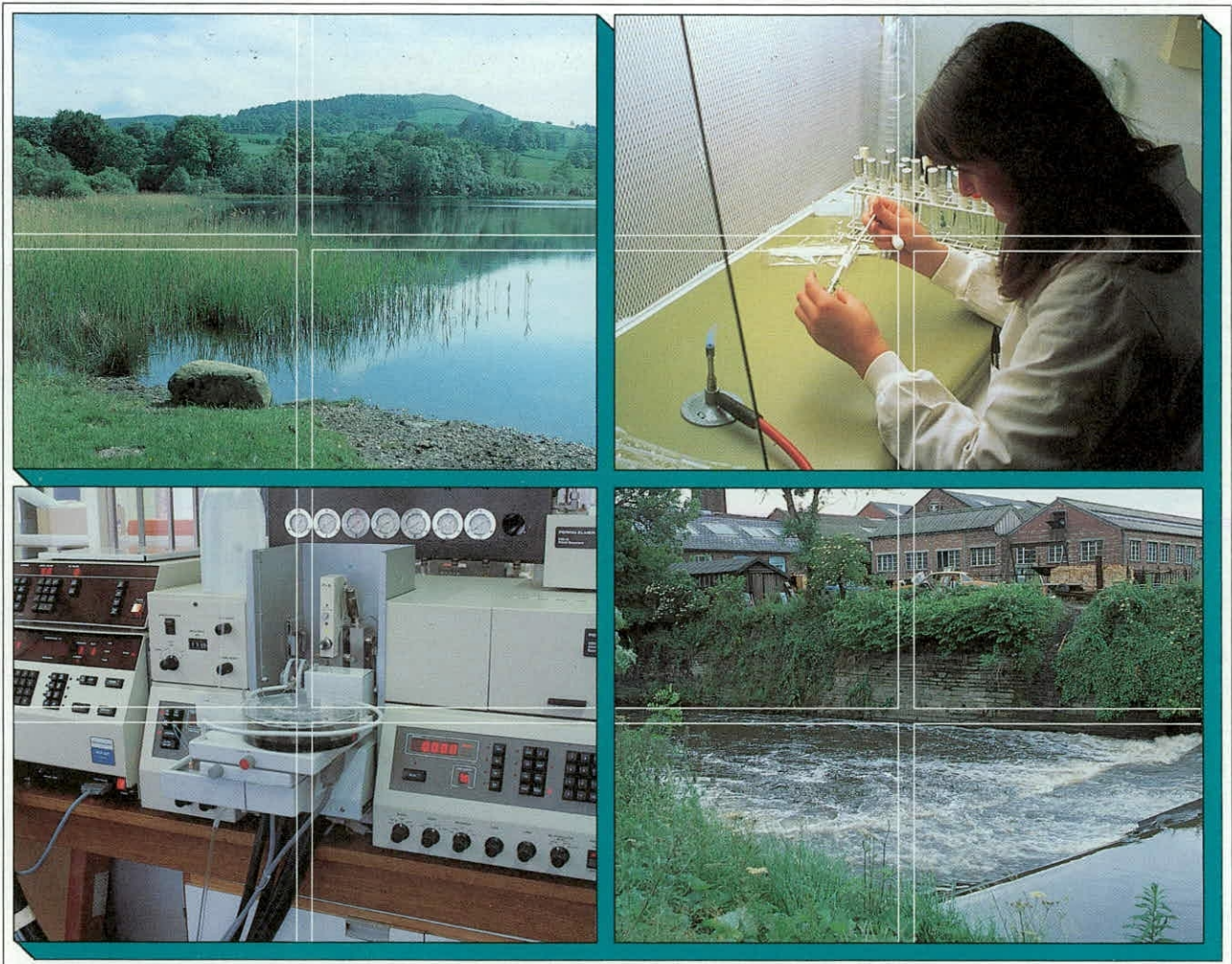


## Strategic Water Resources Studies:

### River Thames Juvenile Fish Gut Contents Survey 1995

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## EXECUTIVE SUMMARY

The report describes the suitability for gut contents examination of preserved roach from the River Thames Juvenile Fish Survey 1994. The gut contents of 30 roach (10 from each of 3 sites) from the survey were identified and the results are described and discussed. The report reviews the potential of the complete catch of juvenile fish (over 40 thousand) from the 1994 survey for further study of gut contents, and makes recommendations for future projects.

The state of the preserved roach was not ideal (tail fins were missing from some individuals), but most could be used for measurements of their lengths and weights, and for gut content examination. Microscopic examination of the contents showed them to be more fragmented than those of juvenile roach from the River Great Ouse examined previously by the Institute of Freshwater Ecology.

The most common prey encountered were Cladocera (water fleas) and Chironomidae (midge) larvae. Identification of these two groups to genus and, occasionally, to species suggested that the roach had been feeding in the vicinity of aquatic plants, either directly from leaf surfaces or deeper in the water column. The presence of some prey items of non-aquatic origin also suggested that some feeding had occurred at the water surface.

The 1994 survey occurred over a short period in late July-early August. Thus, dietary information will not include the seasonal changes that are associated with the rapid growth and development of fish in their first year of life. 14 sites were surveyed, but only roach and gudgeon occurred in adequate numbers for study at all of these. Hence, the potential for between-site comparisons is limited.

It is recommended that:

1. The 1994 survey material is used for:
  - a) comparison of the diets of roach, gudgeon, chub, dace, bleak and perch.
  - b) comparison between sites of the diets of roach, gudgeon, chub and perch.
2. A sampling programme is initiated to provide samples of 0+ fish at c. 4 week intervals from May to September, these to be taken at three or four carefully chosen locations. These samples can be used to provide seasonal growth data, and seasonal changes in diets.

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## 1. INTRODUCTION

### 1.1 Background

As part of a series of strategic water resource studies the NRA are seeking to commission a survey of the gut contents of juvenile fish from the River Thames. The need for this study has been recognized as part of ongoing work to determine the environmental acceptability of strategic water resource options identified in "Future Water Resources in the Thames Region".

### 1.2 Aims

1.2.1 To assess the degree of preservation of the fish sample and its suitability for the analysis of gut contents.

1.2.2 Once 1.2.1 has been established, to identify the gut contents of each fish to the same taxonomic level as in previous studies (as in the Great Ouse) and assess the abundance of each food item. To include where possible the identification of *Cladocera* and *Rotifera*.

1.2.3 To report on the suitability of the fish for further work and recommend appropriate projects with the full fish sample.

## 2. METHODS

### 2.1 Assessment of preservation of fish sample

Three containers of juvenile roach *Rutilus rutilus* (L.) were received from Thames NRA on 6 January 1995, all smelling strongly of glacial acetic acid and formalin. It was confirmed by the NRA (Debbie Jordan) that the fish had been preserved for the first four months after capture in Oudemans' solution (22 parts 70% alcohol: 5 parts glacial acetic acid: 1 part glycerin), and then transferred to 8% formalin.

Oudemans' solution is not a very satisfactory long-term preservative for fish, especially for small (0+) fish. Experience within the Institute of Freshwater Ecology indicates that preservation on capture of 0+ coarse fish in 4% formalin gives excellent long-term preservation. 0+ roach caught in the Great Ouse in 1988, are in a better state of preservation than those received from the Thames survey.

A preliminary examination of the fish suggested that the use of Oudemans' solution before transfer to 8% formalin solution had not impaired the condition of the gut contents, and most fish specimens could be measured and weighed. However, the tail fins were missing from a large proportion of the fish in one container (see below Site 6).

In addition, the ease of fish measurement and extracting the gut contents was not as good as in juvenile roach from the IFE Great Ouse studies. The latter are anaesthetized in benzocaine (to prevent regurgitation of gut contents) before being placed in 4% formalin solution.

Nevertheless, the fish were considered to be in a sufficiently good state of preservation for the project to continue.

## 2.2 Treatment of fish samples

Fish from each pot were washed thoroughly in tap water and preserved in a fresh solution of 4% formalin. A new label (written on water resistant 'Permatrace') was placed within each container as back-up to the vulnerable external paper labels. All three containers had the cardboard disc from inside the black screwtop lids missing and, consequently, they were liable to leak if inverted. Some leakage had occurred during transit from the NRA Thames Region to the I.F.E. Eastern Rivers Laboratory.

## 3. RESULTS

### 3.1 Contents of sample containers

Sample A. Label: Site 1, D, Roach 3-8-94

Roach (number of fish = 47) appeared to comprise two distinct size groups. The smallest fish had suffered some damage, but the caudal fins were intact in all specimens.

Sample B. Label: Site 3, D, Roach 2-8-94

Roach (number of fish = 123) were generally in an acceptable state of preservation, with all caudal fins intact. The guts of two fish had been previously extracted, and one fish was squashed.

Sample C. Label: Site 6, Col, Roach 29-7-94

Roach (number of fish = 220) could be divided into two groups: those with the caudal fins missing (N = 89) and those with the caudal fin intact (N = 128). In addition, two small fish were broken completely in half, and one larger roach (? 1+) was in a very poor state of preservation.

NOTE: The numbers of roach in each container did not tally with the sample (catch) sizes as indicated in the Table contained in the Project Specification. It is therefore assumed that the containers were sub-samples.

### 3.2 Selection and measurement of fish

Thirty fish were selected at random (10 from each container) for gut contents examination. Only fish with tail fins present were used from Sample C. Each fish was given an individual code (A1-A10, B1-B10, C1-C10 according to the pot from which it came) and then measured to the nearest mm (standard length, fork length, total length) and weighed to the nearest 0.01g on a Galaxy 400-SO electronic balance. The data are shown in Appendix 1, in which the weights have been rounded up to 0.1g accuracy (Contract Specification: Methodology item 3.5).

### 3.3 Preparation of gut contents for examination

The entire gut from each fish was removed and its contents extracted under a low power binocular microscope. These were mounted on a glass slide in DMHF (dimethyl-hydantoin-formaldehyde resin dissolved in 70% IMS) under a cover slip. Each slide was identified with the appropriate code number (A1 - C10). The preparations were allowed to dry for c. one week before being examined under a high power microscope (magnifications x40, x100, x200 as appropriate).

### 3.4 Contents of roach guts

The contents of the roach guts were not ideal for identification as many of the individual items had been fragmented. In addition, rupture of bodies of some chironomid larvae and the spread of their gut contents made the detailed structure of some prey items difficult to discern.



For each fish, all animal prey items were identified and counted. This was not possible for detrital residues or for the filamentous algae. For these items, an abundance index was used (scale 0 = item absent to scale 3 = item filling gut), the assessment being made by eye. This procedure was identical to the one adopted by the Institute of Freshwater Ecology for the analysis of the gut contents of juvenile fish from the Great Ouse.

No rotifers were present in any fish, and the majority of Cladocera were believed to have been non-planktonic species associated with plant surfaces, the river bank or the river bed. Some Cladocera were identified to species, but this was not possible for all items. Table 1 indicates the taxa found in the roach guts, and the abbreviated names used in subsequent tables.

Table 1. Names of the taxa found in the gut contents of 0+ roach from the River Thames.

---

Cladocera	
Chyd.	<i>Chydorus</i> spp, <i>Alona</i> spp, <i>Alonella</i> spp, <i>Pleuroxus</i> spp
Eury.	<i>Eurycercus lamellatus</i>
Camp.	<i>Camptocercus rectirostris</i>
Grap.	<i>Graptoleberis testudinaria</i>
Ilio.	<i>Iliocryptus</i> sp
Acro.	<i>Acroperus</i> sp
Unid.	Unidentified Cladocera (isolated fragments)
Eph.	Ephippia (dispersal egg stage of Cladocera)
Ostr.	Ostracoda
Chir. l.	Chironomidae larvae: Orthoclaadiinae ( <i>Cricotopus</i> spp, <i>Thienemanniella</i> spp, <i>Synorthocladus</i> sp), Chironominae ( <i>Polypedilum</i> sp, <i>Micropsectra</i> spp)
Bry.	Bryozoan statoblasts ( <i>Plumatella</i> )
Rhiz.	Rhizopoda
Aq. Col.	Aquatic Coleoptera - early instar
Unid. Aq.	Unidentified aquatic organisms
Unid. Terr.	Unidentified terrestrial organisms - mostly Diptera (Nematocera) adults, probably Chironomidae
Aran.	Araneida (spiders): pre-adult
Thys.	Thysanoptera (thrips)
Fil. alg.	Filamentous algae (probably <i>Oedogonium</i> and <i>Stigeoclonium</i> )
Det.	Detritus - mostly inorganic particles

---

Table 2. Percentage contribution of animal prey items in 0+ roach from the River Thames; mean index of abundance used for filamentous algae and detritus.

Taxa	Site 1	Site 3	Site 6	Combined
Cladocera				
Chy.	42.1	63.9	34.0	45.6
Eury.	5.1	0.9	3.0	3.6
Camp.	4.7	2.8	---	3.2
Grap.	1.3	2.8	---	1.3
Ilio.	1.7	2.8	---	1.6
Acro.	---	---	1.0	0.2
Unid.	---	0.9	---	0.2
Eph.	17.0	---	---	9.0
Ostr.	0.4	9.3	---	2.5
Chir. l.	19.1	9.3	58.0	25.5
Bry.	---	1.8	3.0	1.1
Rhiz.	---	0.9	---	0.2
Aq. Col.	0.4	0.9	---	0.5
Unid. Aq.	0.9	---	---	0.5
Unid. Terr.	4.3	3.7	1.0	3.4
Aran.	1.3	---	---	0.7
Thys.	1.7	---	---	0.9
Fil. alg.	0.2	0.4	0.6	0.4
Det.	---	0.2	---	0.1

The roach diets at the three sites were dominated by Cladocera (especially Chydoridae) and Chironomidae larvae. The Cladocera were all species associated with the benthos or with the submerged surfaces of aquatic plants. No planktonic forms (e.g. *Daphnia* spp, *Bosmina* spp) were found.

The identifiable chironomid larvae from site 1 were *Cricotopus* spp (Orthoclaadiinae), which are characteristic especially of plant surfaces, though some are plant miners. At site 6, the chironomid larvae were predominantly *Cricotopus* spp. but also present were two other Orthoclaadiinae (*Thienemanniella* and, probable identity, *Synorthocladus*) and two Chironominae (*Polypedilum* and *Micropsectra*). This association suggests feeding from lower in the plant stand where there is associated detritus.

A few prey of non-aquatic origin were taken; some were adult Diptera, probably Chironomidae, but a few thrips (Thysanoptera) and pre-adult spiders (Araneida) were also found. Some of the roach contained strands of filamentous algae.

The overall picture is of a diet of Cladocera and Chironomidae larvae taken largely from areas close to aquatic plants but at different levels of the water column. Occasional feeding may have occurred also on the water surface. This pattern of generalised feeding behaviour is typical of roach, and has been observed elsewhere, including in the IFE studies of the River Great Ouse.

#### 4. RECOMMENDATIONS FOR FUTURE STUDIES

##### 4.1. Summary of fish material from 1994 survey

The total numbers of 0 group fish caught in the 14 sites during late July/early August 1994 were:

Roach	32600	Dace	768
Gudgeon	6623	Bleak	587
Chub	982	Perch	574

In addition, small numbers of common bream, pike, barbel, bullhead, minnow, ruffe, stickleback and stone loach were recorded. Full details of all fish caught are given in the Project Specification.

##### 4.2 Limitations of fish collected in the 1994 survey

The catches of each species were not evenly distributed between the 14 sites, or between the 3 microhabitats (deep water, shallow water, shallow with macrophytes) at each site. This will impair the value of between-site comparisons, and between-microhabitat comparisons.

The value of any between-microhabitat comparison will be further devalued by the fact that, based on IFE studies in the Great Ouse, 0 group coarse fish show distinct diel movements between marginal areas and deeper, open water. Hence, the fish caught in one microhabitat may contain prey items taken elsewhere. In addition, although IFE studies in the River Great Ouse revealed few differences between the diets of any one fish species taken from different parts of the main river channel, large differences although contrasting diets were observed between fish from main river and backwater (marinas) sites.

The fish from the 1994 Thames survey were caught over a short time period (c. 2-3 weeks). Consequently the samples will not provide data on the seasonal changes in the diets of different species. 0 group coarse fish show marked changes in their diet as they grow and develop. As the fish grow larger, their mouth gape increases and they can take larger prey. An investigation of the diets of the 0 group fish caught in the 1994 River Thames survey will not show the important variation of different prey species varies during the growing period (late spring-autumn).

Moreover, the period of the survey (late July/early August) is after the probable 'critical period' for early growth and survival of 0 group fish, which largely determines the recruitment success for that year. Hence, in the IFE studies of 0 group fish in the River Great Ouse, samples of the different fish species were taken at regular intervals during the year.

#### 4.3 Future use of 1994 fish material: best options

##### 4.3.1 Comparison between species

Bearing in mind the limitations outlined in 4.2, the best use of the 1994 fish material would be a comparison of the diets of the six most numerous species (roach, gudgeon, chub, dace, bleak, perch). The preliminary study of roach diets described in section 3.4 suggests that the fish were feeding in marginal areas, probably in the close proximity to aquatic plants. However, roach are known to be very flexible in the feeding behaviour and prey preferences. Other species are more specific, so it would be useful to know something of their diets and feeding areas.

##### 4.3.2 Comparison between sites

Sufficient numbers of roach, gudgeon, chub and perch were caught for comparison of fish diets of these species at 7 of the 14

sites (sites 4, 5, 7, 9, 10, 11, 14), but only the first two species occurred in adequate numbers at all sites. More limited comparisons could be made at other sites and for other species, but recommendations on the extent of these require information on site characteristics.

#### 4.4 Diets of 0+ fish: other recommended work

Knowledge of the diets of 0+ fish is a valuable part of the work outlined in section 1.1. In this context, information on the diets of fish during their first two months of life would be valuable in understanding the dynamics of the River Thames fish community.

Hence, it is recommended that a new survey is instigated in which fish samples are taken at regular intervals from May to September. Four weeks is recommended as the longest interval between samples that will provide the necessary data.

The material collected would enable inter-specific differences in diets to be determined, and also the degree to which such differences change as the fish grow and develop. The seasonal changes will also depend in changes in the availability of different prey items.

Differences between major types of habitat could be identified by the selection of appropriate sites. For this last purpose, sampling at 14 sites (plus 3 subsites) as in the 1994 survey would not be necessary. Sufficient information could be obtained from 3 or 4 carefully selected sites.

As a bonus, the fish collected would provide information on seasonal growth characteristics.

Appendix 1. Lengths (mm) and weights (g) of juvenile roach from the River Thames, 1994 Survey, used for gut contents examination. SL = standard length, FL = fork length, TL = total length, Wt = weight.

	SL mm	FL mm	TL mm	Wt g
<hr/>				
<u>Site 1</u>				
A1	50	53	56	1.9
A2	42	46	51	1.3
A3	41	46	51	1.4
A4	36	40	44	0.9
A5	38	44	48	1.1
A6	36	40	45	1.0
A7	33	37	41	0.6
A8	28	31	34	0.4
A9	27	30	32	0.3
A10	21	24	26	0.2
<u>Site 3</u>				
B1	35	38	42	0.8
B2	34	38	41	0.7
B3	35	38	42	0.8
B4	30	35	39	0.6
B5	28	31	35	0.4
B6	29	33	36	0.5
B7	31	35	38	0.6
B8	32	36	39	0.5
B9	32	35	38	0.5
B10	22	25	29	0.2
<u>Site 6</u>				
C1	26	30	32	0.4
C2	30	33	36	0.5
C3	27	30	33	0.4
C4	28	31	34	0.4
C5	29	32	35	0.5
C6	29	32	35	0.4
C7	27	30	33	0.3
C8	26	30	32	0.3
C9	24	26	29	0.2
C10	25	29	32	0.3
<hr/>				

Appendix 2. Numbers of prey items in 10 roach from site 1 of the 1994 River Thames Juvenile Fish Survey. Filamentous algae and detritus are recorded as indices (0 = none to 3 = full).

Site 1	Code A:	1	2	3	4	5	6	7	8	9	10	Tot.
<u>No. of organisms</u>												
Cladocera												
	Chyd	4	5	55	4	11	17		3			99
	Eur.	2	1		3	1	1		4			12
	Camp.	1	1		6	1	1		1			11
	Grap.		2				1					3
	Ilio								4			4
	Acr.											0
	Unid.											0
	Eph.							35	5			40
	Ostr.				1							1
	Chir. l.		14	15	11	1	2	1		1		45
	Bry.											0
	Rhiz.											0
	Aq. Col.		1									1
	Unid. Aq.						1	1				2
	Unid. Terr.		2	2				1	1	3	1	10
	Aran.		1		1			1				3
	Thys.										4	4
<u>Index of abundance</u>												
	Fil. alg.							(1)	(1)			
	Det.											

Appendix 3. Numbers of prey items in 10 roach from site 3 of the 1994 River Thames Juvenile Fish Survey. Filamentous algae and detritus are recorded as indices of (0 = none to 3 = full).

Site 3	Code B:	1	2	3	4	5	6	7	8	9	10	Tot.
<u>No. of organisms</u>												
Cladocera												
Chy.		1		9	1	24	2	20	E		12	69
Eury.								1	M			1
Camp.						2		1	P			3
Grap.				1				2	T			3
Ilio.						1	2		Y			3
Acro.												0
Unid.			1									1
Eph.												0
Ostr.						5	3	2				10
Chir. l.				1	2	4	1			2		10
Bry.				2								2
Rhiz.											1	1
Aq. Col.							1					1
Unid. Aq.												0
Unid. Terr.				1	1			1			1	4
Aran.												0
Thys.												0
<u>Index of abundance</u>												
Fil. alg.				(2)	(1)						(1)	
Det.		(1)									(1)	



Appendix 4. Numbers of prey items in 10 roach from site 6 of the 1994 River Thames Juvenile Fish Survey. Filamentous algae and detritus are recorded as indices (0 = none to 3 = full).

Site 6	Code C:	1	2	3	4	5	6	7	8	9	10	Tot.
<u>No. of organisms</u>												
Cladocera												
	Chyd.	1	1	3	5	2		4	3	5	10	34
	Eury.			1			2					3
	Camp.											0
	Grap.											0
	Ilio.											0
	Acro.									1		1
	Unid.											
	Eph.											0
	Ostr.											0
	Chir. 1.	15		2	5	2	3	7	10	4	10	58
	Bry.	1	1								1	3
	Rhiz.											0
	Aq. Col.											0
	Unid. Aq.											0
	Unid. Terr.	1										1
	Aran.											0
	Thys.											0
<u>Index of abundance</u>												
	Fil. alg.	(1)				(2)		(1)	(1)	(1)		
	Det.											

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