ENVIRONMENT AGENCY
SOUTH WEST REGION

ENVIRONMENT AGENCY

FISHERIES TECHNICAL REPORT

RIVER TEIGN SALMON SPAWNING TARGET AND COMPLIANCE ASSESSMENT.

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RIVER TEIGN SALMON SPAWNING TARGET SETTING AND COMPLIANCE ASSESSMENT

This paper presents the Environment Agency methodology used to set up the spawning target for the River Teign and to assess its compliance. It also provides details of which and how data are collected.

A- SPAWNING TARGET SETTING

The methodology relies on the Environment Agency transportation process from the river Bush to the River Teign, based on habitat classification by stream order and altitude range (SAP Guidelines version 1), and on river specific information such as:

-the accessible stream area for salmon,

-percentage of spawners assumed within each combination of altitude range and stream order; *ie*, spawners distribution within the river catchment,

-percentage of grilse of the River Teign salmon population,

-percentage of females,

-fecundity,

And on national means, such as:

-juvenile density, with proportion of fry and parrs, and

-marine survival.

After assessing these data, the transportation process uses a specific spreadsheet, presented in **Table 1**, to calculate the total egg target for the River Teign .

1-Calculation of the accessible stream area for salmon:

The SAP guideline indicates the catchment area of the River Teign (402.5 km^2), its boundary and which tributary is included with its upstream limit and stream order which is shown on the GIS map provided with the SAP guidelines. From this basis the accessible stream area for salmon is calculated as follows.

1.1 Calculation of the accessible stream length:

Obstacles which always prevent salmon migration, irrespective of flow, are identified from professional knowledge and recorded on the GIS map provided with the SAP guideline.

The inaccessible lengths are measured per habitat class (stream order and altitude class) on the map and are removed from the total length (accessible and inaccessible) within each combination of altitude and stream order given in **table XII.1 in appendix XII of the SAP guideline**.

For the river Teign , the inaccessible sections are on the North Teign, on the Beka brook, on Kate brook. The location of obstacles to salmon migration is shown on the GIS map in **Figure 1**.

The inaccessible sections measured have been grouped by habitat class. **Table 1 of Annex 1** shows the inaccessible lenght in each habitat class which are only stream order 1.

1.2 River wetted width within each habitat class:

To complete the assessment of accessible area, the stream widths have been measured during electrofishing. At each electrofishing site, an average width is calculated from individual width measures 5 metres apart. Then after assigning to each width measurements its habitat class, the mean width per habitat class is calculated.

If no measures have been taken for a habitat class, a default value is used which is an intermediary or successive value. **The table 2 of Annex 1** shows the mean width per habitat category, the default values appear in italic.

By combining length and width, the accessible area per habitat class is calculated. The total accessible area, or total useable area, is equal to **975 890 m² (Table 1).**

2- Juveniles density within each habitat class:

The carrying capacity for parr and fry in each habitat class is given by the extented HABSCORE database for 398 sites with access to salmon in Britain. This is shown in **annex 2 and table 1.**

3- Assumed distribution of spawners in the catchment within each habitat class:

The total accessible stream area is not used by the salmon in a uniform way. The transportation process allows adjustment for the distribution of the spawners in the catchment within habitat class.

Previous redd counts surveys and local knowledge from fisheries staff indicate that spawning is distributed as follows:

1- From upstream of the confluence Teign-Padley stream to downstream Sowton brigde, **50 %** of the adults spawn in **21.6%** of the accessible area.

2-**50 %** of the adults spawn on all the rest of the accessible sections which represents **78.4 %** of the area.

Therefore two areas are identified with 2 different proportions of spawners.

1-50% spawners on 21.6 % of the total accessible area

2-50% spawners on 78.4% of the total accessible area

This distribution is identified within the habitat classes and is adjusted according to the percentage of spawners in each of these two groups of stream area. The calculcation is as follows:

If there is a proportion **Q** of spawners in a proportion **P** of the accessible stream area, the proportion of adults assumed to spawn per habitat class, **s**, is:

$$s = (Q / P) \times a$$

with **a** , the percentage of the area of the habitat order and **P** the percentage of accessible stream area of each group

To help the calculation on the spreadsheet, each habitat order shown on the spreadsheet **(table 1)** is assigned a group 1 or 2 by representing it with tow different borders.

Q% of the spawners are in P% of the accessible stream area

50% of the spawners are in 21.6% of the accessible stream area
50% of the spawners in 78.4% of the accessible stream area

The following table explains the process on the transportation spreadsheet:

Reach	Altitude range (m)	Stream order	Definition Targets Report	% Area, a	% Spawners Assumed, s
6	0-49	1	A1	0.044	0.028
5	50-99	1	B1	0.079	0.051
4	100-149	1	C1	0.045	0.029
3	150-199	1	D1	0.082	0.052
2	200-299	1	E1	0.089	0.057
1	300-399	1	F1	0.051	0.033
	400-499	1	G1	0.014	0.009
	500-599	1	H1	0.007	0.004
	600-699	1	I1	0.000	0.000
	700-799	1	J1	0.000	0.000
12	0-49	2	A2	0.067	0.042
11	50-99	2	B2	0.014	0.009
10	100-149	2	C2	0.000	0.000
9	150-199	2	D2	0.012	0.007
8	200-299	2	E2	0.014	0.009
7	300-399	2	F2	0.007	0.005
	400-499	2	G2	0.000	0.000
	500-599	2	H2	0.000	0.000
	600-699	2	I2	0.000	0.000
	700-799	2	J2	0.000	0.000
18	0-49	3	A3	0.241	0.153
17	50-99	3	B3	0.124	0.288
16	100-149	3	C3	0.091	0.212
15	150-199	3	D3	0.020	0.013

For example, in the habitat H1 which represent 0.7% of the accessible area, 0.07% ÷ 78.4 %X 50% , ie, 0.04% of the adults are assumed to spawn.

4- Marine survival:

For grilse: **25%,** default value from litterature data.
For MSW: **15%,** default value from litterature data.

These survival rates are to the high seas fisheries.

5-Percentage of grilse:

The proportion used for the replacement line is the mean proportion of grilse over the last 10 years mean, $\mathbf{Pg}_{10y}$, which is calculated from monthly weight frequency distribution analyse, $\mathbf{Pg}_{net}$ or **Pg,** of net caught fish, summed for separate seasons.

The sea age composition of the net catches is assumed to be more representative of the sea age composition of the River Teign population then the rod catches. It is recognised that the salmon running in the river after the net season can alter the sea age composition.

For the river Teign it is Pg_{10y} = **83.1%.**

Details of the figures, Pg_{net}, are shown in **annex 3**. **Annex 4** gives the detail of the weight distribution analysis.

6-Percentage of female:

A relationship linking the proportion of female 1SW, named **Fg**, to the catchment size allows us to calculate the sex ratio for the grilse (in **Salmon Action Plan Guidelines appendix VI**).
The catchment areas for the River Teign is 402.5 km^2 (given in Appendix VIII of the guidelines). The sex ratio is considered as a constant throughout the years.

For the River Teign, **Fg** is **51.1%**. For MSW fish, **Fm** is a default mean value of **68.7 %**.

Then by combining the proportion of grilse and MSW, $\mathbf{Pg_{10y}}$ and $\mathbf{Pm_{10y}}$, the overall percentage of female, **F**, for the replacement line, is calculated as follows:

$$\mathbf{F = F_g \times Pg_{10y} + F_m \times Pm_{10y}}$$

Thus $\mathbf{F = 51.1 \times 83.1 + 68.7 \times 16.9 = 54.1\%}$

7- Fecundity:

Fecundity is not measured directly. A relationship between lenght and fecundity allows us to calculate it for each sea age category, **fg** for grilse and **fm** for MSW, (given in the Appendix VII of the guidelines).

The mean weight per sea age category, **Wg** for grilse and **Wm** for MSW, defined from scale reading of net catches from 1964 to 1972 is converted in lenght with the appropriate formula (**in Appendix VII of the guidelines**). **Wg** is equal to **6.1 lb** for grilse and for MSW, **Wm** is equal to **10.0 lb**.

Then the overall fecundity, **f**, is calculated by combining the proportion of grilse and salmon as follows:

$$\mathbf{f = f_g \times Pg_{10y} + f_m \times Pm_{10y}}$$

With $\mathbf{f_g}$ = **4154 eggs per female**

And f_m = **6103 eggs per female**

this gives an overall fecundity, f = **4483 eggs per female**

8- Calculation of the spawning target.

The model used for the transportation is designed on the spreadsheet with the river specific adjustment. **Table 1** gives an overall egg target for the River Teign of **3.07 million eggs**

B-ANNUAL EGG DEPOSITION ASSESSMENT.

For the River Teign the spawning escapement is estimated from the yearly declared rod catch returns.

1-Estimation of the number of salmon available for spawning from declared rod catches.

On the declared rod catches, a correction is applied in order to take into account catches that have not been reported.

Ct= Cd / p

Where **Ct** = total corrected rod catches

Cd = Declared rod catches

p = proportion of declared rod catches, which varies from 53% to 91% depending on the year (SAP guideline ,in **Guy Mawle added paper 6.3.97**).

From the corrected total rod catches, the size of the run for each age category is estimated using:

1-the extant rod exploitation rate for grilse, **Ug** and for MSW, **Um** (which is the proportion of fish taken by the rod fishery from the total annual run without the fish caught by the nets),

2- the proportion of grilse and MSW, **Pg** and **Pm**, estimated from the yearly net catches by weight frequency distribution analysis.
This proportion is the most representative of the population age composition, so Pg_{net} = Pg and Pm_{net} = Pm (like in **part A-5**).

The exploitation rate for all sea ages, **Uall**, is estimated from a relationship between the angling effort which is expressed as days fished per km^2 per catchment area, and the catchment size (**appendix V SAP guideline version1**).
The angling effort is calculated from the 1993 to 1995 catch per licence day and declared rod catch, Cd (**Salmonid and Freshwater Fisheries Statistics For England and Wales, 1995, 1994, 1993**). Its last 3 years mean is equal to **3277 days**.

The angling effort is obtained by dividing the declared rod catch, Cd, by the catch per licence day.

The extant rod exploitation rate, **Ug** and **Um**, is equal successively to **16.3%** and to **22.3%**. The exploitation rate is constant from one season to another as there is no information on its variation. In addition, this rate is assumed to be constant throughout individual years.

The proportion of grilse and MSW in the total corrected rod catches, $\mathbf{Pg_{rod}}$ and $\mathbf{Pm_{rod}}$, estimated as follows:

$$\mathbf{Pg_{rod} = (Ug \times Pg_{net}) / [(Ug \times Pg_{net}) + (Um \times Pm_{net})]}$$

This is used to calculate the number of each sea age category in the total rod catch, **Ctg** and **Ctm**, in order to get the total number of grilse and MSW spawning , **Sg** and **Sm**.

The number of grilse available for spawning: $\mathbf{Sg = [(Ctg / Ug)-Ctg] \times sg}$

With the number of grilse in the rod catch $\mathbf{Ctg = Ct \times Pg_{rod}}$

With **sg**, **sm** for MSW, post rod fishery survival = **0.91**

The same calculation is done for MSW fish.

The number of fish released by anglers have been declared on rod licence returns from 1993 to 1997 so these fish are added to the escapement. The number of grilse and the number of MSW released are calculated with the proportions **Pg** and **Pm**. The post rod fishery survival used is 0.91.

2- Conversion of the annual spawning escapement into a number of eggs.

The spawning escapment is then converted into a number of eggs, **E**, as follows:

$$\mathbf{E = Sg \times Fg \times fg + Sm \times Fm \times fm}$$

Where **Fg = 51.1%**, (Salmon Action Plan Guidelines appendix VI).
fg = 4154 eggs per female, estimated from the mean weight of each age class from scale reading of net catches from 1964 to 1972 (see **part 1**).

Where **Fm = 68.7%** (default value)
fm = 6103 eggs per female, estimated from the mean weight of each age class from scale reading of net catches from 1964 to 1972 (see **part 1**.).

NB: Fecundity and sex ratio are considered as constant across the years.

An example of these calculation is shown on **table 2**. **Table 3** gives the annual egg deposition from 1962 to 98.
Annex 5 gives all the rod catches from 1962 to 1998.

The annual egg deposition is then compared to the spawning target. Following the rule in **SAP guidelines part 3.5**, periods of failure to the spawning target are identified. **Figure 2** shows that the river Teign has failed to comply in the last ten years.

C-SHORTFALL CALCULATION.

In order to measure the amplitude of the failure, a shortfall is calculated. The shortfall estimate is arbitrarily based on the last ten year (1989-98) mean of the difference between the egg spawning target which is a fixed value and the egg deposition which varies annually depending on the rod catch.

For the River Teign, the shortfall is equal to **0.94 million eggs.**

This is equivalent to **322 grilse** and to **62 MSW** in the spawning escapement.

The split is calculated with the last ten year mean of proportion of grilse from weight distribution of the yearly net catches and with the same estimate of fecundity and the same proportion of females used to assess egg deposition.
Figure 2 summarises the compliance assessment of the River Teign.

TABLE 1: RIVER TEIGN SALMON SPAWNING TARGET TRANSPORTATION

River Teign - revised target based on adjusted mean widths and excluding inaccessible reaches.

Reach	Altitude range (m)	Stream order	Definition Targets Report	Width (m) HABSCORE	Length (m) GIS ACCESSIBLE	Area (m2)	% Area	Length (m) GIS USABLE	Area (m2)	% Area	% Spawners assumed
6	0-49	1	A1	3.22	13355	42936	0.044	13355	42936	0.044	0.028
5	50-99	1	B1	4.51	17172	77446	0.079	17172	77446	0.079	0.051
4	100-149	1	C1	2.79	15767	43990	0.045	15767	43990	0.045	0.029
3	150-199	1	D1	4.61	17251	79579	0.082	17251	79579	0.082	0.052
2	200-299	1	E1	4.30	20107	86520	0.089	20107	86520	0.089	0.057
1	300-399	1	F1	3.89	12812	49787	0.051	12812	49787	0.051	0.033
	400-499	1	G1	4.00	3347	13388	0.014	3347	13388	0.014	0.009
	500-599	1	H1	4.00	1679	6716	0.007	1679	6716	0.007	0.004
	600-699	1	I1		0	0	0.000	0	0	0.000	0.000
	700-799	1	J1		0	0	0.000	0	0	0.000	0.000
12	0-49	2	A2	8.35	7782	64941	0.067	7782	64941	0.067	0.042
11	50-99	2	B2	8.00	1760	14080	0.014	1760	14080	0.014	0.009
10	100-149	2	C2	8.00	0	0	0.000	0	0	0.000	0.000
9	150-199	2	D2	7.65	1493	11421	0.012	1493	11421	0.012	0.007
8	200-299	2	E2	7.00	1928	13496	0.014	1928	13496	0.014	0.009
7	300-399	2	F2	7.00	995	6965	0.007	995	6965	0.007	0.005
	400-499	2	G2	4.17	0	0	0.000	0	0	0.000	0.000
	500-599	2	H2	4.17	0	0	0.000	0	0	0.000	0.000
	600-699	2	I2		0	0	0.000	0	0	0.000	0.000
	700-799	2	J2		0	0	0.000	0	0	0.000	0.000
18	0-49	3	A3	12.87	18548	235003	0.241	18548	235003	0.241	0.153
17	50-99	3	B3	10.23	11855	121229	0.124	11855	121229	0.124	0.288
16	100-149	3	C3	11.46	7777	89109	0.091	7777	89109	0.091	0.212
15	150-199	3	D3	11.00	1753	19283	0.020	1753	19283	0.020	0.013
14	200-299	3	E3	6.45	0	0	0.000	0	0	0.000	0.000
13	300-399	3	F3	8.21	0	0	0.000	0	0	0.000	0.000
	400-499	3	G3	8.98	0	0	0.000	0	0	0.000	0.000
	500-599	3	H3	8.78	0	0	0.000	0	0	0.000	0.000
	600-699	3	I3		0	0	0.000	0	0	0.000	0.000
	700-799	3	J3		0	0	0.000	0	0	0.000	0.000
24	0-49	4	A4	15.72	0	0	0.000	0	0	0.000	0.000
23	50-99	4	B4	14.56	0	0	0.000	0	0	0.000	0.000
22	100-149	4	C4	13.49	0	0	0.000	0	0	0.000	0.000
21	150-199	4	D4	12.49	0	0	0.000	0	0	0.000	0.000
20	200-299	4	E4	11.14	0	0	0.000	0	0	0.000	0.000
19	300-399	4	F4	9.55	0	0	0.000	0	0	0.000	0.000
	400-499	4	G4	8.20	0	0	0.000	0	0	0.000	0.000
	500-599	4	H4	7.03	0	0	0.000	0	0	0.000	0.000
	600-699	4	I4		0	0	0.000	0	0	0.000	0.000
	700-799	4	J4		0	0	0.000	0	0	0.000	0.000
30	0-49	5	A5	18.72	0	0	0.000	0	0	0.000	0.000
29	50-99	5	B5	14.56	0	0	0.000	0	0	0.000	0.000
28	100-149	5	C5	13.49	0	0	0.000	0	0	0.000	0.000
27	150-199	5	D5	12.49	0	0	0.000	0	0	0.000	0.000
26	200-299	5	E5	11.14	0	0	0.000	0	0	0.000	0.000
25	300-399	5	F5	9.55	0	0	0.000	0	0	0.000	0.000
	400-499	5	G5	8.20	0	0	0.000	0	0	0.000	0.000
	500-599	5	H5	7.03	0	0	0.000	0	0	0.000	0.000
	600-699	5	I5		0	0	0.000	0	0	0.000	0.000
	700-799	5	J5		0	0	0.000	0	0	0.000	0.000
36	0-49	6	A6	18.72	0	0	0.000	0	0	0.000	0.000
35	50-99	6	B6	14.56	0	0	0.000	0	0	0.000	0.000
34	100-149	6	C6	13.49	0	0	0.000	0	0	0.000	0.000
33	150-199	6	D6	12.49	0	0	0.000	0	0	0.000	0.000
32	200-299	6	E6	11.14	0	0	0.000	0	0	0.000	0.000
31	300-399	6	F6	9.55	0	0	0.000	0	0	0.000	0.000
	400-499	6	G6	8.20	0	0	0.000	0	0	0.000	0.000
	500-599	6	H6	7.03	0	0	0.000	0	0	0.000	0.000
	600-699	6	I6		0	0	0.000	0	0	0.000	0.000
	700-799	6	J6		0	0	0.000	0	0	0.000	0.000
					155381	975690	1.000	155381	975690	1.000	1.000

proportion p of spawners in x % of the accessible area

p % spw	x % area
0.50	0.2155
0.50	0.78

max dens HABSCORE	Fry % smolt Bush SR	survival Bush SR	max dens HABSCORE	Parr % smolt Bush SR	survival Bush SR	MGs	MGsB	MSs	MSsB	SR
9.65	0.0426	0.128	1.87	0.436	0.0389	0.000	0.000	0.000	0.000	0.037
4.79	0.0426	0.128	3.33	0.436	0.0389	0.000	0.000	0.000	0.000	0.115
6.09	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.124
8.77	0.0426	0.128	11.61	0.436	0.0389	0.001	0.000	0.001	0.000	0.322
20.38	0.0426	0.128	18.06	0.436	0.0389	0.001	0.000	0.001	0.000	0.460
44.64	0.0426	0.128	7.02	0.436	0.0389	0.001	0.000	0.000	0.000	0.207
44.64	0.0426	0.128	7.02	0.436	0.0389	0.000	0.000	0.000	0.000	0.056
44.64	0.0426	0.128	7.02	0.436	0.0389	0.000	0.000	0.000	0.000	0.028
44.64	0.0426	0.128	7.02	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
44.64	0.0426	0.128	7.02	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.11	0.0426	0.128	3.49	0.436	0.0389	0.000	0.000	0.000	0.000	0.137
12.06	0.0426	0.128	5.33	0.436	0.0389	0.000	0.000	0.000	0.000	0.040
17.04	0.0426	0.128	7.27	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
27.27	0.0426	0.128	8.67	0.436	0.0389	0.000	0.000	0.000	0.000	0.050
30.34	0.0426	0.128	9.70	0.436	0.0389	0.000	0.000	0.000	0.000	0.061
1.66	0.0426	0.128	7.40	0.436	0.0389	0.000	0.000	0.000	0.000	0.021
1.66	0.0426	0.128	7.40	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
1.66	0.0426	0.128	7.40	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
1.66	0.0426	0.128	7.40	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
1.66	0.0426	0.128	7.40	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
18.73	0.0426	0.128	3.93	0.436	0.0389	0.002	0.000	0.001	0.000	0.506
19.62	0.0426	0.128	8.39	0.436	0.0389	0.001	0.000	0.001	0.000	0.230
34.15	0.0426	0.128	7.70	0.436	0.0389	0.001	0.000	0.001	0.000	0.125
50.20	0.0426	0.128	7.93	0.436	0.0389	0.000	0.000	0.000	0.000	0.086
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
14.83	0.0426	0.128	8.39	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
20.82	0.0426	0.128	5.73	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
40.94	0.0426	0.128	7.50	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
54.68	0.0426	0.128	8.21	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
3.06	0.0426	0.128	11.68	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.58	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.436	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.435	0.0389	0.000	0.000	0.000	0.000	0.000
22.68	0.0426	0.128	2.66	0.435	0.0389	0.000	0.000	0.000	0.000	0.000
						0.009	0.000	0.006	0.000	2.694

Survival - grilse	25
Survival - MSW	15
% grilse	83.9
% females	53.9
fecundity	4467.8
Overall surv	22.8
repl	544

Targets	Estimate	Guess	Smolt
max gain	315	315	2.761
max smolts	468	468	2.897
Any		500	2.694

Total egg target at max gain = 3077717.1

TABLE2: EGG DEPOSITION , RIVER TEIGN 1998

Salmon spawning targets: Egg deposition estimates

River:	teign	Year:	1998
Total wetted area (m2) =			
Total useable area (m2) =		975890	
Catchment area (km2) =		402.50	
Mean angling effort (days) 1993-95 in days =			3277
Number of Grilses caught by nets in 98=			260
Number of MSW caught by nets in 98=			29
Proportion of grilses caught in nets			0.900
Proportion of MSW caught in nets			0.094
Declared catch - all sea ages (Cd) =			160
Rod catch reporting rate (r) =			0.91
Corrected total catch - all sea ages (Ct) =			176
Undeclared catch - all sea ages (Cn) =			16
Proportion 1SW fish in rod catch			0.873
Proportion MSW fish in rod catch			0.127
Proportion 1SW fish in undeclared catch (Png) =			0.873
Proportion MSW fish in undeclared catch (Pnm) =			0.127
Undeclared catch - 1SW fish (Cng) =			14
Undeclared catch - MSW fish (Cnm) =			2.01
Extant rod exploitation rate - all sea ages (Uall) =			0.183
Extant rod exploitation rate - 1SW fish (Ug) =			0.183
Extant rod exploitation rate - MSW fish (Um) =			0.229
Post-rod fishery survival - 1SW fish (sg) =			0.91
Post-rod fishery survival - MSW fish (sm) =			0.91
Proportion female 1SW fish (Pfg) =			0.511
Proportion female MSW fish (Pfm) =			0.667
Mean weight (lbs) grilse (1964,65,66,67,68,71,72)=			6.10
Mean lenght (cm) grilse=			63.00
Mean weight (lbs)MSW (1964,65,66,67,68,71,72)=			10.00
Mean lenght (cm) MSW=			74.26
Total 1 SW rod catch =		154	
Total 1SW spawners (Sg) =		715	
Mean fecundity 1SW fish (fg) =		4154	
Total egg deposition 1SW fish (Edg) =		1,519,292	
Total MSW rod catch		22	
Total MSW spawners (Sm) =		68	
Mean fecundity MSW fish (fm) =		6103	
Total egg deposition MSW fish (Edm) =		286,869	
Total egg deposition - all sea ages (Et) =			1,806,161
Egg deposition per 100m2 useable area (Ed) =			185
Egg deposition target per 100m2 useable area =			315
% Compliance against egg deposition target =			58.8

Number of fish released in rod	34
Number of eggs ADDED	81134.
Post rod survival for C&R	0.91

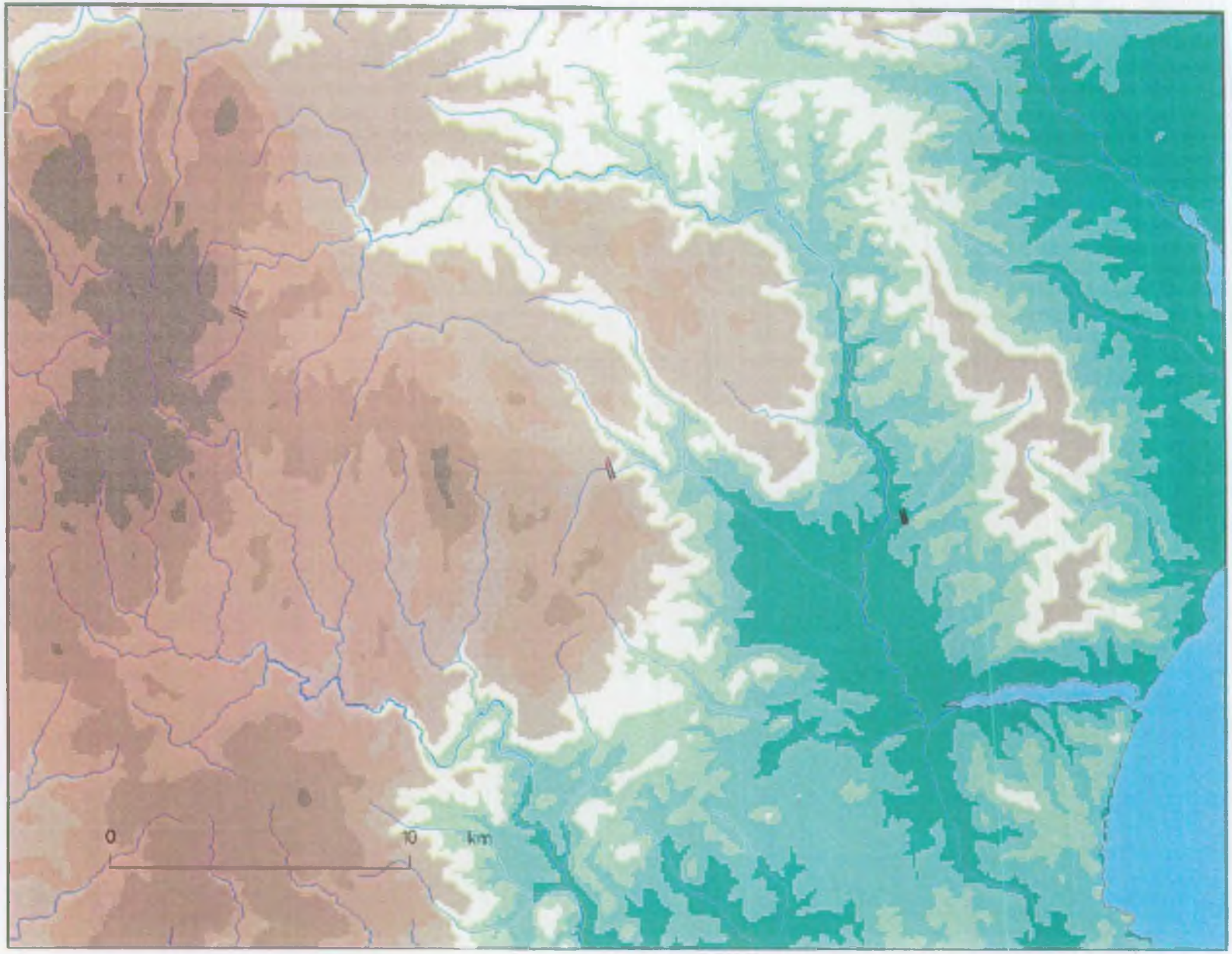
Total egg deposition	1,887,295
Egg deposition per 100m2 useable area (Ed) =	193
% Compliance against egg deposition target =	61.4

TABLE 3: Annual egg deposition, River Teign

Salmon spawning Target =3.1 million eggs

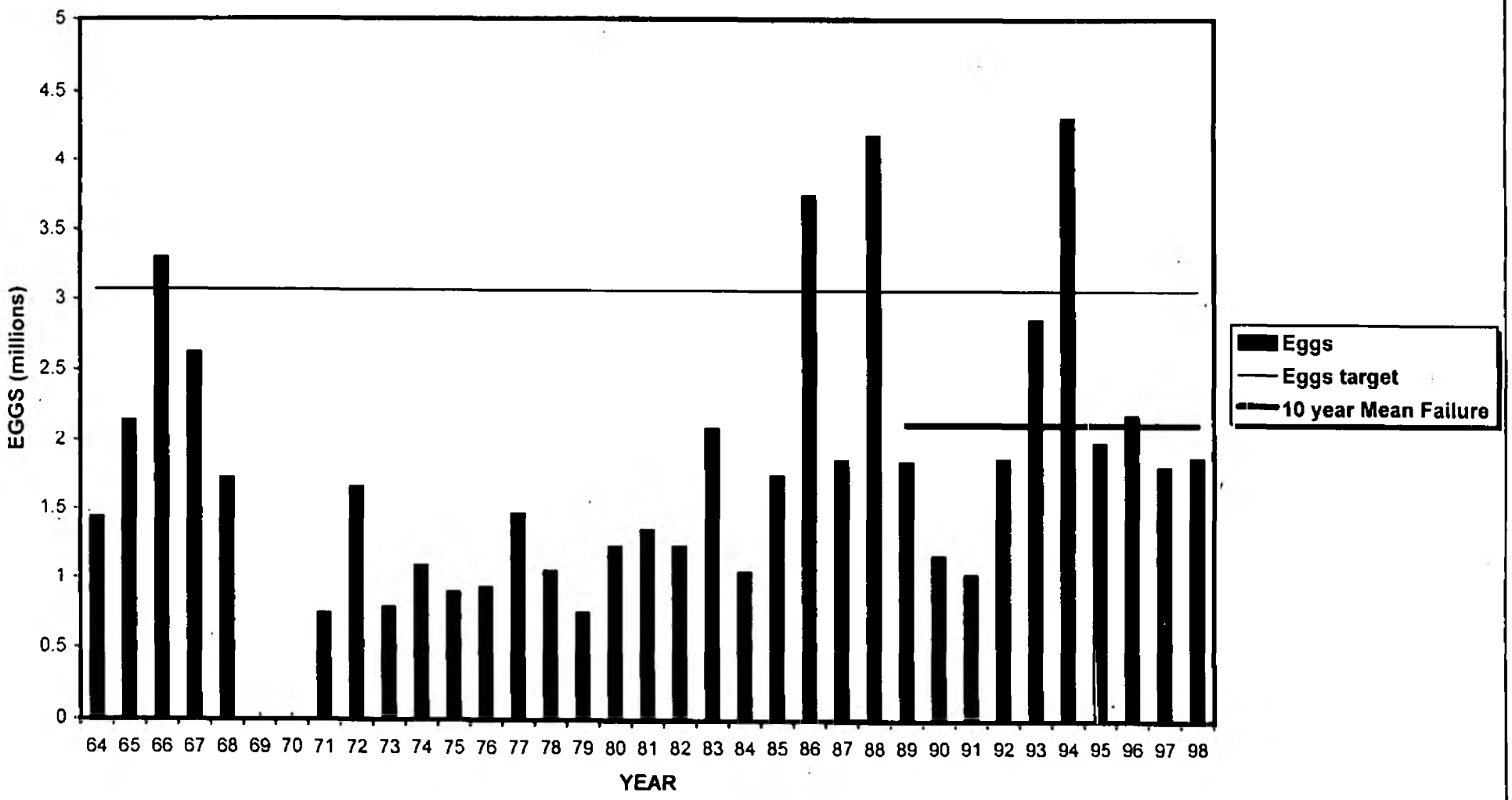
year	eggs (million)
1964	1.4408
1965	2.141
1966	3.304
1967	2.624
1968	1.723
1969	
1970	
1971	0.754
1972	1.6618
1973	0.798
1974	1.096
1975	0.9068
1976	0.942
1977	1.478
1978	1.063
1979	0.763
1980	1.24
1981	1.363
1982	1.243
1983	2.097
1984	1.06
1985	1.7568
1986	3.75
1987	1.865
1988	4.175
1989	1.853
1990	1.179
1991	1.045
1992	1.877
1993	2.88
1994	4.305
1995	1.993
1996	2.197
1997	1.821
1998	1.887
Last 10 year mean	**2.1037**

FIGURE 1



River Teign

FIGURE 2:Compliance With Spawning Targets, Overall Exploitation Rate= 18.3%, 1964-1998, River TEIGN



annex

ANNEX 1

TABLE 1

teign

inaccessible length km

	stream order 1
<49	3
50.99	1
100.149	2
150.199	1.3
200.299	3
300.399	1.5
400.499	4.5
>500	

TABLE 2

teign

width m

		Stream order		
		1	2	3
Altitude	<49	3.22	8.35	12.67
	50.99	4.51	*8*	10.23
	100.149	2.79	*8*	11.46
	150.199	4.61	7.65	*11*
	200.299	4.30	7	
	300.399	3.89	7	
	400.499	*4*		
	>500	*4*		

ANNEX 2

Source:
The transportation of the maximum gain salmon spawning target from the River Bush (N.I.) to England and Wales, R. J. Wyatt and S. Barnard, R&D Technical Report W65

0+ parr densities (η_{1j}, numbers per $100m^2$), Britain

			Stream order			
	Altitude class (m)	Class midpoint (m)	1	2	3	4
A	0-49	25	9.65	14.11	18.73	22.58
B	50-99	75	4.79	12.06	19.62	20.62
C	100-149	125	5.09	17.04	34.15	40.94
D	150-199	175	8.77	27.27	50.20	54.68
E	200-299	250	26.38	30.34	14.83	3.08
F	300-399	350	44.64	1.56	-	-

>0+ parr densities (η_{2j}, numbers per $100m^2$), Britain

			Stream order			
	Altitude class (m)	Class midpoint (m)	1	2	3	4
A	0-49	25	1.87	3.49	3.93	2.66
B	50-99	75	3.33	5.33	6.39	5.73
C	100-149	125	6.39	7.27	7.70	7.59
D	150-199	175	11.51	8.87	7.93	8.21
E	200-299	250	18.06	9.70	8.39	11.68
F	300-399	350	7.02	7.40	-	-

ANNEX 3

RIVER TEIGN- PROPORTION OF GRILSE IN NET CATCHES BY WEIGHT FREQUENCY ANALYSIS

River	Year	Percentage
Teign	1964	24%
Teign	1965	8%
Teign	1966	9%
Teign	1967	33%
Teign	1968	25%
Teign	1969	unknown
Teign	1970	unknown
Teign	1971	32%
Teign	1972	38%
Teign	1973	58%
Teign	1974	62%
Teign	1975	68%
Teign	1976	48%
Teign	1977	58%
Teign	1978	47%
Teign	1979	85%
Teign	1980	33%
Teign	1981	61%
Teign	1982	58%
Teign	1983	64%
Teign	1984	64%
Teign	1985	78%
Teign	1986	64%
Teign	1987	93%
Teign	1988	82%
Teign	1989	80%
Teign	1990	72%
Teign	1991	74%
Teign	1992	91%
Teign	1993	89%
Teign	1994	88%
Teign	1995	79%
Teign	1996	88%
Teign	1997	87%
Teign	1998	90%
last 10 year average		**84%**

Source:
South west catch stat. Database (Access 97)

ANNEX 4

Teign Salmon Nets

1998	1SW	MSW	TOTAL	% Grilse	% MSW
MARCH	0	0	0		
APRIL	0	1	1		
MAY	0	3	3		
JUNE	5	5	10		
JULY	128	7	135		
AUGUST	147	13	160		
TOTAL	280	29	309	**91%**	**9%**

1997	1SW	MSW	TOTAL	% Grilse	% MSW
MARCH	0	0	0		
APRIL	0	6	6		
MAY	2	9	11		
JUNE	47	8	55		
JULY	157	7	164		
AUGUST	37	5	42		
TOTAL	243	35	278	**87%**	**13%**

1996	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	3	3		
MAY	0	20	20		
JUNE	20	13	33		
JULY	229	26	255		
AUGUST	218	4	222		
TOTAL	467	66	533	**88%**	**12%**

1995	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	3	3		
MAY	1	20	21		
JUNE	46	23	69		
JULY	135	17	152		
AUGUST	77	5	82		
TOTAL	259	68	327	**79%**	**21%**

1994

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	0	0		
MAY	0	30	30		
JUNE	209	59	268		
JULY	315	10	325		
AUGUST	252	6	258		
TOTAL	776	105	881	**88%**	**12%**

1993

	1SW	MSW	TOTAL		
MARCH	0	1	1		
APRIL	0	8	8		
MAY	0	37	37		
JUNE	81	27	108		
JULY	401	23	424		
AUGUST	382	16	398		
TOTAL	864	112	976	**89%**	**11%**

1992

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	6	6		
MAY	5	18	23		
JUNE	100	28	128		
JULY	442	19	461		
AUGUST	237	7	244		
TOTAL	784	78	862	**91%**	**9%**

1991

	1SW	MSW	TOTAL		
MARCH	0	1	1		
APRIL	0	12	12		
MAY	0	65	65		
JUNE	29	43	72		
JULY	242	25	267		
AUGUST	189	15	204		
TOTAL	460	161	621	**74%**	**26%**

1990

	1SW	MSW	TOTAL
MARCH	0	0	0
APRIL	0	13	13
MAY	6	150	156
JUNE	172	114	286

JULY	324	13	337		
AUGUST	252	2	254		
TOTAL	754	292	1046	**72%**	**28%**

1989

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	4	4		
MAY	12	194	206		
JUNE	137	116	253		
JULY	703	37	740		
AUGUST	704	26	730		
TOTAL	1556	377	1933	**80%**	**20%**

1988

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	67	67		
MAY	0	103	103		
JUNE	298	74	372		
JULY	607	22	629		
AUGUST	323	12	335		
TOTAL	1228	278	1506	**82%**	**18%**

1987

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	23	23		
MAY	11	84	95		
JUNE	650	42	692		
JULY	1117	23	1140		
AUGUST	574	8	582		
TOTAL	2352	180	2532	**93%**	**7%**

1986

	1SW	MSW	TOTAL		
MARCH	0	4	4		
APRIL	0	64	64		
MAY	0	215	215		
JUNE	211	173	384		
JULY	655	98	753		
AUGUST	239	60	299		
TOTAL	1105	614	1719	**64%**	**36%**

1985

	1SW	MSW	TOTAL
MARCH	0	2	2

APRIL	0	15	15		
MAY	0	90	90		
JUNE	96	133	229		
JULY	602	38	640		
AUGUST	500	59	559		
TOTAL	1198	337	1535	**78%**	**22%**

1984

	1SW	MSW	TOTAL		
MARCH	0	1	1		
APRIL	0	9	9		
MAY	0	80	80		
JUNE	39	123	162		
JULY	312	59	371		
AUGUST	209	37	246		
TOTAL	560	309	869	**64%**	**36%**

1983

	1SW	MSW	TOTAL		
MARCH	0	2	2		
APRIL	0	17	17		
MAY	0	36	36		
JUNE	68	274	342		
JULY	588	120	708		
AUGUST	290	91	381		
TOTAL	946	540	1486	**64%**	**36%**

1982

	1SW	MSW	TOTAL		
MARCH	0	7	7		
APRIL	0	21	21		
MAY	0	74	74		
JUNE	36	153	189		
JULY	143	34	177		
AUGUST	248	22	270		
TOTAL	427	311	738	**58%**	**42%**

1981

	1SW	MSW	TOTAL		
MARCH	0	2	2		
APRIL	0	51	51		
MAY	0	142	142		
JUNE	95	244	339		
JULY	534	25	559		
AUGUST	206	65	271		
TOTAL	835	529	1364	**61%**	**39%**

1980

	1SW	MSW	TOTAL		
MARCH	0	1	1		
APRIL	0	67	67		
MAY	0	247	247		
JUNE	55	247	302		
JULY	129	57	186		
AUGUST	139	31	170		
TOTAL	323	650	973	**33%**	**67%**

1979

	1SW	MSW	TOTAL		
MARCH	0	4	4		
APRIL	0	25	25		
MAY	0	46	46		
JUNE	49	38	87		
JULY	429	32	461		
AUGUST	375	7	382		
TOTAL	853	152	1005	**85%**	**15%**

1978

	1SW	MSW	TOTAL		
MARCH	0	6	6		
APRIL	0	132	132		
MAY	6	124	130		
JUNE	106	96	202		
JULY	131	41	172		
AUGUST	129	13	142		
TOTAL	372	412	784	**47%**	**53%**

1977

	1SW	MSW	TOTAL		
MARCH	0	4	4		
APRIL	0	36	36		
MAY	0	134	134		
JUNE	64	99	163		
JULY	213	39	252		
AUGUST	164	6	170		
TOTAL	441	318	759	**58%**	**42%**

1976

	1SW	MSW	TOTAL
MARCH	0	0	0
APRIL	0	74	74
MAY	0	244	244
JUNE	40	161	201
JULY	243	76	319

AUGUST	233	15	248		
TOTAL	516	570	1086	**48%**	**52%**

1975

	1SW	MSW	TOTAL		
MARCH	0	0	0		
APRIL	0	76	76		
MAY	32	154	186		
JUNE	278	169	447		
JULY	592	175	767		
AUGUST	414	53	467		
TOTAL	1316	627	1943	**68%**	**32%**

1974

	1SW	MSW	TOTAL		
MARCH	0	9	9		
APRIL	0	81	81		
MAY	0	124	124		
JUNE	126	162	288		
JULY	502	76	578		
AUGUST	145	16	161		
TOTAL	773	468	1241	**62%**	**38%**

1973

	1SW	MSW	TOTAL		
MARCH	0	11	11		
APRIL	0	118	118		
MAY	0	164	164		
JUNE	142	112	254		
JULY	351	30	381		
AUGUST	132	15	147		
TOTAL	625	450	1075	**58%**	**42%**

ANNEX 5

RIVER TEIGN - NUMBER OF SALMON CAUGHT IN RODS

River	Year	total
Teign	1964	90
Teign	1965	130
Teign	1966	201
Teign	1967	167
Teign	1968	108
Teign	1969	82
Teign	1970	51
Teign	1971	48
Teign	1972	107
Teign	1973	54
Teign	1974	75
Teign	1975	63
Teign	1976	62
Teign	1977	100
Teign	1978	70
Teign	1979	56
Teign	1980	81
Teign	1981	93
Teign	1982	84
Teign	1983	145
Teign	1984	73
Teign	1985	128
Teign	1986	258
Teign	1987	143
Teign	1988	303
Teign	1989	136
Teign	1990	83
Teign	1991	75
Teign	1992	97
Teign	1993	147
Teign	1994	383
Teign	1995	166
Teign	1996	188
Teign	1997	151
Teign	1998	160

Source:

*South west catch stat. Database (Access 97)

*Salmon and Migratory Trout statistics for England and Wales, 1951-90, MAFF, Fisheries Research Data Report N0 38.