Review of migratory salmonids in the Yorkshire Ouse system

Introduction

This review was instituted by the Yorkshire Dales Rivers Trust (YDRT) to provide a science-based assessment of the status of salmonids in the river and to advise on actions required to ensure the sustainable recovery and future management of the stocks, whilst providing overall benefit to the environment in accordance with the principles of the YDRT.

Specific objectives are:

a. Assess the current state of salmonid stocks in the river and progress with recovery.

b. Identify the key threats and problems faced by migratory salmonids.

c. Consider current monitoring activity and identify future needs.

d. Address other issues identified during the course of the study.

e. Recommend actions that the Trust and others should take over the next five year period.

Although the main purpose is to satisfy the needs of the YDRT Board of Trustees, the arguments adopted also need to cover concerns of the Ure Salmon Group and the Environment Agency.

The Ure Salmon Group was established to help increase the quantity of migratory fish (principally salmon, sea trout and lamprey) in the River Ure system. It is now part of the Yorkshire Dales Rivers Trust, which needs to ensure that this objective can be carried out in accordance with the principles of the Rivers Trust movement.

For these reasons, a Salmon Review Group was set up, consisting of Dr Stephen Axford as YDRT Trustee and independent consultant, David Marx of the Ure Salmon Group, Roger Trees as a salmon angler, fishery owner and independent member, and David Bamford as YDRT and former Ure Salmon Group staff member with special responsibility for salmon restoration activities. The group met twice, to consider how to gather the facts needed to meet the specific objectives and the arguments that needed to be developed, resolved and reported. The discussions within the group made a very valuable contribution to this report and I am very grateful to all the members.

However, this report represents my individual and disinterested views based on available evidence and literature review.

The Status of Salmon Stocks in the Yorkshire Ouse

Until the 1960s, the only measures of the status of the salmon stocks in the Yorkshire Ouse system came from reports of catches by anglers and commercial netsmen. Unfortunately,

the effort involved in making these catches was rarely reported, so catch per unit effort, the preferred measure to reflect the status of stocks could not be calculated for most years. Nevertheless, the total catches suggest that stocks may have peaked in the 1930s, followed by a rapid decline and no sure signs of recovery until very recently (Figure 1).

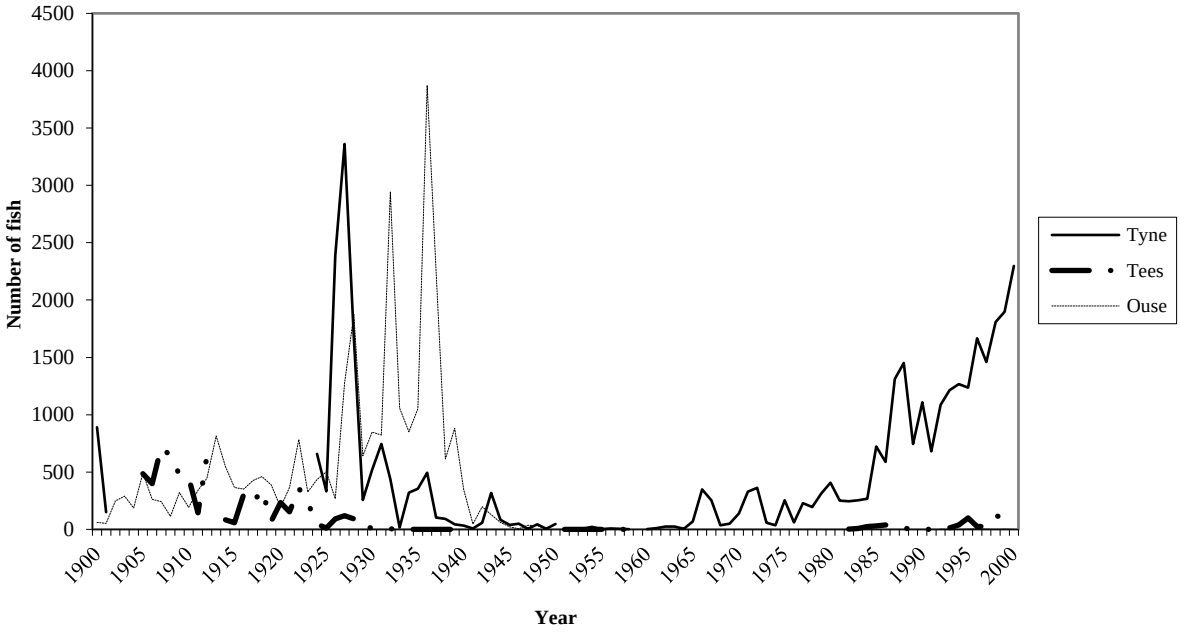


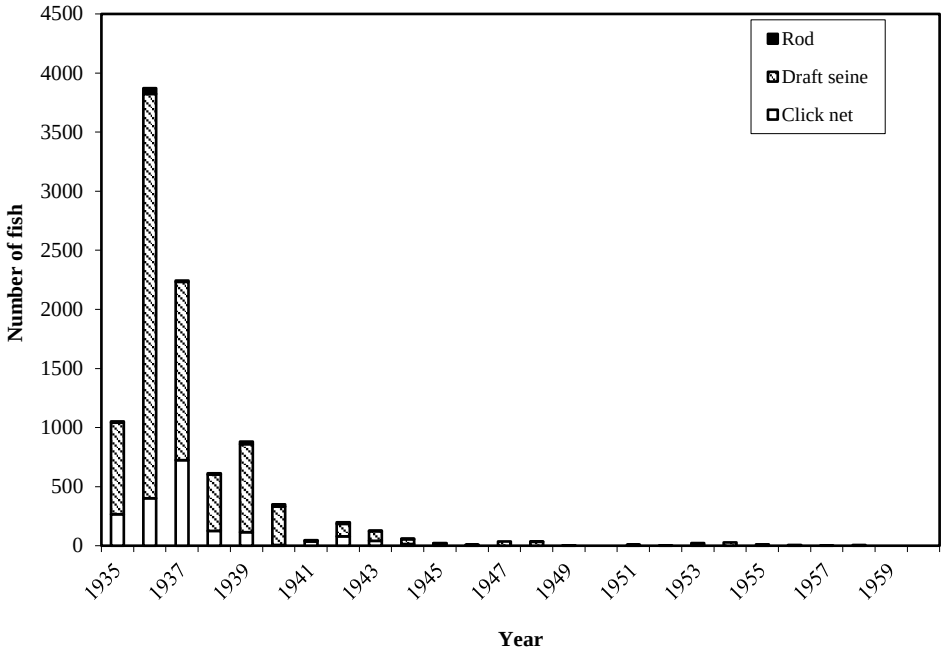
Figure 1. Salmon catches from the Tyne, Tees and Ouse

Ouse catches (Figure 1) show that catches peaked in the 1930s, but they are not readily comparable with other rivers, since they include net catches as well as rod. Figure 2 gives a more detailed breakdown of catches around this time, which shows that nets provided most of the catch, particularly the draft nets, which operate by encircling the fish. This fishery was more strictly controlled in the late 1940s, but by then it was too late. Pollution of the tidal Ouse, along with overfishing by commercial seine and click nets, seems likely to be the main cause of the sudden decline of salmon stocks in the Ouse system after the 1930s. The click nets were large hand nets that were operated by scooping out salmon that surfaced after being asphyxiated in the deoxygenated waters of the tidal Ouse. Good catches by click net could only be made in warm, dry summers when inadequate dilution of effluents caused this deoxygenation. The seine nets probably took more fish when they were held up below Naburn Weir by low flows. Demand for salmon was probably also greater during times of austerity.

Although very large catches of salmon were made from the Ouse in the 1930s, these fell very sharply in the 1940s. Very few fish were caught in subsequent decades, reflecting the poor status of salmon stocks. It is clear that salmon had been under stress from poor estuary water quality in many years, as indicated by the high click net catches in dry years. Despite this the large catches in the 1930s suggested an abundant stock. Likewise, the very sharp fall in catches in the 1940s suggests a lack of fish.

Rods made a small contribution to overall catches. There are incomplete records of rod catches before 1935, but good records since. Catches were very good in the late 1920s - the wet spring of 1928 allowed many fish to ascend and one rod fisherman took 183 fish weighing a total of 3152lb, including 39 fish over 20lb.

Figure 2. The decline of salmon catches from the Ouse



There is no doubt that the salmon stocks were heavily exploited during the 1930s and that overfishing may have contributed to the sharp decline, but some resurgence of stocks might have been expected as effort was reduced in the 1940s, particularly with a ban on netting introduced in 1947. Thus the returns suggest that this was not due to a reduction of capture effort, but was a real reflection of the state of stocks.

The problem was almost certainly in the tideway, where conditions were too poor for adult salmon in summer of most years, let alone smolts, which migrate in spring and have a narrow physiological window in which they can successfully migrate to sea. They cannot retreat from poor conditions once they enter the estuary and would not survive for long in the lower river.

In 1965, the Yorkshire Ouse and Hull River Authority, a predecessor of the Environment Agency started a salmon rehabilitation scheme for the River Ure. The scheme relied upon stocking the catchment with salmon fry, starting with 57,000 fish in 1965, which rose to 289,000 fry in 1968, and an average of 160,000 fry stocked annually. Stocking ceased in 1975 in order to allow recovery to be assessed. During the scheme to assist with the recovery of stocks, smolts were trapped at Mickley on the River Ure, tagged and transported

to Brough on the Humber in order to avoid the area of pollution in the tidal Ouse. The scheme was partly successful, with 88 adult recaptures from the 1978 batch tagged (2.3%) (Table 1). Since stocking ceased in 1975, it is likely that all smolts caught after 1978 were the progeny of fish that bred in the River Ure and its tributaries. The largest proportions of recaptures from each release year were caught in distant waters, mainly the salmon fishery off Greenland. Only 4 fish were recaptured by rod anglers in the Ouse system, while 20 fish were found dead, mostly in the tidal Ouse.

The trap at Mickley was run on an occasional basis afterwards, with 1250 smolts trapped in 1990 indicating that a small natural run of fish continued to exist in the river.

Table 1. Recaptures of smolts

Release year	Number released	Total recaptures (%)	% Distant	% Scotland	% Home	% Rod (No.)	% Other (No.)
1967	500						
1968	689	1 (0.1)	100				
1969	1248	9 (0.7)	77.8		11.1	11.1 (1)	
1970	3980	35 (0.9)	48.6	11.4	25.7	2.9 (1)	11.4 (4)*
1971	969	9 (0.9)	44.4	22.2	33.4		
1972	1320	17 (1.3)	58.8	5.9	29.4	5.9 (1)	
1973	2139	14 (0.7)	42.9	7.1	14.3		35.7 (5)**
1974	3000	86 (2.9)	91.9		1.2		5.8 (5)**
1975	1352	13 (1.0)	61.5	7.7	15.4	7.7 (1)	7.7 (1)**
1976	1257	8 (0.6)	37.5	12.5	25.0		25.0 (2)**
1977	246	1 (0.4)	100				
1978	139	1 (0.7)	100				
1979	220	0					
1980	778	1 (0.1)					100 (1)**
1981	369	2 (0.5)					100 (2)**
1982	89	0					
1983	184	0					

* one fish found dead, one caught in an eel net

** all fish found dead (mostly in tidal river)

From the results of this trial, it is apparent that stocking of salmon fry did not produce a sustained recovery of salmon stocks in the Ouse system, even when smolts were transported past the polluted zone in the tidal Ouse.

What causes the polluted zone in the tidal Ouse?

The severe depletion of dissolved oxygen in dry, summer weather in the tidal rivers of the Humber estuary system is a result of the pollution received from effluent discharges and the rivers of industrial Yorkshire. A suite of mathematical models was developed to provide a water quality management tool. The largest load of oxygen demand came from trade effluents discharging to the tidal Ouse. Trade discharges to tidal waters were poorly controlled until the Water Resources Act 1991 was implemented. Further mathematical modelling has shown that the reduction in dilution due to river abstractions, which have steadily increased since World War II, has also contributed to the degree of oxygen sag produced in the tidal Ouse. There may also have been some reduction in base flow in dry periods due to land use changes in the upper catchment.

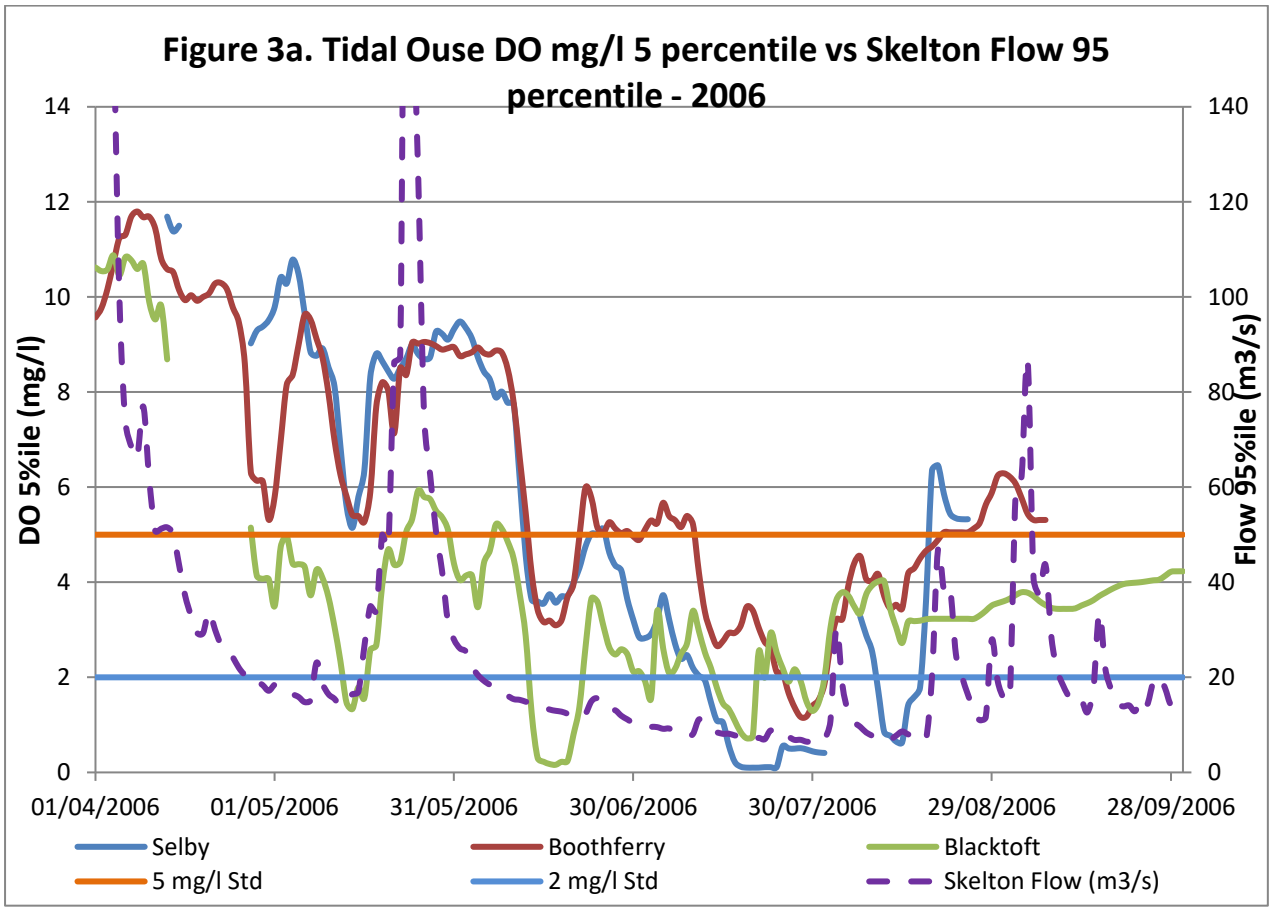
Dissolved oxygen levels in the tidal Ouse have been monitored for many years in relation to the requirements for salmon migration. However, budget cuts meant that this programme was endangered until the Humber Special Area of Conservation was designated, including river and sea lampreys as a qualifying feature. The Water Framework Directive required a Humber River Basin Management Plan to be formulated, which identified the dissolved oxygen sag in the inner estuary during summer months as one of the priority river basin management issues to tackle, largely for its possible effects on the status of lampreys. Consequently, the dissolved oxygen levels in the tidal Ouse have continued to be monitored by data sondes at Selby, Boothferry and Blacktoft from March/April to September each year.

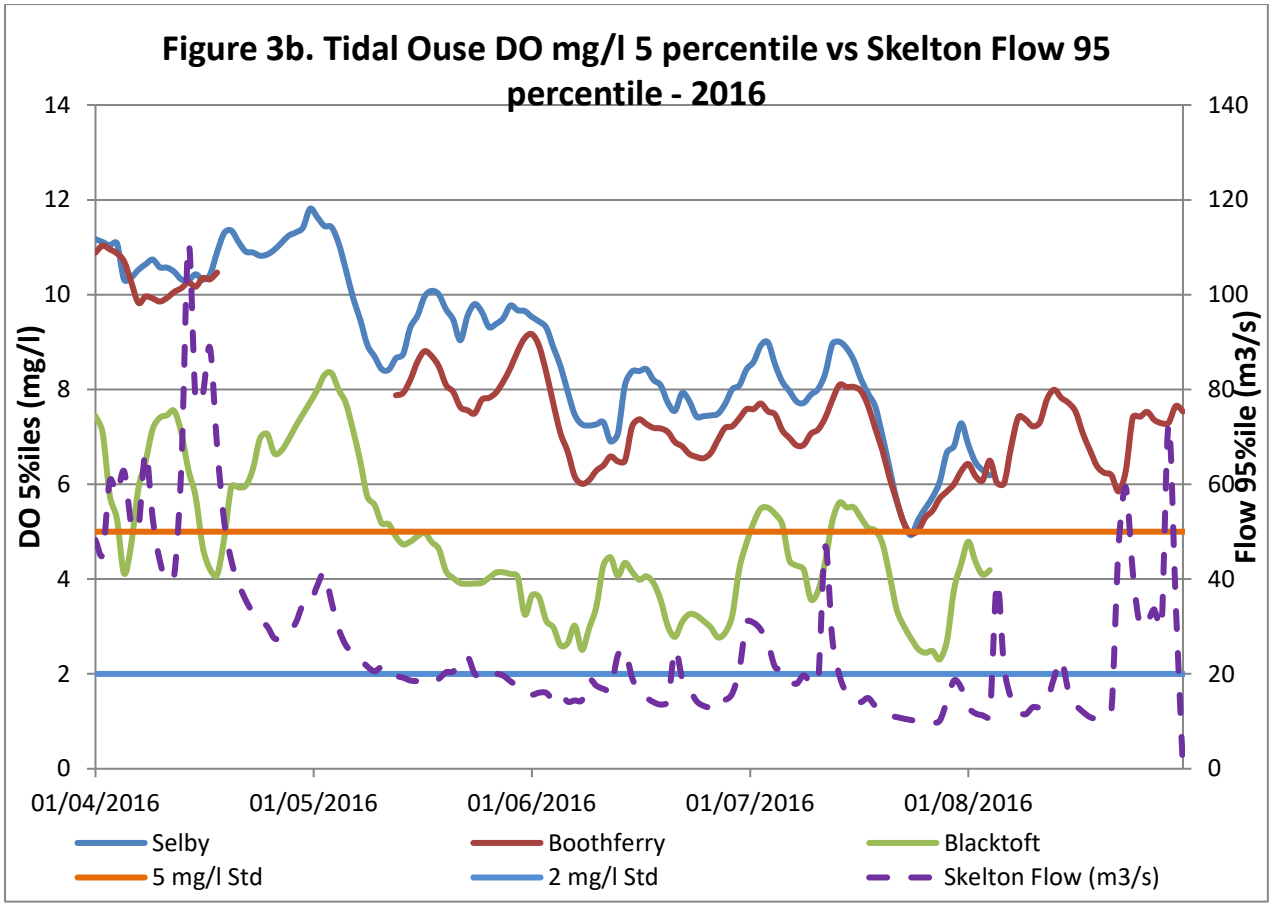
Water quality standards for dissolved oxygen have been developed for classification as required by the Water Framework Directive. They vary with salinity because the solubility of oxygen declines with increasing salinity. They are all set as annual 5-percentiles – the concentrations that should be bettered for 95% of the time. Dissolved oxygen of less than 5 mg/l means that the water quality Class would be regarded as less than Good. Once dissolved oxygen falls below 2 mg/l salmonids become asphyxiated and the standard is that dissolved oxygen should not fall below 2 mg/l at the freshwater end of tidal waters for more than one 6 hour tidal cycle over a 6 year period.

Figures 3a and 3b show dissolved oxygen 5 percentiles in 2006 and 2016 plotted against time and also show flows in the Ouse at Skelton. In 2006, dissolved oxygen levels at Blacktoft and Selby fell below the 5 mg/l standard for most of the summer and below the 2 mg/l standard for significant periods, even falling close to zero for days on end. These extreme periods occurred during low flows, but did not appear to be directly and strongly

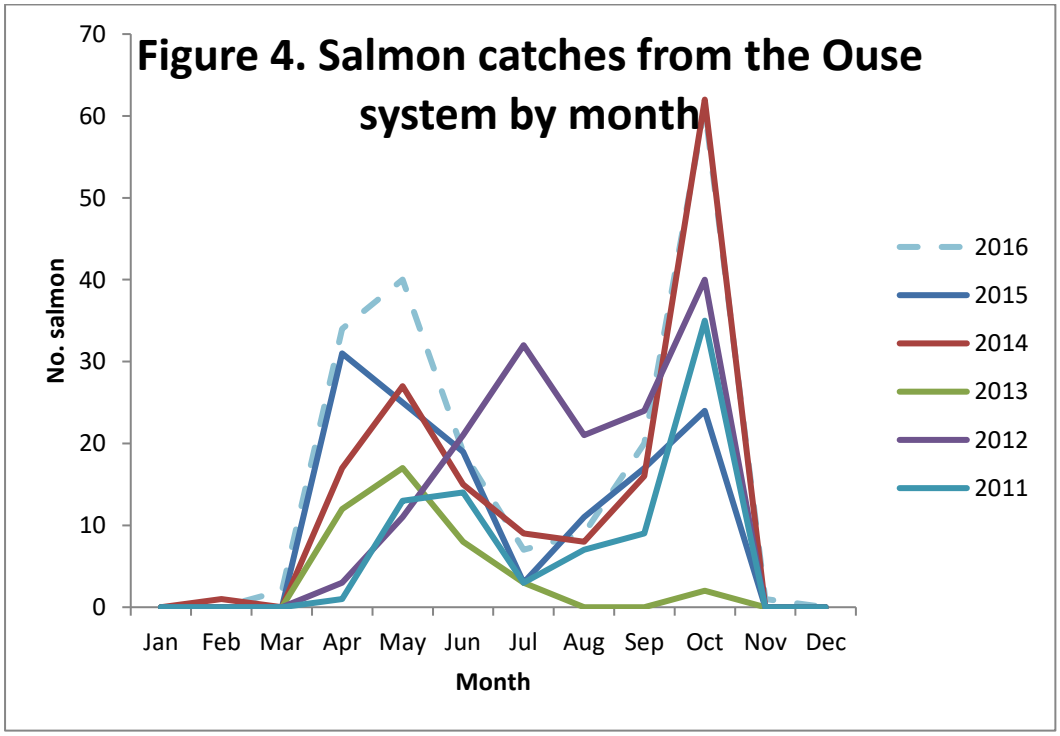
correlated with flow. 2016 saw a very significant improvement in dissolved oxygen at the Selby site, meeting the 5 mg/l standard throughout the summer. Dissolved oxygen levels also improved at Blacktoft and Boothferry, although they often fell below the 5 mg/l standard at Blacktoft. Flows were greater in 2016, but dissolved oxygen levels showed a closer relationship with flows than in 2006.

The focus was initially on the effects of Selby industrial effluents and these were assessed in 2005/6. The need for improvements to biochemical oxygen demand (BOD) loads was identified, and design of control measures began in 2007. Improved control was achieved about 2010/2011 and this is apparent in the analyses of data from the sondes. Examination of dissolved oxygen data for recent years suggests that the control of trade discharges in the Selby area has largely achieved the objective of improving dissolved oxygen levels in the tidal Ouse between Selby and Goole. In wet springs and summers, dissolved oxygen levels now comply with the dissolved oxygen standard. In 2012, a wet year, this showed in both the recorded DO 5 percentiles and the salmon catches.





The problems in dry, warm summers in the tidal Ouse and improvements in water quality are reflected in the salmon angling returns collected by the Environment Agency (Figure 4). These will, however, be biased according to the location of capture reflected in the returns.



Apart from 2012, which had an exceptionally wet summer, especially during June and much of July, catches fell away in the summer months, whereas in other local rivers, such as the Tyne, they rose steadily over the summer to an autumn peak. Summer 2013 was the warmest and driest since 2006 and this was reflected in the very low summer and autumn catches of salmon. There still seems to be a problem in dry years, which is reflected in salmon catches. These data suggest that warm summer weather is still producing unsatisfactory conditions for salmon migration in most years, but the dilution of effluents and cooler water in wet years provide good migration conditions for salmon.

Sonde data show that dissolved oxygen levels are now usually worst at Blacktoft, which may be related to inputs from the Aire, Don and Trent. The salmon (and lampreys) have to pass through this area, so their migration may still be blocked in summer and so account for the dip in catches at this time in dry years. The significance of such levels in relation to salmon stocks (and lamprey stocks) needs to be determined. If they are having significant adverse effects on stocks, then the question arises as to whether or not these low dissolved oxygen levels should be regarded as a natural phenomenon that will have to be tolerated or can be ameliorated by further attention to effluent treatment on the Ouse, Aire, Don or Trent, or by increasing flows. A new Humber dissolved oxygen model is being built and should enable the relative importance of such factors as flow, temperature and BOD to be determined in various scenarios.

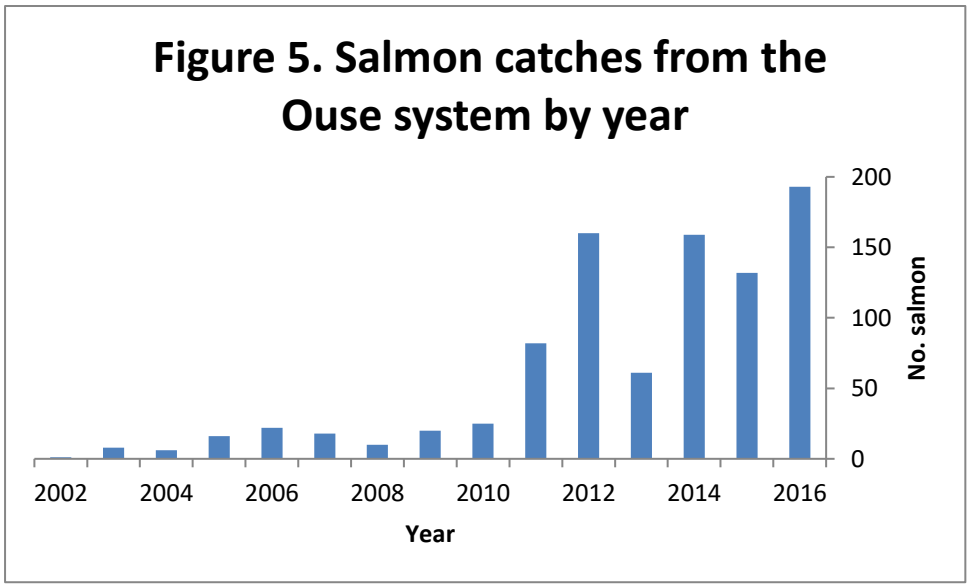
Evidence that natural recovery has been the main influence in the Ouse/Ure comes from the similar circumstances that prevailed in the Tyne, Wear and Tees. A study by in 2004 concluded that straying and improved access when water quality problems were addressed was the main influence on recovery of stocks in the Tyne. The broodstock collection, rearing and stocking scheme assisted the rate of recovery in the early years of operation, but probably had little influence in later years.

Collection of dissolved oxygen data from sondes has been funded for the next couple of years in relation to the status of lampreys in the Humber SAC review of consents, an issue that has been tackled by working with companies with trade discharges of high biochemical oxygen in the Selby area to improve their effluents. If this issue is regarded as solved in relation to lampreys, then continuation of the dissolved oxygen monitoring programme will be in doubt unless representations are made to justify its continuation in relation to management of salmon stock restoration.

Collection of sonde data ought to continue and an improved water quality model to relate to flows and effluent discharges is highly desirable. This needs to form part of the Humber River Basin Plan, since a solution may need to rely on collaboration between several parties, including the Yorkshire and Lower Trent Areas of the Environment Agency, Yorkshire Water Services and Severn-Trent Water. Other Rivers Trusts also need to be involved, since their efforts to improve salmon passage by installing fish passes at weirs may be being frustrated by blocks to migration in the tidal reaches of their rivers. Additional sondes need to be

installed to examine this on the tidal reaches of the Aire, Don and Trent and for input to an improved water quality model for the tidal Ouse.

Irrespective of the need for further data and an improved model of water quality, the sonde data and pattern of salmon catches suggests that there is still a problem for salmon migration through the tidal Ouse in the summer of most years. The Environment Agency should therefore be urged to take further actions to maintain flows and reduce oxygen demand in the tidal Ouse, especially to counter the additional influence of climate change.



In summary, therefore, the salmon stocks in the Ouse and Ure are making good progress towards recovery, but other parts of the system have a long way to go.

Threats and problems faced by migratory salmonids

Salmon and sea trout stocks have reduced in many regions of the United Kingdom. In England, the Environment Agency is keen to restore salmon stocks and has a shared vision with angling and fisheries groups which aims to address pressures at different life stages of salmon and is a vital part of restoring and maintaining England's salmon populations. The 5 points are:

1. Improve marine survival

2. Further reduce exploitation by nets and rods

3. Remove barriers to migration and enhance habitat

4. Safeguard sufficient flows

5. Maximise spawning success by improving water quality.

Improved marine survival is not something that the Yorkshire Dales Rivers Trust can have much influence over, apart from ensuring that migration through the estuary is facilitated and that smolts are in good condition on leaving freshwater.

Exploitation by nets is to be reduced as part of the new Salmon and Sea Trout Protection Byelaws, which will, in relation to measures relevant to the Humber River Basin: maintain the existing measures aimed at protecting spring salmon for a further ten years; close all drift net fisheries; shorten the fishing season, amend fishing areas and require the release of all salmon caught in the North East Coast T and J Net Fishery from 2019; require the return of all salmon caught by rod and line from rivers that have salmon populations that do not have minimum safe spawning levels set for them to be returned for the full salmon fishing season; prohibit some fishing hooks and trebles when fishing for salmon and sea trout from 2019. Due to the number of objections received, any introduction of the National byelaws has been deferred until the 2019 season.

The existing byelaw states that no person shall remove any live or dead salmon taken by rod and line from any waters or banks before 16 June in any calendar year. Schedules 1 and 2 to the proposed byelaws will require anglers on recovering rivers to return all the salmon they catch after the 16 June from 2019. The list of recovering rivers includes the Yorkshire Ouse system.

These byelaws do not prevent angling for salmon, but specify that they do not “apply to any person who lawfully takes a salmon and returns it immediately to the water with the least possible injury”.

Where salmon accumulate below weirs on their upstream migration, there is a great temptation for anglers to take salmon and there is evidence of this problem occurring below Naburn Weir. Once the Ouse is officially recognised in legislation as a recovering river requiring protection, a new byelaw to restrict angling for a distance below Naburn Weir (and other weirs on the Ouse system), similar to that operating in the Northumbrian area of the EA might be promoted.

Barriers to migration are probably the biggest current threat to recovery of salmon stocks in the Ouse system. These start with a water quality barrier in the tidal Ouse and then many weirs on the afferent rivers. In the cases of the Don and Aire, stocks of salmon were probably initially eliminated by the weirs erected. In the YDRT area, weirs and reservoir dams on the Wharfe, Nidd and Swale helped extinguish salmon stocks. Although since 1873 it has been illegal to erect or alter weirs in rivers “frequented by salmon and migratory trout” without providing a fish pass, this has not always been enforced, and once the stocks of salmon and migratory trout had been extinguished, the requirement for a fish pass was also removed. Fish passage has been assisted by installation of fish passes in the Ure system and by removal of weirs on the Laver and Burn. There are still some weirs in the Ure catchment that might be removed to assist salmon stocks.

Poor spawning and nursery habitat also affects salmon stocks in the Ure, most notably on Bishopdale Beck, where gravel removal by a local landowner has left poor habitat. The loss of gravel inputs due to the presence of reservoir dams combined with modified flows also affects some Ure tributaries. These problems for salmonids are much greater on the more heavily reservoired Wharfe and Nidd. Diffuse pollution also causes poor habitat for spawning and nursery areas.

Although large reservoirs help safeguard sufficient flows by release of compensation flows, they also modify habitats, as noted above. Natural Flood Management measures contribute to baseflows and therefore to spawning and nursery habitat as well as to water quality by dilution of effluents, which may be a long way downstream such as the tidal Ouse.

Management of salmon stocks in the Ouse system

One of the objectives of salmon conservation and fisheries management is to develop a practical basis for managing individual salmon stocks and the environment in which they live in order to optimise recruitment. This is the basis of the Salmon Action Plans produced by the Environment Agency for the Principal Salmon Rivers. To achieve this, various stock and fishery reference points are set, including spawning escapement and egg deposition. The conservation limit is a recognised standard accepted by the North Atlantic Salmon Conservation Organization (NASCO) and can be calculated from an assessment of the capacity of the river network (the whole catchment) to generate smolts from spawning and juvenile rearing habitat under conditions of high environmental quality (not necessarily existing quality).

The procedure proposed uses the principle of setting conservation limits to maximise egg deposition, and determines the fish counter or rod catch equivalent against which compliance is assessed. Although conservation limits are currently calculated at the level of the entire catchment, it would be better if individual conservation limits are derived and applied to each biologically significant unit or stock that can be identified. To achieve favourable status the adult run as measured by counters and/or catches must exceed the annual spawning escapement equivalent in any of four years over a five-year period.

Although the Ure is not classed as a Principal Salmon River, in 2002 the EA produced an unofficial Salmon Action Plan for the Ure. Calculating the spawning target for the River Ure relied on modifying a stock recruitment model from the River Bush in Northern Ireland where smolt counts and adult salmon counts have been carried out for a number of years. Altering the model to be specific for the River Ure included calculating the available spawning area, estimating rod exploitation and inputting other factors affecting in river survival.

The spawning target for the River Ure was initially identified as 9,226,168 salmon eggs or 3,286 spawning adults. Alternatively, this can be expressed as 233 eggs per 100 square

metres of accessible area. This target was then shown in terms of a predicted declared rod catch, estimated to be only 20 salmon due to the very low exploitation rate (assuming approximately 91% of the catch is declared). At an exploitation rate similar to the River Tees at that time, this would have equated to an expected declared rod catch for the River Ure of 320 salmon. However, it seems that the declared catch for the Ure/Ouse is low and the exploitation rate now much higher. As the declared rod catch of salmon for the Ure and Ouse in 2016 was 193, then the Ure seems well on the way to restoration. A revised and official Salmon Action Plan for the Ure with better data on catch declaration and exploitation rates would help put the broodstock scheme in context of restoration contribution.

The Ouse seems likely to be recognised as a recovering salmon river in proposed legislation to protect salmon, since it was included in the draft byelaw produced this year. This should entail the development of a Salmon Action Plan and to make all salmon angling catch and release. Pressure needs to be kept upon the Environment Agency and Defra to this effect and for this to be reflected in Area fisheries budgets for enforcement and monitoring in relation to salmon. There is scope for working in partnership with the EA on these aspects. It seems likely that many salmon are being removed from just below Naburn Weir, including illegally before 16 June. A new byelaw to restrict angling for a distance below Naburn Weir (and other weirs on the Ouse system), similar to that operating in the Northumbrian area of the EA is desirable and would need an enforcement budget. Fishery owners in these areas should be urged to help the restoration of salmon stocks.

Monitoring of stocks is an essential part of management. Monitoring of salmon stocks by the EA is currently minimal. A trout and salmon logbook scheme failed through lack of returns and because the Ure is not recognised as a Principal Salmon River there is no dedicated juvenile monitoring programme. On rivers such as the Tyne there is extensive juvenile monitoring and an angling logbook scheme that is well supported and has helped provide information on exploitation rates of salmon and to calibrate data received from the statutory catch returns from migratory salmonid rod licence holders. It is known that on the Ure the rod licence returns greatly underestimate catches, as many salmon caught are unreported, especially from areas leased by coarse angling clubs that fear rents might be greatly increased if the true catches were reported. YDRT and the Ure Salmon Group could help overcome such problems by assisting negotiations with fishery owners to assuage rent increase fears and working with the EA to operate a diary scheme. The YDRT might also assist with juvenile monitoring, including habitat assessment such as Habscore.

The additional details that come from an angling diary scheme with a significant proportion of migratory salmonid anglers included are extremely valuable for determining and accounting for spatial and temporal changes in exploitation rate, effort and effects of changes in fishery rules, e.g. to fly only, on catch per unit effort. For example, the high

catch rates achieved in 2012 were before more widespread application of fly-only method restriction in the Ure, so may not be comparable with later years.

A juvenile salmon monitoring programme would help to identify those areas of the Ouse system where juvenile salmon stocks are below the habitat capacity and why and how this might be overcome by management actions. This needs to be integrated with the projects to control diffuse pollution and improve habitats. It could also provide justification for stocking to assist restoration of stocks if the main problem could be removed.

Salmon counters can be a useful management aid, but need careful siting and maintenance to meet management objectives. An upstream salmon counter at Naburn on the Ouse would be a useful source of data on stocks, migration timings and indications of water quality blocking migration. One was installed during the 1990s, but was subsequently removed. Its current status and location of any data collected are unknown. Linton-on-Ouse weir might also be a useful site for a counter, in conjunction with the refurbished fish pass and hydropower scheme.

YDRT runs a fish counter at Mickley on the weir bypass channel and alongside the Archimedes screw turbine. It is clear that a number of salmon are using this route to migrate upstream, but the data would be of more use if the proportion going over the main weir via the notches could also be counted and linked to the effects of the hydropower generation and river flows.

In the absence of an integrated package of salmon counter data, the existing counter data are of limited value in the context of salmon management for the Ure as a whole.

Redd counting is another monitoring technique that shows where spawning is taking place and the abundance of spawners, but can usefully be employed only in years when redds are not rapidly obscured by gravel movement during floods.

<u>How good are the current stocks in the Ure/Ouse?</u>

Rod returns from the Ouse and Ure show average catch per return made to be ranked in the top ten in English rivers in all years since 2011. In both 2012 and 2013, the Ouse system was ranked in second place. Catch of salmon and grilse in 2012 was 0.23 fish per licence.day, better than for the Tyne.

However, the biggest problem with using rod catch returns as an indicator of the total run size is the unknown but probably very low proportion of total catch. Catches from the waters fished by Leeds & District A.S.A, Thornaby A.A and York & District A.A will far exceed the declared rod catch, but probably include few returns to the EA, often from the excuse that returns of salmon would put up angling rents. David Bamford caught 5 salmon in less than two hours at Naburn. When David Bamford was given access to many of the Ure private beats in 2012 he caught 46 salmon. Restriction of methods to fly only would have

reduced this total. 425 salmon were counted at Mickley in the bypass channel alongside the hydropower generator between April and August 2016, when the reported rod catch for the whole river and entire season was 193.

Broodstock collection and smolt rearing in the Ure and the Environment Agency attitude towards stocking

Hatchery rearing has been successfully used in some parts of the world in the initial stages of restoration of wild stocks and in some rivers, notably in Iceland, a salmon stock is maintained for angling entirely by hatchery rearing/ranching. Whilst these hatchery rearing operations may be financially sustainable, they are not environmentally sustainable. Forty years of research supports a simple, long-standing, evidence-based scientific consensus: if the integrity of wild salmon is a management priority, stocking hatchery fish should be avoided.

The current scientific literature regarding both the effectiveness and impacts of stocking salmon provides evidence that stocking salmon from hatchery-reared fish can potentially have several negative impacts. There is increasing and compelling peer-reviewed evidence that:-

- hatchery reared fish have lower survival to adulthood than wild fish of the same age;
- hatchery fish that survive to adulthood have lower fitness in terms of successful reproduction than wild fish; and
- the presence of hatchery reared fish in wild populations reduces wild population fitness.

There is little available evidence to demonstrate that stocking is effective at improving wild population productivity, and in some cases it has been demonstrated to cause harm at a population level. It is relevant that some major long term salmon stocking programmes in the UK and other countries have recently been or are being brought to an end. Hatchery rearing has no place in the EA's Salmon 5 Point Action Plan to maintain and restore stocks.

The Tyne is often quoted as an example of a successful hatchery rearing and stocking operation that is continuing to benefit salmon stocks. However, a review of the role of stocking in the recovery of Tyne salmon fisheries, showed that while the stocking operation contributed about 20% of the spawning escapement in the first six years, this soon declined and after 1995 was between 2% and 7%. Sea trout stocks recovered at a similar rate to those of salmon, but with very little stocking.

The recovery of salmon stocks in the Tyne once the major problems were removed followed the classic model of a logistic curve of animals expanding their population into a limited environment. This shows a slow increase at first, followed by a rapid rise, which then slows gradually as the environment reaches its carrying capacity. The Ouse/Ure now seems to have entered the period of rapid rise, provided that favourable migration conditions exist.

The marked increase in salmon catches from the Ouse system started in 2011, well before the stripping of broodstock and release of smolts got under way. Since most of the reared salmon smolted at 1+ and would probably return after two sea winters, then the first major contribution from the programme would have been expected in 2016, and, indeed, the total rod catch was the highest recorded in recent years (2017 totals have not yet been released). 24,000 smolts (clipped) were reportedly released from the broodstock collected in 2012 and if these smolts accounted for the additional catch recorded between 2015 and 2016, then that would give a return of 0.25%.

In 2017 catches, there seems to be a high proportion of clipped salmon, denoting those reared in the smolt release pond (Table 2) and particularly amongst those captured for potential broodstock. However, precise homing of stocked fish to their rearing area means that salmon caught in this area are more likely to be from this stock, hence showing a bias towards a high percentage of hatchery returns.

The low rate of reporting of salmon catches from the whole catchment will also positively bias the apparent rate of return of fin-clipped salmon from the broodstock scheme, alongside the spatial bias from angling in areas close to the broodstock collection and smolt release areas, where the anglers will also be keen to look for evidence of fin-clips.

Table 2. Salmon catches from the River Ure 2017 (Data from Ure Salmon Group)

Beat	Number of Fish Caught	Number Fin Clipped	Largest Fish Caught and Released	Beat Position on river
Blue Lion	6	1	25lbs	Upper mid
Bolton	47	1	24lbs	Upper
Jervaulx via Fishpal Jervaulx Fly Fishers	3	0	18lbs	Upper mid
Kilgram	6	0	14lbs	Upper mid
Swinithwaite	14	1	17lb	Upper
Swinton with Phil Ellis	21	4	19lbs	Mid
Swinton other	22	?		
Tanfield	16	1	25lb plus	Mid
Ripon Angling Club	1	1	14lb	Lower mid
Broodstock	19	2	18lb	Mid
	155	**11**		
		7.09%		

From review of the data from EA rod returns, local angling returns and counter data, it would seem that the restoration of salmon stocks in the Ouse/Ure has largely come about naturally following the improvement in dissolved oxygen levels in the tidal Ouse, especially in the wet year of 2012 before the scheme made any contribution. Overall contribution of the local broodstock scheme and smolt rearing to stocks is now low, but much greater around the areas of smolt release and broodstock collection.

The future of the YDRT broodstock collection and smolt rearing programme

Now that the Ouse system is to be regarded as a recovering river in national legislation and restoration is well under way, the YDRT broodstock collection and smolt rearing scheme in its current form is no longer a sustainable requirement of the wild salmon restoration scheme for the Ure/Ouse. However, this would depend on continued recovery.

I do not believe there is currently justification for continuing to operate the smolt release pond by the River Burn. However, the restoration of salmon to the Ure may still need support if migration conditions or some other factor cause collapse of the stock. For example, upstream migration conditions in the first half of 2018 were excellent, but the warm, dry June may well have adversely affected both upstream and downstream migration of salmon.

Adding individuals may rescue small populations from extirpation by chance events that prevent the population replacing itself and help kickstart recovery in other rivers where limiting factors can be removed. Therefore the broodstock holding and parr rearing tank should be retained for future use in the case of urgent need or planned programmes of restoration. For example, to support restoration of stocks at locations in the Ouse system with poor salmon stocks or for restoration in the Ure should catastrophic losses threaten the run. A case might also be made for a local broodstock collection scheme to support restoration of salmon stocks to the Wharfe, Swale or other parts of the Ouse system where river reaches are opened up by fish pass installation or water quality limitations overcome. They could be used, for example, for investigative stocking of the River Swale above Richmond Falls to see whether or not Topcliffe Weir and Richmond Falls are major constraints to the recovery of stocks in the Swale, could help attract spawning salmon to areas of the upper Ure where the habitat has been improved or weirs removed and in the Wharfe, above where fish passes have been installed.

However, salmon are not universally welcomed, as they may increase fishing rents and ticket prices and interfere with brown trout fishing. In the upper river, juvenile salmon may displace juvenile trout and adult salmon may not arrive until the season has closed. Catchments where they have been absent for a long period may be more resistant to restoration of stocks than where they common in more recent years.

The broodstock collection, holding, stripping and rearing of parr consumes much officer time, which might best be diverted to improving fish passage and working with the EA on such matters as dissolved oxygen monitoring, juvenile salmonid monitoring, habitat assessments, enforcement of catch-and-release rules, improving catch returns and fish counter operations on all the YDRT rivers with the potential for salmon restoration.

Recommended actions by the YDRT and others over the next five years

Salmon stocks in the Ure/Ouse seem to be increasing rapidly. I have never seen salmon leaping in the river above Naburn Weir like I did this spring. However, with increasing numbers come increasing problems of management of illegal fishing, diseased and dying fish, complaints from coarse and trout anglers about rent increases for angling, and additional attention to habitat problems for salmon. YDRT should develop a Salmon Strategy that covers such issues and guides its officers.

A Salmon Strategy should include the status of broodstock collection and hatchery rearing schemes and their compliance with Environment Agency requirements with permits and consents. The current scheme appears to have largely achieved its objective on the Ure, barring catastrophic events affecting stocks. Attention now needs to be placed on the need for assisting recovery of stocks in other parts of the Ouse catchment once problems are removed.

Weirs block migratory salmonid passage and lead to increased predation and fishing pressure. YDRT should open discussion with the EA about introducing a byelaw similar to that in the Northumbrian Area of the EA that bans angling for a set distance below specified weirs.

YDRT should work with others to try to ensure that water quality in the tidal Ouse remains suitable for salmon migration. This should also be included in the Humber River Basin Plan. Monitoring of dissolved oxygen and temperature by sondes should continue between April and September; the factors affecting dissolved oxygen should be modelled; pressure maintained on industry in the Selby/Goole area to improve effluents; pressure maintained on Yorkshire Water Services and Severn Trent Water to improve effluent discharges to the Aire/Calder and Trent in relation to abstractions affecting the dilution of effluents affecting the tidal Ouse.

We have a copy of the Salmon Action Plan produced by Paul Frear of the EA and we should offer to assist the EA to produce an updated version that could guide actions of all parties and perhaps influence budget expenditure priorities within the EA locally and nationally.

Great benefits for wild salmon stocks in the Ouse system seem likely to come from assisting recolonization of areas where they were historically present, including rivers outside the YDRT area. Topcliffe Weir is currently recognised by the EA as the top priority for installation of a fish pass. It is unfortunate that plans for installing this using an EMFF grant have failed, but further collaboration with the EA may yet achieve this using other grant sources. There may be resistance from some angling groups to fish passes or weir removal that reduces stocks of fish in their section of river.

Juvenile monitoring of salmon stocks in the Ure by the EA is almost non-existent. It could have great utility if linked to Habscore assessments for deciding actions required to improve

stocks. This might involve investment in equipment and training of YDRT staff and volunteers.

Walkover surveys of river habitats using field mapping techniques provide a detailed representation of the precise location and extent of various habitat features. They can also be used for diffuse pollution tracing and noting of deposition of excessive fine sediment. Fish population habitat surveys and mapping can generate a baseline of habitat availability. The information can also include obstructions that are potential barriers to migrating fish.

The fish counter at Mickley is apparently on extended loan so its future is uncertain. Service and repair costs may also be an issue. Fish counters at Naburn Weir and to cover the main weir at Mickley would provide a very useful tool for salmon management on the Ure/Ouse.

The EA catch return system does not identify the method or specific location of capture of migratory salmonids. The EA did run a local diary scheme but did not get many returns, perhaps because there was little incentive to return the diary and anglers were worried that good catches might put up fishery rents. The Northumbrian Area of the EA, however, has had considerable success with a similar scheme that has helped interpretation of the EA catch returns and counter records.

Proportions of clipped fish taken during broodstock collection and in this locality are likely to be biased in favour of the success of the smolt rearing scheme. Examination of catches lower down the system, e.g. at Naburn would give a fairer picture.

Redd counts would help to identify good spawning areas and the abundance of spawners.

<u>Summary of recommended actions by YDRT and others over the next five years</u>

1. Produce a salmon strategy for the Ouse system to ensure optimal use of officer time and funds in restoring salmon stocks. This should include strategies for the broodstock collection and hatchery rearing schemes, and for improving fish passage. These should also include arguments required to persuade fishery owners of their merits.
2. Explore with the EA the possibility of introducing a byelaw to prohibit fishing for migratory salmonids just below weirs.
3. Improved liaison with the EA over dissolved oxygen levels in the tidal Ouse and links to temperature, flows and inputs from afferent rivers. Push for a revised mathematical model of dissolved oxygen and continuation and expansion of sonde data collection. These aspects to be included in the Humber River Basin Plan.
4. Assist the EA to produce an official Salmon Action Plan for the Ure/Ouse.
5. Carry out habitat assessments, including walkover and site surveys, and associate with juvenile salmonid monitoring to assess habitat utilisation and areas requiring improvement, working alongside the EA.

6. Work with the EA and others to provide a fish counter network relating to salmon stocks in the Ure/Ouse. Check that any hydropower schemes include a counter requirement in the fish pass.
7. Improve interpretation of catch returns from the Ure/Ouse and set up local diary schemes like those on the Tyne, where method, exact dates of capture and further details of location, etc. can be recorded. Calibrate against counter records.
8. Collect data on clipped salmon from various parts of the Ure/Ouse.
9. Organise redd counts to identify spawning areas and assess numbers.