NATIONAL RIVERS AUTHORITY

THAMES REGION

UPPER THAMES AREA

RIVER RAY, WILTSHIRE

FISHERIES SURVEY

1989

HO

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CONTENTS

1. SUMMARY

1. Four sites were surveyed by electrofishing during September and October 1989.

2. The upper section from the source to Swindon Sewage Treatment Works (S.T.W) (9km) is effectively a small stream with low basal flow and is a non-viable fishery. The section immediately below Swindon S.T.W. (0.5km) supports a healthy population of mixed coarse fish. The section from 0.5km below Swindon S.T.W. to the Haydon Wick Brook (3.7km) supports a very poor fish population with only dace being present. The lower section from the Haydon Wick Brook to the River Thames confluence (7.8km) supports a poor population of mixed coarse fish. Aggregated fish populations are present at sites with the capacity for instream re-aeration. This section is an E.C. designated cyprinid fishery and it is estimated that 80% of this section does not achieve its target biomass.

3. The cause of the limited fish population in the section from 0.5km downstream of Swindon S.T.W. to the River Thames confluence is poor water quality. The section from Swindon S.T.W. to the Haydon Wick Brook has an River Quality Objective (R.Q.O.) of class 3. The section from the Haydon Wick Brook to the confluence with the River Thames has an R.Q.O. of 2A which it has failed to achieve during the period 1987-1989 and is effectively class 3. The cause of the poor water quality is organic pollution, with low levels of dissolved oxygen and high levels of un-ionised ammonia being the main problems.

4. The main organic load in the river results from the effluent discharged by Swindon S.T.W. Even when the works complies with its consent conditions the water quality cannot consistently achieve the R.Q.O. of 2A or quality standards for an E.E.C. designated cyprinid fishery downstream of the Haydon Wick Brook.

5. Short term prospects for an improvement in water quality and the fish population are poor. The relaxed consent conditions at Swindon S.T.W. are in force until the 30th September 1991, whilst improvements to the works are undertaken. Long term prospects are better with stricter consent conditions for Swindon S.T.W. coming into force on the 1st October 1991, which should enable compliance with the R.Q.O. of 2A downstream of the Haydon Wick Brook. The habitat quality downstream of Swindon S.T.W. is reasonable to good and any sustained improvement in water quality would be expected to produce improvements in the fish population.

6. Recommendations include continued monitoring of water quality and consented discharges to provide information on the effects of the recent and future changes to the consent conditions at Wroughton and Swindon S.T.W. Further fisheries surveys will be undertaken if chemical and biological monitoring indicate a significant change in water quality. Habitat enhancement opportunities will be investigated, particularly the construction of additional features to increase the capacity for instream re-aeration.

2. INTRODUCTION

2.1 Description of the Watercourse.

A map of the River Ray and significant tributaries is presented in Fig. 2.1. The River Ray rises from a series of springs to the south west of Wroughton (SU 136796) and flows in a northerly direction to join the River Thames near Cricklade (SU 123939), a total distance of 21km. The river has a mean gradient of 1 in 370 and the catchment area is approximately 85km^2.

The river has no large tributaries but those which are significant include the Wroughton Ditch, Swinbourne, Whitehill Stream, Lydiard Brook, Hreod Burna, and the Haydon Wick Brook. The catchment area is dominated by the large conurbation of Swindon which is currently one of the fastest growing towns in Europe. The population has expanded from approximately 130,000 in 1983 to 150,000 at the present time. Local authority structure plans predict a continued rapid rise of the population in future years. Only when the river reaches the Haydon Wick Brook does the land use change to mainly agricultural, with pasture dominant. The increased urbanisation within the catchment has caused large changes to the river, particularly with regard to the increase in the disposal of sewage effluent and drainage problems. The river channel has been substantially altered in the past for land drainage purposes but still retains much of the meandering form and some pool-riffle features.

2.2 Geology

The River Ray rises from a series of springs at the edge of the Marlborough Downs (SU 136796) which corresponds to the boundary of the Lower Chalk and Upper Greensand with the underlying Gault Clay.

The catchment is clay dominated (77%) with the river running over the following strata from source downstream: Gault Clay (source - Wroughton), Kimmeridge Clay (Wroughton - Moredon), Corallian Limestone (Moredon - Haydon Wick) and Oxford Clay (Haydon Wick - Thames Confluence). As the River Ray nears the Thames confluence, there are signs of Terrace Gravels obscuring the Oxford Clay.

2.3 Hydrology

From the source to Swindon Sewage Treatment Works (S.T.W.) (SU 127857) river flow comprises a low base flow from groundwater sources together with seasonal surface run-off. Consequently, this section possesses very low dry weather flows.

The river flow downstream of Swindon S.T.W. is affected greatly by the discharge from the works. The average daily discharge from the works is 0.42 cumecs which represents approximately 40% of the mean daily flow at Water Eaton Gauging Station (SU 121935) located at the bottom of the river. Under dry weather conditions, the maximum consented discharge of 0.37 cumecs constitutes 80% of river flow at the point of discharge.

The dominance of clay in the catchment coupled with the heavy urbanisation produces a 'flashy' response to rainfall. Rapid drainage of clay and urban areas results in high peaks in flow as indicated in the hydrograph for 1988/89 (Fig. 2.3.1). The mean daily flow measured at

FIG. 2.1 RIVER RAY & MAJOR TRIBUTARIES

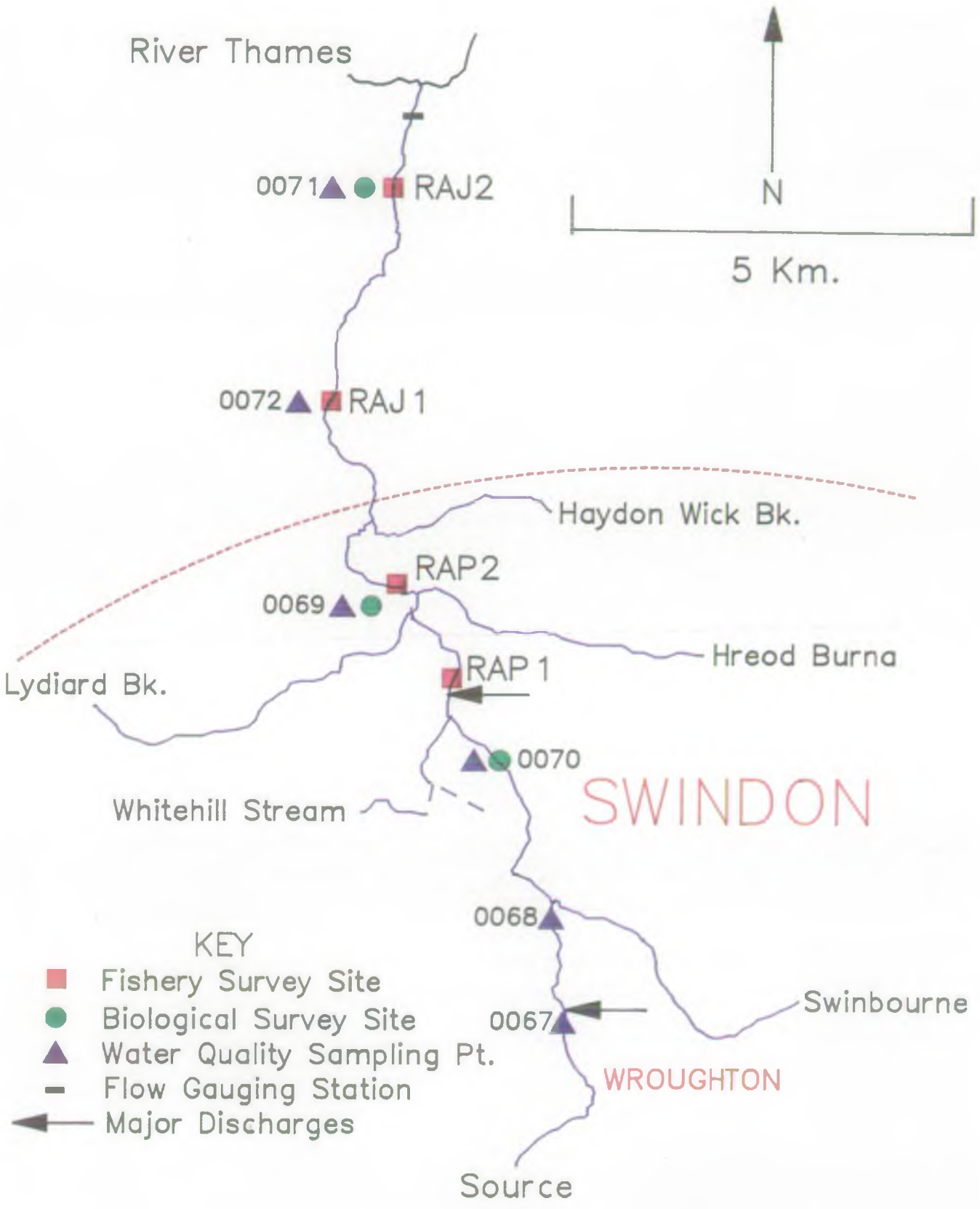


FIG. 2.3.1 RIVER RAY HYDROGRAPH (WATER YEAR 1988–89)

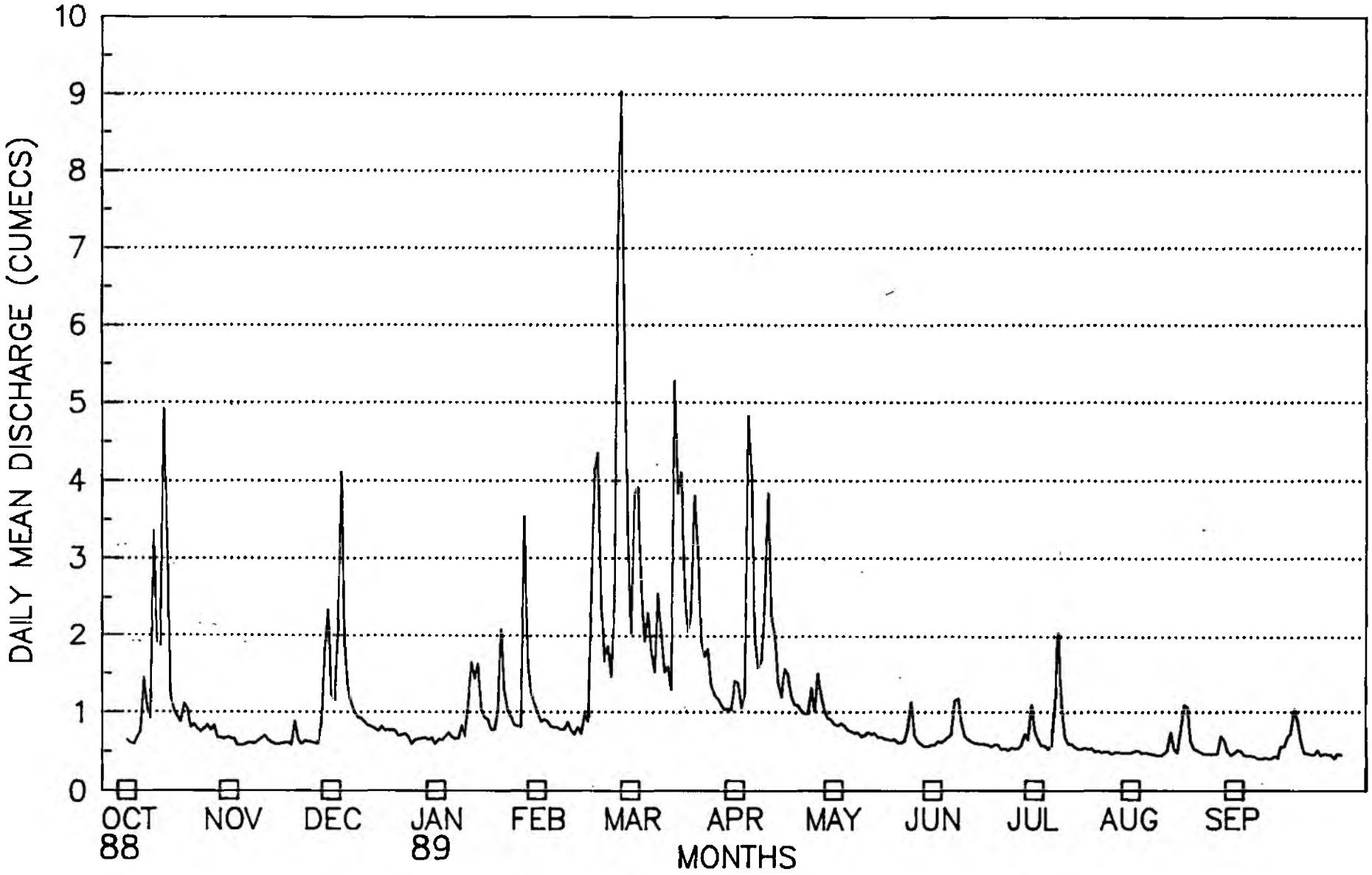
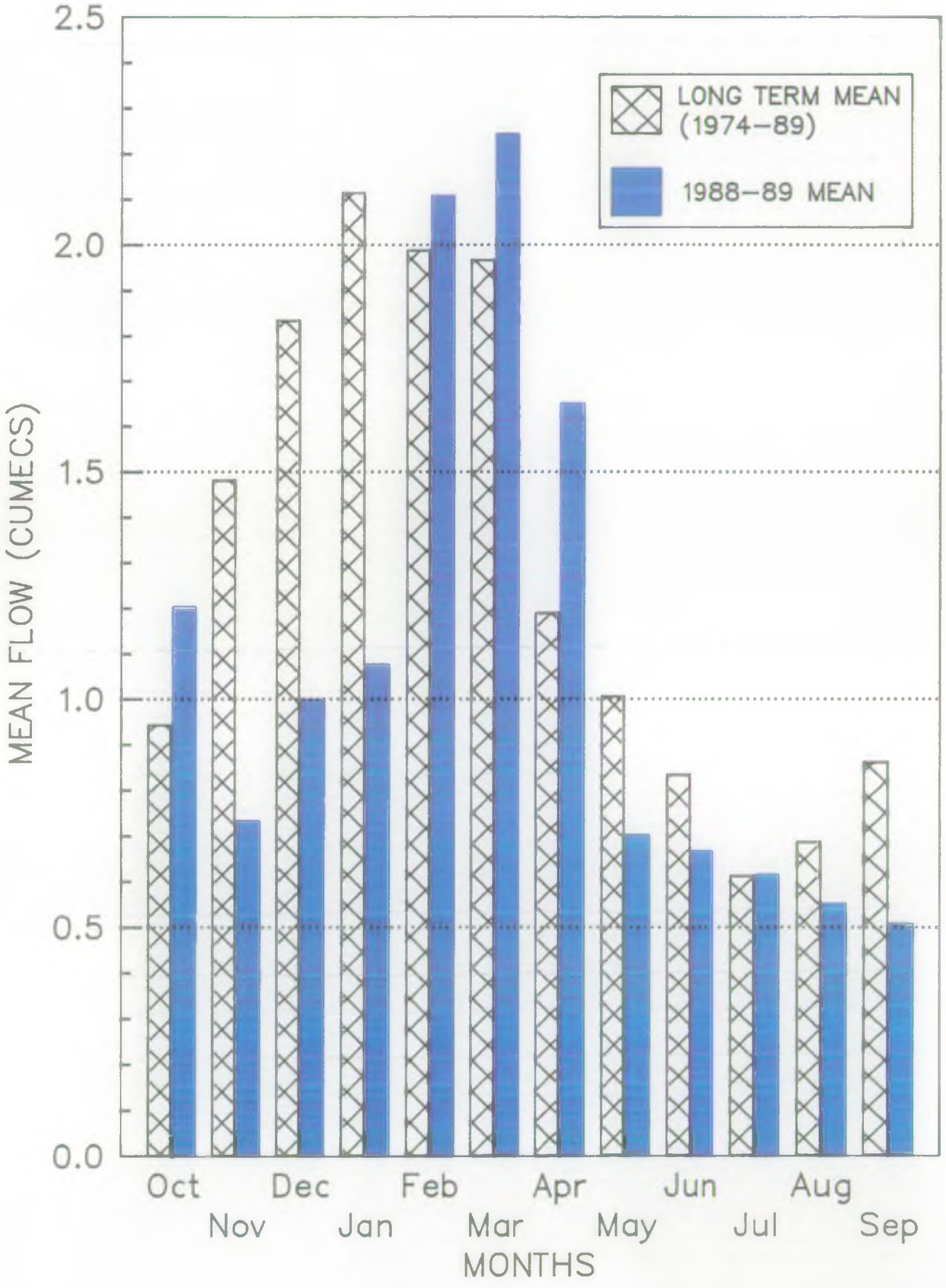


FIG. 2.3.2 RIVER FLOW DATA

Monthly Mean Flows at Water Eaton



Water Eaton is approximately 1.1 cumecs. Dry weather flows are in the region of 0.5 cumecs and flood discharge is in excess of 9 cumecs. The change in drainage patterns due to increased urbanisation was the subject of the River Ray Catchment Study produced by Thames Water in 1987. The report advised that balancing within specific areas of development using storage ponds was the desired option in terms of flood alleviation, water quality and environmental impact. This option achieves flow control without detrimental change to the flow regime or channel structure in the main River Ray.

Monthly mean flows for the Water Year 1988/89 (Fig. 2.3.2.) were less than average (85% of long term mean) with a dry summer and autumn preceeding the survey.

2.4 Water Quality

2.4.1 River Classification

River Water Quality is classified according to the National Water Council (N.W.C.) River Quality Objectives (R.Q.O.) 1978 (as amended by Thames Water Authority 1987). Further details of this classification are presented in Appendices I and II.

The River Ray is classified as below:

Section	Distance (km)	RQO
Source - Swindon S.T.W.	9.0	2B
Swindon S.T.W. - Haydon Wick Brook	4.1	3/2B*
Haydon Wick Brook - River Thames	7.8	2A

* The first element indicates the present objective and the second element the long term objective.

The only classified tributaries of the River Ray are listed as below:

Tributary	Section	Distance (km)	RQO
Wroughton Ditch	Wroughton S.T.W. - River Ray	0.8	2B
Lydiard Brook	Source - Rodbourne Tip	3.7	1A
	Rodbourne Tip - River Ray	0.7	3
Haydon Wick Brook	2.8km upstream - River Ray	2.8	1B

2.4.2 Consented Discharges

There are two main consented discharges in the River Ray catchment.

a) Wroughton Sewage Treatment Works

The situation regarding the consent conditions is complex. The existing consent conditions were altered on the 31st October, 1989 under provisions set out in the new Water Act 1989. This new consent set out further alterations which come into force on the 1st April, 1991. Details of these consents are presented below:

Time Period	Volume	Consent Conditions		
		Suspended Solids(mg/l)	Biochemical Oxygen Demand(mg/l)	Ammoniacal Nitrogen(mg/l)
20/05/83-30/10/89	4550m^3/day	30	20	4
31/10/89-31/03/91	2000m^3/day under dry weather conditions	45 100*	20 60*	6 12*
01/04/91 onwards	2000m^3/day under dry weather conditions	30	20	4

* Compliance with normal consent conditions is based on percentage compliance for each separate determinand over a twelve month period. The values marked * represent an additional absolute limit which no sample shall exceed.

It is important to note that the new consent conditions cannot be altered until the 31st October 1991.

A separate consent to discharge any volume of storm sewage effluent at the same location has remained unaltered since 1983. There are no quality conditions on this discharge but it is not permitted until the rate of flow arriving at the works exceeds 4550m^3/day.

b) Swindon Sewage Treatment Works

This S.T.W. has three separate discharges and thus three discharge consents.

i) Discharge 'A'

This is the main discharge and enters the River Ray at SU 12718580. The situation regarding the consent conditions is complex. The existing consent conditions were altered on 31st October, 1989 under the provisions set out in the new Water Act 1989. This new consent sets out further alterations which come into force on 1st October, 1991. Details of these consents are presented below.

Time Period	Volume	Consent Conditions		
		Suspended Solids(mg/l)	Biochemical Oxygen Demand(mg/l)	Ammoniacal Nitrogen(mg/l)
16/10/85-30/10/89	44300 m^3/day under dry weather conditions	25	15	7
31/10/89-30/09/91	36900 m^3/day under dry weather conditions	25 35*	15 30*	7 (1/4-31/10) 13 (1/11-31/3) 13* (1/4-31/10) 22* (1/11-31/3)
01/10/91-onwards	44300 m^3/day under dry weather conditions	17	11	5

* Compliance with normal consent conditions is based on percentage compliance for each determinand over a twelve month period. The values marked * represents an additional absolute limit which no sample shall exceed.

It is important to note that the new consent conditions cannot be altered until the 31st October, 1991.

ii) Discharge 'B'

This is a storm sewage overflow which discharges to the River Ray at SU 128859. The present consent conditions have been in force since the 10th October, 1985. Details of these conditions are presented below:

> The volume of treated sewage effluent discharged under dry weather conditions shall not exceed 44300 m^3/day. The volume of settled storm sewage discharged shall be limited to that resulting from the overflow of sewage at the storm sewage separating weir of flows in excess of 1540 litres per second.

Suspended Solids	Biochemical Oxygen Demand	Ammoniacal Nitrogen
25mg/l	15mg/l	7mg/l

iii) Discharge 'C'

This is used only in emergencies when discharge 'A' is unavailable for use. The present consent conditons have been in force since October 1982. The volume is 133 thousand m^3/day.

Suspended Solids	Biochemical Oxygen Demand	Ammoniacal Nitrogen
25	7	9

2.4.3 Pollution Incidents

A summary of the pollution incidents reported for the River Ray Catchment during the years 1985-89 is presented below:

Year	No. Reported	No. Confirmed	Category			Incident Type					
			Major	Sign.	Minor	Oil	Chemical	Sewage	Agric.	Gen.	Nat.
1986	14	14	0	0	14	8	1	2	0	3	0
1987	18	12	0	8	10	7	3	2	1	3	2
1988	19	13	1	7	11	11	3	2	1	2	0
1989	23	8	1	3	19	9	3	6	2	2	1
TOTAL	74	47	2	18	54	35	10	12	4	10	3

The types of pollution incidents reflect the urbanisation in the River Ray catchment. Oil pollutions are the most frequent incidents (47%) with most being minor spillages. Chemical (14%) and sewage (17%) are also important sources with agricultural incidents being relatively rare (5%). Only two major incidents occurred during 1985-89, neither of which resulted in a fish mortality. Only one minor fish mortality was reported in the same period, details are given in section 2.5.3.

2.5 Fishery Information

2.5.1 Fishery Designation

The River Ray is an E.C. designated cyprinid fishery between the Haydon Wick Brook and the River Thames (7.8km), under the European Community Directive 78/659/EEC. Further details concerning water quality criteria associated with this classification are presented in Appendix III.

The National Rivers Authority, Thames Region, have set internal fish biomass targets with respect to E.C. designated fisheries, viz. -

Cyprinid-20g/m^2

Salmonid-15g/m^2

The N.R.A., Thames Region have developed a site code classification system based on the River Quality Objective and the E.C. designation. A description of this appears in Appendix IV.

2.5.2 Previous Fisheries Surveys

A brief quantitative fisheries survey (Ref:ARA86) was undertaken early in 1986 in order to provide environmental information for the River Ray Catchment Study. A summary of the data from this survey is presented in Appendix V. The main conclusions were that the river supported a surprisingly good fish population in view of the water quality problems. Most of the species associated with lowland rivers were present and the population structure suggested a healthy recuitment of roach, dace and perch. However, only 2 sites were surveyed during the winter period, one immediately below the works and the other only 1.5km from the River Thames confluence. The location and timing of the surveys casts considerable doubt on the general conclusions drawn.

2.5.3 Fish Mortalities

There have been no major fish mortalities in the period since the previous survey in early 1986.

Only one minor mortality has been investigated during July, 1989. Less than 20 fish were observed at Seven Bridges when the river suffered from a storm sewage overflow.

2.5.4 Fisheries Management

There has been no stocking or culling undertaken on the River Ray and its tributaries during the period since the previous survey in early 1986.

2.5.5 Angling Interests

The majority of the river downstream of Tadpole Bridge (site RAJ1), is leased by South Cerney Angling Club.

3. AIMS AND OBJECTIVES

3.1 Overall Aims of Surveys

The National Rivers Authority (N.R.A.) has a statutory obligation to maintain, improve and develop inland fisheries. To assist in meeting this obligation, N.R.A., Thames Region fisheries staff have engaged upon a 5 year rolling programme of riverine fish population surveys to establish baseline data for each major watercourse in the Thames catchment.

3.2. Specific Aims of Survey

i. To monitor any changes in the fish population since the 1986 survey with regard to environmental factors.

ii. To provide additional baseline data in order to monitor the affect of the recent revision of the discharge consent at Swindon Sewage Treatment Works.

4 METHODS

4.1 Site Selection

A total of four sites were surveyed during September and October, 1989. Sites were selected to represent local environmental conditions within the defined water quality zone, taking into account topgraphy, known water quality impact, and access considerations.

4.2 Capture & 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 D.C. equipment were used. Two runs were undertaken unless catch depletion was poor and a third was required. In addition, a semi-quantitative assessment was made by a single run upstream of the survey section to assess whether the chosen site was representative of a longer section of river.

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

Minor species such as bullhead Cottus gobio, stone loach Noemocheilus barbatulus, stickleback Gasterosteus aculeatus, and minnow Phoxinus phoxinus were noted for presence and qualitative abundance. Details of the major physical characteristics of each site including weed and bankside cover, depth, substrate type and temperature were recorded.

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

4.3 Data Analysis

All data were process on the microcomputer using the Fisheries Information System (FINS) software package developed by N.R.A., Thames Region. Graphics were generated using Freelance Plus V.3.0.

All age analysis was carried out using a microfiche by a single member of staff. All fish were aged in complete years with April 1st employed as the birthdate.

4.4 Health Examination

A representative range of fish species and sizes were selected at the Tadpole Bridge site (RAJ1) and retained for autopsy at the Reading Laboratory. Tissue samples were taken and analysed for heavy metal and pesticides contamination.

4.5. Macroinvertebrate Survey

N.R.A. Biology staff are engaged upon a biological monitoring programme

of the main watercourses in the Thames region. Data on macro-invertebrates from this source are presented in this report. The species composition of invertebrate communities reflect the physico-chemical variations which occur in a river and thus provides a means of monitoring the aquatic environment on a continuous basis.

A system of evaluating this data has been developed based on the Biological Monitoring Working Party (B.M.W.P.) scoring system which relates the invertebrate community to water and habitat quality. The B.M.W.P. score obtained is classified in terms of biotic quality class A-E. The score is also related to a score predicted by a computer model developed by the Freshwater Biological Association (F.B.A.). The predicted score is taken to be that expected given the environmental characteristics of the particular site with no pollution present.

The biological sampling points on the River Ray are listed below:

Sampling Point	Code	N.G.R.
Morris Street, Swindon	PUTR.0070	SU 135849
Moredon Bridge, Swindon	PUTR.0069	SU 121873
Seven Bridges, Cricklade	PUTR.0071	SU 119927

4.6 Water Quality

River Water Quality data is collected at strategically located Reach Assessment Points (R.A.P.) by the N.R.A. Pollution Control Department.

The sampling points on the River Ray are listed below:

Sampling Point	Code	N.G.R.
Above Wroughton Ditch	PUTR.0067	SU 142814
Mill Lane, Swindon	PUTR.0068	SU 140829
Morris Street, Swindon	PUTR.0070	SU 135849
Moredon Bridge, Swindon	PUTR.0069	SU 121873
Tadpole Bridge	PUTR.0072	SU 111898
Seven Bridges, Cricklade	PUTR.0071	SU 119927

Data was examined for the period 1986 to 1989 inclusive. Data was also examined for the main discharges to the River Ray, (i.e. Swindon and Wroughton Sewage Treatment Works) for the same period.

5. RESULTS

5.1 Site Results

5.1.1 SITE RESULTS - DOWNSTREAM OF SWINDON TREATMENT WORKS (RAP1).

WATERCOURSE: River Ray, Wiltshire

SITE NAME: Downstream of Swindon Treatment Works

SITE CODE: RAP1

LOCATION: Immediately downstream of main outfall.

N.G.R.: SU127860

DATE FISHED: 22nd September 1989

METHOD: Upstream electric fishing, wading with two anodes.

R.Q.O.: 3/2b E.E.C. TARGET BIOMASS: Not designated

HABITAT FEATURES

LENGTH: 138m MEAN WIDTH: 6.0m AREA: 828 sqm MEAN DEPTH 1.0m

WATER TEMPERATURE: 17 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 60 MUD & SILT: 40 GRAVEL: 00 STONE: 00 BOULDER: 00

VEGETATION (% COVER)

SUBMERGED: 30 FLOATING: 00 EMERGENT: 00 SHADE: 05

DOMINANT PLANT SPECIES: Sparganium sp.

WATER LEVEL: Normal WATER CLARITY: Tea coloured

PHYSICAL STRUCTURE OF SITE: A straight uniform section with little bankside cover. Good stands of instream Sparganium. Uniform depth with poor clay/silt substrate.

ADJACENT LAND USE: L.B. Rough scrub and lagoons.
R.B. Storm overflow area.

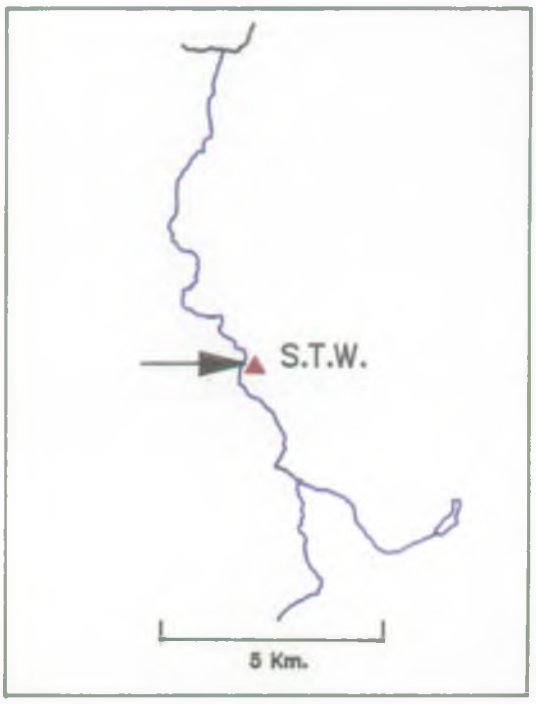
RIPARIAN OWNERS: L.B. Thamesdown Borough Council
R.B. Thames Water P.L.C.

FISHING RIGHTS: L.B. As above
R.B. As above

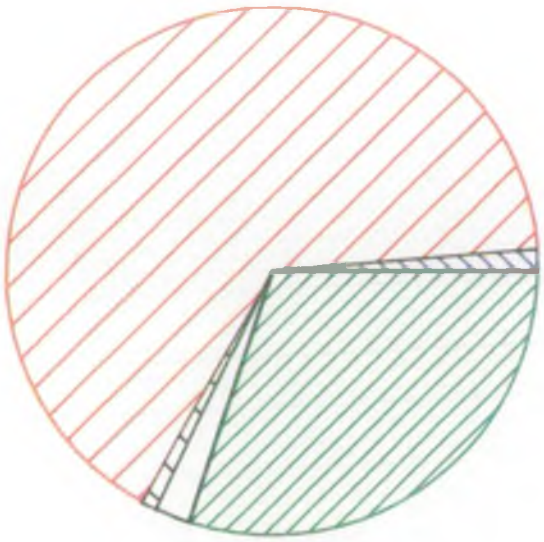
ADDITIONAL INFORMATION: Minnow, stoneloach & stickleback were also present. Fin rot & eye fluke present. Roach & dace were producing eggs. An additional run immediately upstream of the survey section (35 x 5.6m) produced 3.5 kg. This represents a minimum biomass of 17.86g/sqm.

COMMENTS: A healthy biomass and density of mixed coarse species. Dace were dominant with good numbers of roach also present. Both of these species showed good age structures indicating succesful recruitment.

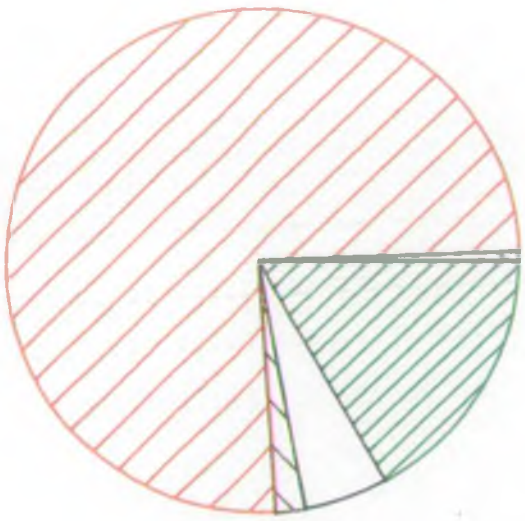
Fig. 5.1.1a DOWNSTREAM SWINDON S.T.W. (RAP 1)
Biomass & Density



	Biomass (gm−2)	Density (nm−2)
Chub	0.3	0.002
Dace	15.2	0.234
Gudgeon	0.2	0.006
Perch	0.5	0.016
Roach	7.0	0.052
TOTAL	23.2	0.310

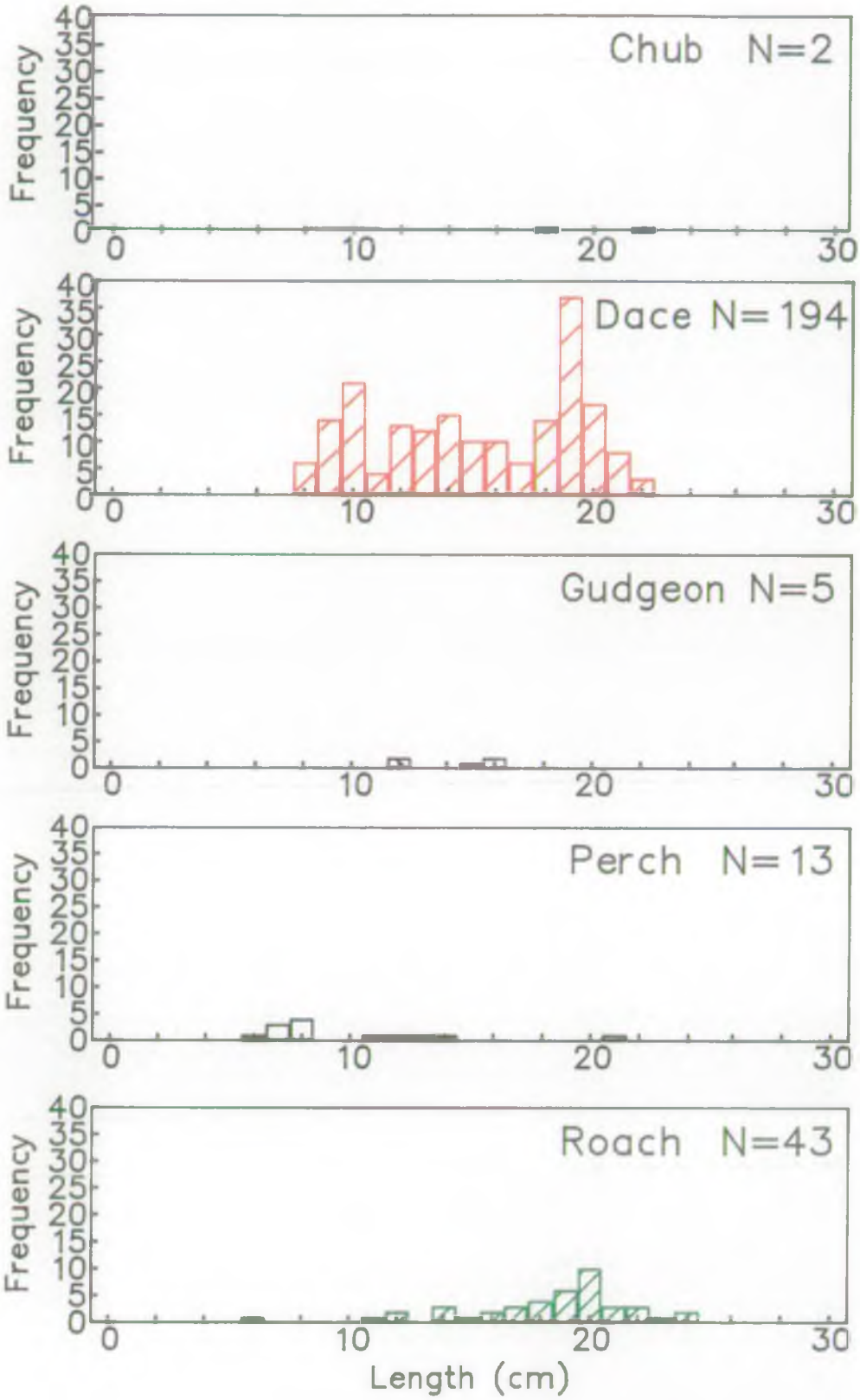


Biomass



Density

Fig. 5.1.1b DOWNSTREAM SWINDON S.T.W. (RAP 1)
Length Frequency



5.1.2 SITE RESULTS - DOWNSTREAM OF MOREDON BRIDGE (RAP2).

WATERCOURSE: River Ray, Wiltshire

SITE NAME: Downstream of Moredon Bridge

SITE CODE: RAP2

LOCATION: 200m downstream of Moredon Bridge.

N.G.R.: SU118873

DATE FISHED: 10th October 1989

METHOD: Upstream electric fishing, wading with two anodes.

R.Q.O.: 3/2b E.E.C. TARGET BIOMASS: Not designated

HABITAT FEATURES

LENGTH: 103m MEAN WIDTH: 5.8m AREA: 597 sqm MEAN DEPTH 0.8m

WATER TEMPERATURE: 15 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 80 MUD & SILT: 20 GRAVEL: 00 STONE: 00 BOULDER: 00

VEGETATION (% COVER)

SUBMERGED: 30 FLOATING: 00 EMERGENT: 00 SHADE: 10

DOMINANT PLANT SPECIES: Ranunculus sp.

WATER LEVEL: Low WATER CLARITY: Tea coloured

PHYSICAL STRUCTURE OF SITE: A straight uniform section with some bankside cover. Good stands of instream Ranunculus. Uniform depth with poor clay/silt substrate.

ADJACENT LAND USE: L.B. Pasture
R.B. Rough pasture

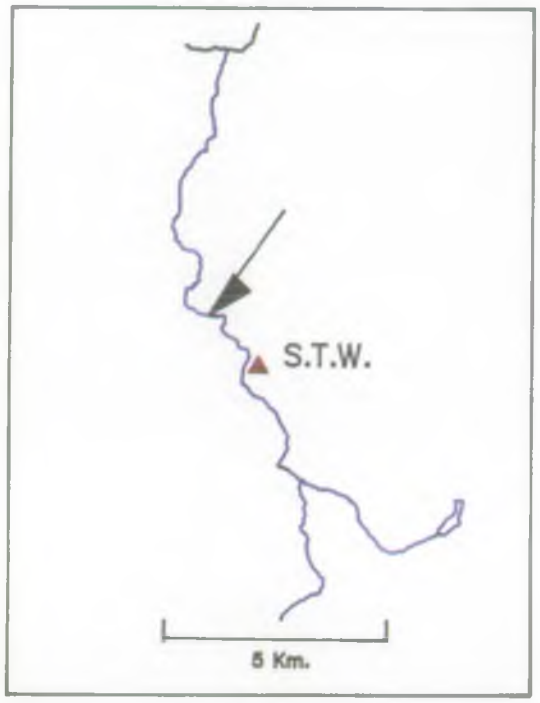
RIPARIAN OWNERS: L.B. Mrs. Webb
R.B.

FISHING RIGHTS: L.B. As above
R.B.

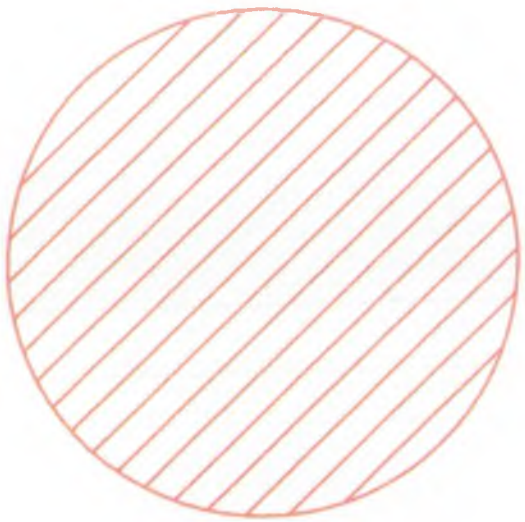
ADDITIONAL INFORMATION: Minnow & stickleback present.
An additional run upstream of the survey section (72 x 6.6m) produced 1.6kg. This represents a minimum biomass of 3.37g/sqm.

COMMENTS: A very poor biomass and density with only dace being present. Age structure of dace shows an absence of the younger age classes found upstream at site RAP1.

Fig. 5.1.2a DOWNSTREAM OF MOREDON BRIDGE (RAP2)
Biomass & Density



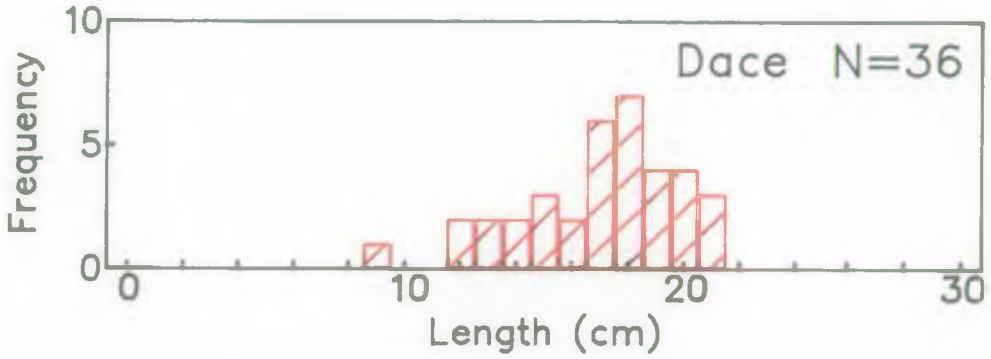
	Biomass (gm−2)	Density (nm−2)
Dace	4.9	0.067
TOTAL	4.9	0.067



Biomass

Density

Fig 5.1.2b DOWNSTREAM MOREDON BRIDGE (RAP2)
Length Frequency



5.1.3 SITE RESULTS - DOWNSTREAM OF TADPOLE BRIDGE (RAJ1).

WATERCOURSE: River Ray, Wiltshire

SITE NAME: Downstream of Tadpole Bridge

SITE CODE: RAJ1

LOCATION: Immediately downstream of Tadpole Bridge

N.G.R.: SU113898

DATE FISHED: 5th October 1989

METHOD: Upstream electric fishing, wading with two anodes.

R.Q.O.: 2a E.E.C. TARGET BIOMASS: 20g/sqm.

HABITAT FEATURES

LENGTH: 104m MEAN WIDTH: 6.8m AREA: 707 sqm MEAN DEPTH 1.2m

WATER TEMPERATURE: 16 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 85 MUD & SILT: 10 GRAVEL: 00 STONE: 05 BOULDER: 00

VEGETATION (% COVER)

SUBMERGED: 05 FLOATING: 00 EMERGENT: 00 SHADE: 05

DOMINANT PLANT SPECIES: Sparganium sp.

WATER LEVEL: Low WATER CLARITY: Tea coloured

PHYSICAL STRUCTURE OF SITE: A straight uniform section with little bankside cover. Little instream cover provided by Sparganium. A deep section with poor clay substrate & one good riffle at upstream border.

ADJACENT LAND USE: L.B. Pasture
R.B. Pasture

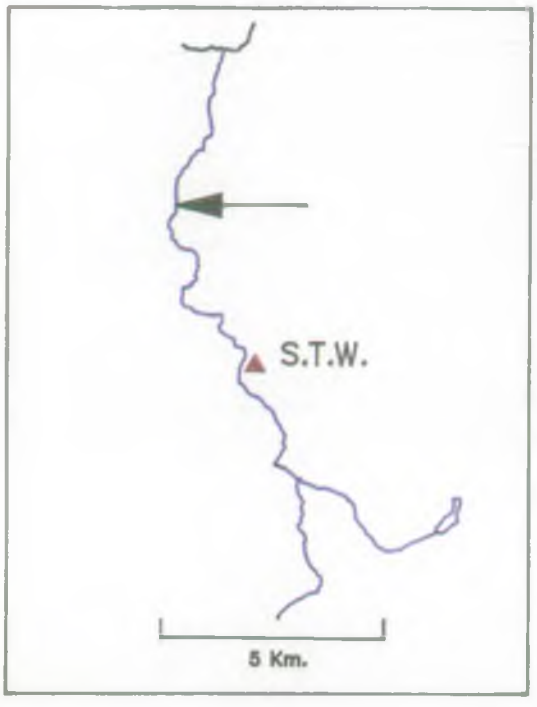
RIPARIAN OWNERS: L.B. Mr J. Marklove
R.B. Mr Ponting

FISHING RIGHTS: L.B. As owner
R.B. South Cerney Angling Club.

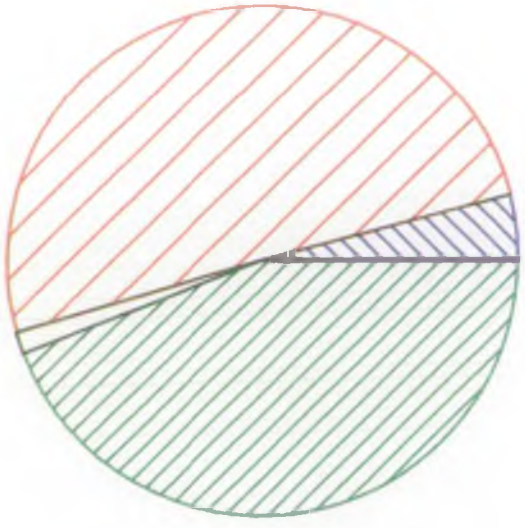
ADDITIONAL INFORMATION: Minnow & stickleback present. Health Sample. An additional run upstream of the survey section (90 x 7.3m) produced 1.9kg. This represents a minimum biomass of 2.89g/sqm. This upstream section was shallow (0.5m) and possessed no riffle feature.

COMMENTS: A healthy biomass and density of mixed coarse species. Dace & roach were dominant with both species showing a good age structure indicating succesful recruitment. This site achieved its target biomass of 20g/sqm. However, the very poor results from the additional upstream run indicate the importance of the riffle feature.

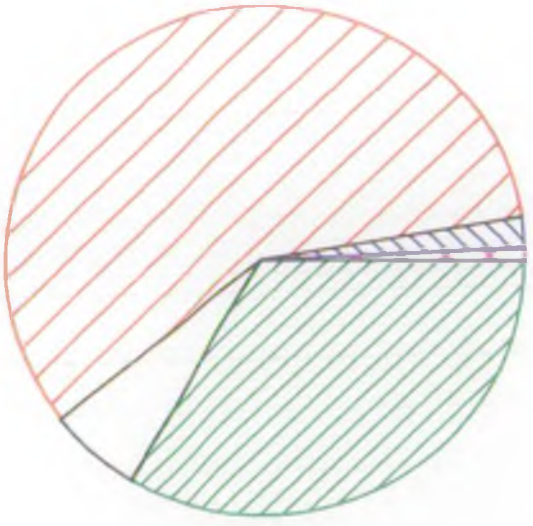
Fig. 5.1.3a DOWNSTREAM TADPOLE BRIDGE (RAJ1)
Biomass & Density



	Biomass (gm−2)	Density (nm−2)
Bleak	0.1	0.003
Chub	1.1	0.007
Dace	13.7	0.210
Perch	0.4	0.021
Roach	12.0	0.121
TOTAL	27.3	0.362

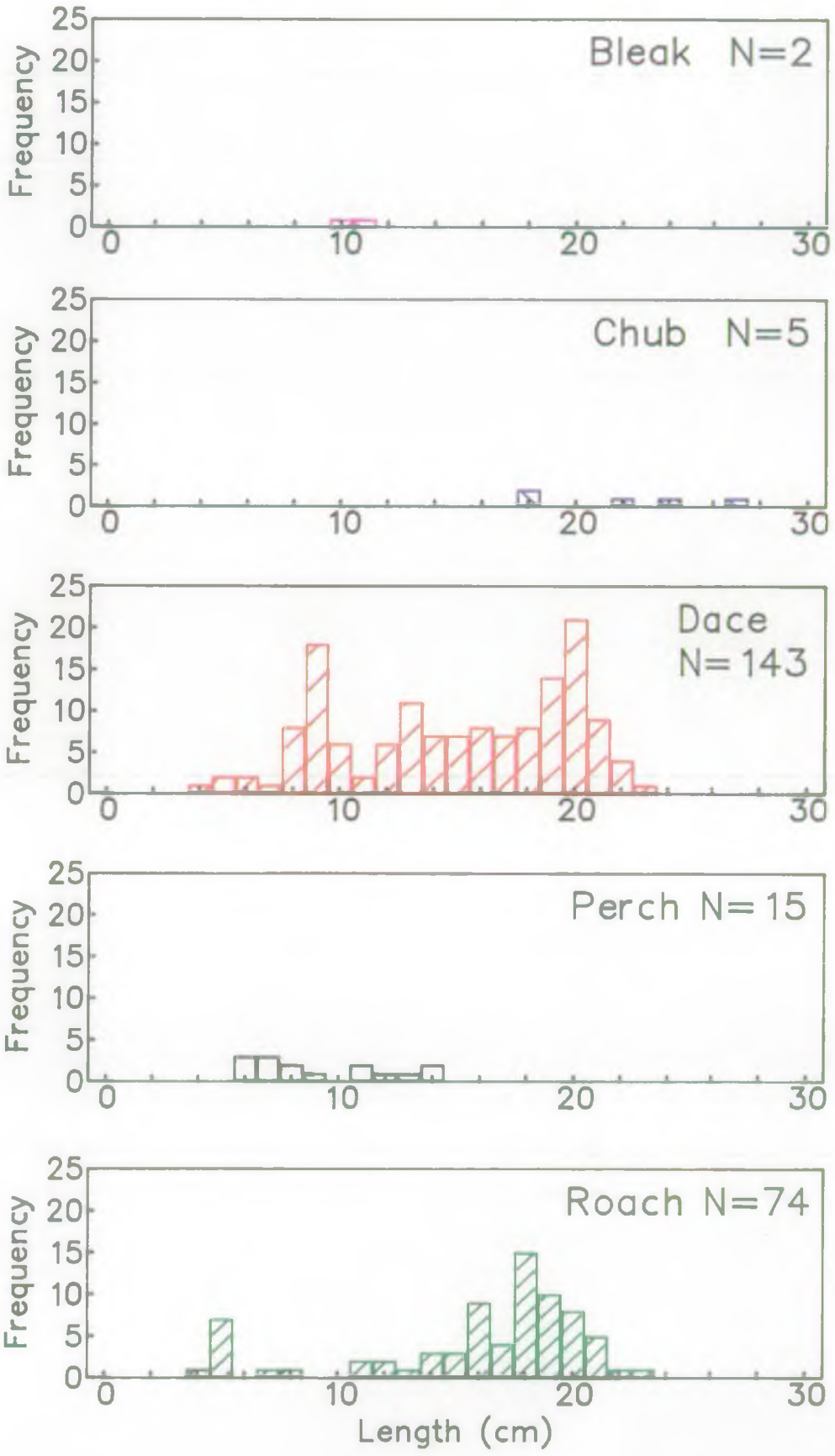


Biomass



Density

Fig. 5.1.3b DOWNSTREAM TADPOLE BRIDGE (RAJ1)
Length Frequency



5.1.4 SITE RESULTS - UPSTREAM OF SEVEN BRIDGES (RAJ2).

WATERCOURSE: River Ray, Wiltshire

SITE NAME: Upstream of Seven Bridges

SITE CODE: RAJ2

LOCATION: 100m upstream of A419 bridge

N.G.R.: SU118925

DATE FISHED: 10th October 1989

METHOD: Upstream electric fishing, wading/boat with two anodes.

R.Q.O.: 2a E.E.C. TARGET BIOMASS: 20g/sqm.

HABITAT FEATURES

LENGTH: 120m MEAN WIDTH: 7.5m AREA: 900 sqm MEAN DEPTH 1.3m

WATER TEMPERATURE: 15 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 80 MUD & SILT: 20 GRAVEL: 00 STONE: 00 BOULDER: 00

VEGETATION (% COVER)

SUBMERGED: 20 FLOATING: 00 EMERGENT: 10 SHADE: 05

DOMINANT PLANT SPECIES: Sparganium, Nuphar, Carex, Callitriche sp.

WATER LEVEL: Low WATER CLARITY: Tea coloured

PHYSICAL STRUCTURE OF SITE: A meandering section with deeper pools. Poor substrate, good stands of instream weed and little bankside cover.

ADJACENT LAND USE: L.B. Pasture
R.B. Pasture

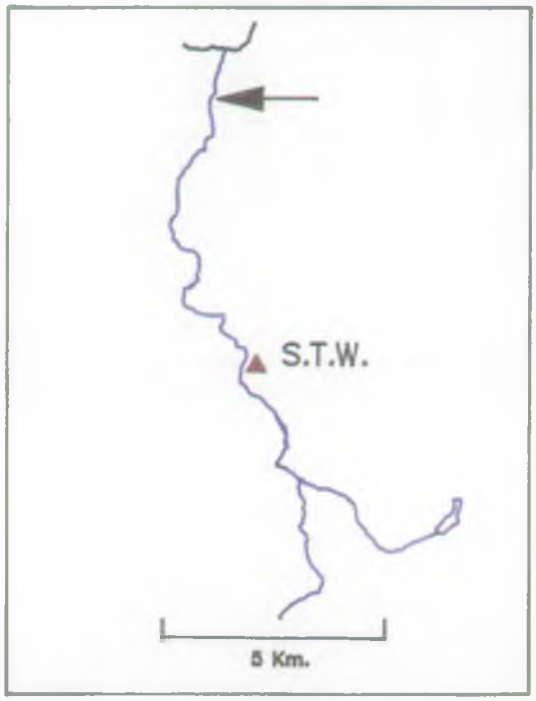
RIPARIAN OWNERS: L.B. Mr R. Freeth
R.B. Mr Gantlett

FISHING RIGHTS: L.B. South Cerney Angling Club
R.B. As above

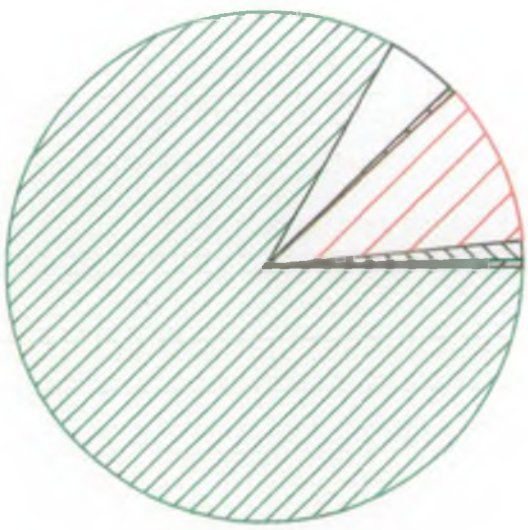
ADDITIONAL INFORMATION: Minnow & stoneloach present.
An additional run upstream of the survey section (97 x 7.0m) produced 4.0kg of same plus 4 chub. This represents a minimum biomass of 5.89g/sqm.

COMMENTS: A poor biomass and density of mixed coarse species. Roach were dominant with this species and dace showing some evidence of succesful recruitment. This site failed to achieve its target biomass of 20g/sqm.

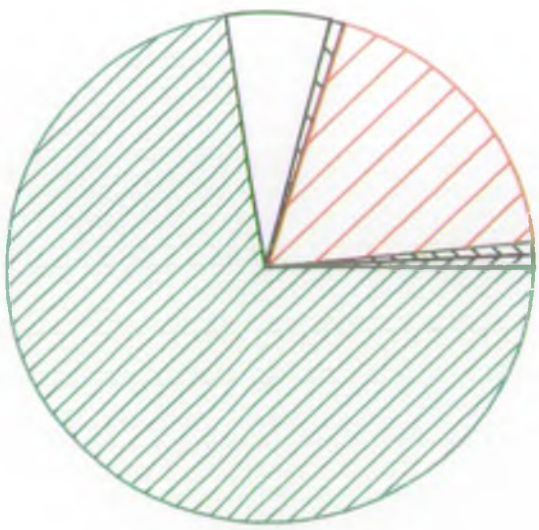
Fig. 5.1.4a UPSTREAM SEVEN BRIDGES (RAJ2)
Biomass & Density



	Biomass (gm-2)	Density (nm-2)
Bream	0.1	0.001
Chub	0.1	0.001
Dace	1.0	0.023
Gudgeon	0.1	0.001
Perch	0.4	0.008
Roach	8.3	0.089
TOTAL	10.0	0.123

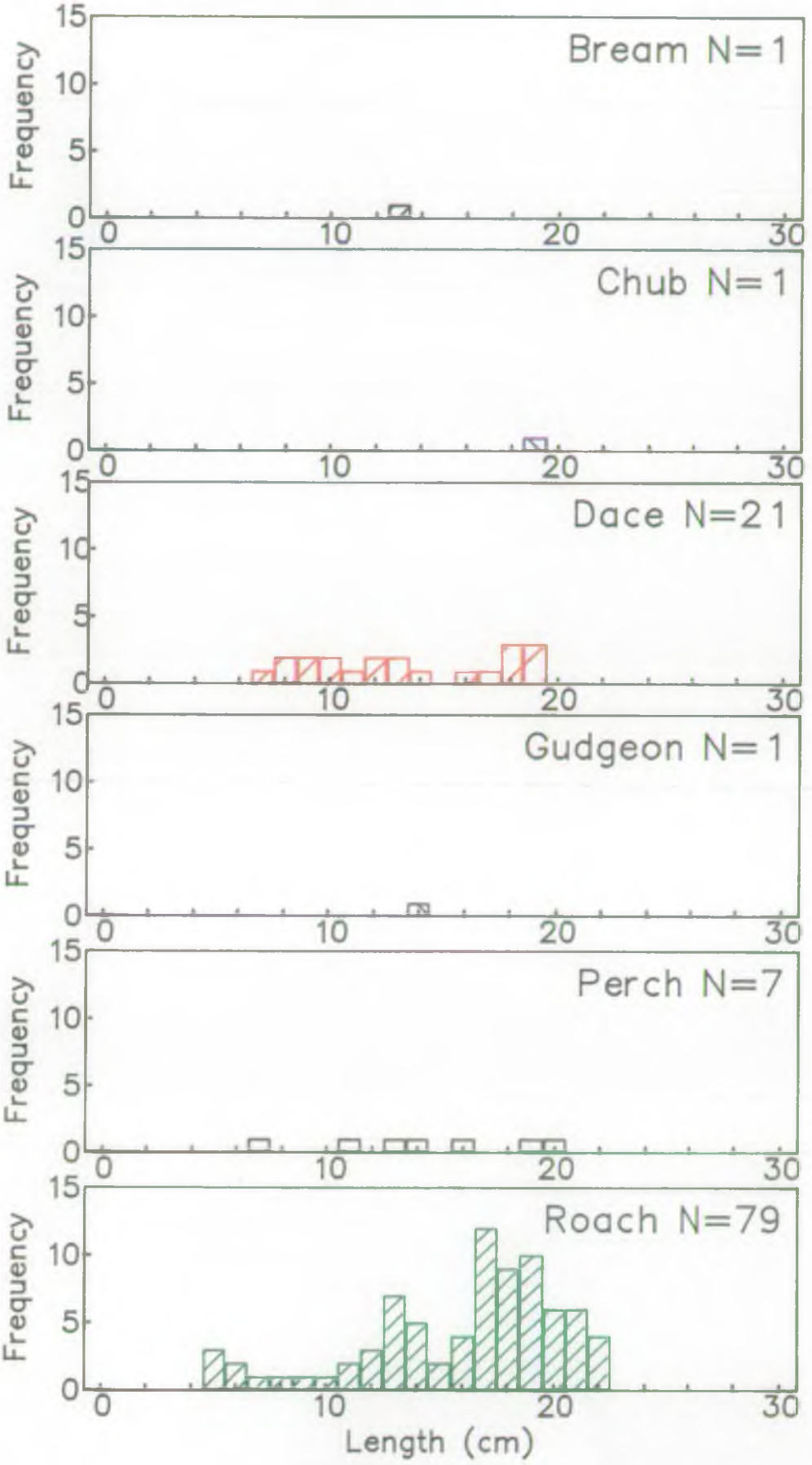


Biomass



Density

Fig. 5.1.4b UPSTREAM SEVEN BRIDGES (RAJ2)
Length Frequency



5.2 Survey Results

5.2.1 Biomass

A schematic summary of biomass and species composition at each site is presented in Fig. 5.2.1.

5.2.2 Age and Growth

Insufficient numbers of most species were captured to enable meaningful estimates of growth to be made. The growth rates of the two main species, dace and roach, are presented in Figs. 5.2.2a and 5.2.2b respectively. These are compared to the "standard" curves derived by Hickley and Dexter (1979). It should be noted that the survey took place towards the end of the growing season when comparing growth with the "standard" curve. This explains the apparent faster growth rate of both dace and roach in their early years. Taking this into account, the growth rate for both species are very similar to the Hickley and Dexter standard.

5.3 Fish Health

The health assessment on the sample taken at Tadpole Bridge (RAJ1) showed significant levels of two parasites, Diplostomum sp (eye fluke) which can cause problems at high levels. Some cataracts was found in the sample as a result of this parasite. Significant levels of Diplozoon sp (gill fluke) were also found but this parasite is fairly benign causing no problems. Further details of the samples parasite fauna are presented in Appendix VI. Some of the fish caught at all sites were in poor general condition with scale loss and fin erosion being present.

The results of the analysis of tissue samples for heavy metals and pesticides were still not available at the time of publishing.

5.4. Water Quality

5.4.1 River Quality

The results of the water quality assessment for the years 1986-89 are summarised below.

Sampling Point	Code	R.Q.O.	Compliance			
			1986	1987	1988	1989
Above Wroughton Ditch	PUTR.0067	2B	Pass	Pass	Pass	Pass
Mill Lane, Swindon	PUTR.0068	2B	Pass	Pass	Pass	Pass
Morris Street, Swindon	PUTR.0070	2B	Pass	Pass	Pass	Pass
Moredon Bridge, Swindon	PUTR.0069	3	Pass	Pass	Pass	Pass
Tadpole Bridge	PUTR.0072	2A	Pass	Fail	Fail	Fail
Seven Bridges, Cricklade	PUTR.0071	2A	Fail	Fail	Fail	Fail

FIG. 5.2.1 SUMMARY OF BIOMASS FOR EACH SITE

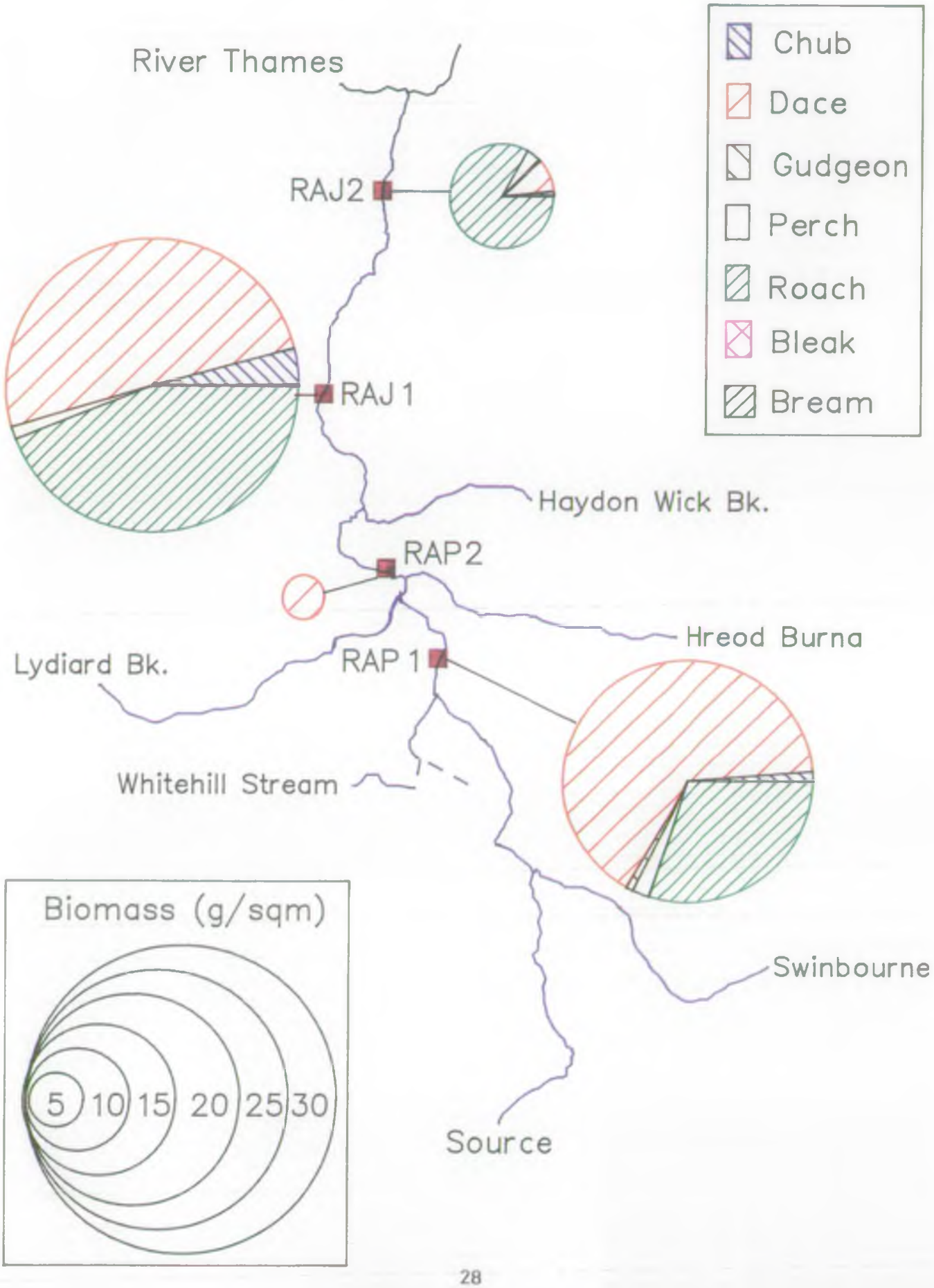


FIG. 5.2.2a GROWTH CURVE FOR DACE

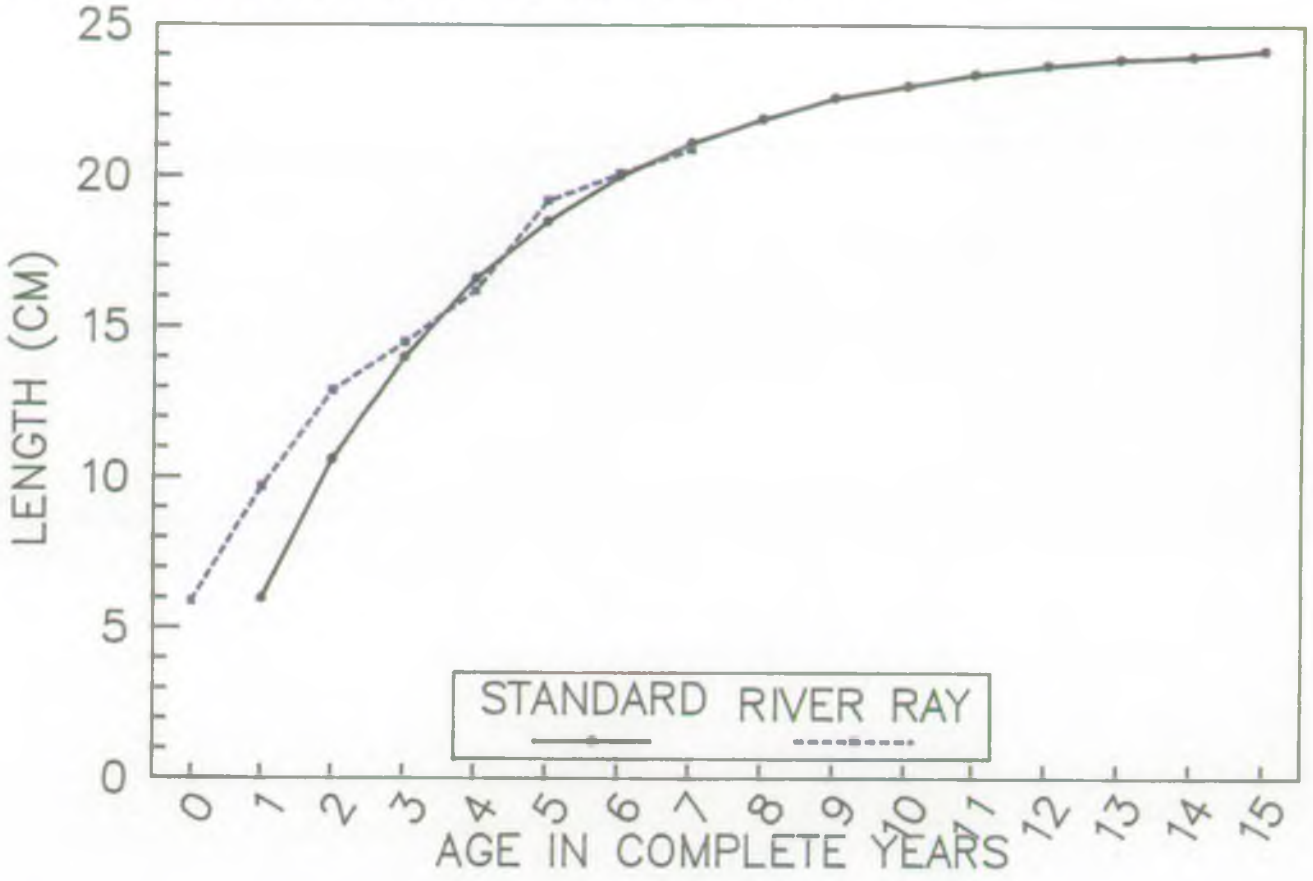
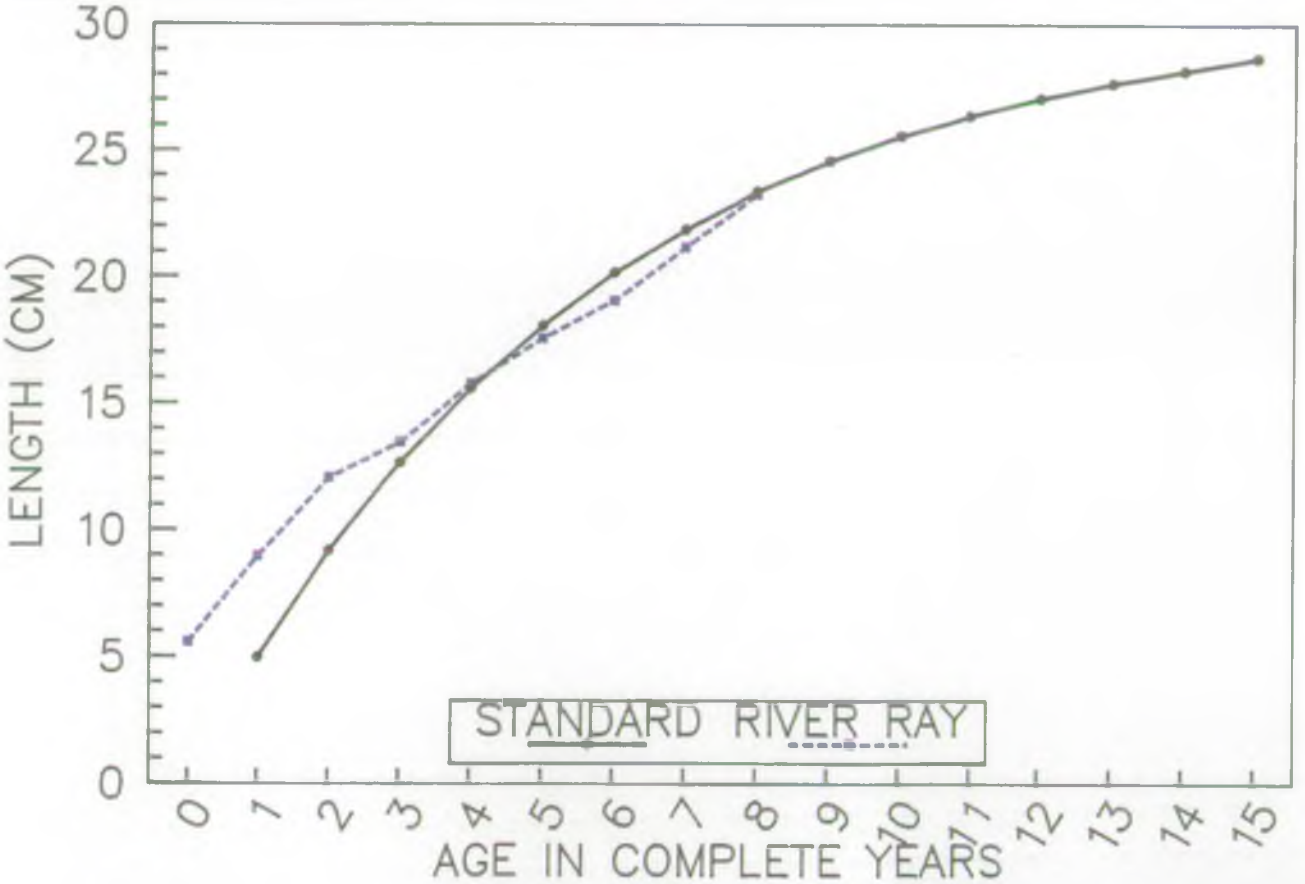


FIG. 5.2.2b GROWTH CURVE FOR ROACH



The results for key parameters (dissolved oxygen, biochemical oxygen demand, ammoniacal ammonia and un-ionised ammonia) during 1989 are shown in Figs. 5.4.1a-d. The results do not show an accurate profile but do give a general picture of parameter levels in relation to River Quality Objective Criteria and the position of Swindon Sewage Treatment Works.

5.4.2 Consented Discharge Quality

The compliance with consent standards are presented below.

a) Wroughton Sewage Treatment Works

Year	Consent Conditions		
	Suspended Solids	B.O.D.	Ammmoniacal Nitrogen
1986	Pass	Pass	Pass
1987	**Fail**	Pass	**Fail**
1988	**Fail**	Pass	**Fail**
11/88-10/89	Pass	Pass	Pass

b) Swindon Sewage Treatment Works

i) Discharge 'A'

Year	Consent Conditions		
	Suspended Solids	B.O.D.	Ammmoniacal Nitrogen
1986	Pass	Pass	Pass
1987	Pass	Pass	**Fail**
1988	Pass	Pass	Pass
11/88-10/89	Pass	Pass	**Fail**

ii) Discharge 'B'

Year	Consent Conditions		
	Suspended Solids	B.O.D.	Ammmoniacal Nitrogen
1986	Pass	Pass	Pass
1987-1989	No samples taken		

iii) Discharge 'C'

No samples taken 1986-89.

FIG.5.4.1a DISSOLVED OXYGEN RESULTS 1989

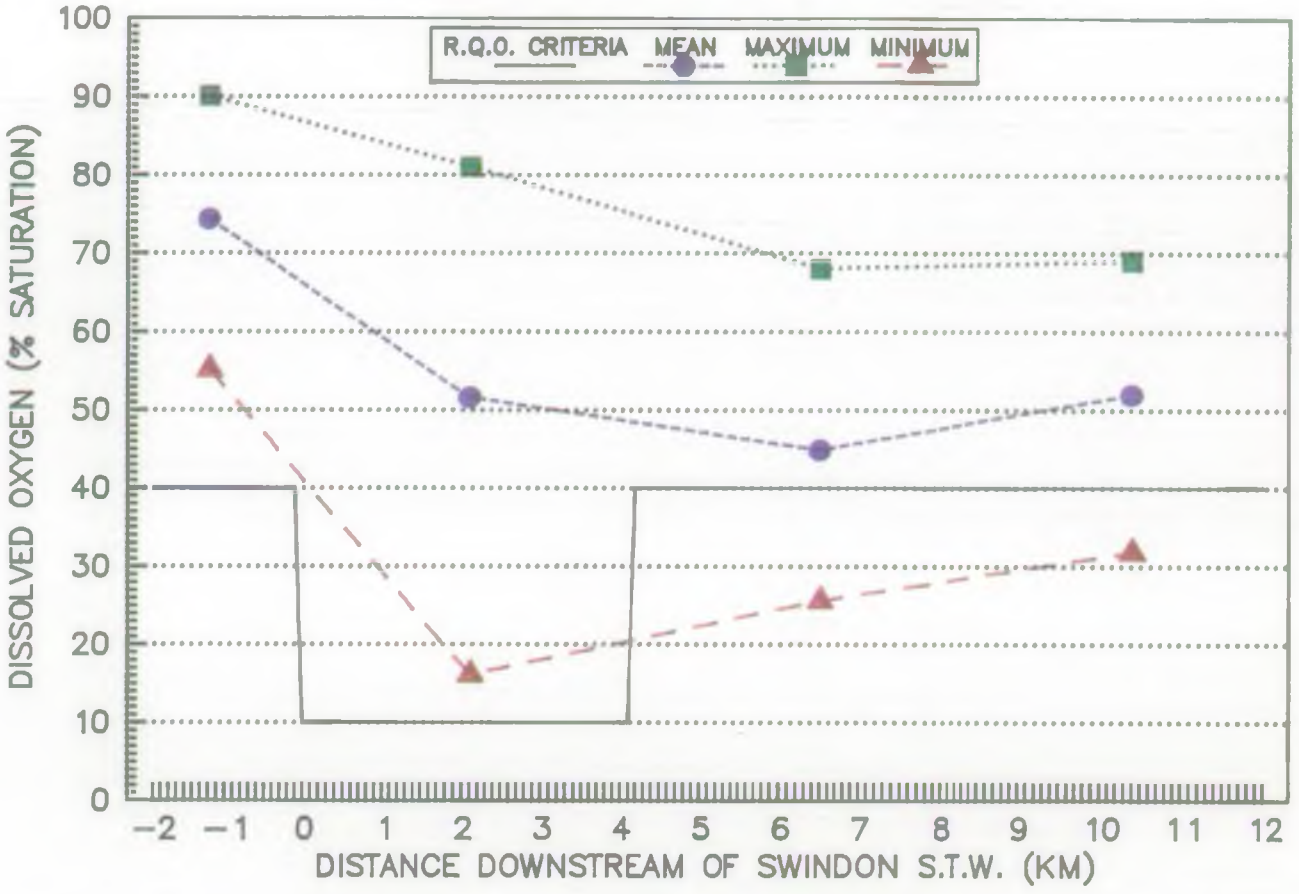


FIG. 5.4.1b BIOCHEMICAL OXYGEN DEMAND RESULTS 1989

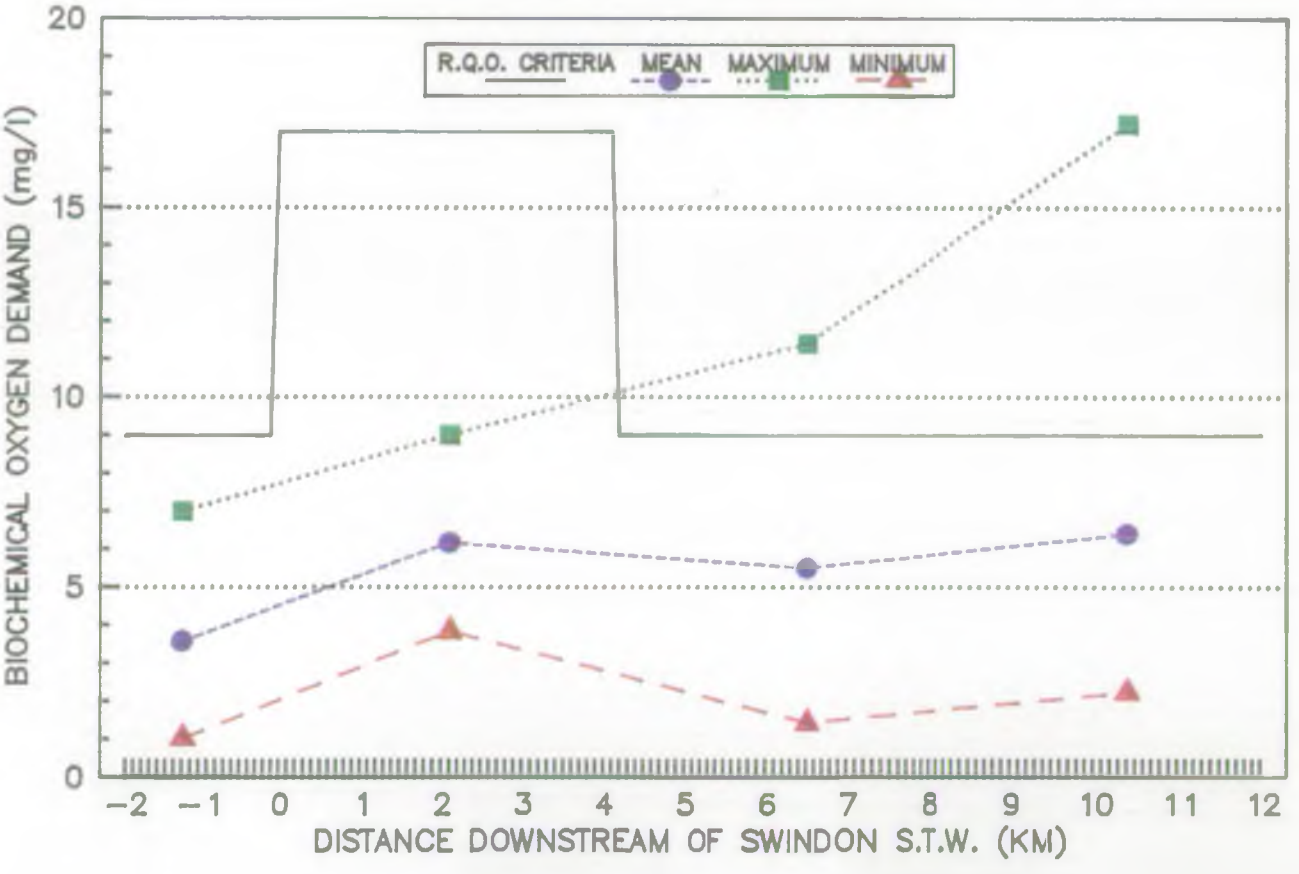


FIG.5.4.1c AMMONIACAL NITROGEN RESULTS 1989

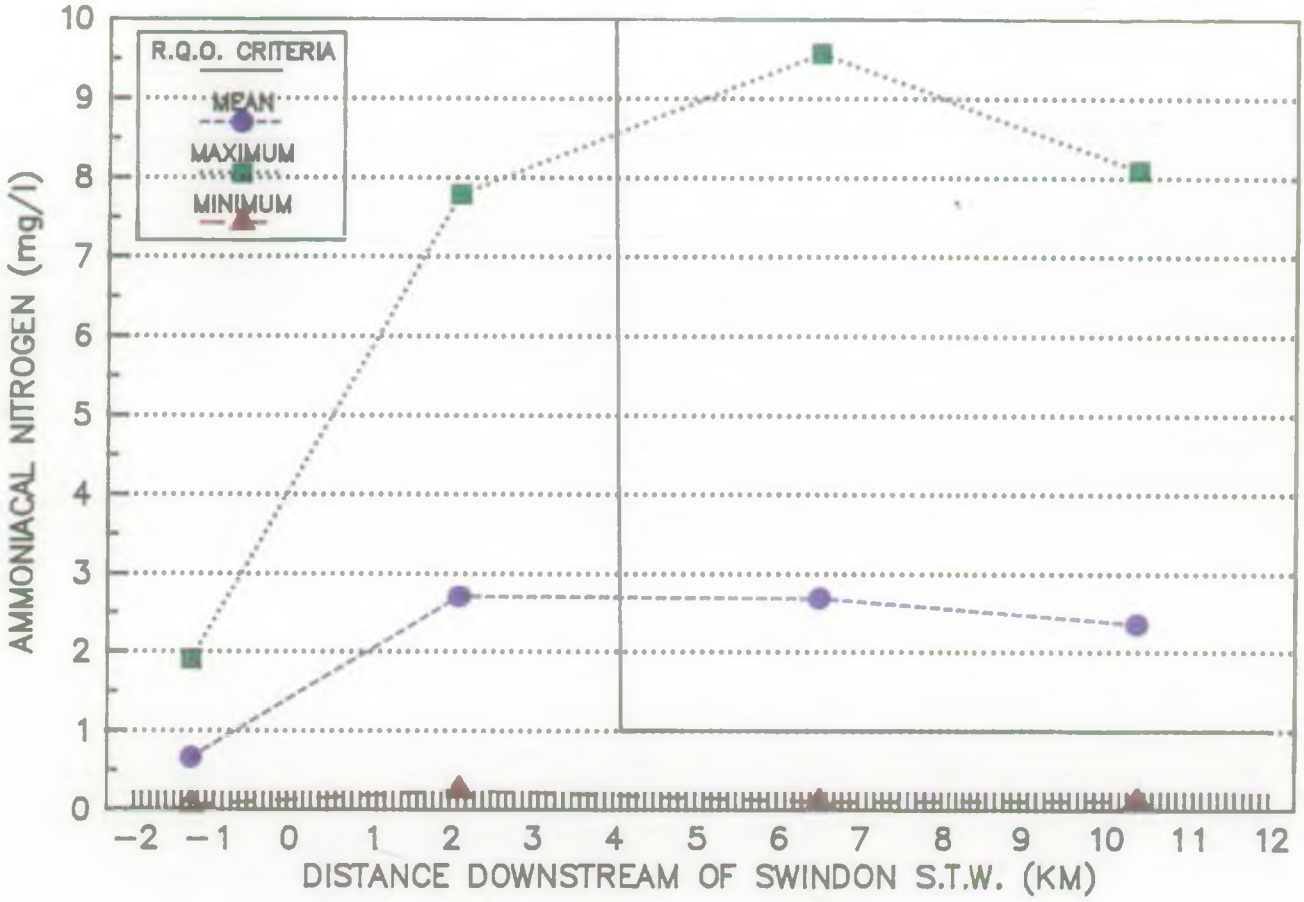
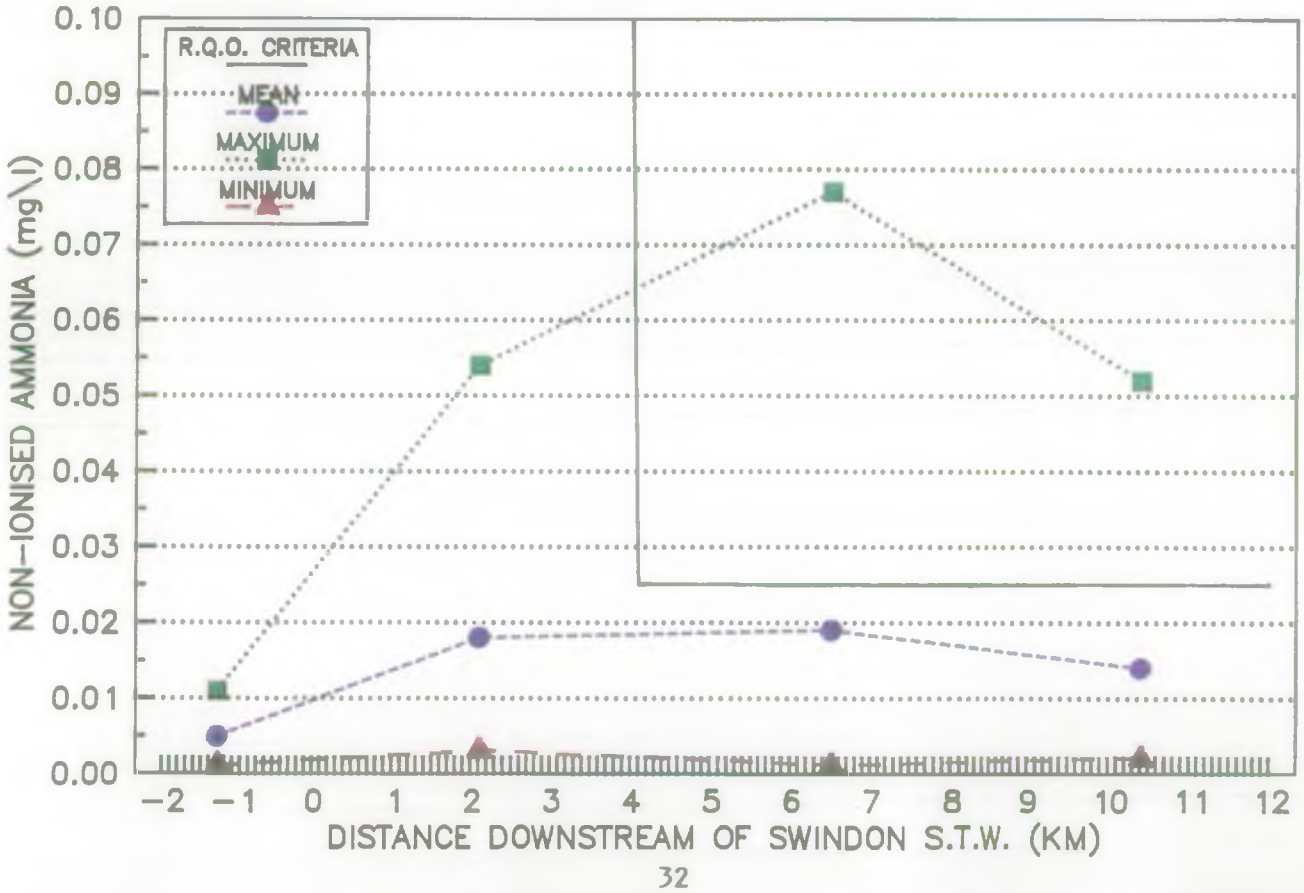


FIG.5.4.1.d UN−IONISED AMMONIA RESULTS 1989

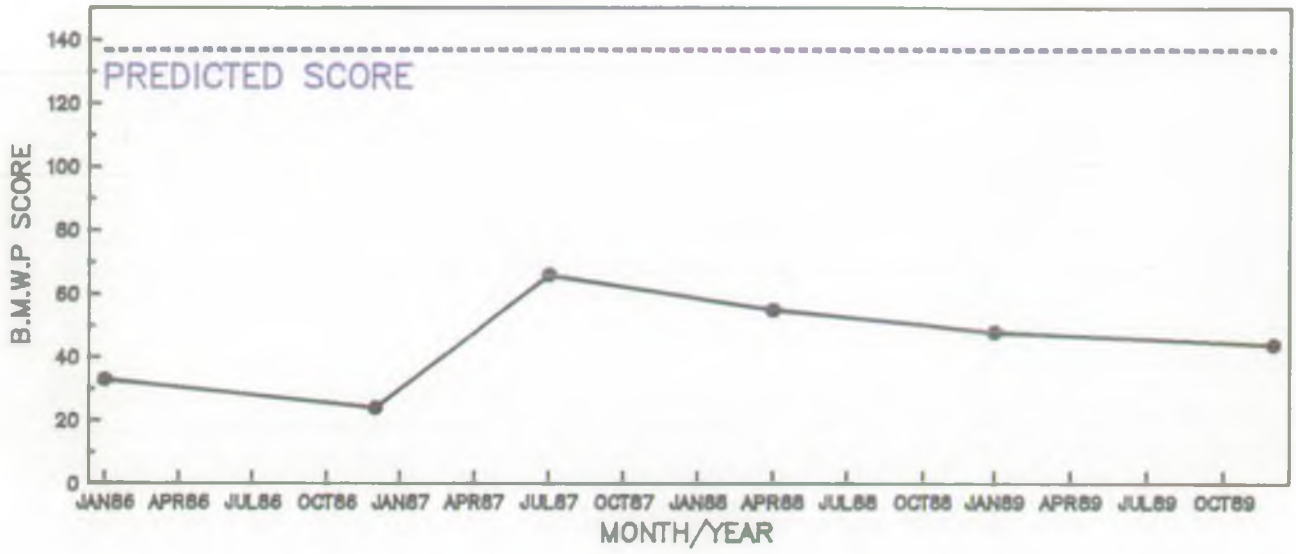


5.5 Macroinvertebrates Monitoring

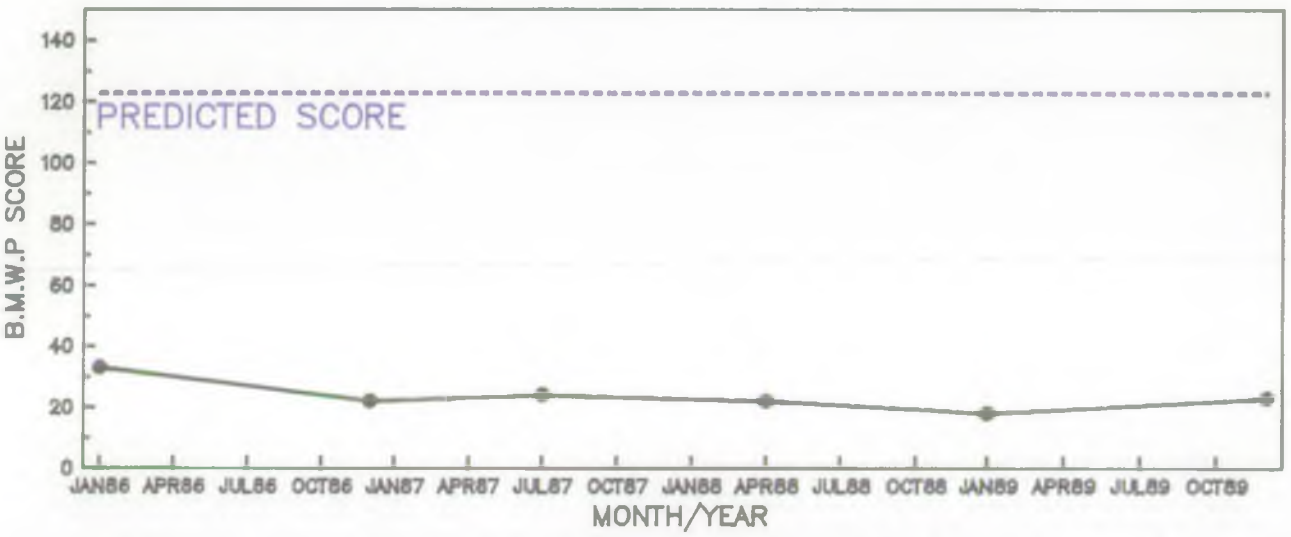
The results of macroinvertebrate monitoring during 1986-89 are presented in Figs. 5.5.a-c.

FIG.5.5.1 BIOLOGICAL MONITORING RESULTS 1986–89

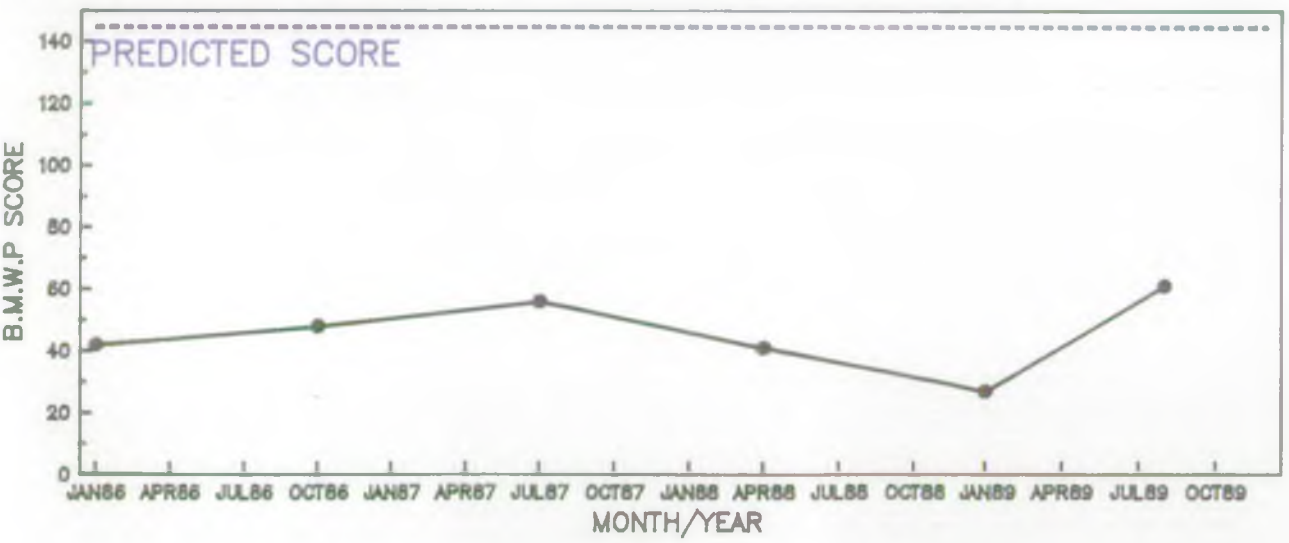
a) Morris Street, Swindon (PUTR.0070)



b) Moredon Bridge, Swindon (PUTR.0069)



c) Seven Bridges, Cricklade (PUTR.0071)



6. DISCUSSION

The upper section of the river from source to Swindon Treatment Works (S.T.W.) (9.0km) is effectively a small stream. This section also experiences low basal flows and excessive weed growth during the summer months and is effectively a non-viable fishery. For this reason no fishery survey site was located in this section. The main consented discharge in this upper section is Wroughton S.T.W. This discharge constitutes virtually all the flow of the Wroughton Ditch during dry weather conditions. This then combines with the River Ray where only 2:1 dilution occurs. Wroughton S.T.W. achieved its discharge consent conditions for the 12 month period immediately before this survey but failed in 1987 and 1988. The results of water quality assessment in the upper section presents conflicting data. The River Quality Objective (R.Q.O.) is 2B and the chemical results show the river has achieved this target during the years 1986-89. However, the biological monitoring indicates that the macroinvertebrate fauna has remained impoverished over the same period with a biotic class of D being well below the predicted class B. The reason for this descrepancy is probably due to the limitations of the infrequent chemical sampling missing sporadic water quality deterioration caused by urban run-off or agricultural discharges. Biological monitoring is a continuous monitor of water quality and can be expected to produce more reliable results. Future monitoring of water quality in this section will show any effect of the recently derogated consent conditions at Wroughton S.T.W.

The character of the river changes greatly at Swindon S.T.W. This large works has an average daily discharge of 0.42 cumecs which represents approximately 40% of the mean daily flow at Water Eaton Gauging Station located at the bottom of the river. Under dry weather conditions the maximum consented discharge is 0.37 cumecs which would constitute a dilution of 1 part river to 4 parts effluent (i.e. 80% of flow). The present mean dry weather discharge of 0.24 cumecs constitutes a dilution of approximately 1 part river to 3 parts effluent (i.e. 75% of flow). The large increase in flow is carried by a much larger channelised river immediately below the discharge and this was the location of the first fishery survey site (RAP 1)$_2$. The survey results show the site to support a healthy biomass (23.2 g/m^2) and density (0.310 fish/m^2) with a range of coarse fish species being present. The population structure shows dace to be the dominant species with a reasonable population of roach also being present. The age structure for these species and also for perch indicate that some successful recruitment to the population is present. The results show an increase in biomass in comparison to the last survey in 1986 (17.5g/m^2). The population structure has also changed with dace becoming dominant and roach declining. The presence of the strong 5+ year class in the present dace population suggests that their increase has been through immigration rather than successful recruitment.

The presence of a healthy fishery immediately below a sewage treatment works is not unexpected and has been found during other surveys (e.g. R. Cherwell - Banbury, R. Thame - Aylesbury, R. Ray (Oxon.) - Merton). The organic load discharged from a treatment works consumes oxygen as it is broken down. However, oxygen levels remain at acceptable levels for a distance which varies depending on size of load, dilution factors, temperature etc. and it is this region which may support a fish population. The aggregation of fish at organic discharges can also be explained by the rich food supply in the form of increased biomass of invertebrates, algae and sewage fungus.

The result of the survey at Moredon Bridge (RAP2) shows a marked contrast to those of the above site located only 2km upstream. The results show a very poor biomass (4.9g/m^2) and density (0.067 fish/m^2) to be present. The population comprised solely of dace with little evidence of the successful recruitment found upstream at site RAP1. The water quality assessment at the site during 1989 showed dissolved oxygen levels as low as 16% saturation and high levels of ammoniacal nitrogen (7.8mg/l) and un-ionised ammonia (0.054mg/l). Biological monitoring also shows an impoverished fauna to be present with the site having been classified as biotic class D continually since 1986 in contrast to the predicted class B. The results show this site to possess very poor water quality and to have complied with its river quality objective of class 3 since 1986.

Downstream of the Haydon Wick Brook, the river is an E.E.C. designated cyprinid fishery with an internal biomass target of 20g/m^2. The R.Q.O. of this section is class 2A. The survey site at Tadpole Bridge (RAJ1) is within the section and the results show a healthy biomass (27.3g/m^2) and density (0.362 fish/m^2) to be present. This site achieved its target biomass of 20g/m^2. The population structure shows a range of coarse species to be present with dace and roach being dominant. These species together with perch also show evidence of some successful recruitment to the population. The key factor concerning this good result is the presence of a large riffle at the upstream end of the survey site. The additional survey upstream of the riffle resulted in a very poor biomass of only 2.9g/m^2. Water quality assessments immediately upstream of the riffle during 1989 have shown dissolved oxygen levels as low as 25.5% saturation and high levels of B.O.D., (11.4mg/l), ammoniacal nitrogen (9.57mg/l), and un-ionised ammonia (0.077mg/l). All of these fall outside of the class limiting criteria for a 2A watercourse and the site failed to achieve its R.Q.O. in 1989 as it has done for the two previous years. The comparison of fish populations upstream and downstream of the riffle illustrate the importance of instream features providing re-aeration. These features are of increased importance in periods of low summer flows when problems with low dissolved oxygen levels are exacerbated.

The survey site at Seven Bridges (RAJ2) is also an E.E.C. designated cyprinid fishery. The results show a poor biomass (10.0g/m^2) and density (0.123 fish/m^2) to be present. This site failed to achieve its target biomass of 20g/m^2. The population structure shows roach to be the dominant species with a range of other coarse species present but in very low numbers. The results show a decrease in biomass and density in comparison to the previous survey in 1986 mainly due to the decline of dace in the population. The water quality assessment at this site during 1989 has shown low dissolved oxygen levels (32%) and high levels of B.O.D. (17.2mg/l), ammoniacal nitrogen (8.1mg/l) and un-ionised ammonia (0.052mg/l). All of these fall outside of the class limiting criteria for a 2A watercourse and the site failed its R.Q.O. as it has done for the past three years. Biological assessment during the same period has also shown a consistantly impoverished invertebrate fauna being biotic class D in comparison to the predicted class B.

Growth rates of the main species found were very similar to the Hickley and Dexter standards.

Fish health analysis showed no specific problems but some fish were in poor general condition indicative of environmental stress. This is likely to be due to the poor water quality.

The survey shows the fish population of the River Ray to be seriously affected by poor water quality caused by organic pollution. From a short distance downstream of Swindon S.T.W. the fish population was found to be poor with the exception of aggregated populations below instream features providing re-aeration. All sites possessed poor water quality with results indicating low levels of dissolved oxygen caused by nitrification and high levels of un-ionised ammonia to be the main problems. Biological monitoring results support the chemical data with the river only achieving a biotic class D. The river fails to meet its R.Q.O. of 2A downstream of the Haydon Wick Brook and is effectively a class 3 for its entire length downstream of Swindon S.T.W. The river below the Haydon Wick Brook also fails to meet the fish biomass target for an E.E.C. designated cyprinid fishery except at sites with capacity for re-aeration. These sites are present but not common and it is estimated that 80% of the designated section would fail to comply with biomass targets.

The source of the organic pollution is Swindon S.T.W. which constitutes approximately 40% of the average daily mean flow at the bottom of the river and up to 80% of the flow at the point of discharge. Results from Swindon S.T.W. show it to have failed its consent conditions for ammonia during the twelve months prior to this survey. However, the works only failed by a narrow margin and has complied with its consent conditions during 1986 and 1988. Even when the works is complying with its consent conditions both fish and the invertebrate fauna are adversely affected. The present consent conditions, given the poor dilution factor, are incompatible with the stated R.Q.O. and E.E.C. fishery designation between the Haydon Wick Brook and the River Thames confluence.

Major improvements at Swindon S.T.W. are presently being undertaken in order to comply with the stricter consent conditions which come into force from the 1st October, 1991. Up until this date the works has relaxed consent conditions which allow the legal discharge of effluent of a lower quality than that prior to October, 1989 when this survey was undertaken.

The short term prospects for improvement to water quality and the fish population are poor with the relaxed consent conditions at Swindon S.T.W. being in force until 30th September 1991. The longer term prospects are better with much stricter consent conditions coming into force on October 1st 1991 which should enable the river downstream of the Haydon Wick Brook to achieve its R.Q.O. of 2A. Such an improvement in water quality would be expected to produce a marked improvement in the fish population. Habitat quality from Swindon S.T.W. to the River Thames confluence is reasonable to good. With good water quality (class 2A) this section has the potential of supporting a healthy population of coarse fish and providing a valuable angling facility. The close proximity of the River Thames would allow immigration of fish once any sustained improvement to water quality had been achieved. It should also be noted that the poor quality of the River Ray has a deleterious effect on the River Thames below their confluence. This section of the River Thames fails to meet its biomass target for an E.E.C. designated cyprinid fishery (Upper Thames Survey 1987).

7. CONCLUSIONS

1. The upper section of the River Ray from the source to Swindon Sewage Treatment Works (S.T.W) (9km) is effectively a small stream with low basal flow. This section is a non-viable fishery.

2. The section immediately below Swindon S.T.W. (0.5km) supports a healthy population of mixed coarse fish.

3. The section from 0.5km below Swindon S.T.W. to the Haydon Wick Brook (3.7km) supports a very poor fish population with only dace being present.

4. The lower section from the Haydon Wick Brook to the River Thames confluence (7.8km) supports a poor fish population of mixed coarse species. Aggregated fish populations are present at sites with the capacity for instream re-aeration. These sites are not common and it is estimated that 80% of this section does not achieve its target biomass for an E.E.C. designated cyprinid fishery.

5. The cause of the limited fish population in the section from 0.5km downstream of Swindon S.T.W. to the River Thames confluence is poor water quality. The section from Swindon S.T.W. to the Haydon Wick Brook has an R.Q.O. of class 3. The section from the Haydon Wick Brook to the River Thames confluence has an R.Q.O. of 2A which it has failed to achieve during the period 1987/89 and is effectively class 3. The macroinvertebrate monitoring results support the chemical data with an impoverished fauna (biotic class D) being found in both of the above sections during the same period. The cause of the poor water quality is organic pollution, with low dissolved oxygen levels and high level of un-ionised ammonia being the main problems.

6. The source of the organic pollution is Swindon S.T.W. The works narrowly failed to meet its consent conditions for ammonia during the year before the survey and also in 1987. However, poor water quality and associated deleterious effects on the fish population still result when the works is complying with its consent conditions. The present consent conditions, given the poor dilution factor, are incompatible with the stated R.Q.O. of 2A and E.E.C. fishery designation between the Haydon Wick Brook and the River Thames confluence.

7. Short term prospects for improvement to the water quality and the fish population are poor. The relaxed consent standards at Swindon S.T.W. are in force until the 30th September 1991 whilst improvements to the works are being undertaken.

8. Long term prospects are better with stricter consent conditions for Swindon S.T.W. coming into force on 1st October 1991 which should enable compliance with the R.Q.O. of 2A downstream of the Haydon Wick Brook. The habitat quality downstream of Swindon S.T.W is reasonable to good and any sustained improvement in water quality would be expected to produce improvement in the fish population.

8. RECOMMENDATIONS

1. Continued monitoring of water quality and consented discharges to provide information on the effects of the recent and future changes to consent conditions at Wroughton and Swindon Sewage Treatment Works.

2. Continued monitoring of the fish population with particular respect to changes in water quality. Further survey work will be undertaken if chemical and biological monitoring indicate a significant change in water quality.

3. Further investigation of habitat enhancement opportunities. The potential benefit of creating additional instream re-aeration features such as riffles and weirs is particularly good. This would enhance the river's capacity to deal with organic pollution and provide additional areas of locally improved water quality.

9. REFERENCES

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2. Hickley, P. and Dexter, K.F., 1979. A comparative index for quantifying growth in length of fish. Fishery Management 10(4), 147-151.

3. National Rivers Authority - Thames Region, 1989. A fisheries survey of the River Cherwell. Internal Report.

4. National Rivers Authority - Thames Region, 1990. A fisheries survey of the River Ray (Oxon.). Internal Report.

5. Thames Water, 1986. River Ray (Wiltshire) Catchment Study. Internal Report.

6. Thames Water, 1987. A fisheries survey of the River Thame. Internal Report.

7. Thames Water, 1987. A fisheries survey of the Upper River Thames. Internal Report.

10. APPENDICES

APPENDIX I N.W.C. CLASSIFICATION OF RIVER QUALITY

CLASSIFICATION OF RIVER QUALITY

River Class	Quality criteria	Remarks	Current potential uses
	Class limiting criteria (95 percentile)		
1A	(i) Dissolved oxygen saturation greater than 80%. (ii) Biochemical oxygen demand not greater than 3mg/l. (iii) Ammonia not greater than 0.4 mg/l. (iv) Where the water is abstracted for drinking water, it complies with requirements for A2** water. (v) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available).	(i) Average BOD probably not greater than 1.5 mg/l. (ii) Visible evidence of pollution should be absent.	(i) Water of high quality suitable for potable supply abstractions and for all other abstractions. (ii) Game or other high class fisheries. (iii) High amenity value.
1B	(i) DO greater than 60% saturation. (ii) BOD not greater than 3 mg/l. (iii) Ammonia not greater than 0.9 mg/l. (iv) Where water is abstracted for drinking water, it complies with the requirements for A2** water. (v) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available).	(i) Average BOD probably not greater than 2 mg/l. (ii) Average ammonia probably not greater than 0.5 mg/l. (iii) Visible evidence of pollution should be absent. (iv) Waters of high quality which cannot be placed in Class 1A because of high proportion of high quality effluent present or because of the effect of physical factors such as canalisation, low gradient or eutrophication. (v) Class 1A and Class 1B together are essentially the Class 1 of the River Pollution Survey. (RPS)	Water of less high quality than Class 1A but usable for substantially the same purposes.
2	(i) DO greater than 40% saturation. (ii) BOD not greater than 9 mg/l. (iii) Where water is abstracted for drinking water, it complies with the requirements for A3** water. (iv) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures not available).	(i) Average BOD probably not greater than 5mg/l. (ii) Similar to Class 2 of RPS. (iii) Water not showing physical signs of pollution other than humic colouration and a little foaming below weirs.	(i) Waters suitable for potable supply after advanced treatment. (ii) Supporting reasonably good coarse fisheries. (iii) Moderate amenity value.
3	(i) DO greater than 10% saturation. (ii) Not likely to be anaerobic. (iii) BOD not greater than 17 mg/l*.	Similar to Class 3 of RPS.	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.
4	Waters which are inferior to Class 3 in terms of dissolved oxygen and likely to be anaerobic at times.	Similar to Class 4 of RPS.	Waters which are grossly polluted and are likely to cause nuisance.
X	Do greater than 10% saturation.		Insignificant watercourses and ditches not usable, where objective is simply to prevent nuisance developing.

(a) Under extreme weather conditions (e.g. flood, drought, freeze up), or when dominated by plant growth, or by aquatic plant decay, rivers usually in Classes 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.

(b) The BOD determinations refer to 5 day carbonaceous BOD (ATU). Ammonia figures are expressed as NH_4.

(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 downgraded on the basis of the biota actually present, and the reasons stated.

(d) EIFAC (European Inland Fisheries Advisory Commission) limits should be expressed as 95% percentile limits.

* This may not apply if there is a high degree of reaeration.

** 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 States.

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

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 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		$\leqslant$ 21.5°C $\nless$ 1.5°C		$\leqslant$ 28°C $\nless$ 3°C
Dissolved oxygen (mg/l O_2)	50% $\geqslant$ 9 100% $\geqslant$ 7	50% $\geqslant$ 9	50% $\geqslant$ 8 100% $\geqslant$ 5	50% $\geqslant$ 7
pH		6--9		6--9
Suspended solids (mg/l)	$\leqslant$ 25		$\leqslant$ 25	
B.O.D. (A.T.U.) (mg/l)	$\leqslant$ 5*		$\leqslant$ 8*	
Nitrites (mg/l)	$\leqslant$ 0.2*		$\leqslant$ 0.5*	
Non-ionized ammonia (mg/l)	$\leqslant$ 0.005	$\leqslant$ 0.025	$\leqslant$ 0.005	$\leqslant$ 0.025
Total ammonium (mg/l NH_4)	$\leqslant$ 0.04	$\leqslant$ 1	$\leqslant$ 0.2	$\leqslant$ 1
Total residual chlorine (mg/l HClO)		$\leqslant$ 0.005		$\leqslant$ 0.005
Zinc (mg/l)		$\leqslant$ 0.3		$\leqslant$ 1
Copper (mg/l)	$\leqslant$ 0.04		$\leqslant$ 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 Thames NRA fisheries and are based on RQO and EEC legislation critera:

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. 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 an unique 4 digit code for each site. Thus RAJ1 - RA=RAY, J=2 cyprinid, 1=individual site.

APPENDIX V

Summary of Results from the River Ray Fisheries Survey 1986 (Ref:ARA86)

SITE	CODE	SPECIES	BIOMASS (g/m^2)	DENSITY ($fish/m^2$)
Downstream	RAP1	Chub	0.66	0.012
Swindon		Dace	1.59	0.012
S.T.W.		Roach	12.26	0.215
		Perch	2.54	0.055
		Bream	0.15	0.002
		Pike	0.28	0.002
		TOTAL	17.48	0.323
Seven	RAJ2	Chub	0.65	0.005
Bridges		Dace	7.45	0.092
		Roach	3.51	0.049
		Perch	1.56	0.015
		Bleak	0.08	0.003
		Gudgeon	0.05	0.002
		TOTAL	13.30	0.166

APPENDIX VI FISH HEALTH EXAMINATION RESULTS

EXAMINATION REF: WYF(S30)018

FISH SPECIES	LENGTH RANGE (cm)	WEIGHT RANGE (g)	AGE RANGE	SEX
Chub	22.2	134.6	(3+)	Male
Dace	13.0 - 21.6	23.8 - 143.4	(1+)-(3+)	Male Female
Roach	14.6 - 23.3	62.0 - 222.9	(2+)-(5+)	Male Female

PARASITES PRESENT:

FISH SPECIES	NO EXAMINED	PARASITE	LOCATION	PREVALENCE (PERCENTAGE INFESTATION)	INTENSITY (DEGREE OF INFESTATION)
Chub	1	*Myxobolus sp*	Gills	100	Light
		Trypanosoma sp	Gill Squash	100	Light
Dace	10	*Diplostomum sp*	Lens	60	Light/Moderate
		Diplozoon sp	Gills	40	Light/Moderate
		Trypanosoma sp	Gill Squash	10	Light
Roach	12	*Diplostomum sp*	Lens	83	Light/Moderate
		Diplozoon sp	Gills	50	Light