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Report on The 2001 Stock Assessment Of The River Darwen Catchment

Darren Wilson



**Environment Agency
Lutra house
Dodd Way
Walton Summit
Bamber Bridge
Preston
PR5 8BX**

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1.0 SUMMARY

1. The River Darwen is a Lancashire river that is extensively impacted by industrial, urban and agricultural practices. These have caused habitat degradation and produced stretches of river with water quality problems.
2. The catchment was first surveyed in 1996 with electric fishing equipment. The 2001 survey is a repeat of the 1996 survey to assess any improvements.
3. Twenty sites on the main river and tributaries were surveyed by electric fishing over the summer period of 2001. Results indicate that Brown Trout populations were present through the majority of the main river, a significant improvement over the 1996 results. Davyfield Brook again showed good Brown Trout populations with little difference between the two surveys. Minor coarse fish species were caught at fourteen sites with major coarse species found at two of the sites, again an improvement over the 1996 survey results.
4. The improving numbers of fish caught in this survey are thought to be due to a combination of improved water quality and strategic fish stocking from the Agency's Leyland Fish Farm.
5. Approximately 9000 fish were stocked for the first time in 1998 in the lower reaches of the Darwen at Houghton Bottoms from the Agency's Leyland Fish Farm as identified in the 1996 survey report. Fish were subsequently stocked in 2000 as a trial in the middle reaches around Davyfield and Witton taking in to account present and prospective water quality with the aim of establishing a sustainable fish population. This had limited success.
6. Many of the water quality issues raised previously have either been addressed by the Agency in conjunction with United Utilities and local farmers or are being considered. As a result of this, improvements in the river quality should continue in the future.
7. Coarse fish were introduced in to the Darwen during November 2001 in strategic locations to assess the environmental conditions with the aim of establishing sustainable fish populations. This is following the positive results identified during the 2001 survey. Impassable structures throughout the catchment continue to make migration through the catchment impossible but sustainable populations between reaches can be achieved.

2.0 INTRODUCTION

The River Darwen is a highly impacted Lancashire river with very little known about its fishery interest above the impassable weir at Salmesbury Bottoms. Below the weir there are populations of coarse fish around the confluence with the River Ribble. To the knowledge of local bailiff staff, prior to 1996 the fish population in the middle and upper River Darwen had never been surveyed by electric fishing. In order to address this lack of knowledge, a survey was undertaken during the summer of 1996 with the aim of evaluating the salmonid and cyprinid fish population in the river.

Twenty two sites were surveyed by electric fishing between June 11th and July 11th 1996. Information was gathered on the presence and density of fish populations in the river catchment, and analysed according to the National Fisheries Classification Scheme in order to determine how these populations compare nationally with sites of similar habitat features. From this report, recommendations were made to improve and develop the fishery potential in relation to water quality and habitat prioritising areas classed as being fishless. It was recommended that juvenile coarse fish should be stocked in the Houghton Bottoms area. This area has excellent fishery habitat and was found to contain a minor coarse fish population. Water quality in this stretch of river was thought to be good enough to establish a major coarse fish population. Fish were introduced for the first time in 1998 at Houghton Bottoms from the Agency's Leyland Fish Farm. 3000 each of Roach, Chub and Dace were introduced. Further fish introductions occurred in 2000 with the stocking of 1000 Chub, again from the Agency's Leyland Fish Farm in the Lower Darwen and Witton areas of the main river on a trial basis.

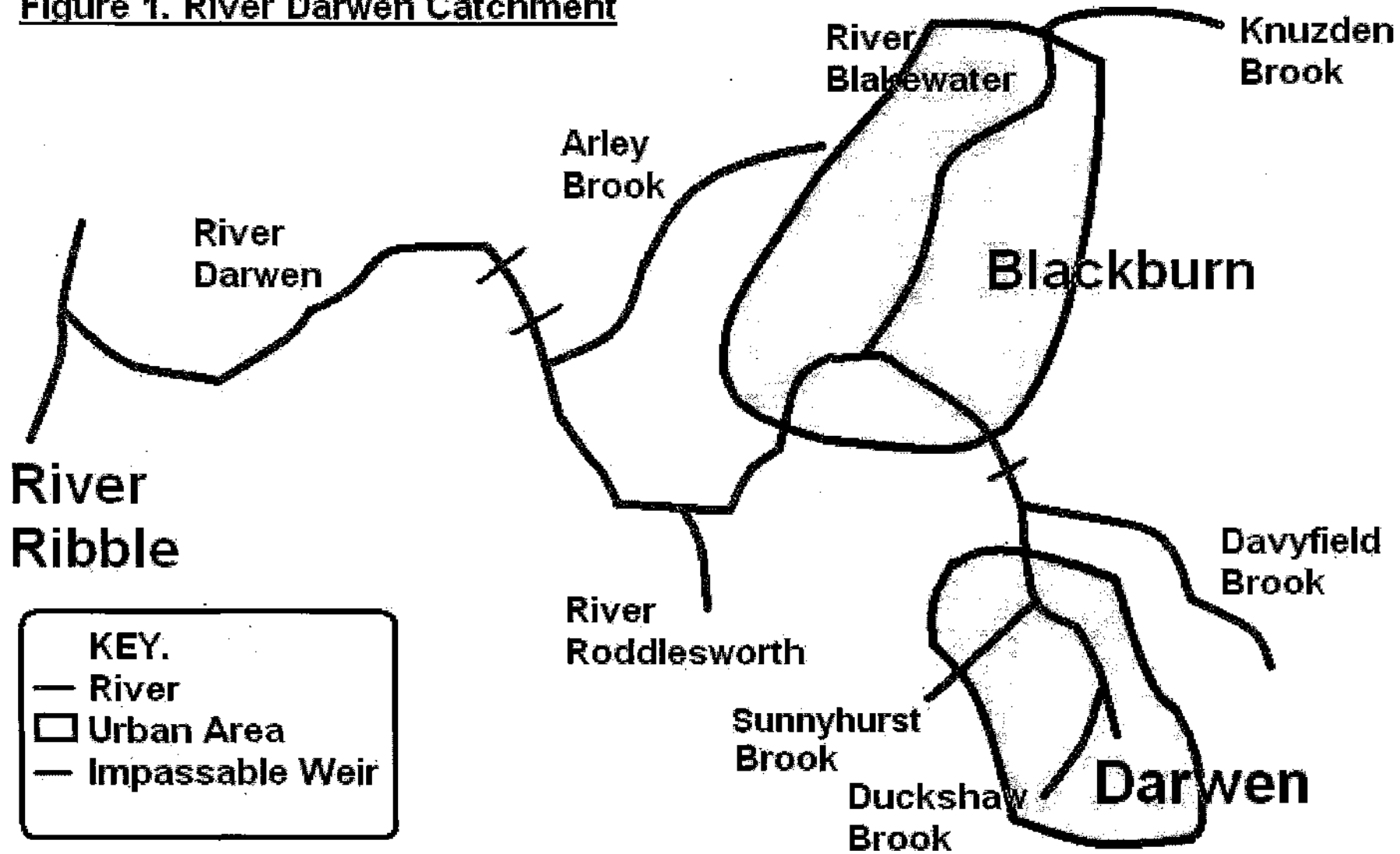
2.1 THE DARWEN CATCHMENT

The River Darwen rises on Darwen Hill and passes through the conurbations of Darwen and Blackburn before flowing in to the River Ribble at Preston, a length of approximately 30 km (Figure 1). The superficial geology of the catchment is boulder clay with areas of glacial gravels. Land use is agricultural in the middle and upper reaches with large industrial and urban areas between. The Darwen has several major tributaries as well as several minor tributaries. These include:

Duckshaw Brook	Sunnyhurst Brook
Davyfield Brook	River Blakewater (Knuzden Brook)
River Roddlesworth	Arley Brook

The Darwen and its principal tributary, the Blakewater, are heavily impacted due to the industrialised and urbanised areas of Blackburn. The majority of the Blakewater is culverted along with parts of the River Darwen. The other tributaries, for the most part, pass through agricultural land.

Figure 1. River Darwen Catchment



2.2 IMPASSABLE AREAS

There are a number of areas of the Darwen that are effectively impassable to both salmonid and cyprinid fish species. There are weirs at Roach Bridge (right), Salmesbury Bottoms and Lower Darwen and culverted sections through Blackburn which are likely to present an impassable barrier because of poor water quality, high velocities and lack of suitable habitat. The impassable areas effectively isolate large areas of river and prevent movement of fish species between them. Fish passes could make these weirs passable, however, the cost of these are not justified given the existing water quality in the middle and upper catchment at present.



2.3 GENERAL WATER QUALITY

The water quality of the Darwen System is affected by a number of point and diffuse discharges. Two major Waste Water Treatment Works (WwTW) discharge in to the River Darwen at Lower Darwen (Darwen Sewage Treatment Works SD 686 244) and at Blackburn (Blackburn Sewage Treatment Works, Salmesbury SD 603 296). In addition, there are four major trade effluent discharges and four major industrial estates in the catchment. There are six active landfill sites including one at Goosehouse Quarry, Blackburn where leachate had been found to contaminate both surface and groundwater. Contamination of surface waters by the wrong connection of foul water to the surface water system has also been found to be a problem in Blackburn resulting in the discharge of polluted water to tributaries of the River Darwen.

In addition to the problems listed above, there are a number of large Combined Sewer Overflows (CSO's) discharging in to the Darwen system. These CSO's are located on sewers or at pumping stations and discharge to local watercourses. They are designed to prevent foul flooding by relieving the sewerage network of excess flows during storm conditions. Unfortunately, this foul water is discharged into the River Darwen system where it creates major problems for the resident biota. There are in excess of 100 CSO's discharging in to the River Darwen System. Twenty eight of these in the Blackburn area are known to be unsatisfactory and discharges in to the Rivers Blakewater and Darwen and to Knuzden Brook. United Utilities had plans to improve 13 of these between 1995 and 2000, with the remainder in the period 2000 to 2005.

In spite of all these water quality problems, the water in much of the main River Darwen is of fair quality and should be able to support a major coarse fish population. A potential problem may be the periodically high levels of ammonia in the water from CSO's which could be harmful to fish. In freshwater, ammonia exist in two distinct forms; ionised (NH_4^+) which has little or no toxicity whilst its unionised 'raw' form (NH_3) is most poisonous to fish. These two forms exist in equilibrium subject to the degree of acidity/alkalinity (pH) and temperature. Consideration of routine water quality monitoring data from the Darwen system suggests that the mandatory EC Fisheries Directive level for unionised ammonia of < 0.021 mg/l has only been exceeded once in the period 1996 – 1997 (a level of 0.0217 mg/l recorded at Salmesbury Mill Bridge in April 1997). These data suggest the normal levels of unionised

ammonia may pose little problem for fish populations. However, the occurrence of 'one-off' events cannot be discounted.

2.4 Mortality Incidents

Various mortality incidents have occurred within the Darwen catchment between the two survey dates. However, the most severe occurred on 24th January 1998 when approximately 4,500 minor coarse species along with approximately 200 major coarse fish species and 132 trout were recovered following a pollution incident. Subsequent investigations by Environment Agency staff concluded that the mortality incident was caused by a point source of pollution at a culvert situated in the River Roddlesworth adjacent to Sappi paper mill. The River Roddlesworth runs through the paper mill site. Electric fishing techniques were used to survey both upstream and downstream of the culvert with positive results. Upstream of the culvert, fish were found, albeit in small numbers. However, downstream of this culvert towards the Roddlesworth/Darwen confluence, no fish were seen. This indicated the upstream limit of the mortality and likely source of pollution. Following this, the facts relevant to the pollution were simple in that dead fish were recovered immediately downstream of the culvert for some considerable distance (down as far as Roach Bridge) with no dead fish being observed above the culvert where live fish were identified. It was therefore reasonable to conclude the pollution was sourced from the culvert in question. It was later determined that the substance which was at the forefront of the mortality was an ingredient in the paper making process which was being used at the adjacent Sappi paper mill. This was determined as the source of pollution and mortality incident.

3.0 METHODOLOGY

As in the 1996 survey, the main river and tributaries within the study area were sampled by electric fishing at approximately 1 km intervals. Figure 2 shows the location of each electric fishing site within the catchment. As far as possible, the exact same site was fished to ensure a valid comparison. All sites were surveyed using a pulsed DC current at 100 Hz fished upstream towards either a stopnet or riffle. At sites less than approximately 3.5 m in width, a single anode was used. On sites wider than this, two anodes were used. At all sites supporting salmonids, the number of fish and the fork length (to the nearest 5mm) of individual fish was recorded as well as total mass. For major coarse fish, the biomass per species was recorded and for minor coarse fish, an estimate of the numbers on a logarithmic scale (10, 100, 1000) per site was made. Examination of the length-frequency distribution for juvenile brown trout made it possible to separate them in to 0+ and older than 0+ age classes.

Minimum density estimates for the various population components were calculated as numbers of fish per 100m² of area surveyed using the following equation:

$$(\text{number of fish} / \text{total area}) \times 100\text{m}^2$$

Figures of numbers of fish per 100m² were input into the National Fisheries Classification Scheme for Absolute and Relative analysis at a Level 1 Classification. Appendix 1 gives more detail on the National Fisheries Classification Scheme.

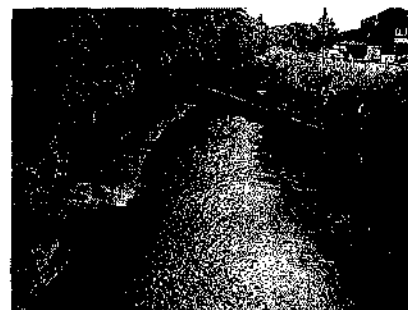
3.1 ELECTRIC FISHING SITES

As far as possible, the electric fishing survey sites selected for use in 1996 were used for the 2001 survey. This was to ensure scientific credibility and ensure the survey was a valid



comparison with the 1996 survey. Table 1 lists and compares the 1996 and 2001 sites with Figure 2 showing their geographical distribution. For the most part, the 1996 survey sites were used in 2001, with a few exceptions. Sites Dw01 to Dw04 were identical (Site Dw03 left), however site Dw05 at Darwen WwTW was unable to be surveyed in 2001 as the works is in the process of being upgraded and would have caused health and safety issues both to the electric

fishing team and other persons on site. This site was therefore left out of the survey. Site Dw06 was identical but again site Dw07 could not be surveyed due to health and safety issues. Site Dw08 was below Ewood Park, off Aqueduct Street, Blackburn in 1996 (right). This site was changed for the 2001 survey as this site has very high, steep gradient banks so was changed on health and safety grounds during the risk assessment process. This site was changed to behind Blackburn Rovers Football Club at Ewood Park (left). The land use is different than the 1996 site with a distance of approximately 0.5 km upstream so cannot be used as a comparison between the two surveys. Site Dw09 was changed slightly in the 2001 survey as it was felt the new site was more representative of the





River Darwen. The 1996 site was just upstream of the River Blakewater confluence which is culverted. The site selected for use in 2001 was from 50 m downstream of the River Blakewater confluence to the confluence itself. This section is not culverted and was more representative than the 1996 site as well as being less of a health and safety issue as the culverted section looked to be very slippery. Because of this, a direct comparison between the sites cannot be given. Sites Dw10 and Dw11 were again

changed very slightly due to access difficulties. In 1996, access to these sites were in the middle of playing fields. In 2001, it would have been difficult to access these sites due to soft ground conditions. The sites were therefore changed to the most accessible site nearest to the 1996 site. This resulted in slight changes although the habitat features remained the same. Site Dw12 remained the same. Site Dw13 was unable to be surveyed in 2001 as this site is only accessible through a farm. The outbreak of Foot and Mouth disease prevented access to this site. Site Dw14 remained the same. Site Dw15 was unable to be surveyed partly due to Foot and Mouth disease as access to this site is on a farm track, but also this site is large at 13 m wide and 2 anodes would not have given a suitable comparison to the 1996 survey when 3 anodes were used.

Sites Bw01 and Bw02 on the River Blakewater remained the same. However, an additional site was added upstream of the 1996 top site, Bw01a (right). Davyfield Brook was surveyed at two sites in 1996. The top site, Da01 remained the same. Unfortunately site Da02, at New Waterside Paper Mill was unable to be surveyed in 2001 as the paper mill had closed down preventing access. Two additional sites were surveyed in 2001 in the lower reaches. Da03 was selected approximately 0.8 km downstream of site Da02 as an alternative and site Da04 was selected just upstream of its confluence with the River Darwen for greater coverage of the brook. Both sites on Knuzden Brook remained the same.

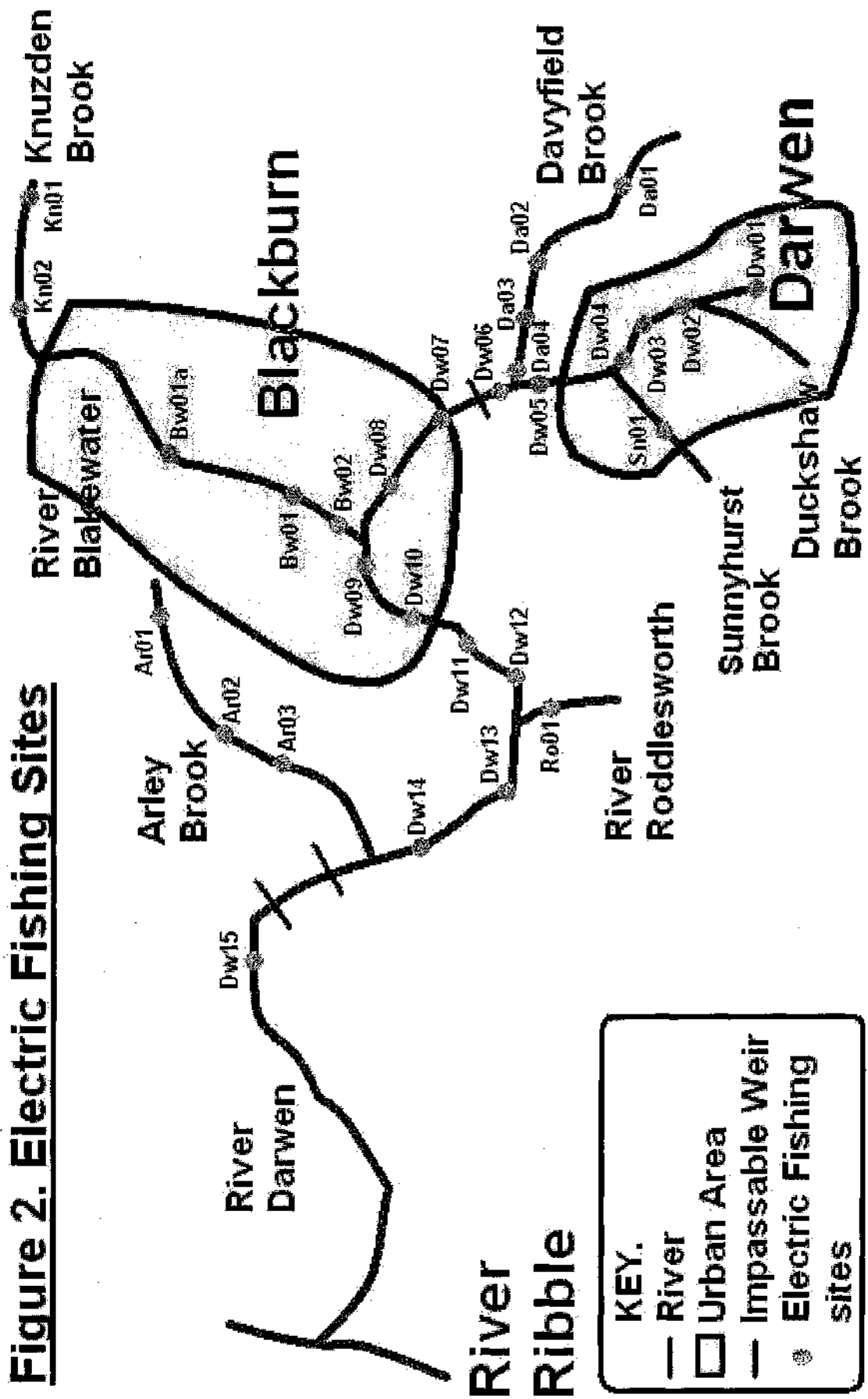


In addition to the sites selected in 1996, sites on Sunnyhurst Brook (left) and Arley Brook, both tributaries of the River Darwen were selected as these had never been surveyed before. These would give broader coverage of the catchment area.

Table 1. 1996 Electric Fishing Sites 1996 and 2001

Table 1. 1996 Electric Fishing Sites 1996 and 2001				
Site Code	Watercourse	Location	Grid Reference	
			1996	2001
Dw01	River Darwen	Watery Lane, Darwen	SD 701 209	SD 701 209
Dw02	River Darwen	Cross Street, Darwen	SD 697 214	SD 697 214
Dw03	River Darwen	Crown Public House, Darwen	SD 693 218	SD 693 218
Dw04	River Darwen	Peabody Lane, Darwen	SD 693 226	SD 693 226
Dw05	River Darwen	Darwen WwTW, Darwen	SD 690 239	-
Dw06	River Darwen	U/S Davyfield Brook, Lower Darwen	SD 690 246	SD 690 246
Dw07	River Darwen	Branch Road, Lower Darwen	SD 683 254	-
Dw08	River Darwen	Ewood Park	SD 676 264	SD 679 256
Dw09	River Darwen	U/S River Blakewater, Witton	SD 663 269	SD 661 271
Dw10	River Darwen	Pleasington Fields, Witton	SD 654 267	SD 656 268
Dw11	River Darwen	Pleasington Fields, Witton	SD 648 265	SD 651 266
Dw12	River Darwen	Pleasington Road, Pleasington	SD 643 257	SD 643 257
Dw13	River Darwen	Viaduct Road, Houghton Bottoms	SD 629 267	-
Dw14	River Darwen	Valley Road, Houghton Bottoms	SD 627 274	SD 627 274
Dw15	River Darwen	D/S Roach Bridge	SD 594 286	-
Bw01a	River Blakewater	George Street, Blackburn	-	SD 684 277
Bw01	River Blakewater	Garden Street, Blackburn	SD 672 277	SD 667 277
Bw02	River Blakewater	U/S River Darwen Confluence, Witton	SD 662 272	SD 662 272
Da01	Davyfield Brook	Waterside	SD 714 235	SD 714 235
Da02	Davyfield Brook	New Waterside Paper Mill	SD 708 241	-
Da03	Davyfield Brook	Roman Road, Blackburn	-	SD 699 245
Da04	Davyfield Brook	M65 Bridge, Lower Darwen	-	SD 690 246
Kn01	Knuzden Brook	St Ives Road, Blackburn	SD 710 279	SD 710 279
Kn02	Knuzden Brook	D/S Davis Pet Foods, Blackburn	SD 706 288	SD 706 288
Ro01	River Roddlesworth	D/S Sappi Paper Mill	SD 645 248	-
Sn01	Sunnyhurst Brook	Sunnyhurst Woods, Darwen	-	SD 679 231
Ar01	Arley Brook	Arley Farm, Blackburn	-	SD 649 293
Ar02	Arley Brook	Old Woodfold Farm, Blackburn	-	SD 637 292
Ar03	Arley Brook	Pleasington Road, Pleasington	-	SD 636 283

Figure 2. Electric Fishing Sites



KEY.

- River
- ▭ Urban Area
- Impassable Weir
- Electric Fishing sites

4. RESULTS

4.1 BRIEF OVERVIEW OF 1996 SURVEY RESULTS

To aid the comparison between the data collected in 1996 and 2001, a brief overview of the 1996 results are given below.

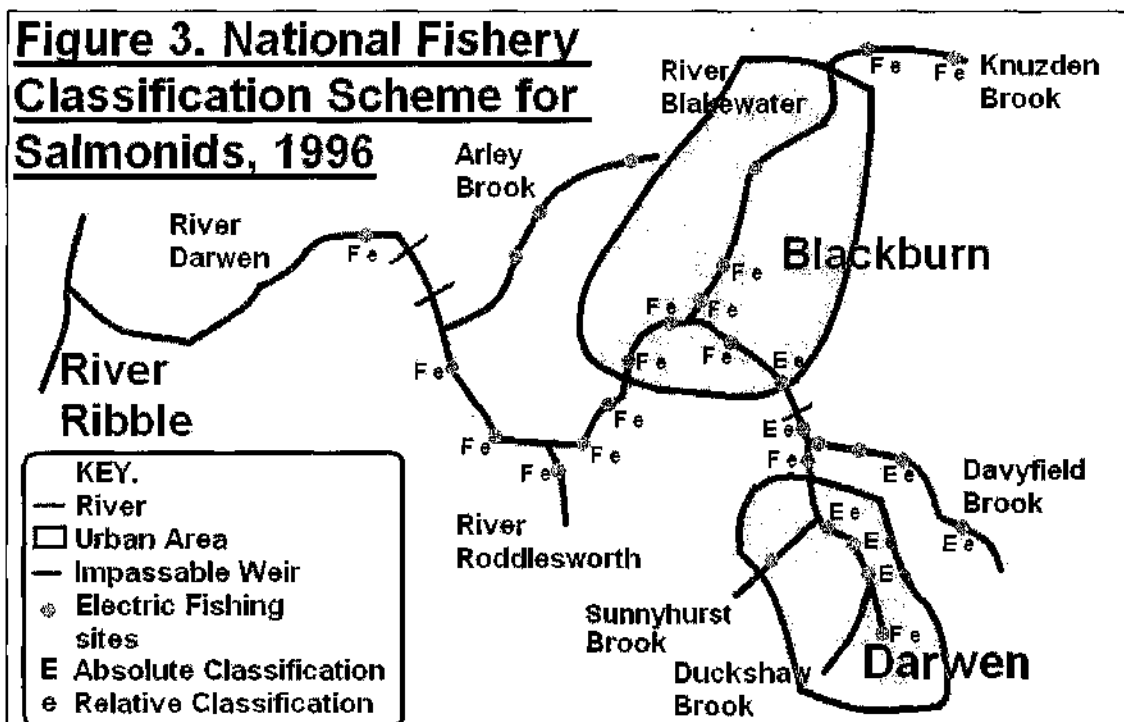
4.1.1 SPECIES PRESENT

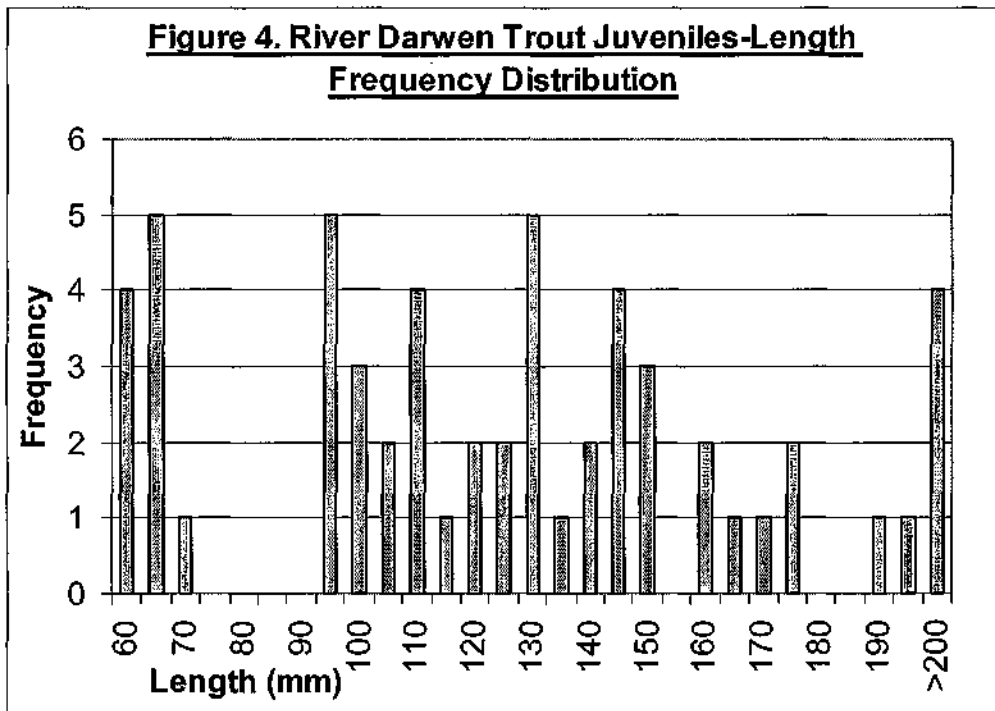
A total of 7 species were found within the study area during the 1996 survey which are listed below. Further details are available in "Report On The 1996 Stock Assessment Of The River Darwen Catchment".

Brown Trout	<i>Salmo trutta</i>
Roach	<i>Rutilus rutilus</i>
Eel	<i>Anguilla anguilla</i>
Stoneloach	<i>Barbatula barbatula</i>
Stickleback	<i>Gasterosteus aculeatus</i>
Minnow	<i>Phoxinus phoxinus</i>
Bullhead	<i>Cottus gobio</i>

4.1.2 1996 BROWN TROUT DENSITIES

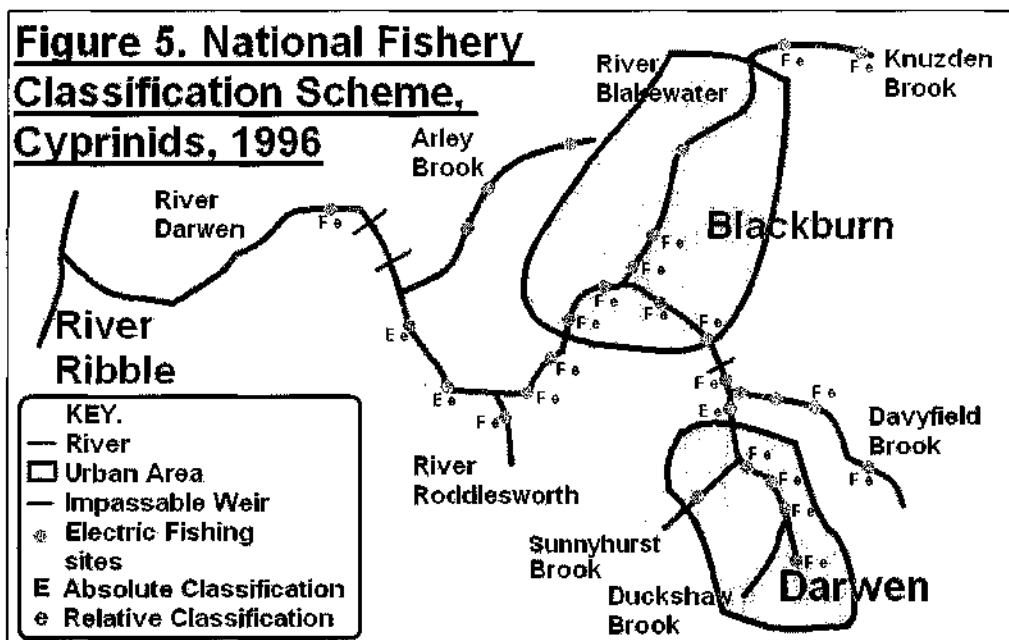
Brown trout were caught at 7 of the sites surveyed in 1996, five sites on the main river and both sites on Davyfield Brook. At all these sites, they were present in low densities. Relative and absolute classification for brown trout at each site are indicated in Figure 3. The length frequency distribution of brown trout, Figure 4, show all brown trout less than 95 mm in length were considered as being of the 0+ age class.





4.1.3 1996 COARSE FISH DENSITIES

Of the sites surveyed, only one major coarse fish species was caught at one site, a roach at site Dw05. Minor coarse fish species were present at 20 of the sites surveyed. No fish species were found at two sites, Dw15 and Bw01. Relative and absolute classification are given for each site in Figure 5.



4.1.4 1996 NATIONAL FISHERY CLASSIFICATION

The number of sites falling in absolute and relative classification for salmonids and cyprinids are given in Table 2. Relative classification for both salmonids and cyprinids were at a minimum class (E). Absolute classification for both salmonids and cyprinids were generally

of class F, indicating that the populations were absent, with the few remaining sites of class E, indicating poor populations.

Class	Salmonid		Cyprinid	
	Absolute	Relative	Absolute	Relative
A	0	0	0	0
B	0	0	0	0
C	0	0	0	0
E	7	22	4	22
F	15	N/A	18	N/a
Total	22	22	22	22

4.2 2001 SURVEY RESULTS

In general, the Darwen Catchment contained a broader range of fish species during the 2001 survey. The abundance's of these species were greater with more variation in size ranges.

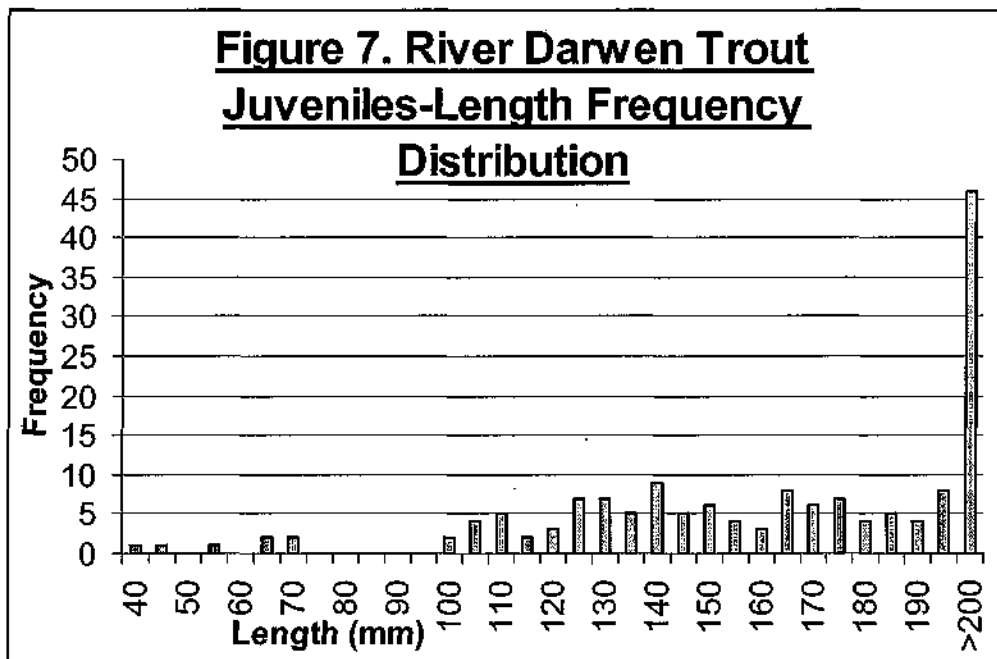
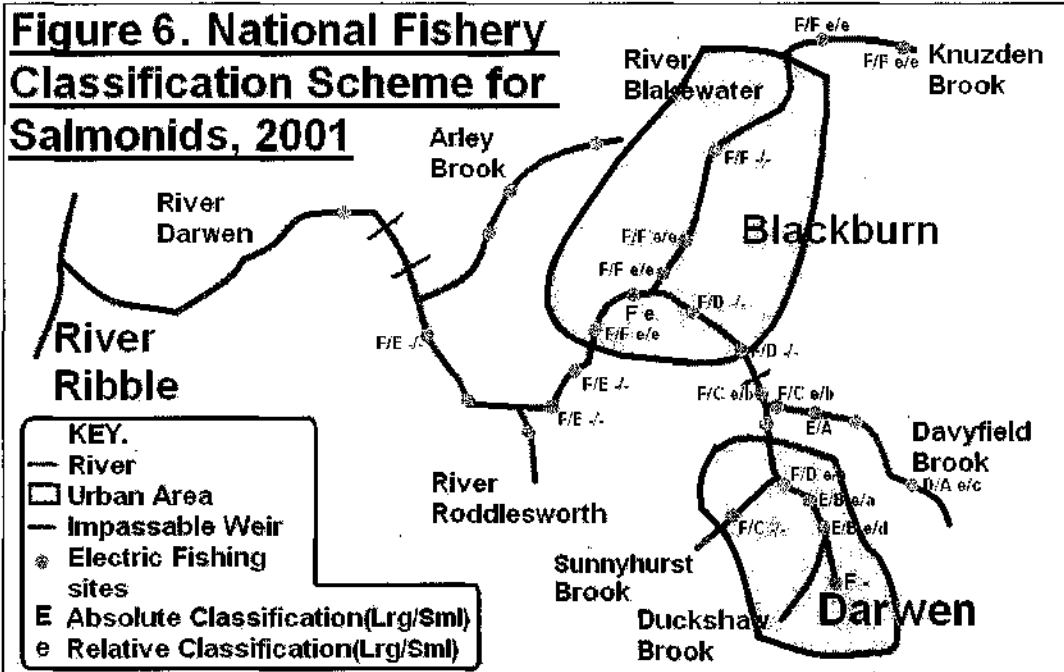
4.2.1 SPECIES PRESENT

A total of 9 species were found within the study area which are listed below. Full details of species caught and description of the habitat at each site are given in appendix 2.

Brown Trout	<i>Salmo trutta</i>
Roach	<i>Rutilus rutilus</i>
Chub	<i>Leuciscus cephalus</i>
Gudgeon	<i>Gobio gobio</i>
Eel	<i>Anguilla anguilla</i>
Stoneloach	<i>Barbatula barbatula</i>
Stickleback	<i>Gasterosteus aculeatus</i>
Minnow	<i>Phoxinus phoxinus</i>
Bullhead	<i>Cottus gobio</i>

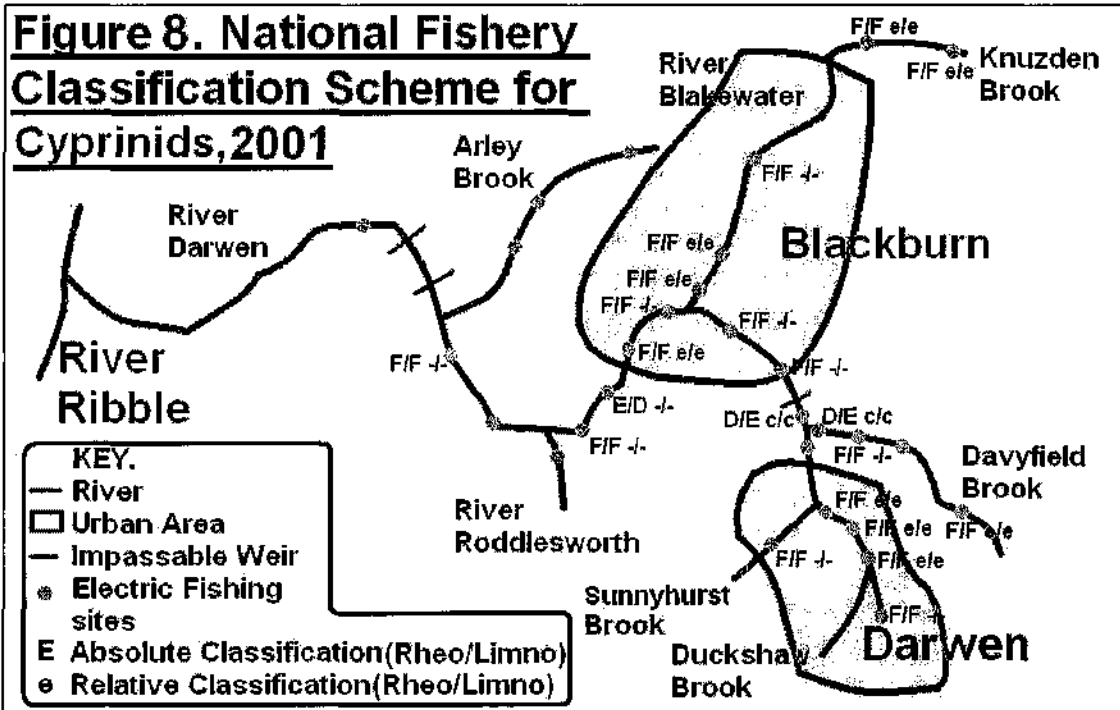
4.2.2 2001 BROWN TROUT DENSITIES

Brown trout were caught at thirteen of the sites surveyed in 2001, nine sites on the main river, all three of the sites on Davyfield Brook and on Sunnyhurst Brook. At the majority of the sites, they were present in low densities, site Da03 being the exception. Relative and absolute classification for brown trout for each site are indicated in Figure 6. The length frequency distribution of brown trout, Figure 7, show all brown trout less than 95 mm in length were considered as being of the 0+ age class.



4.2.3 2001 COARSE FISH DENSITIES

Of the sites surveyed, three major coarse fish species were caught, chub and gudgeon at site Dw11 and chub and roach as site Dv04. Minor coarse fish species were present at 14 of the sites surveyed. No fish species were found at two sites, Kn01 and Bw01. Relative and absolute classification are given for each site in Figure 8.



4.2.4 2001 NATIONAL FISHERY CLASSIFICATION

The number of sites falling in to absolute and relative classification for salmonids and cyprinids are given in Table 3. Relative classification, for the most part, for both salmonids and cyprinids were at a minimum class (E), with the exception of five sites which have improved indicated by the presence of classes A-D. Absolute classification for both salmonids and cyprinids were, for the most part, generally of class F, indicating that the populations were absent. The exception was large salmonids, which varied between classes A-F, indicating significant improvements.

Table 3. 2001 National Fisheries Classification.

Class	Salmonids				Cyprinids			
	Small		Large		Rheophillic	Limnophillic	Rheophillic	Limnophillic
	Absolute	Relative	Absolute	Relative	Absolute	Absolute	Relative	Relative
A	0	0	2	1	0	0	0	0
B	0	0	2	1	0	0	0	0
C	0	0	2	1	0	0	1	1
D	1	0	3	1	1	1	0	0
E	3	10	4	6	1	1	9	9
F	16	NA	7	NA	18	18	NA	NA
Unclassified	0	10	0	10	0	0	10	10
Total	20	20	20	20	20	20	20	20

5. DISCUSSION

5.1 COMPARISON BETWEEN 1996 AND 2001 RESULTS

When comparing the results between the 1996 and 2001 survey, it is clear, in general there has been an improvement in the overall fish stocks within the Darwen catchment. Site Dw01 was found to support eleven stickleback in 1996 but was found to contain only two sticklebacks in 2001 along with a single stone loach. This is a reduction in the overall population at this site but is not surprising considering the culverted, urban nature of this section of river. Site Dw02 fared much better. Six brown trout from fry to 165 mm were found in 1996 along with six bullheads. In 2001, eighteen brown trout were found, a considerable improvement. These ranged between 40 mm and 284 mm, similar in distribution to 1996. Site Dw03 showed a similar improvement to the previous site. In 1996, ten brown trout were found from fry to 195 mm along with minor coarse species (MCS). In 2001, twenty brown trout were found from fry to 235 mm, but no MCS. Site Dw04 showed similar results between 1996 and 2001, six brown trout and MCS were found at both surveys. However, the fish in the 2001 survey were a larger size and few fry were present. Site Dw05 wasn't surveyed in 2001. Site Dw06 showed an improvement, a single brown trout of 200 mm and MCS were found in 1996, but this had improved in 2001 to six brown trout and MCS. Site Dw07 wasn't surveyed during 2001. A straight comparison can't be given at site Dw08 as this site was changed slightly. The site in 1996 was a culverted stretch and therefore was restricted to the species it contained, three minnows. In 2001, the site was changed upstream of the 1996 site to Ewood Park, where five brown trout between 170 mm and 398 mm were found, along with MCS. This indicates the importance of fishery habitat to the distribution of fish populations. Site Dw09 was again changed between the surveys so a direct comparison cannot be given. However, brown trout were found at site Dw09 for the first time in this stretch of river along with MCS and eels. Sites Dw10 and Dw11 were slightly different between the two surveys due to accessibility. However, their habitat features remained the same so a comparison can be given. In 1996, Site Dw10 was found to contain eels and MCS. This remained the same in 2001 with similar densities. Site Dw11 only contained MCS in 1996. However, a brown trout of 334 mm was found for the first time in 2001, together with MCS, gudgeon and chub. Site Dw12 was found to contain only MCS in 1996. However, 5 brown trout between 163 mm and 417 mm were found in 2001 along with MCS. Site Dw13 wasn't surveyed in 2001. Site Dw14 was found to contain good numbers of MCS and an eel in 1996. In 2001, a brown trout was found along with MCS. This site was difficult to survey as it is wide and deep in some sections. Fish were seen and missed and this length is known to contain large brown trout and major coarse fish species. Site Dw15 was not surveyed in 2001.

In addition to the 1996, site Bw01a was found to contain sticklebacks, the first time any fish species have been known to frequent this high up the River Blakewater due to its culverted nature. Site Bw01 which was surveyed in both years had identical results, no fish caught. Site Bw02 was found to contain high numbers of MCS in 1996. This site was found to support MCS in 2001, but in lower densities. The top site on Davyfield Brook, Da01, both contained brown trout, twenty in 1996 between 95 mm and 175 mm, and twenty one between 59 and 163 mm in 2001. Sticklebacks were found in 1996 but not in 2001, but an eel of 210 mm was found in 2001. Site Da02 wasn't surveyed in 2001. Sites Da03 and Da04 were additions to the 1996. Site Da03 was found to contain an excellent brown trout population, forty-seven fish between 71 mm and 400 mm, along with eels and MCS. Site Da04 was found to contain

seventeen brown trout between 123 mm and 282 mm as well as four chub and a roach. No MCS were seen at this site.

The top site on Knuzden Brook, Kn01 were both found to contain no fish. Site Kn01 was found to contain MCS in 1996, and again this was seen during the 2001 survey. Site Ro01 on the River Roddlesworth wasn't surveyed in 2001. An additional site to the 1996 was site Sn01, Sunnyhurst Brook. Fourteen brown trout Between 65 mm and 243 mm were found along with MCS.

5.1.1 MINOR COARSE FISH SPECIES

Populations of minor coarse fish species were found at 14 of the 20 sites (70%) during the 2001 survey. This is a slight reduction in their abundance from the 1996 survey when they were found at 20 of the 22 sites (91%) surveyed.

5.1.2 SITES WITH NO FISH POPULATION

Two sites were found to contain no fish populations; the River Blakewater at Garden Street (Bw01) and the top site on Knuzden Brook. The Blakewater, for the majority of its length has been modified and culverted. The water quality is poor and the velocity is high due to its culverted design, so it is not surprising no fish were caught through this section. This result was the same as in 1996. The top site on Knuzden brook was found to contain Stickleback in 1996. It is likely these have been either washed downstream, below the weir or have perished due to poor water quality during an incident and have not been able to recolonise the area.

5.1.3 COARSE SPECIES

Coarse fish were found at only two sites on the whole Darwen Catchment, chub and gudgeon at site Dw11 and chub and roach as site Dv04, little improvement over the result found in 1996. Of the chub stocked in 2000, only one site was found to support this species, Dv04. Although the water quality suggests the quality is sufficient to support these fish, few fish were found during the 2001 survey. This either suggests the water quality is not stable enough ('one off' events) or the fish have migrated to other areas and were not seen during the survey. It is difficult to tell which is the case. Having said this, the sites where the fish were introduced varied between 3.45 m in the case of Davyfield Brook to over 10 m in the case of the Darwen at Pleasington Fields. Electric fishing equipment with only 2 anodes in this width of river is not as efficient as at lower widths and fish could easily have been missed. The stocking was successful in respect of a new species was introduced to the catchment. Gudgeon have never been stocked in to the Darwen catchment but were found for the first time during the 2001 survey. These have probably colonised the river by natural means.

5.1.4 TROUT

Brown trout have been identified throughout the upper reaches of the River Darwen system and its tributaries. Since there haven't been any recent introductions of brown trout, this population may represent indigenous, wild fish. Of particular encouragement was the presence of fry in the main river and indicate the population is capable of being self sustaining. The distribution of size range is encouraging with good numbers of medium sized fish to mature adults, indicating the habitat for each part of the species life cycle is available. This wild population should be protected wherever possible.

5.1.5 Eels

Eels were found at 5 of the sites surveyed (Dw09/10/14, Da01a/03) as opposed to three sites in 1996 (Dw10/13/14). All these sites are above the weir at the lower end of the Darwen System, Roach Bridge. Assuming these Eels were not carried over the obstacle by some external force, their presence in the area above must be due to the fish having left the water and travelling overland or them scaling the wall of the weir as elvers (juvenile Eels). Both options are possible as Eels have been known to travel overland around obstacles for distances up to 1 km, similarly, elvers are able to climb vertical walls using damp algae and moss for support. Roach Bridge weir and subsequent weirs upstream are therefore less of a limiting factor to the Eels population.

6.0 RECOMENDATIONS

Following on from the 2001 survey review, it is clear that the River Darwen catchment on the whole has seen an improvement in the abundance of fish and species composition with the addition of two new species, Chub and Gudgeon. Water quality data suggests that the river is able to support a coarse fish population. The appearance of Brown Trout and Gudgeon in the Witton Park area of the Darwen suggests that it is the presence of impassable structures that is the limiting factor to the colonisation of major coarse fish species in to this section of river. These species are known to inhabit the lower reaches of the river, although they were not identified during the survey. Upstream migration of these species are halted by impassable structures, therefore stopping any upstream colonisation. It is therefore recommended that Chub and Roach are introduced to this section of river and further fish are stocked in the Houghton Bottoms region. As the river is large with some good fishery habitat, the River could easily sustain a stocking of 10,000 each of Chub and Roach. Approximately 3000 of each species should be stock at Houghton Bottoms with the remainder distributed between site Dw08 and Dw11. The electric fishing survey should be repeated in the summer of 2006 as part of the Agency's rolling core monitoring programme to assess the survival rates of these fish and assess any further improvements due to ongoing water quality improvements.

Looking towards the medium to long term future, as there is an established, self sustaining population of brown trout currently within the River Darwen and its tributaries, there is no reason why, providing migratory fish have access to the river, a self sustaining population of migratory fish (salmon and sea trout) cannot colonise the River Darwen. It is recommended that the barriers to fish migration, i.e. the weirs are opened up to allow fish to pass freely over them. Due to the size and location of the weirs, this will probably entail the construction of pool and traverse or denal type fish passes. However, this will be at a high cost as the weirs within the catchment are large and it is only after a sustaining coarse fish population has been established that these measures should be implemented.

Appendix 1.

National Fisheries Classification Scheme.

The National Fisheries Classification Scheme was developed in order to allow the fishery status of any surveyed site in England and Wales to be compared with a national data base of sites with a similar habitat type.

This classification system operates on four levels of detail; from species type (level 1) up to the status of the fishery (level 4). The most fundamental division in the hierarchy is between the numbers of salmonids and the biomass of coarse fish per 100m² of river surveyed. River gradient and channel width are also used as descriptors of broad habitat type.

The NFCS uses a database containing 949 sites, fished quantitatively, and encompassing the range of fishery types found in the UK. Class boundaries for the classification system were then determined from the database.

To use the NFCS, raw survey data included: the numbers of each year class of salmonids and the biomasses of coarse fish (classed into Linnophillic, Rheophillic, Predator species and Eels) per 100m² surveyed were entered into the database. A classification of the naturalness of the species present as well as broad habitat types are also entered. A level of precision is also included. From this data, a classification of each site was made.

The NFCS classifies sites in an Absolute (Absolute Classification) or Relative (Relative Classification) manner. The absolute classification compares fish abundance at the site with all other sites in the national database within which the species group were present. The relative classification compares the fish abundance at the site with all other sites in the same broad habitat type. Sites are assigned a class according to where they correspond to in the database structure.

Class descriptions for National Fisheries Classification Scheme.	
Class	Description
Absolute Classification	
A	Within the upper quintile of sites/reaches containing species/age groups
B	Within the second quintile of sites/reaches containing species/age groups
C	Within the third quintile of sites/reaches containing species/age groups
D	Within the fourth quintile of sites/reaches containing species/age groups
E	Within the lower quintile of sites/reaches containing species/age groups
F	species/age group absent
Relative Classification	
a	Within the upper quintile of sites/reaches containing species/age groups
b	Within the second quintile of sites/reaches containing species/age groups
c	Within the third quintile of sites/reaches containing species/age groups
d	Within the fourth quintile of sites/reaches containing species/age groups
e	Within the lower quintile of sites/reaches containing species/age groups

Appendix 2.

Electric Fishing Sites 1996 and 2001			
			Grid Reference
Site Code	Watercourse	Location	2001
Dw01	River Darwen	Watery Lane, Darwen	SD 701 209
Dw02	River Darwen	Cross Street, Darwen	SD 697 214
Dw03	River Darwen	Crown Public House, Darwen	SD 693 218
Dw04	River Darwen	Peabody Lane, Darwen	SD 693 226
Dw05	River Darwen	Darwen WwTW, Darwen	-
Dw06	River Darwen	U/S Davyfield Brook, Lower Darwen	SD 690 246
Dw07	River Darwen	Branch Road, Lower Darwen	-
Dw08	River Darwen	Ewood Park	SD 679 256
Dw09	River Darwen	U/S River Blakewater, Witton	SD 661 271
Dw10	River Darwen	Pleasington Fields, Witton	SD 656 268
Dw11	River Darwen	Pleasington Fields, Witton	SD 651 266
Dw12	River Darwen	Pleasington Road, Pleasington	SD 643 257
Dw13	River Darwen	Viaduct Road, Houghton Bottoms	-
Dw14	River Darwen	Valley Road, Houghton Bottoms	SD 627 274
Dw15	River Darwen	D/S Roach Bridge	-
Bw01a	River Blakewater	George Street, Blackburn	SD 684 277
Bw01	River Blakewater	Garden Street, Blackburn	SD 667 277
Dw02	River Blakewater	U/S River Darwen Confluence, Witton	SD 662 272
Da01	Davyfield Brook	Waterside	SD 714 235
Da02	Davyfield Brook	New Waterside Paper Mill	-
Da03	Davyfield Brook	Roman Road, Blackburn	SD 699 245
Da04	Davyfield Brook	M65 Bridge, Lower Darwen	SD 690 246
Kn01	Knuzden Brook	St Ives Road, Blackburn	SD 710 279
Kn02	Knuzden Brook	D/S Davis Pet Foods, Blackburn	SD 706 288
Ro01	River Roddlesworth	D/S Sappi Paper Mill	-
Sn01	Sunnyhurst Brook	Sunnyhurst Woods, Darwen	SD 679 231
Ar01	Arley Brook	Arley Farm, Blackburn	SD 649 293
Ar02	Arley Brook	Old Woodfold Farm, Blackburn	SD 637 292
Ar03	Arley Brook	Pleasington Road, Pleasington	SD 636 283