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Our nations' fisheries

The migratory and freshwater fisheries of England and Wales – a snapshot

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The Environment Agency is the leading public body protecting and improving the environment in England and Wales.

It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats. We also maintain, improve and develop fisheries.

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Our nations' fisheries

Our fish stocks can tell us a lot about the state of our environment. Monitoring fish stocks can help us see where pressures are impacting on our rivers.

The fish populations of England and Wales, together with the fisheries they support, are of enormous environmental, social and economic value. Fish contribute substantially to the economies of both countries with four million anglers spending around £3 billion a year.

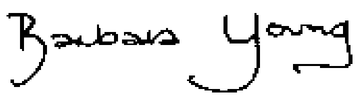
In Wales and rural England angling tourism is growing, bringing new income to these areas. And in urban areas angling provides a healthy and enjoyable pastime and is often the first contact many people have with wildlife.

But it is not all good news for fisheries. Insensitive urban developments and pollution from agriculture can threaten fish habitats

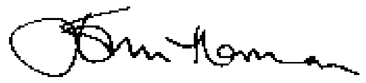
Climate change may be linked to a worrying decline in the number of eels returning to our waters and the reduction in salmon numbers.

This report presents for the first time information about the condition of fisheries for the whole of England and Wales. It also highlights some key issues that we need to address in order to guarantee the future of our fisheries.

This report is an important contribution to the understanding of our environment and sets an important baseline for the future assessment of our fisheries.



Chief Executive, Environment Agency



Chairman, Environment Agency

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Summary

Our nations' fisheries is the first comprehensive report on fish communities and fisheries in England and Wales. In publishing details of the abundance of coarse fish, salmon, trout and eels and the performance of the rod and net fisheries that depend upon them, we also highlight key factors that are affecting fisheries. The progress we all make in managing these factors will largely determine what improvements in fish stocks, and hence in fishery values and performance, we can report in future editions.

Inland fisheries are among our most valuable natural assets. Fish are indicators of the health of our freshwater environment; four million regular anglers each spending on average over £1000 per year on tackle, travel, accommodation and meals during their fishing trips support many thousands of jobs, mainly in rural economies; and participation in angling helps address social problems such as youth offending, anti-social behaviour and truancy. While offering a much smaller contribution, net fisheries for salmon, sea trout and eels can support local economies in some rural and disadvantaged areas.

So how are our fish stocks? The overall picture is reasonably encouraging, but behind that generalisation are some very serious concerns and, thanks to a lot of people's hard work and commitment, some tremendously encouraging success stories too.

Coarse fish numbers are increasing in many of our rivers. In the most recent survey, fish were present at over 98 per cent of sites, and 50 per cent of sites contained eight or more species. This is a big improvement on a decade ago, when many more rivers were grossly polluted with their fish communities restricted to just a few fish of one or two species. Investment in improved sewage treatment has made a big difference to previously fishless rivers such as the Yorkshire Rother, the West Midlands Stour and the rivers of the Manchester conurbation. Although there have been recent year-to-year fluctuations on some rivers, angler catch rates on many important lowland river fisheries, have improved over the past two decades.

Monitoring programmes previously focussed mainly on the more popular and potentially vulnerable river fisheries, and so our knowledge of the status of stillwater coarse fish communities and fishery performance is limited. Many coarse anglers now fish mainly or entirely on stillwaters, an increasing proportion of which are densely stocked to provide catch rates 10 to 20 times those typical of river and canal fisheries. In the light of this shift in angler preferences as well as the introduction of new European legislation, we will need to adapt our monitoring programmes so that we can report more comprehensively on stillwater fisheries in the future.

Salmon stocks are seriously depleted, and stocks of multi-sea-winter fish particularly so. Seventy per cent of rivers failed to meet their conservation limits in 2002, with 46 per cent achieving less than half of this limit. However, it is not all bad news. Stocks on some previously polluted rivers including the Tyne, the Tees and rivers of the South Wales Valleys have recovered dramatically: these recovering rivers now account for some 25 per cent of the total salmon catch.

Sea trout stocks are generally doing very well. The total reported catch in 2002 was significantly greater than the catch of 2001 and above the average for the past five years. Moreover, sea trout abundance has increased on the majority of rivers since 1974 – in many cases significantly so.

In the most recent survey, fish were present at over

98%

of sites

50% of sites contained

8+

species

but

70%

of rivers failed to meet their conservation limits in 2002

Fishing effort in the salmon and sea trout net fisheries of England and Wales has reduced over the past two decades, largely as a result of the phasing out of fisheries that target mixed-stocks. Consequently, the catch in most net fisheries has also fallen. In the North East Coast drift-net fishery, effort halved over the period 1992 to 2002, but the reported catch did not reduce to the same extent. A substantial reduction was recorded in 2003 following the recent buy-out of the majority of the nets.

Partly in response to declining salmon stocks, fewer anglers now fish for salmon; however, rod catches remain fairly steady. Increasingly, anglers are playing their part in the drive to restore salmon stocks. From just 10 per cent a decade ago, the proportion of rod-caught salmon released to augment the spawning stocks rose to over 50 per cent in 2002. That must help, and we may just be seeing the start of an upturn: the proportion of multi-sea-winter fish in the overall rod catch was up by 10 per cent on 2001 and by 14 per cent compared with the average for the preceding five years.

Trout are distributed across much of England and virtually the whole of Wales, with isolated populations of native brown trout present in more than 50 per cent of river catchments. In the majority of sites surveyed most recently, juvenile trout numbers were above the average of a decade ago.

Eel stocks are critically low. The number of juvenile eels returning to our rivers has collapsed to just one per cent of historic levels, prompting the International Council for the Exploration of the Sea (ICES) to declare that the European eel stock is outside safe biological limits and that the current fishery is not sustainable. The reasons for the decline are unclear, but changes in the marine environment may be particularly significant.

Agricultural run-off, including silt, pesticides and fertilisers, is causing serious damage to aquatic habitats, fish and other wildlife. The Agency is committed to working with the farming community, Rivers Trusts and other partners to secure greater protection for freshwater habitats and the fish populations that depend upon them. Domestic and industrial effluents, and water abstraction can also degrade habitats and water quality, seriously affecting fish and the creatures upon which they feed. Now that we have eradicated most gross, point source pollutants we may need to focus more attention on other potentially harmful substances such as endocrine disrupting chemicals that can enter waterbodies. In particular we need to investigate whether mixtures of these substances have safe threshold levels lower than those for the individual substances alone.

We intend to publish future editions of this report at regular intervals, informing our stakeholders of fishery status and trends and of current and emerging issues likely to be affecting fishery performance.

1

Introduction

From large lowland rivers of eastern England to small streams in upland Wales, and from the Cumbrian Lakes to the West Midlands canals, the wide diversity of our inland and migratory fisheries makes a major contribution to our natural and social heritage. Safeguarding the health of our fisheries is therefore essential.

Healthy fisheries support angling and commercial fishing as well as contributing to wildlife conservation and biodiversity. (When we use the word 'fishery' in this report, we are therefore referring both to fish and their habitats and to the fishing activities that they support.) More than a million people buy fishing licences each year and up to a further two million fish on an occasional basis, making a significant contribution to the economy [Ref. 1]. Moreover, society as a whole benefits from the improved health and the education that stem from people's enjoyment of this natural resource. Indeed, it is Government policy to make the most of the benefits that fisheries have to offer to local communities and for the country as a whole.

The Government and Welsh Assembly Government have issued Statutory Guidance [Ref. 2a and 2b] to the Environment Agency to: 'maintain, improve and develop salmonid and freshwater fisheries, and in particular:

- to ensure the conservation and maintain the diversity of freshwater fish, salmon, sea trout and eels and to conserve their aquatic environment
- to enhance the contribution salmon and freshwater fisheries make to the economy, particularly in remote rural areas and in areas with low levels of income
- to enhance the social value of fishing as a widely available and healthy form of recreation
- (specifically in Wales) to contribute to the Welsh Assembly Government's aims and objectives for freshwater fisheries management'.

To achieve these objectives, we set management targets, measure their achievement and the effectiveness of the techniques we use. Of course, fisheries are important to many other people, who can and do make important contributions to this work; they also want to know the current status of fisheries and the main factors that affect them. That is why we have produced this report.

Our Nations' Fisheries describes the current status of our fish stocks and fisheries, and it will serve as a baseline for future reporting. Where historic information is available, current performance is set in this context. The report also considers many of the factors influencing fisheries and the opportunities that exist to enhance their value.

Following a brief description of the methods of monitoring fisheries and constraints on their use, the main body of the report is divided into six chapters:

- Angling participation in England and Wales
- Coarse fisheries
- Salmon and sea trout fisheries
- Brown trout and grayling fisheries
- Eel and elver fisheries
- Factors affecting fisheries.

Our Nations' Fisheries has been written for people with either a professional interest or a personal stake in fisheries – individual fishermen, fishery owners and their representative organisations; local authorities and national governments; Rivers Trusts; and nature conservation and recreation agencies. After all, realising



1 The Bristol Avon at Limpley Stoke. England and Wales have abundant and diverse freshwater fisheries that provide a valuable conservation, economic and recreational resource.
2 A small day-ticket coarse fishery. An increasing number of stillwaters are being managed as fisheries, providing a valuable recreational resource.
3 Perch are often an angler's first catch.

the full potential that our fisheries have to offer will require all of these interests to work in partnership.

Although in this first report we have tried to cover the key aspects of inland fisheries, there is always scope to improve. In future editions we may be able to include more information about individual fisheries. Similarly, while techniques for monitoring fish populations are well established, methods of assessing socio-economic parameters such as angler behaviour and preferences are less well developed; this is an area we would want to cover more comprehensively in future.

A joint effort

All those with a stake in fisheries have a stake in fisheries monitoring. After all, we seek the information to answer questions each of us asks in order to manage fisheries.

For example:

- How can I improve my fishery?
- What factors influence angling participation?
- How are fish populations likely to respond to climate change?

Many of the questions addressed in this report have been brought to the fore by angling organisations and others; indeed, the information we need to collect to answer these questions is rarely the sole responsibility or possession of a single interest. And so, while the report has been collated by one organisation, this has been possible only through the collective efforts of a range of stakeholders. For example, each of the Environment Agency's 2500 annual electric fishing surveys is reliant on the co-operation and goodwill of fishery owners, riparian landowners and angling clubs. Similarly, much of the information in this report comes from angling and net catch returns and has been interpreted in collaboration with other agencies.

Future reporting

This is the most comprehensive account to date of the overall status of migratory and freshwater fisheries, and it includes references to other sources where greater



1 A Thames salmon. Salmon are now returning to a number of urban rivers for the first time in decades.
2 A wild brown trout about to be returned to the River Monnow. Wild trout are increasingly recognised as an important angling resource and conservation species.
3 An adult eel is measured during a survey. Eels are fished for commercially in both their young and adult stages.

detail can be found. For example, *Salmon Stocks and Fisheries in England and Wales* [Ref. 3], the annual report to the International Council for the Exploration of the Sea, is produced jointly by the Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS).

As we collect and analyse more data in successive years and improve our ability to monitor different facets of fishery performance, we should gain a better understanding of inland fisheries and the factors affecting them, and so we will be able to publish more comprehensive reports.

Feedback

We will strive continuously to improve the content, style and relevance of future reports. The process of improvement will be greatly helped by the feedback we receive from readers on this and subsequent editions. Please email your comments to fisheries-status@environment-agency.gov.uk or write (using, if you wish, the feedback report form) to:

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Your views will be welcome.

2

Why, what and how we monitor

Accurate, adequate and up-to-date information on the status of fish stocks, their habitats and fishing is essential for sound fisheries management. Whether considering the introduction of new fishery regulations or options for habitat enhancement, fishery managers are reliant on monitoring results to inform and justify their decisions.

A number of agencies and organisations across England and Wales monitor fisheries. Their work ranges from individual stillwater surveys for fishery owners, through catchment-wide assessments undertaken by Rivers Trusts, to long-term monitoring programmes managed by the Environment Agency.

Work on the Environment Agency's National Fisheries Monitoring Programme began in 2001. Prior to this, monitoring was undertaken primarily to service local needs such as post-pollution impact assessments and regional strategic surveys. The new programme is aimed at providing information, at a local and national level, about the status of fish stocks and trends in fishery performance. It was designed with three key principles in mind: all the data collected should meet specific management needs, as far as possible it would meet predetermined statistical criteria, and it would be based on sound science. With the foot and mouth outbreak restricting access to watercourses in many areas in 2001, 2002 was the first year that we were able to collect the comprehensive data set necessary for producing this baseline report.

Monitoring methods are many and varied. They range from netting surveys, through electric fishing to modern, sophisticated acoustic surveys. Details of specific monitoring techniques are found in Appendix 1.

While monitoring work has historically focussed on fish populations, attention is now turning to other aspects of fisheries. The current national monitoring programme has four components: fish populations, habitats, participation in fishing and the benefits it provides to society, and finally catch results and the effectiveness of various fishing methods.

Fish populations

By using a range of techniques, from fish traps and automatic fish counters to electric fishing and echo-sounding, we can obtain a realistic picture of the status and trends in fish populations across England and Wales. Our monitoring network comprises four tiers: index, temporal, spatial and sentinel sites.

- **Index sites** *(see Figure 2.1)* are monitored intensively to increase our understanding of fish species and their population dynamics, and how environmental and human influences affect them. This involves measuring fish abundance and analysing age structures and sex ratios at a limited number of locations. We have so far developed a salmon index monitoring programme on four principal salmon rivers, and we are designing equivalent programmes for other species.
- Some 545 salmonid and 1010 coarse **temporal sites** *(see Figure 2.2)* are surveyed annually to a lower level of detail than index sites to determine long-term trends in fish populations on all principal river fisheries. In statistical terms, this should be able to detect a 10 per cent change in populations over a ten-year period.
- **Spatial sites** *(see Figure 2.3)* are monitored to detect differences in fish populations between different locations with similar habitats, for example between neighbouring sub-catchments. The sampling frequency for these 4010 salmonid and 825 coarse fish sites can afford to be somewhat lower, and so each site is surveyed once every five years.

The geographic coverage, on the other hand, is much greater than that of either the index or the temporal programme.

- Finally, 575 salmonid and 495 coarse fish **sentinel sites** are monitored once every five years to provide information on the distribution of various fish species, including those that are not sought by anglers but which are of general or high conservation value – for example minnows and bullheads.

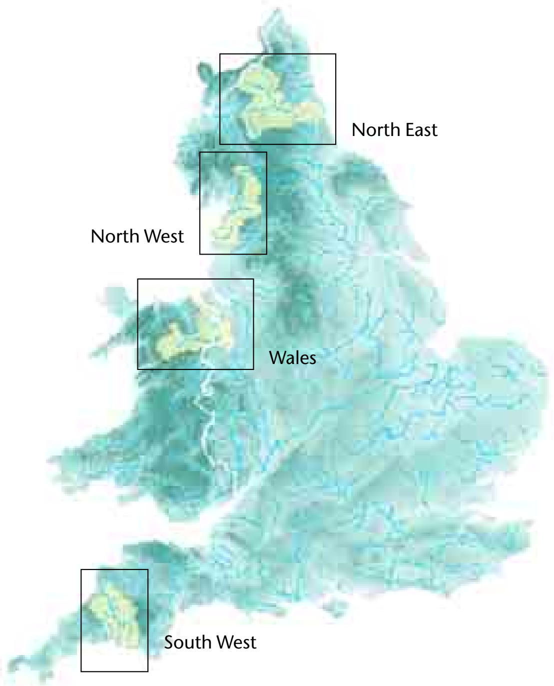
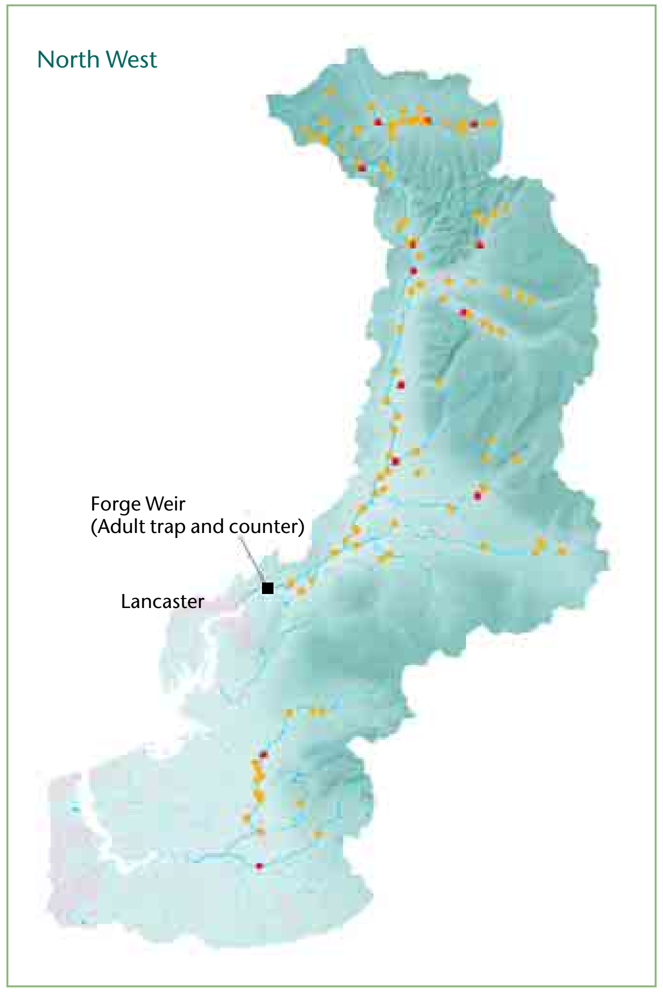
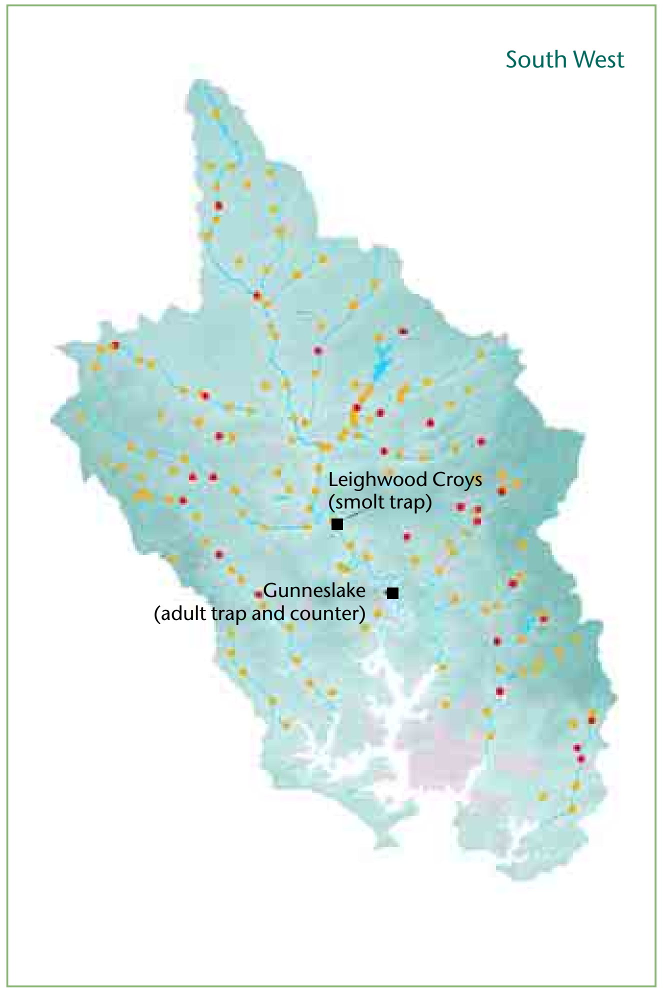


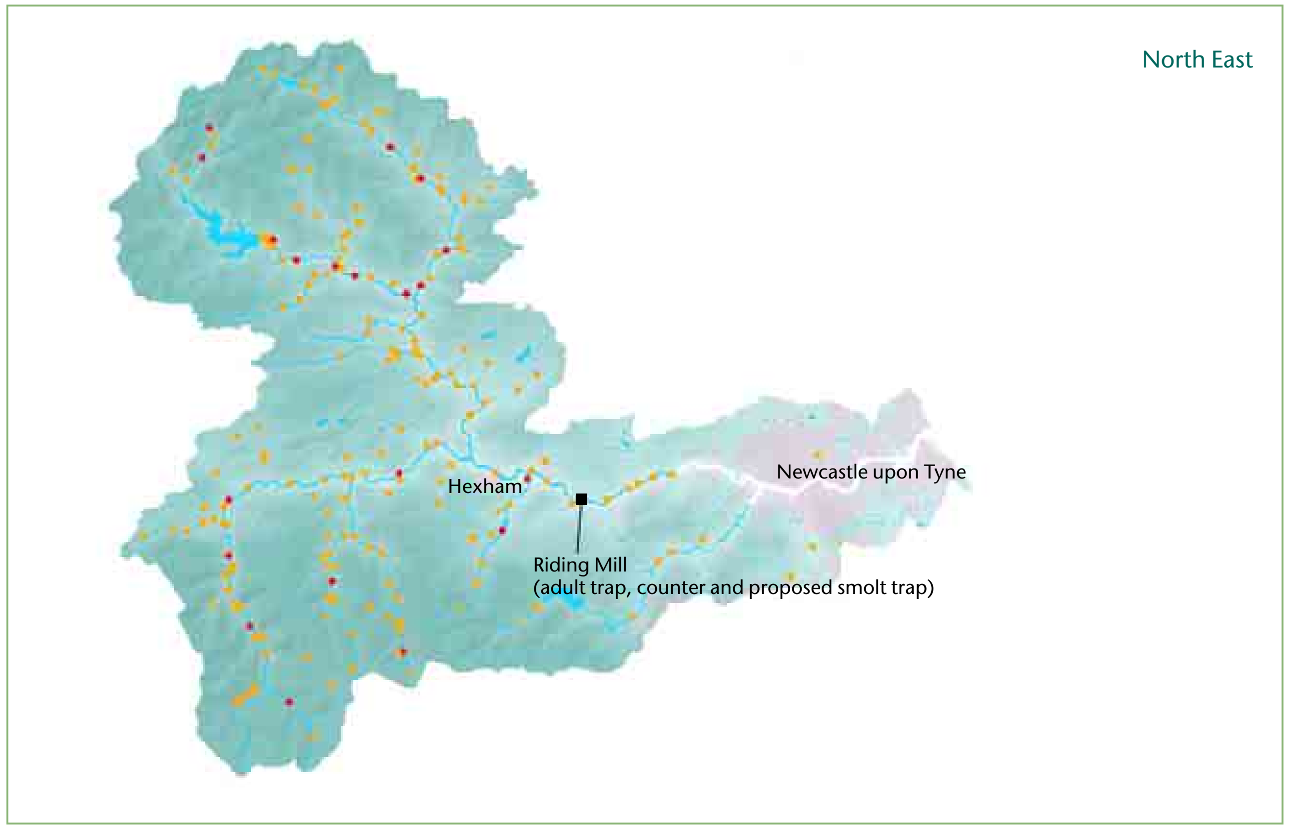
Figure 2.1 **Salmon index monitoring catchments**

The index monitoring programme is based on rivers in Wales, and the South West, the North West and the North East of England. This geographical spread helps us understand the characteristics of the various salmon stocks around England and Wales.

- ■ Fixed monitoring sites (fish traps and counters)
- ● Fully quantitive survey sites
- ● Semi quantitive survey sites







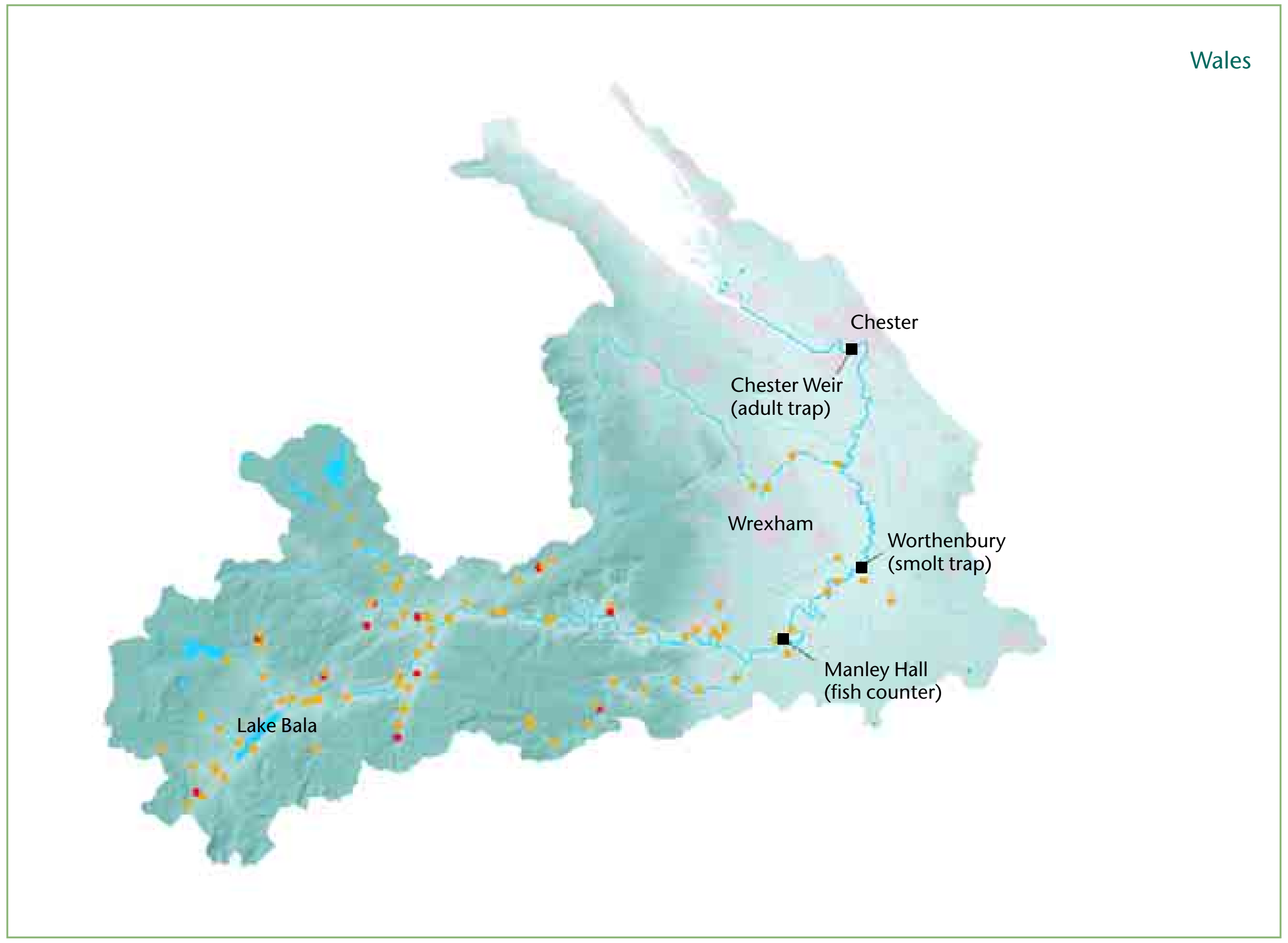


Figure 2.2 **Distribution of temporal monitoring sites across England and Wales**

These sites are surveyed each year to detect trends in fish populations through time.

- ◆ Coarse fish
- • Salmonid

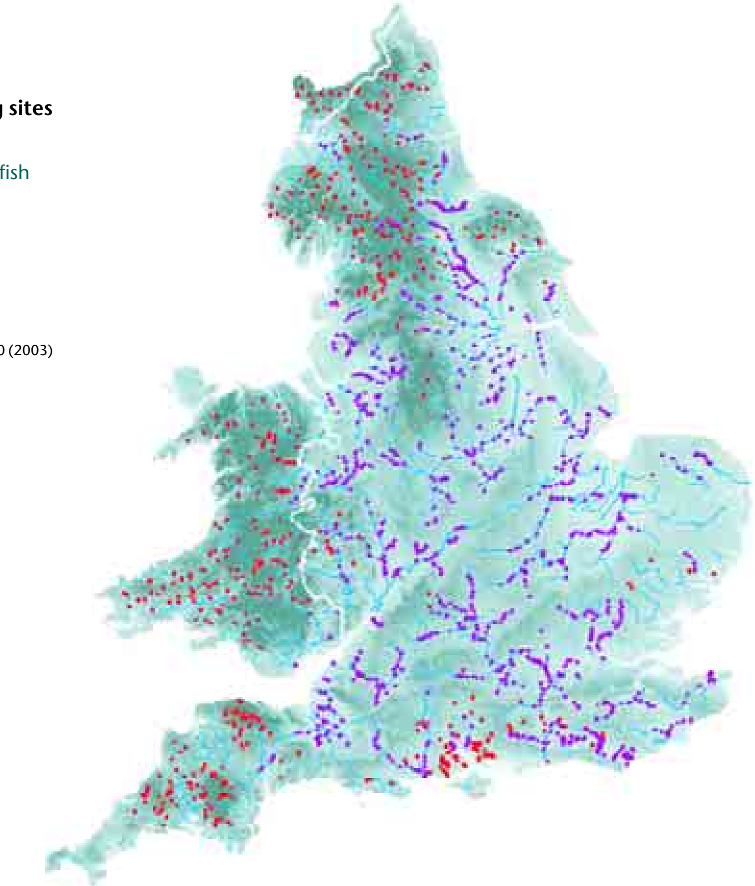


Figure 2.3 **Distribution of spatial monitoring sites across England and Wales**

For salmonids in particular, a greater site density is required to identify differences between catchments. Sites are monitored every five years.

- ◆ Coarse fish
- • Salmonid

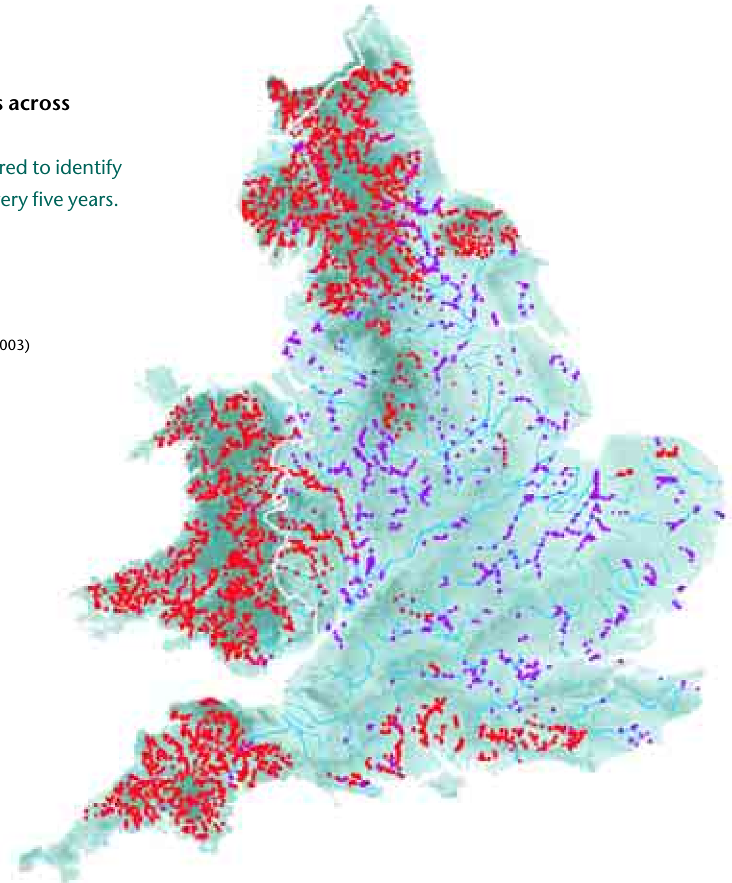
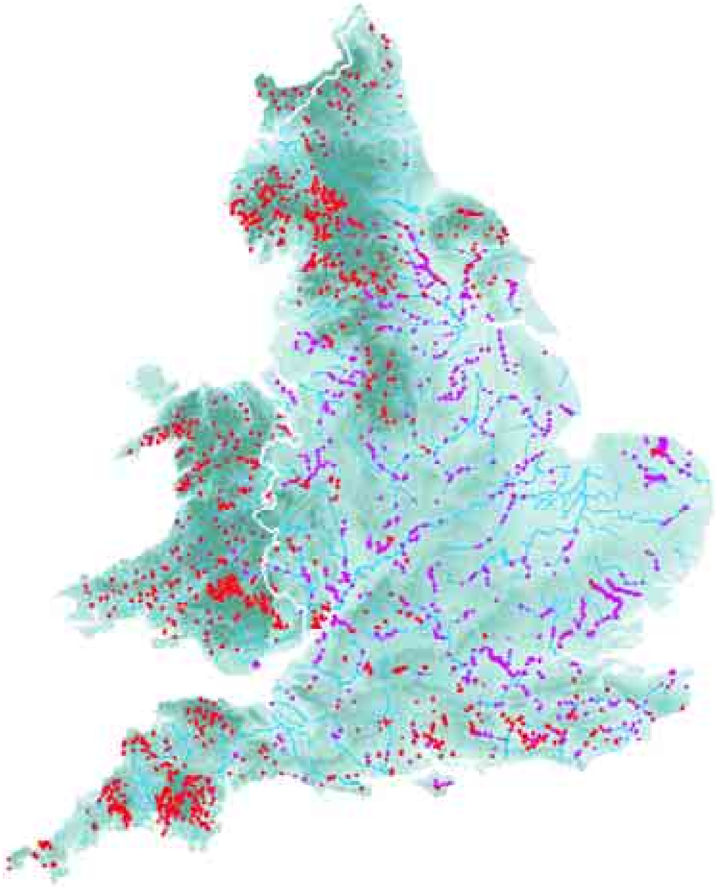


Figure 2.4 **Sites surveyed during 2002**

1140 Salmonid sites and 930 coarse fish sites were surveyed in 2002.

- Coarse fish
- Salmonid



Across England and Wales the national monitoring programme covers a total of 7625 sites, of which 5130 are salmonid (salmon and trout) sites and 2496 are coarse (other freshwater fish) sites. Of the 2070 sites surveyed in 2002, some 1140 were on salmonid fisheries and 930 on coarse fisheries. The distribution of these sites is shown in Figure 2.4. As is to be expected, the salmonid sites are mainly concentrated in the upland rivers of the north and west, while the majority of coarse fish sites are in the larger lowland river catchments of the south and east.

In future years, we will be able to report on trends in fish populations across England and Wales. However, using the Fisheries Classification Scheme it is possible to evaluate a single year's data relative to pre-determined benchmarks.

Fisheries Classification Scheme

The Fisheries Classification Scheme [Ref. 4] is a means of evaluating the results of fish population surveys and translating them into a more readily understandable form. Measures of fish abundance, in terms of weights or numbers of fish per 100 square metres of water surface, are compared with a set of standard abundance classes. These have been derived from surveys of 950 sites undertaken during the early 1990s and represent a baseline for comparison. These classes are defined as:

A – well above average (compared with the early 1990s baseline)

B – above average

C – average

D – below average

E – well below average

F – fishless

The scheme provides several levels of classification detail. At the most general level, an overall score is given for all fish present whether salmonid or coarse fish. At the next level, separate classifications are given for all coarse fish and for all salmonids. These are separated further at the greatest level of detail, where a score is given to different components of the fish population. At the fine detail level, a classification can be given for:

- Salmon fry
- Salmon parr
- Migratory and non-migratory trout fry
- Migratory and non-migratory brown trout parr
- Fast water (rheophilic) coarse fish, for example barbel and chub
- Slow water (limnophilic) coarse fish, for example roach and bream
- Predators, for example pike and perch

The Fisheries Classification Scheme can only be used to classify river fisheries where quantitative sampling provides an accurate estimate of abundance.

1 2 3

1&2 The site (1) has overgrazed banks denuded of vegetative cover, a silted bed and little in-stream cover to act as sanctuaries when predators threaten young fish; using Habscore we have calculated its Habitat Quality Score (HQS) as being only 27 fish per 100 square metres. In contrast, the site immediately downstream (2) has protected bank-side and in-stream weeds and clean spawning gravel; its HQS is much higher, at 36 fish per 100 square metres.

3 A fishing match on the River Weaver. Fisheries need to be managed not only for their fish populations but also for the people who currently fish there and those who might wish to do so in the future. We therefore need to understand the factors of importance to anglers and to monitor trends in these preferences.

Only when we have results from a number of years of monitoring will we be able to detect any significant changes. When we report in future years we hope to see the proportions of sites in Classes E and F reducing and consequently those in classes A to D increasing.

Habitats

We monitor river and stillwater habitats for two main reasons. Firstly, we need to ascertain the quality of fish habitats, in particular to highlight potential pinch-points such as loss of spawning sites due to siltation (see page 80). Secondly, we need to understand the relationship between habitat quality and fish populations. Knowing the sustainable fish abundance for a given habitat quality is essential when deciding on priorities for improving a fishery. Habscore is one method the Agency uses to predict fish abundance from habitat quality.

Participation

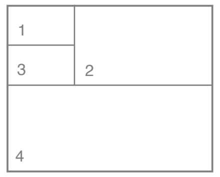
To manage fisheries effectively we also need to understand trends in participation in fishing. This information can be as important to local angling clubs and fishery owners as it is to national angling organisations and to the Agency. Monitoring angling participation is essential if we are to measure the very substantial environmental, social and economic benefits that fishing provides to society.

Catches

The final piece of the jigsaw is monitoring the end product of fishing – what is actually being caught. Catch data serve two purposes – they tell us about stock levels (recognising the complex relationship between catch and stock) and they provide a direct index of fishery performance. In monitoring catches, it is important to record not just the total catch but also the fishing effort, the composition of the catch, and when, where and how the fish were caught. With this information we can determine the status and trends in total catches, catch rates, exploitation rates, the age structure of the catch and the success of different fishing equipment and methods.

By adopting this approach, we can target our efforts and collect relevant information on those aspects that are essential for managing fisheries effectively.

Our ability to monitor some aspects of fisheries is more advanced than for others. For example, salmon fishery monitoring is highly developed to support the national and international obligations for stock assessment and catch control regulations. As we increase our understanding of fish biology and population dynamics, and of fisheries management and participation, techniques will be developed to provide a more accurate assessment of fisheries status for other species and so improve fishery management decisions. Some of these areas for development are also considered in Appendix I.



1-4 Monitoring fish stocks, habitats, participation and catches: The national monitoring programme recognises that the value of fisheries depends not only upon the state of fish stocks but also on the social and economic benefits derived via the opportunity to participate in fishing. A key aim of the monitoring programme is to target management effort and other resources to areas where the greatest benefit will accrue.

Fishing: participation and value

More people in England and Wales go fishing than take part in any other sport. Angler expenditure has been estimated at over £3 billion per year [Ref. 1], and much of this supports employment in rural areas where other job opportunities are limited.

While the amounts are much smaller, net fishing for salmon, sea trout and eels can also make important contributions to rural economies.

The fish removals and transfer industry also affects the status of fisheries and therefore influences both angling participation and the capital value of fisheries.

Angling participation

A survey in 2001 [Ref. 5] showed that some 3.9 million people – nine per cent of the population aged 12 years or over – had fished in the preceding two years.

Rod licence sales figures tell us a lot about trends in freshwater angling participation. Annual and short-term licences are available for those wishing to fish for all species (including salmon and sea trout) or those who just want to fish for coarse fish, non-migratory trout and eels. Full licences run from April to March.

Sales of licences have exceeded 1 million each year since 1994/95, with a peak of 1.2 million in 1997/98 [Ref. 6]. In 2002/03 some 1.18 million people bought rod licences. The difference between licence sales and the survey results is quite understandable: a licence is not required for sea angling; there is also considerable turnover of individual licence holders from one year to the next; and by a combination of bank-side enforcement and high-profile publicity campaigns we have reduced rod licence evasion significantly.

Coarse and trout fishing

Since 1994, when the current licensing system was introduced, sales of annual Coarse and Trout fishing licences have fluctuated between 750,000 and 850,000, but with no overall trend. (See Figure 3.1.)

A young boy fishes for roach at Port Talbot Docks. More fisheries are being developed in or near urban centres, within reach of the majority of the population.

Poor weather, particularly during the spring and early summer tends to deter people from taking out a licence, as does the timing of the Easter Bank Holidays (licence sales are higher if Easter falls after the new annual licence is released in April). Major sporting events such as the Football World Cup or Olympic Games can have an impact too, because they reduce the amount of time people have available for other activities, including angling.

Licence sales fell sharply in 1995/96 and 1999/01. In both instances we worked in partnership with others to reverse the fall by promoting angling and angling opportunities. On both occasions sales responded positively. Countryside access restrictions during the 2001 foot-and-mouth disease outbreak could easily have had a significant impact on angling activity; by

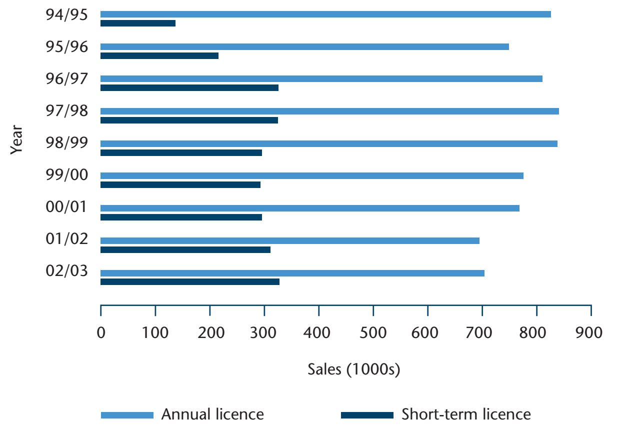


Figure 3.1 Sales of coarse fish, trout and eel rod licences have exceeded 1 million since 1994.

promoting angling and letting people know where they could still go fishing we were able not merely to avoid a reduction in angling participation but to increase licence sales by five per cent

In the two years following the introduction of short-term licences in 1994, their sales increased and have since followed the same pattern as that of the annual licence.

Salmon and sea trout fishing

The overall pattern in salmon and sea trout angling activity is one of steady decline. Sales of annual licences have fallen from 26,641 in 1994/95 to 18,392 in 2002/03 (see Figure 3.2). The fall in angling activity in most likely to be a consequence of the fall in catches from many rivers. Access restrictions during the 2001/02 foot-and-mouth disease outbreak had a considerable impact on licence sales, because many salmon and sea trout rivers were in infected areas. Sales in that year fell to just 13,567, just 75 per cent of the previous year's sales and 50 per cent of the level of seven years earlier.

The effect of introducing short-term licences in 1994 was similar to that for trout and coarse fishing licence sales.

Angler activity and preferences

In March 2001, we carried out a representative poll of over 2600 rod licence holders to obtain a snapshot of angling activity in the preceding year [Ref. 7]. Specifically, we sought to assess the proportion of anglers across England and Wales participating in different types of fishing and the amount of effort spent on each. The survey also recorded anglers' preferences for different fishery types and fish species, including whether they had preferences for stocked trout or wild trout.

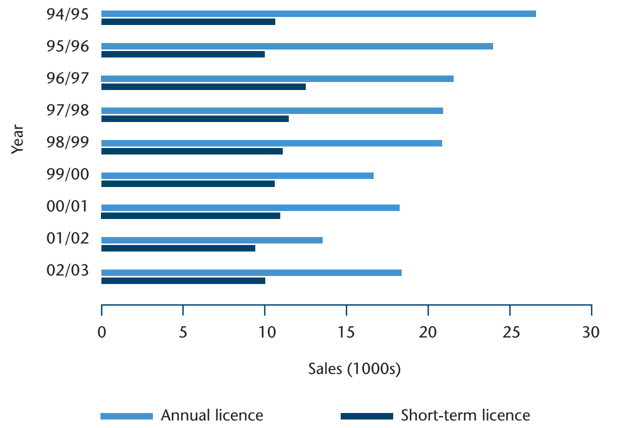


Figure 3.2 Salmon and sea trout rod licence sales have declined by 25 per cent since 1994.

Men aged 35 to 54 years dominated the angling population. Women comprised only five per cent of anglers, and children below the age of 17 only seven per cent. Salmon and sea trout anglers tended to be older than coarse and trout anglers, with 60 per cent being over the age of 45 (compared with 50 per cent for coarse anglers).

Despite purchasing a rod licence, ten per cent of anglers did not go fishing between April 2000 and March 2001. The likelihood of not fishing was highest among young anglers and decreased with age. Most of those who had fished made relatively few angling trips. However, although the median number of trips was 15, the mean was 26 (see Figure 3.4) indicating a wide and skewed distribution. The number of days fished increased with age – anglers over the age of 65 were likely to have fished more than twice as long as the youngest anglers.

The majority of anglers who had fished since April 2000 did so for coarse fish (86 per cent), while 24 per cent fished for brown or rainbow trout, seven per cent for salmon or sea trout, and five per cent for grayling.

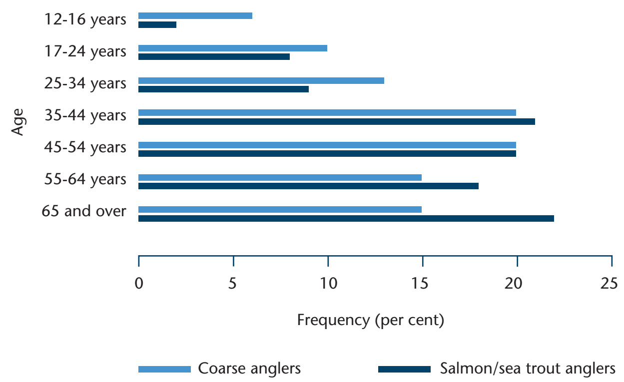


Figure 3.3 The age profile of anglers in England and Wales. Salmon and sea trout anglers are generally older than those who fish for trout and coarse fish.

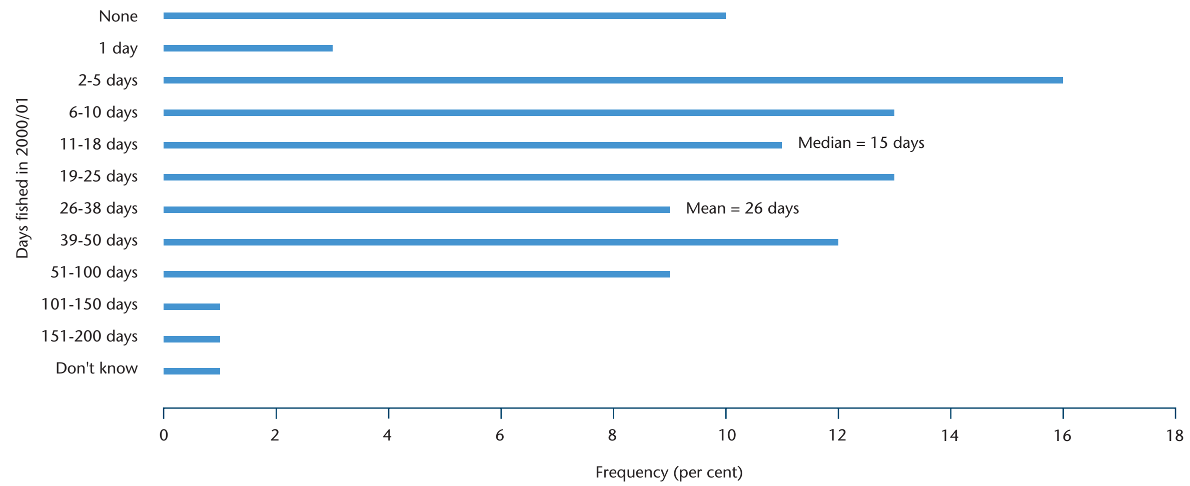


Figure 3.4 Fishing effort by anglers in 2000/01.

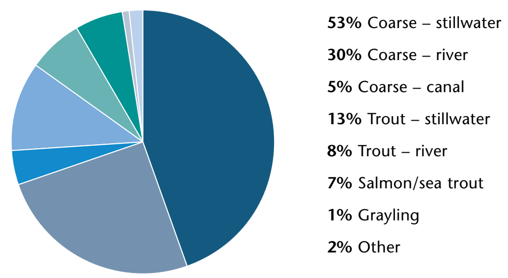


Figure 3.5 Fishing trips involving an overnight stay away from home. Coarse angling accounts for most overnight fishing trips.

Although anglers who fished predominantly for salmon and sea trout, brown and rainbow trout and grayling also fished for other species, few coarse anglers took part in other forms of fishing.

Of those who had fished for coarse fish, the majority had fished and preferred to fish on stillwaters. More than 50 per cent of coarse anglers had fished on rivers, although only a third expressed a preference for doing so. Preference to fish rivers increased with age. These data compare well with those from similar survey in 1994. The most popular target coarse fish species were carp, roach, tench and bream. This was also consistent with the results of a similar survey in 1994, although the popularity of each of these species appears to have risen. However, carp had overtaken roach as the species caught most often, reflecting the recent increased abundance of stillwater carp fisheries.

While more trout anglers stated a preference to fish on rivers than stillwaters, more anglers fished on stillwaters (78 per cent) than on rivers (50 per cent). There was also a contrast between the preferred target species and what was actually caught. The majority of trout anglers preferred to fish for brown trout, but the reality was that more than twice as many anglers caught rainbow trout than caught brown trout. Similarly, wild trout were preferred to stocked fish, but stocked fish were more often what was caught. The preferences to fish on rivers and for wild trout were both higher among older anglers.

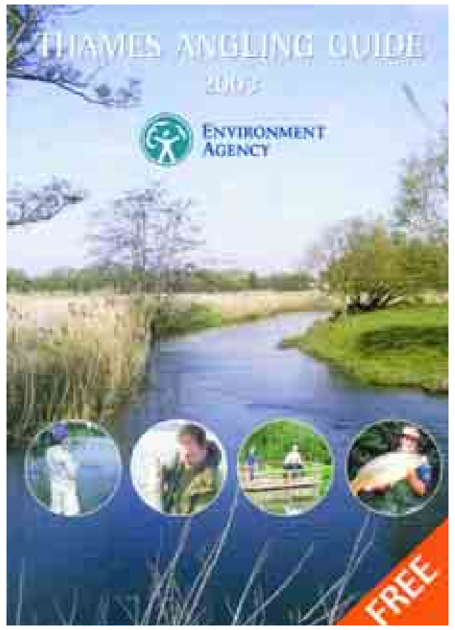
Eighteen per cent of anglers (146,000) had stayed overnight in accommodation on a fishing trip in England and Wales. The vast majority of such trips were made by coarse anglers and most had fished on stillwaters (see Figure 3.5). These figures give some indication of the contribution that angling tourism can make to local economies, with anglers from the Midlands and southeast England contributing the most.

This survey specifically polled anglers' interest in grayling fishing. Overall, almost half of anglers expressed an interest, with the highest level of interest being among the youngest anglers and anglers who already fished for brown trout and rainbow trout. Interest in grayling fishing across England and Wales tended to reflect the presence of healthy grayling populations in the locality.

Factors affecting angling participation

Nine per cent of the population aged 12 and older of England and Wales can be considered as anglers, and as many people again are interested in taking-up the sport [Ref. 5]. Interest is even higher among young people, with a quarter of children between 12 and 14 years showing an interest. Half as many women as men were interested in going fishing, although only five per cent of rod licence holders are women.

For some years, national angling bodies and local angling clubs have been concerned about declining



1 Young anglers display their catch. Many clubs and fishery owners are running angling coaching schemes to encourage more youngsters into the sport.
2 The Thames Angling Guide 2003 contains details of 300 day-ticket fisheries. Fishing guidebooks provide essential information for local and visiting anglers alike.

membership, particularly of juniors. Entries to the High Wycombe, Thames and Wye Valley Angling Association's annual junior match have fallen to between 15 and 20 compared with 60 or more in the 1990s. We receive reports from many clubs that they are unable to raise the six or so team members needed to enter junior competitions.

In a poll of lapsed anglers and non-anglers [Ref. 5], the principal barriers to going fishing were identified as:

- not having someone to go fishing with – this was particularly evident among younger age groups
- not knowing where to go fishing within an easy travelling distance
- not having any gear to use as a beginner.

Research in 2003 showed that among people who do not fish, the possibility of going fishing had simply not occurred to about half of them [Ref. 8]. Thus we need to raise awareness of angling and its benefits if angling participation is to increase.

As well as generating considerable economic benefits (see below), angling is widely accepted to be a healthy form of recreation. Recent convincing evidence [Ref. 9] shows that, when properly organised, angling can play a very cost-effective role in reducing youth offending, anti-social behaviour and truancy and so raising educational performance.

Many people are working hard to increase angling participation, especially among young people in deprived and urban areas. The Agency also contributes, working with individual fisheries and angling clubs, charitable trusts, angling governing bodies and local and central Government to identify and exploit opportunities to increase access to angling. Several angling associations have created junior angling sections and successfully introduced and retained many youngsters in the sport.

The Agency's objectives for developing angling are first to increase interest and participation in angling, and second to contribute to Government's social policy objectives.

Increasing participation

This work comprises three elements: raising public awareness, increasing fishing opportunities, and providing 'angling taster' sessions.

1. Raising awareness.

Lack of information is one of the major barriers to participation [Ref. 5], and so we are working with others to raise awareness of existing angling opportunities. In 2002, we distributed over 50,000 guidebooks on where to fish and approximately 340,000 local fisheries magazines.

We are also working to promote angling through mainstream tourism activities.

Case study: Raising awareness

Fishing Wales

In Wales, where Angling is a major source of tourism income, we have been working with the Wales Tourist Board and other partners to incorporate angling into promotional campaigns. Together with the Fishing Wales [Ref. 10] guidebook, this work aims to encourage tourists to try fishing and broadens the appeal of Wales as a tourist destination.

The partnership has identified three 'unique competitive strengths' for which Wales could be renowned. These are sea trout, grayling and bass fishing. By marketing these products, as well as the wealth of wild brown trout fishing available in Wales, the aim is to attract more specialist anglers – anglers who are more likely to spend more time and money within local rural economies. This initiative not only promotes the availability and quality of the fishing, but also makes sure the necessary infrastructure and facilities are in place to ensure an enjoyable holiday.

The EU Objective 1 funded Fishing Wales initiative is being supported by a partnership of public, private and voluntary organisations throughout Wales including numerous angling clubs and fishery owners.

2. Increasing opportunities.

In 2002 we invested £750,000 in 70 fishery development projects around England and Wales. This investment was matched by similar sums from Sport England and private sector donors and built on previous collaboration with local authorities and others to create new fisheries or to improve existing ones. An emphasis is placed on deprived areas where demand is high but fishing opportunities have reduced as a consequence of urban development.

Initial investment is essential to get individual schemes off the ground. However, it is equally important that these fisheries are maintained and supported by the appropriate infrastructure if they are to be successful in drawing new anglers into the sport.

3. Angling taster sessions.

Angling taster sessions are brief introductions to angling and are aimed at mass participation. Angling coaches are used to support the sessions, which are widely publicised. Having fun while catching fish, rather than technical expertise, is the operating ethic. Starting in 2002, our target, in collaboration with angling clubs and organisations, is to provide an additional 2,000 licensed angling coaches and 100,000 coached angling days in England and Wales by 2005.

Stop Press: Angling is increasing in popularity. In 2003, rod licence sales have increased again – up by 5.5 per cent on 2002 – and we are optimistic that they will reach 1.2 million

Case study: Angler taster sessions

Community outreach project: Stoke Angling For Everyone (SAFE)

SAFE has developed strong community and schools links, promoting the ethic: Come fishing with us and we will provide a safe environment and fishing gear, show you how to fish, and help you to join the local angling clubs.

Over its first two years SAFE, which is run by a consortium of clubs and is supported strongly by its landlord Stoke City Council, introduced more than 1800 people to angling. Eighty-five per cent still go fishing, and junior club memberships had tripled at a time when junior membership in all sporting organisations is declining. Sports Lottery has just awarded £88,000 to the project to help further develop the social inclusion and coaching elements.

Angling and social inclusion

Pilot schemes have shown that properly run angling coaching and development schemes can bring significant social benefits, such as reduced youth offending.

Costs of general angling participation schemes are low, ranging from around £5 per person for angling taster sessions such as at Newton Abbot, to £30 per person for more structured events, such as SAFE. At the other end of the spectrum Get Hooked on Fishing is a very cost-effective way of contributing to Government's social policy objectives, representing good value in the context of sustainable development. For an investment of £340 per participant per year, we can save the taxpayer more than £150,000 for every custodial sentence avoided.

1 Grayling fishing on the River Ithon, mid-Wales. Angling tourism can provide substantial income in rural areas.
2 A young girl learns to fish at Hanley Park on the SAFE scheme. Schemes like this introduce youngsters to fishing in a pleasant, educational and secure environment (courtesy of SAFE).
3 Children participating in an angling taster day organised by the National Federation of Anglers and the Environment Agency at Newton Abbot – one of over 100 such events the Agency contributes to each year. Often run by volunteers, taster days can be an extremely effective way of introducing people to angling.

Case study: Angling and social inclusion

Get Hooked on Fishing

One of a number of projects in the Durham Agency Against Crime police initiative, *Get Hooked on Fishing* [Ref. 9] has reduced offending among young people and, by also reducing school truancy, led to improved behaviour and general educational performance. Although this project provides opportunities for angling across the board, its uniqueness lies in using angling to tackle extreme cases of social exclusion.

Led by professionally trained people with police backgrounds and experience of working with young offenders, the scheme has achieved remarkable results with young people officially identified as being at risk of becoming offenders. These results include:

- zero offending among the 800 'at risk' young people on the scheme to date
- 85 per cent reduction in truancy overall
- increased educational performance. For example, one excluded pupil attained a university place; an 'out-of-control' youngster became a sponsored angling coach; and a semi-literate pupil won the Young Angling Journalist of the Year award
- 70 per cent of participants still go fishing after two years.

Net fishing

Fish can be caught legally by means other than rod and line. Salmon, sea trout and eels are taken by nets and traps in estuarine and coastal fisheries around England and Wales. The catch is almost exclusively destined for human consumption; a small quantity of elvers (young eels) is exported to Scandinavia for restocking rivers there.

Over 1300 people [Ref. 11] are involved, mostly on a part-time basis, in the migratory salmonid and eel net fisheries of England and Wales. Overall, salmon and sea trout netting is declining, in response to the phasing out of mixed stock fisheries and falling demand for wild salmon. Eel and elver net fishing in recent years has fluctuated in response to market forces. More detail on participation, effort and catches in net fisheries is provided in Chapter 5 (Salmon and Sea Trout) and Chapter 7 (Eels and Elvers).

Fish removals and transfers

The management of many coarse and trout fisheries involves removing and stocking fish to maintain or improve catch rates. There are over 1,000 fish and shellfish farming businesses in the UK operating on 1,500 sites directly employing more than 3,000 people [Defra]. Many of these produce and process sea fish and shellfish; however, there are more than 100 members of the British Trout Association [Ref. 12], which represents over 80 per cent of the trout production in the UK, currently producing some 16,000 tonnes per year, including fresh trout sales of £21.5m [Ref. 13]. In addition, there are over 100 coarse fish farms rearing mainly carp for stocking in stillwater fisheries [Ref. 14]. The annual turnover of fish stocking has been estimated to be at least £21 million [Pers. comm. S Chare, Environment Agency].

In some cases, fishery performance is entirely reliant on stocked fish. Stocking can also be an important tool in salmon management. However, fish movements can also potentially damage fisheries by transferring fish diseases and nuisance species: these are discussed further in Chapter 8.

Fish destined for restocking are most frequently caught by netting or electric fishing. These fishing methods, and the act of restocking, have to be strictly regulated. Each operation must have the prior consent of the Agency. (Applications to introduce non-native fish are administered by Defra.) Consent applications are subject to an assessment of the benefits and risks. While some fish movements do take place illegally (without consent), the number of consents applied for and issued provides a good indication of the scale and trends in activity.

In 2002/03, we issued 5386 consents to 760 applicants to stock fish. Although many clubs and fishery owners undertake their own fish movements, the industry is dominated by a relatively small number of fish farms and fish suppliers, and 80 per cent of applications were made by 20 per cent of applicants.

Over the past three years, we have issued an increasing number of consents (see Figure 3.6). Netting and electric fishing consents have increased by 75 per cent in three years (from 1287 to 2241) and stocking consents by 21 per cent (from 4446 to 5386). This may indicate some growth in the restocking industry, possibly in response to the growth in stillwater fisheries in recent years. Indeed, reported figures for farm production of coarse fish for restocking show a steady growth, with a doubling in output between 1997 and 2000. However, it is also generally accepted that continuing efforts to simplify the consent application

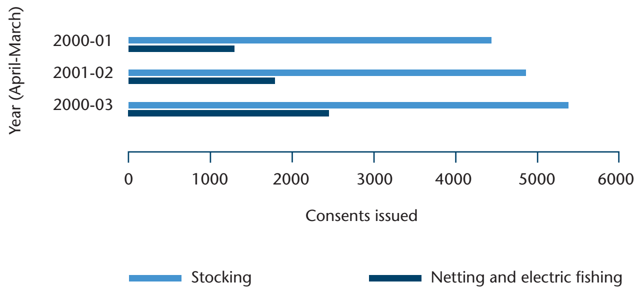


Figure 3.6 An increasing number of removal and stocking consents have been issued in recent years.

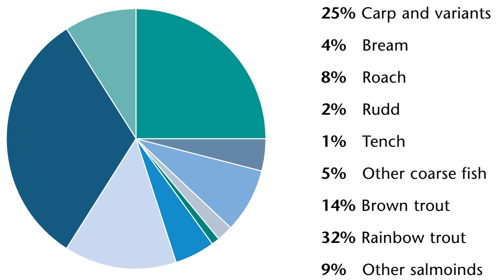


Figure 3.7 Species of fish stocked in 2002/03 in England and Wales. Whilst trout continue to dominate the fish movements industry, there has been a growing demand for carp and other coarse fish in recent years.

process, combined with a visible enforcement campaign, have been successful in increasing the level of compliance and, hence, the number of consent applications made.

We issued consents to stock in excess of 7.5 million fish of 30 species or variants in 2002/03 (see Appendix 3 and Figure 3.7). The consents covered six salmonid and 24 coarse fish species and variants. Trout (brown and rainbow) were the most numerous, comprising 45 per cent of the total number of fish stocked. Carp (common, mirrors and variants) were second, representing 25 per cent of the total and 55 per cent of all coarse fish. Other commonly stocked species include roach, bream and rudd.

With the continued popularity of angling in England and Wales, the fish supply industry will continue to be an important economic sector of fisheries. We will continue to work with the industry and with fisheries and conservation interests to ensure that the significant benefits that fish movements can bring are balanced against the potential risks.

Economic value of fisheries

Coarse fish

An Environment Agency study carried out in 2001 estimated the total capital value of the inland recreational fisheries of England and Wales at £3 billion [Ref 15]. (Capital value is the price for which fishing rights are bought and sold on the open market). Coarse fisheries were reported to be worth £2.3 billion (75 per cent of the total value of all fisheries). The value of stillwater coarse fisheries amounted to more than £1.5 billion, with river and canal fisheries valued at £0.75 billion. The survey also indicated that annual expenditure by coarse anglers (on fishing permits, tackle, travel, accommodation and other costs directly associated with their fishing outings) amounted to almost £2 billion [Ref. 16].

Trout and grayling

Brown and rainbow trout are widely distributed across England and Wales, mainly in high quality rivers in rural areas. Here they may support valuable fisheries and contribute significant economic benefits to rural communities. The construction of many water supply reservoirs and the creation of purpose-built stillwater trout fisheries has led to trout fishing becoming available in many parts of the country where it would not otherwise be. As well as the 6,700 km of river trout fishing in England and Wales, it has been estimated that there are approximately 19,000 stillwater trout fisheries.

In a study in 2001 [Ref. 16], we estimated the market value of trout fishing across England and Wales. In England, river fisheries were valued at £180 million and stillwater fisheries at £380 million. In Wales, where stillwater fisheries are far fewer and generally smaller than in England, the values were £48 million and £15 million, respectively. The same study also estimated the annual expenditure made by the 800,000 salmon and trout anglers on their sport (it was not possible to distinguish between salmon and trout fishing as many items of expenditure would have covered both species). This it estimated to be £545 million. In a report commissioned by the British Trout Association, it has been estimated that trout angling employs over 700 people [Ref. 17].

Salmon and sea trout

Salmon and sea trout fisheries are of significant economic value, particularly in rural areas. An Agency study in 2001 [Ref 16] estimated the market value of fishing rights for salmon rod fisheries in England and Wales to be £128 million. This was based on an average rod catch of 15,200 fish and an average value of £8,400 per salmon caught. In England, the market value of salmon fishing rights was estimated at £86 million (based on an average per-salmon value of £7,800 and

1 Sunset over a Cambridgeshire carp lake. Stillwater coarse fisheries, many of them developed on redundant gravel pits, are valued at over £1.5 billion.

2 Wild trout fishing on Tal-y-Llyn, mid-Wales. Stillwater trout fisheries are a valuable resource and can bring important income into rural economies.

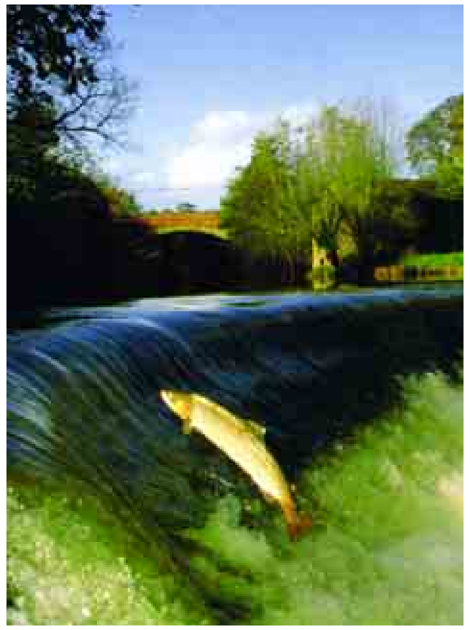
an average annual rod catch of 11,000), whereas in Wales it was estimated at £42 million (based on £10,000 per salmon and an annual rod catch of 4,200).

A previous study of a number of rivers [Ref. 18] has estimated anglers' consumer surplus (this is the amount of money anglers would be willing to pay for their fishing over an above what they do spend) at roughly equivalent to the capital value of salmon rod fisheries. If applied nationally, this would amount to £128 million, bringing the net economic capital value of salmon rod fisheries to over £250 million. In contrast, the same study concluded that in 2001 the net economic capital value of salmon net fisheries in England and Wales was around £3 million. Equivalent values for sea trout fisheries are subsumed within these totals and not estimated separately.

Another recent study [Ref. 5] estimated the individual annual expenditure by game anglers on their sport – including expenditure on tackle, permits, travel and accommodation – to be on average £682, giving a total of £545 million per year. This figure includes expenditure by trout anglers, and the proportion specifically spent on salmon and sea trout fishing is likely to be a small proportion of this (probably less than 10 per cent).

Although salmon and sea trout rod fishing rights represent but a small proportion of the total value of all inland rod fisheries in England and Wales, their local significance can be much higher, particularly in rural areas where incomes are low. In a specific study of the River Teifi in southwest Wales [Ref. 16], the annual contribution made by salmon and sea trout anglers to the local economy (within 25 miles of the river) was estimated to be around £1 million, with a further expenditure of £50,000 in the rest of southwest Wales. It is estimated that this funds the equivalent of around 20 full-time jobs, principally in the hotel and accommodation sector. In reality, much of this work will be part-time and hence anglers' expenditure contributes to the livelihoods of many more individuals. Net fisheries, although overall contributing much lower amounts, can still be important to local rural economies.

Although no estimate has been made of the existence value of salmon nationally, several local studies suggest this may be considerable. Most significant of these was a survey in 2001 of members of the general public living in the Thames catchment [Ref. 16]. Each household was estimated to be willing to pay an average of £2.40 per year to fund the restoration of a breeding population of salmon in the Thames. With five million households in the catchment, this gives a potential economic value of £12 million.



1 An angler returns an Usk salmon. Game anglers contribute £545 million per year to the national economy. Locally, angling can provide much-needed income to rural areas.
2 Salmon leaping Ashford Weir on the River Teme, Worcestershire. Salmon are highly valued as indicators of environmental quality.

Eels and elvers

Fishing for eels in their various life stages can deliver significant economic benefits to local rural economies. In 1997, the export value of adult eels was estimated to peak at £2.5 million and, in 1998, that for the elver or glass eel fishery was estimated at £2.6 million [Ref. 19]. While small in comparison with the sums involved in the marine fish trade, eel fisheries make a useful contribution to the UK's balance of payments.

The export value of elver fisheries peaked at £2.6 million in 1998, but has since declined, with annual income per fisherman falling from £2000 to less than £900 [Ref. 19]. As demand for elvers to stock eel farms has fallen, so prices have also fallen, settling nearer to those of the late 1980s and early 1990s.

Adult eel exports now make only a very small contribution to the balance of trade. The total first-sale value of the adult eel fishery has declined from its peak of £2.5 million in the late 1990s to less than £0.5 million in 2000 [Ref. 19]. Offset against this is the import of between £170,000 (in 2000) and £380,000 (in 1999) of imported fresh and frozen eels. The trend is one of falling demand for eels in England and Wales and in mainland Europe. This is compounded by a greater reliance on eel farming and cheaper imports from the Far East depressing local prices.

Coarse fisheries

There are 21 species of coarse fish native or naturalised to England and Wales (see Appendix 2), and anglers frequently fish for 16 of these. Coarse fish inhabit a wide range of fisheries, although they are absent from steeper salmonid dominated rivers in Wales and in the west and north of England.

Coarse fish make excellent indicators of environmental quality. Many water quality standards are set at levels that ensure the survival of freshwater fish, and many fisheries surveys are undertaken to monitor the effectiveness of water quality improvement work. Coarse fisheries are also important economically – especially to rural communities – and they provide a range of social benefits, most particularly to urban communities.

Coarse fish stocks

Coarse fish populations of England and Wales are very varied, both in terms of fish abundance and diversity of species. A 'one-size-fits-all' rigid approach to monitoring is not the answer, and so the national coarse fish monitoring programme has to take account of the varied nature of the river, lake and canal fisheries in different parts of the country. Nevertheless, adopting a consistent recording method across England and Wales brings not only economies of scale but also the ability to aggregate data and so provide snapshots of fishery status and trends at local, regional and national level.

In larger rivers and in canals and stillwaters, where we must rely on hydro-acoustic techniques and angler catches for monitoring, we cannot currently derive accurate estimates of fish abundance. A lack of historic data also means we have no benchmarks against which current population abundance can be compared, although as we collect future years' information we will be able to develop a similar classification scheme for these larger waterbodies.

Electric fishing data

Our ability to monitor coarse fish populations varies according to the nature of their habitat. In small to medium-sized waters, we can obtain accurate estimates of fish abundance. Because of this and previous extensive monitoring of similar sites, we are able to compare sites monitored in 2002 with benchmarks established in the early 1990s. The Fisheries Classification Scheme (FCS) allows us to make an assessment of the quality of fish populations relative to these benchmarks (see page 15).

The results from 350 of the 1010 coarse fish temporal sites surveyed on small to medium sized rivers in 2002 were processed using the Fisheries Classification Scheme. River fisheries across most of England (excluding the North East, where the emphasis in 2002 was on large spate rivers where it is difficult to obtain quantitative population estimates) are included. Most rivers in Wales are dominated by salmonid fish populations; however, there are important coarse fisheries on the Dee, Wye and Severn and on the lower reaches of the Taff and several other rivers on the eastern side of Wales. Although it was not possible to survey these rivers during 2002 – for example, high flows prevented monitoring on the Severn at times when survey teams were available – they are now included in the programme and will feature in future editions of this report.

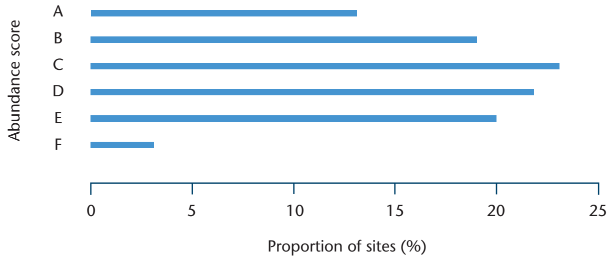


Figure 4.1 Overall coarse fish abundance scores from 350 temporal site surveys. Scores range from A to F – sites scoring 'A' are of the highest quality; those scoring 'F' are fishless. In working to maximise the value of fisheries we need to protect the best and improve the rest so that progressively fewer sites are rated in Classes E and F.

Coarse fish were present at more than 98 per cent of sites surveyed, and only ten sites were either fishless or contained only non-angled species. This is an improvement on a decade or so ago when entire river reaches were fishless because of industrial or domestic pollution.

In terms of coarse fish abundance (expressed herein as weight of fish per 100 square metres of water surface), the results of the 2002 monitoring work show a fairly even spread. Fifty five per cent of sites were of average quality or higher (Classes A to C), compared with the 1990s benchmark. Of these, 13 per cent of sites were well above average or Class A, with more than 3200 grams of fish per 100 square metres. Twenty per cent of sites were classified as well below average, with less than 270 grams per 100 square metres. The highest abundance recorded was on a tributary of the Warwickshire Avon that was estimated to contain almost 11 kg per 100 square metres.

Of the 45 sites recorded as Class A, four sites were on the River Lee, three were on each of the Witham, Solihull Blythe, Cherwell, and Loddon and two sites were on each of the Soar, Ivel, Essex Stour, Leam, Wey and Mole.

The River Wantsum in Kent accounted for three of the ten fishless sites, with a fourth site classed as E. This is due to a localised problem that is now being rectified.

Case study: River Lee

The River Lee rises in rural Hertfordshire and flows south into North London. Much of the river has been heavily engineered for flood management and navigation, and in the lower reaches it suffers from intermittent poor water quality as a result of urban run-off. In these stretches, fish populations are comparatively low, with little evidence of natural recruitment (juvenile survival). The lack of natural cover on many reaches makes whatever adult fish are present vulnerable to cormorant predation.

In stretches further upstream – in particular in the remnant loops of the original river that have not been subject to the same engineering pressures as elsewhere and water quality is comparatively good – natural fish populations thrive. Four of the seven sites that were surveyed and classified in 2002 produced fish abundance figures in excess of 3,200 grams per 100 square metres, or Class A. The highest result was almost 7,000 grams per 100 square metres (the sixth highest of all sites surveyed in England and Wales in 2002). Not only do these higher quality stretches support good fish populations themselves, but also many juvenile fish disperse from there into the lower sections of river.

Recognising the potential, the Agency is working with the Lee Valley Regional Park Authority and British Waterways to improve the quality of the habitat in the lower river with the aim of increasing fish retention. This approach should lead to sustainable fish populations in many of the lower reaches, providing excellent and much-needed fishing opportunities close to London.

The River Lee at Bow, central London. With excellent fish stocks in its rural reaches and in close proximity to a large population, the Lee has great potential as an urban fishery.

Case study: River Wantsum

The River Wantsum is a lowland drain, running along the north Kent coast. It is separated from the sea in its lower reaches by a floodwall, with a tidal sluice at its mouth. This sluice is believed to be faulty and the local angling club, Wantsum A C, has raised concerns that saline intrusion has had a significant impact on the fishery. The Agency's most recent survey appears to bear this out, with three of the four sites monitored being fishless and only a few roach and bream present at the fourth.

Having confirmed the poor status of this fishery, we are now investigating the cause. While the tidal sluice is widely perceived to be at fault, other potential sources of saline intrusion – for example seepage through the sea wall – must also be considered. If the sluice is indeed the cause, we must assess not only the options for its repair but also any other factors, such as loss of habitat, that might prevent the fishery from achieving its potential – before deciding what action is justified.

Gathering and assessing information on fish populations is essential, because it allows us to work effectively with local fisheries interests, quantifying reported problems and where justified, as in this instance, making informed decisions and working together on the best ways of improving fisheries.

Of the ten sites classified as fishless in 2002, three were on the River Wantsum. Electric fishing surveys have confirmed anglers' observations, and a more detailed investigation is being carried out to pinpoint the cause.

70 sites were classified as Class E or well below average. Notably these included five sites on the Royal Military Canal in Kent, a further five on the River Nene, and a number on the rivers of the Manchester conurbation where sewage discharges and urban run-off have rendered the waters fishless for many years. Here even a change from Class F to Class E is an encouraging trend. Ongoing upgrading of sewage treatment works and investment in redeveloping urban areas (for example the recent expansion of Manchester Airport) will contribute towards further fishery improvements.

If only those coarse fish species that live in fast flowing water (known as rheophilic fish species) – for example barbel, dace and chub – are considered, then a large number of sites (26 per cent) contain none of these fish. This is to be expected, because many rivers are not naturally suitable for these species. However, of the 259 sites that do contain these species, 173 (some 67 per cent) are of average quality (Class C) or above, with 59 (or 23 per cent) well above average (Class A); many of these are in the clay catchments of south-east England.

Some of the highest weights of limnophilic fish (fish that prefer still or slow-flowing water) were also found in the clay catchments of southeast England. The River Witham had several sites containing some of the highest weights of these fish, which runs counter to recent

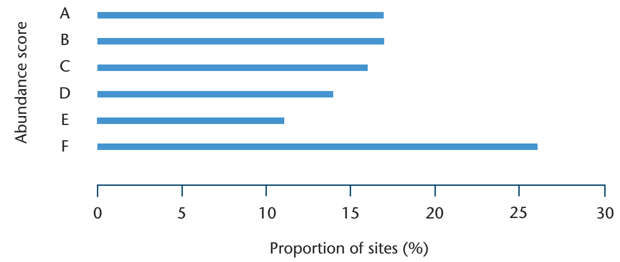


Figure 4.2 Rheophilic (fast flowing water) coarse fish abundance scores from 350 coarse fish temporal sites. Scores range from A to F – sites scoring 'A' are of the highest quality; those scoring 'F' are fishless. Discounting the many sites where rheophilic fish are naturally absent, 67 per cent of sites are of Class C or better.

complaints about its poor status as a fishery. The Nene and Steeping also performed well. Taking into account the relatively large width of these rivers, a large total weight of fish must be present and they should be able to support valuable fisheries.

As expected, there was some correlation between high predator (for example pike and perch) abundance and prey availability. Of the 35 sites recorded as having high (class A) predator abundance, only seven had prey

1 2

1 A newly created meander in the River Bolin downstream of Manchester airport. Following improvements in water quality, poor physical habitat and barriers to fish migration are now perceived to be the major factors constraining fish populations.
2 A large roach is returned to the water. Roach are widespread across much of England and Wales, acting as excellent environmental indicators and providing a valuable angling resource.

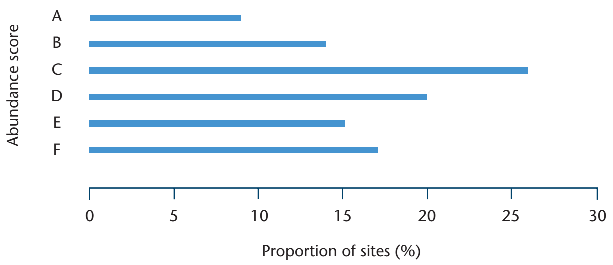


Figure 4.3 Limnophilic (slow flowing water) coarse fish abundance classifications from 350 coarse fish temporal sites Scores range from A to F – sites scoring 'A' are of the highest quality; those scoring 'F' are fishless.

(limnophilic or rheophilic coarse fish) populations of class C or lower.

Figure 4.4 shows the distribution of species richness from the 350 sites classified. The most species rich sites were on the River Mole (Surrey) and the River Lymn (Lincolnshire), each having 14 fish species. Furthermore, 87 sites (some 25 per cent of those surveyed) had ten or more species present, while more than half of the sites surveyed contained eight or more species. Only 56 sites (or 16 per cent) contained fewer than four species, with just three sites being entirely fishless.

The results of the 2002 electric fishing survey provide only a snapshot, and caution is essential when drawing conclusions from a single year's data. A number of environmental factors can influence fish abundance and therefore affect the classification results, and we will be

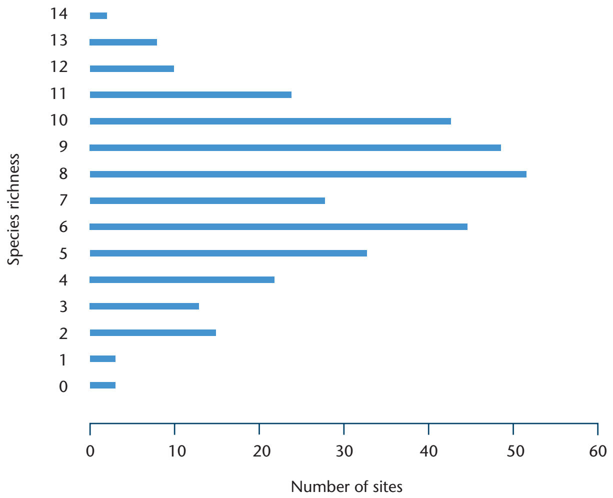


Figure 4.4 Coarse fish species richness. More than half of the 350 coarse fish temporal sites surveyed in 2002 contained eight or more species.

able to examine these in more detail as more years of survey data are accumulated. For example, spawning or other localised aggregations of fish – whether natural or produced by temporary changes in habitat conditions such as saline intrusion – can give a false indication of the status of a reach of river. Similarly, if the efficiency of a survey method has been over-estimated, the results will give a pessimistic view of fishery performance.

Acoustic surveys

On larger rivers, where conventional electric fishing is ineffective, we use acoustic monitoring techniques to survey fish populations (see Appendix 1 for details). Because these do not require us to catch and handle individual fish, we are able to monitor relatively long stretches of river in a single day. This means that surveys are cost-effective and many data from a single reach can be collected under consistent conditions. In 2002 we surveyed 20 sites comprising 150 kilometres of river. Individual surveys produce fish densities (measured as the number of fish per 1000 cubic metres) for every 100 metres of river. These data, averaged to provide overall fish density figures for each site surveyed in 2002, are listed in Table 4.1.

Difficulties with the equipment and poor weather conditions meant that data collected from 80 km of the Trent, Severn, Warwickshire Avon, Bath Avon and the Huntsbill River was unreliable. We intend to develop a system akin to the Fisheries Classification Scheme to establish benchmarks against which different years' and sites' data can be compared. However, at a local scale, the results from individual surveys are already proving to be useful – see opposite.

Catch data

Angler catch data can provide valuable information on fish populations that cannot be sampled by conventional techniques. Results from fishing matches are particularly important on large lowland rivers where it is difficult to obtain accurate fish abundance estimates or where match results can be used in combination with the results of hydro-acoustic surveys.

The Agency has collated results from match venues on principal coarse fisheries since the late 1970s [Ref. 20], and the combined catch rates from ten of the most important lowland river fisheries are shown in Figure 4.10. Although changes in catch rates depend on a number of factors, including changes in the fishing tackle and methods used, trends in anglers' skill and changes in the quality of the fishing available, fish abundance over the last twenty or so years has been able to sustain increasing catch rates in these rivers. While there is considerable year-to-year variation on some rivers, the overall trends run contrary to the opinion sometimes voiced that the number of fish and consequently the quality of river fishing has deteriorated in recent years. These results are discussed in more detail below.

Coarse fishery performance

The value of a coarse fishery and an individual's enjoyment of fishing there are determined by many factors. Significant among these are the likelihood catching one or more fish, the size of individual fish caught, and the variety of fish present. Surveys of angler catches can help us to detect, monitor and understand trends in fishery performance.

Table 4.1 Results of acoustic surveys of river sites in 2002.

River	Reach	Length (km)	Population density
Tees	Aislaby to Tees Barrage	25.0	81.58
Ure/Ouse	Linton to Swale Nab		23.71
Ure/Ouse	Nidd-mouth to York	45.0	91.39
Ure/Ouse	Lendal to Acaster		30.07
Mersey	Bollin Point to Woolston Weir	3.1	2.93
Mersey	Woolston Weir to Howley Weir	5.5	42.93
Weaver	Winsford to Vale Royal Lock	5.2	130.42
Weaver	Vale Royal Lock to Hunts Lock	3.0	30.00
Weaver	Hunts Lock to Saltersford Lock	6.5	67.59
Ribble	Sales Wheel Pool to Ribchester	3.3	35.35
Ribble	Redscar to Church Deeps	7.5	190.83
Lune	Halton Bridge to Skerton Weir	2.8	42.20
Thames	Iffley to Sandford	2.4	109.23
Thames	Sandford to Abingdon	7.2	84.69
Thames	Abingdon to Culham	3.8	58.35
Thames	Culham to Clifton	4.2	22.51
Thames	Clifton to Dayes	4.9	26.77
Thames	Dayes to Benson	6.3	9.07
Dee	U/S A55 road bridge near Chester	6.0	22.04
Dee	U/S Old Farndon bridge	6.0	35.29

Case study – River Mersey

Local angling interests have expressed concerns over a lack of fish in the River Mersey above Howley Weir, near Warrington. The perception is that fish are lost downstream each time the reach is drained to undertake annual weir repairs. Following a partial drain-down of the reach in 2002, the Agency carried out an acoustic survey. Fish densities of up to 150 fish per 1000 cubic metres were recorded, with an average of 45 fish per 1000 cubic metres. However, the survey did follow a spring tide that may have helped recolonisation from below Howley Weir. As a result of this survey, Warrington Angling Association is working with the Agency to provide angling match results to compare with subsequent acoustic surveys; this should help further improve our understanding of factors that are affecting the fishery and what more could be done to improve its performance.

The cause of the drop off in densities above Woolston Weir is unknown but may be due to a combination of factors – the obstruction caused by the weir itself (although it does have a fish pass); periodic low flows upstream of the weir, due to the operation of the Manchester Ship Canal, sometimes leading to low dissolved oxygen; an accumulation of silt flowing out of the Canal; and possible poor quality run-off from adjacent land. Now that we have confirmed the poor status of the reach, these factors will be further investigated.

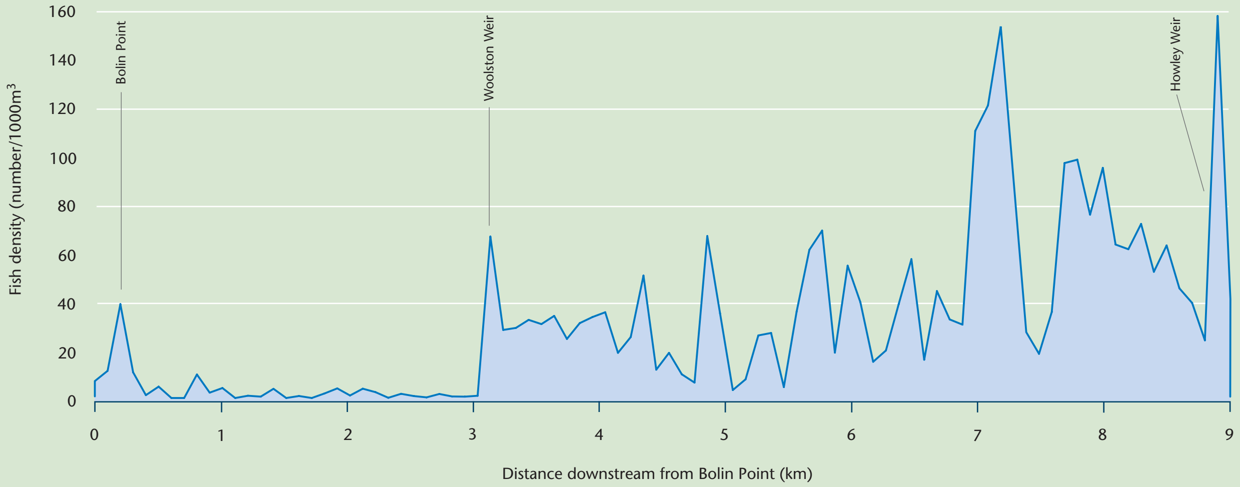


Figure 4.5 The results of a hydro-acoustic survey of the River Mersey in 2002. Fish densities in 100 metre river sections are plotted between Bolin Point and Howley Weir. Note the large increase in fish densities downstream of Woolston Weir.

The easiest way to measure fishery performance is via the catches in coarse fishing matches. In matches, fishing effort and catch results can be obtained from a large number of anglers, all fishing a single venue over a known time period. In comparison, monitoring the results of 'pleasure angling' is much harder to organise and in practice can only be done on a relatively small scale.

Rivers

Catch records from coarse fishing matches on river fisheries provide an insight into fishery performance over many years and serve as a useful index of fish stocks. This is particularly useful on large rivers where conventional monitoring techniques are not very effective.

Despite a frequently-voiced opinion that the quality of river fishing has deteriorated, match angling records show that on seven of the largest coarse fishing rivers, there is an improving trend in catch rates (albeit with increased year-to-year fluctuations) [Ref. 20].

Angler satisfaction does not depend solely on the weight of fish caught. The size range of the fish, the distribution

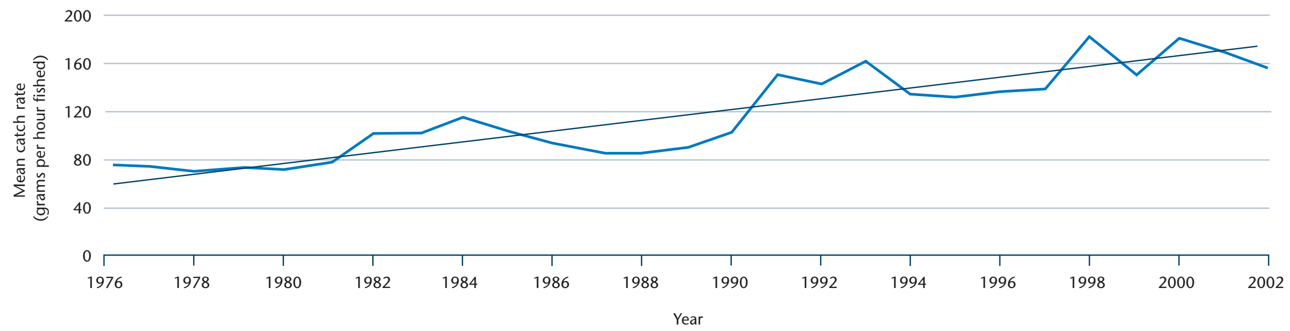


Figure 4.6 Mean catch rates from ten principal lowland river coarse fisheries. Although recently there have been greater year-to-year fluctuations, fish stocks have supported a sustained increase in catch rates over the past few decades.

of catch weights between anglers, and the proportion of match anglers catching fish are also important. The fishery performances of seven of our larger rivers were investigated by analysing records comprising up to 24 years of data. The long-term mean catch rates from different rivers ranged from 56 grams to 320 grams per angler per hour, and all seven rivers showed an improvement in annual average catch rate.

Most anglers caught fish on fisheries that were generally dominated by smaller fish, such as roach. In contrast, fisheries in which larger shoaling species such as bream were important had more highly skewed catch distributions, with a small percentage of match anglers catching most of the weight. However, no rivers showed a significant rise in the proportion of anglers without any catch.

Possible reasons for the upturn in catch rates on most rivers include greater opportunities for selection of fishing places (because in recent years there have been fewer entrants in fishing matches), increases in fish stocks, and improvements in the skill of anglers and the efficiency of fishing tackle.

Angling catch records have proved useful in identifying suitable fishery management actions, as exemplified by the following case studies:

How anglers can help

For many years the Environment Agency has collected angling match results from a limited number of rivers, and we would like to expand the programme to cover more fisheries across England and Wales. We are therefore seeking to collaborate with local angling clubs to gather and analyse data from other important match venues. Not only will this provide a clearer picture of overall trends in fishery performance but it will also enable us to include more individual fisheries in future reports. To get involved, please contact your local Environment Agency office.

Stillwaters

Changes in rural and agricultural land use and urban development have meant that many ponds and small lakes have been filled in over the past 60 years. There are currently around 250,000 stillwaters in Great Britain [Ref. 21], and approximately 30,000 stillwaters in England and Wales remain available for fishing [Ref. 22].

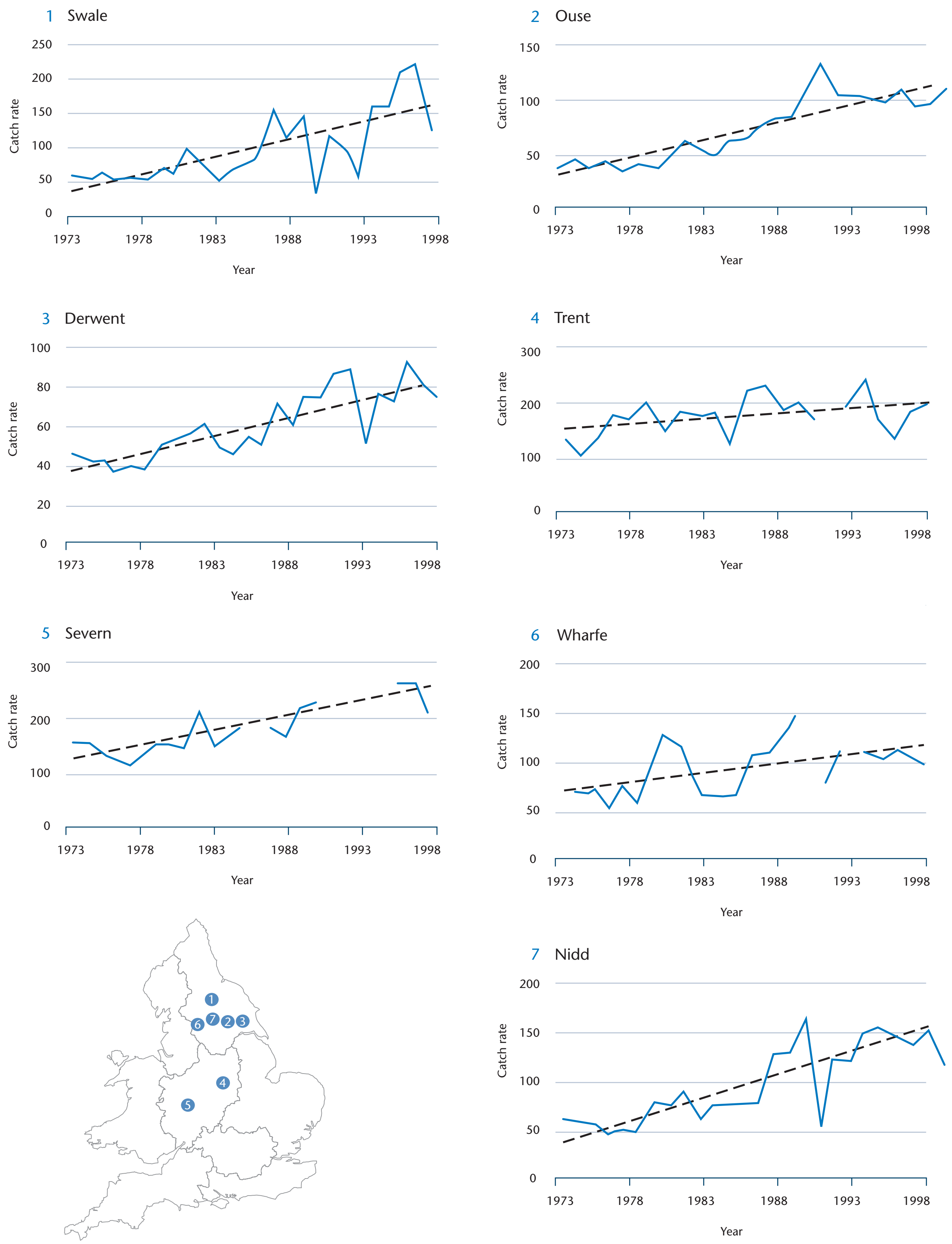
In a 1994 survey [Ref. 23] more than 50 per cent of coarse anglers showed a preference for fishing on stillwaters rather than on rivers or canals; and since 1994 the proportion of anglers favouring stillwaters is thought likely to have increased as more commercial stillwater fisheries have been specially created, offering ease of access and a high likelihood of good catches often near to centres of population.

Case study – River Trent

The number of anglers fishing the River Trent has fallen significantly over the years, despite increasing catch rates. The increased room per angler may have helped to maintain catch rates against a background of changes in species. This fishery, formerly dominated by roach and gudgeon now contains many more large chub, barbel and bream. Catching these larger fish demands different angling techniques. By not adapting their fishing, some anglers are catching fewer fish and pointing the finger at the state of the fishery.

The decline in silver fish abundance is being tackled via a programme of habitat improvements designed to increase recruitment. In particular, connecting riverside gravel pits to the main river will improve survival and provide safe places for juvenile fish to grow without the risk of being swept away by high river flows.

Figure 4.7 Trends in angling match catch rates from seven lowland rivers. The average catch per angler (measured here in grams per hour fished) has increased markedly, in contrast with the frequently-stated opinion that coarse fishing on rivers has deteriorated.



Case study – River Nidd

On the River Nidd in North Yorkshire, a flow-gauging weir was installed in 1978 at a site where angling match catch records were available dating back to 1971. On the stretch below the weir detailed angling results had been recorded since 1966. In 1979 there was a marked drop in catch rates of small fish upstream of the weir, and there were complaints that fish had been seen trying unsuccessfully to ascend the weir.

A comparison of match catch records upstream and downstream of the weir before and after installation of the weir confirmed that the installation had indeed caused a drop in catch weights upstream of the weir and that the proportion of anglers catching fish there had also fallen. Various attempts were made to ease fish passage. A subsidiary weir was built to raise the water level downstream of the weir, and baffles were installed on the face of the weir to improve flow conditions for fish to swim over it. Despite all this, no significant improvement occurred.

In 1999, the weir was removed and replaced by an ultrasonic flow gauge. The following year saw a dramatic improvement in catch rates, especially of small fish. Since then the improvement has been maintained.

The River Nidd at Skip Bridge. By replacing a gauging weir with an ultrasonic flow gauge, a major obstacle to fish migration has been removed. This has led to an upturn in angler catches.

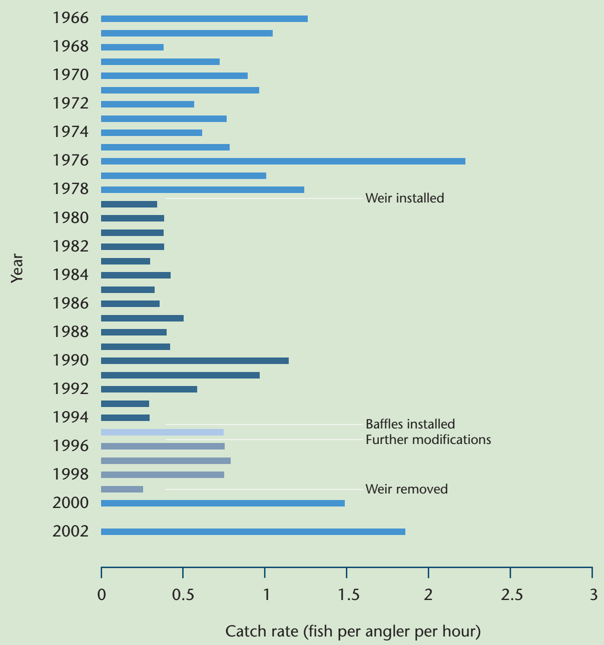


Figure 4.8 Angler catch rates upstream of Skip Bridge weir. While removing or bypassing barriers to migration for salmon and sea trout has long been seen as an important fishery improvement technique, only recently have the benefits of easing passage for coarse fish been fully recognised.

Stillwater coarse fisheries can be recognised as:

- **Natural fisheries** – where there has been no known management activity of any kind in the past 25 years and fish populations are maintained entirely by recruitment from existing stocks. Natural fisheries often have high conservation value.
- **Improved fisheries** – where management activity of some sort has taken place within the past 25 years, usually by introduction or removal of moderate quantities of fish or minor habitat manipulation.
- **Intensive fisheries** – where the primary management objective is to maximise the fish abundance, and hence angling performance, by intensive stocking. These fisheries are operated exclusively for angling and often have very low conservation value.

Using the above definitions to assess 260 stillwater coarse fisheries across England and Wales for which data were available [Ref. 22], only three per cent were considered to be natural fisheries, 77 per cent improved and 20 per cent intensive.

Natural fisheries contained a maximum biomass of less than 500 kg per hectare, and 75 per cent of them held less than 250 kg per hectare. Improved fisheries contained up to 2250 kg per hectare. Intensive fisheries contained the highest fish biomasses, with a maximum of 14,280 kg per hectare and a median of 750 kg per hectare. Many of the well-known and popular intensive fisheries contained between 1500 and 3500 kg per hectare.

The study showed most stillwater coarse fisheries to contain eight species or more. Roach, the most commonly occurring species, was found in 83 per cent of fisheries. Carp, bream, perch and tench were also common and were present in more than 50 per cent of waters. Relative abundance by weight of fish species varied with the category of fishery. Natural fisheries contained similar biomasses of bream, roach, pike, perch and rudd. Improved fisheries were dominated by carp, roach, bream and crucian carp, with these four species accounting for over 75 per cent of the total biomass. In intensive fisheries carp alone predominated, contributing approximately 60 per cent of the total biomass. Biomass values were similar to those for fisheries holding comparable fish communities in Europe and other countries, but the range of biomass was wider here.

The Agency has collected data on angling effort and catches from fishing competitions on a variety of rivers and canals in order to assess fishery performance. Similar surveys of stillwater coarse fisheries are relatively uncommon. The majority of stillwater angling clubs and fishery managers do not retain records of the performance of their fisheries: this valuable information collected at the end of a fishing match is often discarded once the outcome of the event has been established.

Large numbers of competition results from stillwater coarse fisheries are published each week in the angling press. During June 2000, for example, Anglers Mail reported the results of between 110 and 130 angling competitions per week; unfortunately, the information rarely extends beyond the first six places in any competition. We were, however, able to contact just a few fisheries where the owners or managers retained competition results over a reasonable period and were willing to give us access to the catch information. These catch data consisted of results from organised competitions, typically over a five hour period. Using catch per unit effort (grams per angler per hour) as an index of fishery performance, it is possible to compare stillwater coarse fisheries with one another as well as with river fisheries.

All of the small stillwater coarse fisheries for which data were collected produced catch rates in excess of those previously published for rivers, canals or reservoirs in the UK or elsewhere in Europe. The overall catch rate for the stillwater fisheries studied varied from 671 grams to 3429 grams per angler per hour with a mean value of 1722 grams per angler per hour. In the UK, river fisheries typically produce catch rates of 60 grams to 405 grams per angler per hour and canals between 50 grams and 180 grams per angler per hour.

Performance of fisheries as competition venues is influenced by stock density and by the size composition of stock. Figure 4.16 shows examples of the catch rates

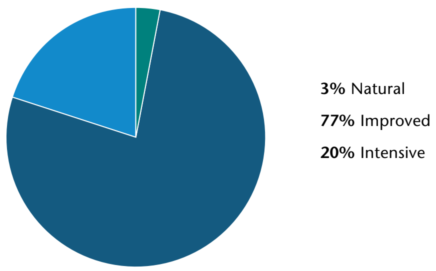


Figure 4.9 The proportion of natural, improved and intensive fisheries. Stillwater fisheries vary markedly in terms of stock level and species, providing a wide range of angling experiences.

of anglers from the winner down to those in 20th or 25th place. Fisheries with high multi-species biomass and a mixture of sizes and species dominated by carp produced the highest catch rates throughout the range of positions, although catch rate declined rapidly with the angler's position in the results table. Fisheries with lower multi-species stock densities and smaller individual fish produced lower catch rates, but the rate of decline of catch with position in the results table was much slower.

Although the Agency does not formally survey stillwater match angler opinions, we do receive feedback via staff at the waterside. In this way we gain valuable insights into the perceptions, preferences and expectations of match anglers. All intensive fisheries offer a much higher catch for a given level of angling skill than would be likely in natural or improved fisheries. Intensive fisheries attract anglers primarily by the promise of a fair and even venue particularly suited to competitive fishing, where every peg is a potential winner and angler skill is the only variable. Match anglers also expect to be able to catch large weights of fish. Winning a competition with 75 kg of fish is likely to provide more satisfaction than winning with 7.5 kg, even though the prize money may be the same and the skill needed to catch the smaller weight may be greater. Anglers who do not win competitions also expect to catch reasonable amounts of fish, and at fisheries where this occurs the numbers of competitors remains consistently high.

Well-managed intensive fisheries can produce consistently high catches, and they appear to be able to withstand extremely high angling pressure without significant detriment to either the fishery's performance or the fish stock. In contrast, in poorly managed fisheries there are frequent instances of fish dying due to angling-related stress.

Our recent research into stillwater fishery management has shown that intensive or improved fisheries with biomass between 1200 kg and 2000 kg per hectare would benefit from compensatory management

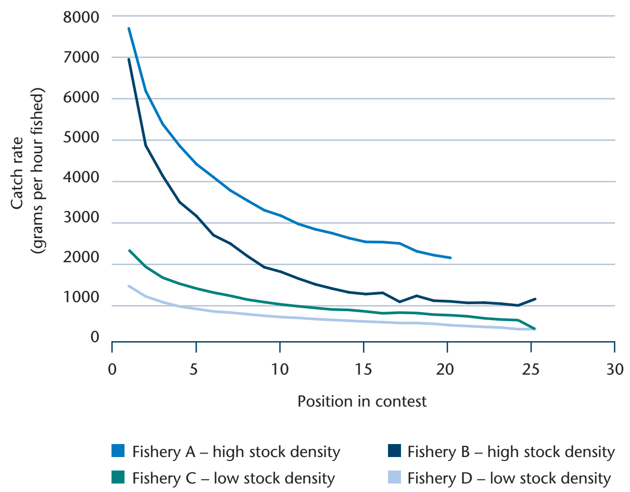


Figure 4.10 Competition catch rates from a range of stillwater fisheries. Although densely stocked fisheries produce high winning weights, catch rates decline rapidly with position in the results table.

(aeration, water quality improvement, control of bait, and other fish welfare measures); and where biomass exceeds of 2000 kg per hectare, the implementation of a compensatory management strategy is essential in order for the fishery to remain biologically viable.

The number of intensive fisheries has increased steadily over the past ten to 15 years, but this has not been matched by a proportionate increase in the number of coarse anglers. While many anglers have moved from rivers, canals and non-intensive stillwater coarse fisheries to these intensive fisheries, in the next five to 10 years the market may reach the point where demand is saturated and the least successful fisheries will close. By disseminating the principles of good compensatory management and encouraging existing and potential fishery managers to follow them, the Environment Agency will seek to maximise the quality of intensive fisheries and so help to keep the widest possible range of angling opportunity available to the public.

In improved and intensive fisheries, trends in fishery performance are largely dictated by management activities, and so routine monitoring of angler catches is of only limited value. Studying a particular fishery and how it responds to different management measures can be of enormous value, and by gathering and analysing catch and stocking information the Agency has been able to advise owners on appropriate fishery management techniques. The Agency will continue to work with fishery owners to obtain the information necessary to define and publicise best practice.

In addition to monitoring carried out to help improve the management of fisheries, the Water Framework Directive [Ref. 24] will also require additional monitoring of certain stillwater fisheries, and this may involve surveying angler catches as well as fish stocks.

Conclusion

Coarse fish numbers are increasing in many of our rivers. In the most recent survey, fish were caught at over 97 per cent of sites, and 50 per cent of sites contained eight species or more. This represents a significant improvement on the situation a decade or so ago, when many more rivers were grossly polluted and fish communities were restricted to a few fish of one or two species. Investment in sewage treatment has resulted in the restoration of coarse fisheries to previously fishless rivers, such as the Yorkshire Rother, the West Midlands Stour and the rivers of the Manchester conurbation. Many important lowland river fisheries have seen anglers' catch rates improve over the last two decades, in contrast to the frequently voiced opinion that the quality of fishing has reduced.

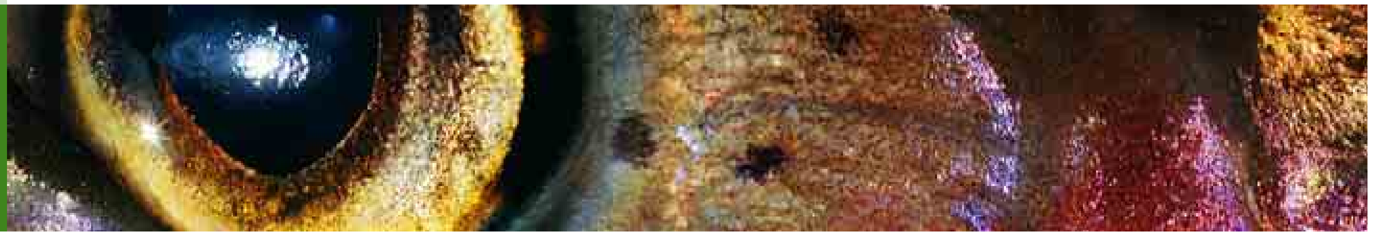
Coarse fisheries provide substantial economic and social benefits. Monitoring of angling catches has been shown to be a cost-effective tool for appraising changes in fishery performance and, thereby, identifying factors that influence the contributions that fisheries make to local communities. Monitoring fishery performance is also essential to assessing management options and making sound choices. We therefore support and encourage angling clubs and fishery owners to monitor and report their match results.

Most of our information on coarse fishery performance is derived from rivers. In terms of catch rates, the performance of river fisheries has improved in recent years; however, changes in the species composition in some rivers has led to an uneven distribution of catches between competing anglers and a perception that river fishery performance has declined. This, together with the perception that angling success is more likely on improved or intensive stillwater fisheries, has meant that the number of anglers fishing on rivers has declined.

Stillwater fisheries provide a wide variety of fishing opportunities, although an increasing proportion of them are being managed as either improved or intensively managed waters yielding catch rates of between 10 and 20 times those of river and canal fisheries. However, without the correct compensatory management, the stock levels required to support high catch rates can result in poor fish health and restricted fish growth with many fish dying prematurely. The Agency is keen to work with fishery owners to develop best practice guidelines so that intensive stillwater fisheries can be managed on a sustainable basis and continue to provide valuable angling opportunities.

Some of the key factors affecting coarse fish are described in more detail in Chapter 8.

5



Salmon and sea trout

Salmon and sea trout have complex lifecycles that expose them to environmental challenges and recreational and commercial fisheries, in freshwater and at sea.

Adults migrate from the sea and ascend their natal rivers to spawn. The eggs hatch, and the young salmon and trout (initially referred to as fry, and later as parr) remain in fresh water for up to three years; they then enter the smolt stage and migrate downstream to begin the marine phase of their lifecycle. Most will remain in the North Atlantic for between one and three years before returning to freshwaters again to spawn.

Salmon and sea trout stocks

The Environment Agency and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) publish an annual assessment of the state of salmon stocks in England and Wales [Ref. 3]. Copies may be downloaded over the Internet from:

www.environment-agency.gov.uk/subjects /fish/165773/169852/285585/

Salmon stocks

To describe the status of salmon stocks, we need to consider each of their three life phases:

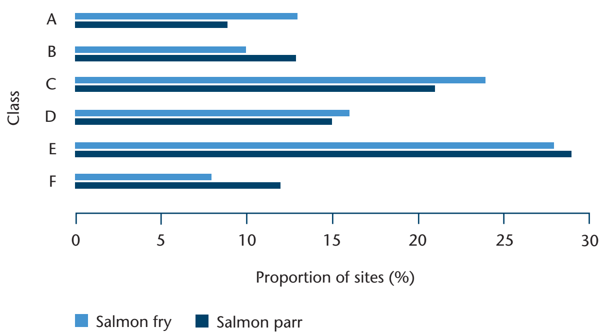
- Juvenile abundance
- Marine survival
- Adult abundance

Juvenile abundance

To monitor trends in juvenile salmon abundance we survey 545 fixed sites each year, comparing their fish densities with a baseline established in the early 1990s. This is done using the Fisheries Classification Scheme (see page 15). For salmonids, this scheme produces two scores for each site – one score for fry (the 'young of the year') and a separate score for parr and smolts from previous years' spawning. In 2002, reliable classifications were obtained from 173 sites in Cumbria, Wales and the South West.

Figures 5.1 shows the pattern of abundance scores for each age class relative to the 1990s baseline.

- Only six sites (3.5 per cent) were classified as well above average for both age classes.
- Both age classes were absent from 11 sites (6.5 per cent).
- For each age class, fewer than half of the sites are classified as average or above (Classes A to C).
- Around 40 per cent of sites were classified as well below average or fishless (Classes E or F) for each age class.
- 46 sites (27 per cent) were classified as well below average or fishless for both age classes.
- Only 16 sites (nine per cent) were above average quality (Class A or Class B) for both age classes.



Figures 5.1 Salmon fry and parr abundance scores from 173 temporal sites surveyed in 2002. Scores range from A to F – sites scoring 'A' are of the highest quality; those scoring 'F' are fishless. More than half of these sites scored lower than the benchmark average set in the 1990s.

At a national level, there is an obvious visual similarity between the pattern of classifications for the two age classes. This might be expected, because rivers with high environmental quality are likely to support good salmon populations of each year class. Indeed, when the data are further analysed we find a strong correlation between salmon fry abundance and that for salmon parr.

Caution is advised when drawing conclusions from these data. The classifications have been derived from a limited number of surveys and cover only one year. Fish populations vary considerably with time and location, and only when several more years' surveys and a wider geographic coverage have been completed will it be possible to detect any meaningful trends. As we progress the work within salmon action plans (and fishery action plans generally, since much of our fishery work, and that carried out by others, benefits a wide range of species) and as we collect data over future years, we would expect to see fewer sites in classes E and F and more in classes A and B.

Marine survival

The numbers and age structure of salmon returning to English and Welsh rivers are greatly influenced by factors in the marine environment that reduce the survival rate of salmon at sea. The effects of climate change, high-seas fishing and exploitation of sea species upon which salmon feed are all potential causes for concern (see Chapter 8).

Trends in marine survival for the River Corrib (Ireland), River Bush (Northern Ireland) and River North Esk (Scotland) are shown in Figure 5.2. These data confirm patterns seen elsewhere in the North Atlantic, which indicate that marine survival can be very variable between stocks and between years. Like most stocks, salmon from the Corrib and the Bush have experienced a decrease in marine survival since 1987. While this has not been apparent over the same timeframe for the River North Esk, if we look further back over the period since 1964 there has been an observable decline in the marine survival of both one- and two-sea-winter fish of the North Esk.

Very little information is available for marine survival of salmon from English and Welsh rivers. In collaboration with CEFAS, the Agency has been collecting marine survival data for the Dee and the Tamar; however, too few years' data are currently available to detect any meaningful trends. A longer data set is available for the Test and Itchen, comprising indices of smolt survival since 1992. These data show that, although marine survival has been very variable, since 1994 there is no significant overall trend.

There have been particularly marked declines in the number and proportion of multi-sea-winter fish in catches in recent years, particularly from those rivers – most notably the Severn, Wye and Dee – that were once renowned for them. (While salmon that return after 1st June comprise a mixture of fish that have spent one or more winters at sea, those returning before this date are nearly all multi-sea winter fish.)

In 2002, some 25 per cent of the total rod catch comprised multi-sea-winter fish, the same as the mean proportion for the previous five years. However, there is considerable variation from river to river, from 4 per cent for the Afon Dyfi in Wales to 79 per cent on the Torridge in southwest England. In six rivers (two more than in the previous year) multi-sea-winter fish

Figure 5.2 Salmon survival rates from Scotland, Northern Ireland and Ireland rivers. We have calculated estimates over a shorter, more recent timescale for the Test and Itchen and, in collaboration with CEFAS, are extending the practice to cover three of our four index rivers.

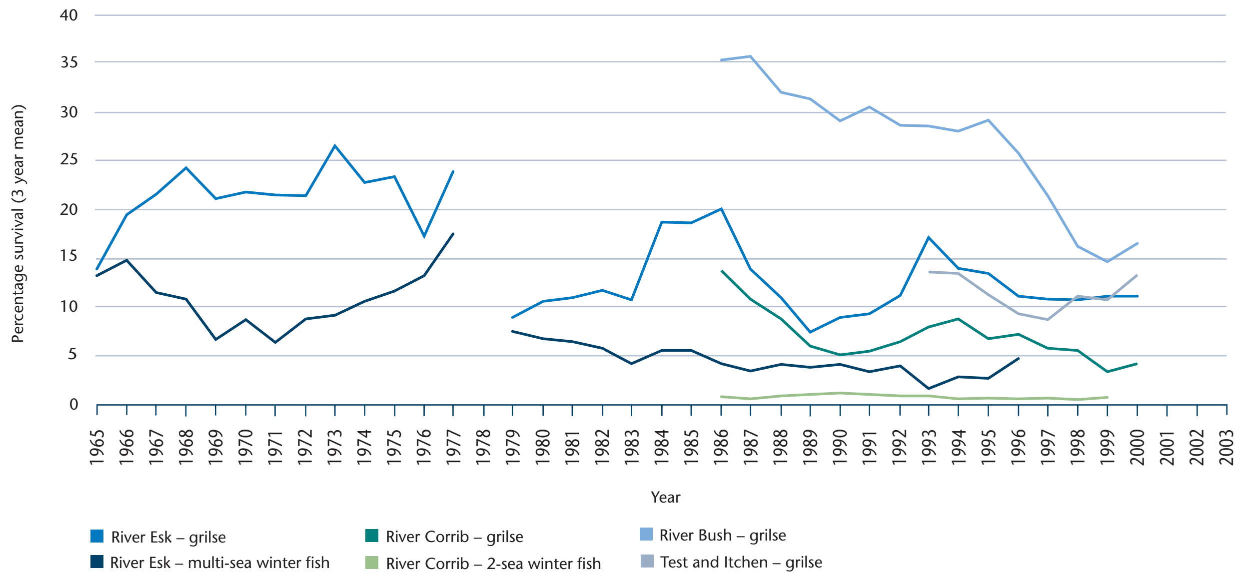
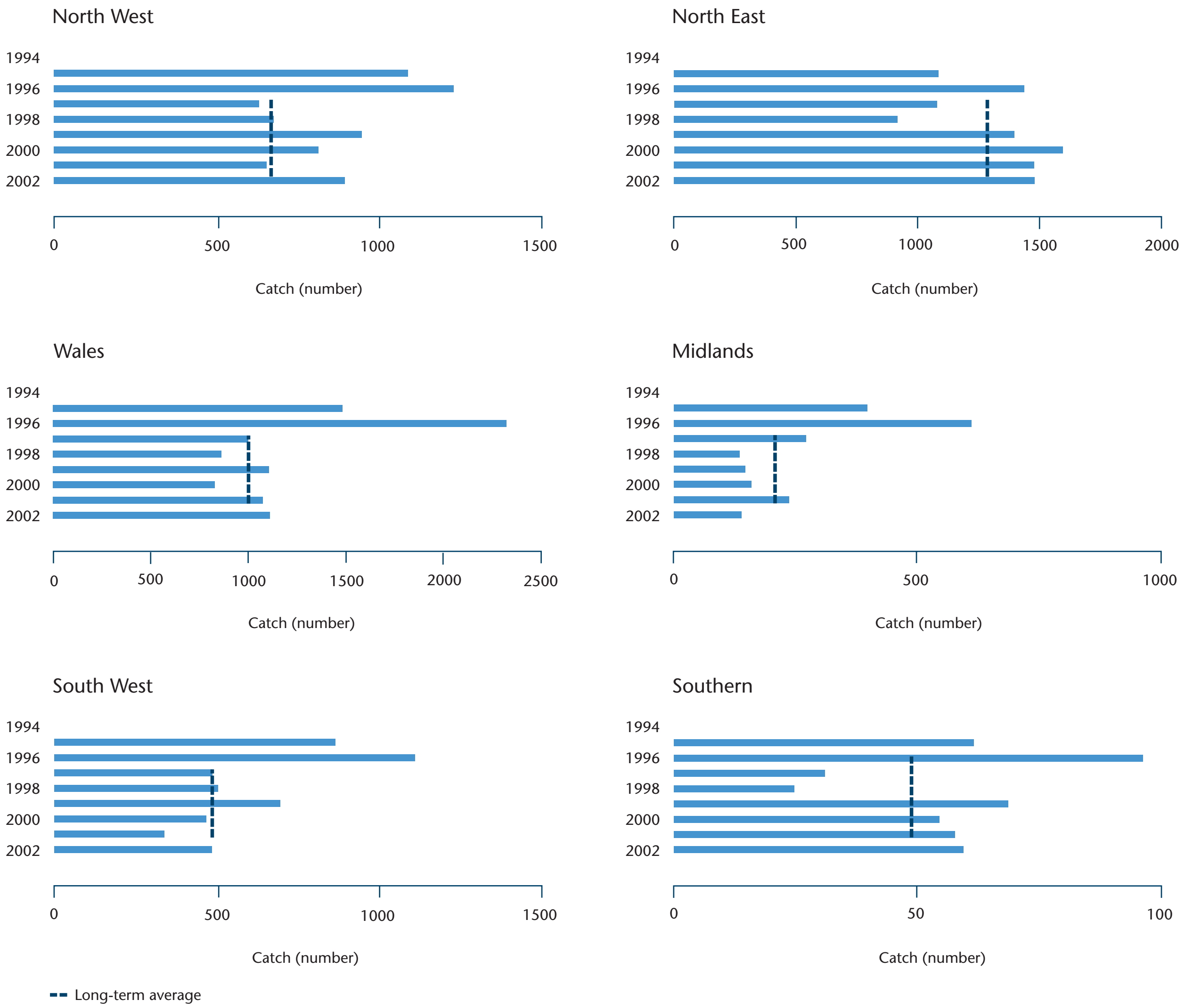
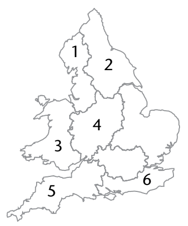


Figure 5.3 Catches of multi-sea winter fish around England and Wales since 1995. A quarter of the 2002 rod catch comprised multi-sea winter fish.





1. North West
2. North East
3. Wales
4. Midlands
5. South West
6. Southern

accounted for more than 50 per cent of the rod catch; they were the Hampshire Avon, Taw, Torridge, Severn, Wye and Usk. These data are presented in Figure 5.3.

While reduced marine survival itself may be difficult to solve in the short-term, we can support stocks in other ways. One such measure was the introduction in 1999 of national byelaws to protect multi-sea winter fish from exploitation. Netsmen are banned from killing and, in most cases, fishing for salmon before 1 June; and all salmon taken by rod and line before 16 June have to be released. These byelaws were time-limited for ten years with a requirement for their review by 2004.

Adult abundance

Adult salmon abundance is assessed in three ways: directly, using net and rod catches, and fish traps and counters; and indirectly, by reference to conservation limits.

Catch. Employing catch data as a surrogate for population status is a well-established and extensively used technique. Since catches have been recorded on most rivers for many years, these data are a valuable and consistent measure of how salmon stocks vary with both time and locality. However, the relationship between catch and stock is complex and care should be applied in interpretation.

1 A rotary smolt trap on the River Dee. By catching and tagging migrating smolts and counting the number of returning tagged adults we can estimate survival rates of salmon at sea.

2 The Chester Weir salmon trap. By tagging salmon as they migrate upstream and with the help of anglers reporting catches of tagged fish allows us to estimate the abundance of different adult age and exploitation rates.

For example, where available, fishing effort (number of licences issued and/or the amount of time fished) should be taken into account when analysing catch data and, depending upon what they are used for, declared figures may have to be adjusted to account for unreported catch. Net catch data are generally less suitable than rod catches for assessment because some nets exploit salmon destined for more than one river, and so the exploitation rates on individual rivers can be highly uncertain. Moreover, changes in fishing regulations have reduced the number of net fisheries and their catches in recent years, rendering them less suitable for stock description purposes. Regulatory changes have also occurred in rod fisheries, but less so than for nets (and they are directed essentially at individual in-river stocks) so that rod catches now provide more accurate indices of adult abundance.

The total declared rod catch in 2002 was 15,231 salmon, compared with the previous five-year average of 14,925 [Ref. 3]. Since 1956, the rod catch for England and Wales has varied considerably from year to year but with no overall significant trend. Reliable fishing effort data have been available only since 1994, since when catch per unit effort has only varied between four and eight fish per 100 days fished (average 6.4 fish per 100 days). In 2002, the overall catch rate was 6.8 fish per 100 days. These data are shown in Figure 5.4.

This national picture conceals a more complex pattern of variation in catches across England and Wales [Ref. 25]. Figure 5.5 (page 44) shows the rate of change in rod catch for all principal salmon rivers in England and Wales. Each bar represents a separate salmon river, starting in North East England at the top of the graph and moving clockwise around the country to the North West at the bottom. Bars to the right of the axis represent an increase in a river's catch since 1974, while those to the left represent a decrease – the longer the bar, the more significant the change. This shows:

- improvements in catches in the rivers of the North East, including the Coquet, Tyne, Tees and Wear.
- declining catches on the chalk rivers of southern England – for example the Test, Itchen and Hampshire Avon.
- a mixture of improving and declining rivers in the South West.
- a decline on the Severn.
- significant improvements on the Usk and rivers of the South Wales Valleys, but declines in some other parts of Wales, most notably on the Wye.
- a mixture of improving and declining rivers in the North West.

There is a pattern to these data. Many of the rivers showing an improvement are in urban or industrial areas – for example the North East Coast and the South Wales

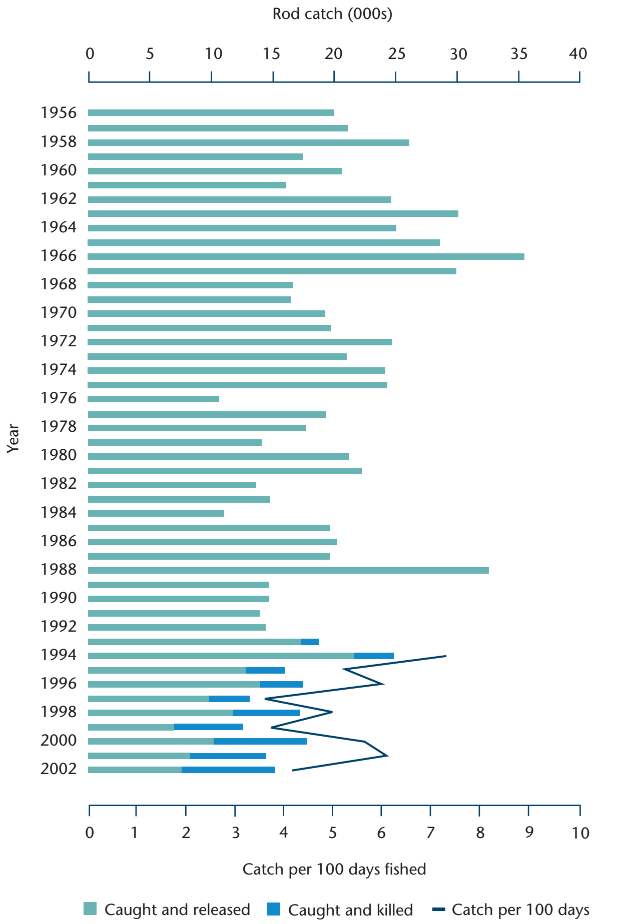


Figure 5.4 Salmon rod catches for England and Wales since 1956 and catch per 100 days fished since 1994.

Valleys (see case study, on page 46). Here, pollution and habitat destruction had had a major impact; investment to improve water quality and work to restore habitats have resulted in a dramatic increase in salmon stocks. This is in stark contrast to the decline in many rivers in rural and notionally pristine areas, some of which – for example the Hampshire Avon, the Wye and the Dee – have been designated as Special Areas of Conservation (see case study on page 49).

Traps and counters. On a number of catchments in England and Wales fish traps and electronic fish counters provide estimates of the upstream run of adult salmon and sea trout. Where possible, counts have been adjusted to separate out returning salmon from other migratory fish. Time-series of counts or other estimates of in-river stocks for selected rivers are shown in Figure 5.6.

The 2002 measures of adult stock abundance are all above the levels recorded in 2001, with very marked improvements evident on some rivers. 70 per cent of the adult stock abundance values for 2002 are also higher

Figure 5.5 Trends in salmon rod catches for principal rivers around England and Wales. Each bar represents an individual river – bars to the right indicate an increase in catch since 1974, those to the left represent a decrease.

than the averages for the previous five years (1997-2001). Counts on the rivers Lune, Caldew and Kent in the North West and on rivers in North Wales (for example the River Dee) also show an upward trend over the past five years.

In some regions the news is rather more mixed. In the South and South West there has still been a downward

Figure 5.6 Salmon counts for selected rivers around England and Wales. 2002 estimates of stock abundance were all above those in 2001, in some cases significantly.

Case study – River Tyne

From a peak catch of 3361 fish in 1927, the salmon fishery on the River Tyne declined through the mid-20th century to the point where no salmon were reported caught in 1951 and 1959. The principal cause was poor water quality in the estuary. Coincident with closure of important industrial plants commencing in the 1960s and complete overhaul of the Tyneside sewerage treatment and disposal system, the estuarine water quality improved dramatically. This has led to a significant recovery in the salmon rod catch in the Tyne (Figure 5.7).

The recovery has always been based on natural re-colonisation, thought to have been achieved by some combination of the resurgence of the residual salmon populations the Tyne (they were never wiped out entirely) and fish straying from the large coastal stocks off the North East Coast.

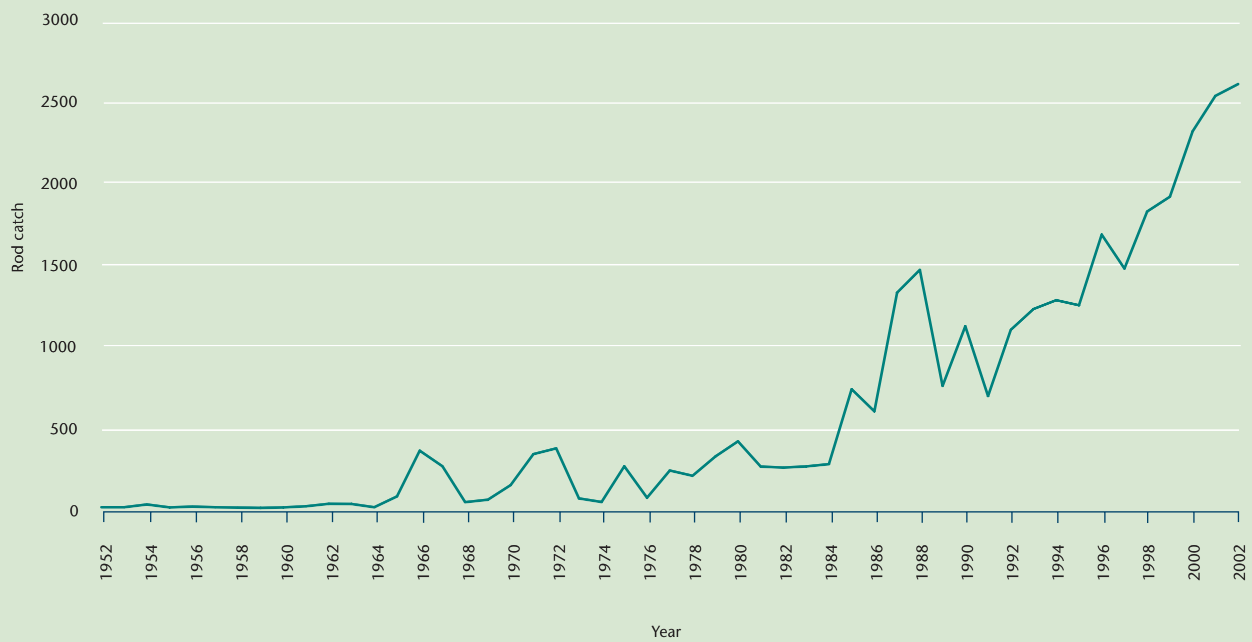
A valuable boost to the recovery came with the contribution from Kielder hatchery, built specifically to mitigate for salmon production lost through the construction of Kielder dam on the North Tyne [Ref. 26]. The hatchery output may well have stabilised the recovery in the early years when water quality improvements were still erratic. Preliminary estimates based on micro-tagging indicate that during the first seven years of hatchery returns, accumulated spawners from the hatchery represented between 15 and 35 per cent of total spawning escapement. Recent monitoring results show that currently between five and eight per cent of the rod catch comprises hatchery-reared fish.

The hatchery contribution also helps to buffer against the loss of returning adults due to intermittent poor water quality in the estuary. In 1995 and 1996, around 2,000 and 1,200 fish respectively died there during the summer months when dissolved oxygen levels fell following extended warm weather. Since then the annual losses have been fewer than 100 fish, with fewer than 50 in 2002. In 2003, however, 2000 fish were reported dead in the estuary during the prolonged warm summer.

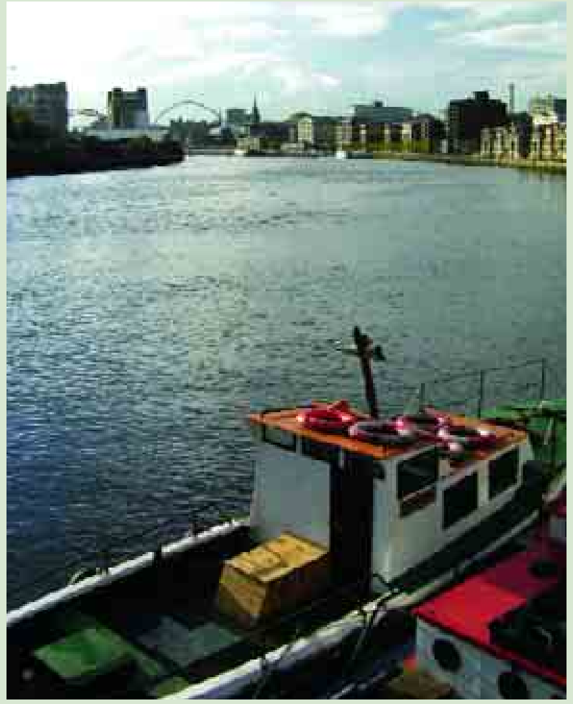
The Tyne, Tees and Wear now support valuable salmon rod fisheries – indeed, the Tyne was the most productive river in England and Wales in 2001 and 2002, when it provided rod catches of 2513 and 2585 fish respectively. This is a clear example of how alleviating a serious environmental problem can lead to the restoration of a major salmon run and development of a valuable fishery.

Rivers in the South Wales Valleys have seen a similar, albeit less dramatic, upward trend in rod catches. For the first time in over 70 years salmon have now reappeared in the Mersey and in the West Midlands Stour. There, as in the Tyne, water quality has improved dramatically following industrial decline and major investment in sewage treatment works.

Figure 5.7 There has been a dramatic recovery in salmon rod catches from the Tyne, following extensive water quality improvements in the estuary.



Case study (continued)



Water quality in the River Tyne through Newcastle has improved in recent years. Alleviating this major environmental constraint has lead to the restoration of a major salmon run and the Tyne producing the highest rod catch in England and Wales.

trend on some rivers (the Thames, Itchen and Frome for example) over the last five years, while others (Tamar and Fowey for example) show an increase in salmon stocks over the same period.

There are no direct measures of adult salmon stock abundance for rivers in the North East although the general trend is of increasing counts of mixed salmon and sea trout stocks. From 2003 a new stock assessment programme (including both a fish counter and fish trap) on the River Tyne will permit direct independent assessment of salmon and sea trout numbers.

Conservation limits. Another way of assessing adult stock status is to compare run sizes with predefined reference points called 'conservation limits'. Conservation limits have been set for all principal salmon rivers in England and Wales, and they define a level of spawning that maximises the sustainable catch by rod and net fisheries. If exploitation rates increase above the sustainable catch levels then, although the catch may temporarily increase, the stock will eventually reduce. Thus, the conservation limit is a lower limit of spawning (egg deposition) below which the risk of stock extinction progressively increases.

Estimates of the number of spawning fish are required to assess compliance with the conservation limit. These estimates can be derived from measures of adult run size obtained ideally from traps or counters or, as on most rivers, on estimates based on rod catches.

Generally, the magnitude of the conservation limit (expressed as the total number of deposited eggs) is dependent on the area of the catchment available for spawning and the level of potential 'productivity.' (High altitude, steeper gradient streams tend to produce more salmon per unit area than their lowland, slower flowing counterparts.)

On the Wye, for example, the conservation limit is 40 million eggs. (Most rivers are much smaller than the Wye and have correspondingly lower conservation limits.) In 2002, the egg deposition on the Wye was estimated to be 6.8 million eggs, based on a rod catch of 357 fish; this is equivalent to less than 20 per cent of the conservation limit.

Across England and Wales, 29 per cent of rivers exceeded their conservation limit in 2002, which was a small improvement on 2001. Some 26 per cent of rivers achieved between 50 per cent and 100 per cent of their conservation limit, again a slight increase on 2001. The summary data for 2002 and the previous five years are presented in Figure 5.8.

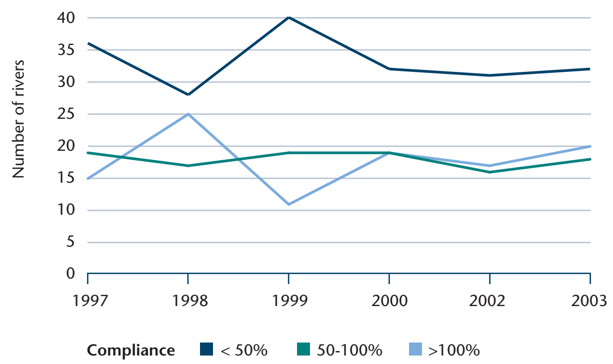


Figure 5.8 Compliance with conservation limits. 2002 saw slight increases in both the number of rivers exceeding their conservation limit or achieving over 50 per cent of the limit.

Figure 5.9 shows the river-by-river variation in the proportion of the conservation limit achieved for 50 principal rivers in England and Wales. Each pie chart represents the percentage compliance, with a dark

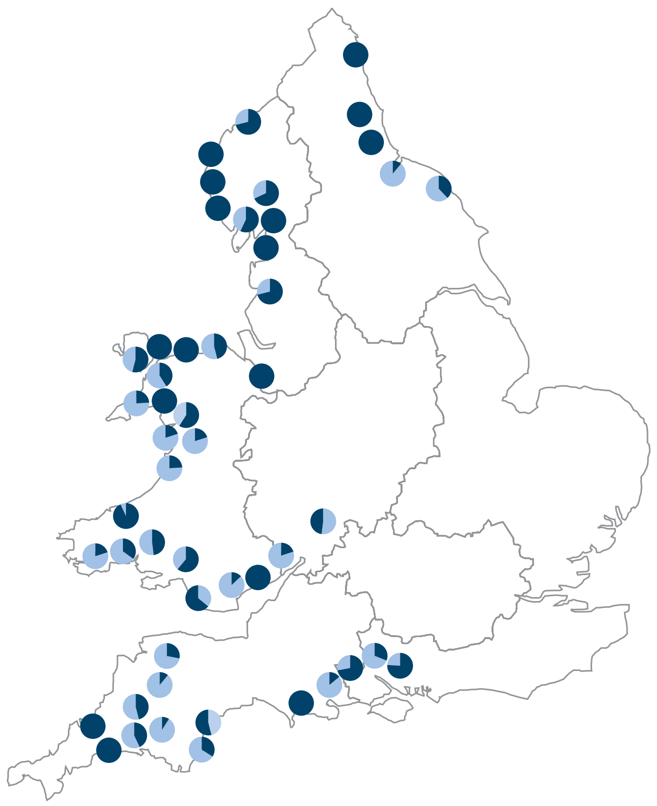


Figure 5.9 Compliance of individual rivers with conservation limits. Rivers in the north of England and North Wales fared better than the South and South West.

circle indicating that the conservation limit is achieved or exceeded. Overall, rivers in the north of England fared better than those of the South Coast and South West. A similar picture emerges in Wales, with rivers in the north generally doing better than those in the south. The Usk bucks this trend, exceeding its conservation limit for the fifth year in succession (see case study on page 50).

It is a Government requirement that Salmon Action Plans (SAPs) must be produced for all 63 principal salmon rivers to implement the National Salmon Strategy [Ref. 29]. By the end of 2002, we had completed plans for 36 rivers; the remainder should be completed during 2003. Each river's plan contains details of the current status of the salmon fisheries and stock, factors limiting performance, and a proposed set of measures to achieve the biological, economic and social objectives of the national strategy. Local stakeholders are consulted on every plan.

Although salmon have been returning in increasing numbers to historically polluted rivers such as the Tyne, Wear and Ogmore, there are concerns over chronic environmental degradation in other rivers, mainly in rural areas. These concerns are related to land use.

Issues of particular concern are siltation resulting from soil erosion, pesticides such as sheep dip chemicals, acidification, and changes in river flows. The relative importance of these effects varies around the country, but clusters of high pesticide levels have been found in Welsh upland streams, while acidification is still extensive in the uplands of Wales and the North West.

Sea trout stocks

Sea trout, the migratory form of our native brown trout, are found in 26 per cent (17,691 km) of all rivers, and their distribution across England and Wales is very uneven. While in the South, the South West and the north of England sea trout are found in between 28 and 43 per cent of rivers, in the Thames catchment, the Midlands and East Anglia they are found only in between 2 and 6 per cent of rivers. Wales has the widest distribution, with sea trout present in 49 per cent of rivers. There are also 13,000 km of river accessible to sea trout but in which their presence has not been confirmed.

As with salmon, monitoring sea trout abundance should cover the fish in their juvenile, marine and returning adult life stages. However, sea trout fry and parr can not be distinguished from brown trout and little information is currently available on sea trout survival at sea. Adult sea trout abundance in individual rivers can be readily assessed and in a similar way to salmon, by using rod catch and fish counter data.

Figure 5.11 shows the reported total rod catch since 1956. Although variable from year to year, these data show an overall upward trend in rod catch over the past nine years. The total declared rod catch for sea trout in 2002 was 49,796, an increase of 23 per cent over 2001, a 20 per cent increase on the five-year mean, and 39 per cent above the long-term average (since 1978). The river with the highest declared rod catch for sea trout in 2002 was the Teifi, in Wales, at 5325; this was followed by the Tywi (Wales) at 5009, the Lune (North West) at 2804, the Wear (North East) at 2611 and the Tyne (North East) at 2608.

As with salmon, there is considerable variation between rivers. Figure 5.12 shows the rate of change in rod catch for the principal sea trout rivers in England and Wales. Results for each of the rivers are represented by separate bars, starting with the Coquet at the top of the graph and moving clockwise around the country to the Border Esk at the bottom. Bars to the right denote an increase in catch since 1974, while those to the left represent a decrease – the longer the bar, the greater the change. There has been an increase in catches on 53 per cent of rivers, of which 29 per cent are statistically significant. On 47 per cent of rivers the graph shows a reduction in catches, of which 21 per cent are statistically significant.

Case study – Chalk rivers

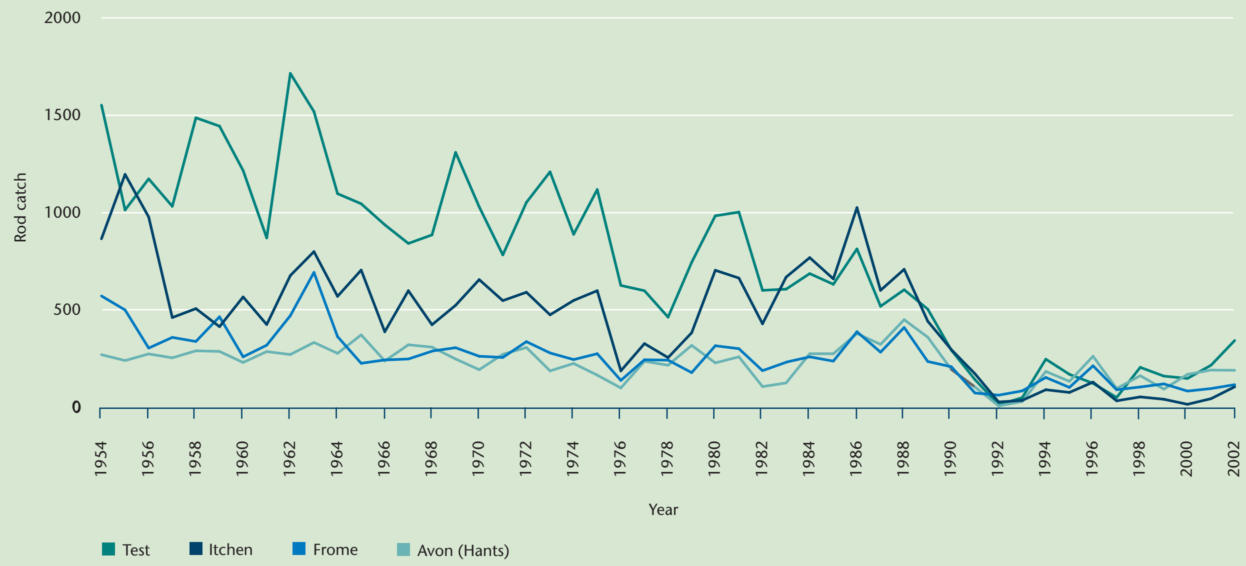
The chalk rivers of the south of England are of the highest ecological and economic value. Although also prized as coarse, trout and salmon fisheries, the scarcity of chalk river habitats has led to several of these rivers – for example the Itchen and Avon – being designated under the EU Habitats Directive as internationally important. Others – for example the Test and Frome – are considered to be of national importance and designated as Sites of Special Scientific Interest. Salmon runs in the chalk rivers of southern England have declined in recent years, with this decline becoming particularly acute after 1988/89.

Concerns raised by local fisheries interests backed the Agency's own monitoring results, and so we carried out an investigation into the factors constraining salmon stocks. The investigation revealed that fine sediment run-off from the land could be causing siltation of the spawning gravels [Ref. 30]. These sediments reduce the amount of oxygen available to the developing salmon eggs so that more of them die. As well as this, river flows had generally been low throughout the decade 1988 to 1997, with periods of extremely low flow at the start and end of the decade.

Based on these findings the Agency has put a number of corrective measures in place, some of which seek to mitigate the problem in the short term and maintain juvenile salmon production. These include catch and release schemes, gravel cleaning, and the use of in-stream incubators. Others actions will address the long-term issues – for example we need to identify and bypass obstructions to migration; to install screens at points of potential entrapment, such as fish farm discharges; to review and where appropriate modify the conditions attached to abstraction licences to protect the river in times of low flow; and to promote 'Landcare' projects to work with farmers and other partners that will reduce run-off from agricultural land.

While it is too early to claim a significant upturn, some of these measures may have already had a beneficial effect. Stocks on the Avon rose to 72 per cent of their conservation limit in 2002 from a low point of 25 per cent in 1994.

Figure 5.10 Salmon rod catch for southern chalk rivers since 1954. The sharp decline in chalk river salmon in the early 1990s has stimulated actions to increase salmon juvenile production.



Changes in sea trout catches follow a pattern similar to those of salmon and show:

- Significant improvements in the North East, most notably on the Tees and Yorkshire Esk
- Marginal trends, both up and down, in catches in southern and southwest England
- Significant improvements in the South Wales Valleys, including the Taff and Ogmore, with a mixed picture for the rest of Wales
- A mixture of marginal, mostly positive trends in the northwest of England

In contrast to salmon catches, sea trout catches on the Dee have shown a significant improvement in recent

Case study – River Usk

A salmon is released back to the Usk. Catch and release, reductions in net fishing and a suite of measures to improve the river's environment are all contributing to an upturn in the fortune of Usk salmon.

During the late 1980s and early 1990s the Usk was suffering from a declining rod catch and was persistently failing its conservation limit. In 1992, the Agency launched 'Usk Salmon – Recommendations for Action' a prototype Salmon Action Plan [Ref. 27]. A decade of improvements followed, with a significant upturn in the Usk's fortune [Ref. 28].

Byelaws introduced in 1992 brought to an end a six-year campaign to stamp out illegal drift netting for 'sea fish' in the Severn Estuary – netting that we estimate accounted for 8,000 salmon per year. Additional byelaws in 1995 and 1999 increased the number of spring salmon spawning. Anglers have responded by returning more of the salmon they catch. Since 1993, the proportion released by anglers has increased from 9 per cent to 51 per cent. A new Net Limitation Order initiated the phase out of the licensed drift nets, which was completed in 2000 through a buy-out led by the Wye and Usk Foundation. The Foundation also bought-off the last remaining putcher rank for five years.

Between 1995 and 2002, a number of environmental bottlenecks were removed:

1995	Uskmouth Power Station ceased its abstraction and cooling water discharge to the estuary
1997	We reached agreement with British Waterways to control the abstraction to the Monmouth-Brecon Canal
1996/97	Major improvements were made to industrial and sewage discharges to the estuary
1998/99	An Agency campaign succeeded in reducing sheep-dip pollution in the Usk's headwaters
2000	Installation and commissioning of full treatment of sewage discharge to the estuary was completed

Improvement works are continuing. In 2003, for example, fish passage over Brecon Weir was improved

The measures set out in the Salmon Action Plan would appear to have had a significant effect. In 2002, the Usk achieved the highest rod catch in Wales for the third year running, with the average weight of rod caught fish increasing and two fish of over 30 lbs caught and released. More significantly, and in contrast to the neighbouring Wye, the Usk has achieved its conservation limit for the fifth year in succession. However, there is no room for complacency and some concerns remain:

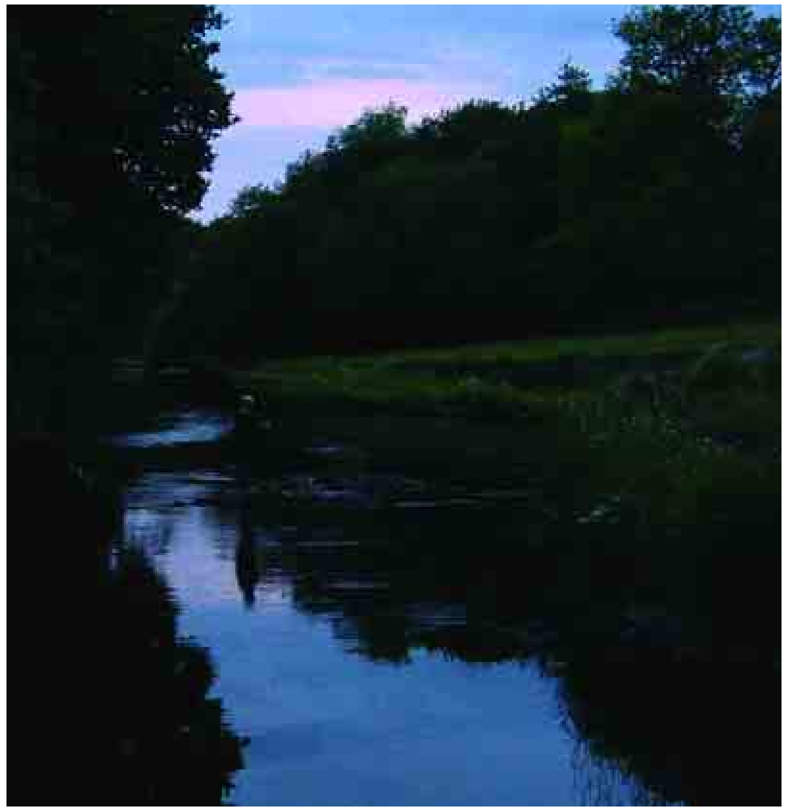
- The impacts of abstraction on smolt and adult migration: this is being discussed with abstractors
- Outstanding problems in some nursery areas: we are collaborating in a bid led by the Wye and Usk Foundation for funding to improve habitat

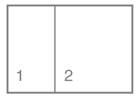
years. Although data have not been collected over the same timescale as on other sea trout rivers, catches on the River Itchen have fluctuated but they increased substantially in the last 14 years, from around 300 fish in the 1990s to a peak of over 1150 in 2001. The 2002 catch was 953 fish. Catches in the neighbouring River Test have remained relatively low, fluctuating between 30 and 360 fish since 1989.

Fish traps and electronic fish counters around England and Wales provide estimates of the upstream run of returning adult sea trout. Figure 5.13 shows time-series for a selected number of counters and traps. The indications from these sites are that:

- Sea trout numbers in the rivers Fowey and Dee have been increasing progressively in recent years. Similarly on the Tamar numbers have increased steadily since 2000. In the Dee the majority of this increase relates to sea trout in their first year (whitling/herling)
- In northwest England, the sea trout population on the Lune has remained relatively stable during the period 1998 to 2002, whereas on the Kent the number of sea trout entering the river has declined over the last three years.

No specific estimates of sea trout numbers are available for North East Coast rivers, but this matter should be addressed with the construction of improved fish





1 A salmon trying to get over Blackweir on the River Taff as a fish pass is being built in the background. As water quality improves in industrial rivers, providing access to spawning grounds becomes a priority.

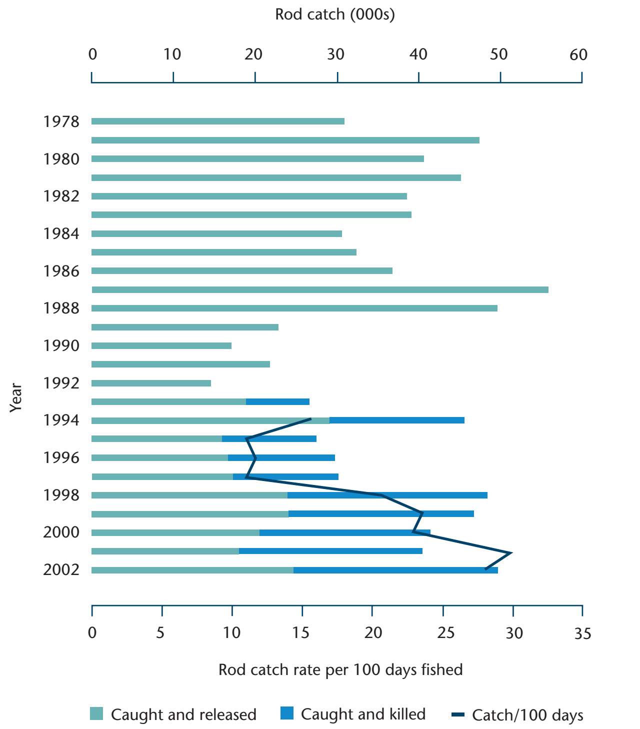
2 Sea trout fishing at night on the River Teifi.

counting and trapping facilities on the River Tyne during 2003.

Fishing effort

Salmon and sea trout fishing is regulated by the Environment Agency. Various regulations govern the fishing methods, close seasons, fishing areas and the numbers of licences issued. A rod licence must be issued to anyone who wishes to buy one (unless the Courts have prohibited them from holding a licence). Net licences may be limited (such that the number of licensees must not exceed a specified maximum), and in most fisheries net limitation orders are in force. Salmon and sea trout also are caught by a variety of methods in fisheries in coastal waters and estuaries. These methods fall into four general categories – sweep nets, gill nets, hand-held nets and fixed engines. Within these categories, there is a wide variety in the design and use, reflecting local conditions and tradition. Capping the

Figure 5.11 Sea trout rod catches for England and Wales since 1978, and catch per 100 days fished since 1994. The catch in 2002 was 23 per cent higher than in 2001 and 20 per cent above the five-year mean.



number of net licences issued and defining length of the fishing season in specific fisheries limits the total allowable net fishing effort.

In 1999, Government confirmed a series of measures to protect spring running multi-sea winter salmon [Ref. 31]. Significant among these was delaying the start of the salmon net fishing season until 1 June and imposing on rod fishermen compulsory release of any salmon caught before 16 June. This significantly restricted the maximum allowable fishing effort for salmon.

A net licence issued for catching salmon also allows the fisherman to take sea trout. Hence, it is impossible to distinguish the allocation of effort between salmon and sea trout fishing. The amount of the maximum allowable effort that is used (the utilised effort) varies through the year, from one year to the next, and between different fisheries. The utilised effort is determined by a number of factors including the weather, sea state, river height, perceptions of the number of fish entering the river, and the sale price of wild salmon and sea trout.

In most regions the effort utilised by nets and fixed engines was lower in 2002 than 2001 [Ref. 3]. The reduction was most noticeable in the southwest of England, where utilised effort fell by 22 per cent. On the Severn the fall was 12 per cent and in the North West it was ten per cent. In contrast, utilised effort rose in the North East by six per cent and in Wales by one per cent. Broadly similar changes occurred between 2000 and 2001.

In 2002, as in previous years, the proportion of maximum allowable effort used varied around England and Wales. Fisheries in Wales and in the North West averaged 22 per cent use of maximum allowable effort. On the River Severn the proportion used was 25 per cent and in the South West it was 31 per cent. North East fisheries averaged the highest at 38 percent.

The long-term picture is one of generally declining net fishing effort. Figure 5.14 shows the numbers of licences issued across England and Wales since 1983. Numbers of all four categories have shown a steady decline and there has been an overall reduction of 59 per cent (an average of three per cent per year). Factors influencing this decline include the phasing out of mixed stock salmon fisheries (see below) and the falling price of wild salmon due to the expansion of salmon farming over the last two decades.

Rod fishing effort is heavily influenced by river flows – these influence the amount of time anglers are willing to fish and the availability and catchability of fish in the river. Overall, flows on all rivers in 2002 were above the long-term average. High water in May and June may also have resulted in the loss of some fishing

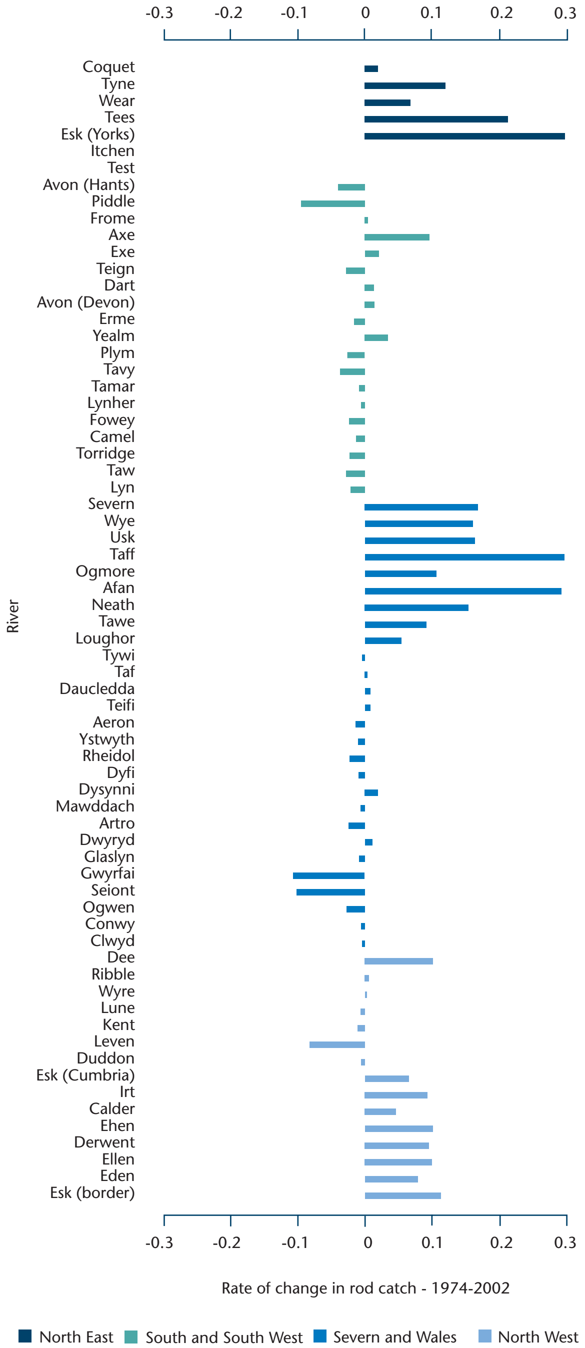
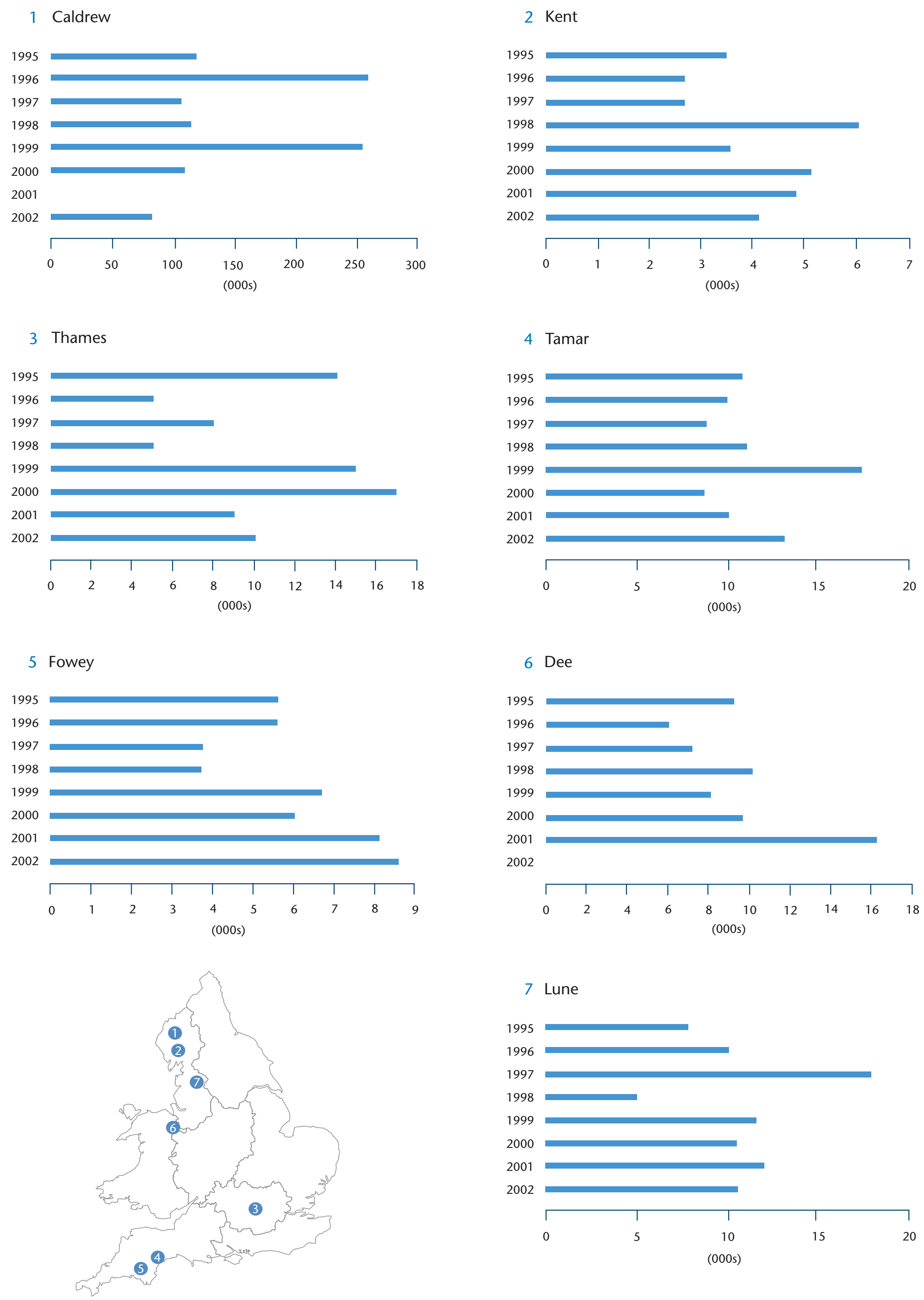


Figure 5.12 Trends in sea trout rod catches for principal rivers around England and Wales. As with salmon, sea trout are returning to the previously polluted rivers of the North East and South Wales.

opportunities, while below average flows in August, September and much of October (typically peak times for rod catches in many areas) provided less than ideal conditions for angling. Where low flows persisted until the end of the fishing season salmon catches remained below average; however, those areas that had heavy rain around the middle of October provided good

Figure 5.13 Estimates of sea trout abundance from counters and traps on selected rivers.



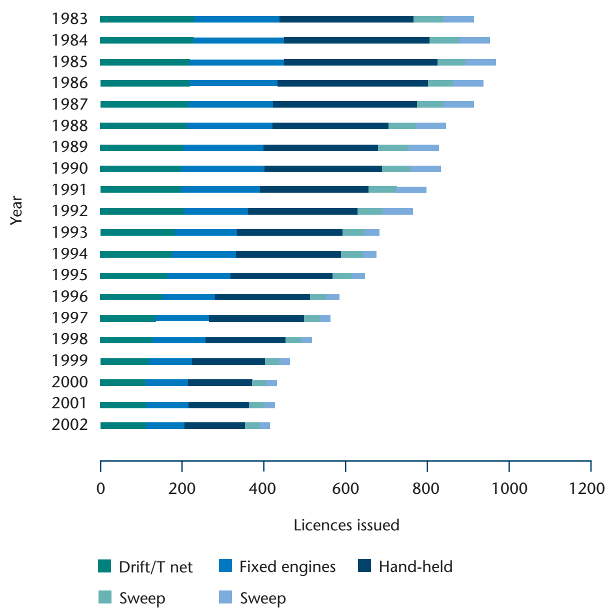


Figure 5.14 Number of each category of salmon net licences issued in England and Wales. Net fishing has reduced over the last two decades, with the phasing out of mixed stock fisheries.

fishing conditions at the end of the season and reported higher catches.

The number of salmon and sea trout rod licences sold each year has fallen by 22 per cent since 1994, when a single national rod licence was introduced. (Prior to 1994 there were separate rod licences for each region and for Wales.) This fall is thought to be influenced by the decline in salmon stocks. The recent early season restrictions to protect spring salmon are also likely to have had an effect in recent years. (Salmon/sea trout rod fishing licence sales rose by 30 per cent in 2002 compared with the previous year; this was largely due to unusually low licence sales in 2001 because of access restrictions imposed during the foot-and-mouth-disease crisis.)

Salmon and sea trout anglers are required to declare the number of days they fish. In 2002, a total of 181,850 days were fished – 40 per cent of the total effort in Wales and 60 per cent in England. Although up by 35 per cent on 2001, the 2002 effort figure is still 38 per cent below the effort declared in 1994 and nine per cent below the five-year average. Falling licence sales are just one factor behind this reduction; the early season restrictions have also had an effect on salmon fishing effort. Analysis of individual returns shows that most effort is concentrated in the part of the season after 16 June. Anglers in Wales accounted for almost half (48 per cent) of the fishing effort during the early part of the season; there the emphasis in spring is mainly on the large, early running sea trout for which the West Wales and Gwynedd rivers are renowned.

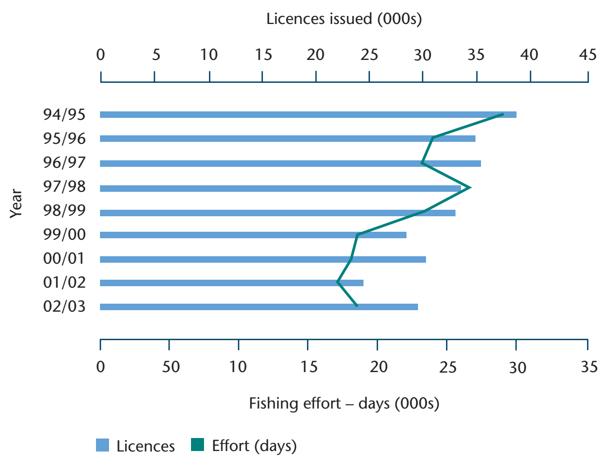


Figure 5.15 Salmon rod licence sales and days fished since 1994. Both licence sales and fishing effort have declined in recent years, with a sharp dip during the 2001 foot and mouth outbreak.

Catches

The Agency publishes an annual report detailing rod and net catches of salmon and sea trout catches on a river-by-river basis [Ref. 11]. Copies may be downloaded over the Internet from:

www.environment-agency.gov.uk/subjects/fish/165773/169852/173045/

Salmon catches

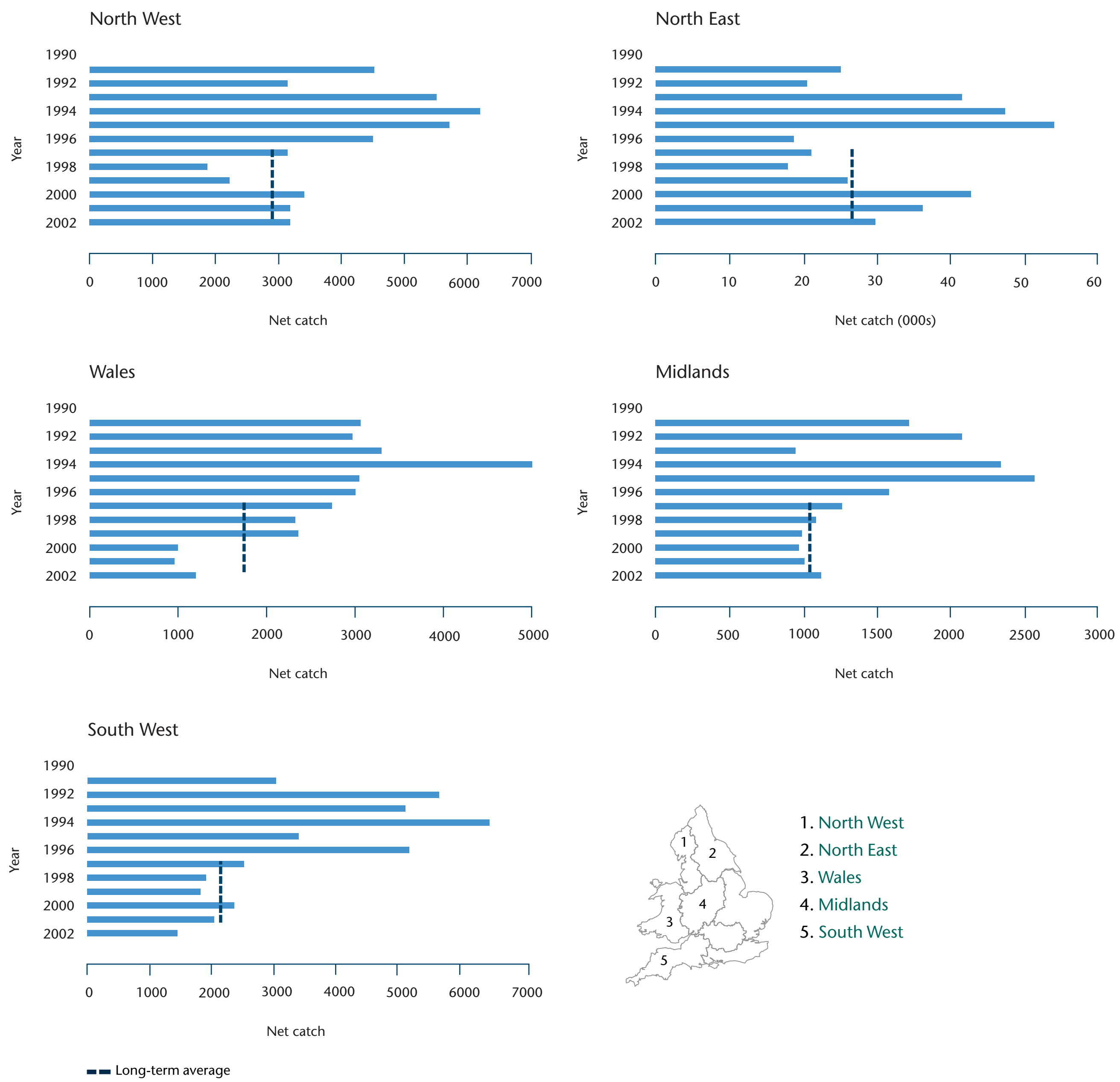
A total of 53,510 salmon were declared caught during 2002.

The total reported salmon net and fixed engine catch for England and Wales was 38,279. This is 11 per cent lower than the 43,243 caught in 2001, but still slightly above the five-year average of 37,009. The catch was dominated by the North East Coast fishery, which accounted for 81 per cent of the 2002 catch. Since 1992, this fishery has consistently accounted for more than 50 per cent of the salmon catch; however, catches are expected to reduce substantially following the buyout of all but 16 of the nets from the start of the 2003 season.

The trend in salmon net catches in recent years is presented in Figure 5.16.

Caution is needed when drawing conclusions from a comparison of catches between consecutive years. More meaningful conclusions can be drawn by comparing groups of years or by examining trends. For example, between the periods 1997 to 1999 and 2000 to 2002, there was a substantial decline in average net and fixed engine catches in some areas, the greatest

Figure 5.16 Declared regional net and fixed engine catches, 1991 to 2002. (The solid horizontal line is the 1997-2001 mean.) Phasing out of mixed stock fisheries, together with effort restrictions, has led to reductions in net catches in all but the North East. NB. Catches in the North East reduced substantially in 2003.



reductions taking place in Wales (55 per cent), the South West (8 per cent) and the Severn (5 percent). This was most likely due to the imposition of the early season fishing restrictions, which have been successful in reducing catches of spring salmon. However, over the same period there were substantial increases in the North West (38 per cent) and in the North East (65 per cent) – this latter result being in spite of the continuing gradual phase out of the North East Coast drift-net fishery. These increased catches may reflect the improving salmon stocks in the north of the country, particularly in the Tyne and Wear, compared with other parts of England and Wales.

Since 1997, the England and Wales salmon rod catch has varied between 12,500 and 17,600 fish. In 2002 rods caught 15,231 salmon. Despite an increase in fishing effort following the lifting of the foot-and-mouth access restrictions, the 2002 catch was only slightly above that of 2001 and just two per cent above the five-year average. The trend in salmon rod catches in recent years is shown in Figure 5.17.

There was significant variation between regions. In Wales and the North West, anglers reported that the late season runs of salmon had been relatively good, but that most of the fish ran too late to feature in catches. As with the net fishery, rod catches in Wales, the South West and on the Severn have declined in recent years, while in the North East they have increased markedly.

Measures to protect salmon stocks

A number of measures have been introduced in recent years to reduce the number of salmon killed in rod and net fisheries.

Catch and Release. In recent years, encouraged by the Agency and many other fisheries interests, anglers have been releasing an increasing proportion of the salmon they catch. In 2002, just over fifty per cent of all rod caught salmon (7,632 fish) were released. Although many fish caught towards the end of the season are coloured and so must, by law, be released, it remains that there has been a steady increase from around 10 per cent releases in 1993 to 42 per cent in 1999 and 44 per cent in 2001.

On the Hampshire Avon, the Wessex Salmon and Rivers Trust sought the collaboration of Tesco Stores to fund a catch and release scheme. Anglers are issued Tesco vouchers to compensate for each salmon they release in the second half of the season, after the end of statutory catch and release period. In 2002, anglers caught 64 fish after June 16 – all were released.

In the joint Avon and Stour estuary the Agency has brokered a catch and release agreement with the seine netsmen. The netsmen have to arrange their own compensation, which, for 2002 and 2003, was provided by the Avon and Stour Fisheries Association. In 2002, 203 fish were returned alive.

Protection of spring salmon. The much-publicised concerns over the decline in spring salmon resulted, in 1999, in Government confirming a series of measures to protect multi-sea-winter fish. Not only did the new byelaws protect salmon during the early season, but also there are clear indications that voluntary catch and release has continued later into the season. In 1998, before the byelaws were in place, 45 per cent of salmon over 14lbs caught after August were released. In 2002, the figure had risen to 63 per cent. The new byelaws also delayed the opening of most salmon net fisheries until 1 June, and only those net fisheries that primarily target sea trout were allowed to operate before this date.

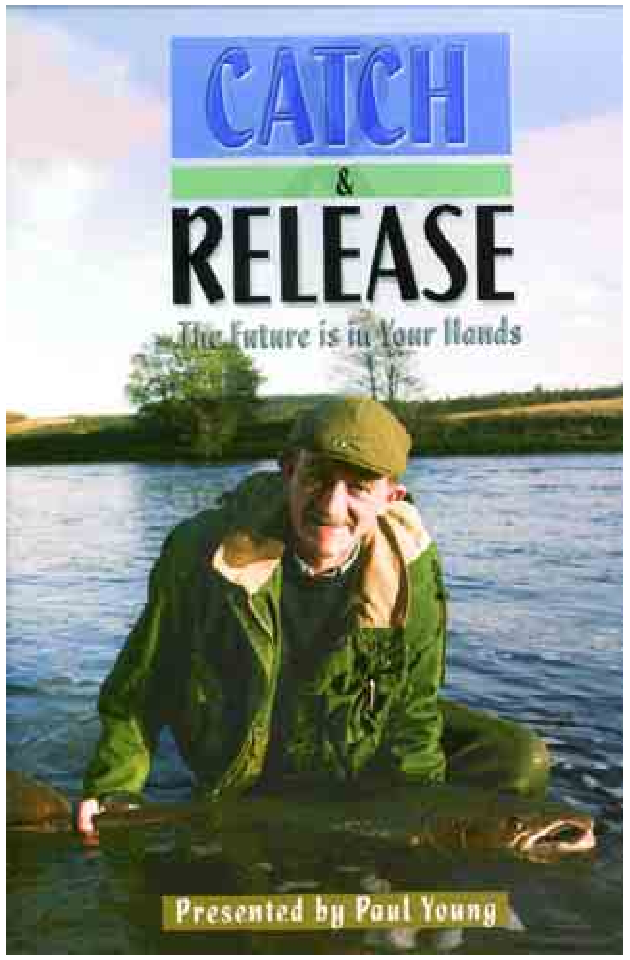
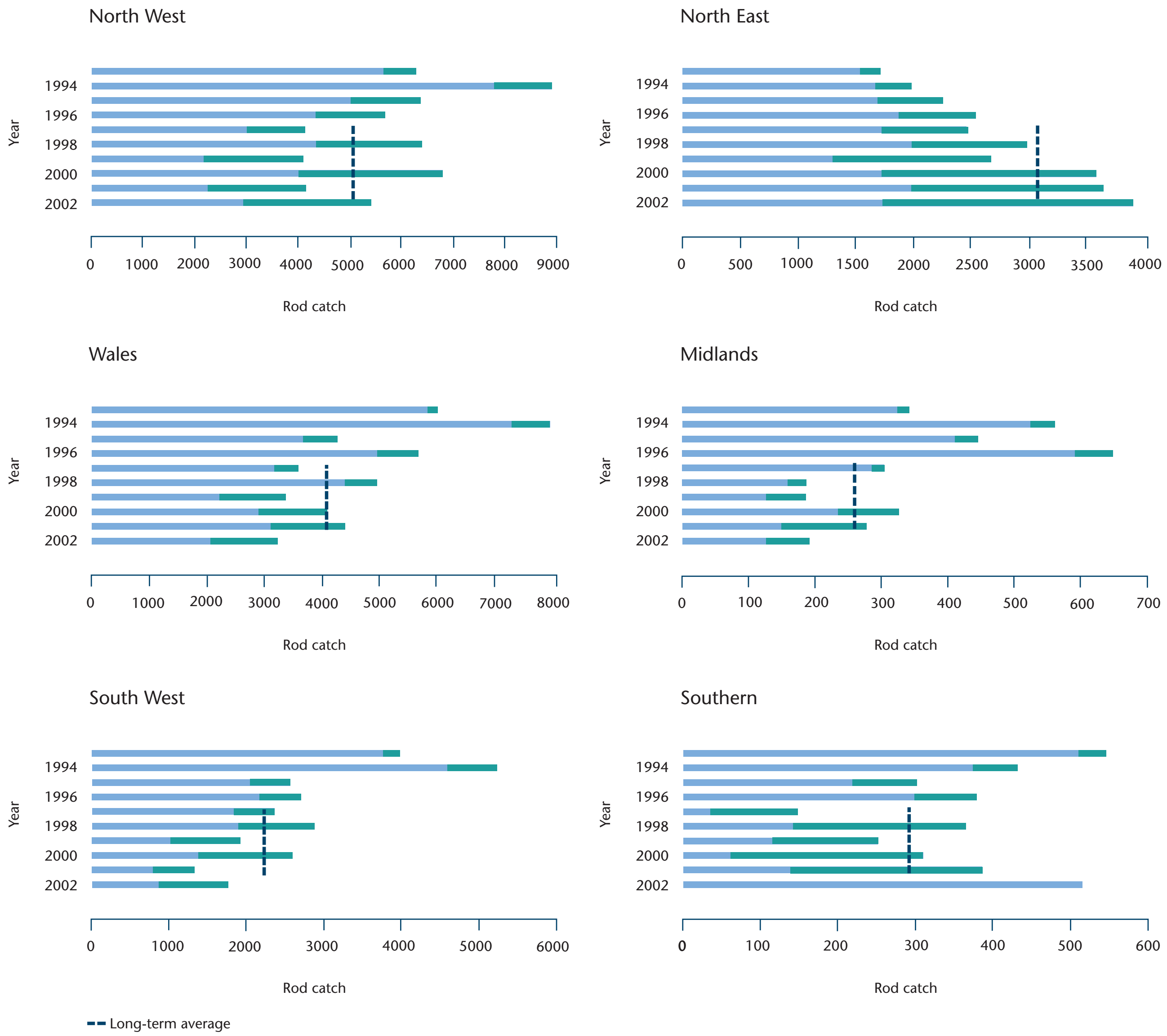


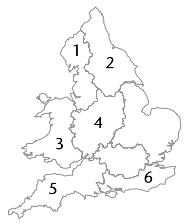
Figure 5.18 Catch and release video. Voluntary schemes, supported by compulsory measures in the early season, have meant that just over half of the catch is now released.

Before the byelaws were introduced, nets took an average of 3,000 salmon before 1 June; since 1999, the figure has fallen to an average of 54, all of which had to be released. In 2002, the pre-1 June net catch was 32.

Closure of Mixed Stock Fisheries. Since 1993 it has been Government policy to phase out mixed stock salmon fisheries – fisheries that exploit stocks from more than one river and therefore compromise the management of individual river stocks. As net fishermen retire, their licences are not re-allocated. Of the ten mixed stock fisheries operational in 1993, seven have now been closed. Of the remaining three, the North East Coast drift-net fishery is the most significant, and in 2003 negotiations were concluded to buy out all but 16 of the remaining nets. The compensation amounted to £3.4 million and was funded by the North Atlantic Salmon Fund (UK) and the Department of Environment, Food and Rural Affairs. The scheme could increase the number of salmon returning to rivers to spawn by up to 75 per cent, thus adding to the recovery of stocks in North East England and Eastern Scotland. The remaining drift nets will continue to reduce in number as licences lapse when netsmen retire from the fishery.

Figure 5.17 Declared rod catch and proportion released, 1993 to 2002. The solid horizontal line is the 1997-2001 mean.





1. North West
2. North East
3. Wales
4. Midlands
5. South West
6. Southern

Other Net Fishery Closures. In addition, to allow more of the catch to be available to the upstream rod fisheries and to boost the spawning stock, arrangements have been made on some rivers to compensate net and fixed engine fishermen for not fishing for all or part of the season. For example:

- South West Water and the Environment Agency have compensated netsmen for a shortened season on various rivers in Devon and Cornwall
- fishery owners, the North Atlantic Salmon Fund and the Wye and Usk Foundation have bought off a private putcher rank in the Severn Estuary; they have also compensated the netsmen in the Usk drift net fishery for relinquishing their licences, and that fishery has now been closed by a zero Net Limitation Order
- The Derwent Owners Association has bought off the Cumbrian coast drift nets and that fishery has now also been closed by a zero Net Limitation Order.

Salmon management in England and Wales aims to optimise the number of fish returning to home-water fisheries. With the recent trend of declining stocks, especially of multi-sea winter salmon, it has been necessary to place additional restrictions on exploitation. However, it is also essential that we try to maximise juvenile salmon and sea trout survival in freshwater. (Whilst sea trout catches have not experienced similar declines to salmon, measures to improve salmon spawning success should also enhance juvenile trout production.)

Within the freshwater environment, several factors are considered to be harming salmon stocks and damaging the fisheries they support. These include acidification of watercourses in afforested areas, sheep dip and other pesticide pollution, illegal fishing and predation. However, diffuse pollution and silt run-off from agricultural land have been highlighted as being of particular concern. (See Chapter 8.)

Sea trout catches

The total sea trout net catch in 2002 was 36,997. This was 18 per cent down on 2001 and four per cent below the five-year average – the latter figure reflecting, in part at least, the reduction in salmon and sea trout fishing effort in recent years. The overall trend in sea trout net catches since 1978 is presented in Figure 5.26.

As with salmon, the North East Coast fishery accounts for most sea trout caught in England and Wales. In 2002 the North East Coast catch of 30,450 fish was more than 80 per cent of the total. Catches from this fishery have remained relatively stable over the past five years, with catches ranging from 22,260 to 38,097.

The remainder of the sea trout net catch (6547 fish in 2002) is taken in fisheries off the coast of East Anglia (1289 fish in 2002), in the South West (2461 fish) and North West (851 fish) of England, and in Wales (1943 fish). With the exception of the relatively low catch in the North West in 2002, the catches from these fisheries have remained relatively stable over the past five years.

In 2002 the declared sea trout rod catch was 49,796 – up by 23 per cent on the previous year and 20 per cent higher than the 5-year mean. The highest declared rod catch in 2002 was 4,841 on the River Teifi, followed by the River Tywi (4,554), the River Lune (2,549) and the River Wear (2,374).

Catches from the North East Coast net fishery have remained relatively stable against a background of reducing numbers of nets, and the North East rod catch has increased over the last four years. The rod catch has fluctuated between 4170 and 5973 during the five years to 2002 with an average of 4,827 fish. In 2002 the sea trout catch was 5790.

On the River Itchen, the rod catch has been increasing steadily since 1990 and in 2002 it stood at 953, compared with a five-year average of 746. The Test rod catch, on the other hand, has fluctuated between 30 and 360 fish, with 286 sea trout recorded in 2002.

The rod catch in the South West has averaged 8,366, fluctuating between 6,472 and 9,668 since 1998. In 2002, the catch was 8,611.

Wales has consistently accounted for the majority of the rod catch of sea trout, with returns fluctuating between 19,439 and 25,027 since 1998. In 2002 the rod catch was 25,435 – more than 50 per cent of the total for England and Wales.

The North West rod fishery caught 9016 fish in 2002. Catches in the preceding five years fluctuated widely, from a high of 11,296 in 2000 to a low of 4874 the following year.

Catch and release has also been widely adopted by sea trout anglers. In 2002, anglers released 25,170 fish following capture; that is just over half of the total catch.

Conclusions

Despite some encouraging recent trends in many regions, salmon stocks generally remain in a seriously depleted state. The proportion of rivers attaining their conservation limits shows that 70 per cent of stocks fell below their egg deposition requirements in 2002, with 46 per cent of rivers achieving less than 50 per cent of the conservation limit. There is, however, some cause for optimism. Some of our historically most polluted rivers are showing strong positive trends, with the Tyne providing the largest rod catch of all rivers in 2002. The Usk has achieved its conservation limit for the fifth year in succession, following a decade of action to protect stocks and improve the river environment. Furthermore, the proportion of multi-sea-winter fish in the England and Wales stock was up by 10 per cent on 2001 and by 14 per cent compared with the average for the preceding five years.

In 2002 sea trout abundance in England and Wales, as measured by rod catch returns, was significantly greater than in 2001 and was above the average for the past five years. Close scrutiny of the figures is equally encouraging: since 1974: on the majority of rivers the sea trout abundance has increased – in many cases significantly so.

The total fishing effort in the salmon and sea trout net and fixed engine fisheries has decreased over the past two decades due largely to the phasing out of mixed stock salmon fisheries and a falling consumer demand for wild salmon. There has also been a reduction in salmon and sea trout rod fishing effort, partly in response to falling salmon stocks.

Figure 5.18 Declared regional sea trout net catch, 1993 to 2002. The North East Coast fishery, which has dominated salmon and sea trout catches, is being phased out by a Net Limitation Order that has been accelerated by a recently agreed compensation scheme.

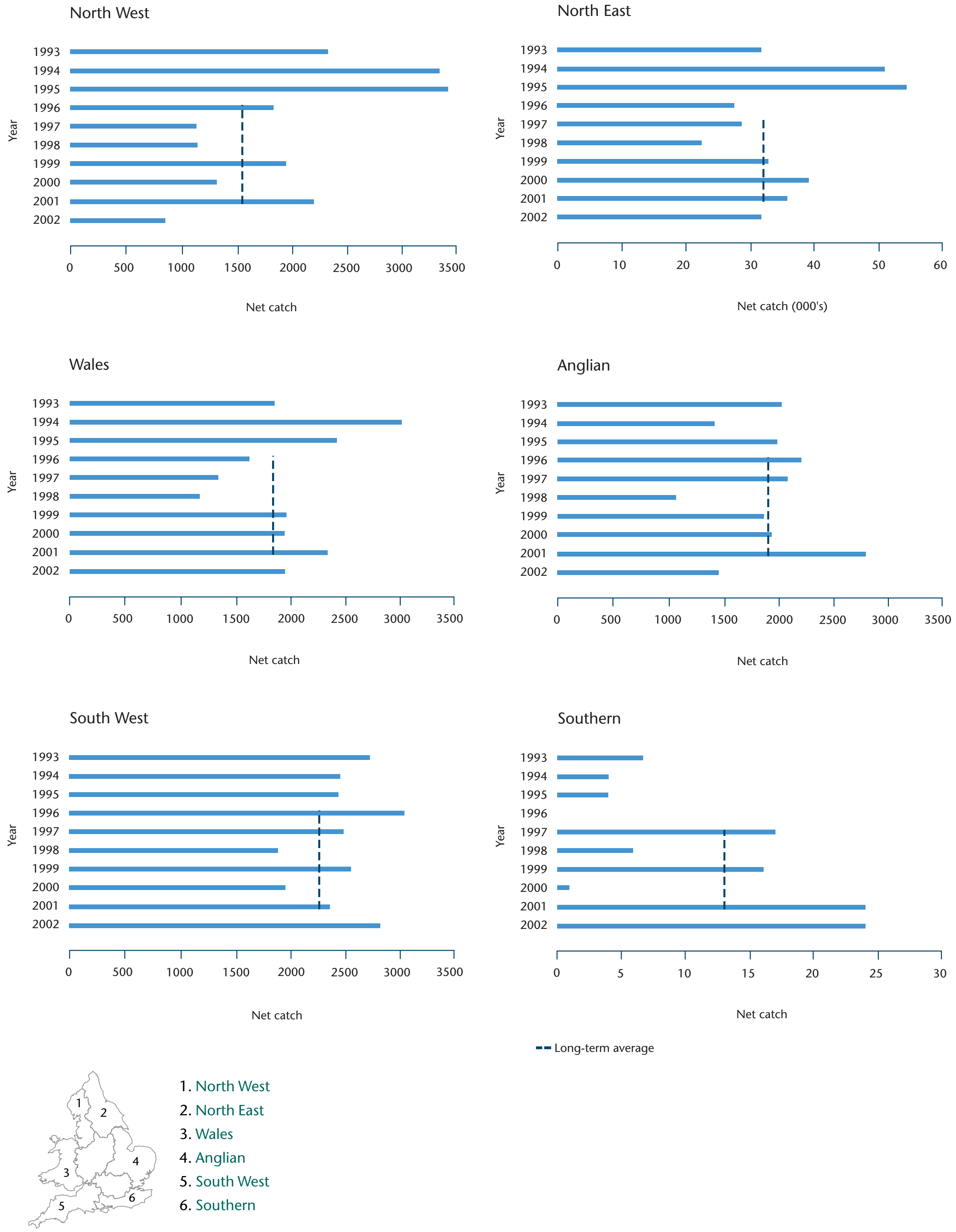
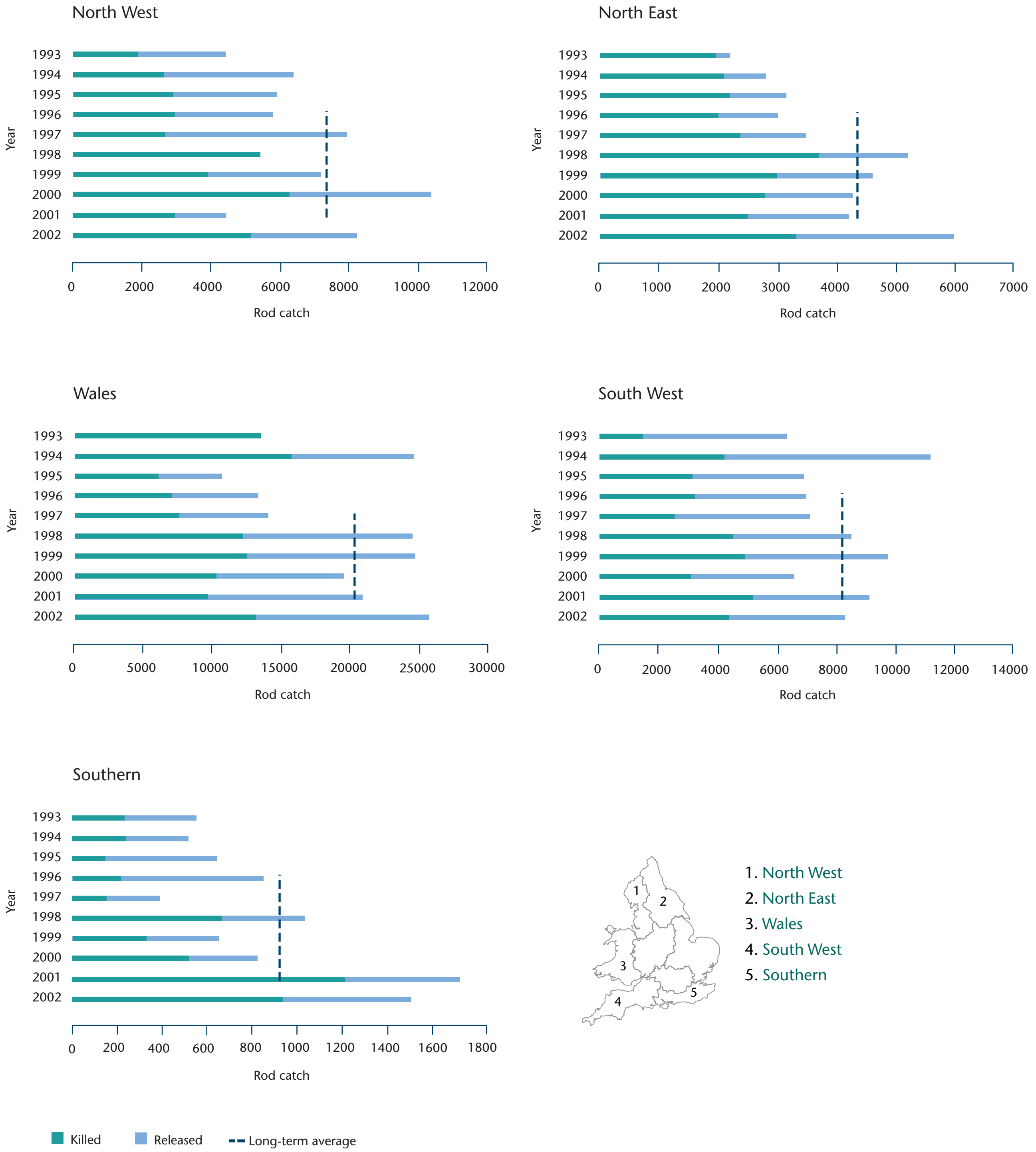


Figure 5.19 Declared regional sea trout rod catch – 1993 to 2002. The 2002 catch was 23 per cent above the 2001 catch and 20 per cent above the five-year mean.



Although 2002 saw net and fixed engine catches increase compared with the foot-and-mouth disease year of 2001, salmon catches have declined in most parts of England and Wales in recent years. The North East Coast fishery is an exception, although catches from this fishery are expected to reduce substantially following the recent buy-out of most of the nets. The picture is similar for sea trout net and fixed engine fisheries; however, the main cause of reducing catches has probably been the reduced effort targeted at salmon.

Despite local variations, the overall England and Wales salmon rod catch has shown no evident trend since 1993. The sea trout rod catch, on the other hand, has increased considerably over the same period.

Following advice from ICES, the UK Government has confirmed a number of fishing restrictions in recent years to help to achieve international salmon management objectives. The most significant of these are the spring salmon byelaws. Although these measures have been very successful in reducing catches of multi-sea-winter salmon, it is too early to determine what effect the measures have had on stocks. We will be able to report on how salmon stocks are responding in future reports.

While survival at sea is probably the single biggest factor restricting salmon populations and the fisheries they support, it is important that we tackle the environmental factors that restrict freshwater spawning and survival. In the past much emphasis has been placed on increasing the quantity of spawning and nursery habitat by re-opening access to spawning sites by removing or bypassing man-made barriers to fish migration. This work will continue; however, it is equally important to focus on the quality of salmon and sea trout spawning sites. As we saw on the River Tyne, the alleviation of a single environmental constraint – in that case poor estuarine water quality – consolidated in the early years by stocking from Kielder Hatchery, has led to the remarkable recovery of an entire river; so much so that the Tyne is now producing a higher rod catch than any other river in England or Wales. It is possible that improvements in land management could bring equally significant increases in salmon catches throughout England and Wales.

6

Trout and Grayling

Salmo trutta is the only species of trout native to the United Kingdom, where we also have one native species of grayling (*Thymalus thymalus*). The rainbow trout (*Onchorynchus mykiss*), a native of North America, is stocked widely across England and Wales but spawns here naturally in only a few isolated locations.

Despite being a single species, a proportion of our native trout are genetically programmed to undergo a physiological change similar to that of young salmon and migrate to the sea. Adult sea trout generally grow much larger than fresh-water brown trout and take on an appearance and lifecycle more akin to salmon.

All trout eggs are laid in spawning gravels in fresh waters, usually in the headwaters of river systems. As the young trout fry develop into parr, they take on the characteristic markings of the adult fish. After between one and three years as parr, those fish that will become sea trout turn into smolts and migrate downstream to the estuary. Brown trout do not migrate to the sea; instead they remain in streams, rivers or lakes and ascend tributaries and headwaters to spawn each year.

As with salmon, brown trout abundance needs to be considered at juvenile and adult life stages. We also have a lot of information, much of it based on local observations, on brown trout distribution. (Sea trout abundance is discussed in Chapter 5.)

Trout distribution in England and Wales

Trout (either as brown trout, sea trout or both) are present in some 70 per cent (48,000 km) of total river length in England and Wales [Ref. 32]. As is to be expected of fish that thrive in cool, fast-flowing water with clean gravel areas for spawning, they are more widely distributed in the north and south west of England and in Wales, where they are present in 35,000 km of river – this latter figure constituting 75 per cent of their total distribution. Wales has the widest distribution, with brown trout or sea trout present in 98 per cent of river length. They are less well distributed in the south and east of England, where they are present in 34 per cent of river length. Note, however, that these figures simply relate to where the species is found and are not necessarily an indication of trout abundance.

Populations of brown trout are found above impassable barriers. These reaches comprise 25 per cent (17,000 km) of total river length and are mostly found in the Midlands, the north east of England and Wales. In lowland England most of the barriers are man-made, while natural barriers are more commonly found in upland regions of the north and west of England and in Wales. Where little or no trout stocking has been undertaken in the past, surveys have shown that anglers value the opportunity to fish for these truly wild trout, which also have a high conservation value [Ref. 7].

The Salmon and Freshwater Fisheries Review, 2000, [Ref. 1] recognised that wild brown trout are highly prized by anglers. The review made a number of recommendations to protect and enhance native trout populations and the fisheries they support, in particular by preventing inappropriate stocking and by improving habitats. These policies are being implemented via the National Trout and Grayling Fisheries Strategy [Ref. 33].

Figure 6.1 shows the distribution of brown trout across England and Wales.

Information on the distribution of trout in stillwaters is less comprehensive than for rivers. In Wales, an independent survey in the mid-1980s [Ref. 34] revealed

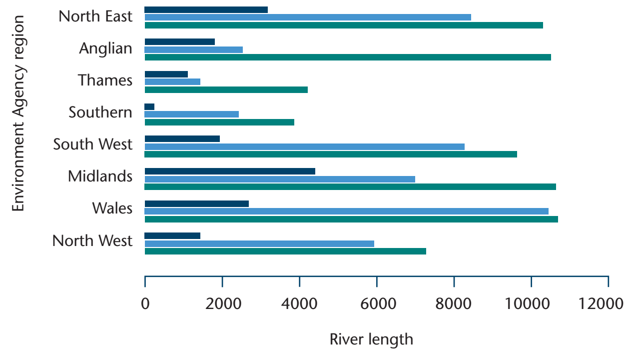


Figure 6.1 Distribution of brown trout in rivers in England and Wales. Brown trout are found in 70 per cent of rivers, with up to a quarter of rivers containing wild stocks.

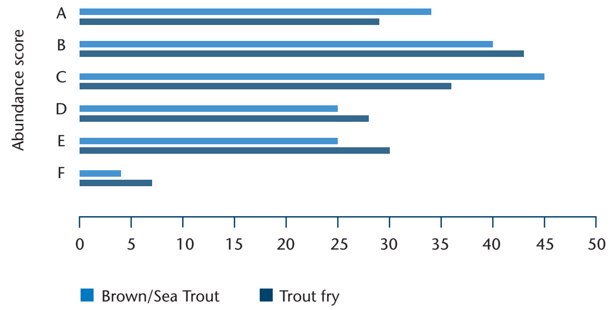


Figure 6.2 Brown trout fry and parr abundance scores from 173 temporal sites surveyed in 2002. Scores range from A to F – sites scoring 'A' are of the highest quality; those scoring 'F' are fishless. At least one age class of trout was present at all sites, and more than 60 per cent of sites scored C or above for each age class.

that 54 per cent of Welsh lakes supported breeding populations of brown trout. Angling magazines are another useful source of information, as are fishing guides that contain catch records. The conservation and angling value of native brown trout is increasing, particularly in natural stillwaters. Proposed work under the forthcoming Water Framework Directive [Ref. 24] will add to our understanding of the distribution, and ultimately the abundance, of brown trout in all stillwaters larger than ten hectares.

Juvenile trout abundance

The Agency carried out 545 quantitative electric fishing surveys on salmonid rivers in 2002. Of these, 173 were processed using the Fisheries Classification Scheme (see page 15). As for salmon, this scheme provides separate classifications for trout fry and trout parr. It is not possible to distinguish between brown trout and sea trout at the fry and parr stages.

We must be cautious about drawing any firm conclusions from these data at this stage, because the classifications have been based upon a limited number of surveys over only one year. Fish populations vary considerably with time and location, and only when results are available from several more years' surveys with wider geographic coverage will it be possible to draw meaningful conclusions about population trends.

Figures 6.2 show the distribution of classifications for trout fry and trout parr. Overall the results are encouraging: for each age class more sites are above the early 1990s average than below it. Trout were present at all sites, and at only six per cent of sites were one or other of the age classes absent.

In future years we will be able to report on a larger number of sites, and as we assess data over successive years it should be possible to detect year-to-year and place-to-place trends in juvenile trout abundance. It will also be possible to track changes in the distribution of fish abundance classes, and we hope that our monitoring programme will show more sites in classes A to D and fewer sites in classes E and F. We also intend to set up a network of index river survey sites; these will be monitored more intensively to improve our understanding of sea trout and brown trout populations and the factors affecting them.

Adult trout abundance

Little reliable information exists about adult brown trout abundance. At present, catch returns are not generally available, and counters are not a viable option for monitoring non-migratory fish. We therefore intend to adapt our electric fishing programme to improve our understanding of trout populations and lifecycles. We will also develop and work with fishery owners, angling clubs and individual anglers to introduce a logbook scheme to monitor angler catches. Although primarily intended for monitoring fishery performance, these catch returns can provide invaluable information on fish abundance and distribution.

Despite the present scarcity of monitoring data, we are aware of several issues known or perceived to be affecting trout populations and the fisheries they support; these include many of the factors affecting salmon populations, such as acidification, siltation and low flows. One issue that has warranted particular attention in recent years is the observed (and in some instances scientifically measured) decline in the abundance of fly life, in particular on chalk rivers, but also on some spate rivers. These and other factors affecting fish populations are discussed in Chapter 8.



1 A grayling is returned. Catch and release is common practice among grayling anglers, a practice endorsed by the Grayling Society.
2 A young angler learns to flyfish at Dyffryn Springs Fishery, Vale of Glamorgan. The development of 19,000 lake, reservoir and purpose-built stillwater fisheries has made trout fishing more readily available throughout England and Wales.
3 A wild brown trout is returned to the River Tawe.

Grayling distribution and abundance

Although the Salmon and Freshwater Fisheries Act [Ref. 35] groups grayling with coarse fish, taxonomically they are included in the salmonid family.

The grayling's natural range is thought to have been restricted to the Ouse, Trent and Hampshire Avon catchments and possibly those of the Dee, Severn, Wye, Ribble and Thames [Ref. 36]; however, over the past 200 years grayling have been introduced into many more rivers across much of England and Wales. In southern England, grayling are most abundant in the chalk rivers, such as the Test and Avon. In the north, the largest populations are found in the Trent, Severn, Ouse, Wharfe and Ribble catchments. Grayling are also found in few locations in East Anglia. In Wales, grayling are no longer confined to the Wye, Dee and Severn but are also present in several South Wales rivers including the Taff, Rhymney and Ewenny. Grayling are also found in two stillwaters – Llyn Tegid (Bala Lake) in North Wales, and Gouthwaite Reservoir, in Yorkshire.

Little data has been collected on the status of grayling populations, although there have been specific studies on some rivers. Any assessment of the overall status of grayling is therefore largely subjective.

In many cases, where they are present grayling are thought to be thriving – for example in the Dee and Severn catchments and the southern chalk rivers, where there are important fisheries. Grayling are sensitive to water quality, and recent improvements in some rivers have led to increases in abundance. In the Yorkshire Don, for example, grayling were absent in 1982 [Ref. 37]. As the river recovered from a legacy of industrial pollution grayling were reintroduced, and over the following decade catches increased from fewer than 50 fish per year to around 1200 (with no substantial change in fishing effort).

In contrast, grayling populations reintroduced to the Anglian rivers Chater, Ise and Whitham and to the River Hull in the North East have all declined in abundance [Ref. 38-40]. The native grayling population in the Worcestershire Teme suffered a similar decline in the 1970s [Ref. 36]. (The stock has subsequently improved, particularly in the middle reaches.) The upper critical temperature for grayling is between 18 and 25 degrees Celsius, and in each of these cases high water temperature during drought conditions has been cited as the cause of the decline. If climate change predictions are realised, water temperature could become a critical factor in grayling distribution and abundance. In other catchments, grayling populations have been impacted by pollution events.

A more accurate picture of the status of grayling populations will emerge in the future. The Agency aims to develop conservation targets for the abundance and structure of grayling (and wild trout) populations, against which population status can be assessed.

Brown trout, rainbow trout and grayling fisheries

Although many brown trout fisheries are stocked with farmed fish to augment stock density and maintain or improve angler catches, wild trout are still an important angling resource. We are currently unable to measure the value of wild trout fisheries, although in a 2001 survey of rod licence holders [Ref. 7] some 67 per cent said that they would prefer to fish for wild rather than stocked trout. In practice, however, the majority (75 per cent) were more likely to fish for and catch stocked fish.

The profile of wild trout has increased in recent years, and The Wild Trout Trust has been established to strive for the protection and improvement of wild trout waters. Through the Trout and Grayling Fisheries Strategy [Ref. 33], we have introduced policies to help protect wild trout and grayling by managing their exploitation, stocking and habitats.

Grayling fisheries are often situated on the same rivers as trout fisheries, and many anglers target both species. Grayling fishing is not as widely distributed as that for trout, reflecting the natural distribution and relative popularity of the species. However, grayling fisheries can be locally important – the River Dee draws grayling anglers from throughout the United Kingdom, and the Dee hosted the World Flyfishing Championships in 1990, when grayling were the main target species.

No attempt has yet been made to quantify the economic importance of grayling fisheries, largely because it would prove extremely difficult to distinguish the value from trout fisheries operating on the same rivers. In a poll of rod licence holders in March 2001 [Ref. 7], only 5 per cent (or 46,000) reported having fished for grayling in the previous year. However, 47 per cent of anglers who had not fished for grayling expressed an interest in doing so in the future. What was most encouraging was that the greatest interest was shown by anglers aged between 12 and 16 years. As with wild brown trout, the growing popularity of grayling has inspired the formation of a special interest group, the Grayling Society. In 2002 membership of the Society was around 1100 [Grayling Society, pers. comm.].

Trout and grayling fishery performance is best monitored through the use of a voluntary catch returns or logbooks. The majority of stillwater trout fisheries operate on a 'put and take' basis and any such monitoring of these fisheries is undertaken by fishery owners. Logbook schemes have been implemented in the past for local river trout fisheries, most notably those with a 'wild trout' component, and in 2001/02 the Agency launched a national logbook scheme for grayling anglers [Ref. 41].

Some 235 logbooks were distributed to grayling anglers before the start of the 2001/02 season and 350 logbooks before the start of the 2002/03 season. The aim of this scheme was to obtain catch results from 150 angling days for each river. The 2001/02 season was severely disrupted by the foot-and-mouth disease outbreak – so much so that we received only a 35 per cent return rate and did not obtain the required amount of data for any rivers. In 2002/03, the response was higher, at 44 per cent, although the target number of angling days was achieved only for the River Dee.

The logbook results showed that 57 rivers in England, Wales and Scotland were fished for grayling in 2001/02. More than 4,200 fish were caught during 671 angler visits. These figures increased in 2002/03, with 8,800 fish being caught from 89 rivers during 1415 angler visits. The regional breakdown of catch and effort is presented in Table 6.1 and Figure 6.3.

Figure 6.3 shows a similar pattern in regional catch per unit effort (CPUE) between 2001/02 and 2002/03, with Thames and the South West consistently recording the highest catch rates. In 2001/02, the highest individual river catch was recorded on the Derwent (Derbyshire) and the highest CPUE was on the Lambourn (Berkshire).

In 2002/03, the highest catch was from the River Dee and the highest CPUE result was achieved on the Hampshire Avon. The distribution of grayling catches

Table 6.1 Grayling fishing catch and fishing effort. NB No returns from Anglian region.

Region	2001/02			2002/03		
	Visits	Hours fished	Catch (num)	Visits	Hours fished	Catch (num)
North East	126	486	486	219	1177	122
Thames	14	78	237	19	101	255
Southern	28	143	310	63	334	665
South West	106	419	1176	103	448	1517
Midlands	137	567	911	140	578	837
North West	54	213	120	103	413	194
Wales	129	569	773	401	1547	3089
Scotland	137	356	414	295	1475	1050
Total	**731**	**3111**	**4427**	**1415**	**6073**	**8828**

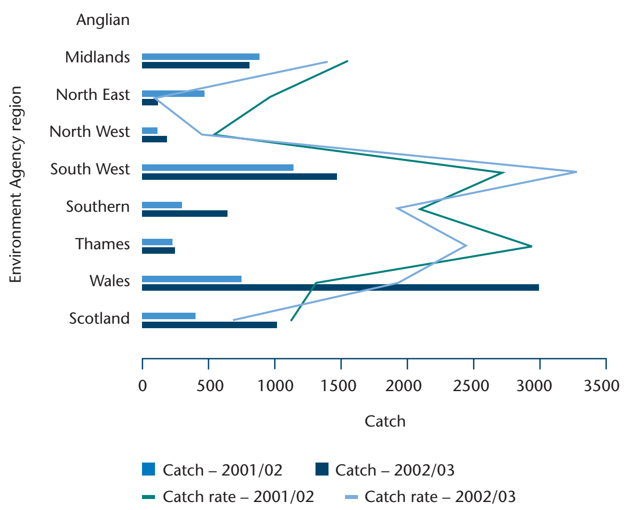


Figure 6.3 Regional grayling catches and catch rates – 2001/02 and 2002/03. NB No returns from Anglian region.

and catch rates is presented in Figure 6.4. These results reflect the relative abundance of grayling in Great Britain, with lower grayling population densities in northern regions and Scotland than in southern England and in Wales.

The logbooks also record information on the size composition of the catch and on angling practices. Overall, there was no pattern in the distribution of size classes, although most of the larger fish (those greater than 35 cm in length) were caught in Southern and North West regions and in Scotland. Fly-fishing was the most popular angling method (56 per cent of all fishing effort) and consequently accounted for the majority of the catch (62 per cent of fish caught).

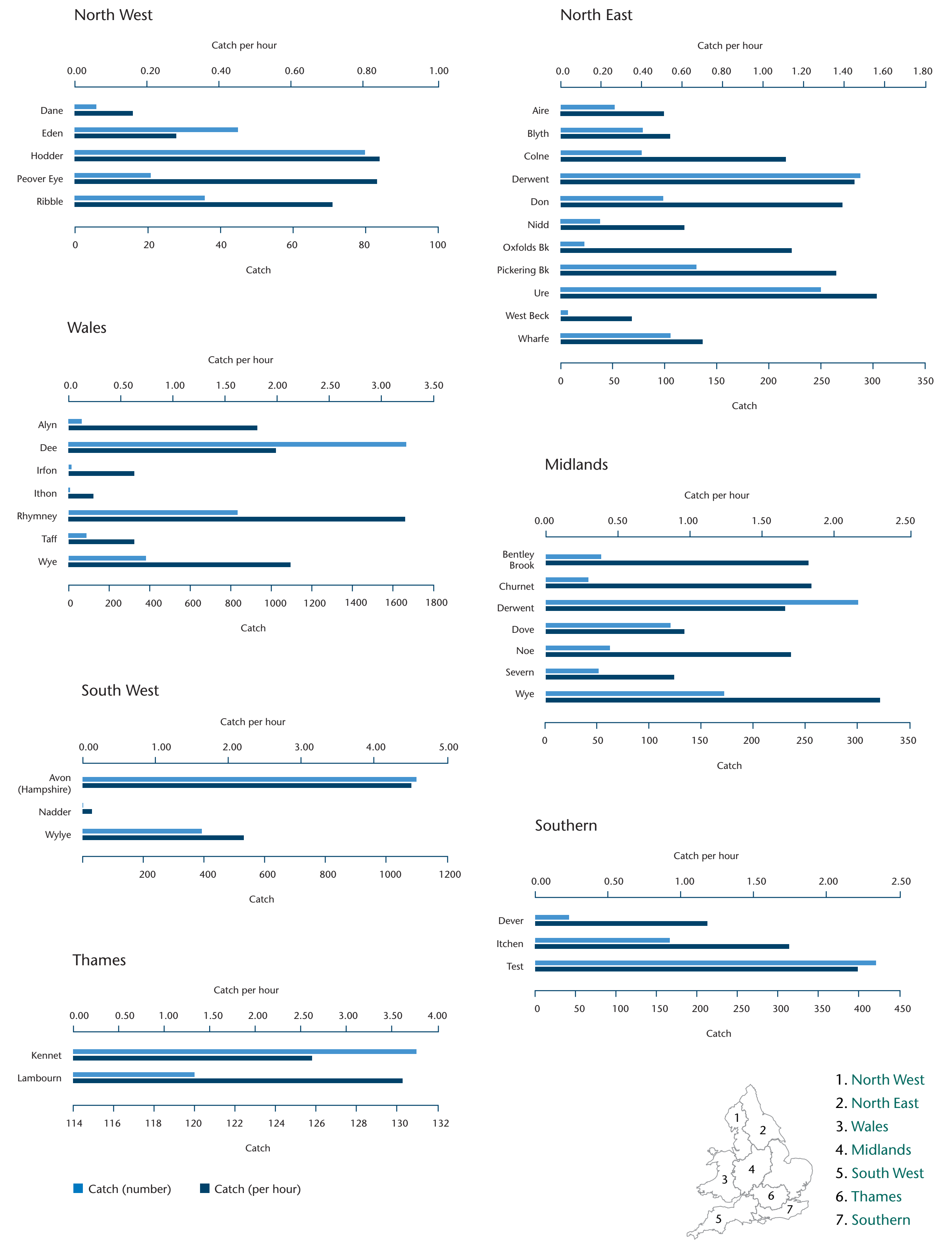
Anglers very rarely kill grayling, and the Grayling Society actively supports and encourages the practice of catch and release. In 2002/03 the majority of all grayling caught were returned alive – the highest proportion of fish killed was just three per cent, in Scotland [Ref. 41]. At these low levels, exploitation is not likely to impact significantly on grayling stocks.

Conclusion

Overall, our understanding of brown trout populations is not as comprehensive as that for salmon. We aim to rectify this by enhancing various components of our fisheries monitoring programme. This will include the creation of a network of index river survey sites, and collaborating with anglers and fishery owners across England and Wales in a native brown trout logbook scheme.

Trout are fairly well distributed across much of England and virtually the whole of Wales, with isolated populations of native brown trout present in over 50 per cent of river catchments. From the results of survey sites classified in 2002, juvenile trout are generally abundant, with more sites being of 'moderate quality' or better. However, we recognise concerns raised by anglers and fishery owners over the widespread and significant decline in fly life. We are undertaking further studies into the nature and causes of this decline.

Figure 6.4 Grayling catches and catch rates from individual rivers – 2002/03. Only rivers which received more than 5 fishing visits are included.



The River Lambourn, Berkshire. The pristine conditions of this Special Area of Conservation make it and other chalk rivers excellent grayling fisheries.

Grayling, once considered as vermin on some southern chalk rivers, are increasingly valued for the autumn and winter sport they provide. Anglers rarely kill these fish, and there are encouraging reports and monitoring evidence to show that in most rivers the grayling populations are healthy. By adapting our monitoring programme, we will be able to report on the status and trends in grayling stocks in future reports.

Eels and Elvers

Eels are migratory fish. Unlike salmon and sea trout, however, eels spend their adult lives in freshwaters, returning to the sea only when they are ready to spawn. They are thought to make the journey across the Atlantic to spawn in the Sargasso Sea, from where eel larvae are carried by oceanic currents back to continental shores.

In April and May the young fish enter estuaries, either as transparent glass eels or as pigmented elvers, on spring tides and then swim up into river systems. Eels are slow growing and can remain in freshwaters for fifteen or more years before migrating seaward again.

Eels are found in all European countries bordering or connected to the North Atlantic. They are caught as elvers or as adults in a variety of fisheries each with different levels of regulation and exploitation. Recent research confirms that North Atlantic eels are all from a single stock, albeit with some distinct genetic differentiation. This makes it imperative that eel fisheries are managed to common objectives across Europe.

The main commercial elver fisheries are on the River Severn and some other rivers draining into the Bristol Channel. Catch returns from these fisheries can provide a good indication of the trend in eel recruitment (the number of elvers entering our rivers), and they have been compulsory over the past two decades. Another measure of elver catches comes from HM Customs export data, because the majority of elvers are exported to the continent or to China.

The eel stock

Eel recruitment in England & Wales has declined catastrophically and now stands at just one per cent of peak historic levels [Ref. 42]. This mirrors changes seen elsewhere in Europe. Figure 7.1 shows the average index of elver recruitment since 1955, derived from 19 river catchments in 12 countries. The separate indices are derived from both fishery-dependent sources (catch records) and fishery-independent surveys across much of the geographic range of the European eel. The River Severn index is derived from elver catch returns and is shown separately.

Over the past two decades, catch data from across Europe show glass eel populations declining rapidly from the high levels of the 1970s. Through the 1980s the general trend was downwards with the exception of the River Erne, in northwest Ireland, where no real trend was apparent. In the 1990s most time series were fairly stable but at low levels, while 2001 produced a record minimum of just one per cent of previous peak levels. Most recent data show a continued decrease, and the 2002 results do not show any significant recovery from the 2001 all-time low for the whole stock. Although the River Severn time-series is limited to the period since 1978, this generally reflects the wider European picture.

Although the cause is not fully understood, this decline is thought to be due to several factors. (Some of the

Elvers. Young eels migrate across the Atlantic and into rivers around England and Wales.

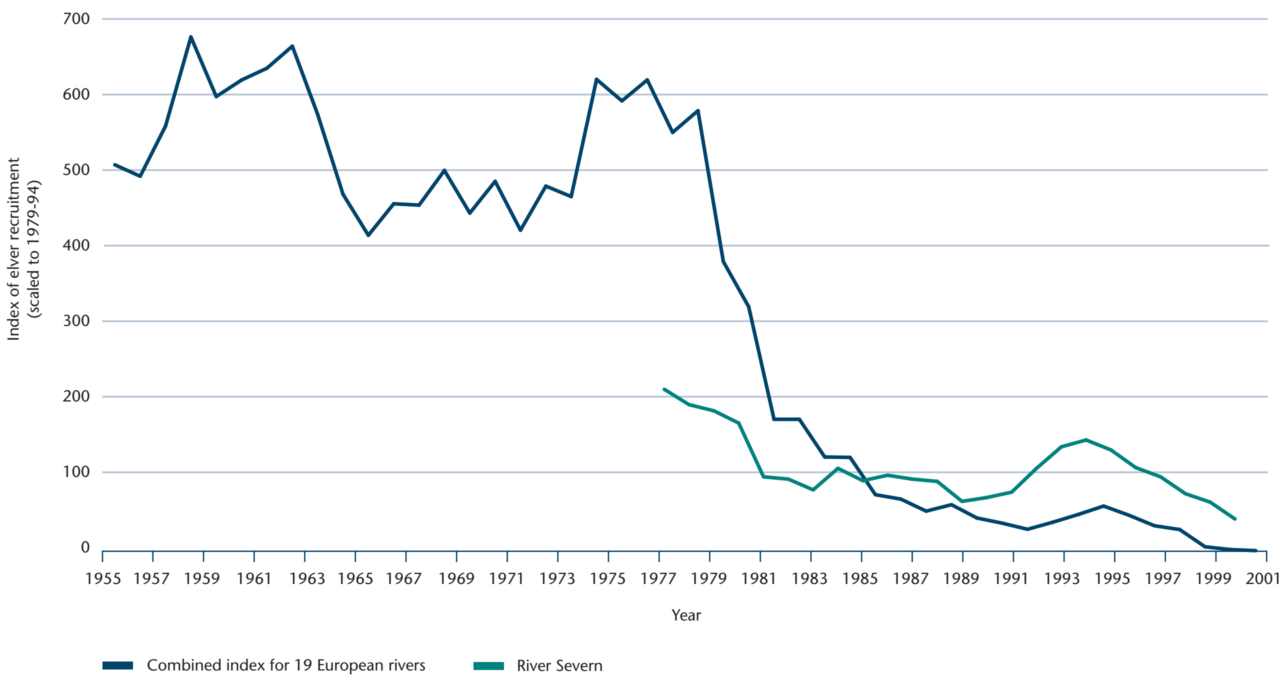


Figure 7.1 Index of elver recruitment in European rivers, including the River Severn (shown separately), from 1955 to 2002. This is the geometric mean of indices from 19 rivers, each scaled to its 1979-94 average. Since the early 1980s there has been a catastrophic decline in the number of elvers returning to European rivers.

environmental pressures affecting eels are outlined in Chapter 8.)

While catch returns are also compulsory from adult (yellow) eel fisheries, the low number and dubious accuracy of the returns makes monitoring by this method unreliable. We must therefore rely on the results of electric fishing surveys.

The Agency is developing a strategic monitoring programme on principal eel rivers across England and Wales. In 2002, ten sites on the River Severn and five sites on the River Dee were surveyed specifically for eel. Although some of these sites had been surveyed previously, it is too early to draw conclusions from the data because of large temporal variability (see below). The 2002 results will serve as a reference point with which future survey results can be compared.

Surveys conducted on the River Severn in 1998 and 1999 compared densities of yellow eel with those found in 1983 [Ref. 43]. Despite large statistical variance in the results between 1998 and 1999, the survey found no substantive evidence for a major change in eel density or biomass over the sixteen-year time period, even though there had been a serious decline in recruitment of glass eels to the system since the early 1980s. The analysis did, however, reveal that between the two survey dates there was, on the lower Severn, a 50 per cent reduction in the proportion of eels smaller than 150 mm in length.

The Frome, Piddle and Dee are three important catchments where eels are subject to low levels of exploitation and for which reliable data from the 1970s and 1980s exist [Ref. 43]. Surveys carried out for the Agency in 1999 indicated that:

- in the Frome and Piddle there has been a decline in biomass and in eel population density, the decline being greater in terms of biomass. The number of eels shorter than 150 mm was very low, indicating a decline in the number of glass eels entering the rivers. The sex ratio in both rivers has changed from being previously male dominated to one where females now dominate the mature population.
- in the Dee, there was no significant change in either density or biomass, nor in the size structure of the eel population.

Examination of less robust data sets for a number of other rivers indicated no statistically significant decline in stocks of yellow eels or changes in population structure over the past 20 to 30 years. However, the absence of widespread detectable changes in yellow eel abundance or population structure should not lead to an assumption that recruitment is necessarily adequate, because the majority of these monitoring programmes were not designed to monitor change. In addition, given the longevity of eels, the recent significant decline in recruitment will have a delayed effect on the densities of eel populations in freshwater systems and the resulting spawner escapement. We herefore expect the recent (and ongoing) decline in recruitment to result in far fewer adult eels in the future.

Eel and elver fisheries

Eel and elver fisheries are regulated. National and regional legislation controls the type of equipment that may be used, how it can be used and, to an extent, where it can be used. No regulations are currently in place restricting eel fishing seasons, except where eel nets and traps could potentially intercept migrating salmon and sea trout, or the amount of fishing effort. The Agency proposed new national byelaws in 2003 to harmonise and improve regulation of eel fishing. Government confirmation is expected in early 2004.

Elver fisheries

Only hand-held dip nets are permitted for the capture of glass eels or elvers, and fishing is concentrated where the fish are plentiful and easy to catch – principally in estuaries of the Severn and other rivers draining into the Bristol Channel. The fishing season is short, coinciding with the elvers entering rivers on spring tides in April and May.

Just a small proportion of the elvers caught in England and Wales are retained for domestic consumption. The majority are sold for re-seeding eel farms in Asia. Also, because eels from England and Wales have a disease-free status, small quantities are exported to restock Scandinavian rivers. Others are sent to Spain and Portugal, where they are a popular delicacy.

Fishing effort varies according to market demand. The number of licences purchased was fairly constant at around 1,000 per year until 1994. Licence sales then rose to a peak of approximately 2,500 in 1997 and 1998, as the elver price increased due to demand for seed stock for new eel farms in China (Figure 7.2). Licence numbers subsequently declined to less than 1,500 in 2000 as a result of farm overproduction and the imposition of import quotas by China. In 2001, licence sales were particularly low at just 838, due to restrictions on access to fishing sites during the foot-and-mouth outbreak that encompassed the whole elver-fishing season. In 2002, licence sales increased only slightly to 899, most likely due to the continued low demand for elvers.

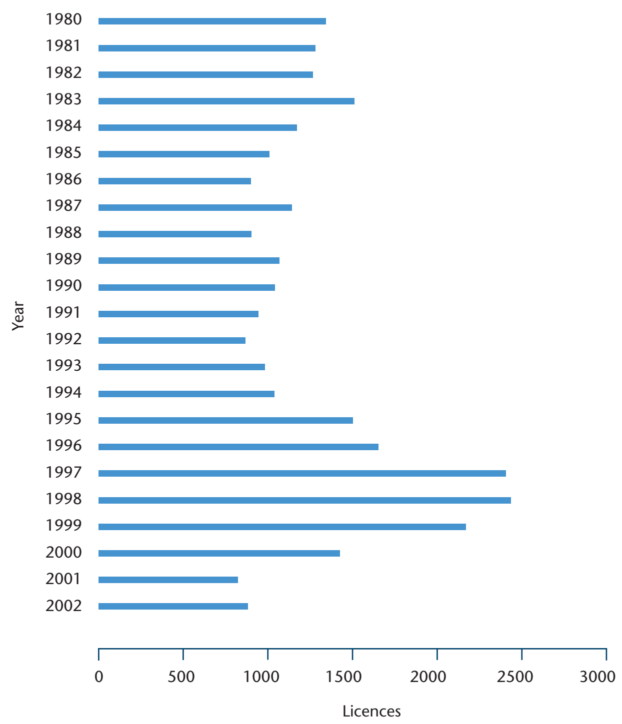


Figure 7.2 Elver licence sales, 1970 to 2002. Sales rose sharply in 1995 in response to increased market demand for elvers.

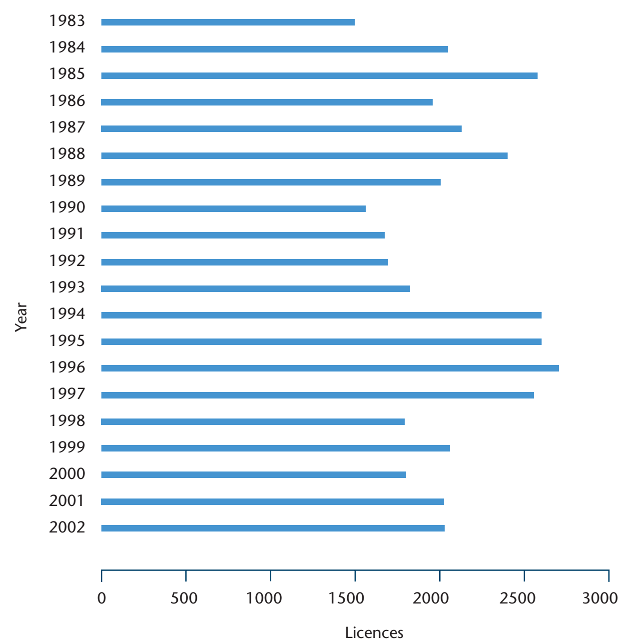


Figure 7.3 Adult eel licence sales (all categories of net), 1970 to 2002.

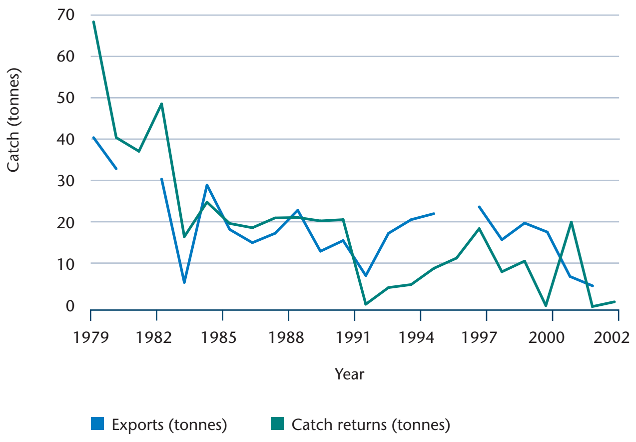


Figure 7.4 Declared elver catches and exports (tonnes) for England and Wales, 1979 to 2002. Elver catches show a pattern similar to those elsewhere in Europe, with significant declines over the past 20 years.

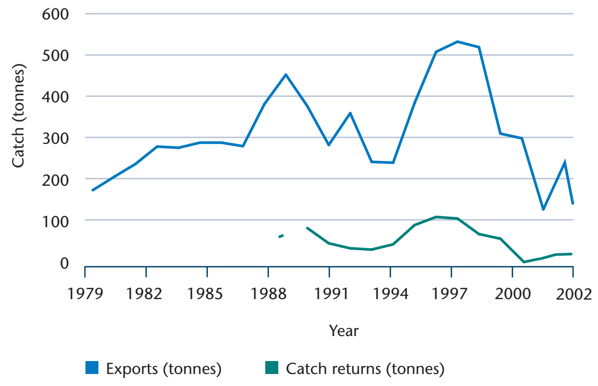


Figure 7.5 Declared adult eel catches and exports (tonnes) for England and Wales, 1979 to 2002. The stock-recovery plan is dependent on accurate catch returns. These are currently under-reported, generally being between five to seven times lower than estimates derived from eel export figures.

Adult eel fisheries

Eels are caught commercially in a number of locations across England and Wales, although East Anglia is the main centre. Adult eel are caught by a variety of instruments including fyke nets, putcheons and weir traps. A small amount of eel trawling also takes place off the south coast of England and in the Thames Estuary.

As with elvers, most adult eel catches are exported; however, the main market for adult eels is mainland Europe. Surprisingly, in the UK domestic market for jellying 90 per cent of the eels used come from farmed imports.

The level of eel fishing effort is measured as the number of licensed instruments of all types and is presented in Figure 7.3. Since 1983, licence sales have fluctuated between 1500 and 2700 licences, most likely in response to market price fluctuations.

Catch returns

There are few reliable catch records for eels and elvers in England & Wales. Since 2001, catch returns have been required from all commercial licence holders (previously returns were required in some regions only), but return rates are sometimes low. Commercial catches are commonly believed to be under-declared, perhaps because fishermen are reluctant to disclose such information because of income tax implications [Ref. 43].

Catch data (available returns combined with estimates of un-declared or under-declared catches) are collated by the Agency and Defra and published annually. We know that these data are incomplete, and we believe that their accuracy is very variable not only as a consequence of the factors outlined above but also because assessment methods have varied between Regions and from year to year. We need to obtain a more accurate picture, and we will continue to work with commercial eel fishermen to achieve this. It is not just the future of eel fisheries in England and Wales that is at threat: because they share just one eel stock, all eel fisheries across Europe are equally at risk.

As most eels caught in England and Wales are exported, estimates of the catch have also been obtainable via Customs and Excise export records. As with catch returns, some concerns remain over the accuracy and completeness of export returns, especially following EU trade liberalisation. Despite these caveats the export data generally provide a reasonable match with the trends in catch data and agree broadly with data from elsewhere in Europe on recruitment, catches and markets.

Figure 7.4 shows the trend in elver catches. Elver catches in England and Wales follow the pattern experienced across the rest of Europe, with significant decreases over the past two decades. The declared elver catch for 2002 was 1.5 tonnes; this contrasts with catches of more than 20 tonnes in the late 1980s. The overall level of elver recruitment is estimated to be now just one per cent of historic levels.

Figure 7.5 shows the pattern of reported adult eel catches in England and Wales. These data are compromised by low reporting rates, and so export data provide a more reliable picture of estimated catches. Estimated catches rose steadily during the

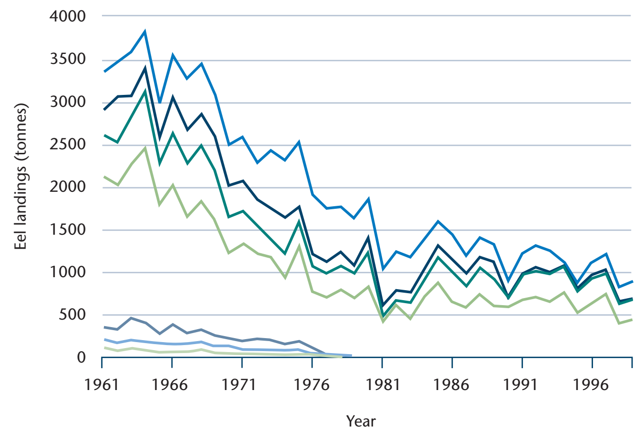


Figure 7.6 Eel landings from countries bordering the Baltic Sea mirror the decline seen elsewhere in Europe. [Wickström, pers. comm.]

1980s to a peak in 1988, before declining during the early 1990s. Catches peaked again in 1996 at around 600 tonnes, followed by a drastic fall in 1998. The total catch in 2002 was 50 tonnes (declared in catch returns) or 122 tonnes (from export records). While in part the reduction in catch may be a response to the earlier decline in elver recruitment, economic pressures are likely to be of even greater significance (see Chapter 3).

Perhaps a clearer picture of eel catches can be gained by turning to data sets recorded in mainland Europe. Figures for combined eel landings compiled by the UN Food and Agriculture Organisation clearly show a decrease in catches from all European countries. In particular, data from countries bordering the Baltic Sea – principally Sweden, Poland, Russia and Germany – indicate a significant decline (see Figure 7.6). Although there has been a decline in effort, the catch per unit effort has also fallen.

Conclusion

The International Council for the Exploration of the Sea (ICES) has concluded that the North Atlantic eel stock is now below safe biological limits and that the current eel fishery is therefore not sustainable. The reasons for the decline are unclear, but changes in the marine environment are generally agreed to be significant.

Eel recruitment remained high until 1980 but has since collapsed to just one per cent of former levels. Recognising this crisis, the EU has recently announced its commitment to a European-wide stock-recovery plan; however the eel's longevity means that any improvements in elver recruitment will not show up as an improvement in adult populations for many years. It is therefore essential that governments and fishermen make a long-term commitment to the plan.

A number of actions are being taken across England and Wales – these are documented in the National Eel Management Strategy [Ref. 44]. We are identifying options to increase the number of spawning adults, which may include stocking eels and elvers into suitable river catchments. Designs for eel and elver passes are being produced and new passes are being installed on weirs and other obstructions when opportunities arise. We are also modifying guidance on the design of water intake screens to prevent the loss of eels in hydropower turbines and other water intakes. We have also proposed new harmonised national byelaws to improve regulation of the England and Wales eel fishing industry. Reductions in fishing effort may also need to be considered, but only in combination with other measures aimed at increasing eel abundance. England and Wales' participation in European eel stock management is hampered by a lack of robust information on domestic stocks. The Agency is establishing an adult eel monitoring programme and 23 sites are to be monitored by electric fishing each year. Even more pressing is the need for much more reliable adult and elver catch return data, both in terms of completeness and quality. We will work with the commercial eel fishing industry to investigate and remove the barriers to achieving this.

The otolith from a 21-year-old eel. The long freshwater life of eels makes it unlikely that we will witness the full impact of the decline in elver recruitment for many years. It is essential that the stock-recovery plan is given time to run its course.

8

Factors affecting fish stocks

Pollution and physical habitat degradation can affect all fish species, while some parasites, diseases and predators sometimes have a particularly serious impact on only certain individual species or groups of closely related species.

Pressures on coarse fish populations

Several factors affect coarse fish populations and, therefore, the fisheries they support.

Physical habitat degradation

Engineering associated with navigation, agriculture and land drainage have all contributed to a reduction in the extent and quality of fisheries habitats in lowland rivers. Weirs and other impoundments prevent fish migration as well as 'drowning out' coarse fish spawning sites. Straightening and narrowing of river channels change flow regimes and reduce the variety of habitat features necessary for healthy fish communities to exist. In the most recent comprehensive survey of river habitats, 49 per cent of lowland sites in England and Wales were classed as being obviously modified, with 28 per cent being significantly or severely modified [Ref. 45].

Although rivers habitats are rarely degraded to the extent that reaches become devoid of fish, poor quality habitat will suppress species diversity, spawning success and stock density. River restoration is undertaken by many interested parties, including River Trusts, angling clubs and fishery owners. Through the Local Authority planning process, our own river maintenance programmes and habitat improvement projects we also work to compensate for or reverse the effect of previous, unsympathetic river engineering work.

Habitat improvement can be equally important and effective in stillwater fisheries, but there the aim is usually to create new habitats in largely featureless gravel pits and reservoirs. More important has been the loss of many small stillwaters over the past 60 years

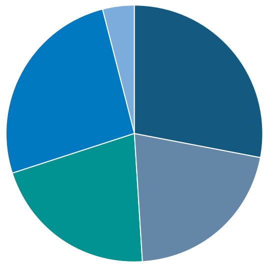


Figure 8.1 The extent of artificial channel modification in lowland river coarse fisheries in England and Wales. Almost a third of sites surveyed were significantly or severely modified.

through agricultural and urban development. Although the decline appears to have halted, the number of ponds in Great Britain has fallen from 470,000 in 1945 to 243,000 in 1998 [Ref. 21].

Predation

Fish, especially young fish and small species, are vulnerable to predation by birds, and in particular cormorants. Following a significant increase since the 1970s, the number of cormorants in Britain has recently stabilised. There are currently around 1,500 nesting pairs and 15,000 over-wintering birds on inland waters [Ref. 48]. Reasons for this may include the increase in stocked reservoirs and gravel pit fisheries, legal protection from persecution and possibly the redistribution inland of coastal birds due to over-fishing of marine prey species. The Agency does not monitor cormorant numbers but relies on data collated by ornithological organisations, including the Wildfowl and Wetlands Trust and the British Trust for Ornithology.

Case study – Habitat degradation

In collaboration with the Upper Thames Fisheries Consultative, we have identified the locations of remaining gravel shoals in the upper River Thames. This will enable us to protect these valuable chub and barbel spawning sites during essential river maintenance work; it will also allow us to prioritise sites for creating new shoals. We also work in partnership with fisheries interests and landowners to take a more strategic approach to habitat improvement. Through Fisheries Action Plans, anglers have identified poor recruitment as being of particular concern on a number of rivers including the Kennet [Ref. 46] and the Sussex Rother [Ref. 47]. On each of these rivers, we are working with local farmers to reconnect redundant meanders to the main river to increase fry survival and so help supplement fish stocks in the main river channels.

The Shopham Loop is the original course of the Western Rother in Sussex. Reconnecting this sinuous channel to the main river will provide important coarse fish habitats and improve recruitment.

Government-funded research [Ref. 49 and 50] has concluded that on a national scale cormorant predation does not have an impact on fish stocks – cormorant numbers are more likely to respond to fish abundance than to limit it. The research shows that cormorants can have an impact on stocks and catches on individual fisheries. It is recognised that such predation can cause serious economic and ecological damage to fisheries: fishery managers can obtain licences from Defra and the Welsh Assembly Government to shoot a limited number of birds, but only as an aid to scaring and where other options to limit the impact of predation, such as fish shelters, have been shown not to be feasible [Ref. 51].

In the wild, fish communities fluctuate in response to many environmental variables, and we cannot easily determine the relative contribution made by predation. However, where fish numbers, particularly of threatened species such as crucian carp, are already depleted, the added pressure from predation could threaten the survival of local populations.

Fish removals and introductions

Transferring fish between waters is an established and recognised fishery management tool. It can:

- improve fish growth rate and health by removing surplus stock from productive stillwater fisheries. This kind of cropping can also provide fish for restocking elsewhere
- boost the production of target species or protecting features of conservation interest by removing damaging species
- pump-prime a fishery recovering from a legacy of pollution as was done, for example, in the River Tyne salmon fishery (see page 46)
- maintain the required fishery performance on waters where an environmental constraint suppresses natural production or where angling pressure is high
- achieve particular management objectives – for example to develop a specimen carp fishery
- create new fisheries.

However, transferring fish carries risks to donor and recipient fisheries, particularly where they contain sensitive or valuable fish communities or features of conservation interest. These risks include:

- spreading fish diseases. There are already 300 fish diseases and parasites in England and Wales and at least another 160 endemic to the European mainland. While the spread of native parasites does not pose a significant risk, the spread of non-native diseases certainly does (see overleaf).
- transferring non-native fish that can damage native fish communities through competition, habitat degradation, predation and hybridisation (see overleaf).
- changing the existing fish community structure in ways that adversely affect fishery performance and aquatic ecology;
- overstocking, which can affect growth and health and lead to in fish mortalities.

Water quality

Water quality improvements River water quality has progressively improved since 1990. Coarse fish are abundant in many more rivers now than at any time over the last century. However, there is a growing awareness that a range of chronic, sub-lethal pollutants may be having an impact on fish populations. This is discussed in more detail below.

Water quality improvements in the 1970s allowed the hardier coarse fish such as roach and gudgeon to survive and produce abundant fish stocks that supported excellent match fisheries; hence, the lower Trent and

Diseases

Coarse fish are vulnerable to a wide range of pathogens. In normal circumstances infection levels remain low and pose no danger to their hosts; however, if fish become stressed due, for example, to the onset of spawning or a change in environmental conditions, clinical symptoms can develop that can lead to significant mortalities. Most disease outbreaks occur in managed stillwater fisheries where stock densities are high.

Fish communities in the wild can suffer from disease, particularly when they come into contact with a foreign pathogen. During the late 1960s and early 1970s, roach and perch ulcer diseases killed millions of fish across England and Wales. Catches of roach on the River Nidd reduced by 90 per cent, and over 98 per cent of adult perch were lost from Windermere. In 1988, Spring Viremia of Carp was reported from 38 sites and killed up to 80 per cent of infected fish. More recently, there has been growing concern over Spring Carp Mortality Syndrome; this is believed to be caused by a pathogen, and outbreaks have been widespread among stillwater carp fisheries

The copepod parasite *Ergasilus seiboldi* can infect a number of coarse fish species. When fish become stressed, parasite levels increase and can lead to extensive fish kills.

Introduction of non-native species

The introduction of new species into an established fishery can have significant impacts. Zander were released into to the Great Ouse Relief Channel in 1963 and rapidly colonised the adjoining rivers in East Anglia. Surveys have indicated that this has affected recruitment in some coarse fish populations – particularly those already under pressure from other factors – resulting in a change in species composition. Zander are still spreading today through the interconnections of rivers and canals, although more slowly and with less dramatic changes in prey fish stocks. More recently we have had growing concerns over the potential impact of released goldfish upon native crucian carp populations. As well as competing for food and living space, goldfish are interbreeding with crucian carp, and the hybrid offspring are causing further competitive problems. There are currently 17 species of non-native fish confirmed as present in the wild in England and Wales (see Appendix 3).

Strict controls seek to limit the movement of non-native and non-indigenous fish and fish diseases into and around the country.

middle Calder gained good reputations for match fishing. The power station cooling process was an important influence in both these cases, oxygenating the water, removing organic matter and ammonia, and increasing water temperatures – all factors leading to increased recruitment of coarse fish.

Further water quality improvements in recent years have allowed fish to flourish in many waters that were formerly either fishless or nearly so. Water quality in reaches of the Trent below Birmingham, the Don and Rother in South Yorkshire, the lower Aire and lower Calder in West Yorkshire, and the Mersey and Weaver in the Manchester conurbation improved markedly in the 1990s, and these rivers are now becoming valuable fisheries.

Not everyone sees these improvements in water quality as beneficial; some anglers complain that rivers that were once good coarse fisheries are now too clean. In the lower Trent, for example, roach and gudgeon had traditionally dominated, with most anglers catching some fish in matches; now a wider diversity of fish, including large chub and carp, feature in match-winning catches but with fewer anglers catching fish. Similarly, in the middle reaches of the Calder continuing improvements in water quality have resulted in trout spreading further downstream to former match fisheries, so much so that many clubs no longer allow trout to be counted in match weights.

Notwithstanding these concerns, coarse fish are now present in more rivers than at any time in the past century; however, many rivers across England and Wales still have depleted coarse fish populations and, in particular, suffer from poor recruitment (juvenile survival). This is in spite of what at first may appear to be satisfactory water quality, flow and physical habitat, suggesting that there must be other factors affecting fish populations.

Effects of sub-lethal pollution It may be that subtle chronic, sub-lethal factors are affecting species diversity, reproduction and recruitment. When gross pollutants such as ammonia and substances that suffocate fish by creating a high oxygen demand have been largely

Case study – Water quality improvements

The River Rother

The River Rother in South Yorkshire had been blighted by pollution for many years. Good mixed fish populations existed in 1885, but as the mining industry grew, increasing chemical pollution wiped out the fish stocks in the main river. Once that had happened, little attention was given to the river's physical habitat and many sections were straightened and canalised. The main river was essentially grossly polluted, with just a few fish in cleaner tributaries. The movement for clean air in the 1960s led to a concentration of coal carbonisation plants in the Rother Valley. Treatment of tar liquors was very expensive. One method was to spray them over colliery spoil heaps, where filtration and some biological treatment occurred but at the expense of chronic, diffuse pollution that continues today.

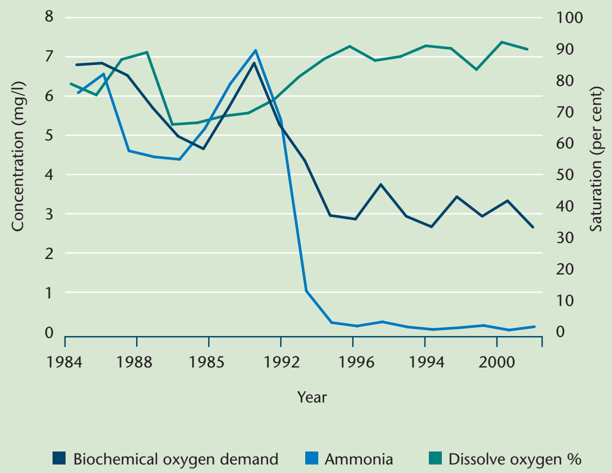
Although there was much effort throughout the 1980s to improve effluents, the major breakthrough came in1989 when, encouraged by local groups and the newly-formed National Rivers Authority, proposals were agreed between local industry and the water utility to address the worst pollution problems. In excess of £30 million was invested over the subsequent 5 years on new sewers and sewage treatment by the water utility and on effluent treatment facilities by industry. New treatment plants were installed by Bolsover Coalite and Staveley Chemicals, a new sewage works built at Staveley and extensive improvements made at Old Whittington sewage works, Chesterfield. There was a very great decrease in average ammonia concentrations in the lower Rother between 1991 and 1994 (Figure 8.6).

Surveys [Ref. 52] had shown that in winter 1984/85 most of the Rother was fishless and just a few three-spined sticklebacks were found near inputs of better quality water. In February 1994, a repeat survey found no improvement in fish stocks despite all the work to improve water quality.

Although there were still doubts about water quality, particularly the possibilities of intermittent spills or deliberate discharges, in March 1994, roach and chub were stocked from Calverton Fish Farm at points in the river where refuges were available in freshwater inputs or aerated water below a weir. Meanwhile, work continued up and downstream, where there were unsatisfactory discharges, to improve water quality.

Following the apparent success of these introductions, many more fish of a number of species were introduced in 1995. A survey in autumn 1995 showed that many of these had survived, particularly below the weir in the lower river, and that growth had been fast since stocking. Further introductions of chub and dace were made in March 1996. A subsequent survey in October 1996 showed similar results, but chub fry were also found, indicating natural recruitment. From grossly polluted to a recreational fishery in just seven years was a remarkable achievement.

The status of the fishery has been maintained by natural recruitment that includes barbel, which were found in a fry survey in 1998.



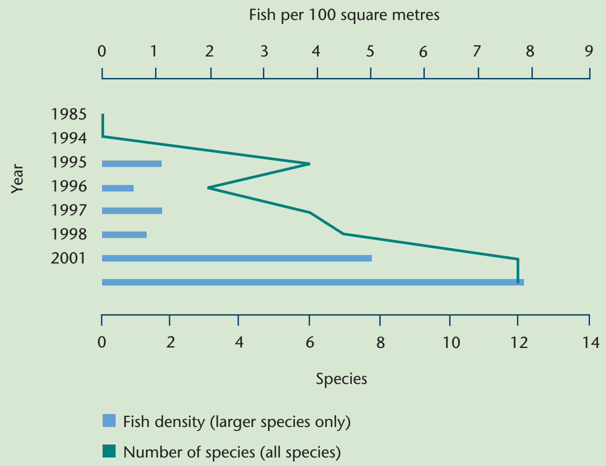


Figure 8.2 Water quality and fish populations in the Yorkshire Rother between 1984 and 2002. As water quality has improved, this previously fishless river has been able to sustain breeding populations of coarse fish.

Case study – Sub-lethal pollution

The impact of Endocrine disrupting compounds

Sewage treatment has systematically improved since water industry privatisation. This has meant that river water quality has never been better, and most coarse fisheries in England and Wales are good and improving. However, some fish populations are at risk from the effects of exposure to oestrogenic substances in sewage effluent. These substances, are not controlled adequately by existing sewage treatment processes.

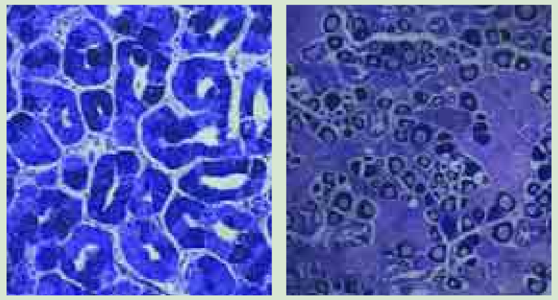
Research has established that certain natural and man-made chemicals, termed endocrine disrupters, have the potential to interfere with the normal functioning of the endocrine systems of humans and animals. There is evidence that environmental exposure to certain chemicals (or mixtures) can cause feminising (oestrogenic) effects in a number of wildlife species and, in particular within the UK, in male freshwater fish [Ref. 53]. The problem has been particularly serious downstream of some sewage treatment works discharges.

The evidence for these effects is compelling, but there are still uncertainties about the causes. We know that steroid oestrogens (female hormones) and man-made chemicals that mimic hormones are present in sewage effluents. Individually their potencies vary, and in practice a mixture of oestrogens within effluents may combine to cause the overall response in fish and other wildlife.

In collaboration with Brunel and Exeter Universities, the Environment Agency has supported a research programme into the role played by treated sewage effluents in causing oestrogenic effects in UK fish populations. The first phase (1995-98) established that oestrogenic effects are common in populations of roach [Ref. 54]. The effects include a high incidence of intersex (the simultaneous appearance of male testes and female ova individual fish – see Figure 8.7) and, in males, the production of vitellogenin (a protein associated with egg production) and reduction in the size of the testes relative to body size. The incidence and severity of intersex are strongly correlated, statistically, with the concentration of treated sewage effluent in the waterbody. Studies in Europe and America have reported similar findings in related fish species.

In March 2000, the Agency launched its strategy to address endocrine disrupting substances in the environment [Ref. 55]. Since 2000, research [Ref. 56] into the causes and consequences of oestrogenic (feminising) effects in fish has now confirmed that:

- certain sewage effluents can cause permanent changes in the sexual organs of male fish; these effects have now been observed in a range of coarse fish



Normal and intersex roach testis. Note the occurrence of many small ova developing in the intersex testis. There is growing concern over the effect that trace organic compounds may be having on fish.

- young fish are particularly vulnerable, but some effects worsen with age and exposure
- male fish with more than moderate changes in their sexual organs are less able to reproduce, with potentially serious implications for fish populations
- the sustainability of some fish populations may be at risk if fish are exposed long-term to these chemicals such that their reproductive capacity is reduced.

During 2002/3 the Agency carried out a survey of oestrogenic impacts on wild roach in rivers throughout England and Wales [Ref. 57]. Of 46 sewage outfalls tested more than 80 per cent were shown to be causing intersex effects in the roach that were sampled.

Although population-level changes that occurred in the past cannot be attributed to endocrine disruption, the effects on the fitness of individual fish (and often significant numbers within a population) is taken by the Agency as harm, since it is a permanent change in their development. The Agency requires action to reduce such effects within fish populations, and thereby to reduce the risk of impacts on recruitment at the population level. However, given the number of variables that affect fish population recruitment, it is likely to be many years before we adequately understand the impact of endocrine disruptors on fish at a population level. We are therefore taking an empirical approach, assessing model species under laboratory conditions in order to determine the level of protection necessary to ensure population sustainability.

The Agency has been working with Defra and the water industry to identify how risks to fish populations can be reduced, and the industry is being asked to launch investigations into treatment technologies for the removal of priority oestrogens. It is expected that in 2003-2004 there will be an initial study into the feasibility of risk-

Case study (continued)

management options; this is to be followed in 2005-2007 by detailed implementation studies. These collaborative studies, involving the Agency, the water industry and other relevant stakeholders, will:

- develop an approach to assessing effluents and identifying priority sewage treatment works
- evaluate the effectiveness and the costs and benefits of treatment options.

The research programmes will focus on a number of high-risk sites and will establish how effluents can be managed to reduce the risk to acceptable levels.

eliminated, other more subtle and sub-lethal factors, largely made up of 'trace-organic' compounds, may be limiting the restoration of healthy, self-sustaining fish populations. These trace-organics comprise a wide range of man-made chemicals, including pharmaceuticals, veterinary medicines and, pesticides; and natural or synthetic endocrine disrupting chemicals. Our understanding of the effects of this on fish and the environment is low, but improving. Where we have evidence of the impacts of certain trace-organics, for example oestrogen hormones or compounds that act like them, it gives rise to concern over others with similar properties, especially where they might have additive impacts.

Endocrine disrupting compounds, whose effects may have been masked in the past by the presence of gross pollution, are now recognised as having the potential to affect the viability of coarse fish populations (see opposite).

Eutrophication The enrichment of rivers and stillwaters with nutrients, particularly phosphorous, can change the balance of algae and macrophytes. This in turn affects the ecology and the value of the watercourse for recreation.

The Agency has developed a national strategy to reduce eutrophication or mitigate for its impacts on vulnerable waters [Ref 58]. We are collaborating with water companies and the agricultural community to make best use of the regulatory framework as well as incentive, educational and voluntary measures to reduce diffuse and point sources. The implementation of the EU Water Framework Directive will give this issue added prominence.

Nutrient enrichment can lead to excessive algal or plant growth which, upon dying and decomposing, suddenly saps dissolved oxygen from the water so that the fish can die, in effect, from suffocation. Some blooms of blue-green algae release into the water toxins that can be lethal to fish and the invertebrates on which they rely for food. In 2002, some 613 instances of fish mortalities were reported in England and Wales; of these, 30 were ascribed to dissolved oxygen crashes following algal blooms.

Fish communities may also be affected by other chronic, non-lethal effects of eutrophication, as the fish species composition changes in response to changes in macrophytes and phytoplankton. Furthermore, some chalk rivers have become almost unfishable due to discolouration caused by high turbidity. There has also been a consequential loss of Ranunculus (water crowfoot), the aquatic plant that characterises chalk river fisheries and is fundamental to their management.

Our understanding of eutrophication and the chemical processes involved has increased in recent years; however, it is essential that the chronic impacts of nutrient enrichment on fish, their habitats and the fishing they support should be further investigated so that appropriate action can be taken.

Siltation Unsympathetic land use has led to increased erosion in some catchments. A study of the Nottinghamshire River Idle has shown that material running off agricultural land has silted up in-stream gravels and reduced the available spawning area for rheophilic gravel spawning coarse fish, such as barbel and dace [Ref. 59]. The impact of siltation on salmonid fisheries is discussed in more detail below.

Pesticides By their very nature pesticides are lethal to living organisms. Indeed, where pesticides are used inappropriately and exceed acceptable levels they can cause significant fish kills or destroy the aquatic invertebrates upon which fish rely for food. That is why the environmental risk posed by each pesticide product is rigorously assessed before its use is approved, and the risk assessment takes into account potential harm to fish and other aquatic wildlife. The Agency advises the Government on the robustness of its risk assessment procedures, aiming to ensure that all risks are suitably accounted for. Notwithstanding all this, as with some other man-made substances there are concerns that some of the more subtle, sub-lethal effects of pesticides are not fully understood. For example, there is some evidence from CEFAS research of low levels of certain pesticides interfering with the olfactory function of male fish, possibly leading to reduced reproductive success.

Bacterial toxins Another issue that has gained prominence in recent years is the incidence of fish mortalities thought to be due to bacterial toxins. In a number of past instances where there has been no obvious cause for fish deaths, for example, accidental or

Case study – Eutrophication

River Kennet

This problem has been particularly severe on the River Kennet. Joe Baker of the Kennet Valley Fisheries Association has been instrumental in raising the profile of this issue. 'Turbidity and the complete loss of macrophytes in some sections has had a catastrophic effect on the performance of what was once one of the best coarse fisheries in the south east,' he reports, adding: 'We have set this as the highest priority in the Kennet Fisheries Action Plan and are working with the Agency to better understand the cause of the problem and possible remedial action.'

Higher up the river, where there have been marked variations in annual flows and a high nutrient input, a local group, Action for the River Kennet, has been working with the Agency and others for several years to identify the cause of the seasonal algal blooms that are increasingly affecting Ranunculus growth. In collaboration with English Nature and the Centre for Ecology and Hydrology we are trying to better understand the ecological processes that are at work, and we are working with local farmers and Thames Water to identify and reduce the source of nutrients.

The River Kennet at Padworth. Local stakeholder involvement in the Kennet Fisheries Action Plan resulted in an investigation into the causes and possible remedies of eutrophication in the river.

illegal pollution, they have been labelled as 'unexplained' or due to 'natural causes'. Following a major fish kill on the Kennet & Avon Canal and the River Kennet in 1998, we are now examining the hypothesis that some of these incidents may be caused by naturally occurring bacterial toxins released following the die-off of algal blooms. (In some instances the disturbance that causes the algae to die may not be a natural occurrence, and so the risk may be one that can be reduced by good management.) It seems that when present in high concentrations these bacteria and the toxins they release can become a serious threat to fish.

The momentum on water quality improvement is being maintained through the National Environment Programme, which sets out the water companies' investment in environmental improvements. A major component of this programme is the designation in 2003 of a further 11,000 km of river under the Freshwater Fish Directive. However, we need to improve our understanding of the impact that some more subtly damaging substances may be having on fisheries. In particular we need to know more about the impact that mixtures of substances can have on fish and other wildlife, and whether the safe threshold levels are lower than those for the individual substances. Any changes in water quality standards will only follow a Regulatory Impact Assessment and a full assessment of costs and benefits.

Pressures on trout and grayling

Siltation

Changes in land use and agricultural practice mean that more silt enters rivers than in the past, and there is concern that in some parts of England and Wales silt may be having a significant impact on salmon and trout stocks. When silt and fine sediments smaller than 0.85 mm enter rivers they can infiltrate salmonid redds, filling in gaps within the gravel matrix. This reduces the permeability of the gravel, slowing the through-flow of water and, therefore, the supply of oxygen to the eggs. Most studies into this subject suggest that significant egg mortalities occur once the proportion of fine material in the gravel reaches 10 to 20 per cent. In addition, recent research at Southampton University shows that many silts have high organic content, increasing oxygen demand and further compromising survival [pers. comm. S Greig/D Sears, Southampton University]. Fine silts also act as a pathway and store for toxic metals and organics, which bind to their surfaces.

In many catchments, siltation of salmon redds has been identified as being a significant issue. The South West Rivers Association has raised concerns over changes in land use on Dartmoor and Bodmin Moor – changes made to secure greater agricultural subsidies – and the impacts these have had on local rivers. Drainage of moorland and changes in livestock management are widely believed to have resulted in the siltation of important salmon spawning sites in the headwaters of the Rivers Tamar (which has failed its salmon conservation limit consistently since 1997), Fowey and Camel; the salmon and trout fisheries on these rivers are estimated to be valued in excess of £15 million [Ref. 62-64]. Elsewhere in Cornwall, china clay mining is perceived to cause similar problems on the Yealm and Plym. Siltation is also seen to be of particular concern in

Case study – Bacterial toxins

The Hungerford fish mortality

In spring 1998, a stretch of the Kennet and Avon Canal and adjacent River Dun and River Kennet suffered a serious fish kill. Not only were 150 tonnes of fish lost from a local fish farm, but several kilometres of the canal and two chalk rivers suffered a total fish mortality. More than a million fish were killed. No obvious man-made chemical cause was identified, but the ensuing investigations and similar but less seriously damaging events in the following years have clearly implicated that the mortalities were caused by of exposure to bacterial toxins [Ref. 60]. As part of the investigations, an effective remedial treatment for the affected water was developed using hydrogen peroxide. This has been applied successfully in subsequent events to eliminate toxicity and save many thousands of fish.

Similar mortalities have been recorded in a number of other waterbodies. In many cases, dead and moribund fish have exhibited similar clinical systems (gill swelling and fusing of the gill lamellae). These reactions are natural defence mechanisms to limit the uptake of toxins, but continued exposure leads to hypoxia and death.

Current scientific evidence suggests that under certain environmental conditions the decay of algal blooms is accompanied by a build up of bacteria. It is thought that as the bacteria break down the algae they release toxins as a by-product, and it is these toxins rather than the bacteria that affect the fish.

Two strains of bacteria thought to be responsible have recently been isolated in laboratory conditions [Ref. 61]; however, the nature and identity of the toxins remains elusive. Research is continuing to isolate the toxins, understand the ecology of the bacteria and to identify the environmental conditions that immediately precede the onset of the algal and bacterial blooms. When we have this information, we should be able to predict the likelihood of such events occurring and take remedial action before fish are affected.

The Hungerford fish kill. Naturally occurring bacterial toxins are believed to have led to one of the most significant fish kills in England and Wales.

the southern chalk rivers, where the combined effect of high sediment loads and low river flows has led to spawning beds becoming heavily compacted. It is important to note that where siltation is an issue it is likely to be acting in combination with other land use factors, for example nutrient enrichment (see above) and river canalisation.

In some catchments, fishery owners and the Agency have invested in 'Landcare' projects to minimise the amount of silt entering rivers from agricultural land, and in regular gravel cleaning to flush out silted spawning beds. Where gravel cleaning has been undertaken there is convincing evidence that more of the eggs survive. [Ref. 30].

To improve our understanding of siltation and its extent and impact, we carried out a survey in 1999/00 of 45 sites in nineteen catchments across England and Wales [Ref. 65]. This involved using retrievable sampling baskets to assess the quantity of fine particles accumulating within artificial redds over the natural salmonid incubation period. The results provided valuable information on:

1. The range of silt concentrations in spawning gravels across the England and Wales. Average content of silt particles by weight from a site ranged from 1.2 per cent to 12.0 per cent, with an average of 4.5 per cent. The maximum fine material content of any single sample was 15.5 per cent, from a site on the River Tywi. The maximum average fine material content for a site was 12 per cent, from River Ribble. Figure 8.10 shows that sites on the River Ribble and to a lesser extent one site on the Yorkshire Esk have percentages of fine particles that are high enough to reduce salmon egg survival. Sites on the southern chalk rivers did not seem to have high levels of fine materials, despite these rivers being of particular concern – this is in line with other studies and suggests that the local geology and hydrological conditions can exacerbate the impacts of any silt that is present by, for example, leading to river bed concretion.

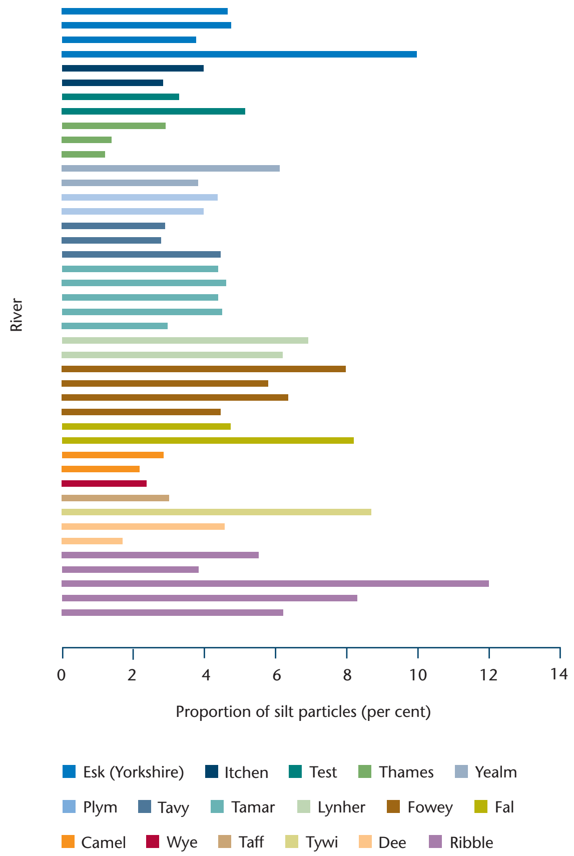


Figure 8.3 Concentration of silt particles in salmon spawning gravels. Our initial survey shows that silt concentrations may reach levels high enough to reduce egg survival.

2. Source of silt accumulating in spawning gravels. By 'fingerprinting' the sediments it is possible to establish their origin, thus allowing us to target remedial measures. If the majority of the sediment is from the catchment surface, control measures have to be targeted at the farming practices. If, on the other hand, the majority of sediment is from the channel bank, bank stabilisation and fencing may be more appropriate control measures. Although catchments vary, this investigation provided valuable evidence of regional patterns.

In southwest England, where rivers tend to have steep banks and livestock numbers are frequently high, bank erosion is usually the most significant source of fine sediments. The main cause is farm animals poaching the channel margins.

In southern England, where arable farming is more commonplace and channels are typically more stable, surface sediment sources are more significant due to the erosion of bare topsoil when heavy rain runs off land that has been cultivated in autumn to sow cereal crops.

Surface soil erosion is also generally more important as a sediment source in catchments where livestock graze moorland and uplands with no field boundaries; in wet weather fine materials washed from slopes denuded of vegetation run off directly into streams and rivers.

3. The risk of siltation in rivers across England and Wales. Having correlated the results from the 45 surveyed sites with information on their geology, land use and drainage patterns we are now able to predict the probability of silt entering other rivers and streams. By mapping these predictions against salmon and trout abundance figures from our electric fishing surveys, we hope to be able to determine where siltation is having an adverse impact on salmonid spawning.

While the survey covered many principal salmon rivers, it was not designed to determine the full extent or impact of siltation across England and Wales. The number and choice of sites was limited and the work was conducted over a single season, and so we were not be able to detect any changes that may have arisen as a result of changes in farming practice. However, the survey has demonstrated that the volume of silt in salmonid spawning gravels does reach levels capable of causing egg mortality, and it has also indicated the likely sources of silt in different parts of the country. We aim to build on this work to get a much more comprehensive picture of siltation and to identify where it is most likely to be the cause of 'pinch-points' in the salmonid lifecycle.

The Common Agricultural Policy (CAP) is the single biggest influence on patterns of agricultural land use in England and Wales and provides the best opportunity for agricultural reform. It is essential that the economic and social value of fisheries is balanced against that of land use and that the CAP, while working to achieve a sustainable agriculture industry, also supports the protection of sustainable fish populations and the freshwater habitats on which they depend.

The Agency can play a valuable role in this process. We are well placed to inform farmers on established good practice, in particular on soil management, and we can regulate to prevent gross environmental impacts. We are keen to see the introduction of agri-environment schemes and cross-compliance, which we see as a route to achieving benefits that are in addition to those gained from regulation.

Loss of fly life

During their fry and parr stages, salmonids are crucially dependent upon insects and other small invertebrate creatures – as indeed are many coarse fish species. The reduction in the numbers of aquatic insects observed on the chalk rivers of southern England and on some spate rivers is therefore of particular concern (see overleaf).

We have met with local associations to report on progress and receive feedback, and we are consulting Agency staff elsewhere in England and Wales to establish the position nationally across all river types.

1 A simple fish refuge in Bracknell Mill Pond. Made of drainage pipes and lily rhizomes, these artificial fish shelters can provide cost-effective protection against cormorant predation.
2 Sticklebacks. The composition of species in fish populations is a useful indicator of water quality. The reappearance of sticklebacks, for example, is often the first indication of real progress when reinstating a fishery on what was a grossly polluted river.
3 Silt run-off from a maize field. Arable farming is the main contributor of silt in rivers in southern England.
4 The River Ribble upstream of Clitheroe. Severe poaching of unfenced riverbanks by livestock can be a major source of silt entering rivers.

Pressures on salmon stocks

Salmon are not only affected by many of environmental pressures that affect the coarse fish, trout and grayling in our rivers, but they also face many challenges while they are at sea.

High-seas salmon fishing

Fisheries off West Greenland and, to a much lesser extent, around the Faroes have intercepted salmon destined for England and Wales. The West Greenland fishery is estimated to have taken around 10 to 20 per cent of English and Welsh multi-sea-winter fish [Ref. 3]. However, quota reductions in the West Greenland fishery and privately funded buy-outs in both fisheries have significantly reduced the impact both might have been having on home-water stocks. In 2002, only a subsistence fishery operated off West Greenland and there were no reported landings from the Faroes.

The Irish coastal fisheries exploit fish returning to English and Welsh rivers to varying extents. Prior to 1997, provisional estimates [Ref. 3] suggested low exploitation of stocks from the north east of England (around 1 per cent), higher for the west coast and Wales (around 5 to 10 per cent) and highest for stocks from the south and southwest (around 10 to 20 per cent). New regulations introduced in Ireland in 1997 are believed to have reduced exploitation levels by up to 50 per cent [Ref. 3].

By-catch in marine fisheries

The potential for salmon to be killed during their marine phase as by-catch in marine fisheries gives cause for concern. In 2001, an ICES survey vessel recorded 198 salmon post-smolts in catches of mackerel totalling almost 8000 kg in the Norwegian Sea during the period

Case study – Loss of fly life

Wiltshire Fishery Association first raised the issue of fly life decline in 1992 as part of a report on 'The Chalkstream Malaise' The report also highlighted problems of increased siltation and poor Ranunculus (water crowfoot) growth.

There was a perception among trout anglers that there was a marked reduction in the numbers of small up-winged flies on the Hampshire Avon and its tributaries. To investigate this issue, Wiltshire Fishery Association and the Environment Agency circulated a questionnaire across all southern chalk rivers, as the perception of fly life decline appeared to be widespread. Responses from 365 anglers and fishery owners giving their observations of fly abundance from the last decade before the Second World War through to 1999 were analysed, and in 2001 the results were published [Ref. 66].

The report made use of anglers' written observations as well as their recollections of fly abundance at times in the past. It provided evidence of a widespread observation of decline in numbers of several types of flies – in particular, of the adult stages of small up-winged species – this decline appearing to be most noticeable during the last decade of the survey period. (A full copy of the report is available on the Agency's website at www.environment-agency.gov.uk). The questionnaire was used again in 2002 and 2003, and it is planned to continue surveying angler perceptions.

In response to these findings, Agency staff have analysed historic invertebrate survey data and produced hypotheses to explain anglers' observations.

On the Avon system where the issue was first raised, changes in the flow regime (extreme low flow periods in the 1990s and dramatically increased high winter flows since 1990) impacting both directly on invertebrate abundance and indirectly (via habitat features) appear to explain many aspects of the decline described by anglers, but other possibilities are still being considered.

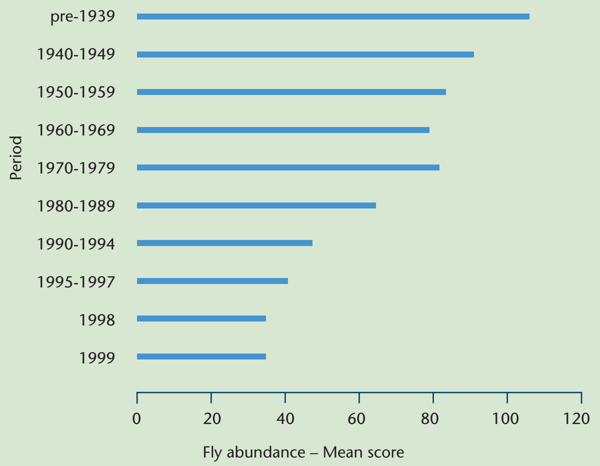


Figure 8.4 The results of the Millenium Chalk Streams Fly Trends Study. Angler and fishery owner records have helped to highlight the decline in fly-life in many chalk rivers.

Hatches of Baëtis rhodani, the Large Dark Olive, are important to dry fly fishing. These and many other up-winged flies have declined in chalk rivers. With the help of fisheries interests, we will assess their status in other rivers.

that the commercial mackerel fishery was operating [Ref. 3]. Scaling up these figures to the whole commercial mackerel catch, an estimated 600,000 to 950,000 post-smolts may be being lost annually to the Norwegian Sea mackerel fishery. Although these findings are provisional, they may prove to be significant.

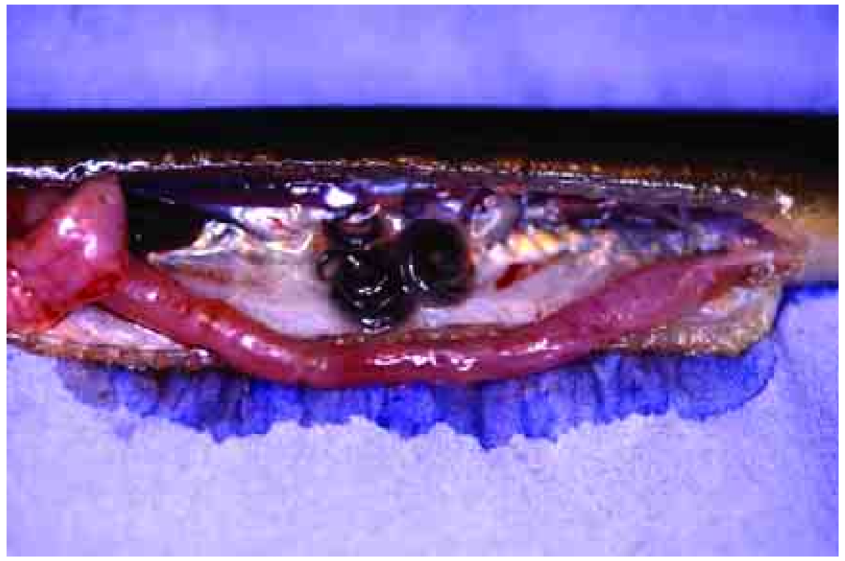
Exploitation of prey species

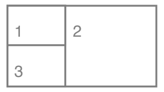
Once at sea, salmon feed on a range of small pelagic fish, including sandeels. These fish are themselves subject to considerable commercial fishing pressure, and there are concerns that many stocks are under threat – so much so that certain sea areas have now been closed for fishing. While no evidence has been published showing that exploitation of these species is affecting the marine survival of salmon, the concern remains and we need to work with the marine fisheries authorities to investigate the matter further.

Oceanic climate change

There is a growing body of evidence that climate change may be exerting an important influence on salmon stocks [Ref. 67]. Salmon survival rates are higher in seawater temperatures in the range six to nine degrees Celsius. The melting of the polar ice pack has cooled the northern Atlantic, reducing the extent of thermally attractive habitat. The North Atlantic Oscillation is a consequence that is correlated to the atmospheric pressure difference between the north- and mid-Atlantic and its amplitude is a useful indicator of climate change. This has varied increasingly in recent years and these changes do appear to correlate with changes in some north Atlantic salmon stocks. At present, however, the cause of any relationship between the North Atlantic Oscillation and salmon stocks remains unknown.

With reduced marine survival rates thought to be the major reason for the decline in returning salmon, it is essential that freshwater survival is maintained at the highest possible level. Degraded spawning gravels and nursery habitats lead to reduced freshwater production and ultimately to rivers failing their conservation limits. This could have a consequential impact on the stability of many rural economies where fishing makes a significant contribution.





1 Pershore Weir elver pass is one of a series of passes on the Warwickshire Avon. Opening up more catchments to migrating elvers can increase the number of adults returning to sea to spawn and hence boosts elver recruitment.
2 *Gyrodactylus salaris* could have a devastating impact on salmon farms and fisheries. Fish farming and angling interests alike must remain vigilant to ensure it is not introduced into the United Kingdom.
3 *Anguillicola crassus* was introduced with infected eels from Asia and spread rapidly across Europe during the 1980s. This nematode parasite affects swim-bladder function and is thought to impair the migration and spawning ability of adult eels.

Disease

Furunculosis and Infectious Salmon Anaemia are of concern on salmonid fish farms, whereas Ulcerative Dermal Necrosis affects wild salmon and sea trout. The skin fluke, *Gyrodactylus salaris*, poses a very significant threat to wild salmon stocks; this parasite, endemic in Baltic Sea stocks, caused a widespread epidemic in Norwegian rivers when transferred in a consignment of farmed fish. If it is introduced and becomes established in British waters, *Gyrodactylus salaris* could have a devastating impact on our salmon stocks and fisheries.

Pressures on the European eel stock

Oceanic climate change

A popularly held view is that the very significant decline in eel recruitment is in some way connected with a long-term change in oceanic currents that can only be seen over decades. The parallel decline of the recruitment of the American eel in some of its distribution area and the correlation between the recruitment and the North Atlantic Oscillation (see above) both tend to support this view.

Habitat loss

Large-scale reductions of wetlands have resulted in a major loss of eel habitat. All across Europe, dams, weirs and dikes have been constructed in recent years. (Most of the large dams have been built since the Second World War.) These kinds of barriers make it much more difficult (and in some cases quite impossible) for eels to migrate up rivers; then, because their survival in the lower reaches of rivers is density dependent, the number of adult eels returning to sea is greatly reduced.

Hydropower stations can kill very many of the downstream migrating silver eels, and the available information indicates a serious impact on the spawner population. The turbine blades can kill anything from 10 per cent to 100 per cent for a single passage, and the problem is inevitably compounded when there are several turbines in series. It is estimated [Ref. 68] that between 2,500 and 10,000 tonnes of eels are killed each year in turbines – the latter figure being equal to the total declared commercial catch.

Predation

Cormorants have been identified as the major eel predator [Ref. 68]. The food intake of a cormorant is approximately 400 to 500 grams per day, and the present estimate of the European breeding population is 250,000 to 300,000 pairs. Cormorants have been estimated to consume between 1800 tonnes of eels per year (two per cent of diet throughout the whole year) and 9000 tonnes of eels per year (20 per cent of diet through half of the year). Cormorant predation is considered in further detail in the discussion on Impacts on Coarse Fish, above.

Disease

The parasite *Anguillicola crassus*, introduced from the Far East, and other pathogens can have an impact on eel populations. *Anguillicola crassus* spread rapidly in the European eel population in the early 1980s. This parasite causes swim-bladder dysfunction and can impair the migration of mature eels [Ref. 68].

Pollution

The decline of the eel in Europe is often related to a reduction in the amount, quality and accessibility of its continental habitat [Ref. 68]. The importance of these factors compared with the impact of exploitation has not been quantified, but it seems likely that they are significant in many European countries. Although we have no evidence of eel distribution and abundance being constrained specifically by poor water quality, in the Mediterranean rivers, eels have disappeared from the middle and upper reaches because of dams and/or pollution caused by industry, agriculture and tourism [Ref. 68]. However, as eels returning to England and Wales are part of the same stock as those in other European countries, we need to take account of factors affecting them on the continent.

Another concern is that the accumulation of pollutants – in particular heavy metals and pesticides – may be impairing the reproductive capability of the eel.

Fishing exploitation

There is ample evidence [Ref. 68] that some fisheries can take so many eels that they significantly reduce the number of potential spawners getting back to sea. The available information also suggests that in extreme cases no potential spawners may be reaching the sea.

Conclusion

In recent years there have been significant improvements in water quality in most of the rivers of England and Wales; however, habitat damage continues to limit fishery performance. The effects of sub-lethal doses of mixtures of chemicals, including some known to disrupt the endocrine systems of fish, are largely unknown, and more research in this area is now being given high priority. Where fisheries are under particular pressure, additional controls on exploitation may be necessary to compensate for factors that are currently beyond our control.

Climate change is emerging as a major consideration in fisheries management. Evidence is growing that the UK climate is warming, and this trend is expected to continue. Temperature changes alone may have direct effects on stocks, and there is already evidence that higher sea temperatures have adversely affected salmon and eel migration routes in the North Atlantic. Warmer, drier summers may result in earlier spawning and a longer growing season for coarse fish, resulting in larger fry that are more likely to survive the winter; however, increased severity and frequency of flooding may work against these benefits, reducing fry survival in rivers. Some species will adapt to these changes better than others, and the result could be changes in the balance of fish communities. Rising temperatures may also increase the variety of fish species and fish diseases that can survive in our climate; if alien species are allowed to become established in our rivers, the consequences for native species such as chub, barbel and dace could be disastrous. Strict disease and parasite screening of fish destined for transfer into the wild, together with controls on the movement of non-native and non-indigenous fish into and around the country are therefore essential.

Understanding the effects of climate change on freshwater fisheries will be a major challenge for the Agency over the next decade, and research is already underway.

References

Much of the information in Our Nations' Fisheries has been derived from fishery survey reports for rivers and stillwaters across England and Wales. Some of these are specifically referenced in the report and are listed below. Many others are available from your local Environment Agency office.

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Appendix I – Monitoring techniques

In Section 2 of this report we outlined the Environment Agency's programme for monitoring the fisheries of England and Wales, including their environmental, social and economic status and trends. Below we provide more details of the monitoring techniques we use and highlight new developments that will influence our monitoring programme in future.

Monitoring fish populations

Fish populations are the fundamental resource upon which fisheries depend; they are also important components of natural ecosystems and excellent indicators of environmental health. Healthy fish populations comprise more than just good numbers of fish, of course. Equally important are the right species composition and age structure as well as evidence of good fish growth and condition. It follows, therefore, that to monitor fish populations properly we need to assess each of these characteristics.

It also follows that we must not rely on monitoring fish populations during just a single life-stage. While a survey of adult fish might show good numbers and growth rate, it might fail to reveal evidence of low juvenile survival and a potential population 'bottleneck'. This is particularly important for migratory fish, where the adults and their progeny may have to be monitored at locations many miles apart.

The Environment Agency has designed the fish population monitoring element of the national programme to provide information of a known statistical quality. Four tiers of survey are undertaken.

- **Index monitoring** aims to increase our understanding of fish species and their population dynamics, and how environmental and human influences affect them. This involves measuring fish abundance and more detailed studies including an analysis of age structures and sex ratios at a limited number of locations. Building on earlier monitoring of principal river fisheries, an index monitoring programme has been established for salmon on the rivers Dee, Tamar, Lune and Tyne. (Index programmes for trout, coarse fish and eels are still under development.) This first tier of monitoring will provide a better understanding of fishery dynamics – including, for example, the marine survival and freshwater spawning success of migratory fish – not only for the waters surveyed but also for all other fisheries. What we learn from the index fisheries helps us not only to refine the other tiers of national monitoring programme but also to provide more authoritative advice to those reviewing net limitation orders or considering environmental impact assessments and byelaw applications.
- **Temporal monitoring** is used to determine long-term trends in fish populations on principal river fisheries. It entails surveying 545 salmonid and 1010 coarse fish sites annually. In statistical terms, this tier of the monitoring programme should be able to detect a 10 per cent change in populations over a ten-year period.
- **Spatial monitoring** seeks to detect differences in fish populations between different locations with similar habitats – for example between neighbouring reaches or sub-catchments. The sampling frequency for these 4010 salmonid and 825 coarse fish sites can afford to be somewhat lower, and so each site is surveyed once every five years. The geographic coverage, on the other hand, is much greater than that of either the index or the temporal programme. Although primarily for detecting spatial differences in fish populations, this tier of monitoring can also highlight temporal changes over a longer timescale (perhaps in excess of 50 years) and so give us a better understanding of the effects on fish populations of such factors as climate change.
- **Sentinel monitoring** provides information on the presence and absence of various fish species, including those that are not sought by anglers but which are of general or high conservation value - for example minnows and bullheads. This entails surveying 575 salmonid and 495 coarse fish sites once every five years.

Across England and Wales the national monitoring programme covers a total of 7625 sites, of which 5130 are salmonid (salmon and trout) sites and are coarse (other freshwater fish) sites. Of the 2070 sites surveyed in 2002, some 1140 were on salmonid fisheries and 930 on coarse fisheries. The distribution of these sites is shown in Figure 4.9. As is to be expected, the salmonid sites are mainly concentrated in the upland rivers of the north and west, while the majority of coarse fish sites are in the larger lowland river catchments of the south and east.

Monitoring techniques

Fish live in a variety of waterbodies, from small streams to large lakes. Consequently, to monitor them we need to employ a variety of techniques each suited to a particular type of waterbody. The most commonly used methods of monitoring fish populations and the limitations of each method are outlined below:

Electric fishing Electric fishing is the most common method of monitoring fish in small and medium-sized rivers. It works by immersing into the river one or more electrodes connected to a power source and control box. The electric field so created stuns the fish within the field and, by interfering with the fishes' swimming muscles, draws the fish towards the centre of the electrode. They are then removed from the water to be counted, measured, and in some cases weighed. A scale sample may be taken so that the age and growth history of the fish can be determined.

Scale reading

Fish lay down growth rings or annuli in their scales in much the same way as trees develop visible rings in their trunks. Assessing the age of scales is used to produce information on life history traits of fish populations. This includes data on age, growth, survival and mortality.

During fish population surveys, one or two scales can be taken from each fish without harming them during fish population surveys. The Environment Agency assesses the age of approximately 53,000 scales each year. The information gained from this work is used to assist in the assessment and evaluation of fisheries monitoring data.

To estimate the number, density and biomass of fish in a river, a reach is isolated using two nets strung across the river. This prevents fish moving into or out of the survey section. Fishing the whole width of the river, working from the lower net to the upper net, fish are caught, counted, measured and then retained in suitable holding facilities until the survey is completed. The reach is fished once or twice more, and on each fishing 'run' the catch is removed, processed and retained. Assuming a constant fishing efficiency, it is possible to 'back-calculate' the total number of fish originally present. After the survey is complete, all captured fish are returned alive to the survey site.

Although electric fishing is very effective in many waterbodies and for sampling certain fish populations, it does have limitations. It is relatively ineffective in larger, deeper rivers, canals and stillwaters. Although new equipment has been developed for sampling deeper water it remains difficult to obtain accurate estimates of fish numbers from larger waterbodies by electric fishing alone.

Concerns have been expressed about the harm electric fishing can do to fish and fisheries, particularly where waters are surveyed repeatedly. Used inappropriately, electric fishing can indeed injure or even kill fish, and poor or excessive handling can also be harmful. Any such damage can be kept to a minimum by following recognised best practice. Electric fishing remains the most effective means of monitoring many fisheries.

Habitat, the time of day and year, and the equipment and method used all affect the accuracy of the estimates of fish abundance and distribution. Nevertheless it is possible to increase the accuracy by careful selection of sampling technique and choice of appropriate survey design and analytical method.

Seine netting Seine netting is the preferred method for sampling fish populations in larger rivers, drains and lakes where electric fishing is not so effective. It is particularly useful for targeting shoaling fish species. As with electric fishing, it is possible to determine fish abundance, species composition, condition and growth rates. However, netting also has limitations – for example it is not so effective in waterbodies with uneven beds where some of the trapped fish are able to escape, or in rivers with moderate to high flows.

Echo-sounding Many of our most important coarse fisheries are in lowland river catchments. Monitoring the performance of these fisheries is clearly a priority,

1 Electric fishing a small salmon stream. Using best-practice procedures, electric fishing can be used to assess fish stocks safely and with minimal long-term effect of fish and their habitats.
2 Agency sonar boat 'Pingu'. Investments of this kind have greatly improved the Agency's ability to monitor coarse fish populations.
3 Although rarely effective in deep waterbodies when used on its own, electric fishing can be combined with other techniques, for example hydro-acoustic monitoring, to give a more accurate picture of fish populations.
4 A scale from a two-year old dace – the annual growth rings are marked with an 'o'.
5 Seine netting on the Thames at Kew, where the fairly flat bed makes this technique an effective means of monitoring fish stocks.

but rivers deeper than say two metres are particularly difficult to monitor. Electric fishing and seine netting techniques are not only inefficient in deep water but they are also unlikely to be cost effective.

In recent years, interest has focussed on the use of echo-sounding, or hydro-acoustic monitoring, to fill this gap in our survey toolbox. The principle is a simple one. An echo-sounder transducer transmits a pulse of acoustic energy into the water as a narrow beam of sound (a 'ping'). When this sound pulse encounters an object in the water, such as a fish or the riverbed, some of the energy is reflected back to the transducer. The echo-sounder amplifies the received echo signal, generates a mark on the display (termed an 'echogram') and, provided certain threshold criteria are satisfied, logs the echo on a computer. Outputs from scientific echo-sounders are subsequently processed to provide estimates of the density of fish present, their positions in the water and their sizes.

Traditionally, echo-sounders have been mounted on the hulls of marine survey boats, the transducers pointing downwards to assess the status of commercially important fish stocks. However, the Agency has been developing their use in a mobile horizontal application, attaching them to modified boats and pointing the beam across the river. The boat is driven along each riverbank in turn in order to provide estimates of fish density from a representative sample of the population.

Due to their speed and high spatial resolution, hydro-acoustic methods have opened up new opportunities to provide an understanding of the dynamics of fish populations not achievable by other methods. Uniquely, they allow a remote, continuous and instantaneous observation of fish in their own habitat, ranging from looking at individual fish at the one extreme and studying entire populations over many kilometres at the other.

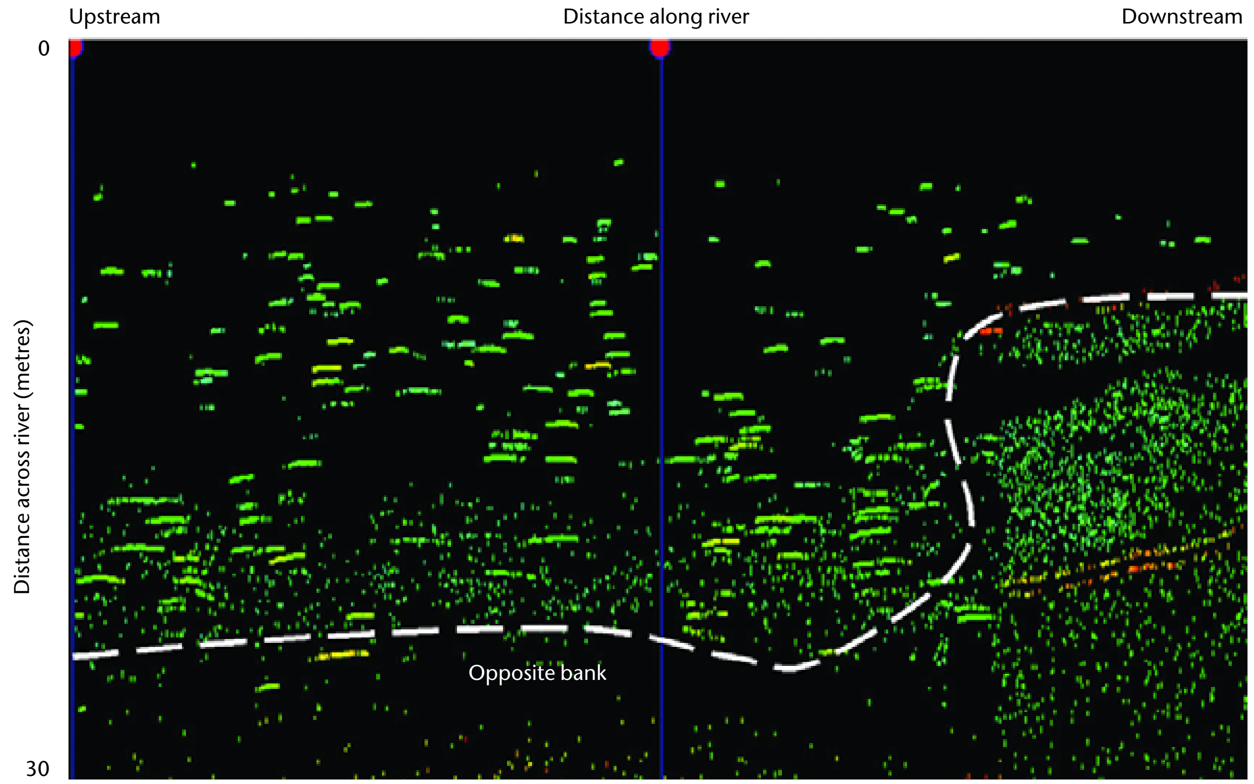


Figure A1-1 Echogram of River Mersey at Kingsway Bridge. The vertical axis represents horizontal distance across the river, with the boat, (at the top of the screen) close to one bank. The horizontal axis represents distance along the river. Fish appear as green / blue horizontal traces. Fish densities here were high (approx. 100 fish per 1000 cubic metres), showing that, with support from The Mersey Basin Campaign, Manchester Ship Canal Company and the Environment Agency, North-west Water Company's recent investments in improved sewage treatment works are also benefiting fish and other wildlife of the River Mersey.

In 2002, the first year in which acoustic monitoring was widely used across the Agency, we carried out hydro-acoustic monitoring at 20 sites comprising 150 kilometres of river.

Outputs from annual hydro-acoustic surveys can be used to demonstrate long-term temporal trends in fish abundance, as well as spatial distribution within a river. Temporal trends will become progressively clearer as successive data sets for each river are recorded over the next five to ten years. More detailed data on fish distribution help local Agency staff to understand population dynamics and make better management decisions; anglers also find this kind of information useful when planning fishing trips.

Traps, tags and counters It is important to monitor fish populations at different stages of their lifecycle in order to track annual changes in abundance and composition and to improve our understanding and management of the factors that influence them. This is easier said than done: while our rivers and seas may be teeming with fish of various species, catching and counting them is no easy matter.

For salmon in particular, whose numbers have declined markedly in the last 30 years right across the North Atlantic, the need to understand 'why?' has never been more pressing. Because the salmon spends part of it life in rivers and part at sea, monitoring its populations is much more difficult than for most freshwater fish.

Smolt trapping. Young salmon (fry and parr) establish territories in shallow streams where they can be sampled with relative ease using electric-fishing methods. However, after one or two years salmon in England and Wales will migrate to sea to begin the adult phase of their lifecycle. At this stage – when they are known as smolts – the young fish shoal up and undergo physical changes in preparation for a life in salt water.

The smolt migration is largely a spring event, and during their passage down river the most effective means of sampling smolts is to intercept them using traps. Smolt trapping can have a number of objectives. At the least, we can sample the age composition of the smolts and obtain information on the timing and relative size of the run. A more ambitious objective might be to count all the smolts leaving a system. (This is only likely to be feasible on very small streams.) Alternatively, we can estimate the total run by tagging and recapture methods; this latter approach usually being the more practicable option (and often preferred because it requires only a small proportion of the run to be sampled and minimises handling at this very sensitive life stage).

In collaboration with CEFAS (Centre for Environment, Fisheries and Aquaculture Science) the Agency undertakes smolt trapping on the Rivers Tamar and Dee each spring to obtain estimates of:

i. The proportion of smolts that survive and return to the river as adults. (This is important because a decline in marine survival has been evident over the last 30 years from studies on a handful of rivers across the North Atlantic).

ii. Exploitation of salmon by marine fisheries (principally the Irish drift-net fishery as far as these two west coast rivers, Tamar and Welsh Dee, are concerned).

To obtain these estimates, scientists aim to trap and microtag 3,000-4,000 smolts each year on both the Tamar and the Dee. Microtags are small (2-3mm long) coded wire tags, which to the naked eye look like a piece of fuse wire. The tags are injected automatically into the snout cartilage of anaesthetised fish, and they remain there for the rest of the fish's life. Microtagged fish also have their adipose fin (a tiny fin near the tail) removed so that they can be identified in the various fisheries that may intercept them on their journey home to spawn. On the Irish coastal salmon fishery the Irish Marine Institute runs a comprehensive screening programme that is essential to estimating the impact of its fishery upon the salmon stocks of rivers outside Ireland. In addition, adult trapping programmes on the Tamar and Dee also screen for microtagged fish; and, taken in conjunction with estimates of adult run size on theses rivers, these provide information for assessing smolt-to-adult salmon return rates.

Smolt trapping is also carried out annually on the River Test to provide run estimates, and on a less frequent basis on other – rivers in England and Wales.

Adult counters and traps Trapping can be equally effective at sampling adult salmon returning to the river as smolts leaving, although the mode of operation differs – for smolts we need to provide an attractant flow to encourage fish to swim into the trap, while adult fish are intercepted in a more passive manner. The reasons for trapping adult fish are similar to those given for smolts – for example to collect information about their length and weight and to provide an estimate of run size.

On the Dee, trapping is used to estimate adult run size based on tagging and recapture. On other rivers in England and Wales where estimates of the adult salmon run are available, these are usually obtained from automatic fish counters of one of two types:

i. **Resistivity counters** These involve a weak electric field – usually between three steel electrodes mounted on the downstream face of a weir or in a fish pass. An object passing over the electrodes will interfere with the electric field; a fish counter (a computer) connected to the electrodes determines whether the resulting signal was caused by a fish or by something else and records the 'count'. This signal also shows the direction the fish was moving in and provides an estimate of the fish's size.

ii. **Hydroacoustic counters** These use an acoustic beam to detect the passage of fish using principals similar to those of echo sounding (see above). Again a counter (or computer) interprets and counts the signals as of 'fish' or 'non-fish' origin.

On the face of it automatic counters appear to offer a labour-saving approach to monitoring salmon run size; however, their effectiveness has first to be determined (for example, what proportion of the passing fish do they actually count?). This is normally established by comparing their recorded count with an independent video recording of fish crossing the counting device.

Counters do not distinguish between species (they cannot distinguish between salmon and sea trout, for example) and so other information (video records, trap or rod catches) has to be obtained for this purpose.

Although there are some 32 fish counters in place across England and Wales, many of these do not operate as effectively as might be desired. This is mainly because it has not been possible to calibrate them to distinguish between salmon and sea trout. Currently, seven counters provide useful information on adult salmon runs. In addition, the Agency operates four adult salmon traps.

Monitoring habitats

Aquatic habitats have a fundamental influence on fish populations. Unless alternative management regimes – for example regular restocking – are put in place, habitat degradation will inevitably result in a decline in the abundance and/or diversity of fish populations and a reduction in the value of the fisheries they support.

Historically, most habitat surveys have focussed on rivers. However, with the recent rapid increase in the popularity of stillwater fishing, techniques are also needed for monitoring stillwater habitats.

1 Rotary screw trap. This technique is used to capture smolts on the Tamar and Dee, where stock assessment relies upon partnership. Anglers help to build up an accurate picture of these fisheries by completing logbooks and providing details of any tagged fish that they catch.

2 Anglers fishing the River Irwell, Greater Manchester. The number of anglers, their preferences and fishing practices is all important information in managing fisheries.

We monitor river and stillwater habitats for two main reasons. First, we need to ascertain the quality of fish habitats, in particular to highlight potential pinch-points such as loss of spawning sites. The second reason for monitoring habitats is to understand the relationship between habitat quality and fish populations. Knowing the sustainable fish abundance for a given habitat quality is essential when deciding on priorities for improving a fishery. Habscore is one method the Agency uses to predict fish abundance from habitat quality (see below).

River habitat quality can be defined in three broad categories – water quality, physical habitat, and river flows. Each is important both in isolation and in combination with the others. With the exception of Habscore, this report does not deal with the methods for and results of monitoring river habitat quality. However, the Agency publishes a range of information on its website (www.environment-agency.gov.uk) and a number of reports on environmental quality are listed in the bibliography, for further information.

Physical habitat

Fish populations vary greatly from place to place and also from one year to the next. We need to know what causes these variations if we are to understand the other factors that affect fish populations. To investigate the role that physical habitat plays in the place-to-place variation of juvenile salmon and trout populations, – we have developed a system called Habscore.

Habscore uses the habitat characteristics of a particular site – for example river substrate, in-stream cover and bank-side vegetation – to predict how many juvenile salmon and trout the site ought to contain if there were no other limiting factors such as a lack of spawning adults or poor water quality. By comparing the predicted number of fish with the actual number of fish found by an electric fishing survey, it is possible to determine whether a site contains fewer fish than it should. If so, further work can be undertaken to identify and mitigate the cause.

Habscore was developed for juvenile salmon and trout only. Habscore assessments will be undertaken at all 5130 salmonid monitoring sites, at least once every 10 years.

There are many more species of coarse fish than there are of salmonids and they occupy a much wider range of habitats. Habscore cannot cope with the much more complex interactions between coarse fish species and their habitats, and so we need to develop a method of habitat assessment suitable for coarse fish.

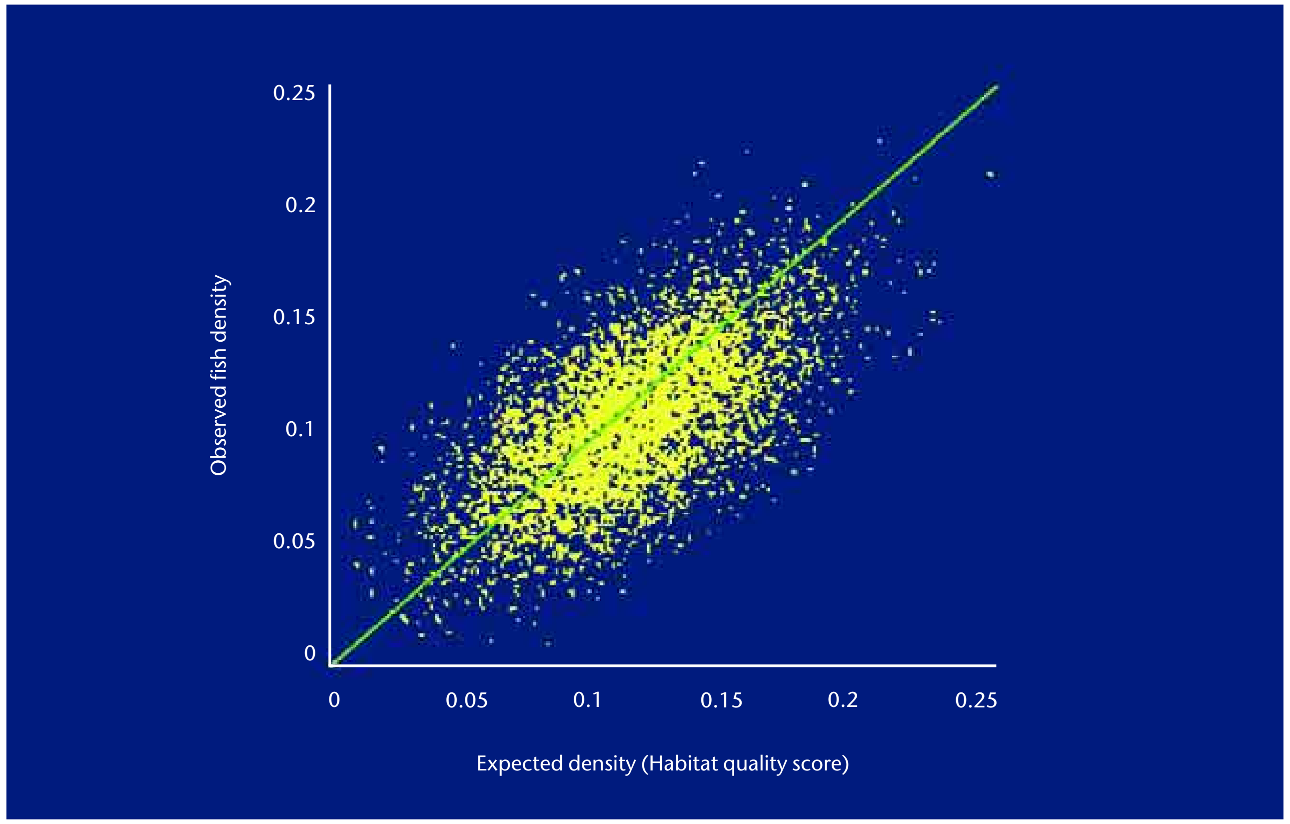


Figure A1-2 Fish density vs Habscore for a range of salmon river stretches. Habscore provides a prediction of the juvenile salmon 'carrying capacity' of a stretch of river; survey results falling significantly below the Habscore prediction indicate that problems other than habitat quality may be limiting fishery performance.

Monitoring participation

To manage fisheries effectively we need to monitor more than fish populations and their habitats. Understanding the status and trends in participation in fishing can be as important to local angling clubs and fishery owners as it is to national angling organisations and to the Agency. Monitoring angling participation is also essential if we are to measure the very substantial benefits that fishing provides to society.

In monitoring participation, fishery managers are seeking to answer a number of questions.

- How many people are fishing?
- How much are they fishing?
- What are they fishing for?
- What would they like to fish for?
- What factors affect their enjoyment of fishing?
- What can be done to increase their satisfaction?
- What would make a non-angler take up fishing?

One measure of participation is rod and net fishing licence sales. From annual rod licence sales the Environment Agency is able to determine not only the total number of licensed anglers but also the uptake of licences per 1000 population and the proportion of concessionary licences sold. Each of these can be broken down by postcode district. We can then investigate the reasons for low uptake – for example lack of or poor access to fishing opportunities.

While licence sales provide fairly accurate and long-term trends in participation, they shed little light on anglers' fishing behaviour and preferences. We therefore employ direct market research techniques, such as telephone interviews. Asking questions like 'Would you prefer to fish for brown or rainbow trout?' and 'Would you prefer to fish for coarse fish on rivers or on stillwaters?' we can build up a picture of the factors affecting fishing activity and so decide how the social and economic benefits associated with fishing can be enhanced.

The Environment Agency undertook such a survey in 2001, interviewing over 2600 licence holders from across England and Wales. This built on a similar, less extensive survey in 1994?

In addition to the behaviour and preferences of existing anglers, it is also important to understand and monitor the attitudes of potential anglers (the general public). The Agency carried out a telephone survey in 2001 interviewing over 2000 randomly selected members of the public. This has provided valuable information on the likely percentage of the population who could be encouraged to take up fishing and the factors currently preventing them from doing so; it also shed light on the public's perception of angling.

The results of both of these surveys are presented in Chapter 3.

Monitoring catches

The final piece of the jigsaw is monitoring the end product of fishing – what is actually being caught. In monitoring catches, it is important to monitor not just the total catch but also the fishing effort, the composition of the catch, and when, where and how the fish were caught. This information is essential to determine the status and trends in:

- total catches
- catch rates, in terms of catch per unit effort
- exploitation rates– that is the proportion of the total stock caught and killed
- the age structure of the catch and species composition
- the success of different fishing equipment and methods
- catch and release.

Different fisheries require different approaches to monitoring catches.

Salmon and sea trout

All licensed salmon and sea trout anglers and netsmen are required by law to make returns of all fish caught during the year, or to submit a nil return. Anglers make a single end-of-year return, whereas netsmen submit details of fish caught and their fishing activity on a monthly basis. The return rate from anglers is in excess of 70 per cent and is likely to account for 90 per cent or fish caught. Return rates from netsmen are considerably higher. Catch returns are processed by the Agency and published in two annual reports – the Salmon Stocks and Fisheries in England and Wales (published jointly with the Centre for Environment, Fisheries and Aquaculture Science) and Salmon and Freshwater Fisheries Statistics for England and Wales.

Eels and elvers

All commercial eel and elver fishermen are required to submit catch returns at the end of each season. While byelaws requiring catch returns have been in place in some parts of England and Wales, only since 2001 have they been required from all netsmen. Again, the results are published in Salmon and Freshwater Fisheries Statistics for England and Wales.

Non-migratory trout and grayling

There is no statutory return system for non-migratory trout and grayling catches. Instead, the Agency has organised voluntary logbook schemes for anglers to complete and submit. Previously, separate arrangements have been in place in various parts of the country. A national grayling logbook scheme was launched in 2001 and a similar scheme for wild brown trout catches is being piloted in 2003. Over and above this, many owners of river and stillwater trout fisheries operate their own return systems.

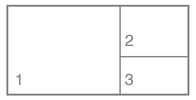
Coarse fish

Because of the huge variation in coarse fishing practice and the large number of species that can be targeted, catch data from coarse anglers are of great value to fisheries management. Important information on the status of coarse fisheries can be obtained from catches made during angling competitions. While this mainly relates to large river and canal fisheries, where matches are traditionally held, it can, in the absence of electric fishing or netting surveys, provide vital information on fish populations. Match returns provide information on the size and species composition of the catch, and which species feature most in winning weights; from this we can calculate the catch per unit effort as well as angling success (the percentage of anglers catching fish). Although results of river-specific surveys have been published previously, this report collates for the first time all available information from selected coarse fisheries.

Future developments

Our ability to monitor some aspects of fisheries is more advanced than for others. As we increase our understanding of fish biology and population dynamics, and of fisheries management and participation, techniques will be developed to provide a more accurate assessment of fisheries status and so improve fishery management decisions.

Filling in the gaps. The value of many of our fisheries monitoring techniques is limited both in terms of the



1 There is a long history of eel fishing in England and Wales: Accurate catch returns from eel and elver fishermen will be invaluable in deciding on international actions to arrest and reverse the very serious decline in the European eel stock – a problem that now threatens the very future of these economically important fisheries.

2 A fishing match on the River Weaver. Data provided by the organisers of these kinds of events are particularly valuable to the Agency's fish stock assessment programme because the fishing rules and duration are consistently controlled.

3 Usk salmon is drawn into the net: The accuracy and completeness of catch returns has improved in recent years, as more people come to appreciate how important such data are to the effective management of fisheries.

target waterbody and target species. For example, we cannot obtain accurate estimates of fish populations in larger rivers by conventional electric fishing and netting techniques. However, the recent development of acoustic monitoring has opened up a valuable window on these valuable fisheries. Further development of acoustic monitoring will provide us with a much better understanding of large river fisheries.

Electric fishing can be very effective at providing an overall picture of coarse fish populations. However, current practices may not be precise enough to give an accurate assessment of certain species, for example eel. We will continue to develop best practice techniques in electric fishing to increase our understanding of fish population dynamics.

Likewise, the use of Habscore to predict fish populations from habitat quality is restricted to salmonids in smaller streams only. We need to gain a better understanding of the relationship between river habitats and coarse fish species and between habitat quality and fish in larger rivers.

Although we have established catch return systems for salmon and sea trout, we will be improving our understanding of brown trout and grayling catches through our angler logbook schemes. In addition, we are seeking to expand the network of rivers included in our coarse fish 'match catch' survey.

Stillwaters

Most fisheries monitoring to date has been focussed on rivers. While fishery owners monitor angler catches and the general condition of many stillwater fisheries, there is little effort put into monitoring their fish populations. This will change dramatically in the near future with the introduction of the European Union Water Framework Directive (see below) which will require the Agency to monitor fish populations in a proportion of stillwaters across England and Wales. It will also mean some changes to our river fishery monitoring programme (in terms of extent and frequency). The qualities that make acoustic monitoring suitable for large lowland rivers also make it suitable for many stillwater fisheries.

Fish, Fisheries and the Water Framework Directive

The Water Framework Directive provides an overall framework for the protection and enhancement of all European waters. The Directive takes a holistic approach to water management and updates existing EC water legislation through the introduction of a statutory system of analysis and planning based upon River Basin Districts. Ten districts are proposed for England and Wales. Integrated water management will cover all lakes, rivers, streams, estuaries and coastal waters, as well as groundwaters. Heavily modified waterbodies, such as on-stream reservoirs, and artificial waterbodies, including canals, are also covered.

The purpose of the Directive is to:

- establish a new, integrated approach to the protection, improvement and sustainable use of surface waters and groundwater
- prevent further deterioration and protect and enhance the status of aquatic ecosystems
- progressively reduce the discharge of priority substances and phase out priority hazardous substances
- contribute to mitigating the effects of floods and droughts.

The Directive requires that 'good' ecological and chemical status is achieved in all surface waters by 2015. 'Good' status allows for only slight changes from natural conditions due to human impact. Ecological status is assessed using four biological quality elements, including fish. The five categories, in descending order are high, good, moderate, poor and bad. For fish, the Directive requires an evaluation of the species composition and abundance together with the age structure of the fish community. All fish species that would naturally be expected to be present in a waterbody type must also be present if a waterbody is to achieve 'High' status, the highest of the five categories. More flexible objectives can be put in place for heavily modified and artificial waterbodies to take account of their use, and the objective then becomes one of achieving 'good ecological potential'.

Surveillance monitoring of fish is required by the Directive every six years, during each River Basin Management Plan cycle. However, it may be that fish are not used for more intensive operational and investigative monitoring– unless they are indicative of the 'pressure' to which the waterbody in question is subject.

Current surveys for the Agency's fisheries monitoring programme cover fish species composition, abundance and age structure on fished rivers but not on lakes and stillwaters. The Directive requires the monitoring of lakes larger than 50 hectares, but consultation undertaken to date has suggested that smaller waterbodies, such as those over 10 hectares, should also be monitored in Ecoregion 18 – England, Scotland and Wales.

The Directive was passed in 2000 and will be transposed into UK legislation by the end of 2003. It is proposed that the Environment Agency will be the sole competent authority charged with the Directive's implementation in England and Wales.

Socio-economic factors

Our present understanding of changes in angling participation and behaviour is fairly limited. Through further analysis of rod licence sales and subsequent surveys of angler preferences, we should gain a better insight into trends in angling and the factors behind those trends. We also need to improve our understanding of the socio-economic aspects of fisheries – for example the capital value of fishing rights and the factors that affect them. Recent research projects have provided an initial insight, but further work is required before we can integrate socio-economic factors more widely into mainstream fisheries management.

Working with others

A number of organisations and individuals monitor fisheries in England and Wales, including private fisheries, river trusts and the Government agencies. Each has its own aims and objectives and these in turn direct why and what they need to monitor. There is scope for co-ordinating the efforts of the various interests so that all data are collected to the same high standards. Indeed, protocols have already been agreed between government agencies on specific fishery monitoring programmes – for example, there is an agreement between the Agency and CEFAS on monitoring salmon index rivers, and the Agency is equally keen to explore opportunities for collaboration with other interests.

Appendix 2 – Summary of consented introductions of native fish species in England and Wales

Species or variant	2000/01	2001/02	2002/03
Barbel	22,765	29,615	19,655
Bream (common and silver)	226,288	237,275	289,714
Common carp (and varieties)	523,154	769,251	1,908,005
Chub	177,937	101,704	92,476
Crucian carp	89,250	75,309	82,787
Dace	109,177	7,590	29,520
Grayling	12,400	200	500
Gudgeon	30,749	4,750	10,170
Orfe	31,481	23,760	30,350
Perch	77,981	44,753	72,607
Pike	578	6,473	3,302
Roach (incl. Hybrids)	562,236	662,393	587,456
Rudd	163,608	140,676	157,724
Tench (and varieties)	104823	82875	102227
Others	20130	25193	29354
Total coarse fish	**2,152,557**	**2,211,817**	**3,415,847**
Arctic char	85	100	0
Atlantic salmon	215,250	244,740	604,120
Brown trout (and variants)	516,699	691,622	1,066,064
Rainbow trout	1,731,787	2,061,379	2,465,419
Sea trout	107,700	92,850	34,500
Total salmonid	**2,571,521**	**3,090,691**	**4,170,103**
Eel	14,022	50	0
Grand total	**4,738,100**	**5,302,558**	**7,585,950**

Appendix 3 – Migratory and freshwater fish species in England and Wales

Coarse fish – principal angled species

Dace	*Leuciscus leuciscus*
Barbel	*Barbus barbus*
Chub	*Leuciscus cephalus*
Roach	*Rutilus rutilus*
Rudd	*Scardinius erythrophthalmus*
Carp	*Cyprinus carpio**
Crucian Carp	*Carassius carassius*
Orfe	*Leuciscus idus**
Goldfish	*Carassius auratus**
Gudgeon	*Gobio gobio*
Pike	*Esox lucius*
Perch	*Perca fluviatilis*
Common Bream	*Abramis brama*
Silver Bream	*Blicca bjoerkna*
Tench	*Tinca tinca*
Ruffe	*Gymnocephalus cernuus*
Bleak	*Alburnus alburnus*

Non-angled coarse fish and conservation species

Allis Shad	*Alosa alosa*
Twaite shad	*Alosa fallax*
Minnow	*Phoxinus phoxinus*
Bullhead	*Cottus gobio*
Stone Loach	*Noemacheilus barbatulus*
Spined Loach	*Cobitis taenia*
Three-Spined Stickleback	*Gasterosteus aculeatus*
Ten-Spined Stickleback	*Pungitius pungitius*
Vendace	*Coregonus albula*
Powan/Schelly/Gwyniad	*Coregonus lavaretus*

Salmonids

Atlantic Salmon	*Salmo salar*
Sea/Brown trout	*Salmo trutta*
Rainbow Trout	*Oncorhynchus mykiss**
Charr	*Salvelinus alpinus*
Grayling	*Thymallus thymallus*

Eels

European Eel	*Anguilla anguilla*

Lampreys

Marine Lamprey	*Petromyzon marinus*
River Lamprey	*Lampetra fluviatilis*
Brook Lamprey	*Lampetra planeri*

* Classed as ordinarily resident to England and Wales

Non-native species recorded in the wild in England and Wales

Zander	*Stizostedion lucioperca*
Bitterling	*Rhodeus sericeus/Rhodeus amarus*
Ictalurid Catfish	*Ictalurus spp.*
Ameiurid Catfish	*Ameiurus spp*
Wels Catfish	*Siluris spp.*
American Brook Trout	*Salvelinus fontinalis*
Chinese Black Carp	*Mylopharyngodon piceus*
Common White Sucker	*Catostomus commersoni*
Fathead minnow or Roseyreds	*Pimephales promelas*
Grass carp	*Ctenopharyngodon idella*
Landlocked salmon	*non-anadromous varieties of the species Salmo salar*
Large-mouthed black bass	*Micropterus salmoides*
Silver carp	*Hypophthalmichthys molitrix*
Sturgeon or sterlet	Species of the genera *Acipenser, Huso, Scaphirhynchus and Pseudoscaphirhynchus*
Sunbleak or Motherless Minnow	*Leucaspius delineatus*
Pumpkinseed	Species of the genus *Lepomis*
Topmouth gudgeon	*Pseudorasbora parva*

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