

**R. LEACH**  
**FISHERIES SURVEY 1993**  
EQ/POL/FS

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ENVIRONMENT AGENCY



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## 1.0 SUMMARY.

Six sites on the River Leach were surveyed by electric fishing between 08-06-93 and 22-07-93.

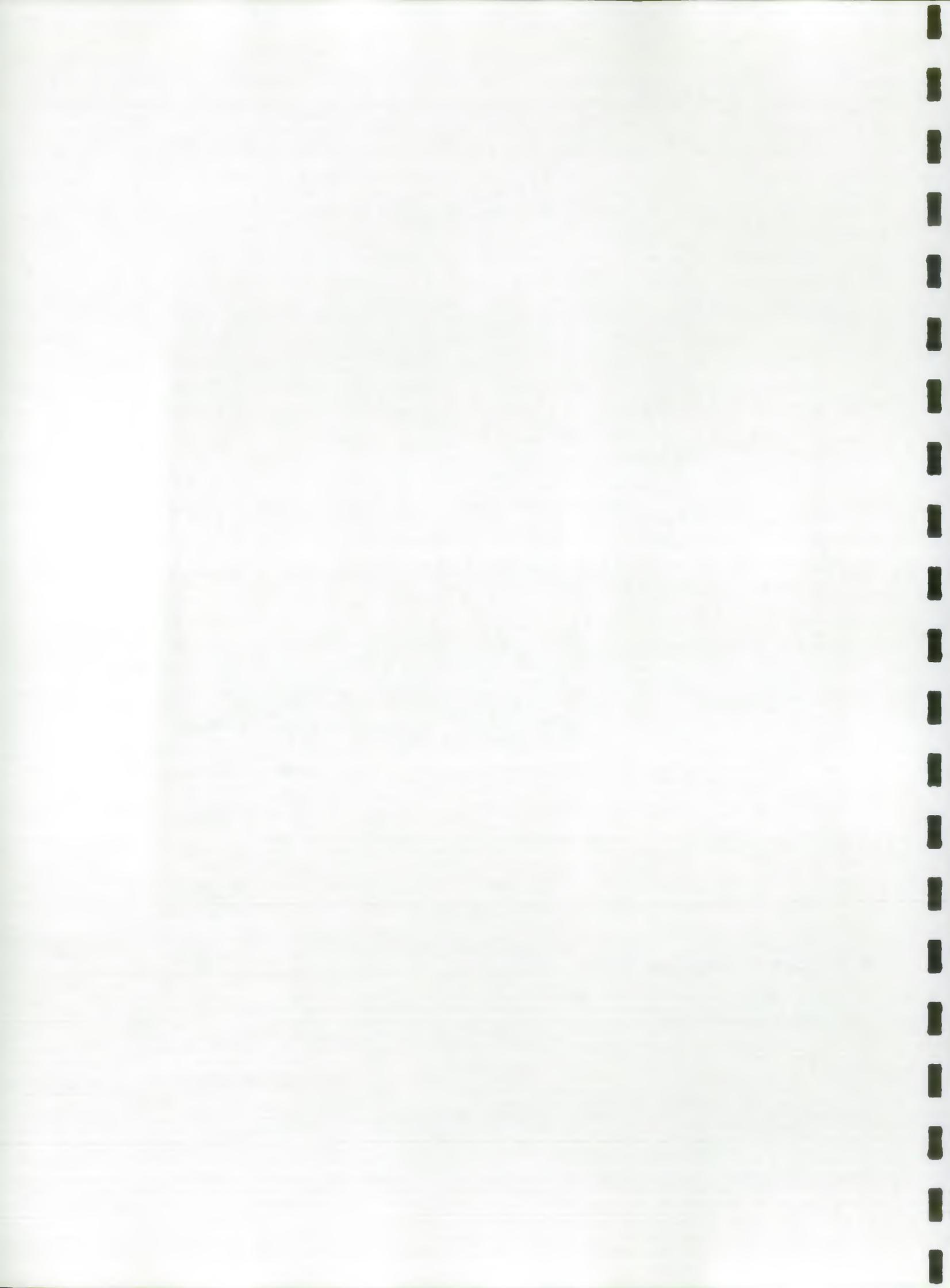
Of the six sites surveyed two are designated salmonid fisheries under EC fisheries directive 78/659/EEC, and both exceeded their biomass targets of 15gm<sup>2</sup>.

Lack of suitable spawning sites appears to be largely responsible for the poor natural recruitment of the brown trout population.

The drought period from 1989 to 1992 caused much of the "ephemeral" Leach above Eastleach Martin to be dry for longer periods than normal, and this may have had some effect upon recruitment.

Fig. 1 R. Leach Catchment





## **2.0 INTRODUCTION.**

This survey of the River Leach follows on from the survey carried out in 1987 and is part of the five year rolling programme of surveys undertaken by Thames Region NRA.

Fig. 1 shows the River Leach from source to confluence with the Thames below Lechlade and includes fishery survey sites, water quality sampling points, biological survey sites, major towns and villages.

### **2.1 Description of the Watercourse.**

The Leach rises from a set of springs to the west and north of the village of Hampnett in Gloucestershire. The river runs over the Inferior Oolite limestone through the small town of Northleach. Below Northleach the river is ephemeral, as the river runs over Great Oolite limestone until it reaches the Forest Marble near Eastleach. From here the flow is more

permanent, though still influenced by the level of the water table. The river reaches the Oxford Clay approximately 0.5km below Southrop. Most of the water for the Leach is provided by springs and ephemeral tributaries; there is little in the way of surface run-off except in extreme circumstances such as those occurring in early June 1993 when approximately 7-8 centimetres of rain fell in the Leach valley in under two hours and caused localised flooding.

The RQO of the Leach is 1A from source to confluence, and this objective is achieved. From Little Faringdon to the Thames at Lechlade (3.5km), the river is designated as an EEC Salmonid fishery with a Thames Region NRA internal biomass target of 15gm<sup>-2</sup>.

Lechlade STW and the trout farm at Lechlade both discharge into the lower river. There is a steady influx of escapee rainbow trout into the river which may have some effect upon the resident brown trout population through competition for space and available food.

The river has a length of 30.5km from source to the River Thames, and a mean gradient of 1 in 244. The channel has been modified for milling and for the now disused railway in several locations. It is still impounded by mills at Lechlade, Little Faringdon, Southrop and at Cote Mill which is situated between Eastleach Martin and Southrop. These impoundments make up a significant length of the permanent river and may contribute to the modest recruitment of brown trout.

The river from Eastleach downstream provides reasonable trout fishing, and is regularly stocked with brown trout.

### **2.2 Water Quality.**

River water quality is classified by the National Water Council (NWC) River Quality Objectives (RQO) 1978. Details are shown in Appendix 1. The River Leach is classified as 1A for its whole length.

### 2.3 Main Discharges.

Two discharges affect the lower Leach; one from Lechlade Trout Farm at SP224011, and one from Lechlade STW, SU227995, which discharges to the river downstream of Lechlade Mill. Both of these are currently meeting their discharge consents. There has, however, been a perceived problem downstream of the trout farm accompanied by occasional complaints of discoloured water and lack of fly hatches, particularly of the common Baetis spp., e.g. Medium Olives, which are the main daytime fly hatches on chalk and limestone rivers.

### 2.4 Land Drainage Works.

Very little recent land drainage work has been carried out on the Leach, and nothing of a major nature. With the exception of some small dredging operations on the old R. Leach in 1992, and at Eastleach Martin in 1991 the rest of the work has been maintenance trimming and some weedcutting.

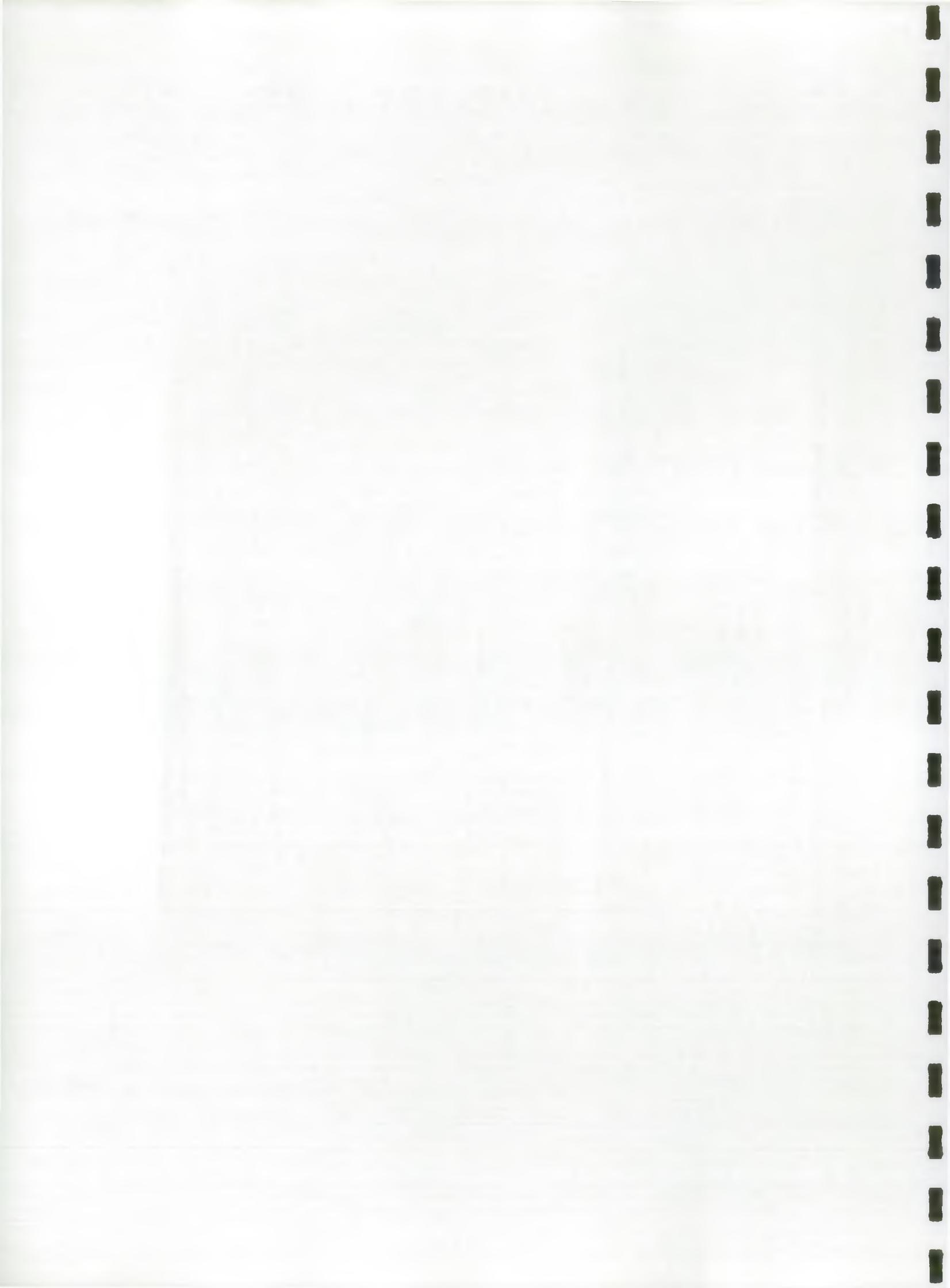
### 2.5 Fishery Management and Habitat Work.

Due to the lack of suitable spawning gravels brown trout recruitment has been generally poor on the Leach. In an effort to improve this a site was selected at Cote Mili, upstream of Southrop, for a spawning box in the autumn of 1991. During the winter period of 1992/93 more than 13,000 brown trout fry were counted out of the box by the owner of Cote Mill. Little evidence has been seen to date that this attempt at improving brown trout productivity is bearing fruit, and the work may need to be linked to improvements in the habitat before any increases in brown trout numbers are observed. Attempts have also been made to improve spawning gravels by rotavating to break up the gravel crust and allow the current to wash out accumulated silt, and by the use of high pressure jet wash equipment. Restocking is done by some of the riparian owners or their tenants and is usually with brown trout only. 200 brown trout are stocked per annum below Little Faringdon, and approximately 250 at Common Barn Farm by Cotswold Flyfishers.

### 2.6 Hydrology.

Fig. 2 shows the monthly mean flow for the River Leach.





### 3.0 AIMS AND OBJECTIVES.

#### 3.1 Overall aims of Surveys.

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

#### 3.2 River Classification.

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

Under European Community Directive 78/659/EEC river zones are classified as capable of supporting either salmonid or cyprinid fish.

Details of the NWC classification system and the EC Directive appear in Appendices I - III.

Thames Region NRA has developed a classification system based upon the River Quality Objectives and the EC Directive. A description of this system is shown in Appendix IV.

Fish biomass targets apply within Thames Region NRA with respect to EC designated fisheries, viz:-

Cyprinid	20gm <sup>-2</sup>
Salmonid	15gm <sup>-2</sup>

#### 3.3 Specific Aims.

The first survey of the River Leach in 1987 provided baseline data for the river and was part of an initial series of surveys in a five year rolling programme. This current survey will enable comparisons to, and changes in, the fish populations to be assessed.

## 4.0 METHODS.

### 4.1 Site Selection.

Six sites were selected and fished between 8/6/93 and 22/7/93. Four of the sites were repeats of those surveyed in 1987, and two, LHA2 and LHK5, were new sites. LHA2 was sampled to investigate the spread of coarse fish upstream from the Thames, and LHK5 at Cote Mill in an attempt to quantify successful recruitment from the spawning box which is located just upstream of the survey site.

### 4.2 Fish Capture and Data Acquisition.

Catch depletion electrofishing techniques were employed at each site, using non-independently switched pulsed DC equipment. At least two runs were fished according to the catch efficiency in enclosed sections of at least 100m in length. All fish captured were enumerated by species, measured to the nearest millimetre and weighed to the nearest gramme. In view of the relatively small numbers of fish found in each survey section it was deemed inappropriate to take scale samples for age analysis.

Minor species such as stoneloach (*Noemacheilus barbatulus*), minnow (*Phoxinus phoxinus*), bullhead (*Cottus gobio*) and stickleback (*Gasterosteus aculeatus*) were noted for relative abundance.

All other relevant site details were noted and appear in the site reports.

All data acquired in the field was entered into a Husky Hunter data logger and was later downloaded to a Novell Network file server for analysis.

Single qualitative electrofishing runs were made upstream at most sites where conditions permitted with the aim of assessing the viability of the results from the survey section over a greater area.

### 4.3 Backpack Sites.

The acquisition in early 1993 of Electracatch backpack electrofishing equipment has meant that previously inaccessible sites in the headwaters of rivers such as the Leach can now be sampled. From Northleach to Eastleach Martin the Leach is ephemeral in nature, and usually flows only in the early part of the year providing the winter period has had sufficient rainfall. Following the heavy autumn/winter rains of 1992/93 the ephemeral Leach was still flowing in early August. It was decided to undertake qualitative surveys on two of these sites as well as on three side channels lower down the river. A list of these sites and a brief outline of the data acquired appears in Sec 5. The value of the backpack equipment lies in its flexibility and lightness. Several small qualitative sites can be investigated in a day using only the two staff as laid down by Health & Safety guidelines.

#### 4.4 Data Analysis.

The data was processed on the LAN system using the Fisheries Information System (FINS) software. Graphics were created using Lotus Freelance v4.0.

#### 4.5 Macroinvertebrates.

NRA Biology staff are engaged upon a continuous biological monitoring programme of the main watercourses in the Region. Data from this source is presented in Fig. 3.

Invertebrate samples tend to reflect the physio-chemical variations which occur in rivers and thus provide a means of monitoring the aquatic environment on a continuous basis. The results are evaluated using the Biological Monitoring Working Party scoring system. Results obtained are compared to scores predicted for the site.

#### 4.6 Water Quality.

River quality objectives (RQO) were set according to existing water quality conditions and the uses of the river. Discharge consents are determined in order to meet the RQO. NRA Pollution officers take routine samples from consented discharges to monitor compliance with consent conditions, and from reach assessment points to determine whether the RQO is being met.

The samples are analysed for different parameters according to its source. Results from routine samples are held on a register which is available for public examination.

**5. SITE REPORTS.**

Site reports together with biomass/density and length frequency charts are presented in the following pages.

## 5.1 SITE REPORT

WATERCOURSE: R. Leach.

SITE NAME: Old Rectory, Eastleach Martin.

SITE CODE: LHK2

LOCATION: Opposite Old Rectory

NGR: SP 205054

DATE FISHED: 8-Jun-93

METHOD: Electric fishing by wading. 2 anodes, 2 nets. Stop nets used.

EC TARGET N/A

BIOMASS: 3.24gm<sup>2</sup>

1987 Biomass: 5.9gm<sup>2</sup>

### HABITAT FEATURES

LENGTH: 117m WIDTH (RANGE): 6.8m (5.9-7.3m) AREA 796m<sup>2</sup>

DEPTH (RANGE): 1.2m (0.9-1.3m)

WATER TEMPERATURE: 10°C

WATER LEVEL: Above normal.

WATER CLARITY: Clear

FLOW RATE: Above average

### SUBSTRATE COMPOSITION (%)

BARE: 0 MUD & SILT: 15 GRAVEL: 40 STONE: 40 BOULDER: 5

### VEGETATION (% COVER)

SUBMERGED: 60 FLOATING: 0 EMERGENT: 0 SHADE: 70

DOMINANT PLANT SPECIES (AQUATIC): *Callitriche, Hippuris, Fontinalis, Berula*

DOMINANT PLANT SPECIES (BANKSIDE): Grass

ADJACENT LAND USE L.B.: Pasture

ADJACENT LAND USE R.B.: Woodland

### REMARKS

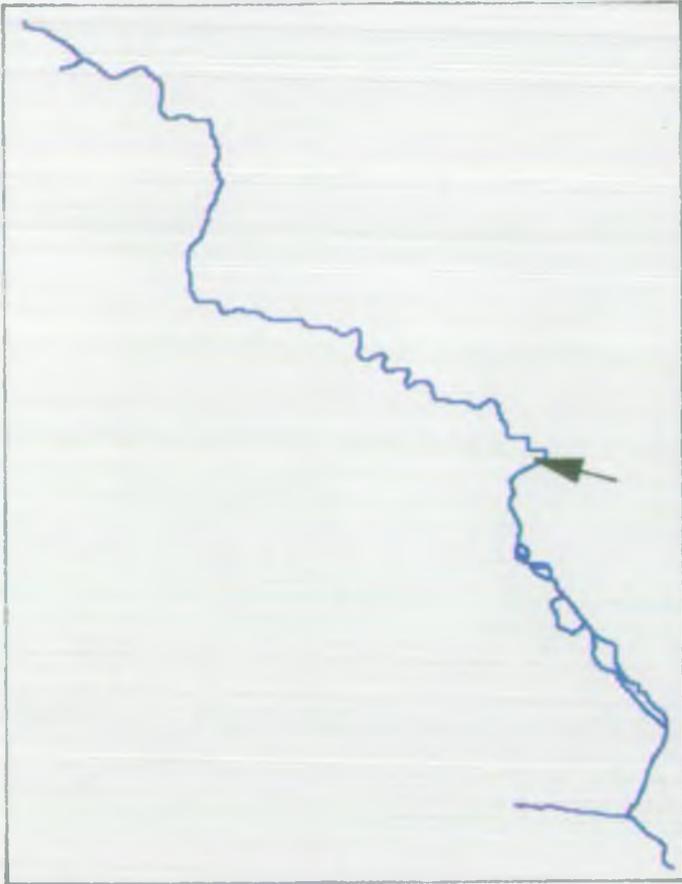
#### PHYSICAL STRUCTURE OF SITE:

Straight section of uniform width. Deep pools to 1.5m in river bed. Water very clear and higher than normal level. Substrate generally poor with stone and silt in equal proportions. Reasonable macrophyte growth

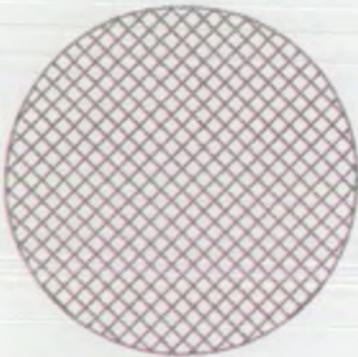
#### CATCH:

Bullheads present in low numbers. Only 8 brown trout captured in survey section. Upstream run produced 3 brown trout for 1.5kg. Upstream run section 108m x 7.1m.

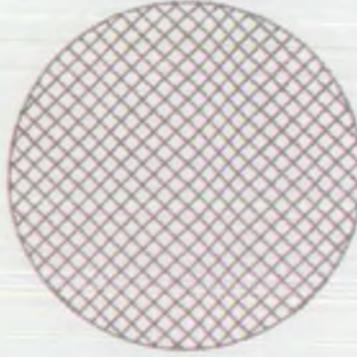
Fig. 5.1a Site LHK2 Biomass & Density.



	Biomass (gm <sup>-2</sup> )	Density (nm <sup>-2</sup> )
 BT	3.2	0.010



Biomass



Density

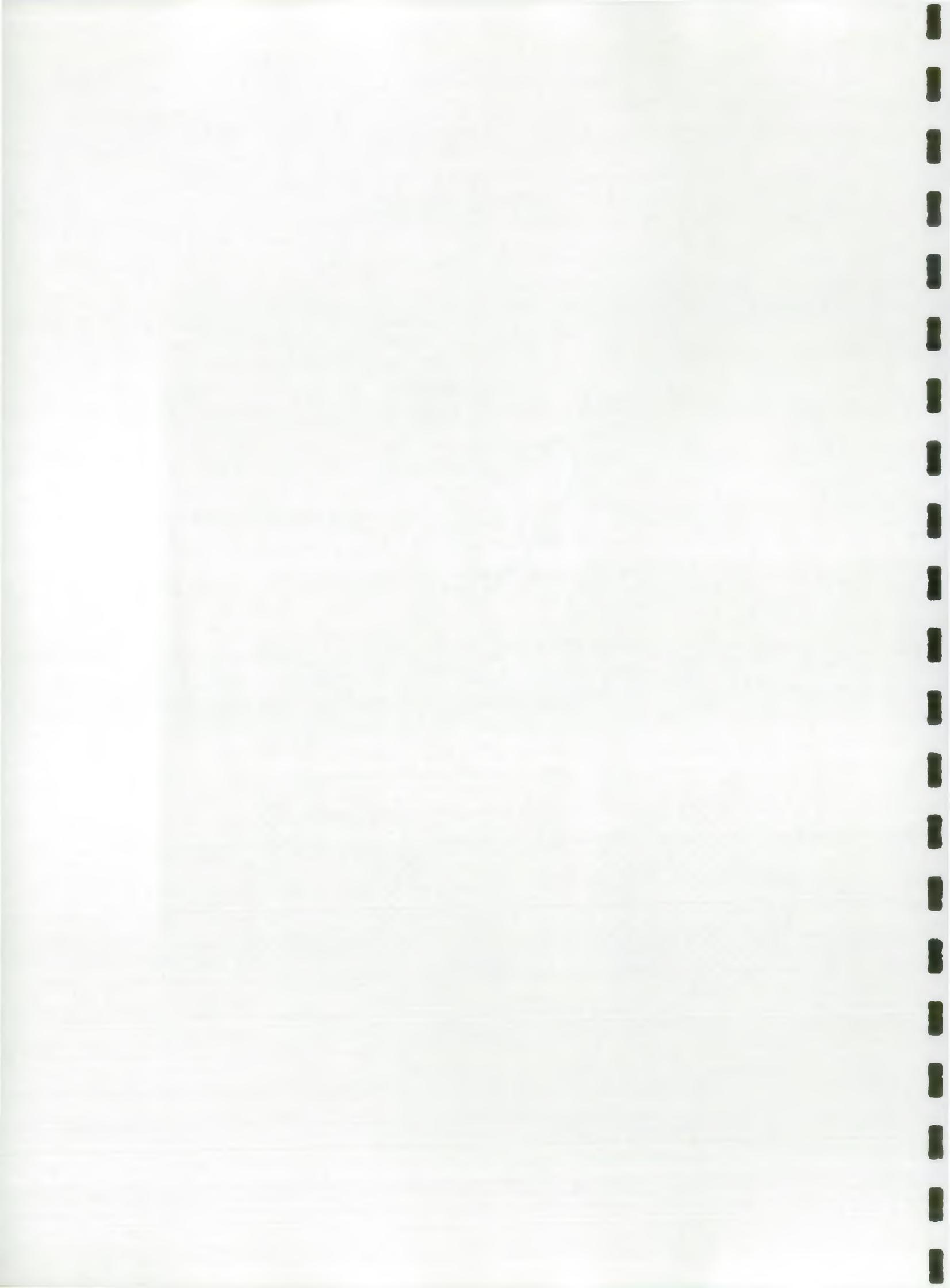
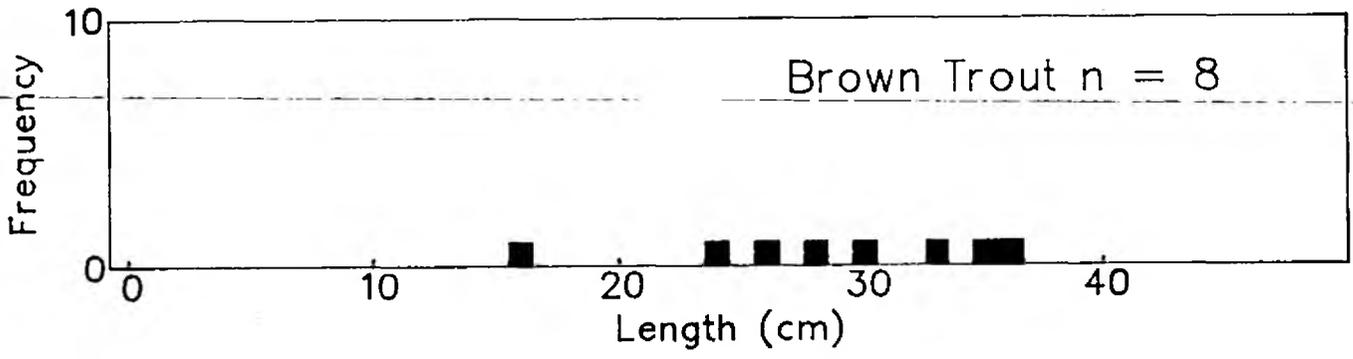


Fig. 5.1b Site LHK2 Length Frequency



## 5.2 SITE REPORT

WATERCOURSE: R. Leach

SITE NAME: Cote Mill

SITE CODE: LHK5

LOCATION: D/S of footbridge and confluence with mill channel

NGR: SP202044

DATE FISHED: 06-July-93

METHOD Electric fishing by wading. 2 anodes, 2 nets. Stop nets used.

EC TARGET N/A

BIOMASS: 6.21gm<sup>2</sup>

### HABITAT FEATURES

LENGTH: 80m WIDTH (RANGE): 7.2m (6.7-7.6m) AREA: 576m<sup>2</sup>

DEPTH (RANGE): 0.3m (0.1-0.5m)

WATER TEMPERATURE: 9°C

WATER LEVEL: Normal

WATER CLARITY: Clear

FLOW RATE: Normal

### SUBSTRATE COMPOSITION (%)

BARE:0 MUD & SILT: 10 GRAVEL: 80 STONE: 10 BOULDER: 0

### VEGETATION (% COVER)

SUBMERGED: 5 FLOATING: 0 EMERGENT: 15 SHADE: 50

DOMINANT PLANT SPECIES (AQUATIC): *Callitriche*, *Hippuris*.

DOMINANT PLANT SPECIES (BANKSIDE): *Glyceria*, *Rorippa*

ADJACENT LAND USE L.B.: Tree lined.

ADJACENT LAND USE R.B.: Grazing.

### REMARKS

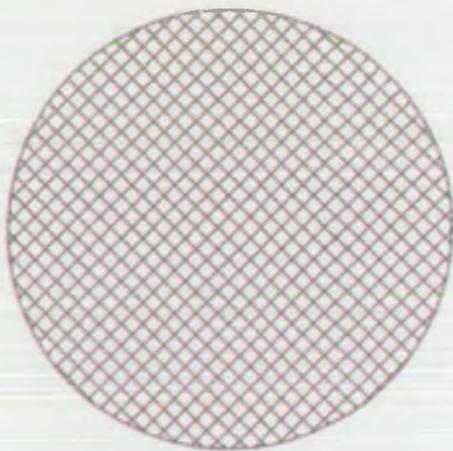
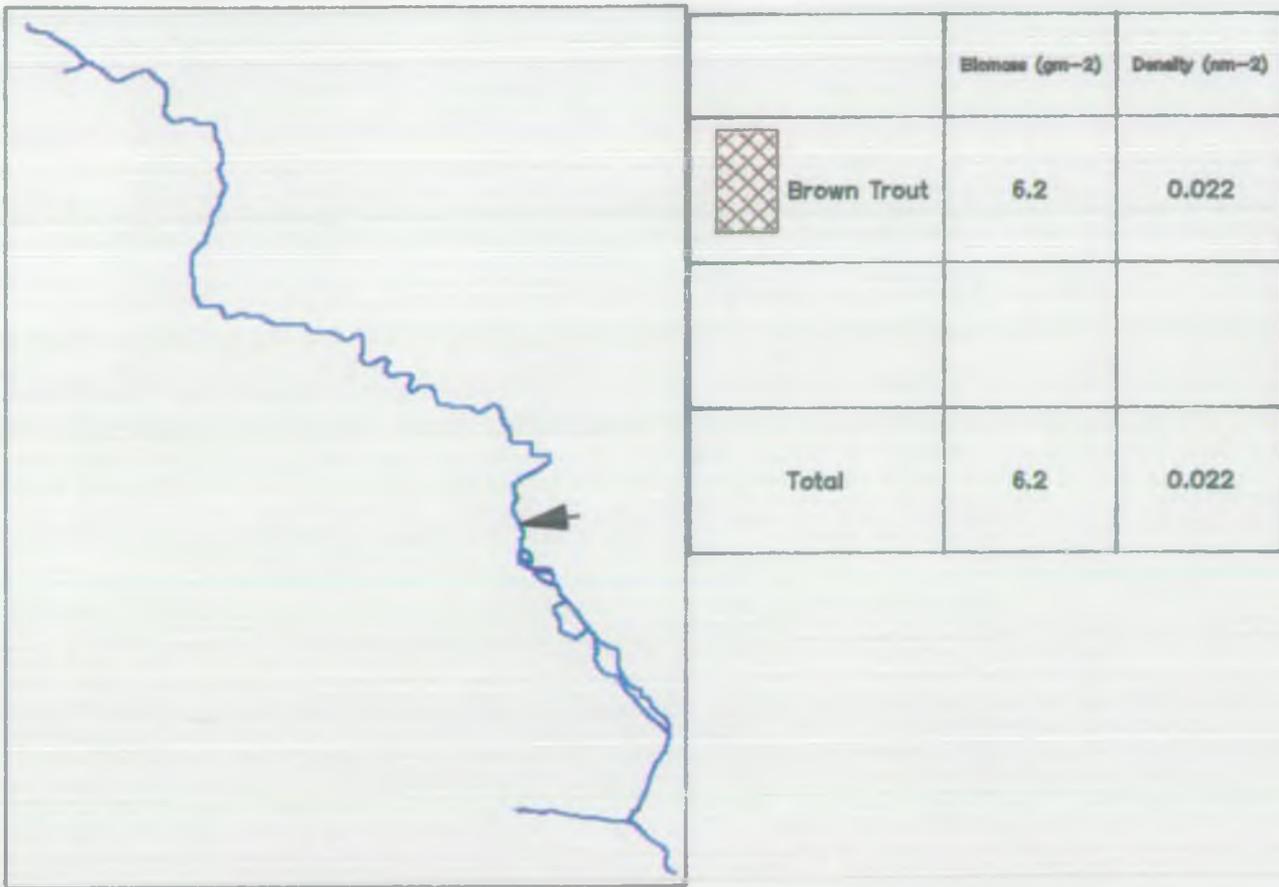
PHYSICAL STRUCTURE OF SITE:

Straight section of even depth. Substrate has been rotovated in the past.

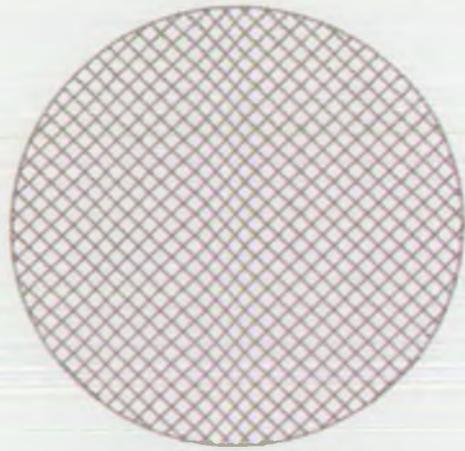
CATCH:

Brown trout dominated. Bullheads common. Upstream run of 82m by 6.3m produced 3.5kg. Biomass of 6.77gm<sup>2</sup>.

Fig. 5.2a Site LHK5 Biomass & Density



Biomass (gm<sup>-2</sup>)



Density (nm<sup>-2</sup>)

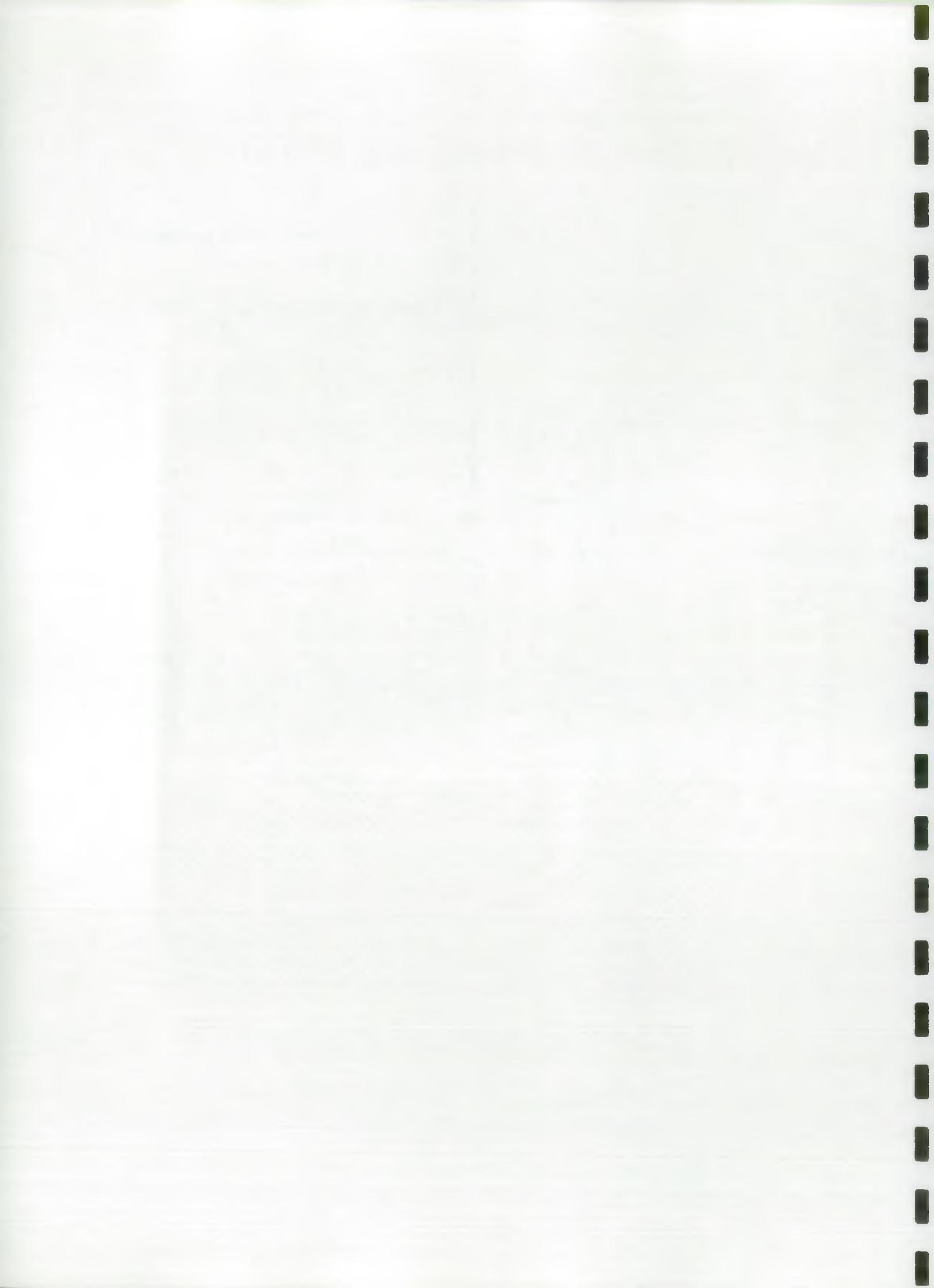
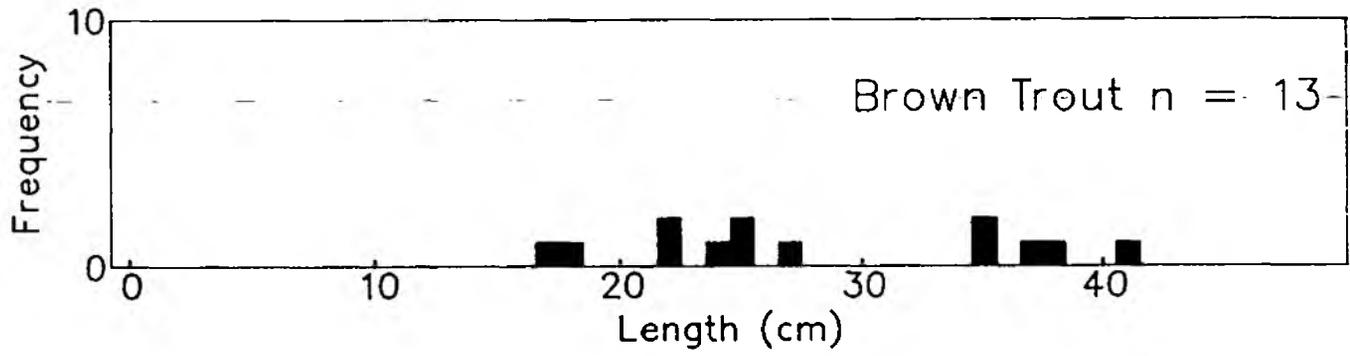


Fig. 5.2b Site LHK5 Length Frequency



### 5.3 SITE REPORT

WATERCOURSE: R. Leach

SITE NAME: Fyfield

SITE CODE: LHK3

LOCATION: Upstream of stone bridge at d/s boundary of Baxter's Farm.

NGR: SP 203037

DATE FISHED: 29-June-93

METHOD: Electric fishing by wading. 3 anodes 2 nets. Stop nets used.

EC TARGET N/A

BIOMASS: 5.46gm<sup>2</sup>

1987 Biomass: 10.9gm<sup>2</sup>

#### HABITAT FEATURES

LENGTH: 104m WIDTH (RANGE): 8m (6.9-8.8m) AREA: 832m<sup>2</sup>

DEPTH (RANGE): 0.8m (0.5-1.1m)

WATER TEMPERATURE: 10°C

WATER LEVEL: Above normal

WATER CLARITY: Clear

FLOW RATE: Fast

#### SUBSTRATE COMPOSITION (%)

BARE: 0 MUD & SILT: 80 GRAVEL: 19 STONE: 1 BOULDER: 0

#### VEGETATION (% COVER)

SUBMERGED: 80 FLOATING: 0 EMERGENT: 2 SHADE: 50

DOMINANT PLANT SPECIES (AQUATIC): *Berula*.

DOMINANT PLANT SPECIES (BANKSIDE): *Sparganium*, *Phalaris*

ADJACENT LAND USE L.B.: Unimproved pasture

ADJACENT LAND USE R.B.: As Above

#### REMARKS

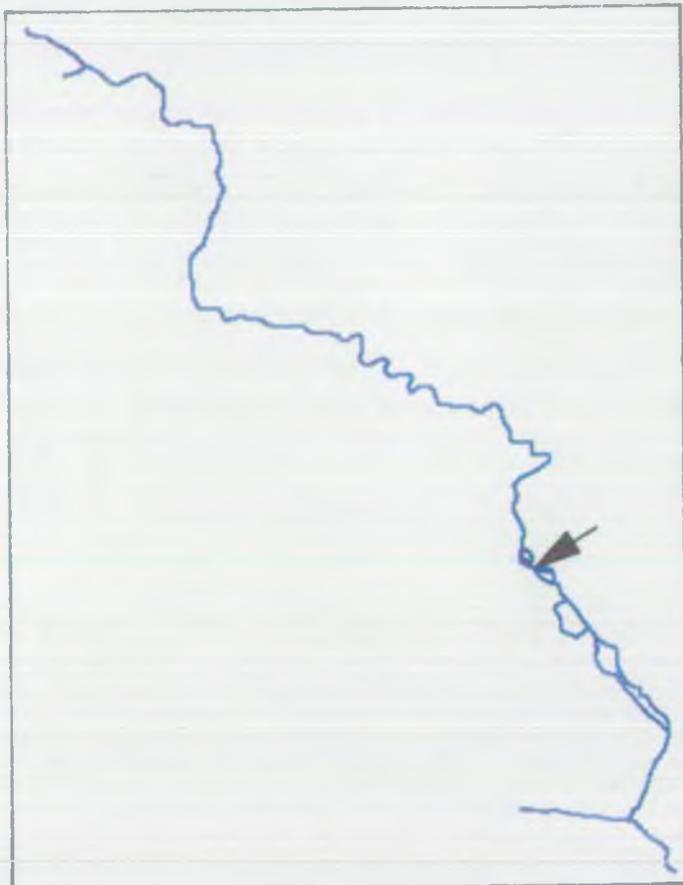
##### PHYSICAL STRUCTURE OF SITE:

Straight section above stone bridge. Tree lined and of uniform depth. Generally silty substrate due to heavy growth of *Berula*.

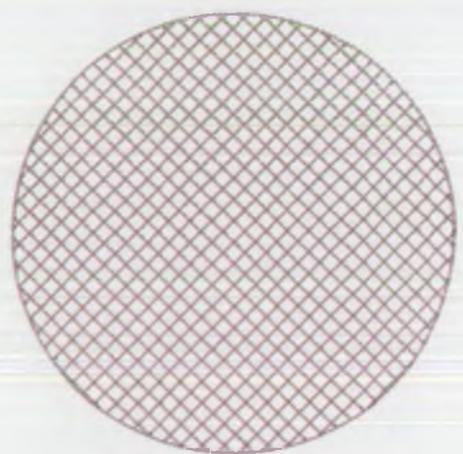
##### CATCH:

Upstream run of 177m by 11m produced a total catch of 11.5kg. This gives a biomass of 5.91gm<sup>2</sup>. This is very slightly greater than that found in the survey site. Brown trout were the only major species found. Bullheads were noted as being present only.

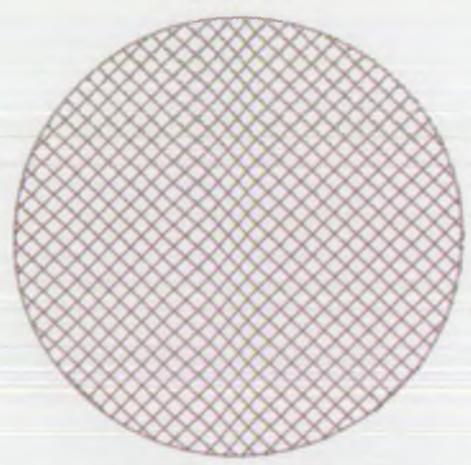
Fig. 5.3a Site LHK3 Biomass & Density.



	Biomass (gm-2)	Density (nm-2)
 Brown Trout	5.5	0.017
Total	5.5	0.017



Biomass (gm-2)



Density (nm-2)

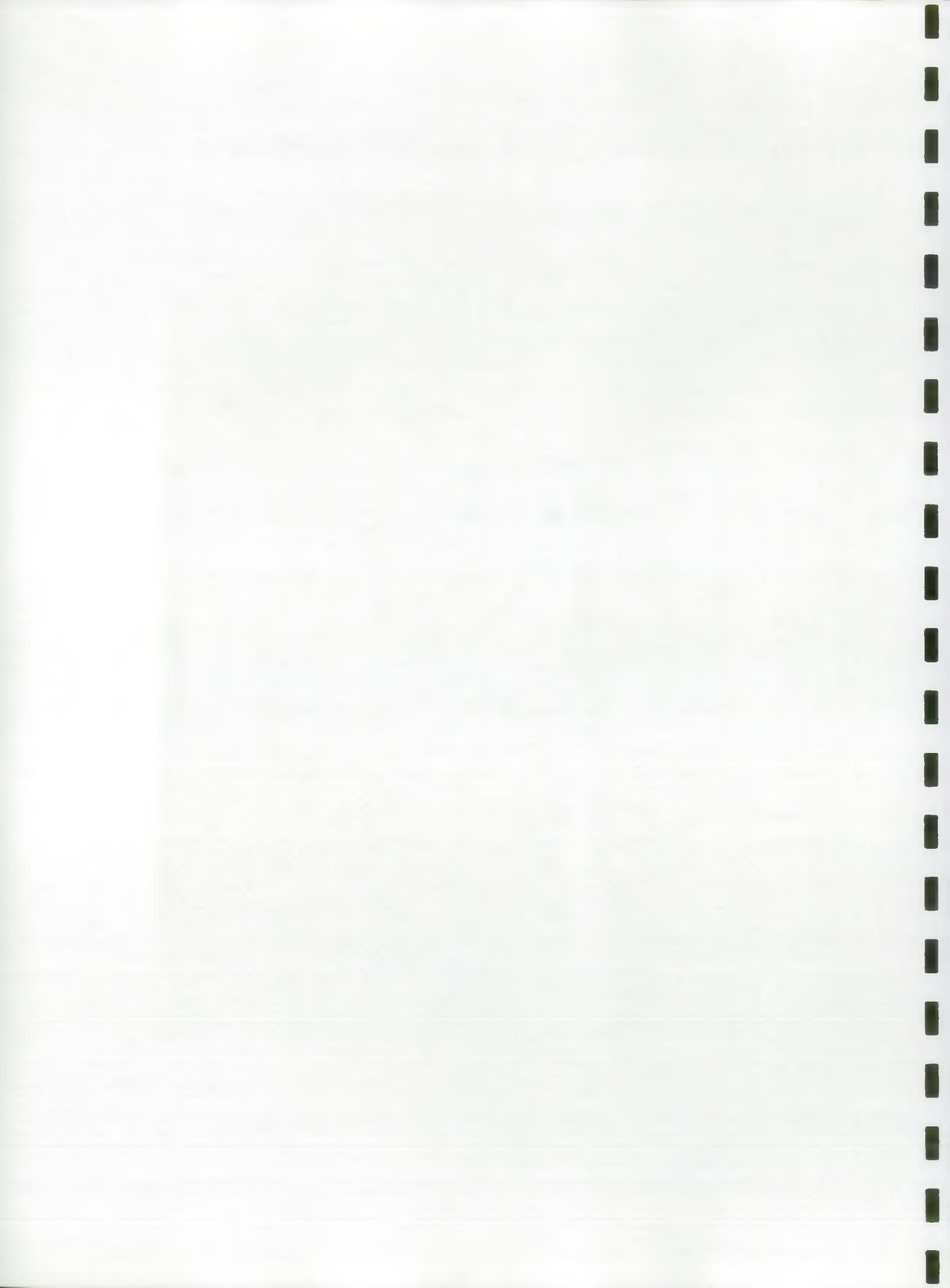
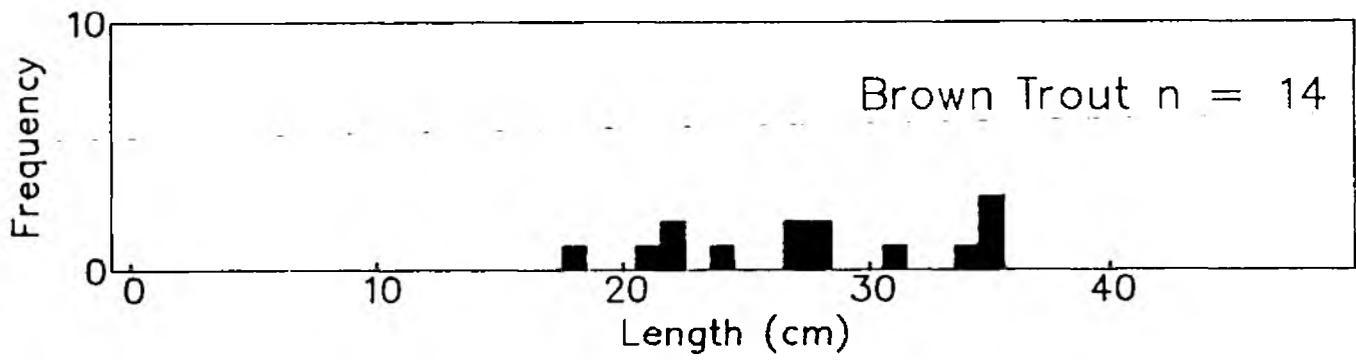


Fig. 5.3b Site LHK3 Length Frequency



#### 5.4 SITE REPORT

WATERCOURSE: R. Leach.

SITE NAME: Common Barn Farm.

SITE CODE: LHK4

LOCATION: Down gravel track opposite Common Barn Farm. Site u/s ford

NGR: SP215021

DATE FISHED: 22-Jun-93

METHOD: Electric fishing by wading. 2 anodes, 2 nets. Stop nets used.

EC TARGET N/A

BIOMASS: 10.9gm<sup>2</sup>

1987 Biomass: 23.0gm<sup>2</sup>

#### HABITAT FEATURES

LENGTH: 161m WIDTH (RANGE): 5.8m (5.0-6.4m) AREA: 933.8 m<sup>2</sup>

DEPTH (RANGE): 1m (0.6-1.5m)

WATER TEMPERATURE: 10°C

WATER LEVEL: Above normal

WATER CLARITY: Clear

FLOW RATE: Fast

#### SUBSTRATE COMPOSITION (%)

BARE: 0 MUD & SILT: 5 GRAVEL: 95 STONE: 0 BOULDER: 0

#### VEGETATION (% COVER)

SUBMERGED: 10 FLOATING: 0 EMERGENT: 10 SHADE: 40

DOMINANT PLANT SPECIES (AQUATIC): *Ranunculus*

DOMINANT PLANT SPECIES (BANKSIDE): *Carex, Phalaris*

ADJACENT LAND USE L.B.: Rough Grass

ADJACENT LAND USE R.B.: Scrub

#### REMARKS

##### PHYSICAL STRUCTURE OF SITE:

Pool/riffle section with one deep pool. Deeply cut banks with overhanging trees and scrub. River bed mostly gravel and sand. Part of this site has been rotovated to improve trout spawning potential.

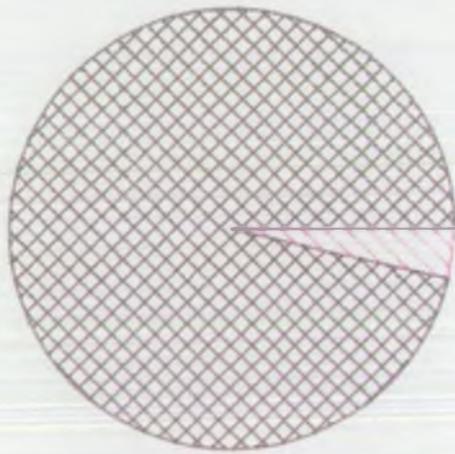
##### CATCH:

Brown trout dominant with one escapee rainbow. Minor species mostly absent with exception of small numbers of bullheads. Good range of brown trout sizes and 1993 year class brown trout fry noted in shallows, though none caught.

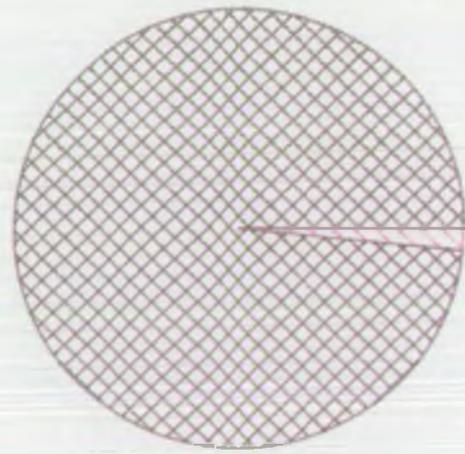
Fig. 5.4a Site LHK4 Biomass & Density



	Biomass (gm-2)	Density (nm-2)
 Brown Trout	10.5	0.062
 Rainbow Trout	0.4	0.001
<b>Total</b>	<b>10.9</b>	<b>0.063</b>



Biomass (gm-2)



Density (nm-2)

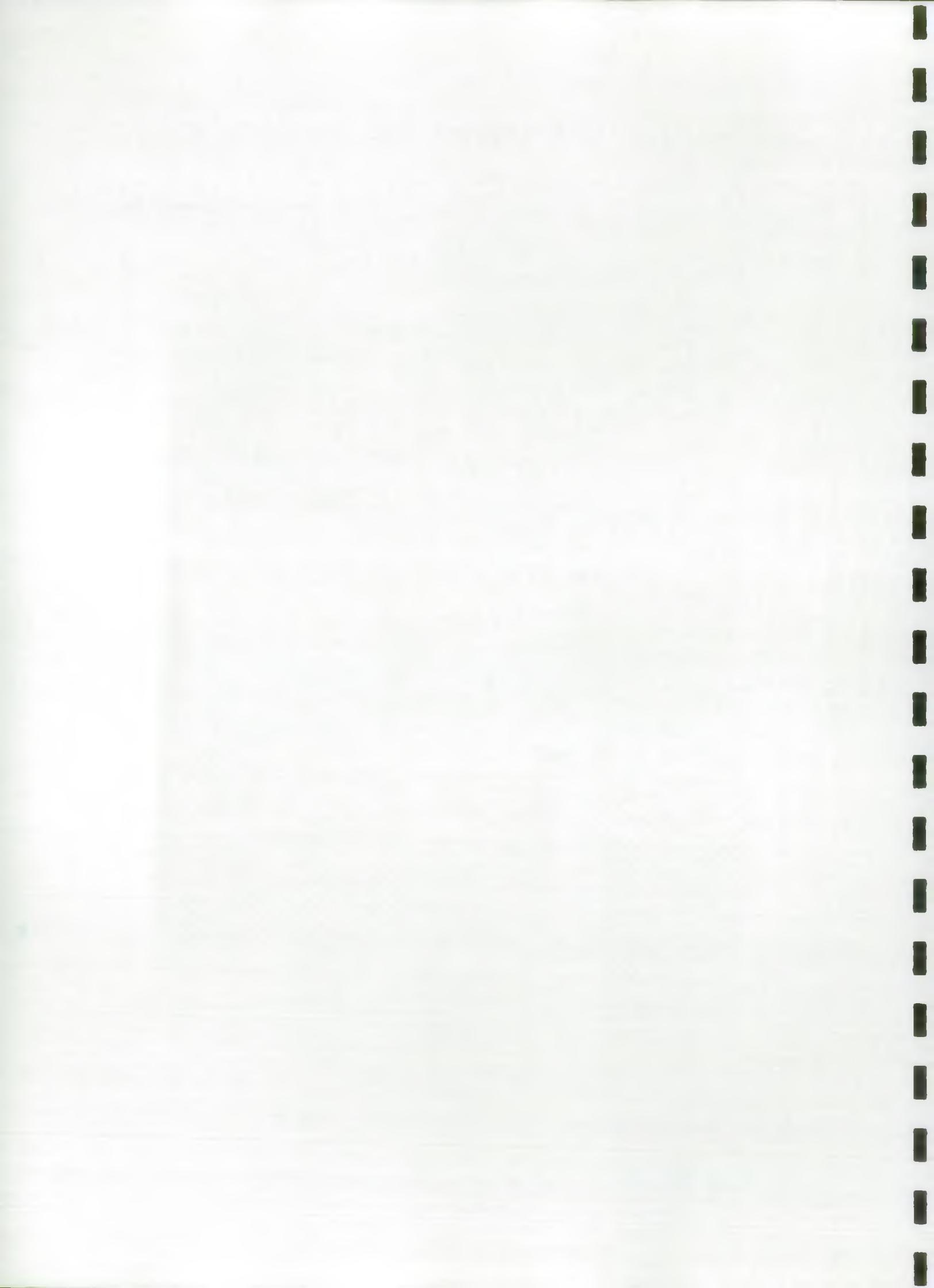
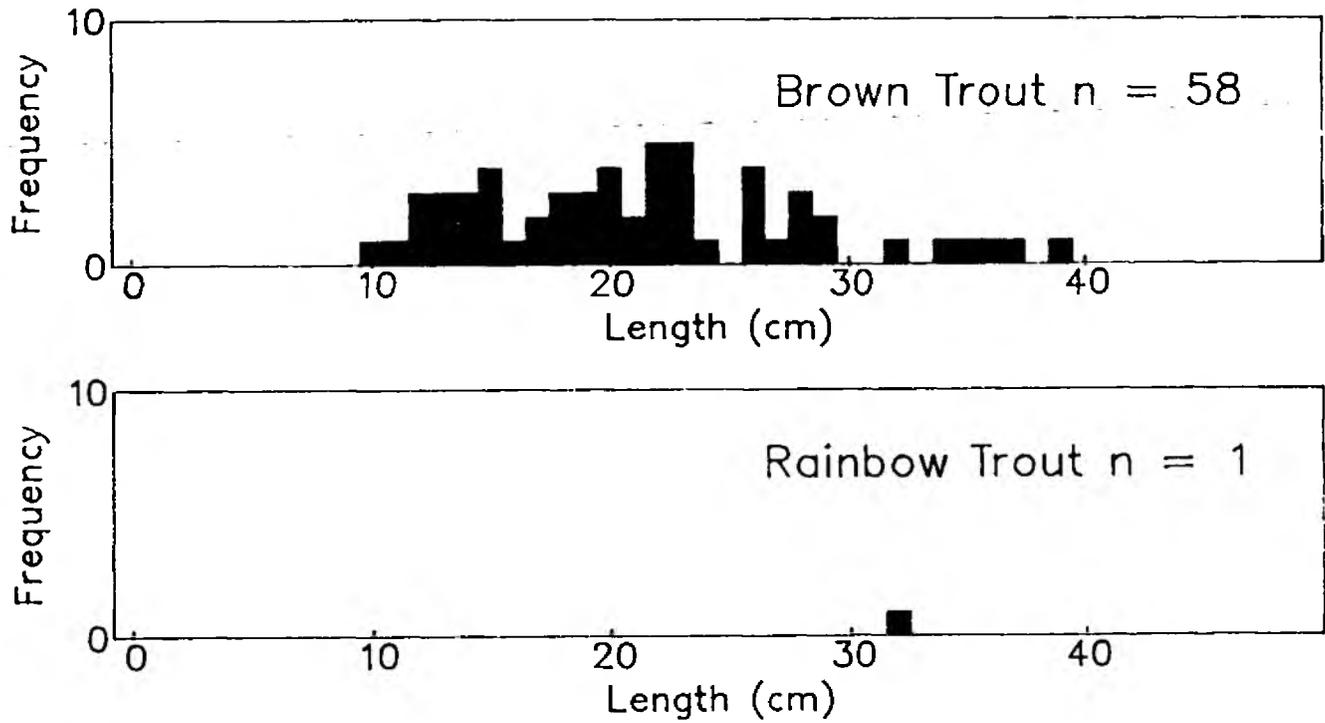


Fig. 5.4b Site LHK4 Length Frequency



## 5.5 SITE REPORT

WATERCOURSE: R. Leach  
SITE NAME: Old Railway Crossing  
SITE CODE: LHA1  
LOCATION: Downstream of Little Faringdon. Disused railway line crosses river.  
NGR: SP 230004  
DATE FISHED: 1-July-93  
METHOD: Electric fishing by wading. 3 anodes, 2 nets. Stop nets used.  
EC TARGET 15gm<sup>-2</sup>  
BIOMASS: 17.83gm<sup>-2</sup>  
1987 Biomass: 18.45gm<sup>-2</sup>

### HABITAT FEATURES

LENGTH: 109m WIDTH (RANGE): 7.2m (6.9-7.4m) AREA: 784.8m<sup>2</sup>  
DEPTH (RANGE): 0.6m (0.3-1.0m)  
WATER TEMPERATURE: 12°C  
WATER LEVEL: Normal  
WATER CLARITY: Slightly turbid  
FLOW RATE: Good

### SUBSTRATE COMPOSITION (%)

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

### VEGETATION (% COVER)

SUBMERGED: 15 FLOATING: 0 EMERGENT: 10 SHADE: 50  
DOMINANT PLANT SPECIES (AQUATIC): *Ranunculus*, *Myriophyllum*  
DOMINANT PLANT SPECIES (BANKSIDE): *Sparganium*  
ADJACENT LAND USE L.B.: Pasture  
ADJACENT LAND USE R.B.: As Above

### REMARKS

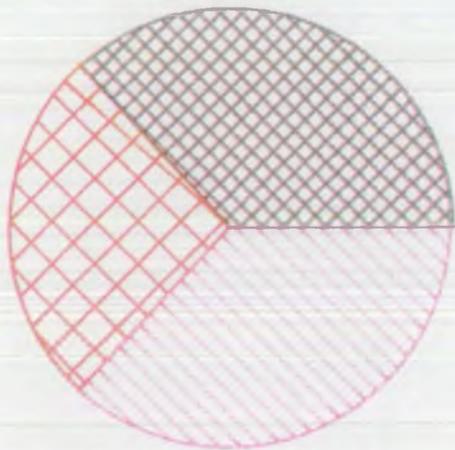
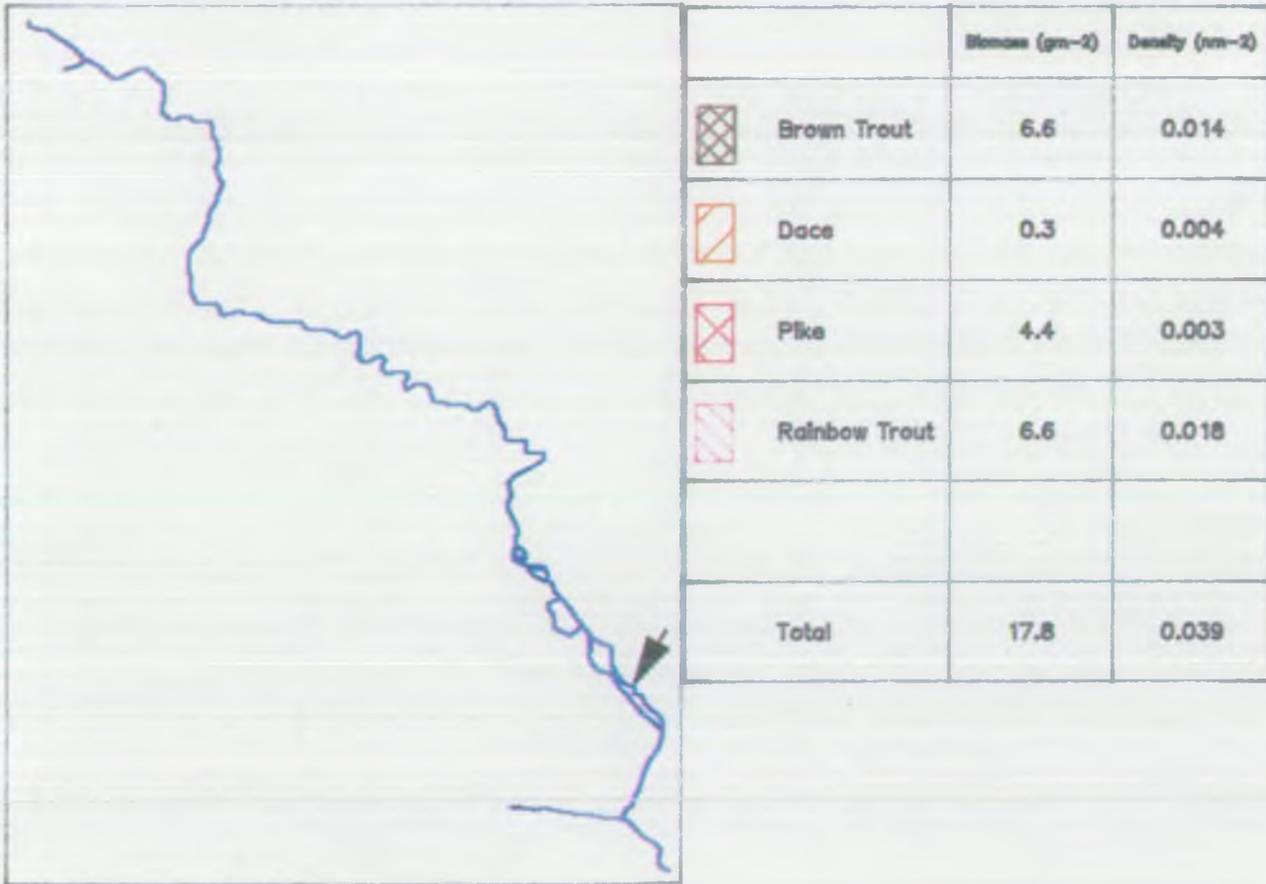
#### PHYSICAL STRUCTURE OF SITE:

Fairly straight section, tree lined and with moderate pool/riffle characteristics.

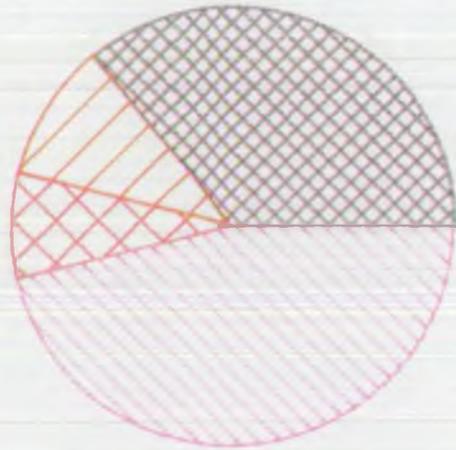
#### CATCH:

Rainbow trout dominated by number, brown trout by weight. Rainbows are probably escapees from nearby trout farm. U/S run produced 8.5kg from 146m by 6.9m. This gives a biomass of 8.44gm<sup>-2</sup>.

Fig. 5.5a Site LHA1 Biomass & Density



Biomass (gm<sup>-2</sup>)



Density (nm<sup>-2</sup>)

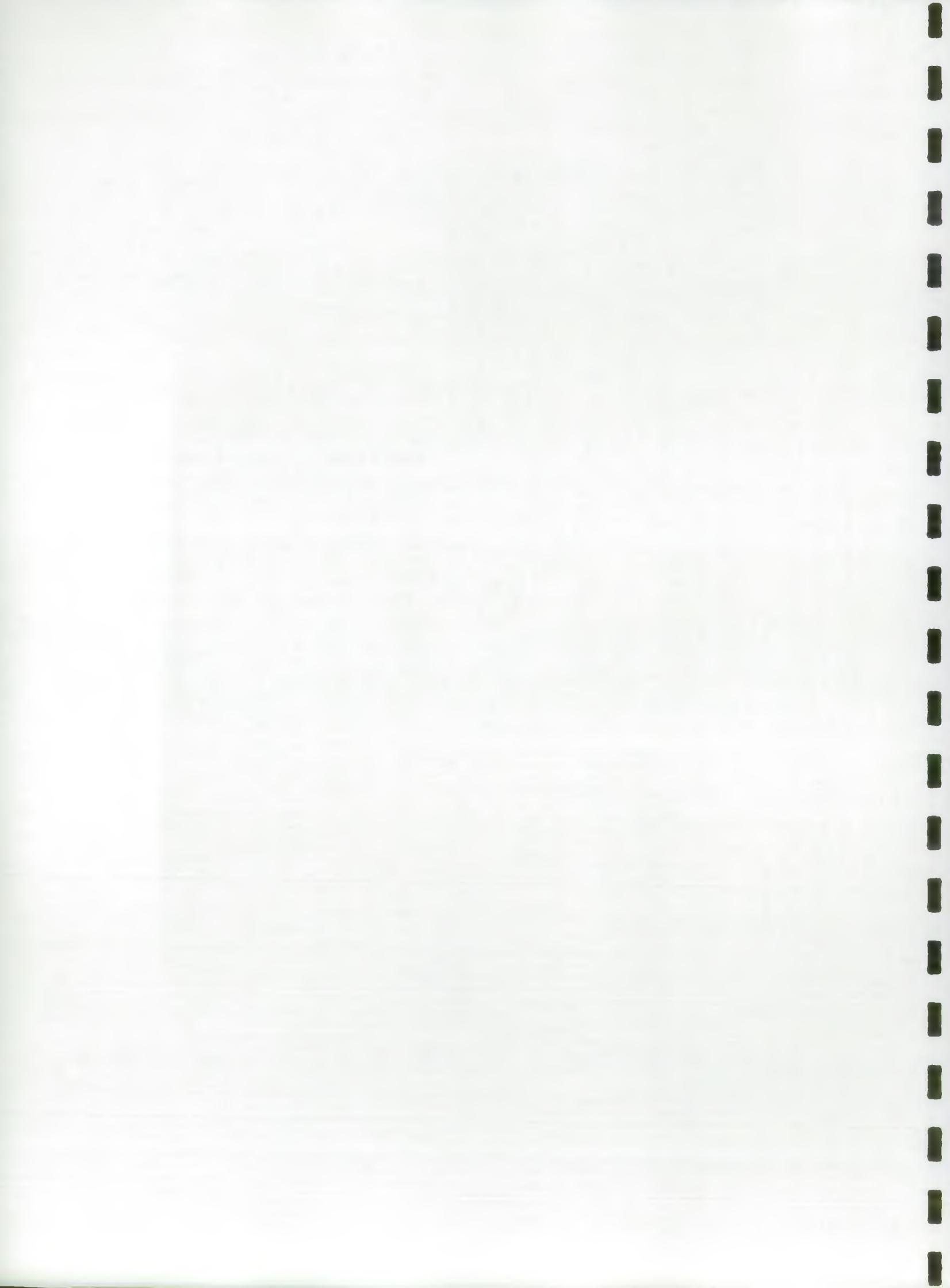
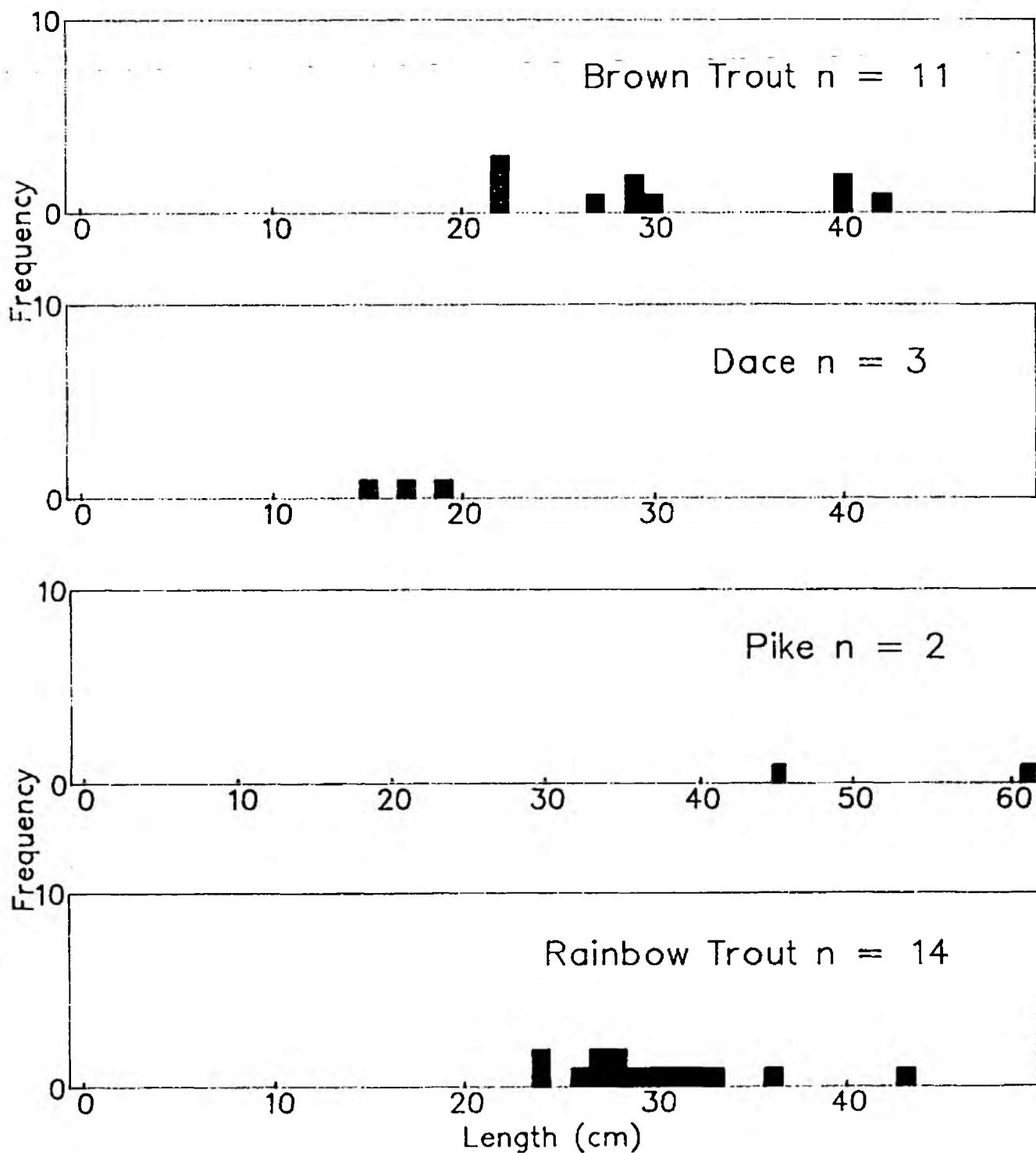


Fig. 5.5b Site LHA1 Length Frequency



## 5.6 SITE REPORT

WATERCOURSE: R. Leach

SITE NAME: Lechlade Mill

SITE CODE: LHA2

LOCATION: Factory site immediately d/s Lechlade Mill.

NGR: SU228995

DATE FISHED: 22-July-93

METHOD: Electric fishing by wading. 2 anodes, 2 nets. Stop nets.

EC TARGET 15gm<sup>2</sup>

BIOMASS: 16.5gm<sup>2</sup>

### HABITAT FEATURES

LENGTH: 98m WIDTH (RANGE): 6m (5.3-6.2m) AREA: 588m<sup>2</sup>

DEPTH (RANGE): 0.6m (0.2-0.9m)

WATER TEMPERATURE: 12°C

WATER LEVEL: Normal Summer

WATER CLARITY: Clear

FLOW RATE: Normal

### SUBSTRATE COMPOSITION (%)

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

### VEGETATION (% COVER)

SUBMERGED: 15 FLOATING: 0 EMERGENT: 5 SHADE: 80

DOMINANT PLANT SPECIES (AQUATIC): *Ranunculus*, *Potamogeton pectinatus*

DOMINANT PLANT SPECIES (BANKSIDE): *Glyceria*.

ADJACENT LAND USE L.B.: Arable

ADJACENT LAND USE R.B.: Arable

### REMARKS

#### PHYSICAL STRUCTURE OF SITE:

Heavily shaded pool/riffle section. One pool created by fallen tree 3 years ago. Good gravel substrate.

#### CATCH:

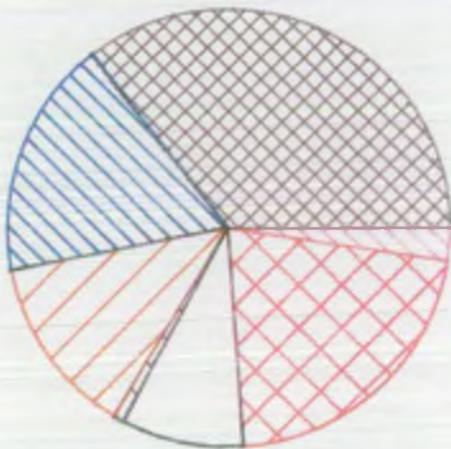
Minnows present, bullheads common. Brown trout dominated by weight and by number.

Upstream run of 40m by 5.5m produced 3.5kg., a biomass of 15.91gm<sup>2</sup>, similar to the survey section.

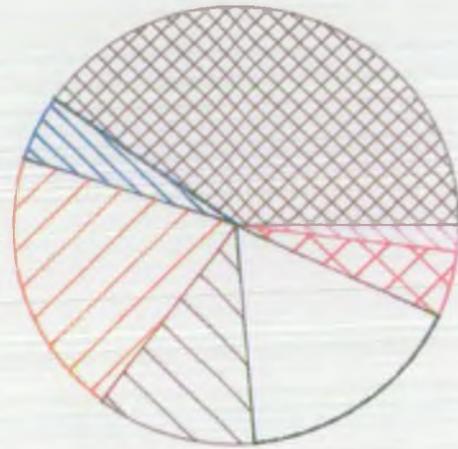
Fig. 5.6a Site LHA2 Biomass & Density



	Biomass (gm <sup>-2</sup> )	Density (nm <sup>-2</sup> )
 Brown Trout	5.9	0.041
 Chub	2.9	0.005
 Dace	2.2	0.020
 Gudgeon	0.1	0.012
 Perch	1.5	0.017
 Pike	3.5	0.005
 Rainbow Trout	0.4	0.002
<b>Total</b>	<b>16.5</b>	<b>0.084</b>



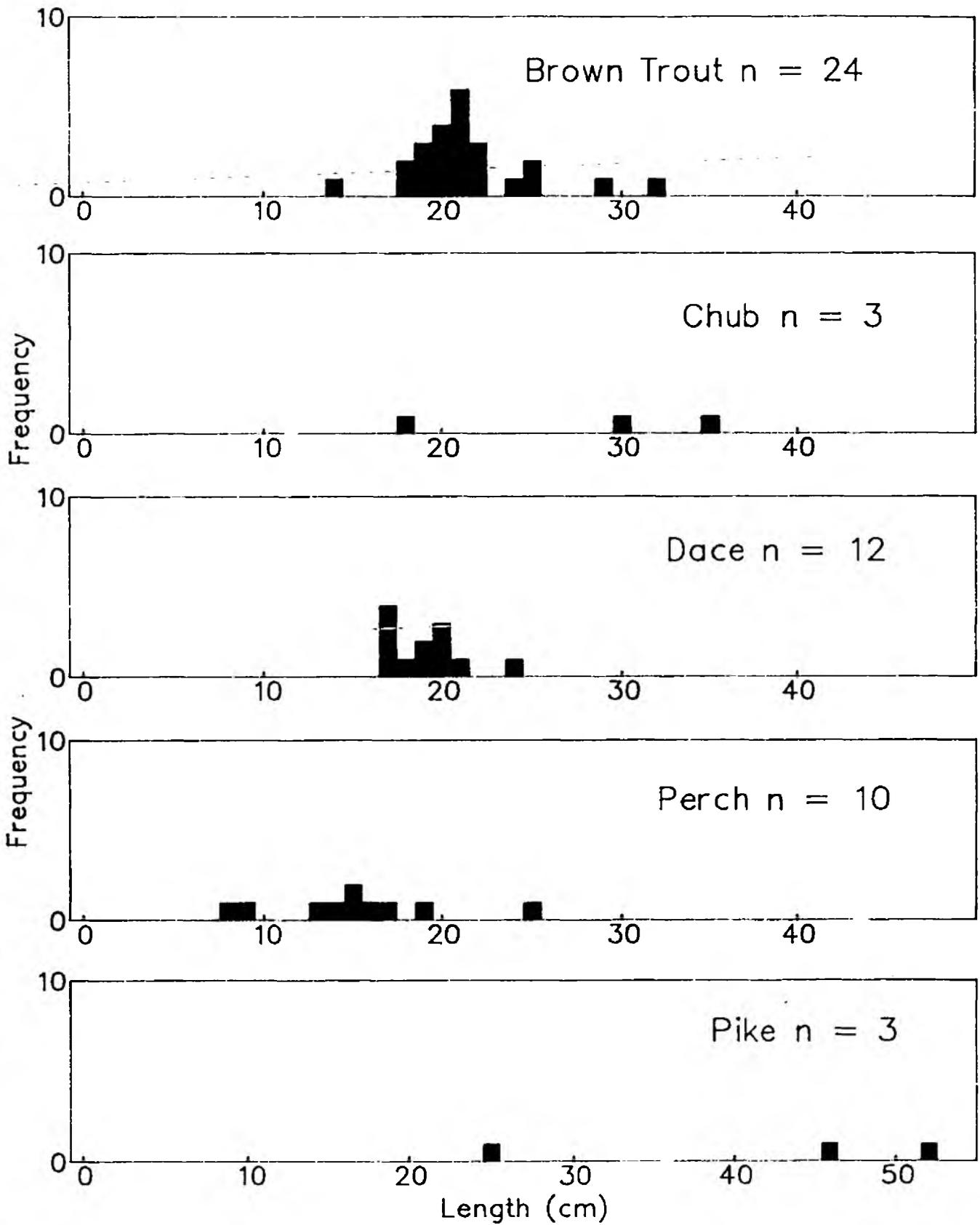
Biomass (gm<sup>-2</sup>)



Density (nm<sup>-2</sup>)



Fig. 5.6b Site LHA2 Length Frequency



### 5.7 Backpack Sites.

Five sites were selected for the use of the new backpack electrofishing equipment. These sites were done in a single day as a purely qualitative investigation into fish populations above and within the ephemeral section of the Leach, as well as in side streams off the lower river.

LHK1 is situated in the recreation ground in Northleach and was a repeat of the survey carried out in 1987. Only bullheads and sticklebacks were found in the survey length, though a single brown trout was found in an upstream run. This section of the river holds water at all times so it is likely that a very small population of brown trout exists here.

LHKA is at Swyres Farm, Aldsworth and had been dry for at least two years. Sticklebacks and stone loach were found here in small numbers. These fish must have migrated from elsewhere, probably from downstream.

LHKB is a side channel at Fyfield and is adjacent to LHK3. When the river site was surveyed in June the side channel was carrying a reasonable flow, but in the intervening few weeks the river had dropped and reduced the flow in LHKB. Bullheads and sticklebacks were present only.

A site on the Fennymoor Ditch adjacent to Lechlade Trout Farm (LHKC) was surveyed. Escapee rainbow trout were common, and bullheads, minnows, stone loach and sticklebacks were present in varying degrees of abundance.

LHKD, the final backpack site was on the Shire Ditch. Two small pike were present together with bullheads and minnows.

The value of the backpack equipment lies in its flexibility and lightness. Several small qualitative sites can be investigated in a day using only the two staff as laid down by Health and Safety guidelines.

## 6. DISCUSSION.

Six sites were surveyed on the Leach between Eastleach Martin and the confluence with the Thames downstream of Lechlade. The upper four sites were principally brown trout fisheries, while the lower two showed more diverse fish populations, with the presence of rainbow trout and coarse fish more prevalent closer to the Thames.

At LHK2, Eastleach Martin, only eight brown trout were captured, giving a biomass of  $3.24\text{gm}^{-2}$ . Numbers in all the size ranges are too small to draw any conclusions, but the length frequency shows similarities to that obtained in 1987 insofar as the bulk of the fish were between 15-35cms., and there is a lack of the 0+ and 1+ fish that should be present.

Cote Mill, LHK5, is a new site put in to try and monitor results from a spawning box which was installed at the Mill in the autumn of 1991. During the 1992 winter season the owner of Cote Mill recorded the number of brown trout fry leaving the box as being in excess of 13000. Results from the survey are not encouraging. Only 13 brown trout were found giving a biomass of  $6.21\text{gm}^{-2}$ . All of these fish were more than 15cms in length. Part of the Cote Mill site has also been rotovated by Thames Region fisheries staff in order to break up the gravel and encourage trout spawning, but these actions do not appear to be showing results as yet.

LHK3 is located at Fyfield and again results are disappointing. The biomass was  $5.5\text{gm}^{-2}$ , almost exactly half that found in 1987. The length frequency again shows a similar pattern to LHK2 when compared with the 1987 results in that none of the fish were below 15cms and very few are above 35cms.

A slightly better picture is noted at LHK4, Common Barn Farm. This section is fished by Cotswold Fly Fishers and receives some stock fish annually. The biomass was  $10.9\text{gm}^{-2}$ , less than 50% of the biomass in 1987. However, some smaller fish of 10-15cms were found, and brown trout fry from the 1993 year class were observed in the shallows, though not caught. Part of this site has also been rotovated in an attempt to improve spawning facilities for the brown trout. Physically this site is the least affected by land drainage or impoundments and has a good flow regime of pools and riffles and plentiful cover from macrophyte growth and overhanging trees and bushes.

LHA1 downstream of Little Faringdon is the first designated site and had a biomass of  $17.8\text{gm}^{-2}$ . This is only fractionally less than the 1987 survey. Nevertheless, it is interesting to note that the brown trout biomass has halved from  $12.9\text{gm}^{-2}$  to  $6.6\text{gm}^{-2}$ , while that of the rainbow trout has more than trebled from  $2.0\text{gm}^{-2}$  to  $6.6\text{gm}^{-2}$ . There are now significantly more rainbow trout present in this part of the river, and considerably less brown trout, with again the smaller 0+ and 1+ fish being absent. Coarse fish are also present for the first time. This part of the river receives an annual introduction of takeable size brown trout by the fishing tenant.

The last site, LHA2, is a new site put in to monitor the spread of coarse fish upstream from

the Thames. Brown trout dominated both by weight and by number, and there were reasonable numbers of dace and perch present. Pike were also present, but only with three individual fish, two of which were in excess of 40cms in length. The dace were of a very respectable size for a small stream, but it is worth noting that there were no small fish coming through to take the place of the larger specimens.

It seems likely that the upper sites on the Leach have been very heavily impacted by low flows during the past 3-5 years and this has had an equally serious effect on the fish populations. The lower sites, with the closer proximity of the Thames do not appear to have been so badly affected.

## 7. CONCLUSIONS.

It is apparent that the brown trout populations of the Leach have suffered a considerable decline since 1987, and it is probable that the extended drought period of 1989 to 1992 has played a major part in this. During this period flows in the ephemeral reaches would have been erratic at best and this would have inhibited upstream migration of brown trout towards more suitable spawning habitat. Spawning success and recruitment would have suffered in consequence.

Much of the perpetual part of the river has a substrate that is not conducive to brown trout spawning, so recruitment lower down the river will be limited. Much of this is due to the various impoundments that occur on the river's course, and which are now mostly unused. There are at least six impoundments of varying sizes between Eastleach Martin and the Thames, and the effects of these on the flows and substrate on their upstream sides will be to reduce the available spawning areas in a significant proportion of the perpetual river.

It is therefore important on the Leach that available spawning gravels are maximised in order to improve the recruitment. Efforts to improve recruitment by rotavating the river bed in selected locations to break up the gravels and make spawning easier, and by installing a spawning box at Cote Mill, have proved inconclusive at this stage, but with end of the extended drought period and a return to more normal flows during 1992 and 1993 these experiments will continue with every hope of measurable success.

Rainbow trout which have in all probability escaped from the trout farm at Lechlade may be impacting on the brown trout populations lower down the river by competing for space and food.

The presence of coarse fish in the lower sections of the river is not likely to have any significant impact on the brown trout population.

APPENDIX I

River quality classification

River Class	Quality criteria	Remarks	Current potential uses
1A Good Quality	<p>Class limiting criteria (95 percentile)</p> <p>(i) Dissolved oxygen saturation greater than 80%</p> <p>(ii) Biochemical oxygen demand not greater than 3 mg/l</p> <p>(iii) Ammonia not greater than 0.4 mg/l</p> <p>(iv) Where the water is abstracted for drinking water, it complies with requirements for A2* water</p> <p>(v) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available)</p>	<p>(i) Average BOD probably not greater than 1.5 mg/l</p> <p>(ii) Visible evidence of pollution should be absent</p>	<p>(i) Water of high quality suitable for potable supply abstractions and for all other abstractions</p> <p>(ii) Game or other high class fisheries</p> <p>(iii) High amenity value</p>
1B Good Quality	<p>(i) DO greater than 60% saturation</p> <p>(ii) BOD not greater than 5 mg/l</p> <p>(iii) Ammonia not greater than 0.9 mg/l</p> <p>(iv) Where water is abstracted for drinking water, it complies with the requirements for A2* water</p> <p>(v) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available)</p>	<p>(i) Average BOD probably not greater than 2 mg/l</p> <p>(ii) Average ammonia probably not greater than 0.5 mg/l</p> <p>(iii) Visible evidence of pollution should be absent</p> <p>(iv) Waters of high quality which cannot be placed in Class 1A because of the high proportion of high quality effluent present or because of the effect of physical factors such as canalisation, low gradient or eutrophication</p> <p>(v) Class 1A and Class 1B together are essentially the Class 1 of the River Pollution Survey (RPS)</p>	<p>Water of less high quality than Class 1A but usable for substantially the same purposes</p>
2 Fair Quality	<p>(i) DO greater than 40% saturation</p> <p>(ii) BOD not greater than 9 mg/l</p> <p>(iii) Where water is abstracted for drinking water it complies with the requirements for A3* water</p> <p>(iv) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available)</p>	<p>(i) Average BOD probably not greater than 5 mg/l</p> <p>(ii) Similar to Class 2 of RPS</p> <p>(iii) Water not showing physical signs of pollution other than humic colouration and a little foaming below weirs</p>	<p>(i) Waters suitable for potable supply after advanced treatment</p> <p>(ii) Supporting reasonably good coarse fisheries</p> <p>(iii) Moderate amenity value</p>
3 Poor Quality	<p>(i) DO greater than 10% saturation</p> <p>(ii) Not likely to be anaerobic</p> <p>(iii) BOD not greater than 17 mg/l. This may not apply if there is a high degree of re-aeration</p>	<p>Similar to Class 3 of RPS</p>	<p>Waters which are polluted to an extent that fish are absent or only sporadically present. May be used for low grade industrial abstraction purposes. Considerable potential for further use if cleaned up</p>
4 Bad Quality	<p>Waters which are inferior to Class 3 in terms of dissolved oxygen and likely to be anaerobic at times</p>	<p>Similar to Class 4 of RPS</p>	<p>Waters which are grossly polluted and are likely to cause nuisance</p>
X	<p>DO greater than 10% saturation</p>		<p>Insignificant watercourses and ditches not usable, where the objective is simply to prevent nuisance developing</p>
Notes	<p>(a) Under extreme weather conditions (eg flood, drought, freeze-up), or when dominated by plant growth, or by aquatic plant decay, rivers usually in Class 1, 2 and 3 may have BODs and dissolved oxygen levels, or ammonia content outside the stated levels for those Classes. When this occurs the cause should be stated along with analytical results.</p> <p>(b) The BOD determinations refer to 5 day carbonaceous BOD (ATU). Ammonia figures are expressed as NH<sub>4</sub>.</p> <p>(c) In most instances the chemical classification given above will be suitable. However, the basis of the classification is restricted to a finite number of chemical determinands and there may be a few cases where the presence of a chemical substance other than those used in the classification markedly reduces the quality of the water. In such cases, the quality classification of the water should be down-graded on the basis of biota actually present, and the reasons stated.</p> <p>(d) EIFAC (European Inland Fisheries Advisory Commission) limits should be expressed as 95 percentile limits.</p>		
	<p>* EEC category A2 and A3 requirements are those specified in the EEC Council Directive of 16 June 1975 concerning the Quality of Surface Water Intended for Abstraction of Drinking Water in the Member State.</p>		

APPENDIX II N.R.A. - THAMES REGION. RIVER QUALITY OBJECTIVE PARAMETERS -

Class IA - 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 any 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 abstraction points, and
3. Suitable for all other abstractions, and
4. Suitable for game or any other high class fisheries, (complying with the requirements of Directive 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 the requirements of 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 waters

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.

N.B. 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.

APPENDIX III E.C. WATER QUALITY  
CRITERIA FOR FISHERIES

LIST OF DETERMINANDS

Determinand	Salmonid Waters		Cyprinid Waters	
	G	I	G	I
(a) Temperature (max) (b) Temperature rise		$\leq 21.5^{\circ}\text{C}$ $\nearrow 1.5^{\circ}\text{C}$		$\leq 28^{\circ}\text{C}$ $\nearrow 3^{\circ}\text{C}$
Dissolved oxygen (mg/l O <sub>2</sub> )	50% $\geq 9$ 100% $\geq 7$	50% $\geq 9$	50% $\geq 8$ 100% $\geq 5$	50% $\geq 7$
pH		6--9		6--9
Suspended solids (mg/l)	$\leq 25$		$\leq 25$	
B.O.D. (A.T.U.) (mg/l)	$\leq 5^*$		$\leq 8^*$	
Nitrites (mg/l)	$\leq 0.2^*$		$\leq 0.5^*$	
Non-ionized ammonia (mg/l)	$\leq 0.005$	$\leq 0.025$	$\leq 0.005$	$\leq 0.025$
Total ammonium (mg/l NH <sub>4</sub> )	$\leq 0.04$	$\leq 1$	$\leq 0.2$	$\leq 1$
Total residual chlorine (mg/l HClO)		$\leq 0.005$		$\leq 0.005$
Zinc (mg/l)		$\leq 0.3$		$\leq 1$
Copper (mg/l)	$\leq 0.04$		$\leq 0.04$	

\* The revised G-values that have been set by the U.K. government

APPENDIX IV N.R.A. FISH SURVEY SITE CODING SYSTEM

The following habitat codes are used by NRA (Thames region) Fisheries staff, 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 Coarse  
E 1B Salmonid  
F 1B Coarse  
G 2/1B Salmonid  
H 2/1B Coarse  
I 2 Salmonid  
J 2 Coarse

2. RQO 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 a unique 4 digit code for each site. Thus OCF1 - OC = River Ock, F = 1B Coarse, 1 = individual site.