SALMON STOCKS AND FISHERIES IN ENGLAND AND WALES, 1998

Preliminary assessment prepared for ICES, April 1999





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FOREWORD

This is the second annual report on the state of salmon stocks in England and Wales prepared by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and the National Salmon and Trout Fisheries Centre (NSTFC) of the Environment Agency.

The main purpose of the report is to submit information on the status of stocks and fisheries in England and Wales to the International Council for the Exploration of the Seas (ICES) who, in turn, provide advice to the North Atlantic Salmon Conservation Organisation (NASCO). The objectives of NASCO are to contribute to *'the conservation, restoration, enhancement and rational management of salmon stocks'*. In particular, they are responsible for negotiating the quotas for the salmon fisheries at West Greenland and Faroes. Each spring, information is compiled by the ICES Working Group on North Atlantic Salmon and then reviewed by the ICES Advisory Committee on Fisheries Management before being presented to NASCO at its annual meeting in June. (See Annex 2 for further information on NASCO and ICES.)

The full list of information requested by NASCO from ICES for its annual meeting in 1999 is given at Annex 1. However, for this report, the pertinent requests relating to events in 1998 are to:

'provide an overview of salmon catches, including unreported catches, and catch and release, and production of farmed and ranched salmon';

'describe the events of the 1998 fisheries and the status of the stocks';

'provide age specific stock conservation limits for all stocks';

'evaluate non-catch fishing mortality for all salmon gear';

'provide a compilation of microtag, finclip and external tag releases'; and

'provide a compilation of egg collections and juvenile releases.'

NASCO has previously indicated that they would like the information on the fisheries to relate to 'catches, gear, effort, composition and origin of the catch (including escapees and sea ranched fish), and rates of exploitation'. These headings have therefore been used in the appropriate sections of the report.

The format of the report reflects its primary purpose, which is to provide data in a form appropriate for the ICES Working Group. However, an attempt has also been made to give sufficient explanation of the information for it to be of value for others. It must be noted that much of the data relating to 1998 are provisional and will not be finalised until complete catch data are obtained and records can be fully validated. Final data will be published in the Agency's annual publication of the Salmonid and Freshwater Fisheries Statistics and their annual Salmon Action Plan progress reports (Annex 4), which will be published in the summer. There will inevitably be a considerable amount of descriptive information in this report which will be the same as last year. However, we feel that the report should stand alone, and so much of the background explanation in each section of the report has been retained.

The first report was well received, but CEFAS and the Agency would welcome comments on this report, which should be addressed to: Ted Potter (CEFAS) or Dr Nigel Milner (Environment Agency) (contact addresses on inside cover).

EXECUTIVE SUMMARY

- This report presents a preliminary assessment of the state of salmon stocks and fisheries in England and Wales in 1998 to assist ICES in providing scientific advice to NASCO and to provide early feedback to fishery managers.
- The number of licences issued for salmon fishing with nets and fixed engines fell by a further 9% in 1998 partly as a result of continuing measures taken to reduce levels of exploitation and to phase out mixed stock fisheries.
- In general, 1998 was a fairly wet year. These conditions may have attracted salmon into freshwater more quickly than normal, possibly reducing their availability to the net fisheries. Angling conditions were generally good, although high flows constrained fishing for some periods.
- The declared salmon catch for 1998 (including released fish) is provisionally estimated at 143.4 t, comprising 84.7 t by nets and fixed engines and 58.7 t by rods. The total retained catch (excluding released fish) was 125.7 t; of which 41.0 t was by rods.
- The net catch was 51% below the 5yr mean and the lowest recorded over this period. The rod catch was 15% below the 5yr mean, but an improvement on catches in 1995 and 1997. The total catch was the lowest on record.
- The use of catch and release in rod fisheries has continued to increase. In 1998, provisional estimates indicate 30% of salmon caught by anglers were released following capture, compared with 10% in 1993.
- The catch per unit of fishing effort (CPUE) for net fisheries was below the 5yr mean for all Regions, and was particularly low in the NW Region. CPUE data for rod fisheries were above, or close to, the 5yr mean for all Regions except Midlands, where it was 50% below.
- Rod catches of grilse in 1998 were better than in 1997 in all Regions and 8% above the previous 5yr mean overall. By contrast, rod catches of multi-sea-winter (MSW) salmon in 1998 were well below the 5yr mean in all Regions, with a 37% reduction overall. They were also the lowest recorded over the period in all Regions, except the North East. MSW salmon were estimated to make up 17% of the rod catch in 1998, compared with 27% in 1997. Catches of spring salmon by both rods and nets were the lowest for at least 10 years.
- The total unreported and illegal catch of salmon in 1998 is estimated to have been about 30 tonnes, 20% of all fish killed.
- Exploitation rates in six monitored rod fisheries in England and Wales in 1998 were similar to the previous 5yr mean. Net exploitation rates were reduced.
- Data from counters and traps in England and Wales in 1998 show that runs into freshwater were better than in 1997 in all cases, with figures above the 5 yr mean in a number of instances. However, there has been a significant downward trend in estimated runs for monitored rivers on the south coast over the past 5 and 10 years.
- Spawning escapement was above the target levels (including provisional targets) in 19 rivers (28%) in 1998; between 50% and 100% of the targets in 17 rivers (25%) and less than 50% of the target in 33 rivers (48%). Despite the improvements in grilse runs in 1998, the majority of salmon stocks in England and Wales continue to be in a depleted state.
- The estimated number of salmon eggs artificially spawned from broodstock taken from the wild has been reduced from just over 5 million in 1990 to about 2.4 million in 1996.
- In 1998, 182k hatchery-reared salmon parr and 2.8k wild salmon smolts were marked and released in England and Wales for assessment or enhancement investigations. A total of 1,425 adult salmon were tagged for assessment or radio tracking studies.



Figure 1. Map of England and Wales showing the main salmon rivers

REPORT ON SALMON FISHERIES IN 1998

1. Gear and effort

1.1 Gear

Brief descriptions of all the nets and fixed engines used in England and Wales are included in Annex 3. The principal salmon rivers for which data are presented in this report are shown in Figure 1, and the types of gear used in each net fishery operating in 1998 are listed in Table 2.

There were no recorded changes in the types of gear used for the capture of salmon in England and Wales in 1998. However, the use of a T-net was authorised, on an experimental basis, in the southern area of the Northumbria coastal fishery (NE Region) where T-nets have not previously been operated.

1.2 Effort

Levels of exploitation of migratory salmonids by both rods and nets in England and Wales are regulated principally by byelaws controlling the fishing gear that may be used, and where and when fishing may take place. Separate licences are required to use rods and nets. There is no restriction on the number of rod licences that may be issued, but, for most net fisheries, the number of licences is limited by Order (Table 2).

Within these restrictions on the 'allowable' fishing effort, there will be annual variations in the amount of fishing actually undertaken, due to factors such as prevailing weather conditions (e.g. sea conditions or river flow) and local perceptions about the abundance of returning stocks. In addition, the first sale price of salmon has decreased in real terms over the past two decades due to the rapid expansion in the production of farmed salmon, and the costs of both rod and net licences have increased. These factors may also have affected the take-up of licences and the fishing effort.

1.2.1 Allowable effort

Net fisheries:

The various fishing gears used to catch salmon in England and Wales (other than by rod and line) have been grouped into broad categories based on their method of capture (see definitions in footnote to Table 1 and Annex 3). The numbers of netting licences issued for gill nets, sweep nets, hand-held nets and fixed engines have continued to decline as a result of measures taken to reduce levels of exploitation and the declining commercial viability of some fisheries; the total number of licences issued fell by a further 9% in 1998 (Table 1 and Figure 2). Overall, the number of net licences issued between 1983 and 1998, has decreased by an average of nearly 4% per year (total decrease, 42%).

Year	Rod licences		Gear Type	e				Total
	Short-term	Annual	Gill	Sweep	Hand-held	F.E.	Combined drift/T net	net licences
1983			232	209	333	74	75	848
1984			226	223	354	74	75	877
1985			223	230	375	69	75	897
1986			220	221	368	64	75	873
1987			213	206	352	68	75	839
1988			210	212	284	70	75	776
1989			201	199	282	75	75	757
1990			200	204	292	69	75	765
1991			199	187	264	66	75	716
1992			203	158	267	65	75	693
1993			187	151	259	55	36	652
1994	10,637	26,641	177	158	257	53	30	645
1995	9,992	24,949	163	156	249	47	29	615
1996	12,508	22,773	151	132	232	42	29	557
1997	11,640	21,146	139	131	231	35	27	536
1998	11,066	18,516	130	129	196	35	26	490

 Table 1. Numbers of rod licences (1994-98) and net and fixed engine licences (1983-98) issued in England and Wales

Notes: Rod short-term licences are for 1 or 8 days; annual licences are valid from the date of issue to 31 March following, the rod licence data for 1998 are provisional.

Gill nets include: drift, trammel, sling and coracle nets.

Sweep nets include: seine (draft and draw) and wade nets.

Hand-held nets include: haaf/heave and lave/dip nets.

Fixed engines include: T-nets, J-nets, stop (compass) nets, putcher ranks, traps, weirs, cribs (coops) and fishing baulks. Combined drift/T net licences (issued in Northumbria (northern area)) have been included in the gill net, but not the F.E. totals.

East Anglian coastal nets (targeted primarily at sea trout) have been excluded.



Figure 2. Numbers of salmon net and fixed engine licences issued in England and Wales, 1983-98

A number of net fisheries in England and Wales are being phased out because they exploit salmon returning to several rivers (i.e. mixed stock fisheries). Licence numbers are reduced as fishermen retire from the fishery. Progress with these phase-outs in 1998 has been as follows: -

- North East Coast Fishery: the number of drift net licences issued fell to 75, a 47% reduction since the initiation of the phase-out in 1993.
- Anglian Coastal Fishery: the number of nets fell to 54, an 8% reduction since 1996. This fishery takes mainly sea trout.
- River Usk: there was no reduction in the number of drift net licences (8) issued in 1998.
- South West Wales Coastal: the number of seine/wade net licences issued fell from 1 to 0.
- River Dwyfawr: the number of seine net licences fell from 2 to 1.
- North Menai Straight (River Ogwen): there was no reduction in the number of seine net licences (2) issued in 1998.
- South Menai Straight (Rivers Gwyrfai and Seiont): no seine net licences were issued in 1998.
- River Clwyd: the phase out of the sling net fishery was hastened by a buy-out (funded by the Federation of Clwyd Angling Clubs in conjunction with Clwyd and Elwy Riparian Angling Society); the number of licences issued fell from 2 to 0.
- North Lleyn Peninsular (River Llyfni): no seine net licences were issued in 1998.

The following new netting regulations came into force:

• Rivers Taw and Torridge: the start of the netting season was delayed from 1 March to 1 June; the season closing as before on 31 August.

Arrangements have also been made to reduce netting effort in the following fisheries by compensating netsmen not to fish for the periods shown:

- River Tavy seine nets (complete season);
- River Tamar seine nets (2 March 7 June, and 9 July 31 August);
- River Lynher seine nets (2 March 7 June);
- River Exe seine nets (18 April 31 May);
- River Fowey seine nets (2 March 7 June);
- Cumbrian coast (NW Region), three of the four drift net licencees (complete season).

For the other five fisheries (in SW England) funding was provided by South West Water plc and the Agency for a scheme implemented as an alternative to previous mitigation stocking. Compensation in the Cumbrian fishety was funded by the Derwent Owners Association.

In addition, on the Rivers Avon and Stour (Christchurch Harbour fishery), netsmen were compensated for releasing 84 of the 86 salmon caught. Compensation was funded and organised by Tescos and the Wessex Salmon Rivers Trust.

Rod fisheries:

There are no statutory restrictions on the numbers of rod licences that may be issued.

No new compulsory restrictions on fishing effort were imposed on rod fisheries in 1998. Voluntary restrictions are known to be imposed by fishery owners and angling associations, but there is no national record of these, and so no information is available on any new measures introduced in 1998.

Region	River/ Fishery	Method	No. Lics	NLO	Days available	Allowable effort net. days	Utilised effort net. days	net. tides	% utilised	Av. day/lic
NE	N. Coastal (N) N. Coastal (S) N. Coastal (S)	Drift & T Drift T	47 19 1	X X	113 113 113	5311 2147 113	1731 832 23		33 39 20	36.8 43.8 23.0
	Y. Coastal Y. Coastal NE Region	Drift T or J	9 12 88	Х	113 113	1017 1356 9944	317 411 3314		31 30 33	35.2 34.3
SW	Avon & Stour Poole Harbour Exe Teign Dart Camel Tavy Tamar Lynher Fowey Taw/Torridge Lyn SW Region	Seine Seine Seine Drift Seine Seine Seine Seine Seine FE	5 1 18 6 15 7 5 15 5 2 14 1 88	6 1 18 * 10 18 7 5 * 15 * 5 * 2 * 14 n/a	78 78 130 121 110 131 118 118 118 131 53 131	390 78 2340 726 1650 917 590 1770 590 262 742 131 9718	112 30 201 169 657 199 0 170 77 34 550 45 2102		29 38 9 23 40 22 0 10 13 13 74 34 22	22.4 30.0 11.2 28.2 43.8 28.4 0.0 11.3 15.4 17.0 39.3 45.0
Midlan	dsSevern Severn Midlands Region	Seine Lave	4 20 24	4 n/a	181 181	724 3620 4344		158 794 952	16 16 16	28.2 28.4
Wales	Usk Tywi Tywi Taf E&W Cleddau Nevern Teifi Dyfi Mawaddach Glaslyn Dwyfawr Ogwen Conwy Clwyd Dee Dee Welsh Region	Drift Seine Coracles Wade Compass Seine Seines	8 5 5 1 8 1 3 11 3 2 1 1 2 3 0 4 14 72	X 9 12 1 6 1 4 12 3 2 X X 3 X X 2 8	76 110 110 109 109 109 109 109 109 109 109	608 550 550 110 872 109 327 1199 327 218 109 109 218 327 0 216 966 6875		426 218 187 25 137 26 146 321 170 26 61 1 51 87 0 185 937 3004	50 28 24 16 11 17 32 19 37 9 40 1 17 19 0 48 69 31	$\begin{array}{c} 38.0\\ 31.1\\ 26.7\\ 17.9\\ 12.2\\ 18.6\\ 34.8\\ 20.8\\ 40.5\\ 9.3\\ 43.6\\ 0.7\\ 18.2\\ 20.7\\ 0.0\\ 33.0\\ 47.8 \end{array}$
NW	Ribble Lune Lune Kent Leven S&W Cumbria Eden & Esk Eden	Drift Haaf Drift Seine Lave Lave Drift Haaf Coop	5 26 10 1 8 6 4 128 3 188	6 26 10 1 8 6 4* 155 n/a	109 109 109 109 109 109 109 109 141 109	545 2834 1090 109 872 654 436 18048 327 24588		154 1046 430 6 147 310 12 3386 12 5491	20 26 28 4 12 34 2 13 3 16	22.0 28.7 30.7 4.3 13.1 36.9 2.1 18.9 2.9

Table 2. Allowable and utilised effort for the salmon net fisheries in England and Wales in 1998. (excluding fisheries for which no licences were issued or effort returns were not provided)

Notes: In calculating the days available, any day, or part day, on which fishing has been allowed are included. For fisheries in which utilised effort is recorded in terms of tides fished (Wales and NW Region) the proportion of the available effort used has been estimated by assuming that an average of 1.4 tides have been fished per day. Key:

NLO refers to number of nets allowed under the terms of the net limitation order for that fishery.

X Denotes fishery being phased out as existing licensees leave the fishery.

* Denotes partial or complete buy-out operating in this fishery in 1998.

1.2.2 Utilised effort

The amount that both netsmen and anglers fish is largely dictated by weather conditions and their perception of stock abundance, which is based mainly on catch rates. England and Wales experienced higher than average rainfall in 1998, and river flows were relatively high for much of the fishing season. Figure 3 shows the monthly river flows for 13 rivers in England & Wales expressed as a percentage of the monthly long-term average; flows were low in February but generally well above average in January, April, June, July, October and November.



Figure 3. Monthly river flows in 1998 for 13 rivers in England and Wales expressed as a percentage of the monthly long term average. (Data supplied by Institute of Hydrology)

Net fisheries:

Table 2 presents data on allowable and utilised effort for the principal salmon net fisheries in England and Wales in 1998. It is likely that the high flows, particularly in the summer, attracted salmon into freshwater quite quickly, and this may have reduced their availability to the net fisheries. High flows may also have prevented the operation of certain net fisheries at some times.

In all Regions, the percentage of available effort utilised by net fisheries was lower in 1998 than in the preceding year. The data suggest that the percentage of effort utilised varied considerably between fisheries (range 0% to 74%) and was highest, on average, for the NE Region (33%). Compensation arrangements have reduced the amount of effort utilised in some fisheries, particularly in the SW Region; the utilised effort for the SW Region fell by half, from 44% in 1997 to 22% in 1998, a much more substantial reduction than seen in other Regions.

It is virtually impossible for most fisheries to utilise 100% of the allowable effort and, in practice, factors such as weather conditions, tide heights and availability of fishing stations will constrain the overall effort. In the north east coast fishery, for example, it is suggested that ~75% of the allowable

effort represents a practical upper limit to actual effort in the summer months under normal weather conditions (Anon., 1997a).

Rod fisheries:

The numbers of licences purchased for salmon and migratory trout angling (annual and short-term) between 1994 and 1998 are shown in Table 1; the data for 1998 are provisional (annual licences are valid from the date of purchase to the 31 March following). No comparable data are available for earlier years because of changes in licensing arrangements. The total number of rod licences issued has fallen by 20% over this five year period and the number of annual licences has fallen by 30%. The number of short-term (one day and eight day) licences issued has remained relatively consistent, but the proportion they represent of the total has increased from about 28% in 1994-5 to about 36% in 1996-8. These changes in the numbers and proportions of licence types issued are thought to have been influenced by the decline in salmon stocks and the increase in licence prices in 1996.

Although conditions probably increased the availability of salmon to the rod fisheries in 1998, high flows at certain times made angling difficult. Overall catch rates (Section 2.2) were generally better in 1998 than in 1997; catches of early-running MSW spring fish remained low, but grilse catches improved. Table 3 shows the average numbers of days fished per catch return (for anglers who supplied effort data on their return) each year from 1994 to 1998. These data indicate quite wide variation between Regions, with the average number of days fished per angler (catch return) ranging from about 10 days (Southern and South West Regions) to 23 days (Midlands Region). There is less variation within Regions, on a year to year basis, but in most, the number of rod days fished per catch return was markedly lower (range 12-18%) in 1998 than the average for the previous five years and the lowest in the time series. This shift may have resulted partly from a change in the types of licences taken out by anglers. Given this reduction in days fished per angler and the reduced number of annual rod licences issued, there would appear to have been a significant overall reduction in angling effort in 1998 compared with the previous five years.

Table 3 also shows the total numbers of days fished by anglers who made catch returns. This indicates that most of the salmon and sea trout angling took place in Wales (37%) and NW Region (28%) and there was relatively little angling for these species in Anglian, Thames and Southern Regions (total 1%).

	NE	Anglian	Thames	Southern	SW	Mids	Wales	NW	Total
1993	19.9		23.0	12.8	13.0	24.0	17.1	15.7	16.5
1994	15.9		18.5	10.9	10.7	21.8	14.8	14.3	14.2
1995	14.8		29.6	9.8	9.5	22.7	12.4	12.1	12.4
1996	16.9		14.0	10.2	10.5	24.8	13.5	12.6	13.4
1997	14.5	10.0	30.2	10.1	10.6	21.0	14.2	13.2	13.5
1998	13.3	4.3	24.2	9.1	8.7	19.5	12.5	11.6	11.8
Average (1993-97)	15.9		22.1	10.4	10.6	22.7	14.2	13.4	13.8
1998 as % change or 1993-97 average	n -16.4%		9.5%	-12.5%	-17.9%	-14.1%	-12.0%	-13.4%	-14.5%
Total angler.days fished in 1998	38,229	26	145	2,095	31,285	11,493	85,906	64,248	233,427

Table 3. Average number of rod days fished per angler (catch return) for each EA Region, 1994-98

Note: Data for 1998 are provisional.

Anglers taking out more than one short-term licence in a season may make more than one catch return.

1.3 Catch limits

No national catch limit regulations apply to salmon fisheries in England and Wales, but under a byelaw introduced in 1998, angling bag limits for salmon and sea trout have been imposed on the Rivers Taw and Torridge. No more than two salmon may be retained on either river before 1 June. In addition, on the Torridge, no more than two salmon may be retained in any twenty-four hour period, three in any seven day period and ten in any season. On the Taw, two salmon may be retained in any seven day period and seven in any season. Anglers are permitted to continue fishing after they have taken their bag limit as long as they release any fish caught, but all fish over 70 cm must be released after 1 August.

2. Catches and CPUE

2.1 Catches

The reporting procedures for net catches have been consistent over recent years. The 1998 catch returns for the nets and fixed engines are almost complete and are not expected to change significantly.

The catch data for rod fisheries are based largely on anglers' returns, although for a few rivers where the data from fishery owners' returns are considered to be more complete, these are used in preference. The provisional figures for 1998 are based upon returns received up until 8 February 1999; an allowance of 2% has been made for late returns (based on last year's experience and improved validation procedures).

2.1.1 Catches in 1998

Provisional net, rod and total catches for each Agency Region for 1998 are presented in Table 4. In summary, the confirmed salmon catches in 1997 for England and Wales and the provisional catches in 1998 (including fish that were released) were:

Method	1997	1998
Nets and fixed engines	31,459 (107.2 t)	25,179 (84.7 t)
Rods (inc. released fish)	13,047 (48.7 t)	17,015 (58.7 t)
Total	44,506 (155.9 t)	42,194 (143.4 t)

The net and fixed engine catches in 1998 (Table 5, Figure 4) were very low in all parts of England and Wales, being 20% below those recorded in 1997 (itself a poor year in all Regions) and 51% below the average of the previous 5 years nationally. The reductions were greatest in the NW and the SW Regions, where catches were 64% and 60% below the previous five year averages respectively.



Figure 4. Regional declared salmon net and fixed engine catches. The histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Note that the histograms are not drawn to the same scale. Data for 1998 are provisional.

Environment	Net catch		Rod catch		Total catch	
Agency Region	No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)
North East	18,265	61,725	2,971	12,207	21,236	73,932
Anglian	3	6	-	-	3	6
Thames	-	-	-	-	-	-
Southern	-	-	366	1,183	366	1,183
South West	1,759	5,128	2,889	9,250	4,648	14,378
Midlands	1,074	3,499	188	873	1,262	4,372
Welsh	2,300	8,360	4,237	14,099	6,537	22,459
North West	1,778	6,015	6,351	21,000	8,129	27,015
unknown	-	-	13	53	13	53
Total	25,179	84,733	17,015	58,665	42,194	143,398

Table 4. Provisional declared salmon catches for England and Wales - 1998 season

Notes: Provisional rod catches have been increased by 2% to allow for late licence returns, with the exception of the rivers Wye, Test and Itchen which have more reliable data (e.g. owners returns) and have therefore not been incremented.

EA Region	NE	Anglian	Southern	SW	Mids	Wales	NW	Total
Year			(a)					
1993	41,800	4	11	5,017	950	3,324	5,460	56,566
1994	46,554	3	4	6,437	2,321	4,995	6,143	66,457
1995	53,210	5	0	3,251	2,588	3,039	5,566	67,659
1996	18,581	3	0	5,093	1,608	2,931	4,464	32,680
1997	21,922	0	0	2,466	1,282	2,628	3,161	31,459
1998 (provisional)	18,265	3	0	1,759	1,074	2,300	1,778	25,179
Mean (1993 - 1997)	36,413	3	3	4,453	1,750	3,383	4,959	50,964
% change:								
1998 on 1997	-17			-29	-16	-12	-44	-20
1998 on 5-yr mean	-50			-60	-39	-32	-64	-51

Table 5. Summary of declared regional salmon net and fixed engine catches, 1993-98

Key: (a) From 1992, the River Itchen seine net was fished for scientific purposes only; salmon caught in this fishery were tagged for release.

Due to changes in data collection procedures, rod catches for 1993 were heavily under-reported; rod catch reporting arrangements were improved in 1994 and have subsequently remained relatively consistent (Environment Agency, 1998). To enable comparison with catches in recent years, rod catches have been corrected for under-reporting (Table 6, Figure 5). This suggests that the provisional rod catch for England and Wales in 1998 was substantially better (up 31%) than the poor catch in 1997, but still 15% below the average of the previous five years.

However, there was considerable regional variability, with catches in Southern Region being 144% up on 1997 and those in the Midlands Region being 40% down. Catches in the North East Region were significantly above the five year average (up 27%) and the highest recorded for the period; this may reflect the continuing phase-out of the coastal drift-net fishery. Catches in all other Regions (except Southern) were well below the five-year average. This was particularly evident for the Midlands Region (River Severn) where catches were estimated to be 63% below the five-year average.



Figure 5. Regional salmon rod catches corrected for under-reporting (see Table 6). The histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Note that the histograms are not drawn to the same scale. Data for 1998 are provisional.

EA Region	NE	Thames	Southern	SW	Mids	Wales	NW	Total
Year								
Declared catch								
1993	1,696	16	545	3,922	336	5,986	6,241	18,742
1994	1,939	11	432	5,213	555	7,901	8,840	24,891
1995	2,201	13	302	2,554	442	4,146	6,348	16,006
1996	2,514	34	384	2,681	643	5,468	5,720	17,444
1997	2,445	2	150	2,372	312	3,622	4,144	13,047
1998 (provisional)	2,971	0	366	2,889	188	4,237	6,351	17,015*
Corrected catches (adjus	tment made fo	r under-repor	ting: x 1.9 fo	r 1993 and	x 1.1 for 1	994-98).		
1993	3,222	16	545	7,452	638	8,406	11,858	32,138
1994	2,133	11	432	5,734	611	8,457	9,724	27,102
1995	2,421	13	302	2,809	486	4,456	6,983	17,471
1996	2,765	34	384	2,949	707	5,831	6,292	18,963
1997	2,690	2	150	2,609	343	3,911	4,558	14,263
1998 (provisional)	3,268	0	366	3,178	207	4,693	6,986	18,717*
Mean (1993 - 1997)	2,646	15	363	4,311	557	6,212	7,883	21,987
% change:								
1998 on 1997	+25		+144	+25	-40	+20	+58	+31
1998 on 5-yr mean	+27		+1	-26	-63	-24	-11	-15

Table 6.Summary of declared and corrected regional salmon rod catches (including released fish),1993-98

* Includes 13 fish of unkown Region of capture.

2.1.2 Long term catch trends

Figure 6 shows the declared net catch for England and Wales since 1960 and distinguishes the catch in the NE coast fishery from that in all other areas. The catch in the NE coast fishery increased rapidly in the late 1960s with the introduction of synthetic nets and has comprised well over 50% of the total net catch in England and Wales in most subsequent years; a phase-out of the drift net fishery began in 1993. The catch in the other net fisheries has been declining since the late 1960s and in 1998 fell to its lowest level in the past 40 years. This reflects both the steady reduction in fishing effort and the decline in stocks.

The declared rod catch of salmon has been declining gradually since the late 1960s (Figure 7). This trend probably underestimates the true rate of decline in catches because reporting rates have improved and catch data for the past five years are the most complete in the time series. The trend probably further underestimates the decline in stocks both because angling effort is believed to have increased from the 1960s to the early 1990s and because the exploitation rate by rods tends to increase as stocks decline.

2.1.3 Catch and release

Within England and Wales there has been increasing use of catch-and-release by salmon anglers in recent years and this has been encouraged by the Agency and other organisations. Details of fish caught and released are published for each major salmon river in England and Wales in the annual catch statistics; the data are summarised in Table 7. In 1998, provisional data indicate that 30% of the salmon caught by rods were released following capture, a proportion that has increased from 10% in 1993 (the first year for which such data are available). In all years, a smaller proportion of the catch was released before the beginning of June than later in the year.



Figure 6. Total declared salmon net and fixed engine catch for England and Wales 1960-98, with a five-year running mean; shaded area indicates the catch in the north-east coast fishery.



Figure 7. Total declared salmon rod catch for England and Wales, with a five-year running mean, for the period 1960-98

Year	No. salmon released	% of catch released
1993	1,448	10.3
1994	3,227	13.0
1995	3,187	19.9
1996	3,428	19.7
1997	3,132	24.0
1998 *	5,116	30.1

Table 7. Number and proportion of declared salmon rod catch released by anglers, 1993-98

*Provisional values

The catch data presented in Tables 4 and 6 and Figure 4 include fish that have been caught and released. Excluding these fish provides an estimate of the numbers and weight of fish caught and retained by anglers in England and Wales in 1998 of 11,899 fish (41.0 tonnes). Thus the total landing of salmon (caught and killed) in England and Wales in 1998 by all methods is estimated at 37,078 fish (125.7 tonnes).

2.1.4 Spring salmon catches

There are well-publicised and ongoing concerns about the decline in the numbers of early-running multi-sea-winter (MSW) 'spring' salmon. The contribution of MSW salmon to catches, in recent years, is covered in Section 2.4. The proportion of the catch taken before June 1 in 1998 was also well below that in 1997 and the below average for the previous five years for both rod and net fisheries (Table 8). On average, in recent years (1993-97), about 11% of the rod catch has been taken before June 1 compared with 6% of the net catch.

The numbers of salmon caught before June in 1998 by both nets and rods were the lowest recorded in the ten year time series and were 26% and 39% of the previous five year means for nets and rods respectively.

	Net catch			Rod catch	Rod catch				
	Numbers			%	Numbers			%	
	< 1 June	>1 June	Total	< 1 June	< 1 June	> 1 June	Total	< 1 June	
1989	4,742	64,198	68,940	6.9	3,199	11,529	14,728	21.7	
1990	7,339	64,488	71,827	10.2	2,423	12,426	14,849	16.3	
1991	3,637	34,038	37,675	9.7	2,279	11,695	13,974	16.3	
1992	2,497	31,352	33,849	7.4	1,012	9,725	10,737	9.4	
1993	1,630	54,936	56,566	2.9	865	13,194	14,059	6.2	
1994	4,824	61,633	66,457	7.3	2,609	22,282	24,891	10.5	
1995	4,888	62,771	67,659	7.2	2,141	13,865	16,006	13.4	
1996	2,913	29,767	32,680	8.9	2,691	14,753	17,444	15.4	
1997	1,528	29,931	31,459	4.9	1,381	11,666	13,047	10.6	
1998	832	24,347	25,179	3.3	758	16,257	17,015	4.5	
Mean (1993-97)	3,157	47,808	50,964	6.2	1,928	15,074	17,003	11.3	

Table 8.Number and proportion of declared salmon net and rod catch taken before and after
the beginning of June 1989-98



Figure 8. Regional CPUE data for net and fixed engine salmon fisheries. The histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Note that the histograms are not drawn to the same scale. Data for 1998 are provisional.

2.2 Catch per unit effort

It is recognised that much of the reason for changes in catches is the annual variation in the time anglers and netsmen spend fishing. Catch per unit of fishing effort (CPUE) therefore provides an alternative measure of the success of fisheries, and of the relative status of stocks, to the declared catch data. For net fisheries in England and Wales, regional CPUE data have been collated using the number of days fished (or in Wales and the North West the number of tides fished) as a measure of the amount of fishing undertaken by each licence holder. Rod CPUE data (catch per licence day) are now reported annually for all major salmon rivers in England and Wales in the annual catch statistics reports.

2.2.1 CPUE in net fisheries

Regionally aggregated CPUE data for 1998, compared with previous years, are shown in Table 9 and Figure 8. It should be noted, however, that these data do not take any account of the differing fishing methods employed in the various Regions, or of any changes in the relative proportions of different gears used. In addition, CPUE is likely to vary within the season. Thus cautious interpretation is required.

In 1998, the CPUE for nets and fixed engines in Wales and the NE and NW Regions (the only Regions for which there are time series of data) were all below the mean of the previous five years. For net fisheries in the NW Region, catch rates were almost half the five-year mean and the lowest for the period, suggesting in-season availability of fish may have been particularly low. A trend analysis of the CPUE for the net fisheries in these Regions shows a significant decline over the past five years ($B_{crit} = -0.09$, p = 0.95), although there has been no overall trend for the past 10 years ($B_{crit} = .38$, p < 0.9) (The B_{crit} analysis is explained in Annex 2). This suggests that the availability of salmon to these net fisheries (or their catchability) has been declining in recent years and was low in 1998, at least during the period in which the fisheries were operating.

Table 9. Regional CPUE data for net & fixed engine salmon fisheries, 1988-98

EA Region	NE	Southern	SW	Midlands	Wales	NW
Year				<u>(b,c)</u>	(c)	(c)
1989	4.39	16.8	-	-	0.90	0.82
1990	5.53	8.56	-	-	0.78	0.63
1991	3.2	6.40	-	-	0.62	0.51
1992	3.83	5.00	-	-	0.69	0.40
1993	6.43	(a)	-	-	0.68	0.63
1994	7.53	(a)	-	-	1.02	0.71
1995	7.84	(a)	-	-	1.00	0.79
1996	3.74	(a)	-	-	0.73	0.59
1997	5.30	(a)	0.59	-	0.77	0.35
1998	5.12	(a)	0.78	0.25	0.69	0.32
Mean (1993 - 1997)	6.17	(a)	-	-	0.84	0.61

Data expressed as catch per licence-day (catch per licence-tide for Midlands, Wales and NW)

Key: (*a*) *No net fishery from 1993.*

(b) Seine nets and lave nets only.

(c) Catch per licence tide.



Figure 9. Regional rod catch of salmon per 100 days fished. The histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Data for 1998 are provisional.

2.2.2 CPUE in rod fisheries

Regional summaries of rod CPUE data for anglers making returns (expressed as number of salmon caught per 100 days fished) are presented in Table 10 and Figure 9 for the period 1993 to 1998. It should be noted, however, that these figures include returns from some anglers who fish primarily for sea trout. The mean number of salmon caught per 100 days fished varies from 1.7 for the Thames Region to 7.7 for the NW Region. The rod CPUE for 1998 was close to the average for the previous five years in Wales and Southern Region, and above average in the South West (+8%), North West (+11%) and North East (+31%). However, CPUE data for rod fisheries in the Midlands (River Severn) in 1998 show a 50% reduction on the five-year average.

A trend analysis of the rod CPUE data for all Regions shows no consistent overall trend over the past 6 years, the period for which data are available ($B_{crit} = 0.004$, p < 0.9).

EA Region	NE	Thames	Southern	SW	Midlands	Wales	NW
Year							
1993	5.0	1.4	4.2	6.9	2.1	4.0	7.0
1994	4.1	0.0	6.8	9.9	2.9	4.7	9.6
1995	4.7	3.1	6.0	5.8	2.4	3.8	8.9
1996	6.0	3.2	9.2	6.9	3.9	4.7	7.8
1997	5.0	0.6	3.1	5.2	1.7	2.6	5.3
1998	6.5	0.0	5.9	7.5	1.3	3.9	8.6
Mean (1993 - 1997)	5.0	1.7	5.9	6.9	2.6	4.0	7.7
% change							
1998 on 5-year mean	+31		+1	+8	-50	-2	+11

Table 10. Number of salmon caught per 100 days fished for regional rod fisheries, 1993-98

2.3 Unreported and illegal catches

If the full effects of fisheries upon stocks are to be assessed, managers must take account of unreported catches by net and rod licence holders and also the scale of illegal catches. In previous years, best 'guess-estimates' of the levels of under-reporting and illegal fishing (expressed as percentages of the declared regional catches) have been provided by regional fisheries staff. However, in an effort to improve these estimates, the methodology was re-examined in 1997 and a similar approach has been used for catches in 1998.

2.3.1 Under-reporting by licence holders

For net fisheries in England and Wales, the rate of reporting is generally considered to be high in most Regions and this has been supported by the findings of two studies. In North East England, under-reporting in the coastal fishery has been estimated at about 7% (Anon., 1991). In the North West, comparison of the catches seen by the bailiff with those declared for that day, suggested that catches in the estuary net fishery on the River Lune were under-reported by around 8%. Opinions on the level of under-reporting in net fisheries in other Regions of England and Wales were collected from Environment Agency regional fisheries personnel in February 1998; these fell in the range 0% to 15%. It has been suggested that over-reporting of catches may occur in some fisheries, in response to rumours about potential future buy-outs (and the perception that compensation will be based on declared catches). For this report, a figure of 8% has been used for the level of under-reporting of the national net catch.

For the purpose of setting spawning targets under their Salmon Action Plan guidelines (see Section 3 and Annex 4), the Environment Agency have estimated that declared salmon rod catches from 1994 should be increased by 10% to allow for under-reporting of the legal rod catch across England and Wales. This has been based on a study of catch returns made following reminders (Environment Agency, 1998). Exceptions to this apply for the River Wye in Wales, the Southern Region (Rivers Test and Itchen) and for the Wessex area of the South West Region (Rivers Avon, Frome, Stour and Piddle) (1994-96) for which the fishery owners' returns are regarded as more accurate. No scaling factor has been applied for catches in these rod fisheries to allow for under-reporting.

2.3.2 Illegal catches by unlicensed fishermen

By their nature, illegal catches are very difficult to quantify accurately. However, assessments can be made on the basis of enforcement activities. Consultation with Environment Agency regional fisheries personnel was used as the basis for an updated assessment in February 1998 and this provided 'guess estimates' of illegal catches in coastal waters and within rivers and estuaries. These estimates of illegal catches, expressed as a percentage of the regional declared catch, ranged from 5% to 18% for different Regions. For this report, a figure of 12% has been used to estimate the total illegal catch for England and Wales.

2.3.3 Under-reporting and illegal catch estimate for 1998

On the basis of the above estimates, the non-reported and illegal catch for England and Wales in 1998 is estimated at about 30 tonnes, which represents approximately 20% of the total weight of salmon caught.

2.4 Other sources of non-catch fishing mortality

NASCO has asked ICES to evaluate non-catch fishing mortality (NCFM) for all salmon gear. NCFM includes all sources of mortality generated directly or indirectly by fishing which are not included in the recorded catch. It includes the illegal and unreported catches, discussed above, in addition to losses caused by: fish that are removed from the gear by predators; fish that fall out of the net; fish that escape and die later; and dead or dying fish that are released or discarded.

The extent of the likely losses will vary between fisheries because of the type of gear used and its method of operation. In addition, the impact of predators, particularly seals, varies between areas. However, in most net fisheries in England and Wales the netsmen remain with their gear and remove any fish caught quite quickly; thus relatively few fish will drop out and losses to predators can usually be limited. Sweep and hand-held nets cause very little damage to the fish and so losses of fish that may escape are likely to be minimal. However, small losses may occur from gilling nets, and predation losses may be significant in the NE Coast fishery, which is close to a large grey seal colony.

No data are available on the NCFM during normal angling activities. The use of catch-and-release, however, is likely to result in some fish dying as a result of being exhausted or damaged; studies suggest that such losses should be less than 20%, and can be minimal if fish are handled carefully.

2.5 Composition of catches

2.5.1 Age composition of net catches

It is not currently possible to provide precise figures on the proportions of one-sea-winter (1SW) and multi-sea-winter (MSW) salmon in all regional net fisheries, because some netsmen have not been required to report the sizes of individual fish caught and few scale samples have been collected. Data collection procedures are being standardised for all fisheries from 1999, and this will permit age composition of catches to be estimated in the future.

An indication of the age composition of net catches in 1998 is available for the Northumbria area of the NE Coast fishery, based on the declared catches which are reported as either 'grilse' or 'salmon' based upon a weight split. 'Salmon' made up only 34% of the catch in 1998 compared with a long-term average of 42% (1965-97). A large number of 1SW salmon are classed as 'salmon' by this method and the proportions are affected by changes in the mean weight of fish of different ages. Nevertheless, it emphasises the apparent low proportion of MSW salmon in returns in 1998.

2.5.2 Age composition of rod catches

Insufficient scale samples have been collected and read to provide reliable estimates of the relative contributions of 1SW and MSW fish in the rod catches in many Regions of England and Wales. Monthly age/weight keys for salmon from the river Dee trap for the period 1992-98 have therefore been used to estimate the age composition of catches for principal salmon rivers (Table 11). These estimates were derived from the declared catches where a weight and date of capture have been provided.

There were only two rivers (Hampshire Avon and Severn) in 1998 (5 in 1997) in which over 50% of the salmon rod catch was of MSW salmon. Of the remaining rivers, six had between 25% and 49% MSW salmon in the rod catch (9 in 1997) and 33 had less than 25% MSW salmon. These changes reflect both decreases in MSW and increases in 1SW salmon catches.

Region	River	No. grilse	%	No. MSW	%
NF	Coquet	433	74	149	26
	Tyne	1 141	66	586	34
	Wear	319	91	31	9
Southern	Itchen	66	93	5	7
	Test	47	95	2	5
SW	Hants Avon	26	40	26	51
511	Frome	20 72	70	30	30
	Fre	550	87	30 70	13
	Taian	117	07 77	25	13
	Teign	117	71	33 29	25
	Dart	92	/1	38	29
	Tavy	8/	91	9	9
	Tamar	322	83	68	17
	Lynher	73	89	9	11
	Fowey	101	95	5	5
	Camel	196	93	15	7
	Taw	311	77	91	23
	Torridge	57	80	15	20
	Lyn	152	90	17	10
Midlands	Severn	60	34	116	66
Wales	Wve	391	62	237	38
Wales	Usk	/01	75	161	25
	Ogmora	75	01	8	23
	T	75	91	0 5	9
	Tawe	91	95	5	5
	Tywi Tr f	310	82	68	18
	Tar	50	93	4	/
	E&W Cleddau	49	84	9	16
	Teifi	400	86	63	14
	Dyfi	123	94	8	6
	Mawddach	105	89	13	11
	Ogwen	102	95	5	5
	Conwy	116	91	11	9
	Dee	444	82	97	18
NW	Ribble	666	92	54	8
	Lune	1 238	92	104	8
	Kent	693	92	64	8
	Leven	78	9 <u>7</u> 07	2	3
	Levell	/0	97 07	ے ج	3
	III F1	13/	97	5 17	3 5
	Ehen	555	95	1/	5
	Derwent	618	88	82	12
	Eden	826	80	211	20
	Border Esk	487	87	74	13

Table 11. Proportions of grilse and MSW salmon in provisional declared 1998 rod catches (Data not corrected for incomplete returns)

The estimated numbers of 1SW and MSW salmon, and the proportion of MSW fish, in regional rod catches over the period 1993 to 1998 are provided in Table 12 and Figure 10. In all Regions, the numbers and proportions of MSW salmon taken by rods in 1998 were down on 1997 and well below the means of the previous five years; the total rod catch of MSW salmon was 37% below the five-year mean. Catches in the NE Region are likely to have been affected by the phase-out of the coastal drift net fishery; in the other Regions there has been an overall downward trend in the MSW catches over the past 6 years ($B_{crit} = -0.1$, p = 0.96).

By contrast, rod catches of grilse in 1998 were above the mean of the previous five years in several Regions (NE, NW and Southern) and up by 8% overall. The numbers of grilse taken in the NE Region was particularly high, and 78% up on the mean of the previous five years, possibly reflecting the phase-out of the drift net fishery. The numbers of grilse taken by rods was below, but fairly close to, the five-year mean in Wales and the SW Region, but was 47% below the five-year mean in the Midlands Region (River Severn). There has been an overall downward trend in the grilse catches in all Regions (excluding NE) over the past 6 years ($B_{crit} = -0.08$, p = 0.96).

Table 12. The estimated number of grilse and MSW salmon and the percentage composition of MSWsalmon in regional rod catches in England and Wales, 1993-98

Numbers														
Year	EA Re	gion											All Reg	gions
	NE		South	ern	SW		Midlar	nds	Wales		NW			
	Grilse	MSW	Grilse	MSW	Grilse	MSW	Grilse	MSW	Grilse	MSW	Grilse	MSW	Grilse	MSW
1993	1,001	695	480	65	3,273	649	150	186	4,874	1,112	5,322	919	15,100	3,626
1994	1,285	654	289	143	4,280	933	228	327	5,782	2,119	7,257	1,583	19,119	5,761
1995	1,217	984	237	65	1,772	782	76	366	2,791	1,355	5,346	1,002	11,440	4,553
1996	1,236	1,278	287	97	1,666	1,015	95	548	3,389	2,079	4,604	1,116	11,277	6,133
1997	1,364	1,081	118	32	1,902	470	53	259	2,605	1,017	3,545	599	9,588	3457
1998	2,108	863	342	24	2,410	479	64	124	3,439	798	5,685	666	14,048	2,954
Mean (1993-97)	1,221	938	282	80	2,578	770	120	337	3,888	1,536	5,215	1,044	13,305	4,706
% change: 1998 on 1997 1998 on 5-year	+59	-20	+189	-24	+30	+5	+24	-52	+35	-22	+65	+14	+51	-15
mean	+78	-8	+21	-70	-7	-38	-47	-63	-12	-48	+12	-36	+8	-37
Percentage MSW														
Year	EA Re	gion											All	
	NE		South	ern	SW		Midlar	nds	Wales		NW		Region	S
1993	41		12		17		55		19		15		19	
1994	34		33		18		59		27		18		23	
1995	45		21		31		83		33		16		28	
1996	51		25		38		85		38		20		35	
1997	44		21		20		83		28		14		27	
1998	29		7		17		66		19		10		17	
Mean (1993-97)	43		22		23		74		28		17		26	



Figure 10. Estimated number of MSW salmon in regional rod catches. The histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis) for comparison purposes. Note that the histograms are not drawn to the same scale. Data for 1998 are provisional.

2.6 Origin of catches

2.6.1 Reared fish

There is currently no ranching in England and Wales and only one small salmon cage-rearing facility. The contribution of farmed and ranched fish to the catches is therefore thought to be negligible. In a number of catchments juvenile salmon are stocked from hatcheries for mitigation or enhancement purposes. This year, for the first time, NASCO has asked for information on the numbers of eggs taken for artificial rearing. The purpose of this is to provide an estimate of the proportion of the natural egg deposition that has been taken for management purposes.

Annex 5 provides a summary of these data for the period 1990 to 1998. Full details of the numbers of fish stocked in these programmes, and the stage of release, are included, on a catchment by catchment basis in the Salmonid and Freshwater Fisheries Statistics published annually by the Agency. In most instances, when they return as adults these fish cannot be distinguished from fish derived from natural spawning, although marking and tagging programmes are undertaken in some areas to assess the efficacy of these programmes (Annex 6).

2.6.2 Salmon from other countries

Based upon studies conducted in the 1980s, approximately 80% of the salmon caught in the North East Coast Fishery in England and Wales are estimated to be returning to rivers in Scotland; this represents $\sim 14,500$ fish in 1998. The fishery operating in the Solway Firth is also thought to exploit some salmon returning to rivers in Scotland, but the proportion of such fish in the Solway net catch has not been estimated. There are very few records of tagged salmon from other countries being taken in England and Wales.

2.7 Exploitation rates

2.7.1 Homewater exploitation

Exploitation rates have been estimated for fisheries on certain rivers in England and Wales for which reliable counts are available (Table 13 and Figure 11). The levels of exploitation in 1998 were similar to the average of the previous five years in six rod fisheries for which data are available. This suggests that the increased rod catches of grilse, observed in many rivers in 1998, probably resulted from an increase in the numbers of fish rather than from more favourable angling conditions. Exploitation rates are available for two net fisheries, the Dee and the Lune. In the latter case the net exploitation rate was only about half that in recent years. This would also be in line with the suggestion that levels of exploitation by the nets were affected by the high river flows.

Table 13. Estimated exploitation rates (%) for selected fisheries in England and Wales, 1988-98(rates include released fish)

	EA Reg	gion												
	NE	South	ern		South	West		Wales				North V	West	
River Fishery Year	Coquet rods	Test rods (d)	Itchen rods	Itchen nets	Frome rods (a)	Tamar rods	· Fowey rods	Dee rods 1SW (b)	Dee rods MSW (b)	Dee nets	Taff rods	Leven rods	Lune rods	Lune nets
1988		39	33		9									
1989		29	47	9	7								22	44
1990		36	47	20	10								30	36
1991		26	43	30	8								27	30
1992		25	29	(c)	9			14	18	15	5		33	30
1993		33	39	(-)	11			11	15	11	6	27	21	30
1994	14	32	39		13			15	21	22	5	28	35	35
1995	24	28	25		9			7	11	18	4	37	24	27
1996	22	23	36		13			9	11	17	3	45	23	24
1997	19	14	39		7	7		8	9	17	1	26	25	29
1998	n/a	23	36		9	10	14	10	10	15	n/a	n/a	24	14
Mean														
(1993 - 1997)	20	26	36		10			10	13	17	4	33	26	29
% change														
1998 on 1997		-10	-37		+29	+51		+18	+13	-12			-4	-52
1998 on 5-yr mean		-52	-71		-14			-2	-26	-12			-6	-52

Key: (a) Data based on IFE counter at Wareham, and supplied courtesy of IFE.

(b) Data derived from mark recapture experiment.

(c) Woodmill net fishery operated for scientific purposes only, all fish released alive.

(d) Includes rod caught fish retained for broodstock.



Figure 11. Exploitation rates (%) for selected rod and net salmon fisheries in England and Wales. Where available the histograms display data for the six years 1993 to 1998, together with the five-year mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Data for 1998 are provisional. Note also that estimates for the Dee have been split by age class (1SW and MSW), all other estimates are combined for all ages.

2.7.2 Exploitation in fisheries outside England and Wales

Salmon stocks in England and Wales are exploited in a number of fisheries other than those operating under the jurisdiction of the Agency within national waters. These include the distant water fisheries at Faroes and West Greenland, and other fisheries such as those operating off Ireland and in homewaters in other parts of the UK. Tagging studies have provided information on the levels of exploitation for English and Welsh stocks in many of these fisheries and this is summarised briefly below:

West Greenland

This fishery exploits only salmon that would have returned to Europe and North America as MSW fish. Prior to recent negotiated reductions in the quota for this fishery, the estimated exploitation rates on the MSW component of English and Welsh stocks was estimated to be in the region of 10 to 20%. However, following recent significant quota reductions, current levels of exploitation on MSW fish have probably fallen to very low levels.

Faroes

The Faroes fishery exploits both 1SW and MSW salmon of largely northern European origin. Prior to the recent buy-out arrangements, few tags of English and Welsh origin were recovered in this fishery and estimated exploitation rates on English and Welsh stocks were very low (\sim 1%). Since 1991, the Faroes salmon quota has been bought out, and only a small research fishery has operated; the current levels of exploitation are therefore negligible.

Ireland

Discussions are currently underway between scientists from CEFAS, the Agency and the Irish Marine Institute to agree estimates of exploitation in the Irish drift net fishery for selected English and Welsh stocks. Provisional estimates of the levels of exploitation prior to the introduction of new fisheries regulations in 1997, vary substantially between stocks in different Regions and from year to year. Exploitation rates were low (~1%) for stocks in the North East of England, higher (at around 5 to 10%) for rivers on the west coast and in Wales, but highest (perhaps 10 to 20%) for stocks from south coast rivers. The effects of the new measures on the level of exploitation have not been assessed.

Other homewater fisheries

Few tags of English and Welsh origin have been returned from homewater fisheries in Northern Ireland and Scotland. The exploitation rates in these fisheries have not been estimated but are thought to be low.

Marine by-catch

The potential catch of salmon post-smolts in industrial fisheries continues to be a matter of concern. NASCO has requested information on the possible by-catch in the mackerel fisheries in the Norwegian Sea and estimates should be provided by ICES in 1999.

No new data are available on the possible effects of sandeel fisheries on salmon post-smolts, but the British Government has proposed measures to ban sandeel fishing along the east coast of England and Scotland. This would principally be to protect certain bird species, but it might also benefit stocks of salmon and sea trout.

REPORT ON STATUS OF STOCKS IN 1998

3. Status of stocks

3.1 Spawning targets

3.1.1 Setting targets

Both nationally and internationally there has been a realisation in recent years that objective methods are required to determine the stock levels that must be protected to ensure the conservation of salmon. Internationally ICES and NASCO use stock 'conservation limits' to describe the status of stocks and to set quotas for the distant water fisheries. NASCO currently defines the conservation limit as the spawning stock level that produces maximum sustainable yield and has determined that management measures should be aimed at maintaining all salmon stocks above these limits. Within England and Wales, the Agency has established conservation limits (referred to as 'spawning targets') for all principal rivers.

The spawning targets in England and Wales have been set using a nationally agreed method (Environment Agency, 1998) which adjusts a stock-recruitment relationship for the River Bush (Northern Ireland) according to the quality and quantity of juvenile habitat in each river, derived from a simple habitat model (Wyatt and Barnard, 1997). These adjustments provide different egg deposition requirements per 100m² for each river, which are multiplied by the accessible wetted area of the river to estimate total egg deposition requirements for the system. Separate targets for different age groups are not explicitly set, although observed egg deposition is partitioned into 1SW and MSW components for comparison against historical data (Table 14).

Compliance of the spawning escapement with the spawning targets is not normally assessed for individual years but in three-year blocks. Compliance is based upon two 'rules' relating to 'episodes' (periods of years) when the escapement falls below the target. (Environment Agency, 1998).

Rule 1 states that episodes may last no longer than two years; and Rule 2 states that the clear gap between episodes should be at least two years.

Within a three year period spawning escapement estimates are assessed against the spawning target and values above and below the target will result in the following compliance assessments:

Escapement above (A) or below (B) target in 3yr period	Compliance assessment
2As or more	pass
ABB	near miss
BBA	near miss
BAB	fail
BBB	fail

					All fish			Proporti	on of
	River	Accessible	Spawning	Spawning	Egg dep	osition inc	l rod	Target a	ttained (%)
		wetted area	target	target	released	fish (milli	ons)	1998	1997
		hoctores	$aggs/100m^2$	aggs (millions)		insii (iiiiiii	–		1777
					1SW	MSW	All	All	All
**	Coquet	144	316	4.5	0.3	0.1	5.3	116	159
*	Tvne	542	289	15.7			27.0	173	157
**	Wear	232	336	7.8	2.6	23	49	62	38
	Tees	319	302	9.6	17	17	33	35	10
*	Esk-Yorks	36	197	0.7	1.7	1.7	0.7	94	123
	Total	20	197	38.3	5.4	4.8	41.1	107	95
	_								
*	Test	80	425	3.4			1.9	57	23
Ŧ	Itchen	69	234	1.6			1.0	63	31
	Total			5.0			3.0	59	25
**	Avon-Hants	360	237	8.5	3.8	1.4	5.2	61	58
	Piddle	25	194	0.5	0.1	0.0	0.1	12	22
**	Frome	90	223	2.0	2.0	1.8	3.8	191	147
	Axe	57	247	1.4	0.0	0.1	0.1	9	6
	Exe	205	343	7.0	6.5	1.5	7.9	113	122
*	Teign	98	315	3.1	1.4	0.6	1.9	63	60
*	Dart	132	297	3.9	1.0	0.6	1.6	40	45
	Avon-Devon	18	294	0.5	0.3	0.0	0.3	50	44
	Erme	10	300	0.3	0.0	0.0	0.1	19	32
	Yealm	8	297	0.3	0.4	0.0	0.4	144	57
	Plvm	17	436	0.8	0.3	0.0	0.3	43	52
	Tavv	23	312	0.7	14	0.2	16	225	133
**	Tamar	197	293	5.8	71	33	10.4	181	145
*	Lynher	29	294	0.9	0.9	0.1	11	124	60
	Fowey	34	430	1.5	0.9	0.1	1.0	69	83
	Camel	37	338	1.5	2.1	0.1	23	185	183
	Taw	174	323	5.6	3.8	1.6	5.4	96	57
*	Torridge	155	291	4.5	0.9	0.3	13	28	19
	Ivn	27	556	1.5	14	0.2	1.5	101	114
	Total	21	550	50.0	34.3	11.9	46.2	93	80
*	Severn	898	190	17.1	-	-	11.5	67	138
	Total			17.1	-	-	11.5	67	138
*	Wye	1653	281	46.4	5.2	6.4	11.6	25	29
	Usk	242	423	10.2	5.6	2.7	8.4	82	64
	Taff	72	436	3.1	0.2	0.1	0.3	10	5
	Ogmore	35	253	0.9	0.7	0.1	0.7	84	82
	Afan	17	450	0.8	0.2	0.0	0.2	25	16
	Neath	37	419	1.6	0.5	0.0	0.5	33	15
	Tawe	45	379	1.7	0.8	0.1	0.9	51	49
	Loughor	35	289	1.0	0.1	0.0	0.1	7	7
*	Tywi	500	314	15.7	7.2	3.2	10.3	66	50
	Taf	88	276	2.4	0.5	0.0	0.5	20	31
	E&W Cleddau	122	402	4.9	0.5	0.1	0.6	11	11
*	Teifi	296	401	11.9	8.7	1.7	10.4	88	108
	Aeron	35	417	1.4	0.0	0.0	0.0	1	2
	Ystwyth	46	397	1.8	0.4	0.0	0.4	23	24
	Rheidol	50	426	2.1	0.3	0.1	0.4	18	21
*	Dvfi	179	311	5.6	2.5	0.2	2.8	49	45
*	Dysinni	-	-	0.9	0.1	0.0	0.1	8	4
**	Mawddach	57	312	1.8	0.9	0.1	1.0	57	52
	Artro	9	423	0.4	0.1	0.0	0.1	18	9
*	Dwyryd	9	246	0.2	0.4	0.0	0.4	157	194
*	Glaslyn	25	242	0.6	0.2	0.0	0.3	52	93
*	Dwyfawr	33	322	11	0.2	0.0	0.2	21	48
*	Seiont	21	288	0.6	0.2	0.0	0.8	138	114
*	Ogwen	24	449	11	23	0.0	2.5	231	196
*	Conwy	50	171	0.9	1.2	0.1	13	158	149
*	Clwvd	84	312	2.6	1.2	0.2	2.1	79	15
**	Dee	617	248	153	82	8.0	161	106	91
	Total	517	210	137.0	49.4	23.5	73.0	53	50
	~								

Table 14. Spawning targets and % of target attained in 1998 for the principal salmon rivers of England and Wales (all results are provisional)

					All fish			Compliance	e		
Riv	er	Accessible wetted area	Spawning target	Spawning target	Egg der released	Egg deposition incl r released fish (million		% Target 1998	% Target 1997		
					1SW	MSW	All	All	All		
	Ribble	93	413	3.8	7.0	1.0	8.1	211	89		
	Wyre	46	264	1.2	0.4	0.0	0.4	34	5		
**	** Lune 423 327 13.8 11.0 3.6	327 13	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	14.6	106	43					
	Kent	42		1.7 5.3 0.6 5.9	1.7 5.3 0.6 5.9	1.7 5.3 0.6 5.9 3.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$		5.3 0.6 5.9	5.9 350	350
**	Leven	46	249	1.1	5.3 0.6 5.9 - - 0.5 0.2 0.1 0.3		0.5	44	36		
**	Crake	16	243	0.4			0.3	64	12		
	Duddon	11	402	0.4	0.4	0.0	0.4	99	30		
	Esk	14	401	0.6	0.7	0.1	0.9	154	50		
	Irt	20	317	0.6	0.9	0.0	0.9	151	88		
<	Ehen	41	283	1.2	-	-	2.8	244	83		
k	Calder	13	326	0.4	-	-	0.4	99	123		
	Derwent	135	369	5.0	7.1	1.5	8.6	173	137		
	Ellen	17	322	0.5	0.3	0.0	0.3	61	6		
k	Eden	688	300	20.6			17.8	86	74		
	Esk-Border	144	440	6.3	7.4	2.0	9.4	148	166		
	Total			57.8	41.6	9.4	51.0	88	44		
	Total			305.2	-	-	225.8	74	64		

Table 14. continued - Spawning targets and % of target attained in 1998

* Refined target identified in Draft Salmon Action Plans or Local Environment Agency Plan (LEAP) documents. Remaining targets are provisional and require refinement through river specific inputs.

** Refined target identified in Final Salmon Action Plan.

Note: compliance estimates for 1997 have been corrected since last year.

Failure does not distinguish between a real deterioration in the egg deposition and a chance (1-in-20 year) false alarm. The circumstances would have to be investigated to determine which was the more likely explanation and corrective action taken if necessary. A river classed as failing would remain classified as such until a reassessment, for a subsequent three-year period, showed a pass. Recent history of English and Welsh SAP rivers is shown in Table 15, in which the timing of each three-year block is determined by the particular Salmon Action Plan.

3.1.2 Spawning escapement in 1998

Table 14 and Figure 12 indicate wide variation in the levels to which spawning targets were met in 1998. There are few obvious regional trends, although spawning escapement tended to be below target levels in the rivers in South Wales and in the south coast chalkstream catchments (with the exception of the Frome). A number of rivers, such as the rivers Wear and Tees in the North East, and some catchments in South Wales are being restored from previous polluted conditions and may require interim rebuilding targets to be set.

The provisional nature of the targets should be noted. Many rivers, and particularly some of the smaller catchments on the west coast of Wales, support relatively small salmon stocks and are principally regarded as sea trout rivers. Currently, the Salmon Action Plan guidelines do not take account of this, and targets for such rivers may need to be refined in the future.



Figure 12. Pie charts for individual rivers for which refined targets have been set (marked * or ** in Table 14) showing the % of the spawning targets attained in 1998. A black circle indicates that the target was met <u>or exceeded</u>

Region	River	Spawning	Total egg	deposition (m	illions)		
		eggs (millions)	1994	1995	1996	1997***	1998***
NE	** Coquet	4.54	4.88	4.24	4.96	7.24	5.25
	* Tyne	15.65	18.07	20.26	27.73	24.54	27.03
	** Wear	7.81	3.21	4.06	4.70	2.94	4.85
	* Esk-Yorks	0.70	2.08	0.58	0.29	0.87	0.66
Southern	* Test	3.40	1.37	1.08	1.19	0.77	1.94
	* Itchen	1.63	0.56	1.64	0.68	0.50	1.02
SW	** Avon-Hants	8.53	2.16	2.75	5.21	4.91	5.21
	** Frome	2.00	2.53	2.56	3.06	2.93	3.81
	** Tamar	5.77	16.93	18.21	13.43	8.36	10.43
	* Lynher	0.86	1.31	0.23	0.27	0.52	1.07
	* Torridge	4.52	4.56	2.35	1.61	0.85	1.28
Midlands	* Severn	17.06	34.96	36.79	48.75	23.48	11.51
Wales	* Wye	46.45	15.27	15.97	31.89	13.70	11.64
	* Tywi	15.70	24.42	14.26	15.24	7.83	10.32
	* Teifi	11.89	16.70	8.08	19.56	12.89	10.43
	* Dyfi	5.57	6.40	3.69	5.56	2.53	2.75
	* Dysinni	0.88	0.38	0.05	0.17	0.04	0.07
	** Mawddach	1.77	3.00	1.29	1.42	0.93	1.01
	* Dwyryd	0.23	0.76	0.55	0.52	0.44	0.36
	* Glaslyn	0.61	0.76	0.83	0.52	0.56	0.32
	* Dwyfawr	1.07	1.13	0.45	0.50	0.52	0.22
	* Seiont	0.61	0.90	0.70	0.70	0.69	0.84
	* Ogwen	1.07	2.93	2.01	1.56	2.10	2.48
	* Conwy	0.85	1.29	1.13	1.12	1.27	1.35
	* Clwyd	2.62	1.65	0.62	0.41	0.39	2.06
	** Dee	15.30	11.80	14.64	12.97	13.94	16.15
NW	** Lune	13.83	10.10	8.80	9.20	6.00	14.60
	** Leven	1.14	0.71	0.64	0.37	0.41	0.50
	** Crake	0.40	0.26	0.29	0.16	0.05	0.25
	* Ehen	1.16	2.11	1.80	1.38	0.96	2.82
	* Calder	0.41	0.30	0.35	0.37	0.50	0.41
	* Eden	20.63	33.52	25.99	22.06	15.17	17.82

Table 15. Spawning target and egg deposition estimates for principal salmon rivers, 1994-98.Shaded blocks indicate compliance failure (see Section 3.11)

* Refined target identified in Draft Salmon Action Plans or LEAP documents. Remaining targets are provisional only and require refinement through river specific inputs.

** Refined target identified in Final Salmon Action Plan.

*** Estimates include eggs contributed by rod released fish.

There are 32 rivers in England and Wales for which egg deposition has been estimated for a series of years (Table 15). Compliance assessments (see section 3.1.1) for these stocks indicate that 19 (59%) have shown compliance failure over the most recent three year assessment period (shaded blocks). The compliance failures are fairy evenly distributed in different Regions.

For most of the rivers in south and west Wales the egg deposition in 1998 was estimated to be towards the lower end of the range observed in the past 5 years, while in the Southern and NE Region it was towards the upper end of the range.

3.2 Measures of abundance/escapement

Various salmonid stock monitoring programmes are conducted on rivers in England and Wales. These include: juvenile surveys, smolt run estimates, counts of returning adults (counters and traps), and redd counts.

Surveys of the juvenile salmonid populations are conducted in many rivers in England and Wales to assess the levels of production. Table 16 shows data from 10 tributaries on the Rivers Torridge and Fowey in the SW Region and the River Derwent in the NW Region, where quantitative surveys have been conducted at the same sites since the mid 1970s or earlier. An example of the data for one tributary on the River Fowey (Cardinham) is also shown in Figure 13.

Of the ten tributaries investigated, six showed significant long-term changes, and of these, five showed declines with only one tributary showing a significant increase. It may be noted that the two rivers on which the juvenile production is falling, Torridge and Fowey, were below their spawning targets in 1997 and 1998, while the Derwent, where production seems to be increasing, is above its target. These data provide only a very limited picture of production in England and Wales and should not be considered representative of all rivers or Regions. Further work is being carried out on existing data to see if the general picture of significant decline shown here extends to other catchments nationally.

Table 16.	Changes in freshwater production in the tributaries of three rivers in England and Wales
	over the past two to three decades

Catchment	Tributary	Period	No of years with data	No. of sites on Trib.	Significant changes (annual%)	Significance level
Torridge	Lew	1964 - 1992	8	4	- 3.5	0.0427
0	Waldon	1964 - 1992	7	4	- 11.8	< 0.0001
	Torridge	1964 - 1992	8	3	- 8.1	< 0.0001
	Okement	1964 - 1992	9	7	N.S.	0.1482
Fowey	St Neot	1969 - 1994	16	9	- 4.5	0.0047
-	Fowey	1969 - 1997	11	15	N.S.	0.6331
	Cardinham	1969 - 1998	12	10	- 3.5	0.0036
	Warleggan	1969 - 1998	10	8	N.S.	0.8633
Derwent	Glenderamakin	1974 - 1996	9	4	+ 7.4	0.009
	St Johns	1974 - 1996	13	7	N.S.	0.4735

N.S - Result is not significant at 0.05 level

Data was analysed using a poisson Generalised Linear Model



Figure 13. Densities of juvenile salmon recorded on the Cardinham tributary of the River Fowey, 1969-98

Stage:	Smolts		Adults												
Region:	NE	S	NE	Thames	Southern		SW			Wales	NW				
River:	Wear	Test [#]	Coquet	Thames [#]	Test	Itchen	Frome	Tamar	Fowey	Dee	Lune	Kent	Leven	Calder	Caldew
Method:	Run estin	mate	RSE ¹	L	RSE ¹	RSE ¹	 ر	 C	G	RSE^2	RSE	C(>4Ib)	C(>4lb)	C(>41b)	E
1987															
1988	63426				1507	1336	4093								
1989	52894			91	1730	791	3186				8785	1137			
1990	28282			63	790	367	1880				8261	2216			
1991	19959			36	538	152	805				7591	1736	667*		
1992	36690	11967		247	614	357	006			4643	5567	1816	394		
1993	ı	7131		259	1249	852	1182			9757	10852	1526	469		
1994	55259	3381	2254	143	775	374	1078	6343		5285	9236	2072	562		1590
1995	40576	6853	2508	163	647	880	1016	5623		5703	6111	2762	329	379	1417
1996	15338	4712	2509	122	623	437	1353	3975		4931	6080	3246	387	212	1289
1997	ı	7229	3913	27	361	246	1157	2813		5495	4371	1473	233	224	889
1998		14672	n/a	9	898	453	1210	3132	767	6661	7457	4871	n/a	n/a	1106
Mean (1993-1997)	37058	5861	2796	143	731	558	1157	4689	ı	6234	7330	2216	396	272	1258
; ;	.														

Table 17. Available information on status of regional salmon stocks

C = adult salmon count.Key to methods: T = adult trap.

C(>4lb) = Adult count (fish greater than 4 lb in weight). $RSE^{1} = returning stock estimate (validated count + catch below counter).$

 $RSE^2 = returning stock estimate (mark/recapture estimate).$

* Denotes incomplete record. Key:

Denotes stock supported by large-scale stocking from hatchery programme.



Figure 14. Counts (C) and returning stock estimates (R) for selected salmon stocks in England and Wales. The histograms display data for the six years 1993 to 1998, together with the fiveyear mean for the period 1993-1997 (displayed as a horizontal line, with the mean value indicated against the y-axis). Note that the histograms are not drawn to the same scale. Data for 1998 are provisional.

Electronic fish counters are operated on a number of catchments in England and Wales to provide estimates of the upstream run of adult salmonids. Time-series of counts, or returning stock estimates, are presented in Table 16 and Figure 13. Where possible, the counts have been adjusted to provide estimates of the returning salmon stock.

All available measures of adult stock abundance were higher in 1998 than in 1997, and many were also above the averages for the previous five years (1993-97). This further confirms the indications from the rod catch data that salmon stock abundance in England and Wales was better in 1998 than in some recent years, although as previously indicated this was entirely due to the increased contribution of grilse. The counts in Table 17 also show significant downward trends on southern rivers (Tamar, Frome, Test and Itchen) over the past five years ($B_{crit} = -0.09$, p = 0.98) and 10 years ($B_{crit} = -0.15$, p > 0.99). The counts on the rivers in the north and west (Lune, Levern, Calder, Dee and Taff) show no significant common trends over these periods.

Although salmon have been returning strongly to some historically polluted rivers (e.g. Tyne, Wear, Ogmore), there is concern about chronic environmental degradation in others, mainly in rural areas, driven by land use practices, especially agriculture and forestry. Issues of particular concern are siltation resulting from soil erosion, pesticides from sheep dip chemicals, acidification and changes in river flows. The relative importance of these effects vary around the country, but clusters of high pesticide levels (synthetic pyrethroids) have been found in Welsh upland streams, and acidification is still extensive in the uplands of Wales and the North West. Salmon catches in the chalk rivers of Southern Region have suffered simultaneous decline in recent years, but the full reasons for this are not yet clear. The extent and nature of soil erosion impacts are being investigated and national water abstraction licence legislation is under review.

3.3 Survival indices

No data are available to evaluate long-term trends in marine survival for stocks in England and Wales at the current time. Marine survival estimates for the River Corrib (Ireland), River Bush (Northern Ireland) and River North Esk (Scotland) are shown in Table 17. These data confirm patterns seen elsewhere in the North Atlantic which indicate that marine survival can be quite variable between stocks and between years. In the North East Atlantic most stocks experienced low marine survival for smolts emigrating in 1989 and 1990, and for some stocks, this pattern has continued in the 1990s.

Smolt migration	Ireland River Corrib		UK (N.Ireland) R. Bush	UK (Scotland) North Esk	
year	1SW	2SW	1SW	1SW	2SW
1987	12	1	35.1	13.9	3.4
1988	12.4	0.5	36.2	-	-
1989	5.3	1	25	7.8	4.9
1990	4.4	0.6	34.7	7.3	3.1
1991	5.6	0.1	27.8	11.2	4.5
1992	5.9	-	29	-	-
1993	9	0.2	-	-	-
1994	7.8	0.1	27.1	17.2	2.3
1995	6.7	-	-	11.5	5.1
1996	4.1	n/a	31	10.7	n/a

Table 18. Estimated return rates of salmon to index rivers in UK and Ireland (From Anon., 1998)

4. Microtag, fin clip and external tag releases

Details of all marking and tagging of salmon undertaken in England and Wales in 1997 are included at Annex 6.

In 1998, 103k hatchery-reared salmon parr and 2.8k wild salmon smolts were microtagged and released in England and Wales to assess levels of exploitation and marine survival and to investigate the efficacy of enhancement programmes; a further 79k hatchery parr were marked with adipose fin clips only. A total of 1,425 adult salmon were tagged for the assessment of returning stocks and in conjunction with the use of radio tags.

5. References

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ANNEX 1. NASCO's request for scientific advice from ICES (CNL(98)13)

- 1. With respect to Atlantic salmon in the North Atlantic area:
 - 1.1 provide an overview of salmon catches and landings, including unreported catches by stock complex and catch and release, and worldwide production of farmed and ranched salmon in 1998;
 - 1.2 evaluate non-catch fishing mortality for all salmon gear;
 - 1.3 report on significant developments which might assist NASCO with the management of salmon stocks;
 - 1.4 develop a framework for stock rebuilding programmes;
 - 1.5 provide a compilation of egg collections and juvenile releases in 1998;
 - 1.6 provide a compilation of microtag, finclip and external tag releases by ICES member countries in 1998.
- 2. With respect to Atlantic salmon in the North-East Atlantic Commission area:
 - 2.1 describe the events of the 1998 fisheries and the status of the stocks;
 - 2.2 update the evaluation of the effects on stocks and homewater fisheries of the suspension of commercial fishing activity at Faroes since 1991;
 - 2.3 further develop the age-specific stock conservation limits for smaller stock units in the Commission area, where possible based upon individual river-based estimates;
 - 2.4 further develop methods to estimate the expected abundance of salmon for smaller stock units in the Commission area;
 - 2.5 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
 - 2.6 provide an estimate of the by-catch of salmon post-smolts in pelagic fisheries;
 - 2.7 identify relevant data deficiencies, monitoring needs and research requirements.
- 3. With respect to Atlantic salmon in the North American Commission area:
 - 3.1 describe the events of the 1998 fisheries and the status of the stocks;
 - 3.2 update the evaluation of the effects on US and Canadian stocks and fisheries of management measures implemented after 1991 in the Canadian commercial salmon fisheries;
 - 3.3 update age-specific stock conservation limits based on new information as available;
 - 3.4 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
 - 3.5 identify relevant data deficiencies, monitoring needs and research requirements.
- 4. With respect to Atlantic salmon in the West Greenland Commission area:
 - 4.1 describe the events of the 1998 fisheries and the status of the stocks;
 - 4.2 evaluate the effects on European and North American stocks of the Greenlandic management measures since 1993;
 - 4.3 provide a detailed explanation of any changes to the model used to provide catch advice and of the impacts of any changes to the model on the calculated quota.
 - 4.4 provide age-specific stock conservation limits {spawning targets} for all stocks occurring in the Commission area based on best available information;
 - 4.5 examine critically the model used to provide catch advice, looking at all the assumptions, and comment on the confidence limits on the output from the model;
 - 4.6 provide catch options or alternative management advice with an assessment of risks relative to the objective of exceeding stock conservation limits;
 - 4.7 identify relevant data deficiencies, monitoring needs and research requirements.

ANNEX 2. Further information

North Atlantic Salmon Conservation Organisation

The North Atlantic Salmon Conservation Organisation (NASCO) was establishment in 1984 following calls for international co-operation on the management of salmon stocks. The Contracting Parties to the NASCO Convention are: Canada; Denmark (in respect of the Faroe Islands and Greenland); European Union; Iceland; Norway; the Russian Federation; and USA. Much of the business of the organisation is conducted by three regional Commissions: the North American Commission; the North East Atlantic Commission; and the West Greenland Commission. One of the main functions of these Commissions is to propose regulatory measures for fisheries of one Party to the NASCO Convention which exploit salmon originating in the rivers of other Parties. The main fisheries of relevance for the management of European stocks are those operated on the west coast of Greenland and within Faroese waters. The NASCO Convention requires that, in establishing regulatory measures for fisheries within their areas, the three Commissions should take account of the Sea (ICES). NASCO therefore makes an annual request for scientific advice from ICES (Annex 1).

International Council for the Exploration of the Sea

The International Council for the Exploration of the Sea (ICES) provides biological information and advice on a wide range of fish stocks in order to help fisheries managers maintain viable fisheries within sustainable ecosystems. Information is compiled and assessments are conducted by Working Groups which are comprised of national experts on the specific fish stocks. The Working Group reports are passed to the Advisory Committee on Fisheries Management (ACFM) for peer review and to compile the advice to managers. Their advice may take many forms, but in general it involves: assessments of stock dynamics; evaluation of the status of the stocks; projections of various stock parameters into the future; and management options. For Atlantic salmon, ICES provides advice relating to the list of questions posed by NASCO (Annex 1). The assessment of salmon stocks and fisheries present particular problems to the ICES scientists both because of the highly migratory nature of the fish and because they comprise a large number of distinct river stocks which must, to some extent at least, be managed separately.

B_{crit} analysis

The B_{crit} analysis is a randomisation test developed by Rago (1993). Randomisation tests are useful for assessing changes in stock status because: they require few assumptions; the results are readily interpretable; and the sampling distribution of the test statistic can be easily approximated on a portable computer.

The B_{crit} test allows inferences to be made about the composite trend in data from multiple sites. The composite trend is estimated as a weighted average of the slope of log transformed count data versus time. In the randomisation model, the problem is stated as follows: 'Under the null hypothesis that the observations are randomly ordered within each series, what is the probability of obtaining a value of B greater than or equal to the observed B_0 ?' This type of model has been widely applied by North American and European avian biologists.

ANNEX 3. Glossary of fishing methods (nets and fixed engines) used for taking salmon and migratory trout in England and Wales

A wide variety of nets and fixed engines are used to take salmon and sea trout. The term fixed engine is an ancient one used to describe a variety of stationary fishing gears. However, it should be noted that the following are generalised descriptions (for further details see Russell et al., 1995); in practice there is considerable regional variation in the precise mode of operation of specific gears and in the dimensions and mesh sizes of the nets. These criteria have generally evolved to suit local conditions and are regulated by local byelaws.

Basket trap This is a type of fixed engine which is only used on the river Conwy in North Wales. It consists of a metal basket set between two boulders, which is designed to catch salmon and sea trout which fall back when attempting to ascend a small waterfall.

Coastal net A loose term used to describe the nets used in the fishery off the East Anglian coast. In practice, various methods of fishing have been employed, including seine nets, drift nets and nets pulled along the coast close to the shore (known locally as long-shoring).

Compass net These nets are operated from boats held stationary against the current. A net is hung between two long poles lashed together in a V-shape and held over the side of the boat so that the net streams out underneath the boat. When a fish strikes the net, the poles are pivoted upwards with the aid of counter-balancing weights. Similar nets were known as stop nets on the Wye and Severn (no longer in operation).

Coracle net These nets are only used in parts of Wales. Short lengths of trammel net are suspended between two coracles (small boats), which then drift downstream with the net strung across the current.

Crib (or Coop) These ancient fixed engines have been little used in England and Wales. They consist of stone buttresses set across a river, the gaps between the buttresses being filled by box-like traps made of either wood or metal with in-scale entrances. The river Eden cribs were built in 1133 A.D. by monks, although the Derwent cribs are of more recent construction.

Drift net The drift net consists of a sheet of netting which hangs from a floated head rope to a weighted foot rope and is designed to drift with the current or tide. Regional names include: hang, whammel, sling and tuck nets.

Fishing baulk This gear is another ancient fixed engine which has been used in the North West Region only. It consists of two large, woven (traditionally wattle) fences supported on wooden stakes which are constructed in an estuary in the form of a right-angle. As the tide innundates the structure fish are able to move in via a hinged section, but as the tide ebbs and the water recedes, the fish are left stranded. the fishing baulk situated on the river Esk at Ravenglass is known locally as a garth. A similar fish trap operates at the mouth of the River Lyn in South West England.

Haaf or heave net These one-man-operated nets are operated exclusively in the North West Region. The gear consists of a rectangular net hung from a horizontal wooden beam up to 5.5m wide. A central pole permits the netsmen to stand in the tideway holding the net facing the current with the netting streaming behind him. The net is lifted when a fish strikes the net. It is usual for several netsmen to work together line-abreast.

J-net (or P-net) The name sometimes used for the method of operating a drift net as a semi-fixed beach net, the nets being weighted to retard their drift. Set at right-angles to the beach, often with the end furthest from the shore turned back to form a hook.

Lave (or dip) net A variety of regional terms have been used to describe similar hand-held, oneman-operated nets, these include stand, bow, click and topping nets. Lave nets consist of a large Yshaped wooden frame supporting a net, similar in design to an anglers landing net, but measuring up to 2 m across. The netsman actively stalks fish in estuary pools or shallows at low tide.

Putts and Putchers Putts and putchers are wickerwork conical baskets which, when erected on stages, form putcher ranks (containing up to 800 putchers). This type of fixed engine is peculiar to the Bristol Channel and is dependent upon the high turbidity and large tidal range which occurs in this area. Each putcher has a mouth from 3 to 5 feet wide, tapering to a narrow point which will prevent fish of moderate size from passing through. Putts are larger and more closely woven conical baskets, which are less efficient for catching salmon, but will take smaller fish, shrimps and eels. Relatively few putts are used. A netting leader is often used also.

Seine net The seine net (also known as the draft or draw net) consists of a wall of netting with a weighted foot rope and floated head rope. One end is held on the shore while the rest is paid out from a boat to enclose an area of water between two points on the shore. The net is then retrieved and any fish enclosed drawn up onto the shore. Seine nets normally operate within estuaries, although some are also fished off coastal beaches.

Sling net The sling net is a type of drift net used exclusively on the river Clwyd in North Wales. The sling net differs from other drift nets only in so far as the nets are permitted to carry weights (not exceeding 9 lbs) at either end, designed to retard the drift.

T-net T-nets are fixed engines operated close to the shore. They comprise a 'leader', usually about 200 m in length, stretching out from the beach to a 'headpiece', which contains two traps with funnel entrances. Some fish may become enmeshed or entangled in the leader of the net, but the majority are taken, free-swimming, in the traps. T-nets are normally fished in specific berths.

'T or J'-net 'T or J'-nets are fixed engines operated close to the shore. The nets consist of plain sheets of netting on a floated head rope which hang vertically in the water by means of a weighted foot rope. These are held stationary by means of weights, anchors or stakes and are set from the shore usually in the shape of a 'J' or 'P'. Fish can only be caught in a 'T or 'J' net by becoming enmeshed or entangled in the walls of the net.

Trammel net Trammel nets are similar to drift nets but are modified by the addition of sheets of larger mesh netting on one or both sides of the net. Such nets are referred to as being 'armoured'. A fish striking a trammel net pushes the small mesh net through one of the large meshes in the adjoining net and is caught in the resultant pocket. Sometimes known locally as Tuck nets.

Wade net A wade net consists of a short $(\sim 30 \text{ m})$ single sheet of netting which is attached to a pole at each end, and is pulled along the foreshore parallel to the beach by two men, one wading and the other on the beach. Nets are 'beached' at regular intervals, or when a fish strikes, in much the same way as a seine net.

ANNEX 4. Status of Salmon Action Plans (SAPs)

SAPs are the means by which the Agency aims to meet the objectives of its National Salmon Management Strategy (launched in 1996) at a local level. Each SAP comprises two documents:

- The Consultation Document reviews stock and fishery status (including the use of spawning targets), identifies factors limiting performance and lists a series of costed options to address these. This is circulated to outside interests to seek their opinion and support for the plan.
- The Final Plan follows consultation and contains an agreed list of actions which the Agency, in partnership with others, is committed to address in the five year lifetime of the plan. Progress against these actions is reviewed annually at both regional and national levels.

A Ministerial Direction issued to the Agency in September 1998 requires all SAPs to be completed by the year 2002. The provisional schedule above identifies the timetable for production of final plans on individual rivers to comply with the 2002 deadline.

	Scheduled date fo	r completion of	Final SAPs - give	n as calendar year er	iding:	
Region	1997	1998	1999	2000	2001	2002
North	Coquet*	Wear*	Tyne			
East		Esk**	Tees			
Thames			Thames			
Southern	Test**	Itchen**				
South	Tamar*	Frome*	Taw	Teign	Exe	Yealm
West	Avon		Torridge**	Axe	Erme	Plym
	(Hants)*		Lynher**	Dart	Lyn	Fowey
				Tavy	Piddle	
				Camel	Avon (Devon)	
				Stour		
Midlands	Severn**			Severn Estuary		
Welsh	Dee*	Ogwen**	Clwyd	Dyfi	Ogmore	Rheidol
	Mawddach*	Seiont**	Conwy	Tawe	Neath	Aeron
	Teifi**	Dwyfawr**	Taf	Loughor	Afan	Ystwyth
	Wye**	Tywi**	Taff	Cleddau	Glaslyn/	Dysynni
				Nevern	Dwyryd	
				Usk		
North	Eden**		Ehen	Derwent	Duddon	Border Esk
West	Leven (& Crake)*		(& Calder)	Kent	Wyre	Irt
		Lune*			Ribble	Cumbrian Esk

Environment Agency's schedule for production of SAPs for 68 salmon rivers in England and Wales (at 1.4.99)

Note: Rivers in italics are those where there is no Ministerial requirement to produce a plan but where Regions have elected to do so to support Local Environment Agency Plans.

* Rivers with completed Final SAPs

** Rivers with completed SAP Consultation Documents

Blank fields indicate data not availbale. Shaded bands indicate relationship between eggs and stocked groups.

(excluding private commercial sea ranching)

Annex 5.

UK (England and Wales) - Eggs taken and juvenile Atlantic salmon and eggs stocked

Year	Total Eggs Artificially	Eggs St (rounde	tocked of to nearest	1,000)	No. Fry St (rounded to	ocked o nearest 1,0	(00	No. Parr St (rounded to	ocked nearest 100			No. Smolts (rounded to	nearest 100)	
		Spawne Green	Eyed	All eggs	Unfed	Fed	All fry	+0	1 & 1+	2 or >	All parr	-	2 or more	All smolts
Grand Total	28,059,000	0	706,000	706,000	1,701,000	11,030,524	12,731,524	7,518,453	1,825,537		9,343,990	1,442,382	0	1,442,382
1990	5,025,000	0	20,000	20,000	109,000	1,812,000	1,921,000	331,700	201,400	0	533,100	121,200	0	121,200
1991	5,103,000	0	12,000	12,000	373,000	1,561,000	1,934,000	1,186,700	216,600	0	1,403,300	126,000	0	126,000
1992	3,587,000	0	220,000	220,000	171,000	1,830,000	2,001,000	1,203,300	391,000	0	1,594,300	183,000	0	183,000
1993	5,130,000	0	0	0	172,000	1,248,000	1,420,000	872,000	173,700	0	1,045,700	218,700	0	218,700
1994	3,590,000	0	48,000	48,000	688,000	2,024,000	2,712,000	812,300	199,100	0	1,011,400	152,500	0	152,500
1995	3,209,000	0	379,000	379,000	139,000	1,386,000	1,525,000	578,900	143,100	0	722,000	203,800	0	203,800
1996	2,415,000	0	25,000	25,000	49,000	720,000	769,000	1,127,800	143,200	0	1,271,000	127,300	0	127,300
1997	n/a	0	0	0	0	277,000	277,000	1,141,000	199,200	0	1,340,200	185,400	0	185,400
1998	n/a	0	2,000	2,000	0	172,524	172,524	264,753	158,237	0	422,990	124,482	0	124,482

(e.g. eggs recorded for 1996 were spawned during the autumn/winter period of 1996/1997)

tag releases
and external
l, fin clip
microtag
Compilation of
ICES (
ANNEX 6.

Marking Season: 1998 Country: UK (England and Wales)

105,9521,425

2,799Wild

All

Adults

Hatchery 103,153

Juveniles

Totals:

	Microtags		103,153	2,799		105,952					
	External tag	gs			1,425	1,425					
	Adipose cli	ip	79,420			79,420					
	Other clips.	, external mark	S								
	Total fish 1	narked	182,573	2,799	1,425	186,797					
Marking	Age	Life	M/H	Stock	Primary	Number	Code or	Auxiliary	Release	Place of	River
Agency		stage		Origin	tag or mark	marked	serial	clip	date	release	Catchment
EA North East	+	Parr	Н	Tyne	Microtag	7589	20/42/12	Adipose	03-April-98	East Kielder Burn	R.Tyne
EA North East	+1+	Parr	Η	Tyne	Microtag	7625	20/42/13	Adipose	03-April-98	Scaup Burn	R.Tyne
EA Thames	0^+	Smolt	Н	Thames	None	17669		Adipose	17-Mar - 21-May	R. Kennet	R. Thames
EA Thames	Var	Adult	W	Thames	Floy/Radio	5	4700-4703 Red	None	10-Jul - 04-Sep	R. Thames	
EA Thames	Var	Adult	M	Thames	Floy	1	4775 Yellow	None	29-Jul-98	R. Thames	
EA Southern	$^{+0}$	Parr	Η	Test	None	61751		Adipose	Var	R. Test	
EA Southern	Var	Adult	M	Test	Floy	12	C000076-C00005	87 None	Var	R. Test	
EA South West	$\frac{1}{1}$	Parr	Н	Avon/Stour	Microtag	2931		Adipose	Mar-98	R. Avon (Hamp)	
EA South West	Var	Adult	W	Avon/Stour	Floy	84		None	Var	R. Avon/Stour	
EA Welsh	+	Smolt	Η	Shannon	Microtag	10182	23/42/20	Adipose	Jan-98	R. Kennet	R. Thames
EA Welsh	+	Smolt	Η	Shannon	Microtag	10194	23/42/21	Adipose	Jan-98	R. Kennet	R. Thames
EA Welsh	1 +	Smolt	Η	Shannon	Microtag	10103	23/42/22	Adipose	Jan-98	R. Kennet	R. Thames
EA Welsh	$\frac{1}{1}$	Smolt	Н	Shannon	Microtag	10124	23/42/23	Adipose	Jan-98	R. Kennet	R. Thames
EA Welsh	1^+	Smolt	Н	Neath	Microtag	4885	23/42/24	Adipose	Jan-98	R. Neath	
EA Welsh	2^{+}	Smolt	Н	Taff	Microtag	10551	23/42/13	Adipose	Mar-98	R. Taff	
EA Welsh	$\frac{1}{1}$	Smolt	Η	Dee	Microtag	1787	23/42/01	Adipose	May-98	R. Alwen	R. Dee
EA Welsh	$\frac{1}{1}$	Smolt	Η	Dee	Microtag	1734	23/42/01	Adipose	Jun-98	R. Alwen	R. Dee
EA Welsh	+	Smolt	Η	Dee	Microtag	066	23/42/01	Adipose	Jul-98	R. Alwen	R. Dee
EA Welsh	$\frac{1}{1}$	Smolt	Η	Dee	Microtag	2620	23/42/01	Adipose	12-Jun-1998	R. Alwen	R. Dee
EA Welsh	$^{+}$	Smolt	Н	Dee	Microtag	2767	22/42/36	Adipose	Jan-1998	R. Tryweryn	R. Dee
EA Welsh	Var	Adult	M	Dee	Floy	1139			Var	R. Dee	
EA Welsh	Var	Adult	W	Taff	Floy	184			Var	R. Taff	
EA North West	Var	Smolts	W	Leven	Microtag	513	01/42/21	Adipose	Var	R. Leven	
EA North West	Var	Smolts	Η	Derwent	Microtag	8502	01/42/52	Adipose	01-Apr-98	R. Derwent	
CEFAS / EA Southern	Var	Smolts	M	Test	Microtag	1765	01/42/24	Adipose	Apr - May-98	R. Test	
CEFAS / EA Southern	Var	Smolts	Н	Test	Microtag	2067	01/42/25	Adipose	Apr - May-98	R. Test	
EA North West	Var	Smolts	W	Leven	Microtag	513	01/42/21	Adipose	May-98	R. Leven	
EA North West	Var	Smolts	Н	Leven	Microtag	8502	01/42/52	Adipose	Apr-98	R. Derwent	
CEFAS	Var	Smolts	M	Tamar	Microtag	8	01/42/09	Adipose	07-May - 12-May-98	R. Tamar	