EA - SOUTH WEST BOX 18

ENVIRONMENT AGENCY

ENVIRONMENT AGENCY

South West Region.

Gunnislake Fish Counter.

Annual Report 2002.

Cornwall Area Ecological Appraisal Team

March 2003

ENVIRONMENT AGENCY

South West Region.

Gunnislake Fish Counter.

Annual Report 2002.

Cornwall Area Ecological Appraisal Team
March 2003

Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

- The following report presents the daily upstream counts of migratory salmonids recorded on the River Tamar at Gunnislake Weir fish counting station (SX 435 713) situated in 2002.

- Data contained within this report covers the period of the commercial migratory salmonid net buy-back scheme and the National Spring Salmon Bylaws:
  - Net buy-back (8 August – 31 August inclusive)
  - National Spring Salmon Bylaws – No netting before 1 June

- The fish counter at Gunnislake is a resistivity based system (Logie 2100A – Aquantic limited) and is installed in the fish pass on the Cornish bank of the River Tamar at the head of the tide.

- The run pattern observed for salmon and sea trout in 2002 was generally consistent with that of previous years. However, the total combined annual count of upstream migrating salmon and sea trout on the River Tamar in 2002 was 19.4% higher than the 8-year average.

- The minimum salmon count for 2002 was 4540, 45% higher than that recorded in 2001. A breakdown of the 2002 salmon run into the two main run components reveals the following:
  - A 6.9% increase in the numbers of multi sea winter "spring" salmon (April – May) when compared to 2001 figures and a 21% increase when compared to the 8-year average.
  - A 69% increase in the numbers of post - 1st June salmon (June – September) when compared to 2001 figures (excluding figures for October) and a 35% increase when compared to the 8-year average. Including the data for October suggests a 51% increase in post - 1st June salmon numbers when compared to figures for 2001 over the same period. This equates to a 45% increase in this component of the stock when compared to the 8-year average for the same period.

- The 2002 upstream count for sea trout was 9751. A 30% increase in the total number of sea trout recorded when compared to the 2001 data (7503).

1. Introduction

The following report presents upstream salmon and sea trout counts recorded on the River Tamar at Gunnislake fish counting station (SX 435 713) during 2002. The count data has been considered with respect to:

- daily mean residual flow (cumecs)
- temperature (°C)
- barometric pressure (mBar)

The flow data reflects the residual flow that exists at Gunnislake Weir following abstraction by South West Water (SWW) 1.5km upstream of Gunnislake Weir (SX 435 725).

The report also includes details of the on-going counter validation work and the annual audit of counter data. This is primarily used to assess counter efficiency and to develop improved methodologies for species apportionment.

2. Background

Fish counters, such as the one installed at Gunnislake Weir, are increasingly becoming essential tools in the management of salmonid fisheries. They provide vital baseline data on the size of the migratory salmonid populations and information on the times during which their migrations occur. This information used in conjunction with other fishery data, such as juvenile salmonid survey data and rod / net catches, significantly enhances the formulation of effective management strategies.

The current fish counter at Gunnislake weir is a resistivity-based system (Logie 2100A) manufactured by Aquantic Ltd. The counter was installed in 1992 and validated during 1993 and 1994.

The fish counter at Gunnislake is situated on the River Tamar at the head of the tide and is installed in the fish pass on the Cornish bank of the gauging weir at Gunnislake. The counter operates over a single channel, 1.6 metres in width, via 3 stainless steel electrodes. The electrodes are incorporated into the downstream face of a 'Crump' sectioned weir, which is contained within the fish pass.

The effectiveness of the fish pass was investigated in 1994 / 1995 using radio tracked salmon. The study indicated that 75% of salmon used the Cornish fish pass to migrate up into the freshwater Tamar. The remaining 25% were assumed to have used the Devon bank fish pass or ascended the weir when high spring tides coincided with high water levels – Solomon *et al* (2000).

The counter at Gunnislake is one of two resistivity based systems operated by the Cornwall Area Fisheries Science Team. The other counter is located on the River Fowey at Restormel Weir (SX 107 613).

A description detailing the operation of the resistivity fish counter at Gunnislake is provided in Appendix 5.

3. Net Buy-Back

National byelaws to protect stocks of 'spring' salmon were introduced on the 15 April 1999. The implementation of these byelaws effectively restricts the salmonid-netting season on the River Tamar from 1 June – 31 August, inclusive.

As in 1997, 1998, 1999, 2000 and 2001 South West Water (SWW) operated a buy-back of commercial migratory salmonid netting time within the Tamar estuary during 2002. In 1998, it switched from 2 March – 7 June to 8 August – 31 August, inclusive. This put a further limit on the times available for netting, effectively restricting the netting season to 1 June – 7 August.

The main aim of the SWW buy-back scheme is to mitigate for the construction of Roadford reservoir and was originally timed to assist in the conservation of multi sea winter fish. It now mainly protects the grilse run.

4. Species Apportionment

The counter has the ability to record electrical changes that are directly proportional to the size of fish that have traversed the counter electrodes. Species apportionment is possible due to the linear relationship that exists between fish length and deflection size. However, it is not possible to distinguish between a salmon and a sea trout of comparable size. It is therefore inevitable that the salmon count may include some large sea trout. As this situation is most likely to exist between March and the end of June, a data handling protocol has been developed to minimise this eventuality. This is described in Appendix 6.

5. Validation of counter efficiency

Initial validation studies to assess counter efficiency were carried out in 1993 and 1994. The counter was re-validated in 1998 and counter data is now audited, using video footage taken over the weir, on an annual basis. Counter events are matched up with video events, which can then be used to assess the efficiency of the counter and to investigate anomalies in the counter data.

Video validation and the annual audit of counter data is a vital part of the fish counter work at Gunnislake and gives confidence in the accuracy of the data that the fish counter is recording. A complete description of the video validation strategy and methodology is described in Appendix 7.

6. Results

The migratory salmonid counts obtained for the River Tamar recorded at Gunnislake fish counting station in 2002 are presented as follows:

6.1. Upstream Fish Counts

Figure 1: Presents the monthly upstream counts for salmon recorded at Gunnislake weir in 2002 along with the 8-year average. The total number of salmon counted moving upstream in 2002 was 4540 (Table 1).

Figure 2: Presents the monthly upstream counts for sea trout recorded at Gunnislake weir in 2002 along with the 8-year average. The total number of sea trout counted moving upstream in 2002 was 9751 (Table 2).

Figures 3 & 4: Present the annual upstream counts of 'Multi Sea Winter' Salmon and 'Post 1st June' Salmon on the River Tamar 1994 – 2002.

Figures 5 & 6: Present the annual upstream counts of 'Larger Repeat Spawning' Sea Trout and 'School Peal' on the River Tamar 1994 – 2002.

Figures 7 & 8: Present the daily upstream counts for salmon and sea trout, in relation to monthly mean residual flow (cumecs) at Gunnislake Weir in 2002 (Appendix 1).

Figures 9 & 10: Present the daily upstream counts for salmon and sea trout, in relation to daily mean temperature (°C) – Appendix 2.

Figures 11 & 12: Present the daily upstream counts for salmon and sea trout in relation to daily mean barometric pressure (mBar) – Appendix 3.

Figures 13 – 36: Each of these figures presents daily upstream counts for salmon and sea trout, for each month, in relation to daily mean residual flow (cumecs) recorded at Gunnislake weir (Appendix 4).

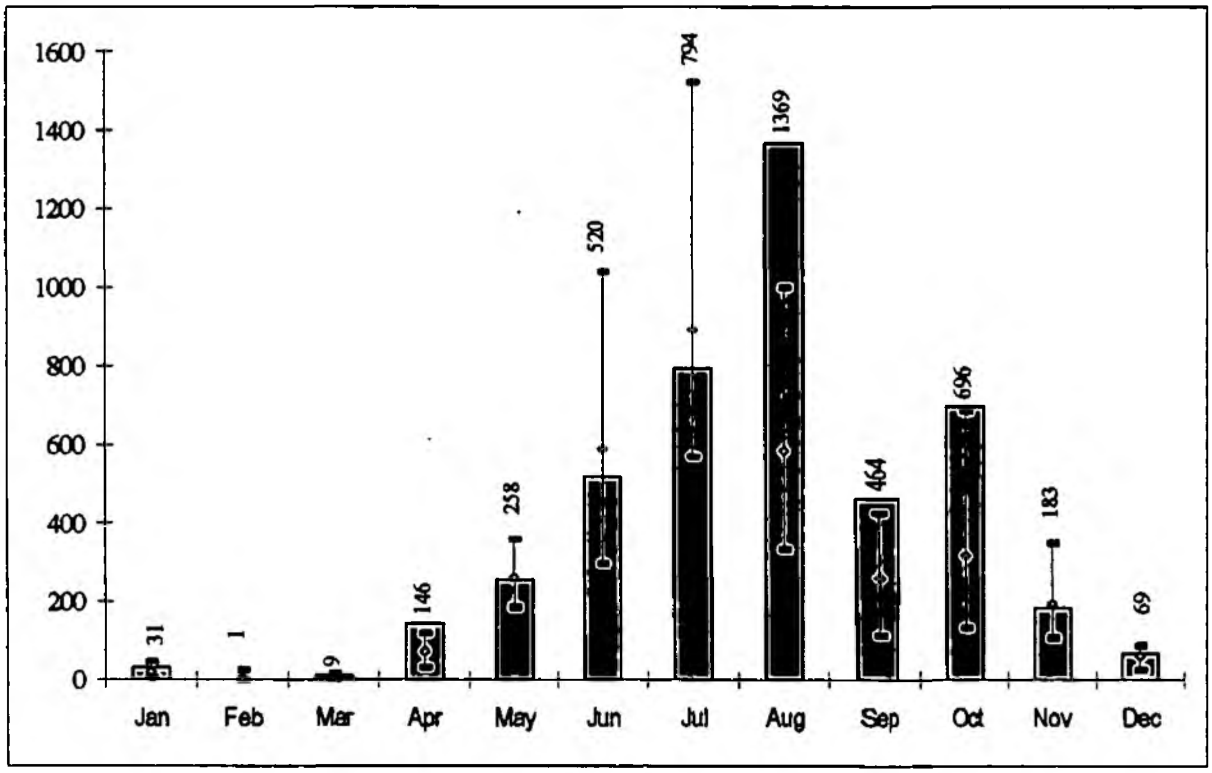
Note:

- To aid in interpretation of the data, axis scaling may differ between the monthly summary plots. Care should therefore be taken when interpreting the data within each figure.

- The flow data presented is the residual flow that exists at Gunnislake weir. This has been calculated by subtracting the Daily Mean Abstraction (DMA) from Daily Mean Flow (DMF) data.

- A 7 and 8-year average has been calculated in Tables 1 and 2. The two figures have been calculated to take into account the loss of fish counter data in 2000, as a result of flood damage. For convenience the 8-year average is used to refer to both the 7 and 8 year averages in the report hereafter.

Figure 1 – Monthly Upstream Counts for Salmon at Gunnislake Weir 1994 – 2002.

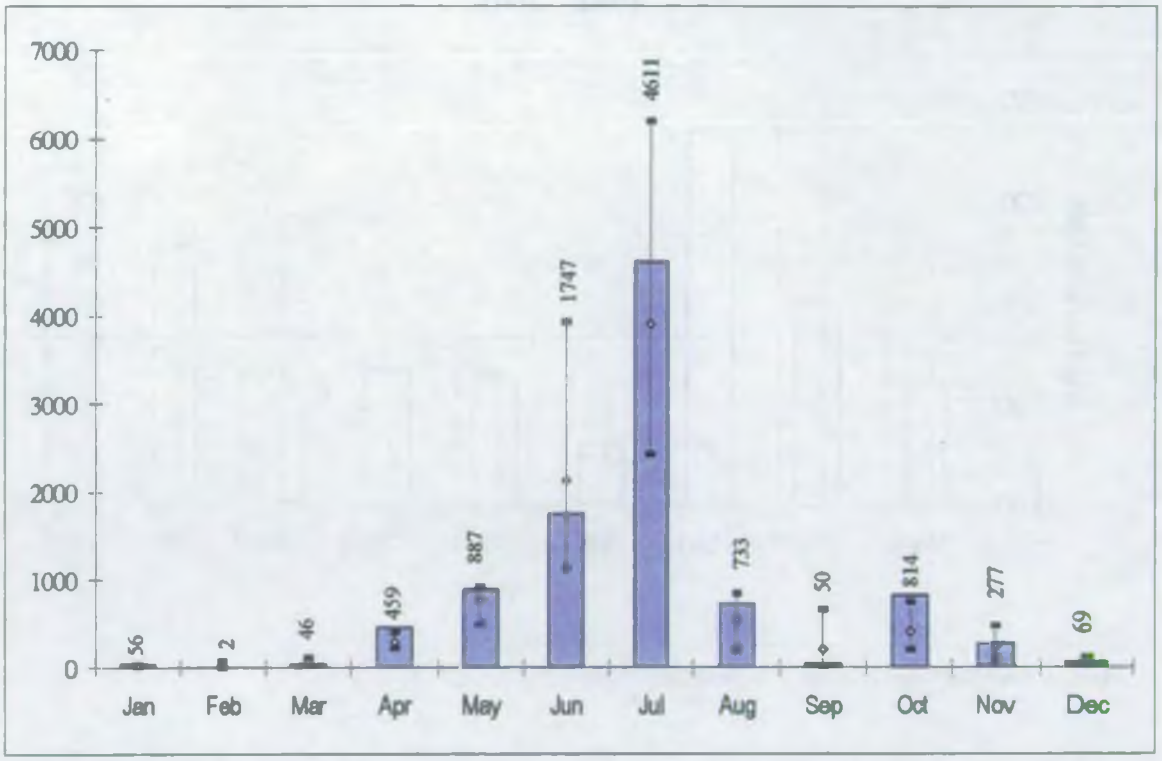


* Data labels and coloured bars indicate 2002 figures. High low bars indicate max, min and average from 1994 - 2002.

Table 1 - Monthly Upstream Counts for Salmon at Gunnislake Weir 1994 – 2002.

Month	1994	1995	1996	1997	1998	1999	2000	2001	2002	7-yr average 8-yr average
Jan	15	22	45	32	6	11	*	9	31	20
Feb	3	6	1	27	9	3	*	4	1	8
Mar	6	11	1	8	7	16	*	3	9	7
Apr	90	116	76	95	30	60	74	41	146	73
May	222	234	360	185	283	257	223	337	258	263
Jun	1042	591	409	342	295	683	503	844	520	589
Jul	1520	1525	576	603	949	571	825	576	794	893
Aug	1000	376	557	464	850	374	730	332	1369	585
Sep	397	427	400	185	244	160	156	112	464	260
Oct	211	552	354	133	268	177	143	687	696	316
Nov	204	303	126	142	109	350	*	117	183	193
Dec	59	65	86	26	82	29	*	76	69	60
Totals	4769	4228	2991	2242	3132	2691	2654	3138	4540	3287
Adjustment for fish pass efficiency	6359	5637	3988	2989	4176	3588	3539	4184	6053	

Figure 2 – Monthly Upstream Counts for Sea Trout at Gunnislake Weir 1994 – 2002.

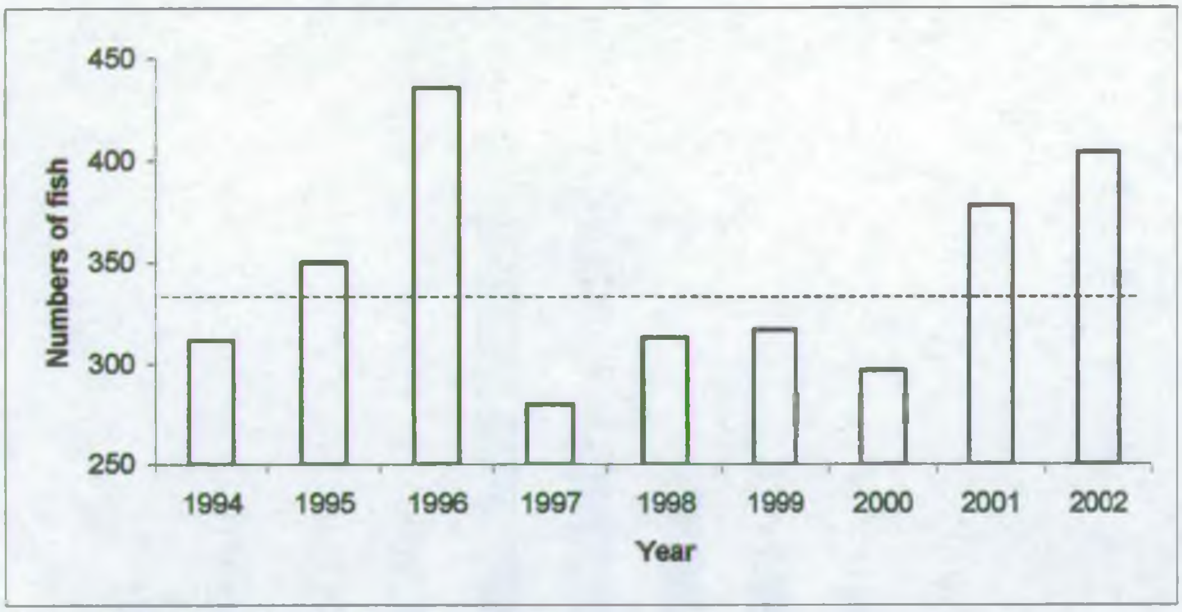


* Data labels and coloured bars indicate 2002 figures. High low bars indicate max, min and average from 1994 – 2002.

Table 2 - Monthly Upstream Counts for Sea Trout at Gunnislake Weir 1994 – 2002.

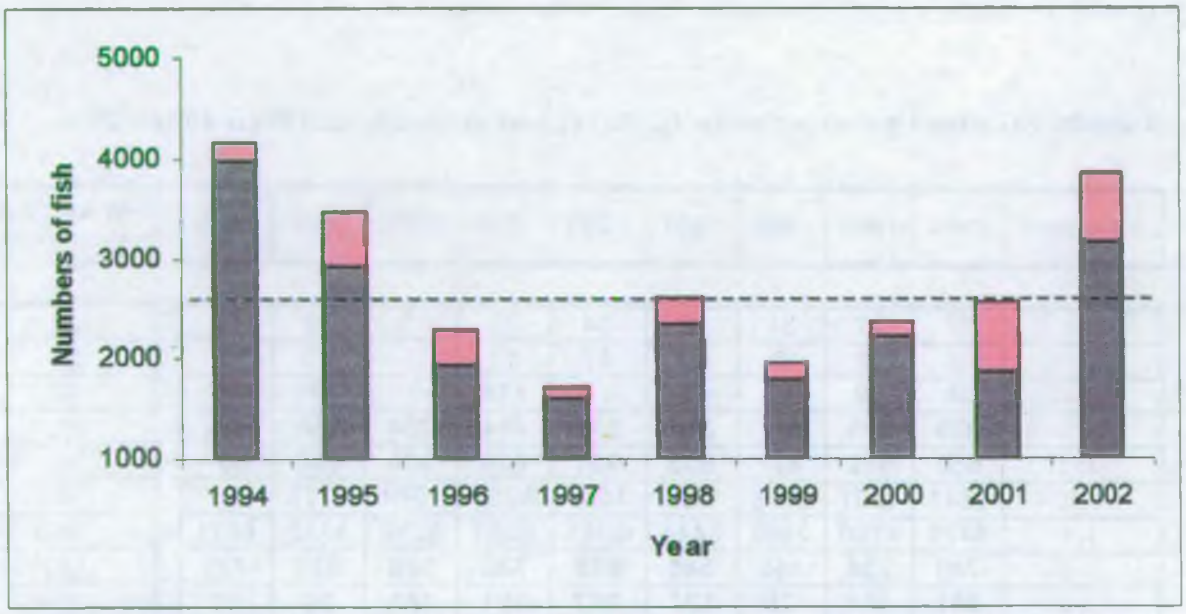
Month	1994	1995	1996	1997	1998	1999	2000	2001	2002	7-yr average 8-yr average
Jan	32	17	51	22	34	28	*	13	56	28
Feb	2	12	8	62	59	11	*	13	2	24
Mar	55	59	49	65	71	116	*	121	46	77
Apr	329	221	313	333	217	411	254	266	459	293
May	653	659	817	835	921	826	901	506	887	765
Jun	2841	1807	1875	1724	1131	3927	1964	1776	1747	2131
Jul	5478	4190	2868	2440	4311	6207	2530	3213	4611	3905
Aug	748	206	556	548	838	549	326	559	733	541
Sep	661	181	78	127	237	191	163	30	50	209
Oct	377	438	529	194	354	338	279	749	814	407
Nov	275	284	230	220	82	482	*	144	277	245
Dec	51	78	78	62	120	59	*	113	69	80
Totals	11502	8152	7452	6632	8375	13145	6417	7503	9751	8704
Adjustment for fish pass efficiency	15336	10869	9936	8843	11167	17527	8556	10004	13001	

Figure 3 - Annual upstream counts of 'Multi Sea Winter' Salmon - River Tamar 1994 – 2002.



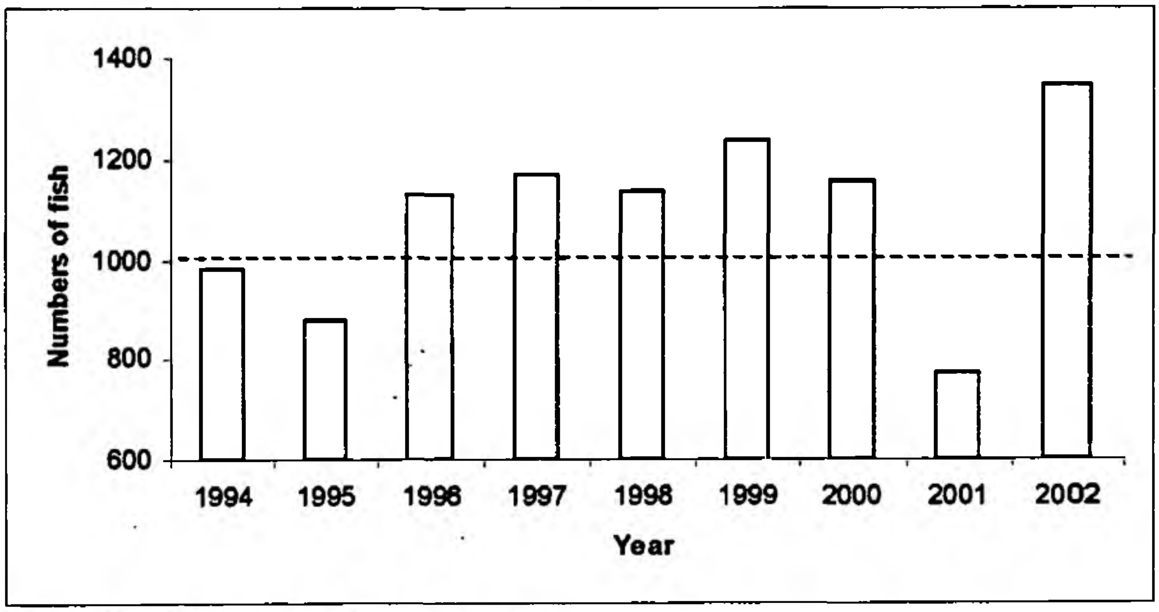
Note: - Dotted line denotes 8 – year average.

Figure 4 – Annual upstream counts of 'Post 1st June' Salmon - River Tamar 1994 – 2002.



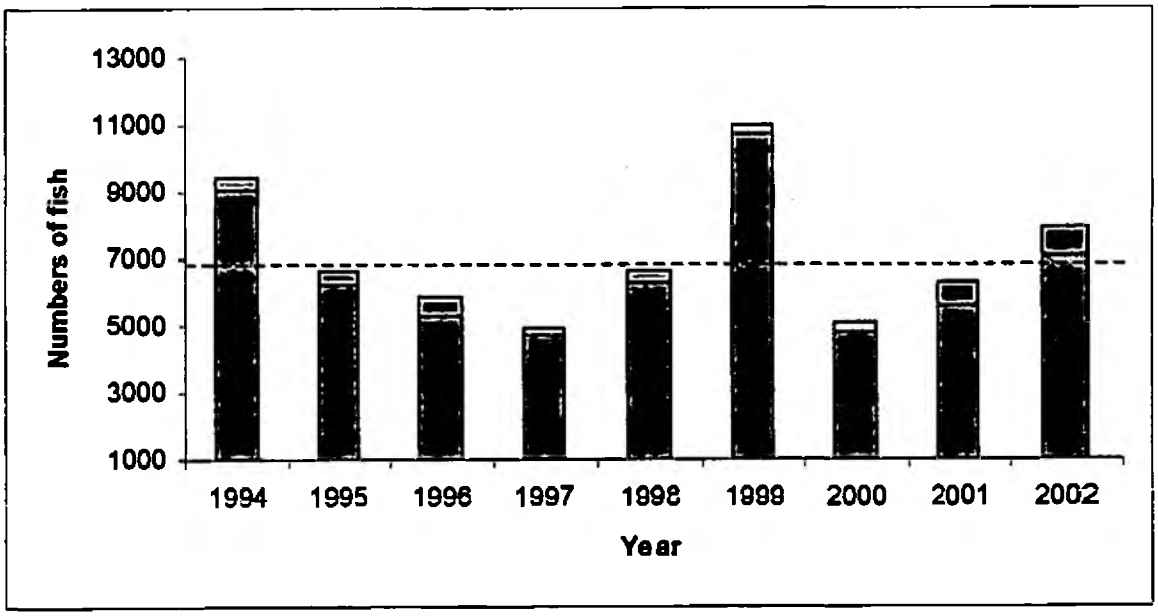
Note: - Dotted line denotes 8-year average (2643). The 8-year average takes into account counts for October. The coloured bands indicate the additional October counts.

Figure 5 - Annual upstream counts of 'Large Repeat Spawning' Sea Trout - River Tamar 1994 – 2002.



Note: - Dotted line denotes 8 – year average.

Figure 6 – Annual upstream counts of Sea Trout ('School Peal') - River Tamar 1994 – 2002.



Note: - Dotted line denotes 8-year average (6984). The 8-year average takes into account counts for October. The coloured bands indicate the additional October counts.

6.2 Video Validation & Counter Efficiency

6.2.1 Counter Efficiency

Table 3 – Analysis of video validation data for Gunnislake fish counter (2002).

Counter Event	Counter	Trace	Video	% Efficiency	
				Counter:Trace	Trace:Video
Upstream Salmonid Counts	160	195	219	82	89
Missed Counts	18	18	0		
Non - directional events (E)	62	27	22		
Downstream events	3	3	2		

The overall detection efficiency for upstream salmonids for the period 10th May to 24th September was 89%, which is higher than that recorded in 2002 (85%) over the same period. The detection efficiency was calculated using data for upstream migrating salmonids (individuals and groups) detected by the counter or seen on video. Non-target species (lamprey etc) or spurious events were removed from the data prior to this analysis. Trace efficiencies have been included to illustrate how trace information can be used as a relatively quick way of checking raw fish counter data and to improve count accuracy when video data is unavailable.

6.2.2 Size Correction Factors

Table 4 utilises matched counter and video data for upstream migrating salmonids to calculate count correction factors for the period 10th May to 24th September 2002. All non-target species i.e. non-salmonids, have been removed for the purposes of this calculation.

Table 4 – Size correction factors for salmonid counts recorded at Gunnislake fish counter (10th May to 24th September 2002).

Deflection	Counter	Video	Size (cm)	Correction Factor
Salmonids ≥50	57	46	Salmonids ≥50	0.81
Salmonids <50	124	135	Salmonids <50	1.09
Total	181	181		

7. Discussion

Figures 1 and 2 indicate that the seasonal run patterns observed for salmon and sea trout on the River Tamar in 2002 were generally consistent with previous years. Notable periods which move away from this general pattern of consistency include August and, as in 2001, September.

There was a 34.3% increase in the total combined annual count for upstream migrating salmonids on the River Tamar in 2002 (14291) when compared to 2001 (10641) for the same period. corrected?

Comparisons with the 8-year average (11971) indicate that the total combined count for salmonids in 2002 (14291) has increased by 19.4%.

7.1 Salmon counts recorded on the River Tamar 1995 – 2002.

The salmon run on the River Tamar ordinarily begins in April / May and continues until the end of November / beginning of December. The larger multi-sea winter 'spring' salmon are generally the first component of the salmon run to be seen (March – beginning of June), followed by larger numbers of smaller one-sea winter fish, grilse. The grilse component of the stock tends to be most prevalent in the period June - September.

The minimum salmon count estimate for 2002 was 4550. Overall, the salmon run estimate for 2002 was 45% higher than in 2001 (3138) and was the second highest recorded count over the past 9 years. The highest was recorded in 1994 (4769) and the lowest in 1997 (2242).

The salmon counts for 2002 are up on the 8-year monthly averages for January, March, April, June, August, September and October and 39% up on the 8-year average overall.

To attempt to differentiate between the different components of the stock the salmon count data, as in 2000 and 2001, has been split into its two major constituents i.e. multi-sea winter 'spring' salmon (Figure 3) and 'post - 1st June' salmon (Figure 4). The split is approximate and is primarily based on information of run timing and analysis of historical trap, net and rod catch data (Gunnislake Fish Counter Annual Report 2000 - Appendix 4). The breakdown of the 2002 salmon run data into its two main run components is as follows:

- The 404 multi-sea winter "spring" salmon, counted between April – May 2002, represents a 6.9% increase in the size of this component of the salmon run when compared to figures over the same period in 2001. Comparisons to the 8-year average (335) for the same period show a 21% increase in the multi-sea winter 'spring' salmon component of the salmon run. The figure of 404 is the second highest count recorded for the period over the past 9 years.
- The 3147 'post - 1st June' salmon counted between June – September 2002 represents a 69% increase in this component of the total salmon run estimate, in relation to 2001 (1864). Comparing this to the 8-year average (2327) over the

same period suggests a 35% increase in the size of this component of the salmon run in 2002. The minimum count estimate for the period June to September (3147) is the second highest figure recorded over the past 9 years.

The upstream salmon counts recorded at Gunnislake in 2002 are extremely encouraging when compared to those reported in 2001. Overall, the upstream counts are the second highest recorded at Gunnislake over the past 9 years.

The count data in 2002 implies that there have been notable increases in the numbers of both the multi-sea winter (spring) and 'post - 1st June' components of the salmon stock (27% and 35% respectively), when compared to figures for 2001 and the 8- year running average.

The figures recorded for multi-sea winter salmon over the period April to May for previous years implies that the number of these fish returning is fairly constant between years. Even so, the overall trend over the past few years seems to suggest that salmon numbers are increasing, albeit slowly. This suggests that measures designed to protect this component of the stock, such as the National Spring Salmon Bylaws, may in fact be working.

The year to year fluctuations that was noted in the multi-sea winter component of the stock is also apparent in the numbers of returning 'post - 1st June' salmon. The overall trend based on the last 9 years of counter data, is not clear but seems to indicate that the numbers of returning 'post - 1st June' salmon may be increasing. The reasons for the marked increase in the size of the post - 1st June salmon run for 2002 and for the massive influx of these fish in August is not immediately obvious. Flow conditions will have been a major contributory factor to the timing of the movement but do not explain the substantial increases in the overall numbers.

It must also be noted that immediately after an increase in flow levels on the 13th October there were substantial increases in the numbers of salmon recorded moving upstream. This was particularly obvious in the middle part of the month where on one day (15th October) 177 upstream salmon were counted traversing the weir.

The salmon count for October 2002 (696) was the highest figure that has been recorded by the counter, for this month, and was almost three times the 8-year average (263). It is highly likely that these later run salmon, probably the majority of which were grilse, were fish that had been held up in the estuary by the low flow conditions that prevailed over the period end of August - beginning of October. If this is the case then the overall increase in the numbers of 'post - 1st June' salmon is greater than first thought. If the counts for October are taken into account then the figures indicate a 51% increase in numbers, when compared to the same periods in 2001. This equates to a 45% increase in this component of the stock when compared to the 8-year average for the same period.

7.2 Sea Trout Counts Recorded on the River Tamar 1995 – 2002.

Historically, the main sea trout run on the River Tamar has been consistent with that of many other Southwest rivers. The sea trout run normally begins in April / May with the peak movement, predominantly 'school peal', taking place during June and July.

The smaller, but still significant, runs of sea trout tend to occur in April, May and August. The numbers decline sharply near the end of August with only small numbers moving upstream thereafter.

The counter data indicates that 2002 was a good year for sea trout (9751). The minimum run estimate for 2002 represents a 30% increase when compared to the 2001 estimate (7503). The 2002 count is the second largest count recorded over the past 9 years of counter operation. The lowest count (excluding 2000 due to missing data for January to March and November to December) that has been recorded over the period was in 1997 (6632).

The timing and pattern of the run is generally consistent between years except for a notable increase in the number of sea trout moving upstream in October, which is significantly higher than the 8-year average. It is also interesting to note that the upstream count for September is significantly lower than the 8-year average. This trend was also evident in the 2001 counter figures and appears to be flow related.

The numbers of fish moving upstream are higher than the 8-year monthly averages for all months with the exception of February, March, June, September and December. As Figure 2 indicates the majority of the run (65%) was concentrated in June and July.

As with the salmon data historical net, trap and rod catch data, together with anecdotal information on run timing, has been utilised in an attempt to split the sea trout run into its two major components, namely the larger repeat spawners and the smaller 'school peal' (27 cm – 31 cm in length). The initial split between salmon and sea trout has already been provided through the use of deflection sizes. In the 2000 and 2001 annual reports this splitting of the sea trout data provided a clearer indication on the state of each portion of the sea trout stock. The assumptions made for this split are that the majority of 'larger repeat spawners' are concentrated in the months April to May (Figure 5) and 'school peal' in the period June – August (Figure 6).

A breakdown of the 2002 sea trout run data into its two main run components is as follows:

- Count figures indicate that repeat spawners counted between April – May 2002 (1346) represented a 74% increase in the size of this component in comparison to figures for 2001 (772). Comparisons to the 8-year average (1058) for the same period shows that there has been an overall increase of 27% in the size of this component of the sea trout run in 2002.

- Counter data indicates that the 7091 'school peal' counted between June – August 2002 represents a 28% increase in this component of the total sea trout run estimate, when compared to 2001 figures (5548). Comparing this to the 8-year average (6577) over the same period implies a 7.8% increase in the size of this component of the sea trout run in 2002.

As in the case of salmon ('post - 1st June' salmon) it appears that flow has been the major influencing factor on the numbers of sea trout passing through the fish pass during the period June to August, historically the peak migration time for sea trout.

Similarly, after a sudden increase in flow rates, around the 13th October, sea trout counts suddenly increased and resulted in the highest monthly count recorded by the counter over the past 9 years (749). If this is taken into account the increase in the size of the school peal run in 2002 is closer to 26%, when compared to the figures recorded for the same period in 2001. This would equate to a 13% increase in the size of this component of the stock when compared to the 8-year average for the same period.

7.3 Other Species

As observed in previous years there were large runs of sea lamprey (*Petromyzon marinus, L*) migrating through the fish pass in 2002. The 2002 run was not as large as that seen in 2001. It is estimated that in excess of 300 lampreys moved up through the fish pass. These events were identified from counter data and video footage and the counts adjusted to remove these species from the salmonid count. No other species were identified from video footage.

7.4 Environmental Factors

The environmental variables routinely measured at Gunnislake are flow, temperature, barometric pressure and conductivity (fish counter). Rate of flow is generally considered to be the dominant factor controlling the upstream migration rate of salmonids. However it should not be considered in isolation as its effects are often modified by other factors such as water temperature, changes in barometric pressure; together with wind, weather and tidal conditions etc.

7.4.1 Flows on the River Tamar

The residual patterns of flow at Gunnislake in 2002 during the period of the main fish runs were generally consistent with that of previous years although flow rates were lower than usual for the period end of August to the beginning of October.

As in previous years the majority of upstream migrating salmonids (April – October) tended to utilise flows between 3 – 20 cumecs.

The periods January to April and November to December showed some marked and extended elevations in flow rates.

Analysis of the count figures for 2002 indicated that 8% of salmon and 6% of sea trout out of the total number of fish recorded moved over the weir when daily mean flows were in excess of 40 cumecs. Flow conditions in excess of 40 cumecs were present for 25% of the time in 2002, which is almost double the figures for 2000 / 2001 - 14% and 13% respectively.

7.4.2 Water Temperature

Figures 9 and 10 indicate that the patterns of fish movement coincide with rises and falls in temperature over the period of the main runs for salmon and sea trout. The temperature profiles for 2002 (based on monthly averages) are consistent with those for 2000 and 2001 although November was noticeably warmer. Although the evidence for the influence of temperature on upstream migration is inconclusive

(Banks, 1969) it is generally accepted that salmonids tend to move within an optimum temperature band of between 5°C – 21.5°C (Alabaster, 1970). The data for 2002 indicated that only a tiny proportion of fish moved upstream outside of this temperature band (0.2% salmon and 0.07% sea trout).

Milner (1989) suggested that temperature accounted, in part, for the timing of river entry but thereafter flow probably provided the biggest environmental stimulus for upstream migrants. With the current interest in global warming temperature data may provide important clues into the effects of climate change on migratory fish populations and in particular, changes in the timing of their migrations.

7.4.3 Barometric Pressure

Changes in barometric pressure have often been thought to a play a part in stimulating the upstream movements of salmonids. However evidence in the scientific literature is inconclusive and often contradictory. Banks (1969) conducted a thorough literature review of the factors affecting the upstream migrations of salmonids and concluded that although temperature had a significant effect on salmonid migrations the effect of changes in barometric pressure were minimal. However, anecdotal evidence seems to suggest that changes in barometric pressure affect the behaviour of migratory fish, once the fish are within the river system and it is therefore worthy of further investigation.

As in 2000 and 2001, Figures 11 and 12 indicate that the relationship between barometric pressure and fish movements is not as clear as that existing for temperature and flow. Generally, it is also not clear to see from the data whether fish are moving prior to an increase in flow i.e. using a drop in pressure to predict an increase in flow. The exception to this is the period around the first half of October where a rapid drop in pressure coincided with large numbers of salmonids moving upstream following a long period of low flows. As the numbers of fish moving did not increase substantially until the 14th October, when flows increased, it is probably more likely that fish were responding to an increase in flow rather than the drop in pressure. Although difficult to prove, it is possible that the rapid drop in pressure may have acted as a trigger to 'prime' the fish to move when the flows increased i.e. got them in a state of readiness to move upstream. This may also explain the increased levels of activity often reported by anglers after a rapid drop in barometric pressure.

Summary

The continuing increase in the numbers of returning multi-sea winter 'spring' salmon is extremely encouraging. The 2002 increases, together with the overall consistency of the numbers over the years, suggest that measures designed to protect this component of the salmon stock may be working.

If we take into account the late runs of fish in October, which occurred directly after a prolonged spell of low flows then the numbers of post - 1st June salmon returning to the Tamar have increased by 51%, when compared to 2001. This massive increase in the numbers of these 'post – 1st June' salmon is also encouraging and could be due to one or a combination of favourable factors. The introduction of net buy-back schemes over the past few years will undoubtedly have allowed a greater proportion of these fish to enter the freshwater Tamar.

Overall the numbers of sea trout passing through the fish pass were up on the figures for 2001. The 2002 counter figures, taking into consideration data in October, suggests that there has been a healthy increase (25%) in the number of school peal in comparison to figures recorded in 2001. The counter data also showed a significant increase in the numbers of returning large multiple spawning sea trout. Even though the yearly variation in the numbers of these large fish is fairly small the overall trend seems to suggest that sea trout numbers are on the increase. It is also possible that this may be a by-product of the measures designed to protect multi-sea winter 'spring' salmon.

The environmental data indicates that flow is the overriding factor affecting fish movement. The effect of changes in temperature and barometric pressure on fish migration is still unclear but the temperature data in particular does seem to suggest some link to the timing of fish entry into the river.

7.5 Video Validation and Counter Efficiency

Video data was collected 24-hours per day over period of the main salmon and sea trout runs during 2002. Table 5 details the period over which video footage was recorded and also the total number of hours of video collected.

Table 5 – Summary of Video Validation at Gunnislake Fish Counter 2002.

Camera	No. of Hrs Recorded	Period of Operation	No. of Hrs Watched
Downward Facing Camera	2532.9	10/5 - 22/9	314

The counter efficiencies (Table 3) are based on the number of fish that have been seen on video and recorded by the counter, predominantly during the hours of darkness, over the period (11/5/01 – 14/7/01).

The overall detection efficiency of the counter for upstream migrating fish was estimated at 85%. The level of efficiency is comparable to previous years and in the initial validation study conducted in 1993 (90%). Slight losses in efficiency can be attributed to the large numbers of sea trout passing over the weir in groups of two or more. In many cases these were recorded as single fish counts or as "non-fish" events, which resulted in a slight under estimate for sea trout.

Video evidence allows us to correct for these events but these slight losses in efficiency only have a small effect on the figures for the run estimates overall. It is this type of information that can be used to fine tune the settings of the fish counter and improve the detection efficiency in the long term.

Counts have not been extrapolated or estimated for the period 25th – 27th May when the counter suffered a loss in data due to a fault. As the average flows for this period were in excess of 50 cumecs it was considered that few fish would be moving in these conditions. In light, of this it was thought unlikely that a reliable and accurate estimate of upstream fish counts could be made for this period.

8. Data Processing

The data presented in this report represents final adjusted counts, which takes into account maintenance work on the fish pass and non-target species etc.

The original monthly summary reports distributed in 2002 were intended to give a general indication of salmonid movements and to provide an estimated minimum salmonid count for each month. Any data contained within the original monthly summary reports has been superseded by this report.

9. Update

- The fish counter at Gunnislake site has suffered from only one major period of data loss during 2002 (25th – 27th May). This was due to a counter fault.
- The WebCam at Gunnislake has had some teething problems, primarily due to water ingress into the camera housing. However, the project has proved how valuable the camera is for remotely checking river conditions and general site security etc.
- The renovation works on the fish trap at Gunnislake are progressing and will be finished by the end of March 2002. It is hoped that adult trapping will begin shortly after this work is finished as part of the River Tamar index study. The data gained from the trapping studies will also provide information that can be used to improve the efficiency of the counter at Gunnislake.

10. Future Work

- Continued validation of the counter's performance and efficiency will be carried out on an annual basis using overhead video cameras.
- The Environment Agency has conducted a topographic survey of the Gunnislake site and is hoping to relocate the hut to an area of the site that is less prone to flooding. A scoping study has been carried out and funds have been made available. It is envisaged that works will begin sometime in 2003/2004. In the interim the counter hut and equipment has been waterproofed to keep flood damage to a minimum.
- To assess the presence and abundance of non-target species traversing the fish pass e.g. Shad (*Alosa sp.*), Sea Lamprey (*Petromyzon marinus*) and Mullet (*Mugil sp.*).
- Collection of temperature and barometric pressure at hourly intervals via two sensors / data-loggers will be continued in 2003.

- Use of fish counter data to improve information on flows required for species specific upstream migrations i.e. salmon, sea trout etc. Information from radio tracking studies have already been used to calculate migration indices for salmon at Gunnislake Weir but fish counter information could provide more detailed information over a wider range of conditions, for a larger sample size and for a range of species. An Environment Agency report coming out at the end of March 2003 will also outline a methodology for calculating flow response curves for salmonids, which will improve our understanding of fish movements on the River Tamar.

- As part of the index river study the trap at Gunnislake will be operating in 2003. The data from the trapping study will provide valuable information on the different components of the migratory salmonid runs on the River Tamar. It will also provide data on non-target species such as Shad (*Alosa sp.*) and Sea Lamprey (*Petromyzon sp.*).

11. Downtime

The counter was operational for 8560 hours out of a possible 8760, approximately equivalent to 8.3 days out of a total of 365 days. The majority of this downtime can be attributed to a counter fault. The downtime has been broken down as follows:

Table 6 – Breakdown of Counter Downtime in 2002.

Item	Downtime		Sub-Total	% Downtime	
	Enforced	Routine		Enforced	Routine
1. Weir cleaning (gate shut)	0.00	2.23	2.23	0.00	2.32
2. Counter Maintenance	0.00	0.00	0.00	0.00	0.00
3. Camera Maintenance	0.00	4.78	4.78	0.00	4.98
4. Counter Fault	38.17	0.00	38.17	36.70	0.00
5. Other	64.48	38.80	103.28	62.00	40.44
6. Trapping	1.35	50.13	51.48	1.30	52.25
Total Downtime (Hours)	104.00	95.94	199.94		
Expected Operational Hours	8760.00				
% Time Operational	97.72				

12. References

01. Environment Agency (1997). Design and Use of Open Channel Resistivity Fish Counters (Advisory Manual). Fisheries Technical Manual No. 2. Environment Agency North West Region. R&D Technical Report W23.

02. Environment Agency (1997). Salmon and Sea Trout Movements Recorded at Gunnislake Fish Counting Station on the River Tamar during 1996. Environment Agency. Annual Report 1997.

03. Environment Agency (1998). "A Preliminary Assessment of the Buy-back of licensed Migratory Salmonid Netting Time on the River Tamar in 1997 and 1998. Environment Agency. Gunnislake Fish Counter Data Report - July 1998.

04. Solomon, D.J, Sambrook, H.T, Broad, K.J (2002). Salmon Migration and River Flow: "Results of Tracking Radio Tagged Salmon in Six Rivers in South West England." Research & Development Publication 4. Environment Agency 2002.

05. Environment Agency (1998). Gunnislake Fish Counter. Annual Report 1998. Environment Agency 1998.

06. Environment Agency (1999). Gunnislake Fish Counter. Annual Report 1999. Environment Agency 1999.

07. Environment Agency (2000). Gunnislake Fish Counter. Annual Report 2000. Environment Agency 2000.

08. Environment Agency (2001). Gunnislake Fish Counter. Annual Report 2001. Environment Agency 2001.

09. Banks,J.W. (1969). A review of the literature on the upstream migration of adult salmonids. J. Fish Biol. 1, 85-136.

10. Milner, N. J. (1989). Fish movement in relation to freshwater flow and quality. Workshop proceedings of The Atlantic Salmon Trust 6 April 1989.

11. Alabaster, J.S. (1970). River flow and upstream movement and catch of migratory salmonids. J. Fish. Biol. 2, 1-13.

13. Appendices

Appendix 1 – Daily upstream counts in relation to flow at Gunnislake Weir 2002.

Figure 7 – Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir 2002.

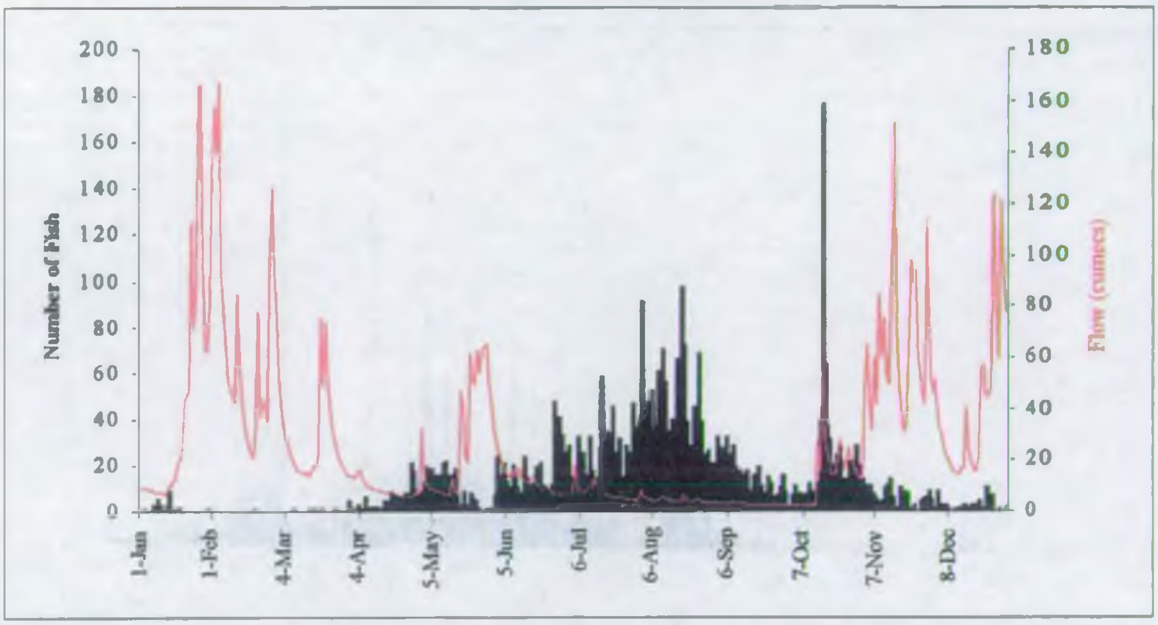
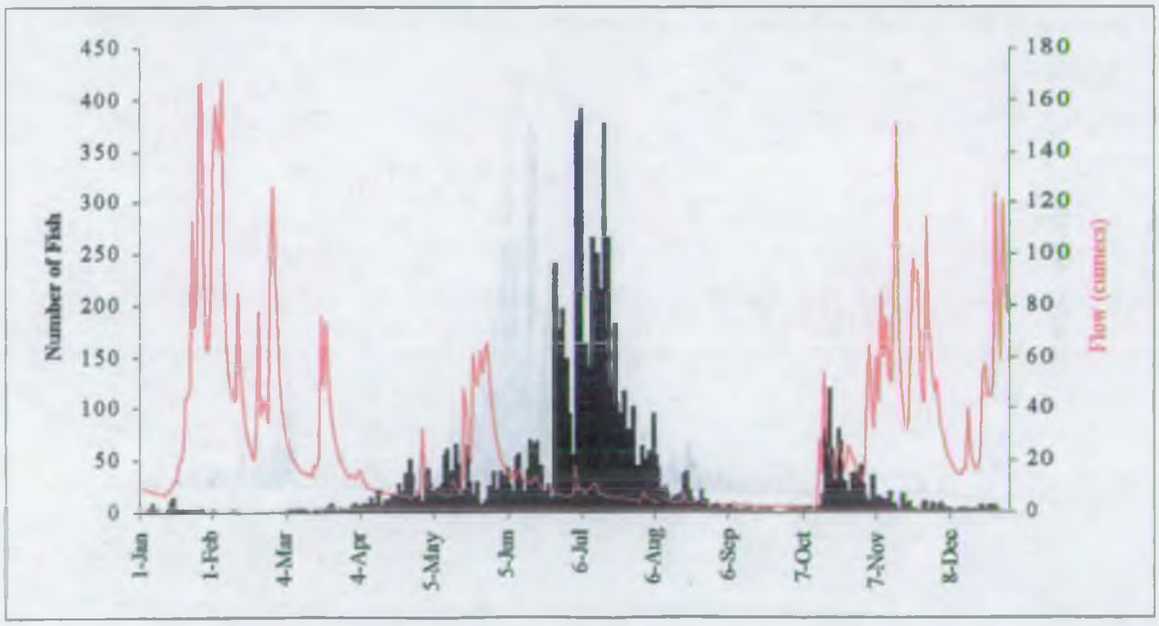


Figure 8 – Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir 2002.



Appendix 2 – Daily Upstream Counts in Realtion to Temperature (°C) at Gunnislake Weir 2002.

Figure 9 - Daily Upstream Counts of Salmon in Relation to Temperature (°C) at Gunnislake Weir 2002.

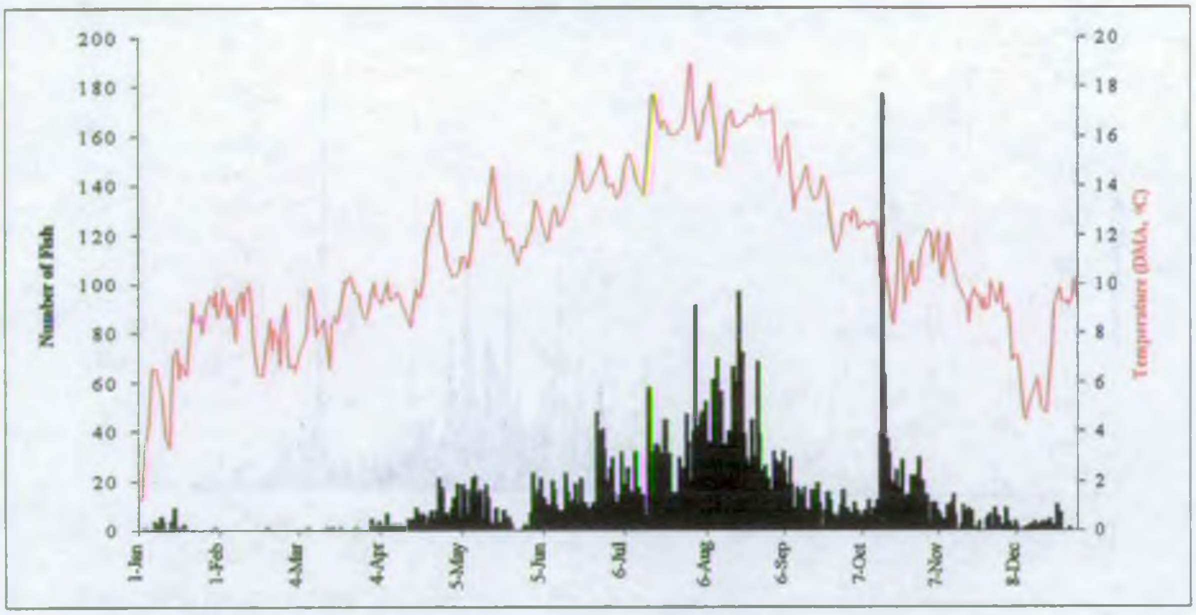
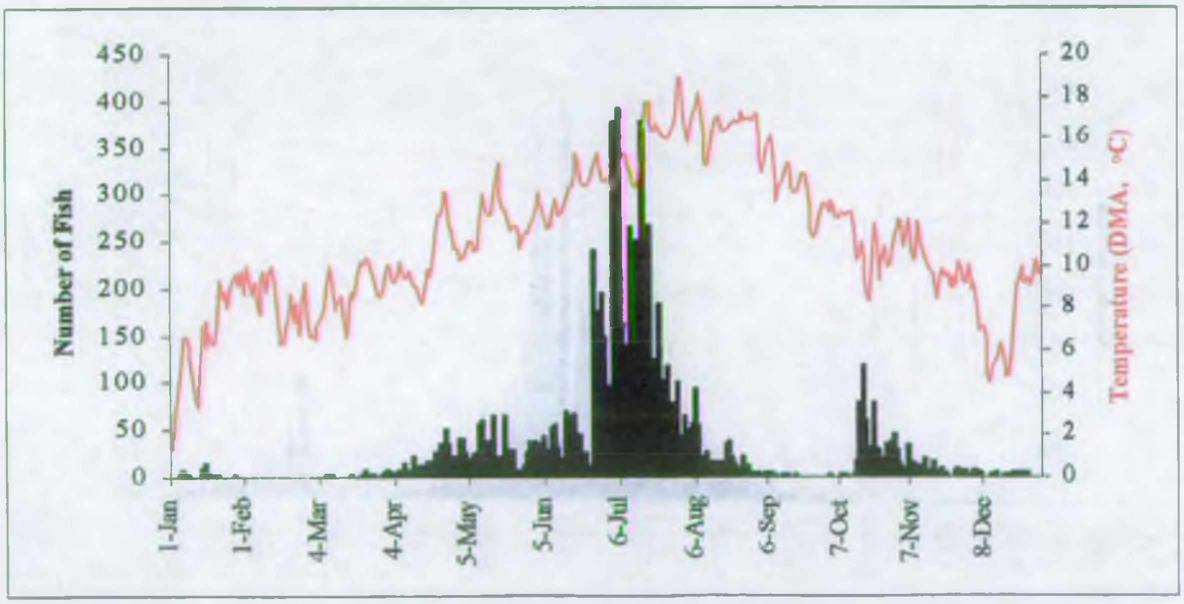


Figure 10 - Daily Upstream Counts of Sea Trout in Relation to Temperature (°C) at Gunnislake Weir 2002.



Appendix 3 – Daily Upstream Counts of Salmon in Relation to Changes in Barometric Pressure at Gunnislake Weir 2002.

Figure 11 - Daily Upstream Counts of Salmon in Relation to Changes in Barometric Pressure (mBar) at Gunnislake Weir 2002.

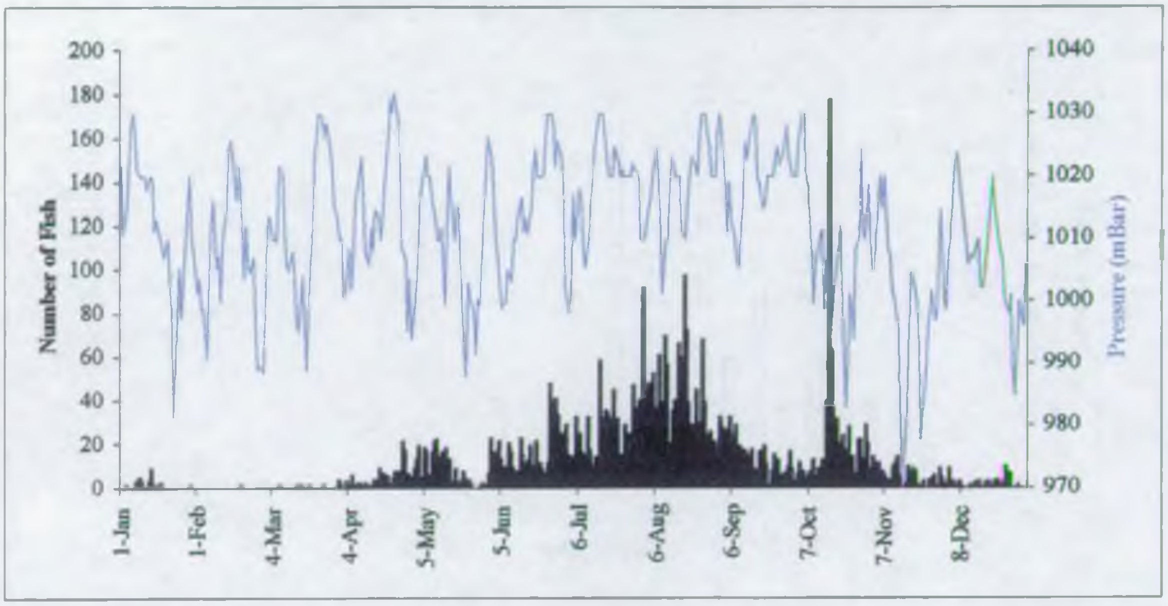
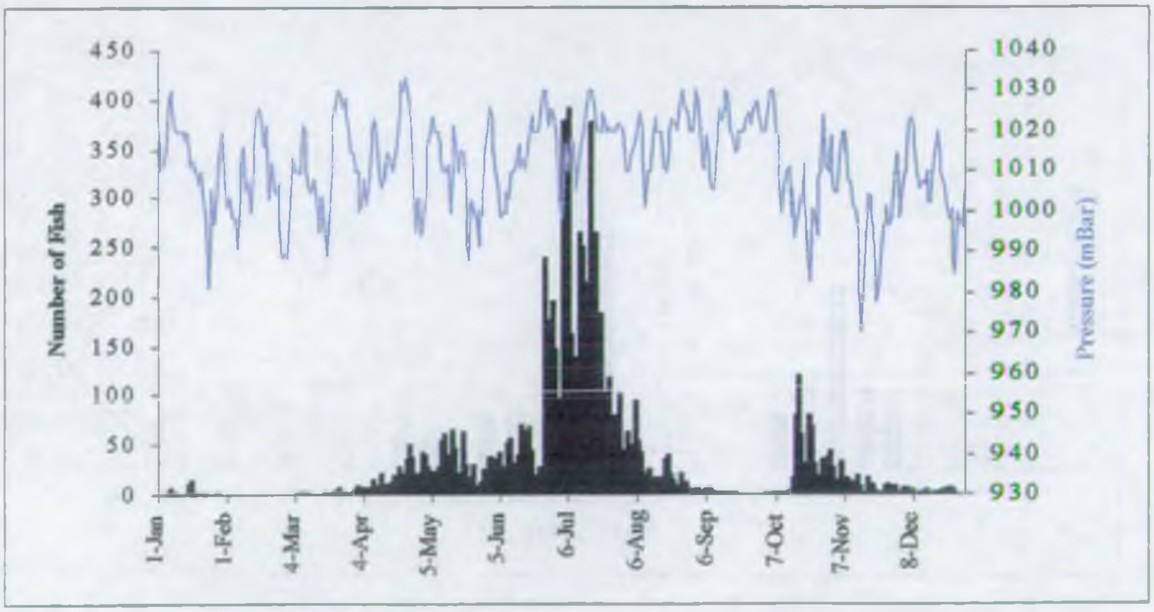


Figure 12 - Daily Upstream Counts of Sea Trout in Relation to Changes in Barometric Pressure (mBar) at Gunnislake Weir 2002.



Appendix 4 – Daily Upstream Counts of Salmon in Realtion to Flow (cumecs) at Gunnislake Weir 2002.

Figure 13 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – January 2002.

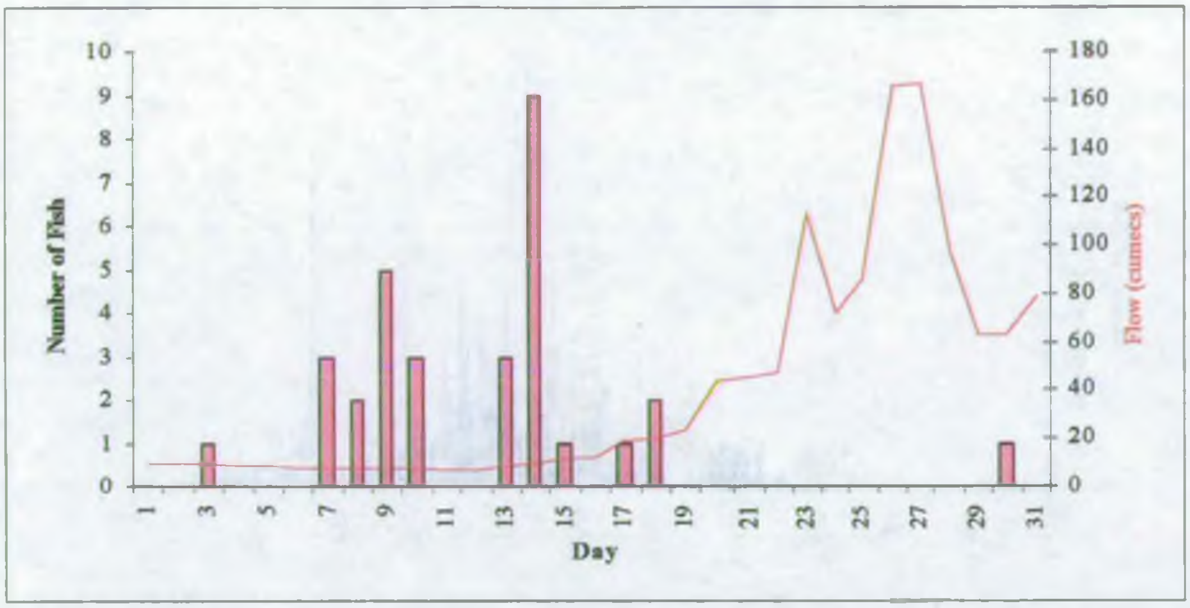


Figure 14 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – January 2002.

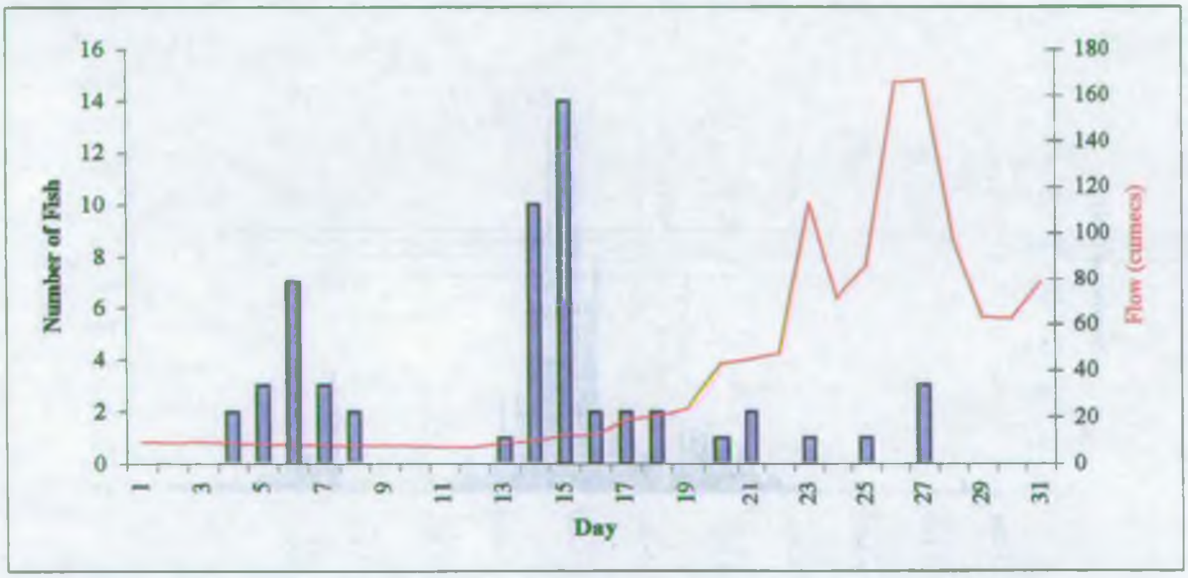


Figure 15 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – February 2002.

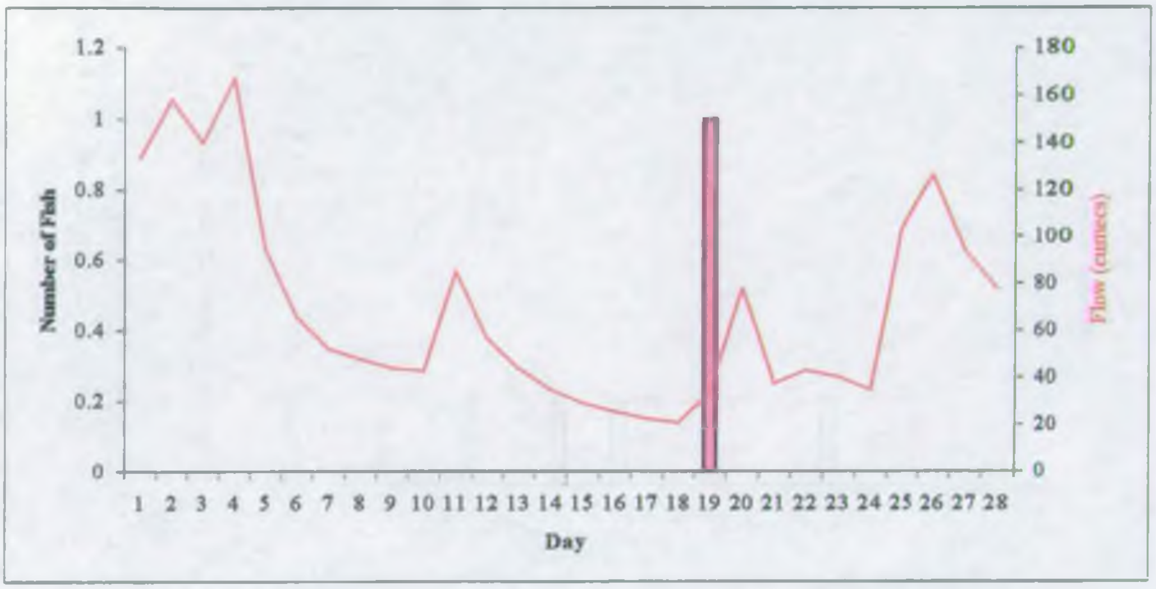


Figure 16 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – February 2002.

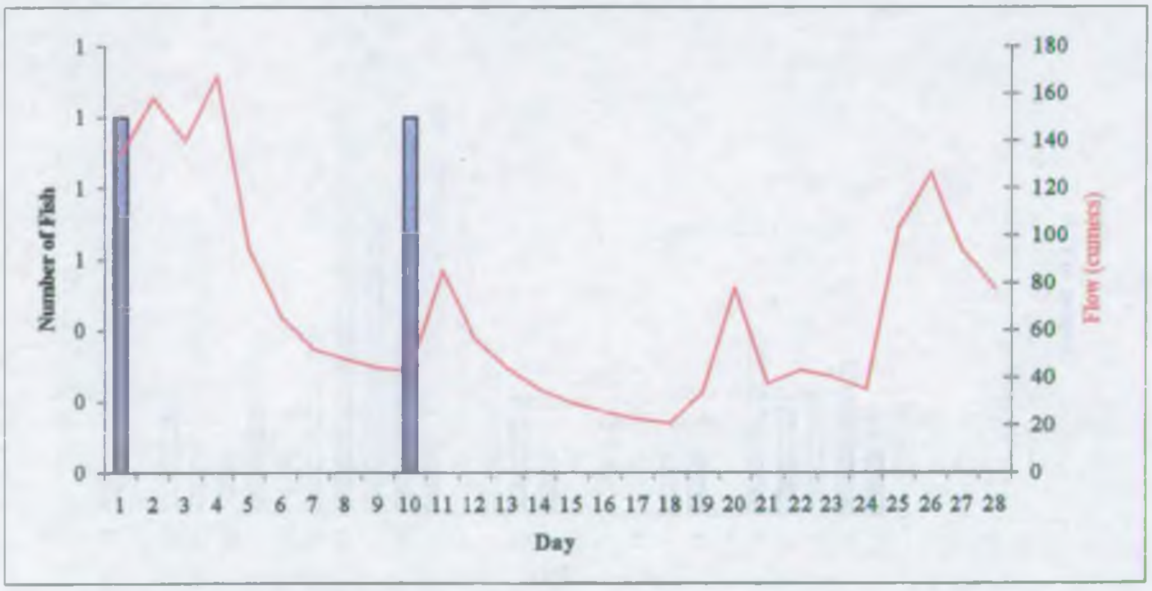


Figure 17 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – March 2002.

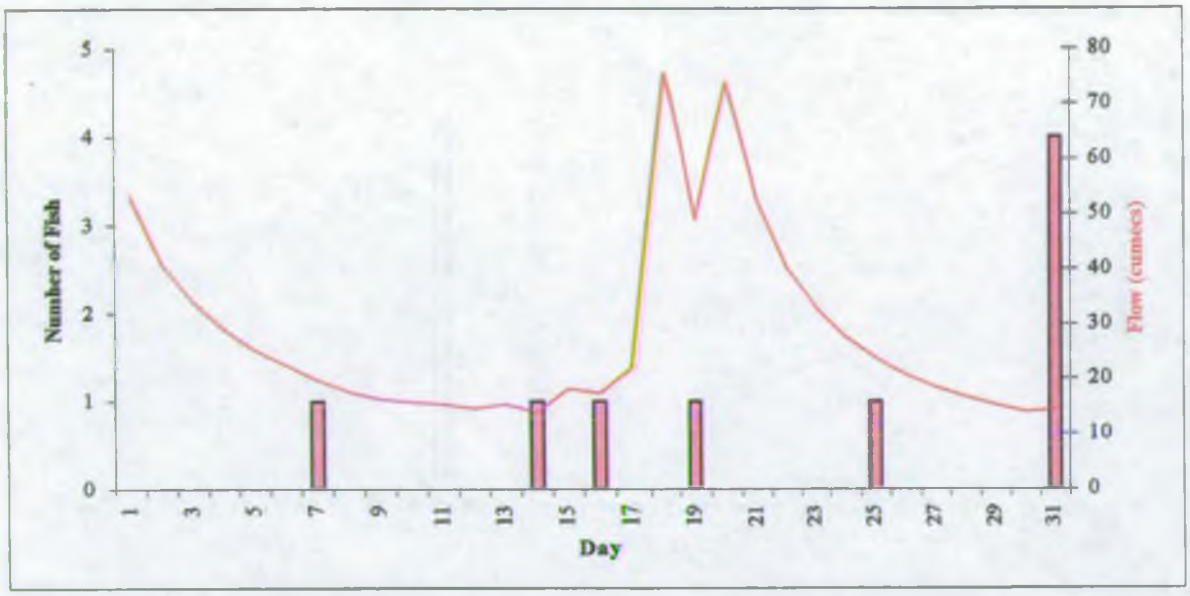


Figure 18 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – March 2002.

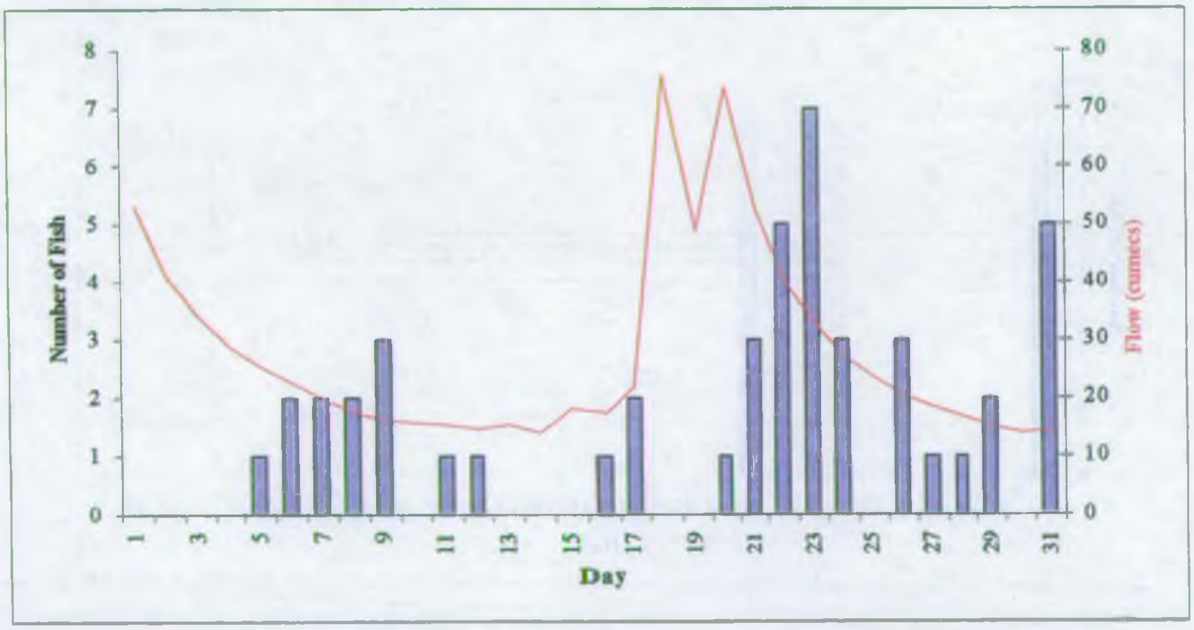


Figure 19 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – April 2002.

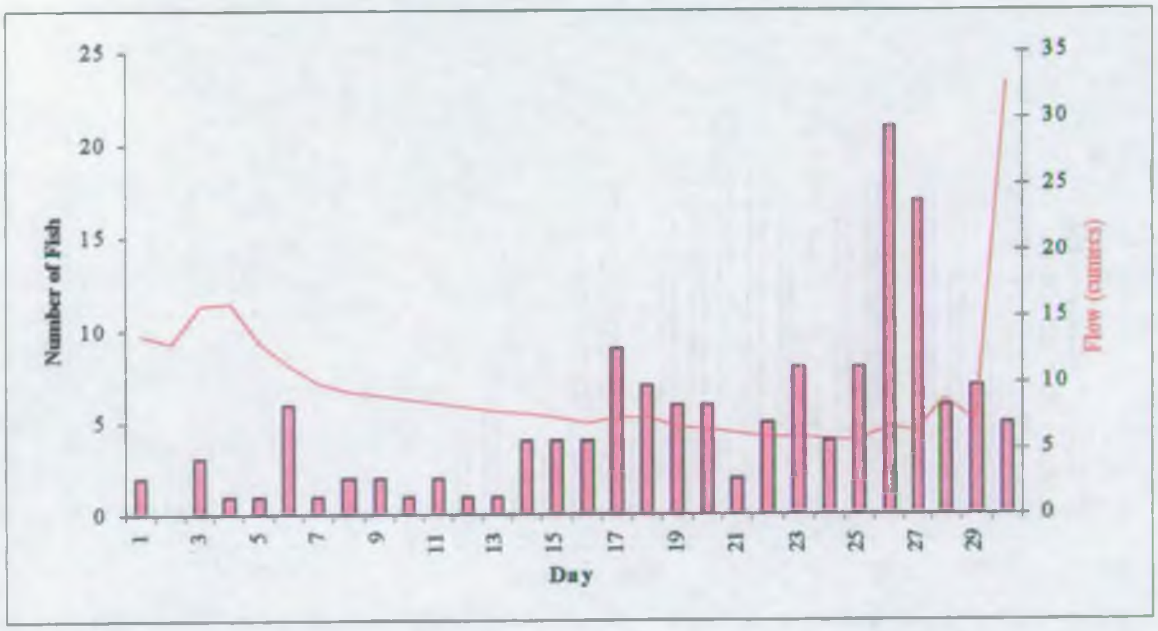


Figure 20 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – April 2002.

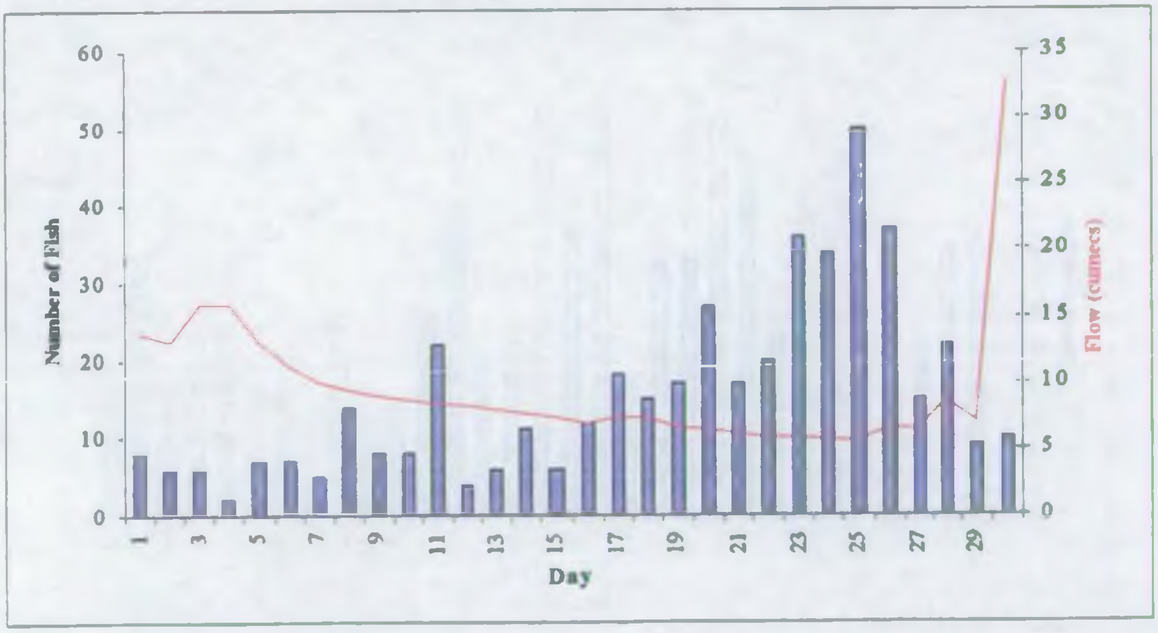


Figure 21 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – May 2002.

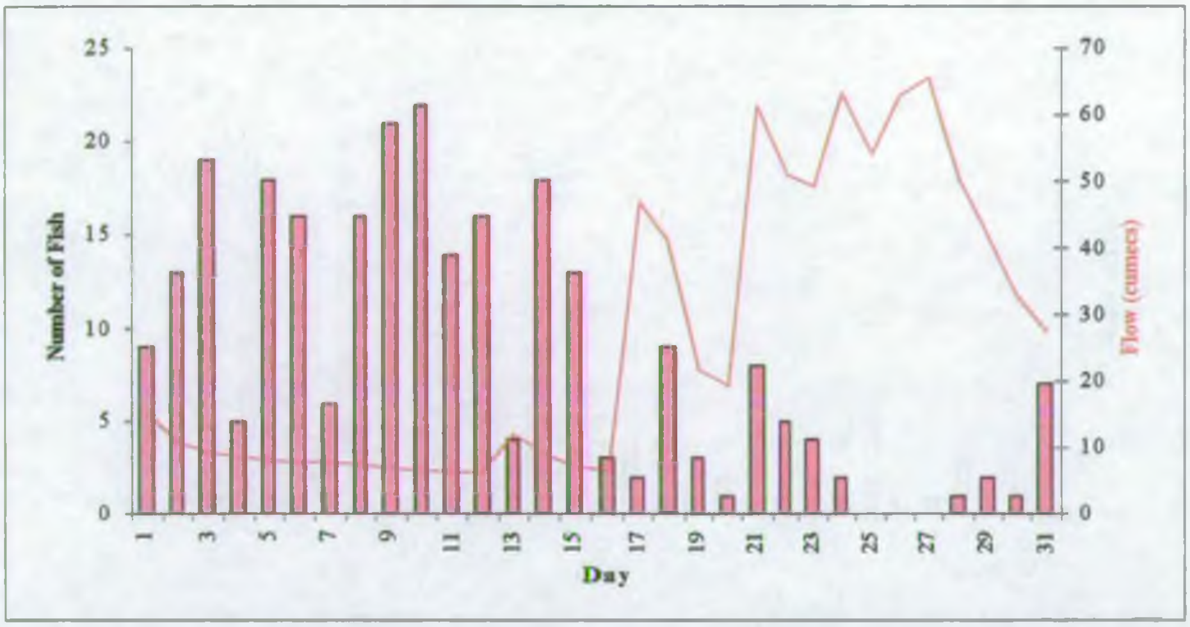


Figure 22 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – May 2002.

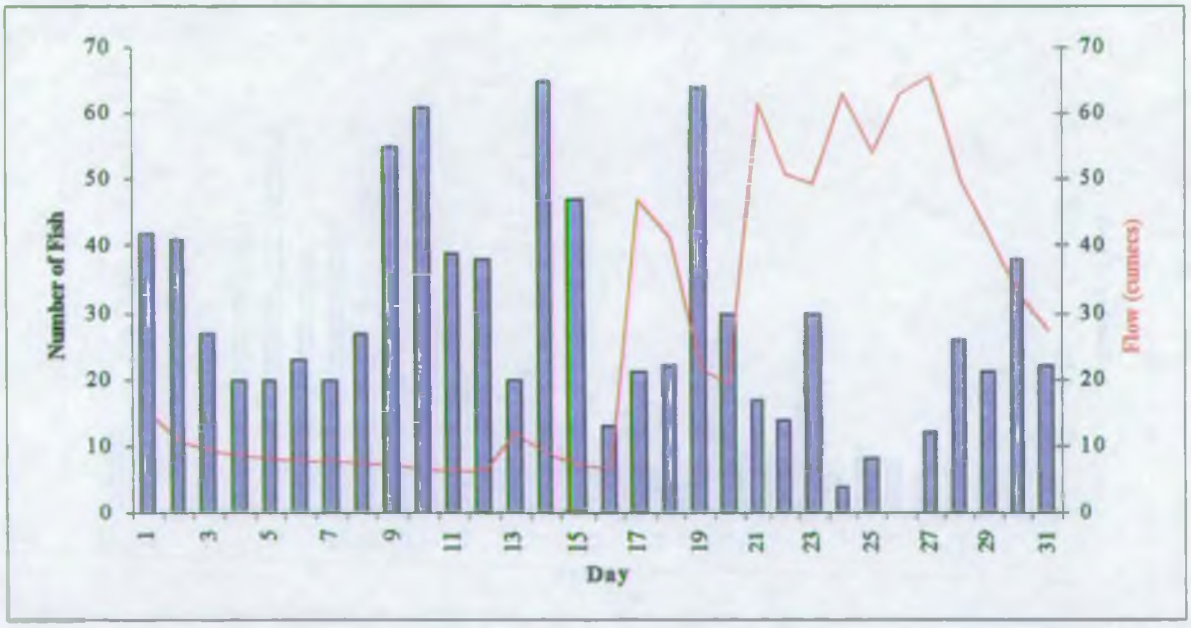


Figure 23 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – June 2002.

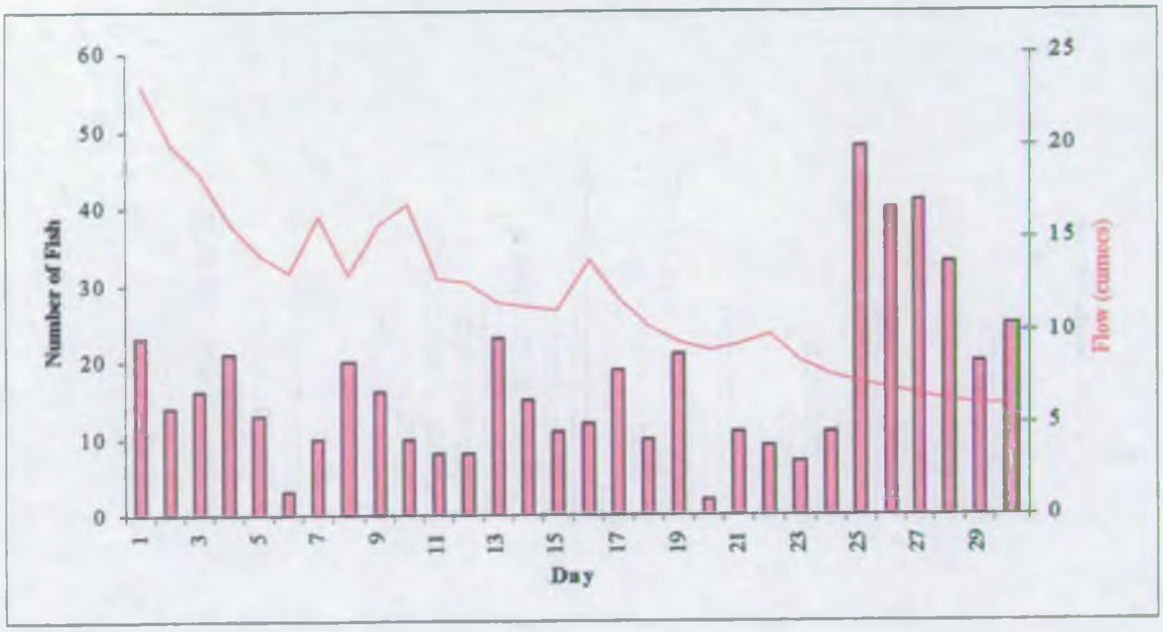


Figure 24 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – June 2002.

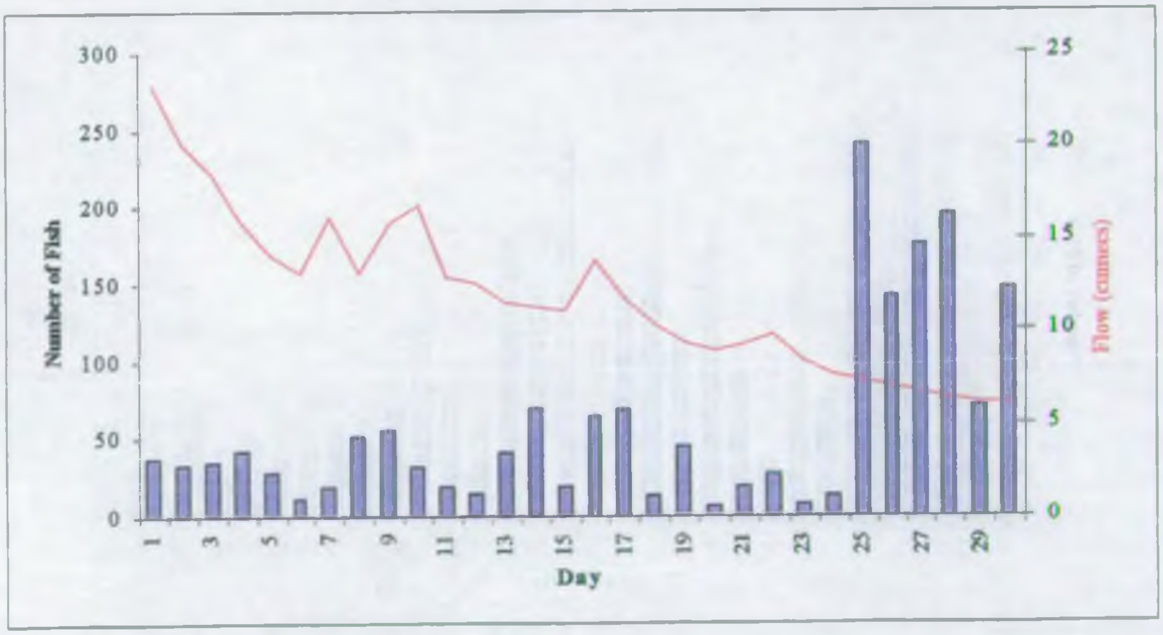


Figure 25 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – July 2002.

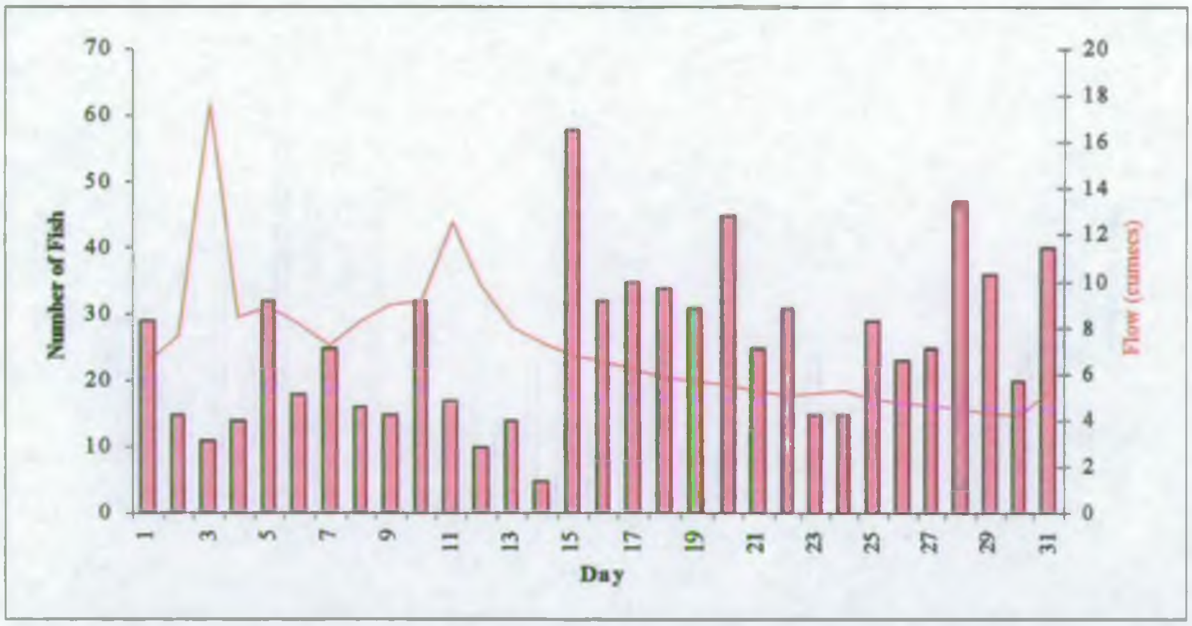


Figure 26 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – July 2002.

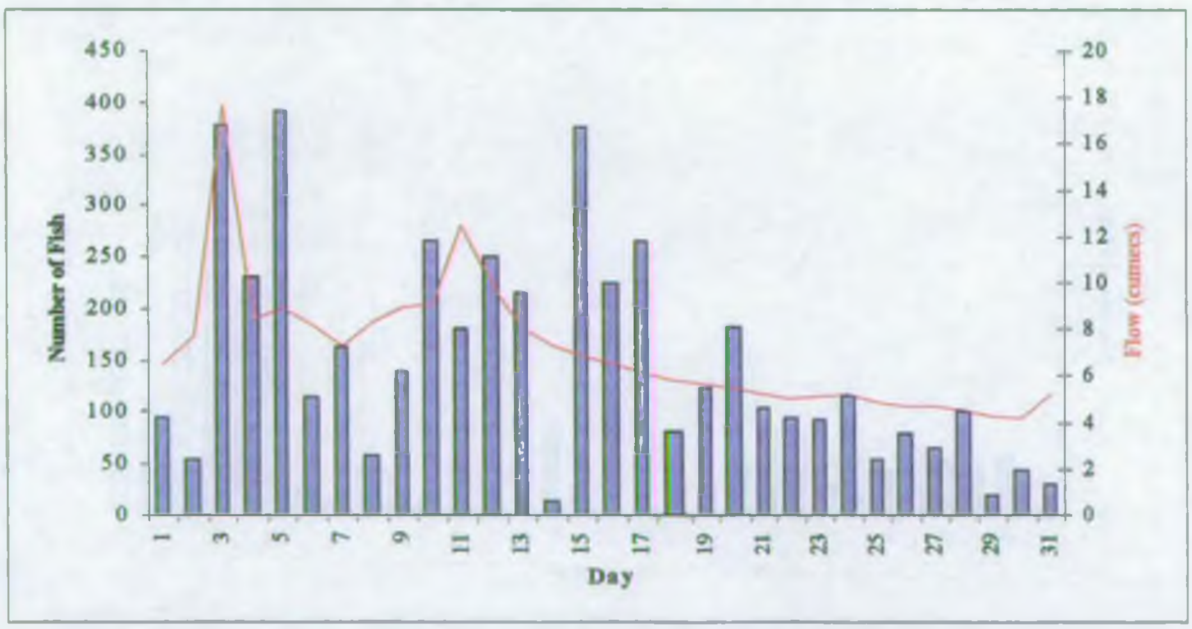


Figure 27 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – August 2002.

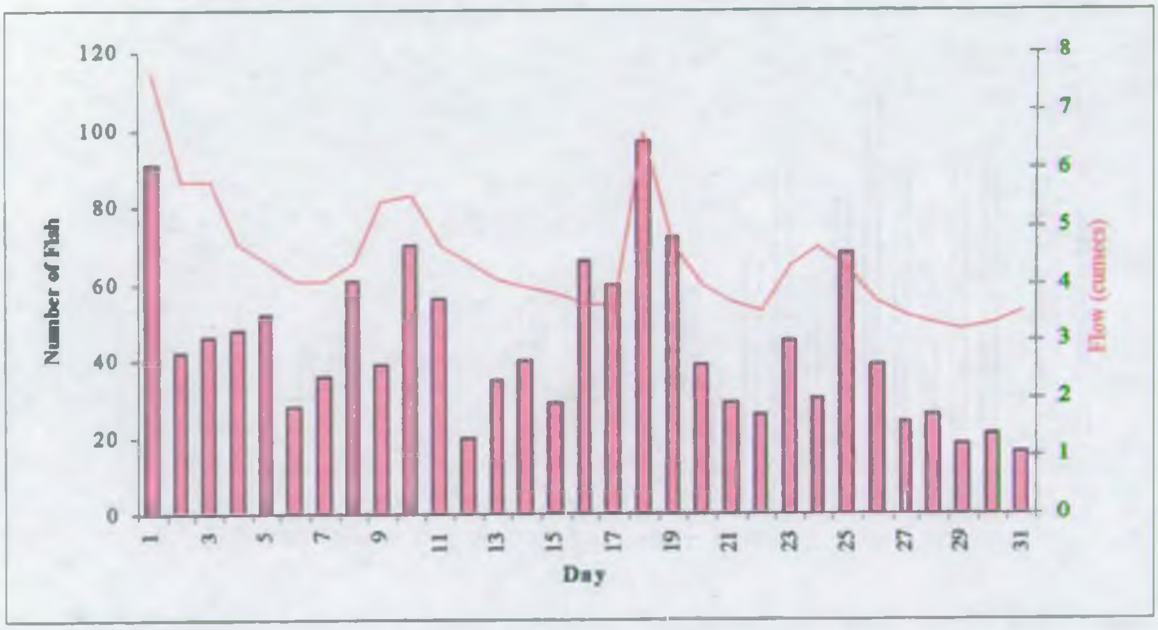


Figure 28 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – August 2002.

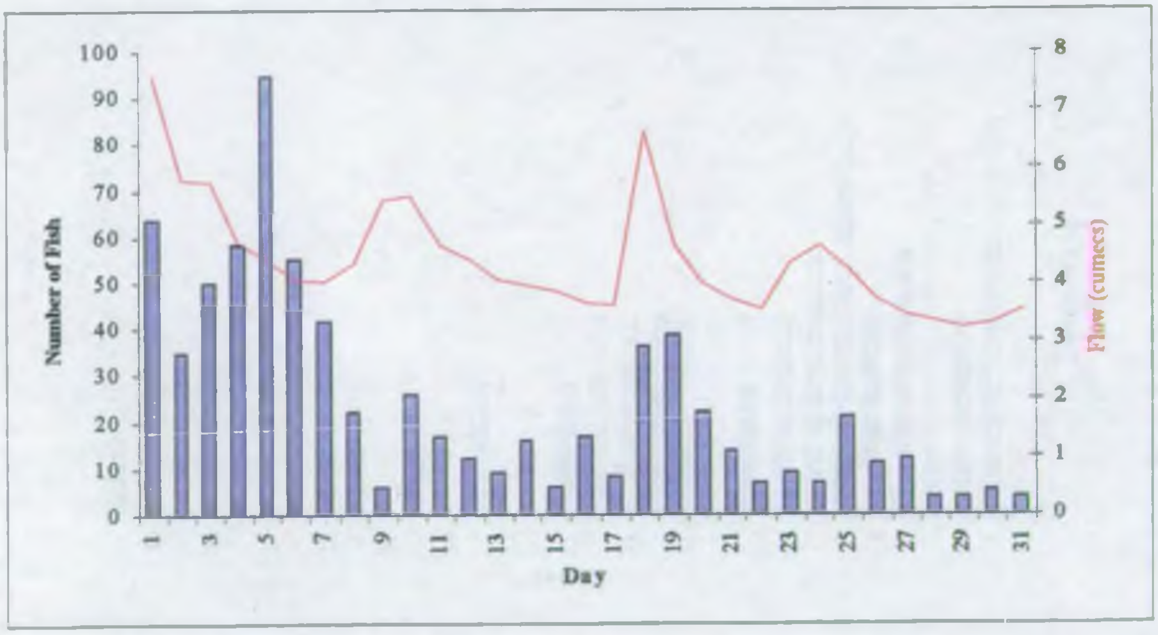


Figure 29 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – September 2002.

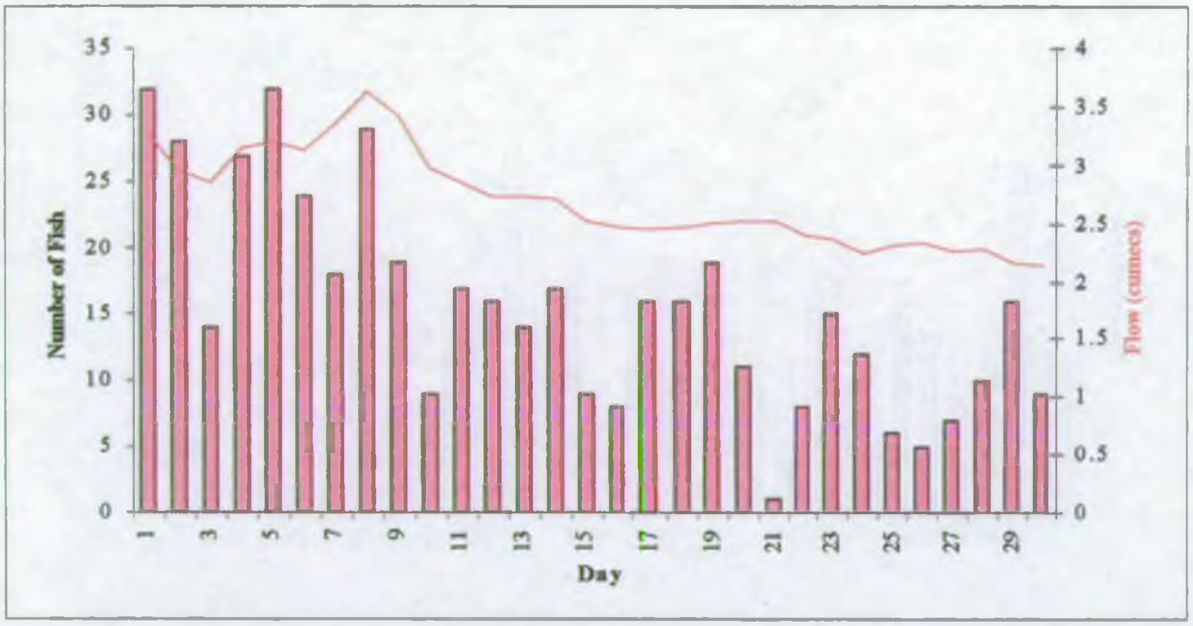


Figure 30 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – September 2002.

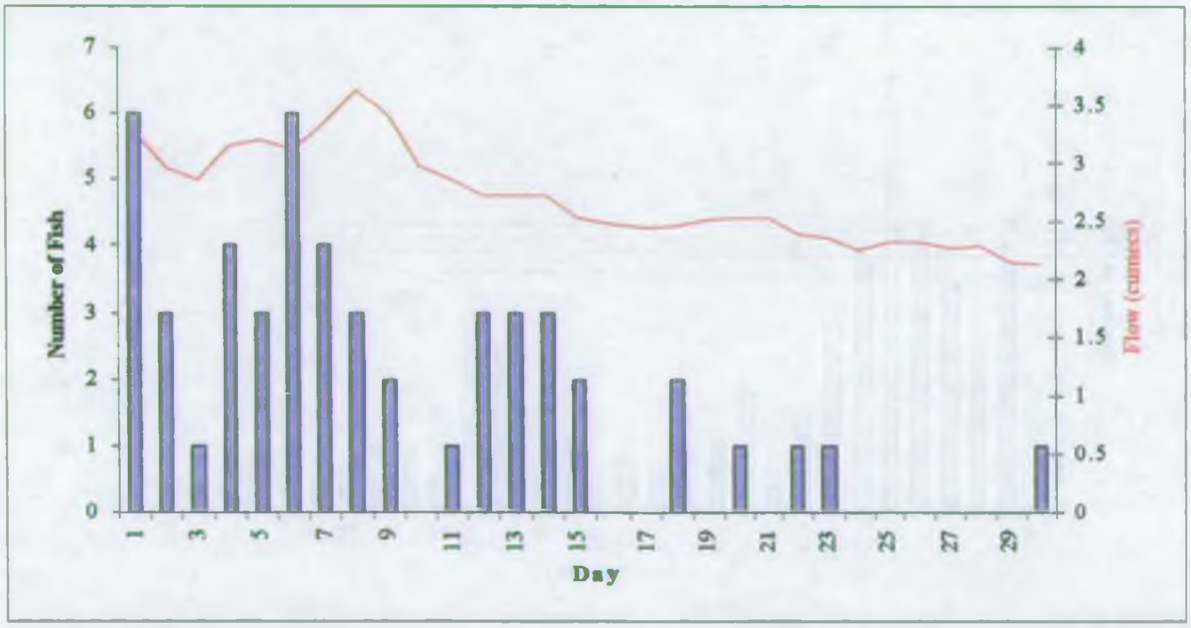


Figure 31 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – October 2002.

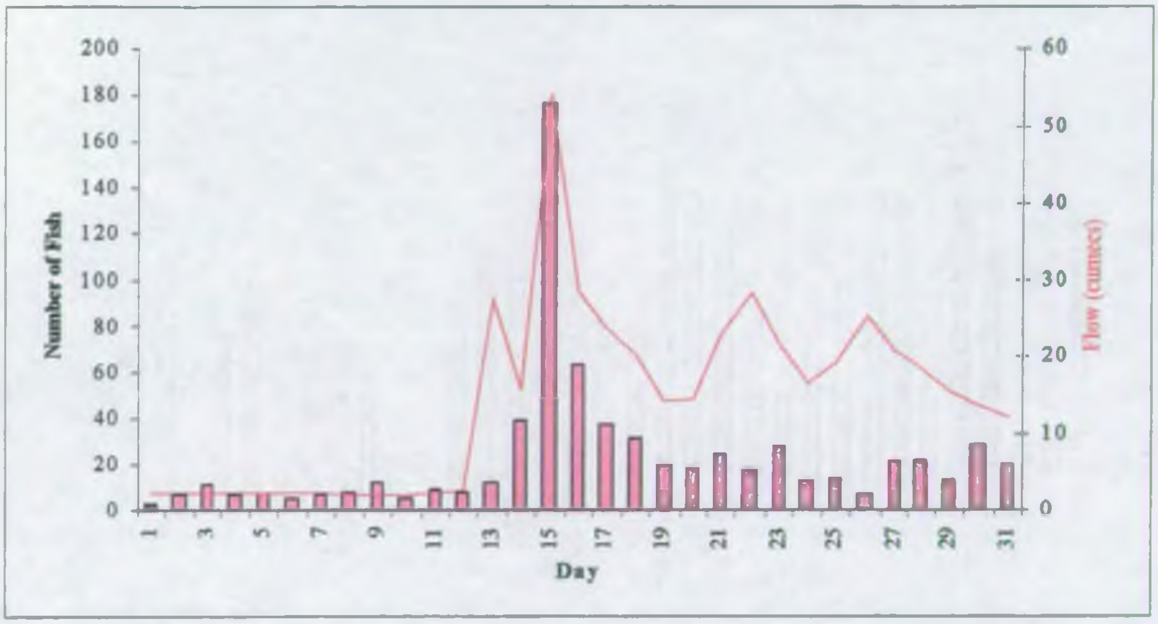


Figure 32 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – October 2002.

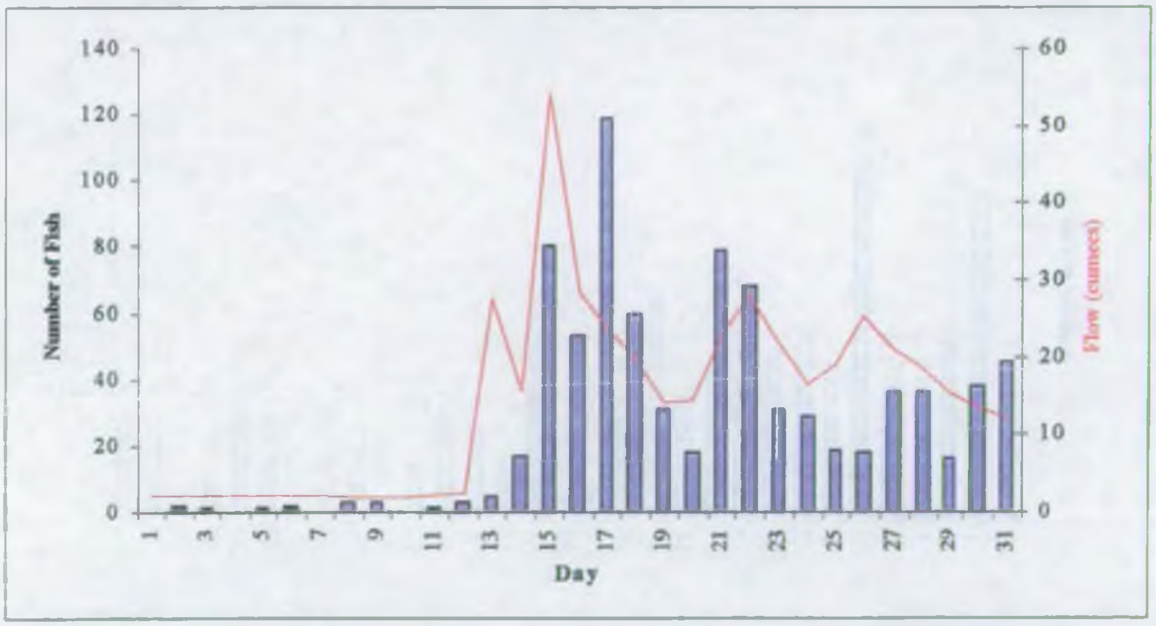


Figure 33 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – November 2002.

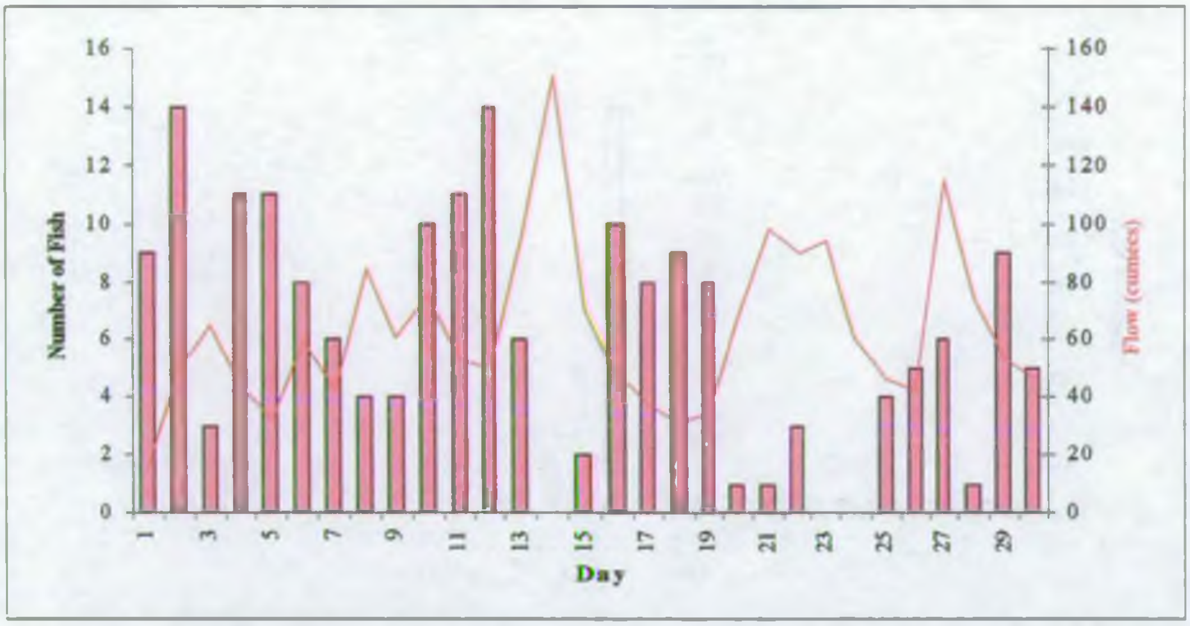


Figure 34 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – November 2002.

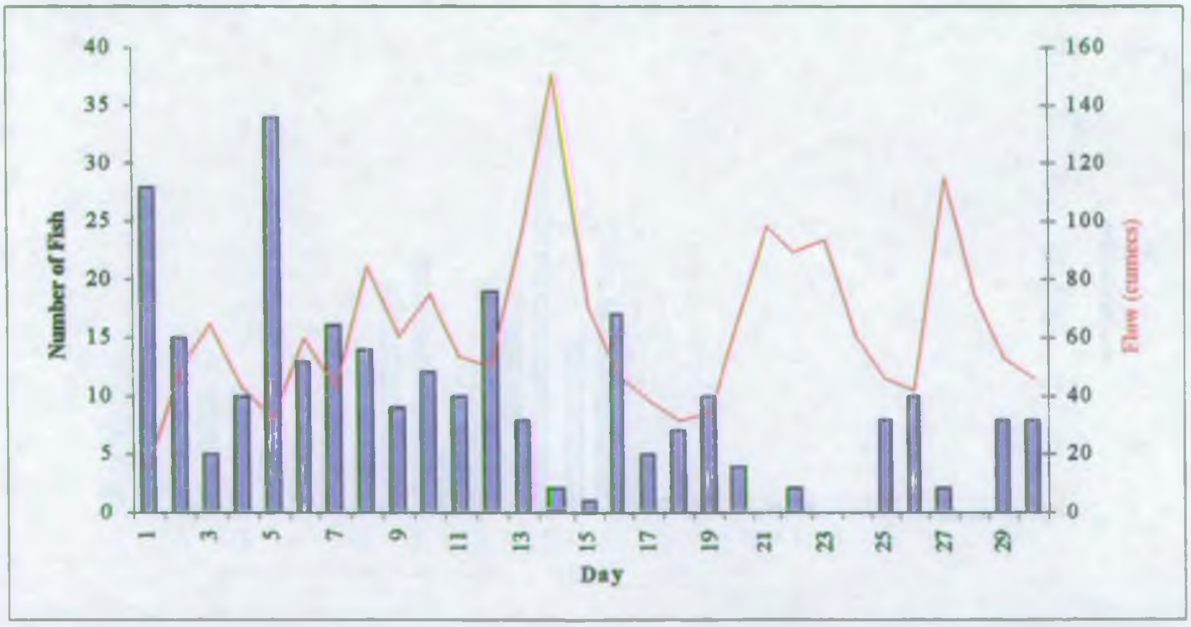


Figure 35 - Daily Upstream Counts of Salmon in Relation to Flow (cumecs) at Gunnislake Weir – December 2002.

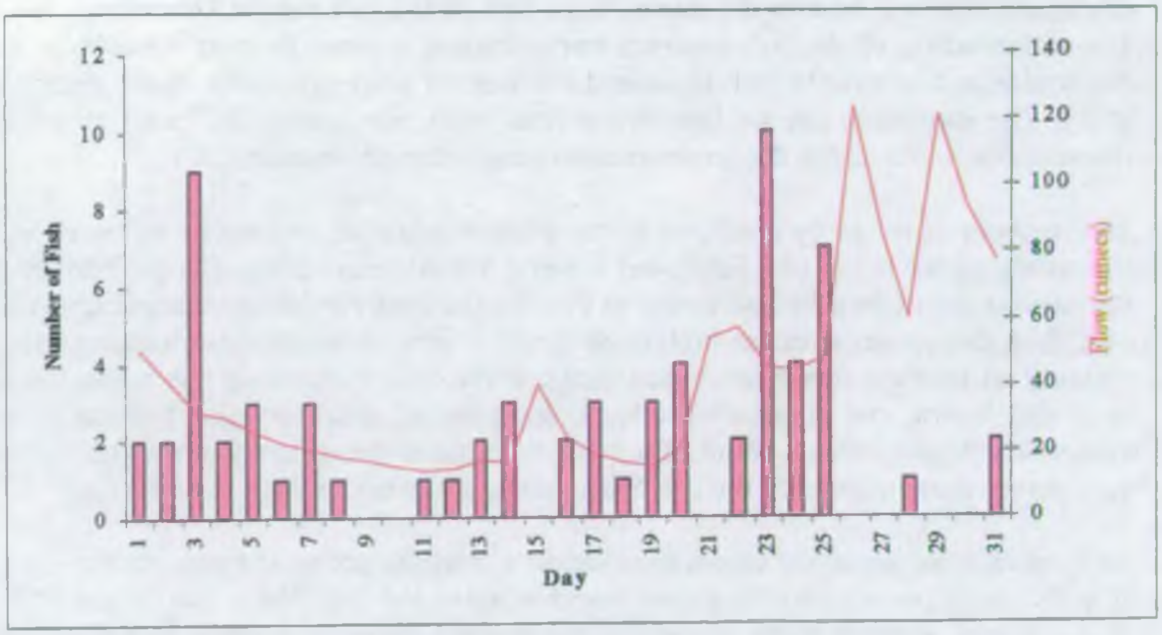
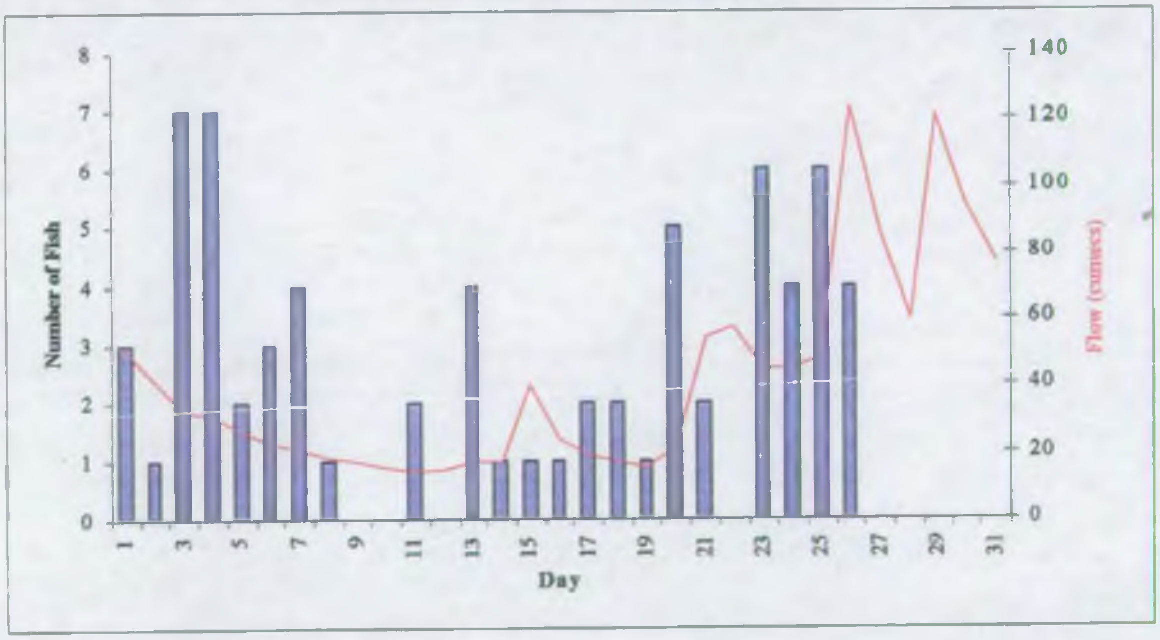


Figure 36 - Daily Upstream Counts of Sea Trout in Relation to Flow (cumecs) at Gunnislake Weir – December 2002.



Appendix 5 - Operating protocol for the Logie 2100A resistivity fish counter at Gunnislake Weir.

To detect fish passing upstream, the Logie 2100A utilises three stainless steel electrodes that are set into the downstream face of the fish pass at Gunnislake Weir. The construction of the fish pass ensures a smooth laminar flow of water over the electrodes and allows the fish to ascend the weir in close proximity to the electrode array. The electrodes are set into 'Nitomortar' (low conductivity cement) to reduce fluctuations in resistivity due to the structure and between the electrodes.

The counter operates by applying a low positive/negative voltage (5 volts) at high frequency to the upper (+5 volts) and lower (-5 volts) electrodes. The net voltage at the central electrode is virtually zero as the two voltages effectively cancel each other out. As a fish passes over the bottom electrode it acts as a weak electrical conductor, causing an increase in the negative voltage at the central electrode. As a fish passes over the central and upper electrode it causes an increased positive voltage at the central electrode. The net result of a fish passing over the electrode array is a typical sine wave, the amplitude of the waveform being governed by the size of the fish.

The counter processes the signal received from the electrodes and uses an algorithm, together with pre-set parameters, to assess whether the object is a fish or not. If the positive and negative parts of the waveform are similar the counter recognises the 'event' as a fish and logs it as either an 'upstream' or a 'downstream' fish. The counter also records information connected to the event such as date, time, direction, water conductivity and signal strength (deflection signal size). If the deflection signal does not conform to that of a 'typical fish', it is logged as an event or discarded. In this way the counter can distinguish between fish and inanimate objects such as leaves and twigs.

Appendix 6 - Species Apportionment and Data Analysis

Species apportionment is made on the basis of the deflection signal size that is generated by the counter when a fish passes over the electrodes on the weir. The validation study conducted by the Environment Agency (1997) using video equipment to identify and measure fish traversing the weir found a linear relationship between fish length and deflection signal size. The study concluded that a deflection signal size of 50 could be used to differentiate between the majority of salmon and sea trout between June and February (88% of all fish greater than 50 cm attained a deflection size greater than 50).

Data from previous years indicated that larger sea trout run into the river from March – May. In order to eliminate these larger sea trout from the salmon count within this period, the deflection signal size to differentiate salmon from sea trout is increased to 70. It must be stressed that this relationship is not 100% accurate and that some large sea trout, those greater than 70 cm, may be counted as salmon.

It is hoped that together with video, net catch and rod catch data that the ability of the counter to apportion species can be improved to get a more accurate split both between species and within species.

Appendix 7 - Video Validation / Audit Strategy and Methodology.

Video validation studies are carried out every 5-years, or during the commissioning of a new counter, and involve a detailed analysis of video and count data.

Data audits are carried out between validation studies to provide a 'snapshot' of the main fish runs and to highlight any errors in the counter data. Data audits aim to watch between 10-20% of the available video over a range of flow conditions.

Video Validation / Audit Strategy.

The following strategy is valid for both validation and auditing purposes.

Video footage of fish movements is collected over the fish pass between April and August. This is when the greatest numbers of fish and a wide range of river flows have been identified. The videotape is checked for quality before the operator leaves the site to ensure that any potential problems with picture quality or equipment failure are identified and rectified.

The aim is to carry out an initial review of the videotape within 7 days of collection. As each video is watched the "viewer" is required to complete a "video session recording sheet." This provides a record of each video session that the person has viewed and other relevant details e.g. picture quality, camera orientation etc.

The videos are reviewed twice. Initially the tapes are watched 'blind' i.e. without referring to the counter data. The tapes are then reviewed a second time, over the same period, using the data from the counter, to highlight fish that may have been missed during the first review. This ensures an unbiased video count and an accurate video record of fish passage.

The protocols for data audits and validation are as follows:

Data Audits

Video footage over a range of flow conditions is selected to ensure that counter efficiencies do not significantly alter with changes in flow rate. If a problem is detected in the count data then further periods are analysed to identify and rectify the problem.

The flow ranges are selected by constructing a cumulative percentage frequency curve of all the flows available to fish over the period for which video is available (Figure A). Arbitrary cut-off points of 40% and 70% are then selected to separate the flows into high, medium and low flows. Generally, most of the video footage selected for the audit covers periods of low and medium flows due to poor visibility conditions that exist during high flows, which make fish difficult to see on the video footage.

Video Validation

The watcher randomly selects, through the use of random number tables, two one-hour periods within each recorded video session. This acts as an initial screening of video data. Additional hourly periods may need to be reviewed to reach a required number of fish for statistical validity or because of poor picture quality etc.

Each period is viewed until an event i.e. fish, is seen. All events are identified. If it is a fish event then the fish is identified, where possible, and its total length and orientation (upstream/downstream) recorded.

- **Video Event Sample Size**

As large amounts of video data are collected, a meaningful method of quickly and accurately reviewing footage collected has been developed. This is based on an assumption of counter efficiency and a level of confidence required for statistical validity. Comparing the numbers of salmon and sea trout recorded by the counter with the numbers on the video footage, an estimate of counter efficiency can be made.

The following method is used as a guide to assess how many fish per sample group are required for an estimate of the counter detection efficiency at different levels of precision and confidence. A sample group could be defined as either upstream migrating salmonids or even a single species. The same criteria can be applied for different species, size classes or environmental conditions. The level of confidence for the purposes of counter validation should be between 90 - 95%.

As an example, assume that we were interested in assessing the detection efficiency of the counter for:

- Upstream migrating salmonids
- At a confidence level of 95%
- At a precision level of 5%

If we also assume a counter efficiency of 50%*, then reading the information from Table A, we can see that we would need to have seen and recorded 384 upstream salmonids on the videotapes over the year. This means that a sample size of 384 fish is required to ensure with 95% confidence that the estimated efficiency will be within ±5% of the true estimate - Environment Agency R&D Technical Report (1997).

**Based on the lowest efficiency that we could expect.*

Table A – Sample size required at various levels of confidence and precision, assuming a 50% counter efficiency.

	Confidence	90%	95%	99%
Precision	0.01	6765	9604	16590
	0.05	271	384	664
	0.1	67	96	166
	0.2	17	24	42

Table extract taken from Environment Agency R&D Technical Report (1997).

To reach the given sample size, two one-hour periods per 24-hour period are randomly selected. The periods are reviewed and the number of upstream migrating salmonids within each one-hour period recorded. If the required sample size is not reached then additional one-hour periods can be reviewed until the required sample size is reached. In practice, all of the video footage for the year is first reviewed using the above technique. If, at the end of the tape review, the sample size for the whole year is below the required sample size or level of confidence/precision, then the tapes are reviewed again. This time, only one hour per day would be randomly selected until the required sample size is reached. Alternatively, a lower level of confidence, requiring a smaller sample size, could be selected.

- **Matching Counter Data and Video Events**

To determine the efficiency of the:

i. Counter
ii. Video watching

During the second videotape review, the counter data is utilised to identify events that have been detected or missed by the counter. The video data is then matched to the corresponding counter data and recorded as one of the following:

- Upstream Fish - Salmon, Sea Trout or other species.
- Downstream Fish - Salmon, Sea Trout or other species.
- Upstream Event
- Downstream Event

Appendix 4 – Table B: Fish deflection values for upstream migrating salmonids recorded at Gunnislake Weir in 2002.

Deflection	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	1	1	1	0	0	0	0
10	0	0	0	0	0	2	3	0	0	0	0	0
15	2	0	5	7	39	62	121	31	4	65	20	3
20	8	1	2	24	48	218	302	117	3	116	35	3
25	8	1	5	24	83	292	255	157	9	108	41	9
30	8	0	6	45	89	317	178	117	5	112	34	14
35	15	0	10	54	120	278	128	106	3	117	43	8
40	20	0	5	54	112	239	76	81	6	107	47	10
45	9	0	3	52	93	188	65	65	12	109	35	15
50	4	0	0	56	82	175	39	71	10	100	31	7
55	2	0	4	55	72	122	32	70	16	89	30	4
60	3	0	2	37	63	86	20	96	18	70	26	9
65	4	1	1	32	48	73	10	96	21	79	21	9
70	2	0	5	23	49	44	6	139	31	44	14	7
75	0	0	1	22	31	38	4	119	29	43	9	6
80	0	0	2	21	34	37	2	127	26	50	7	4
85	3	0	0	16	23	12	4	99	31	42	7	4
90	2	0	1	14	33	14	5	103	35	35	8	3
95	1	0	1	21	80	46	7	367	153	70	13	3
100	4	0	2	31	37	7	0	42	35	52	17	6
105	2	0	0	5	2	2	1	29	20	19	3	1
110	1	0	0	4	2	1	0	13	9	18	0	0
115	0	0	0	2	2	0	0	14	10	12	2	1
120	0	0	0	2	0	4	1	15	8	15	3	0
125	1	0	0	2	1	1	2	6	6	7	1	1
130	9	0	0	2	2	8	0	21	12	31	13	11

Appendix 8 - Daily Movements of Salmon and Sea Trout Recorded at Gunnislake Fish Counter in 2002.

Environment Agency

Gunnislake fish counter data for 2002

January 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Jan	0	0	9.47
02-Jan	0	0	9.45
03-Jan	1	0	9.53
04-Jan	0	2	8.90
05-Jan	0	3	8.44
06-Jan	0	7	8.33
07-Jan	3	3	8.02
08-Jan	2	2	7.76
09-Jan	5	0	7.87
10-Jan	3	0	7.68
11-Jan	0	0	7.34
12-Jan	0	0	7.40
13-Jan	3	1	9.08
14-Jan	9	10	10.00
15-Jan	1	14	12.56
16-Jan	0	2	12.32
17-Jan	1	2	19.19
18-Jan	2	2	20.54
19-Jan	0	0	23.82
20-Jan	0	1	43.49
21-Jan	0	2	45.43
22-Jan	0	0	47.68
23-Jan	0	1	113.22
24-Jan	0	0	71.83
25-Jan	0	1	86.30
26-Jan	0	0	165.95
27-Jan	0	3	166.84
28-Jan	0	0	97.56
29-Jan	0	0	63.41
30-Jan	1	0	63.13
31-Jan	0	0	78.67

Monthly totals :	31	56
Monthly Totals January 2001:	9	13
7-Year Average:	20	31
2002 Yearly cumulative totals	31	56
2001 Yearly cumulative totals	9	13

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

February 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Feb	0	1	133.89
02-Feb	0	0	158.40
03-Feb	0	0	140.42
04-Feb	0	0	167.69
05-Feb	0	0	94.76
06-Feb	0	0	66.00
07-Feb	0	0	52.59
08-Feb	0	0	48.23
09-Feb	0	0	44.36
10-Feb	0	1	43.15
11-Feb	0	0	85.20
12-Feb	0	0	56.89
13-Feb	0	0	44.28
14-Feb	0	0	35.22
15-Feb	0	0	29.52
16-Feb	0	0	25.76
17-Feb	0	0	22.87
18-Feb	0	0	21.03
19-Feb	1	0	33.83
20-Feb	0	0	78.11
21-Feb	0	0	37.74
22-Feb	0	0	43.36
23-Feb	0	0	40.53
24-Feb	0	0	35.20
25-Feb	0	0	103.66
26-Feb	0	0	126.69
27-Feb	0	0	94.57
28-Feb	0	0	77.97

Monthly totals :	1	2
Monthly Totals February 2001:	4	13
7-Year Average:	8	26
2002 Yearly cumulative totals :	32	58
2001 Yearly cumulative totals :	13	26

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

March 2002

Date	Upstream Salmon. Deflections > 70 No. of fish	Upstream Sea trout. Deflections < 70 No. of fish	Daily Mean Residual Flow (cumecs)
01-Mar	0	0	53.15
02-Mar	0	0	41.18
03-Mar	0	0	34.18
04-Mar	0	0	29.14
05-Mar	0	1	25.38
06-Mar	0	2	22.64
07-Mar	1	2	19.88
08-Mar	0	2	17.75
09-Mar	0	3	16.38
10-Mar	0	0	15.87
11-Mar	0	1	15.45
12-Mar	0	1	14.70
13-Mar	0	0	15.43
14-Mar	1	0	14.03
15-Mar	0	0	18.25
16-Mar	1	1	17.54
17-Mar	0	2	22.03
18-Mar	0	0	75.70
19-Mar	1	0	49.06
20-Mar	0	1	73.95
21-Mar	0	3	52.39
22-Mar	0	5	40.26
23-Mar	0	7	33.09
24-Mar	0	3	27.76
25-Mar	1	0	23.92
26-Mar	0	3	20.81
27-Mar	0	1	18.48
28-Mar	0	1	16.80
29-Mar	8	2	15.31
30-Mar	0	0	14.07
31-Mar	4	5	14.38

	Salmon	Sea trout
Monthly totals :	9	46
Monthly Totals March 2001:	3	121
7-Year Average:	7	69
2002 Yearly cumulative totals	41	104
2001 Yearly Cumulative Totals	16	147

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

April 2002

Date	Upstream Salmon. Deflections > 70 No. of fish	Upstream Sea trout. Deflections < 70 No. of fish	Daily Mean Residual Flow (cumecs)
01-Apr	2	8	13.70
02-Apr	0	6	13.09
03-Apr	3	6	15.94
04-Apr	1	2	16.00
05-Apr	1	7	13.08
06-Apr	6	7	11.30
07-Apr	1	5	10.07
08-Apr	2	14	9.44
09-Apr	2	8	9.05
10-Apr	1	8	8.77
11-Apr	2	22	8.41
12-Apr	1	4	8.23
13-Apr	1	6	7.95
14-Apr	4	11	7.74
15-Apr	4	6	7.41
16-Apr	4	12	6.96
17-Apr	9	18	7.42
18-Apr	7	15	7.36
19-Apr	6	17	6.69
20-Apr	6	27	6.50
21-Apr	2	17	6.16
22-Apr	5	20	5.93
23-Apr	8	36	5.86
24-Apr	4	34	5.72
25-Apr	8	50	5.62
26-Apr	21	37	6.62
27-Apr	17	15	6.42
28-Apr	6	22	8.75
29-Apr	7	9	7.06
30-Apr	5	10	32.74

Monthly Totals :	146	459
Monthly Totals April 2001:	41	266
8-Year Average:	73	297
2002 Yearly Cumulative Totals:	187	563
2001 Yearly Cumulative Totals:	57	413

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

Environment Agency

Gunnislake fish counter data for 2002

May 2002

Date	Upstream Salmon. Deflections > 70 No. of fish	Upstream Sea trout. Deflections < 70 No. of fish	Daily Mean Residual Flow (cumecs)
01-May	9	42	15.43
02-May	13	41	10.94
03-May	19	27	9.42
04-May	5	20	8.71
05-May	18	20	8.22
06-May	16	23	7.87
07-May	6	20	7.86
08-May	16	27	7.60
09-May	21	55	7.11
10-May	22	61	6.54
11-May	14	39	6.35
12-May	16	38	6.25
13-May	4	20	12.10
14-May	18	65	9.10
15-May	13	47	7.30
16-May	3	13	6.75
17-May	2	21	47.02
18-May	9	22	41.39
19-May	3	64	21.71
20-May	1	30	19.42
21-May	8	17	61.42
22-May	5	14	51.13
23-May	4	30	49.49
24-May	2	4	63.20
25-May	0	8	54.37
26-May	0	0	63.12
27-May	0	12	65.79
28-May	1	26	50.16
29-May	2	21	42.25
30-May	1	38	33.06
31-May	7	22	27.59

Monthly Totals :	258	887
Monthly Totals May 2001:	337	506
8-Year Average:	263	802
2002 Yearly Cumulative Totals:	445	1450
2001 Yearly Cumulative Totals:	394	919

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only

Environment Agency

Gunnislake fish counter data for 2002

June 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Jun	23	38	23.27
02-Jun	14	34	20.17
03-Jun	16	35	18.49
04-Jun	21	43	15.95
05-Jun	13	28	14.16
06-Jun	3	11	13.19
07-Jun	10	19	16.21
08-Jun	20	52	13.11
09-Jun	16	56	15.81
10-Jun	10	32	16.83
11-Jun	8	19	12.89
12-Jun	8	14	12.63
13-Jun	23	41	11.53
14-Jun	15	70	11.36
15-Jun	11	19	11.11
16-Jun	12	65	13.80
17-Jun	19	68	11.80
18-Jun	10	13	10.32
19-Jun	21	45	9.41
20-Jun	2	6	8.93
21-Jun	11	19	9.31
22-Jun	9	27	9.81
23-Jun	7	8	8.39
24-Jun	11	13	7.64
25-Jun	48	240	7.30
26-Jun	40	142	6.96
27-Jun	41	176	6.64
28-Jun	33	195	6.31
29-Jun	20	71	6.11
30-Jun	25	148	6.09

Monthly Totals :	520	1747
Monthly Totals June 2001:	844	1776
8-Year Average:	589	2181
2002 Yearly Cumulative Totals:	965	3197
2001 Yearly Cumulative Totals:	1238	2695

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

July 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Jul	29	96	6.52
02-Jul	15	54	7.73
03-Jul	11	379	17.68
04-Jul	14	230	8.48
05-Jul	32	392	8.95
06-Jul	18	115	8.17
07-Jul	25	162	7.31
08-Jul	16	58	8.35
09-Jul	15	139	9.00
10-Jul	32	265	9.17
11-Jul	17	181	12.51
12-Jul	10	251	9.87
13-Jul	14	215	8.88
14-Jul	5	13	7.36
15-Jul	58	377	6.88
16-Jul	32	225	6.55
17-Jul	35	266	6.21
18-Jul	34	82	5.89
19-Jul	31	125	5.71
20-Jul	45	183	5.51
21-Jul	25	104	5.28
22-Jul	31	95	5.11
23-Jul	15	94	5.20
24-Jul	15	117	5.25
25-Jul	29	54	4.93
26-Jul	23	79	4.77
27-Jul	25	65	4.70
28-Jul	47	100	4.53
29-Jul	36	19	4.34
30-Jul	20	44	4.26
31-Jul	40	32	5.28

Monthly Totals :	794	4611
Monthly Totals July 2001:	576	3213
8-Year Average:	893	4003
2002 Yearly Cumulative Totals:	1759	7808
2001 Yearly Cumulative Totals:	1814	5908

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

August 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Aug	91	64	7.60
02-Aug	42	35	5.79
03-Aug	46	50	5.77
04-Aug	48	58	4.71
05-Aug	52	95	4.42
06-Aug	28	55	4.06
07-Aug	36	42	4.05
08-Aug	61	22	4.36
09-Aug	39	6	5.45
10-Aug	70	26	5.53
11-Aug	56	17	4.66
12-Aug	20	12	4.41
13-Aug	35	9	4.07
14-Aug	40	16	3.96
15-Aug	29	6	3.85
16-Aug	66	17	3.67
17-Aug	60	8	3.63
18-Aug	97	36	6.61
19-Aug	72	39	4.67
20-Aug	39	22	4.00
21-Aug	29	14	3.72
22-Aug	26	7	3.54
23-Aug	45	9	4.34
24-Aug	30	7	4.65
25-Aug	68	21	4.24
26-Aug	39	11	3.71
27-Aug	24	12	3.46
28-Aug	26	4	3.33
29-Aug	18	4	3.24
30-Aug	21	5	3.31
31-Aug	16	4	3.55

Monthly Totals :	1369	733
Monthly Totals August 2001:	332	559
8-Year Average:	585	539
2002 Yearly Cumulative Totals:	3128	8541
2001 Yearly Cumulative Totals:	2146	6467

The data provided is for fishery management purposes only. Circulation of data is on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

September 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Sep	32	6	3.27
02-Sep	28	3	2.96
03-Sep	14	1	2.86
04-Sep	27	4	3.16
05-Sep	32	3	3.21
06-Sep	24	6	3.13
07-Sep	18	4	3.36
08-Sep	29	3	3.63
09-Sep	19	2	3.43
10-Sep	9	0	2.97
11-Sep	17	1	2.86
12-Sep	16	3	2.73
13-Sep	14	3	2.73
14-Sep	17	3	2.72
15-Sep	9	2	2.53
16-Sep	8	0	2.48
17-Sep	16	0	2.45
18-Sep	16	2	2.47
19-Sep	19	0	2.51
20-Sep	11	1	2.54
21-Sep	1	0	2.53
22-Sep	8	1	2.40
23-Sep	15	1	2.37
24-Sep	12	0	2.25
25-Sep	6	0	2.32
26-Sep	5	0	2.33
27-Sep	7	0	2.28
28-Sep	10	0	2.29
29-Sep	16	0	2.16
30-Sep	9	1	2.14

Monthly Totals :	464	50
Monthly Totals September 2001:	112	30
8-Year Average:	260	234
2002 Yearly Cumulative Totals:	3592	8591
2001 Yearly Cumulative Totals:	2258	6497

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

October 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Oct	3	0	2.23
02-Oct	7	2	2.33
03-Oct	11	1	2.43
04-Oct	7	0	2.44
05-Oct	8	1	2.30
06-Oct	5	2	2.26
07-Oct	7	0	2.26
08-Oct	8	3	2.19
09-Oct	12	3	2.15
10-Oct	5	0	2.17
11-Oct	9	1	2.27
12-Oct	8	3	2.63
13-Oct	12	5	27.62
14-Oct	39	17	15.86
15-Oct	177	80	54.22
16-Oct	63	53	28.55
17-Oct	37	119	23.83
18-Oct	31	60	20.18
19-Oct	20	31	14.20
20-Oct	18	18	14.56
21-Oct	24	79	22.79
22-Oct	17	68	28.26
23-Oct	28	31	21.64
24-Oct	13	29	16.66
25-Oct	14	19	19.21
26-Oct	7	18	25.24
27-Oct	22	36	20.83
28-Oct	22	36	18.70
29-Oct	13	16	15.54
30-Oct	29	38	13.69
31-Oct	20	45	12.16

Monthly Totals :	696	814
Monthly Totals October 2001:	687	749
8-Year Average:	316	358
2002 Yearly Cumulative Totals:	4288	9405
2001 Yearly Cumulative Totals:	2945	7246

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

November 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Nov	9	28	15.15
02-Nov	14	15	49.06
03-Nov	3	5	65.01
04-Nov	11	10	43.42
05-Nov	11	34	32.29
06-Nov	8	13	59.87
07-Nov	6	16	42.42
08-Nov	4	14	84.82
09-Nov	4	9	60.73
10-Nov	10	12	75.29
11-Nov	11	10	53.63
12-Nov	14	19	50.05
13-Nov	6	8	95.73
14-Nov	0	2	151.00
15-Nov	2	1	70.44
16-Nov	10	17	47.76
17-Nov	8	5	38.36
18-Nov	9	7	31.47
19-Nov	8	10	34.58
20-Nov	1	4	68.38
21-Nov	1	0	98.53
22-Nov	3	2	89.91
23-Nov	0	0	94.13
24-Nov	0	0	61.02
25-Nov	4	8	46.43
26-Nov	5	10	42.33
27-Nov	6	2	114.85
28-Nov	1	0	74.30
29-Nov	9	8	53.24
30-Nov	5	8	46.46

Monthly Totals :	183	277
Monthly Totals November 2001:	117	144
7-Year Average:	193	262
2002 Yearly Cumulative Totals:	4471	9682
2001 Yearly Cumulative Totals:	3062	7390

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.

ENVIRONMENT AGENCY

Gunnislake fish counter data for 2002

December 2002

Date	Upstream Salmon. Deflections > 50 No. of fish	Upstream Sea trout. Deflections < 50 No. of fish	Daily Mean Residual Flow (cumecs)
01-Dec	2	3	51.13
02-Dec	2	1	41.53
03-Dec	9	7	32.68
04-Dec	2	7	31.05
05-Dec	3	2	26.31
06-Dec	1	3	22.83
07-Dec	3	4	20.86
08-Dec	1	1	18.67
09-Dec	0	0	17.30
10-Dec	0	0	15.75
11-Dec	1	2	14.66
12-Dec	1	0	15.09
13-Dec	2	4	17.34
14-Dec	3	1	17.15
15-Dec	0	1	40.23
16-Dec	2	1	23.91
17-Dec	3	2	19.29
18-Dec	1	2	17.18
19-Dec	3	1	15.92
20-Dec	4	5	21.39
21-Dec	0	2	54.49
22-Dec	2	0	57.48
23-Dec	10	6	45.32
24-Dec	4	4	44.85
25-Dec	7	6	48.39
26-Dec	0	4	123.77
27-Dec	0	0	85.68
28-Dec	1	0	60.07
29-Dec	0	0	121.32
30-Dec	0	0	94.89
31-Dec	2	0	77.65

Monthly Totals :	69	69
Monthly Totals December 2001:	76	113
7-Year Average:	60	75
2002 Yearly Cumulative Totals:	4540	9751
2001 Yearly Cumulative Totals:	3138	7503

The data provided is for fishery management purposes only. Circulation of data on a restricted access basis only.