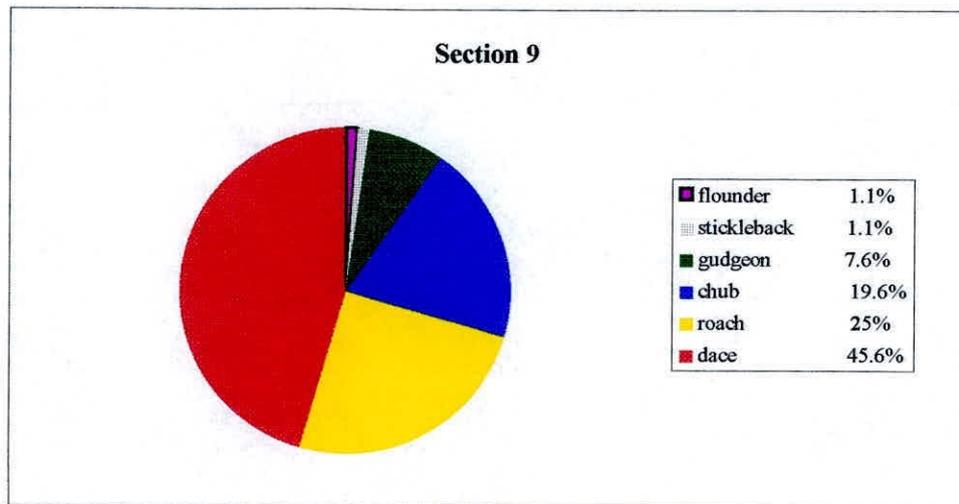
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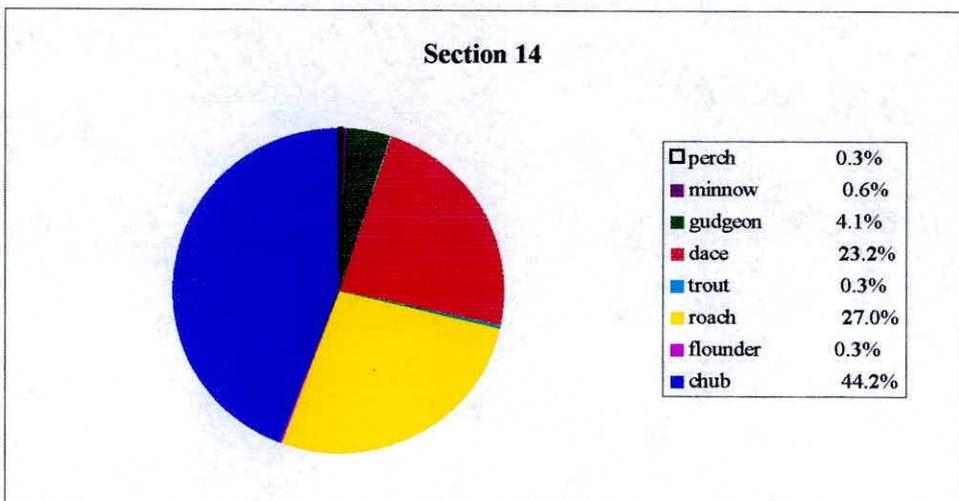
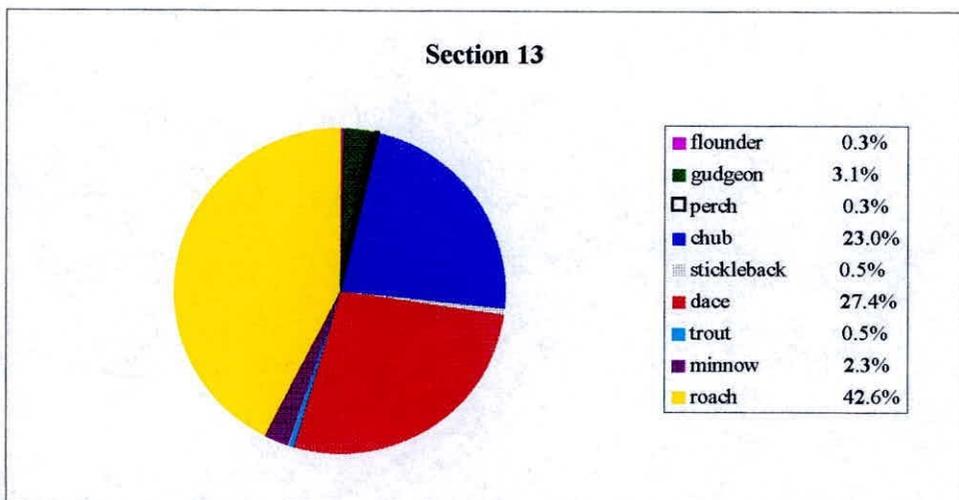
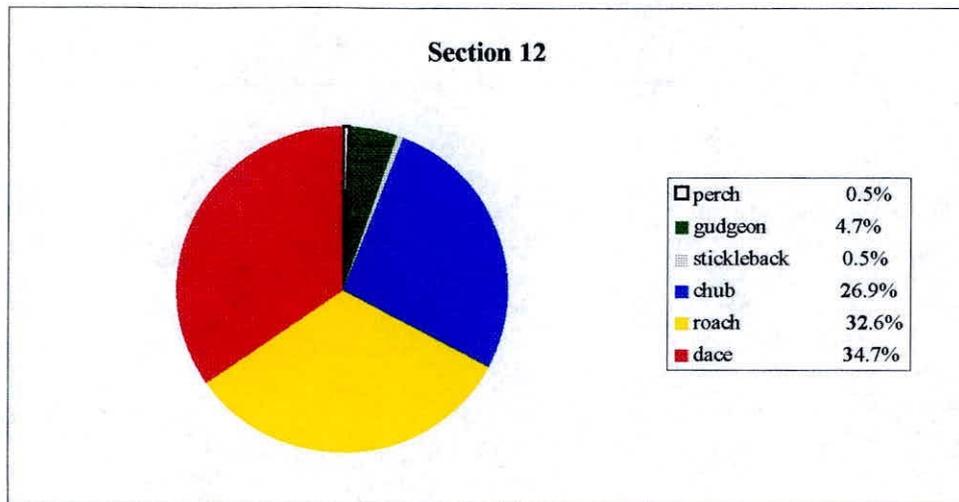
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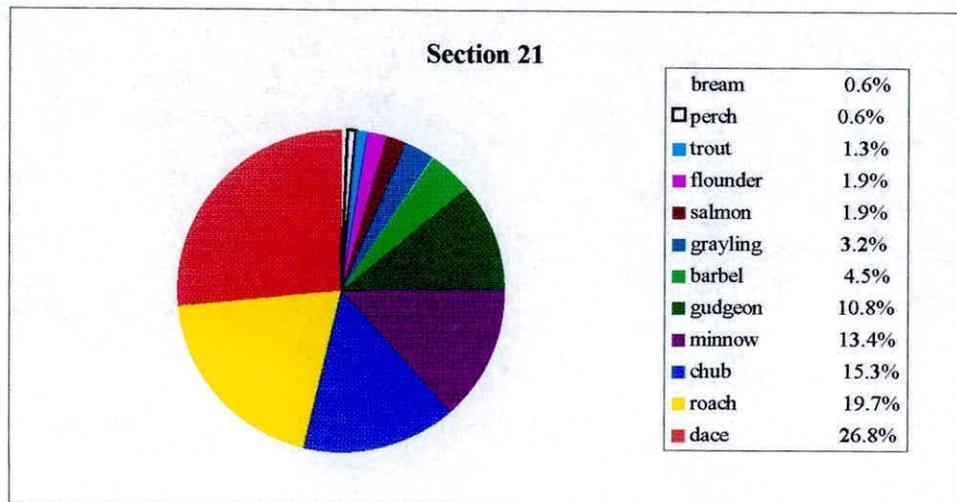
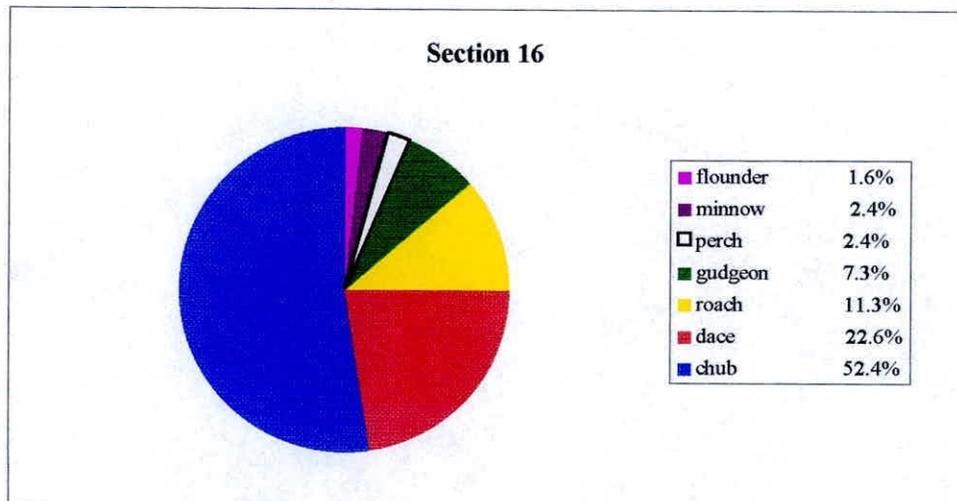
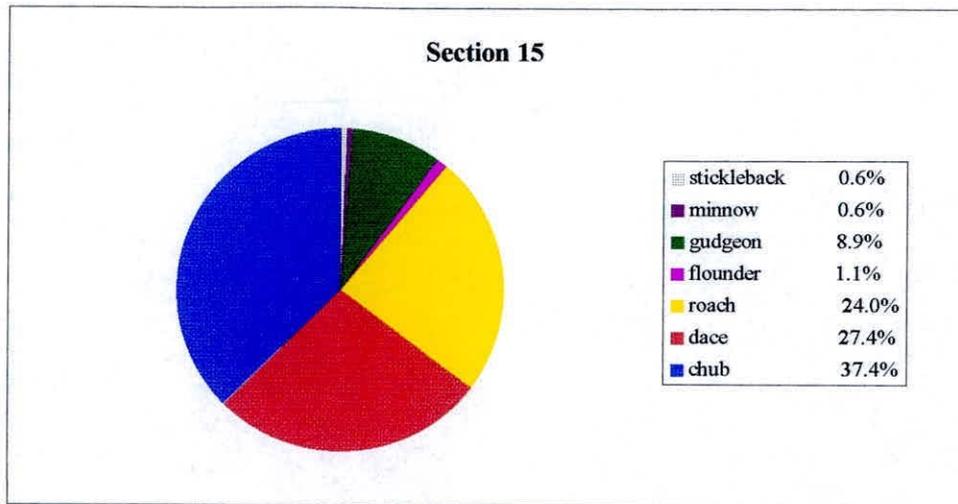
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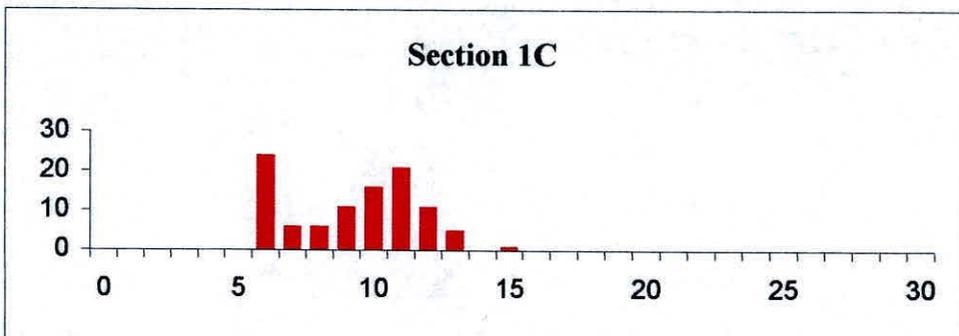
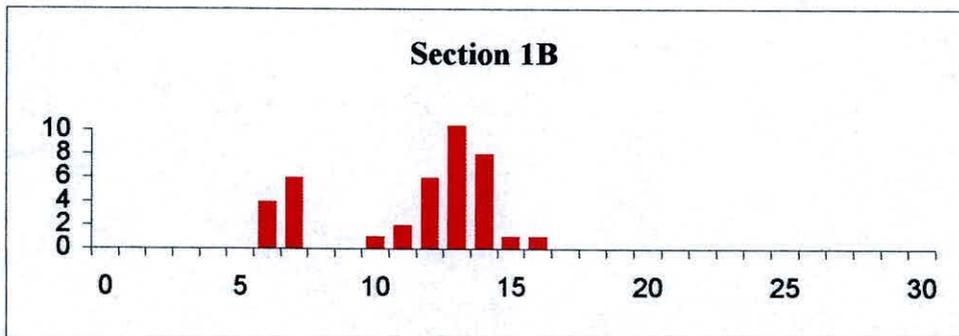
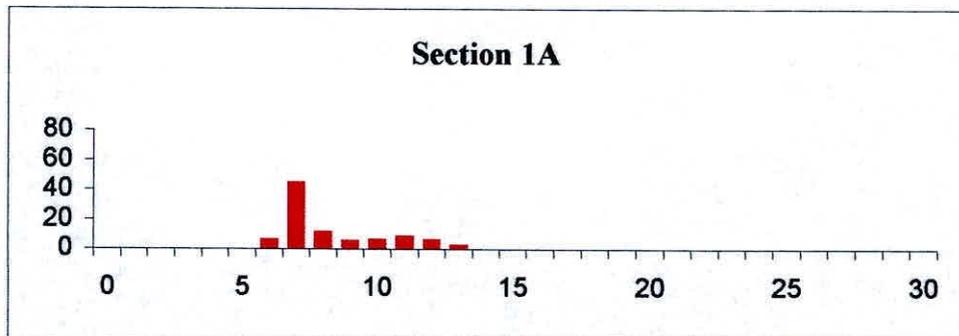
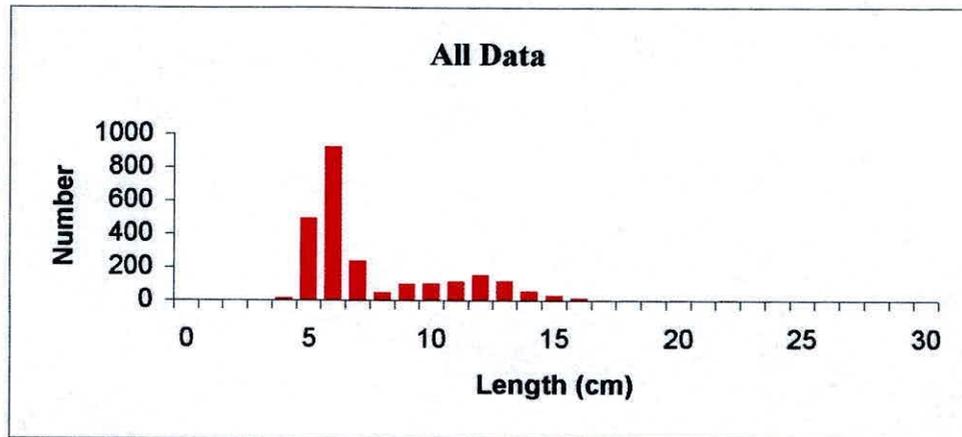
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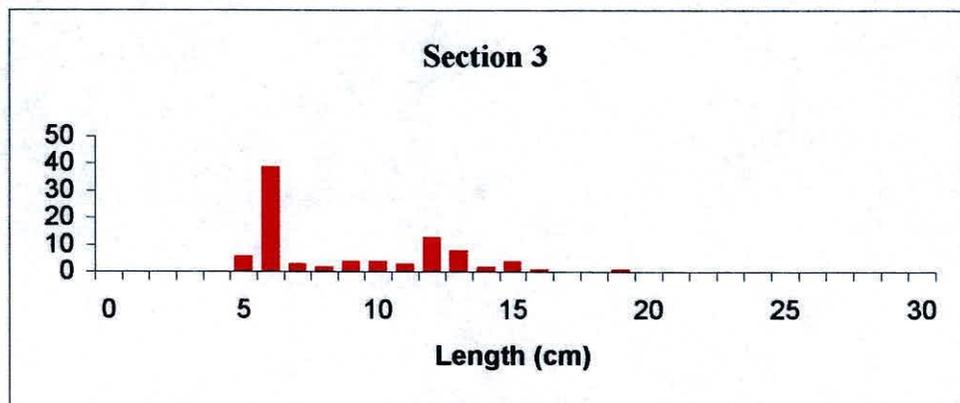
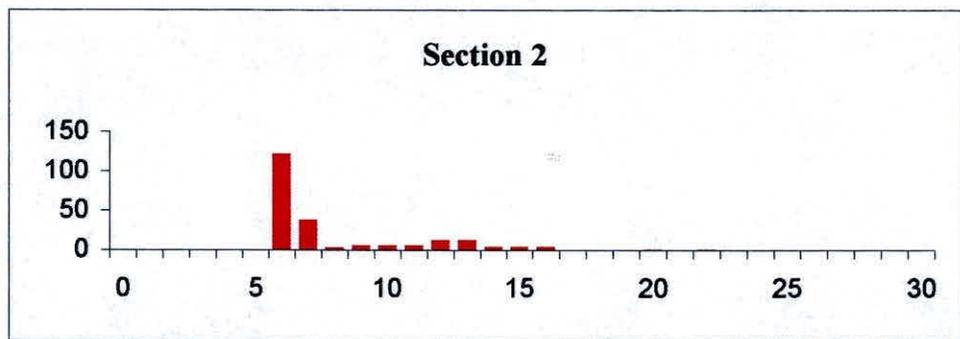
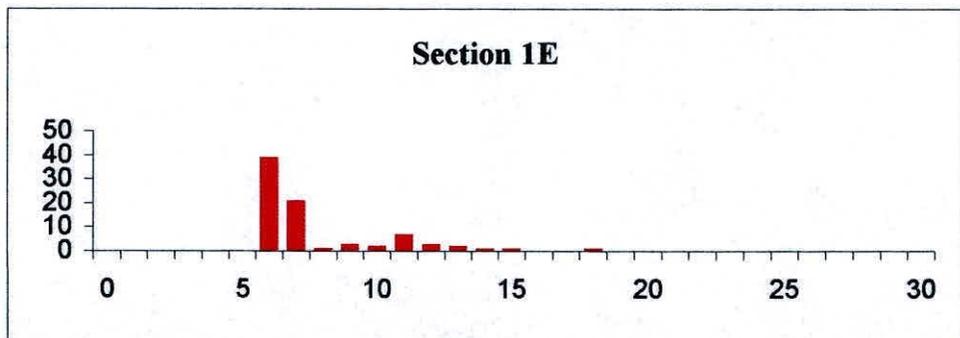
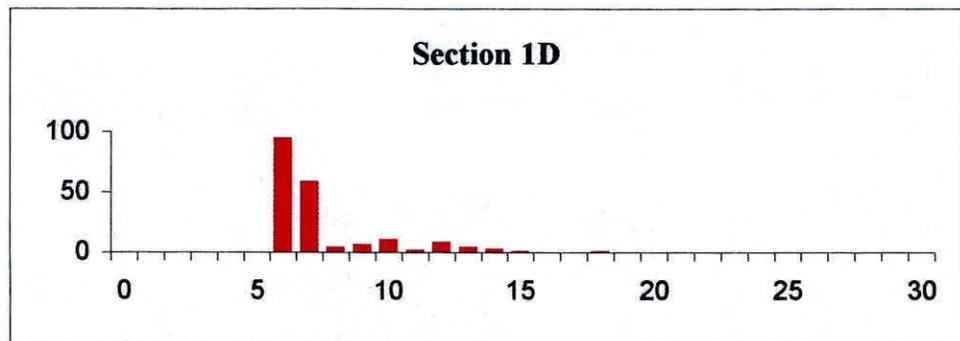
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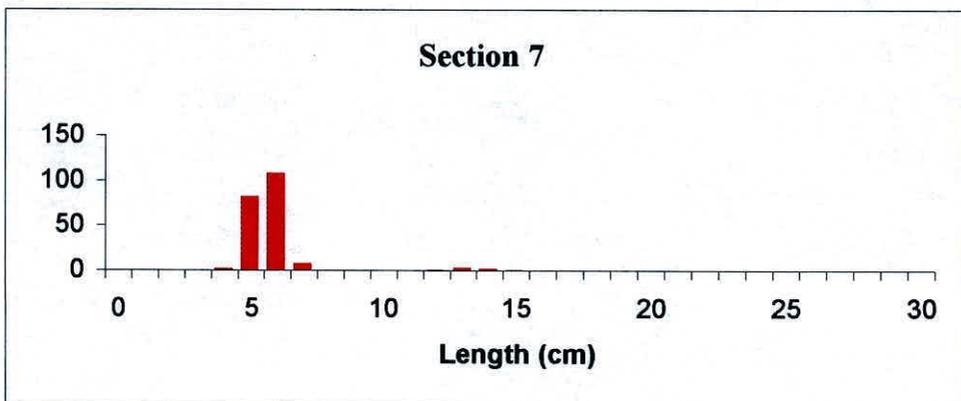
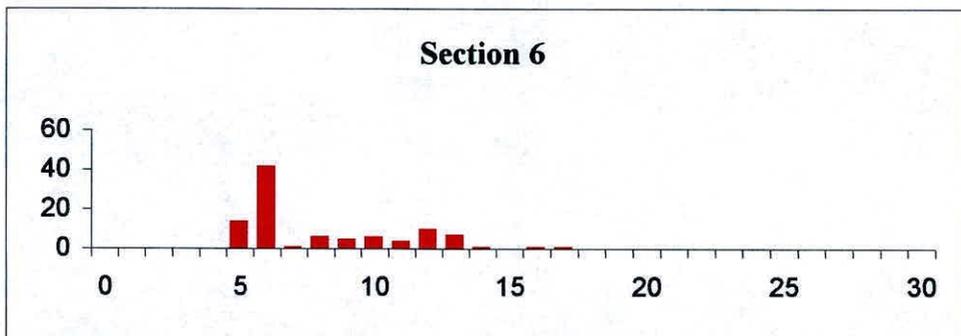
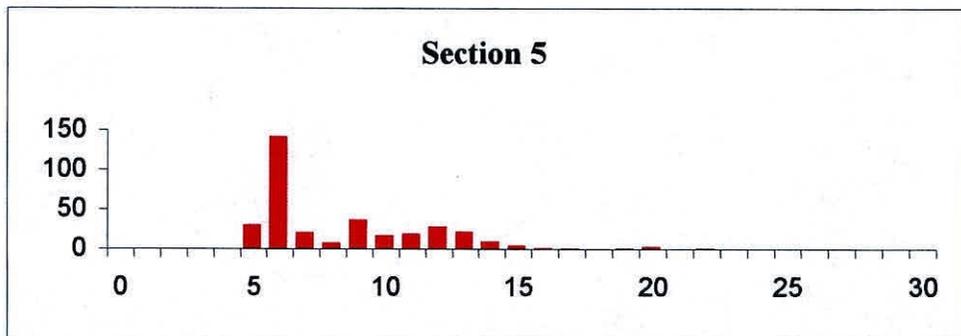
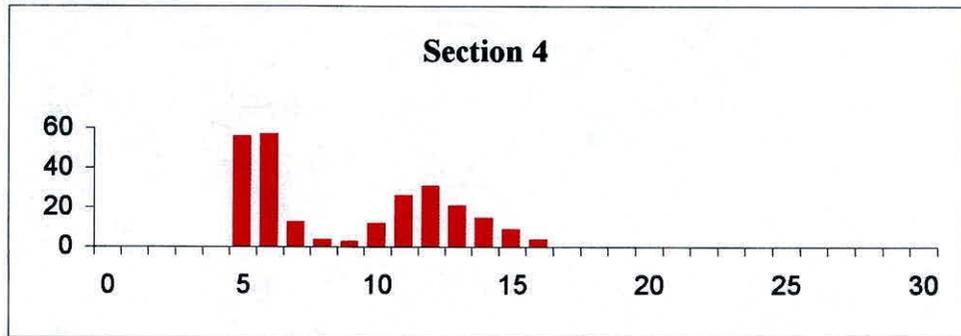
Appendix 6 Length frequency distribution of dace in each section of the R. Tees in September 1997



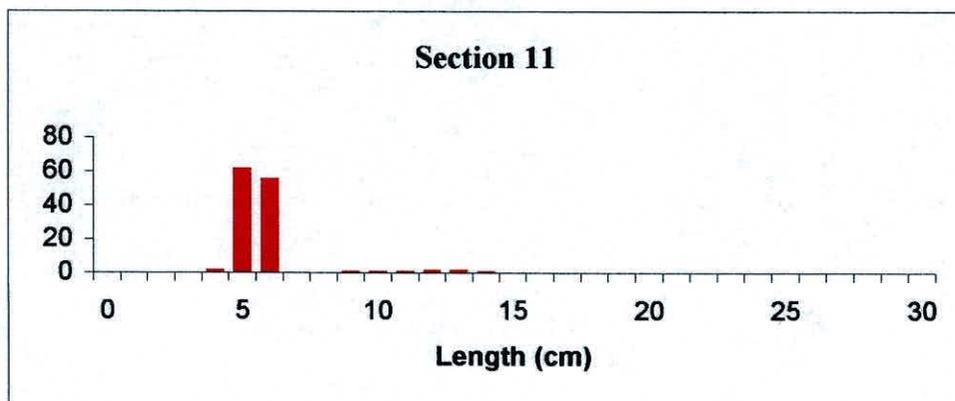
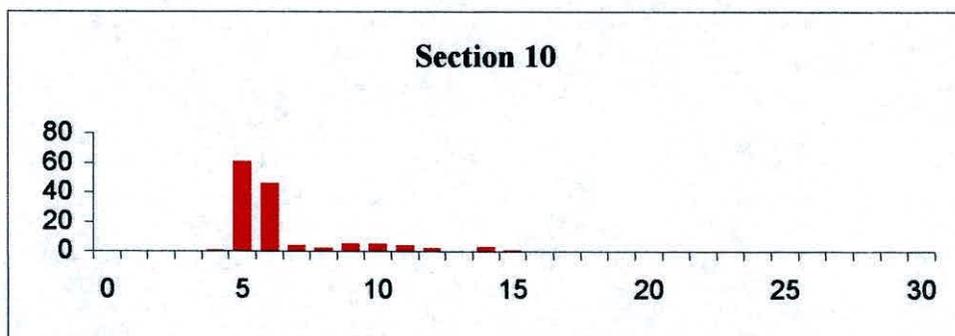
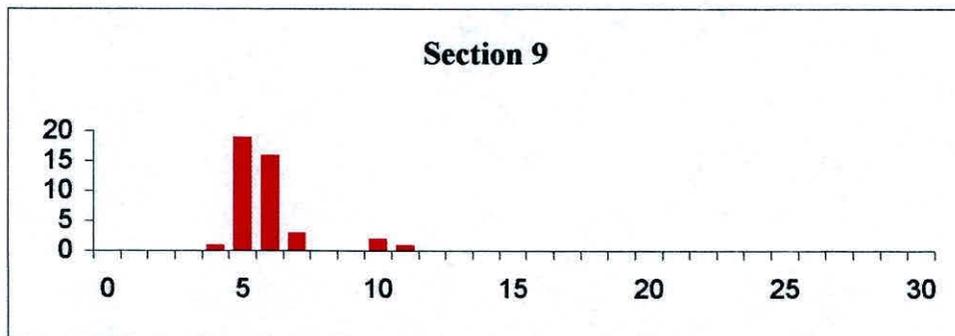
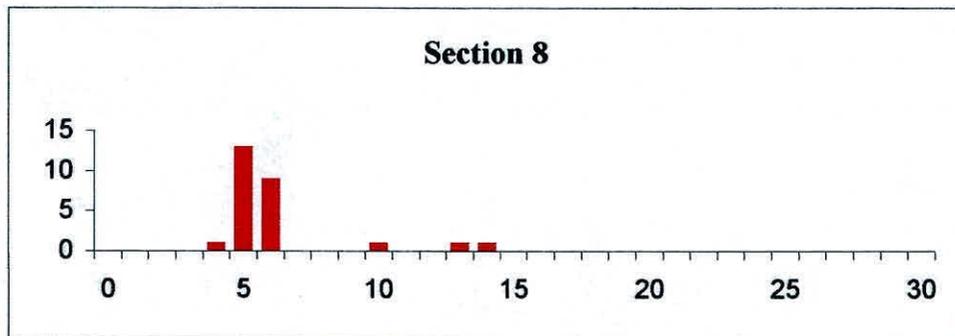
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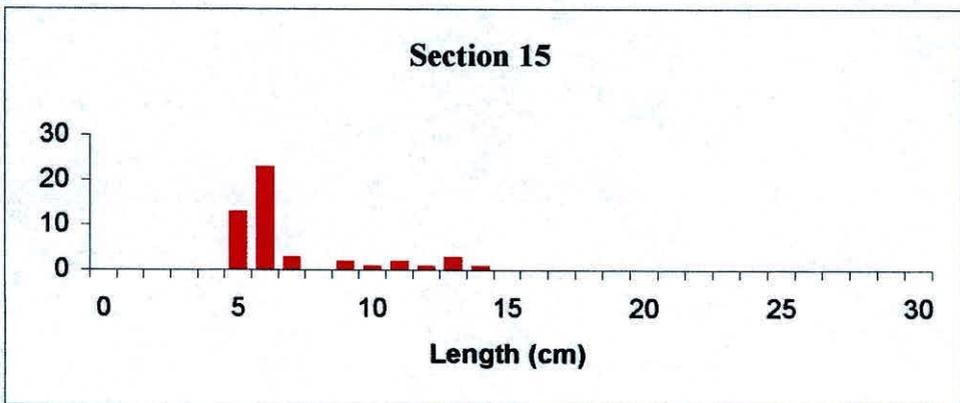
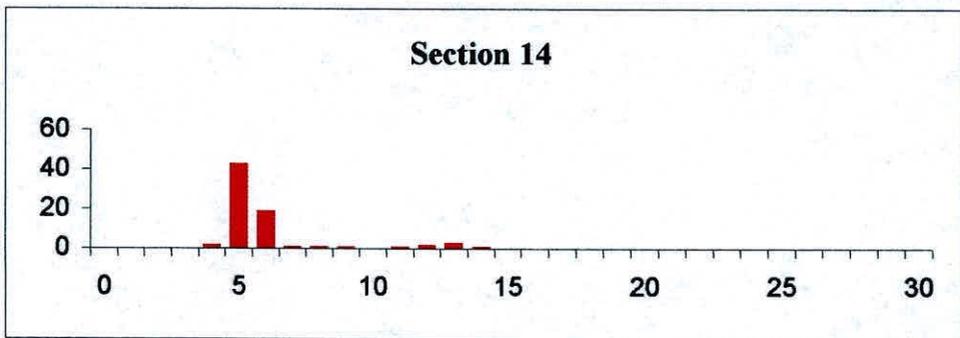
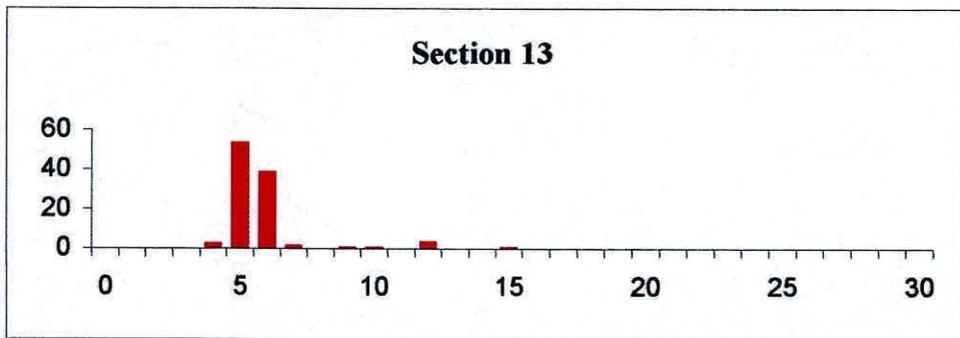
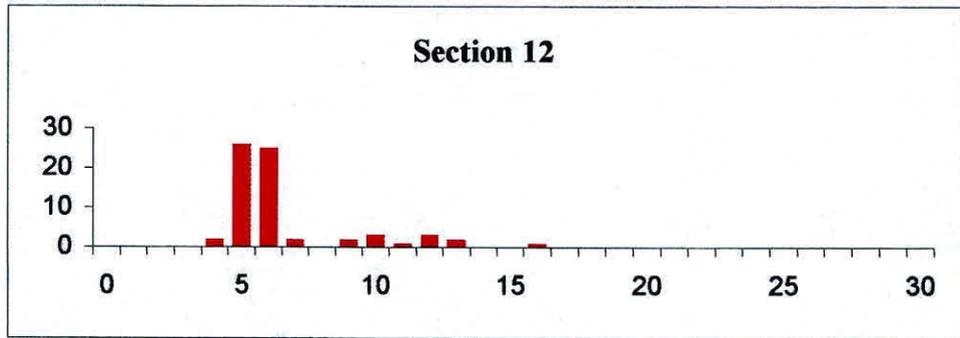
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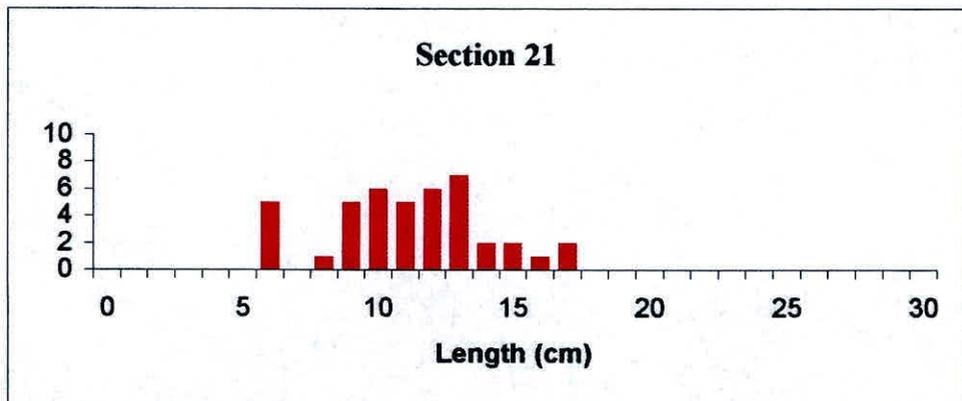
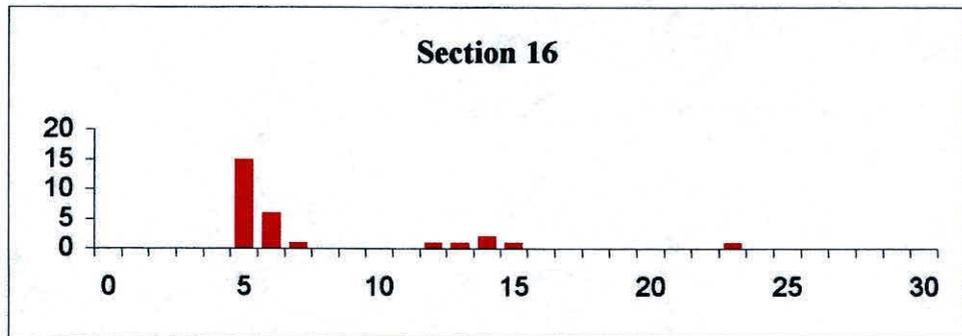
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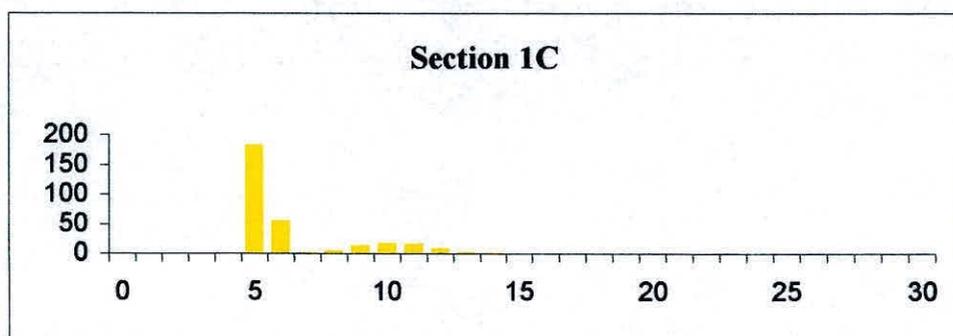
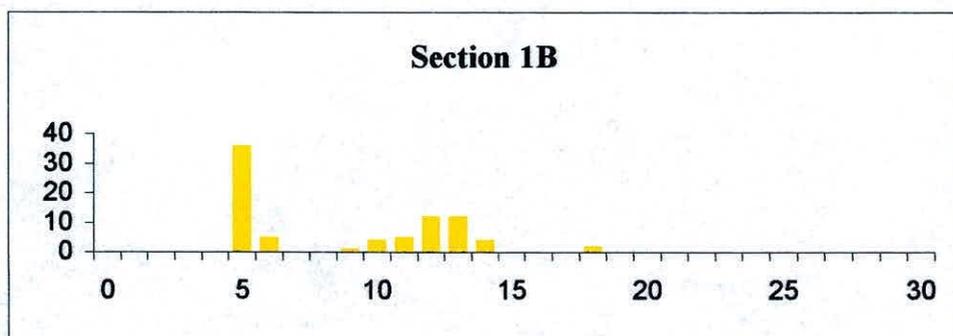
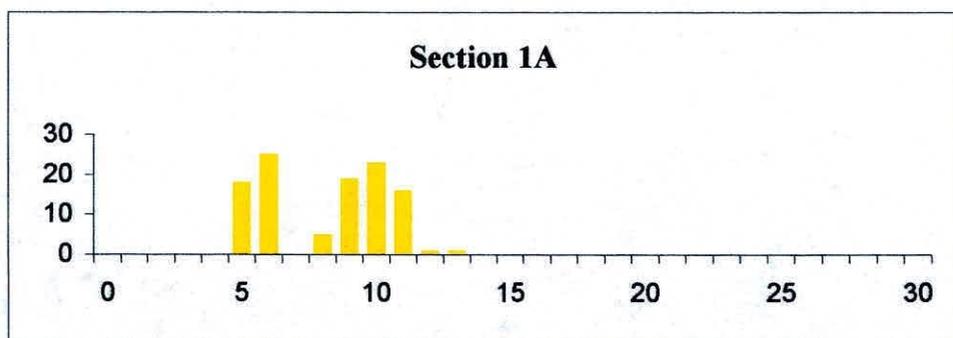
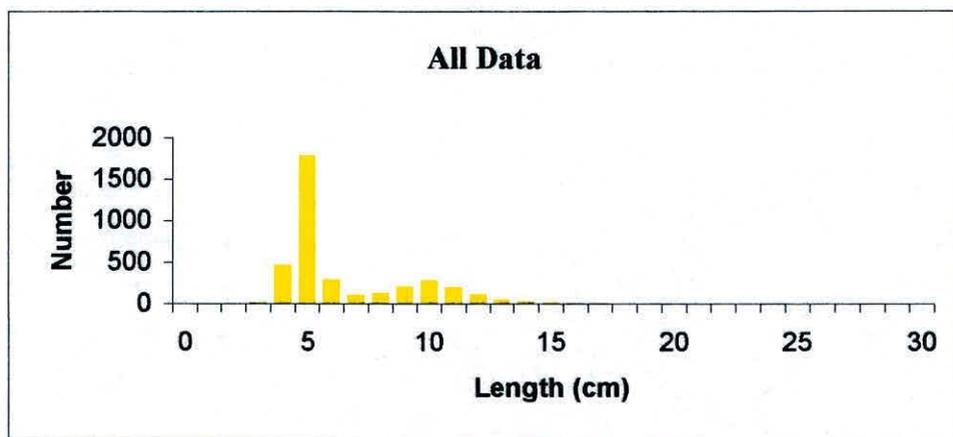
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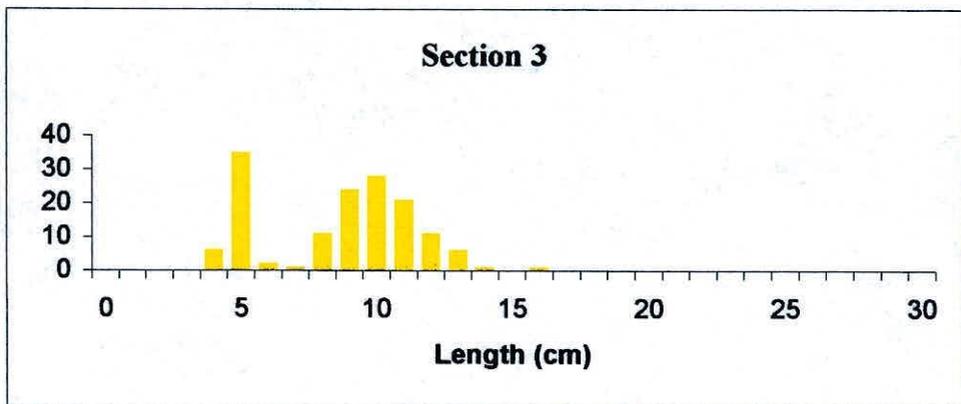
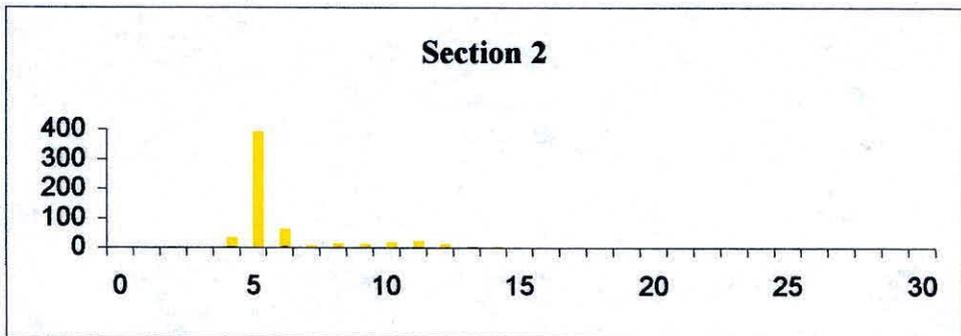
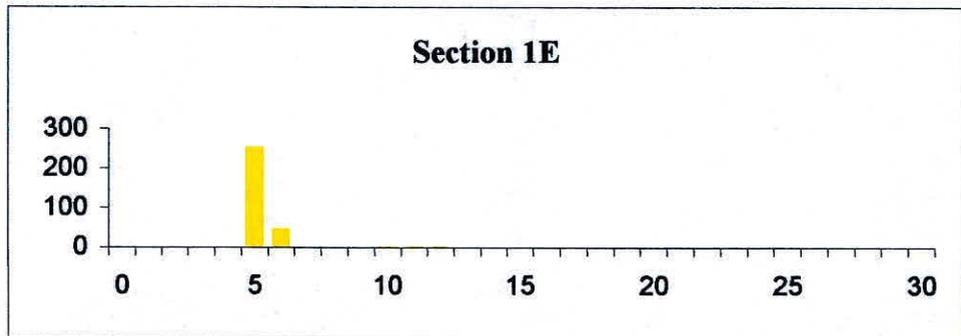
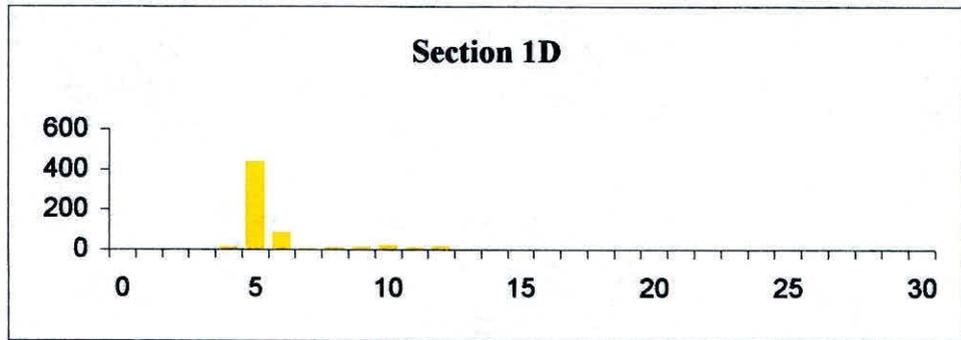
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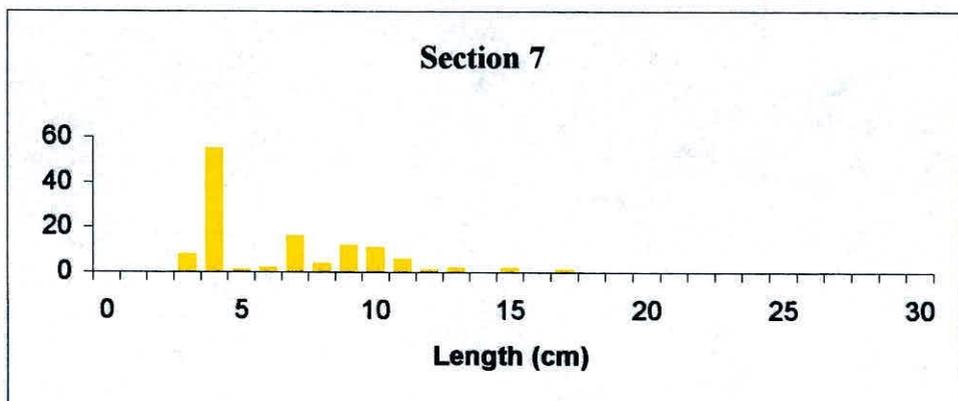
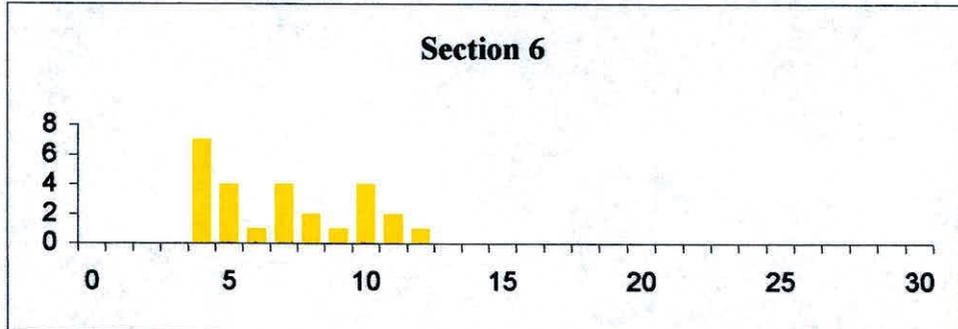
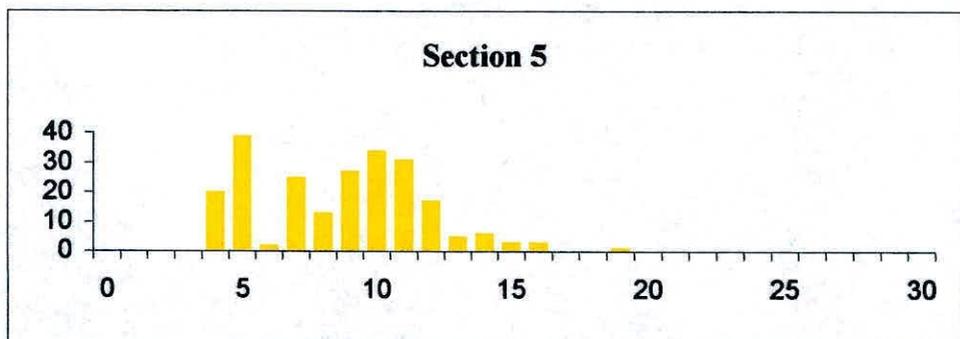
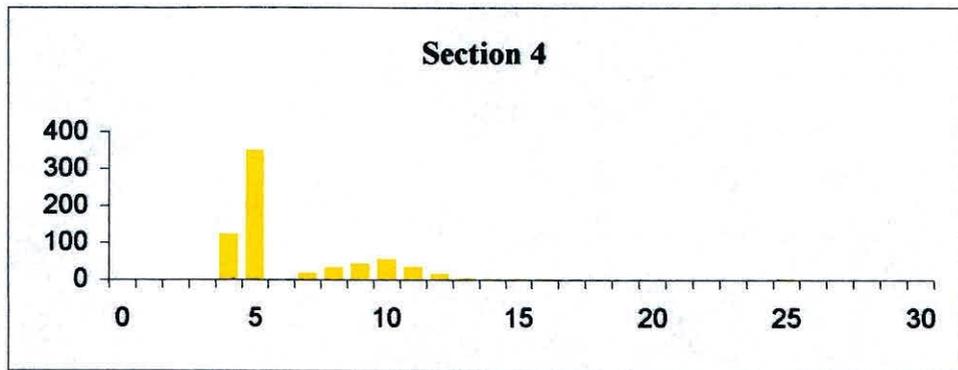
Appendix 7 Length frequency distribution of roach in each section of the R. Tees in September 1997



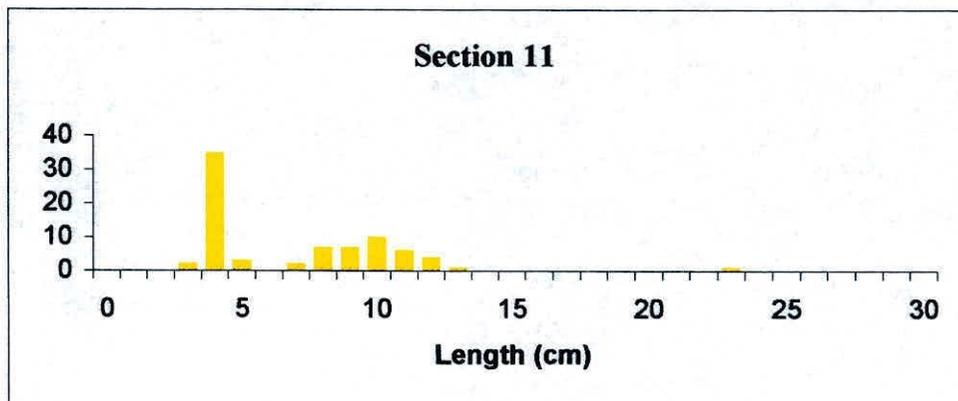
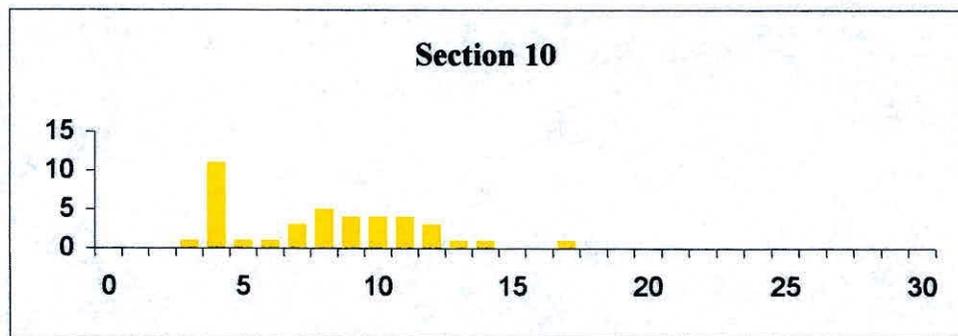
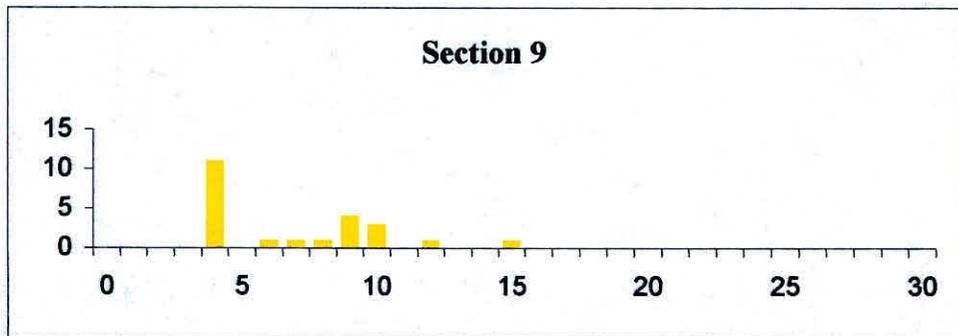
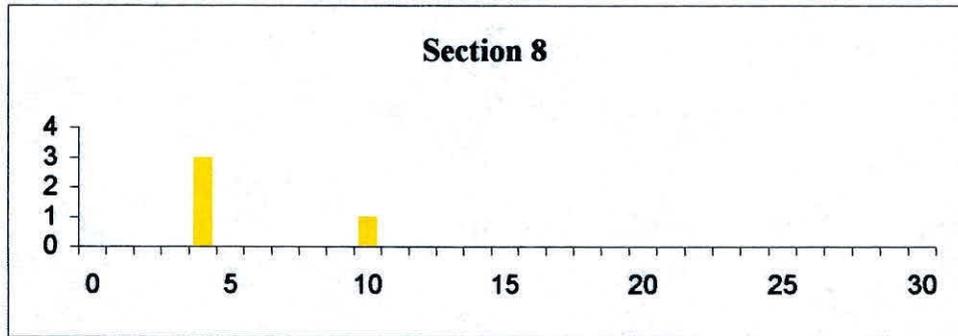
Appendix 7 continued



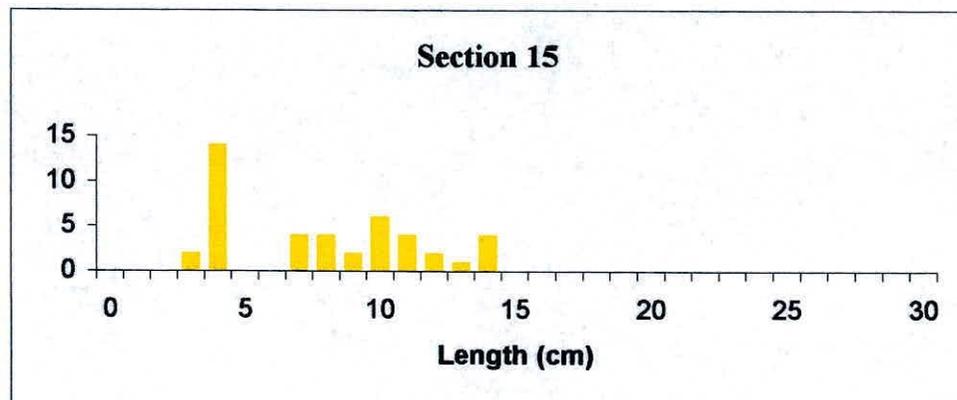
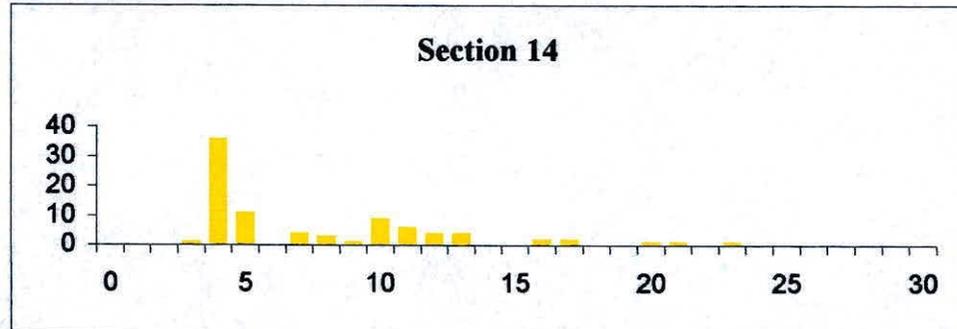
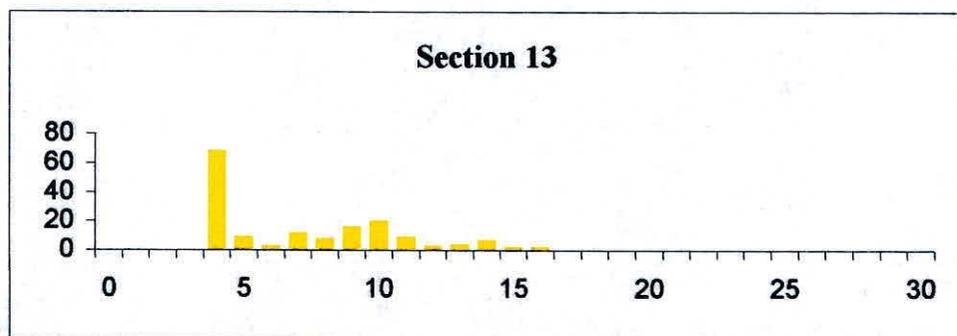
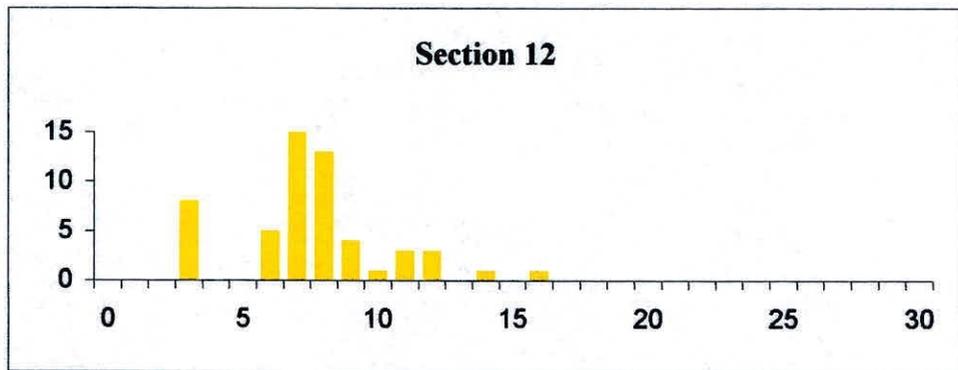
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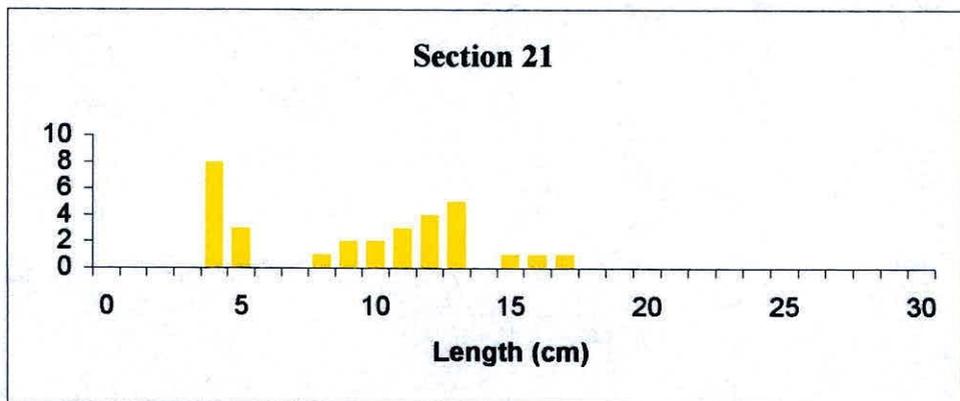
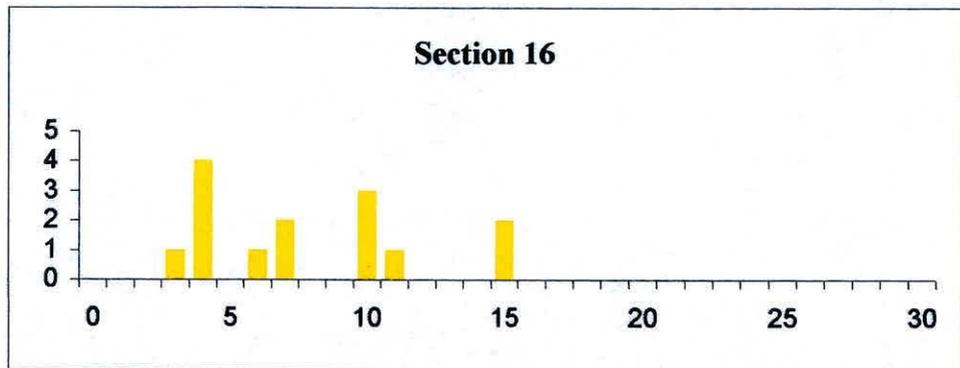
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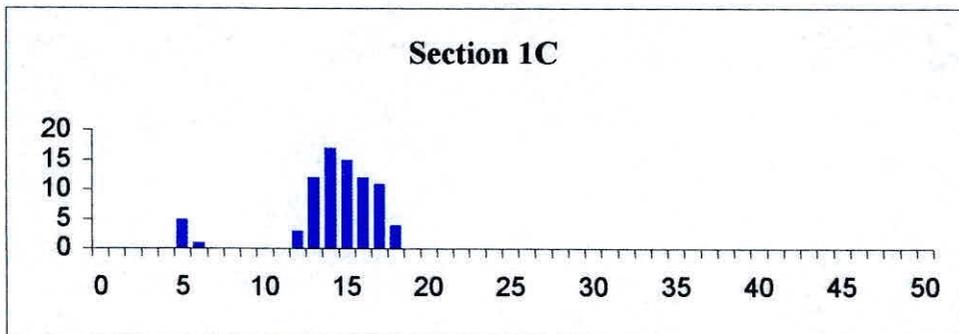
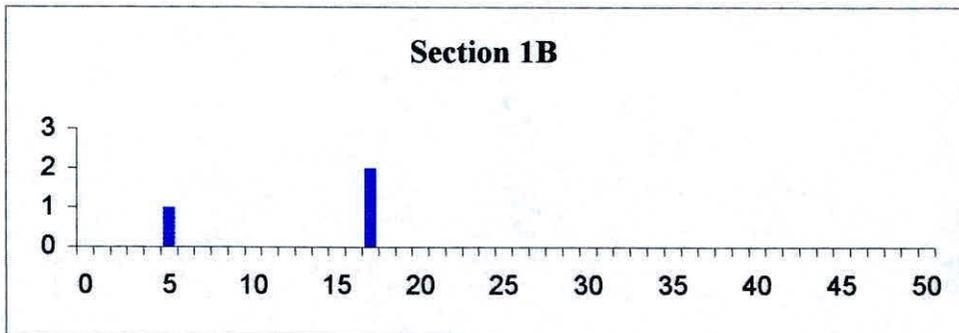
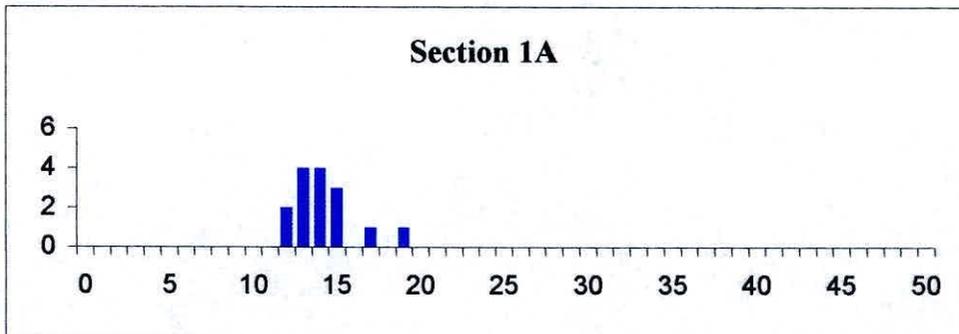
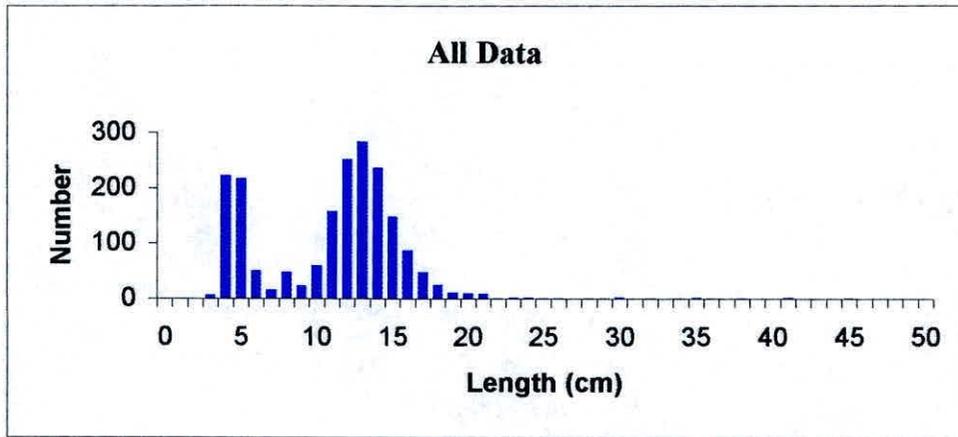
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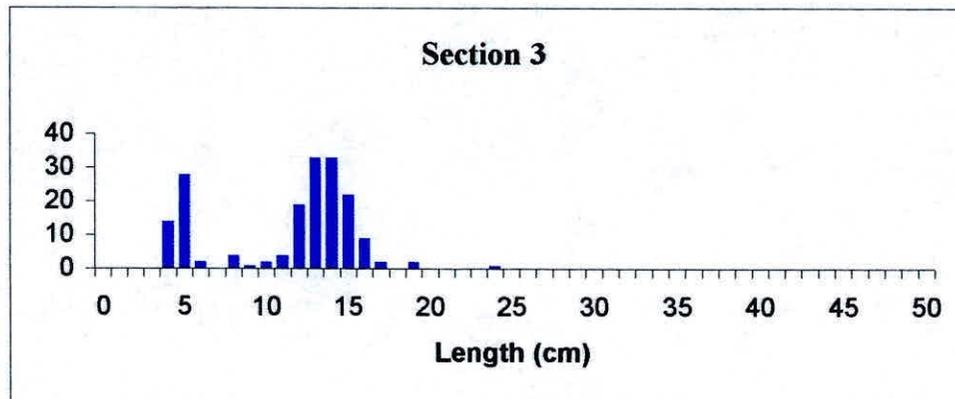
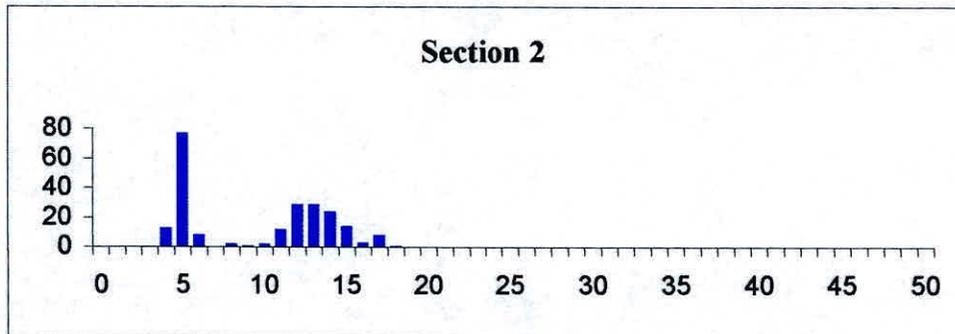
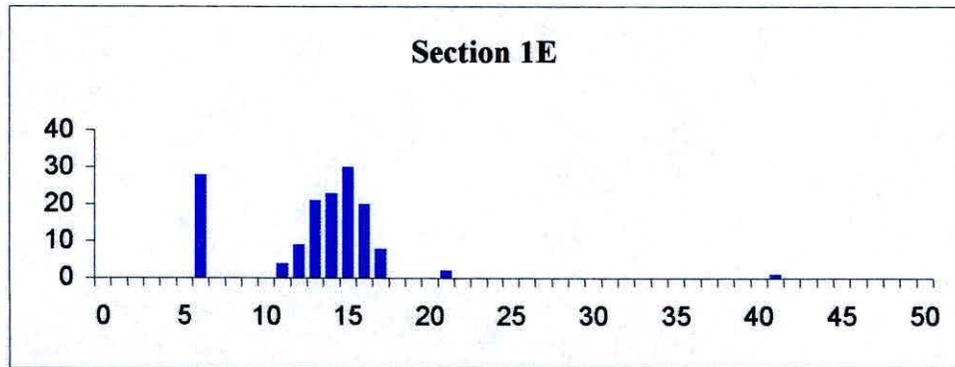
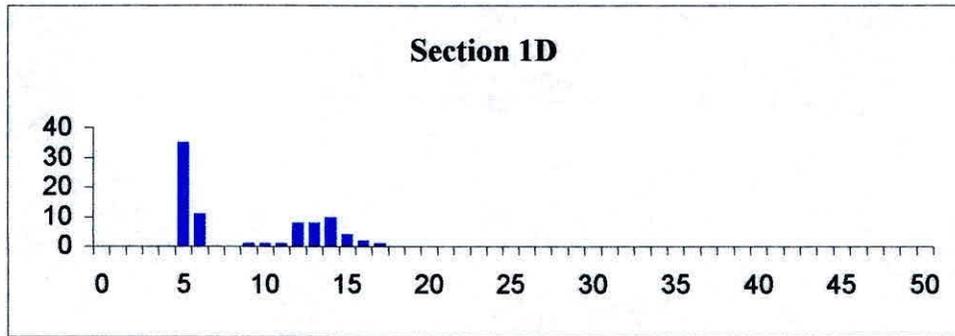
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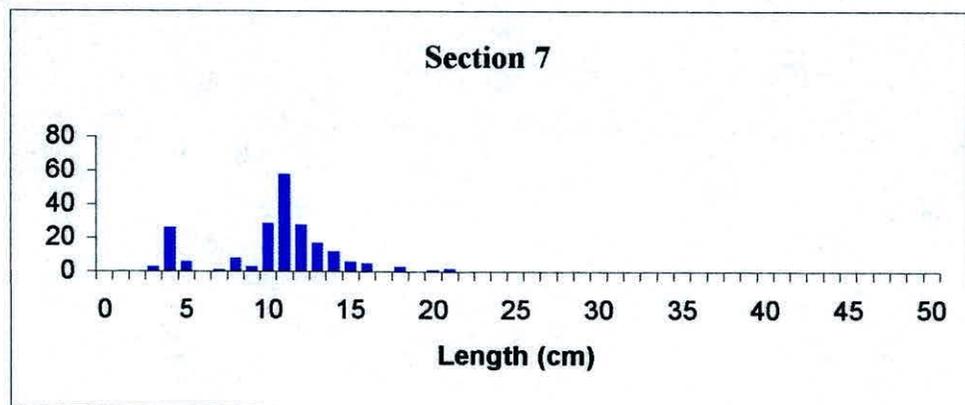
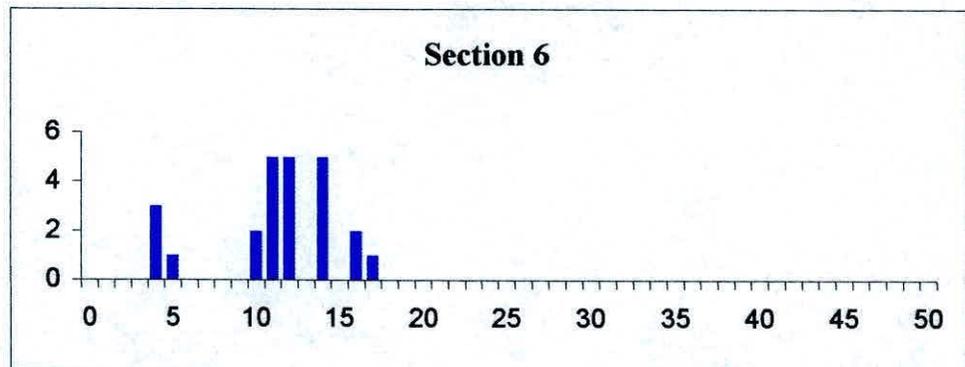
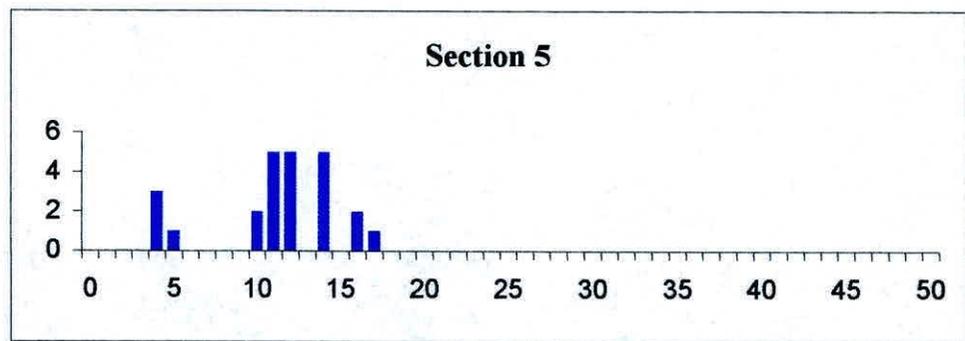
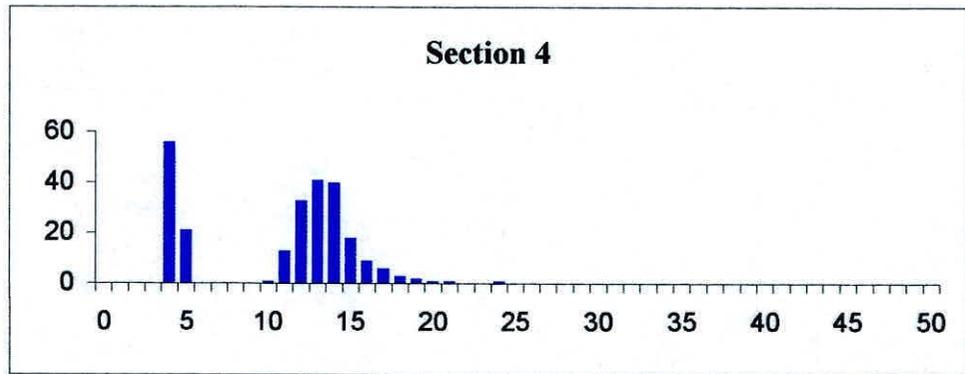
Appendix 8 Length frequency distribution of chub in each section of the R. Tees in September 1997



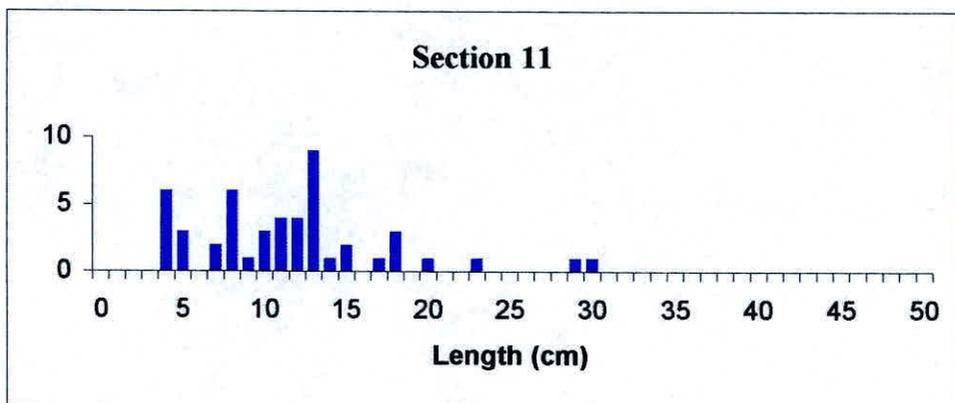
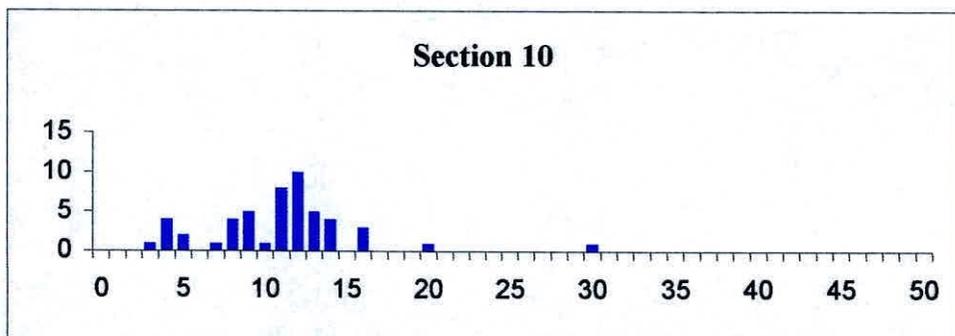
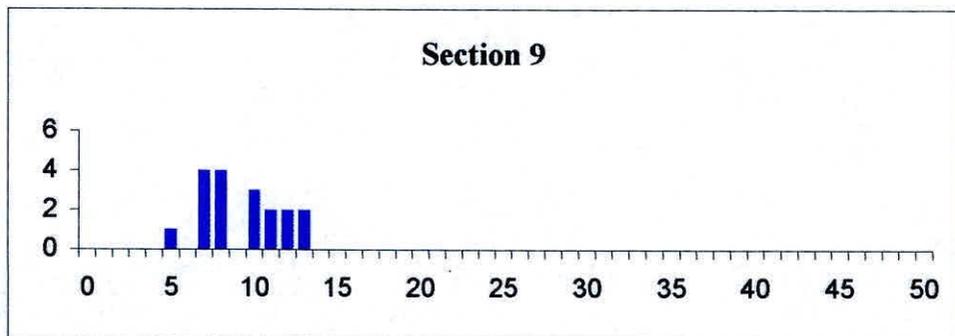
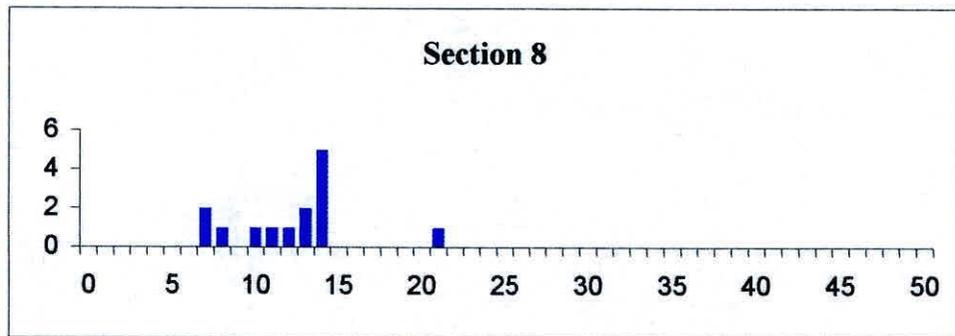
Appendix 8 continued



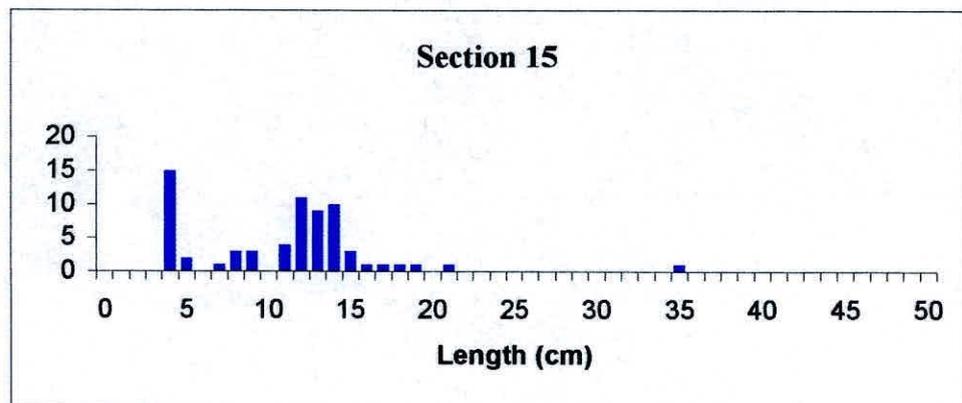
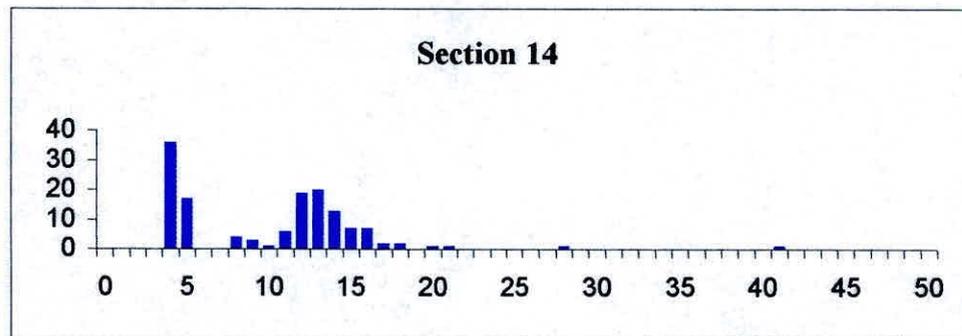
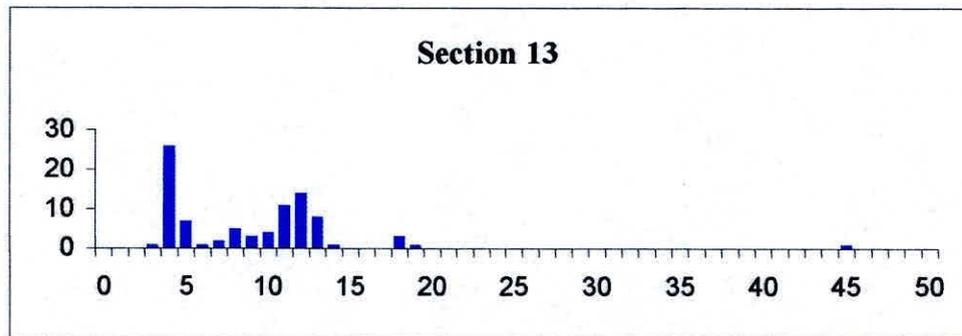
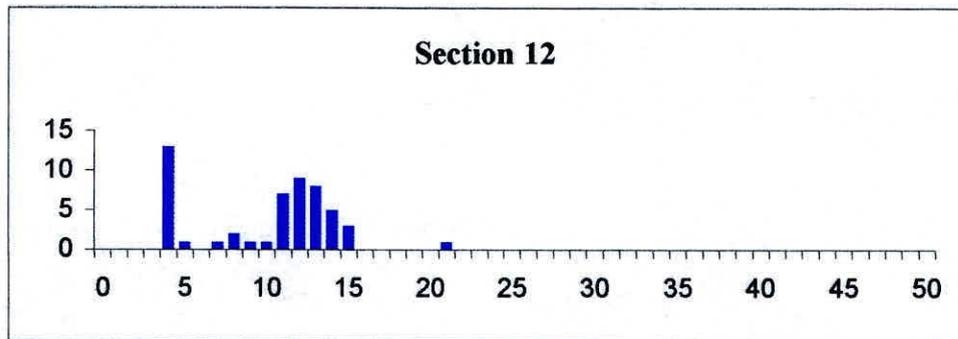
Appendix 8 continued



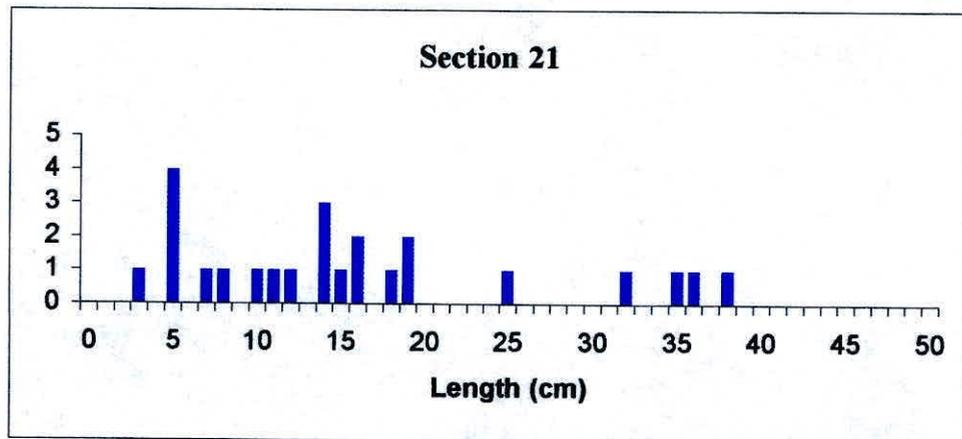
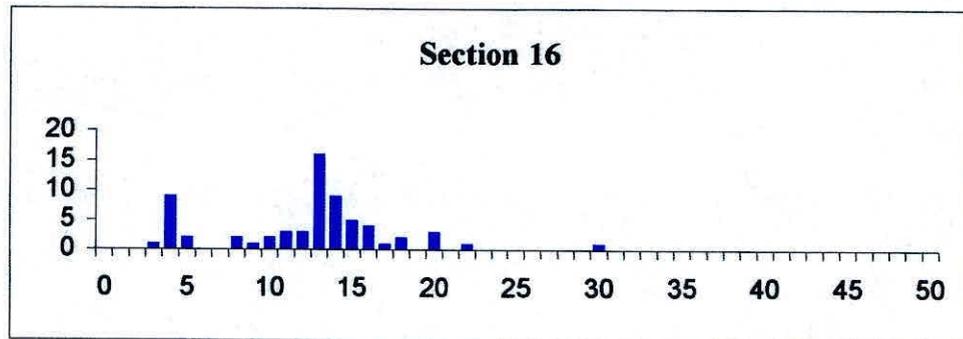
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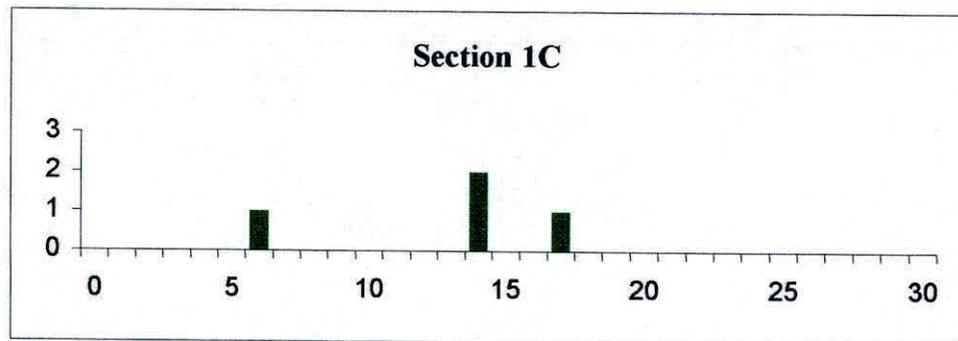
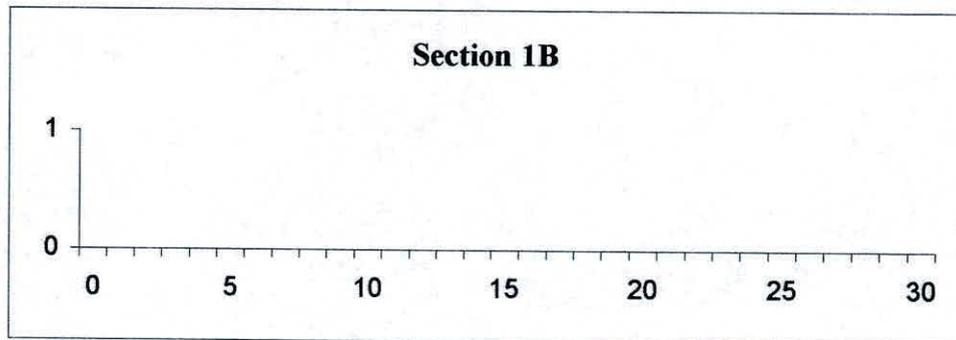
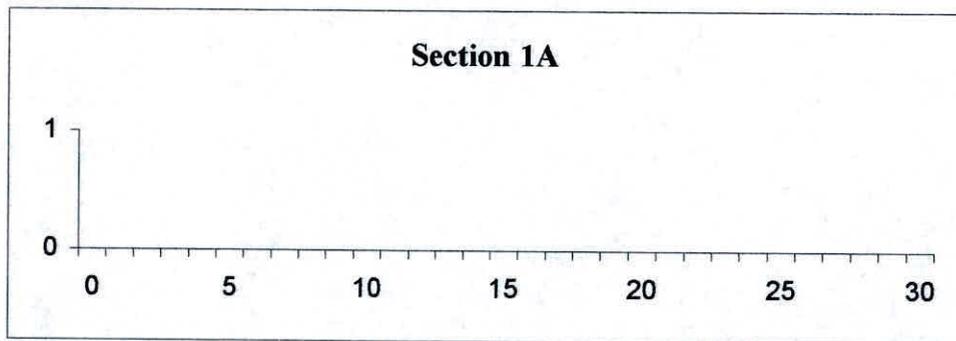
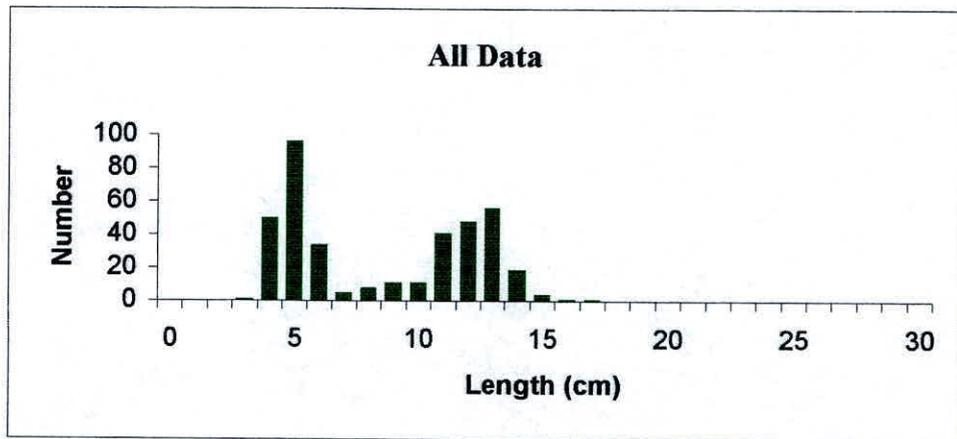
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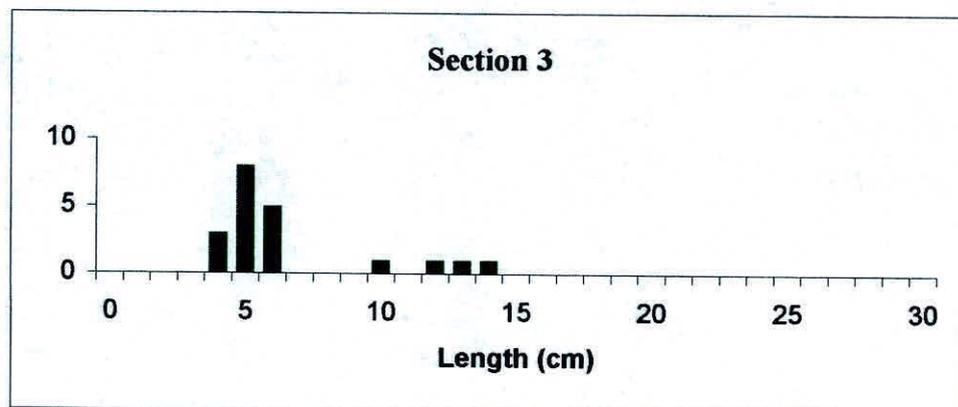
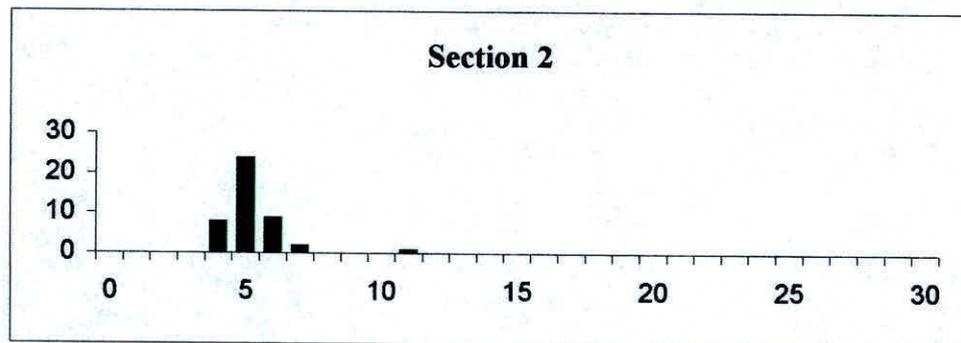
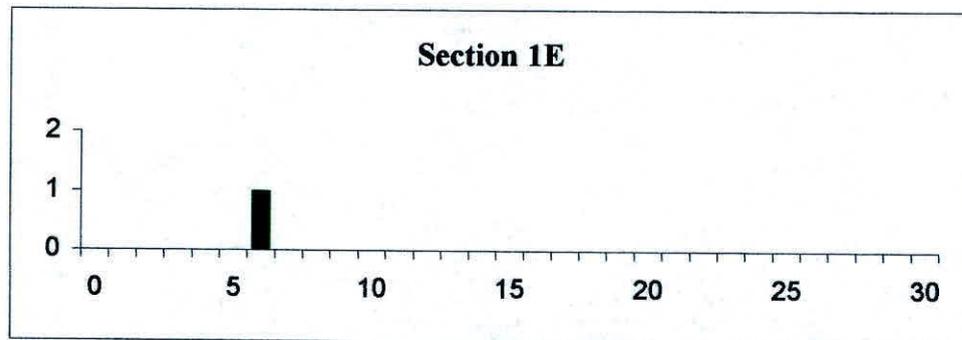
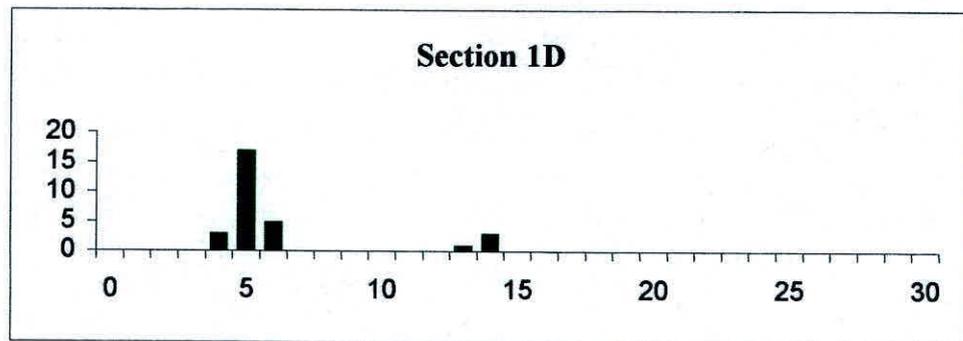
Appendix 8 continued



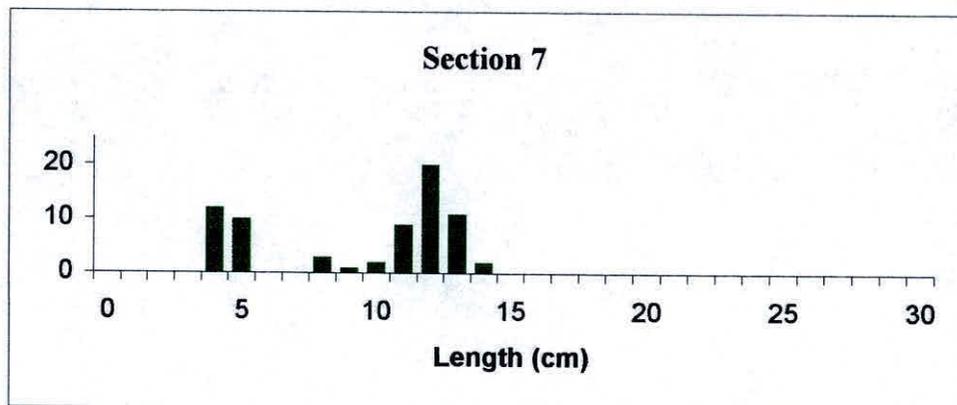
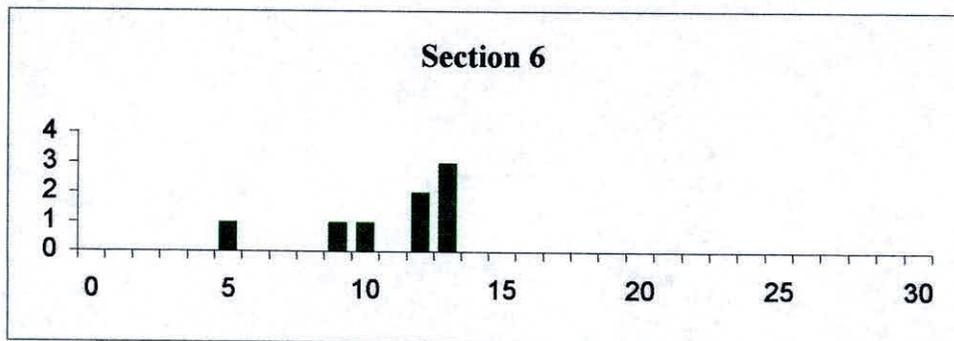
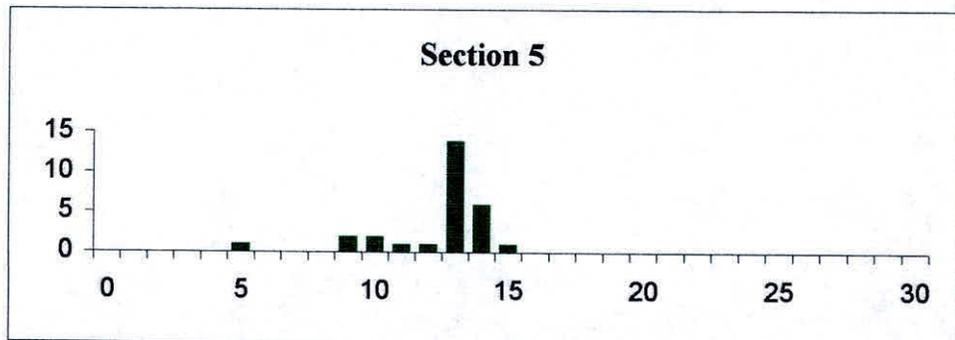
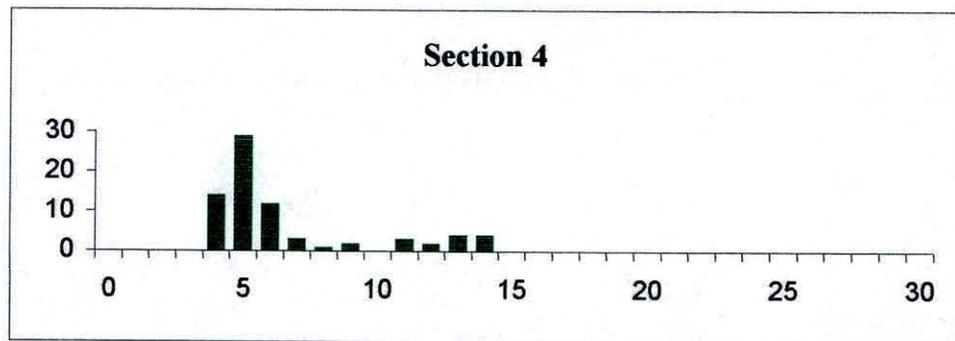
Appendix 9 Length frequency distribution of gudgeon in each section of the R. Tees in September 1997



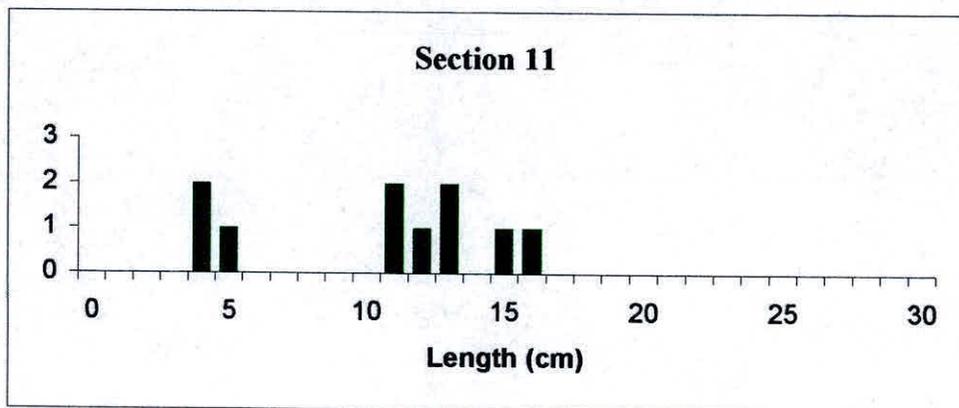
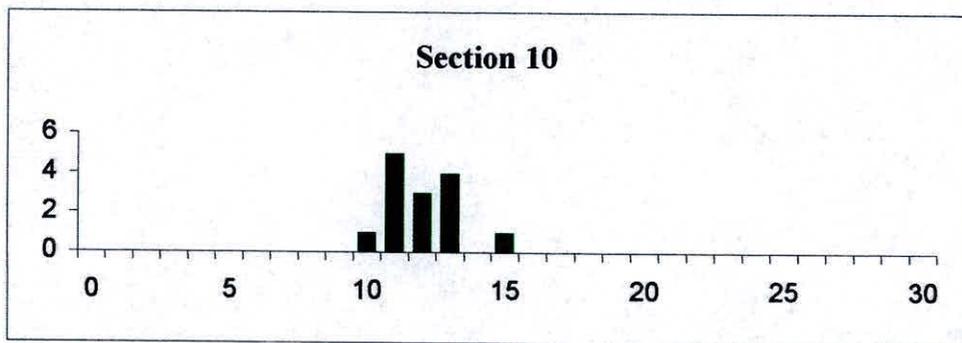
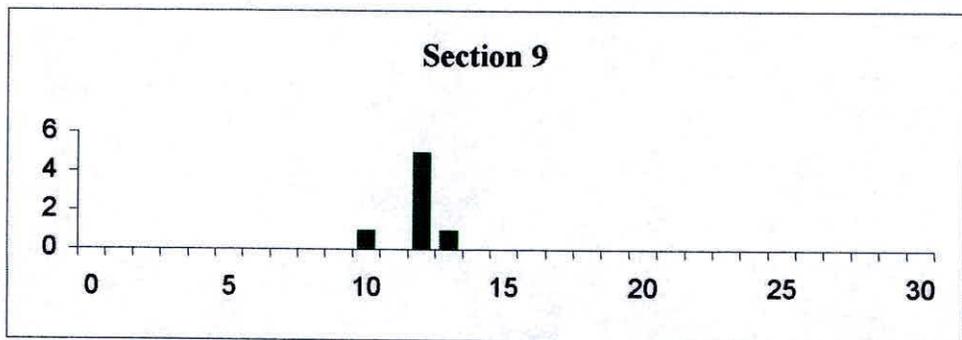
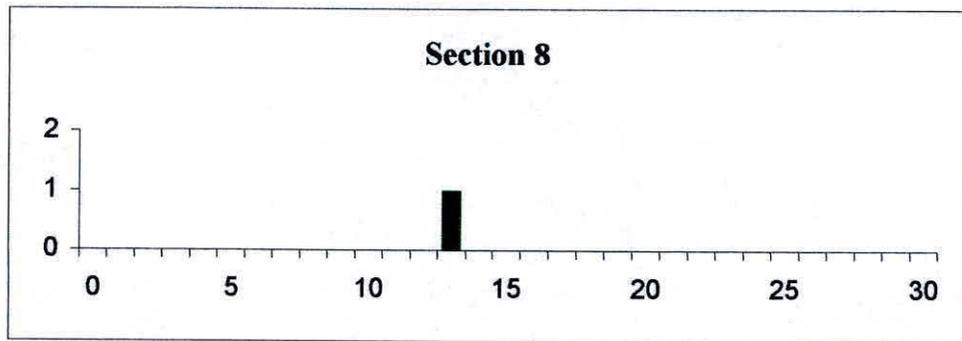
Appendix 9 continued



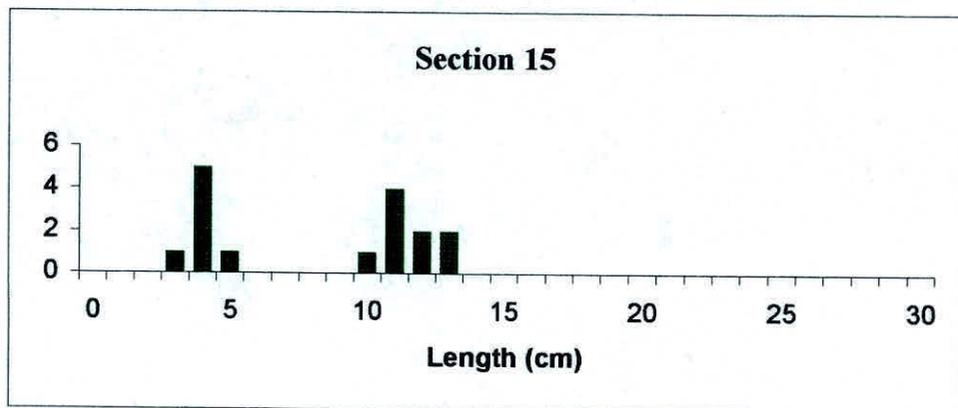
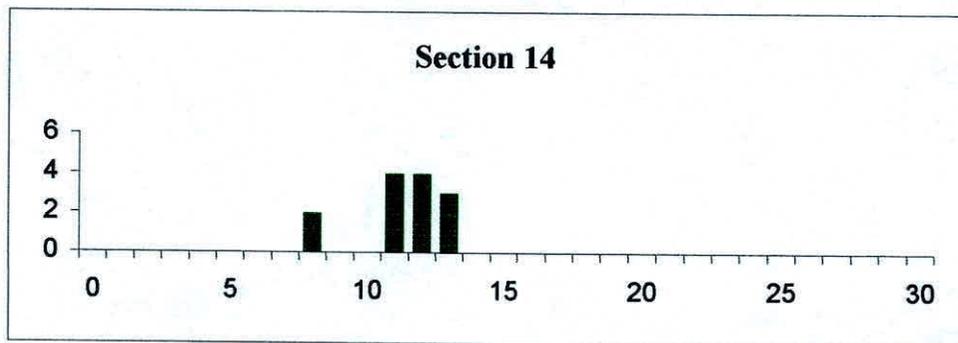
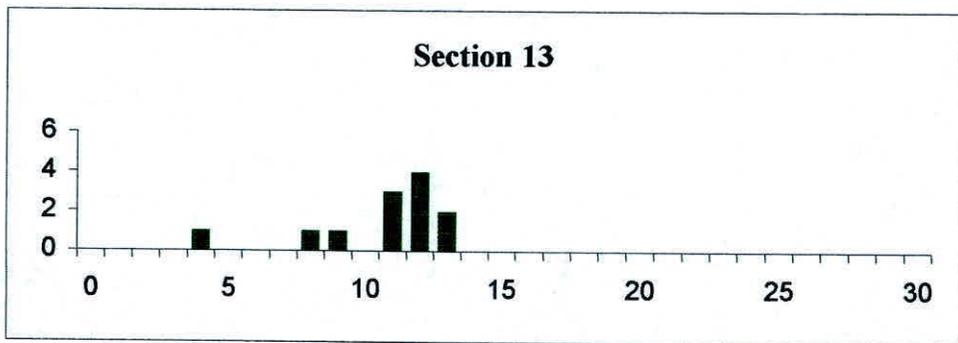
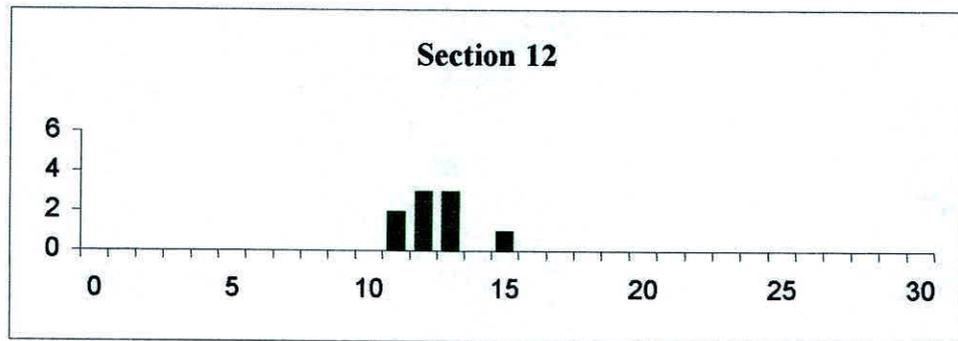
Appendix 9 continued



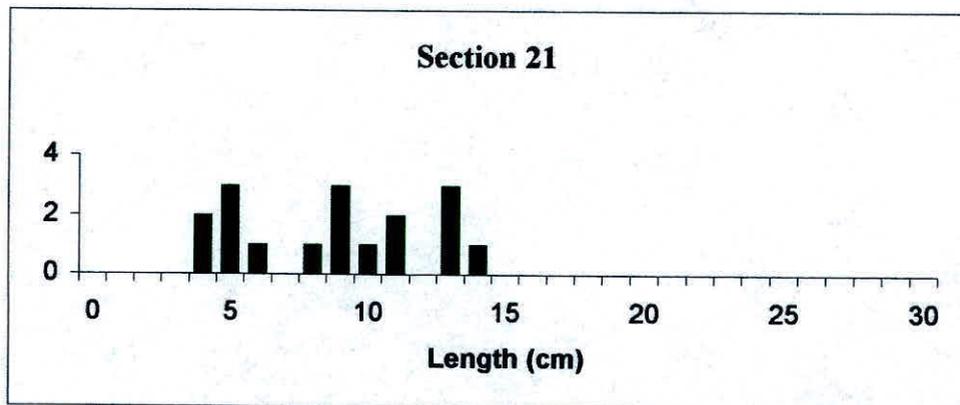
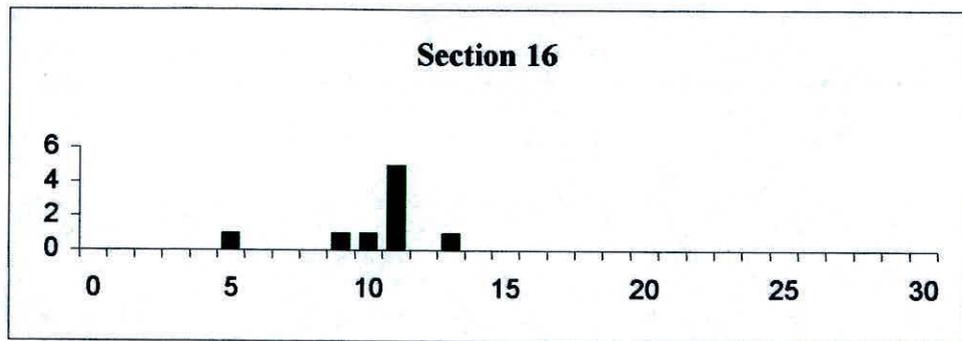
Appendix 9 continued



Appendix 9 continued



Appendix 9 continued



Appendix 10 Results of angling matches 1977-1996. x = mean catch per angler per match (ounces) \pm 95% confidence limits; y = mean catch per angler per match (ounces) \pm 95% confidence limits for the top ten anglers in each match.

Year	x	y
1977/78	59.4 \pm 6.0	111.2 \pm 15.7
1978/79	68.3 \pm 6.6	132.5 \pm 15.0
1979/80	76.2 \pm 8.6	113.9 \pm 15.0
1980/81	58.3 \pm 8.2	78.3 \pm 12.5
1981/82	85.5 \pm 11.7	125.5 \pm 18.9
1982/83	66.1 \pm 7.7	113.3 \pm 15.1
1983/84	25.1 \pm 3.6	75.2 \pm 10.9
1984/85	14.8 \pm 2.9	40.5 \pm 7.6
1985/86	22.6 \pm 3.0	52.6 \pm 7.1
1986/87	20.4 \pm 3.1	64.2 \pm 9.0
1987/88	27.4 \pm 4.0	85.2 \pm 11.5
1988/89	30.9 \pm 4.0	102.7 \pm 12.2
1989/90	47.5 \pm 5.7	145.3 \pm 14.2
1990/91	62.1 \pm 7.1	165.8 \pm 19.4
1991/92	85.4 \pm 10.0	186.1 \pm 14.6
1992/93	54.0 \pm 8.0	143.1 \pm 19.1
1993/94	30.7 \pm 4.0	66.3 \pm 8.2
1994/95	33.0 \pm 9.9	60.5 \pm 19.3
1995/96	42.6 \pm 3.5	101.7 \pm 10.5
1996/97	41.7 \pm 2.9	95.3 \pm 9.6