Rotary Screw Trap Data from the River Truim

2012

Processing the catch on a lovely May morning at the Truim RST

Prepared for

Dr Alastair Stephen
Scottish and Southern Energy
Cluny HQ
Pitlochry

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CONTENTS

Rotary Screw Trap Data from the River Tromie 2012

Brian Shaw
Spey Foundation, 1 Nether Borlum Cottage, Knockando, Morayshire AB38 7SD.
Tel 01340810841, Fax 01340 810842, email research@speyfisheryboard.com

Prepared for

Dr Alastair Stephen, Scottish and Southern Energy, Cluny HQ, Pitlochry.

1. OBJECTIVES

The aim of this study was to:

1. Continue the operation of a rotary screw trap in the River Truim
2. Provide estimates of salmon and sea trout smolt production for the River Truim
3. Collect baseline data on size, age and run time salmon and sea trout smolt runs.

2. INTRODUCTION

The River Spey is a Special Area of Conservation (SAC) for four species: Atlantic salmon (*Salmo salar)*, otter (*Lutra lutra*), sea lamprey (*Petromyzon marinus*) and the freshwater pearl mussel (M*argaritifera margaritifera*). The Spey salmon population supports long-term average catches of around 9000 fish per annum and the sport fishery brings considerable economic benefits to the local and national economy.

Scottish and Southern Energy (SSE) have applied to SEPA to vary the compensation flow regime in the River Truim as part of a review of the Tummel Hydro scheme CAR licence. As part of the monitoring associated with the proposed licence variation SSE have provided funding for the Spey Foundation (SF) to assess salmonid smolt production in the River Truim.

In order to sample and quantify the smolt run a Rotary Screw Trap (RST) (http://www.scotland.gov.uk/Uploads/Documents/FW27Screwtap.pdf) was deployed in the lower River Truim from the beginning of March to the end of May.

A rotary screw trap had already been operated in the same site in 2010 and 2011 (Laughton 2010b) and this report provides data from operation in 2012 and compares the results with previous years.

3. MATERIALS AND METHODS

3.1 Trap Installation

A 6ft diameter rotary screw trap (RST) (Key Mill Construction Ltd, Ladysmith, BC, Canada) was installed in the lower River Truim downstream of the Bridge of Truim (Grid Ref. 268900/794920).

The trap is constructed with two large floating pontoons supporting a centrally position rotating funnel. The depth of the upstream facing funnel can be adjusted to maintain the rotation speed within its operational range. An internal screw turns the funnel and allows any smolts entering the drum to pass freely into a holding box at the rear of the trap without being removed from the water. The trap was anchored to the river bank by chain and rope attached to bankside trees and rock mounted anchor bolts.

The trap was inspected and cleaned daily, generally in the morning, and captured fish were removed for analysis. During periods of high flows the drum of the trap would be lifted to protect the device and staff. Accessing the trap during periods of high flow is considered unsafe. There are therefore period when the trap is non-operational, although these were kept to an absolute minimum.

Captured fish were removed from the holding box by dip net. Fish were anaesthetised (benzocaine) and species identified. Fish length was measured for all fish captured and a small sample of scales for age determination was collected from every tenth salmon and trout captured, a swell, as from unusual or large fish. All salmon and trout were assessed visually for their condition and classed as parr, smolt, adult, etc.

A proportion of salmon and trout smolts were marked on their underside using a spot of Alcian Blue dye for mark re-capture estimates. These fish were then transported approximately 0.1km upstream before release back into the Truim. Subsequent smolt catches were then examined for recaptures of marked fish so that the efficiency of the RST could be calculated and thus, the size of the overall smolt run to be estimated.

3.2 Environmental Data

River flow data was provided by SEPA for their gauging station at Invertruim (268600/796300) which monitors flows in the River Spey immediately below the Truim confluence. This is the nearest and most relevant gauging station available. A comparison between the river flows recorded at the Invertruim gauging station and local river height readings recorded on a marker gauge at the Bridge of Truim showed a close correlation. A temperature logger (VEMCO minilog) was deployed at the site to record water temperature at hourly intervals but unfortunately the battery had ran out and no readings were obtained. In order to provide some information on water temperature the readings from the Tromie logger have been used.

4. RESULTS

4.1 Site operation

The RST was deployed in the River Truim at Bridge of Truim (Grid Reference 268900/794920) in the same location as used in 2010 and 2011 (Laughton 2011). In 2012 a 4ft diameter rotary screw trap was installed and operated from the 5th March 2012 to the 25th May 2012.

Trapping conditions were almost ideal in 2012 with stable flows for most of the trapping period. Four days were missed due to high water conditions, two in late April and two in mid May when the bulk of the smolt run had already passed.

4.2 Fish Data 2012

Table 1: Number, age, and mean length of salmon and trout captured in the lower River Truim RST during 2012.

Salmon		Trout	
Smolt	5467	Silvery	77
Parr	23	Parr	322
		Adult	37

Scale Samples Collected						
Salmon Smolts				Trout		
Age	Number	%	Mean Length (mm)	Number	%	Mean Length (mm)
1	0	0.0		0	0.0	
2	130	39.3	113	4	6.7	99.7
3	139	53.1	125.3	11	18.3	147.6
4	16	6.1	139.5	14	23.3	187.4
5				12	20	228.8
6				13	21.7	342.1
7+				2	3.3	395
No Age Resolved	4	1.5		4	6.7	
Un Read	0	0		0	0.0	
Total	262	100		60	100	

Salmon were by far the most dominant fish type with 5490 captured, of these 5467 (99.6%) were identified as smolts, the remainder being parr.

436 trout were captured with 17.6% being assessed as silvery in colour indicating the fish may be smolting and therefore likely to become a sea trout. Trout over 220mm were generally categorised as adults rather than parr. The largest trout recorded was 550mm.

Scales were collected from 262 salmon smolts and scale readings indicated that 2 and 3 year olds dominated with 3 year olds making up over half of the total. There was a more even spread of trout ages although it should be stated that the trout scale sampling was skewed by scale samples taken from a high proportion of the larger trout trapped.

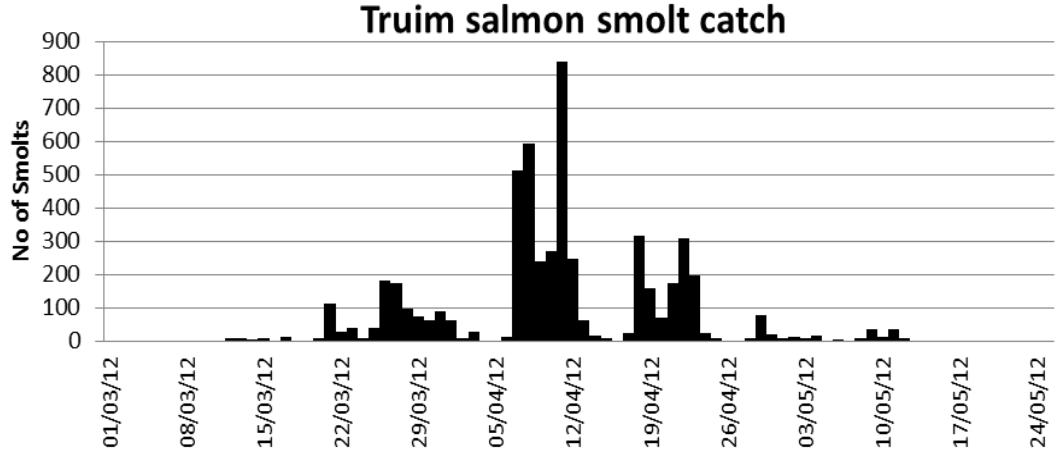

Figure 1: Daily salmon smolt capture in the River Truim RST, 5th March 2012 to the 25th May 2012.

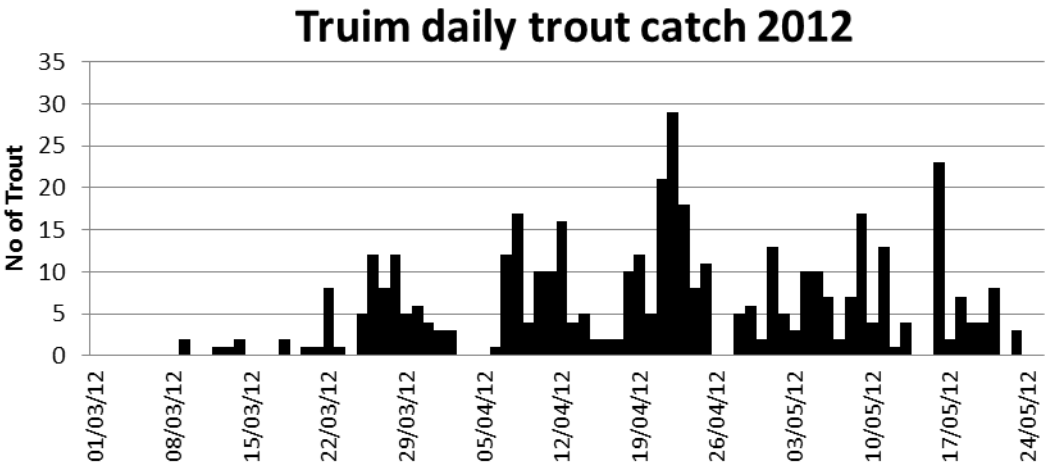

Figure 2: Daily trout capture in the River Truim RST, 5th March 2012 to the 25th May 2012.

Figures 1 and 2 show the daily catches of salmon smolts and trout respectively. The first salmon and trout were captured on the 9th March and from that day onwards fish were captured every operational day until the 5th May. The highest daily capture total for salmon smolts was on the 11th April when 839 were caught. During the six day period from the 7th to the 12th April 49.5% of the salmon smolts were caught. The profile of the trout captures was quite different with increasing numbers of fish caught, peaking in late April with 29 captured in the 22nd April.

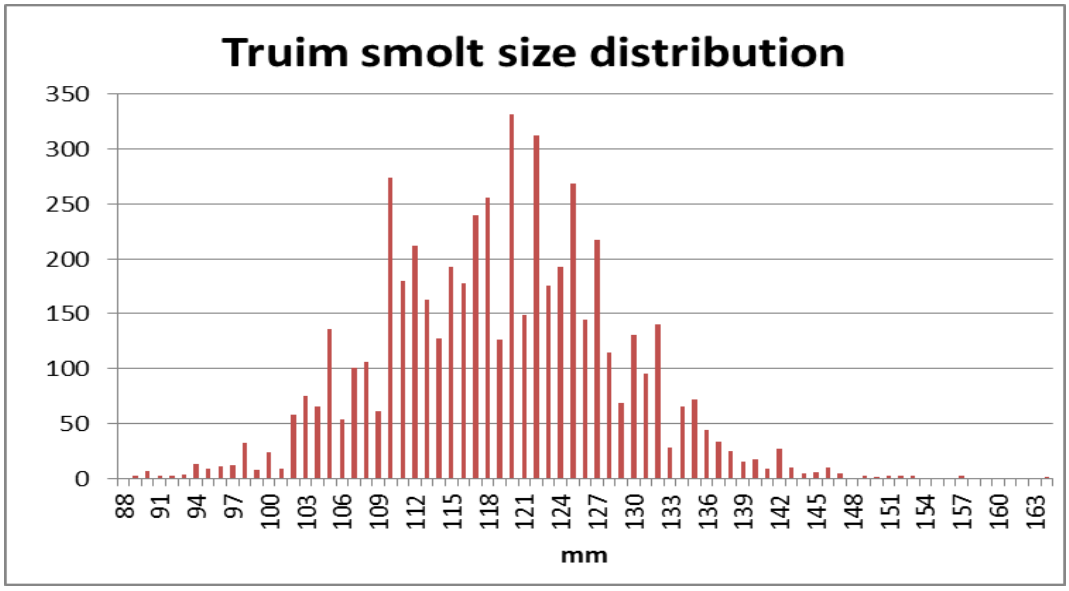

Figure 3: Size distribution of the Truim 2012 salmon smolts

The mean size of the salmon captured in 2012 was 119mm. The largest salmon smolt was 164mm.

4.3 Salmon and Trout Capture and Environmental Parameters

Smolt Capture and River Temperature

Due to the failure of the battery in the Truim temperature logger the temperature data for the Tromie logger has been used. The altitudes of both loggers are similar and the linear distance between the two sites is only 11km so it is considered that the Tromie logger will provide a reasonable substitute for the Truim. Temperature was recorded hourly using a VEMCO minilogger and the mean daily temperatures for the period of smolt trap operation is plotted with the daily catches of salmon smolts and trout in Figures 4 and 5 respectively. There were considerable fluctuations in the mean daily temperature during the trap operation period. During the second half of March there was a period of exceptionally warm and sunny weather and river temperatures increased to a high of 8^{o}C. April was generally cooler and it was into May before the mean daily temperature reached 8^{o}C again. It is clear that temperature alone is not driving salmon smolt migration as the peak smolt run that commenced on the 7th April occurred during lower river temperatures than had prevailed the week before. In the last week of May air temperatures reached the high 20's across the region and water temperatures increasing accordingly.

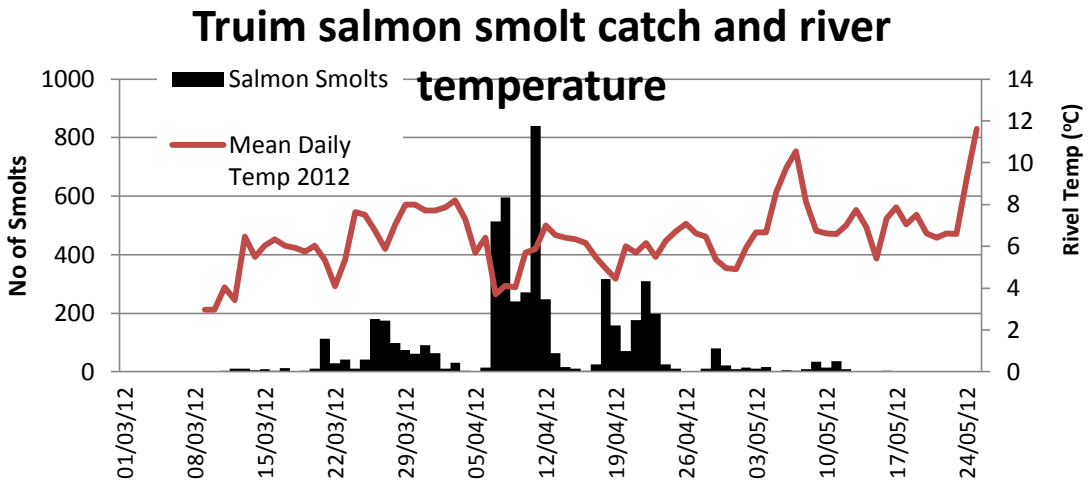

Figure 4: Truim salmon smolt capture and mean daily river temperature.

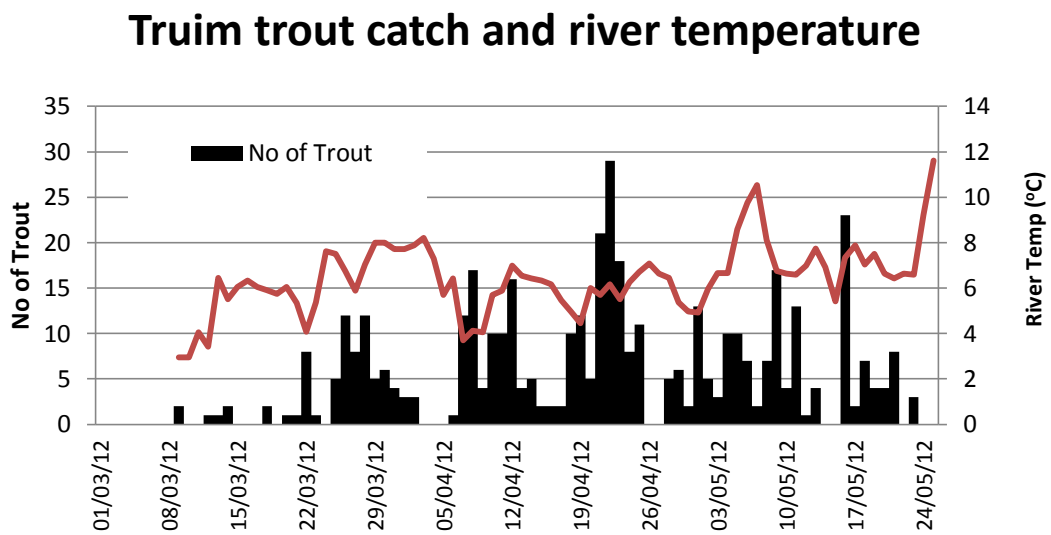

Figure 5: Truim smolt trap trout capture and mean daily river temperature

Smolt Capture and River Flow

River flow data from the SEPA Invertruim gauging station was obtained from SEPA as there is no gauging station on the Truim itself. The flows recorded at the Invertruim station are therefore influenced by changes in flows in the Upper River Spey and tributaries. However the river height at the smolt trap location was recorded daily by Spey Foundation and there appears to be a close correlation between those readings and the SEPA Invertruim river flows (See Figure 6). The SEPA Invertruim data was therefore used and plotted against fish capture data.

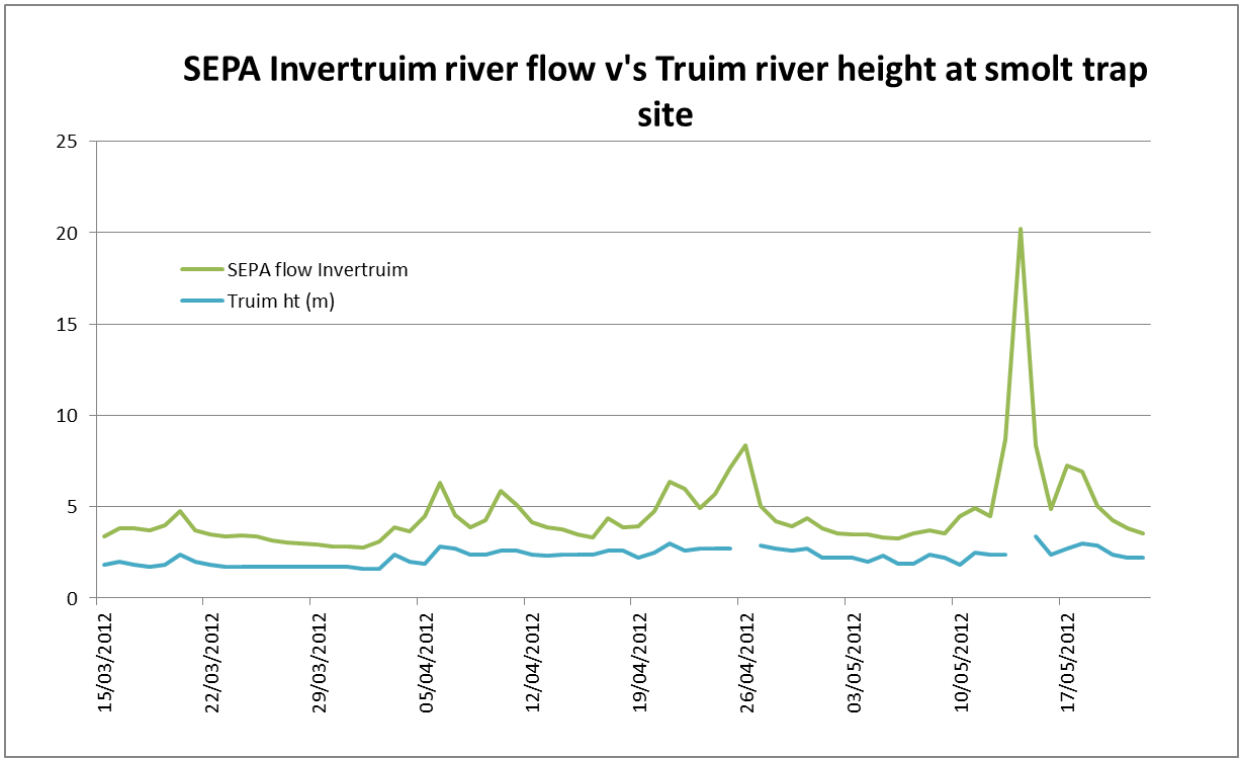

Figure 6: SEPA Invertruim river flows compared to River Truim river heights

The major peak in the salmon smolt run started on the 7th April immediately after a small rise in river flow. The mean daily flow for the five day period preceding the rise was 3.57m^3/s compared to 4.97m^3/s for the five days following. This represents a 39% increase in flow, a relatively modest increase. The graph below shows that each small rise in river flow resulted in an increased movement of salmon smolts.

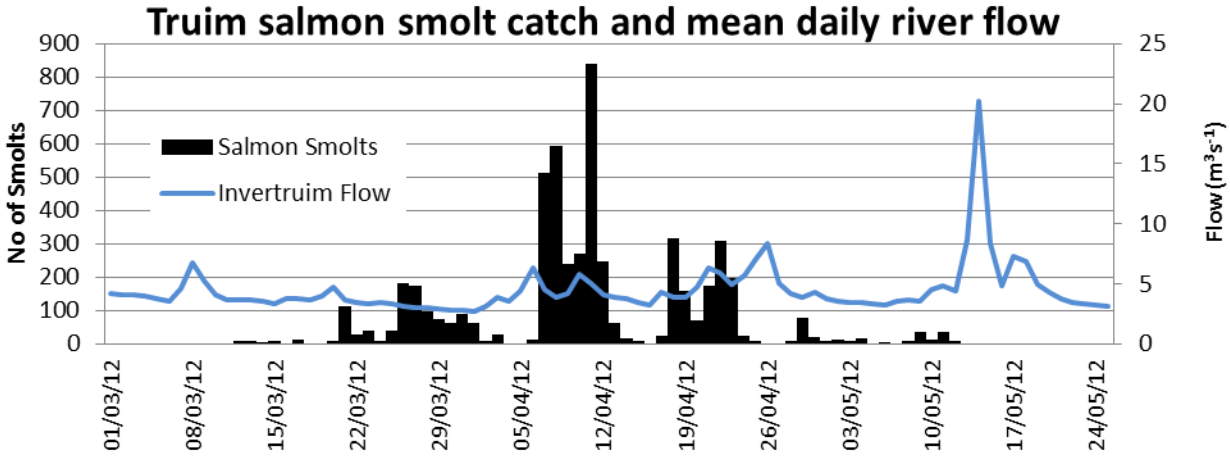

Figure 7: Salmon smolt capture and mean daily river flows (m^3/s) Invertruim. River level data supplied by SEPA.

The profile of the trout capture results is more spread out with relatively constant numbers of trout captured from late March almost to the end of the trap operation.

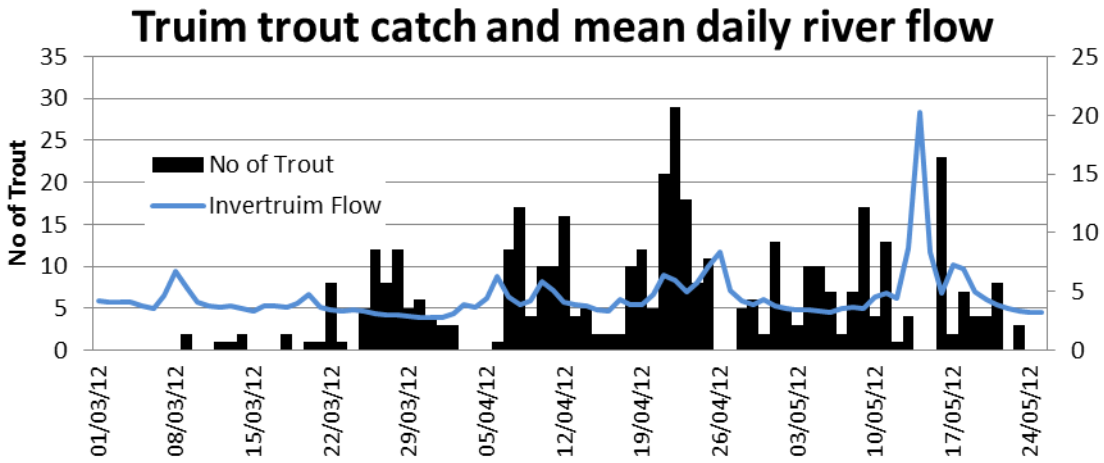

Figure 7: Truim trout capture and mean daily river flow at Invertruim. River level data supplied by SEPA.

4.5 Cumulative Salmon Smolt Catch

Figure 8 shows the cumulative smolt catch from 1st March for each of the study years 2010, 2011 and 2012. It is evident that the timing of the smolt runs can vary widely from year to year, although the influence of non-operational trapping periods must be taken into account. 50% of the salmon smolts had migrated by the 11th April 2012, three weeks earlier than in 2010, with an even greater difference for the 90th percentile.

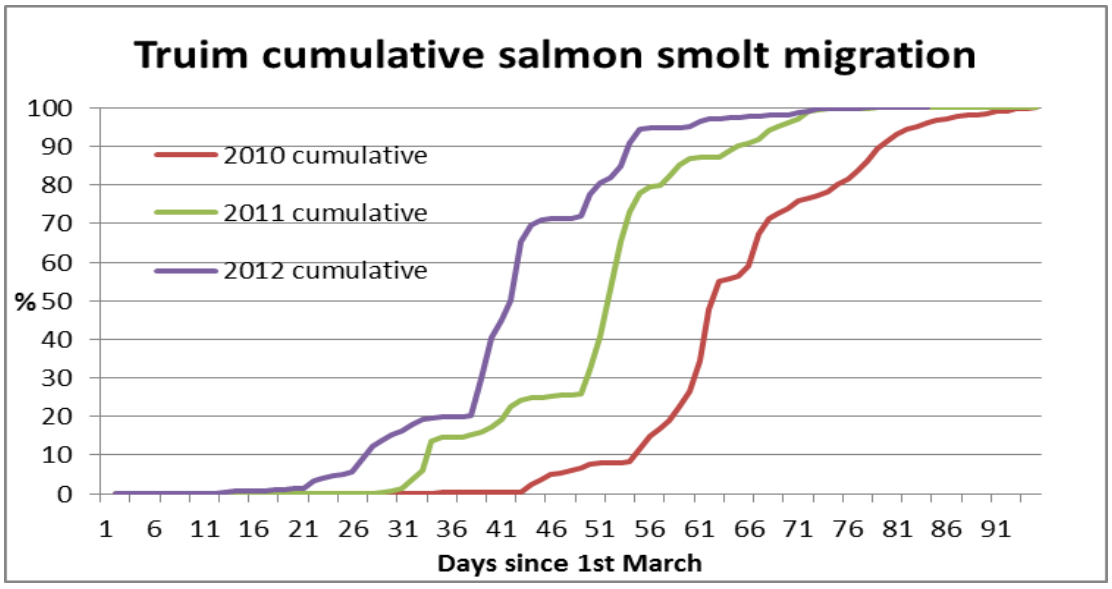

Figure 8: Cumulative salmon smolt catch (%) from 1st March during 2010, 2011 and 2012 on the River Truim.

4.6 Estimating River Truim salmon smolt production

4.6.1 Mark and recapture

A mark and recapture technique was used to estimate the River Truim salmon smolt run. Throughout the smolt trapping operation a proportion of both salmon and trout smolts were marked using a simple Alcian Blue dye mark, transported approximately 0.1km upstream and released. The numbers of marked smolts recaptured were then recorded. A simple Petersen mark-recapture equation (Volkhardt, *et al,* 2007) was used to estimate the overall population as follows:

$$N_i = n_i \, (M_i/m_i)$$

Where:

N_i = Estimated number of downstream migrants during period i

n_i = Number of fish capture during period i

m_i = Number of marked fish captured during period i

M_i = Number of fish marked and released during period i

This equation also provides a measure of trap efficiency e_i as follows:

$$e_i = (m_i/M_i)$$

The marking method used did not vary from day to day so no assessment of trap efficiency in relation to water flow was possible. Therefore during elevated river flows the efficiency of the trap may be reduced. As runs of smolts trapped are highly correlated to river flows the overall efficiency measure is likely to be an underestimate.

Table 2 below shows the estimated salmon smolt productivity from the Truim for 2010 to 2012 based on the RST results. A 4ft diameter RST was used on the Truim each year and trap efficiency estimates have been consistent.

The estimated salmon smolt output of the Truim in 2012 was considerably higher than estimated in previous years. The total number of salmon smolts caught in the trap in 2012 was approximately double that recorded in previous years.

The trout output estimates for 2011 and 2012 were consistent although there was considerable variation in the trap efficiency for trout.

Table 2: Salmon smolt run estimates for the River Truim for 2010 to 2012 using Petersen mark-recapture method (from Volkardt, *et al* 2007).

Simple Petersen Recapture Model					
Year	Total Salmon Smolts Captured (n_i)	Marked Smolts (M_i)	Marked Smolts Recaptured (m_i)	Estimate of Population Size (N_i)	Trap Efficiency (e_i)
2010	2845	2662	916	8268	34.4
2011	2139	1668	467	6293	28.0
2012	5467	3651	1127	17825	30.8

Table 3: Trout run estimates for the River Truim 2010 to 2012 using Petersen mark-recapture method (from Volkhardt, *et al* 2007).

Simple Petersen Recapture Model					
Year	Total Trout Captured (n_i)	Marked Smolts (M_i)	Marked Smolts Recaptured (m_i)	Estimate of Population Size (N_i)	Trap Efficiency (e_i)
2010	138	116	13	1231	11.2
2011	528	194	17	2579	8.8
2012	436	278	45	2691	16.2

4.6.2 Truim Smolt productivity

Using the smolt population size estimates it is possible to estimate the salmon smolt productivity of the Truim upstream of the trap. Based on electrofishing site measurements across the Truim and lengths measured on Google Earth the habitat area available for salmon smolt production is estimated to be 225,018m2 wetted area. Dividing the smolt population estimates by the available habitat gives a salmon smolt productivity of 8/100m2 in 2012. This 2012 estimate is approximately three times higher than the lowest estimated production of 2.8/100m2 from 2011.

The trout productivity estimate in 2012 was similar to that derived for 2011 at 1.2/100m2

Table 4: Truim salmon smolt productivity estimations

River Truim	**2010**		**2011**		**2012**	
Population Estimates	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number Dye Marked	2662	116	1668	194	3651	278
Recaptures	916	13	467	17	1127	45
Percentage %	34.4	11.2	28.0	8.8	30.8	16.2
Petersen Method Estimate	**8268**	**1231**	**6293**	**2579**	**17825**	**2691**
Smolt production/m2	**0.037**	**0.005**	**0.028**	**0.012**	**0.080**	**0.012**

4.7 Comparison with previous years

2012 was the third successive year of operation for the Truim RST. The results from the three years are summarised in the table below. The number of salmon smolts captured in 2012 was approximately double the highest number recorded in the previous years. The ideal and consistent trapping conditions experienced in 2012 would have been a factor explaining the apparent increase in salmon smolt productivity measured in 2012, certainly compared to 2010 when 14 days were non-operational. Operational periods for the Truim RST are shown in Table 6 below. In 2010 the significant non-operational periods in early April, a peak migration period in

2012 may have resulted in significant underestimates of total smolt output for that year.

Table 5: River Truim Rotary Screw Trap results 2010 to 2012

River Truim	**2010**		**2011**		**2012**	
Start Date	25/03/2010		24/03/2011		05/03/2012	
End Date	03/06/2010		24/05/2011		22/05/2012	
Operating Period (Days)	70		61		78	
Total Days Lost	14		2		4	
Actual Fishing Days	56		59		74	
Fish Data	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number smolts captured	2845	67	2139	102	5490	77
Number parr/adult captured	41	71	17	426	23	359
River Age	%	%	%	%	%	%
1	0.0	0.0	0.6	0.0	0.0	0.0
2	46.5	12.1	36.5	7.3	39.4	6.7
3	45.1	33.3	55.8	26.8	53.1	18.3
4	0.3	15.2	0.6	14.6	6.1	23.3
5	0.0	21.2	0.0	36.6	0.0	20.0
6	0.0	0.0	0.0	0.0	0.0	21.7
7+	0.0	0.0	0.0	0.0	0.0	3.3
No Age Resolved	8.0	18.2	6.6	14.7	1.4	6.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
Population Estimates	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number Dye Marked	2662	116	1668	194	3651	278
Recaptures	916	13	467	17	1127	45
Percentage %	34.4	11.2	28.0	8.8	30.8	16.2
Petersen Method Estimate	**8268**	**1231**	**7639**	**2579**	**17825**	**2691**
Smolt production/m2	**0.037**	**0.005**	**0.034**	**0.012**	**0.080**	**0.012**
	Other Fish Species (Number)					
Minnow	4		0		0	
Eel	2		1			
Lamprey (Tr)	5		1			
Stickleback (3 Spine)	1		1			
Pike			3			

Table 6: Operational days for the Tromie RST 2009-2012

5. DISCUSSION

2012 provided excellent conditions for the operation of the RST in the River Truim. With little or no snow on the hills river flows were stable with the occasional moderate rainfall driven rise in levels. The trap was fished continuously throughout the main period of the salmon smolt run with only 4 days non-operational due to high flows, all later in the trapping season when the bulk of the salmon smolts had already passed. The ideal trapping conditions were a factor contributing to a salmon smolt catch which was almost double that recorded in previous years, although there does appear to have been significantly higher smolt production in 2012 than in previous years.

The peak salmon smolt migration occurred much earlier than recorded in the previous three years. This may be due to the abnormally warm weather that persisted throughout March and the almost complete absence of lying snow on the hills. However the impact of non-operational periods during early April in 2010 on the profile of the salmon smolt capture pattern in that year must also be considered.

5949 salmon and trout were captured in the trap in 2012, 92% of which were salmon smolts. Calculations for the salmon smolt productivity for the Truim provide a figure of 8.0 salmon smolts/100m^2 wetted area. Comparable smolt outputs from the Water of Mark (upland tributary of the North Esk) and the Girnock (River Dee) for 2009 and 2010 indicate smolt production figures of between 3-5/100m^2 with the higher value of 7/100m^2 for the North Esk as a whole (Mackay et al,. 2009).

The normal range of salmon smolt outputs across the North Atlantic home range of salmon is considered to be 1-10/100m^2 (Symons, 1979). The Truim is a relatively high altitude stream (area accessible to salmon lies between 245m to 440m) therefore the 2012 salmon smolt productivity must be considered to be at the upper end of expectations. The good trapping conditions mean that there can be high confidence that the full extent of the smolt run in 2012 was captured but comparison with previous years suggests that there was a significant actual increase in smolt output from the Truim this year.

In 2011 the RST was not deployed until the 24th March. Less than 5% of the smolts captured in 2012 were trapped before the 24th Mar 2012, a year of exceptionally warm March weather when smolts may have been expected to run early. So the later start of trapping in 2011 is likely to have had minimal impact on the results. In both 2011 and 2012 the traps were operated almost continuously throughout the main smolt run period and should have provided a good indication of the smolt run.

The winters of 2009/10 and 2010/11 were significantly colder than those experienced in recent years with the winter of 2012 very open and snow free in comparison. The mean monthly air temperatures for Aviemore during Jan to May 2009-2012 are shown below. The mean monthly temperatures in 2010 were significantly lower than recorded in the other years. The cumulative mean temperatures for Jan to Mar in 2012 were 41% higher than that recorded in 2009 and 2011 and many times higher than that for the same months in 2010.

There would appear to be a close correlation between the mean monthly temperatures in each of these years and the cumulative salmon smolt catch with the 2010 salmon smolt run later than the other three years.

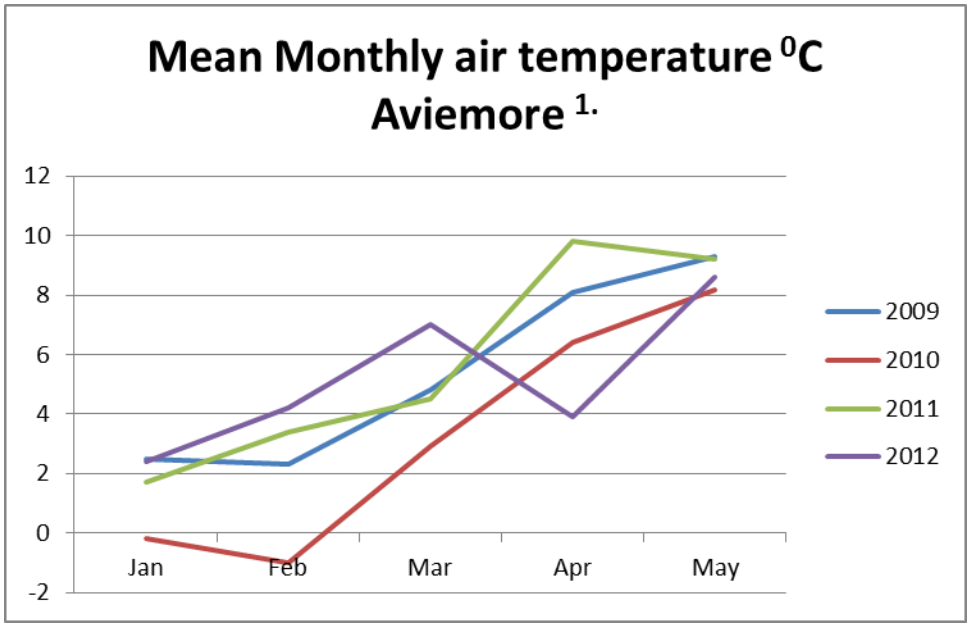

Figure 9: Mean monthly air temperatures Aviemore 2009-2012

1. http://www.tutiempo.net/en/Climate/AVIEMORE/30630.htm

Table 9: Cumulative mean monthly temperature at Aviemore (Jan to Mar) (^{o}C days)

Aviemore	2009	2010	2011	2012
Cumulative	290.7	55.7	287.4	409

The lengthy non-operational periods in April 2010 may have led to an underestimate of the smolt run during that year but the results from the three trapping years show that there is considerable fluctuation in the salmon smolt output from the Truim. This is not uncommon and similar variations have been recorded on the Water of Mark. Salmon smolt output is the key measure of the productivity of a salmon river so understanding the factors influencing smolt productivity is of fundamental importance.

Three electrofishing sites were completed in the River Truim in 2011 and at two of the sites the parr numbers were low in comparison to the long-term average for each site, whilst one was above average. Based on these limited results there was no indication that there would be such a high smolt output in 2012. However three electrofishing sites on the Truim is unlikely to be enough to assess the fish population effectively but in 2013 the Truim will be electrofished intensively as part of the electrofishing survey rota for the Spey catchment.

Information from other areas with long running smolt traps suggest that cold winters depress smolt output the following year (Ian McMyn, Kyle of Sutherland Salmon Fishery Board, pers comm,) but does the opposite hold true, i.e. high smolt output following after a mild winter? A longer term study of consistent smolt trapping would be required to determine if this was the case for the Truim

The instream habitat in the Truim is generally good with mixed juvenile habitat throughout. Conductivity readings taken at the Truim smolt trap in March 2012 found that the average for the Truim was around 70µS/cm or higher whilst on the Tromie it was generally below 30µS/cm. The underlying geology in the Truim and Tromie catchments are similar with both largely quartz-feldspar-granulite, relatively insoluble

rocks providing low minerals input. There are a number of potential sources of inputs that could affect the conductivity of the Truim including Dalwhinnie STWs, the distillery, road run-off etc. It is quite likely that one or all of these anthropogenic factors are responsible for the elevated conductivity readings in the Truim. High conductivity readings in themselves are not an indication of higher productivity, but if the sources include organic or mineral inputs then instream productivity could be enhanced potentially increasing the carrying capacity of the Truim.

The excellent habitat and potential enrichment of the Truim could explain what appears to be high salmon smolt output for a high altitude highland stream. Another factor could be the flow regulation and the compensation flow that keeps the minimum flow above that which would naturally occur during dry weather periods. This ensures that the maximum wetted area is available at all times for juvenile production and may enhance overall productivity.

The scale reading found that the proportion of two year old smolts was just below 40%, similar to that recorded in previous years. At 6.1% the proportion of 4 year old smolts was the highest recorded. The proportion of three year old smolts in the Truim (53.1%) was lower than recorded in the Tromie (65.4%) in 2012. Considering the apparent higher productivity of the Truim a higher percentage of younger age smolts could be expected. Scale sampling from rod caught fish in the River Spey from 2009 to 2012 found that two year old smolts typically form 65-70% of the total with most of the balance three year olds and very few one or older smolts sampled. It would be expected that smolts produced in the relatively high altitude River Truim would grow slower and become smolts at an older age than those produced lower down the catchment.

The age of the trout captured in the Truim smolts trap ranged from 2 to 7+ years old. Many of the trout captured in the Truim trap are not true trout smolts rather a range of fish from small parr to large adults are captured. Many of the smaller trout parr are likely to become resident trout in the Truim or Spey rather than migrate to sea. The Truim has a significant spawning run of large river or loch trout and some of the larger trout captured in the trap may well be fish returning downstream after spawning the previous autumn. The salmon smolt run in the Truim is also likely to attract big trout as it provides a readily accessible food source in the spring.

The last three years smolt trap operation in the Truim has provided an interesting insight into the salmonid smolt production of this important upland tributary of the Spey. Salmon smolt productivity estimates have varied by a factor greater than two but all estimates are within the range expected. The 2012 result in particular highlights the importance of the Truim to the River Spey salmon population and the fishery is supports.

6. CONCLUSIONS

In 2012 the rotary screw smolt trap on the River Truim was operated successful with almost ideal trapping conditions throughout. The number of salmon smolts captured was almost double that captured in the two previous years and using a mark and recapture approach smolt production estimates were derived. At 8.0/100m2 wetted area the salmon smolt production estimate for the Truim are exceptionally good for a high altitude tributary in the Scottish highlands. The higher number of smolts trapped in 2012 appears to be the results of increased productivity rather than purely due to the optimum trapping conditions. Juvenile trout numbers captured were similar to those recorded in previous years.

7. ACKNOWLEDGEMENTS

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