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Fisheries Management Focus Area Report

European Union -UK (England and Wales)

North Atlantic Salmon Conservation Organisation
FOCUS AREA REPORT ON MANAGEMENT OF SALMON FISHERIES

UK(England and Wales)

Contents:

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1. Objectives of the national salmon management strategy

The current **Strategy for the Management of Salmon in England and Wales** (NRA 1996) has the following four main objectives:

(i) Optimise the number of salmon returning to homewater fisheries.
(ii) Maintain and improve the fitness and diversity of salmon stocks.
(iii) Optimise the total economic value of surplus stocks.
(iv) Ensure necessary costs are met by beneficiaries.

These objectives are primarily aimed at securing the well-being of salmon stocks but, in doing so, also strive to improve catches and associated economic returns to the fisheries. They are addressed through local **Salmon Action Plans (SAPs)** which have been produced for all the main salmon rivers/fisheries in England and Wales. Each plan is developed in consultation with local interest groups and reviews the status of the stock and the fisheries on a particular river, seeks to identify the main factors limiting performance, and draws up and costs a prioritised list of options, including management actions for fisheries, to address these.

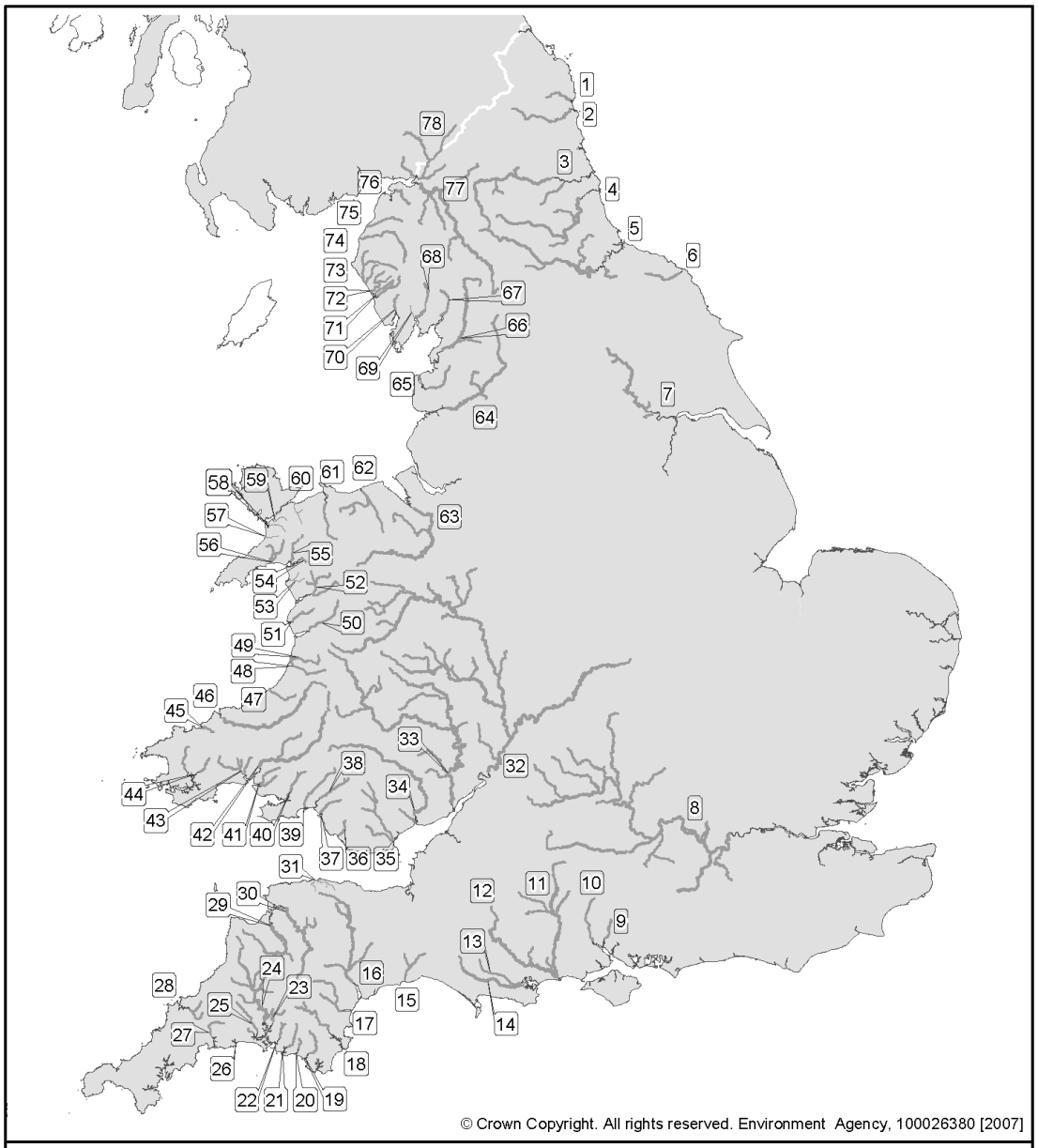
The National Salmon Management Strategy has set policy and guided delivery over the decade since its publication in 1996. There have been significant developments in this period, including publication of the Government-sponsored Salmon and Freshwater Fisheries Review in 2000, the Environment Agency's salmon stock conservation review in 2004, and changes in the status of salmon stocks and in their regulation. The Environment Agency has now embarked on a review and expects to publish a new, revised Strategy in 2008. [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 1].

2. Description of stocks

Nature and extent of the salmon resource

There are 78 rivers in England and Wales that support salmon (Figure 1), although some of these river stocks are very small and support minimal catches. These rivers vary significantly in their nature, ranging from spatey upland catchments to stable, groundwater-fed chalk rivers. SAPs have been developed for the 64 rivers that have been designated 'principal salmon rivers', as well as one major estuary (the Severn). The 64 'principal' salmon rivers are subject to a Ministerial Direction and their status must be reported on annually. There are a further 13 rivers shown in the FAR (Figure 1) that do not have SAPs. These generally have no catch or a very small catch (<15) of salmon and also have a significantly greater (more that 5 times) catch of sea trout. None of these rivers supports a net fishery, and the rod fisheries are managed principally to address the status of the sea trout stocks, although salmon catches are also taken into account.

There are a number of principal salmon rivers that have recovered (e.g. River Tyne) or are recovering (e.g. River Tees) from the effects of pollution and major industry during the early part of the 20th century such that they now again support salmon fisheries. Some other river systems, including some of significant size, are also now in the very earliest stages of recovery from historic degradation, but are not amongst those for which SAPs have been developed; CLs are likely to be developed for these and management actions to improve salmon stocks will be included in Water Framework Directive programmes of measures as the recovery progresses. Where salmon are being recorded breeding in these (e.g. River Mersey and Yorkshire Ouse system) there is potential for new and significant populations to develop.



1 Aln
2 Coquet*
3 Tyne*
4 Wear*
5 Tees*
6 Esk (Yorkshire)*
7 Ouse
8 Thames*
9 Itchen*$
10 Test*
11 Avon (Hants)*$
12 Stour (Dorset)*
13 Piddle*
14 Frome*
15 Axe*
16 Exe*
17 Teign*$
18 Dart*$
19 Avon (Devon)*
20 Erme*$
21 Yealm*$
22 Plym*
23 Tavy*$
24 Tamar*
25 Lynher*
26 Looe
27 Fowey*
28 Camel*$
29 Torridge*
30 Taw*$
31 Lyn*
32 Severn*
33 Wye*$
34 Usk*$
35 Taff*
36 Ogmore*
37 Afan*
38 Neath
39 Tawe*
40 Loughor*
41 Gwendraeth Fawr
42 Tywi*
43 Taf*
44 E & W Cleddau*
45 Nevern*
46 Teifi*$
47 Aeron
48 Ystwyth
49 Rheidol*
50 Dyfi*
51 Dysynni*
52 Mawddach*$ & Wnion*
53 Artro
54 Dwyryd*
55 Glaslyn*
56 Dwyfach & Dwyfawr*
57 Llyfni
58 Gwyrfai$
59 Seiont*
60 Ogwen*
61 Conwy*
62 Clwyd*
63 Dee*$
64 Ribble*
65 Wyre*
66 Lune*
67 Kent*
68 Leven*
69 Crake*
70 Duddon*
71 Esk (Cumbria)*
72 Irt*
73 Ehen & Calder*$
74 Derwent*$
75 Ellen
76 Wampool
77 Eden*$
78 Esk (Border)*

** River with Salmon Action Plan; $ River designated as a Special Area of Conservation*

Figure 1. Map of England and Wales showing the main salmon rivers and denoting those (*) with Salmon Action Plans and those ($) designated as Special Areas of Conservation in which salmon must be maintained or restored to favourable conservation status**.**

Table 1. Summary of the number and percentage of rivers above their Conservation Limits (CL), between 50% and 100% of the CL, and less than 50% of the CL, from 1993 to 2006

Year	>CL		50-100% CL		<50% CL	
	No.	%	No.	%	No.	%
1993	33	54	13	21	15	25
1994	41	65	14	22	8	13
1995	26	41	21	33	16	25
1996	31	49	15	24	17	27
1997	21	33	25	39	18	28
1998	30	47	23	36	11	17
1999	20	31	23	36	21	33
2000	26	41	25	39	13	20
2001[$]	20	34	18	31	20	34
2002	26	41	21	33	17	27
2003	18	28	18	28	28	44
2004	41	64	15	23	8	13
2005	31	48	18	28	15	23
2006	**38**	**59**	**16**	**25**	**10**	**16**
Average % 1993-2005		44.4		30.3		25.3

Key: [$] No assessment possible for 6 rivers due to impact of Foot and Mouth Disease.

Eighteen rivers have also been designated Special Areas of Conservation (SACs), under the EU Habitats Directive 92/43/EEC, with salmon as a named qualifying species. This places an additional requirement on managers to maintain the habitats in these rivers in a favourable condition for salmon.

2.2 Status of stocks

A national assessment of the status of the salmon resource in England and Wales is undertaken annually, using the Pre-fishery Abundance and National Conservation Limit Models (Potter *et al*., 2004), and reported to ICES (Figure 2). The total pre-fishery abundance (PFA) of salmon (the number of salmon alive on 1st Jan of their first sea winter) from English and Welsh rivers is estimated to have declined from over 350,000 in the 1970s to around 150,000 in the past 10 years, despite substantial reductions in exploitation both in homewater and distant water fisheries. However, the reduction in exploitation means that there has been a less severe decline in the spawning escapement, from about 130,000 to about 80,000. Spawning escapement has also been buffered to some extent by an increase in the proportion of smolt emigration at an earlier age.

The status of individual river stocks in England and Wales is also evaluated annually against the stock CLs and management targets (MTs) in line with the requirements of ICES and NASCO (see also Section 5 for methods) [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 4]. Egg deposition requirements have been derived for each of the 64 main salmon rivers in England and Wales, and estimated deposition each year can be compared with these values (Annex 1). There was a slight decrease in the proportion of stocks meeting their conservation limits over the period 1993 to 2003, but there has been a substantial improvement in the past three years (Table 1).

The 'management objective' for each river is that the stock should be meeting or exceeding its CL in at least four years out of five (i.e. >80% of the time). The compliance of the 64 principal river stocks with this management objective in 2006 (see Section 6) was:

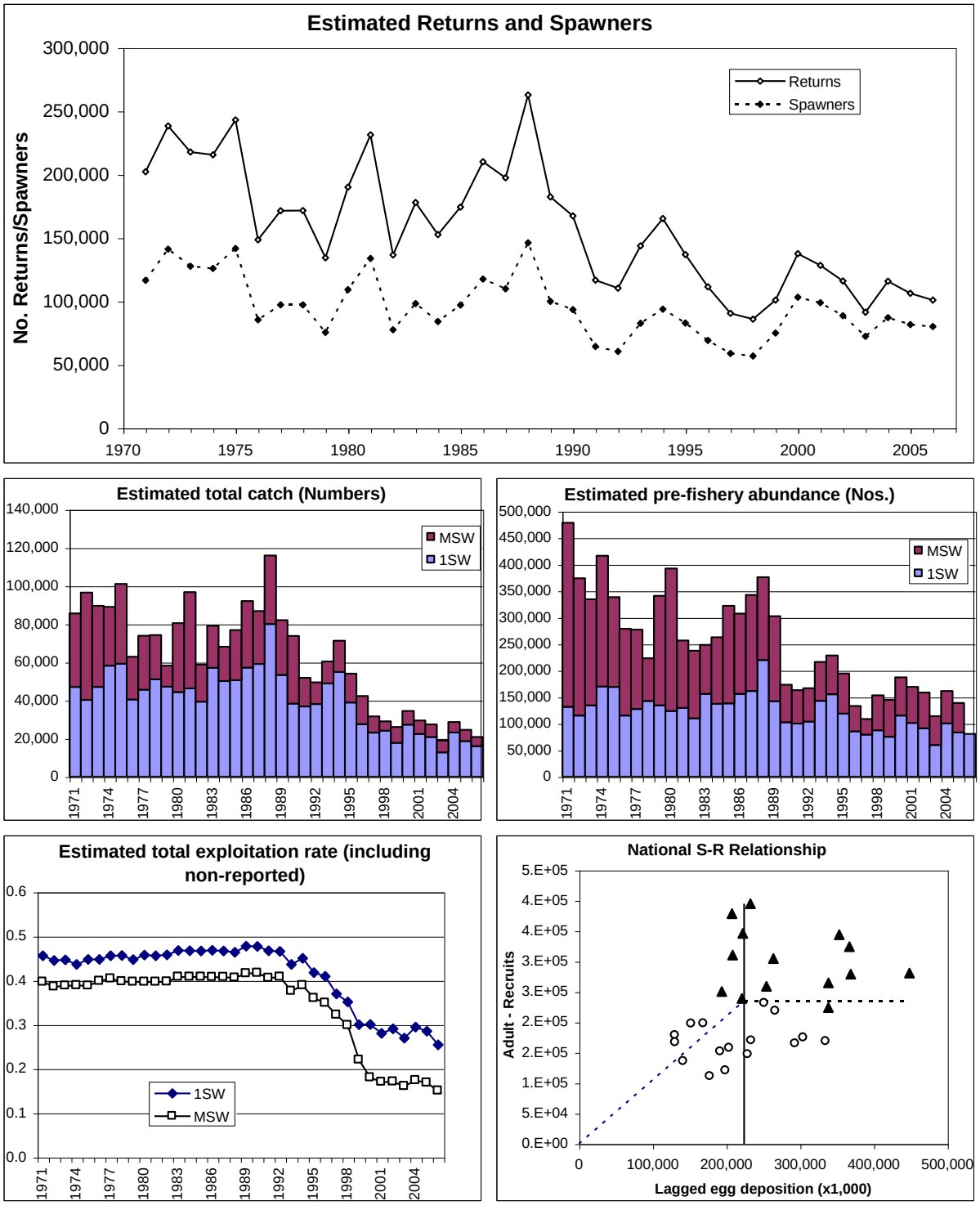


Figure 2. Summary assessment of the status of the national salmon stock in England and Wales for 1970 to 2006 based on the ICES "NEAC PFA & NCL models". (The lower right panel is the output of the ICES model which estimates a national conservation limit (NCL) based on national estimates of egg deposition and adult recruitment over about 30 years; black triangles denote years before 1990, and open circles the years subsequently.)

- 11 rivers (17%) had a high probability of meeting the management objective;
- 28 rivers (44%) had a high probability of failing to meet the management objective; and
- 25 rivers (39%) fell between a clear fail or pass.

The probability of these stocks meeting the management objective in 2011 has also been assessed, as:

- 11 are forecast to have a high probability of meeting the management objective;
- 19 are forecast to fail to meet the management objective; and
- the assessment for the remaining 34 falls between a clear fail or pass.

Densities of juvenile salmon are also monitored in a sample of river reaches each year in a rolling programme of surveys. [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 15]. Rivers are classified according to the abundance of fish relative to baseline average values (density of fry or parr) derived from measurements in the early 1990s. In surveys conducted between 2001 and 2006, only 23% of rivers had more than 50% of their stream length at or above the baseline values (class A to C); and in 49% of rivers, 50% of the stream length was well below average or fish-less (class E or F) in terms of juvenile salmon densities. Such information is used alongside the assessments of spawning escapement against CLs and MTs to make judgements on the management measures appropriate for each river.

Stock diversity

Measures of stock diversity potentially encompass a wide range of characteristics, but those of greatest significance for the management of fisheries are the population structure within the river, and the run timing and sea age composition of the returning adult stock.

Individual breeding populations are difficult to identify within a river but these may be expected to be spatially separated. Thus monitoring programmes which evaluate the status of the stock throughout the river can be used to safeguard the population structure. In England and Wales, juvenile surveys are undertaken to ensure that there is satisfactory production from all parts of the catchment (see Section 5), and the distribution of catches both in space and time is also considered.

Salmon return to rivers in England and Wales throughout most months of the year, and run-timing and sea age are closely linked. Multi-sea-winter (MSW) salmon tend to return in the spring (although there are also summer and autumn runs of these fish) with the oldest fish tending to return earlier in the year. Grilse, on the other hand do not begin returning until about June, although some rivers may have runs of grilse as late as December.

In common with many regions of the North Atlantic, England and Wales has seen a decline in the proportion of MSW salmon in returns, with the greatest reduction being in the early running fish, particularly 3SW and older. Efforts are therefore made to monitor the weight composition of the catches (as a surrogate for age composition). Since 2001, data collection procedures for all net fisheries have been standardised into small (<3.6kg) and large (>3.6 kg) categories to provide a consistent picture of changes in the age-composition of the catches over time (Table 2).

Nationally, the proportions of MSW salmon recorded in catches since 1999 are expected to have been reduced by the introduction of the measures restricting fishing effort in the early part of the season when MSW salmon comprise the majority of the catch (Section 3.2). The catch from 63 principal salmon rivers have been analysed for changes in the proportion of multi-sea winter salmon and catch per unit effort (number of salmon caught per 100 days effort) between 1994 and 2006. The data were analysed on a monthly basis and a statistical model was used to estimate the proportion and abundance of MSW salmon in the catch.

Table 2. Proportion of small and large salmon in net catches in England and Wales in 2006.

Region	% small salmon (<3.6 kg)	% large Salmon (>3.6 kg)	Total catch
North East	45	55	7,566
Anglian	100	0	15
South West	66	34	477
Midlands	34	66	864
Wales	68	32	679
North West	72	28	3,977
Total	**54**	**46**	**13,578**

For the majority of the 63 rivers (42.8%), there was no significant change in the proportion or the abundance of MSW salmon over the time period. Eighteen (28.6%) showed an increase in abundance, while only five (7.9%) showed an increase in proportion. This would suggest that, in the majority of rivers, the diversity (ratio of 1SW:MSW fish) has remained relatively constant. Only in a few rivers was the rate of increase of MSW salmon faster than for grilse.

The age composition of emigrating smolts varies in different parts of the England and Wales and has also changed over time. In some rivers there has been a significant reduction in their mean age, and this may have consequences for marine survival rates and age at return. For example on the River Dee (Wales) the proportion of salmon smolts migrating as two year olds has declined from ~90% historically to currently around 60%, the remaining 40% migrating as one year old smolts (Aprahamian et al., in press).

3. Description of the fisheries

Overview of salmon fisheries in England and Wales

Salmon and sea trout stocks in England and Wales support recreational and commercial fisheries in rivers, estuaries and coastal waters that have a capital value of about £130 million (2001 figures) (Radford et al 2001). Around 20 different 'netting' methods are employed for catching migratory salmonids (Annex 2), along with angling by rod and line. The netting methods fall into four main categories comprising: gilling nets, which include drift, trammel and coracle nets; sweep/encircling nets, which include seine, draft, draw and wade nets; fixed engines[1], which include T-nets, J-nets, stop (compass) nets, putcher ranks, traps and cribs (coops); and hand-held nets, which include haaf (heave) and lave (dip) nets. The number of net licences, the approximate number of fishermen employed and the weight of the catch in 2006 in each of these categories is shown in Table 3.

There are rod fisheries for salmon in 78 rivers in England and Wales (Figure 1), although the catch in some of these rivers is very small, and in 2006 net fisheries were licensed to operate within the estuaries and/or lower reaches of 25 of them. These fisheries, along with the types of nets used and the effort restrictions (number of licenses and number of days fishing allowed) are listed in Table 4. All these salmon fisheries also exploit migratory trout to a greater or lesser extent.

[1] The term fixed engine is used as a generic descriptor of stationary fishing gears in the UK.

Table 3. Summary information on fishing methods employed to catch salmon in England and Wales in 2006.

Category	Number of net licences	Estimated number of fishermen	Weight caught & retained and % of total
Gilling nets	52*	~130	20.6 (26%)
Encircling nets	57	~115	2.9 (4%)
Hand held nets	147	~147	10.7 (13%)
Fixed engines/Trapping nets	65	~130	16.3 (20%)
Rod and line - short term - annual	8,637 18,465	~24,000	29.6 (37%)
Total			**80.7 t**

* Includes 5 combined licences for the use of drift and T/J nets.

The number of licences issued for nets and fixed engines has been significantly reduced over the past 20 years as a result of measures taken to cut levels of exploitation and to phase out mixed stock fisheries, as well as the declining commercial viability of some fisheries. Overall, the number of net licences issued has decreased from 897 in 1985 to 321 in 2006, a 64% reduction. The largest reduction has been in the numbers of 'gilling nets' (77%), which have accounted for the majority of the catch in coastal waters, followed by encircling nets (75%) and hand-held nets (61%) which have been operated mainly in estuaries. It is likely that there were around 500 fishermen participating in net and trap fishing for salmon fishing in 2006, compared with around 24,000 anglers.

Regulatory framework for salmon fisheries

Both rod and net fisheries for migratory salmonids in England and Wales are regulated mainly by effort controls. Regulatory measures may be applied nationally, regionally or on a local (e.g. fishery) basis and are imposed through primary or secondary legislation. Some controls may also be introduced on a voluntary basis or through agreements between interested parties. Regulations are generally applied on a multi-annual basis, usually operating for five to 10 years. This is designed to ensure some stability and continuity in the fisheries, while at the same time allowing management objectives (e.g. restoring the stock above its CL) to be applied over an appropriate timeframe. The recent trend has been for an increase rather than a reduction in restrictions. Nevertheless, the status of stocks is reviewed annually and if major new problem arise or there is an unexpected major change in the status of a stock, the authorities may review the existing byelaws or bring in new byelaws, which will take effect as soon as they are approved.

Anyone fishing for salmon with net, fixed engine or rod and line must have a licence. The numbers of net/fixed engine licences issued are usually limited by Net Limitation Orders (NLOs) that apply to individual fisheries (e.g. within each estuary) (Table 4). A review process, including stakeholder groups, commences prior to the expiry of the NLO and the Decision Structure (Annex 3) is used to determine the requirements for, and implement, new controls. [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 5]. The procedures for reviewing and selecting management options are as follows:

- identify level of control required to meet conservation need over an appropriate timescale;
- assess regulatory options to achieve this;
- propose option(s) that best account for social and economic aspects;
- consult affected/interested parties informally and formally; and
- seek Ministerial confirmation for refined proposal.

Table 4. Allowable and utilised effort for the principal salmon net fisheries in England and Wales in 2006

Reg	River/ Fishery	Method	No. of licences	NLO	Days available *	Allowable effort net days **	Utilised effort		% days utilised #	Av. day/lic.	Av. annual catch 2002-2006
							net days	net tides			
NE	N Coastal (N)	Drift	5	X	66	330 }			31	37	7615
	N Coastal (N)	Drift & T	5	X	114	570 }	1,132				
	N Coastal (N) [1]	T	21	25	114	2,850 }					3626
	N Coastal (S)	Drift	4	X	66	264	212		80	53	1435
	N Coastal (S) [1]	T	1	1	114	114	23		20	23	24
	Y Coastal	Drift	2	X	66	132	83		63	42	703
	Y Coastal [1]	T or J	28	50	114	5,700	707		12	25	394
	NE Region		**66**			**9,960**	**2,157**		**22**		13797
SW	Avon & Stour	Seine	4	4	52	208		153	53	27	98
	Poole Harbour	Seine	1	1	52	52		42	58	30	11
	Exe	Seine	11	11	64	704		187	19	12	336
	Teign [1]	Seine	3	3	119	357		75	15	18	186
	Dart [1]	Seine	3	3	133	399		129	23	31	143
	Camel [2]	Drift	7	7	26	182		2	1	0	35
	Fowey [1,3]	Seine	2	2	66	132		33	18	12	3
	Taw/Torridge	Seine	3	X	52	156		93	43	22	143
	SW Region		**34**			**2,190**		**714**	**23**		**1038**
Midlands	Severn	Putchers	5		76	380	368		97		820
	Severn	Seine	3	4	78	312		38	9	9	28
	Severn	Lave	21		78	1,638		530	23	18	213
	Midlands region		**29**			**2,330**	**368**	**568**	**33**		**1060**
Wales	Wye	Lave	7		78	546		206	27	21	7
	Tywi [1]	Seine	8	9	131	1,179		375	23	33	39
	Tywi [1]	Coracles	5	12	131	1,572		223	10	32	37
	Taf	Coracles	1	1	131	131		30	16	21	0
	Taf	Wade	1	1	131	131		14	8	10	0
	E/W Cleddau	Compass	6	6	75	468		109	17	13	20
	Nevern [1]	Seine	0	1	131	131		0	0	0	0
	Teifi [1]	Seine	1	4	131	524		87	12	62	42
	Teifi [1]	Coracles	7	12	131	1,572		184	8	19	70
	Dyfi [1]	Seine	2	3	131	393		67	12	24	17
	Dysynni	Seine	1	1	131	131		3	2	5	5
	Mawddach	Seine	2	3	78	234		86	26	31	1
	Conwy	Seine	2	3	78	92		56	17	20	26
	Dee	Trammel	3	X	53	159		144	65	34	364
	Dee	Seine	9	X	53	477		291	44	23	375
	Welsh Region		**55**			**7,740**		**1,875**	**17**		**1004**
NW	Ribble	Drift	6	6	78	468		177	27	21	209
	Lune	Haaf	12	12	78	936		891	68	53	381
	Lune	Drift	7	7	78	546		287	38	29	823
	Lune	Seine	1	0	78	78		45	41	32	45
	Kent	Lave	8	8	78	624		98	11	9	47
	Leven	Lave	3	0	53	159		120	54	29	9
	Eden & Esk	Haaf	96	155	87	13,485		4,512	24	34	1951
	Eden & Esk	Coops	3		87	261		0	0	0	
	NW Region		**136**			**16,557**		**6,130**	**26**		**3550**

Notes: *National spring salmon byelaws apply - all net fisheries closed until June 1. Some sea trout fisheries exempted from byelaws, but all salmon caught before June 1 to be returned.*
NLO refers to number of nets allowed under the terms of the net limitation order for that fishery.
In calculating the days available, any day, or part day, on which fishing has been allowed is included.
For fisheries in which utilised effort is recorded in terms of tides fished (Wales, Midlands, SW and NW Regions) 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: ** Days available have been adjusted to take account of partial buy-off arrangements.*
*** Allowable effort is calculated by multiplying the days available by the number of nets permitted under the NLO, except where the number of licences exceeds the NLO, in which case the higher figure is used.*
 # Expressed as days utilised (i.e. tide data x 1.4).
X Denotes reducing NLO - fishery being phased out as existing licensees leave the fishery.

[1] *Sea trout fisheries - exempted from national spring salmon byelaws (all salmon caught before 1 June to be released).*
[2] *Buy-off 1 July to 31 August.*

Fishing effort in a net/fixed engine fishery may be cut by reducing the NLO, but this will not necessarily have immediate effect on the number of licences issued because existing licensees who are dependent upon fishing for their livelihood retain the right (under primary legislation) to receive a licence as long as they wish to continue operating. In such circumstances payments can be made to netsmen to temporarily or permanently cease fishing, so speeding reductions in fishing effort.

The above rights could also be superseded by a byelaw to introduce more rapid change or to close the fishery if there was clear evidence that the stock was in a particularly serious state. However, such approaches may not be used to bypass the protection afforded to licensees under normal circumstances. Provisions being proposed in new legislation would provide emergency byelaw making powers, avoiding delays for consultation. They also propose to adjust the balance between conservation of fish stocks and protection of licensees to more strongly favour the former.

A small number of net/fixed engine fisheries are privately owned and are not subject to NLOs, but the number of gear units is limited. There is no limit on the number of licences that can be issued for fishing with rod and line, but most rod fisheries are privately owned and access is normally limited by the fishery owner or clubs/associations which run them.

All fisheries are also subject to byelaws which specify the nature of the gear, including baits and lures that may be used by anglers, along with where, when and how the gear may be used. Byelaws may be introduced to make immediate reductions in fishing effort (e.g. fishing times or length of seasons) but can only be used to close a fishery if there is a very serious conservation concern. Byelaws are reviewed prior to their expiry and the requirements for subsequent controls determined through the application of the Decision Structure [NASCO Implementation Plan 2006-11, Action 6].

National byelaws are used where there is a desire to have a consistent approach throughout England and Wales (e.g. banning the use of gaffs). Concerns about the decline in the numbers of MSW salmon, particularly those returning early in the year ('spring salmon'), resulted in national measures being introduced in 1999 for a period of 10 years. These banned netsmen from killing and, in most cases, fishing for salmon before 1st June and imposed compulsory catch and release in rod fisheries until 16th June. The need for continuing these national measures is currently under review.

As well as statutory measures, there is a range of voluntary measures in place. These include agreements between angling and netting interests, which result in netsmen being compensated to release fish or not to fish, and extensive voluntary catch and release of rod-caught fish. In total 56% of rod-caught fish were released in 2006 in response to both statutory and voluntary measures.

4. Mixed stock fisheries (MSFs)

Definition of MSFs

One of the objectives of salmon management should be to protect all breeding populations of the species. Such populations are not easy to distinguish, but genetic studies indicate that there may be several (and sometimes many) distinct populations within each salmon river. Simultaneous exploitation of salmon from several populations may present problems if the fishery takes a disproportionate number of fish from one population and thereby over-exploits it. However, nearly all fisheries, whether by rods or nets, take salmon from more than one population, and those operating in estuaries and the lower reaches of rivers will generally take fish from a number of populations sometimes originating from different catchments.

Thus efforts to target exploitation on individual populations would probably confine fisheries to spawning areas and result in a significant reduction in fishing opportunities.

As a result, managers have concluded, based on scientific advice (ICES 1996), that the practical unit for salmon management should be the 'river stock'. Furthermore, ICES (e.g. 2007) has advised NASCO that '*management for all fisheries should be based upon assessments of the status of individual [river] stocks'*, and '*that fisheries on mixed stocks, either in coastal or distant waters, pose particular difficulties for management as they cannot target stocks that are at full reproductive capacity*'. They therefore go on to advise that '*conservation would be best achieved if fisheries target stocks that have been shown to be at full reproductive capacity'*, and that '*fisheries in estuaries and rivers are more likely to meet this requirement*'.

The NASCO Decision Structure outlines the basis on which information should be compiled for the management of both single river stock and mixed river stock fisheries, and defines a mixed stock fishery as '*a fishery exploiting a significant number of salmon from two or more river stocks*'. Although this definition is slightly unclear, the approach indicates that, the management of a single river stock fishery requires information on the abundance and diversity of the stock, selectivity of the fishery and other fisheries exploiting the stock, any non-fishery factors affecting the stock, and socio-economic factors. The same information is required for the management of a mixed stock fishery, but it must be considered for all contributing stocks.

Within England and Wales, MSFs have been defined as '*fisheries that predominantly exploit mixed river stocks of salmon*'; this is consistent with the principles outlined above. The policy has been interpreted to refer to all fisheries operating outside river estuaries. Catchments discharging through a single estuary are treated as a single management unit (river stock), and where a fishery operates in such an estuary, fishing effort is regulated to protect the weakest component. A similar definition to that adopted in England and Wales has also been used by the European Commission in 2006 in a Commission Staff Working Document, 'Report On Mixed Stock Fisheries For Salmon in Atlantic Community Waters'.

In the case of very large estuaries, such as the Severn Estuary and the Solway Firth, a pragmatic decision has had to be made about which fisheries may be considered to fall within the river estuary and which are in 'coastal waters' and thereby constitute MSFs. Because of the highly complex nature of the fisheries in the Severn Estuary, including heritage fisheries and fisheries with private rights, it was decided to develop a specific Salmon Action Plan for the whole estuary and propose appropriate management measures for each of the fisheries.

There are two principal salmon rivers entering the Solway which are totally (Eden) or partly (Border Esk) in England, but there is no obvious boundary between the estuaries (or common estuary) of these rivers and the coastal waters within the Solway. In English waters, a single fishery operates in the estuary/ies of these rivers employing haaf nets (Annex 2). The means of operation of these nets, the upstream extent of their use and the topography of the area led mangers to conclude that this should be regarded as an estuarine fishery.

Operation of MSFs in England and Wales

In the early 1990s, there were 10 fisheries operating in coastal waters in England and Wales (Table 5). The largest of these was the North East Coast fishery, which accounted for 66% of the total England and Wales catch between 1985 and 1989. The main component of this fishery was based on drift nets operated up to 6 miles offshore, although a lesser number of fixed engines ('T nets' or 'T/J nets') were also worked from specified beaches.

Table 5. Numbers of net licences issued to fish for salmon in 10 MSFs in England and Wales since 1993.

Year	Fishery										
	NE Coast	Anglian Coast	Severn Estuary[1]	SW Wales coast	River Ogwen	R. Seiont	R.Clwyd	R Llyfni	R Dwyfawr	SW Cumbria
Net type	Drift[2]	T&J[2]	various	various	seine	seine	seine	sling	seine	seine	drift
1993	124	63	93	61	11	1	1	3	0	2	4
1994	114	46	72	60	16	2	2	2	0	2	4
1995	99	41	65	63	9	2	1	2	0	2	4
1996	89	42	59	43	0	2	1	2	1	2	4
1997	81	42	56	42	1	2	1	2	0	2	4
1998	75	40	54	32	0	2	0	0	0	1	4
1999	72	39	54	35		2				1	1
2000	71	38	46	31		1				0	1
2001	70	39	46	29		0					1
2002	69	41	46	24							1
2003	16	46	45	39							0
2004	16	55	40	31							
2005	16	54	39	30							
2006	16	55	36	29							

[1] The Severn Estuary Fishery has employed seine nets, drift nets, lave nets & putcher ranks but is managed as a single fishery
[2] Joint drift/T-net licences are recorded in both columns.

Eight of the remaining nine MSFs were quite small, and were thought to exploit mainly local stocks. These include six seine net fisheries operating on the Welsh coast and a small drift net fishery off the northwest coast. A larger drift and seine net fishery operated off the coast of East Anglia, but this was a mixed species fishery taking very few salmon.

The final MSF operated in the Severn Estuary and employed 8 drift nets, up to 4 seine nets, a variable number of lave nets and over 50 putts and putchers (see Annex 2). Eight salmon rivers flow into this estuary, and it was not obvious where the estuary limits might be drawn in order to define which, if any, of the fisheries may be regarded as a single stock fishery. The Environment Agency therefore drew up a single Salmon Action Plan for the whole estuary and determined that most parts of the fishery should either be closed or capped at the 2002 level.

About 30t of salmon was taken by coastal MSFs in 2006, comprising about 80% of the catch by both gilling nets and fixed engines/traps and 37% of the total national landings.

Management of MSFs in England and Wales

In 1996, a policy for MSFs was adopted for the whole of England and Wales which stated that '*exploitation…should take place, as far as possible, where the stock of salmon is from a single river. In fisheries which can be shown to exploit predominantly mixed stocks, fishing will be phased out over an appropriate timescale'* (NRA 1996). This followed an earlier decision to phase out the North East Coast Drift Net Fishery based on the recognition that exploiting salmon in MSFs makes management of individual river stocks difficult and may

prejudice their full protection (Anon 1993). In 2000, the Salmon and Freshwater Fisheries Review (MAFF 2000), undertaken by an independent group of experts, endorsed the policy of phasing out mixed stock fisheries and also agreed that it was reasonable that this policy was not applied to estuary fisheries exploiting fish from a small number of rivers as long as these could be managed to protect the weakest stock. The advice was accepted by both English & Welsh Governments (MAFF 2001).

This policy has been applied to the ten coastal mixed stock fisheries in England and Wales and has been completed for seven of them (Table 5). In several cases, the phase-out has been accelerated by introducing compensation schemes to encourage fishermen to retire from the fishery early. Thus, significant advance was made with the phase-out of the North East Coast Salmon fishery in 2003. A £3.4 million buy-out, funded by the Department of Environment, Food and Rural Affairs (£1.25M) and the North Atlantic Salmon Fund UK (£2.15M), was agreed which resulted in 52 of the remaining 68 netsmen leaving the fishery. When these fishermen left the fishery, their licences could not be reissued.

The remaining mixed stock fisheries operate in areas where information is available on the stocks being exploited. Nevertheless, additional research is being undertaken to develop genetic stock identification techniques to improve this information. The fisheries will be managed, taking account of social-economic factors and other constraints outlined elsewhere in this report, to ensure that the stocks being exploited are meeting their conservation limits or, where this is not the case, the fishery is not significantly prejudicing other efforts to ensure that this objective is achieved within a reasonable timescale. This is consistent with the principles of NASCO's agreements on the application of the Precautionary Approach and use of the Decision Structure.

The current management plan is to continue the phase out of the North East coast drift nets and the Anglian nets as fishermen retire, although this policy will have to be reviewed at least every 10 years. By 2012, the measures for the fishery will also be evaluated and determined to ensure that they are consistent with the England and Wales policy [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 3]. There is a limit on the number of T/J net licences that may be issued in the North East coast fishery (Table 4). Future changes to this limit will be judged against the impact on individual river stocks exploited, particularly those that are in the weakest state.

The Environment Agency's Severn Estuary SAP (2003) sets out the principle of seeking to phase out exploitation by fisheries in the estuary over an appropriate time-scale. However, the unique ownership and rights that control the operation of the fixed engines restrict the management options available. The general approach has been: closure of the drift net fisheries and some of those fisheries that have not operated in recent years; to reduce or cap fishing effort in all other fisheries; and to plan a detailed evaluation of the mixed stock issues in the light of other management considerations. The SAP also proposes a review of the cultural value of the traditional fisheries employed in the estuary in order that this can be taken into account in the management plans.

5. Management approach to control salmon harvest in England and Wales

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Conservation limits and management targets

Procedures have been developed for managing salmon fisheries in England and Wales building on the NASCO Decision Structure, which was designed to provide a basis for more consistent approaches to the management of salmon exploitation. The Decision Structure proposes the use of reference points, such as conservation limits and management targets, to trigger management actions to address any failure in abundance or diversity.

The use of conservation limits in England and Wales has developed in line with the requirements of ICES and NASCO to set criteria against which to give advice on stock status and the need to manage and conserve individual river stocks. Conservation limits (CLs) indicate the minimum desirable spawning stock levels below which stocks should not be allowed to fall. The CL is set at a stock size below which a further decline in spawner numbers is likely to result in significant reductions in the number of juvenile fish produced in the next generation.

Two relationships are used to derive the CLs:

(i) a stock-recruitment curve – defining, for the freshwater phase of the life cycle, the relationship between the number of eggs produced by spawning adults (stock) and the number of smolts resulting from those eggs (recruits).

(ii) a replacement line – converting the smolts emigrating from freshwater to surviving adults (or their egg equivalents) as they enter marine homewaters. This relationship requires an estimate of the survival rate at sea.

The model used by the Environment Agency to derive a stock-recruitment curve for each river assumes that juvenile production is at a 'pristine' level for that river type (i.e. is not affected by adverse water quality, degraded physical habitat, etc). Similarly, in deriving the replacement line, marine survival rates for most river stocks were assumed to be equivalent to the rates estimated on UK monitored rivers (such as the North Esk) in the 1960s and 1970s. Default survival values recommended for this purpose were 25% for 1SW salmon and 15% for MSW fish. However, that period is thought to be one of high sea survival, and new default values of 11% for 1SW salmon and 5% for MSW fish which are more representative of sea survival over the last 20 years were introduced by the Environment Agency in April 2003.

These rates have now been applied in calculating CLs for all rivers with SAPs. Introducing marine survival rates which are intended to be closer to those currently experienced by UK salmon stocks will reduce the effect of high mortality at sea as a cause of failing CLs. This will help managers focus on other issues over which they have more control (e.g. poor environmental quality in-river, over-exploitation by net and rod fisheries, etc.) when compliance failure occurs. The reduction in CLs means, however, that lower levels of spawning escapement are accepted before the stock is considered to be threatened. The Environment Agency also uses the 'management objective' for each river (e.g. in reviewing management actions and regulations) that the stock should be meeting or exceeding its CL in at least four years out of five.

Performance assessment and uncertainty

The performance of salmon stocks in England and Wales is assessed using a compliance scheme designed to give an early warning that a river has fallen below its CL. The compliance assessment and a forecast of expected compliance in five years time are then two of the factors feeding into the national Decision Structure for developing fishing controls for salmon fisheries in England & Wales (Annex 3). These procedures are a further development of principles described in the NASCO Agreement on Adoption of a Precautionary Approach and the Decision Structure For Management of North Atlantic Salmon Fisheries.

The compliance scheme provides a way of summarising the performance of a river's salmon stock over the last 10 years (including the current year), in relation to its CL. Bayesian regression analyses are applied to egg deposition estimates from the last 10 years, on the assumption that there might be an underlying linear trend over the period. The method fits a 20 percentile regression line to the data and calculates the probability that this regression

line is above the CL, and thus that the CL will be exceeded four years out of five (the management objective). If there is a low probability (less than 5%) that the 20 percentile regression line is above the CL, the river fails to comply, whereas if the probability is high (more than 95%), the river complies in that year. Between these probability values we cannot be certain of the stock status. The scheme also allows the 20 percentile regression line to be extrapolated beyond the current year in order to predict the likely future performance of the stock relative to its CL, and so assess the likely effect of recent management intervention and the need for additional measures.

The compliance graphs for the Rivers Wear, Ogwen, Leven and Erme are shown as examples (Figure 3). When the upper bound (95 percentile) of the regression line confidence interval is below the CL line the river is judged to be failing its CL (i.e. there is a ≥95% probability of failure). For example, this is the case on the Wear from 1997 to 2000 and is indicated by the X symbol on the CL line. When the lower bound (5 percentile) of the regression line confidence interval is above the CL line the river is judged to be passing its CL (i.e. there is a ≤5% probability of failure). This is the case on the Wear from 2003 to 2011 and is indicated by the Δ symbol on the CL line. Between these two extremes, the shaded confidence interval of the regression line overlaps the CL line and so the status of the river is judged as 'uncertain' (i.e. the probability of failure is >5% but <95%). This is the case on the Wear from 2001 to 2002 and is indicated by the O symbol on the CL line.

Egg deposition estimates for a river may be consistently above the CL but status may still be uncertain. This is the case on the Ogwen in 1997 and from 2004 to 2011 (O symbol on the CL line). In part, this reflects the marked year-to-year variation in egg deposition estimates on this river, which produces a broad confidence interval around the regression line, but also arises because of the increasing uncertainty associated with all regressions once extrapolated beyond the data set.

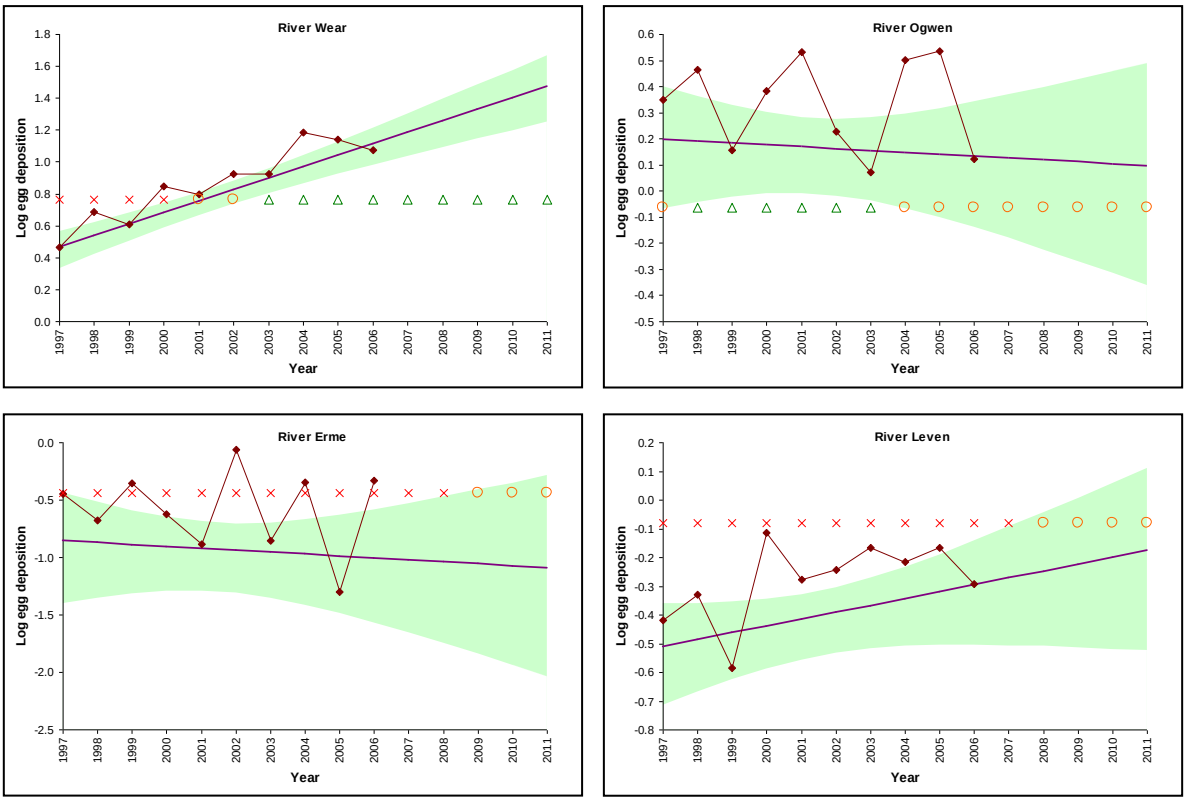

Figure 3. Compliance graphs for the Rivers Wear, Ogwen, Leven and Erme showing individual egg deposition estimates (black dots on the graphs), the 20 percentile regression lines and (shaded) 90% confidence intervals, and the CL lines (represented by up to three symbols: X, O and Δ).

As well as providing an assessment of the status of a river in relation to its CL, the direction of the trend in the 10-year time-series of egg deposition estimates and its statistical significance may also serve as an important indicator of the need to take management action and of the degree of intervention required. For example, CL compliance projections for the Rivers Leven and Erme both indicate 'uncertain' status in the years 2009 to 2011 (in both cases the upper 95 percentile of the regression line confidence interval is close to the CL), but the negative trend on the Erme, in contrast to the positive trend on the Leven, would give additional cause for concern.

The Environment Agency is continuing to review and revise its procedures for using reference points and other modelling techniques in the assessment and management of salmon stocks [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 2]. Work is underway to better reflect real exploitation rates, where these are available, in stock assessments, and to review the balance between use of default (generic) and river-specific data. The assessment approach described above is now incorporated into the national decision structure for guiding decisions on fishery regulations (Annex 3).

Stock diversity and selectivity of the fisheries

Although river specific CLs and MTs have been established for all principal salmon rivers in England and Wales, it has not proved possible to develop age specific values, as recommended by NASCO, other than at a national level (Potter et al, 2004; ICES 2007). This is primarily because it is difficult to establish the appropriate baseline for such reference points at a local level, and consequent concerns that imposing such limits might apply unreasonable restrictions on fisheries.

However, when assessing the status of stocks in England and Wales account is also taken of trends in catches of grilse and MSW salmon, and where available estimates of the exploitation rates for these components. Consideration is also given to the selectivity of the fisheries for different age classes, based upon their size, run timing and behaviour. Thus, for example, most net fisheries operate during the peak of the summer runs and therefore tend to target grilse stocks which return to freshwater at this time. Furthermore, netsmen using gilling nets will usually use a mesh size that is most effective for grilse. On the other hand, rod fisheries may select MSW salmon both because conditions tend to be favourable for angling in the spring when the early running MSW fish enter freshwater and are more vulnerable to capture by rod and line, and once in freshwater, these fish will be exposed to angling pressures for much longer than the later running grilse.

Such factors are taken into account in determining how effort restrictions should be shared between the different fishing methods with the aim of achieving the management objective for the target stock(s).

Non-fishery factors affecting the stock

CLs and MTs form only one part of the assessment of the status of a stock, and management decisions in England and Wales are never based simply on a compliance result alone. Because stocks are naturally variable, the fact that a stock is currently exceeding its CL does not mean that there will be no need for any management action. Similarly, the fact that a stock may fall below its CL for a small proportion of the time may not mean there is a problem. Thus, a range of other factors are taken into account, particularly the structure of the stock and any evidence concerning the status of particular stock components, such as tributary populations or age groups, based for example on patterns of run timing and the production of juveniles in the river sub-catchments. These data are provided by a programme of river catchment monitoring.

The impact of other factors on the stocks is also evaluated within the Salmon Action Plans. Stock conservation and recovery programmes will normally require a range of measures including both fishery and habitat management activities. Fishery regulations may be expected to have a more immediate effect on spawning stock abundance, whereas the benefits of habitat improvement may take longer to realise. However, there is no point in reducing fishing effort to increase the spawning escapement if there is insufficient river habitat (e.g. spawning or nursery areas) for the increased stock to utilise. Thus, fishery regulation is viewed as part of a suite of measures to conserve and enhance salmon stocks, as indicated in the NASCO Guidelines on the Use of Stock Rebuilding Programmes in the Context of the Precautionary Management of Salmon Stocks

Other fisheries exploiting the stock

Salmon returning to rivers in England and Wales have been exploited in the distant water fisheries on the west coast of Greenland and in the Norwegian Sea, in the coastal fisheries of neighbouring states such as Ireland, and in our own coastal waters. Extensive micro-tagging studies have been undertaken to estimate the effects of many of these fisheries on English and Welsh stocks (e.g. Russell and Potter 1996) and the latest information on the fisheries is reviewed annually in the Cefas[2]/Environment Agency annual report on salmon stocks (e.g. Cefas/Environment Agency, 2007). This information is taken into account when interpreting trends in stock status and catches and determining the need for changes to fishery regulations. Furthermore, through positive engagement with other relevant jurisdictions, directly and through the EU and NASCO, the relevant authorities seek to ensure that exploitation of any English or Welsh salmon stock in home-water fisheries outside England and Wales does not exceed 1% [NASCO Implementation Plan for UK(England & Wales) 2006-11, Action 7].

5.6 Socio-economic factors

When determining the need for increasing or decreasing the controls on a salmon fishery, the primary objective is to ensure the conservation or restoration of the exploited stock(s). Such measures may not only affect the level of catch but also the allocation of the catch between different parts of the fishery (e.g. rod and nets). Thus, unless there is a risk of serious or irreversible deleterious impacts to the salmon or its environment, there will be a need to determine whether the potential socio-economic consequences of the measures are acceptable. The approach used to do this in England and Wales is broadly consistent with the NASCO Guidelines for Incorporating Social and Economic Factors in Decisions under the Precautionary Approach.

Stakeholders are identified as part of the review process and are involved in subsequent discussions of the management options. The impact of the alternative options on the different stakeholder groups is considered in the light of the overall objectives and the need to ensure that they are permissible within the legislation, and not unreasonable or unjust.

In this context, consideration is given to whether a proposed measure will have an unreasonable effect on someone's livelihood (e.g. net fishing) or the value of their property (e.g. fishing rights). Such considerations may mean that it is necessary to reduce the full impact of a conservation measure, for example by postponing implementation, or planning the recovery of the stock over a longer period. Thus, for example, in the case of the phase out of the North East Coastal Drift Net Fishery, Fisheries Ministers in England and Scotland concluded that a full review of the fishery had not produced evidence of an immediate threat to stocks and thus any justification for depriving existing licensees of their licence at a stroke

[2] The Centre for Environment, Fisheries and Aquaculture Science is an executive agency of the Department of Environment, Food and Rural Affairs

(Anon 1993). However, they also determined that it would aid and improve the management of individual east coast salmon and sea trout stocks if the drift net fishery were to come to an end, and that it was therefore desirable to phase out the drift net fishery, but gradually so as not to cause unnecessary hardship.

Consideration must also be given to whether one group of stakeholders will be unreasonably affected in favour of or at the expense of another group. Thus, there is a need to ensure that measures affecting rod and net fisheries are equitable, bearing in mind that these fisheries will select different parts of the stock. Furthermore, measures may affect the value of these fisheries differently. Thus, the value of commercial fisheries is directly related to the landed catch, but this relationship is not as clear-cut for recreational fisheries, which may retain a value even if the catch has to be released.

In determining what type of measures might be introduced, detailed consideration is given to the types of fisheries involved. Thus, two options for reducing fishing effort could be to reduce the number of licences or to reduce the length of net that they may operate. Both measures may reduce the overall catch, but in the latter case the fishermen will have to work for more days. This may make the fishing activity uneconomic and might therefore be regarded as unreasonable. Where a fishery (whether rod or net) is considered to be recreational it may be appropriate to allow more individuals to participate but to limit their catches.

5.7 Expected extent and timescale of effects

As indicated above, effort regulations in English and Welsh salmon fisheries are generally reviewed and updated every 5 to 10 years. No attempt is made to forecast stock abundance or the harvestable surplus on an annual basis. Rather, the need for changes in fishery regulations is based on trends in the catches and other measures of stock status (e.g. juvenile abundance). Where stocks are below their CLs, new measures may be introduced to restore these over appropriate timescales, with the ultimate objective of stocks exceeding their CLs in four years out of five.

This is a different approach to that which NASCO suggests 'could' be adopted in the Agreement on Adoption of a Precautionary Approach. However, the overall objective is the same, to ensure that there is a high probability (in this case >80%) of stocks exceeding their CLs. The approach used has the advantage of ensuring greater stability in the fisheries, although there is a risk that the fishery may not compensate for years of high or low abundance. Thus in years of high abundance the stock may be underexploited and part of the harvest will be foregone, and in years of low abundance the stock may be overexploited.

6. Monitoring and identifying information deficiencies

Catch statistics are collected annually for all rod and net salmon fisheries in England and Wales and are used in the annual stock assessments. In addition, the Environment Agency operates fish counters on a number of catchments to provide estimates of the upstream run of adult salmonids and, together with catch data, of fishery exploitation rates. Effort is similarly collected for all fisheries but is recorded as combined effort on fishing for salmon and sea trout. A recent survey has enabled the effort on salmon and sea trout to be effectively partitioned. These data are being used in models to more effectively estimate exploitation and run size in those rivers in England and Wales where no counters exist

Extensive juvenile monitoring is undertaken, and the sampling programme was reviewed in 2002 to ensure a consistent approach in identifying spatial differences and temporal trends in juvenile salmon populations. The programme samples the same 494 sites semi-quantitatively each year to identify temporal trends in abundance, and 2,529 sites are sampled semi-quantitatively once every six years to identify spatial variation in juvenile populations. The

habitat at all sites is assessed using the model HABSCORE (Milner et al 1996), which provides reference conditions against which the abundance of the juvenile salmon population at any site can be compared.

Wild smolt tagging programmes are being run by the Environment Agency in collaboration with Cefas on the Rivers Tamar (South-west) and Dee (Wales) to monitor trends in marine survival for salmon from rivers in England and Wales.

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ANNEX 1. Conservation Limits (CL) and the proportion of the CL attained for the period 1997-2006 for the principal salmon rivers of England and Wales. Current compliance and predicted compliance in 2011 are shown in the right hand columns (see Section 5.2 for details).

	Accessible Wetted area (ha)	CL Eggs $100m^{-2}$	CL Eggs ($x10^6$)	Mgmt target Eggs ($x10^6$)	2006 egg deos'n ($x10^6$)	Proportion of Conservation Limit attained (%) *										Current Comp-liance #	Predicted Comp-liance in 2011 #
						1997	1998	1999	2000	2001	2002	2003	2004	2005	2006		
NE																	
Coquet	144	218	3.14	5.82	8.77	199	219	158	245	249	283	242	455	462	280	**Pass**	**Pass**
Tyne	542	208	11.25	25.59	67.64	215	241	307	355	421	427	356	677	533	601	**Pass**	**Pass**
Wear	232	250	5.80	9.05	11.85	59	99	82	153	118	133	147	261	238	204	**Pass**	**Pass**
Tees	620	240	14.90	15.94	3.07	6	27	25	23	16	15	20	37	17	21	**Fail**	**Fail**
Esk-Yorks	86	236	2.02	2.57	2.17	43	22	14	28	36	52	34	85	93	107	**Uncertain**	**Uncertain**
Southern																	
Test	138	246	3.40	4.08	2.58	23	56	56	39	29	75	26	81	82	76	**Fail**	**Uncertain**
Itchen	69	234	1.63	1.86	1.02	31	62	26	28	32	30	31	62	62	63	**Fail**	**Uncertain**
SW																	
Avon-Hants	369	175	6.48	7.73	3.63	17	28	40	64	58	95	30	51	26	56	**Fail**	**Uncertain**
Stour	142	149	2.12	2.19	0.25	11	7	8	14	12	19	6	10	5	12	**Fail**	**Fail**
Piddle	18	177	0.31	0.40	0.22	106	113	103	165	54	77	53	67	51	71	**Fail**	**Fail**
Frome	88	171	1.50	1.99	2.13	195	200	131	95	97	137	95	124	98	142	**Uncertain**	**Uncertain**
Axe	83	175	1.45	1.65	0.45	21	20	28	19	25	70	34	22	10	31	**Fail**	**Fail**
Exe	282	253	7.14	11.62	8.05	188	196	255	298	150	137	111	317	154	113	**Uncertain**	**Uncertain**
Teign	98	251	2.47	3.35	2.51	93	88	76	134	87	58	50	199	99	102	**Uncertain**	**Uncertain**
Dart	137	218	2.98	3.49	1.64	67	51	53	67	49	39	34	106	47	55	**Fail**	**Fail**
Avon-Devon	35	202	0.70	0.91	1.13	52	62	59	72	78	126	122	103	117	162	**Pass**	**Pass**
Erme	20	180	0.37	0.57	0.47	97	59	120	65	36	237	38	124	13	129	**Fail**	**Uncertain**
Yealm	11	212	0.24	0.34	0.13	53	163	17	91		67	10	28	54	55	**Fail**	**Fail**
Plym	29	188	0.55	0.67	0.43	77	69	33	57	41	57	21	18	17	78	**Fail**	**Fail**
Tavy	68	201	1.37	1.90	1.21	96	182	79	82	68	20	19	80	101	88	**Fail**	**Fail**
Tamar	293	395	11.56	13.78	12.50	64	78	84	68	84	127	118	96	121	108	**Uncertain**	**Pass**
Lynher	29	233	0.68	0.92	0.76	76	155	63	130	60	58	52	151	144	111	**Uncertain**	**Uncertain**
Fowey	42	207	0.86	1.47	2.40	127	152	221	222	225	311	255	414	318	279	**Pass**	**Pass**
Camel	56	176	0.98	1.51	3.04	177	184	131	185	180	214	258	320	277	309	**Pass**	**Pass**
Taw	274	211	5.78	9.89	7.68	108	213	200	353	98	123	101	238	92	133	**Uncertain**	**Uncertain**

ANNEX 1 (Continued)

	Accessible Wetted area (ha)	CL Eggs $100m^{-2}$	CL Eggs ($x10^6$)	Mgmt target Eggs ($x10^6$)	2006 egg deos'n ($x10^6$)	Proportion of Conservation Limit attained (%) *										Current Compliance #	Predicted Compliance in 2011 #
Torridge	198	207	4.10	5.12	2.67	35	95	47	84	17	38	26	102	66	65	**Fail**	**Uncertain**
SW (cont'd)																	
Lyn	27	359	0.97	1.61	1.89	144	172	208	360	293	247	208	320	118	195	**Uncertain**	**Uncertain**
Midlands																	
Severn	898	143	12.85	16.82	18.05	138	72	72	93	116	70	137	128	178	140	**Uncertain**	**Uncertain**
Wales																	
Wye $	1,610	221	35.66	39.63	22.43	71	61	60	46	65	28	49	71	63	63	**Fail**	**Fail**
Usk	407	248	10.11	13.67	19.13	122	148	153	209	216	174	89	197	124	189	**Uncertain**	**Uncertain**
Taff & Ely	146	219	3.19	3.44	0.28	18	19	36	15	7	18	26	11	9	9	**Fail**	**Fail**
Ogmore	61	180	1.10	1.36	0.34	70	76	61	77	62	46	26	117	34	30	**Fail**	**Fail**
Tawe	88	211	1.85	2.28	1.80	39	43	32	21	64	78	31	83	87	97	**Fail**	**Uncertain**
Tywi	500	226	11.30	14.65	14.31	56	78	71	89	44	67	85	162	108	127	**Uncertain**	**Uncertain**
Taf	90	189	1.70	2.50	1.99	83	54	85	107	133	48	32	226	136	117	**Uncertain**	**Uncertain**
E&W Cleddau	87	179	1.55	1.66	0.45	41	44	30	50	39	26	28	41	32	29	**Fail**	**Fail**
Teifi	326	265	8.65	12.40	12.01	139	132	145	143	164	128	89	286	128	139	**Uncertain**	**Uncertain**
Rheidol	31	222	0.68	0.80	0.36	76	60	56	51	48	30	27	98	70	52	**Fail**	**Fail**
Nevern	19	259	0.48	0.62	0.67	28	36	50	69	71	40	85	103	63	140	**Uncertain**	**Uncertain**
Dyfi	179	235	4.21	5.27	5.26	60	83	58	72	85	27	28	97	75	125	**Fail**	**Uncertain**
Dysinni	31	216	0.68	0.75	0.04	28	40	8	23	6	26	4	18	6	6	**Fail**	**Fail**
Mawddach	57	242	1.37	1.63	1.03	99	107	117	67	80	79	69	133	83	75	**Fail**	**Fail**
Dwyryd	9	201	0.19	0.44	0.66	279	281	140	79	234	497	251	630	286	353	**Pass**	**Uncertain**
Glaslyn	25	191	0.48	0.63	0.27	136	72	39	24	42	52	15	108	36	57	**Fail**	**Fail**
Dwyfawr	33	258	0.86	1.03	0.39	61	35	35	47	34	28	20	106	35	46	**Fail**	**Fail**
Seiont	21	226	0.48	1.17	1.63	158	198	111	214	242	69	85	645	375	342	**Uncertain**	**Uncertain**
Ogwen	24	362	0.87	1.61	1.33	259	336	165	279	392	195	137	367	396	153	**Uncertain**	**Uncertain**
Conwy	50	127	0.63	1.22	1.99	226	267	173	345	430	214	304	552	344	315	**Pass**	**Pass**
Clwyd	84	237	1.99	2.52	0.80	27	128	77	63	81	60	46	90	24	40	**Fail**	**Fail**
Dee	617	248	15.30	17.58	15.49	91	107	81	61	85	114	88	121	83	101	**Uncertain**	**Uncertain**

ANNEX 1 (Continued)

	Accessible Wetted area (ha)	CL Eggs $100m^{-2}$	CL Eggs ($x10^6$)	Mgmt target Eggs ($x10^6$)	2006 egg deos'n ($x10^6$)	Proportion of Conservation Limit attained (%) *										Current Compliance #	Predicted Compliance in 2011 #
NW																	
Ribble	351	242	8.49	10.67	9.60	26	63	63	81	38	71	71	97	123	113	**Uncertain**	**Uncertain**
Wyre	67	70	0.47	0.60	0.08	16	96	15	14	35	41	9	96	13	18	**Fail**	**Fail**
Lune	423	280	11.84	17.47	17.88	56	120	95	165	130	154	142	264	198	151	**Pass**	**Pass**
Kent	68	223	1.52	3.26	6.13	139	366	117	271	414	472	429	467	486	403	**Pass**	**Pass**
Leven	46	182	0.83	0.97	0.51	45	56	31	92		68	81	73	81	61	**Fail**	**Uncertain**
Crake	16	194	0.32	0.43	0.23	14	109	32	64		58	6	108	117	72	**Fail**	**Uncertain**
Duddon (& Lickle)	26	121	0.31	0.68	1.18	56	200	77	69		115	52	345	351	380	**Uncertain**	**Uncertain**
Esk	20	181	0.37	0.63	1.03	55	161	173	261	116	89	59	192	251	278	**Uncertain**	**Uncertain**
Irt	35	198	0.69	1.03	1.38	90	157	47	120	35	90	54	170	179	200	**Uncertain**	**Uncertain**
Ehen	41	230	0.94	1.76	2.11	88	253	52	343		306	101	275	243	225	**Uncertain**	**Uncertain**
Calder	13	261	0.33	0.50	0.41	149	220	26	176		183	57	140	85	124	**Uncertain**	**Uncertain**
Derwent	213	185	3.93	7.42	8.47	139	146	144	299	235	209	125	440	357	215	**Pass**	**Pass**
Eden	688	200	13.75	20.29	20.93	110	95	92	101	108	107	87	252	212	152	**Uncertain**	**Uncertain**
Esk-Border	306	255	7.79	9.67	8.87	89	85	63	102	75	120	69	135	147	114	**Uncertain**	**Uncertain**
E & W Total			**262.53**	**355.07**	**349.83**												

Footnotes

* Estimates include eggs contributed by rod-released fish.

Basis for current and predicted compliance explained in Annex 2.

$ Egg deposition estimates based on rod catch data & assumed exploitation rate - counter data & returning stock estimate considered too unreliable.

Prior to 1 April 2005, Border Esk egg deposition estimates were based only on English rod catch and likely to be underestimates.

ANNEX 2. Description 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 as a general descriptor of stationary fishing gears. The following are generalised descriptions of the gear used in England and Wales (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 characteristics have generally evolved to suit local conditions and are regulated by local byelaws.

GILLING NETS:

Drift net A 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.

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.

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.

Sling net The sling net is a type of drift net that has previously been used exclusively on the river Clwyd in North Wales. It differs from other drift nets only in so far as the nets are permitted to carry weights (not exceeding 4 kg) at either end, designed to retard the drift.

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 drift nets and beach seine nets (which may take fish by gilling).

SWEEP/ENCIRCLING NETS:

Seine net A seine net (also known as a 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.

Wade net A wade net consists of a short (~30 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.

FIXED ENGINES:

Basket trap This is a type of fixed engine which has only been 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.

Compass net These nets are operated from a boat 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.

Crib (or Coop) These ancient fixed engines 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 by monks in 1133 A.D., although the Derwent cribs are of more recent construction.

Putchers (and Putts) Putchers are wickerwork or metal 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 1 to 1.5 m wide, tapering to a narrow point which will prevent fish of moderate size from passing through. A netting leader is often used to guide fish into the putchers. Putts are of similar design to putchers, only larger.

T-net T-nets are fixed engines operated close to the shore, usually in specific berths. 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.

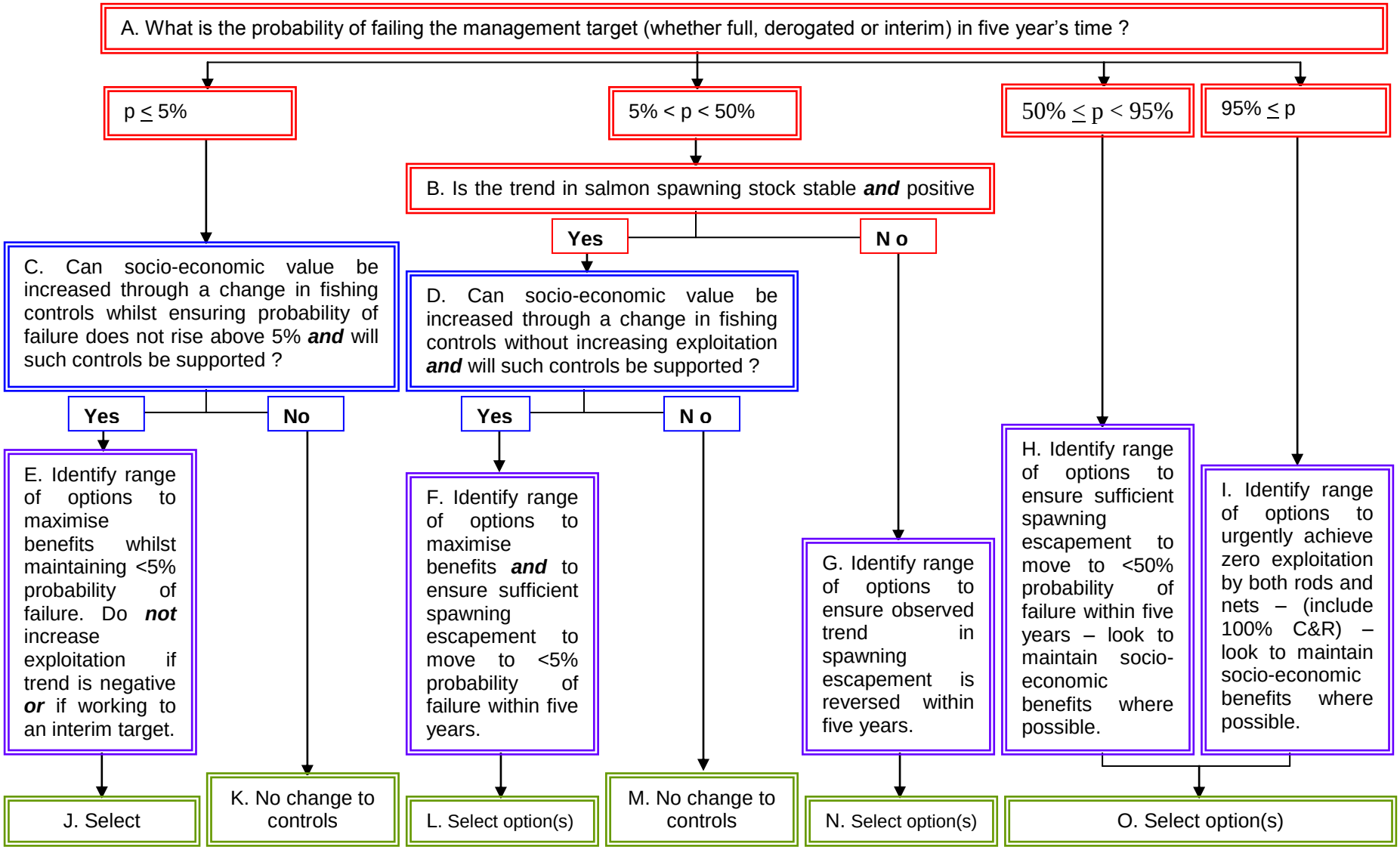
'T or J'-net 'T or J'-nets consist of plain sheets of netting on a floated head rope which hang vertically in the water by means of a weighted foot rope and are set from the shore in the shape of a 'T', 'J' or 'P'. These nets are usually operated as fixed engines, held stationary by means of weights,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

HAND-HELD NETS:

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.

Lave (or dip) net Lave nets, one regional variety of similar hand-held, one-man-operated nets, consist of a large Y-shaped wooden frame supporting a net, similar in design to an angler's landing net, but measuring up to 2 m across. The netsman actively stalks fish in estuary pools or shallows at low tide.

ANNEX 3 Developing fishing controls for salmon fisheries in UK(England & Wales)



ANNEX 3 (continued). Noes to accompany decision structure flow diagram.

INITIAL STAGE - STOCK ASSESSMENT

Assessing compliance with the management objective:

- The management objective is for spawning escapement (in terms of egg deposition) to exceed the spawning target (the Conservation Limit or the interim or derogated target where appropriate) for four years out of five.
- Compliance assessments are based on a Bayesian analysis which is used to estimate the probability that spawning escapement (in terms of egg deposition) will exceed the Conservation Limit (or the interim or derogated target where appropriate) for 80% of the time by a specified target date.

SECOND STAGE – INITIAL SCREENING FOR POTENTIAL OPTIONS

Within the second stage of the decision structure (blue boxes - 'C' & 'D') both socio-economic concerns and stakeholder support are considered for those rivers that have a <50% probability of failing the management target. By affording these two factors a higher level of importance the 'do-nothing' option remains a valid outcome for these rivers.

This stage can be seen as a screening stage for these rivers, for example effectively ruling out those management options that would not be supported by stakeholders.

For all other rivers (i.e. those where there is >50% probability of failing the management target) the decision structure does not provide the option of ruling out potential management controls in this way. In these cases all options must be carried through to the next (evaluation) stage.

THIRD STAGE - OPTION EVALUATION

The third main stage (purple boxes – 'E' to 'I') sets out and evaluates those options that could be employed to realise the required changes in exploitation. Considerations that will constrain or direct the thinking at this stage are effectively identified according to which vertical branch of the structure has been followed.

FINAL STAGE – SELECTION AND IMPLEMENTATION

The final stage of the decision structure (green boxes – 'J' to 'O') represents the final selection and implementation stage.