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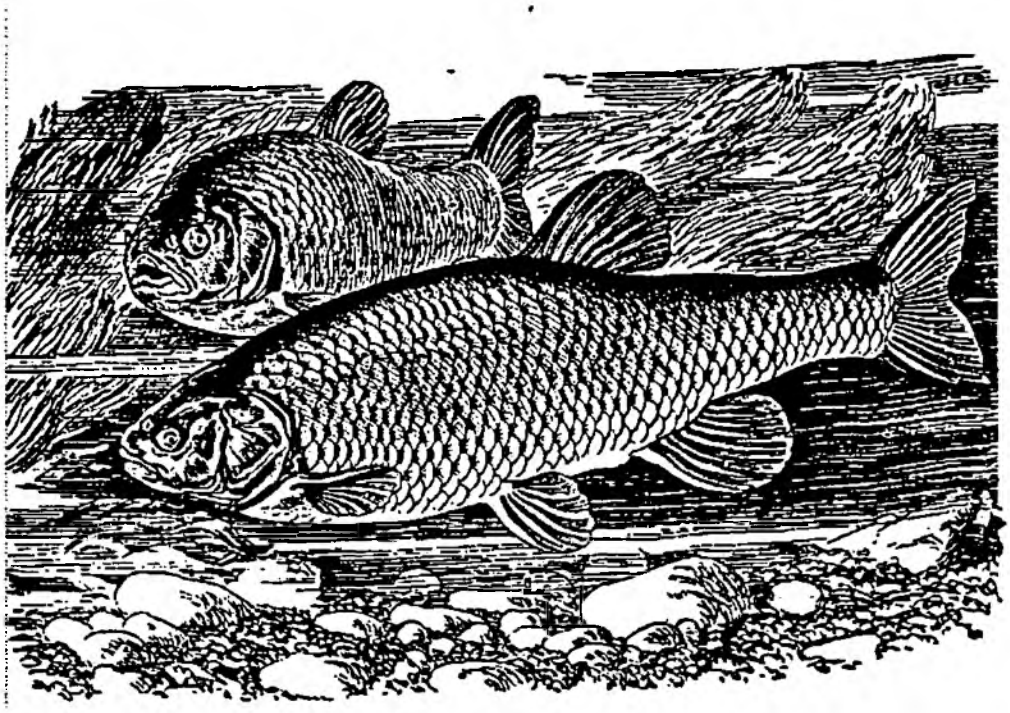
NRA

National Rivers Authority
Thames Region

RIVER BOURNE SYSTEM

FISHERIES SURVEY

1989-1990



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CONTENTS

1 SUMMARY

The fish populations of the Bourne system were surveyed by Mid-Thames Fisheries between October 1989 and June 1990. 14 sites were fished; 5 on the North Bourne, 4 on the Halebourne, 2 on the Grantsbourne and 3 on the South Bourne.

On the North Bourne 3 of the sites were EC designated, representing 6.5km of river, and all exceeded their target biomass of $20gm^{-2}$ for a cyprinid fishery. Sites fished on the South Bourne also produced excellent biomass results. The survey revealed fish populations on the Halebourne to be generally poor.

Growth rates were slightly below standard for most species throughout the Bourne system.

The principal species found were dace, *Leuciscus leuciscus*, chub, *Leuciscus cephalus*, roach, *Rutilus rutilus*, gudgeon, *Gobio gobio*, eel, *Anguilla anguilla*, and perch, *Perca fluviatilis*.

2 INTRODUCTION

This survey represents the first study of fish populations of the River Bourne system. Due to the scarcity of organised angling, only limited information has previously been obtained, from fish mortalities and through monitoring as part of the Salmon Rehabilitation Scheme on the Grantsbourne and Halebourne.

The Grantsbourne and the Halebourne were known to support small numbers of brown trout *Salmo trutta*. These streams were identified as potential nursery sites for salmon *Salmo salar* and were stocked with parr between 1979 and 1982, though this was discontinued as a result of the poor survival rate shown by follow up surveys. Elsewhere on the Bourne system coarse fishing takes place mostly on a casual basis, the North Bourne above Chertsey being noted as one of the more popular sections.

2.1 Description of Watercourse

A map of the Bourne system is shown in Fig.1.1 annotated with the reference ascribed to each site surveyed. The major discharge points are also indicated.

The Bourne system comprises the North Bourne and the South Bourne, the upper South Bourne having main tributaries, the Halebourne and the Grantsbourne.

The North Bourne arises from Bagshot Beds north-east of Chobham Common. It flows east through Virginia Water, Thorpe and Chertsey, meeting the confluence with the South Bourne at Chertsey Meads (TQ063657); a distance of approximately 21 km.

The main source of the Halebourne is the Windlebrook, which arises from Bagshot Beds north-west of Bagshot. Flowing east for approximately 9 km, and passing through Chobham, the Halebourne joins the Grantsbourne south of Fairoaks Airport (TQ002615). A small tributary, the Clappers Brook, arises south of Chobham Common and meets the Halebourne 1 km before Chobham (SU965619).

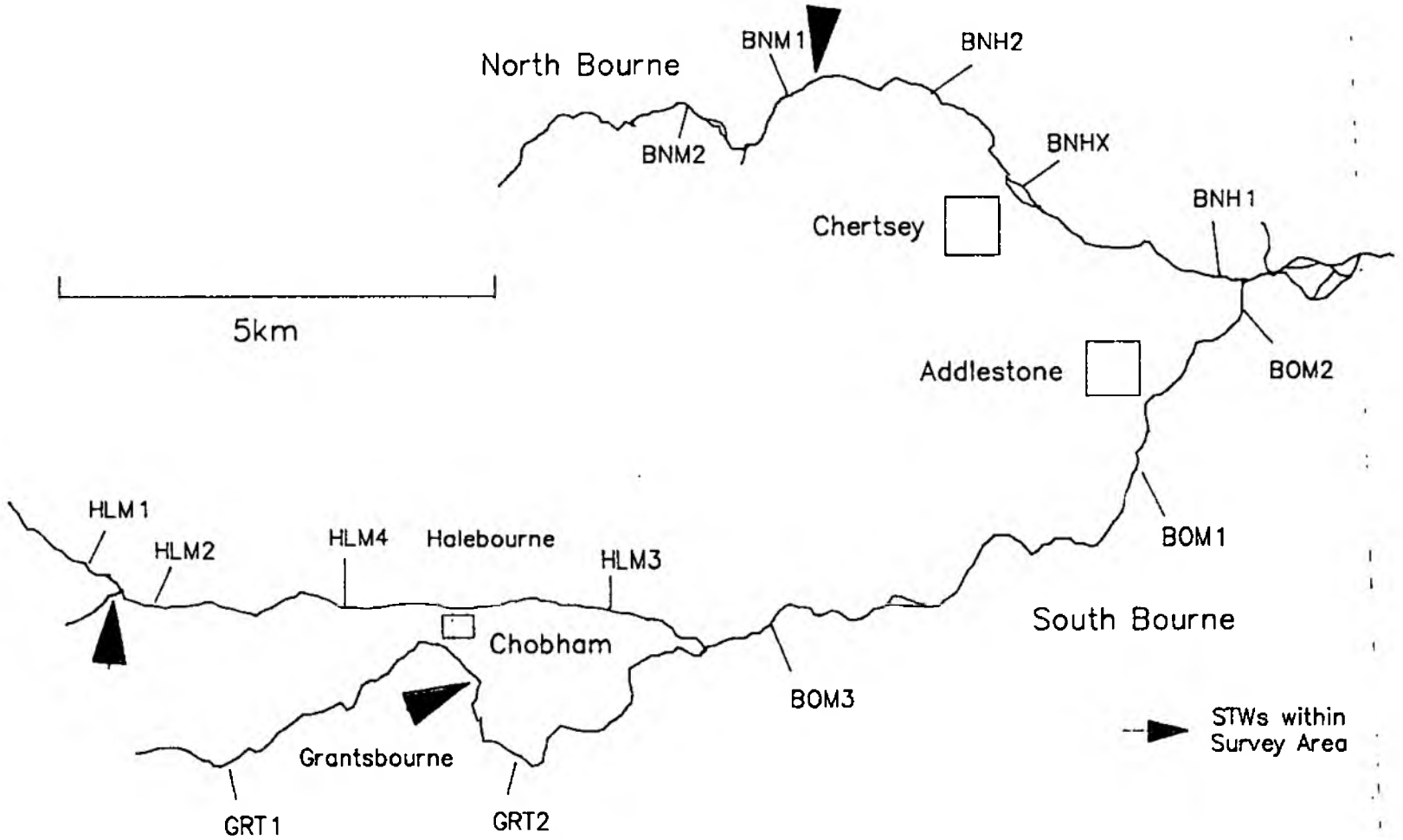
The Grantsbourne originates from a number of small streams arising from Bagshot Beds on Westend Common. It flows east for approximately 9km, before reaching the confluence with the Halebourne. The South Bourne then flows east to Woodham and north-east through Addlestone to meet the North Bourne, a distance of approximately 22km.

The combined Bourne flows approximately 1km before joining the River Thames on the loop around Penton Hook Island (TQ070656).

2.2 Geology

The geology of the catchment is mainly alluvium on Bagshot Beds.

Fig 1.1 – Map of River Bourne System
Showing Survey Sites



2.3 Hydrology

There are no gauging stations on the Bourne system and hence flow data is somewhat limited, particularly for recent years. The National Rivers Authority Hydrological Services have data spanning thirty years for several sites. Flow gaugings recorded between 1988 and 91 are presented in Fig. 2.1.

2.4 Main Discharges

		Consent Conditions			
	Volume m3/day	BOD	S.S.	NH3	N.G.R.
North Bourne: Chertsey S.T.W.	79080	18	30	10	TQ016680
Halebourne: Lightwater S.T.W.	12350	18	36	16	SU939622
Grantsbourne: Chobham S.T.W.	12600	10	20	10	SU977611

2.5 Fish Mortalities

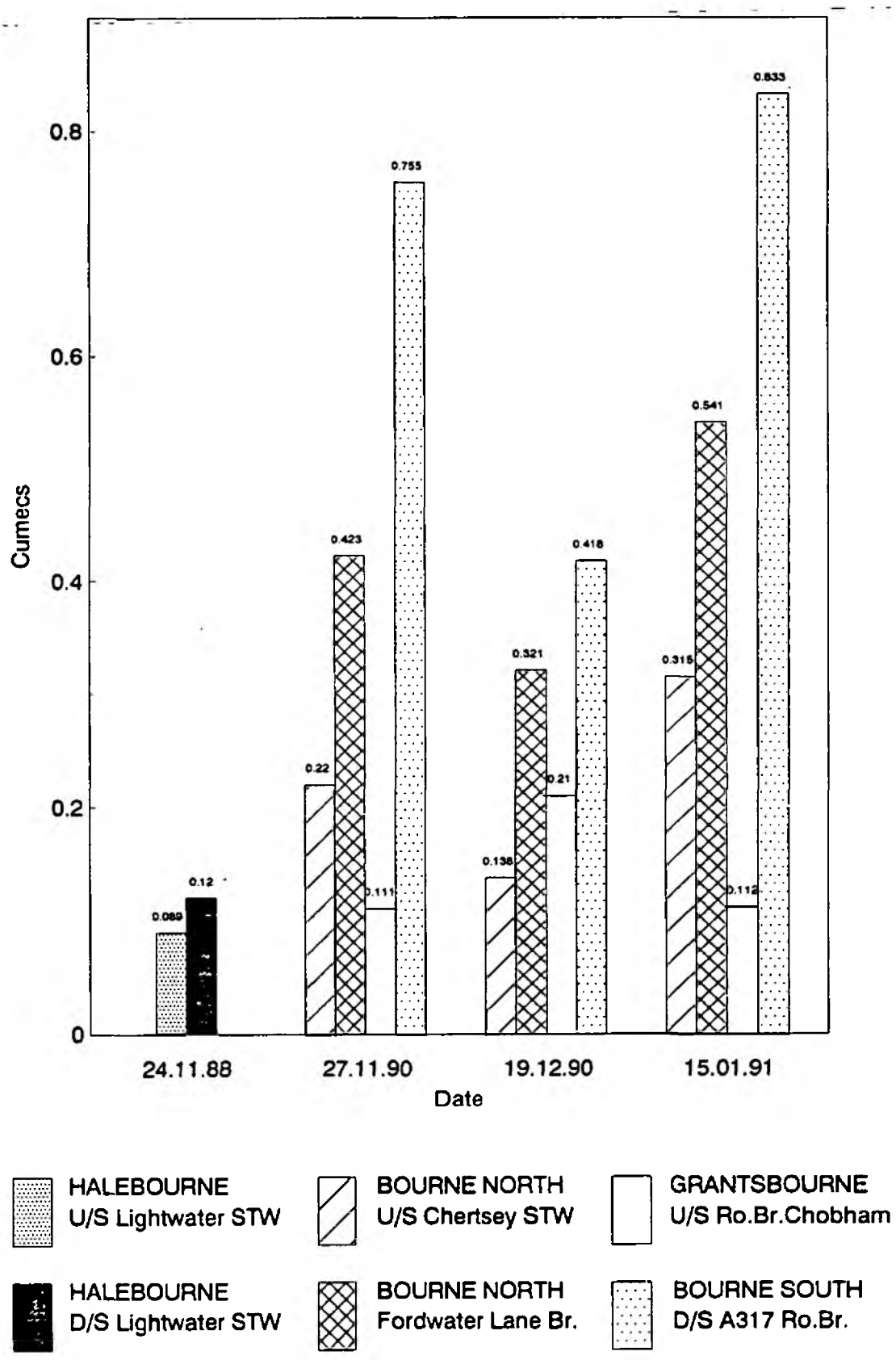
Records show the North Bourne to have suffered no significant fish mortalities in the last ten years.

The southern arm of the Bourne has been less fortunate. In 1983 a minor mortality occurred on the Windlebrook involving a small number of brown trout and various minor species. This followed heavy rainfall and was assumed to be the result of a low pH input flushed from the surrounding area. Also in 1983 a localised mortality occurred on the South Bourne in the Woodham area 10 km upstream of the North/South Bourne confluence, the suspected pollutant being a pesticide.

A more serious incident occurred in the summer of 1985 when approximately 1.2 cubic metres of Cuprinol wood preservative entered the Windlebrook. It was estimated that over 500 fish, including gudgeon, chub, pike *Esox lucius* and brown trout, were killed as far downstream as the confluence of the Halebourne with the Grantsbourne. Then, in February 1986, another Cuprinol pollution occurred from the same source. This time 1000 gallons was spilt causing a further major loss of fish and invertebrate life.

Farm silage entering the Grantsbourne at West End killed several brown trout in the summer of 1984. In the same area in May 1989 an unknown pollutant killed over 200 fish including 50 brown trout.

Fig. 2.1: Bourne System Flow Gaugings



The South Bourne suffered a mortality in the New Haw and Addlestone area in July 1983 involving over 500 fish including chub, dace, pike and brown trout. The pollutant was thought to be a pesticide, though this was never proven. Around the same area in March 1984 a localised chlorine pollution killed an estimated 160 coarse-fish.

2.6 Fisheries Management Work

In July 1989 the Grantsbourne was stocked with 100 brown trout following a localised mortality. Prior to this, fisheries management on the Bourne system has been limited to the work of the salmon rehabilitation scheme. As a result of this the Halebourne was stocked with a total of 1800 salmon parr over 1979 and 1980, and the Grantsbourne stocked with 5600 parr between 1979 -1982.

3 AIMS AND OBJECTIVES

3.1 Overall Aims and Objectives

The National Rivers Authority has a statutory obligation to maintain, improve and develop inland fisheries. To assist in meeting this obligation, NRA Thames Region fisheries staff have engaged upon a five year rolling programme of riverine fish population surveys to establish baseline data for each major watercourse in the Thames catchment.

3.2 River Classifications

River water quality is classified according to the National Water Council River Quality Objectives 1978 (as amended by Thames Water Authority 1987).

Under the European Community Directive (78/659/EEC), river zones are designated as capable of supporting either salmonid or cyprinid fish.

Further details of the N.W.C. classification system and the EC Directive appear in appendices I-III.

The NRA Thames Region have developed a site code classification system based upon the RQO and the EC Directive. A description of this appears in Appendix IV.

Fish biomass targets are applied within the NRA Thames Region with respect to EC Designated fisheries, viz -

Cyprinid - $20gm^{-2}$
Salmonid - $15gm^{-2}$

The RQO and EC directives assigned to the Bourne catchment are as follows (EEC designation in parentheses):

Bourne North : Source to Chertsey STW - 1B

Chertsey STW to Thames - 2/1B (Cyprinid)

Halebourne : Source to Bourne South - 1B

Grantsbourne : Source to Bourne South - Unclassified

Bourne South : Confluence to Thames - 1B

3.3 Specific Aims

The specific aim of this survey was to obtain baseline data on the fish populations of the Bourne system as part of the NRA's monitoring program.

4 METHODS

4.1 Site Selection

A total of 13 sites were selected and fished between October 1989 and December 1989. An extra site (BNHX) was fished in June 1990 in reaction to proposed development and river enhancement at Chertsey. Sites were selected to represent local environmental conditions within the defined water quality zones, taking into account topography, known water quality impacts and access considerations.

4.2 Capture and Data Acquisition

At each site, a stretch of river of at least 100m in length was enclosed by stop-nets. Catch-depletion electrofishing techniques, using pulsed DC equipment developed in-house, were applied at each site. 3 runs were made at most of the sites, but only 2 at sites where depletion was particularly good. Where appropriate, a qualitative assessment was made upstream and downstream to assess whether the chosen site was representative of a longer stretch of river.

At each of the sites, all fish captured were enumerated by species and their fork length measured to the nearest mm. When catches were relatively low (<40 per species), all fish were also weighed to the nearest g. With larger catches, subsamples of up to 40 fish of each species were weighed. Samples of scales, taken from the shoulder region, were also removed and stored for later age estimation.

Minor species, such as bullhead *Cottus gobio*, stone loach *Noemacheilus barbatulus*, stickleback *Gasterosteus aculeatus*, and minnow *Phoxinus phoxinus*, were generally noted only as present or absent.

Details of the major physical characteristics of each site, such as weed and bankside cover, depth, temperature, and substrate type were also recorded. These details appear in the relevant site report (section 5.1 *et seq.*).

All data acquired in the field were entered into a Husky Hunter datalogger. This was later downloaded to an IBM compatible microcomputer for subsequent analysis.

4.3 Data Analysis

All data were processed on the microcomputer using the Fisheries Information (FINS) software developed by Thames NRA. Graphics were generated using Freelance plus v.3.0.

4.4 Health Examination

No samples were collected for parasitology. No disease related external symptoms were observed by visual assessment. Following a major wood preservative pollution that occurred on the southern arm of the Bourne shortly after this survey, fish have been collected for tissue analysis. These samples have yet to be analysed.

4.5 Macroinvertebrates

NRA Biology staff are engaged upon a biological monitoring programme of the main watercourses in the Thames region. Data on the macroinvertebrates from this source are presented in this report. The species composition of invertebrates tend to reflect the physico-chemical variations which occur in a river and this provides a means of assessing the aquatic environment on a continuous basis.

A system of quantifying this data has been developed based on the Biological Monitoring Working Party (BMWP) scoring system, Which relates the scored result to the RQO.

4.6 Water Quality

River water quality is collected at strategically located Reach Assessment Points by the NRA Environmental Quality department. Listed below are the sampling points falling within the survey area.

Bourne North at Hamperstone Bridge. TQ035672 PBNR.0001

Bourne North at Sandpit Bridge. TQ029677 PBNR.0002

Bourne North at Thorpe Green Bridge. TQ014680 PBNR.0003

Halebourne above Lightwater S.T.W.. SU939623 PBNR.0033

Halebourne at Halebourne Lane. SU954619. PBNR.0006

Bourne South at Mimbridge. SU991606 PBNR.0004

Bourne South at Woburn Bridge, Addlestone. TQ061650 PBNR.0023

Bourne South at Dunfold Bridge. TQ017619 PBNR.0019

Bourne above Thames. TQ067657 PBNR.0005

5 RESULTS

5.1 Site Results

Results are presented on the following pages in the form of a site report, biomass and density summaries and relevant length/frequency histograms for each site. Fish less than 8cm in length are not included in the graphic biomass and density summaries. Where total biomass and density is referred to in the site report, this includes fish under 8cm.

Graphical information - biomass, density and length-frequency distribution - relating to each site is shown following the details of each individual site, and a schematic representaiom of fish biomass at each site is shown in Fig.5.15.

5.1.1 Site BNM2 Trumps Green

WATERCOURSE: North Bourne

N.G.R.: TQ003676 DATE: 30.11.89

METHOD: Electric fishing from boat. 2 anodes. No stop nets.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 140m
WIDTH: 4m
AREA: 0.056 sq.km
DEPTH: 1.5m

SUBSTRATE COMPOSITION (%):

BARE: 70
MUD&SILT: 25
GRAVEL: 5
STONE: 0

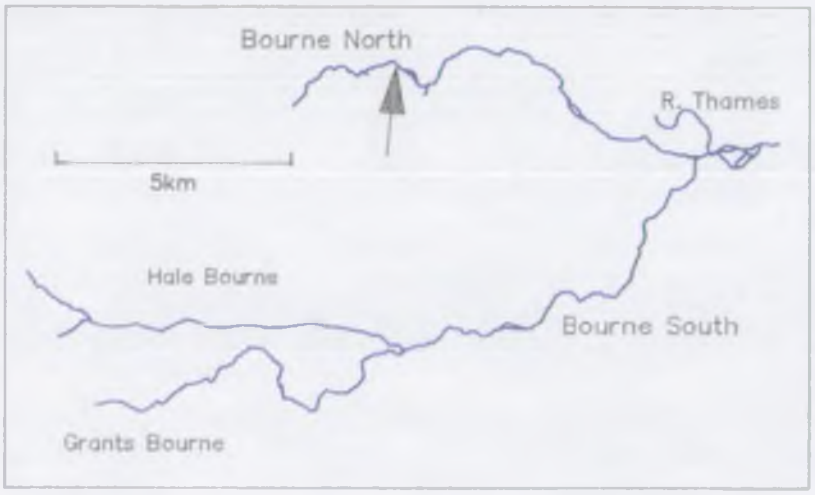
VEGETATION (% COVER):

SUBMERGED: 0
FLOATING: 0
EMERGENT: 0
SHADE: 90

This site represents the upstream limit of the North Bourne fish populations. The habitat was extensively shaded by thick woodland on both banks and the channel deep with no instream vegetation. The water has an orange colour indicating iron in solution which can also be seen deposited in association with iron bacteria on fixed objects in the water. From approximately 1km upstream of the Chertsey S.T.W. outfall there appears to be little suitable habitat for fish due to the heavy shading and lack of aquatic vegetation.

Despite sampling an extended length of river at this site, only a single juvenile perch was found.

FIG 5.1a: SITE BNM2 Biomass and Density



	Biomass gm-2	Density nm-2
Total	0.0	0.000

5.1.2 Site BNM1 Lyne Lane

WATERCOURSE: North Bourne

N.G.R.: TQ014679 DATE: 24.10.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 162m
WIDTH: 4.1m
AREA: 0.066 sq.km
DEPTH: 0.5m

SUBSTRATE COMPOSITION (%):

BARE: 60
MUD&SILT: 25
GRAVEL: 15
STONE: 0

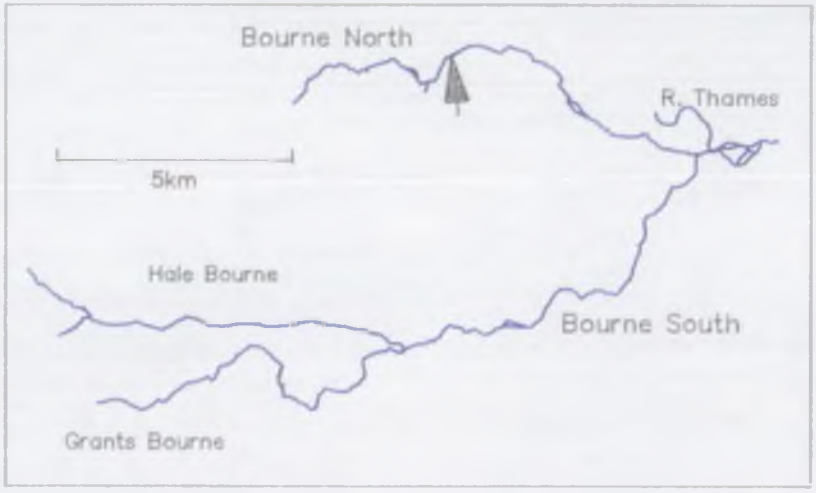
VEGETATION (% COVER):

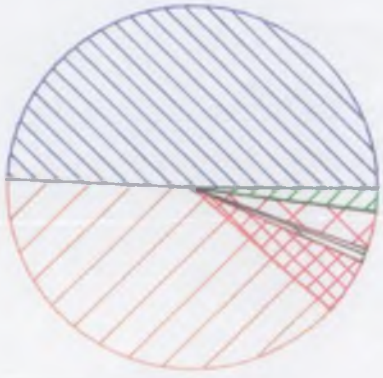
SUBMERGED: 0
FLOATING: 0
EMERGENT: 15
SHADE: 45

This site is approximately 100m upstream of the Chertsey S.T.W. outfall. The channel was shallow, narrow and meandering with a mainly bare clay substrate. Small areas of riffle over gravel were also present. Shade was provided by woodland on the left bank while the right bank was more open, bordering onto an uncultivated field. There was little weed cover, mostly *Schoenoplectus lacustris*.

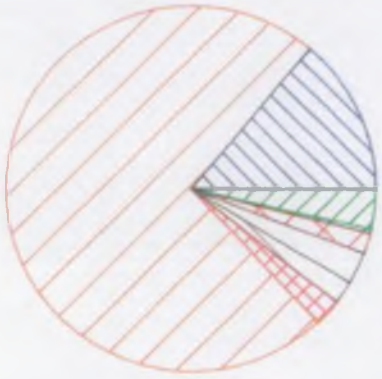
Thirteen species were found, attaining a biomass of 63.1 gm^{-2}, the greatest in the whole of the Bourne system, with a density of 0.613 nm^{-2}. Dace and chub heavily dominated the catch. Lampreys were abundant.

FIG 5.2a: SITE BNM1 Biomass and Density





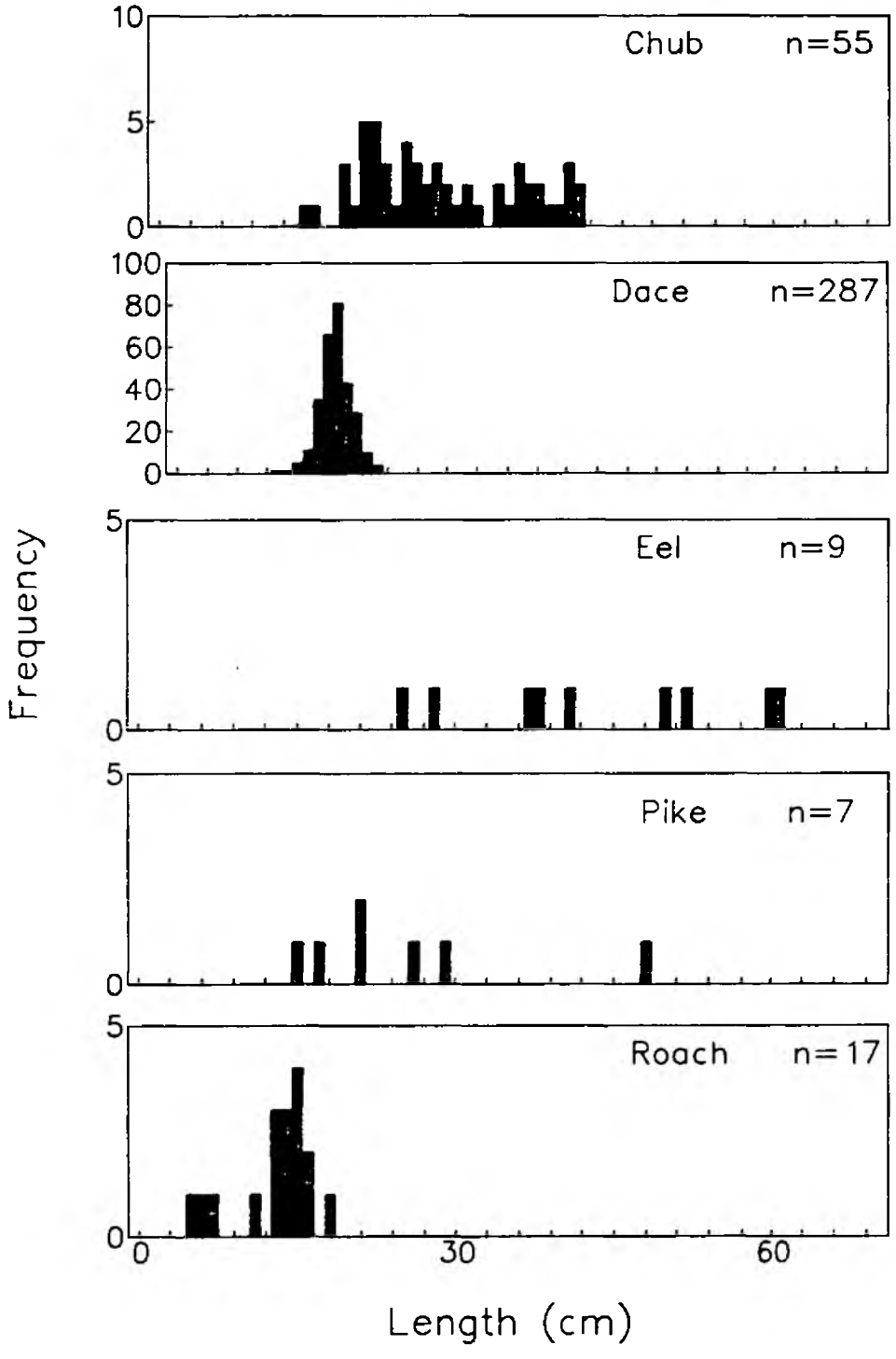
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	31.1	0.083
Dace	24.7	0.439
Eel	3.2	0.014
Gudgeon	0.4	0.012
Perch	0.3	0.017
Pike	2.1	0.011
Ruffe	0.0	0.002
Roach	1.2	0.021
Total	63.0	0.599

Fig 5.2b: BNM1 – Length Frequency By Species



5.1.3 Site BNH2 Thorpe

WATERCOURSE: North Bourne

N.G.R.: TQ030677 DATE: 26.10.89

METHOD: Electric fishing by wading. 3 runs. 2 anodes.

R.Q.O.: 2/1B E.C. TARGET BIOMASS: 20gm^{-2}

HABITAT FEATURES.

LENGTH: 119m
WIDTH: 4.6m
AREA: 0.055 sq.km
DEPTH: 0.4m

SUBSTRATE COMPOSITION (%):

BARE: 0
MUD&SILT: 90
GRAVEL: 10
STONE: 0

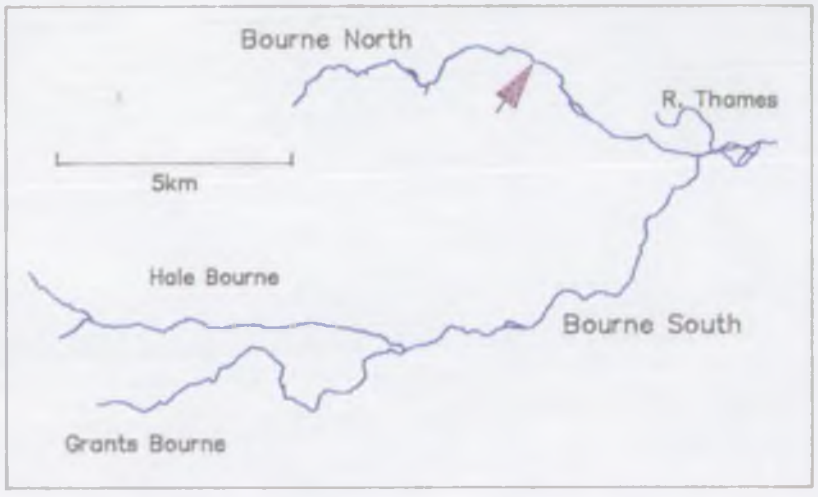
VEGETATION (% COVER):

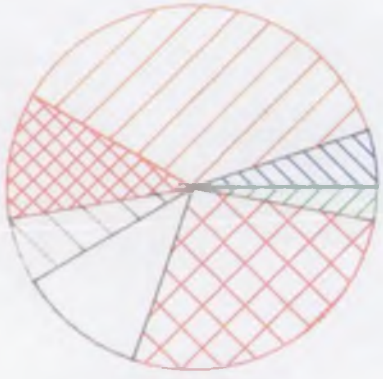
SUBMERGED: 10
FLOATING: 20
EMERGENT: 10
SHADE: 65

Situated approximately 1 km below Chertsey S.T.W. outfall, this site incorporates part of the Leisure Sport Chertsey venue. The channel was shallow, silty and of uniform depth and width. Woodland bordered one bank while shade from the opposite bank was provided by shrubs and a few small trees.

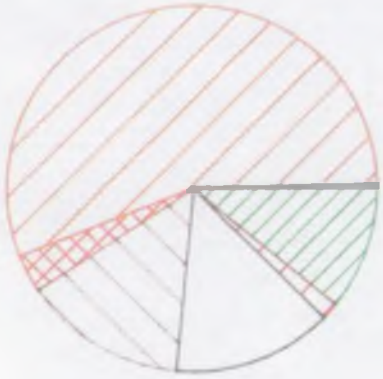
The catch here was characterised by the very large number of juvenile fish, mainly roach under 8 cm. In all, 14 species were recorded. Dace and pike dominated the total biomass of 29.9 gm^{-2} while dace contributed to over half the total density of 1.401 nm^{-2}. Several good sized perch were caught, up to 27 cm, presumably thriving on the large numbers of small prey fish. Chub were rare with only one adult found.

FIG 5.3a: SITE BNH2 Biomass and Density





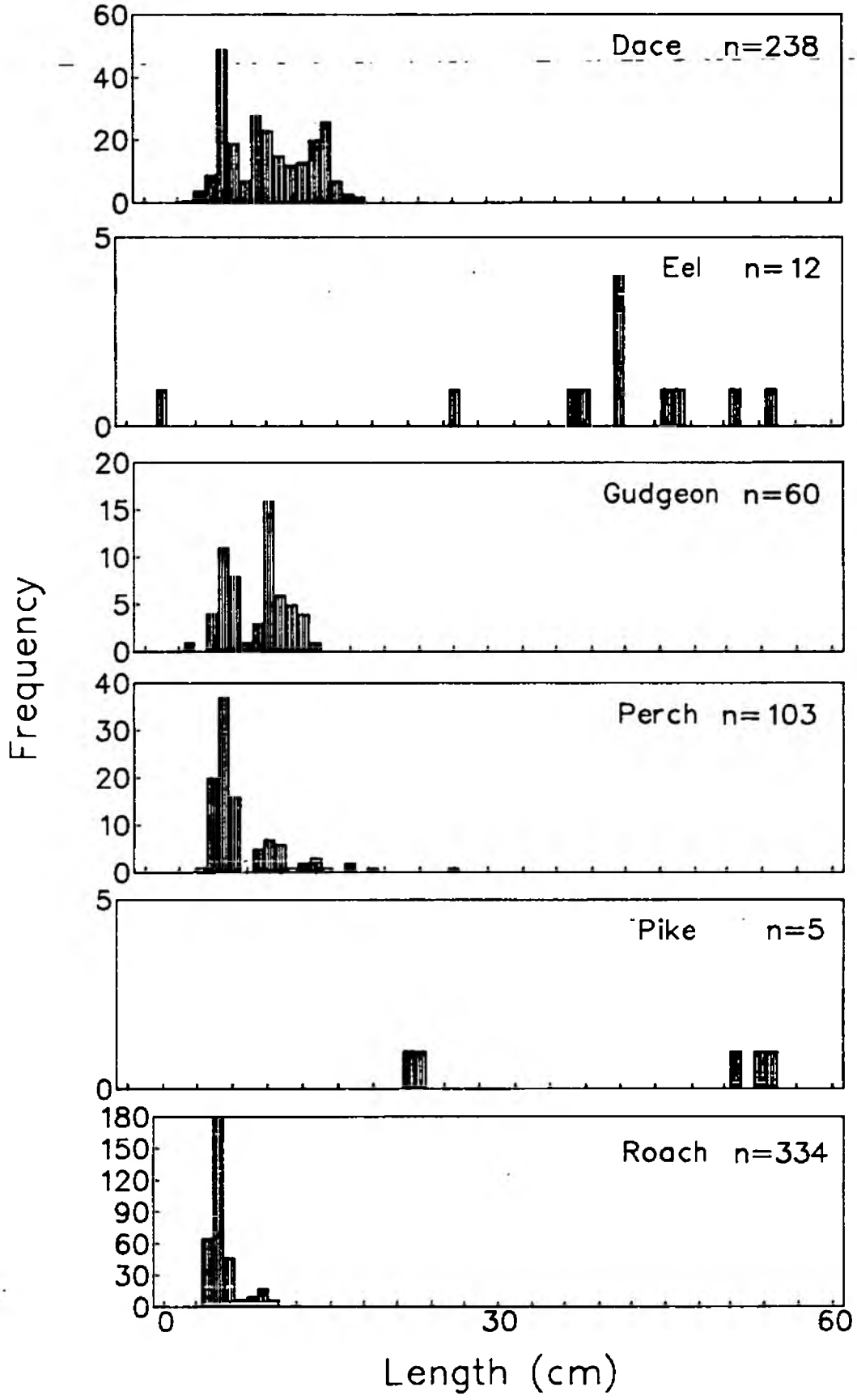
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	1.4	0.002
Dace	10.0	0.331
Eel	3.1	0.020
Gudgeon	1.6	0.084
Perch	3.0	0.084
Pike	7.5	0.009
Roach	0.8	0.065
Total	27.4	0.595

Fig 5.3b: BNH2 – Length Frequency By Species



5.1.4 Site BNHX Gogmore Farm

WATERCOURSE: North Bourne

N.G.R.: TQ036670 DATE: 18.06.90

METHOD: Electric fishing by wading. 2 anodes. 1 run.

R.Q.O.: 2/1B E.C. TARGET BIOMASS: $20gm^{-2}$

HABITAT FEATURES.

LENGTH: 100m
WIDTH: 4m
AREA: 0.040 sq.km
DEPTH: 1m

SUBSTRATE COMPOSITION (%):

BARE: 0
MUD&SILT: 99
GRAVEL: 0
STONE: 0

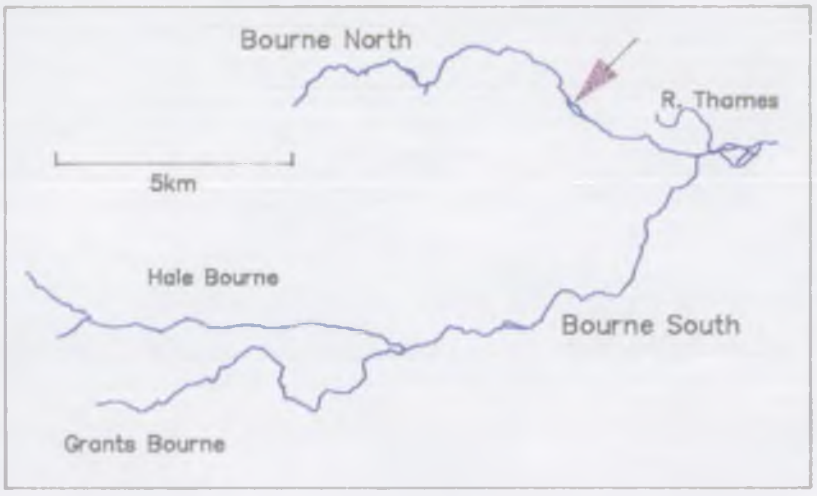
VEGETATION (% COVER):

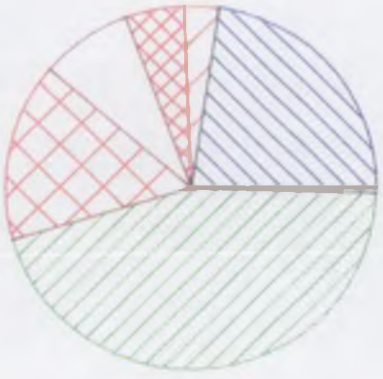
SUBMERGED: 80
FLOATING: 40
EMERGENT: 30
SHADE: 20

This site was surveyed as a result of intended redevelopment in and adjacent to the river. The channel had been dredged over width in the past and hence contained a great depth of silt. Natural recovery through the extensive encroachment of emergent vegetation creating sinuosity in the channel was observed . Species included yellow iris, *Iris pseudacorus*, reedmace, *Typha sp.* reed canary-grass, *Phalaris sp.* and watercress *Rorippa spp.*. Filamentous algae was very abundant mid-channel.

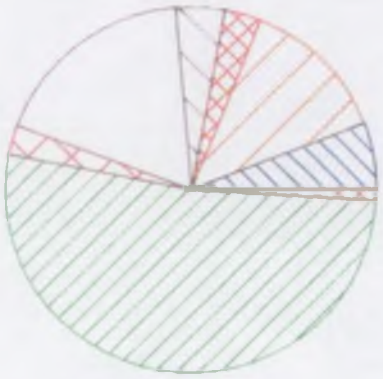
Efficient sampling was difficult and only a single run was carried out giving a minimum biomass estimate of $40.9gm^{-2}$ and a density of $0.381nm^{-2}$. Roach were the dominant species, length frequency results indicating successful recruitment. Chub were the next most abundant by biomass though natural recruitment was not evident. No minor species were observed.

FIG 5.4a: SITE BNHX Biomass and Density





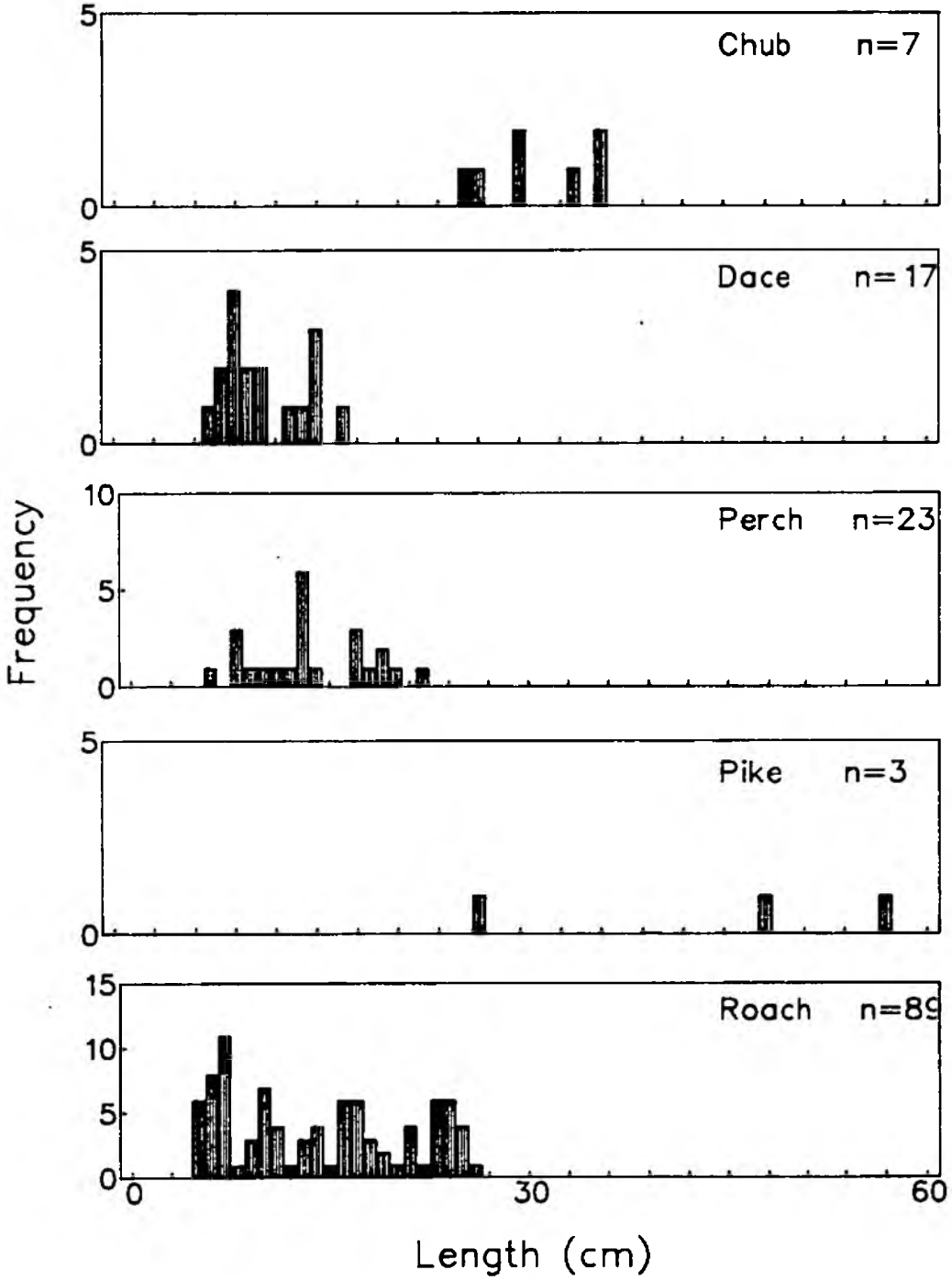
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	9.3	0.018
Dace	1.2	0.040
Eel	2.1	0.010
Gudgeon	<0.1	0.013
Perch	3.3	0.055
Pike	6.5	0.008
Roach	18.4	0.160
Tench	0.2	0.003
Total	40.9	0.307

Fig. 5.4b: BNHX – Length Frequency By Species



5.1.5 Site BNH1 Chertsey Meads

WATERCOURSE: North Bourne

N.G.R.: TQ064658 DATE: 20.10.89

METHOD: Electric fishing by wading. 2 anodes. 3 runs.

R.Q.O.: 2/1B E.C. TARGET BIOMASS: $20gm^{-2}$

HABITAT FEATURES.	SUBSTRATE COMPOSITION (%):
LENGTH: 155m	BARE: 0
WIDTH: 6.8m	MUD&SILT: 90
AREA: 0.105 sq.km	GRAVEL: 10
DEPTH: 1.5m	STONE: 0

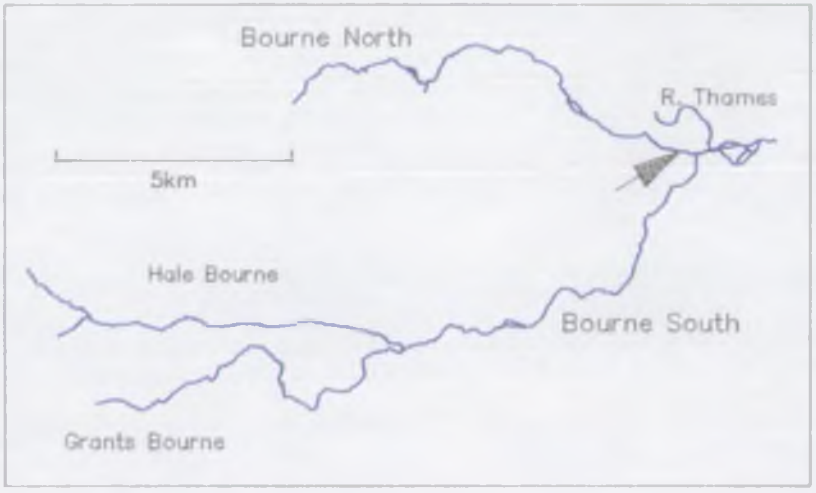
VEGETATION (% COVER):

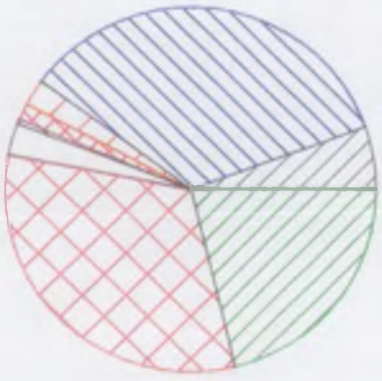
SUBMERGED: 10
FLOATING: 0
EMERGENT: 0
SHADE: 65

Bourne, starting 100 metres upstream of the South Bourne confluence. The substrate was littered with debris from overhanging trees and deep with silt. The banks were steep, the channel having been heavily dredged in the past. Thick woodland overhangs the right bank, with mainly nettles covering the left bank. Instream vegetation comprised mostly hornwort, *Ceratophyllum sp.*.

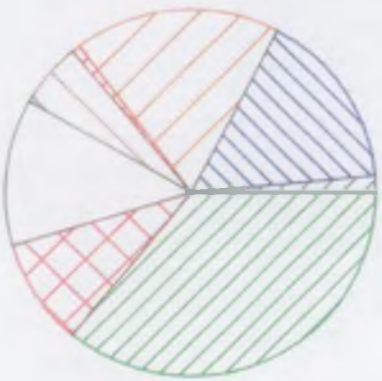
Due to the depth of the channel and the nature of the substrate wading was difficult and efficiency of capture poor. Nevertheless a biomass of $31.4gm^{-2}$ and a density of $0.173nm^{-2}$ was recorded. Roach were the most numerous species, found over a wide size range demonstrating good natural recruitment. Chub and pike dominated the biomass. The presence of small dace and, to some extent, chub is likely to be due to the influence of the habitat downstream on the combined and south Bourne.

FIG 5.5a: SITE BNH1 Biomass and Density





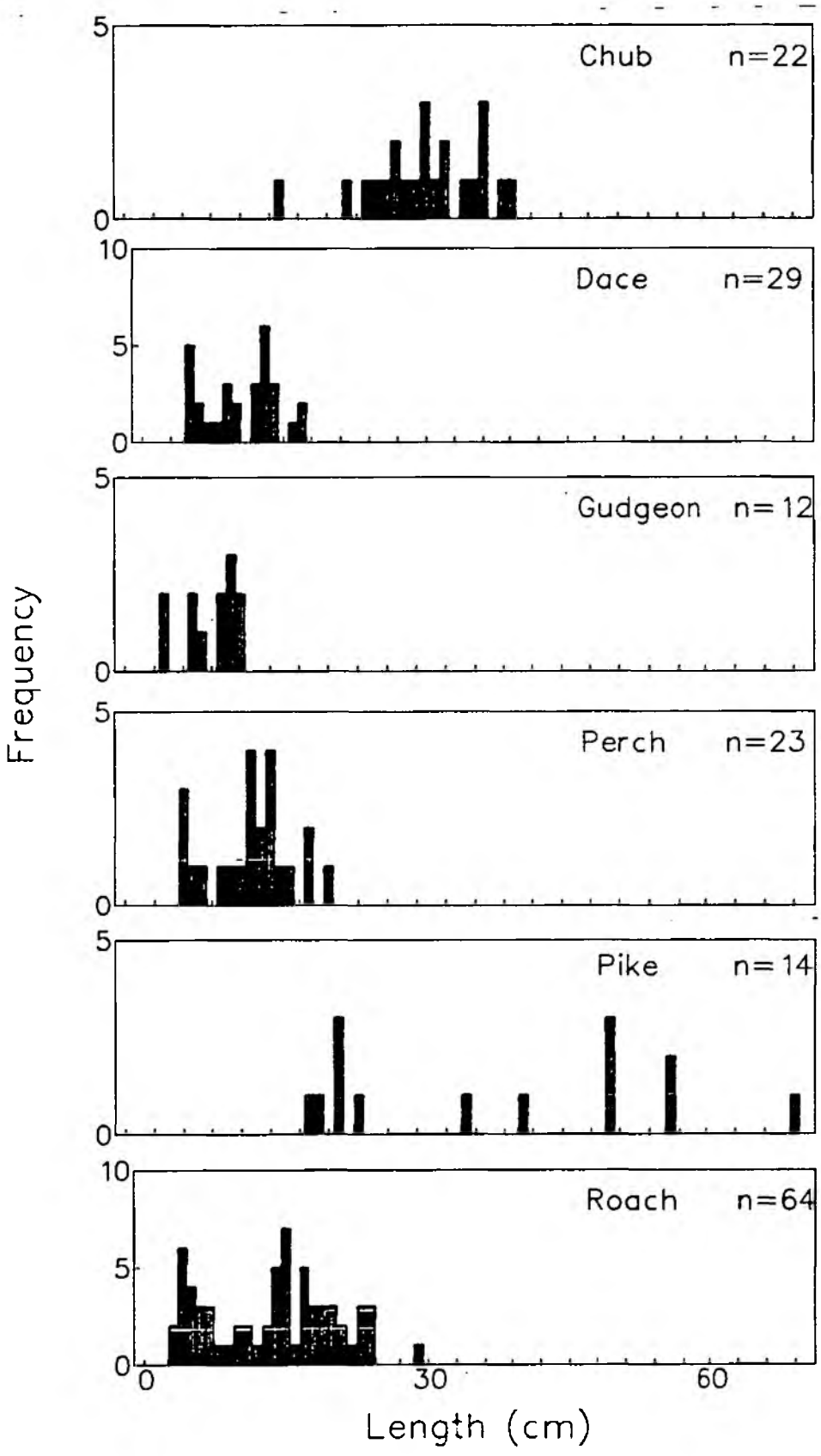
Biomass



Density

	Biomass gm−2	Density nm−2
Bream	1.7	0.002
Chub	10.8	0.022
Dace	0.7	0.025
Eel	0.5	0.001
Gudgeon	0.1	0.008
Perch	0.9	0.018
Pike	10.0	0.013
Roach	6.7	0.050
Total	31.4	0.139

Fig 5.5b: BNH1 – Length Frequency By Species



5.1.6 Site HLM1 Windlebrook

WATERCOURSE: Halebourne

N.G.R.: SU936624 DATE: 17.10.89

METHOD: Electric fishing by wading. 2 anodes.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 120m
WIDTH: 2.3m
AREA: 0.028sq.km
DEPTH: 0.4m

SUBSTRATE COMPOSITION (%):

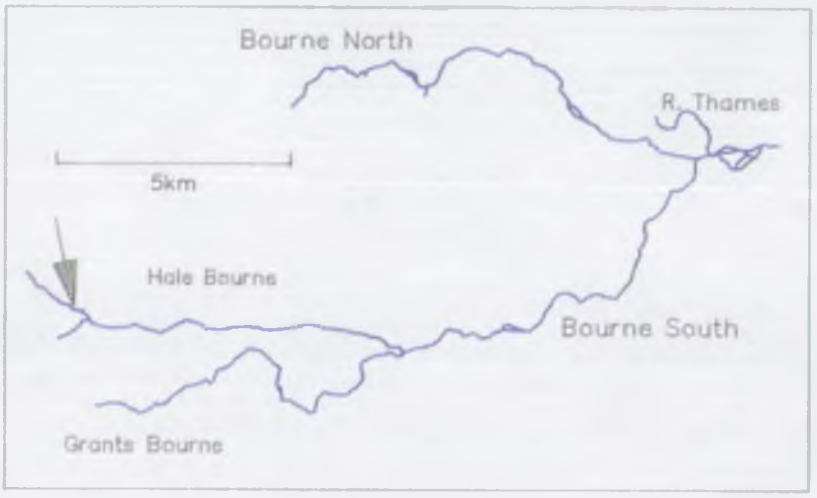
BARE: 30
MUD&SILT: 50
GRAVEL: 20
STONE: 0

VEGETATION (% COVER):

SUBMERGED: 5
FLOATING: 0
EMERGENT: 5
SHADE: 85

This site was 20 metres upstream of the Lightwater S.T.W. discharge. The stream ran through a densely wooded area and was very narrow, slow flowing and turbid. The substrate consisted of clay with a fine covering of silt and was virtually bare of aquatic vegetation. A single perch fry was found along with small numbers of bullhead and stone loach.

FIG 5.6a: SITE HLM1 Biomass and Density



	Biomass gm−2	Density nm−2
Total	0.0	0.000

5.1.7 Site HLM2 Hookmill Stables

WATERCOURSE: Halebourne

N.G.R.: SU941621 DATE: 17.10.89

METHOD: Electric fishing by wading. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 150m
WIDTH: 2.6m
AREA: 0.039sq.km
DEPTH: 0.3m

SUBSTRATE COMPOSITION (%):

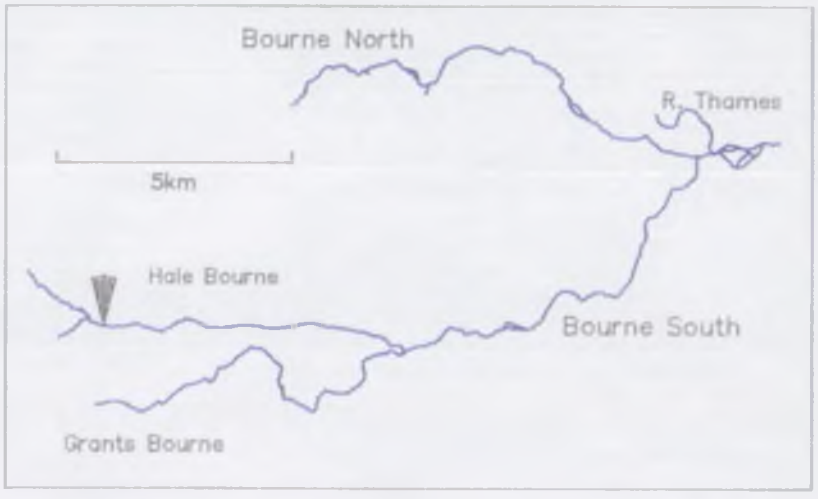
BARE: 0
MUD&SILT: 40
GRAVEL: 60
STONE: 0

VEGETATION (% COVER):

SUBMERGED: 10
FLOATING: 0
EMERGENT: 5
SHADE: 75

This site ended 50 metres below the Lightwater S.T.W.. The discharge enters approximately 10 metres above the confluence with a side stream. The physical habitat appeared to be good with a mainly gravel substrate, pools and riffles and patches of *Ranunculus sp.*. A disappointing biomass of 2.5 gm^{-2} was recorded comprising two pike and an eel. Bullhead were quite common while stone loach and stickleback were present in low numbers.

FIG 5.7a: SITE HLM2 Biomass and Density

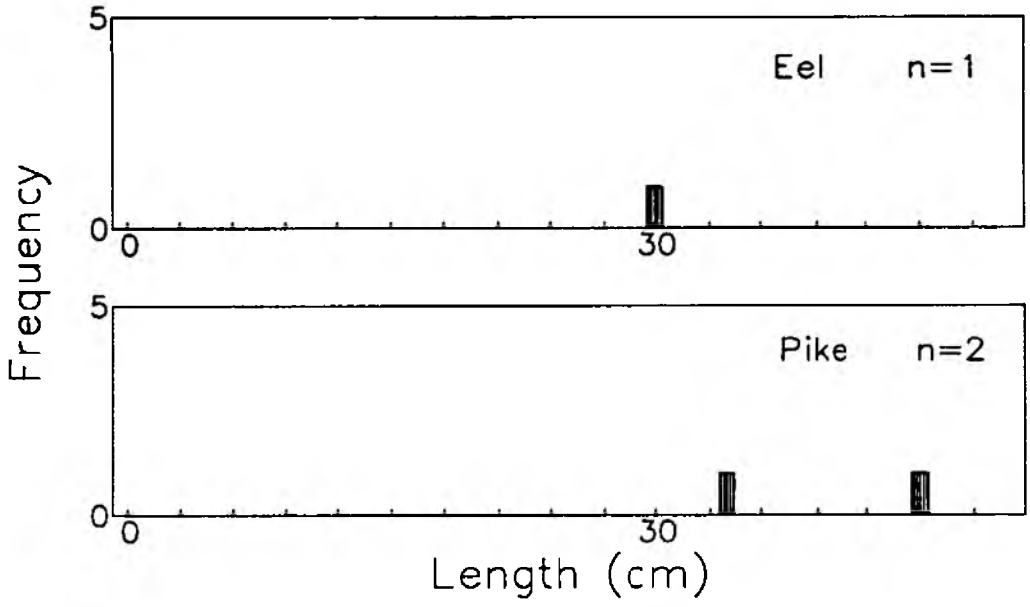


Biomass

Density

	Biomass gm−2	Density nm−2
Eel	0.1	0.003
Pike	2.4	0.005
Total	2.5	0.008

Fig 5.7b: HLM2 – Length Frequency By Species



5.1.8 Site HLM4 Bourne Farm

WATERCOURSE: Halebourne

N.G.R.: SU960622 DATE: 31.10.89

METHOD: Electric fishing by wading.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 200m
WIDTH: 2m
AREA: 0.04sq.km
DEPTH: 0.2m

SUBSTRATE COMPOSITION (%):

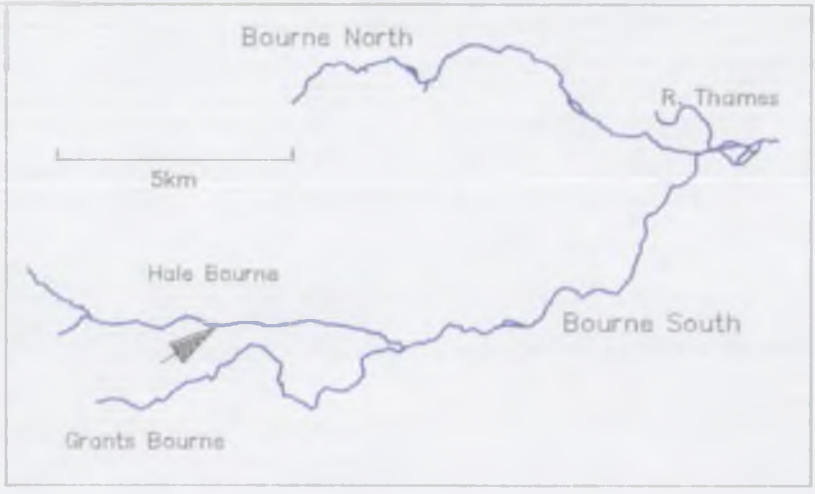
BARE: 0
MUD&SILT: 10
GRAVEL: 90
STONE: 0

VEGETATION (% COVER):

SUBMERGED: 5
FLOATING: 0
EMERGENT: 0
SHADE: 90

No fish were found at this site despite a reasonable looking habitat of shallow riffle over gravel substrate and deeper pools on the sharp bends. This section was heavily shaded by tree cover with very little vegetation in the stream. The water-hoglouse *Asellus aquaticus* was noted amongst leaf litter on the bed.

FIG 5.8a: SITE HLM4 Biomass and Density



	Biomass gm-2	Density nm-2
Total	0.0	0.000

5.1.9 Site HLM3 Emmetts Mill

WATERCOURSE: Halebourne

N.G.R.: SU996618 DATE: 31.10.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 120m
WIDTH: 2.2m
AREA: 0.026sq.km
DEPTH: 0.8m

SUBSTRATE COMPOSITION (%):

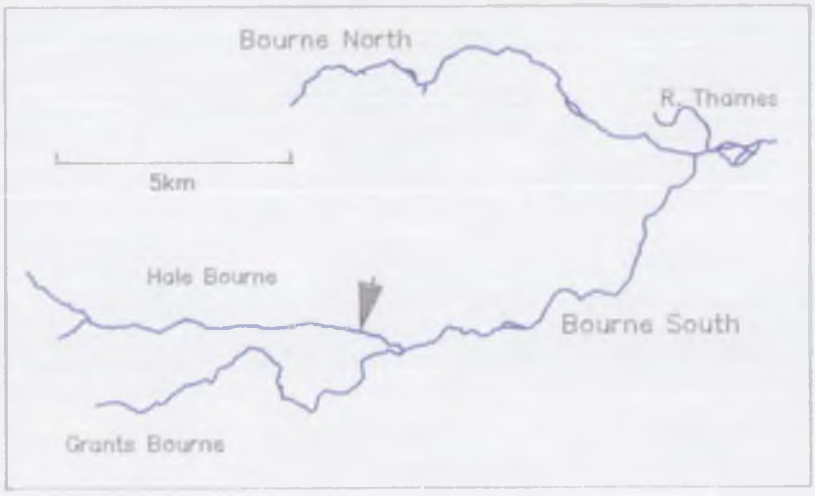
BARE: 0
MUD&SILT: 80
GRAVEL: 20
STONE: 0

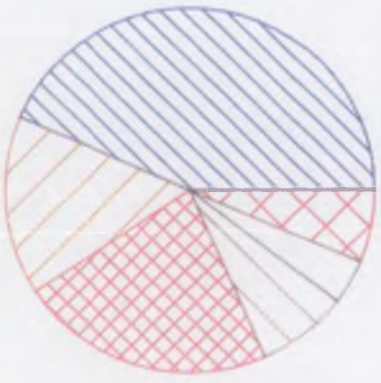
VEGETATION (% COVER):

SUBMERGED: 10
FLOATING: 5
EMERGENT: 10
SHADE: 60

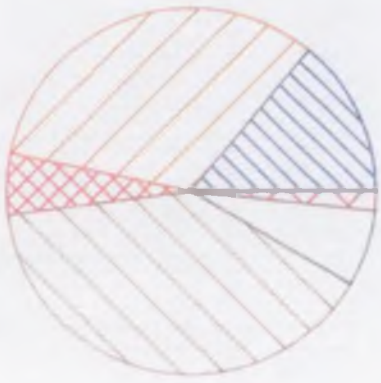
This section was 30 metres downstream of Emmetts Mill pool. The channel was fairly straight with tall, steep banks providing most of the shade. Depth was even and the substrate comprised of mainly silt. A biomass of 23.1 gm^{-2} was recorded with chub contributing 10 gm^{-2}. Large numbers of gudgeon were caught which, together with dace, dominated the density of 0.258 gm^{-2}.

FIG 5.9a: SITE HLM3 Biomass and Density





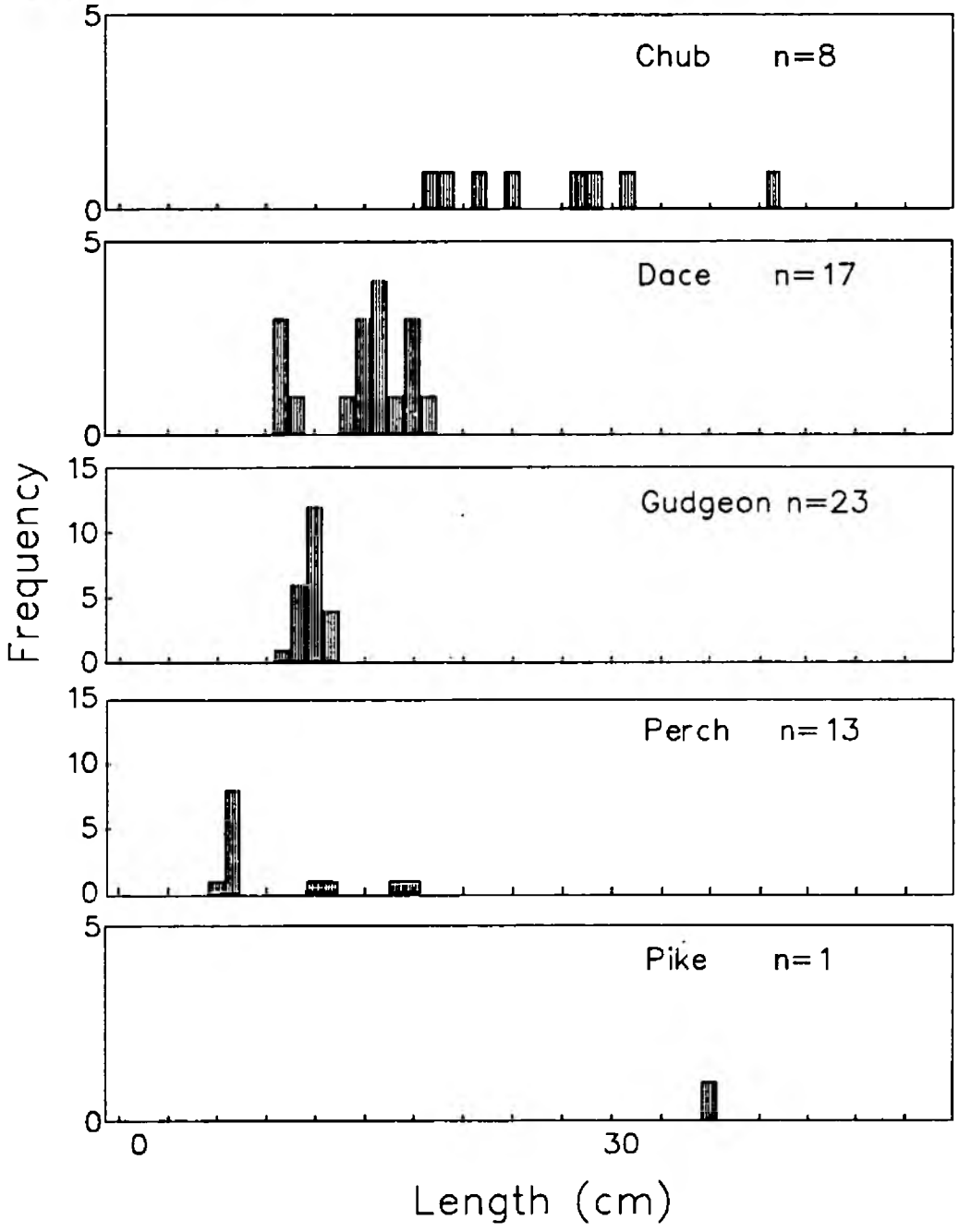
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	10.0	0.031
Dace	3.7	0.073
Eel	5.2	0.012
Gudgeon	1.8	0.088
Perch	0.9	0.015
Pike	1.5	0.004
Total	23.1	0.223

Fig 5.9b: HLM3 – Length Frequency By Species



5.1.10 Site GRT1 West End

WATERCOURSE: Grantsbourne

N.G.R.: SU949602 DATE: 13.10.89

METHOD: Electric fishing by wading. 1 run

R.Q.O.: Unclassified E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 130m
WIDTH: 1.5m
AREA: 0.02sq.km
DEPTH: 0.3m

SUBSTRATE COMPOSITION (%):

BARE: 0
MUD&SILT: 30
GRAVEL: 70
STONE: 0

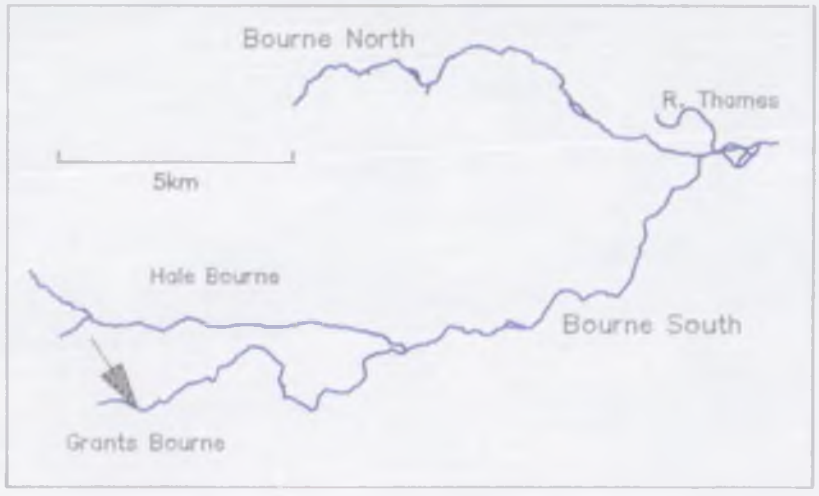
VEGETATION (% COVER):

SUBMERGED: 5
FLOATING: 0
EMERGENT: 5
SHADE: 80

This site represents the highest upstream site on the Grantsbourne. The top half of the site was very shallow and narrow, densely overgrown with hawthorn and fast flowing over a stone substrate with patches of *Ranunculus sp.*. Several lampreys, some large stone loach and a single brown trout were captured here. The bottom half of the site comprised a steep sided, tree lined channel with a pronounced meander, deep pools and a substrate of mostly mud and silt. This area contained most of the trout and a dace. Total biomass and density results were poor at 3.114gm^{-2} and 0.035nm^{-2}.

In May 89 an unidentified pollutant entered the Grantsbourne 300m upstream of this site. An estimated 40 brown trout up to 25cm were killed and the shallow section included in this site was littered with large numbers of dead bullhead. Recolonisation of the bullhead appears to have been poor. Approximately 400 small brown trout were restocked in July 89.

FIG 5.10a: SITE GRT1 Biomass and Density

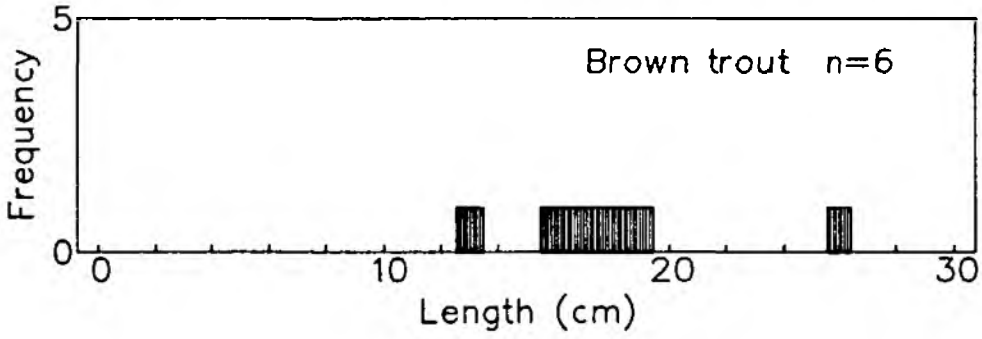


Biomass

Density

	Biomass gm−2	Density nm−2
Brown trout	2.6	0.030
Dace	0.5	0.005
Total	3.1	0.035

Fig 5.10b: Site GRT1 – Lengnth Frequency By Species



5.1.11 Site GRT2 Deep Pool Farm

WATERCOURSE: Grantsbourne

N.G.R.: SU983602 DATE: 01.12.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: Unclassified E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 147m
WIDTH: 2.2m
AREA: 0.032sq.km
DEPTH: 0.5m

SUBSTRATE COMPOSITION (%):

BARE: 0
MUD&SILT: 99
GRAVEL: 0
STONE: 0

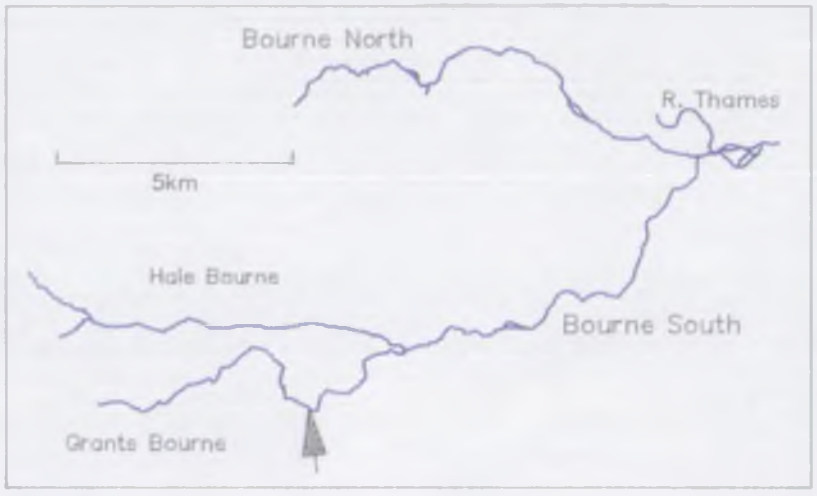
VEGETATION (% COVER):

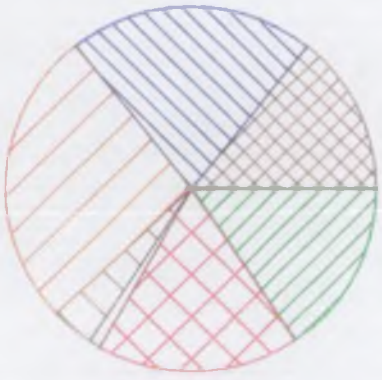
SUBMERGED: 25
FLOATING: 0
EMERGENT: 15
SHADE: 15

This site was approximately 100m upstream of the Horsell road run-off discharge and 30m above the confluence of a small side stream, the Parley Brook. The channel was straight and dredged with steep banks and very little tree cover. The substrate was composed of mud and silt. A broad band of emergent vegetation covered the greater part of the channel width in places.

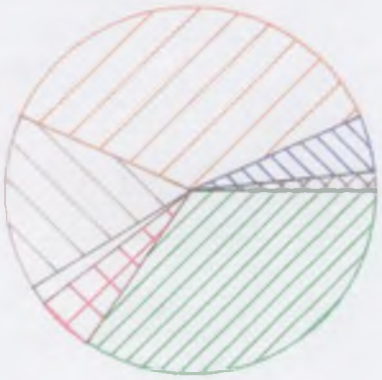
The total biomass of 18.1 gm^{-2} was dominated by dace, chub, pike, and roach with a single 42cm brown trout contributing 2.6 gm^{-2}. The fry of roach and perch were found in great numbers, thriving amongst the emergents and contributing to a good density of 0.573nm^{-2}.

FIG 5.11a: SITE GRT2 Biomass and Density





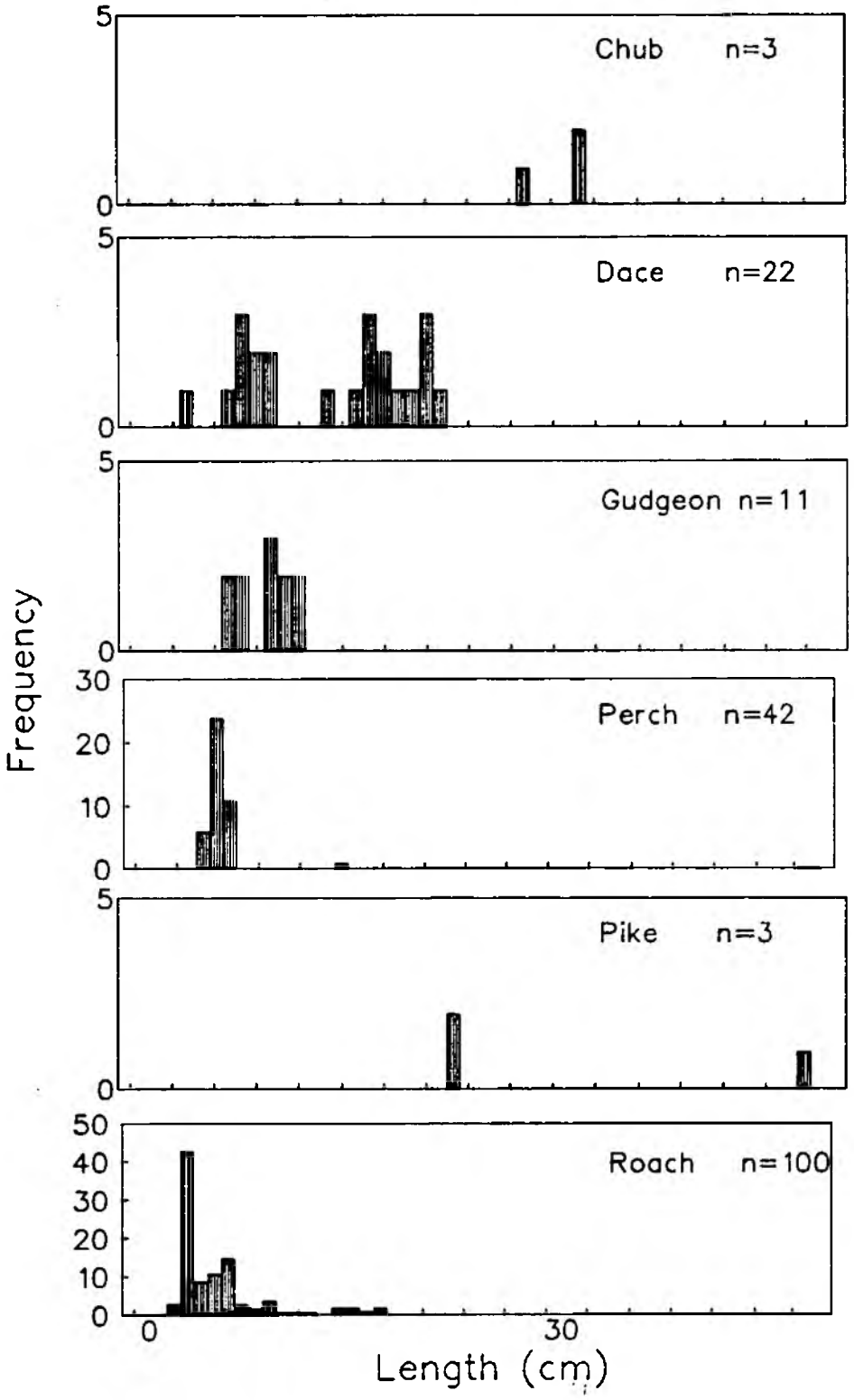
Biomass



Density

	Biomass gm−2	Density nm−2
Brown trout	2.6	0.003
Chub	3.9	0.009
Dace	4.8	0.066
Gudgeon	0.7	0.028
Perch	0.2	0.003
Pike	3.2	0.009
Roach	2.8	0.062
Total	18.1	0.180

Fig 5.11b: GRT2 – Length Frequency By Species



5.1.12 Site BOM3 Mizzens Farm

WATERCOURSE: South Bourne

N.G.R.: TQ008617 DATE: 01.11.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 100m
WIDTH: 4m
AREA: 0.04sq.km
DEPTH: 1.2m

SUBSTRATE COMPOSITION (%):

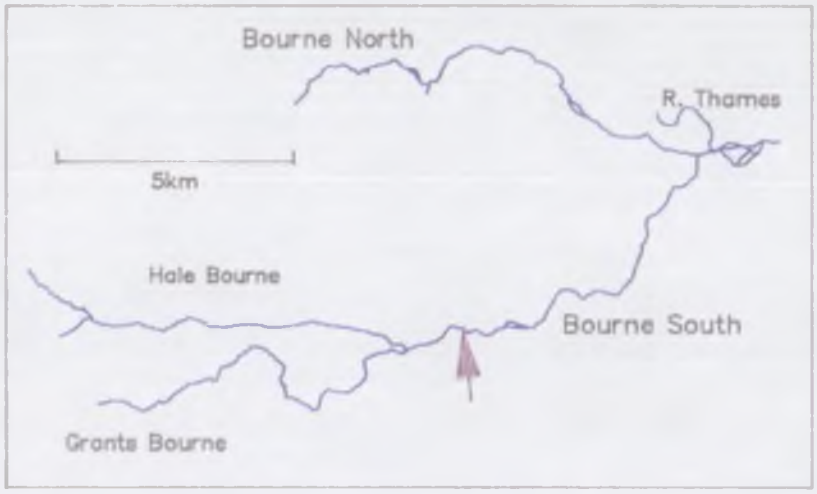
BARE: 0
MUD&SILT: 80
GRAVEL: 20
STONE: 0

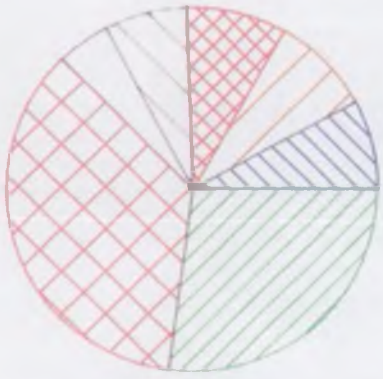
VEGETATION (% COVER):

SUBMERGED: 10
FLOATING: 10
EMERGENT: 20
SHADE: 70

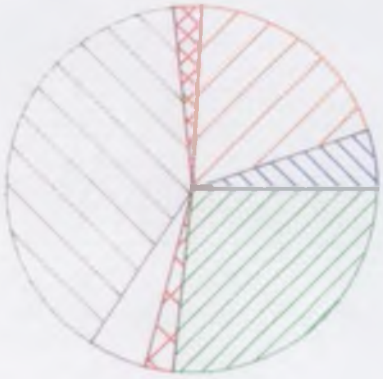
This section was approximately 0.5 km downstream from the confluence of the Grants Bourne and the Hale Bourne. The upstream half of the site appeared to have been dredged straight with steep banks. The remainder had a wide and shallow right bank with extensive bankside vegetation. Aquatic plants included *Potamogeton natans* in the channel and good emergent stands encroaching well into the channel in places to produce shallower, faster flowing areas with a gravel substrate. The principal species contributing to the biomass of 29.2 gm^{-2} were pike and roach. Gudgeon were predominant by number followed by roach, then dace, the total density being 0.324nm^{-2}. A good size range of roach were represented at this site including large numbers of fry found amongst the emergents in the margins.

FIG 5.12a: SITE BOM3 Biomass and Density





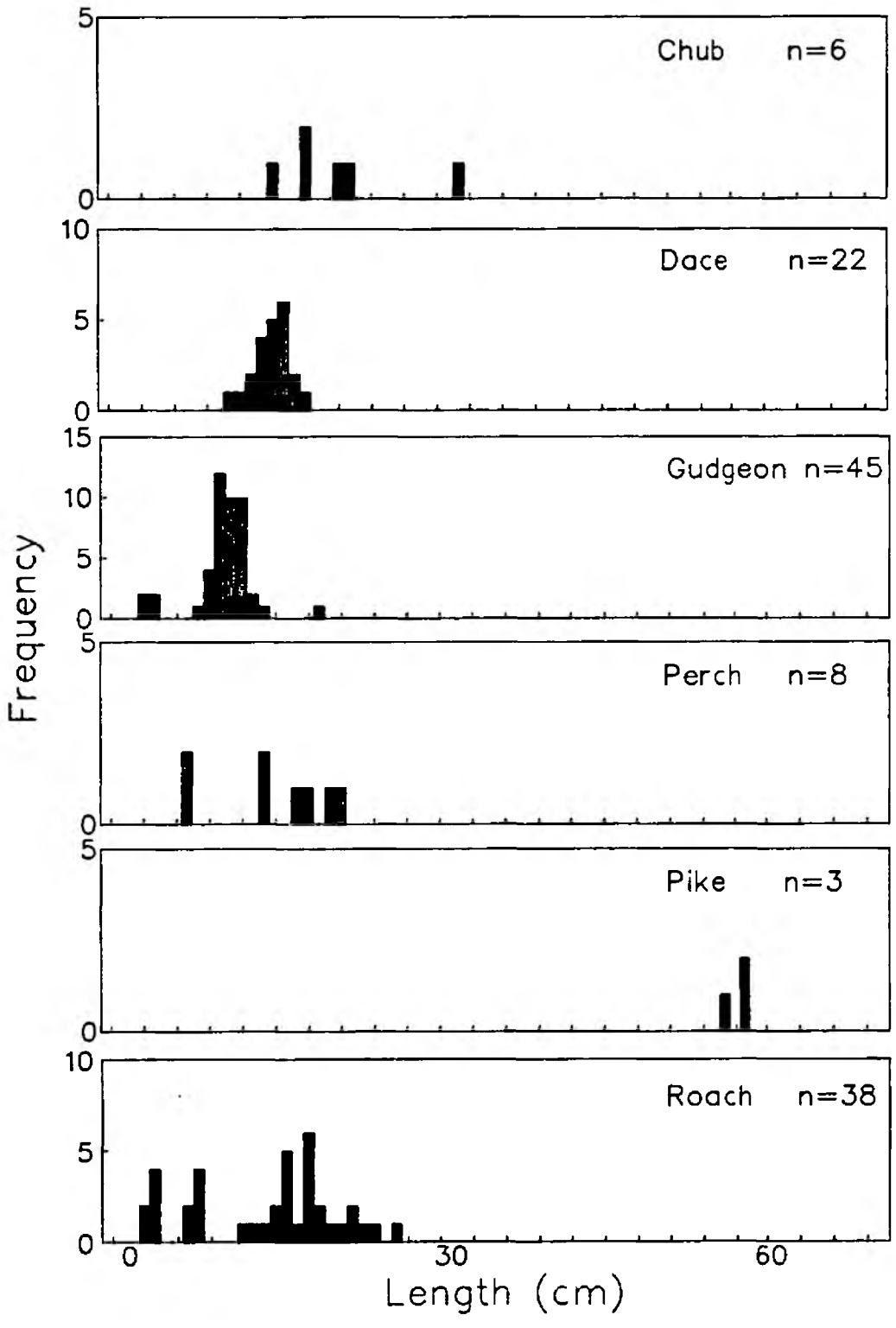
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	2.3	0.015
Dace	2.6	0.055
Eel	2.6	0.007
Gudgeon	2.1	0.113
Perch	1.4	0.015
Pike	10.4	0.007
Roach	7.9	0.077
Total	29.1	0.289

Fig 5.12b: BOM3 – Length Frequency By Species



5.1.13 Site BOM1 Crockford Bridge

WATERCOURSE: South Bourne

N.G.R.: TQ054642 DATE: 12.10.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES.

LENGTH: 117m
WIDTH: 5.2m
AREA: 0.061sq.km
DEPTH: 1m

SUBSTRATE COMPOSITION (%):

BARE: 0
MUD&SILT: 80
GRAVEL: 20
STONE: 0

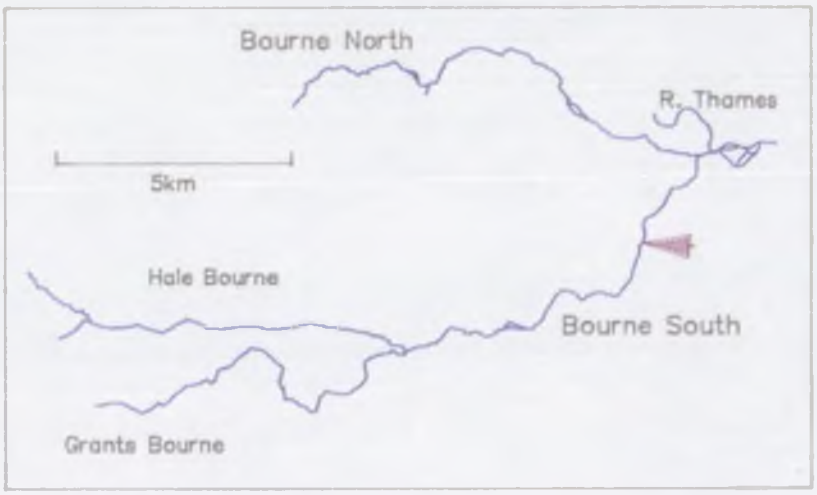
VEGETATION (% COVER):

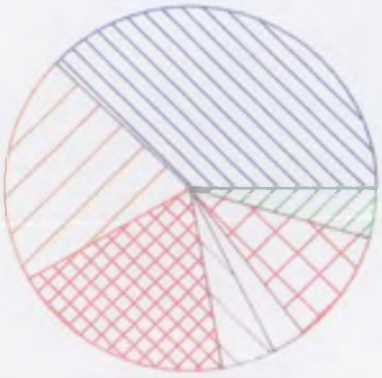
SUBMERGED: 5
FLOATING: 0
EMERGENT: 10
SHADE: 70

This site was immediately upstream of Crockford Bridge in Addlestone. The channel was wider than at other sites on the South Bourne, with steep banks, the taller right hand bank supporting overhanging brambles. Emergent vegetation was scarce except where openings in the dense canopy allowed sufficient light to penetrate. Shallow areas supported small stands of starwort *Callitriche sp.* The majority of the substrate consisted of mud and silt, with rubble and various items of rubbish dumped at various points along the length. Trees line the river along this section and a public footpath runs adjacent on the left bank.

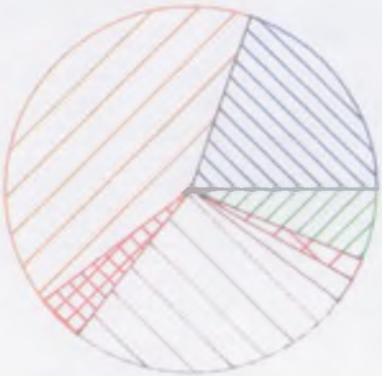
This section is fished and hook damage was noticed on a proportion of the fish caught. A wide size range of chub contributed most to the total biomass of 41.5 gm^{-2} while dace and eel were also strongly represented. The total density of 0.369nm^{-2} was dominated by dace and gudgeon.

FIG 5.13a: SITE BOM1 Biomass and Density





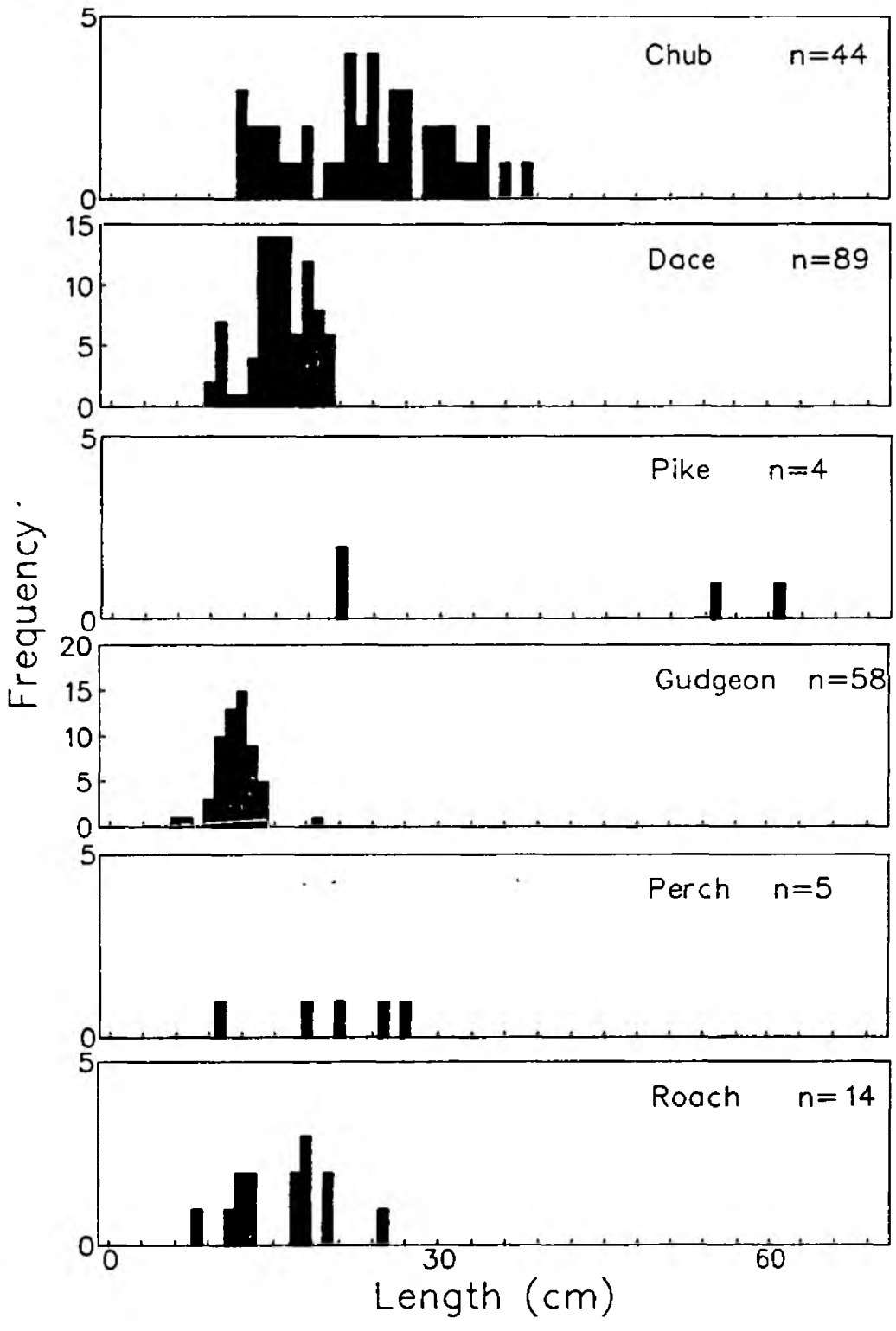
Biomass



Density

	Biomass gm−2	Density nm−2
Chub	15.7	0.072
Dace	8.4	0.149
Eel	8.1	0.015
Gudgeon	1.9	0.092
Perch	1.2	0.008
Pike	4.2	0.007
Roach	1.8	0.023
Total	41.5	0.366

Fig 5.13b: BOM1 – Length Frequency By Species



5.1.14 Site BOM2 Woburn Park

WATERCOURSE: South Bourne

N.G.R.: TQ064657 DATE: 19.10.89

METHOD: Electric fishing by wading. 2 anodes. 2 runs.

R.Q.O.: 1B E.C. TARGET BIOMASS: N.A.

HABITAT FEATURES. SUBSTRATE COMPOSITION (%):

LENGTH: 102m BARE: 0
WIDTH: 4m MUD&SILT: 20
AREA: 0.041sq.km GRAVEL: 80
DEPTH: 0.5 STONE: 0

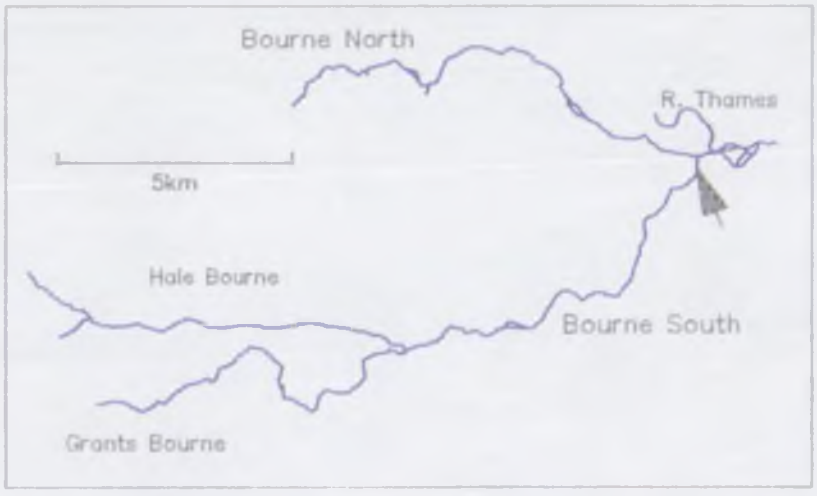
VEGETATION (% COVER):

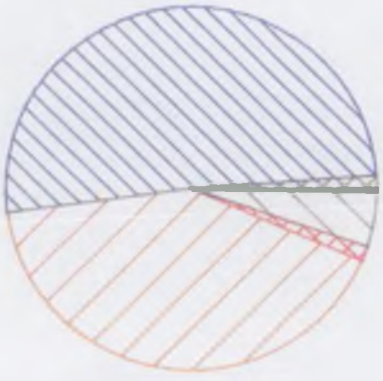
SUBMERGED: 10
FLOATING: 0
EMERGENT: 5
SHADE: 85

This was the furthest downstream site on the South Bourne, situated 20 metres upstream of the confluence with the North Bourne. The substrate was predominantly gravel, producing shallow riffles and pools. The banks were shallow with deciduous woodland on either side casting considerable shade over the channel. Aquatic vegetation was limited to occasional patches of submerged species, *Callitriche sp.* and *Ranunculus sp.*

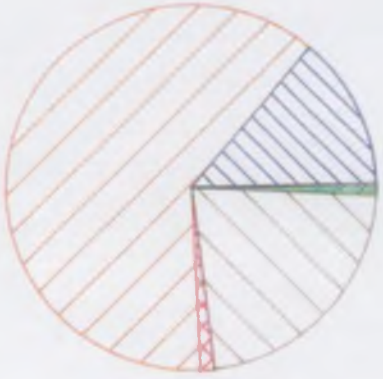
The favourable physical habitat occurring here produced a biomass of 49.9gm^{-2} and a density of 0.787nm^{-2}, the highest found on the South Bourne system. This was dominated by dace and chub exhibiting good recruitment, and included two brown trout. Pike were notably absent.

FIG 5.14a: SITE BOM2 Biomass and Density





Biomass



Density

	Biomass gm−2	Density nm−2
Brown trout	0.6	0.002
Chub	25.4	0.080
Dace	20.6	0.366
Eel	0.7	0.007
Gudgeon	2.4	0.132
Ruffe	0.1	0.002
Roach	<0.1	0.002
Total	49.9	0.591

Fig 5.14b: BOM2 – Length Frequency By Species

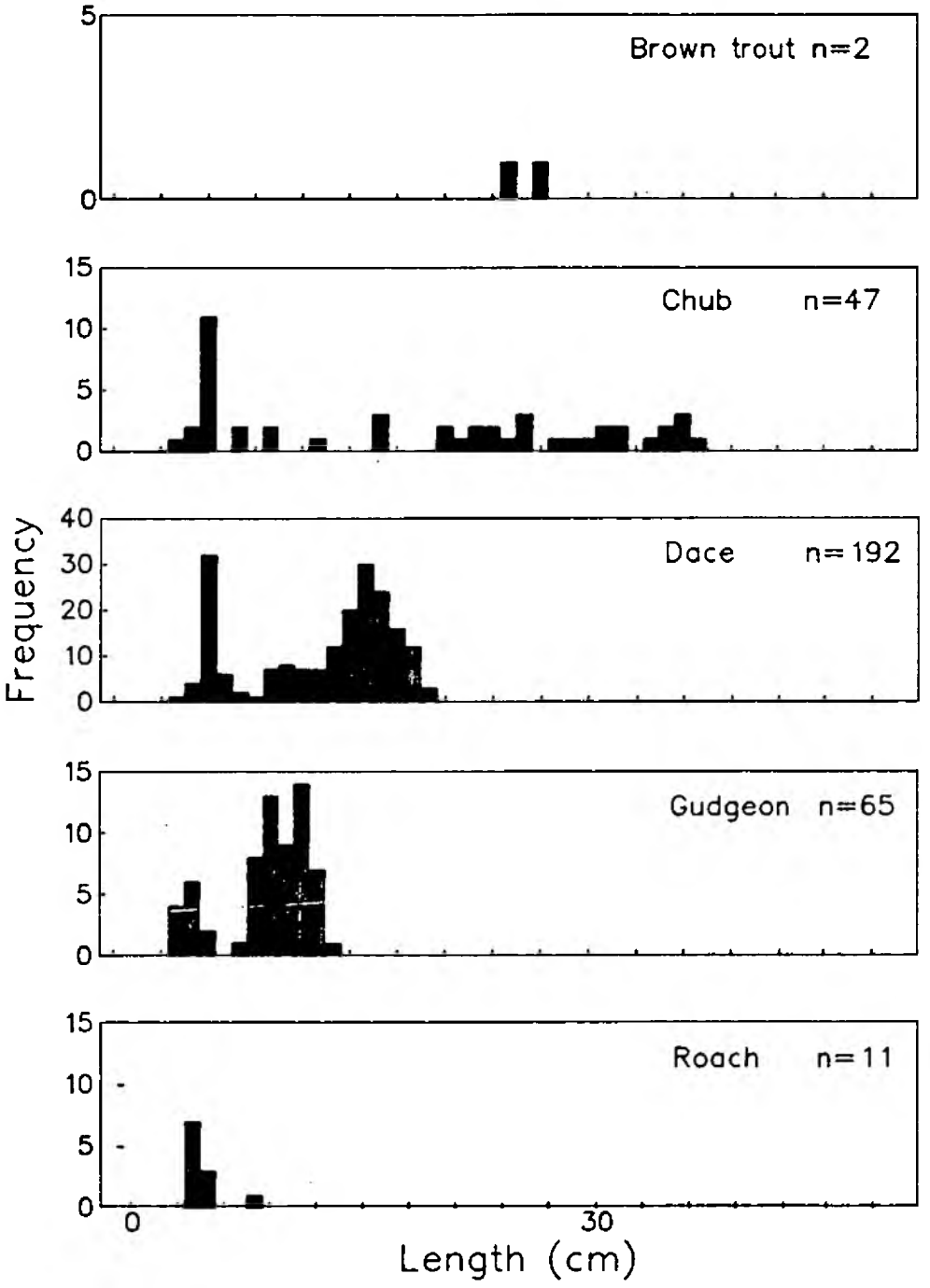
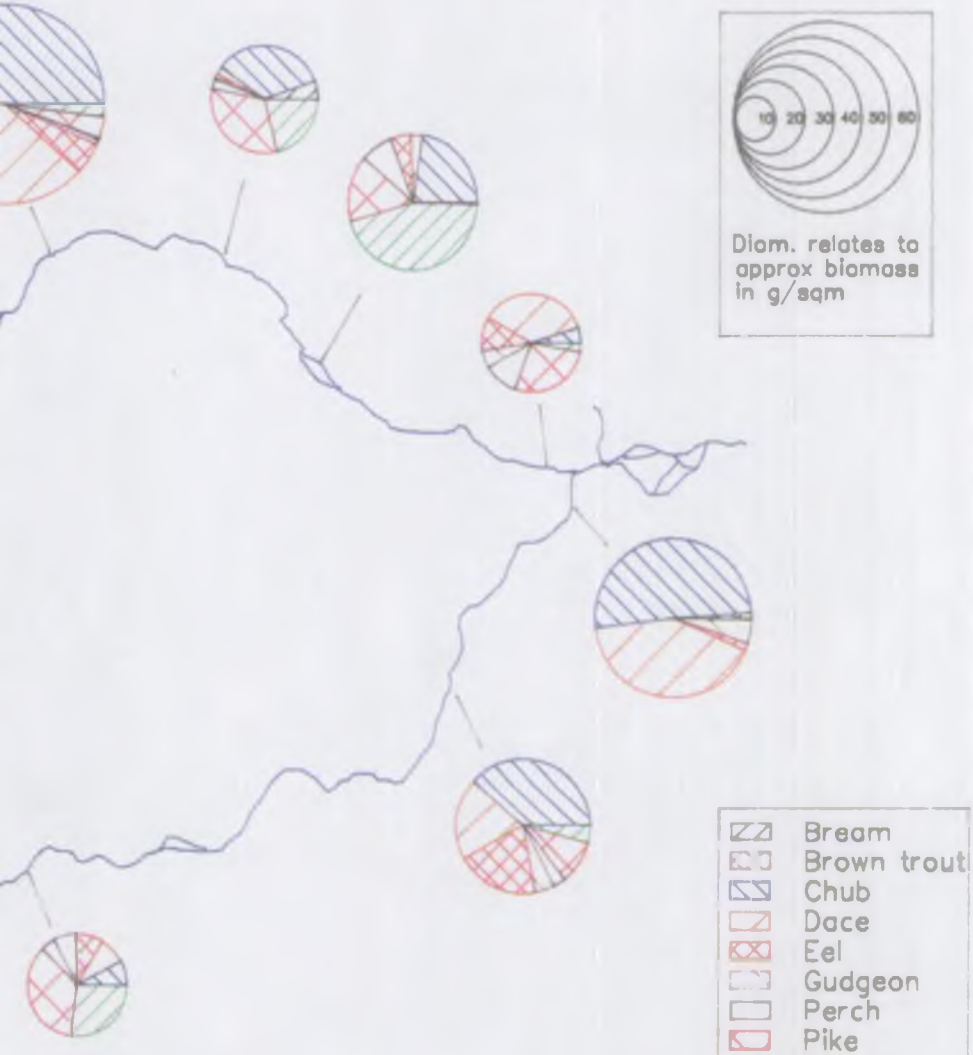


Fig 5.15 – Summary of Biomass
For Each Site


10
20
30
40
50
60
Diam. relates to approx biomass in g/sqm
Bream
Brown trout
Chub
Dace
Eel
Gudgeon
Perch
Pike
Roach
Tench

5.2 Age and Growth

Insufficient numbers of most species of fish were captured at each site to allow meaningful estimates of growth for individual sites. Estimations of average length for age were therefore calculated by combining data in each habitat unit. These are shown in Figs. 5.16 to 5.20 compared with a "standard" derived by Hickley & Dexter (1979).

5.3 Water Quality

Reach Assessment Points, compliance with RQO Sites sampled in 1989.

River	Reach	RQO	Sample Point	Class Achieved	Parameter Failing
Bourne	Woburn to Thames Park	1B	Bourne us Thames	2A	Ammonia
Bourne (North)	Source to Chertsey STW	1B	Thorpegreen Bridge	2A	Ammonia
Bourne (North)	Chertsey to Bourne STW	2A	Hamperstone Bridge	2B	Ammonia
Bourne (South)	West End to Bourne Common	1B	Mimbridge Chobham	1B	
Halebourne	Berks to Bourne Glf Cse (South)	1B	Halebourne	2B	Ammonia

5.4 Macroinvertebrates

Biological results for the Bourne system are presented in histograms of BWMP scores since 1980 in figs. 5.21 to 5.25.

Fig. 5.21: BWMP Scores - Bourne North

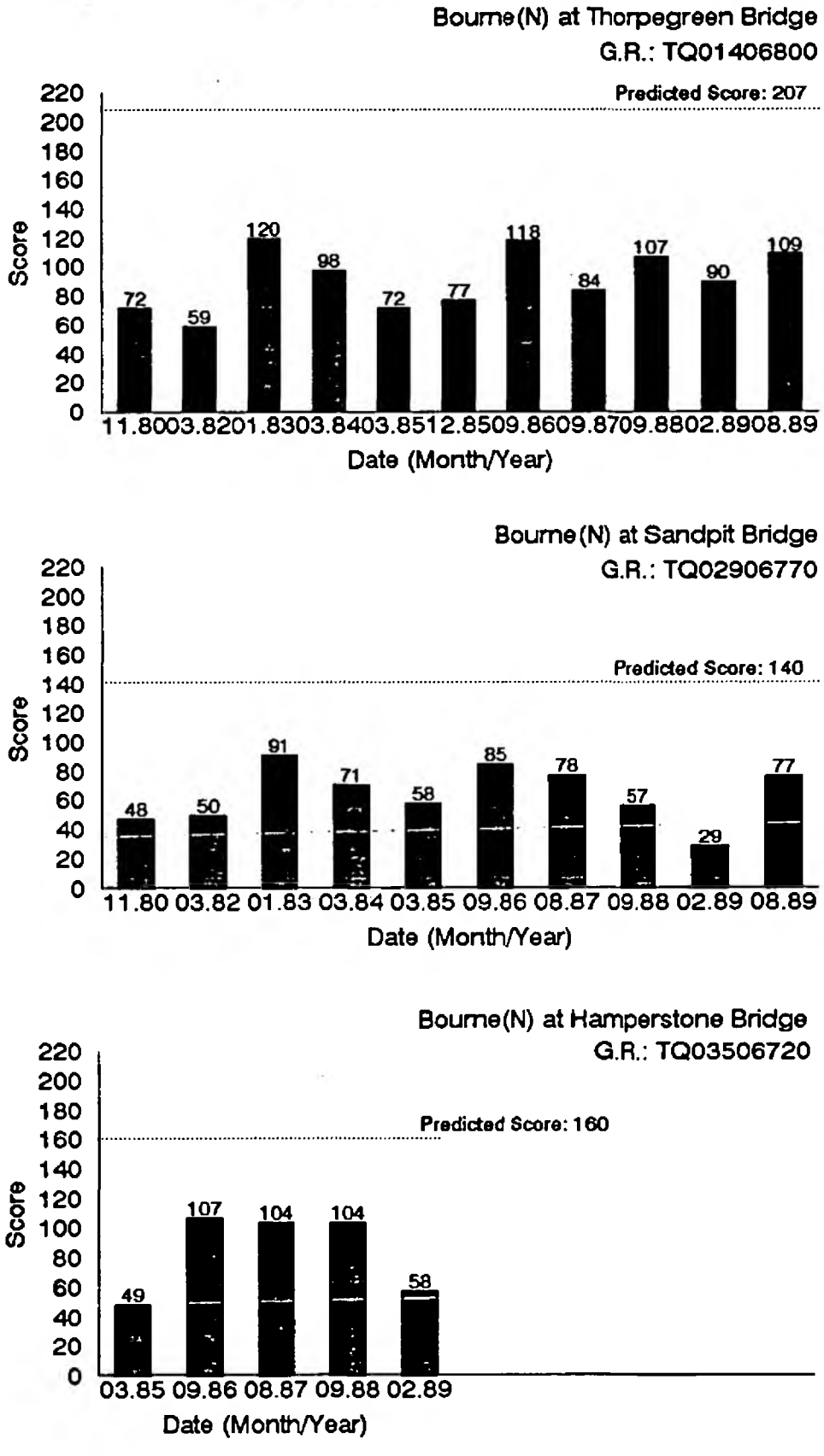
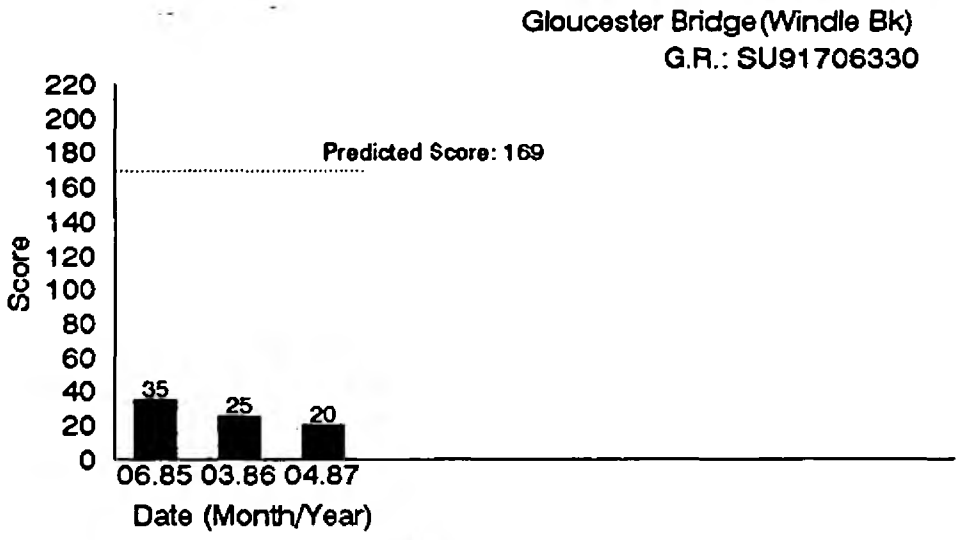
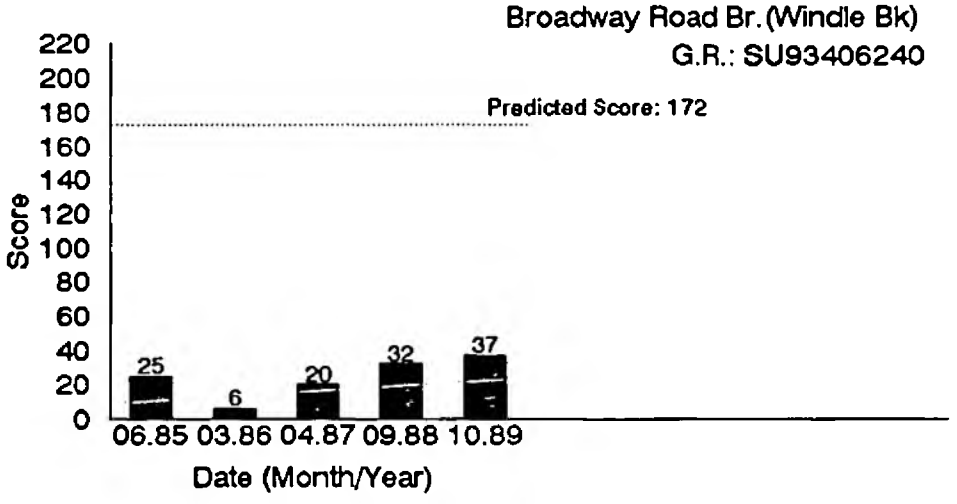


Fig. 5.22: BWMP Scores - Halebourne





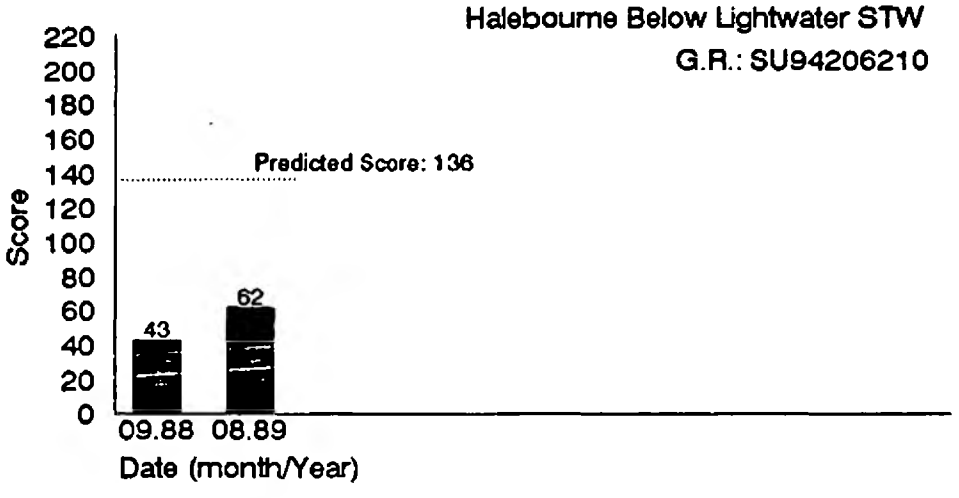


Fig. 5.23: BWMP Scores - Halebourne

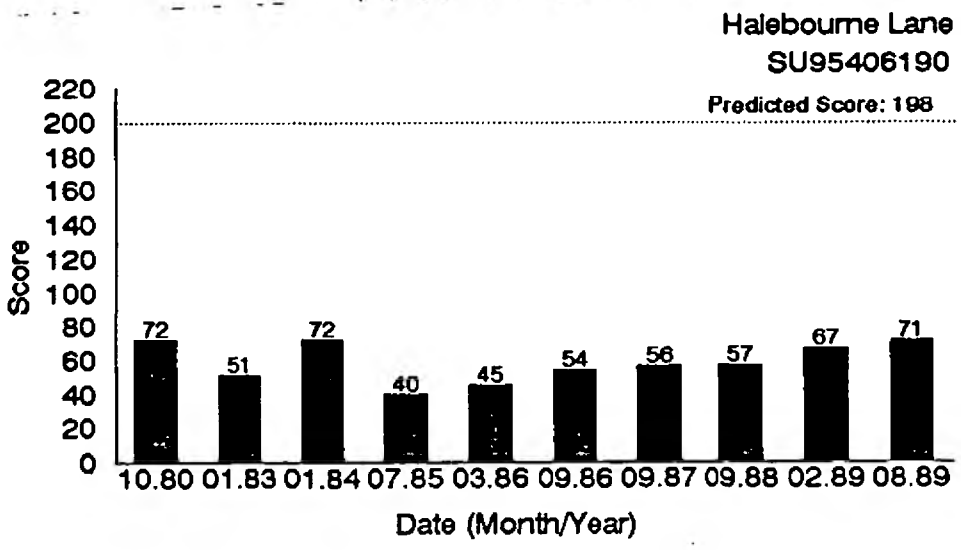
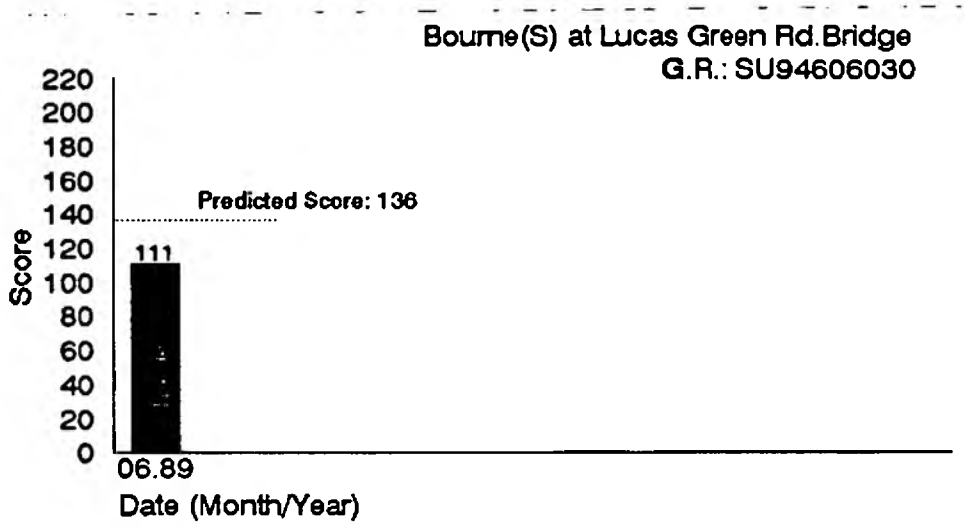
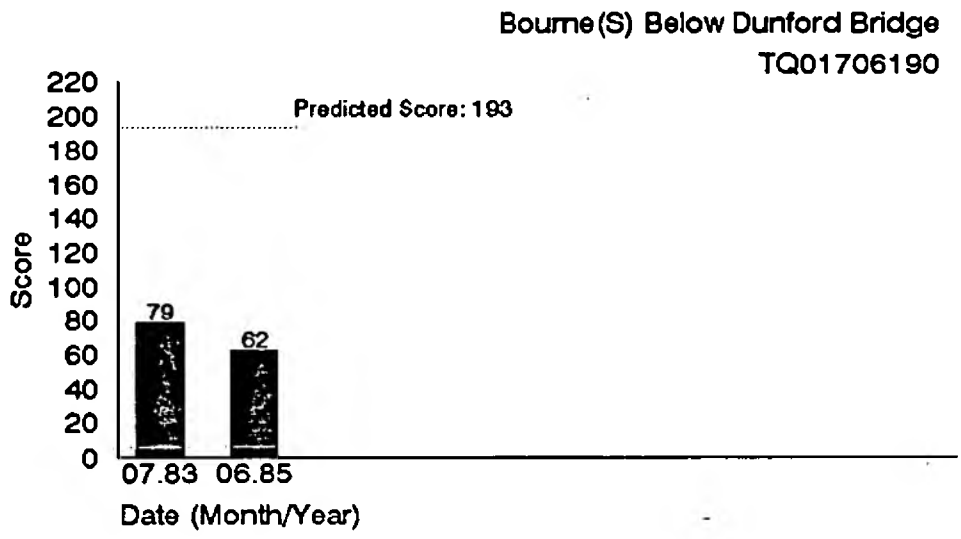


Fig. 5.24: BWMP Scores - Bourne South





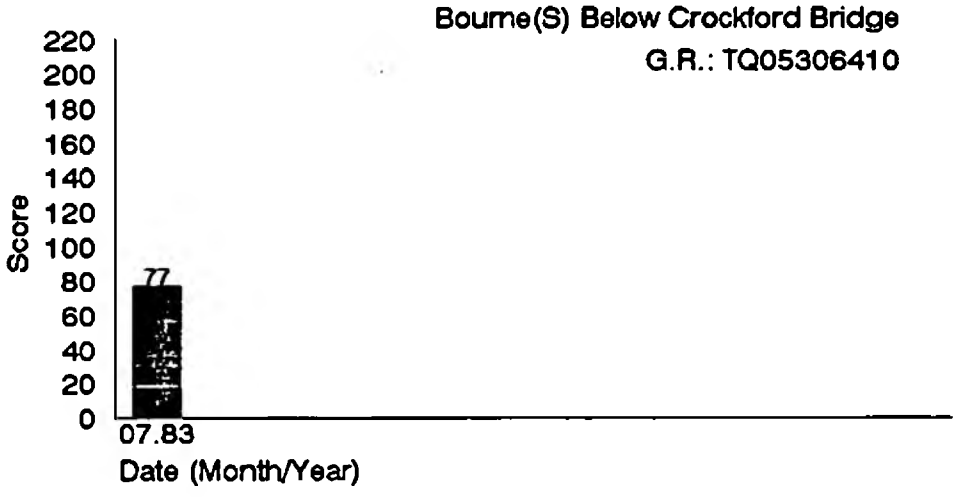


Fig. 5.25: BWMP Scores - River Bourne

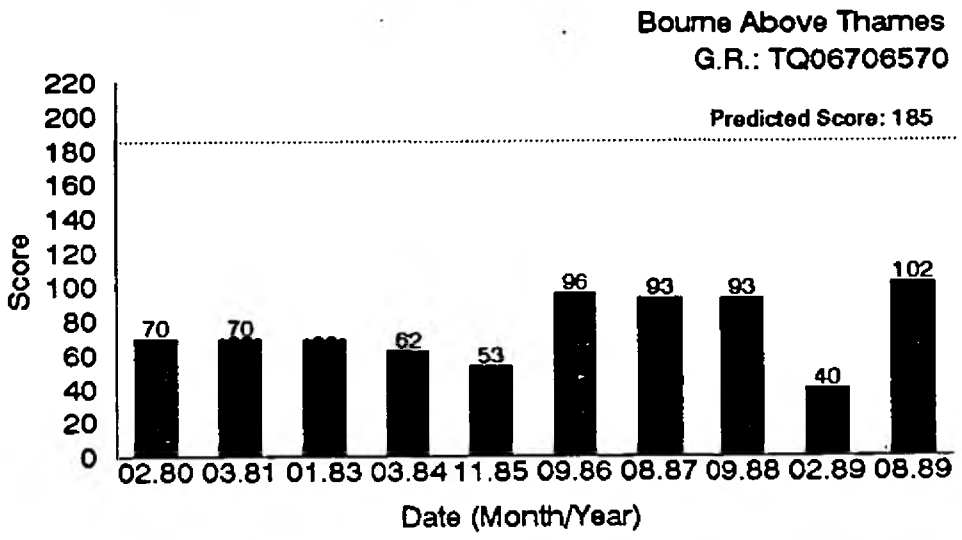


Fig 5.16: Chub – Age vs Length

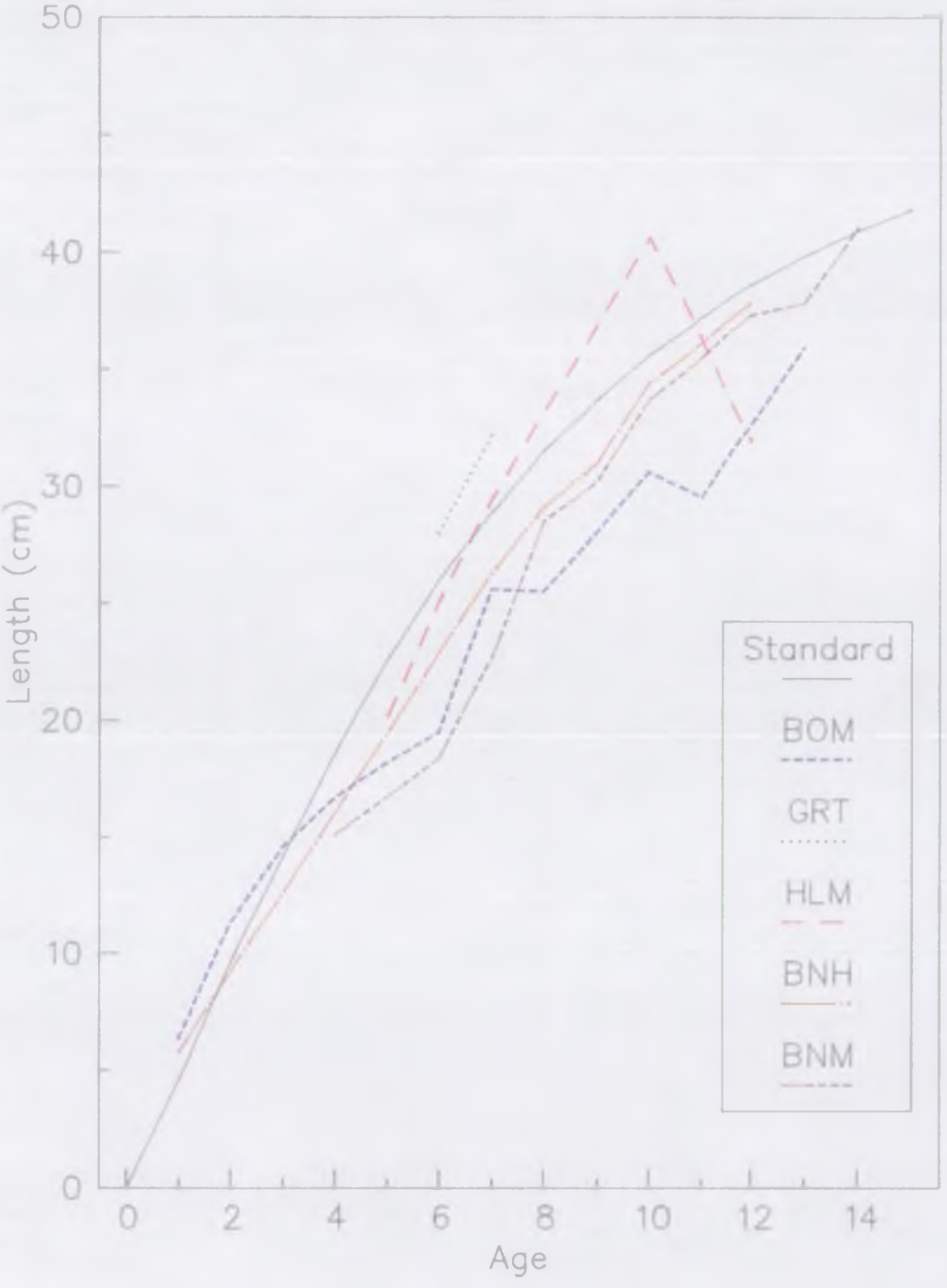


Fig 5.17: Dace – Age vs Length

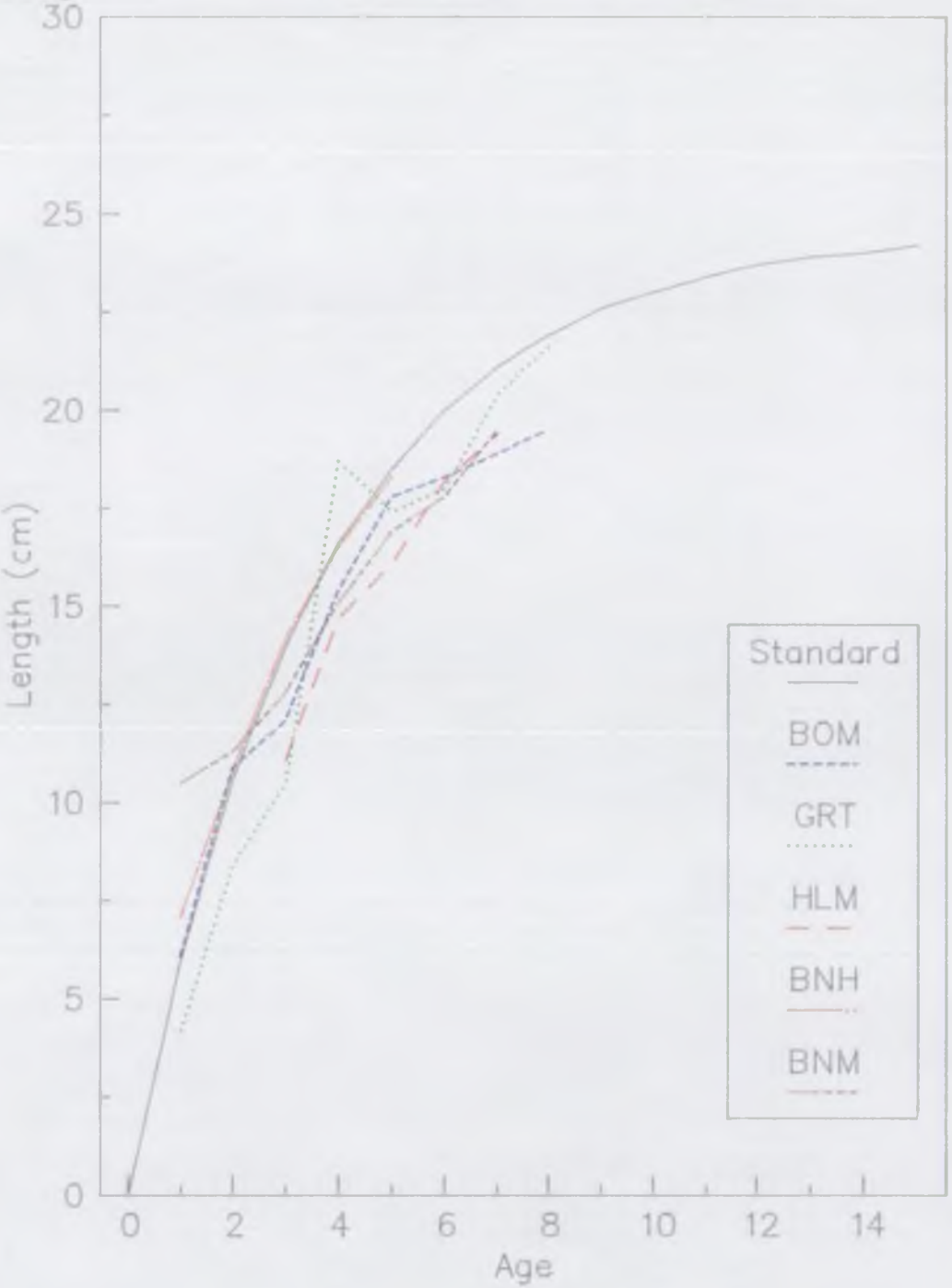


Fig 5.18: Gudgeon – Age vs Length

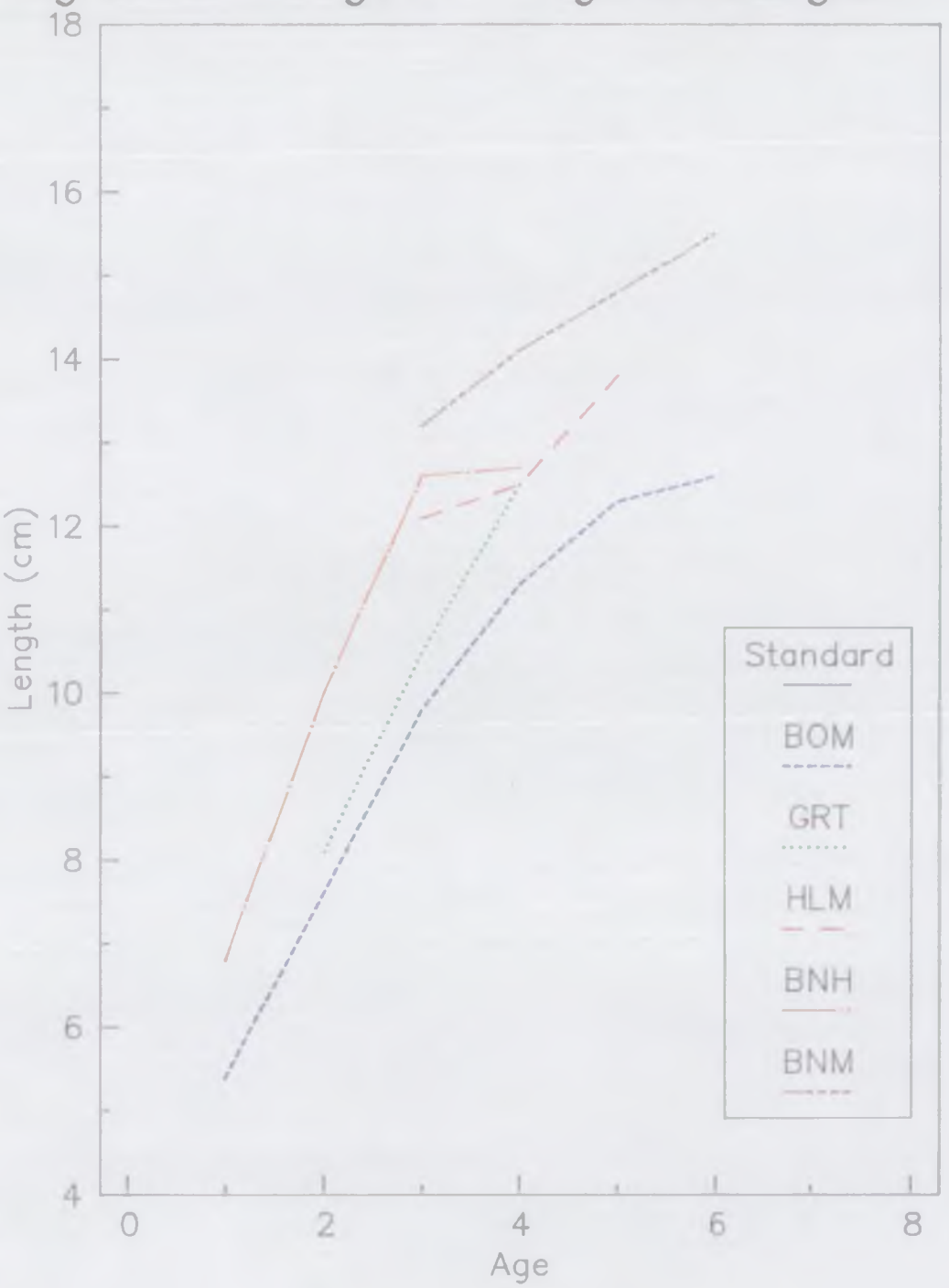


Fig 5.19: Pike – Age vs Length

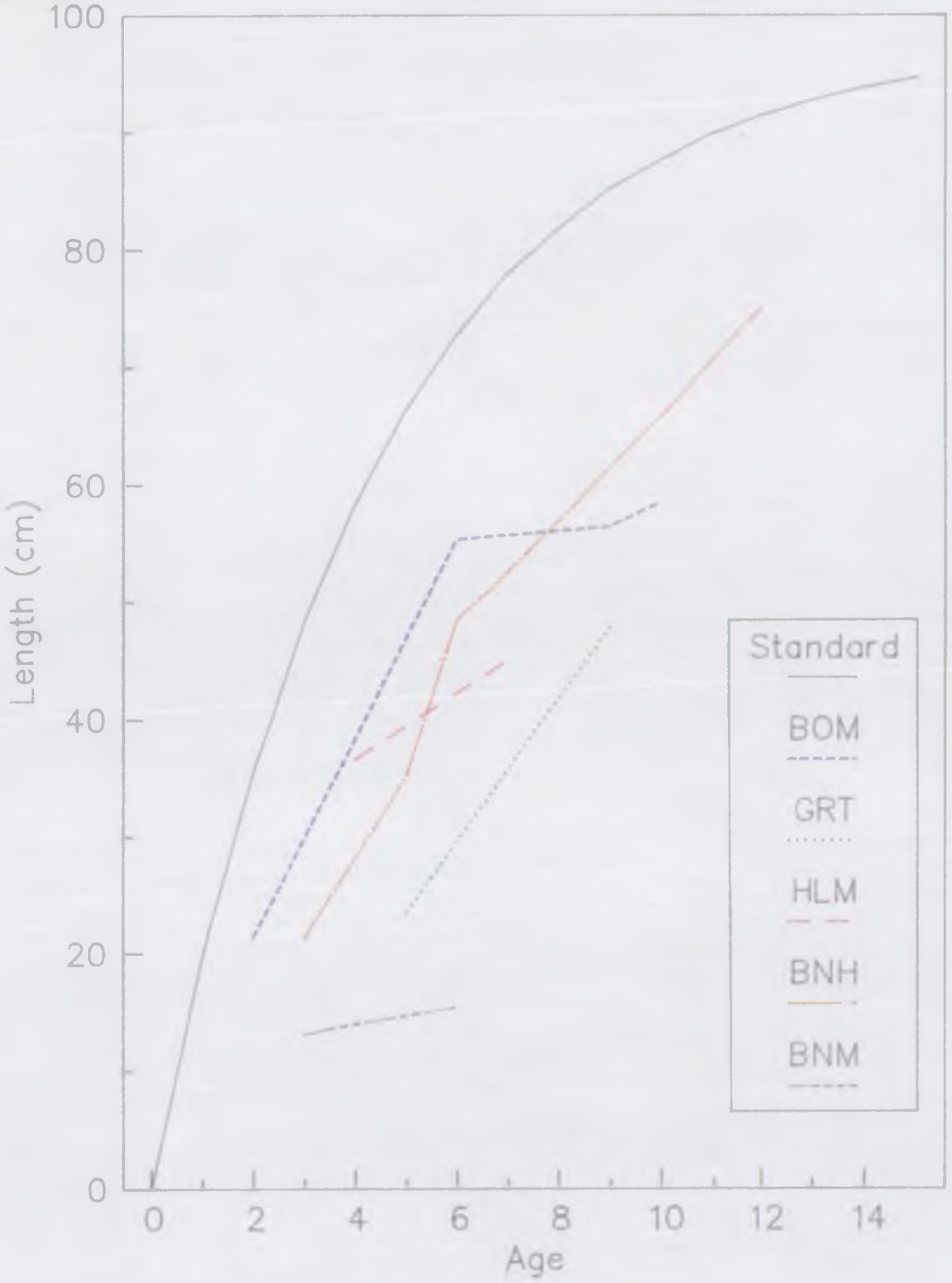
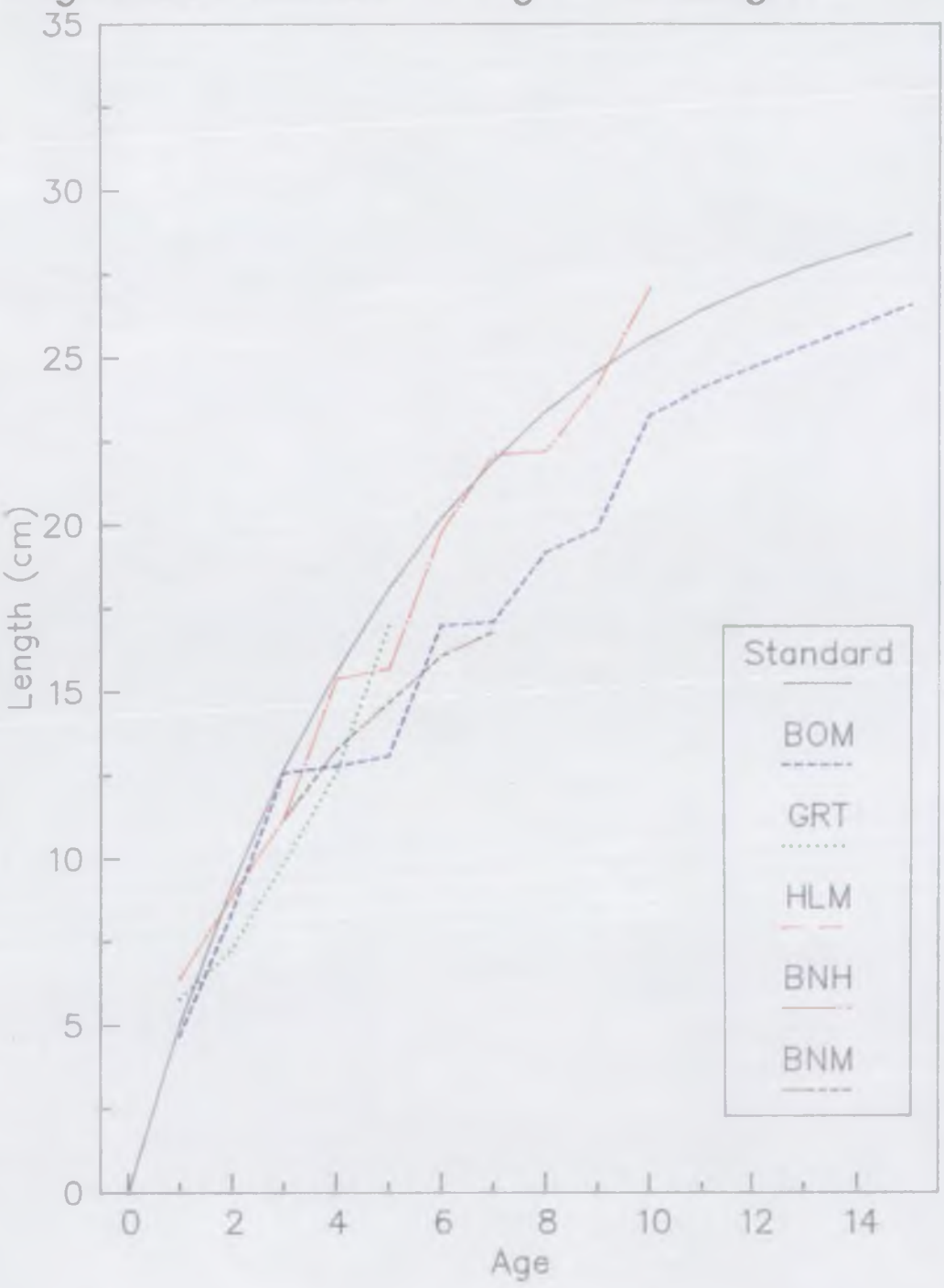


Fig 5.20: Roach – Age vs Length



6 DISCUSSION

The North Bourne below Chertsey STW, the only designated fishery on the Bourne system, exceeded the biomass target of 20gm^{-2} at all sites sampled. Results for the Halebourne above Emmetts Mill were very disappointing with no sites exceeding the biomass of 2.5gm^{-2} found at Hookmill Stables (HLM2). The Grantsbourne appeared capable of supporting small numbers of stocked brown trout in its upper reaches with a good coarse fish biomass of 18.1gm^{-2} lower down at Deep Pool Farm (GRT2). Below the Halebourne and Grantsbourne confluence, the South Bourne showed a progressive increase in biomass heading downstream with 29.1gm^{-2} at Mizzens Farm (BOM3), 41.5gm^{-2} at Crockford Bridge (BOM1) and 49.9gm^{-2} at Weybridge (BOM2).

With the exception of the upper reaches where habitat and possibly the acidic nature of the water are limiting factors, fish populations of the North Bourne are very impressive, biomass results ranging between 30 and 60gm^{-2} at all sites sampled. A 1.5 km stretch of river above Chertsey sewage treatment works provides an important habitat, although shaded by high banks and dense canopy cover, it demonstrates a pool-riffle regime with good areas of gravel substrate. This is reflected by the chub and dace dominated population that included 13 species, and the excellent biomass and density results of 63.2gm^{-2} and 0.61nm^{-2} respectively found at site BNM1. In contrast, upstream of the habitat represented by this site, the channel is of an acidic nature covered with a layer of iron deposits and heavily shaded, supporting no aquatic macrophytes. It is this impoverished habitat that would explain the apparent absence of a fish population in this top section of the North Bourne. Below Chertsey STW the habitat changes; vegetation is generally luxuriant and substrate mainly mud and silt. Although chub and dace are still well represented 1km below the STW, roach recruitment is more evident. Of the 334 roach caught at site BNH2 approximately 90% were less than 7cm in length corresponding to 1+ year fish or younger. The great numbers of juvenile fish contained in this reach accounted for the exceptional density of 1.40nm^{-2} at Thorpe. Numerous perch from juveniles up to 27cm in length were also caught, presumably associated with the abundant source of suitably sized prey. The vicinity of gravel pits in the middle reaches, one of which is freely connected to the river, must be an important influence (and *vice versa*: chub having been reported in adjacent pits) possibly explaining the large number of juveniles. Downstream, roach begin to dominate. There is a wide range of sizes found below Thorpe, illustrated by the length frequency histogram for site BNHX (Fig. 5.4b). Growth rates for roach in the middle to lower reaches of the North Bourne are better than elsewhere in the system (Fig. 5.20). The lowest site at Chertsey Meads (BNH1) revealed large numbers of roach although chub contributed most to the biomass. The presence of chub and small dace at this site could be attributed to the influence of the combined and South Bourne immediately below this site where suitable spawning substrate is present. The channel running through Chertsey Meads appears to have been

over dredged in the past, having steep banks and being deep and silted. This yielded the greatest number of pike on the Bourne system and was the only site to produce bream, *Abramis brama*.

The North Bourne below Chertsey STW has an RQO of 2A. This RQO has been achieved since 1982, though it failed on ammonia in 1989. The popularity of angling below the Chertsey outfall and the results from this survey do not indicate any apparent detrimental effects on the fish population (as a result of the Chertsey STW effluent) at least immediately downstream of the discharge. The receiving water generally being of pH 7 or less will minimise the toxic effects of ammonia. In addition, the exposure of fish to sublethal levels of ammonia increases their subsequent resistance to lethal concentrations. It is possible that fish immediately below the discharge show avoidance behaviour by swimming upstream when the quality of the effluent is sufficiently poor. This might explain the exceptional biomass found upstream at site BNM1. At present it appears the influence of Chertsey STW may be beneficial to the productivity of the river downstream, though because of the relaxed discharge consent, the vulnerability of the fish population downstream, with its apparent excellent recruitment, is of concern.

The furthest downstream site on the Halebourne at Emmetts Mill (HLM3) produced a reasonable fish biomass and density (23.1gm^{-2} & 0.258 nm^{-2} respectively), dominated by chub, dace and gudgeon. Sites upstream of here produced very disappointing results with only three fish being caught at Hookmill (HLM2). Despite an extended section being fished at Halebourne Farm (HLM4) no fish were found. This is particularly surprising as the habitat available on the Halebourne between Lightwater STW downstream to Chobham appears excellent although very shaded in many places. Where light can penetrate beds of *Ranunculus sp.* and *Callitriche sp.* grow. A pool-riffle regime over a gravel bed exists along this length although much of the gravel is covered in a fine brown clay/silt deposit. The absence of fish may be due to two serious wood preservative pollution incidents in 1985 and 1986. Both resulted in reported mortalities of over 500 fish mainly comprising gudgeon and brown trout. Biological quality since this has been generally poor (figs. 5.22 & 5.23). This pollution occurred on the upper reaches of the Windlebrook and it is likely that unaffected fish populations capable of recolonising were very limited. Recolonisation from downstream would be limited due to the obstruction of Emmetts Mill. The presence of brown trout had been noted before 1985. Another major factor that may be adversely affecting the Halebourne is water quality as a result of Lightwater STW discharge. The RQO downstream of this works is 1B, though this is rarely achieved. The actual class achieved in 1989 was 2B, the RQO failing on ammonia. Again, the fairly low pH of the receiving water will reduce the adverse effects of the ammonia. Another problem from this works has been high solids which may explain the fine sediment found covering much of the gravel substrate for several kilometres downstream of the works. The spawning grounds of trout are very vulnerable to finely divided solids, quite a small turbidity in the water or deposition on

or in the gravel causing spawning fish to avoid them or preventing consequent successful egg development. Lightwater STW has been given a relaxed consent while improvement works are carried out. With an improvement in water quality it is hoped that a reasonable fish population will colonise the potential good habitat available. This may involve restocking and some habitat improvement measures to promote aquatic plant growth and to clear silt from the gravel bed.

The top end of the Grantsbourne appears to be capable of supporting brown trout and dace. Biomass and density results at West End (GRT1) were poor, possibly due to an unidentified pollution six months before the survey. There was no evidence of a natural brown trout population; restocking was carried out following this pollution and local reports suggest unconsented stocking in the past. The habitat is more uniform lower down at Deep Pool (GRT2) with extensive emergent growth and a silt and mud substrate. Excellent roach, perch and dace recruitment was evident here.

A general downstream trend is observed on the South Bourne; roach and pike populations on the upstream reaches progressively giving way to a chub and dace dominated fish population. Similarly, the habitat varies downstream. Abundant vegetation and deep slow flowing areas where past dredging was evident at Mizzens Farm (BOM3) provides spawning and nursery areas for pike and roach. In contrast the bottom site at Weybridge (BOM2) represented over 1km of important habitat above the confluence of the North and South Bourne. Here the channel flows through thick woodland and appears undisturbed by dredging. A gravel substrate dominates with pools and riffles, providing an excellent spawning area for chub and dace. Due to the extensive shading and nature of the substrate, vegetation is scarce. The lack of cover for predatory species would explain their absence here.

This survey has revealed the North and South Bourne to have great potential as a fisheries resource. At present organised angling is quite limited, exceptions being Leisure Sport A.C. on the North Bourne at Thorpe, Molesey A.C. at Chertsey Meads and on the South Bourne a section running through the Central Veterinary Laboratory fished by the staff club. There are various reasons that may explain an under utilisation by anglers, not least a lack of awareness of the existence of the river or its ability to support a reasonable fish population. Other limiting factors include lack of accessibility and excessive weed growth in the channel making angling difficult in some places. Promoting an awareness of the Bourne as a fishery to landowners and anglers and by using habitat improvement techniques to produce more 'angler friendly' stretches would open up more of the river to a greater number of fishermen. Efforts have been made in this direction at Gogmore Farm in Chertsey where the NRA are working with the Borough Council to produce a channel more amenable to anglers through the provision of fishing platforms; creating fish holding areas, using trees for low cover; by shading out excessive weed growth through tree planting, and by generally creating a greater diversity of habitat.

7 CONCLUSIONS

This survey revealed that much of the Bourne system is an excellent mixed coarse fishery, generally yielding a very impressive biomass of fish. The designated section of the North Bourne far exceeded its biomass targets at all sites fished. Upstream of Chertsey STW suitable habitat for fish is limited.

The South Bourne, although undesignated, also exceeded 20gm^{-2} at all sites fished. The Halebourne above Emmets Mill was very disappointing. Although habitat appeared to be excellent, very few fish were found. Past serious pollutions and the absence of sources of recolonisation probably account for this. Similarly, the fish population at the top end of the Grantsbourne was impoverished due to a recent pollution. In this case, however, successful recolonisation is more likely.

Comparison of the North and South Bourne systems reveals a greater length of inhabitable river for fish fauna on the South Bourne. A general trend of dace and chub dominated populations being replaced with roach and pike dominated populations downstream is observed on the North Bourne, while the opposite trend appears to occur on the South Bourne.

8 RECOMMENDATIONS

a) The thinning of the canopy shading the channel in selected areas, at the top end of the North Bourne by Virginia Water, would encourage the growth of aquatic vegetation. This would improve the riverine habitat which may in turn support the colonisation of a fish population.

b) There is potential for enhancement of habitat at the lower end of the North Bourne. Unsympathetic dredging operations in the past have created a slow moving heavily silted channel with vertical banks.

c) The possibility of a surviving wild brown trout population on the Halebourne and Windlebrook warrants further investigation. Restocking of brown trout upstream of Emmetts Mill may also be appropriate.

d) Past land drainage operations on the Grantsbourne have produced over wide stretches prone to siltation and excessive mid-channel channel weed growth. Land drainage operations to overcome present flooding problems should incorporate opportunities to diversify substrate and flow regime. Natural berms should be encouraged, effectively creating a two stage channel and stone deposition onto the bare clay substrate in discrete areas is recommended.

e) The South Bourne warrants classification as an EC designated fishery.

f) The Grantsbourne is of sufficient significance to justify assignment of an RQO.

g) Greater prominence should be given to the recreational potential of this system.

9 REFERENCES

Hickley, P. & Dexter, K.F. (1979). A comparative index for quantifying growth in length of fish. *Fisheries Management* **10**, 147-151.

10 APPENDICES

APPENDIX I

THAMES REGION - RIVER QUALITY STANDARDS (FRESHWATER)

RIVER QUALITY OBJECTIVES

Class 1A - High quality waters

1. Suitable for potable supply at defined abstraction points, and
2. Suitable for all other abstractions, and
3. Suitable for game or other high class fisheries, (complying with the requirements of Directive 78/659/EEC for salmonid waters), and
4. Of high amenity value.

Class 1B - High quality waters

1. Used for the transport of high proportions of sewage effluent trade effluent or urban run-off and
2. Suitable for potable supply at defined abstractions points, and
3. Suitable for all other abstraction and
4. Suitable for game or other high class fisheries, (complying with the requirements of Directives 78/659/EEC for salmonid waters and
5. Of high amenity value.

Class 2A Fair quality waters

1. Suitable for potable supply after advanced treatment at defined abstraction points, and
2. Suitable for agricultural uses, and
3. Capable of supporting good coarse fisheries, (complying with Directive 78/659/EEC for cyprinid waters), and
4. Of moderate amenity value.

Class 2B - Fair quality waters

1. Suitable for potable supply after advanced treatment at defined abstraction points, and
2. Suitable for agricultural uses, and
3. Capable of supporting reasonably good coarse fisheries, and
4. Of moderate amenity value.

Class 3 - Poor quality water

1. Suitable for low grade industrial use, and
2. Not anaerobic or likely to cause a nuisance, and
3. Capable of supporting a restricted aquatic flora and fauna.

NB Not required to be capable of supporting a viable fishery.

Class 4 - Bad quality waters

1. Likely to cause a nuisance.
2. Flora and fauna absent or restricted to pollution tolerant organisms.

Class X - Insignificant watercourses

1. Watercourses, not usable, and not placed in Classes 1A to 4 above.
2. Capable of supporting a restricted flora and fauna and
3. Not likely to cause a nuisance.

Class E - Ephemeral waters

1. Watercourses in which there is regularly no flow.
2. When water present, complies with the RQO of the downstream reach.

APPENDIX II

THAMES REGION - RIVER QUALITY STANDARDS (FRESHWATER)

Notes:

1. Figures in parenthesis are guidelines only, to be used in setting discharge quality standards.

2. Standards are expressed in the units specified in source documents.

3. Where standards for zinc and copper are given for specific levels of hardness rather than for a range of hardness, standards for intermediate values of hardness should be calculated by linear interpolation between the tabulated figures.

4. An asterisk (*) denotes values interpolated as above from values in the source document.

Sources of standards:

Standards have been drawn from the following sources:

a) National Water Council Classification of River Quality.

b) European Inland Fisheries Advisory Commission (EIFAC).

c) EC Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life.

d) EC Directives 76/464/EEC on pollution caused by certain dangerous substances discharge into the aquatic environment of the Community, and related Directives.

CLASS 1A

DETERMINAND		UNITS	MEAN	50%ile	95%ile	MAX	
Dissolved Oxygen (min)		%sat			80		
Dissolved Oxygen (min)		mg/l		9			
BOD (ATU)		mg/l	(1.5)		3		
Ammonia as NH4		mg/l			0.4 (0.31 AS N)		
Ammonia, non-ionized as NH3		mg/l			0.025 (0.021 AS N)		
Suspended solids (105 deg C)		mg/l		(25)			
pH					6-9		
Nitrite as NO2		mg/l			(0.2)		
Cadmium		ug/l	5				List 1 substances
Mercury		ug/l	1				
Hexachlorocyclohexane		ug/l	0.1				
Carbon tetrachloride		ug/l	12				
Para-para DDT		ng/l	10				
DDT		ng/l	25				
Pentachlorophenol		ug/l	2				
Hexachlorobenzene		ug/l	0.03				
Hexachlorobutadiene		ug/l	0.1				
Chloroform		ug/l	12				
Aldrin		ng/l	10 from 01/1994		1/1989 total 'drins		
Dieldrin		ng/l	10 from 01/1994		<= 30 ng/l		
Endrin		ng/l	5 from 01/1994		& endrin		
Isodin		ng/l	5 from 01/1994		<= 5 ng/l		
Arsenic		ug/l	50				List 2 substances
Chromium hardness	0-50	ug/l	5				
	50-100	ug/l	10				
	100-200	ug/l	20				
	>200	ug/l	50				
Copper hardness	0	ug/l	1				
	10	ug/l	*2		(5)		
	50	ug/l	6		(22)		
	100	ug/l	10		(40)		
	200	ug/l	10		*(76)		
	250	ug/l	28		*(94)		
	>300	ug/l	28		(112)		
Lead hardness	0-50	ug/l	4				
	50-150	ug/l	10				
	>150	ug/l	20				
Nickel hardness	0-50	ug/l	50				
	50-100	ug/l	100				
	100-200	ug/l	150				
	>200	ug/l	200				
Zinc hardness	0	ug/l	8				
	10	ug/l	*16		30		
	50	ug/l	50		200		
	100	ug/l	75		300		
	200	ug/l	75		*350		
	250	ug/l	125		*375		
	>500	ug/l	125		500		

THAMES REGION - RIVER QUALITY STANDARDS (FRESHWATER)

DETERMINAND			UNITS	CLASS 1B MEAN	50%ile	95%ile	MAX	
Dissolved Oxygen (min)			%sat			60		
Dissolved Oxygen (min)			mg/l		9			
BOD (ATU)			mg/l	(2)		5		
Ammonia as NH4			mg/l			0.9 (0.7 AS N)		
Ammonia, non-ionized as NH3			mg/l			0.025 (0.021 AS N)		
Suspended solids (105 deg C)			mg/l		(25)			
pH						6-9		
Nitrite as NO2			mg/l			(0.2)		
Cadmium			ug/l	5				List 1 substances
Mercury			ug/l	1				
Hexachlorocyclohexane			ug/l	0.1				
Carbon tetrachloride			ug/l	12				
Para-para DDT			ng/l	10				
DDT			ng/l	25				
Pentachlorophenol			ug/l	2				
Hexachlorobenzene			ug/l	0.03				
Hexachlorobutadiene			ug/l	0.1				
Chloroform			ug/l	12				
Aldrin			ng/l	10 from 01/1994		) 1/1989 total 'drins		
Dieldrin			ng/l	10 from 01/1994		) <= 30 ng/l		
Endrin			ng/l	5 from 01/1994		) & endrin		
Isodin			ng/l	5 from 01/1994		) <= 5 ng/l		
Arsenic			ug/l	50				List 2 substances
Chromium	hardness	0-50	ug/l	5				
		50-100	ug/l	10				
		100-200	ug/l	20				
		>200	ug/l	50				
Copper	hardness	0	ug/l	1				
		10	ug/l	*2		(5)		
		50	ug/l	6		(22)		
		100	ug/l	10		(40)		
		200	ug/l	10		*(76)		
		250	ug/l	28		*(94)		
		>300	ug/l	28		(112)		
Lead	hardness	0-50	ug/l	4				
		50-150	ug/l	10				
		>150	ug/l	20				
Nickel	hardness	0-50	ug/l	50				
		50-100	ug/l	100				
		100-200	ug/l	150				
		>200	ug/l	200				
Zinc	hardness	0	ug/l	8				
		10	ug/l	*16		30		
		50	ug/l	50		200		
		100	ug/l	75		300		
		200	ug/l	75		*350		
		250	ug/l	125		*375		
		>500	ug/l	125		500		

THAMES REGION - RIVER QUALITY STANDARDS (FRESHWATER)

DETERMINAND			UNITS	CLASS 2A MEAN	50%ile	95%ile	MAX	
Dissolved Oxygen (min)			%sat			40		
Dissolved Oxygen (min)			mg/l		7			
BOD (ATU)			mg/l	(5)		9(8)		
Ammonia as NH4			mg/l			3 (2.33 as N)		
Ammonia, non-ionized as NH3			mg/l			0.025 (0.021 as N)		
Suspended solids (105 deg C)			mg/l		(25)			
pH						6-9		
Nitrite as NO2			mg/l			(0.5)		
Cadmium			ug/l	5				List 1 substances
Mercury			ug/l	1				
Hexachlorocyclohexane			ug/l	0.1				
Carbon tetrachloride			ug/l	12				
Para-para DDT			ng/l	10				
DDT			ng/l	25				
Pentachlorophenol			ug/l	2				
Hexachlorobenzene			ug/l	0.03				
Hexachlorobutadiene			ug/l	0.1				
Chloroform			ug/l	12				
Aldrin			ng/l	10 from 01/1994				} 1/1989 total 'drins
Dieldrin			ng/l	10 from 01/1994				} <= 30 ng/l
Endrin			ng/l	5 from 01/1994				} & endrin
Isodin			ng/l	5 from 01/1994				} <= 5 ng/l
Arsenic			ug/l	50				List 2 substances
Chromium	hardness	0-50	ug/l	150				
		50-100	ug/l	175				
		100-200	ug/l	200				
		>200	ug/l	250				
Copper	hardness	0	ug/l	1				
		10	ug/l	*2			(5)	
		50	ug/l	6			(22)	
		100	ug/l	10			(40)	
		200	ug/l	10			*(76)	
		250	ug/l	28			*(94)	
		>300	ug/l	28			(112)	
Lead	hardness	0-50	ug/l	50				
		50-150	ug/l	125				
		>150	ug/l	250				
Nickel	hardness	0-50	ug/l	50				
		50-100	ug/l	100				
		100-200	ug/l	150				
		>200	ug/l	200				
Zinc	hardness	0	ug/l	75				
		10	ug/l	*95			300	
		50	ug/l	175			700	
		100	ug/l	250			1000	
		200	ug/l	250			*1250	
		250	ug/l	500			*1375	
		>500	ug/l	500			2000	

THAMES REGION - RIVER QUALITY STANDARDS (FRESHWATER)

		CLASS 2B			
DETERMINAND	UNITS	MEAN	50%ile	95%ile	MAX
Dissolved Oxygen (min)	%sat			40	
Dissolved Oxygen (min)	mg/l		(5)		
BOD (ATU)	mg/l	5		9	
Ammonia as NH4	mg/l				
Ammonia, non-ionized as NH3	mg/l		0.025 (0.021 AS N)		
Suspended solids (105 deg C)	mg/l		(80)		
pH				5-9.5	
Nitrite as NO2	mg/l				
Cadmium	ug/l	5			List 1
Mercury	ug/l	1			substances
Hexachlorocyclohexane	ug/l	0.1			
Carbon tetrachloride	ug/l	12			
Para-para DDT	ng/l	10			
DDT	ng/l	25			
Pentachlorophenol	ug/l	2			
Hexachlorobenzene	ug/l	0.03			
Hexachlorobutadiene	ug/l	0.1			
Chloroform	ug/l	12			
Aldrin	ng/l	10 from 01/1994) 1/1989 total 'drins			
Dieldrin	ng/l	10 from 01/1994) <= 30 ng/l			
Endrin	ng/l	5 from 01/1994) & endrin			
Isodin	ng/l	5 from 01/1994) <= 5 ng/l			
Arsenic	ug/l	50			List 2 substances
Chromium hardness 0-50	ug/l	150			
50-100	ug/l	175			
100-200	ug/l	200			
>200	ug/l	250			
Copper hardness 0	ug/l	1			
10	ug/l				
50	ug/l	6			
100	ug/l	10 hardness 100-200			
200	ug/l				
250	ug/l	28 hardness >250			
>300	ug/l				
Lead hardness 0-50	ug/l	50			
50-150	ug/l	125			
>150	ug/l	250			
Nickel hardness 0-50	ug/l	50			
50-100	ug/l	100			
100-200	ug/l	150			
>200	ug/l	200			
Zinc hardness 0	ug/l	75			
10	ug/l				
50	ug/l	175			
100	ug/l	250 hardness 100-200			
200	ug/l				
250	ug/l	500 hardness >250			
>500	ug/l				

DETERMINAND	UNITS	CLASS 3 MEAN	50%ile	95%ile	MAX
Dissolved Oxygen (min)	%sat			10	
Dissolved Oxygen (min)	mg/l				
BOD (ATU)	mg/l			17	
Ammonia as NH4	mg/l				
Ammonia, non-ionized as NH3	mg/l				
Suspended solids (105 deg C)	mg/l				
pH				5-9.5	
Nitrite as NO2	mg/l				
Cadmium	ug/l	5			List1 substances
Mercury	ug/l	1			
Hexachlorocyclohexane	ug/l	0.1			
Carbon tetrachloride	ug/l	12			
Para-para DDT	ng/l	10			
DDT	ng/l	25			
Pentachlorophenol	ug/l	2			
Hexachlorobenzene	ug/l	0.03			
Hexachlorobutadiene	ug/l	0.1			
Chloroform	ug/l	12			
Aldrin	ng/l	10 from 01/1994) 1/1989 total 'drins			
Dieldrin	ng/l	10 from 01/1994) <= 30 ng/l			
Endrin	ng/l	5 from 01/1994) & endrin			
Isodin	ng/l	5 from 01/1994) <= 5 ng/l			
Arsenic	ug/l	50			List 2 substancea
Chromium hardness 0-50	ug/l	150			
50-100	ug/l	175			
100-200	ug/l	200			
>200	ug/l	250			
Copper hardness 0	ug/l	1			
10	ug/l				
50	ug/l	6			
100	ug/l	10 hardness 100-200			
200	ug/l				
250	ug/l	28 hardness >250			
>300	ug/l				
Lead hardness 0-50	ug/l	50			
50-150	ug/l	125			
>150	ug/l	250			
Nickel hardness 0-50	ug/l	50			
50-100	ug/l	100			
100-200	ug/l	150			
>200	ug/l	200			
Zinc hardness 0	ug/l	75			
10	ug/l				
50	ug/l	175			
100	ug/l	250 hardness 100-200			
200	ug/l				
250	ug/l	500 hardness>250			
>500	ug/l				

CLASS 4

DETERMINAND			UNITS	MEAN	50%ile	95%ile	MAX	
Dissolved Oxygen (min)			%sat					
Dissolved Oxygen (min)			mg/l					
BOD (ATU)			mg/l	There are no quality standards that apply, BUT				
Ammonia as NH4			mg/l					
Ammonia, non-ionized as NH3			mg/l					
Suspended solids (105 deg C)			mg/l	Discharges containing dangerous substances, i.e. List 1 & List 2 substances must not cause concentrations in the receiving water to exceed those set for Class 3 or to increase the existing levels if these are greater.				
pH								
Nitrite as NO2			mg/l					
Cadmium			ug/l					List 1 substances
Mercury			ug/l					
Hexachlorocyclohexane			ug/l					
Carbon tetrachloride			ug/l					
Para-para DDT			ng/l					
DDT			ng/l					
Pentachlorophenol			ug/l					
Hexachlorobenzene			ug/l					
Hexachlorobutadiene			ug/l					
Chloroform			ug/l					
Aldrin			ng/l					
Dieldrin			ng/l					
Endrin			ng/l					
Isodin			ng/l					
Arsenic			ug/l					List 2 substances
Chromium	hardness	0-50	ug/l					
		50-100	ug/l					
		100-200	ug/l					
		>200	ug/l					
Copper	hardness	0	ug/l					
		10	ug/l					
		50	ug/l					
		100	ug/l					
		200	ug/l					
		250	ug/l					
		>300	ug/l					
Lead	hardness	0-50	ug/l					
		50-150	ug/l					
		>150	ug/l					
Nickel	hardness	0-50	ug/l					
		50-100	ug/l					
		100-200	ug/l					
		>200	ug/l					
Zinc	hardness	0	ug/l					
		10	ug/l					
		50	ug/l					
		100	ug/l					
		200	ug/l					
		250	ug/l					
		>500	ug/l					

DETERMINAND			UNITS	CLASS X MEAN	50%ile	95%ile	MAX	
Dissolved Oxygen (min)			%sat			10		
Dissolved Oxygen (min)			mg/l					
BOD (ATU)			mg/l			(17)		
Ammonia as NH4			mg/l					
Ammonia, non-ionized as NH3			mg/l					
Suspended solids (105 deg C)			mg/l					
pH						5-9.5		
Nitrite as NO2			mg/l					
Cadmium			ug/l	5				List 1 substances
Mercury			ug/l	1				
Hexachlorocyclohexane			ug/l	0.1				
Carbon tetrachloride			ug/l	12				
Para-para DDT			ng/l	10				
DDT			ng/l	25				
Pentachlorophenol			ug/l	2				
Hexachlorobenzene			ug/l	0.03				
Hexachlorobutadiene			ug/l	0.1				
Chloroform			ug/l	12				
Aldrin			ng/l	10 from 01/1994		1/1989 total 'drins		
Dieldrin			ng/l	10 from 01/1994		<= 30 ng/l		
Endrin			ng/l	5 from 01/1994		& endrin		
Isodin			ng/l	5 from 01/1994		<= 5 ng/l		
Arsenic			ug/l					List 2 substances
Chromium	hardness	0-50	ug/l					
		50-100	ug/l					
		100-200	ug/l					
		>200	ug/l					
Copper	hardness	0	ug/l					
		10	ug/l					
		50	ug/l					
		100	ug/l					
		200	ug/l					
		250	ug/l					
		>300	ug/l					
Lead	hardness	0-50	ug/l					
		50-150	ug/l					
		>150	ug/l					
Nickel	hardness	0-50	ug/l					
		50-100	ug/l					
		100-200	ug/l					
		>200	ug/l					
Zinc	hardness	0	ug/l					
		10	ug/l					
		50	ug/l					
		100	ug/l					
		200	ug/l					
		250	ug/l					
		>500	ug/l					

APPENDIX III

EXTRACT FROM E.E.C. DIRECTIVE 78 / 659

LIST OF DETERMINANDS

Determinand	*Salmonid Waters*		*Cyprinid Waters*	
	G	*I*	*G*	*I*
(a) Temperature (max) (b) Temperature rise		≤ 21.5°C ≯ 1.5°C		≤ 28°C ≯ 3°C
Dissolved oxygen (mg/l)	50% > 9 100% > 7	50% > 9	50% > 8 100% > 5	50% > 7
pH		6 – 9		6 – 9
Suspended solids (mg/l)	≤ 25		≤ 25	
B.O.D.(A.T.U.) (mg/l)	≤ 5•		≤ 8 •	
Nitrates (mg/l)	< 0.2•		≤ 0.5•	
Non-ionized ammonia (mg/l)	< 0.005	< 0.025	≤ 0.005	< 0.025
Total ammonium (mg/l NH_4)	< 0.04	< 1	< 0.2	< 1
Total residual chlorine (mg/l HClO)		< 0.005		< 0.005
Zinc (mg/l)		< 0.3		< 1
Copper (mg/l)	< 0.04		< 0.04	

• The revised G-values that have been set by the U.K.Government

Appendix IV. NRA Fish Survey Site Coding System

The following habitat codes are used by Thames NRA fisheries and are based on RQO and EEC legislation criteria:

1. EEC Designated Watercourses

Code	Description
A	1A Salmonid
B	1A Coarse
C	1A/1B Salmonid
D	1A/1B Cyprinid
E	1B Salmonid
F	1B Coarse
G	2/1B Salmonid
H	2/1B Coarse
I	2 Salmonid
J	2 Cyprinid

2. ROO Watercourses

Code	Description
K	1A
L	1A/1B
M	1B
N	2/1B
O	2
P	3/2
Q	3
R	4/3
S	4
T	Unclassified

A 2 digit code for a watercourse is combined with the above and an individual site number to provide an unique 4 digit code for each site. Thus WNH1 = WN, Wey North; H, 2/1B cyprinid; 1, individual site.