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ENVIRONMENT AGENCY

River Tamar Marine Index river

Summary report of trapping of adult migratory salmonids at Gunnislake during 2003 season

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Executive Summary

1. This report summarises the results of the Tamar Marine Index River Programme for the calendar year 2003. The report contains standard tables of results and graphs and highlights the main findings.

2. Trapping was carried out at Gunnislake Weir Fish Trap for 1634 hrs (18.7% of the year) in 2003. Trapping commenced on 31 March, was suspended on 20 June, recommenced on 14 August and continued until the end of the year. 374 salmon and 956 sea trout were trapped, which represents 7.7% and 7.2% of the respective runs. 894 sea trout were VI tagged. In total, 180 salmon and 623 sea trout were aged to provide freshwater and marine ages.

3. An annual fish counter run estimate of 4835 salmon in 2003 was 7.4% higher than the 1994-2002 average. Run estimates for grilse (1 Sea Winter) and 2SW salmon were not calculable for 2003.

4. In 2003, the grilse (1SW) and multi-sea winter (MSW) components of the River Tamar stock are estimated to have contributed approximately 2.09 million eggs into the catchment – well below the current Conservation Limit (CL) for the River Tamar of 4.24 million eggs. Since 1999, the River Tamar has significantly failed its Conservation Limit for salmon egg deposition and one full failure episode has been recorded in this period (2000-2002).

5. The average trap catch rate for salmon at Gunnislake Weir in 2003 was 0.24 fish per hour, although the period corresponding to the main grilse run was not trapped. A net catch of 219 salmon marks a slight improvement on the previous two years, while CPUE at 0.44 fish per tide was the highest since 1996. The latter may have been influenced by the National byelaw which, because of the 1-month delay in the start of the season, prevented fishing at the least productive time of year. On the rod fishery, a declared catch of 114 fish was the joint lowest in the years 1993-2003. In the first year of the logbook scheme CPUE reported by logbook anglers was 0.05 fish per hour. In-season exploitation by the net fishery at 4.3% was less than the 1994-2003 average rate (9.0%), although net buy-backs have been operational since 1997 which has reduced the net exploitation rate. On the rod fishery, an exploitation rate of 1.3% was the lowest on record. Rod exploitation rates excluded released fish – equivalent to 40% of the declared catch in 2003.

6. The average trap catch rate for sea trout at Gunnislake Weir in 2003 of 0.59 fish per hour, although trapping was not undertaken during the main school peal run in June and July. The annual fish counter figure of 9913 sea trout in 2003 was 13.0% higher than the 1994-2002 average. Due to the suspension of trapping in the summer it was not possible to calculate total run estimates for sea age classes in 2003, which included fish of sea age 0+ to 0+6SM+.

7. The declared sea trout net catch (44) was 45% below the 1993-2002 average, although the catch per tide (0.09) was similar to the long-term average (0.10). The CPUE on the rod fishery was 0.20 fish per hour. A declared rod catch of 515 fish was up on the 1994-2002 average (486 fish). In season exploitation by the net fishery at 0.3% was lower than the 1994-2002 average (0.7%), as was exploitation by the rod fishery at 2.3% (excluding released fish) compared to an average of 2.7%. 40% of the sea trout caught by anglers in 2003 were released.

8. A high proportion of salmon and sea trout exhibited lice damage (46.5% and 31.4% respectively). A proportion of salmon (25.3%) and sea trout (21%) had either wounds (old and

new), fin damage or scale loss. A low incidence of net marks was recorded (1.8% salmon; 0.4% sea trout).

9. Eleven microtagged grilse were caught in the trap during 2003, with an additional six recovered from the rod and net fisheries. Marine survival estimates were not calculable for 2003.

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1 INTRODUCTION

1.1 The requirement for Index River Monitoring

Index monitoring for migratory salmonids describes targeted and intensive monitoring on a small number of selected rivers that are considered to be representative of rivers generally on both a broad regional and national scale. Some features of the salmon stock are broadly similar within wide geographical bands (e.g. marine survival, exploitation in interceptory fisheries, marine growth, changes in run timing or stock composition). However, others are more dependent upon broad catchment based similarities e.g. freshwater growth and survival, smolt age and stock recruitment estimate. As a result of the Environment Agency's national fisheries monitoring review, it has been identified that one index river for England and Wales is not capable of defining all of the observed variability that exists within salmon stocks nationally.

The data provided by index river monitoring comprises selectively sampled stock characteristics and estimates of fishery performance that is targeted to meet the needs of both the Environment Agency and external parties e.g. ICES/ NASCO, EN etc.

The main requirements for marine index river monitoring are:-

- To determine exploitation in the Irish fishery
- To determine exploitation in home water fisheries
- To determine exploitation in west Greenland fisheries
- Monthly counts from fish counters
- Smolt run estimates
- Marine survival
- To specify conservation limits for salmon
- To provide parameters for assessing current egg deposition and compliance
- To evaluate effectiveness of generic management practices
- To improve understanding of processes controlling stocks and fisheries
- To evaluate the effects of climate change

This report is primarily concerned with the operation of the adult trap for the purpose of capturing adult migratory salmonids. In addition, the designation of the River Tamar as a marine index river ensures that this work will be supported by the operation of the fish counter, smolt trapping and tagging to enable the assessment of exploitation in the Irish drift net fishery and the monitoring of juvenile migratory salmonid densities in an index tributary. Details of this work will be provided in future reports.

1.2 The River Tamar and its fishery

The River Tamar is one of the premier salmon rivers in the South West region supporting the second highest salmon rod catch (in most years). Until 2004, the Tamar supported fifteen licensed estuary nets; these have been bought out by the Agency under a Net Limitation Order for a ten-year period. The river was once a renowned spring salmon fishery and, like many rivers in England and Wales, the catches have become dominated by grilse in recent years. Three sea winter (3 SW) salmon and previous spawners are considered to be rare in the Tamar with two sea winter (2 SW) fish predominant within the pre-June fishery. The Tamar also supports a major game fishery for sea trout and brown trout (Environment Agency, 1997).

The Tamar catchment drains an area of approximately 927.75 km². The main river rises 6 km north west of the town of Bradworthy on the border between Cornwall and Devon. The river flows in a southerly direction towards Plymouth where it discharges into the English Channel, a distance of approximately 139 km (Figure 1). The average annual runoff for the Tamar catchment between the period 1957 to 1993 has been 22.5 cumecs with a maximum recorded daily mean flow recorded at Gunnislake being 482.3 cumecs. The lowest recorded flow at Gunnislake was 0.581cumecs (August 1976).

Figure 1 - River Tamar catchment

1.2.1 Net fishery

- In 1961, following the introduction of the byelaw known as the "Limitation of salmon and migratory trout netting licences order " the total number of licences on the River Tamar estuary and tributaries was restricted to 25. 15 (inclusive of 1 Tavy / Tamar joint net) of these licences were allocated to the main Tamar estuary, 5 (inclusive of 1 Tavy / Tamar joint net) to the River Tavy estuary and 5 to the River Lynher estuary.

- Since 1996, the take-up of licences on the River Tamar has been consistently 15. However, following the premature retirement of the netsmen holding the joint Tavy/ Tamar net in early 2003, only 14 licences have been issued this year. The Minister, in his letter of 16 December 1996, was particularly keen to ensure that on the event of this licence being retired, that the replacement with 2 new licence holders may require remedial action to prevent a significant increase in exploitation.

- The net fishery has historically operated from 2 March until 31 August. In addition to monthly restrictions, there are weekly netting close periods between the following times:

  - 06:00 hrs on Friday to 06:00 on Monday. 2 March to 31 May
  - 06:00 hrs on Saturday to 06:00 on Monday. 1 June to 31 August

  The 72hr close period in the spring was introduced on 12 February 1962 and provides additional protection to spring salmon.

- In 1997, the Agency assisted in brokering a buy-back of netting time between South West Water (SWW) and the Tamar, Tavy and Lynher netsmen. The aim of the buy-back scheme was to mitigate for the loss of salmon and sea trout spawning, juvenile rearing habitat and regulated flow changes caused by the construction and operation of Roadford Reservoir. This replaced a hatchery based mitigation programme that was considered to be unsuccessful and operating under a high cost to benefit ratio. In 1997, the buyout operated from 21 April to 7 June and between 2 March and 7 June in 1998. In 1998, the riparian interests on the Tamar also funded an additional buyback of netting time between 9 July to 31 August.

- The association of the Lynher and Tavy nets with the Tamar nets in the Roadford netting time buy back scheme reflects the ability of these nets to exploit stocks from the Tamar catchment. This suggests that the Tamar estuary complex represents a small scale mixed stock fishery for both salmon and sea trout stocks.

- On 15 April 1999, new national spring salmon byelaws were introduced by the Agency for a period of 10 years. This byelaw delayed the start of the salmon netting season from 2 March to 1 June in order to protect spring salmon. The national spring salmon byelaw expires on 31 December 2008.

- Following the introduction of the national spring salmon byelaws, which displaced the previous netting time buyback arrangements, the Agency has assisted in brokering a new SWW buy-back agreement from 8 to 31 August in the period 1999 to 2002. Since 1999, the SWW buy-back scheme and the introduction of the national spring salmon byelaws have effectively reduced the open netting season for both salmon and sea trout on the Tamar from 1 June to the 7 August.

- Negotiations culminated in a ten-year buy-back under a Net Limitation Order commencing in 2004. These buybacks represent mitigation for the construction of Roadford Reservoir and replaced an intensive hatchery stocking programme. These byelaws will be in force for a period of ten years with a review after five. It is considered that the index river work undertaken on both the Dee and Tamar will be vital in determining the success of this protective measure.

1.2.2 Rod fishery

- In 1961, a byelaw was introduced that reduced the length of the early spring salmon rod fishing season by four weeks. The new season then began on 1 March and closed on 30 September.

- The salmon rod fishing season has always extended beyond the end of the netting season. Up to and including 1972 the rod season closed on 30 September. In 1973, a byelaw was introduced

to extend the rod-fishing season by 14 days to 14 October. The extension enabled rod fishermen to exploit the late run of salmon which is often associated with the equinoctial storms and spates of late September and October. From 1973 to 2002 the average number of salmon taken per year during this 14 day extension has been 65. Catches in October constitute 18 % of the average total recorded catch for this period (October total of 2802 salmon). The maximum and minimum salmon in this period were 286 (1975) and 21 (1978) respectively.

- In 1994 a byelaw was introduced on the Tamar that prevented the use as bait of any shrimp, prawn, worm or maggot, whether real or imitation, when fishing with rod and line for salmon or migratory trout after 31 August.

- In 1995 and 1996, the NRA requested the introduction of voluntary catch restrictions on the River Tamar and Tamar estuary tributaries (with the exception of the River Plym) in an attempt to reduce angling pressure on spring salmon stocks. Within this area, anglers were asked to retain a maximum of two salmon prior to 1 June.

- Voluntary bag limits on the Tamar catchment are part of a general agreement amongst Cornish fishing clubs to have an "all Cornwall" limit of 2 salmon per day, 5 salmon per week, 10 salmon in a season and no more than 4 sea trout in a day. There is a voluntary maximum of 1 salmon per day with all salmon over 8lb to be returned Nn the River Inny.

- The Tamar and tributaries Fisheries Association have promoted catch and release of salmon since 1994 and have agreed a voluntary catch and release of all fish caught over 10lbs throughout the rod season.

- In addition to releasing fish, riparian interests have also voluntarily agreed to run a salmon egg box rearing programme using salmon donated by anglers. A key aspect of this programme is that donated fish are "clean" and would otherwise have been considered takeable by the rods. Although the numbers of broodstock used for the programme have been limited, the message promoting the need to conserve salmon stocks on the river has been of great value and contributed to the increasing return of captured salmon.

- Many fishing syndicates and fishing beats throughout the Tamar catchment have initiated voluntary fishing method restrictions. Many of the extensive private fishing beats have a fly only rule in force throughout the rod fishing season.

- On 15 April 1999, national spring salmon byelaws came into force as a result of a significant decline observed in spring salmon runs nationally over recent years. Any angler catching a salmon before 16 June must return it with minimum injury. Angling before 16 June can only be undertaken with artificial fly or lure.

1.2.3 Juvenile production

Juvenile salmonid production on the upper Tamar catchment has historically always been low. The vast majority of juvenile salmonid production occurs on the tributaries, principally, the River Ottery, River Lyd sub-catchment, River Inny and to a lesser extent, the River Kensey.

1.3 Gunnislake fish trap and counter

Gunnislake fish trap and counter on the River Tamar are located within the Cornish bank fish pass associated with the head of tide weir (SX 435 713) (Figure 2). In 1992, the Cornish bank fish pass and trap structure were renovated and extended in an upstream direction for the purpose of incorporating a crump sectioned weir designed specifically to facilitate the operation of the resistivity fish counter. The trap consists of three partitioned sections separated by baulk timbers that serve to arrest flows and provide fish with resting areas whilst they ascend the pass (Figure 3).

Figure 2 - Map showing the position of the counter and trap at Gunnislake

The Cornish bank pass represents the primary route for migratory salmonid passage into the freshwater Tamar. In 1994 and 1995, radio tracking studies indicated that 76% of tagged salmon utilised the Cornish pass with the remaining 24% assumed to have either negotiated the weir or utilised the smaller Devon bank pass. Analysis of salmon migration in relation to river flows indicated that there appeared to be little difference between prevailing flow and migration through the pass or by other routes.

The fish trap facility at Gunnislake was operated between May 1986 and August 1991 between mid March and mid November. From 1987, trapping was undertaken on two 24-hour trapping sessions per week when flow conditions permitted. In total, 1222 salmon and 3681 sea trout were caught migrating upstream with maximum annual catches of salmon and sea trout being 506 and 1296 respectively under this regime. It has been reported that between 1 June and 31 August, which coincides with the maximum runs of salmon and sea trout, the operation of the trap was consistent between years. The trap has been operated at flows up to 16 cumecs although very high flows will prevent the trapping operation on the grounds of health and safety and the flooding of the site.

Historic operation of the trap, and more recently the counter, has provided an insight into the run patterns of migratory salmonids within the River Tamar. Sambrook and Broad (1990) identified that;

- Only 2 SW salmon were captured prior to 1 June

- From the beginning of June, grilse became more prevalent within the trap catch and by the end of the month, grilse were predominant

- The peak runs of grilse occur in July and August supported by a relatively small proportion of 2 SW fish that continue to be captured until October

- Salmon were recorded in the trap across the full range of flows above 1 cumec. Higher numbers were captured on higher flows. Between 1987 and 1989, the cumulative 50 percentile of the catch was reached at flows between 5 and 11 cumecs

- Sea trout were caught across the full range of trapped flows although it was considered that the numbers caught declined as flows approached 15 cumecs. Large numbers of sea trout were caught on flows of less than 3 cumecs. In general, sea trout appeared to migrate into freshwater on any flow above 1 cumec.

The counter at Gunnislake has been operated since 1994 following an extensive validation programme in 1993 to assess counter efficiency. Owing to the linear relationship that exists between fish length and counter generated deflection units, it is possible, on the basis of trap and net catch data, to split the counter generated data between salmon and sea trout on the Tamar. An annual audit of the counter data adds confidence to the data and ensures that the findings of the validation remain true. The raw counter data is collated at the end of each year and a report written that incorporates the findings of the annual audit. In addition, counter and fish pass efficiencies are applied to the raw data sets to enable calculation of a total run estimate. The tagging of adult migratory salmonids and the recovery of tagged fish from the rod fishery will provide an independent estimate of the runs of salmon and sea trout.

Although highly unusual flood events limited the period of operation of the counter in 2000, its location and design provides a unique opportunity to use CCTV and infra red lighting systems to observe many fish that migrate into the Tamar. The recent use of a surface skimming camera (Fewings, 1998) has enabled species identification, detection of adipose fin clipped fish in addition to determination of daily patterns of migration for migratory salmonids in relation to prevailing environmental variables e.g. flow. Annual and monthly counts of salmon and sea trout into the Tamar are provided in Appendix (Tables 1 and 2, Appendix 1).

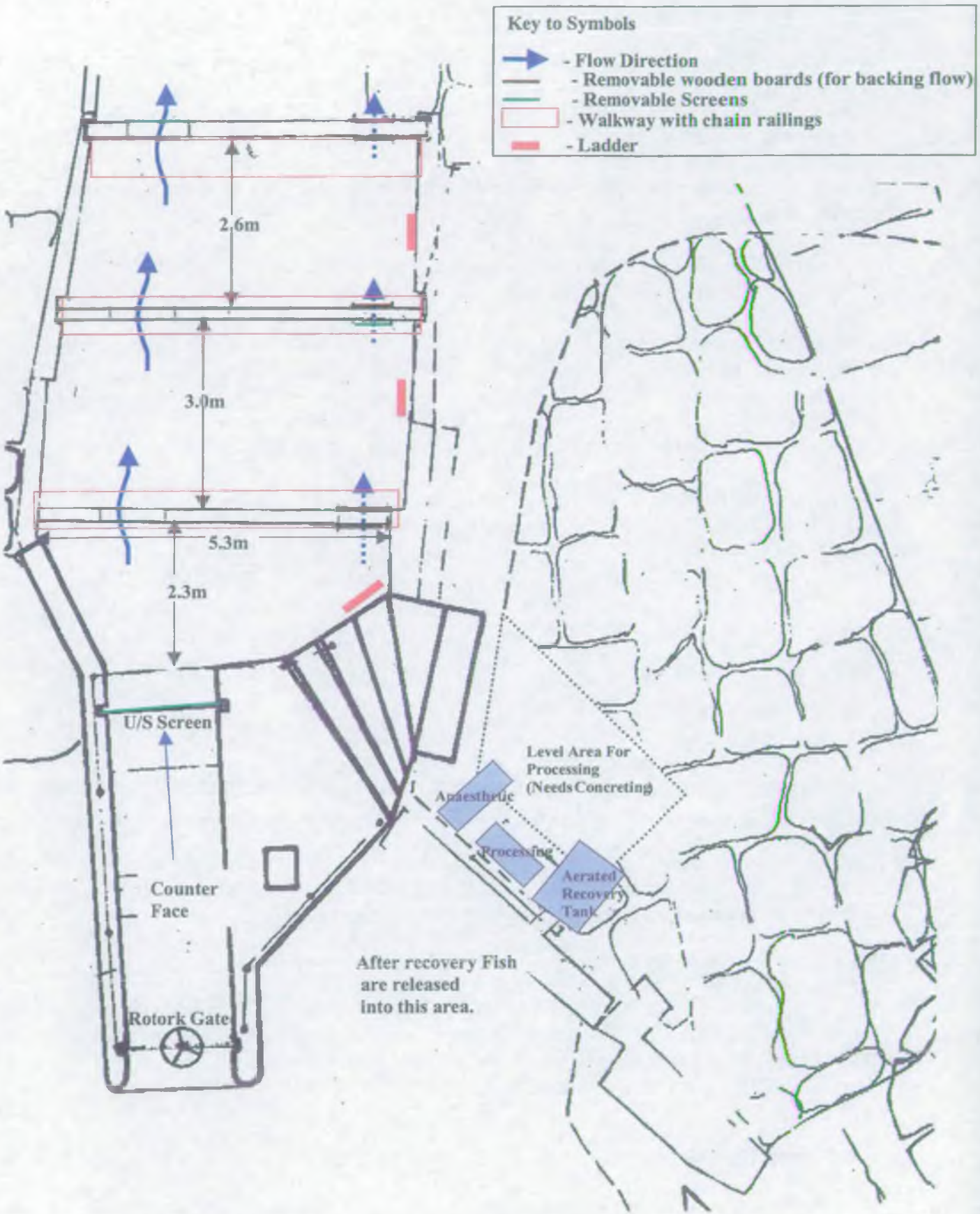


Figure 3 - Diagram of Gunnislake Fish pass and trap

1.3.1 Fish counter detection efficiency

In order to produce a run estimate based upon fish counter figures, the detection efficiency of the counter must be known. Each year, video footage is collected to provide a validation of the fish counter figures. A proportion of this video footage is viewed to audit the efficiency of the counter at detecting fish. This is undertaken by watching randomly selected hours of video, without viewing the counter data (blind watching). By comparing the number of fish detected by the fish counter to the number of fish missed by the counter but seen on the video a detection efficiency can be calculated.

The overall detection efficiency for upstream salmonids (blind watch sample size of 202 fish over 182 hours) for the period 17th April to 12th September 2003 was 98.5%.

During 37 hours of blind watching only 3 fish were recorded as undetected (2 salmon and 1 sea trout) out of a total of 202. Missed fish were detected on:

- 21st June: 1 salmon + 1 sea trout
- 16th August: 1 salmon

The number of blind hours planned was originally 183, which equates to 1 hour per video day, but had to be reduced due to either poor video quality or trapping operations.

Month	Hours watched (including blind watching)	% Detection (Salmon)	% Detection (Sea Trout)
April	59	100	100
May	22	100	100
June	46	99	99
July	23	100	100
August	28	98	100
September	4	100	100
Totals	182		

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.

1.3.2 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 2003 was calculated as 67%.

1.4 Sampling period

The Tamar Index River Project was implemented on 31 March 2003 when trapping commenced. For reporting purposes this report focuses on results from the 2003/04 season (31 March 2003 to 31 December 2003). Operation of the adult trap was suspended from 20 June 2003 until 14 August 2003 due to concerns by riparian groups that trapping operations were linked with fish deaths.

After a thorough investigation, trapping recommenced on 14 August 2003 with an amended methodology.

2 OBJECTIVES

2.1 Adult migratory salmonid trapping programme

In order to ensure that the River Dee and Tamar marine index rivers share similar objectives and that the data is collected in a co-ordinated and consistent manner, the adult trapping programme on the Tamar adopts the following list of objectives. These are: -

- to ensure that all sampling of adult fish is undertaken using best practice methods in order to minimise risks to sampled fish and maximise in-river survival
- To monitor adult migratory salmonid run size (in river, within and outwith fishing seasons) and spawning escapement
- To monitor year class strength and seasonal run pattems (by ageing components of run)
- To monitor net and angling catch and in-river exploitation rate
- To investigate relationships between catch and run size
- To investigate environmental factors (in estuary and freshwater) influencing run, catch and exploitation
- To obtain estimates of estuarine and in-river illegal catch
- To assist in the apportionment and annual audit of fish counter data
- To identify adipose fin clipped salmon within the annual run to assist in the development of run reconstruction models and calculation of marine exploitation rates and survival
- To investigate biological factors (e.g. parasites, disease, predator damage).

These objectives will be achieved through the following: -

- Operation of the trap at Gunnislake to collect biological measurements and samples from a representative proportion of different sea age classes of migratory salmonids that run into the River Tamar
- To tag a representative proportion of migratory salmonids to enable the calculation of an independent (from the counter) run estimate using tag recovery from the fishery, assessment of freshwater exploitation, survival and possible spawning distribution for month of river entry and sea age class
- Census of both the rod and net fisheries using catch returns and a log book scheme to assess fishing success, capture efficiency, exploitation rates of salmon and sea trout on the basis of sea

age class and time of entry to the fishery and the derivation of a run estimate based on the models developed by Schaefer (1951) and Chapman (1951).

As on the Dee, the Tamar adult trapping programme, and the index river monitoring work generally, will have significant benefits for the future management of salmon stocks both at a local, regional and national level. In terms of benefits to the Tamar catchment specifically, the programme will offer the following: -

- Development of a fisheries management strategy, based on objective performance measures.
- Effective input to integrated catchment planning, enabling targeting of environmental quality improvements to priority issues or areas (e.g. effects of flow regulation, abstraction, habitat degradation, etc.)

2.2 Report objectives

This is the first report to be produced on the Tamar Index Monitoring Programme and provides a summary of the run size and characteristics and the biological findings. This report contains information on the run of fish from the start of the Index River Programme on 31 March 2003, to 31 December 2003, referred to in the text as the 2003 migration. Future reports will discuss findings from 31 December 2003 onwards.

3 METHODOLOGY

3.1 Trap operation, biological data collection and tagging (31 March to 20 June 2003)

The trap was operated for three 24-hour periods per week, as agreed with riparian owners. On trapping days, trapping was divided into a morning and evening session of approximately equal duration i.e. two 12-hour periods.

Trapping days were predetermined at the beginning of each week and were based largely upon flow forecasts, predicted rainfall, prevailing environmental conditions and staff availability.

When the trap was fished the penstock gate remained shut for a maximum period of two hours to ensure that the holding time for fish was minimised as they awaited processing.

Flows within the trap were controlled using a "Rotork" automated penstock. To initiate trapping, the anterior (upstream) trap screen was lowered into position to restrict upstream access. As a precaution, rubber matting was positioned above this screen to minimise the possible risk of damage to fish that may jump at the screen. Previous experience of trapping at this site identified that fish have not been damaged or observed to be attempting to escape the trap. While in operation, the trap structure was covered with weld-mesh screening and padlocked to prevent the possible theft of fish from the site.

Prior to the lowering of the automated penstock to reduce flows within the trap, the posterior exit of the trap was screened to prevent the escape of fish. Additional pre-fabricated screens were

inserted into the remaining exits and entrances for each trap section. Previous experience of using the trap has indicated that trapped fish are pre-dominantly located within the anterior trap partition.

A small "sweetening flow" was maintained within the trap to prevent possible stranding and unnecessary damage to fish as they awaited processing. This flow also served to maintain ambient water temperatures and dissolved oxygen concentrations.

The processing of fish utilised the methods adopted from the Roadford fish-trapping programme. Trapped fish were netted using an appropriate large, fine mesh, un-knotted net and immediately transferred to the anaesthetic tank.

Fish were anaesthetised using clove oil as per best practice adopted from the River Dee adult trapping programme. Clove oil, like many other anaesthetics currently used by the Agency and CEFAS, is un-approved by the Veterinary Medicines Directorate (VMD) for use on fish. The only approved fish anaesthetic, MS 222, has a 5-day withdrawal period for fish that may subsequently enter the human food chain (21 days in US). Clearly, fish released at the head of tide have the potential to enter the fishery following release from the trap site. It is understood that CEFAS are currently pursuing the approval of "AQUI-S", a product that may prove to be of use in the future. The exposure time of fish to the anaesthetic was judged by the trap scientists and varied between each fish and the prevailing environmental conditions.

Once anaesthetised, fish were removed from the trap to the processing area. At this point, the following measurements and observations were routinely recorded: -

- Species – Salmon / Sea trout
- Fork length to nearest mm.
- Weight to within 10 g.
- Girth to nearest mm.
- Number and distribution of sea lice (tailed / un-tailed) and other external parasites.
- Scale sample taken (4 scales from area on the flank immediately behind dorsal fin for salmon, approximately 6 scales for sea trout)
- Sex of fish from external features (where possible)
- Evidence of predator damage / net marks etc. Photographed where necessary.
- Evidence of disease (swabs taken from infected ulcers / lesions). Photographed where necessary.
- Presence / absence of adipose fin noted (Where absence noted the fish was screened for a microtag using a detector wand)

Individually coded external "Floy" brand T-bar anchor tags were fitted to salmon immediately posterior to the dorsal fin. In was intended that the tagging be used for the purpose of providing an independent estimate of run, exploitation rates in relation to time of river entry / sea age class, in-river survival and spawning distribution. At the time of tagging, antiseptic / antibiotic lotion was applied to the point of insertion and the tag number recorded.

Owing to the relative longevity and ability of sea trout to migrate to the sea and spawn on a number of occasions, the use of floy tags can result in attachments of filamentous marine algae. For this reason, sea trout were tagged using a "visible implant" (VI) tag that was inserted into the transparent adipose tissue immediately behind the eye. This method has been used successfully on the River Dee with the main limitation being a possible under-recording of the captured fish owing

to the increased difficulty in observing the tag by anglers. Following tag insertion antiseptic lotion was applied to the point of insertion and the tag number recorded.

Following processing, fish were placed into a pre-fabricated, aerated recovery tank. The tank received water pumped from the river that served to maintain ambient water temperature and create circulating currents that assisted fish recovery. When deemed to be fully recovered by the trap scientists, a gate on the recovery tank was lifted and the fish retumed to the river via a sluice arrangement. This arrangement ensured that fish had fully recovered before being released back into the river and eliminated the requirement for double handling of the fish that may have resulted in additional stress. The period of processing for each fish was not longer than approximately 5 minutes.

The number of operational trap hours and the numbers of fish caught within each species and age class will be used to calculate catch per unit hour of trapping. This will provide a relative measure of salmonid migration within each month and between years as well as an annual assessment of capture efficiency of each species and run component in relation to recorded environmental parameters.

The following environmental data is currently recorded at the site on a routine basis and will be related to trap capture efficiency.

- Tidal data – Height of tide/ timing of tide
- Barometric pressure
- Temperature
- DO, temperature, pH, turbidity and chlorophyll data are collected by chemical monitoring teams via a permanent monitoring probe at Gunnislake Weir.

The data collected from the fish was initially recorded manually in a hard copy format. At the end of each fish processing session, fish records were entered onto a standardised MS Access data entry spreadsheet.

Data was collated on a weekly basis and forwarded to the Cornwall Area Fisheries Technical Team Leader. A monthly report was made to the National Salmon and Trout Centre (NSTC to provide in-season information on the runs of fish within the Tamar to ensure that data remained consistent and met the requirements for which it was collected.

An essential objective of the salmon-tagging programme is the calculation of an independent run estimate. The ability to achieve this is entirely dependent upon the re-capture and reporting of tagged fish from the rod fishery. Therefore, it was critical that the Agency facilitated and encouraged angler participation in the project at an early stage. Anglers and ghillies were approached to maintain logbooks that enabled the calculation of catch per unit effort data. This information is vital for the calculation of run estimates using models derived by Schaefer (1951) and Chapman (1951).

3.2 Trap operation, biological data collection and tagging (14 August 2003 to 31 December 2003)

On 20 June 2003, following a salmonid fish kill in the Tamar estuary which occurred earlier in June, trapping operations ceased and an investigation ensued into the possible link between

trapping operations and the fish kill event. Although, no link was found between the trap operation and the fish kill, in the interest of caution the following measures were adopted:

- floy-tagging of salmon was ceased
- the use of anaesthetic when processing salmon was ceased
- one in every three fish were processed, with the other two being identified as grilse or MSW salmon or sea trout only
- fish processing was restricted to a 2 hour period.

Salmon were processed in the trap boxes using a carp sack to hold the fish. Biological information was collected from salmon as before, after which the fish was placed in the aerated recovery tank before being released.

3.3 Trapping Effort

Trapping commenced on the 31 March 2003 so data was not available from February and March 2003. However, fish counter figures show that the majority of the salmon and sea trout migrate upstream between March and January, and it was therefore unlikely that many fish were missed by not trapping from January to March 2003. It was also suspended from 20 June to 14 August. Where possible, trapping effort remained consistent between months. However, due to operational problems and adverse weather conditions there was some variability between months (Table 3, Appendix 2). Trapping effort ranged from 131.3 to 268.0 hours per month between April 2003 and December 2003, with an average monthly trapping effort of 207.0 hours per complete trapping month. In total, the trap was fished for 1634 hours during 2003, which represents 18.7% of the year. However, trapping did not commence until the end of March 2003 and trapping ceased for approximately two months during June, July and August.

3.4 Sampling considerations

The adult trapping programme on the River Tamar has two distinct requirements in terms of the numbers of fish that need to be captured. These are: -

1. To gain a representative sample of specific biological data for each migratory salmonid sea age class stratified on the basis of month of river entry and relative contribution of each run component to the overall run that occurs within each month.

2. To enable an estimation of freshwater exploitation for month of river entry and sea age class and an estimate of the annual salmon and sea trout run (to complement the counter estimate) through mark- recapture tagging studies associated to a prescribed level of confidence and precision.

If Point 1 is considered initially, the numbers of fish required to ensure that a representative sample of biological parameters is taken for each age class can, theoretically, be predicted on the basis of the desired level of confidence and precision and the known efficiency of the trap. If we assume that we require a 95% confidence level with a precision level of + / - 0.05 and that the efficiency of the trap (in capturing the migratory salmonid run) is 76% then the following equation (Zar, 1984) can be used to predict the desired sample size. The equation is as follows: -

$$N = u^2 p (1-p^2)\delta^2$$

Where: -

N = Sample size
P = prior estimate of fish pass efficiency –assumed to be 76%
u = Standard normal deviate corresponding to cumulative probability (u =1.96)
δ = desired precision (0.05)

The use of the above equation therefore suggests that we require 288 fish within each age class division (Grilse, MSW, 0+, 1+, 0+SM+ etc). Failure to reach the desired number of fish within each group meant that lower levels of confidence and precision can be applied to the data.

On the basis of the above calculation, consideration was given to the stratification of the sample to ensure that, for example, grilse are sampled in the proportions in which they are likely to enter the river in any given year. The historic trapping data has indicated that the grilse run exists predominantly in June, July and August with lower numbers of fish after this time to the end of the rod season in mid October. It is therefore proposed to split the desired numbers of fish to be sampled based on the relative proportion of the run of each age class predicted from historic trap data. For example, this may require that the total sample of 288 grilse (95% CL, +/- 0.05) will comprise 10% in June, 60%in July, 30% in August etc. The same principle can be applied to sea trout and MSW salmon.

It is suggested that for the floy tagging of salmon and visible implant (VI) tagging of sea trout, to obtain an independent estimate of run size, the 95% confidence limits should be within + /- 30% of the run estimate. The ability to obtain such an estimate will be dependent upon the ability to collect adequate angler recapture data stratified by month. It is unlikely that estimates will be produced for separate sea age groups as sufficient data is unlikely to be available from the rods for each age class.

A similar approach was taken for sea trout and it was assumed that the above constants will be broadly similar for both species. However, it is considered that this can only be assessed through the initiation of the project and a careful appraisal of the data provided on an annual basis. In particular, the feasibility for sea trout population estimates using mark-recapture and log book returns may be adversely affected by a possible low tag recovery and reporting rate as a result of the use of relatively small sub-cutaneous VI tags.

Selected anglers were approached throughout the Tamar catchment in attempt to ensure that a representative proportion of the angling community was engaged in the log-book scheme. It is important to consider that there may be a significant bias in the capture and reporting rates for certain components of the salmon and sea trout runs if anglers used in the scheme predominantly fish specific areas of the catchment and utilise species selective angling methods. This aspect will require further consideration and assessment when the programme has been operational for one year.

Mark Re-capture Sampling Requirements

In terms of the sampling requirements for the mark-re-capture population, Ian Davidson (pers. comm.) of the NSTC made some simulations for the Tamar based upon the mean Tamar salmon run at Gunnislake of 4,096 (1994 to 1999) as derived from the ICES report. This was done on the basis that:

- The fish pass efficiency at Gunnislake remains constant at 0.7
- Trapping is undertaken for 2 to 3 days per week
- The proportion of the salmon run entering within the fishing season is 0.9
- The proportion of the total trap catch that is tagged is 0.9
- The extant rod exploitation rate is 14.8% for all fish (13.2% for 1 SW and 18.5% for 2 SW)
- The proportion of the tags retained by fish is 95%

If the above constants are used and the trap is operated for 3 days per week it is estimated that approximately 700 to 1000 salmon per year could be captured. In addition, during the initial stages of the project it should, theoretically, be possible to obtain 30% of all recovered tags from log book anglers. This should ensure that an annual salmon run estimate can be derived with 95% confidence limits within +/- 30% of the mean.

3.5 Fish ageing

A subsection of fish were aged by scale reading. This was undertaken predominantly by the EA National Laboratories but also by the Cornwall Area Ecological Appraisal Team. For fish that were measured but the scales proved to be unreadable, age class was assigned based upon length and time of year using historical data as described in Section 3.5.3.

Fish Sea Age nomenclature in this report is as follows:

3.5.1 Salmon

- Grilse; fish which has spent one winter at sea
- 2SW; a multi-sea winter fish (MSW) that has spent 2 winters at sea

3.5.2 Sea Trout

- 0+; School Peal; fish returning to freshwater in the first summer or autumn of their sea life
- 0+SM+; a fish that returned as a school peal to spawn the previous year
- 0+2SM+; a fish that has spawned twice previously
- 0+3SM+; a fish that has spawned three times previously
- 0+4SM+; a fish that has spawned four times previously
- 0+5SM+; a fish that has spawned five times previously
- 0+6SM+; a fish that has spawned six times previously
- 1+; a 'maiden fish' returning to freshwater for the first time after one winter at sea
- 1+SM+; a 1+ fish that has spawned once previously
- 1+2SM+; a 1+ fish that has spawned twice previously

3.5.3 Using length and time of year to assign age-class in salmon

- Historical trapping data and 2003 data indicates that all salmon entering the river between March and June are MSW (1986-89 trapping data; sample size = 49 salmon; 2003 trap data = 37 salmon).

- Therefore all fish entering the river in March to May inclusive were considered to be MSW fish.

- Due to the cessation of trapping in June, July and August of 2003 the MSW/grilse split must be extrapolated using historic data only.

- Discriminant analysis of salmon lengths caught during June (1986-89 trapping data sample size 97 salmon) indicates that **685mm** was the most accurate cut of point between grilse and MSW (100% correctly classified).

- Discriminant analysis of salmon lengths caught during July (1986-89 trapping data sample size 163 salmon) indicates that **685mm** was the most accurate cut of point between grilse and MSW (94.5 correctly classified).

- Discriminant analysis of salmon lengths caught during August (1986-89 trapping data sample size 90 salmon) indicates that **715mm** was the most accurate cut of point between grilse and MSW (93.3 correctly classified).

- Discriminant analysis of salmon lengths caught during September to December (2003 trapping data sample size 50 salmon) indicates that **755mm** was the most accurate cut of point between grilse

4 RESULTS; Adult Salmon

4.1 Trap catch rate, composition and timing

4.1.1 Trap catch

An average annual trap catch rate of 0.24 salmon per hour was recorded during the 2003 season (Table 3, Appendix 2), although this year did not contain representative data from all months of the year. A total of 374 salmon were trapped during the 2003 season.

The total salmon run estimate of 4835 (3626 adjusted by 25% for fish pass efficiency) taken from Gunnislake Fish Counter Annual Report 2003, indicates that in 2003, 7.7% of the salmon run was trapped.

Figure 4 shows the relative proportion of salmon trapped throughout the year; the catch was representative of the run throughout the year, except when trapping ceased in July.

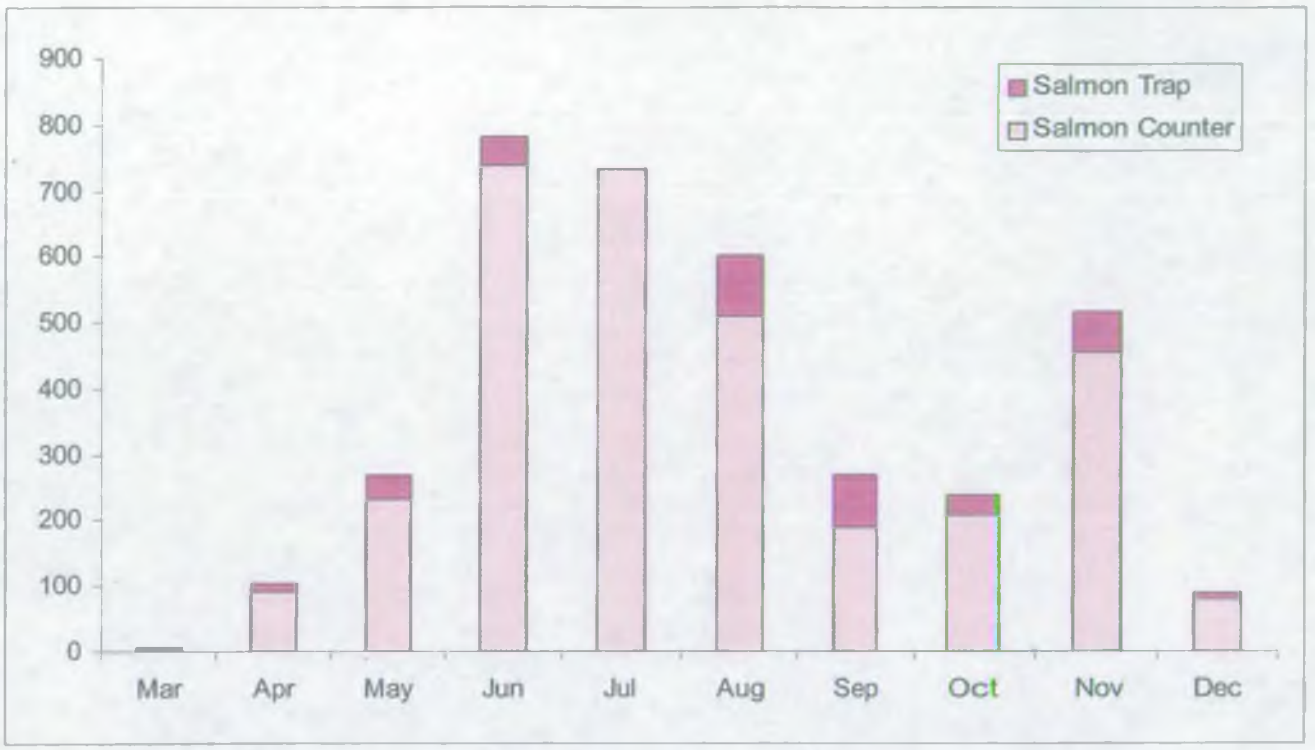


Figure 4 - The proportion of the salmon run trapped during each month in 2003

2 SW fish dominated in April, May and the beginning of June until trapping ceased on the 20 June. When trapping recommenced on the 14 August grilse dominated the salmon run until the end of the year.

4.1.2 Age composition

4.1.2.1 Sea age

A total of 180 salmon were aged either by scale reading or attributing sea age based upon time of year and length, using historical data.

The run of salmon during 2003 was composed of 2SW and 1SW fish. Due to the cessation of trapping between mid-June and mid-August it was not possible to produce run estimates for each of the sea age components of the run. Table 4 (Appendix 2) shows the number of MSW and grilse caught during each month and the relative proportions of MSW and grilse in the run. Figure 4 shows the relative numbers of MSW and grilse during 2003, based upon the relative proportions of sea age classes applied to the fish counter figures. Due to the small number of fish trapped, processed and aged during 2003 and the cessation of trapping in months when the MSW and grilse components overlapped (June-August), the relative abundance of MSW and grilse is not absolute.

Trapping in 2003 showed that during April and May the run was entirely composed of MSW fish with the first grilse running in June. Because trapping only took place in the first half of June, the proportion of MSW fish running during June shown in Figure 4 is probably larger than the actual number. When trapping recommenced in mid-August the run was dominated by grilse, which continued until the end of the year.

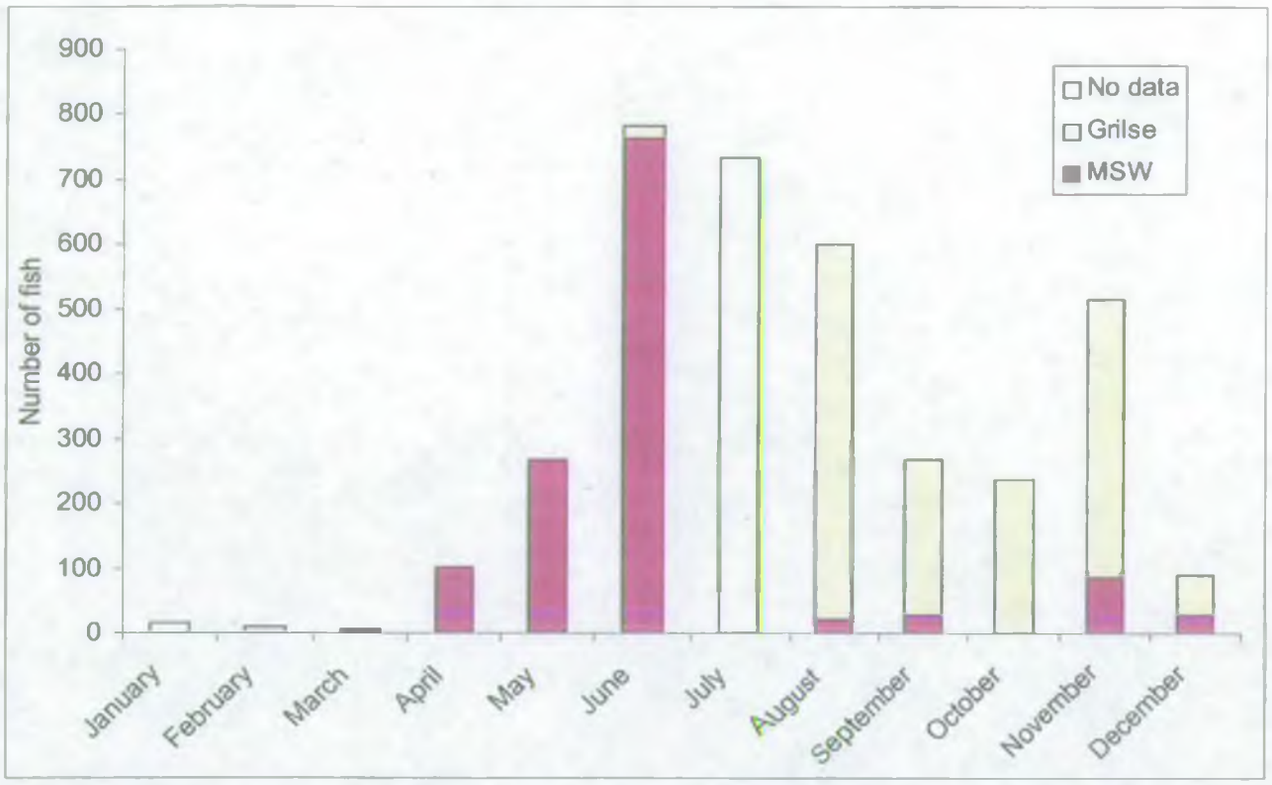


Figure 5 - The relative proportions of MSW and grilse within the 2003 salmon run

4.1.2.2 Smolt age

Of 130 salmon aged by scale reading during 2003, most smolted at age 2 (89.2%; n = 116) with a proportion at age 1 (10.8%; n = 14).

4.1.3 Sex composition

A very small number of fish were sexed in 2003 and analysis of sex composition was not possible.

4.1.4 Weight composition by sea age

69 grilse were measured during 2003, with all but one trapped from August onwards; the weight ranged from 1.35-4.40kg (average = 2.83kg; standard deviation = 0.612). The weight of the 81 2SW fish measured ranged from 3.40kg to 7.40kg (average = 4.90kg; standard deviation = 0.795). Table 5 (Appendix 2) shows the weight composition for salmon sea age classes, by month.

4.1.5 Weight-length relationship

Figure 6 shows the weight-length relationship for all salmon trapped during 2003 (n=176).

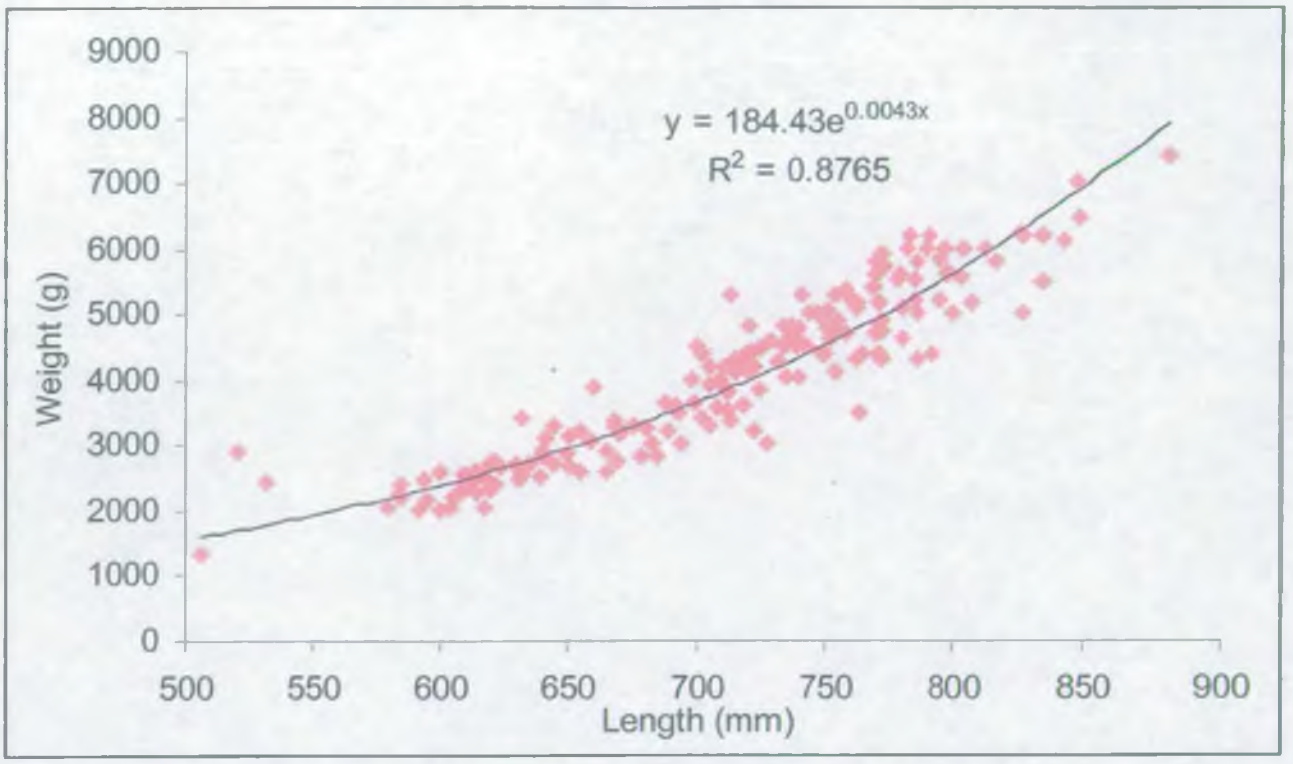


Figure 6 - Weight-length relationship for salmon trapped during 2003

4.1.6 Length at age

Figure 7 shows 180 (aged from scales) of the 374 salmon (grilse and 2SW fish) captured in the trap in 2003. The data suggests that there is little or no overlap in the length of grilse and 2SW fish within each month, although as expected, the relative size of both grilse and 2SW fish increases towards the latter part of the year. It is unfortunate that the July data set is missing, as this would probably show a certain degree of overlap between grilse and 2SW fish fork lengths. The size range (min and max) of fish lengths within the grilse age class increases from August onwards as the grilse run starts to take over from the main MSW run.

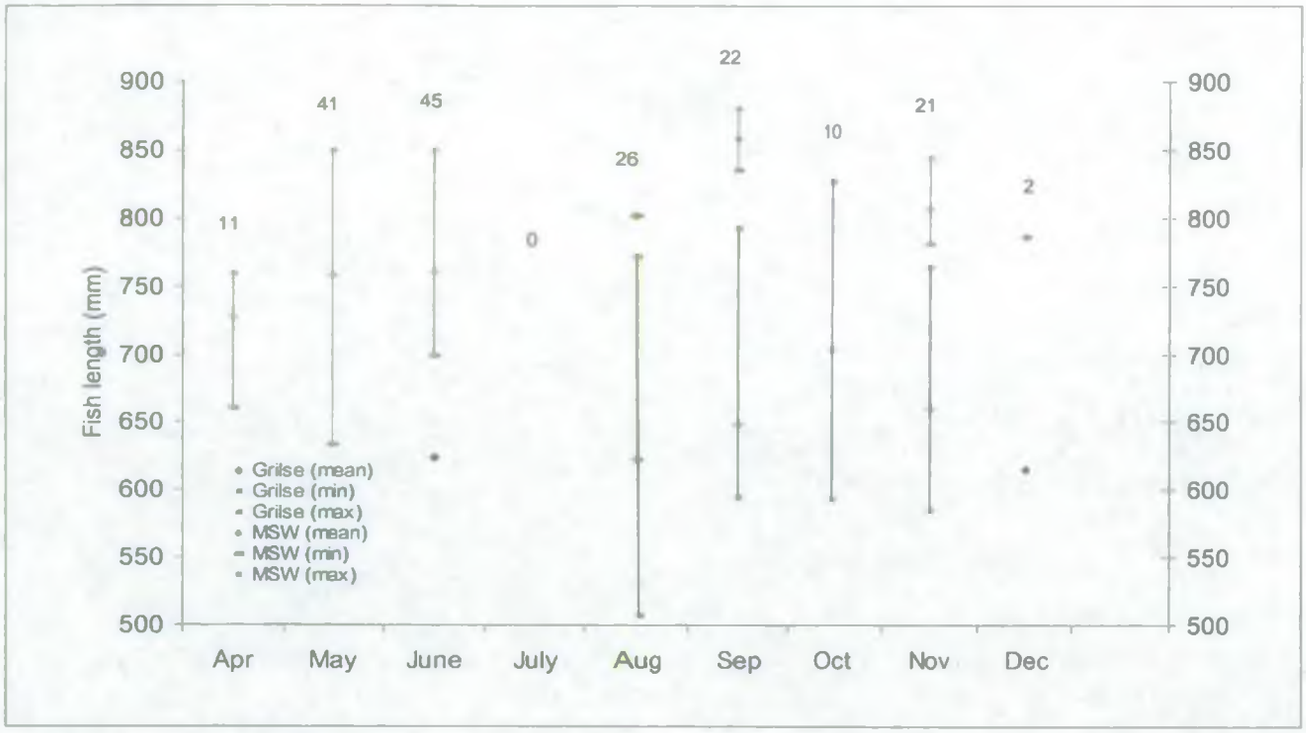
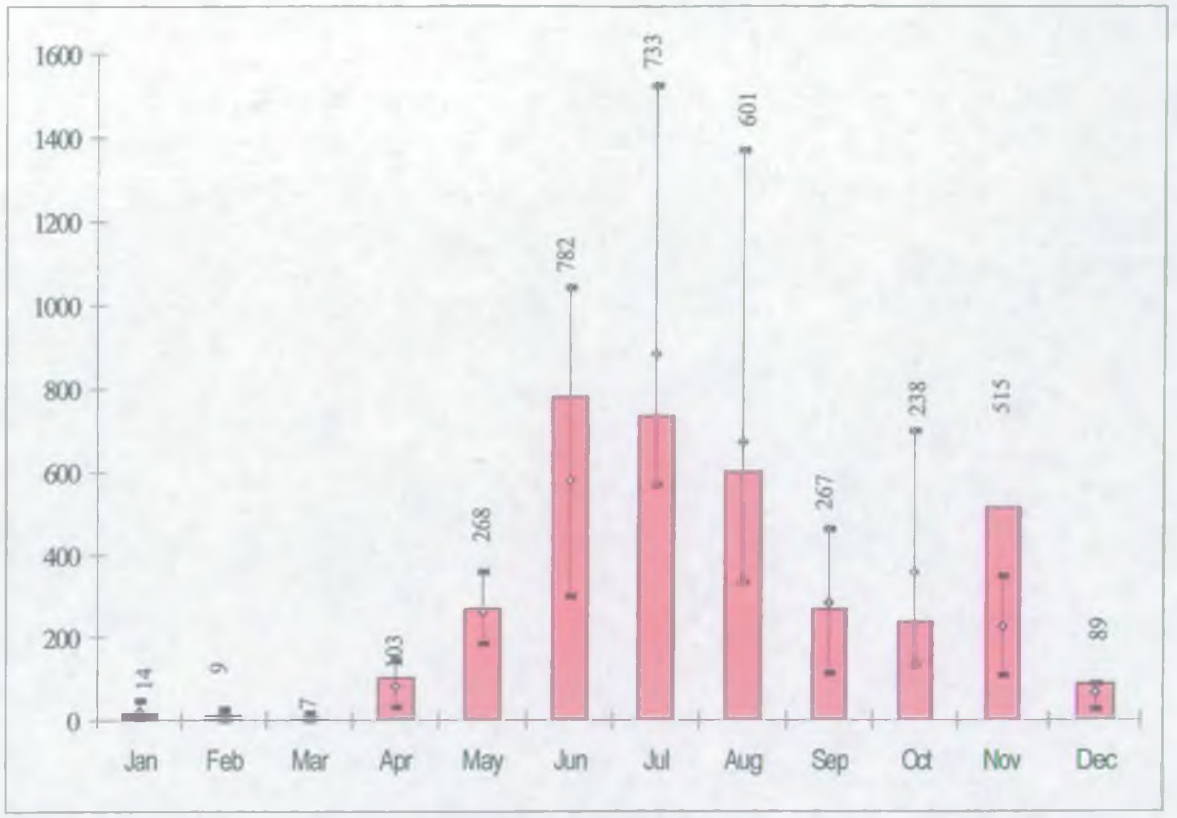


Figure 7 - Sea age class length by month for salmon, 2003

4.2 Run Size

4.2.1 Fish Counter

Based upon the data from Gunnislake fish counter, the total salmon run estimate for 2003 is 4835 (3626 adjusted by 25% for fish pass efficiency). Compared to the 1994-2002 average estimate of 4501 the 2003 salmon run was slightly above average. Figure 8 shows the monthly upstream counts of salmon during 2003 compared to the 1994-2002 average. Most salmon ran in June, with good numbers running in July and August. There was an unusually high salmon run in November during 2003, but runs from July to October were below the 1994-2002 average.



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

Figure 8 - Monthly upstream counts for salmon at Gunnislake weir 1994 – 2003.

4.2.2 Tagging

Eleven salmon were floy-tagged in April, 41 in May and 45 in June (Total = 97). Tagging ceased in mid-June.

4.2.3 Recaptures and straying

In 2003, one floy-tagged salmon was recaptured by a rod angler and one by a commercial netsman.

Due to the cessation of floy tagging, the small number of salmon tagged and consequently the low number of floy tagged salmon caught by anglers, it was not possible to use tag returns to estimate the size of the run or exploitation rates, independently of the fish counter.

4.3 Year Class Strength

The 2003 run estimate (corrected for fish pass efficiency) for salmon of 4835, was 7.4% higher than the 1994-2002 average (4501) (Figure 9).

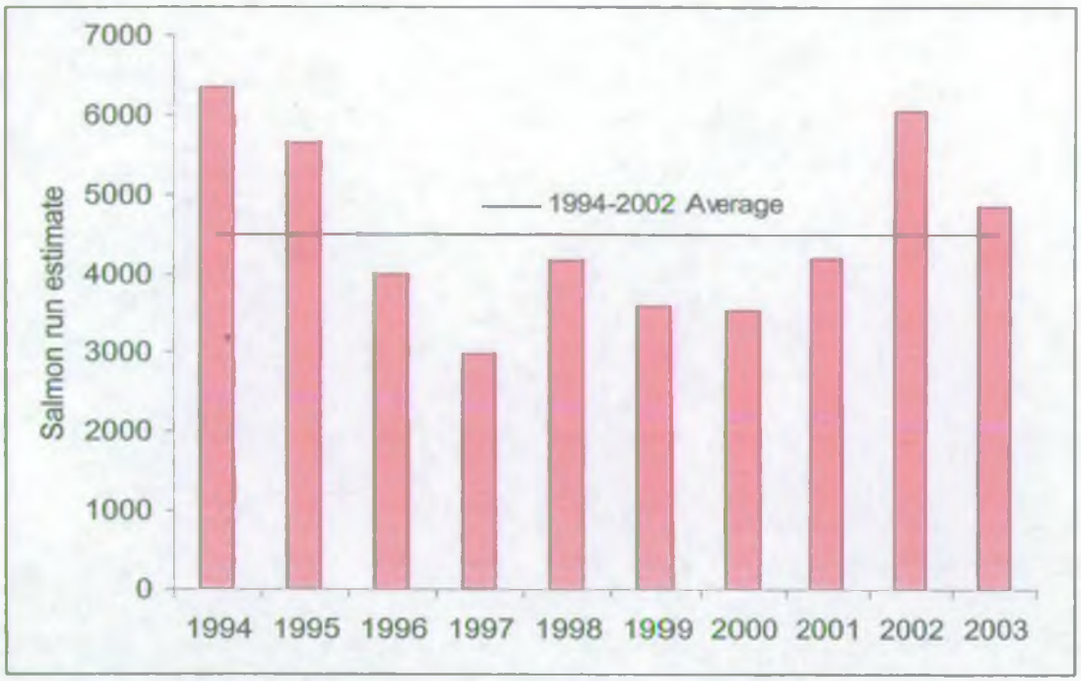


Figure 9 - Salmon run estimate from Gunnislake Fish Counter, 1994-2003

4.4 Fishery performance

4.4.1 Net Fishery

4.4.1.1 Catch and catch effort

A catch of 219 salmon was declared by the net fishery in 2003. This represented a slight improvement on the catches of the two previous seasons (Table 11, Appendix 4).

An overall catch rate of 0.44 fish per tide was the second highest recorded to date (Table 12, Appendix 4). However, it must be noted that netting effort reduced significantly from 1997 onwards due to spring salmon byelaws and buyback arrangements.

Recorded catch rate was highest in August (0.98 fish per tide). The majority of these fish were grilse (Table 12).

4.4.1.2 Weight composition

Table 13 (Appendix 4) shows that in 2003, grilse and 2SW fish were exploited in approximately equal proportions by the estuary nets (assuming fish under 8lbs are grilse and greater than 8lbs are MSW).

4.4.1.3 Exploitation rate

Exploitation rates for the Tamar net fishery in 2003 (and previous years) are shown in Table 14 (Appendix 4) and are based on a pre-net fishery estimate of run size, which combines the run at Gunnislake Weir with the declared net catch. On this basis at 4.3% the net exploitation rate in 2003 was consistent with the previous 5 years. Relatively low exploitation rates have been observed on the Tamar since 1997, when the fishing effort was greatly reduced (see Table 14). This reflects a combination of declining effort, a reduced number of available days and a declining stock of salmon.

4.4.2 Rod Fishery

4.4.2.1 Catch- licence return

A declared rod catch of 114 salmon in 2003 was the joint lowest number ever recorded on the river (Table 11). However, it must be noted that rod fishing effort has reduced significantly in recent years due to poor catches and a general downtrend in salmon fishing, compounded by Foot and Mouth restrictions during 2001. Catch-and-release resulted in the return of 40% of the catch (46 fish).

4.4.2.2 Catch effort- logbook return

73 Tamar anglers were asked to participate in the log book scheme. 35 of these anglers agreed to join the scheme and were sent logbooks. At the end of the fishing season 22 anglers returned their books, of which 18 had fished for salmon.

Due to the low numbers of anglers in the scheme care should be taken when interpreting the results, as they might not reflect angling on the river as a whole.

In total, 41 salmon were declared by logbook return for the 2003 season. The number of salmon caught per 100 hours fished by the log book anglers was 4.6 (Table 16, Appendix 4). The majority of fishing effort and salmon caught was on the main Tamar between Gunnislake Weir and Horsebridge and between the River Inny and Lyd confluences (Table 17).

4.5 Microtag returns

Eleven microtagged salmon were trapped at Gunnislake during 2003. These were returning grilse, having been tagged as smolts in April 2002. Five were recaptured in August, three in September, two in October and one in November. Because trapping ceased during the period of the main grilse run, it is likely that a large number of microtagged salmon were not caught. An additional six microtagged salmon were recaptured by fishing activities; three were recaptured by rod anglers and three by commercial netsmen.

Because trapping ceased during the main grilse run from mid June to mid August, it is not possible to calculate accurate survival estimates for 2003. Furthermore, because smolt tagging commenced in 2002, a proportion of tagged smolts will return in 2004 as MSW fish. Until we know how many of the 2002 smolt run return as MSW fish in 2004 it will not be possible to estimate marine survival rates.

4.6 Egg deposition and Conservation Limit compliance

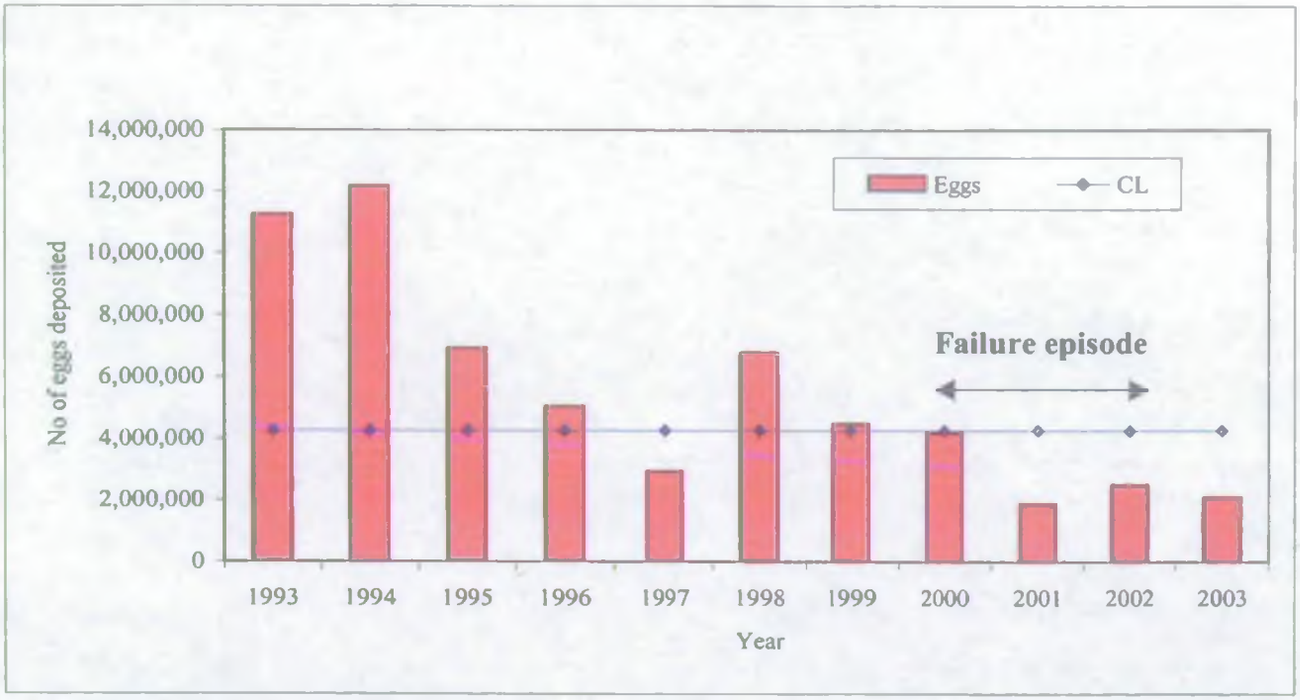


Figure 10 - Annual salmon egg deposition compared to River Tamar Salmon Action Plan (SAP) Conservation Limit (CL)

The salmon Conservation Limit (spawning target) for the River Tamar was published in the River Tamar Salmon Action Plan (SAP) consultation document in 1997. The Conservation Limit was calculated using guidelines developed by the Environment Agency. The River Tamar SAP Conservation Limit was recalculated for the Salmon Stocks and Fisheries in England and Wales report, 2003, to account for current marine survival estimates that are much lower than historic figures. The revised Conservation Limit was calculated as 4.24 million eggs based on the deposition of 293 eggs per $100m^2$ of accessible stream area. Compliance assessments are illustrated above for the period 1993 to 2003 (Figure 10).

Salmon egg deposition within the SAP guidelines has exceeded the Conservation Limit from 1993 to 1999 although there is an evident decline in deposition. During the period 1997 to 1999 the River Tamar was exceedingly close to a failure period. Since 1999, the River Tamar has significantly failed its Conservation Limit for salmon egg deposition and one full failure episode has been recorded in this period (2000-2002).

In 2003, the grilse (1SW) and multi-sea winter (MSW) components of the River Tamar stock are estimated to have contributed approximately 2.09 million eggs into the catchment – well below the current Conservation Limit (CL) for the River Tamar of 4.24 million eggs. This estimate includes the contribution of 45 rod-released fish.

Urgent management action was implemented through 2003/2004 to protect the Tamar salmon stock because of the extent and progressive nature of the Conservation Limit failures since 1999, coupled with a significant decline in net and rod catches, reducing Catch Per Licence Day figures

from 1995 onwards and below expected densities of juvenile salmonids in many parts of the catchment.

4.7 Biological Observations

A moderate proportion of salmon exhibited some damage, albeit scale loss, fin damage or unspecified wounds- including new, healing and old wounds (Figure 11). The proportion of salmon exhibiting sea lice damage was high (46.5%). At 5.9%, predator damage was low, although this is a minimum estimate because a proportion of unspecified wounds will probably have been caused by predators. Net marks (recent and mended) and disease were very low (1.8% and 0.6% respectively).

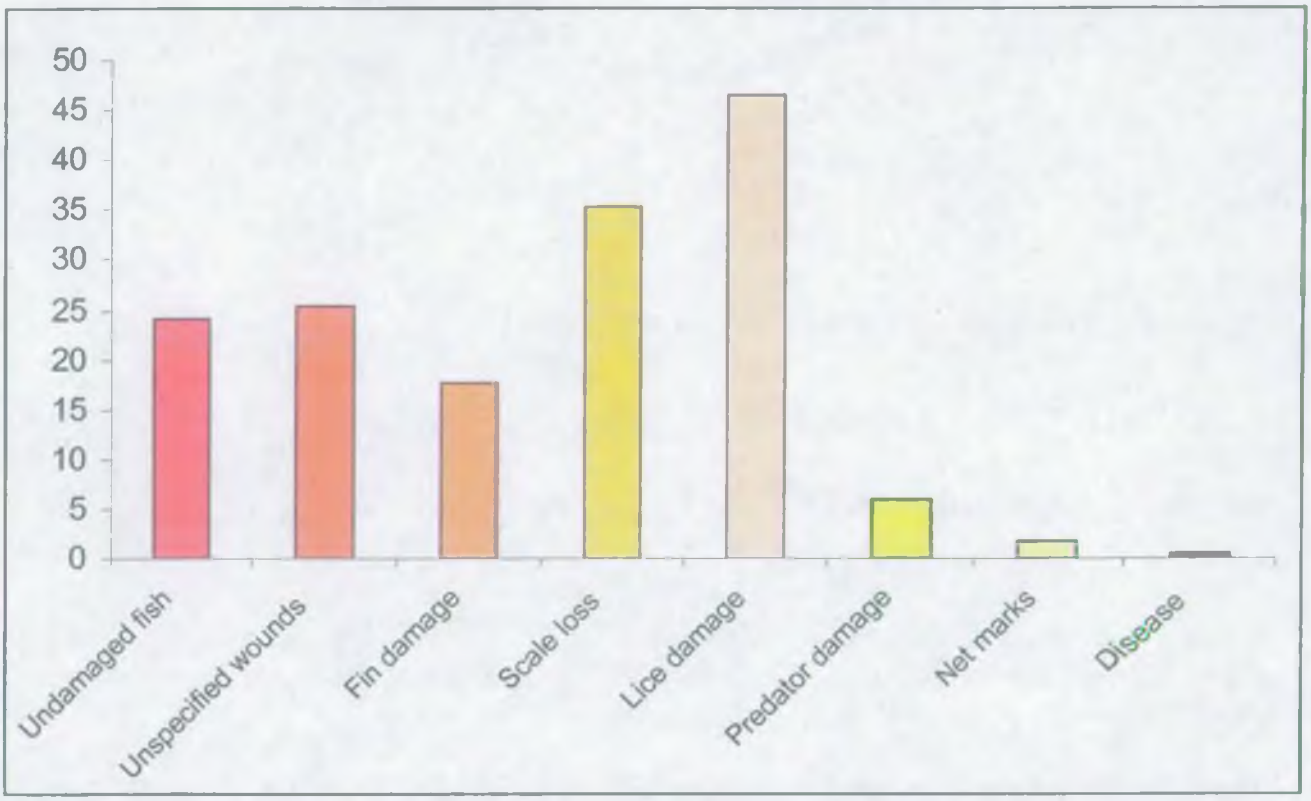


Figure 11 - Observations on wounds and damage from salmon, 2003

Figure 12 indicates that although the majority of salmon had sea lice, in most cases parasitisation was not greater than 10 lice per fish.

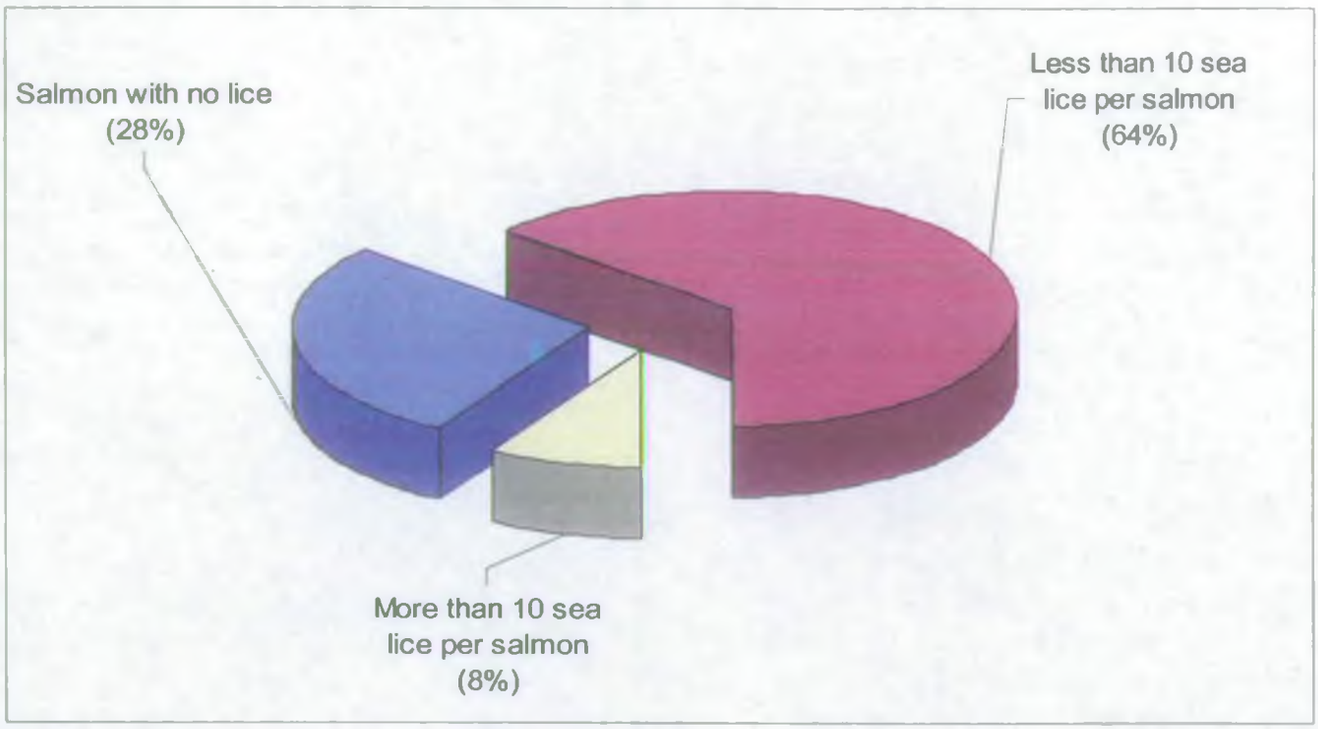


Figure 12 - Prevalence of lice damage to salmon, 2003

5 RESULTS; Adult Sea Trout

5.1 Run composition and timing

5.1.1 Trap catch

An average annual trap catch of 0.59 sea trout per hour was recorded during the 2003 season (Table 7, Appendix 3), although this year did not contain representative data from all months of the year. A total of 956 sea trout were trapped during the 2003 season.

The total sea trout run estimate of 13217 (9913 adjusted by 25% for fish pass efficiency) taken from Gunnislake Fish Counter Annual Report 2003, indicates that in 2003, 7.2% of the sea trout run was trapped. However, the adjustment for fish pass efficiency is based on a radio-tracking study of salmon, not sea trout.

Figure 13 shows the relative proportion of sea trout that were trapped throughout 2003. A sample of the run was trapped in all months except July.

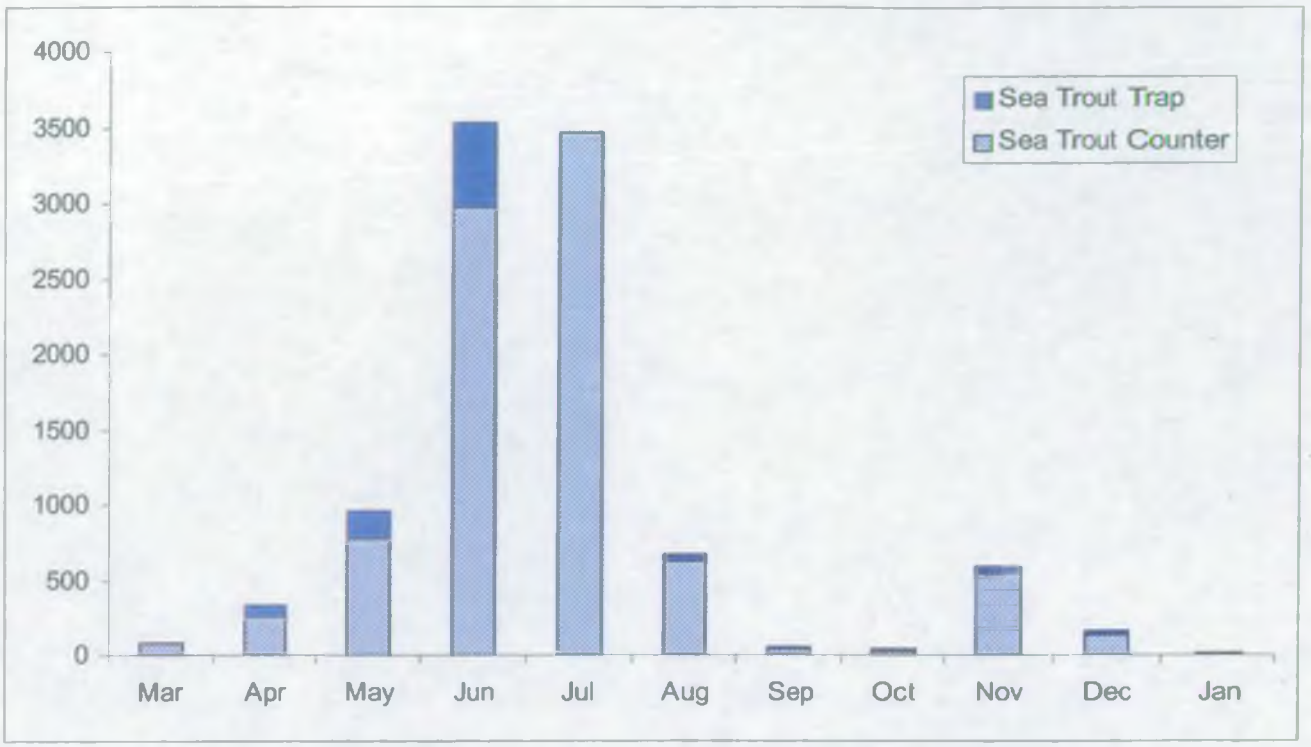


Figure 13 - The proportion of the sea trout run trapped during each month in 2003

5.1.2 Age composition

5.1.2.1 Sea age

A total of 662 sea trout were aged from scales, 623 of which successfully (39 unreadable). The sea trout run comprised fish of sea ages between 0+ (peal) and 0+6SM+ and a very small number of 1+, 1+SM+ and 1+2SM+ (Table 8, Appendix 3). Of the fish aged, 16.5% were school peal (0+), 0.6% were maiden fish (1+) and 82.4% were previous spawners. However, trapping was not carried out during the main school peal run.

Due to the cessation of trapping between mid-June and mid-August it is not possible to accurately apportion the run by sea age class for the entire year. Repeat spawning fish were commonest between April and mid-June, when trapping ceased. The peal (0+) run commenced in early June, but, based upon fish counter data, it is thought to have occurred during the end of June and throughout July when trapping did not take place. The 0+SM+ age class formed a significant proportion of the run, dominating the run during May and early June.

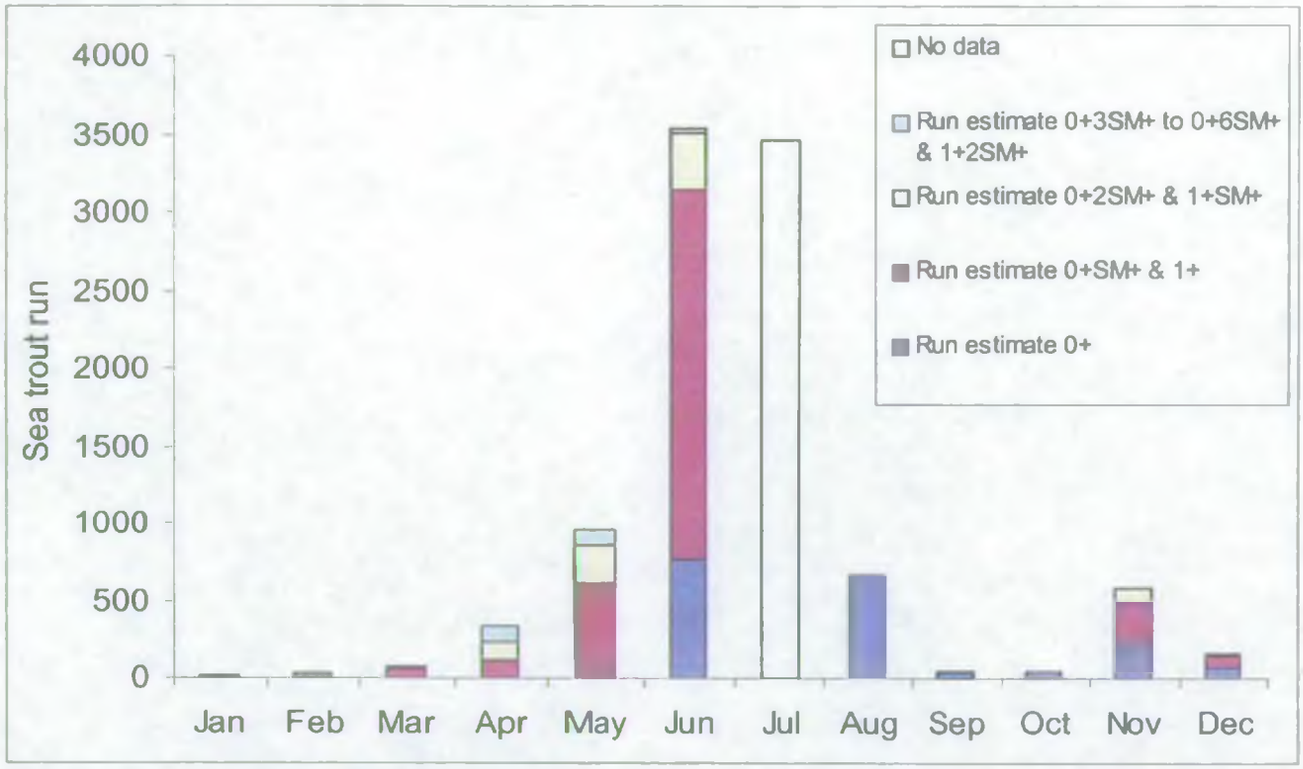


Figure 14 -The relative proportions of sea age classes within the 2003 sea trout run

5.1.2.2 Smolt age

Of 443 sea trout aged by scale reading during 2003, most smolted at age 2 (83.5%; n = 370) with smaller proportions that smolted at age 1 (1.4%; n = 6) and age 3 (15.1%; n = 67). Due to the large number of returning 1+ fish compared to 0+ or 0+SM+ fish and the cessation of trapping during the main 0+ run, it was not possible to investigate the relationship between smolt age and duration at sea. This may be possible in future years.

5.1.3 Sex composition

A very small number of fish were sexed in 2003 and analysis of sex composition was not possible.

5.1.4 Weight composition by age

Table 9 (Appendix 3) shows the weight of sea trout for each month, by sea age class. The majority of previous spawners were trapped between March and June, with the heaviest average weight occurring in April (1.41 kg; n = 69). School peal (0+) dominated the run between August and October, but in November and December previous spawning sea trout were recorded and the average weight of fish increased.

5.1.5 Weight-length relationship

Figure 15 shows the weight-length relationship for all sea trout trapped during 2003 (n=912).

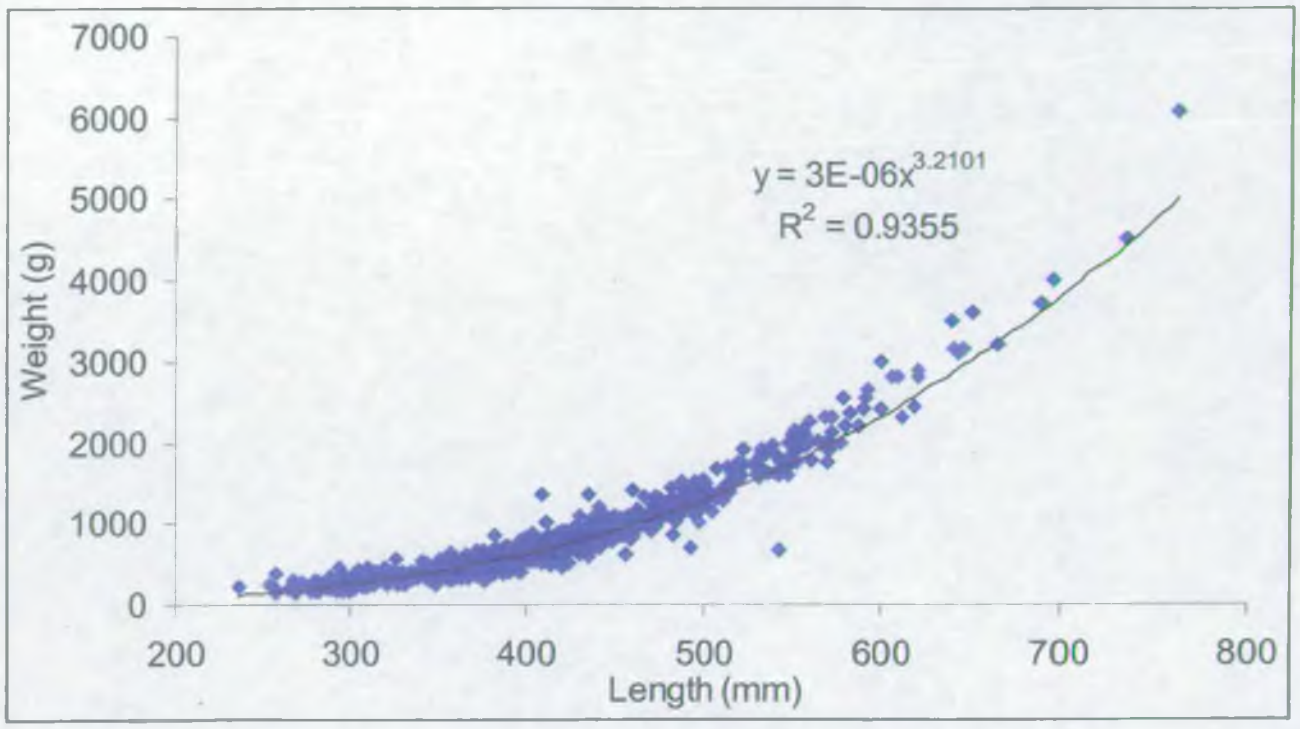


Figure 15 - Weight-length relationship for sea trout trapped during 2003

5.1.6 Length at Sea age

Figure 16 shows the sea age of class length by month for 665 (aged from scales) of the 956 sea trout (school peal and previous spawners) captured in the trap in 2003. The data suggests that there is a certain degree of overlap in months in which the main school peal run traditionally takes place i.e. June and July. It is highly probable that the missing data for July would have shown a higher degree of overlap between the age classes as the majority of the peal run tends to occur during July.

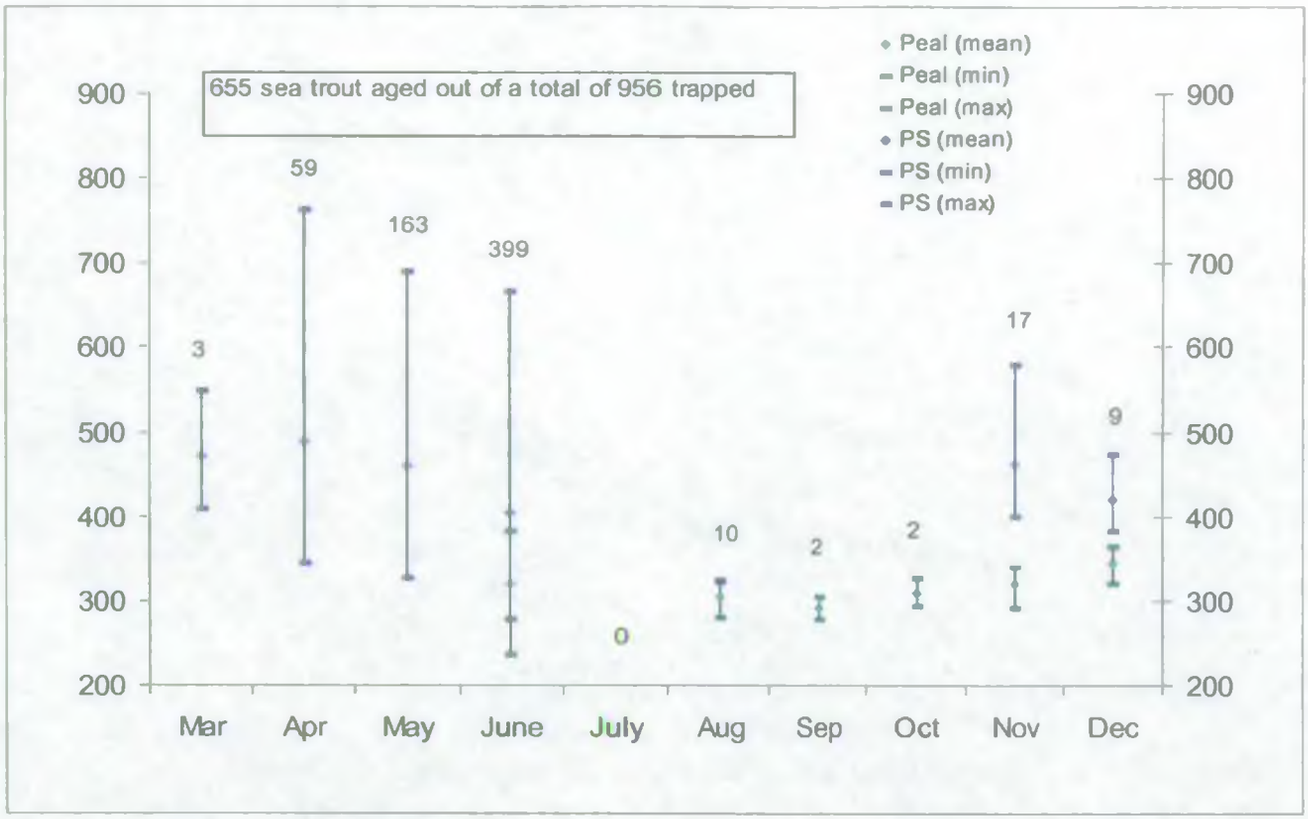
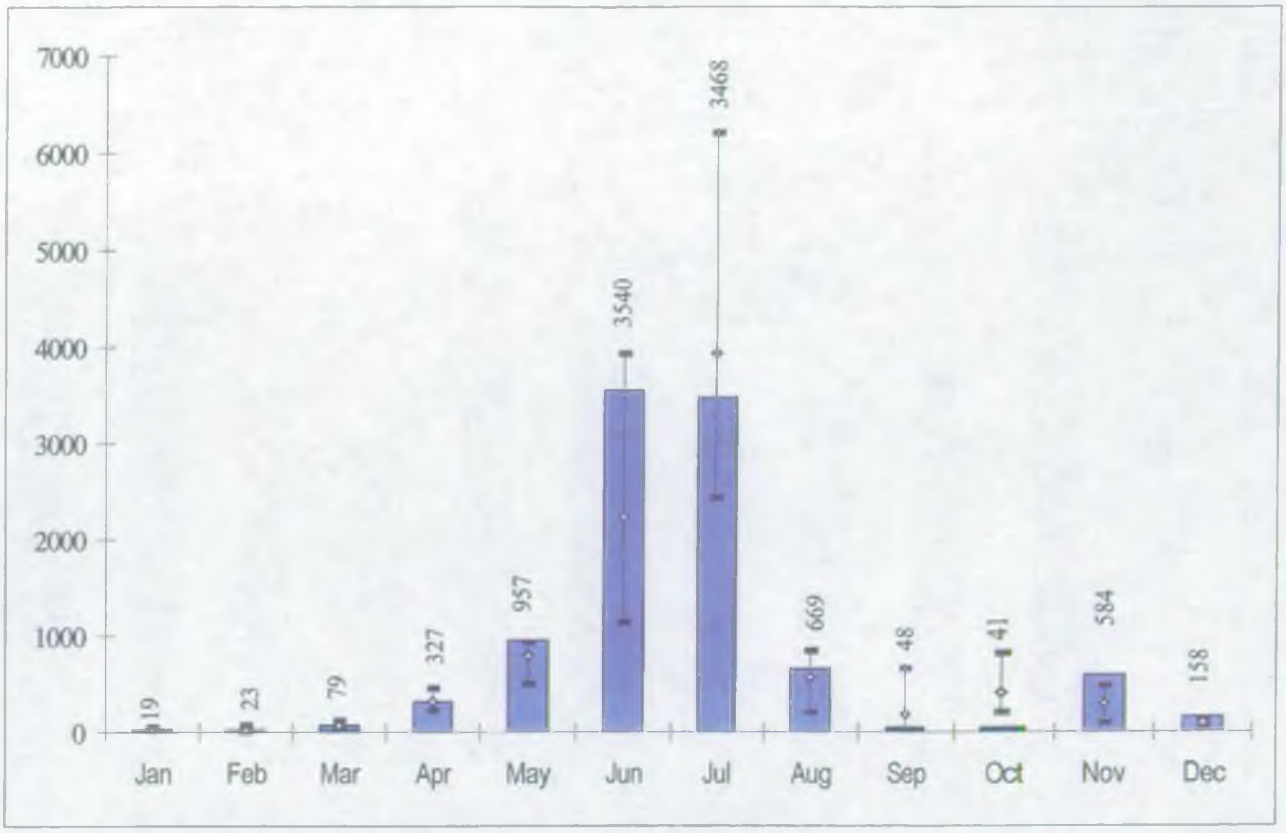


Figure 16 - Sea age class length by month for sea trout, 2003

5.2 Run Size

5.2.1 Fish Counter

The annual total upstream fish counter figure for sea trout of 9913 in 2003 (unadjusted for fish pass efficiency) was higher than the 1994-2002 average of 8770. Figure 17 shows the monthly upstream counts for sea trout at Gunnislake Weir from the fish counter figures during 2003 (unadjusted for fish pass efficiency), compared to the 1994-2002 average. There was an above average run during June and a good run during July. Other months were comparable to the 1994-2002 average, except November during which the run was a record high.



** Data labels and coloured bars indicate 2003 figures. High low bars indicate max, min and average from 1994 – 2002. Numbers are unadjusted for fish pass efficiency.*

Figure 17 Monthly upstream counts for sea trout at Gunnislake weir 1994 – 2003

5.2.2 Tagging

894 sea trout were tagged with a visible implant (VI) tag during 2003. Table 8 (Appendix 3) shows the relative number of sea trout sea age classes tagged.

5.2.3 Recaptures and straying

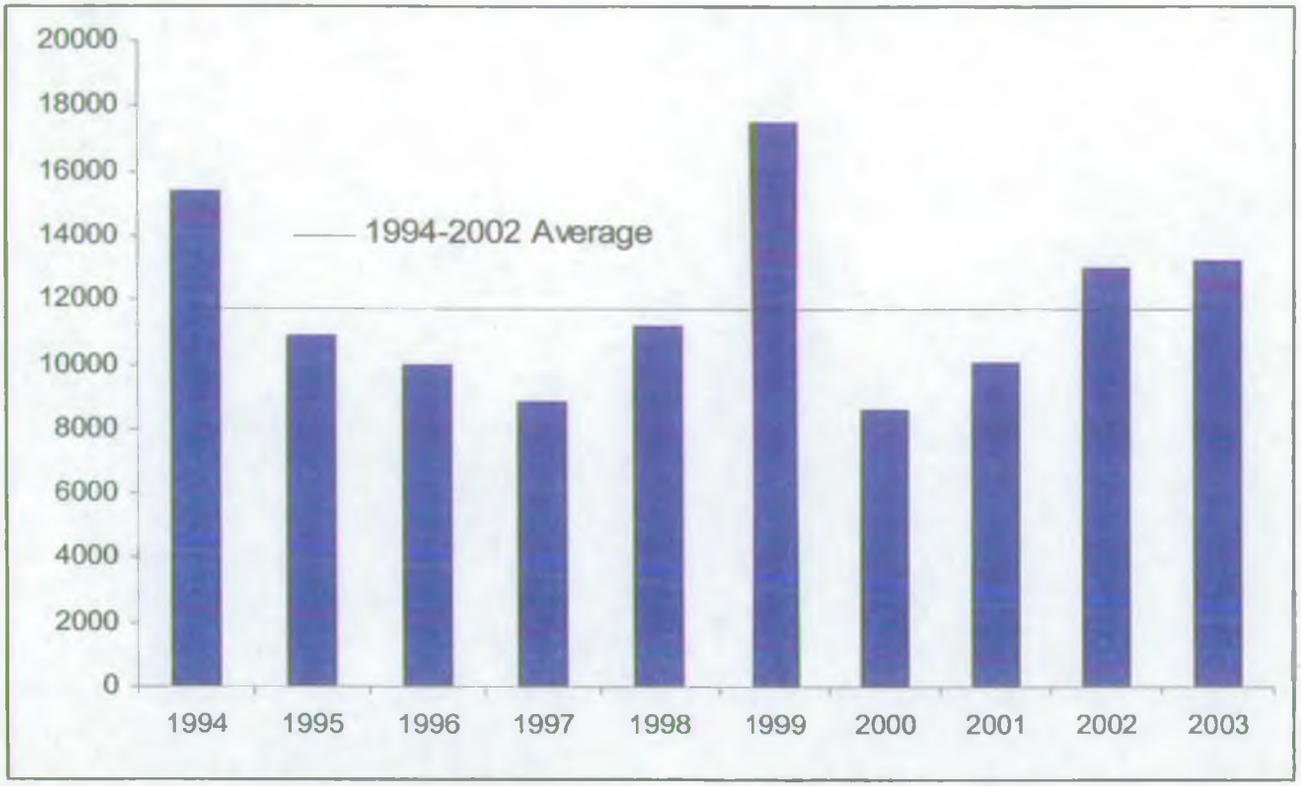
Twelve fish were subsequently recaptured at Gunnislake during 2003. Because this was the first year of VI tagging, marine survival estimates could not be calculated.

5.2.4 Run estimates

Run estimates (i.e. independent of Gunnislake Fish Counter estimates) were not attempted from sea trout VI captures. Tags were used as a method of estimating marine survival rates, rather than as a method for estimating the run.

5.3 Year Class Strength

The 2003 run estimate for sea trout of 13217 (Fish counter figure = 9913), was 13.0% higher than the 1994-2002 average (11693, fish counter figure = 8770) (Figure 18). Total run estimates for sea trout should be treated with caution as fish pass efficiency at Gunnislake Weir has only been studied for salmon.



Counter figures adjusted for fish pass efficiency

Figure 18 Sea trout run estimate from Gunnislake Fish Counter, 1994-2003

5.4 Fishery performance

5.4.1 Net fishery

5.4.1.1 Catch and catch effort

44 sea trout were caught in 2003 (Table 18, Appendix 5). The overall catch per tide was 0.09 fish (Table 19, Appendix 5).

5.4.1.2 Exploitation rate

Exploitation rates for sea trout are shown in Table 20 (Appendix 5) and are based on a pre-net fishery estimate of run size, which combines the annual run at Gunnislake Weir with the declared net catch. A large proportion of the Tamar sea trout run is 'school peal', especially during the netting season (June and July). Very few of these fish are captured by the nets because of their small size. This helps explain the relatively low exploitation rate of sea trout by the nets (0.3% in 2003).

5.4.2 Rod fishery

5.4.2.1 Catch- licence return

A declared sea trout catch of 515 fish in 2003 was consistent with the past 10 years catch (Table 20, Appendix 5). However, it must be noted that rod fishing effort has reduced significantly in recent years.

5.4.2.2 Catch effort- logbook return

The number of sea trout caught per 100 hours fished by the log book anglers was 19.6 (0.20 per hour). Sea trout catch by month and by river section are shown in Tables 21 and 22 (Appendix 5). Care should be taken when interpreting the results of the logbook scheme (See Section 4.4.2.2).

5.4.2.3 Exploitation rate

The overall exploitation of sea trout in the rod fishery was 2.3% in 2003 (Table 20, Appendix 5). This relatively low exploitation of sea trout is consistent with the past 10 years, although fishing effort has declined in recent years.

5.5 Biological Observations

40.6% of sea trout were undamaged, but a significant percentage exhibited scale loss or lice damage (Figure 19). A percentage of fish had either unspecified wounds or predator damage (27%). The prevalence of net marks and disease among sea trout was very low.

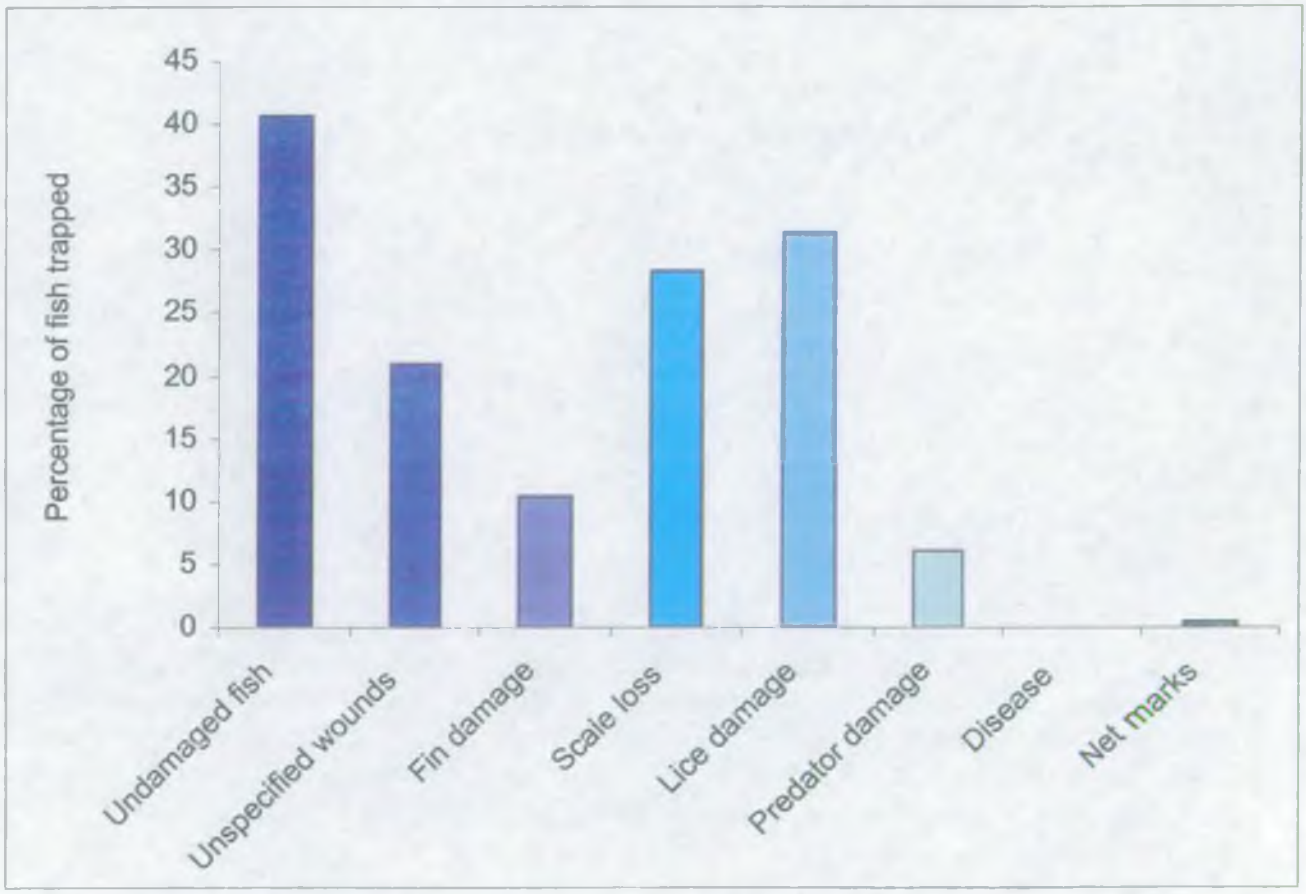


Figure 19 Observations on wounds and damage from sea trout, 2003

Figure 20 shows that although the proportion of sea trout with more than 10 sea lice was low (3.7%), the total number with sea lice was high (66%).

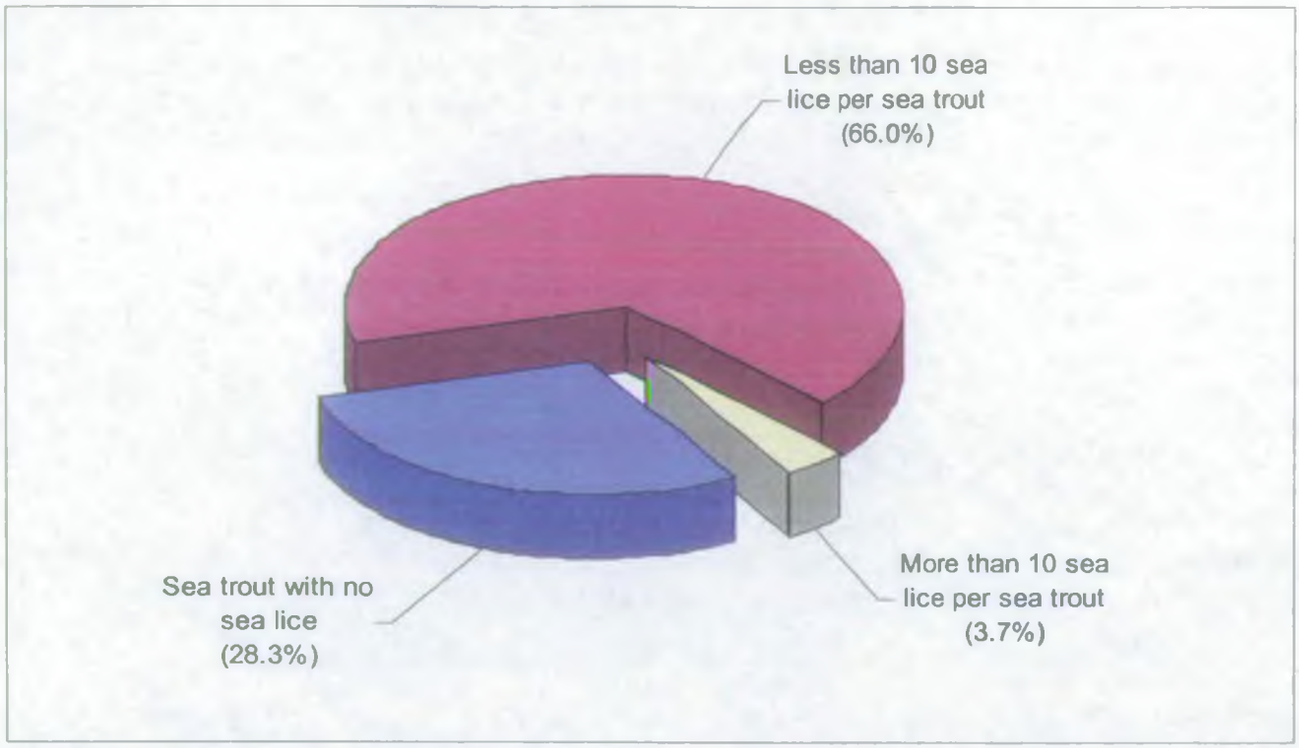


Figure 20 Prevalence of lice damage to sea trout, 2003

6 Environmental Data

6.1 Flow

Figures 22 & 23 (Appendix 6) 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.

6.2 Water temperature

Figures 24 and 25 (Appendix 6) 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.

6.3 Chlorophyll

Figure 26 (Appendix 6) shows the chlorophyll levels at Gunnislake Weir from mid-August at the time the probe was installed, until the end of 2003. Due to the absence of data from the beginning of the year, the relationship between fish migration and chlorophyll levels was not investigated. Chlorophyll ranged from 0 to 21.2 µg/l from mid-August until the end of the year.

6.4 Dissolved oxygen

Figure 27 (Appendix 6) shows the dissolved oxygen (DO) levels at Gunnislake Weir from mid-August at the time the probe was installed, until the end of 2003. Due to the absence of data from the beginning of the year, the relationship between fish migration and DO levels was not investigated. Dissolved oxygen ranged from 77.5% to 126.2%.

6.5 pH

Figure 27 (Appendix 6) shows the pH at Gunnislake Weir from mid-August at the time the probe was installed, until the end of 2003. Due to the absence of data from the beginning of the year, the relationship between fish migration and pH was not investigated. From mid-August until the end of the year, pH remained fairly neutral ranging from 6.93 to 8.84.

7 Acknowledgements

Paul Elsmere, Adam Fraser, Alan Cole, Emily Duckworth and John Cossens (EAT team) contributed to the trapping, scale reading, data handling and writing of this report. Robert Hurrell (FRB team) assisted with the section on spawning escapement and egg deposition.

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9 Appendices

9.1 Appendix 1 Fish Counter Data

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	

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	

9.2 Appendix 2 Salmon Trap Data

Table 3 - Salmon catch rate (Catch per hour) at Gunnislake Trap, 2003

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
HRS TRAPPED	-	-	12.00	231.6	227.3	186.8	-	131.5	268.0	218.0	131.5	227.7	**1634.0**
CATCH	-	-	0	12	41	45	-	90	77	38	61	10	**374**
CPHR	-	-	0.00	0.05	0.18	0.24	-	0.69	0.29	0.17	0.46	0.04	**0.24**

CPHR = Catch per hour

Table 4 - Salmon sea age composition and run estimates; Gunnislake Trap, 2003

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
TOTAL CATCH	-	-	0	12	41	45	-	90	77	38	61	10	**374**
AGED [i] (%)	-	-	0 (0.0)	12 (100.0)	41 (100.0)	45 (100.0)	-	26 (28.9)	22 (28.6)	10 (26.3)	21 (34.4)	3 (30.0)	**180**
NOT AGED[ii]	-	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-	64 (71.1)	55 (71.4)	28 (73.7)	40 (65.6)	7 (70.0)	**194**
SEA AGE[iii] (%)													
1SW (%)	-	-	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.2)	-	25 (96.2)	20 (90.9)	10 (100.0)	18 (85.7)	2 (66.7)	**76 (42.2)**
>=2SW (%)	-	-	0 (0.0)	12 (100.0)	41 (100.0)	44 (97.8)	-	1 (3.8)	2 (9.1)	0 (0.0)	3 (14.3)	1 (33.3)	**104 (57.8)**
FISH COUNTER	14	9	7	103	268	782	733	601	267	238	515	89	**3626**
RUN ESTIMATE[iv]													
1SW ESTIMATE[v]	0	0	0	0	0	17[vi]	-	578[vi]	243	238	429	59	-
>=2SW ESTIMATE[v]	14	9	7	103	268	765[vi]	-	23[vi]	24	0	86	29	-

i = Aged from scales or length and time of year trapped
ii = Fish were not aged
iii = Percentages given for 1SW and >=2SW fish are of the aged sub-sample (i.e. exclude fish not aged)
iv = Unadjusted for fish pass efficiency
v = Run estimates based on proportions of sea age classes caught and aged from the trap. Total 1SW & >=2SW estimates not possible due to incomplete data set.
vi = Estimates not considered accurate due to small sample sizes, absence of trap data from mid-June to mid-August.
SW = Sea Winter

Table 5 - Salmon weight composition; Gunnislake Trap, 2003

SEA AGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
1SW n	-	-	0	0	0	1	-	25	20	8	14	1	**69**
MEAN Wt (Kg)	-	-	-	-	-	2.65	-	2.79	2.75	3.23	2.83	2.50	**2.83**
2 SW n	-	-	0	9	28	38	-	1	2	1	1	1	**81**
MEAN Wt (Kg)	-	-	-	4.43	4.68	5.06	-	5.00	6.80	5.00	6.10	4.30	**4.90**
UNK n	-	-	0	2	13	6	-	0	0	1	4	0	**26**
MEAN Wt (Kg)	-	-	-	4.40	5.23	5.00	-	-	-	2.80	3.24	-	**4.35**
ALL n	-	-	0	11	41	45	-	26	22	10	19	2	**176**
MEAN Wt (Kg)	-	-	-	4.43	4.85	5.00	-	2.88	3.12	3.36	3.09	3.40	**4.06**

SW = Sea Winter
UNK = Unknown

Table 6 - Salmon length (mm) by sea age class (2003)

MONTH	n	1SW			2SW		
		Mean	Min	Max	Mean	Min	Max
JAN	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-
MAR	0	-	-	-	-	-	-
APR	11	-	-	-	726	660	758
MAY	41	-	-	-	757	632	848
JUN	45	624	624	624	760	698	849
JUL	0	-	-	-	-	-	-
AUG	26	622	506	771	801	801	801
SEP	22	648	594	792	857	834	880
OCT	10	704	592	827	-	-	-
NOV	21	659	585	764	806	780	843
DEC	2	615	615	615	786	786	786

SW = Sea Winter

9.3 Appendix 3 Sea Trout Trap Data

Table 7 - Sea Trout catch rate (Catch per hour) at Gunnislake Trap, 2003

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
HRS TRAPPED	-	-	12.00	231.6	227.3	186.8	-	131.5	268.0	218.0	131.5	227.7	**1634.0**
CATCH	-	-	4	70	187	581	-	42	3	8	43	18	**956**
CPHR	-	-	0.33	0.30	0.82	3.11	-	0.32	0.01	0.04	0.29	0.08	**0.59**

CPHR = Catch per hour

Table 8 - Sea trout sea age composition, numbers aged and tagged at Gunnislake Trap during 2003

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
TOTAL CATCH	-	-	4	70	187	581	-	42	3	8	43	18	956
TOTAL TAGGED (%)[w]	-	-	4 (100.0)	64 (91.4)	187 (100.0)	566 (97.4)	-	17 (40.5)	3 (100.0)	8 (100.0)	32 (74.4)	13 (72.2)	894 (93.6)
SCALE SAMPLE (%)	-	-	3 (75.0)	59 (84.3)	154 (82.4)	399 (68.7)	-	10 (23.8)	2 (66.7)	2 (25.0)	17 (39.5)	9 (50.0)	655 (68.5)
UNREADABLE (%)[i]	-	-	0 (0.0)	2 (2.9)	12 (6.4)	23 (4.0)	-	1 (2.4)	0 (0.0)	0 (0.0)	1 (2.3)	0 (0.0)	39 (4.1)
READABLE (%)[i]	-	-	3 (75.0)	57 (81.4)	152 (81.3)	376 (64.7)	-	9 (21.4)	2 (66.7)	2 (25.0)	16 (37.2)	9 (50.0)	626 (65.5)
NOT AGED (%)[i]	-	-	1 (25.0)	11 (15.7)	23 (12.3)	182 (31.3)	-	32 (76.2)	1 (33.3)	6 (75.0)	26 (60.5)	9 (50.0)	289 (30.2)
SEA AGE (%)	-	-					-						
0SW (%)	-	-	0 (0.0)	0 (0.0)	1 (0.7)	81 (21.5)	-	9 (100.0)	2 (100.0)	2 (100.0)	7 (43.8)	4 (44.4)	103 (16.5)
TAGGED (%)[v]	-	-	0 (0.0)	0 (0.0)	1 (0.7)	80 (14.1)	-	9 (52.9)	2 (66.6)	2 (25.0)	7 (21.9)	3 (23.1)	103 (11.5)
1SW (%)	-	-	0 (0.0)	0 (0.0)	3 (2.0)	1 (0.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.3)	0 (0.0)	5 (0.6)
TAGGED (%)[v]	-	-	0 (0.0)	0 (0.0)	3 (2.0)	1 (0.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	1 (3.1)	0 (0.0)	5 (0.6)
TOTAL PS (%)	-	-	3 (100.0)	57 (100.0)	148 (97.4)	295 (78.5)	-	0 (0.0)	0 (0.0)	0 (0.0)	8 (50.0)	5 (55.6)	516 (82.4)
TAGGED (%)[v]	-	-	3 (75.0)	52 (80.0)	148 (97.4)	293 (51.8)	-	0 (0.0)	0 (0.0)	0 (0.0)	8 (25.0)	4 (30.8)	508 (56.8)
PS AGE CLASS BREAKDOWN[=]													
0+SM+ (%)	-	-	2 (66.7)	20 (35.1)	90 (59.2)	252 (67.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	6 (37.5)	4 (44.4)	374 (59.9)
TAGGED (%)[v]	-	-	2 (50.0)	18 (27.7)	90 (59.2)	250 (44.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	6 (18.8)	3 (23.1)	370 (41.3)
0+2SM+ (%)	-	-	0 (0.0)	20 (35.1)	38 (25.0)	38 (10.1)	-	0 (0.0)	0 (0.0)	0 (0.0)	2 (12.5)	1 (11.1)	97 (15.5)
TAGGED (%)[v]	-	-	0 (0.0)	19 (29.2)	38 (25.0)	38 (6.7)	-	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.3)	1 (7.7)	98 (10.9)
1+SM+ (%)	-	-	0 (0.0)	0 (0.0)	2 (1.3)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.3)
TAGGED (%)[v]	-	-	0 (0.0)	0 (0.0)	2 (1.3)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.2)
0+3SM+ (%)	-	-	0 (0.0)	6 (10.5)	10 (6.6)	1 (0.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	17 (2.7)
TAGGED (%)[v]	-	-	0 (0.0)	5 (7.7)	10 (6.6)	1 (0.2)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (1.8)
1+2SM+ (%)	-	-	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)
TAGGED (%)[v]	-	-	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
0+4SM+ (%)	-	-	1 (33.3)	9 (15.8)	6 (3.9)	1 (0.3)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	17 (2.7)
TAGGED (%)[v]	-	-	1 (25.0)	9 (13.8)	6 (3.9)	1 (0.2)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	17 (1.9)
0+5SM+ (%)	-	-	0 (0.0)	2 (3.5)	0 (0.0)	2 (0.5)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.6)
TAGGED (%)[v]	-	-	0 (0.0)	1 (1.5)	0 (0.0)	2 (0.4)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.3)
0+6SM+ (%)	-	-	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.2)
TAGGED (%)[v]	-	-	0 (0.0)	0 (0.0)	1 (0.7)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
UNKNOWN	-												
TAGGED (%)[v]	-	-	1 (25.0)	12 (18.8)	35 (18.7)	192 (34.1)	-	8 (47.1)	1 (33.3)	6 (75.0)	16 (50.0)	6 (46.2)	278 (31.1)

i = Unreadable and readable scales, and fish not aged are presented as a proportion of the total catch
ii = Sea age classes presented as percentages of aged fish with readable scales per month
iii = PS age class breakdown presented as percentages of all aged fish (maiden fish and previous spawners) with readable scales per month
iv = Total tagged fish presented as a percentage of the total catch per month
v = Tagged fish within each age class presented as a percentage of the total number of tagged fish per month

Table 9 - Sea Trout weight composition; Gunnislake Trap, 2003

SEA AGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
0 SW													
0+ n	-	-	0	0	1	81	-	9	2	2	7	4	**106**
MEAN Wt (Kg)	-	-	-	-	0.40	0.34	-	0.24	0.22	0.27	0.36	0.40	**0.33**
1SW													
0+SM+ n	-	-	2	20	90	252	-	0	0	0	6	4	**374**
MEAN Wt (Kg)	-	-	0.90	0.88	0.73	0.59	-	-	-	-	0.86	0.68	**0.65**
1+ n	-	-	0	0	3	1	-	0	0	0	1	0	**5**
MEAN Wt (Kg)	-	-	-	-	1.00	1.92	-	-	-	-	0.86	-	**1.16**
2SW													
0+2SM+ n	-	-	0	20	38	38	-	0	0	0	2	1	**99**
MEAN Wt (Kg)	-	-	-	1.34	1.35	1.09	-	-	-	-	1.60	0.92	**1.25**
1+SM+ n	-	-	0	0	2	0	-	0	0	0	0	0	
MEAN Wt (Kg)	-	-	-	-	1.41	-	-	-	-	-	-	-	
3SW													
0+3SM+ n	-	-	0	6	10	1	-	0	0	0	0	0	**17**
MEAN Wt (Kg)	-	-	-	1.65	2.16	1.90	-	-	-	-	-	-	**1.97**
1+2SM+ n	-	-	0	0	1	0	-	0	0	0	0	0	**1**
MEAN Wt (Kg)	-	-	-	-	1.55	-	-	-	-	-	-	-	**1.55**
4 SW													
0+4SM+ n	-	-	1	9	6	1	-	0	0	0	0	0	**17**
MEAN Wt (Kg)	-	-	1.80	2.03	2.90	1.56	-	-	-	-	-	-	**2.29**
5SW													
0+5SM+ n	-	-	0	2	0	2	-	0	0	0	0	0	**4**
MEAN Wt (Kg)	-	-	-	5.03	-	2.56	-	-	-	-	-	-	**3.79**
6SW													
0+6SM+ n	-	-	0	0	1	0	-	0	0	0	0	0	**1**
MEAN Wt (Kg)	-	-	-	-	3.60	-	-	-	-	-	-	-	**3.60**
PS n	-	-	3	57	148	294	-	0	0	0	8	5	**515**
MEAN Wt (Kg)	-	-	1.20	1.45	1.11	0.68	-	-	-	-	1.05	0.73	**0.90**
UNK n	-	-	1	12	35	199	-	8	1	6	17	7	**286**
MEAN Wt (Kg)	-	-	0.90	1.22	1.43	0.46	-	0.22	0.90	0.26	0.75	0.23	**0.61**
ALL n	-	-	4	69	187	575	-	17	3	8	33	16	**912**
MEAN Wt (Kg)	-	-	1.13	1.41	1.16	0.56	-	0.23	0.21	0.26	0.74	0.43	**0.74**

SW = Sea Winter; PS = Previous Spawner; UNK = Unknown

Table 10 - Sea trout length (mm) by sea age class (2003)

MONTH	n	0SW			PS		
		MEAN	MIN	MAX	MEAN	MIN	MAX
JAN	-	-	-	-	-	-	-
FEB	-	-	-	-	-	-	-
MAR	3	-	-	-	471	409	548
APR	59	-	-	-	487	343	763
MAY	163	347	347	347	460	326	690
JUN	399	320	236	378	405	277	666
JUL	0	-	-	-	-	-	-
AUG	10	304	280	323	321	321	321
SEP	2	292	278	305	-	-	-
OCT	2	310	292	327	-	-	-
NOV	17	321	291	340	461	400	578
DEC	9	345	319	364	420	381	472

PS= Previous Spawner

9.4 Appendix 4 Rod and Net Fishery; Salmon

Table 11 - Annual salmon catch from net and rod fisheries, 1993-2002

FISHERY	YEAR											10 Year Mean (1993-2002)
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	**2003**	
NET	1544	1990	971	716	339	58	251	285	176	137	**219**	607.8
ROD	428	820	433	304	171	404	241	250	114	143	**114**	311.1
COMBINED	1972	2810	1404	1020	510	462	492	535	290	280	**333**	918.9

Table 12 - Monthly salmon net catch and catch-effort, 2003

	YEAR													
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003			
											JUN	JUL	AUG	ALL
CATCH	1544	1990	971	716	339	58	251	285	176	137	36	129	54	**219**
TIDES FISHED	NA	NA	NA	1417	1077	238	682	662	610	589	190	254	55	**499**
CATCH PER TIDE	-	-	-	0.51	0.31	0.24	0.37	0.43	0.29	0.23	0.19	0.51	0.98	**0.44**

Note; Prior to 2001 effort was reported as number of days fished. For the purpose of estimating effort prior to 2001 a figure of 1.4 tides per day has been assumed.
NA= Data not available

Table 13 - Salmon weight composition (lbs) of net fishery, 2003

WEIGHT CATEGORY	MONTH			
	JUN	JUL	AUG	ALL
0-8 lbs	6	67	39	112
>8 lbs	30	62	15	107
TOTAL WEIGHT	357	1017	375	1749
MEAN WEIGHT	9.92	7.88	6.94	7.99

Table 14 - Salmon net and rod exploitation rates on the River Tamar, 1994-2001

YEAR	DECLARED NET CATCH	RUN POST-NETS[2]	RUN PRE-NETS	NET[1] EXPLOITATION %	DECLARED ROD CATCH	RELEASED FISH	FISH KILLED	ROD EXPLOITATION %	TOTAL EXPLOITATION %
1994	1990	6359	8349	23.8	820	87	733	8.8	32.6
1995	971	5637	6608	14.7	433	53	380	5.8	20.4
1996	716	3988	4704	15.2	304	44	260	5.5	20.7
1997	339	2989	3328	10.2	171	43	128	3.8	14.0
1998	58	4176	4234	1.4	404	166	238	5.6	7.0
1999	251	3588	3839	6.5	241	125	116	3.0	9.6
2000	285	3539	3824	7.5	250	109	141	3.7	11.1
2001	176	4184	4360	4.0	114	36	78	1.8	5.8
2002	137	6053	6190	2.2	143	54	89	1.4	3.7
2003	219	4835	5054	4.3	114	46	68	1.3	5.7

1. Netting in the Tamar estuary catches fish from other stocks such as the River Tavy, Plym and Lynher
2. Run estimate from Fish Counter, adjusted for fish pass efficiency

Table 15 - Anglers logbook returns, 2003

YEAR	2003
ANGLERS ASKED TO PARTICIPATE	73
LOG BOOKS DISTRIBUTED	35
COMPLETE RETURNS	18
(%)	51.4
INCOMPLETE RETURNS	5
(%)	14.3
DID NOT FISH	1
(%)	2.9
TOTAL RETURNS RECEIVED	24
(%)	68.6
TOTAL SALMON CATCH	41
(% DECLARED CATCH)	36
TOTAL SEA TROUT CATCH	147
(% DECLARED CATCH)	28.5

Table 16 - Salmon catch per 100 hours, by month from anglers logbook returns, 2003

	MONTH								
	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
NO. OF ANGLERS PER MONTH	2	1	9	14	14	11	11	13	18
HOURS FISHED PER MONTH	20.5	22	99	202.75	196	134.75	119.75	95.5	890.25
SALMON CAUGHT PER MONTH	0	1	10	7	9	4	6	4	41
SALMON CAUGHT PER 100 HOURS FISHED	0.0	4.5	10.1	3.5	4.6	3.0	5.0	4.2	4.6

Table 17 - Distribution, number and catch rate of salmon (SL) by rods during 2003 season

SECTION NUMBER	SECTION	NO. OF ANGLERS PER SECTION	HRS FISHED PER SECTION	SL CAUGHT PER SECTION	SL CAUGHT PER 100 HRS FISHED
1	D/s of Gunnislake Weir	4	99	4	4.0
2	U/s of Gunnislake Weir to Horsebridge	7	241.3	15	6.2
3	U/s of Horsebridge to River Inny confluence	4	31.5	1	3.2
4	U/s of River Inny confluence to River Lyd Foot	8	349.5	18	5.2
5	U/s of Lyd Foot to River Ottery confluence	4	87.5	2	2.3
6	U/s of the River Ottery confluence	2	44	0	0.0
7	River Inny (including Penpont River)	2	35	1	2.9
8	River Lyd (including Rivers Lew, Thrushel and Wolf)	1	2	0	0.0
9	River Ottery	0	0	0	0.0
-	**TOTAL**	**18**	**889.75**	**41**	**4.6**

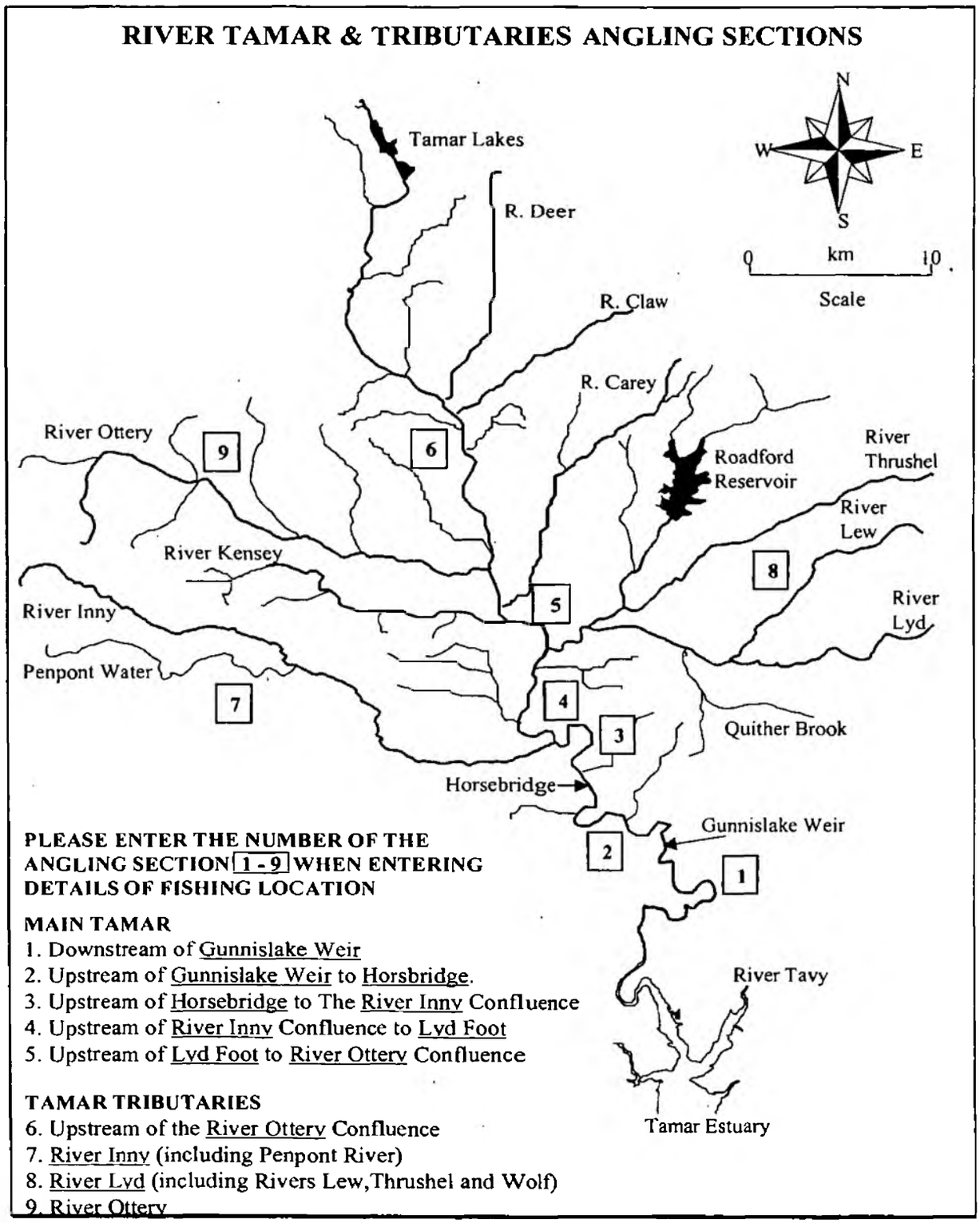

Figure 21 - River Tamar and Tributaries Angling Sections for Logbook Scheme

9.5 Appendix 5 Rod and Net Fishery; Sea Trout

Table 18 - Annual sea trout catch from net and rod fisheries, 1993-2002

FISHERY	YEAR											10 year mean (1993-02)
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
NETS	237	170	127	162	38	36	92	45	66	55	44	97.5
RODS	281	500	617	428	344	475	772	423	289	524	515	469.8
COMBINED	518	670	744	590	382	511	864	468	355	579	559	567.3

Table 19 - Monthly sea trout net catch and catch-effort, 2003

	YEAR													
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003			
											Jun	Jul	Aug	All
CATCH	237	170	127	162	38	36	92	45	66	55	30	6	8	44
TIDES FISHED	NA	NA	NA	1417	1077	238	682	662	610	589	190	254	55	**499**
CATCH PER TIDE	-	-	-	0.11	0.04	0.15	0.13	0.07	0.11	0.09	0.16	0.02	0.15	**0.09**

NA= Data not available

Table 20 - Sea trout net exploitation rates from the River Tamar, 1994-2001

YEAR	DECLARED NET CATCH	RUN POST-NETS[1]	RUN PRE-NETS	NET EXPLOITATION %	DECLARED ROD CATCH	RELEASED FISH	FISH KILLED	ROD EXPLOITATION %	TOTAL EXPLOITATION %
1994	170	15336	15506	1.1	500	115	385	2.5	3.6
1995	127	10869	10996	1.2	617	201	416	3.8	4.9
1996	162	9936	10098	1.6	428	100	328	3.2	4.9
1997	38	8843	8881	0.4	344	81	263	3.0	3.4
1998	36	11167	11203	0.3	475	238	237	2.1	2.4
1999	92	17527	17619	0.5	772	297	475	2.7	3.2
2000	45	8556	8601	0.5	423	149	274	3.2	3.7
2001	66	10004	10070	0.7	289	147	142	1.4	2.1
2002	55	13001	13056	0.4	524	237	287	2.2	2.6
2003	44	13217	13261	0.3	515	206	309	2.3	2.7

[1] = Sea trout run estimates are based upon a fish counter figure adjusted for fish pass efficiency, using data from a radio-tagging study on salmon

Table 21 - Sea trout catch per 100 hours by month, from anglers logbook returns, 2003

MONTH	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
NO. OF ANGLERS PER MONTH	2	5	8	14	16	15	8	6
HOURS FISHED PER MONTH	20.5	34.5	100.5	186.75	204	117.5	62.5	23.5
SEA TROUT CAUGHT PER MONTH	0	3	8	25	47	43	10	11
SEA TROUT CAUGHT PER 100 HOURS FISHED	0.0	8.7	8.0	13.4	23.0	36.6	16.0	46.8

Table 22 - Distribution, number and catch rate of sea trout (ST) by rods during 2003 season

SECTION NUMBER	SECTION	NO. OF ANGLERS PER SECTION	HRS FISHED PER SECTION	ST CAUGHT PER SECTION	ST CAUGHT PER 100 HRS FISHED
1	D/s of Gunnislake Weir	1	68	12	17.6
2	U/s of Gunnislake Weir to Horsebridge	5	118.8	48	40.4
3	U/s of Horsebridge to River Inny confluence	0	0	0	0.0
4	U/s of River Inny confluence to River Lyd Foot	5	268.5	25	9.3
5	U/s of Lyd Foot to River Ottery confluence	4	118	19	16.1
6	U/s of the River Ottery confluence	3	50	3	6.0
7	River Inny (including Penpont River)	5	82	11	13.4
8	River Lyd (including Rivers Lew, Thrushel and Wolf)	2	44.5	29	65.2
9	River Ottery	0	0	0	0.0
-	**TOTAL**	**18**	**749.8**	**147**	**19.6**

9.6 Appendix 6 Environmental Data

9.6.1 Flow

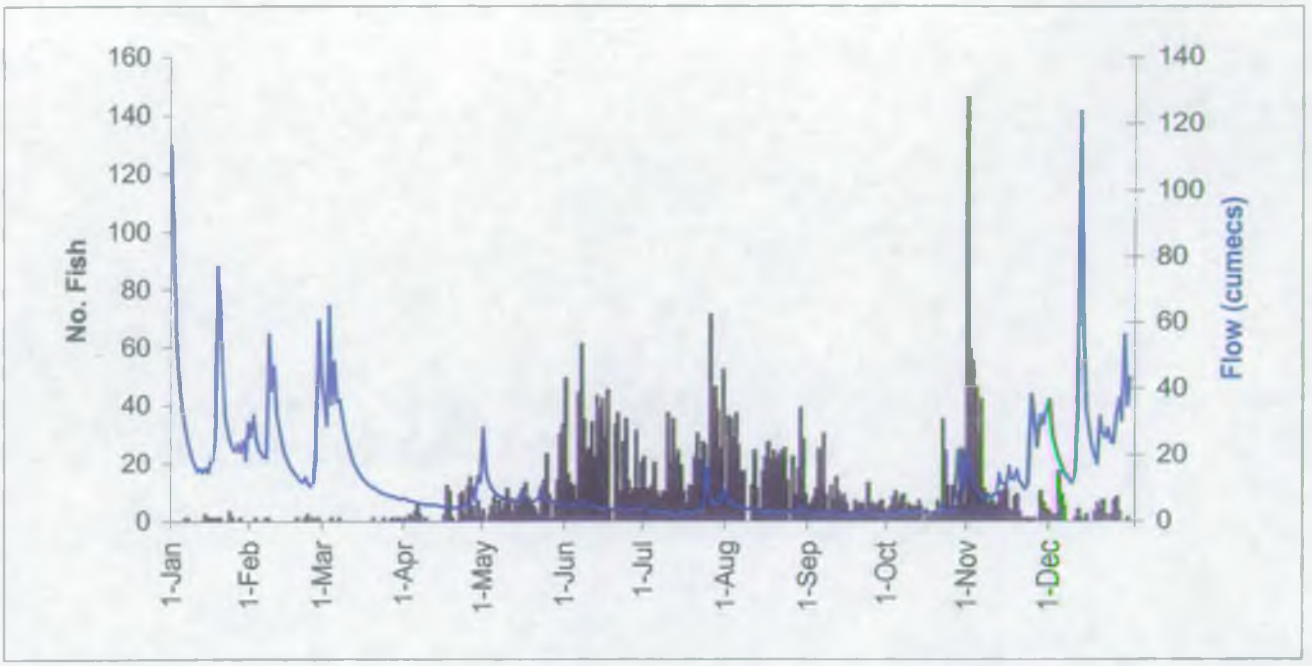

Figure 22 - Daily upstream counts of salmon in relation to flow (cumecs) at Gunnislake weir 2003

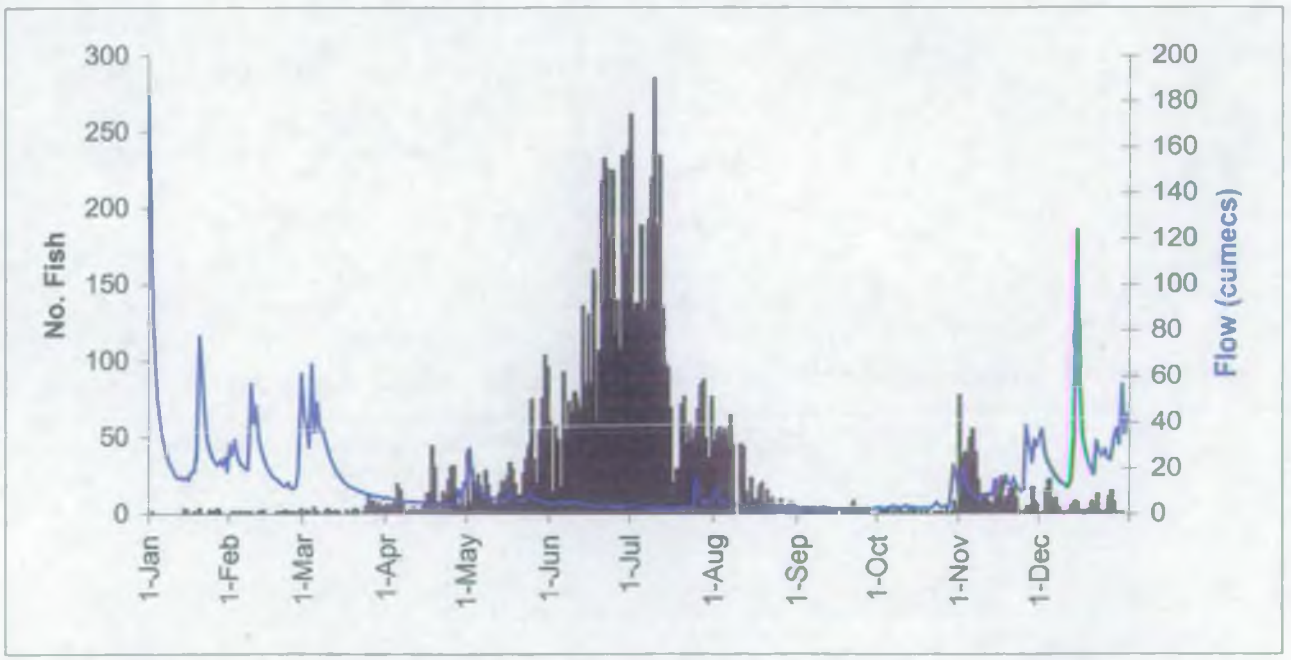

Figure 23 - Daily upstream counts of sea trout in relation to flow (cumecs) at Gunnislake weir 2003

9.6.2 Water temperature

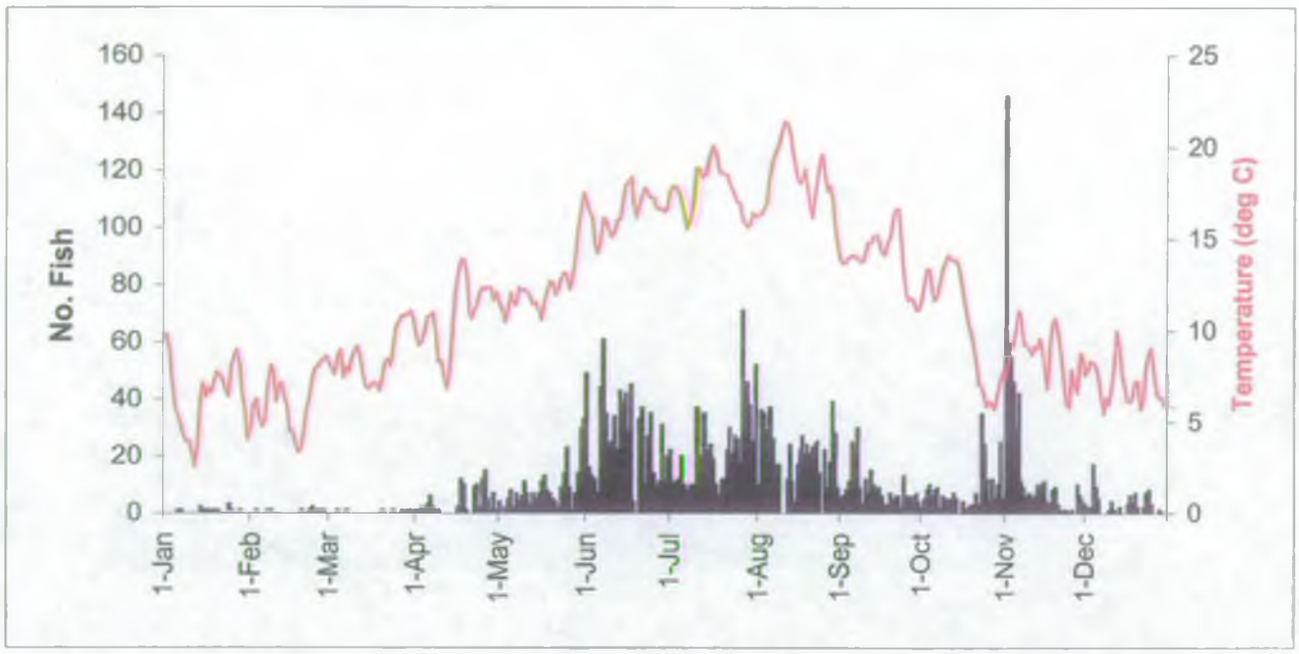

Figure 24 - Daily upstream counts of salmon in relation to temperature (°C) at Gunnislake weir 2003

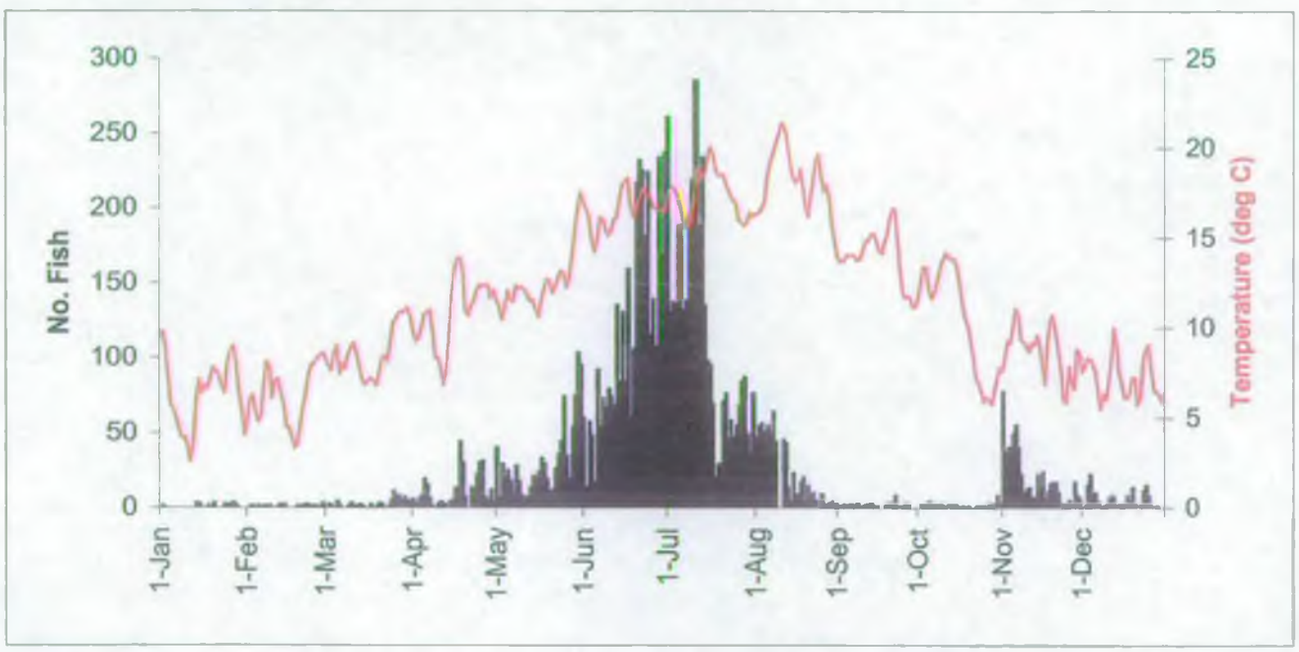

Figure 25 - Daily upstream counts of sea trout in relation to temperature (°C) at Gunnislake weir 2003

9.6.3 Chlorophyll

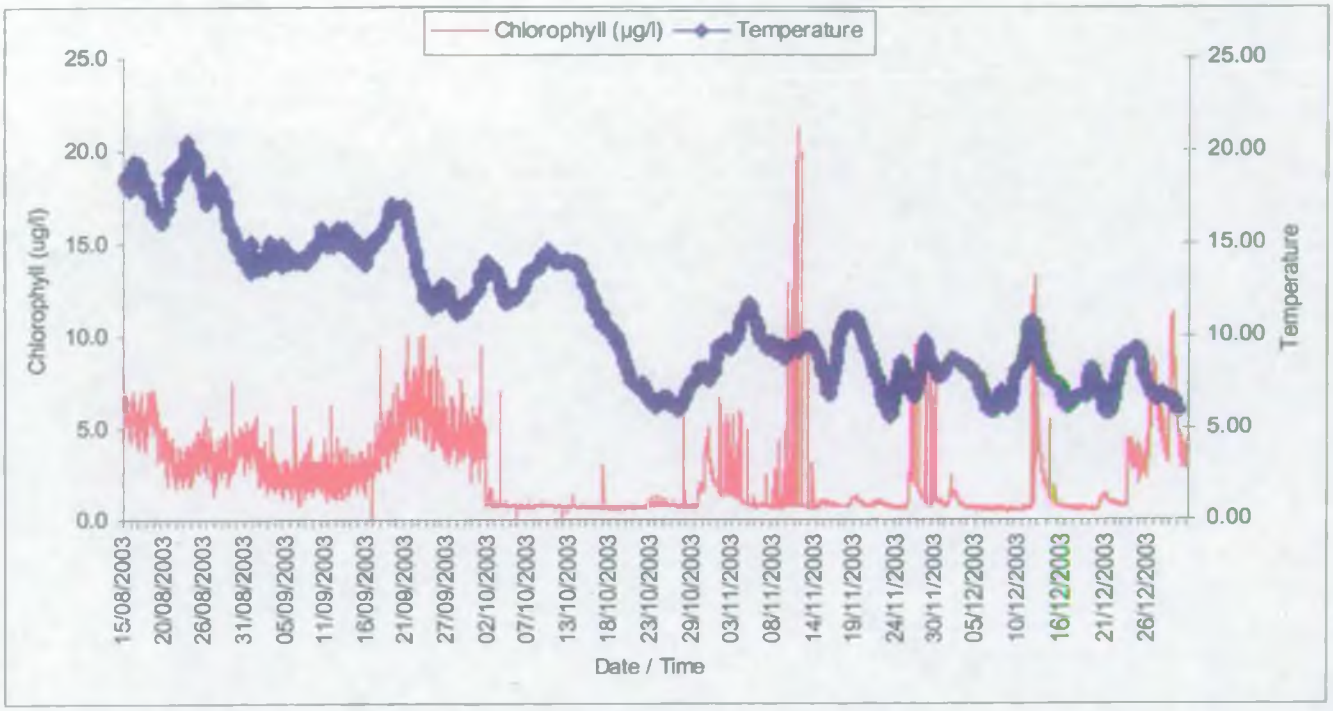

Figure 26 - Chlorophyll level and temperature at Gunnislake Weir from mid-August to the end of the year, 2003

9.6.4 pH and Dissolved Oxygen

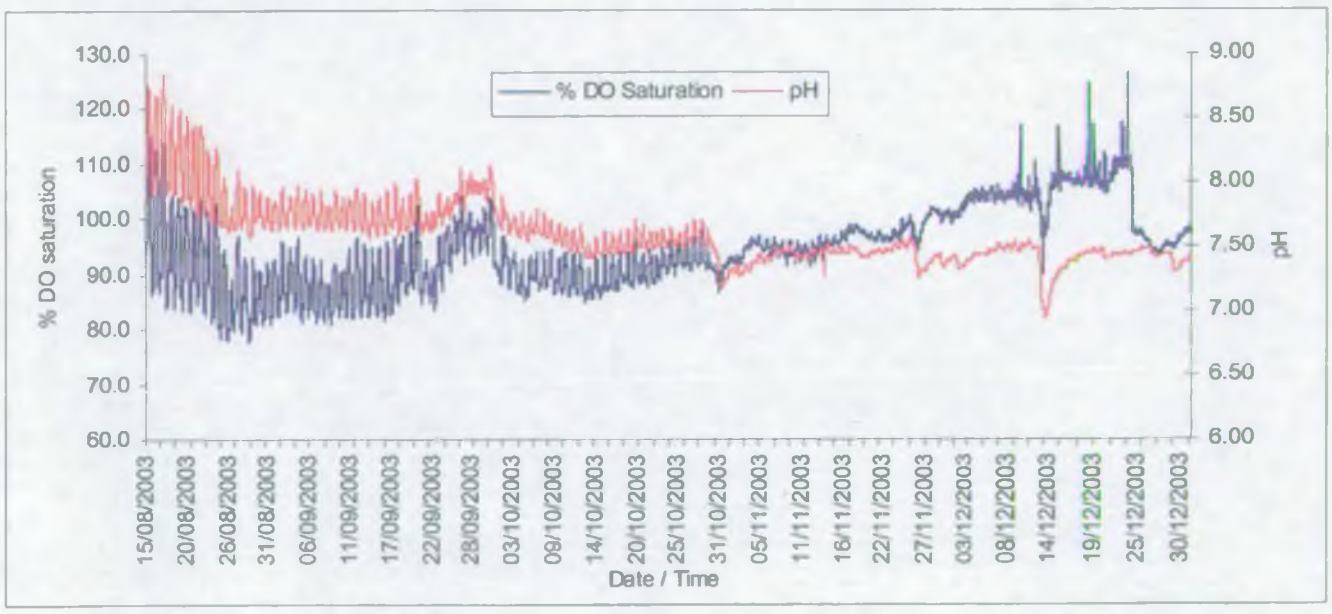

Figure 27 - Dissolved oxygen (DO) and pH at Gunnislake Weir from mid-August to the end of the year, 2003