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Executive summary

- The following report presents the daily upstream counts of migratory salmonids recorded at Gunnislake weir fish counting station and trap (River Tamar SX 435 713) in 2003.

- 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 total combined annual count of upstream migrating salmon and sea trout on the River Tamar in 2003 was 7% higher than the 9-year average.

- The minimum **salmon** count for 2003 was **3626**, a **20% decrease** when compared to the counts recorded in 2002. A breakdown of the 2003 salmon run into the two main run components reveals the following:

  - An 8% decrease in the numbers of multi sea winter "spring" salmon (April – May) when compared to 2002 figures and an 8% increase when compared to the 9-year average.
  - A 22% decrease in the numbers of post - 1st June salmon (June – November) when compared to 2002 figures and a 7% increase when compared to the 9-year average.

- The 2003 upstream count for **sea trout** was **9913**, which is a **2% increase** in the total number of sea trout recorded when compared to the 2002 data (9751).

- Trap data for 2003 is consistent with historic trapping and net data in terms of the size split between salmon and sea trout stocks.

- The majority of counter downtime for 2003 can be attributed to trap operations however this has not had a major effect on the overall operation of the counter.

1. Introduction

The following report presents upstream salmon and sea trout counts recorded on the River Tamar at Gunnislake fish counting station and trap (SX 435 713) during 2003. The count data has been considered with respect to:

- daily mean residual flow (cumecs)
- temperature (^{o}C)

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

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 weir.

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

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).

3. Net Buy-Back

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

South West Water (SWW) has operated a buy-back of commercial migratory salmonid netting time within the Tamar estuary during since 1997 (8 August – 31 August, inclusive). This puts 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.

4. Species apportionment

The counter records 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 4.

5. Validation of counter efficiency

Trace information is initially used as a relatively quick way of checking raw fish counter data and identifying any potential problems. Analysis of trace data can also be used to improve count accuracy when video data is unavailable.

An assessment of counter efficiency was carried out in 1993 / 94 and again in 1998. In addition to trace analysis counter data is now audited, using video footage taken over the weir, on an annual basis. Counter events are matched to video events, which can then be used to assess the efficiency of the counter and 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.

6. Results

The migratory salmonid counts obtained for the River Tamar recorded at Gunnislake fish counting station in 2003 are presented as follows:

6.1. Upstream fish counts

Figure 1: Presents the monthly upstream counts for salmon recorded at Gunnislake weir in 2003 along with the 9-year average. The total number of salmon counted moving upstream in 2003 was 3626 (Table 1).

Figures 2 & 3: Present the annual upstream counts of 'multi-sea winter' salmon and 'post 1st June' salmon on the river Tamar 1994 – 2003.

Figures 4: Presents the monthly upstream counts for sea trout recorded at Gunnislake weir in 2003 along with the 9-year average. The total number of sea trout counted moving upstream in 2003 was 9913 (Table 2).

Figures 5 & 6: Present the annual upstream counts of 'large sea trout' (repeat spawners) and 'school peal' on the river Tamar 1994 – 2003.

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 2003 - Appendix 1.

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

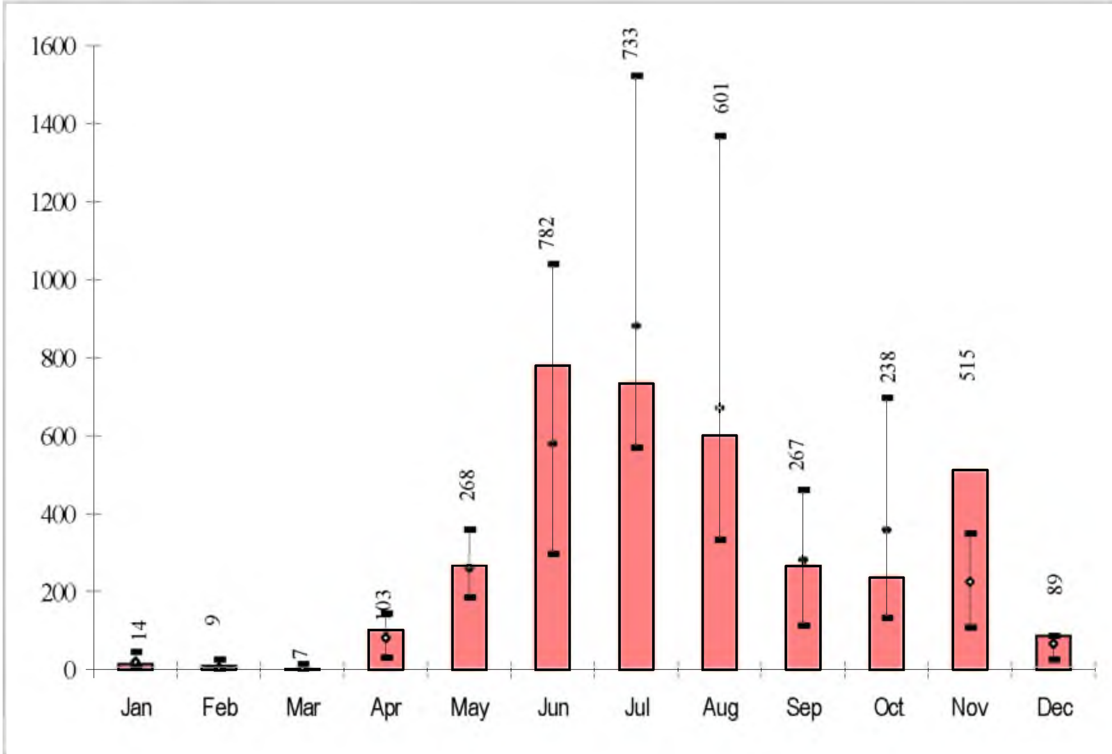
Note:

- 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.

- An 8 and 9-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 9-year average is used to refer to both the 8 and 9 year averages in the report hereafter.

Figure 1 – Monthly upstream counts for salmon at Gunnislake weir 1994 – 2003.

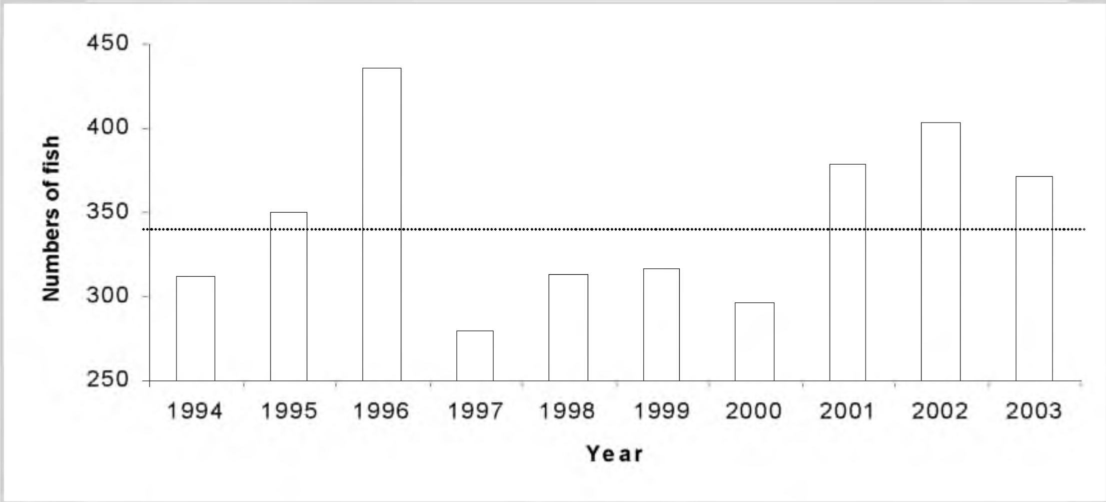


** Data labels and coloured bars indicate 2003 figures. High low bars indicate max, min and average from 1994 - 2002.*

Table 1 - Monthly upstream counts for salmon at Gunnislake weir 1994 – 2003.

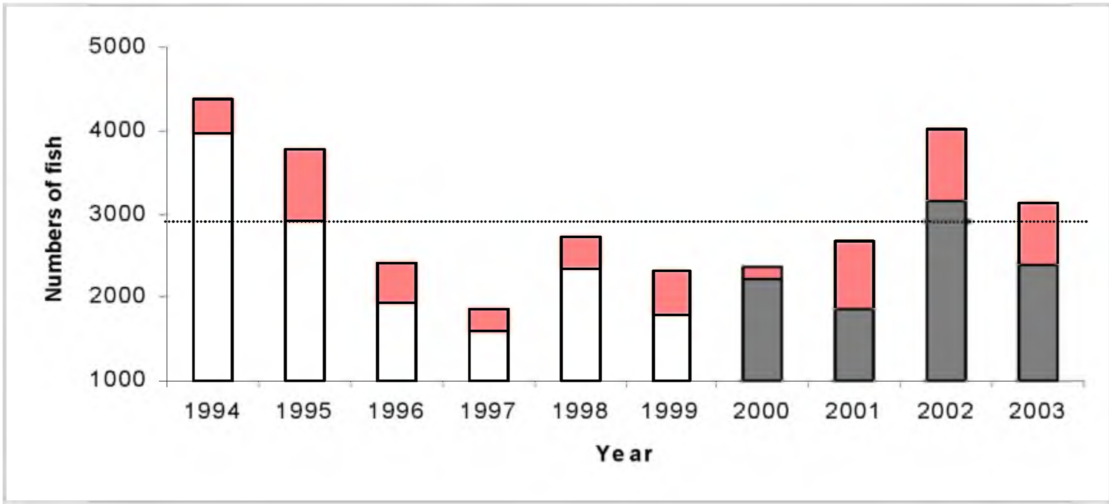
Month	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	9-yr average
Jan	15	22	45	32	6	11	*	9	31	14	21
Feb	3	6	1	27	9	3	*	4	1	9	7
Mar	6	11	1	8	7	16	*	3	9	7	8
Apr	90	116	76	95	30	60	74	41	146	103	81
May	222	234	360	185	283	257	223	337	258	268	262
Jun	1042	591	409	342	295	683	503	844	520	782	581
Jul	1520	1525	576	603	949	571	825	576	794	733	882
Aug	1000	376	557	464	850	374	730	332	1369	601	672
Sep	397	427	400	185	244	160	156	112	464	267	283
Oct	211	552	354	133	268	177	143	687	696	238	358
Nov	204	303	126	142	109	350	*	117	183	515	228
Dec	59	65	86	26	82	29	*	76	69	89	65
Totals	4769	4228	2991	2242	3132	2691	2654	3138	4540	3626	3447
Adjustment for fish pass efficiency	6359	5637	3988	2989	4176	3588	3539	4184	6053	4835	

Figure 2 - Annual upstream counts of 'multi-sea winter' salmon - River Tamar 1994 – 2003



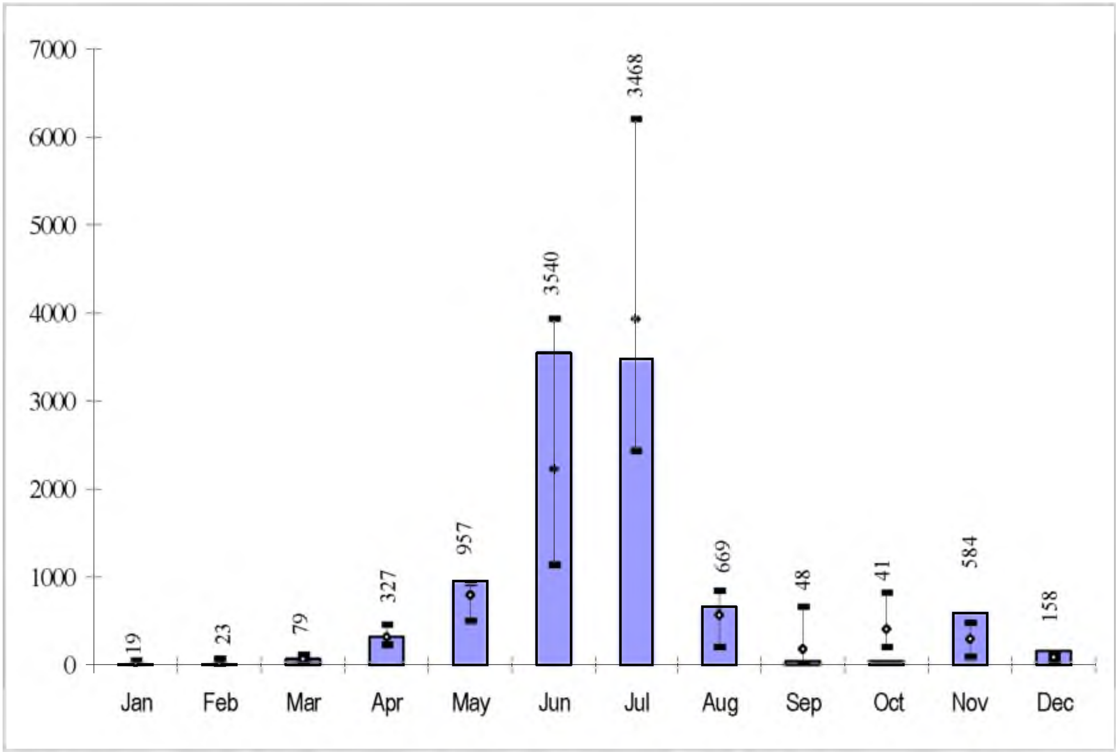
Note: - Dotted line denotes 9 – year average (343).

Figure 3 – Annual upstream counts of 'post 1st June' salmon - River Tamar 1994 – 2003



Note: - Dotted line denotes 9-year average (2927). The 9 -year average takes into account counts for October & November. The coloured bands indicate the additional October & November counts.

Figure 4 – Monthly upstream counts for sea trout at Gunnislake weir 1994 – 2003

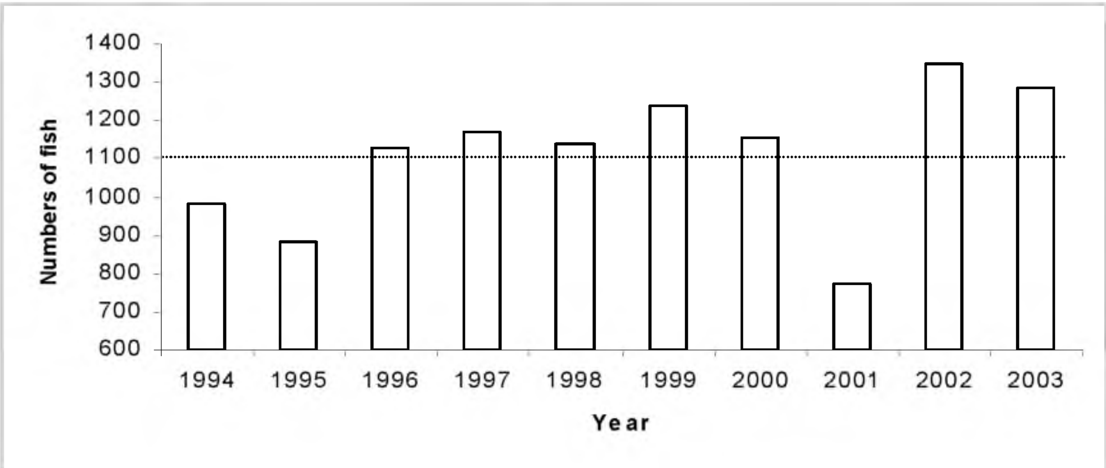


** Data labels and coloured bars indicate 2003 figures. High low bars indicate max, min and average from 1994 – 2002.*

Table 2 - Monthly upstream counts for sea trout at Gunnislake weir 1994 – 2003

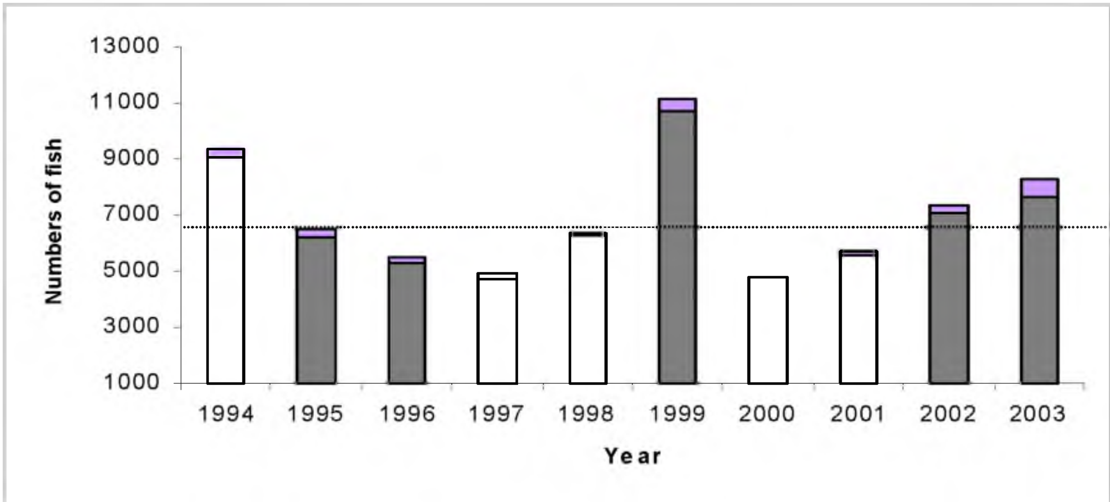
Month	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	9-yr average
Jan	32	17	51	22	34	28	*	13	56	19	30
Feb	2	12	8	62	59	11	*	13	2	23	21
Mar	55	59	49	65	71	116	*	121	46	79	73
Apr	329	221	313	333	217	411	254	266	459	327	313
May	653	659	817	835	921	826	901	506	887	957	796
Jun	2841	1807	1875	1724	1131	3927	1964	1776	1747	3540	2233
Jul	5478	4190	2868	2440	4311	6207	2530	3213	4611	3468	3932
Aug	748	206	556	548	838	549	326	559	733	669	573
Sep	661	181	78	127	237	191	163	30	50	48	177
Oct	377	438	529	194	354	338	279	749	814	41	411
Nov	275	284	230	220	82	482	*	144	277	584	286
Dec	51	78	78	62	120	59	*	113	69	158	88
Totals	11502	8152	7452	6632	8375	13145	6417	7503	9751	9913	8934
Adjustment for fish pass efficiency	15336	10869	9936	8843	11167	17527	8556	10004	13001	13217	

Figure 5 - Annual upstream counts of 'large sea trout' (repeat Spawners) - River Tamar 1994 – 2003



Note: - Dotted line denotes the 9 – year average (1090).

Figure 6 – Annual upstream counts of sea trout ('school peal') - River Tamar 1994 – 2003



Note: - Dotted line denotes 9-year average (6920). The 9-year average takes into account counts for November. The coloured bands indicate the additional November counts.

6.2 Video validation & counter efficiency

6.2.1 Counter efficiency

The overall detection efficiency for upstream salmonids for the period 17th April to 12th September was 98%.

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.

6.2.2 Sizing efficiency

The calculation for sizing efficiency utilises matched counter and video data for upstream migrating salmonids. All non-target species i.e. non-salmonids, have been removed for the purposes of this calculation. The overall sizing efficiency for the period 17th April to 12th September was calculated as 67%.

7. Discussion

The 2003 run patterns i.e. run timing and numbers, for salmon and sea trout were generally consistent with previous years although a higher proportion of fish ran in the latter parts of the year.

There was a 5% decrease in the total combined annual count for upstream migrating salmonids on the River Tamar in 2003 (13539) when compared to 2002 (14291). Comparisons with the 9-year average (12381) indicate that the total combined count for salmonids in 2003 (13539) has increased by 9%.

7.1. Salmon counts recorded on the river Tamar 1995 – 2003

The minimum salmon count estimate for 2003 was 3626, 20% lower than in 2002 (4540). However, it was the fourth highest recorded count over the past 9 years.

Overall salmon counts for 2003 are 5% up on the 9-year average with increases on the 9-year monthly averages for February, April, May, June, November and December (Table 1).

For ease of interpretation the 2003 salmon count data has been split into its two major constituents i.e. multi-sea winter 'spring' salmon (Figure 2) and 'post - 1st June' salmon (Figure 3) as follows:

Please note: 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).

Multi-sea winter salmon

- The 371 multi-sea winter "spring" salmon, counted between April – May 2003, represents an 8% decrease in the size of this component of the salmon run when compared to figures over the same period in 2002 (404).

- Comparisons to the 9-year average (343) for the same period indicate an 8% increase in the multi-sea winter 'spring' salmon component of the salmon run.

Post 1st June salmon

- The unusually high November salmon counts can probably be attributed to grilse that had been held up in the estuary by the low flow conditions that prevailed over the period June – end of October. For this reason October and November counts have been included in the split for post 1st June salmon (Figure 3 – shows split data for June to August with additional count data for October and November added).

- The 3136 'post - 1st June' salmon counted between June – November 2003 represents a 20% decrease in this component of the salmon run, in relation to 2002 (4026).

- Comparing this to the 9-year average (2927) over the same period suggests a 7% increase in the size of this component of the salmon run in 2003.

The 2003 salmon figures were a little disappointing with decreases in both multi sea winter and Post 1st June salmon. The figures for post 1st June fish were of particular concern with count figures for grilse over July and August being well down on previous years. The grilse run also appeared to be later in the season, which may have a knock on effect in terms of spawning success. Reports from other parts of the country show a similar pattern. It is highly likely that the environmental conditions prevalent around this time affected both the timing of the run and the numbers of returning adults.

The figures recorded for multi-sea winter salmon over the past 10-years does indicate that the number of these fish returning is fairly constant between years. The overall trend over the past few years seems to suggest that salmon numbers are increasing, albeit slowly. However the 2003 trap and counter figures seem to suggest that the multi sea winter run is now later than that recorded historically and possibly extends up until the end of June. Unfortunately trapping operations were suspended for the last two weeks of June and for the whole of July so positive confirmation of this fact will not be possible until age data is obtained during the 2004-trapping season. If true, then it is a major cause for concern as the measures designed to protect this component of the stock, such as the National Spring Salmon Bylaws are not protecting a significant proportion of the multi-sea winter salmon run.

Although it has been a poor year the numbers of returning 'post - 1st June' salmon the overall trend based on the last 9 years of counter data, seems to indicate that this component of the stock may be increasing.

It must also be noted that immediately after an increase in flow levels at the beginning of November there were substantial increases in the numbers of salmon recorded moving upstream. This was particularly obvious on the 1st November when 146 salmon were counted traversing the weir.

7.2. Sea trout counts recorded on the river Tamar 1995 – 2003

The counter data indicates that 2003 was a good year for sea trout considering the environmental conditions. The run estimate for 2003 (9913) represents a 2% increase when compared to the 2002 estimate (9751).

The 2003 count is the third largest count recorded over the past 10-years of counter operation.

The timing and pattern of the run is generally consistent between years except for notable increases in the number of sea trout moving upstream in June and November, which are significantly higher than the 9-year average. It is also interesting to note that the upstream counts for September and October are significantly lower than the 9-year average. This trend was also evident in the 2001 and 2002 counter figures and appears to be flow related.

The numbers of fish moving upstream are higher than the 9-year monthly averages for all months with the exception of January, July, September and October. As Figure 4 indicates the majority of the run (71%) 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. This splitting of the sea trout data provides a clearer indication on the state of each portion of the sea trout stock. The assumptions made for the split are that the majority of larger 'repeat spawners' are concentrated in the months April to May (Figure 5) and smaller 'school peal' (27 – 31 cm in length) in the period June – August (Figure 6).

A breakdown of the 2003 sea trout run data into its two main run components is as follows:

- Count figures indicate that repeat spawners counted between April – May 2003 (1284) represented a 5% decrease in the size of this component in comparison to figures for 2002 (1346). Comparisons to the 9-year average (1090) for the same period shows that there has been an overall increase of 15% in the size of this component of the sea trout run in 2003.

- The 7677 'school peal' counted between June – August 2003 represent an 8% increase in this component of the total sea trout run estimate, when compared to 2002 figures (7091). Comparing this to the 9-year average (6920) over the same period implies a 14% increase in the size of this component of the sea trout run.

It appears that, as in the case of salmon, 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, counts increased following a sudden increase in flow rates, around the beginning of November resulting in the highest monthly count recorded by the counter for November over the past 10-years (584). If this is taken into account the increase in the size of the school peal run in 2003 is closer to 11%, when compared to the figures recorded for the same period in 2002. This would equate to a 16% increase in the size of this component of the stock when compared to the 9-year average for the same period.

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 could be on the increase. It is also possible that this increase is a by-product of the measures designed to protect multi-sea winter 'spring' salmon.

7.3 Rod and net catches

Salmon

The catch data for salmon (Appendix 5 – Figure) indicates that rod catches for salmon were fairly constant throughout the season. The total rod and net catch was 317 (98 rods: 219 nets). The combined exploitation rate was 9% - 3% (rods) and 6% (nets).

Sea trout

The pattern of catches (rods) is consistent with previous years (Appendix 5 – Figure). The highest catches were recorded in July, which ties in with the run of sea trout recorded by the fish counter over the same period. The combined rod and net catch for sea trout was 415 (317 rods: 44 nets). This equates to a combined exploitation rate of 4% with 3.5% attributable to the rods and 0.5% to the nets.

7.4. Other species

Only small numbers of non-target species i.e. sea lamprey (*Petromyzon marinus, L*), shad *(Alosa spp.*) were seen migrating through the fish pass in 2003. The majority of these events were identified from counter data and video footage and the counts adjusted to remove these species from the salmonid count.

7.5. Environmental factors

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.

7.5.1. Flow

Figures 7 & 8 (Appendix 1) indicate that periods of prolonged low flows were a major feature over the main run period (April – August) in 2003. The periods January to March and November to December did show some marked and extended elevations in flow rates however, average flow rates were significantly down for the period April – October 2003 when compared to historic averages (1998 – 2002).

As in previous years the majority of upstream migrating salmonids (April – November) tended to utilise flows between 3 – 20 cumecs. The low flows do not seem to have significantly affected the proportions of fish using this band of flows – 73% (2003) and 83% (2002). Analysis of the count figures for 2003 indicated that only 0.5% of salmon and 0.2% 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 rates in excess of 40 cumecs were present for 5% of the time in 2003.

7.5.2. 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 2003 (based on monthly averages) are consistent with previous years (2000 – 2002) although June and July were significantly warmer. The evidence for the influence of temperature on upstream migration is inconclusive (Banks, 1969) but 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 2003 indicated that only a tiny proportion of fish moved upstream outside of this temperature band (0.05% salmon and 0.03% sea trout).

The pattern of low flows, compared to historic averages, over the main run period seems to be a pattern that has been repeated over the last three years. It is likely that these low flows will have had a major influence on fish migration, salmon in particular. High summer water temperatures will have further compounded this problem and will have been a major contributory factor towards the salmon mortalities reported in the estuary and river in 2003.

7.6. Video validation and counter efficiency

Video data was collected 24-hours per day over period of the main salmon and sea trout runs during 2003. Counter efficiencies 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 (17/4/03 – 12/9/03).

The overall detection efficiency of the counter for upstream migrating fish was estimated at 98%. This level of efficiency is slightly higher than 2002 (85%) but comparable to the initial validation study conducted in 1993 (90%). Slight losses in efficiency can usually be attributed to large numbers of sea trout passing over the weir in-groups of two or more. It was noted that not many group events were seen during the review of the 2003 video footage. This may account for the increased detection efficiencies for 2003.

Video evidence allows us to correct for certain events and to investigate anomalies in the counter data. However, slight losses in efficiency only tend to 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 and sizing efficiencies in the long term.

8. Data processing

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

The original monthly summary reports distributed in 2003 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 two periods of data loss during 2003 (18^{th} – 22^{nd} April and 8^{th} – 11^{th} August). These were due to a counter fault (conductivity card).

- The Webcam at Gunnislake is currently awaiting repair.

- Adult trapping began at the end of March 2003 as part of the River Tamar index monitoring study. The data gained from the trapping studies has already provided information that will be used to improve the efficiency of the counter at Gunnislake.

10. Future work

- The relocation of the fish counter 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 for the work to be carried out sometime in 2004.

- 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.*).

- Continued audits of the counter's performance and efficiency will be carried out on an annual basis using overhead video cameras.

- Collection of temperature at hourly intervals via two sensors / data-loggers will be continued in 2003. In addition a probe that records turbidity, pH and chlorophyll has been deployed to enable us to investigate other biological factors that may have an effect on fish movements.

- Use of fish counter data to improve information on flows required for species specific upstream migrations i.e. salmon, sea trout, shad etc.

- The trap at Gunnislake will be operating in 2004 as part of the Tamar Index River study. 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 6813 hours out of a possible 8760 i.e. approximately 81 days out of a total of 365 days of downtime. The majority of this downtime (1947.27 hours) can be attributed to trapping operations and a counter fault (80.27 hours). The downtime has been broken down as follows:

Table 3 – Breakdown of counter downtime in 2003

Item	Downtime		Sub-Total	% Downtime	
	Enforced	Routine		Enforced	Routine
1. Weir cleaning (gate shut)	0.00	0.72	0.72	0.00	0.04
2. Counter Maintenance	0.00	0.00	0.00	0.00	0.00
3. Camera Maintenance	0.00	0.00	0.00	0.00	0.00
4. Counter Fault	80.27	0.00	80.27	87.68	0.00
5. Other	11.28	0.00	11.28	12.32	0.00
6. Trapping	0.00	1855.00	1855.00	0.00	99.96
Total Downtime (Hours)	91.55	1855.72	**1947.27**		
Expected Operational Hours	8760.00				
% Time Operational	77.77				

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Appendices

Appendix 1 – Daily upstream counts in relation to flow at Gunnislake weir 2003

Figure 7 – Daily upstream counts of salmon in relation to flow (cumecs) at Gunnislake weir 2003

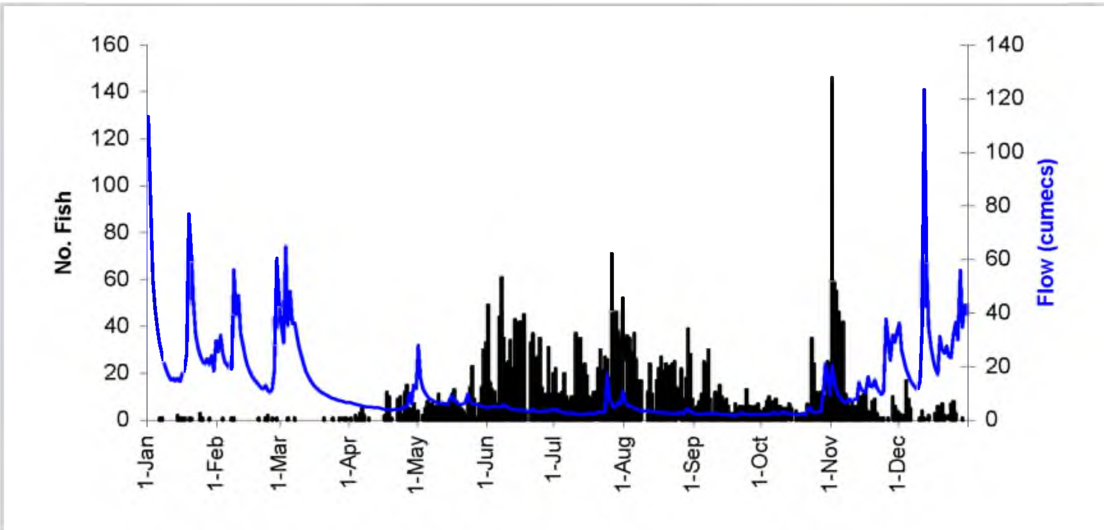
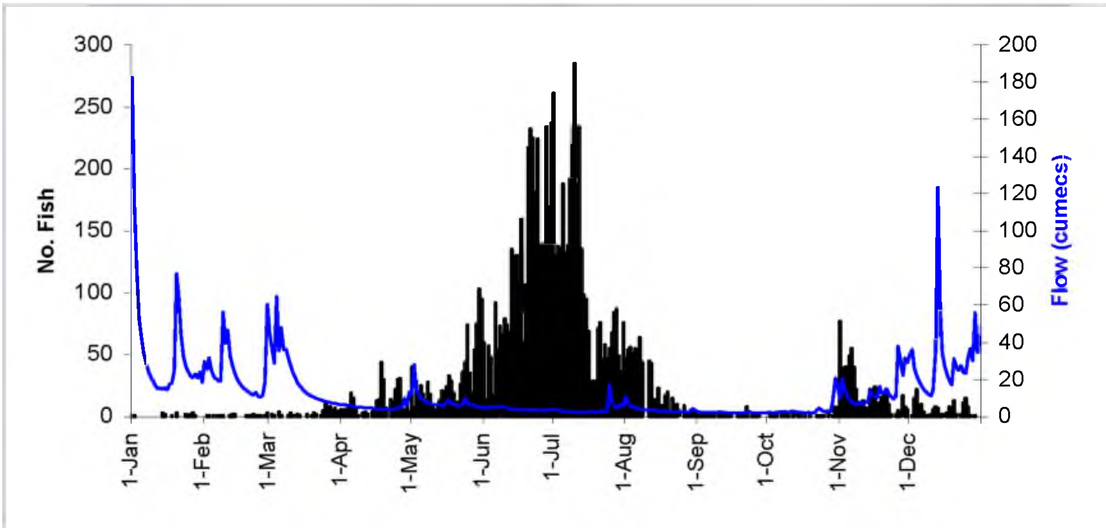


Figure 8 – Daily upstream counts of sea trout in relation to flow (cumecs) at Gunnislake weir 2003



Appendix 2 – Daily Upstream Counts in Relation to Temperature (°C) at Gunnislake Weir 2003

Figure 9 - Daily upstream counts of salmon in relation to temperature (°C) at Gunnislake weir 2003

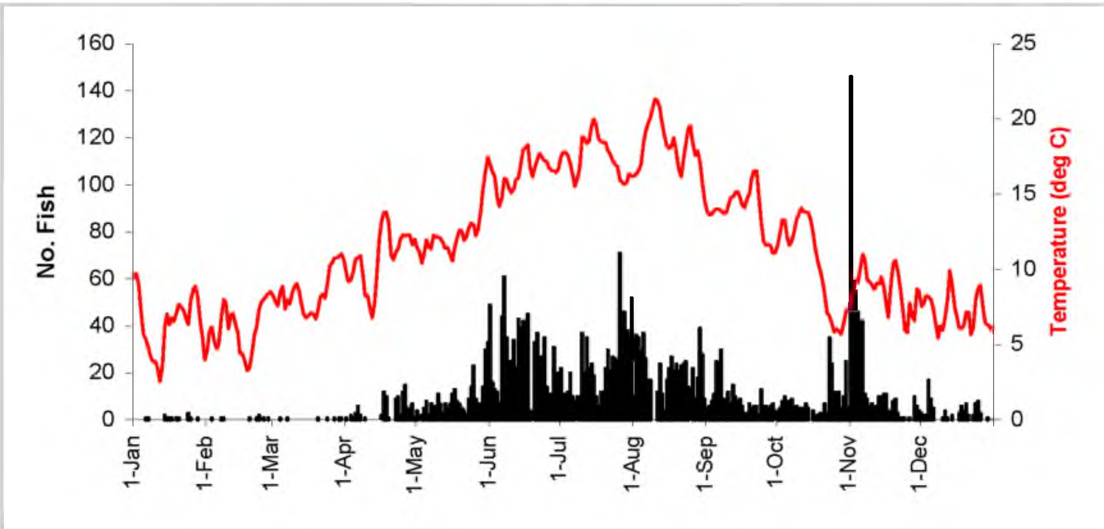
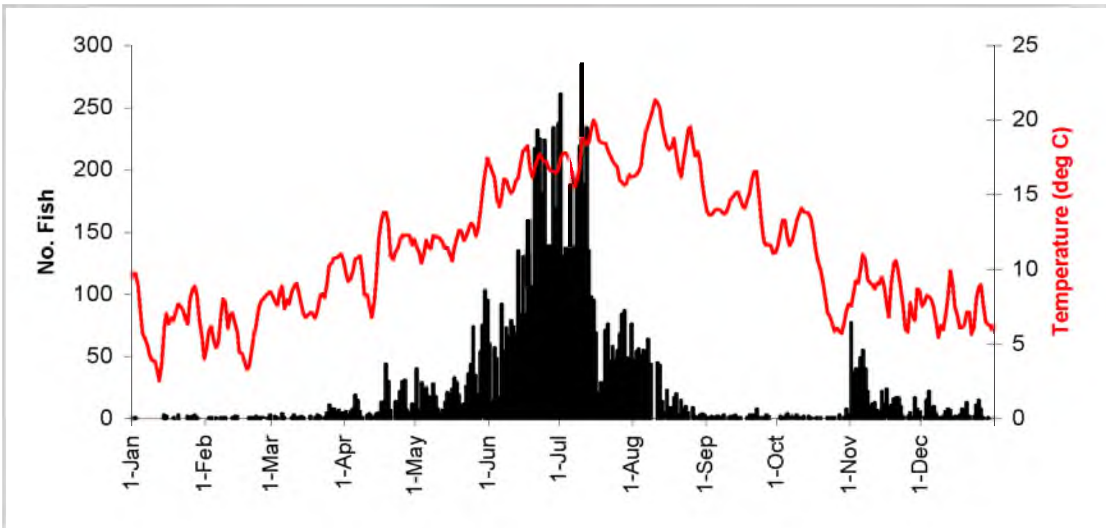


Figure 10 – Daily upstream counts of sea trout in relation to temperature (°C) at Gunnislake weir 2003



Appendix 3 - 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.

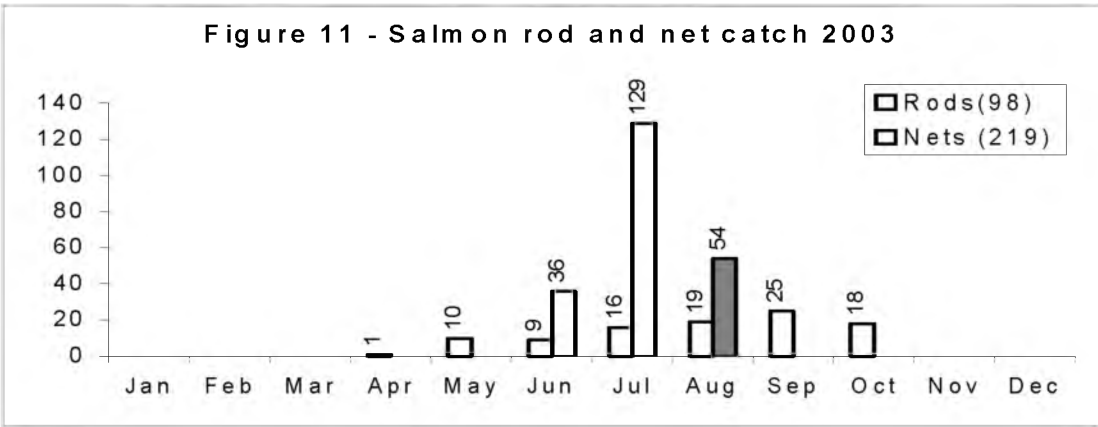
Appendix 4 - Species Apportionment and Data Analysis

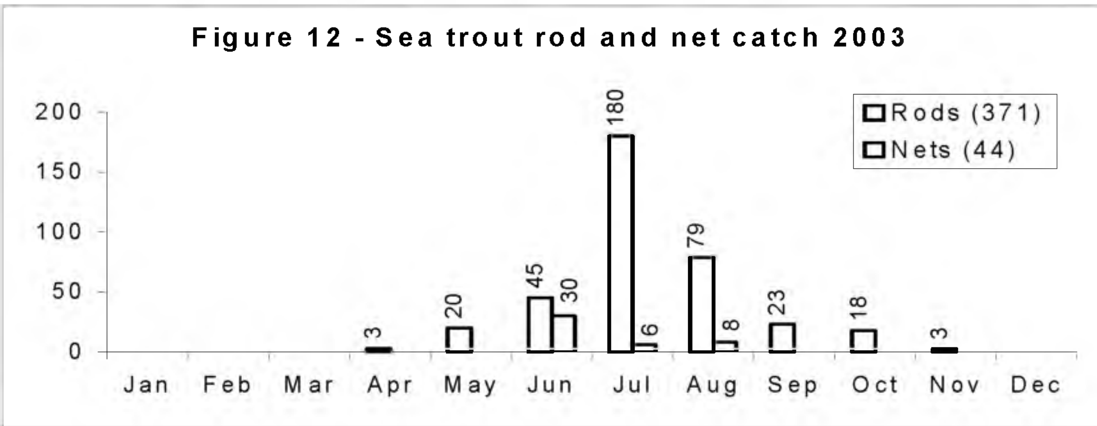
Species apportionment is made on the basis of the deflection signal size that is generated by the counter when a fish passes over the electrodes on the weir. The validation study conducted by the Environment Agency (1997) using video equipment to identify and measure fish traversing the weir found a 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. Trap data collected in 2003 confirms that the use of these seasonal deflection cut-off sizes is still valid.

It is hoped that together with video and trap 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 5 – Provisional salmon and sea trout rod / net catches 2003





Appendix 6 - Daily movements of salmon and sea trout recorded at Gunnislake fish counter and trap in 2003