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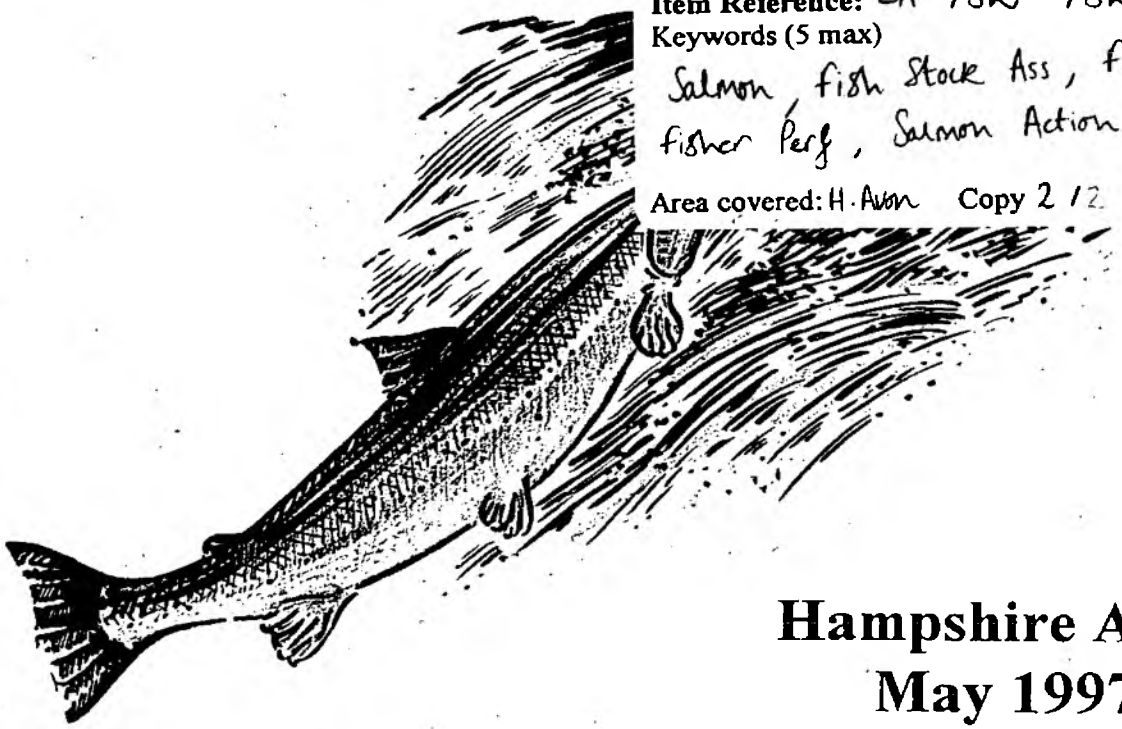
Box 7

EA-South West

SALMON Action Plan CONSULTATION



Hampshire Avon
May 1997

ENVIRONMENT AGENCY

EA - South West

ENVIRONMENT AGENCY

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EXECUTIVE SUMMARY

Local Salmon Action Plans are the means by which the Environment Agency will implement the National Strategy for the management of salmon fisheries in England and Wales.

The Hampshire Avon Salmon Action Plan is the first to be produced in South Wessex and represents a fundamental shift in approach to the management of salmon stocks in the area.

The plan contains descriptions of the current fishery status and historical trends. The current status is then examined in the context of compliance with a spawning target for the stock. Limiting factors are identified, ranked, and the feasibility of their removal assessed. Actions designed to achieve target egg deposition within 5 years are proposed. Finally, an assessment of costs and overall benefits of actions with respect to limiting factors are set out to support prioritisation of expenditure, and funding scenarios are put forward.

The Avon salmon population is currently showing signs of recovery from a decline which began in the late 1980's, and which reduced catches to approximately 20% of long term average by 1994. However, in 1996, egg deposition was still only 61% of that required for the Minimum Biologically Acceptable Level. The composition of the stock has also changed with large 3-sea-winter salmon contributing a smaller proportion than historically. The population of the Avon appears to be genetically pure in contrast to some other southern chalkstream stocks which have undergone changes as a result of artificial propagation schemes.

SUMMARY OF MOST URGENT ACTIONS

ISSUE	ACTIONS
Limited understanding of factors and mechanisms determining stock abundance	R&D to improve understanding of mechanisms controlling chalk stream salmon populations to allow more efficient management..
Insufficient spawning escapement (low egg deposition)	Ensure increased escapement from rods and nets (particularly 2SW salmon) via catch and release and introduction of **byelaws**.
Poor egg survival due to siltation and concretion of gravel	**Habitat improvement** via enhanced level of gravel cleaning, including evaluation and development, and **"Landcare"** initiatives.
Stock monitoring is not accurate enough to support optimal management	Continue existing monitoring programme. Obtain a complete count of adult salmon using resistivity counters.

The Agency currently spends £56,000 per annum managing the Hampshire Avon salmon

stock, however, this funding is vulnerable due to cuts in grant-in-aid. Some of the actions proposed cannot be accommodated within the Agency's budget. The plan is designed to encourage active involvement of all user groups in order to maximise opportunities for generation of new funding sources and facilitate a coordinated approach to the resolution of issues.

This process is in keeping with the Agency's intention to enhance the collaborative integrated management of catchments and to seek openness and accountability in all its actions.

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PART 1 INTRODUCTION

1.1 NATIONAL SALMON MANAGEMENT STRATEGY (NRA, 1996a)

The Atlantic salmon has a complex life history during which it is at the mercy of the oceanic, estuarine and river environments, over which man has limited control. Stocks of salmon are thus subject to year-to-year fluctuations (and perhaps longer term cycles) in abundance caused by oceanic, climatic and other factors. Management can take account of some of these factors but cannot eliminate them. Further management challenges are presented by the fact that English and Welsh salmon stocks are exploited not just in home waters but in distant water and coastal fisheries over which the Environment Agency has no direct control.

The overall status of salmon stocks in the North East Atlantic gives cause for concern. In particular, the multi-sea-winter component of many stocks are at very low levels and may still be declining. Failure to manage salmon stocks properly could result in long term or even permanent damage to our fisheries, with associated economic and social consequences.

In February 1996 the National Rivers Authority published *A Strategy for the Management of Salmon in England and Wales*. This is the first ever national strategy, identifying clear objectives allowing resources to be focused on priority activities. It provides consistent policies and a framework to manage stocks. The objectives for the future management of this resource are given as:

1 *optimise the number of salmon returning to home water fisheries;*
2 *maintain and improve the fitness and diversity of salmon stocks;*
3 *optimise the total economic value of surplus stocks;*
4 *meet the necessary costs of managing the resource.*

The Strategy document outlines how these could be achieved in practice.

The Agency is responsible for implementing this strategy by means of local Salmon Action Plans drawn up by the year 2000 for all our principal salmon rivers, through consultation with local interest groups. The Hampshire Avon plan is the first drawn up by the South Wessex Area, South West Region. The Action Plans will:

- set spawning targets and fishing effort controls for salmon stocks and fisheries;
- identify and establish the feasibility of removing factors limiting salmon survival and production;
- outline a programme of works to carry out necessary remedial, improvement and development measures.

The Strategy seeks to ensure the sustainable and cost effective exploitation of our salmon, which will conserve this species for future generations. Several of the actions proposed have wider benefits to other species and the environment as a whole.

1.2 DESCRIPTION OF THE CATCHMENT (NRA, 1994a)

- The Hampshire Avon catchment (Figure 1) lies within the counties of Hampshire, Dorset and Wiltshire. The main river, with its source in the Greensand of the Vale of Pewsey, flows in a southerly direction draining into Christchurch Harbour and the English Channel. The catchment statistics are summarised in table 1.

- The catchment provides an important link between three areas; the chalk downlands of Wiltshire, the Dorset heathlands and the New Forest, reflected in the wide range of semi-natural habitats including good examples of lowland heath, unimproved grasslands and ancient broadleaved woodlands.

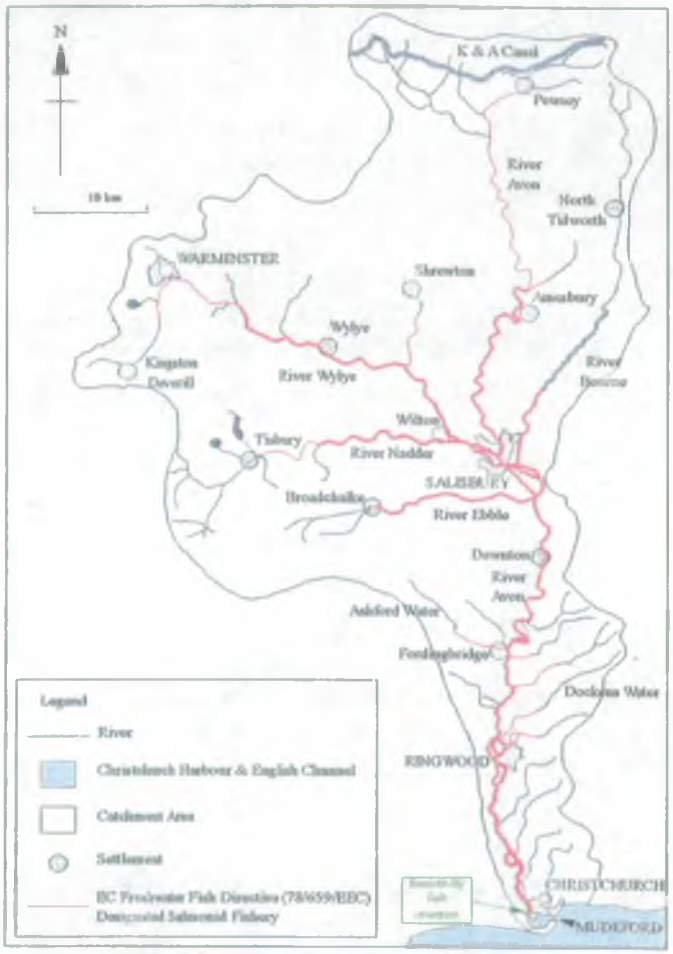

Figure 1: Hampshire Avon catchment

- The chalk aquifer underlying the upper catchment is a major source of water for domestic, agricultural and industrial purposes as well as the source of all major tributaries in the catchment.

- The total fall of the river from Pewsey is 108 metres and its average gradient is approximately 1 m/km. Because of the high degree of groundwater contribution to its flow, the Avon exhibits a low ratio of maximum to minimum discharge typically about 6:1 at Fordingbridge.

- The river supports a vigorous growth of weed, in particular *Ranunculus* species, which needs to be cut at times to prevent summer flooding.

- Although the major valleys of the Salisbury Plain carry perennial streams, most of their tributary valleys are dry or contain winterbournes which flow only for limited periods of the year.

- As the industry in the catchment is mainly light, water quality in the river has been maintained at a high standard, very nearly all of it falling into either the RE1 or RE2

classification, with a target of complete compliance with those in the areas which salmon use. This means that water quality, as characterised in this classification scheme, is not believed to limit the salmon populations of the Avon.

Table 1: Hampshire Avon catchment statistics

General	Catchment area	1701 km²
	Length of main Avon	122 km
	Population	200,000
Water Resources	Average annual rainfall	770 mm (at Salisbury)
	Average daily flow from catchment at Knapp Mill	19.7 m³/sec
	Dry weather flow from catchment (5%ile) at Knapp Mill	6.0 m³/sec
	Total licensed abstraction	14.78 m³/sec
	Consumptive licensed abstraction	3.57 m³/sec
Water Quality (based on 1996 data)	Length in RE1 class	176 km
	Length in RE2 class	179.7 km
	Length in RE3 class	10.1 km
	Length in RE4 class	1.7 km
	Length in RE5 class	4.4 km
Flood Defences	Length of statutory main river	322 km

- Land use within the catchment of the Avon has changed in ways which could result in serious impacts on salmon populations over the years. Agriculture in the catchment has greatly increased the potential for run-off to carry silt and agricultural fertilisers and pesticides to the river. Major upturns in soil erosion have been noted in the mid 1980s and the 1990s. Silting of the bed is a common feature and calcareous concretion also occurs in some areas.

- Other major land users in the catchment include the Ministry of Defence whose use of Salisbury Plain for tank training provides a high potential for silt run-off to the river.

- Management of the river itself has changed, old estate records showing that wide scale bank protection using planking held in place by oak stakes was a common feature before the Second World War. Harrowing of the river bed also took place using horses, to assist successful trout breeding. This type of activity tended to die out with the rise in labour costs and the growth of hatcheries supplying cultured trout for stocking.

- Since about 1970, aquaculture in the form of large scale table trout production has grown rapidly in the Avon's flood plains, making use of the old structures and level controls left over from the mills and water meadows. The structure of these farms, with diversion of

large flows from the river, has caused extra difficulties for salmon in both their upstream and downstream migrations as adults and as smolts.

- The present river channel and its associated ditch system developed from around 1100 AD for milling purposes and further modified from around 1600 AD for water meadow supply and drainage, is one of the most important in Britain for the diversity of plants and animals which it supports.

- The River Avon and its tributaries are of national and international importance for their wildlife communities. The Avon is richer and more varied than most chalk streams with over 180 species of aquatic plant having been recorded, one of the most diverse fish faunas in Britain and a wide range of aquatic invertebrates. The majority of the river system has been designated as a river Site of Special Scientific Interest (SSSI) under the Wildlife and Countryside Act, 1981. The diverse fish fauna is one of the reasons for notification. A conservation strategy for the river SSSI is currently being produced jointly by the Agency and English Nature, and this will embody a strategy for the protection and enhancement of salmon populations.

- The River Avon is being considered as a possible Special Area of Conservation (pSAC) under the EU Habitats Directive because it contains habitat types and species which are rare or threatened within a European context. The pSAC includes four component SSSIs in the catchment area. Atlantic salmon is one of the species of European importance. A favourable conservation status for salmon will need to be defined and measures taken to ensure it is maintained.

PART 2 DESCRIPTION OF THE FISHERIES (ROD AND NET)

Rod fishing

- The rod fishing season runs from 1 February to 31 August, both dates inclusive.
- Since the introduction of new byelaws in 1994, fishing prior to 15 May is restricted to artificial fly only, and after this date any legal lure or bait is permitted.
- Salmon fishing on the Avon is controlled by large estates, clubs and syndicates and is entirely in private ownership.

Netting

- Licensed netting for salmon and migratory trout takes place in Christchurch Harbour, the joint estuary of the Rivers Avon and Stour, in the Mudeford 'Run', the narrow mouth of the estuary, and from the beach within the public fishery part of the Harbour.
- Fishing is solely by means of seine nets and exploits both Hampshire Avon and Stour stocks (87% of Mudeford fish run up the Avon, 6.5% of Mudeford fish run up the Stour and the remainder are strays from other rivers (Solomon, 1991)).
- The number of nets is limited to six in accordance with the National Rivers Authority (Poole Harbour and Christchurch Harbour) (Limitation of Draft and Seine Net Licences) Order 1993, and these are licensed by the Agency.
- The netting season runs from 15 April to 31 July, both dates inclusive.
- Weekly close times are between 6.00 am on Saturday and 6.00 am on the following Monday and the period between 9.00 pm on each of the evenings of Wednesday, Thursday and Friday and 5.00 am on each of the respective following mornings.

2.1 CATCHES AND CATCH EFFORT

- Salmon catches on the Avon in the past six years have been at their lowest ever level. Historical data are derived from Area records given as catch statistics published by Russell *et al* (1995) and NRA (1991, 1992, 1993a, 1994b).

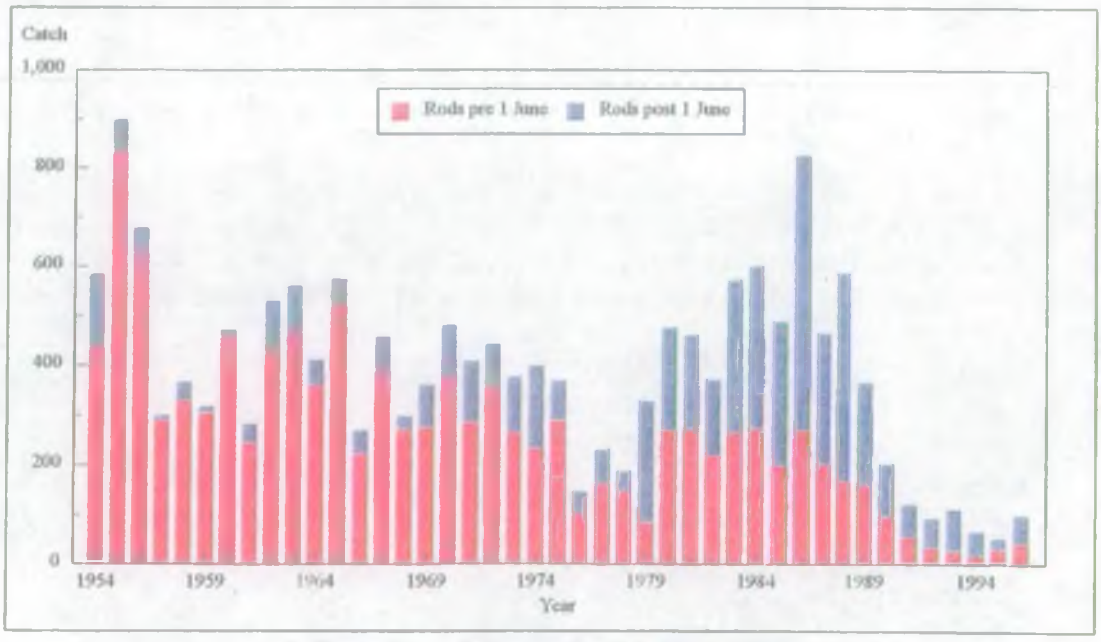

Figure 2: Salmon rod catch, 1954 -1996

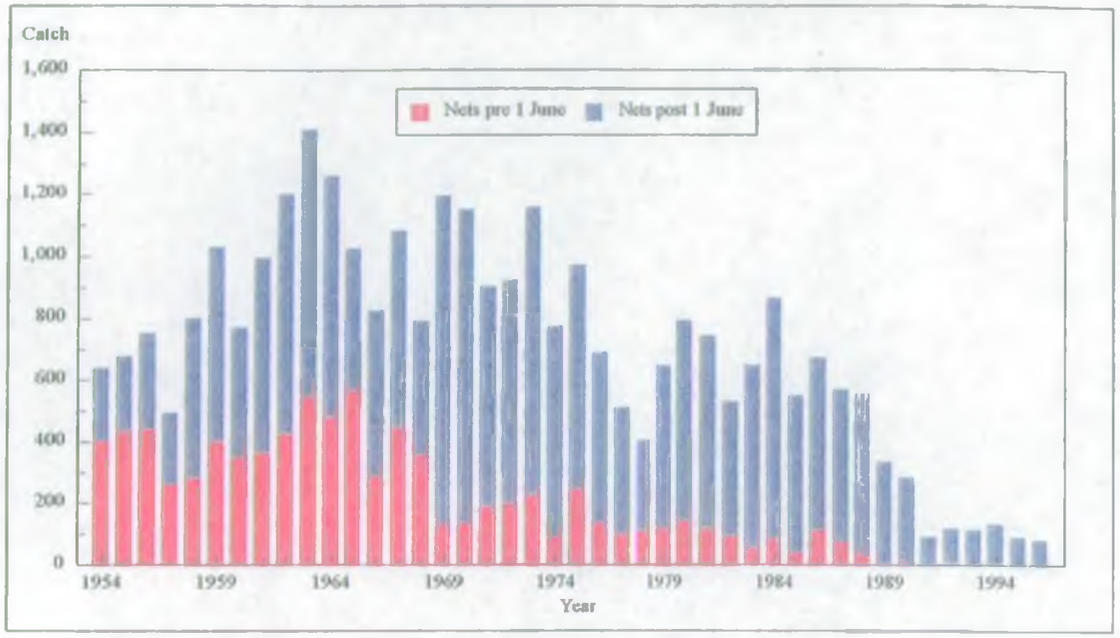

Figure 3: Salmon net catch, 1954 - 1996

- The decline of salmon on the Avon can be divided into two components, a long term decline of spring running salmon and a shorter term decline of later running salmon apparent in the figures above.

- In accordance with the national guidelines spring salmon and grilse are defined as those fish caught before and after 1 June respectively, as shown in figures 2 and 3. However, a study into the decline in catches of spring salmon on the Avon (Solomon, 1992) showed catches between February and April have fallen to the greatest extent, with May catches on the Avon being maintained to a much greater extent. Therefore, for the purposes of this report spring salmon are taken as those fish caught before 1 May.

- The age-class structure of catches on the Hampshire Avon are discussed further in section 3.2.

2.1.1 Spring salmon

- Numerically, spring catches peaked in the 1930s, having gradually built up as a result of both increased spring runs and increased angling exploitation. Catches remained at a high level until the 1950s, but have steadily declined since then.

- Figure 4 presents the catches of spring fish numerically (histogram) and as a percentage of the season's total catch (points and trend line). The decline in spring catch, both in numbers and as a percentage, is clearly apparent. The spring catch has fallen from an average of about 300 per year in the 1950s, to around 20 in the years preceding the 1994 revised byelaws (see section 6.11). This represents a fall as a proportion of the season's

catch from around 50% to 10%.

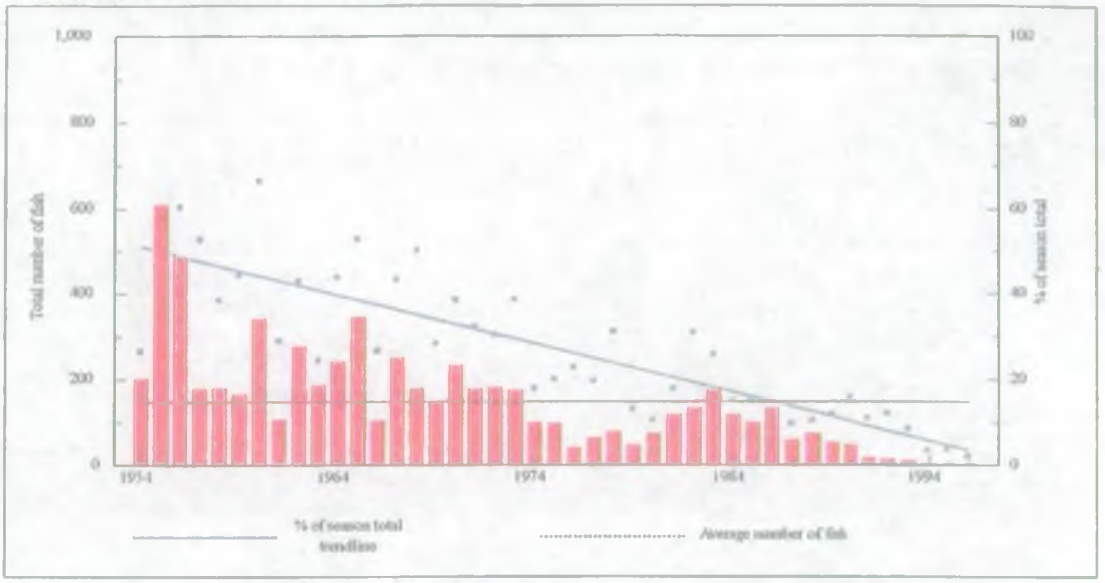

Figure 4: Spring salmon rod catch, February - April

- New byelaws were introduced in 1994 to give increased protection and to allow greater spawning escapement for spring salmon, permitting only the use of artificial fly for rod fishing until 15 May.

- Despite a small upturn in 1996, overall catches of both spring and non-spring salmon to rods have been lower since the introduction of the byelaw changes than at any time since 1954 (figure 2). In the absence of a full count of Avon salmon, it is not possible to apportion the decline directly between exploitation changes and numbers of fish running the river.

- The decline in spring salmon catches from the nets is less dramatic although it is also known that effort in the net fishery is heavily influenced by the fishermen's perception of success. At Mudeford, no salmon had been netted prior to 15 April between 1990 and 1993.

- In the byelaw revision of 1994 the opening of the netting season at Mudeford was set back from 1 February to 15 April and since then little netting has taken place before May.

2.1.2 Non-spring salmon

- Stocks of later running salmon (May to September) had also been subject to a serious shorter term decline which affected all southern chalk streams. This decline had taken place during a run of four very dry years, 1988 to 1991, and when two year classes of smolts, 1989 and 1990, were also known to have suffered high mortality at sea.

- Rod catches in the 1990s have been poor throughout the season. While low water

conditions have not been conducive to good catches, the main cause appears to have been poor marine survival of smolts emigrating in 1989 and 1990, and high in-river mortalities of all other life stages during the 1988 - 1991 drought.

Table 2: Rod and net catch summary

	PRE-1 JUNE CATCH		POST-1 JUNE CATCH		ANNUAL CATCH		CATCH PER LICENCE DAY	
	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95
Rods	42	32.4	86	85.4	128	117.8	0.03	0.02
Nets	0	4	83	108.8	83	112.8	1.16	0.47

2.1.3 Effort

- Rod effort data for the Hampshire Avon (catch per licence day in table 2) have been derived from that given in national catch statistics and from responses to a questionnaire distributed to the major fisheries during 1996.

- Net effort data (catch per licence day in table 2) have been obtained via returns from individual licences and our own monitoring of netting activity.

- A significant increase in salmon angling effort occurred in the period between 1950 and 1965. This arose partly because the area of fishable water was increased by weed cutting and the installation of fish passes. Effort has since remained relatively constant until the early 1990s, when declining stocks and byelaw changes resulted in reduced effort (see section 2.2.1).

- Net fishing methods have changed little over this period, but there has been some variation in the numbers of licences issued, regulated by a series of Net Limitation Orders. The number of licences was reduced from 10 to 6 in 1962, although, because of the protection awarded to existing licensees, numbers fell to the target figure only in 1988. The existing NLO remains in force until 2003.

- However, the nature of the Mudeford 'Run' restricts netting operations such that in practice netting effort is thought to have remained relatively constant over the period despite the number of fishing licences issued having varied between 6 and 18 (Russell *et al*, 1995).

2.1.4 Illegal fishery

- The known illegal salmon fishing on the Avon occurs in Christchurch Harbour and the sea immediately offshore, and on the spawning grounds.

- The illegal fishery in the harbour and sea occurs usually during the period June to

September and the favoured method is fixed gill netting. The evidence we have suggests that this fishery is actually targeting sea trout and that salmon are a small by-catch. This fishery may be more of a problem during a low flow summer when salmon accumulate in the Harbour and tidal river. We carry out anti-poaching patrols during vulnerable times to counter the threat from this fishery.

- Occasional spawning fish are caught illegally by foul hooking (snatching) during December/January. Again, we carry out patrols which target this illegal activity during the vulnerable period.

2.1.5 Sea trout

- Figure 5 below shows the reported sea trout catches by both rods and nets for the period 1950 to 1996 as numbers of fish caught.

- It is believed that catch returns for sea trout are less comprehensive (accurate) than those of salmon. Reported rod catches have varied widely since 1950. Since the mid-1980s there has been a decline in stock numbers, similar to that experienced by salmon stocks although not as prolonged, initiated by the drought period.

- Reported net catches have varied between 10 and 1,000 fish.

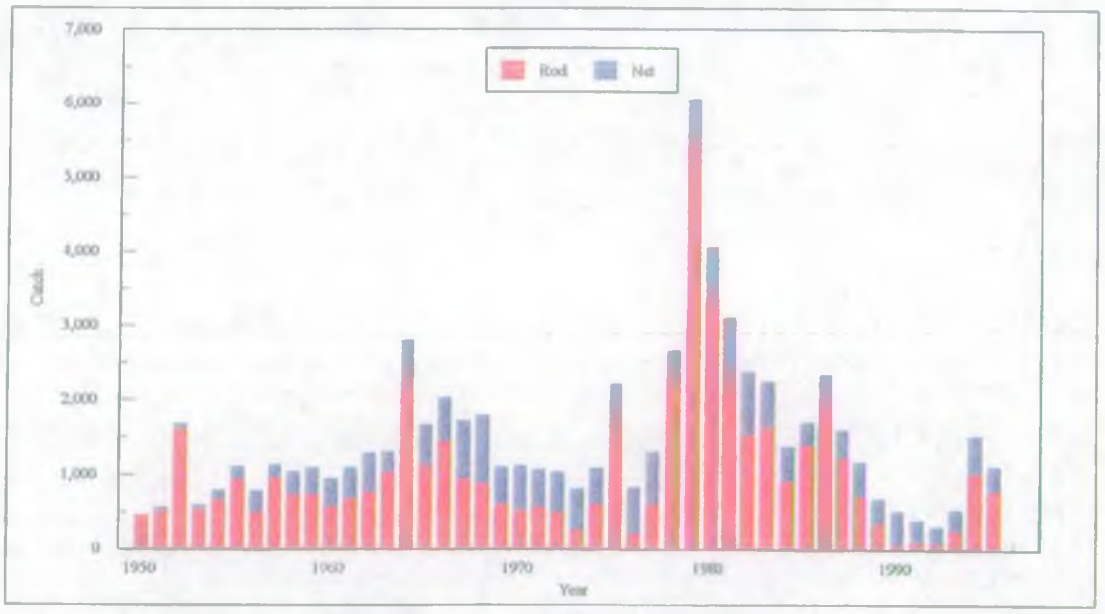

Figure 5: Sea trout catch, 1950 - 1995

2.1.6 Contributions to other fisheries

- Returned tags from salmon smolts released between 1966 and 1978 (Wessex Water Authority artificial propagation scheme (WWA, 1987)) give an indication of the home water and high seas fisheries exploiting Avon stocks.

- Less than 0.2% of smolt tags were returned. However, this indicated that the total smolt release from the Avon was exploited in the following proportions: West Greenland high seas fisheries 47%, Irish coastal fisheries 6%, Test and Itchen 9%, rods on the River Stour 3%, rods on the Avon 16% and Mudeford nets 19%. It must be emphasised that the small number of tags returned over the years mean that the confidence limits attached to these figures are very wide indeed. Appendix 1 gives further information on marine fisheries.

2.2 NON-BIOLOGICAL FISHERY DESCRIPTION

(figures rounded to nearest hundred/thousand/million as appropriate)

2.2.1 Participation

- Participation by rod anglers has been estimated from national catch return statistics and from a questionnaire circulated to Avon fisheries in 1996. Participation over the last 5 years is summarised in table 3. For the purpose of this report "visiting anglers" are defined as those anglers living outside the South Wessex Area.

- This analysis suggests that rod fishing effort has fallen over the last 5 years and is currently 64% of longer term average.

Table 3: Rod fishery participation

RESIDENT ANGLERS				VISITING ANGLERS				TOTAL			
Number		Days fished		Number		Days fished		Number		Days fished	
1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95
115	159	1580	2480	165	228	2270	3550	280	387	3850	6030

- Net fishery participation over the last 5 years (summarised in table 4) suggests that net fishing effort has also decreased. However, due to the nature of the fishery it is considered that this analysis overestimates the true reduction in fishing effort (see section 2.1.3).

Table 4: Net fishery participation

LICENSEES		ENDORSEES		TOTAL NETSMEN		DAYS FISHED	
1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95	1996	Mean 1991-95
2	6	5	12	7	18	70	250

2.2.2 Economic evaluation

There is no single parameter to express the value of a salmon fishery. Different parameters of value reflect the differing perspectives of those associated with a fishery. For example,

anglers value a rod fishery in a different way to local traders who benefit from anglers' expenditure.

The minimum **Nett Economic Value** of a salmon fishery to the country may be defined as the sum of:

- Value to fishery owners (market value of fishing rights)
- Value to anglers (consumers' surplus)
- Value to netsmen (profits from sale of catch)

For the Avon it is not possible to separate the values generated by the salmon and sea trout fisheries. The estimates presented therefore cover both species, although it is believed that on the Avon the contribution made by sea trout fishing alone is relatively small.

Market value of fishing rights

- This is the present value of the capitalised future nett benefits to the owners of the fisheries and is largely a function of the average annual catch.

- Using the average value of a salmon in England and Wales, £8000 (Radford *et al* 1991), and the 5-year annual average catch, the value of the rod fisheries on the River Avon is estimated to be £0.9 million.

- The catch over the last five years is unusually low and the value of the fishery may be underestimated using this approach. For example, if the period 1987 to 1991 is considered the value is estimated to be £7.5 million. Any five year period can be deemed unusual, therefore if longer term data (1954 - 1996) is used for comparative purposes the value is estimated as £4.1 million.

- This calculation assumes that the fishing rights have no alternative value in the absence of angling for migratory salmonids. This is clearly not the case on the Avon due to the presence of valuable coarse fisheries.

Anglers' consumers' surplus

- This can be defined as the difference between what the anglers are willing to pay for their fishing and what they actually pay.

- The results of a study by Radford (1984) showed that this value varied widely between rivers. If the lowest ratio is used as the most conservative then, the anglers' consumers' surplus (capitalised) is equivalent to market value of rod fisheries.

- Using the average catch for the last five years the value for the Avon can be taken as £0.9 million. The values used are given in Table 5.

Table 5: Value to fishery owners and to salmon anglers for most recent five year period

Mean declared rod catch 1992-96	Mean total rod catch 1992-96*	Mean value per salmon	Market (capital) value to rod fishery	Ratio Anglers' consumers: surplus Market value	Anglers' consumers' surplus
110	115	£8,000	£1 M	1:1	£1 M

* 95% rod catch declaration assumed

Profits to netsmen

- The gross revenue to netsmen can be estimated from declared weight of fish caught and the price (£) per unit weight.

- The profits calculated from multiplying the 5-year average declared catch to the Mudeford fishery by local prices for salmon and sea trout, less 40% for operating costs (Radford *et al*, 1991) are given in table 6. For comparison with the capitalised values for rod fisheries, netsmen's profits' have also been capitalised.

Table 6: Value to netsmen

Species	Mean declared weight of catch 1991-95	Price per kg	Gross revenue	Nett profit	Capitalised nett profit
Salmon	400 kg	£6.60	£2,600	£1,560	£10,000
Sea trout	738 kg	£5.30	£3,900	£2,340	£16,000

Calculation of Nett Economic Value

- The **minimum Nett Economic Value** of the Avon salmon and sea trout fisheries could therefore be estimated as the sum of the components in table 7 below.

Table 7: Fishery nett economic value

VALUE	£
To fishery owners	£1 M
To salmon anglers	£1 M
To netsmen	£26,000
minimum Nett Economic Value	£2 M

There are other non-use aspects of Nett Economic Value (e.g. option value, existence value and bequest value) that have not been estimated here. Nonetheless, it cannot be assumed that such values are negligible, existence values in particular may be substantial in some circumstances.

spawning (they can be 1SW to 4SW) and their absence since first spawning (generally 1 year on the Avon, but can be a few months to 2 or more years).

- The decline of the spring catch since the 1950s has been as a result of a drop in numbers of 3SW fish; the small 2SW component has remained relatively stable over the past 40 years until the very recent fall from 1988 onwards.

- Changes in the sea-age composition have occurred before. There were reasonable numbers of grilse in the 1870s, which fell by the 1890s and very few were apparent by 1920. However, taking account of the relatively low fishing effort in earlier years, the present paucity of 3SW fish appears more extreme and longer-lasting than other fluctuations in the past 120 years.

3.3 JUVENILE ABUNDANCE

- Annual monitoring of parr populations shows that in excess of 95% are aged 0+. Although there is considerable year to year variation in the age composition, due in part to variation in year class strength, this confirms that a very large proportion of Avon salmon migrate as smolts after a single year in freshwater.

- Mean densities of 0+ salmon on the Avon catchment for the period 1988 - 1996 are shown in figure 6 . These data show considerable variation in mean parr density over the 9 year monitoring period. In addition, variation between sites is considerable, some sites yielding high densities, whilst at others parr can be absent.

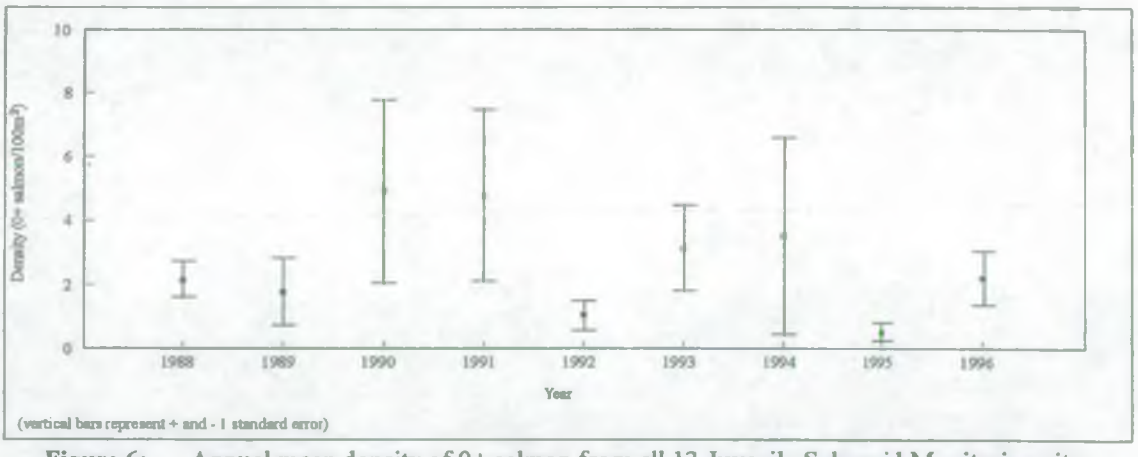

Figure 6: Annual mean density of 0+ salmon from all 13 Juvenile Salmonid Monitoring sites

- It should be noted that in recent years the principal spawning tributary in the catchment has been the River Nadder which is not included in the Juvenile Salmonid Monitoring (JSM) programme.

3.4 DISTRIBUTION OF SPAWNING AND UTILISATION OF THE CATCHMENT

- Figure 7 shows the typical range of salmon in the Avon catchment. This is restricted to the main river and carriers below Salisbury (few of the lower tributaries being used on a regular basis) and part of each of the upper tributaries.

- There is believed to have been an upstream shift in the spawning distribution, though not as great as the change in distribution of angling catches would suggest. Reports from the 1860s mention spawning as far upstream as Salisbury, with occasional fish in the Wylye.

- The total wetted area of the catchment used by salmon is 3.6 million m^2 (derived from a habitat mapping study), of which 19% and 14% can be described as 'good' and 'moderate' nursery habitat respectively (table 9).

Figure 7: Areas used by salmon

Although the percentage of suitable habitat is not large it is thought that the existing area is under-utilised at current stock levels (see section 4.2).

Impact on the economy

- This can be considered the economic activity generated by salmon fisheries which will contribute to employment and incomes within a given area.

- Radford *et al* (1991) estimated average expenditure by salmon anglers in England and Wales to be £40 per day. Using an estimate of the mean number of days fished on the Avon (6,030) gives an estimate of £241,000 per annum (table 8).

Table 8: Anglers' expenditure

Mean total days fished 1991-95	Expenditure per day	Total expenditure
6,030	£40	£241,000

PART 3 DESCRIPTION OF STOCKS, CURRENT STATUS AND RELEVANT TRENDS

3.1 STOCK MONITORING

Comprehensive stock monitoring is a fundamental requirement for effective stock management. This is particularly important at a time of low stock levels if limiting factors are to be identified and, where possible eased. We aim to achieve this by targeting life stages, times and conditions, for which data of a satisfactory precision can be obtained within constraints of finance and physical river conditions.

- **Spawners:** assessed in two ways: *i*) reported rod and net catch and estimates of exploitation rates are used to calculate spawning escapement; *ii*) when conditions allow redds are counted and mapped.

- **Juveniles:** since 1988 thirteen sites on the Avon catchment have been electric-fished annually in order to determine the density of salmon parr and provide an estimate of year class strength.

- **Adults:** reported rod and net catches are a useful indicator of run size in a given year. However, the preferred method of assessment is to count adult fish as they enter the river. To this end the Agency has been developing two resistivity fish counters on the Royalty Fishery, Christchurch over the last two years. These counters will be further developed with the objective of obtaining a complete count with species identification in the near future.

The ultimate monitoring arrangement would allow the derivation of a stock-recruitment relationship for the Avon. This would require comprehensive counting of adults and a measure of freshwater production (preferably smolt enumeration) annually over a period of 10 or more years. With this as a long term objective, we will modify our monitoring programme as finances and technologies allow.

3.2 ADULT SALMON RUN

- Historically spring salmon catches (1 February to 30 April) on the Avon have been dominated by large 3 and 4 sea-winter fish averaging 9.1 kg and 17.3 kg in weight respectively.

- 2SW fish (averaging 5.5 kg) occur in very small numbers during February to April, but become an increasingly important component during May and June.

- Grilse (1SW of 3.6 kg and under) usually appear in rod catches during late June and dominate the catch from July onwards.

- Previous spawners can occur at any time and range in size according to age at first

Table 9: Hampshire Avon habitat assessment - summary statistics

RIVER (subcatchment)	TOTAL AREA (m^2)	JUVENILE HABITAT		TOTAL BANK LENGTH (km) (including both banks)	% LENGTH UNFENCED	ADJOINING LAND USE		
		% Area of good habitat	% Area of moderate habitat			% Arable	% Pasture	% Urban**
Wylye (u/s limit Fisherton De La Mere)	156,900	28	21	35.2	50.8	0.04	79.6	20
Nadder (u/s limit Sutton Mill)	115,800	50	24	41.6	25.35	0	85.33	14.6
Bourne (u/s limit Ford Mill)	36,100	40	36	9.5	18.8	0	71.8	28.2
Ebble (u/s limit A338)	4,200	60	30	2.1	50	0	80	20
Ashford Water (u/s limit Alderholt Mill)	15,000	40	30	6.0	16	0	84	16
Avon u/s of Salisbury	763,100	20.2	17.7	87	36.7	3	88	9
Avon d/s of Salisbury* (d/s limit Bugmoor Hatches)	2,495,400	16.8	12.2	190.62	24	0	96	4
Dockens Water (u/s limit Moyles Court)	11,300	60	25	5.67	10	0	20	80***
TOTAL	**3,597,800**	**18.85**	**13.89**	**377.69**	**29.08**	**0.66**	**89.25**	**10.04*** **

* river length includes carriers and side streams **including industrial estates, back gardens, trout farms, parks *** Including New Forest Heritage Area

- Figure 8 gives the approximate location of individual salmon redds in January 1996, whilst figure 9 shows the known sea trout spawning areas in the catchment. The lower tributaries, in particular the streams draining the New Forest (e.g. Dockens Water, Huckles Brook, and Ripley Brook) are utilised by sea trout more heavily than by salmon.

- The presence of excessive amounts of fine sediment in salmonid spawning gravels can adversely affect egg and alevin survival. Silting of the bed is believed to be a problem in the spawning gravels of the Avon and is likely to be a limiting factor. Gravel cleaning and R&D into silt ingress are some of the current initiatives attempting to address the problem.

Figure 9: Sea trout spawning areas

Figure 8: 1996 redd map

This is discussed further in section 6.

PART 4 ASSESSMENT OF STOCK AND FISHERY PERFORMANCE

4.1 SPAWNING TARGETS

The first objective of the Salmon Management Strategy is that:

> **"Individual salmon stocks and the environment in which they live should be managed to optimise recruitment to home water fisheries."**

This objective needs to be expressed in terms of biological targets. To do this nationally requires a common approach across the Agency's regions to the setting of targets and the assessment of compliance (Environment Agency, 1996).

- Although several types of target can be set for the management of salmon, ICES (1995) has recently recommended that spawning stock at maximum gain should be the standard target defining the **Minimum Biological Acceptable Level (MBAL)** of a stock's abundance to assure its continuation.

- MBAL has been adopted by the Environment Agency as the target most closely describing the objectives of the Salmon Strategy, whilst recognising that, due to natural stock variability and environmental influences, the target should be regarded as a minimum.

- The relationship between spawners and recruits can be summarised as a stock-recruitment (S-R) curve (figure 10). The replacement line represents the relationship between recruits and spawners and the difference between this and the S-R curve is referred to as "gain". These are the surplus fish (recruits) potentially returning to the system above the level required to replace the spawning stock that generated them. Maximum Gain, S_g, is thus a mathematically definable unambiguous point on the curve.

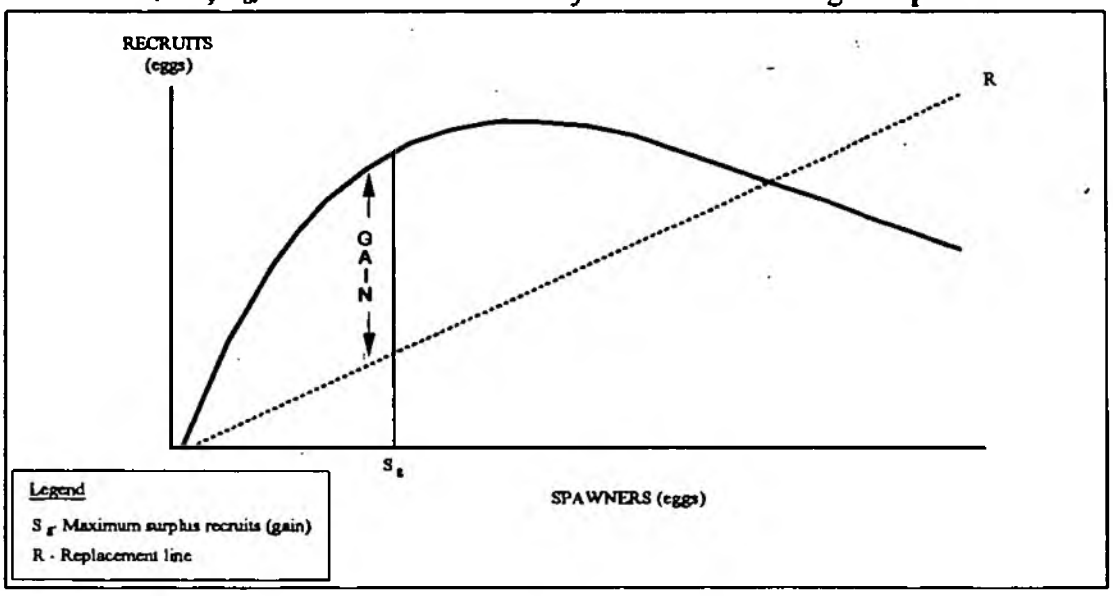

Figure 10: Diagrammatic stock recruitment curve

- MBAL has been definitively calculated for only one river in the UK - the River Bush, Northern Ireland. The target egg deposition for the Bush (563 eggs per 100 m^2 of "usable" habitat) is used as a benchmark which can be transported to other rivers using a system devised by WRc.

- The corresponding target for the Hampshire Avon is 237 eggs per 100 m^2 of total wetted surface area, which equates to a total of 8.53 million eggs. The calculation of this target is summarised in Table 10 .

Table 10: Summary of spawning target calculation

TARGET	VALUE
Maximum Gain (S_g) egg target	237/100 m^2 or 8.53 million eggs
Spawners equivalent to S_g egg target	2,225
Total rod catch equivalent to S_g egg target	262
Declared rod catch equivalent to S_g egg target	249
Parameters used to calculate above: Wetted area from habitat mapping = 3.6 x 10^6 m^2 Marine survival (to high seas fisheries) = 20.5% Mean Fecundity = 5,966 Grilse = 67.3% Females = 51.5% Post rod fishery mortality = 5% Rod exploitation (1996): 1SW = 5%; MSW = 17% Rod catch declaration = 95%	

- If the upper Wylye and Ebble (areas which salmon rarely access) are included in the calculation, the target becomes 9.23 million eggs, which could be considered a possible longer term target for the Avon. However, initiatives to provide improved access to these areas would be subject to a feasibility study, impact assessment and cost-benefit analysis.

- It is the objective of this plan to identify and promote actions that will achieve the target egg deposition on the Avon within 5 years.

- It should be noted that methods for the calculation of spawning targets are relatively crude at present and will benefit from further refinement for chalk streams. The figures quoted should therefore be viewed as a first attempt and may change as our knowledge and understanding of the stock and its interaction with its habitat improves.

- It follows that "passing" or "failing" of targets *in isolation* is not the only guide to management. Professional scientific judgement combined with consideration of the full range of other factors acting on a fishery are also essential guides to action.

4.1.1 Historic egg deposition

- Egg deposition was calculated for the period 1950 to 1996 according to the national protocol and is shown in figure 11.

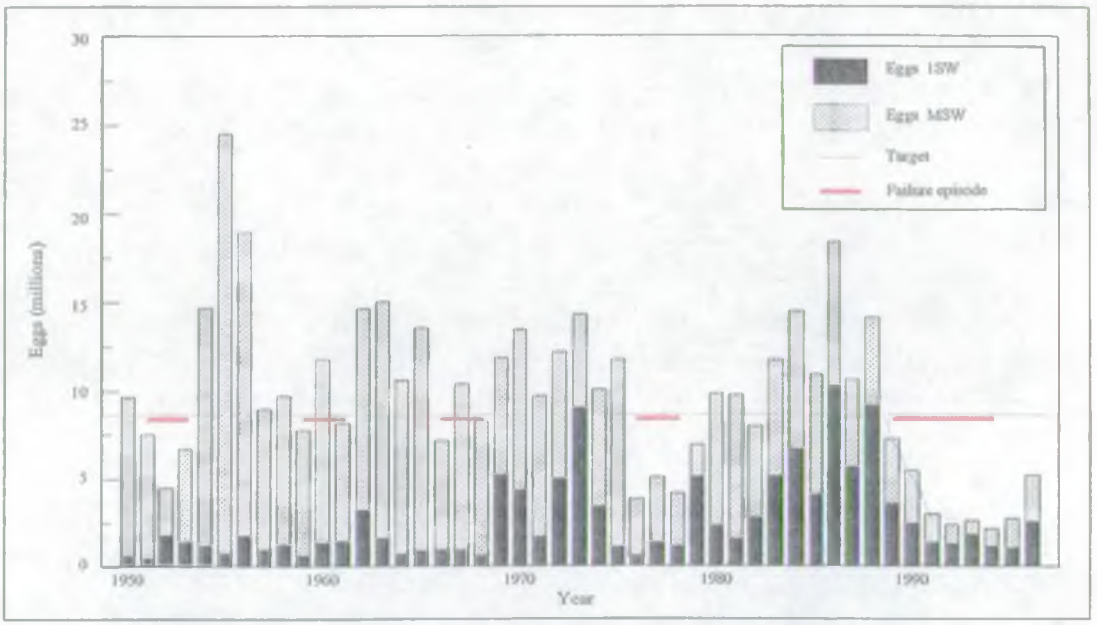

Figure 11: Egg deposition on the Hampshire Avon, 1950 - 1996

- To allow a more detailed examination of recent trends, data for the period 1987 - 1996 are given in Table 11.

Table 11: Recent trends in egg deposition

YEAR	Egg deposition (million)	Target deposition (million) (S_e)	% Compliance
1987	10.6	8.53	124
1988	14.1	8.53	165
1989	7.26	8.53	85
1990	5.45	8.53	64
1991	2.98	8.53	35
1992	2.39	8.53	28
1993	2.64	8.53	31
1994	2.15	8.53	25
1995	2.75	8.53	32
1996	5.20	8.53	61

Table 12: Egg deposition

Current (Total no. of eggs)	Target (number of eggs)	(Possible longer term target)	Has compliance failed within last 3 years?
5.2 million	8.53 million	9.23 million	Yes

4.1.2 Spawning target compliance

The national protocol for assessing target compliance has been used. Basically this introduces two "rules" against which compliance is assessed:

Rule a. Episodes may last *no longer than two years.*
Rule b. The clear gap between episodes should be *at least two years.*

An "episode" being a period when egg deposition falls below the target.

- During the period 1950 to 1996 (48 years), egg deposition on the Avon has fallen below the target level in 20 years (42%).

- If national compliance assessment rules are applied, then there have been five failure episodes. The most recent failure, lasting from 1990 to date, has seen egg deposition plunge to critical levels with a low point in 1994.

- It is worth noting that egg deposition has been at similar low levels on two previous occasions and in each case a strong recovery followed.

4.1.3 Expected catch

Just as catch can be used to assess compliance against the egg deposition target, so this spawning target can be expressed as an equivalent rod catch. It represents the catch that would prevail on average if the run size to the river was at a level which maintained the optimum spawning stock.

- On the Avon the spawning target corresponds to a total rod catch of 262 fish, comprising 184 MSW and 78 grilse. It should be noted, however, that this calculation assumes exploitation rates at current (1996) levels and it is believed that these could be increased somewhat once stock are at satisfactory levels.

4.2 FRESHWATER PRODUCTION

- Information from electric fishing and redd surveys suggests that salmon production on the Avon is widespread. Notable exceptions are the River Ebble upstream of Bodenham and the Wylye upstream of Fisherton, to which salmon rarely gain access.

- Densities of parr on the Avon are low compared with other local chalk streams. The

maximum mean density recorded on the Avon during the period 1988 - 1996 was 4.9/100 m^2, compared with 19.2/100 m^2 and 12.2/100 m^2 for the Piddle and Frome respectively.

- It is considered that juvenile habitats on these three chalk streams are similar in terms of carrying capacity and it is concluded therefore, that habitat on the Avon has been under-utilised for at least the last 9 years.

- Whilst it is clear that in recent years there have not been enough spawners to fully utilise habitat on the Avon, other factors, in particular in-gravel survival, may be limiting production.

4.3 DIVERSITY AND FITNESS

The second objective of the National Salmon Strategy states that the Agency will:

"maintain and, where appropriate, improve the diversity and fitness of individual salmon stocks".

To achieve this objective we will manage local salmon stocks, which typically are genetically distinct, in order to maintain and improve their diversity and fitness. As a precaution, we will continue to prohibit the transfer of salmon stocks between different river catchments, except where a river has lost its stock.

The decline of spring-run stocks of multi-sea-winter (MSW) salmon is of particular concern and here we will continue to apply special measures to protect these valuable fish from over-exploitation; carry out research to improve our understanding of the reasons for their decline and to identify solutions.

- Salmon populations from different rivers can differ in a wide range of characteristics including growth rates, age at maturity and run timing. These differences are believed to reflect (at least in part) genetic differences between stocks. It is possible that these differences are indicative of variation throughout the whole genome which allow each population to be adapted for its particular environment.

- During 1996 tissue samples from Avon salmon parr were examined using allozyme analysis to determine allele frequency at 5 loci: Malic enzyme (mMEP-2*), Malate dehydrogenase (mMDH-3*), Aspartate dehydrogenase (sAAT-4*), Isocitrate dehydrogenase (IDHP-3*) and Iditol dehydrogenase (IDDH-2*). The results of this analysis are given in table 13.

Table 13: Frequencies of the less common allele for five enzyme loci in the Hampshire Avon

mMDH-3*	mMEP-2*	sAAT-4*	IDDH-2*	IDHP-3*
0.00	0.21	0.04	0.38	0.01

- In Atlantic salmon the greatest allele frequency differences have been observed at the sAAT-4* locus, and this is therefore the most useful for identifying differences between populations.

- Historically, salmon populations from southern chalk streams have been different from other rivers in the UK (figure 12). Although the alleles found in these rivers are not unique, the frequencies are very different from other rivers suggesting a major distinction between these populations and the remainder.

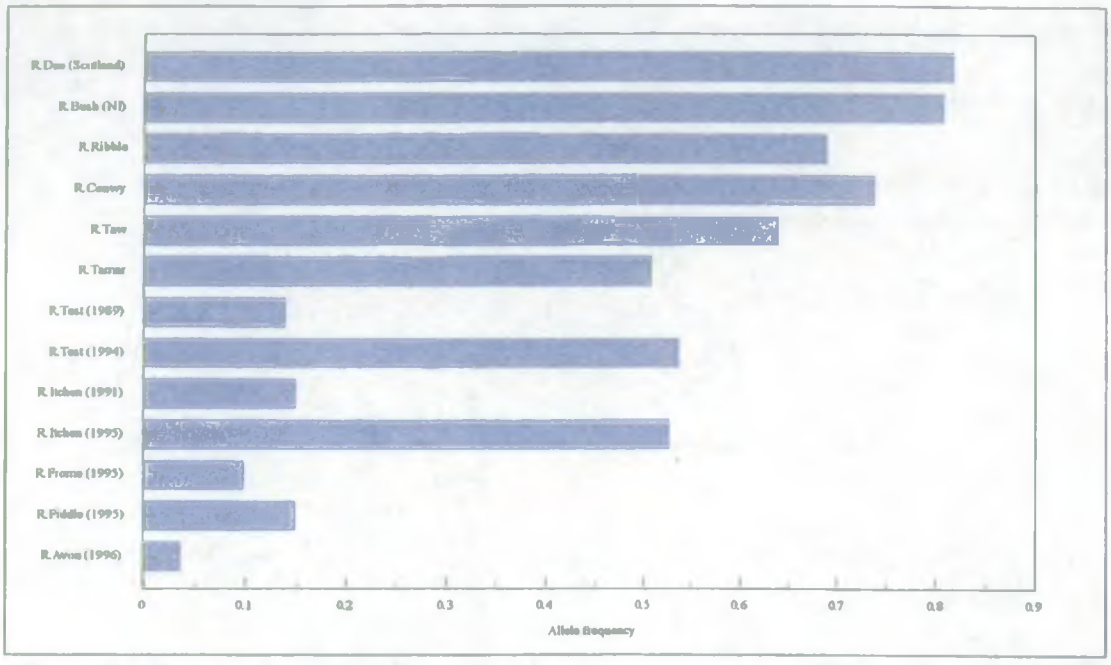

Figure 12: Allele frequency variation at the sAAT-4* locus in salmon parr from different rivers in the British Isles

- Allele frequencies in the Avon population are similar to those of the Piddle and Frome (1995) and the original Test and Itchen stocks in the late 1980s/early 1990s. They are considered typical of a pristine chalk stream salmon population.

- Since 1991 there has been a significant change in the Test and Itchen stocks and they are now genetically distinct from those of the Avon, Frome and Piddle. It is believed that these changes, which have implications for the fitness of the Test and Itchen stocks, result from the introduction of fish of foreign origin via the artificial propagation programme.

- The changes that have occurred on neighbouring rivers underlines the vulnerability of these salmon populations. The data we have on the composition of the Avon stock will be a valuable baseline for the protection of its fitness in the future. It will be particularly important to preserve the pristine nature of this population in view of the pSAC status of the river.

PART 5 LIMITING FACTORS

Factors which could currently or potentially be limiting salmon stocks and/or the salmon fishery on the Hampshire Avon thereby contributing to the non-attainment of the egg deposition target have been considered in terms of the impact they are currently having and the benefit of removing this limitation, together with a measure of confidence in this assessment. The full list is given below.

ENVIRONMENTAL LIMITING FACTORS

Impacts on physical habitat

- Flow perturbations in upper river - all life stages
- Flow perturbations in lower river - all life stages
- Silt from out-with river sources affecting bed composition and hence spawning medium
- Silt from within river sources affecting bed composition and hence spawning medium
- Other impacts on bed composition and hence spawning medium (e.g. concretion processes)
- Perturbed channel morphology on suitability of spawning areas
- Weed cutting on physical features of fry and parr habitat
- Perturbed channel morphology on physical features of fry and parr habitat
- Other impacts on physical features of fry and parr habitat
- Weed cutting on physical features of adult habitat
- Perturbed channel morphology on physical features of adult habitat
- Other impacts on physical features of adult habitat
- Control structures on smolt migration
- Blind channels on smolt migration
- Fish passes on smolt migration
- Water intakes and fish farms on smolt migration
- Control structures on adult migration
- Blind channels on adult migration
- Fish passes on adult migration
- Water intakes and fish farms on adult migration
- Eel trap operation on adult migration
- Control structures on kelt migration
- Blind channels on kelt migration
- Fish passes on kelt migration
- Water intakes and fish farms on kelt migration
- Global warming

Impacts on chemical habitat

- Eutrophication
- Pesticides
- Endocrine disruptors
- Other determinands (DO/BOD/ammonia etc.)

BIOLOGICAL LIMITING FACTORS

- Poor pre-fishery sea survival of smolts

- Competition for habitat from trout
- Competition for habitat from other fish species
- Food source competition in river
- Food source competition at sea
- Avian predation on adults
- Piscivorous predation of adults
- Mammal predation on adults
- Avian predation on fry and parr
- Predation by other fish species on fry and parr
- Mammal piscivorous predation of fry and parr
- Diseases
- Parasites
- Adverse genetic change

FISHERY LIMITING FACTORS

Management issues

- Limited understanding of factors and mechanisms determining stock abundance (need for R&D)
- Inadequate monitoring of adult, parr and smolt life stages
- River management for trout (electric fishing, trout stocking, creation of unsuitable habitat)

Exploitation issues (limiting factors in marine phase are discussed further in Appendix 1)

- Legal high seas fisheries
- Legal Irish fishery
- Legal fishing in Christchurch Harbour
- Licensed rod fishing
- Illegal high seas fisheries
- Illegal Irish fishery
- Illegal fishing in Christchurch Harbour
- Illegal fishing in river
- Private artificial propagation

The above list of factors has been reduced to those which are considered to have the most significant impacts on salmon stocks and/or the salmon fishery at present and where a resolution is deemed to be possible, with no consideration of the financial aspects at this stage. These are:

- Limited understanding of mechanisms determining stock abundance
- Inadequate monitoring of adult, parr and smolt life stages
- Legal net catch in Christchurch Harbour
- Licensed rod catch
- Legal Irish fishery
- Silt from out-with channel sources affecting bed composition and hence spawning medium
- Competition for habitat from trout
- Piscivorous predation of fry and parr

- Blind channels on adult migration
- Control structures on adult migration
- Flow perturbations in lower river
- River engineering on physical features of fry, parr and spawning habitat (channel morphology)
- Silt from within river sources affecting bed composition and hence spawning medium
- Poor pre-fishery sea survival of smolts

Figure 13 below depicts at which stage in the salmon life cycle these limiting factors are impacting.

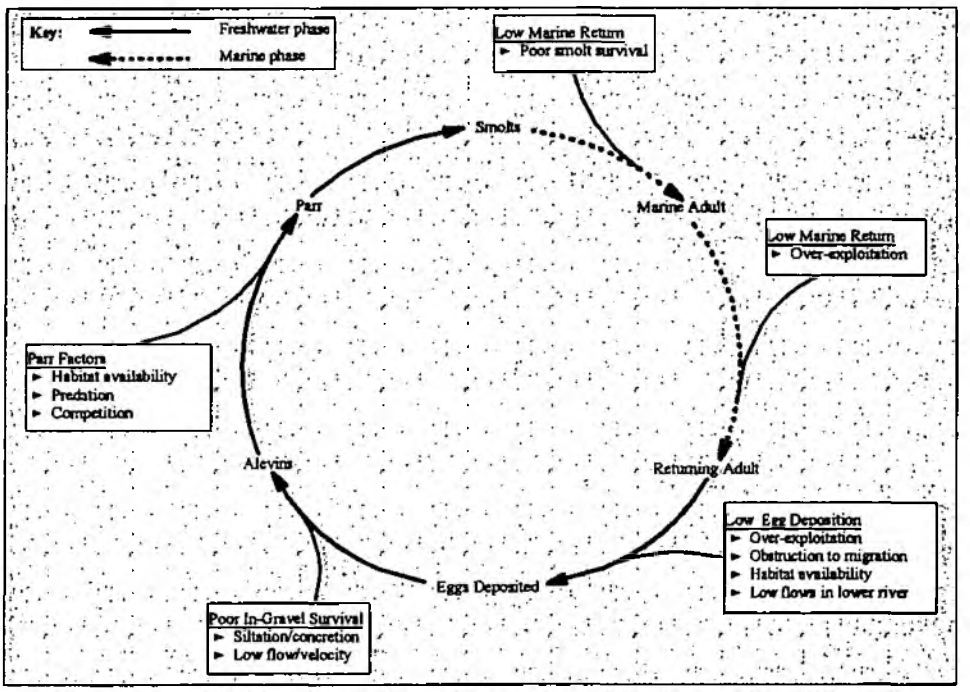

Figure 13: Limiting factors impacting on Hampshire Avon salmon life cycle

However, some of the issues have no feasible resolution at present. These are:

- Legal Irish fishery (this is being tackled by the Agency at a National level)
- Competition for habitat from trout
- Piscivorous predation of fry and parr
- Poor pre-fishery sea survival of smolts.

Hence, table 14 in section 6 is comprised of the issues which are considered to be having the most significant impacts on the salmon stocks of the Hampshire Avon at present and for which a feasible solution can be envisaged.

PART 6 ISSUES AND ACTIONS (for consultation purposes)

Table 14: Proposed actions (main action headings are in priority order) [Funds as £thousands; Priority: Very High (VH); High (H); Medium(M)]

ACTION (priority)		1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	FUNDING SOURCES	COMMENT
Improve understanding of mechanisms controlling chalk stream salmon populations to allow more efficient management (see section 6.1) (VH)							Agency National R&D Budget	Scoping study 96/97, followed by investigations in field. Necessary level of funding available from Agency sources thereafter. Outputs from this investigation will guide priorities for actions.
Improve monitoring of stocks (see section 6.4)	Existing programme (H)	25	25	25	25	25	Current Agency Fisheries Budget	This budget is vulnerable.
	Count salmon currently bypassing resistivity counters (VH)	(8)	(3)	(3)	(3)	(3)	(source unidentified at present)	Extra expenditure to allow count of salmon passing through hatches.
	Count smolts (M)		(25)	Expenditure in these years will be dependent on findings of feasibility study.			(source unidentified at present)	Fish friendly technique needs to be established before this is initiated. Would eventually allow S-R curve production. Feasibility study in 98/99 possible if funding is found.
	Increase frequency of juvenile monitoring on Nadder from 5 to 3 years (H)	1	1	1	1	1	Current Agency Fisheries Budget	This budget is vulnerable.

figures in brackets represent funds being sought

Table 14 (continued)

ACTION (priority)		1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	FUNDING SOURCES	COMMENT
Ensure increased escapement from nets - particularly 2SW salmon (see section 6.11 and 6.12)	Existing level of catch & release (H)	(4)					(source unidentified at present)	
	Introduce byelaw (see section 6.13) (H)	1					Agency Fisheries Budget	
	Additional catch & release and/or transport past Harbour until spawning levels are satisfactory. (H)		(=<4)	(=<4)	(=<4)	(=<4)	(source unidentified at present)	Owners/Associations may wish to pay nets not to fish (Agency will act as honest broker) or finance catch, transport and release.
Ensure increased escapement from rods - particularly 2SW salmon (see section 6.11 and 6.12)	Introduce byelaw (see section 6.13) (H)	1					Agency Fisheries Budget	
	Continue to promote catch & release until spawning levels are satisfactory (H)	2	2	2	2	2	Agency Fisheries Budget and existing partnership with WSA	

figures in brackets represent funds being sought

Table 14 (continued)

ACTION (priority)		1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	FUNDING SOURCES	COMMENT
Habitat improvement: spawning medium (see section 6.5)	Existing level of gravel cleaning (H)	3	3	3	3	3	Current Agency Fisheries Budget	This budget is vulnerable.
	Enhanced level of gravel cleaning and evaluation and development (M)	(5)	(5) (15)	(5) (15)	(5)	(5)	(source unidentified at present)	Evaluation of existing techniques and development of improved techniques, and optimised future programme for Avon - linking to national R&D report.
	"Landcare" (see section 6.7) (H)	40					Agency Budget	Funding for 97/98 project has been agreed. As yet no budget for subsequent years.
			(20)	(20)	(20)	(20)	(source unidentified at present)	Could be expanded, will depend on output of pilot study and available funds.
	Promote fencing out of stock to reduce ingress of silt where significant (see section 6.6) (M)		(2)	(2)	(2)	(2)	(source unidentified at present)	Where excessive erosion is being caused.
Migration improvements (see section 6.9)	Existing (H)	4	4	4	4	4	Agency Fisheries Budget	Provision of manpower to supervise free passage at critical times.

figures in brackets represent funds being sought

Table 14 (continued)

ACTION (priority)		1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002	FUNDING SOURCES	COMMENT
Migration improvements (continued)	Outstanding elements of Dr Solomon's recommendations with evaluation (M)	(10)	(10)	(10)			(source unidentified at present)	So far Agency Bid money has been used. Not now available under MAFF. Some evaluation desirable.
	Increase accessible range (M)	(10)	(20)				(source unidentified at present)	97/98 feasibility, cost/benefit study. 98/99 works, if justified (R. Ebble and upper Wylye).
Optimise flow levels in lower Avon (see section 6.3) (H)							Agency Water Resources Budget	Optimal operating rules will be incorporated into new and existing licences when these are reviewed.
Optimisation of channel morphology for salmon life stages (see section 6.8)	Existing (H)	5	5	5	5	5	Agency Flood Defence Budget, and Fisheries Budget	Control of flood defence works, mitigation and enhancements.
	Expanded programme (M)						(source unidentified at present)	Expenditure to be guided by R&D output and cost/benefit considerations.

figures in brackets represent funds being sought

Note: All habitat initiatives need to be integrated with other Agency functional objectives in Local Environment Agency Plans (LEAPs); and need to be agreed with English Nature.

Initiatives are ongoing to investigate and/or address some of the issues and limiting factors identified in table 14. In some cases significant studies have been undertaken, and R&D projects are underway. The following sections summarize the recent initiatives and explain the byelaw changes we are proposing to introduce in 1998.

6.1 CHALK STREAM SALMON

In order to improve our understanding of the mechanisms which control chalk stream salmon populations an R&D project (R&D DO3(95)05, Decline in Chalk Stream Salmon) has been initiated. The initial scoping study is being completed. It identifies areas for further investigation in subsequent years

6.2 FLOW IN THE UPPER RIVER

Issue

Groundwater abstraction from the upper catchment, largely for public water supply (PWS) has increased in recent decades, with a corresponding increase in concern amongst public and conservation bodies.

Compared to the average annual recharge to the River Wylye catchment in the period 1970-1994 (449 m^3/sec), PWS groundwater abstraction has risen from less than 1% of recharge in 1970, to some 9% in 1994.

Actions so far

A 1991 investigation by Halcrow (NRA, 1993b and 1996b) into the impacts of the abstraction concluded that there are significant effects on low summer-autumn flows where sources are located in sensitive upper or winterbourne reaches, i.e. Nine Mile River, upper Wylye, Chitterne Brook, Till and Bourne.

A second phase of the project has been commissioned comprising a more detailed look at the Wylye catchment, with recommendations for flow alleviation measures. These measures include new augmentation schemes on the Chitterne Brook and River Till. Boreholes have already been drilled and test pumping is due to be carried out in 1997. Further work is planned to identify the impact of reduced flows in the Middle and Lower Wylye in salmon and trout habitats. This work is being funded entirely by the Agency's Water Resources function.

Future actions

Future actions will depend on the outcome of the above investigations. Where significant impacts are proven action will be taken to reduce them.

6.3 FLOW IN THE LOWER RIVER

Issue

A 5 year radio-tracking study (Solomon, 1991) was conducted to establish the relationships between salmon migration and catches, and river flow and other environmental variables, thereby assessing the impact of water resource development.

The results indicated that patterns of movement exhibited by returning adult fish were closely related to river flow. At residual flows to the estuary (after abstraction) below a critical level of 8-9 m^3/sec an increasing proportion of fish remain in the estuary where they experience a mortality rate, which increases with falling flow. The survivors enter the river in the autumn.

As a result of existing levels of abstraction in drier than average years critical flows can be reached earlier than they will naturally occur resulting in curtailed migration into the river.

Actions so far

A simple model was developed to predict the pattern of movements that would be shown by the run of fish for any week of the angling season at any flow. This can be used to predict the likely impact of any abstraction scenario at any point in the river, and to demonstrate the impact of existing abstractions.

Future actions

A set of optimal operating rules has been drawn up. These will be considered for incorporation when existing licences are being reviewed, or in the event of new abstraction licences being sought.

In addition, with the regard to the proposed SAC status of the Hampshire Avon, under the EU Habitats Directive the Agency is instructed to review all abstraction licences as soon as reasonably practicable.

6.4 STOCK MONITORING

Actions so far

The principal elements of our monitoring programme have been described in section 3.1. During the last two years we have put considerable effort into the development of counters at the Royalty Fishery in Christchurch. A knowledge of the number of fish entering the river is a fundamental requirement of effective stock management, and this site located approximately 0.5 km upstream of the tidal limit is perfectly placed. The counters, which reside in the fish pass sections of the Great Weir and the Turbine House, work very efficiently, detecting in excess of 95% of fish over a threshold size. During autumn 1996 we fitted side-viewing cameras to the Turbine House counter and these will allow greater accuracy of species differentiation.

However, due to alternative access at Great Weir, we miss significant numbers of fish during periods of higher flow (October to June) and the count is therefore incomplete.

Future actions

We will further develop these counters during 1997 with a view to providing a complete count of ascending adults on the Avon in the near future.

6.5 SILT FROM SOURCES OUT-WITH THE CHANNEL AFFECTING BED COMPOSITION

Issue

Considerable evidence exists to show that the presence of fine sediment in salmonid spawning gravels can adversely affect the survival of eggs and alevins. In 1993 an investigation into the salmon spawning gravels in the area (Institute of Freshwater Ecology, 1993) concluded that the Avon, as well as other local chalk fed streams, was on the limits of fine sediment loading. Any excess of sediment particularly in late winter to early spring could prevent successful spawning/incubation/emergence of salmon.

A number of factors such as water abstraction, reduced weed growth and enhanced erosion of the land surface are likely to contribute to a deterioration of spawning conditions.

A study (University of Exeter, 1994) which analysed the physical and chemical properties of suspended sediment transported by the upper River Piddle and of fine sediment mantling the channel bed, indicated that this material is primarily from sources out-with the channel. This chalk stream study represents the best available model for the Avon.

Actions so far

A "Landcare" project (see section 6.7) was initiated in 1996 to identify potential non-point, out-with channel, sources of silt in the upper Avon tributaries and investigate improved land management procedures to prevent the ingress of silt into the channel.

Annual gravel cleaning initiatives have been undertaken since 1993 to improve spawning areas, together with evaluation of utilisation of cleaned sites. Figure 14 shows the location of sites where gravel cleaning has been undertaken. In 1994 a comparison of survival of eggs and alevins in cleaned and uncleaned sites was undertaken. The results suggested that survival was greater (as much as doubled) in the cleaned sites. Work elsewhere has also tended to demonstrate some degree of benefit. In January 1997, 15% of recorded salmon redds on the Avon were located on sites that

Figure 14: Gravel cleaning sites

had been cleaned.

The R&D project mentioned in section 6.1 will produce specific guidance on methods of gravel cleaning and channel re-engineering to overcome and prevent the effect of siltation on gravel spawning beds. It will include a specific review of the importance of siltation and the work that has been done on sediment budgets and factors influencing increased loadings in rivers.

Future actions
The guidance and recommendations identified by the R&D project will be put into practice as soon as possible.

6.6 SILT FROM SOURCES WITHIN THE CHANNEL AFFECTING BED COMPOSITION

The Agency would like to promote fencing of the river in areas where there is excessive silt ingress due to stock damage causing erosion of the bank.

6.7 LANDCARE PROJECT

A "Landcare" project commenced in 1996. It aims to address problems in watercourses caused by non-point source pollution. Such problems include "chalk stream malaise", choked salmon spawning gravels and pesticide residues. The target area, which comprises the Avon tributaries upstream of Salisbury, is shown in figure 15.

Work will include bed sediment monitoring and the identification of areas of high diffuse pollution risk. This will be based on the erodability of soils, the steepness of slopes, high risk land uses and rainfall.

In 1997 non-point source pollution will be discussed with land owners who farm in high risk areas to ask them to explore, in partnership with the Agency, how land management techniques may be modified to reduce diffuse pollution. Funding

Figure 15: "Landcare" initiative

via agri-environment schemes will be actively pursued.

6.8 CHANNEL IMPROVEMENTS

When dealing with Agency Flood Defence proposals the Fisheries function ensures future salmon requirements are not damaged. Habitat enhancement works are carried out in association with river works and these will be guided by the output from the R&D project (decline in chalk stream salmon).

6.9 MIGRATION CONDITIONS

Issue

With a few exceptions migration conditions on the Avon are satisfactory. Adult fish are known to ascend blind-ended effluent channels at Trafalgar fish farm where they become trapped. Fish are also believed to experience difficulties under certain low flow conditions at Breamore Mill. Salmon are at present unable to regularly access the River Ebble upstream of Bodenham and possibly the Wylye upstream of Fisherton due to obstructions. Low flows within the catchment and the operation of eel traps also impact on migration.

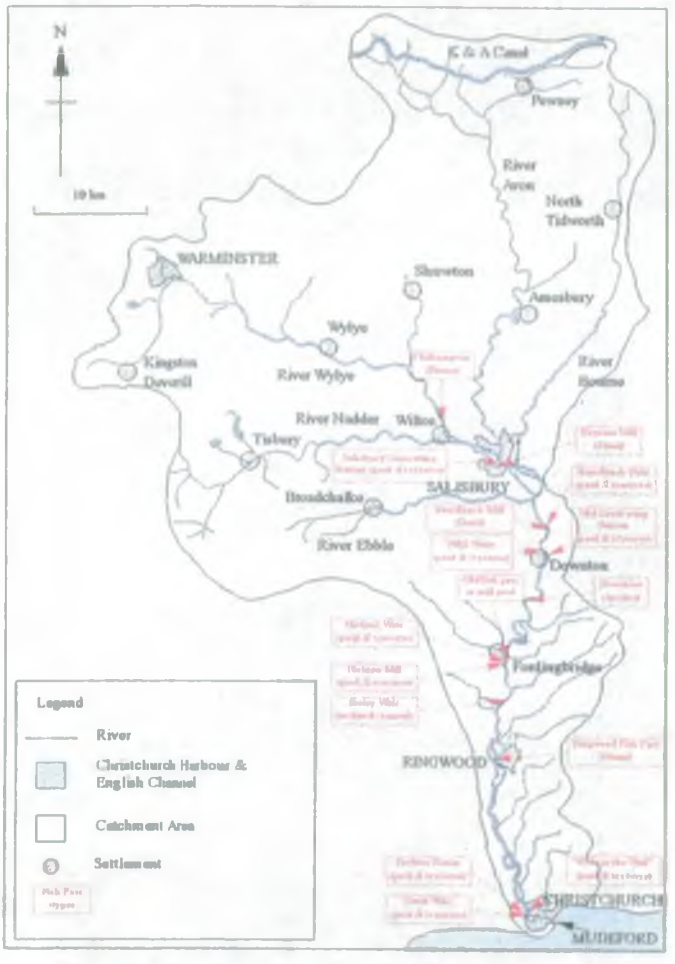

Figure 16: Fish passes on the Hampshire Avon

Actions so far

During the last forty years a number of fish passes have been installed in structures on the Avon. The most recent major passes (1988) were installed at Bickton Weir, Standlynch Mill and Standlynch Weir, where salmon were being delayed due to water diversion for fish farming (figure 16).

In 1987 investigations at Trafalgar fish farm concluded that the site was trapping significant numbers of smolts. As a result the Western unit was modified to allow safe smolt passage. Measures to safeguard smolt migration were also taken at Bickton fish farm.

Figure 17: Migration problems

In 1995 the NRA commissioned a review of migration conditions downstream of Salisbury. The report (Solomon, 1995) made a number of prioritised recommendations. The Agency has since implemented all of the high priority recommendations (figure 17) which were:

- acoustic smolt excluders on two major water meadow systems at Britford;
- smolt screen on the Eastern intake at Trafalgar fish farm;
- smolt screen on the PWS intake at Knapp Mill;
- screens to exclude adults from the effluent channel and trout streams at Bickton;
- investigate entrapment of adults in Trafalgar fish farm effluent channels.

During 1995 and 1996 the operation of eel traps on the Avon have been audited to assess their impact on adult salmon migration.

In early 1997 we instigated a study of the obstructions on the lower Ebble, which also included proposals for facilitating salmon migration.

Future actions

We will seek to implement the outstanding recommendations of Dr. Solomon's migration report and to carry out evaluations of solutions where this is desirable.

6.10 ARTIFICIAL PROPAGATION OF SALMON

This section is included because there exists a widespread perception that this process represents an obvious answer to depleted stocks.

The investigation into the alleged decline of migratory salmonids by Wessex Water in the Avon and Dorset Division (WWA, 1987) recommended that artificial propagation of salmon and sea trout should not be considered unless it could be demonstrated that a significant loss of wild reproductive potential seemed likely to, or had occurred. Every endeavour should first be made to safeguard the diminishing stock by removing constraints on natural recovery. As a consequence artificial propagation in Wessex was terminated.

The policy being pursued by the Agency in South Wessex is one of removing environmental

constraints and managing exploitation, to support the long term well being of the resource and maximise sustainable yield.

Past experience of taking salmon into artificial environments in an attempt to improve on natural performance, has been of failure to demonstrate real gains. Perhaps more importantly, it has not been possible to prove that no detrimental effect has occurred. Elsewhere in southern England the experience is of very poor return rates from artificially reared salmon, with no hard evidence of benefit to wild breeding populations.

There is growing evidence of the deficits, in terms of homing, wild breeding, genetic change and survival which come with artificial rearing. This has tended to strengthen commitment to habitat and exploitation based policies in response to unsatisfactory wild population and catch levels.

In 1992, following a decline in catches in local chalk streams, and because of wide support amongst local owners, the Agency (then NRA) agreed to the trialing of a hatchery scheme being promoted by the Wessex Salmon Association. This scheme was to use broodstock from nets and rods only so as to cause no extra losses to the spawning population and was to be fully evaluated and kept under review.

The scheme has been unsuccessful to date, producing very low outputs per spawner taken and no proven returns to the river.

The Agency's present position is that the scheme should only continue on a small scale evaluation basis and then only if there is continuing widespread support amongst local salmon interests. The scheme should not expand without solid evidence of beneficial effect.

6.11 SPRING SALMON

Issue

The spring salmon component of the rod catch on the Avon has been declining steadily since the 1940s (see section 2.1.1).

Actions so far

In 1991 the NRA commissioned a study in to the status of spring salmon on the rivers Avon and Frome (Solomon, 1992) which included recommendations as to how spring salmon may be protected and enhanced.

In 1994 new byelaws were introduced with the intention of reducing exploitation of spring fish. These were:

- rod fishing season shortened to 1 February - 31 August;
- fly only prior to 15 May;
- start of net fishing season put back to 15 April.

Whilst the loss of September from the rod fishing season has probably increased escapement, the impact of the fly only byelaw is less easy to assess. The rod catch up to the end of

September for the two years since and prior to the byelaw is shown in figure 18 and an analysis of the catches is given in table 15. Whilst the catch up to the end of April is lower during the fly only period, by the end of May there is no difference. Catch in the second half of May appears to increase and it is thought that this largely affects 2SW fish via an upsurge in effort. Fluctuations in run pattern may also be involved.

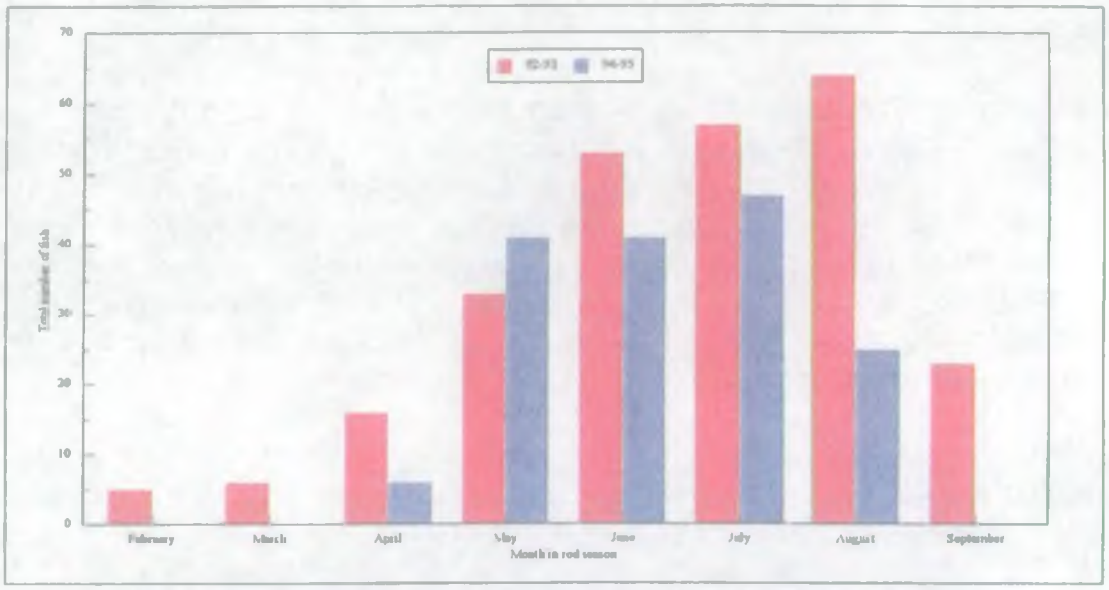

Figure 18: Hampshire Avon rod catch - pre and post 1994 byelaw changes

Table 15: Temporal pattern of salmon rod catches for Hampshire Avon

Year	February - April %	February - May %	June - August %
1984 - 1993	13.97	32.95	67.05
1992 - 1993	11.68	26.00	74.00
1994 - 1995	3.76	30.00	70.00

Spring salmon are the focus of several research initiatives in the UK and R&D within the Agency, which aim to increase our knowledge of all aspects of these fish.

Future actions

We will be seeking to strengthen protection of 3SW salmon and to reduce exploitation of 2SW fish in particular through the introduction of new byelaws in 1998 (see section 6.13). We will also be seeking to reduce net catch in the earlier part of the season so that overall impacts on both rods and nets since 1994 become roughly equal.

6.12 OVERALL LEVEL OF EXPLOITATION

Issue

The Environment Agency seeks to manage stocks on a sustainable yield basis. The analysis of historic egg deposition on the Avon (see section 4.1.1) suggests that the stock may have been over-exploited at times since 1950.

Actions so far

The byelaws introduced in 1994 (described above) have reduced overall exploitation. It is estimated that the loss of September alone has reduced exploitation directly by approximately 10%. In addition to legislative measures (section 6.10), the Agency has promoted two other initiatives aimed at increasing escapement. Both of these are voluntary in nature but can be very effective and represent an easily variable "fine-tune" for exploitation over and above the basic protection provided by legislation.

Rod catch and release is now a common practice in Europe and North America and is widely acknowledged as a valuable tool in the conservation of Atlantic salmon. The Agency has actively promoted this practice and has published a guide on how to maximise survival of released fish. In South Wessex we have produced a pamphlet to promote catch and release on the Avon. In addition the Wessex Salmon Association (WSA) have negotiated support from Tesco who have sponsored the practice by offering vouchers to anglers who return fish. These initiatives have been increasingly successful with 8 (12%) and 30 (23%) fish released in 1995 and 1996 respectively.

Table 16 shows how the rate of catch and release varied through the 1996 season. A majority of fish released were released after 15 June and were grilse. The release rate of fish caught between 15 May and 15 June (largely 2SW fish) was relatively low. Our byelaw proposals to help increase egg deposition on the Avon have therefore focused on this particularly vulnerable component of the run.

Table 16: Salmon catch and release, 1996

	Number caught	Number released	% catch and release
1 February -14 May	10	3	30.0
15 May - 15 June	48	5	10.4
15 June - 31 August	70	24	34.3

In 1995 we attempted a 3 year buy back of the net fishery whereby netsmen would be paid not to fish. However, this did not receive unanimous support from the nets and was abandoned. As an alternative we have purchased live salmon from the nets and released them to the Harbour or lower river, 42 and 26 fish being released in 1995 and 1996 respectively. In 1996 we were not able to meet our target of approximately 50% of the catch released by agreement with the other parties involved.

Future actions

The Agency will continue to promote catch and release by rods and there may be scope for continued release of net caught fish if suitable funding and arrangements can be negotiated.

6.13 BYELAW PROPOSALS

The following are the byelaws we are proposing to introduce on the Avon for 1998. The

byelaws will be reviewed with this plan in 2002. The byelaws have been designed such that the impact on the net fishery is approximately equivalent to the impact of byelaws from 1994 onwards on the rod fishery.

Between 15 May and 15 June (inc) lures shall be restricted to artificial fly or spinner only: this will enhance the protection given to 3SW fish by the 1994 byelaws, but is specifically designed to reduce exploitation of 2SW salmon.

16 June to 31 August (inc) fishing shall be by artificial fly, spinner, plug, prawn or shrimp only: effectively this byelaw is banning the use of worm as bait, which is the only commonly used method not specified. We are making a conservative assumption of little impact on catch overall in this period. It is considered that the use of worm is not compatible with catch and release, as fish caught by this method are often gorged and less likely to survive.

Artificial lures shall carry no more than one treble hook: this is designed to minimise the potential damage caused by hooking thereby increasing the proportion of fish suitable for catch and release.

The net fishing season will be from 15 June to 31 July (inc): this byelaw will reduce exploitation of 2SW fish with a small benefit to grilse. Perhaps most significantly it concentrates net exploitation into a period when flows are falling rapidly and salmon entering the Harbour are less likely to enter the river.

We estimate that the effect of these byelaws will be a direct increase in egg deposition of 0.22 million at current stock levels. Whilst this is a relatively small number of eggs compared with the present deficit against target, there should be a cumulative effect over the 5 year life of the byelaws.

The remainder of the egg deposition deficit will be met as a result of an increase in the level of catch and release (currently contributing approximately 0.25 million eggs), and the environmental improvements outlined above, acting via population growth processes.

In the short term at least, the additional controls on both fisheries are likely to cause reductions in exploitation over and above the direct ones calculated, as they will be perceived as less attractive to participants.

6.14 SUMMARY

It is judged that the combination of existing and proposed exploitation controls, along with existing and proposed habitat enhancements guided by the ongoing R&D, should underpin and strengthen the recent upward trend in egg deposition and support an acceptable rate of population increase, given reasonably normal climatic conditions. They should also allow development of both the knowledge and means to maintain the fishery closer to its optimal status in the longer term.

PART 7 FUNDING THE PLAN

7.1 THE FUNDING BACKGROUND

The Environment Agency currently spends about £9 million on salmon and sea trout fishery management, of which about 12% comes from rod licence income and 2% from net licences. 82% will come from grant in aid (GIA) in 1997/98. GIA continues to decrease, a further 5% reduction to £7.4 million in 1997/98 has been announced. Therefore the Agency must look to secure more funding from the beneficiaries to achieve objective four of the Salmon Strategy.

The salmon action plan is a vehicle for promoting this and should creatively explore all avenues for alternative funding, such as:

- beneficiaries, i.e. owners and users, and their associations;
- local businesses;
- English Nature sources;
- Agri-environment schemes;
- European Community (through the Habitats Directive, LIFE Fund);
- National Lottery;
- Millennium Fund;
- cross funding from other Agency functions;
- Wessex Water Authority/Game Conservancy habitat improvement funding.

The possibility of obtaining sponsorship and creating partnerships for collaborative projects using the above funding sources is being investigated.

7.2 WHAT WE ARE DOING NOW

- Fishery management activities currently in hand on the Avon are listed and costed in table 17. The costs include work carried out on salmon and sea trout fisheries since the two are almost indistinguishable.

Table 17: Fishery management activities

ACTIVITY	WORK INVOLVED	COST (thousands per annum)
Enforcement	including rod and net licence checks, byelaw checks, antipoaching in river, Harbour and offshore	£20
Monitoring	including juvenile salmonid monitoring, counter, catch return analysis and redd counts	£25
Habitat Improvement	Gravel cleaning..... Maintaining migration conditions for smolts and adults..... Wylye alleviation of low flow..... TOTAL.....	.....£3 .....£4 .....£2 .....£9
Regulation	Controlling the activities of others (development, planning, abstractions, discharges etc.)	£2
TOTAL		**£56**

These activities are funded by Agency sources outlined in section 7.1 and Agency cross-functional support. In order to carry out the initiatives outlined in table 14 further funds are required from non-Agency (Fisheries function) sources.

7.3 COSTS AND BENEFITS

The objective of the action plan outlined in table 14 is to achieve target egg deposition on the Avon within 5 years. Using the expected rod catch at target egg deposition and the approach described in section 2.2.2, the value of the fishery at this stock level would be approximately £4.2 million (£2.1m market value + £2.1m anglers' consumers' surplus). The difference between this and the current value (£4.2m - £1.8m = £2.4m) can be considered the potential benefit. There would be an additional benefit to other homewater fisheries which has not been considered here.

However, because of our limited understanding of the mechanisms controlling chalk stream salmon populations, and other factors beyond Agency control, it is not possible to predict the benefit of any single action, or to guarantee the outcome of the collective proposed actions. Nevertheless, this analysis allows the action plan to be put into context in terms of cost against potential long term benefits.

PART 8 CONSULTATION PLAN

Table 18: Consultation plan

STEP	CONSULT WITH	MEANS	AIM	TIMESCALE
1	Agency Regional Function Managers/Area Staff	Circulate draft plan internally	Account for Agency cross-functional comments	Mar 3 - 31
2	National Salmon Group	Copy draft plan	Quality check; ensure consistency across Agency	Mar 17
3	Salmon Liaison Group	Circulate agreed draft plan and discuss in meeting		Mar 19
4	AMT	Circulate agreed draft plan and discuss in meeting	Raise awareness of, and publicise process; receive initial comments.	Mar 24
5	RFAC and AEG	Circulate agreed draft plan and discuss in Committee	Raise awareness of, and publicise process; receive initial comments; initiate external consultation	Apr 16 - AEG Apr 22 - RFAC
6	Fishery Forum	Circulate agreed draft plan and discuss in Forum	Raise awareness of, and publicise process; receive initial comments; initiate external consultation/internal approval etc.	June 2
7	External interest groups: Wiltshire Fishery Assoc., Christchurch Angling Club, Lower Avon & Stour Fishery Assoc., Riparian Owners, Mudeford net licensees, Wessex Salmon Assoc., Game Conservancy Trust, IFE, English Nature, S&TA, SFC, MAFF, Country Landowners Assoc., Wessex Water plc, Bournemouth & West Hants Water Company.	a Press release b Circulate draft document to known contacts	a Raise awareness of, and publicise consultation process b Provide opportunity for all interests to review and comment	May 16 - July 9

HAMPSHIRE AVON SALMON ACTION PLAN - CONSULTATION SCHEDULE

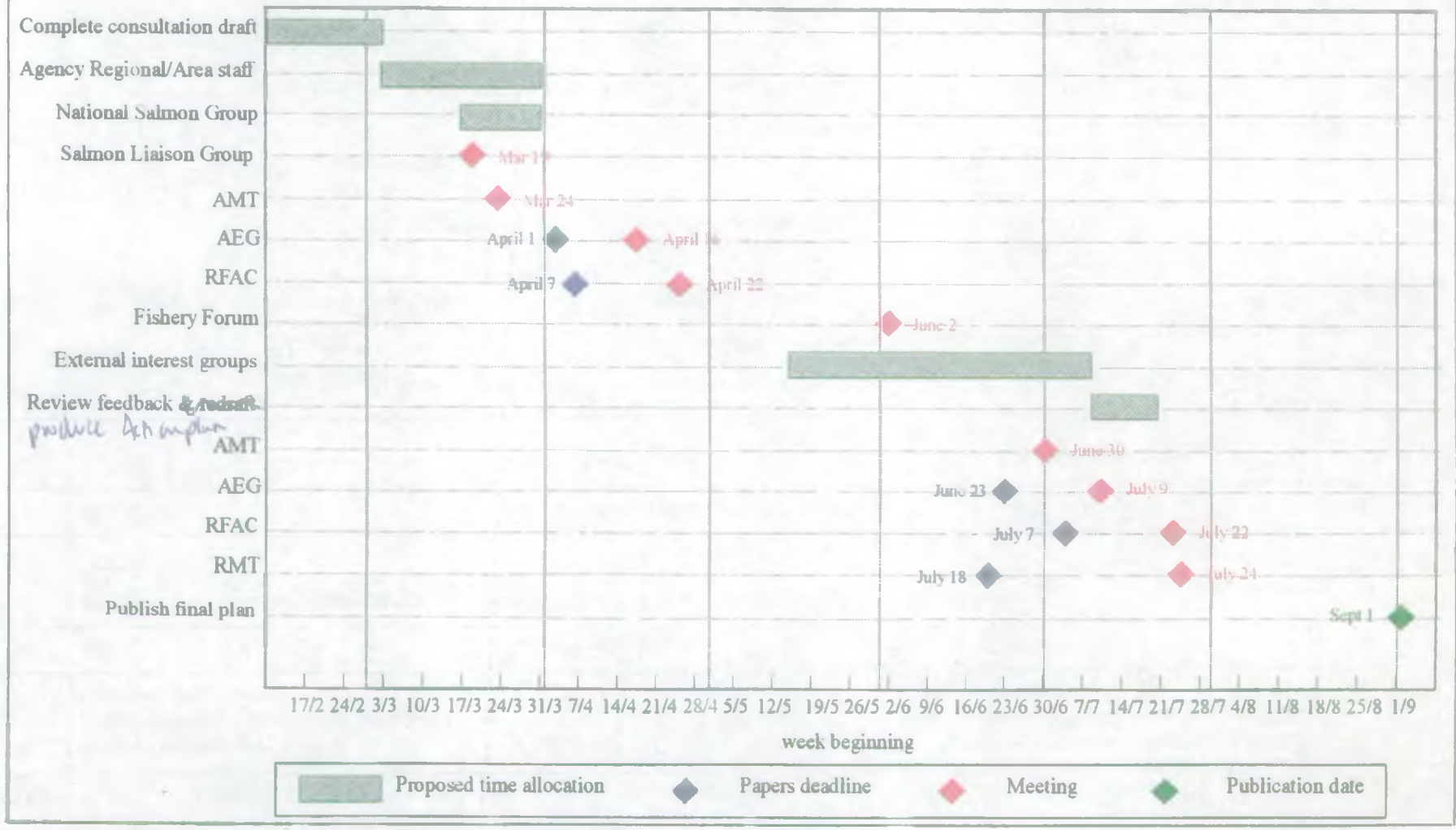

Table 18 (continued)

STEP	CONSULT WITH	MEANS	AIM	TIMESCALE
8	Review feedback Redraft plan and extend/amend actions and responsibilities sections	Officer group	Account for external comment; accommodate accepted new proposals for actions and for responsibilities	July 9 - 20
9	AMT	Submit final draft plan	Final endorsement	June 30
10	RFAC, AEG & National Salmon Group	Submit final draft plan to all groups	Final endorsement	July 9 - AEG July 22 -RFAC
11	RMT	Submit final draft plan	Final approval	July 24
12		Publish final plan and publicise	Achieve wide ranging awareness of plan and commitment to it	By Sept 1

PART 9 APPENDICES

9.1 LIMITING FACTORS IN THE MARINE PHASE

Natural mortality: Advice to NASCO suggests that natural mortality during the marine phase, although variable, has been increasing over the last 5-10 years. Fewer smolts are therefore surviving to become salmon. Changes in ocean climate may be a factor. The abundance at sea of salmon which would return as multi-sea-winter fish is strongly related to the availability of ocean at temperatures preferred by salmon (6-8 deg. C). The amount of such suitable thermal habitat has been lower in the 1980s and 1990s than during the 1970s (Reddin and Friedland, 1996).

Greenland fishery: There has been a net fishery on the west coast of Greenland since the 1960s. Catches peaked in 1971 at 2689 tonnes. Since 1976, only Greenland vessels have fished it and the catch has usually been limited by a quota agreed at NASCO. Since 1993 the quota has been related to estimates of the pre-fishery abundance of salmon and have been declining. About 15% of the catch is thought to be derived from rivers in England and Wales. In 1993 and 1994, the fishery did not operate, netsmen being paid not to fish. As a result about 5000 additional multi-sea-winter salmon are estimated to have returned to England and Wales in each subsequent year (Potter, 1996). In 1995 and 1996, catches in the fishery were 81 and 70 tonnes respectively.

Faroes fishery: Also developed in the 1960s, this fishery uses long-lines. The catch peaked at 1027 tonnes in 1981 but subsequently has been controlled by an annual quota. Unlike Greenland this quota has not been directly related to salmon abundance. Since 1990, the permitted quota has been 550 tonnes but this has never been taken. From 1992, commercial fishing has ceased due to compensation payments and only a research fishery has operated, which now takes only about 5 tonnes a year. Potter (1996) estimated the number of extra salmon which returned to homewaters due to the reduction in the fishery. For all of England and Wales this only amounted to about 1200 salmon each year, of which 750 would have been grilse.

International fishery: An unregulated high seas fishery operates in international waters by countries which are not signatories to the NASCO convention. Annual catches are thought to be between 25 and 100 tonnes, comprising predominantly European stocks.

Irish fishery: The reported catch of salmon in Ireland increased from about 700 tonnes in the 1960s to a peak of over 2000 tonnes in the mid-1970s. This coincided with the expansion of a coastal drift net fishery. About three-quarters of the Irish salmon catch, some 700 tonnes in 1995, is currently taken by the drift nets. Tagging studies indicate that these nets take a significant, though variable, proportion of the stock of salmon destined for English and Welsh rivers. For rivers in the south and west (e.g. Test, Taff and Dee) about 10-20% of the stock is thought to be taken by the Irish drift nets. For stocks from rivers in the north (e.g. Eden and Wear) the level of exploitation is likely to be less, perhaps 5%. The catch comprises mainly, but not exclusively, grilse.

The Irish Government has recently announced additional controls on the driftnet fishery, including delaying the season until 1 June and restricting fishing to daylight and within 6 miles. These measures may reduce exploitation of English and Welsh stocks. However, there is no intention, as yet, to phase out this mixed stock fishery.

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PART 11 GLOSSARY OF TERMS

Accessible habitat: the total area of the catchment accessible to adult salmon.

Alevins: juvenile salmon during the life stage between hatching and absorption of the yolk sac, whereupon they become free swimming and referred to as fry.

Alleles: alternate forms of genes which determine characteristics in living things.

Broodstock: adult salmon removed from the river catchment, to provide eggs/sperm, to produce artificially reared fry/parr.

CEFAS: The Centre for Environment, Fisheries & Aquaculture Science (previously the Directorate of Fisheries Research section of MAFF - Ministry of Agriculture, Fisheries and Food). Involved with salmon research and data collation at national and international levels.

"Chalk stream malaise": Group of symptoms frequently quoted by chalk stream dry fly fishermen including turbid water, excessive algal growth, abnormally low *Ranunculus* growth, low numbers of smaller upwing flies and poor breeding success of wild brown trout.

Concretion: calcification of gravel, leading to an effect not unlike concrete in the top layer of the river bed. Digging of redds by spawning salmon and egg survival may be severely impaired.

Exploitation: removal of stock through legal/illegal fishing.

EC/EU: European Community/ European Union. As members of the EC/EU we are obliged to act upon European law, issued in the form of Directives.

Entrapment: the trapping and/or delay of smolts and/or adults by structures or channel features, leading to death or delays in migration.

Escapement: the stock remaining after exploitation.

Fecundity: the total number of eggs produced by one mature female.

Fitness: specific genetic adaptation to a particular environment. Artificial propagation, influx of non native genotypes, and changing environmental conditions may lower the suitability of chalk stream salmon for their environment.

Fry: juvenile life stage between alevin and parr, where the alevin becomes free-swimming and actively hunts for food.

Genome: the complete set of chromosomes that is contained in a single cell.

ICES: International Council for the Exploration of the Seas. The mission of which is to collate, research and report data on the international status of salmon stocks.

JSM: Juvenile Salmonid Monitoring. Annual programme of electric fishing monitoring collating data on parr densities, carried out since 1988. Due to restricted access on the Avon catchment quantitative data on salmonid populations are collected at 13 sites, restricted to the tributaries and carrier streams, chosen on the basis of geographical distribution, habitat availability and accessibility.

Locus: (plural loci) the location of a particular gene on a chromosome.

Maximum Gain (S_g): Defines, from a stock-recruitment curve, that level of spawning which maximises the sustainable catch (total catch, comprising all marine and freshwater fisheries). This is also referred to as Minimum Biologically Acceptable Level (MBAL).

Parr: juvenile life stage, following fry, where the fish exhibit characteristic parr marks/bars as dark vertical stripes upon their flanks.

RE1-5: The targets for managing water quality are known as River Quality Objectives (RQOs); these are based on the River Ecosystem (RE) classification scheme. RE1 is described as water of very good quality suitable for all fish species; RE2 is water of good quality suitable for all fish species; RE3 is water of fair quality suitable for high class coarse fish populations; RE4 is water of fair quality suitable for coarse fish populations; RE5 is water of poor quality which is likely to limit coarse fish populations.

Redd: salmon 'nest' in river bed. Dug out of gravel/stony beds by spawning adults, with eggs deposited in displaced material.

Run: the number of adult salmon ascending, or smolts descending, a given river in a given year.

Siltation: deposition of waterborne suspended solids in/on the river bed. Siltation blocks gaps between substrate particles, preventing the through passage of water, necessary for egg survival.

Smolt:	life stage between freshwater parr and seawater 'adult' phase, where parr undergo a process of pre-adaption to a saltwater environment. As a part of this process, smolts acquire a characteristic silver appearance, similar to adult salmon, prior to migration down river and out to sea.
SAC:	Special Area for Conservation, pSAC is a possible SAC. A designation under the EC Habitats Directive affording protection to an area because it contains habitat types and/or species which are rare or threatened within a European context.
SSSI:	Site of Special Scientific Interest. A designation, administered by English Nature, intended to conserve the biological interest of a given site through legal restrictions on development/management practices.
Substrate:	the composition of the river bed.
The Agency:	the Environment Agency, successors to the National Rivers Authority (NRA).
WRc:	Water Research Centre.
WSA:	Wessex Salmon Association.
Year class:	the population of salmon, of all life stages, resulting from one year's spawning.