UPPER THAMES AREA

OXFORD CANAL
FISHERIES SURVEY
1990

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Contents

1. Summary

1. Two sites were surveyed by electrofishing between August 1989 and January 1990, in order to evaluate effects on the fish population of poor water quality in two reaches of the South Oxford Canal.

2. Site OX01 (downstream Wolvercote Lock) supported a biomass of 30.4g/m2, whilst a single electrofishing run upstream of Wolvercote Lock produced a biomass of 0.7g/m^2. This low figure is a direct consequence of previous fish mortalities.

3. Site OX02 (downstream of Alcan Industry's consented discharge) supported a biomass of 9.2g/m^2. A single electrofishing run upstream of Hardwick Lock produced a biomass of 7g/m^2.

4. Water quality problems exist in the reaches receiving effluent from Kidlington STW and Alcan Industries.

   In the reach downstream of Kidlington STW water quality (sampled at PTHR.0159, 1.2km below Kidlington STW) is not achieving its 2A River Quality Objective.

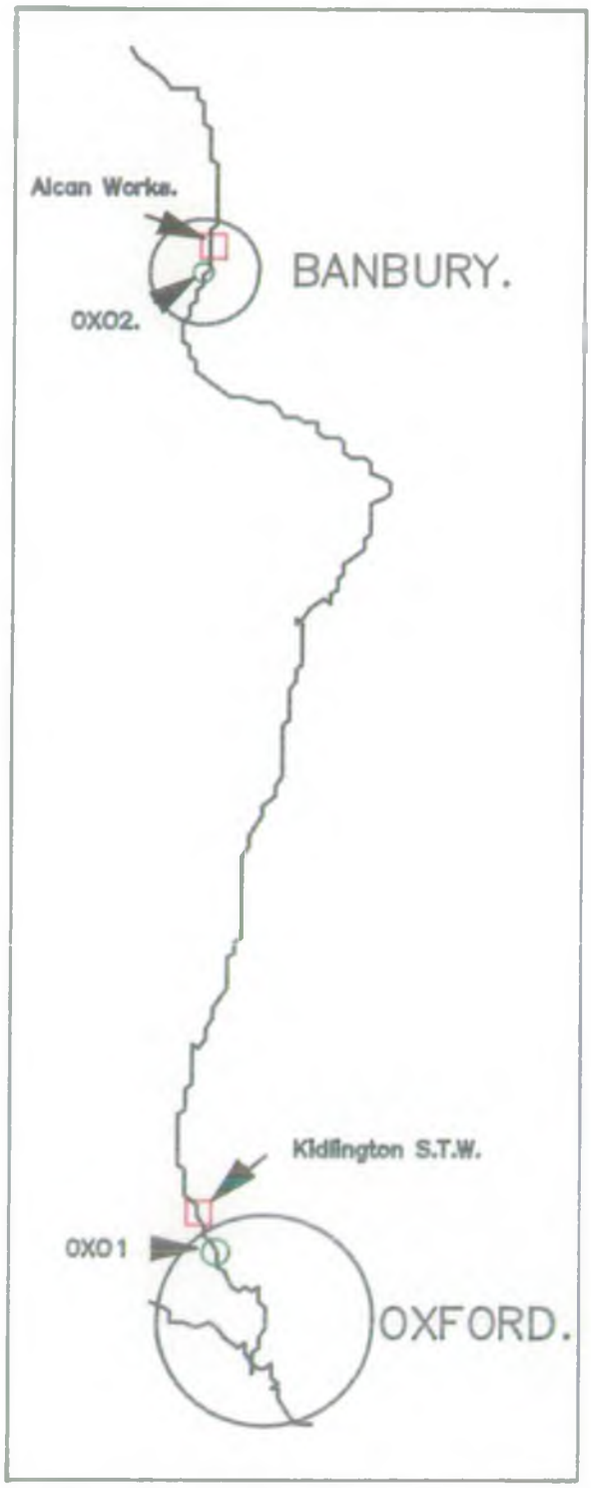
   In the reach downstream of Hardwick Lock, Banbury, dissolved oxygen levels are not compatible with its 2A River Quality Objective. In addition heavy loading of oil and thermal pollution also affect the reach's fish population.

5. Despite improvements to Kidlington STW under Thames Water Utilities KEYCHANGE programmes, there is little prospect of water quality in the canal downstream of the works outfall improving dramatically.

6. Recommendations for fisheries include an immediate review of water quality in these reaches and investigation of the possibility of diverting discharges away from the canal. Restocking of the canal, and further survey work will be undertaken if an improvement in water quality takes place.

Fig. 2.1

OXFORD CANAL.



KEY.

□ CONSENTED DISCHARGE.

○ SURVEY SITE.

2. Introduction

2.1. Description of the Watercourse

Authorised in 1764, the Oxford Canal (Fig. 2.1) was built with the dual aim of moving coal from Warwickshire to Banbury and Oxford, whilst providing a link from the Coventry Canal to the River Thames.

Originally a 91 mile contour canal, designed by James Brindley, the canal has been updated several times in an effort to maintain competitiveness against more modern, direct routes.

The present canal is some 14 miles shorter than the original and divides conveniently into two major sections; the North Oxford Canal, running from the Coventry Canal to its confluence with the Grand Union Canal at Braunston Turn (SP 532 660), and the South Oxford Canal, running south from here to join the Castle Mill Stream at Oxford Basin (SP 503 065).

Jurisdiction over water quality and fisheries in the Canal is shared between Severn-Trent and Thames, National Rivers Authority (NRA) regions, with the latter controlling the section south of the Tunnel, Fenny Compton (SP 438 523), the subject of this report. Navigation, recreation and engineering functions are the responsibility of British Waterways.

For much of its course the South Oxford Canal shadows the River Cherwell, actually crossing it at Nellbridge (SP 495 338) and combining channels for the 1.5km between Enslow (SP 479 178) and Shipton-on-Cherwell (SP 486 170).

Three main reservoirs, Boddington (SP 490 520), Clattercote (SP 450 485) and Wormleighton (SP 448 518) provide water for the canal, although with the increasing pleasure boat traffic using the route, the supply is at times insufficient to guarantee 24 hour access, with lock restrictions the norm during dry summers, such as 1989.

The catchment area of the Oxford Canal is approximately 895km^2. Agriculture is the dominant land use, although there are two main connurbations on the canal, Banbury (population @ 1990 38,880) and Oxford (population @ 1990 87,360).

2.2. Geology

The Oxford Canal is an artificial, clay puddled watercourse. Consequently it is difficult to assess the impact of local geology on the canal's water quality.

2.3. Hydrology

Flow down the Canal is provided from Boddington, Wormleighton and Clattercote reservoirs, combined with backpumping from Napton Locks (SP 456 605) in NRA, Severn-Trent Region.

Figures provided by British Waterways show for the years 1979-89 an average weekly flow of 8970m^3 measured at Claydon Locks (SP 465 475). Distribution of this flow varies throughout the year, with peak flows corresponding to the periods of highest boat traffic. Input from the reservoirs and via backpumping normally begins during April, with peak

flows experienced during August. (Appendix I).

The very low summer flows, and the impoundment of the locks act together to affect water quality adversely.

2.4. Water Quality

2.4.1 River Classification

The Oxford Canal has a National Water Council (NWC) river quality objective (RQO) of 2A, throughout its length.

This RQO is consistent with a "fair quality water", capable of supporting good coarse fisheries, complying with directive 78/659/EEC, for cyprinid waters, as modified by Thames NRA Region (Appendix II).

2.4.2 Consented Discharges

There are nine consented discharges to the Oxford Canal (Appendix IV), two of which have significant impact on water quality. These are the cooling water discharges from Alcan Industries at Banbury (SP 459 425) and the discharge from Kidlington Sewage Treatment Works (S.T.W.) (SP 491 124). Details of consents of these two sources are given in Appendix V.

The total volume of effluent consented for discharge to the Oxford Canal is 17,432m^3/day, which represents 93.2% of the total dry weather flow (d.w.f.).

2.4.3. Pollution Incidents

A summary of the pollution incidents reported for the Oxford Canal and tributaries during the years June 1987 - July 1990 is presented below:

YEAR	TOTAL REPORTED	CATEGORY						
		Sewage	Chemical	Natural	Oil	General	Agricultural	Unknown
1987	8	2	1	1	2	1	0	1
1988	16	3	2	0	8	2	0	1
1989	32	5	6	3	13	2	1	2
1990	11	3	1	2	3	0	0	2
TOTAL	67	13	10	6	26	5	1	6

Analysis of the pollution incidents investigated, reveals a preponderance of oil (39%) and sewage (21%) related events, reflecting both the influence of urban element of the catchment, and the problems associated with Kidlington S.T.W. Chemical discharges (15%) also make up a significant proportion of the total.

Fish mortalities associated with these incidents are detailed in Section 2.5.2.

2.5. Fishery Information

2.5.1 Fishery Designation

The Oxford Canal is a European Community (E.C.) designated cyprinid fishery between the Summit and Hardwick Lock (13.5km) and Aynho Weir Lock and Shipton Weir Lock (24.0km) under the E.C. directive 78/659/EEC. Further details concerning water quality criteria associated with this classification are presented in Appendix VI.

The NRA, Thames Region, have set internal fish biomass targets with respect to E.C. designated fisheries, viz. - Cyprinid - 20 g/m^2
Salmonid - 15 g/m^2

They have also developed a site code classification system based on the River Quality Objective and E.C. designation. Details of this are given in Appendix III.

2.5.2 Fish Mortalities

During the period 1984-1989, there have been numerous reports of dead fish in the Oxford Canal. Details of confirmed fish mortalities are given below.

Fish Mortalities on the South Oxford Canal 01/01/85 - 01/06/90

Date	Site	Species	Number	Size Range (cm)	Total Weight (kg)	Cause
7/7/86	Upper Heyford	Carp	20	20-30	20	Unknown
6/6/87	Duke's Lock Area	Mixed Coarse	400+	10-40	50	Unknown
7/7/87	Duke's Lock Area	Carp	10	10-20	3	Unknown
31/7/87	Adjacent to Alcan Works, Banbury	Carp	25	10-20	6	Unknown
23/9/87	Downstream Kidlington STW	Mixed Coarse	12	15	1	Kidlington STW
7/12/87	Kidlington STW downstream to Thames	Mixed Coarse	10,000	10-40	1250	Kidlington STW
7/7/89	Aynho	Carp	10	35	12	Unknown
25/5/89	Adjacent to Lucy's Foundry Jericho	Mixed Coarse	200	10-35	10	Storm discharge from unattributed source
9/7/89	Duke's Lock Area	Mixed	2000	5-60	350	Storm discharge from unattributed source

The main incident during this period was associated with discharges of poor quality effluent from Kidlington S.T.W. (C.F. 2.4. Water Quality).

Prompt deployment of instream aeration equipment by the then Thames Water staff, prevented the pollution of 25/5/89 from becoming a major mortality.

2.5.3 Fisheries Management Work

Prior to this survey, no quantitive stock assessment had been carried out on the Oxford Canal by Thames Water/NRA fisheries staff. Qualitative examination of stocks in the Somerton area were undertaken in 1982/3, which showed a typically clumped distribution of fish, especially carp.

Of more significance is a report on the ecology of the Oxford Canal South, prepared by Edwards, Hanbury and Burt (1987), which presents data gathered during a British Waterways Board survey during 1983/84.

The fish stocks of the whole Oxford Canal were assessed by electrofishing. Biomass figures, species richness and distribution of selected species were presented for the various reaches of the Canal. Graphical representation of these results are presented in Appendix VII.

During the period 31/12/84-31/12/89, a total of 19,693 fish, weighing 1683kg was stocked to the Oxford Canal, at a variety of locations, by Thames Water/NRA fisheries staff. This restocking was in response to the extensive fish mortalities which had occurred in the canal

A full list of all stocking carried out during this period is presented in Appendix VIII.

2.5.4 Angling Interests

Angling on the Oxford Canal is controlled by British Waterways, either under direct management, or via leasing agreements with angling societies.

The canal is a popular venue, with many large matches held on it, especially during the autumn period.

3. 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 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 Aim of Survey

i) To evaluate the status of the fish population in the canal reaches receiving discharges from Kidlington S.T.W. and Alcan Industries.

ii) To monitor any changes in the fish population since the British Waterways fish survey during 1983/84.

iii) To provide baseline data on fish populations prior to the KEYCHANGE programme of improvements by Thames Water Utilities, at Kidligton S.T.W.

3.3 River Classification

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

Under the European Community Directive (78/659/EEC), some river and canal reaches are designated as capable of supporting either salmonid or cyprinid fish. (Further details of the N.W.C. classification and the E.C. directive appear in the appendices).

The N.R.A. Thames Region have developed a site code classification system based upon the R.Q.O.s and the E.C. directive. (Appendix vii).

Fish biomass targets apply within the N.R.A. Thames Region with respect to E.C. designated fisheries, viz-

Cyprinid - 20g/sqm
Salmonid - 15g/sqm

Methods

4.1 Site Selection

Sites were selected to represent local environmental conditions within the defined water quality zones, taking into account bed topography, known water quality impacts and access considerations.

4.2 Capture and Data Acquisition

Catch depletion electrofishing techniques using pulsed D.C. equipment were employed at each site and operated within enclosed sections of approximately 250m in length. Two or more runs were fished at each site depending on the catch efficiency.

All fish captured were enumerated by species. Fork length was measured to the nearest mm. A subsample of up to 40 fish of each species at each site was weighed to the nearest gram. Scale samples from the shoulder of up to three fish from each 1cm size class were taken for age estimation. Minor species such as stoneloach (Neomacheilus barbatulus), minnow (Phoxinus phoxinus) and bullhead (Cottus gobio) were noted for relative abundance.

Other relevant site details were taken and appear in the site reports.

All data acquired in the field was entered into a Huskey Hunter data logger. This was later down-loaded to a personal computer. Single electrofishing runs were made immediately upstream of the site (where practicable), with the aim of assessing the validity of results obtained in the survey site.

4.3 Data Analysis

The data was processed on the computer using the Fisheries Information System (FINS) software package. Graphics were generated using Freelance Plus V.3.0.

Age analysis was carried out using the following notation; fish in year class 1 are between one and two years old, fish in year class 2 are between two and three years old, etc. The assumed birthdate varies according to species.

4.4 Health Examination

No fish were examined from the Oxford Canal for health status.

4.5 Macroinvertebrates

N.R.A. biological staff are engaged upon a biological monitoring programme of the main watercourses in the region. Macroinvertebrate data from this source is presented in this report. Invertebrate samples tend to reflect the physico-chemical variations which occur in the river and this provides a means of monitoring the aquatic environment on a continuous basis.

The results were evaluated using the Biological Monitoring Working Party (BMWP) scoring system. Results obtained were compared to scores predicted

for the site if it were unpolluted.

4.6 Water Quality

Discharge consent standards are set with reference to the R.Q.O. and the total load of pollutants.

N.R.A. pollution inspectors take routine samples, from consented discharges to monitor compliance with consent conditions, and from river points to assess that the R.Q.O. is being met. River and discharge samples are also taken following reports of pollution.

The samples are analysed for a variety of parameters depending on the source of the sample. The three main parameters are Biological Oxygen Demand (B.O.D.), Ammonia and suspended solids. Routine sample results are held on a register available for public inspection, at King's Meadow House, Reading.

4.7 Hydrology

Data was obtained from the engineering department of British Waterways. Flow rates were calculated using known discharges from feeder reservoirs, and number of lockings recorded.

5. Results

5.1 Site Results

SITE REPORT

WATERCOURSE: Oxford Canal.

SITE NAME: Wolvercote Lock.

SITE CODE: OX01.

LOCATION: Immediately downsteam of Wolvercote Lock.

N.G.R.: SP493009.

DATE FISHED: 8th August 1989.

METHOD: Upstream electrofishing,using Severn-Trent's "boom" boat.

R.Q.O.: 2A E.E.C. TARGET BIOMASS: N/A.

HABITAT FEATURES

LENGTH: 268m MEAN WIDTH (RANGE): 11.5(11-12)m AREA: 3082 sqm

MEAN DEPTH (RANGE): 1.3m(1-1.5)m

WATER TEMPERATURE: 20 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 50 MUD & SILT: 50 GRAVEL:0 STONE: 0 BOULDER:0

VEGETATION(% COVER).
SUBMERGED: 10 FLOATING: 2 EMERGENT:20
SHADE: 0

DOMINANT PLANT SPECIES(AQUATIC): Myriophyllum.

DOMINANT PLANT SPECIES(BANKSIDE): None dominant.Cover very sparse.

WATER LEVEL: Summer low.

WATER CLARITY: Moderate.

PHYSICAL STRUCTURE OF SITE: A typical piece of canal,with the associated lack of feature.
ADJACENT LAND USE: L.B.Rough pasture.
R.B.Towpath.

RIPARIAN OWNERS: L.B. British Waterways.
R.B. British Waterways

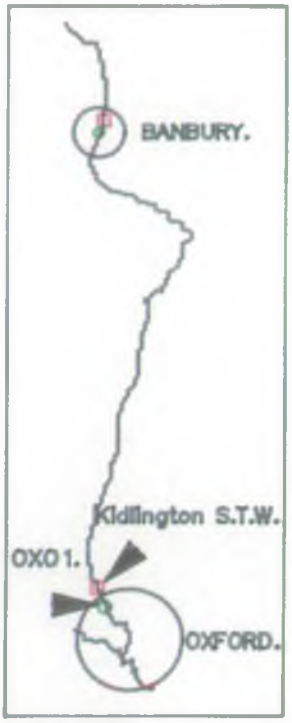
FISHING RIGHTS: L.B. As above.
R.B. As above.

COMMENTS: A two catch electrofishing depletion was made in the survey section,in order to assess catch efficiency.A further single electrofishing run was then made upstream of Wolvercote Lock,for a distance of 1500m.This produced a total catch of 12.25kg,a biomass of 0.7 g/sq.m.

The massive difference in biomass obtained upstream and downstream of Wolvercote Lock was almost certainly due to the pollution which occurred in the canal on the 9th and 10th July 1989.

Fig 5.1.1. Downstream Wolvercote Lock.(OX01)

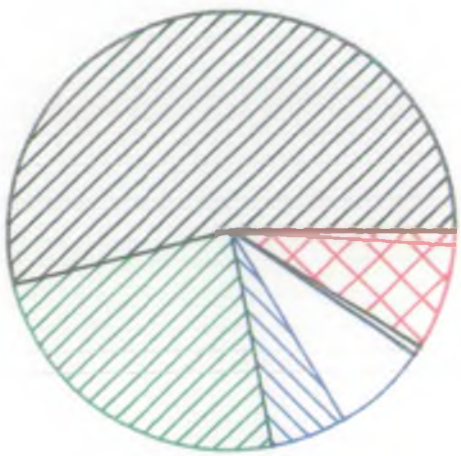
Biomass and Density.



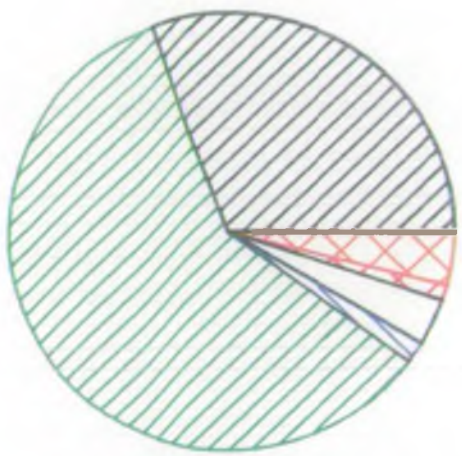
KEY.

- CONSENTED DISCHARGE.
- SURVEY SITE.

	Biomass (gm-2)	Density (nm-2)
Bream.	16.4	0.080
Roach.	7.3	0.153
Chub.	1.7	0.004
Carp.	2.1	0.000
Perch.	0.2	0.009
Pike.	2.4	0.003
Others.	0.3	0.010
Total.	30.4	0.260



Biomass



Density

Fig.5.1.2.Downstream Wolvercote Lock(OX01)

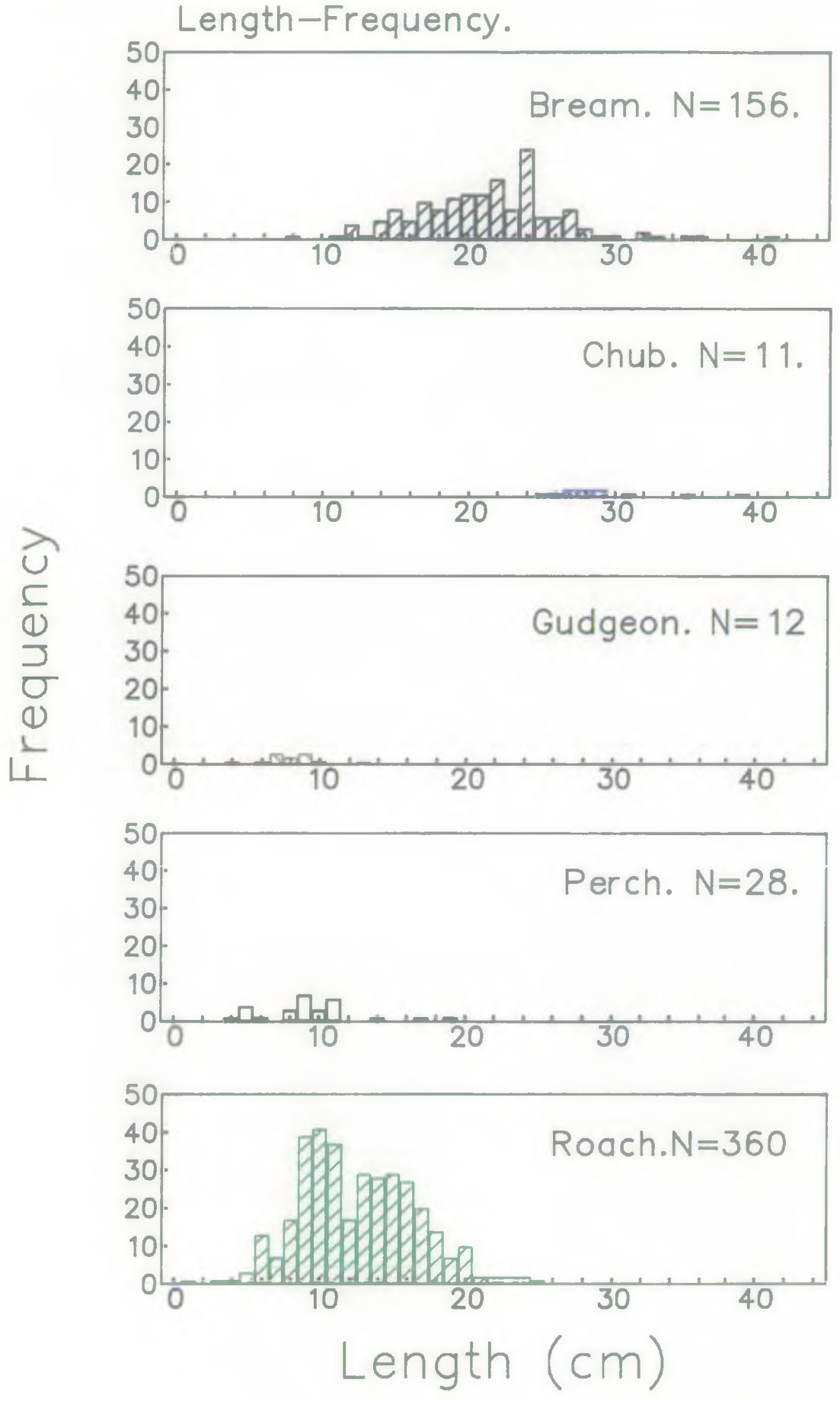
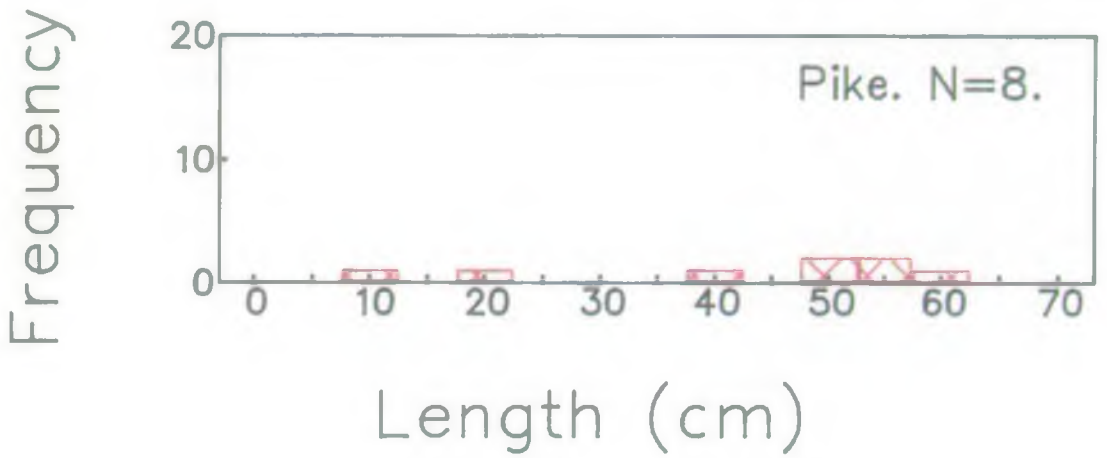


Fig.5.1.3.Downstream Wolvercote Lock.(OX01).

Length-Frequency(2).



SITE REPORT

WATERCOURSE: Oxford Canal.

SITE NAME: Alcan Works.

SITE CODE: OXO2.

LOCATION: Immediately downstream of the Alcan Works outfall.

N.G.R.: SP 455423.

DATE FISHED: 11th January 1990.

METHOD: Upstream electrofishing from 2 boats,using 4 anodes.

R.Q.O.: 2A. E.E.C. TARGET BIOMASS: N/A.

HABITAT FEATURES

LENGTH: 232. MEAN WIDTH (RANGE): 11.7m(10-13)

AREA: 2714.4 sqm MEAN DEPTH (RANGE): 1.0(0.5-1.5)

WATER TEMPERATURE: 16 degrees C

SUBSTRATE COMPOSITION (%)

BARE: 500 MUD & SILT: 50 GRAVEL: 0 STONE: 0 BOULDER: 0

VEGETATION (% COVER)

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

DOMINANT PLANT SPECIES(AQUATIC): Sparganium erectum

DOMINANT PLANT SPECIES(BANKSIDE): None dominant.

WATER LEVEL: Normal winter. WATER CLARITY: poor.

PHYSICAL STRUCTURE OF SITE: A straightish site,with only one sweeping bend throughout its length.Bed and bank profiles were typically uniform,whilst the substrate was poor,being dominated by puddled clay and silt.Little instream or marginal vegetation was present.The site finished adjacent to the Alcan outfall.

ADJACENT LAND USE L.B. Permanent pasture.
" " " R.B. Industrial site.

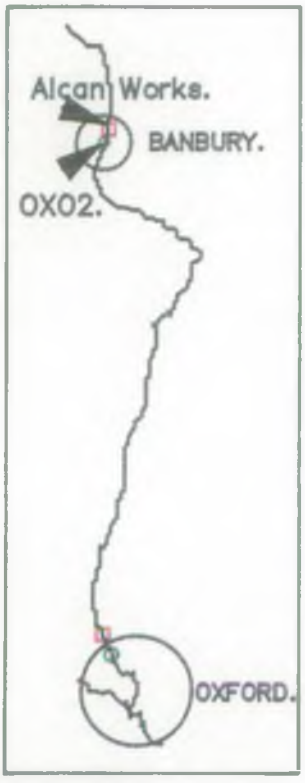
RIPARIAN OWNERS: L.B. British Waterways.
" " R.B. British Waterways.

FISHING RIGHTS: L.B. Banbury and District A.A.
" " R.B. British Waterways.

COMMENTS: The site was still receiving oily effluent from Alcan outfall on the day of the survey.A creamy scum was present over much of the margin of the site.Thermal effects of the discharge were apparent in the unusually high(16 degrees C)water temperature.
The external condition of the fish was noticably poor,with many having severe lesions,coupled with split and eroded fins.
A single electrofishing run upstream of Hardwick Lock,produced a biomass of 7g/sq.m.,dominated by chub.The canal above Hardwick Lock is an E.E.C designated fishery,with an N.R.A target biomass of 20g/sq.m.

Fig.5.1.4.Downstream Alcan Industries.(OX02)

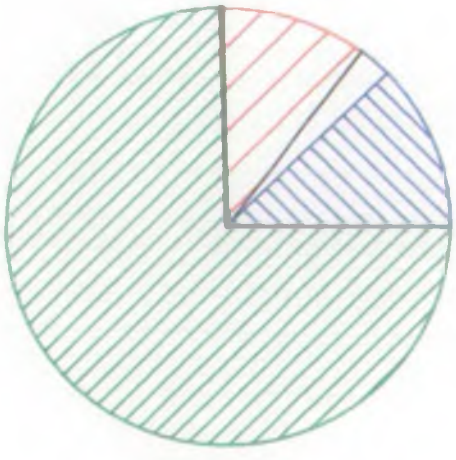
Biomass and Density.



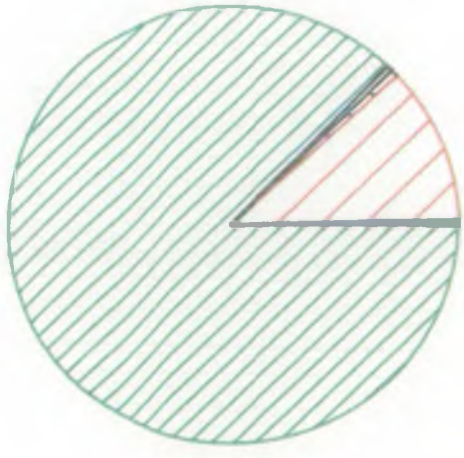
KEY.

□ CONSENTED DISCHARGE.
○ SURVEY SITE.

	Biomass (gm-2)	Density (nm-2)
CHUB	1.1	0.001
CRUCIAN CARP	0.2	0.000
DACE	1.0	0.027
GUDGEON	0.0	0.001
PERCH	0.0	0.001
ROACH	6.8	0.203
TOTAL	9.2	0.233



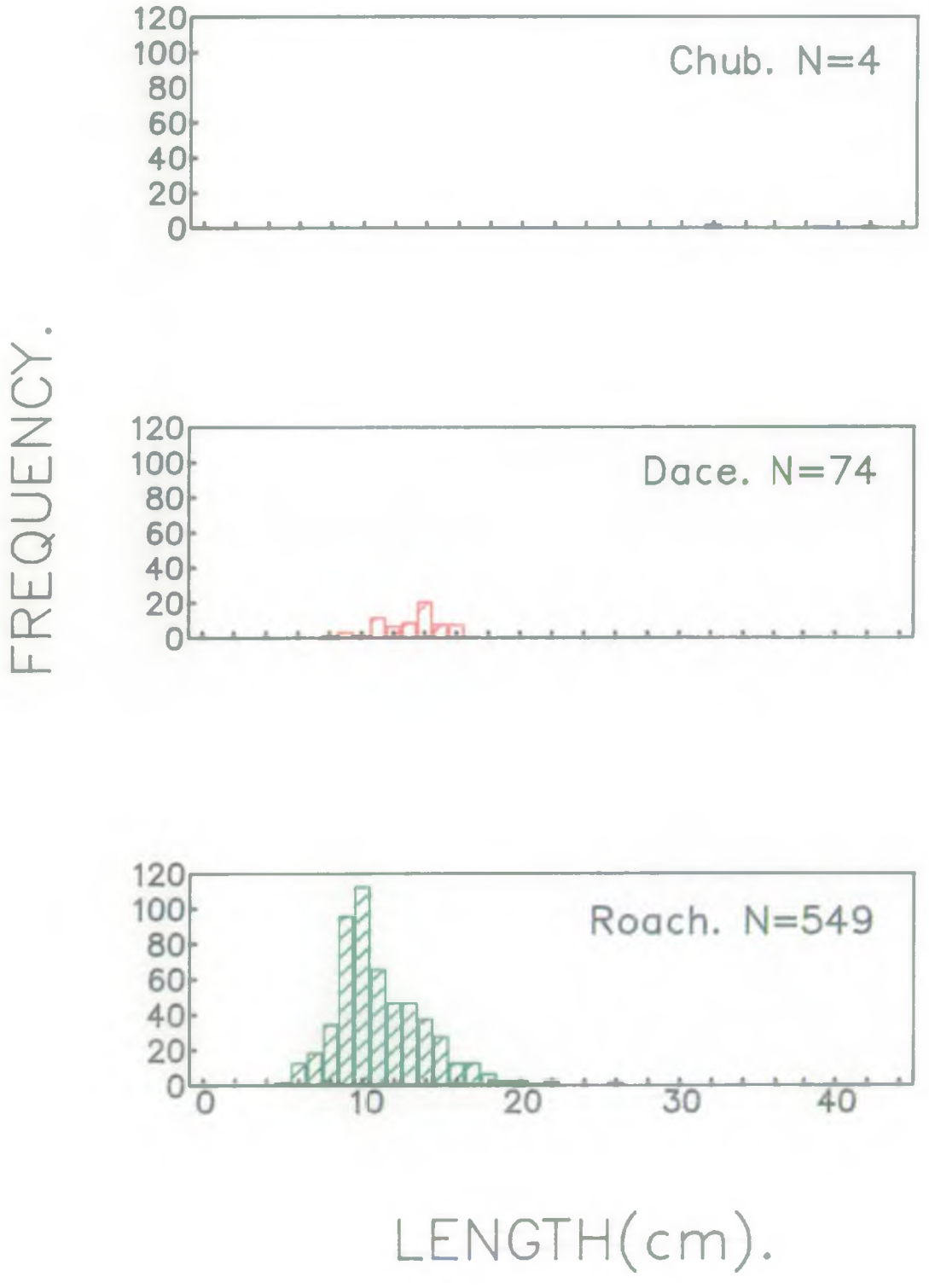
Biomass



Density

Fig.5.1.5.Downstream Alcan Industries.(OX02).

Length-Frequency.



5.2 Survey Results

5.2.1 Biomass

A schematic summary of biomass and species composition at both sites is presented in 5.2.1.

5.2.2 Age and Growth

A sample sufficient to assess age and growth was obtained only from the roach (Rutilus rutilus) population (Fig. 5.2.2.)

5.3 Fish Health

No sample was taken for assessment of fish health as part of this survey.

5.4 Water Quality

5.4.1. River Quality

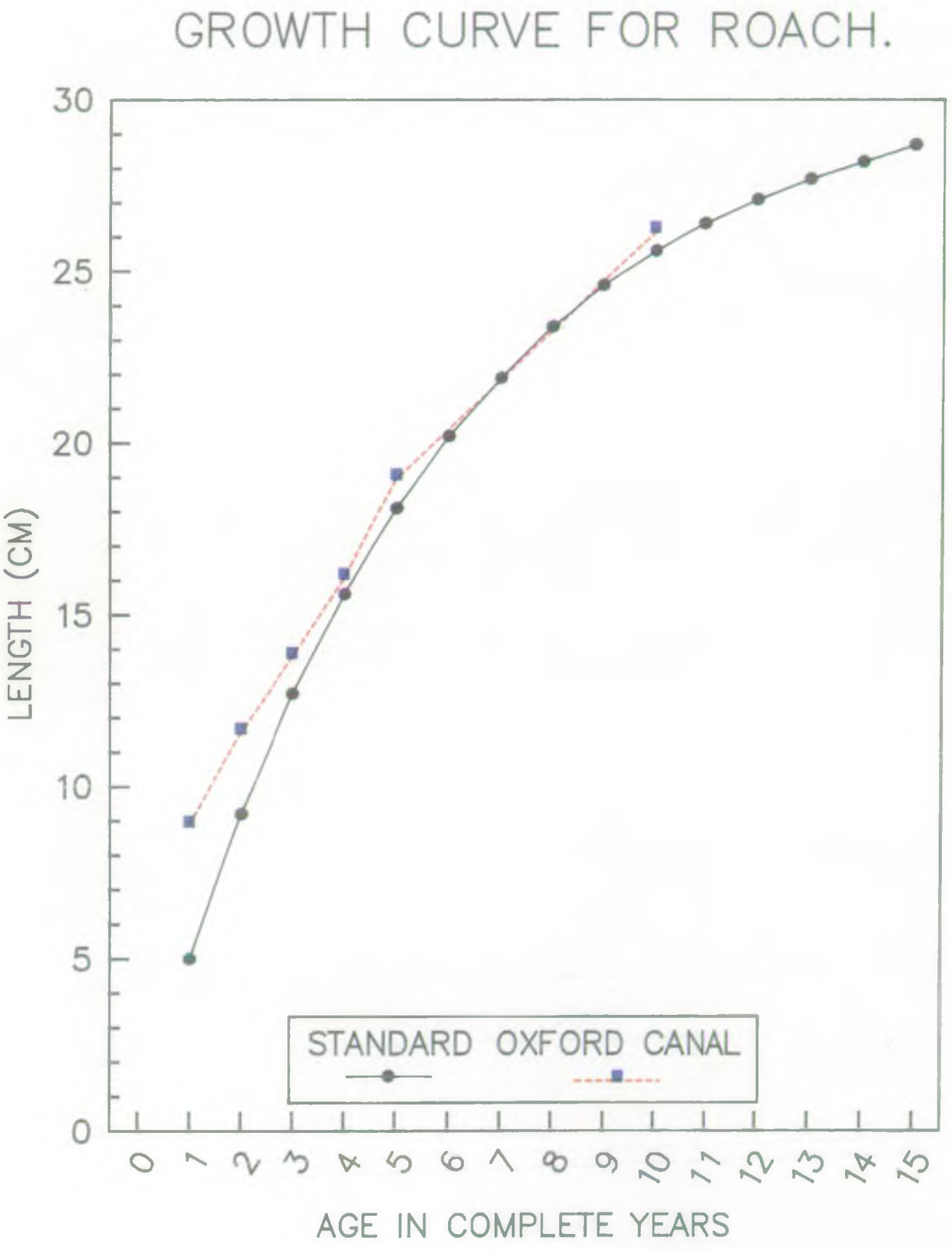
The results of the water quality assessment for the years January 1988 - April 1990 are summarised below.

Sampling Point	Code	R.Q.O.	COMPLIANCE		
			1988	1989	1990
Tunnel/Bridge, Fenny Compton	PCHR.0037	2A	PASS	PASS	PASS
Cropredy Bridge	PCHR.0035	2A	PASS	PASS	PASS
Heyford Bridge	PCHR.0036	2A	PASS	PASS	PASS
1.2km below Kidlington STW	PTHR.0159	2A	FAIL	FAIL	PASS

The results for key parameters/dissolved oxygen, biological oxygen demand, ammoniacal ammonia and un-ionised ammonia during 1989, are shown in Figs. 5.4.1 and 5.4.2.

The results do not present an accurate profile of canal water quality, as continuous water quality monitoring is not undertaken. However, they do give a general picture of parameter levels in relation to R.Q.O. criteria.

Fig.5.2.2


GROWTH CURVE FOR ROACH.
LENGTH (CM)
30
25
20
15
10
5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
AGE IN COMPLETE YEARS
STANDARD OXFORD CANAL

5.4.2 Consented discharge quality

Compliance with consent standards are presented below.

a) Alcan Industries, Banbury

	CONSENT COMPLIANCE		
Year	Suspended Solids	B.O.D.	Oil & Grease
1988	FAIL	FAIL	FAIL
1989	FAIL	FAIL	NO ANALYSIS AVAILABLE
To June 1990	FAIL	FAIL	FAIL

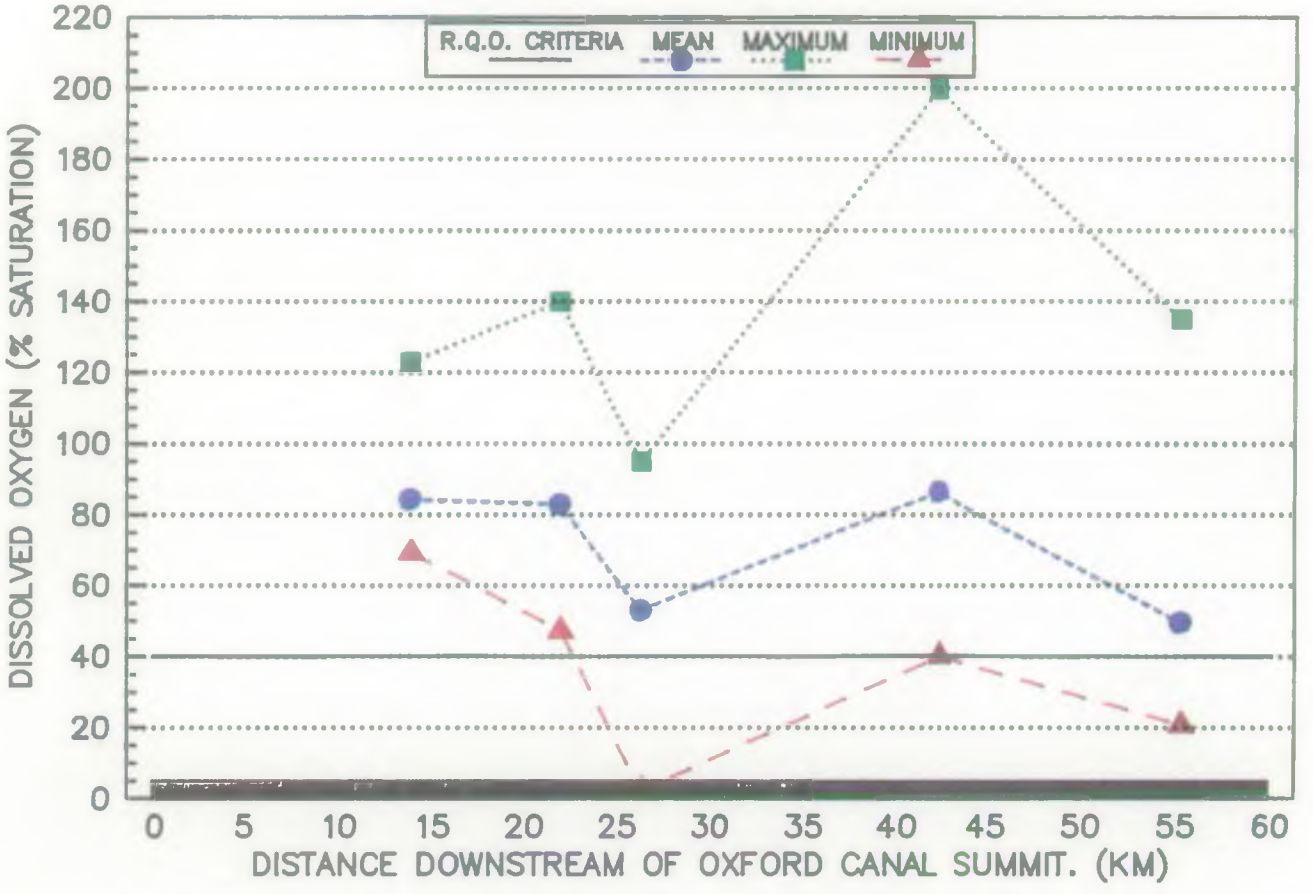
b) Kidlington Sewage Treatment Works

	CONSENT COMPLIANCE		
Year	Suspended Solids	B.O.D.	Ammoniacal Nitrogen
1988	FAIL	FAIL	PASS
1989	PASS	PASS	PASS
To June 1990	PASS	PASS	PASS

Full results of samples taken of these discharges are held on a public register, which may be viewed by the public during normal office hours, at King's Meadow House, King's Meadow Road, Reading.

Fig 5.4.1

DISSOLVED OXYGEN/B.O.D PROFILE.



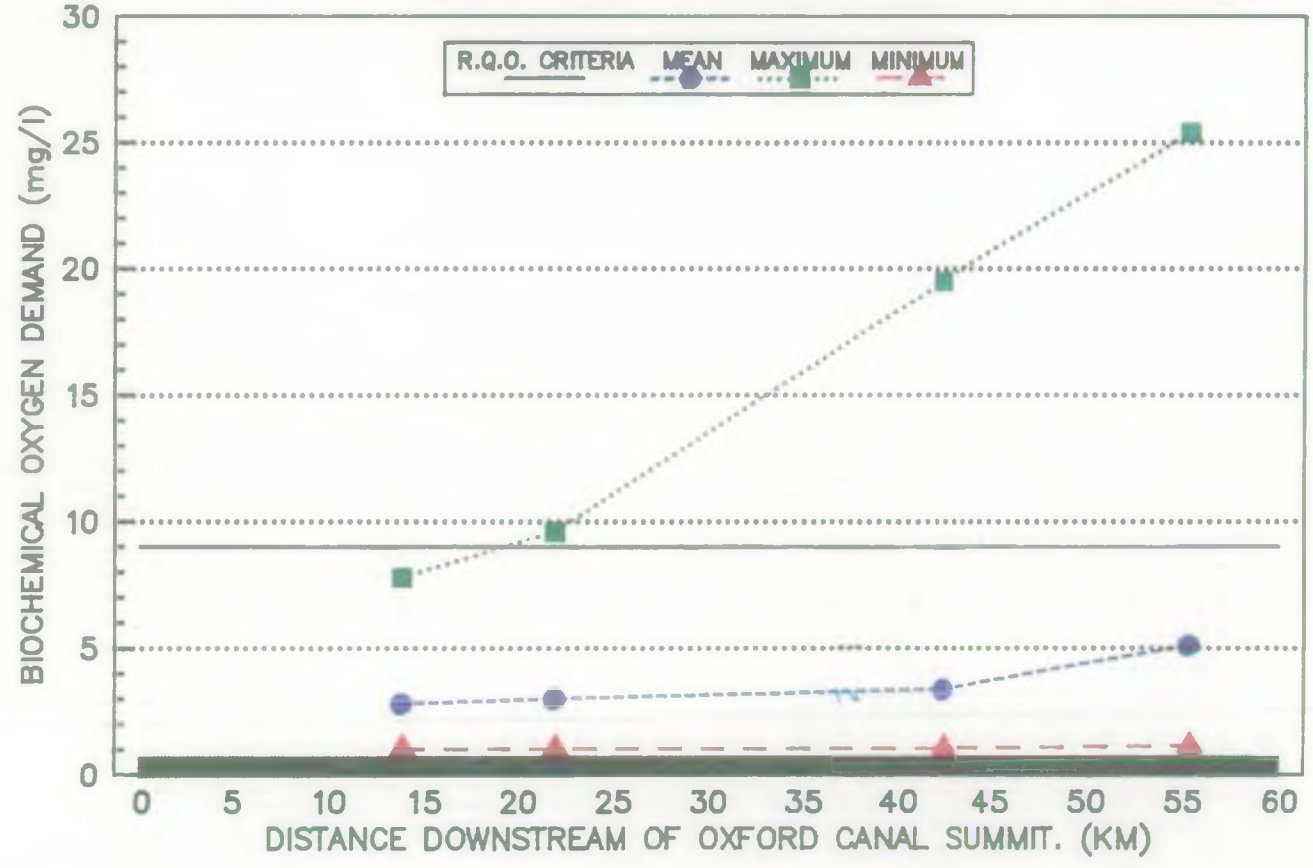
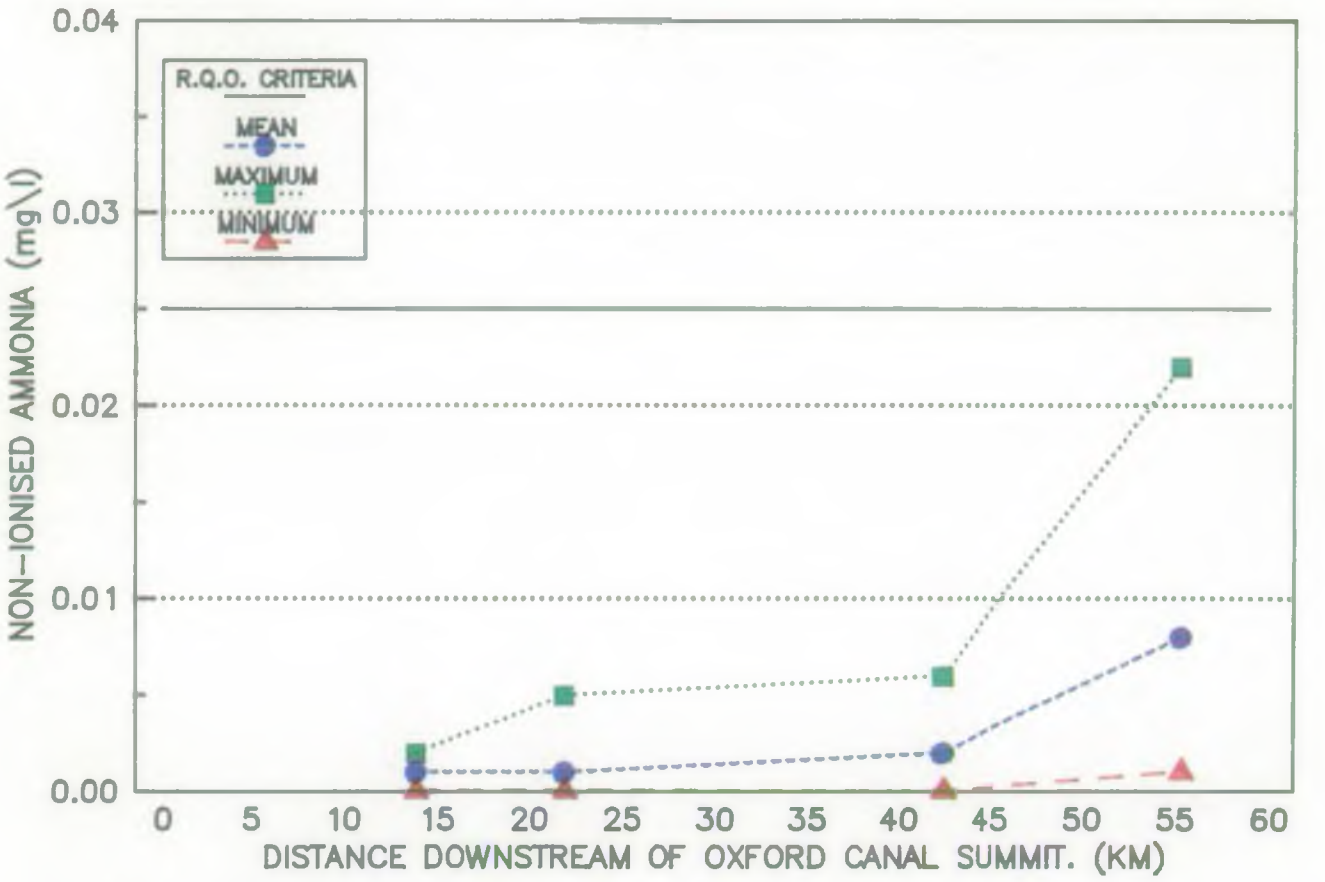
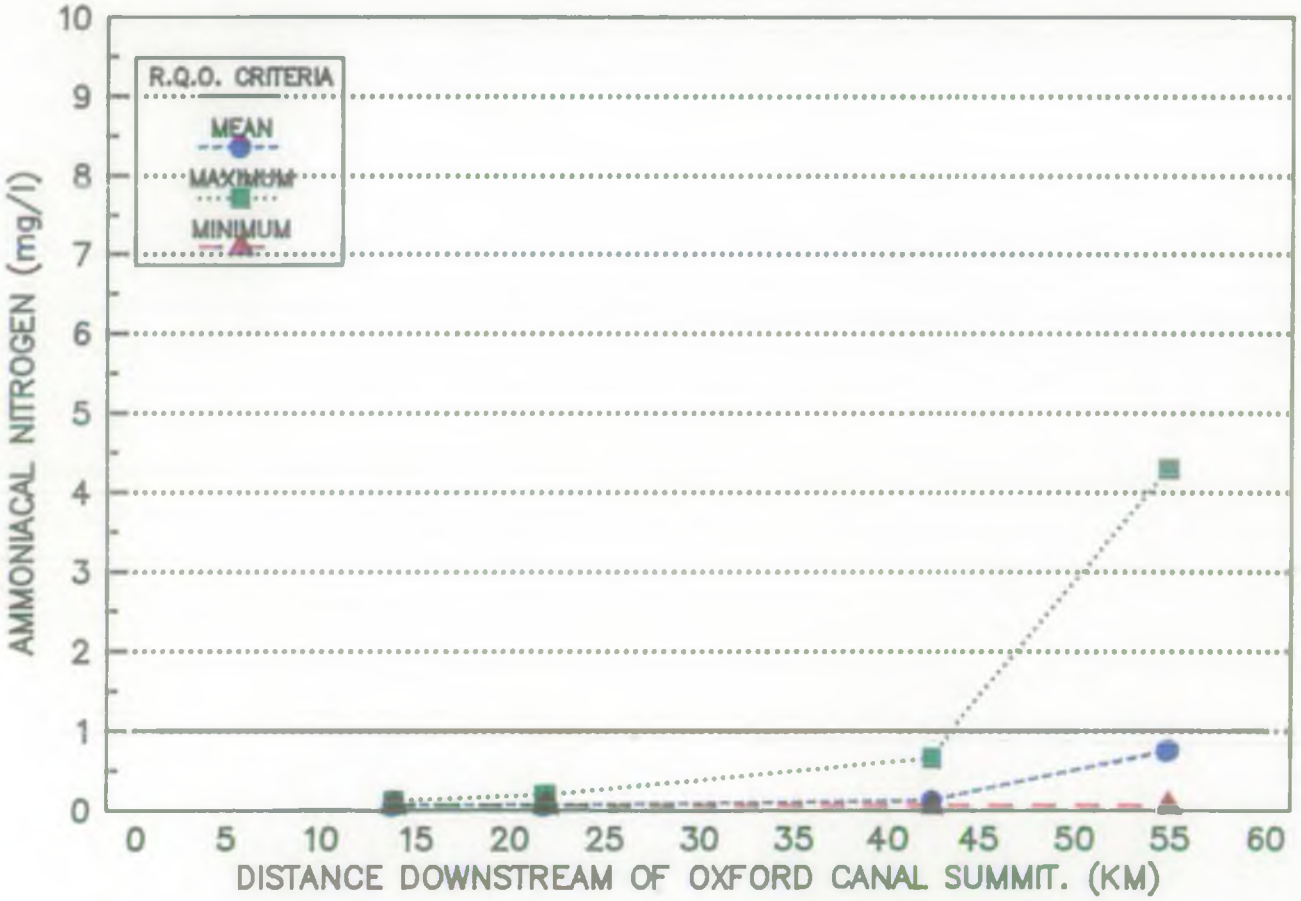


Fig 5.4.2.

UN-IONISED AMMONIA & AMMONIACAL NITROGEN PROFILES.





5.5. Macroinvertebrate Monitoring

Results of macroinvertebrate monitoring for 1990 are presented below.

Results for OXFORD CANAL (UPPER SECTION)

* Non Routine Samples

Sample Number	Sample Date	BMWP Score	Pred BMWP	ASPT	Pred ASPT	Biotic Class	RQO	Chemical Quality
PCHR.0035 At Cropredy Bridge SP46904650								
1900328	16/05/1990	48		4.36		D	2A	
1900527	18/07/1990	87		4.14		C	2A	

Results for OXFORD CANAL (MIDDLE SECTION)

* Non Routine Samples

Sample Number	Sample Date	BMWP Score	Pred BMWP	ASPT	Pred ASPT	Biotic Class	RQO	Chemical Quality
PCHR.0036 At Heyford Bridge SP48302470								
01900329	16/05/1990	92		4.60		C	2A	
01900528	18/07/1990	77		3.85		C	2A	

Results for OXFORD CANAL (LOWER SECTION)

* Non Routine Samples

Sample Number	Sample Date	BMWP Score	Pred BMWP	ASPT	Pred ASPT	Biotic Class	RQO	Chemical Quality
PTHR.0159 1.2km Below Kidlington STW SP48881120								
01900330	16/05/1990	90		4.29		C	2A	
01900529	18/07/1990	55		3.67		C	2A	

6. Discussion

This survey was undertaken largely as a result of two chronic water quality problems in reaches of the South Oxford Canal.

Site OX01 was located downstream of Wolvercote Lock and is not E.E.C. designated. It produced an excellent biomass of 30.4g/m^2. By weight, over 50% of this total (16.4g/m^2) comprised bream, with roach the most abundant species (0/153n/m^2). British Waterways' report "The Ecology of the Oxford Canal (South), 1987, [1]" showed a biomass of approximately 26g/m^2 for this reach, and 35g/m^2 for the kilometre upstream (Appendix VIII). However, one notable difference was the species composition found by the British Waterways survey, with more than 60% of the total biomass being made up of roach, with less than 2% being bream. Results of the NRA survey were almost certainly a reflection of the heavy stocking of bream carried out in October 1988, by Thames Water fisheries department in the pound affected by the Kidlington STW discharge. A longer single electrofishing run upstream of Wolvercote Lock, over a length of 1500m, resulted in a biomass of only 0.7g/m^2.

These results are consistent with the pollution profile experienced during the last major incident during July 1989. Dead fish were found mainly in the pound between Kidlington STW outfall and Wolvercote Lock. Aeration took place at the overspill from Wolvercote Lock, resulting in very few dead fish below this point. Routine water quality assessment confirms that at sampling point PTHR.0159 (1.2km below Kidlington STW) the canal failed to comply with its RQO of 2A during both 1988 and 1989, due to low dissolved oxygen (D.O.) and ammoniacal nitrogen levels. A series of intensive D.O. monitoring exercises carried out by the pollution control department of the NRA showed conclusively that the trough of the D.O. sag occurred at the A34 crossing (SP490115) with D.O. readings here regularly below 20% during the summer (temperature approximately 20°C).

Biological monitoring has been infrequent. Data available for PTHR.0159 for 1990 indicates a Biological Monitoring Working Party (BMWP) score of 90 (16/5/90) and 55 (18/7/90), placing the site within Biotic Class C. This result is similar to those found at sites on the Upper and Middle reaches of the Canal, and equates to chemical classification of less than 2B, with a preponderance of pollution tolerant species. Throughout the period 1988 - June 1990, Kidlington STW achieved overall consent compliance, apart from the parameters of suspended solids and biological oxygen demand (BOD) during 1988. However, during 1988-1990, individual samples failed to meet the standard for individual parameters. During summer/autumn 1990, Thames Water Utilities are undertaking upgrading of Kidlington STW as part of their KEYCHANGE programme. However, the long term viability of the Kidlington STW to Wolvercote Lock stretch, as a fishery is in doubt. The consistently low summer D.O.'s coupled with episodic pollution incidents have resulted in five confirmed mortalities in this reach in the last three years; the number of fish stocked, and frequency of stocking bear stark testimony to these continued problems. If water quality in the Kidlington reach eventually improves, a major restocking exercise will be undertaken to enhance the low fish stocks.

The second site OX02, was immediately below the cooling water outfall from Alcan Industries, downstream of Hardwick Lock, Banbury. Again, this site is not an E.E.C. designated fishery reach. Electrofishing produced a biomass of 9.2g/m^2 with roach (6.8g/m^2, 0.203n/m^2) making up the bulk of the catch by weight and number. A single electrofishing run upstream of Hardwick Lock, in an E.E.C. designated cyprinid fishery reach, produced a

biomass of $7g/m^2$, dominated by chub. British Waterways survey, 1987, gave an estimated biomass for the canal around Alcan outfall of approximately $5g/m^2$, with roach again the dominant species. Recruitment of roach at OXM2 appeared good, with a predominance of small fish.

Numerous complaints were received from members of the public during 1989 and 1990 regarding dead and dying fish in the pound downstream of Hardwick Lock. Despite numerous visits by NRA staff, few of the reported mortalities were confirmed.

The quality of the cooling water discharge from Alcan Industries was found to be consistently poor, failing its consent on suspended solids, B.O.D, and oil and grease parameters, during the period 1988 - June 1990 (with the exception of oil and grease in 1989 when no analysis was available). In addition, the temperature of the discharge exceeded its consent of $28^{o}C$, reaching a peak of $31^{o}C$; above the lethal temperature for roach, perch and tench (Alabaster & Lloyd 1980)[4]. A series of dissolved oxygen (D.O.) surveys was undertaken between 18th September 1989 and 28th February 1990. These revealed depressed D.O. levels in the vicinity of Hardwick Lock with the position of the oxygen sag varying (Appendix IX). Lowest recorded oxygen reading was 2%, immediately below the survey section on 27th October, 1989. These problems culminated in the NRA prosecuting Alcan Industries at Banbury Magistrates Court on 25th May 1990, under Section 107(i)(c)(i) of the Water Act 1989. Alcan were found guilty and fined £1000 with £170 costs.

Following this conviction, NRA arranged for a series of seven samples to be taken of the Alcan discharge, between 27th June 1990, and 3rd September 1990. Of these, four sample results have now been obtained; all failed to comply with consent conditions. Since this time some improvements have been made at the Alcan Industries site. Pollution Control staff are monitoring the situation.

The effect of Alcan's effluent on the canal's fish population is hard to assess. Despite numerous claims of fish mortalities in the area, few dead fish were seen by NRA officers. The possibility of large scale losses cannot be ruled out.

There is circumstantial evidence that thermal pollution from the effluent may affect distribution of the fish stocks. During the winter months, shoals of carp accumulate in this reach, with the warm water possibly enabling winter growth to occur at an enhanced rate. However, during the summer, periods of high temperature may act as a deterrent to fish in the vicinity of the outfall.

Habitat assessment at both sites was difficult. The canal has a generally uniform cross-section and depth, with a clay-puddled bottom, overlain with silt. Its ecology is dominated by the heavy boat traffic; physical disturbance associated with this results in very turbid water, with a high loading of suspended solids. One effect of this is to limit submerged macrophyte growth severely . Murphy + Eaton (1983)[2] state that traffic in the range 1000-2000 movements/year is enough to suppress macrophyte abundance sufficiently to arrest vegetation encroachment; the Oxford Canal boat traffic exceeds this figure. Bank erosion is another result of heavy boat traffic. Subsequent sheet/concrete piling reduced the opportunity for the establishment of marginal plant communities with consequent reductions in habitat quality for fish.

Qualitative surveys carried out in the past showed a markedly clumped fish distribution in relation to overhanging cover. As the proportion of

bushes and trees increased, so to did the number of fish found, especially chub and carp. Both OX01 and OX02 had some overhanging cover, but were generally rather open sections. Bankside management by British Waterways has, in the past, been to the detriment of this important cover.

Growth rate of roach was assessed over both sites combined from scale samples. The growth curve (Fig. 5.2.2.) compared favourably with the Hickley & Dexter standard, especially in year classes 0-6, where the canal roach appeared to have an enhanced growth rate.

Conclusions

1. Sections of the South Oxford Canal are adversely affected by discharges from two point sources, Kidlington STW and Alcan Industries, Banbury. Both are consented discharges.

2. The fish population in the reach from Green Lock, Kidlington to Wolvercote Lock has been severely reduced by pollution. Below Wolvercote Lock, the canal supports a biomass of 30.4g/m^2, an excellent figure. With the current effluent loading from Kidlington STW, coupled with unattributable episodic pollution incidents, the reach above Wolvercote Lock cannot support a viable fishery.

3. Alcan Industry's consented discharge into the Oxford Canal at Banbury has a significant effect on the canal's ecology. However, it is impossible to attribute any significant fish mortalities to this source. There is no doubt that levels of dissolved oxygen recorded in the reach below the works, would at times have been insufficient to support fish life. In addition, thermal warming caused by effluent as hot as 31^{o}C may produce localised temperatures above the lethal limit for some species.

The biomass present at OX02 (9.2g/m^2) is not markedly different from that found in this section of the canal by the British Waterways survey in 1987. The possibility of large scale movements of fish stocks below Hardwick Lock in response to dissolved oxygen levels and temperature cannot be ruled out.

4. Both Alcan Industries and Kidlington STW have failed their consent conditions during the past three years. Other, unattributable polluting discharges have also entered the reaches below Green Lock, Kidlington and Hardwick Lock, Banbury, during this period.

Both pounds have, on occasion, failed to reach the required water quality for a 2A R.Q.O.

8. Recommendations

1. From a fisheries standpoint, a review of water quality in these reaches and an assessment of effluent input should take place as a matter of urgency.

2. The possibility of diverting discharges away from the canal should be investigated. Even with tight consent conditions, dilution in the canal is probably insufficient to deal with large volumes of effluent, and ensure compliance with an R.Q.O. of 2A.

3. Once water quality in the reaches below the two discharges improves, restocking should be carried out.

4. Further fisheries survey work should be carried out to assess stock levels in the remainder of the South Oxford Canal.

5. British Waterways should be encouraged to enhance fish habitat, where practicable. It is accepted that heavy boat traffic precludes major habitat manipulation.

9. References

1. Edwards, C., Hanbury, R. and Burt, A. (1987). The Ecology of the Oxford Canal (South). A British Waterways Report.

2. Murphy, K., and Eaton, J., (1983). Effects of pleasure boat traffic on macrophyte growth in canal. J. Applied Ecol. 20 713-729.

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

4. Alabaster J.S. & Lloyd R, 1980. Water Quality Criteria for Freshwater Fish. Butterworths.

Appendix I

CLAYDON LOCKAGE 1979 TO 1980

4 week periods/ year	79	81	82	83	84	85	86	87	88	89	Average 79-89	Average Flow Ml.
1	0	0	0	0	0	8	32	40	62	0	14.2	1.35
2	0	0	4	0	22	0	8	24	64	4	12.6	1.20
3	17	45	25	0	12	0	65	75	92	64	39.5	3.75
4	130	511	717	674	508	523	217	323	409	553	456.5	43.37
5	528	749	518	827	608	399	341	630	332	531	546.3	51.90
6	690	838	754	976	666	650	660	782	358	740	711.4	67.58
7	592	684	775	918	886	741	766	341	490	678	687.1	65.27
8	868	842	834	947	836	837	952	0	591	598	730.5	69.40
9	4	892	717	860	553	911	934	275	0	421	556.7	52.89
10	147	770	321	880	291	649	774	745	805	324	570.6	54.21
11	194	521	133	429	166	362	488	234	373	265	316.5	30.07
12	18	10	0	0	96	61	115	21	23	0	34.4	3.27
13	28	0	0	0	25	48	49	8	0	0	15.8	1.50

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, 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 criteria:

1. EEC Designated Watercourses

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

2. 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 RAJ1 - RA=Ray, J=2 cyprinid, 1=individual site.

Appendix IV

CONSENTED DISCHARGES TO OXFORD CANAL

	Volume (m^3)	Effluent Type
Claydon Council Housing Site STW: Claydon	16	Treated Sewage
Bignolds Close Housing Site STW: Claydon	23	Treated Sewage
Little Bourton Irrigation Area	75	Treated Sewage
Alcan Industries Cooling Water: Banbury	12273	Cooling Water
Banbury Builders STW: Adderbury	23	Treated Sewage
Heyfordian Travel Ltd. Trade Effluent: Upper Heyford	5	Trade
Shipton on Cherwell Housing Site STW	29	Treated Sewage
Jolly Boatman Inn STW: Thrupp	5	Treated Sewage
Kidlington STW	4983	Treated Sewage

Appendix V

NRA THAMES REGION
WATER ACT - 1989
THE CONTROL OF POLLUTION (REGISTERES) REGULATIONS 1989

CONSENT REGISTER

Consent No. 1428 Application No.

Provisions under which Consent was given RIVERS (P.O.P.O) 1951

Name and Address of Applicant

ALCAN BOOTH EXTRUSIONS LTD., SOUTHAM RD., BANBURY, OXON

Date of grant 11/10/74
Came into force 11/10/74
Review period 2 YEARS

Place

PREMISES, BANBURY, OXON

National Grid Reference SP 4590 4250

Nature & composition of discharge TRADE EFFLUENT
COOLING WATER

To OXFORD CANAL

Conditions All values mg/l unless otherwise stated

TEMPERATURE (deg C)	28
pH MINIMUM	6.5
pH MAXIMUM	8.5
SAMPLING FACILITIES	YES
MEANS OF DISCHARGE	PIPE OUTLET
MAX. VOLUME (m^3/d)	12273.00
NUMBER OF OUTLETS	1

THE DISCHARGE SHALL NOT CONTAIN ANY TRACE OF OIL OR GREASE

Additional Information

BOD IN 5 DAYS AT 20°C NOT TO EXCEED THE INTAKE WATER VALUE.
SUSPENDED SOLIDS NOT TO EXCEED THE INTAKE WATER VALUE.
THE INTAKE VALUE SHALL BE TAKEN TO BE THE RELEVANT VALUE OF THE WATER ABSTRACTED AT THE POINT OF ABSTRACTION SPECIFIED ON LICENCE SERIAL NO. 28/39/14/27 GRANTED UNDER THE WATER RESOURCES ACT, 1963 (VIZ. AT NGR SP46204260) AS DETERMINED BY ANALYSIS TAKEN OF SUCH WATER WITHIN THE PERIOD OF 10 MINUTES TO PRIOR TO THE TIME OF THE DISCHARGE IN QUESTION.
THE OUTLET SHALL CONSIST ONLY OF COOLING WATER.

Date of entry 11/10/74

Particulars of notices served

None

Printed 07/11/89

PROPOSALS IN THE FORM OF A DRAFT NOTICE SET OUT BY THE THAMES WATER AUTHORITY PURSUANT TO ARTICLE 4 OF THE WATER AUTHORITIES (CONTROL OF DISCHARGES) ORDER 1978

RIVERS (PREVENTION OF POLLUTION) ACTS 1951-1961
WATER ACT, 1973
THE WATER AUTHORITIES (CONTROL OF DISCHARGES) ORDER 1979

NOTICE IS HEREBY GIVEN that the conditions of consent No. 607 granted to Ploughley Rural District Council by the Conservators of the River Thames on 8th April 1963 and which apply now to a dischrge made by the THAMES WATER AUTHORITY as hereby varied as follows:-

Delete condition No.2 thereof viz:-

"The effluent shall conform to the following standard:-
B.O.D. in 5 days at 20°C (68°F) not to exceed 20 mg/l.
Suspended Solids not to exceed 30 mg/l.

Delete Condition No.1 thereof viz:-

"The quantity of effluent discharged shall not exceed 925,000 g.p.d."

and substitute therefore:-

"The effluent discharged shall conform to the following standard:-

(a) Biochemical Oxygen Demand (A.T.U.) in 5 days at 20°C (68°F) not to exceed 35 milligrammes per litre.
(b) Suspended Solids dried at 105°C not to exceed 40 milligrammes per litre.
(c) Ammonia Nitrogen (as N) not to exceed 20 milligrammes per litre."

"The quantity of sewage effluent discharged shall not exceed 12,6000 m^3 per day."

On the eleventh day of September 1980 this draft Notice took effect as a Notice deemed to have been given by the Secretary of State for the Environment in accordance with Article 4(7) of the Water Authorities (Control of Discharges) Order, 1978, varying the conditions of Consent No. 607 accordingly.

Solicitor
Thames Water

c.c. ADM (Scientific Services)

Divisional Manager
Vales Division

Thames Conservancy Divsion

Divisional Manager
Thames Conservancy Division

7th November 1980

Your Ref:
Our Ref: RP/51/367/12/REC/PB

Rivers (Prevention of Pollution) Acts 1951-1961
The Water Authorities (Control of Dicharges)
Order 1978
Sewage Works at Kidlington, Consent No. 607

With reference to previous correspondence, proposals relating to the above sewage works, set out in the form of a draft variation of the above numbered Consent and forwarded to the Secretary of State for the Environment were deemed to have been granted by the Secretary of State on 11th September 1980 and I now enclose such variation in this matter duly endorsed, for your retention.

You will note the quality of effluent required by the conditions of such variation but, as you will be aware, the target quality for the effluent from these works is:-

(i) Suspended solids dried at 105°C not to exceed 35 milligrammes per litre.

(ii) Biochemical oxygen demand in 5 days at 20°C (nitrification suppressed with allylthiourea) not to exceed 25 milligrammes per litre.

(iii) Ammoniacal Nitrogen content not to exceed 6 milligrammes per litre.

B.J. HARDCASTLE

Enc.

APPENDIX VI E.C. WATER QUALITY CRITERIA FOR FISHERIES

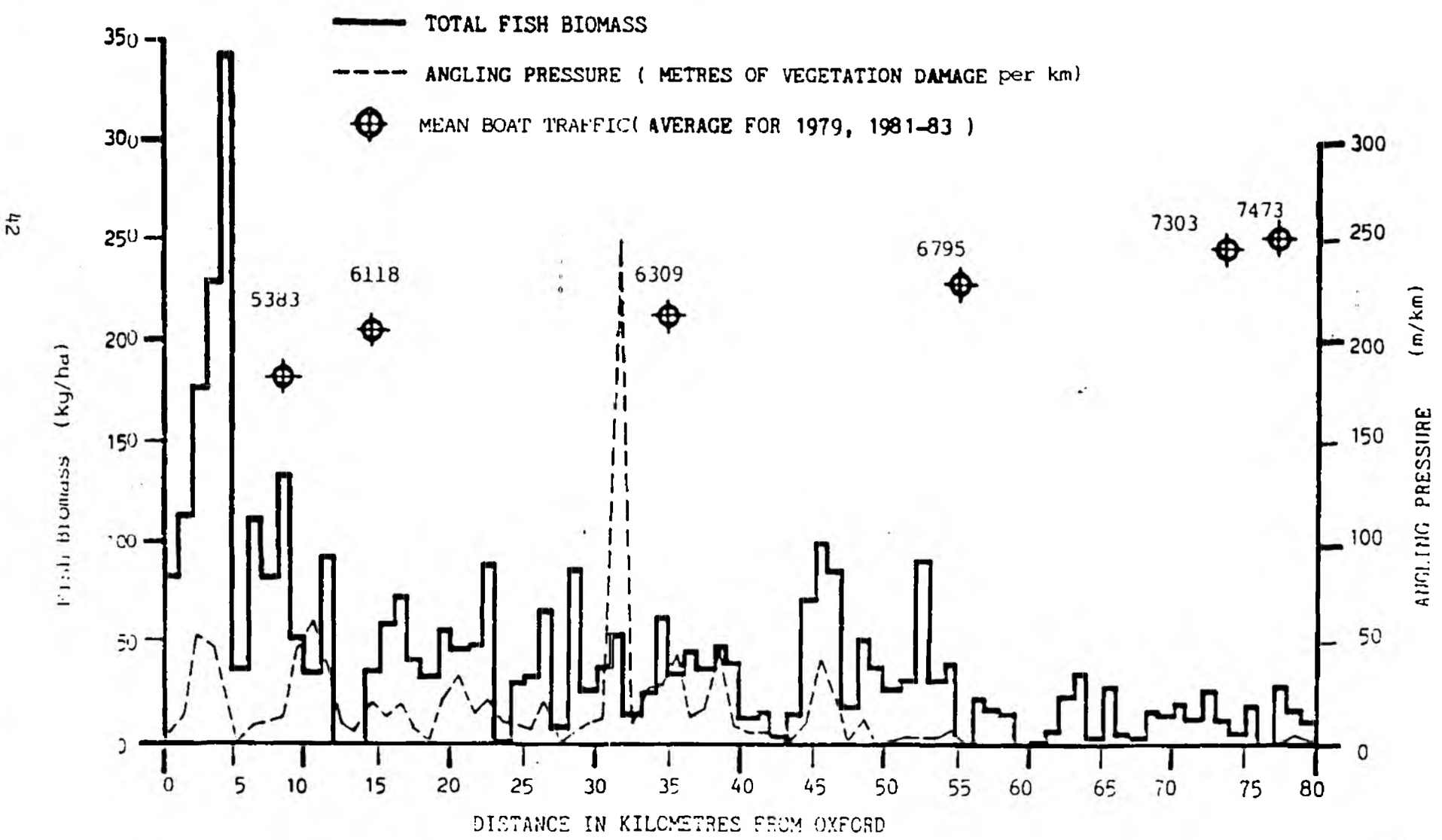
LIST OF DETERMINANDS

Determinand	*Salmonid Waters*		*Cyprinid Waters*	
	G	*I*	*G*	*I*
(a) Temperature (max) (b) Temperature rise		$\leqslant$ 21.5°C $\not>$ 1.5°C		$\leqslant$ 28°C $\not>$ 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 VII

Total fish biomass, angling pressure and boat traffic



Appendix VII

Mean biomass of fish species in different sections and over the canal as a whole.

Region (km)	Roach	Chub	Carp	Gudgeon	Dace	Perch	Bream	Pike	Bleak	Tench	Bullhead	Stoneloach	Total
0-12	65.27	25.94	6.59	5.23	4.7	3.83	3.78	2.05	1.99	0.95	0.006	0.005	120.33 kg.ha^{-1}
14-55	25.54	5.23	6.40	2.94	3.13	0.45	0.53	0.51	0.32	0.05	0.002	0.002	45.11 kg.ha^{-1}
56-80	16.55	-	-	1.76	0.30	0.56	0.01	0.29	-	-	0.02	0.003	19.5 kg.ha^{-1}
0-55	34.25	9.77	6.45	3.44	3.47	1.19	1.24	0.85	0.68	0.24	0.003	0.003	61.60 kg.ha^{-1}
0-80	29.44	7.11	4.70	2.99	2.61	1.02	0.91	0.70	0.50	0.18	0.007	0.003	50.16 kg.ha^{-1}

Appendix VIII

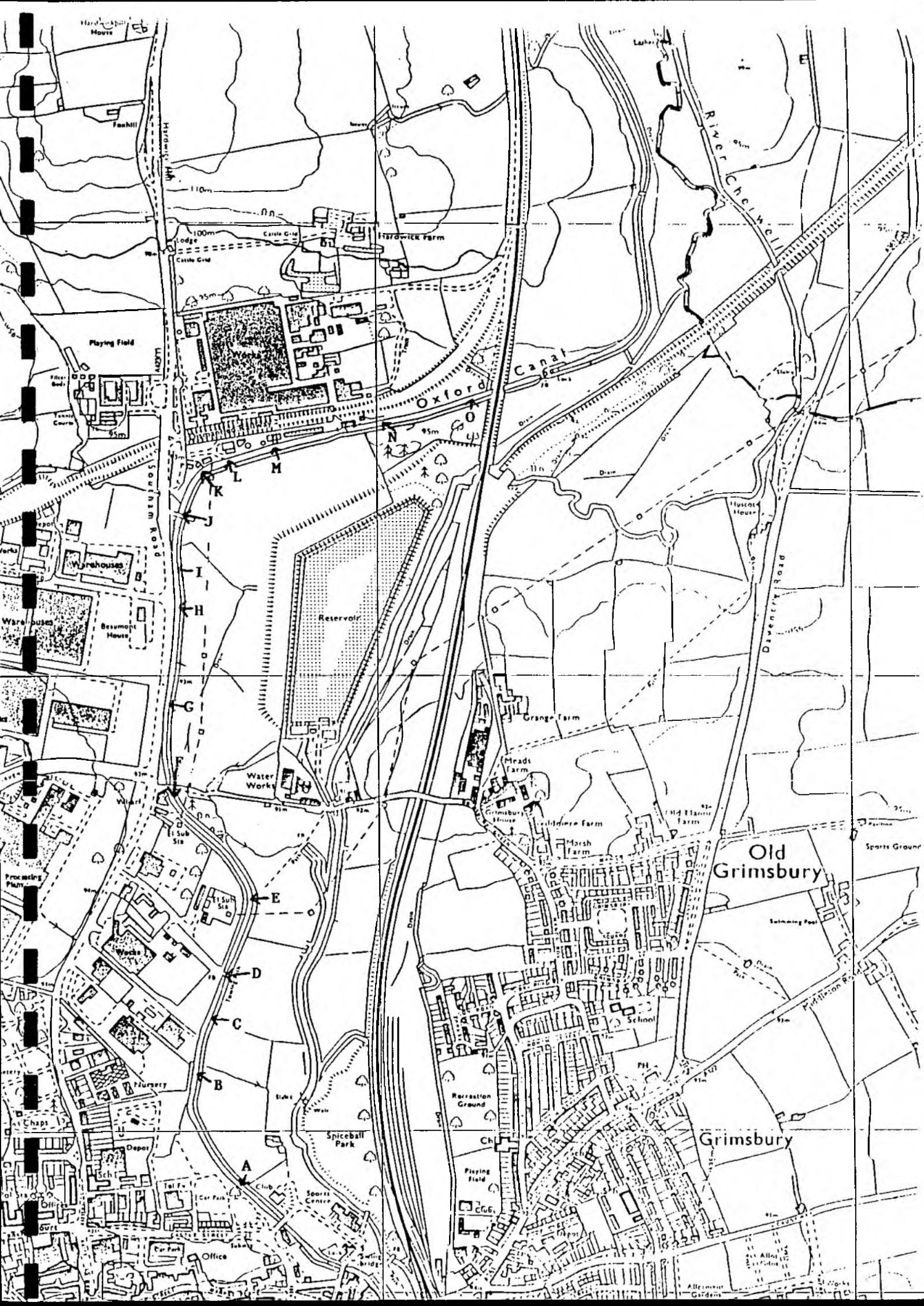
Fish Stocked to the Oxford Canal - 31/12/84-31/12/89

			No.	Total Weight(kg)
14/10/86	Kidlington	Tench	50	3.75
14/10/86	Kidlington	Carp	50	12.5
14/10/86	Kidlington	Rudd	50	2
26/11/86	Kidlington	Bream	900	200
2/12/86	Kidlington	Bream/Rudd	1200	125
23/11/87	Duke's Lock	Roach & Perch	270	25
25/11/87	Duke's Lock	Roach, Perch & Pike	700	70
20/10/88	Kidlington	Chub	2000	50
26/10/88	Kidlington	Bream	1200	636
26/10/88	Kidlington	Roach	800	100
28/10/88	A40 + A34 Roadbridge	Roach	600	75
30/11/88	A40 + A34 Roadbridge	Roach	50	5.5
30/11/88	A40 + A34 Roadbridge	Tench	350	20.5
1/12/88	Wolvercote Lock	Roach	140	15.5
1/12/88	Wolvercote Lock	Tench	350	20.5
21/12/88	Wolvercote Lock	Perch	133	22
23/12/88	Wolvercote Lock	Roach	500	25
23/12/88	Wolvercote Lock	Perch & Pike	100	5
21/04/89	Kidlington	Roach	9500	190
21/04/89	Kidlington	Perch	500	10
25/04/89	Kidlington	Roach	120	20
25/04/89	Kidlington	Perch	100	20
25/04/89	Kidlington	Pike	30	30
		TOTAL	19693	1683.3kg

Appendix IX

DATE	A	B	C	D	E
18 September 1989	53				
27 October 1989	8	6		8	
31 October 1989					
06 November 1989					
07 November 1989	40			35	
09 November 1989	61				
21 November 1989	46	49	53	46	47
28 November 1989	32	40	45	53	57
04 December 1989	26	24	24	37	56
11 December 1989	31	39	42	54	56
15 December 1989	75	78	79	82	80
20 December 1989	95	92	91	92	91
03 January 1990	87	83	84	84	83
28 February 1990	75	74	74	76	77

F	G	H	I	J	K	L	M	N	O
				55					54
4	2			13		9			72
	16			30		50		39	
				50		59		49	
	25			40					
40	35	31	33	33	27	33	52	34	36
44	44	40	50	58	55	46	49	61	56
58	62	50	58	60	55	56	62	60	62
59	62	70	73	77	73	81	78	80	82
86	83	85	85	85	80	80	84	86	87
93	93	92	92	92	86	86	90	90	95
82	84	85	83	88	76	76	74	77	85
73	76	76	78	79	71	73	74	73	73


Hardwick Farm
Foxhill
Playing Field
Works
Oxford Canal
River Cherwell
Warehouses
Reservoir
Grange Farm
Meads Farm
Water Works
Marsh Farm
Old Grimsbury
Grimsbury
Spiceball Park
Recreation Ground
Sports Ground
Swimming Pool
School
Nursery
Depot
Office
Sports Centre
Allotment Gardens
Duventry Road
Southam Road
A
B
C
D
E
F
G
H
I
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K
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