Snapshots of the Environment
The National Centre for Environmental Data and Surveillance
Environment Agency

Managing our freshwater fisheries

1.0 Introduction

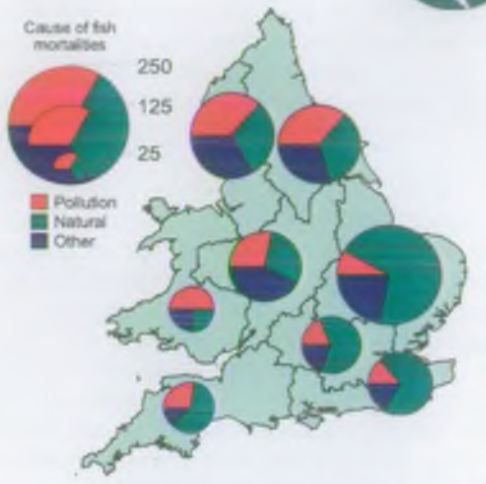
1.1 The **Snapshots on the Environment** series explores some of the issues related to each of the nine **Themes** identified in the Environment Agency's **'An Environmental Strategy for the Millenium and Beyond'**. Each Snapshot uses the **Viewpoints on the Environment** and the **Stresses and Strains** frameworks to look at some of the pressures on the Environment. This, the fourth Snapshot in the series, focusses on **Managing our Freshwater Fisheries**. A guide to the acronyms used is provided at the end of the document.

1.2 Given the wide range of potential topics and the restricted space, these Snapshots can only touch upon some of the issues and not be a comprehensive review. As more information becomes available, or new issues develop, they will be covered in future Snapshots. An important aspect of the Snapshots is that they will look at issues that can be followed across the nine Themes covered in the series.

2.0 Freshwater fisheries

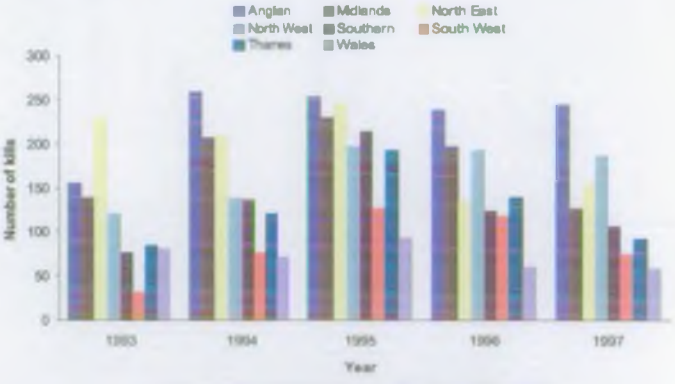
2.1 In the UK, about 19,500km of rivers and canals are designated as protected under the European Community (EC) Freshwater Fish Directive (78/659/EEC). Imperative standards include temperature, dissolved oxygen, pH, ammonium and zinc, with guideline standards for a wide range of other substances. In 1996, 150 out of 2,288 stretches (6.5%), covering 1,220km were non-compliant, and a further 28 stretches received derogations due to weather or geographical conditions (Environment Agency, 1998). Compliance does not guarantee healthy fish populations, because other anthropogenic or natural factors also affect fisheries.

2.2 In the period 1997/98, 1043 fish kills were reported in England and Wales with about one quarter of all incidents directly linked to pollution events, although the proportion varied considerably amongst regions. The number of incidents was similar to that in previous years.



Fish mortalities and cause, 1997/98

2.3 Such events can have serious impacts on fish populations, and cases are often well documented due to the highly visible nature of fish kills. Sub-lethal stresses on fish are much more difficult to quantify, but the effects on populations, such as reduced recruitment, can be as important as lethal impacts. Any changes within a freshwater system will inevitably exert some effect upon fish communities, and a number of these are discussed in the following sections.



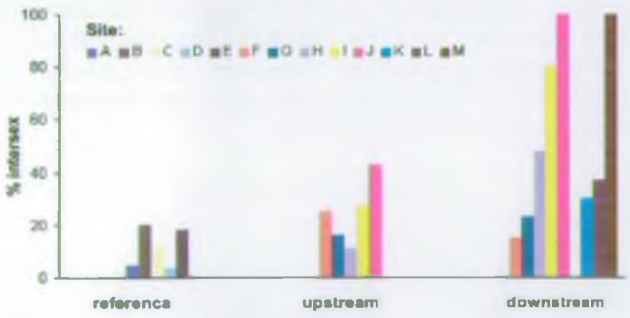
Reported fish kills by Agency Region, 1993 - 1997

2.4 Migratory behaviour is not limited to salmon or sea trout, as many coarse fish species may move large distances upstream or downstream from spawning areas during their lives (Cowx, 1995). Flounder and eel breed in the sea but feed in fresh waters. Habitat requirements can change at different periods of the life-cycle, and consequently any fish can be exposed to a wide variety of environmental stresses throughout its life history. This can complicate efforts to quantify effects on fish populations, particularly when the effects are subtle and sub-lethal.

3.0 Water Quality

3.0 The effects of pollutants vary between species and life stages, with larval and developmental stages generally being more sensitive. Chronic exposure to low levels of pollutants can lead to certain species of fish becoming more prone to disease through immunosuppression or result in morphological disorders. In order to evaluate the impact of such effects, populations need to be monitored over several generations. Such work is complicated by unquantified antagonistic or synergistic toxic effects of chemical cocktails (Environment Agency, 1998a).

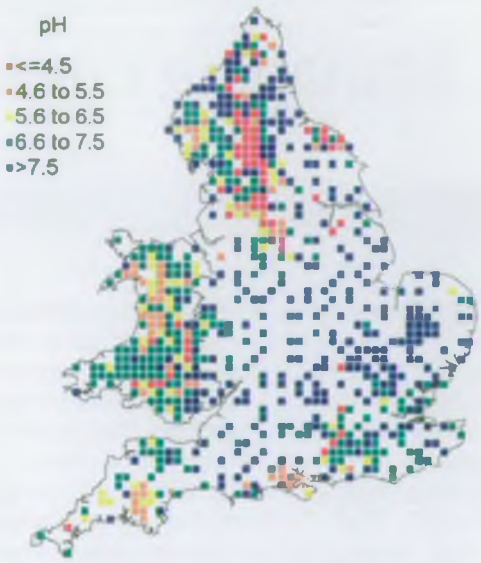
3.1 The degree to which certain factors may affect fish populations can sometimes be unclear, but effects at an individual level can be discerned. In a recent survey of wild roach in several English rivers, incidence of intersex characteristics and the degree of intersexuality was found to be higher in fish sampled downstream of certain sewage treatment works. This suggests feminisation in male fish is more common than previously thought. Similar characteristics have been found in other fish species both in freshwaters and estuaries. For example, in the Tyne, Mersey and Solway Firth, male flounder have shown signs of feminisation, and on the River Lee in North London one third of male roach were affected (Environment Agency, 1998a).



A - Calverton fish farm
B - Canal site, Ireland
C - Canal site, Notts.
D - Lake, Notts.
E - Drain, Lincs.
F - R. Wreake, Leics.
G - R. Ouse, Yorks.
H - R. Lee, London
I - R. Arun, Sussex
J - R. Nene, Northants.
K - R. Trent, Notts.
L - R. Rea, Worcs.
M - R. Aire, Yorks.

Proportion of male roach with signs of feminisation at selected river sites

3.2 The ecological significance of these observations is not well understood. Some chemicals, such as natural or synthetic steroids in sewage effluents, may have been present in the environment for many years. In addition, the endocrine disrupting properties of chemicals are difficult to assess. Effects may occur at very low levels and a simple linear relationship between dose and response cannot be assumed (ENDS, 1997).



Distribution of pH in surface waters, 1990 - 1992

3.3 Acidification in upland streams can have severe impacts upon fish communities. Acid rain can result in lowered pH in headwaters, particularly where geology and base-poor soils afford minimal neutralisation. Afforestation of upland areas can also increase acidification (CLAG, 1996). Upland areas of Wales and the North West are particularly at risk. Low pH in streams increases the solubility of metals and the resultant elevated concentrations, particularly of aluminium, can be highly toxic to fish, especially juvenile stages. Most notably, salmon fry are at risk as these areas are used as spawning grounds. Invertebrate life is also severely impoverished in acidified waters, resulting in a lack of food for fish. In a recent study on acidification in Wales, 48 out of 85 streams sampled showed lower densities of salmon than predicted. This is linked to concentrations of both aluminium and manganese (ITE, 1997). Programmes of lime dosing are being carried out to reduce acidification in a number of catchments, for example the upper Tywi in Wales (Environment Agency, 1998b). This has led to a significant increase in spawning success.

3.4 Upland headwaters in areas associated with sheep farming are threatened by releases of sheep dip. Synthetic pyrethroid (SP) dips are a particular danger due to their extreme toxicity to both invertebrates and fish. Use of these dips is increasing as organophosphate (OP) pesticides are phased out due to associated human health problems. Since 1995 the Ministry of Agriculture, Fisheries and Food (MAFF) requires certificates of competence for users of OP dips. In 1996, only 13.7% of the UK's 90,000 sheep farmers had certificates, suggesting the remainder use injection methods or SP dips (ENDS, 1996). A 1997 study in Wales of 117 farms found SP dips used by 19% of farmers (Environment Agency, 1998c).

4.0 Habitat

4.1 Siltation of river beds can occur if the high flow rates which serve to flush out bed gravels are inhibited, or where suspended solid loads increase. The consequent smothering of vegetation and invertebrate life leads to a loss of habitat and food supply for fish. Siltation is a threat to species that bury their eggs in gravel depressions (redds), such as salmon, trout and grayling. It is also of importance to fish spawning on gravels, such as barbel and chub (Cowx, 1995). Breeding success in salmon relies upon a good supply of dissolved oxygen to the eggs through the gravel. This is prevented when siltation occurs. In areas where salmon spawning grounds still exist, the threat of siltation mainly relates to agricultural activities within the catchments.

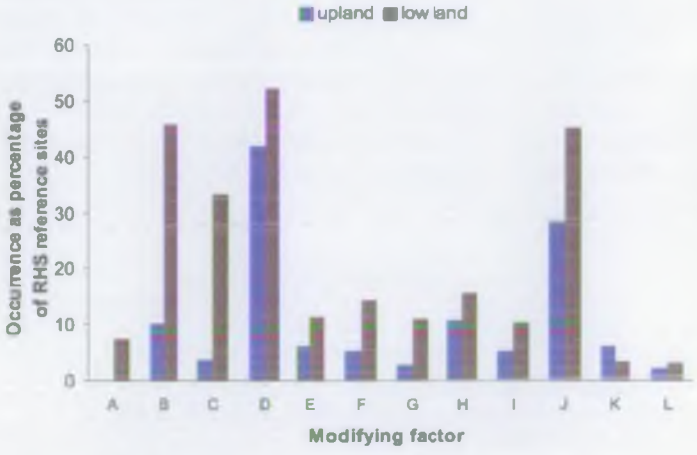
4.2 Intensive arable agriculture is a major contributory factor to soil erosion leading to river siltation (Snapshot 2). Exposure of soil and the consequent risk of increased run off is not limited to lowland arable farming. Bank damage (poaching) by watering livestock can cause destabilisation and release of silt. In the 1994 to 1997 River Habitat Survey (RHS) over 4500 river sites were sampled in the UK. Over 20% of surveyed sites in the UK showed some degree of "poaching" with 4% showing extensive "poaching". Evidence of siltation was noted in 0.8% and 1.9% of upland and lowland RHS sites respectively (Environment Agency, 1998d).

A heavily damaged (poached) bank

4.3 Quantitative evidence relating to the effects of siltation on spawning gravels is limited. A recent study found that some evidence existed to demonstrate a link between suspended sediment in rivers and agricultural induced erosion in localised areas, but no definite proof exists to implicate such erosion in the decline of salmonids (Theurer, 1998).

4.4 Activities associated with land or water resource development can both directly and indirectly modify river habitats and consequently fish communities. Channelisation, bank reinforcement and culverting of watercourses all result in major reductions in habitat diversity, loss of suitable substrate and reduction in food resources for fish species. The modification of flow regimes through increased slope, decreased surface roughness and lack of vegetation also has implications for fish communities. The potential for high flow rates, particularly during storm events, can lead to the displacement of juvenile fish downstream, adversely influencing recruitment (Cowx, 1995). Culverts with excessive slope, shallow flow and lack of a plunge pool at the outfall act as barriers to migration for both salmonid and coarse fish species. Wide, shallow aprons on fords or under some bridges have a similar impact (Marine Laboratory, Aberdeen, 1998). Such modifications are primarily associated with lowland urban development or road crossings (Environment Agency, 1998d).

4.5 Impoundment of river channels by dams, weirs or sluices has major effects on flow regimes and habitat. Siltation can occur where flow speeds are reduced and structures can act as barriers to migration for coarse as well as salmonid species. In the year 1996/97 fish passes and screens were installed in 59 locations across England and Wales. Impounding structures were found at 10.6% of upland and 15.6 % of lowland RHS sites, amounting to about 690 sites in total (Environment Agency, 1998d).

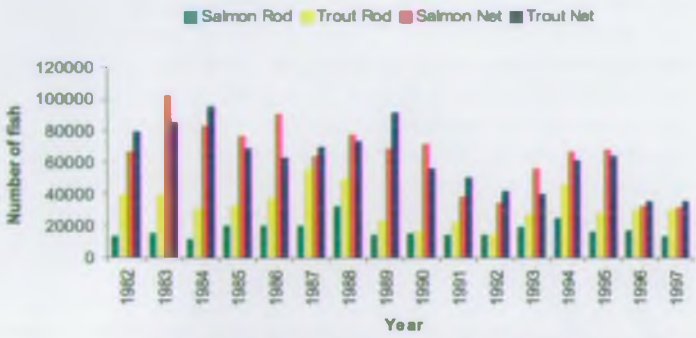


Occurence of channel modifications at RHS sites

5.0 Fishing

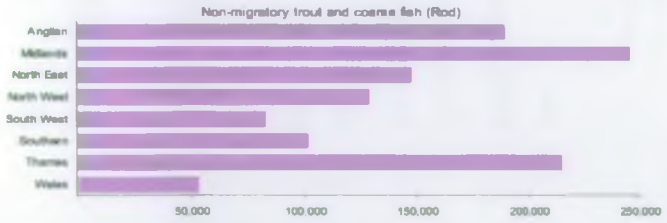
5.1 Recorded catches of salmon and migratory trout reflect a decline in overall populations. Catch returns rose after 1994 when a reminder was issued to licence holders to report catches (Environment Agency, 1997). Despite this increase, there has been an overall decrease of 39% and 29% for declared net and rod salmon catches respectively compared with the previous five year mean. Sea trout rod catches have

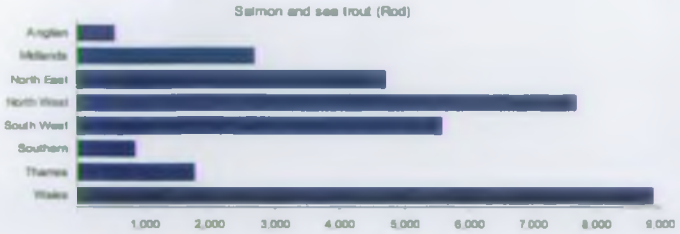
increased by 5%, but net catches have fallen by 26% over the same period.



Migratory salmon and trout catches, 1982 - 1997

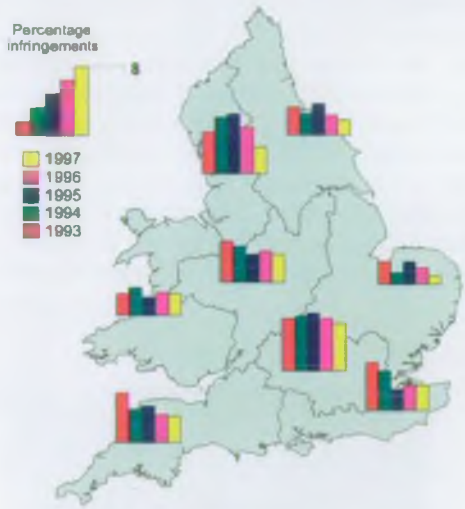
5.2 The decline is, in part, due to environmental pressures on populations including those in sections 3 and 4 above, but over-exploitation of fish stocks makes a significant contribution to the problem. Voluntary catch and release initiatives for angling (The Gamefishing Web, 1998) have increased the proportion of live salmon releases to 24% of the total catch. There is concern over salmon exploitation in the Irish coastal drift nets, and the Agency is lobbying for increased controls through MAFF and the Welsh Office (FOCUS 25, 1998). The International Atlantic Salmon Accord ratified in June 1998 through the North Atlantic Salmon Conservation Organisation (NASCO) aims to protect the fishery through both environmental and fishery improvements (Association of Salmon Fisheries, 1998).





5.3 Returns of salmon from the Atlantic to freshwaters also appear to be decreasing irrespective of fisheries pressures. Increases in sea temperature in the mid Atlantic are believed to be reducing feeding opportunity for salmon and thus decreasing survival rates (FOCUS 25, 1998). The change in sea temperature is thought to be due to climate change, but no definite link has been established in terms of salmon survival.

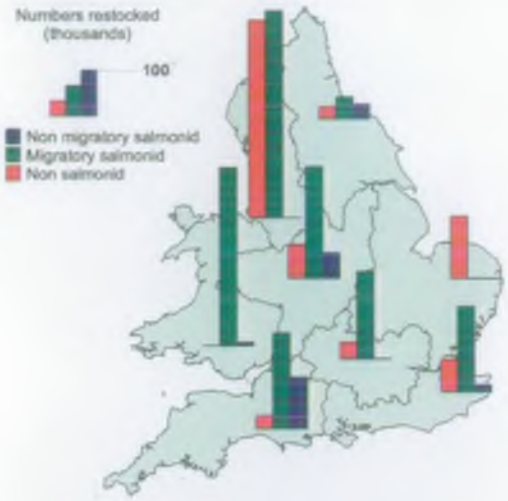
5.4 Illegal fishing is a problem for both coarse and salmonid fisheries. Infringements on rod licences have shown a slight decline in recent years in terms of the total number of checks made. Illegal salmon fishing unsurprisingly is most prevalent in heavily fished areas. In the North West and Wales, seventy cases of suspicious salmon handling were investigated in 1997/98.



Licence infringements as a percentage of total number of licence checks made, 1993 to 1997.

5.5 Many fish populations are maintained at an artificially high level by fisheries owners and managers through restocking, in order to improve catches and encourage anglers to fish their waters. In many cases, such activities do not lead to long term sustainable increases in populations due to either water quality problems or migration (Cowx, 1995). Stocking of non-native species with the intention of increasing species diversity can have the opposite effect. For example, introduction of zander in East Anglia contributed to the decline of native coarse species through predation of roach and bream (Linfield, 1979).

5.6 Stocking of fish can also increase the risk of disease transmission. At present the most serious threats are from gyrodactylosis in salmon and spring viraemia of carp (SVC). Gyrodactylosis is caused by the parasite *Gyrodactylus salaris* and has been found in



Number of fish stocked, 1997/98

several European countries, causing heavy losses in Atlantic salmon stocks. At present it has not been detected in the UK, but could spread rapidly if introduced. SVC affects species including carp, tench and roach and is well established in continental Europe, but outbreaks in the UK have so far been contained. Controls are maintained in the UK through import restrictions of live fish and initiatives amongst anglers to prevent infections through contaminated equipment (MAFF, 1998).

5.7 Within England and Wales, stocking of fish is monitored by the Environment Agency through issuing of consents under Section 30 of the Salmon and Freshwater Fisheries Act, 1975. In 1997, over six thousand consents were issued. Mandatory health checks are required on any fish introduced into rivers, streams or canals.

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Acronyms

MAFF - Ministry of Agriculture, Fisheries and Food
NASCO - North Atlantic Salmon Conservation Organisation
OP - organophosphate
RHS - River Habitat Survey
SP - synthetic pyrethroid
SVC - spring viraemia of carp

For further information contact:

The Environment Agency
National Centre for Environmental Data and Surveillance
Lower Bristol Road
Bath, BA2 9ES

Tel: 01225 444066
GTN: 7 24 4223
Fax: 01225 469939

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