Rotary Screw Trap Report River Tromie

2012

Prepared for

Dr Alastair Stephen
Scottish and Southern Energy
Cluny HQ
Pitlochry

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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 Tromie
2. Provide estimates of salmon and sea trout smolt production for the River Tromie
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 Tromie 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 lower River Tromie.

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

A rotary screw trap had already been operated in the lower River Tromie in 2009, 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 Tromie immediately downstream of the

Scottish Environment Protection Agency (SEPA) river flow gauging station (Grid Ref. 278900/799600).

The trap is constructed with two large floating pontoons supporting a rotating funnel in the centre. The funnel faces upstream and is turned by the river flow. An internal screw 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.

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 may therefore be periods when the trap is non-operational, however non-operational periods are kept to a 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. All salmon and trout were assessed visually for their condition and classed as smolt, parr, brown trout, silvery trout, 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 0.3km upstream before release back into the Tromie. 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 could be estimated.

3.2 Environmental Data

River level data was provided by SEPA for their gauging station at Tromie Bridge (278900/799600) which monitors flows in the tributary. River temperature data was recorded at the site using a temperature logger (VEMCO minilogs) set to record at hourly intervals.

4. RESULTS

4.1 Site operation

The monitoring site adjacent to the SEPA gauging station at Tromie Bridge (278900/ 799600) had been used in 2009, 2010 and 2011 (Laughton 2010b). In 2012 a 6ft diameter rotary screw trap was installed from 5th March 2012 to the 25th May 2012. In 2011 and 2010 a smaller, 4ft diameter, RST was used at the same location. As capture efficiency is assessed on an on-going basis throughout the trapping season the effect of using a different size trap can be accounted for.

Trapping conditions were almost ideal in 2012 with stable low flows for most of the trapping period. Only 2 days were missed due to high water conditions, both in late April when the counts indicate that the bulk of the smolt run had already passed.

Table 1: River Tromie RST operation and fish count data 2012

River Tromie	2012	
Start Date	05/03/2012	
End Date	22/05/2012	
Operating Period (Days)	78	
Total Days Lost	2	
Actual Fishing Days	76	
Fish Data	**Salmon**	**Trout**
Number smolts captured	9005	164
Number parr captured	15	980
Population Estimates	**Salmon**	**Trout**
Number Dye Marked	2954	880
Recaptures	1935	272
Percentage %	65.5	30.9
Petersen Method Estimate	**13770**	**3701**
Smolt production/m2	**0.063**	**0.017**
Other Fish Species (No.)		
Minnow		
Eel		

4.2 Fish Data 2012

Table 2: Number, age, and mean length of salmon and trout captured in the River Tromie RST during 2012.

Salmon		Trout	
Smolt	9005	Silvery	164
Parr	15	Parr	980

Scale Samples Collected

Salmon Smolts				Trout		
Age	**Number**	**%**	**Mean Length (mm)**	**Number**	**%**	**Mean Length (mm)**
1	0	0.0		0	0.0	
2	91	27.7	109.5	9	13.6	112
3	215	65.4	128.7	29	44.1	149.7
4	9	2.7	130	19	28.8	191.4
5				3	4.5	231.6
6				2	3.0	294

7				1	1.5	315
No Age Resolved	11	3.3		3	4.5	
Un Read	3	0.9		0	0.0	
Total	329	100		66	100	

Salmon were by far the most dominant fish type with 9020 captured, of these 9005 (99.8%) were identified as smolts, the remainder being parr.

1144 trout were captured with 14.3% being assessed as silvery in colour indicating the fish may be smolting and therefore likely to become a sea trout.

Scales were collected from 329 salmon smolts and scale readings indicated that 2 and 3 year olds dominated with 3 year olds making up almost two thirds of the total. For trout the dominant age was also 3 year old (44% of the total) although there were six year classes identified. For both salmon and trout the mean size of each age class of fish increased.

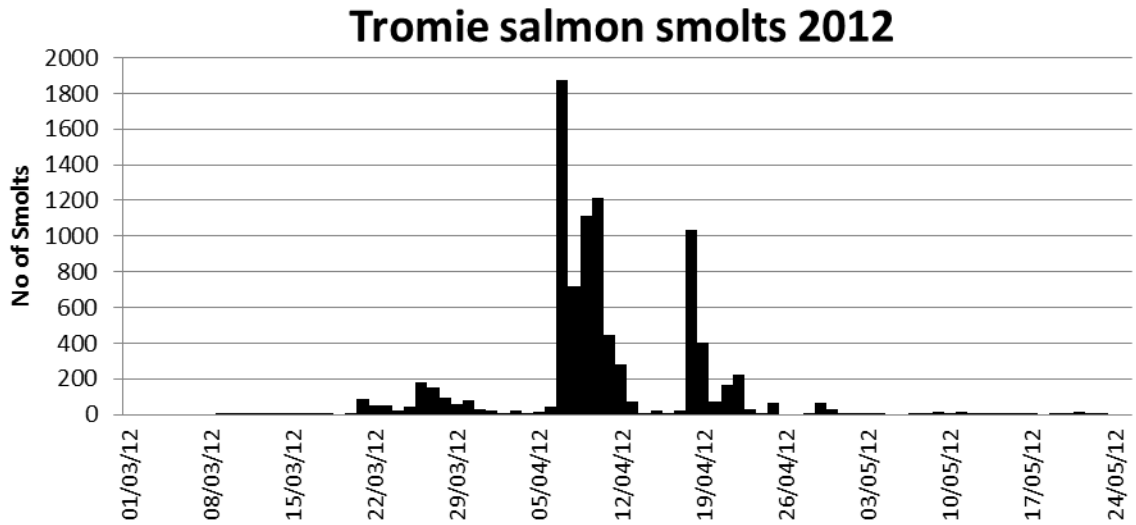


Figure 1: Daily salmon smolt capture in the River Tromie RST, 5th March 2012 to the 25th May 2012.

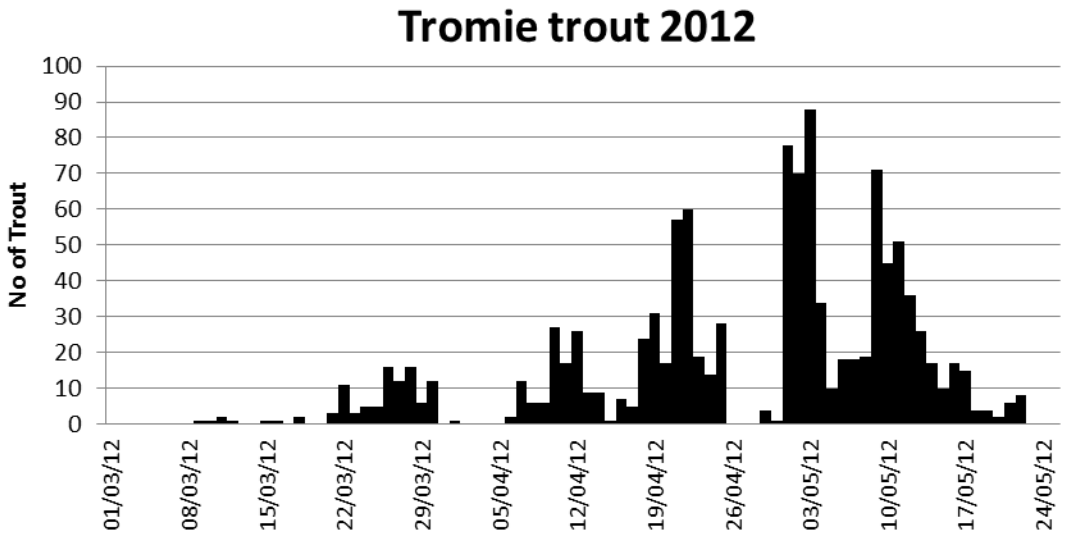


Figure 2: Daily trout capture in the River Tromie RST, 5th March 2012 to the 25th May 2012.

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 most days. The highest daily capture total for salmon smolts was on the 7th April when 1873 were caught. During the four day period from the 7th to the 10th April 54.5% of the salmon smolts were caught. The profile of the trout captures was quite different with increasing numbers of fish caught during March and April, peaking in early May with 88 captured in the 3rd May.

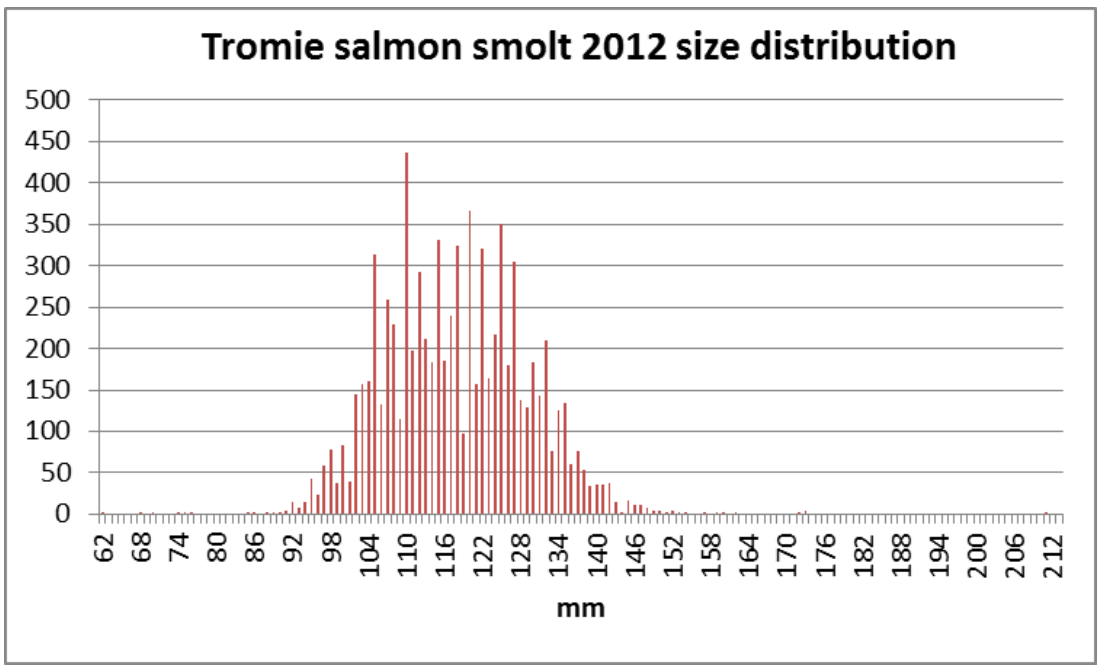


Figure 3: Size distribution of the Tromie 2012 salmon smolts

The mean size of the salmon captured in 2012 was 118mm. The largest salmon smolt was a fish of 211mm caught in late March.

4.3 Salmon and Trout Capture and Environmental Parameters

Smolt Capture and River Temperature

Temperature data for the Tromie was recorded hourly using a VEMCO minilogger and the mean daily temperatures for the period of smolt trap operation are 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°C. April was generally cooler and it was into May before the mean daily temperature reached 8°C again. It is clear that temperature alone is not driving salmon smolt migration although the peak of migration in the second week of April occurred during rising temperatures. In the last week of May air temperatures reached the high 20's across the region and water temperatures increasing accordingly.

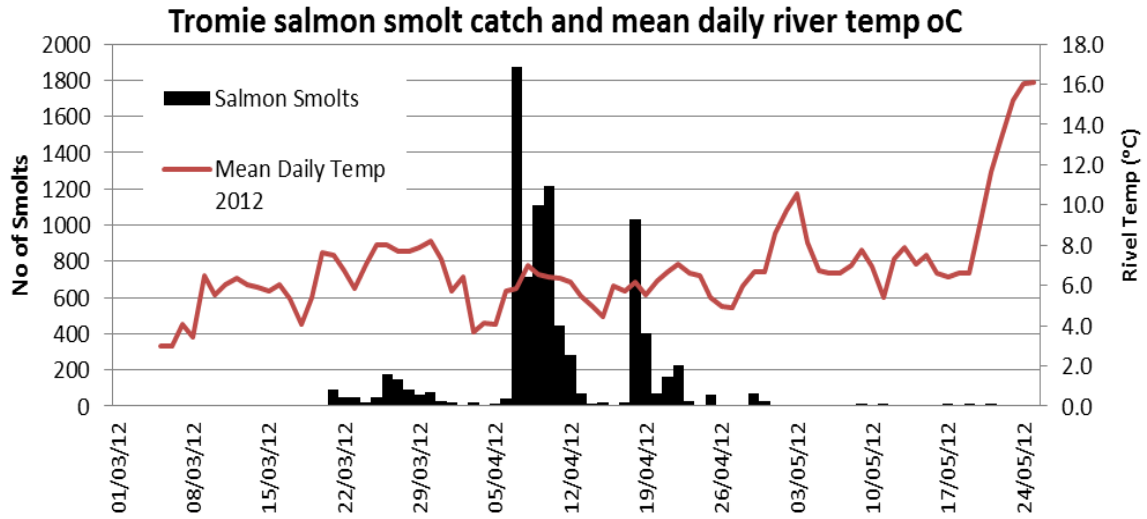


Figure 4: Tromie salmon smolt capture and mean daily river temperature.

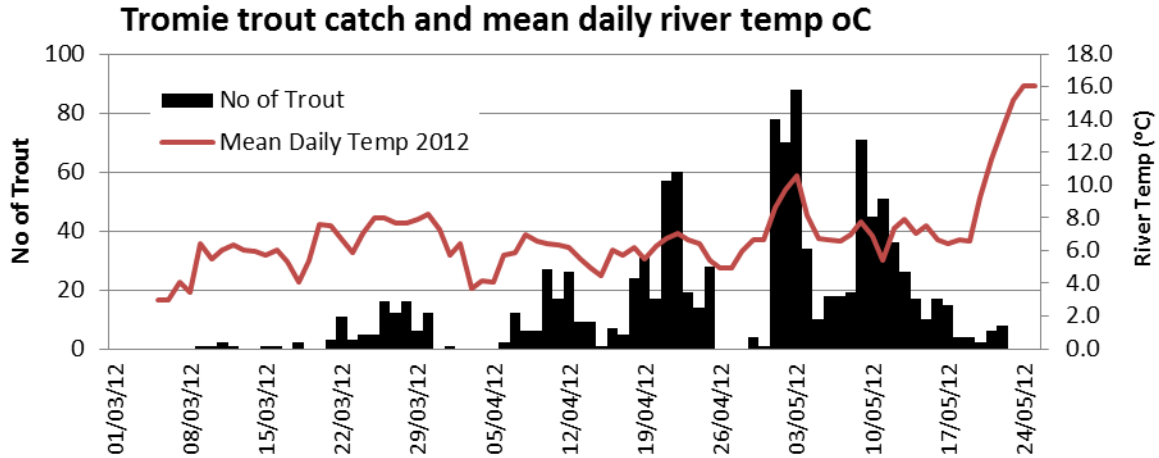


Figure 5: Tromie smolt trap trout capture and mean daily river temperature

Smolt Capture and River Flow

River level data from the Tromie Bridge gauging station was provided by SEPA. The salmon smolt and trout catch data and river levels are shown in Figures 6 and 7 below. The salmon smolt migration in 2012 was characterised with a sharp peak in catches between the 7th to the 12th April when 62.5% of the smolt run occurred. This peak in the smolt run appears to have been stimulated by the 0.066m rise in river level that occurred on the 6th April. SEPA record river levels at the Tromie gauging station rather than flows but this modest rise in river level height would have represented a significant increase in the flow. For operational and health and safety reasons the trap was lifted on the 26/27th April during a period of high flows but the profile of catches in the following days suggests the salmon smolt run was largely over by then.

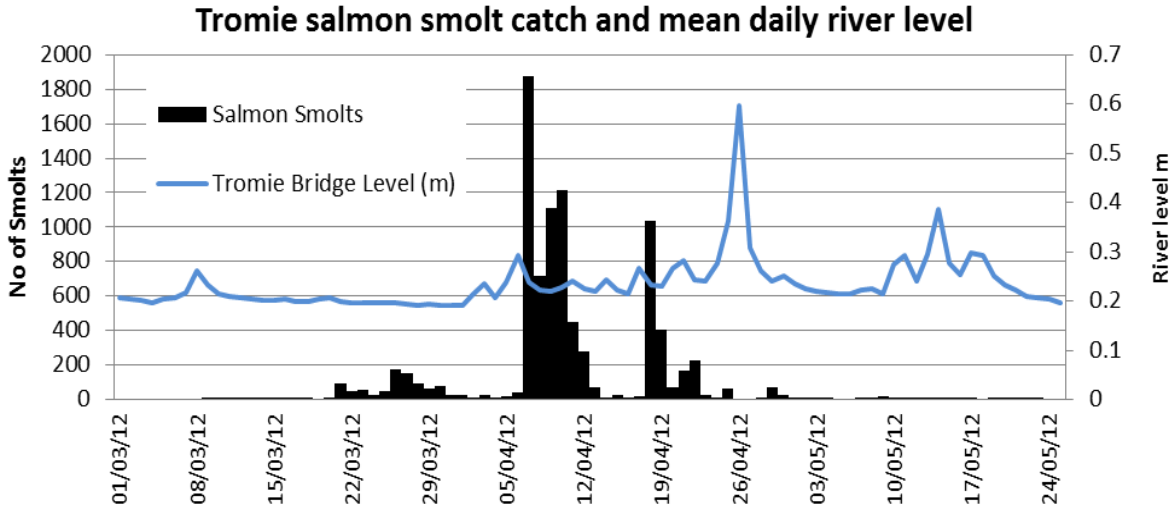


Figure 6: Salmon smolt capture and mean daily river level (m) River Tromie. River level data supplied by SEPA.

There does not seem to be any correlation between river flows and trout capture with the two capture peaks in May occurring in different phases of the river hydrograph.

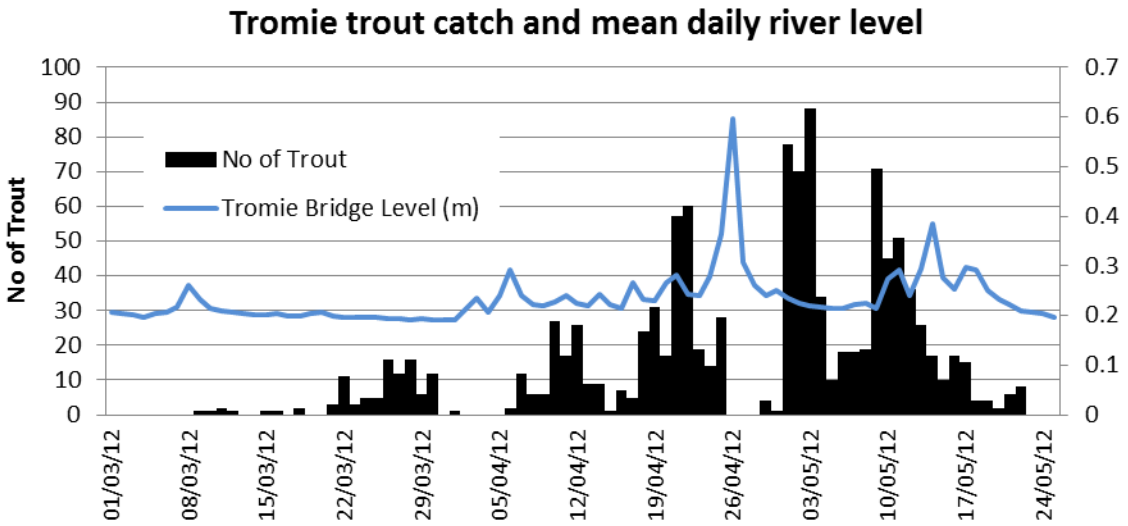


Figure 7: Trout capture and river level (m) at 12:00 each day during March to June 2011 on the River Tromie. River level data supplied by SEPA.

4.5 Cumulative Salmon Smolt Catch

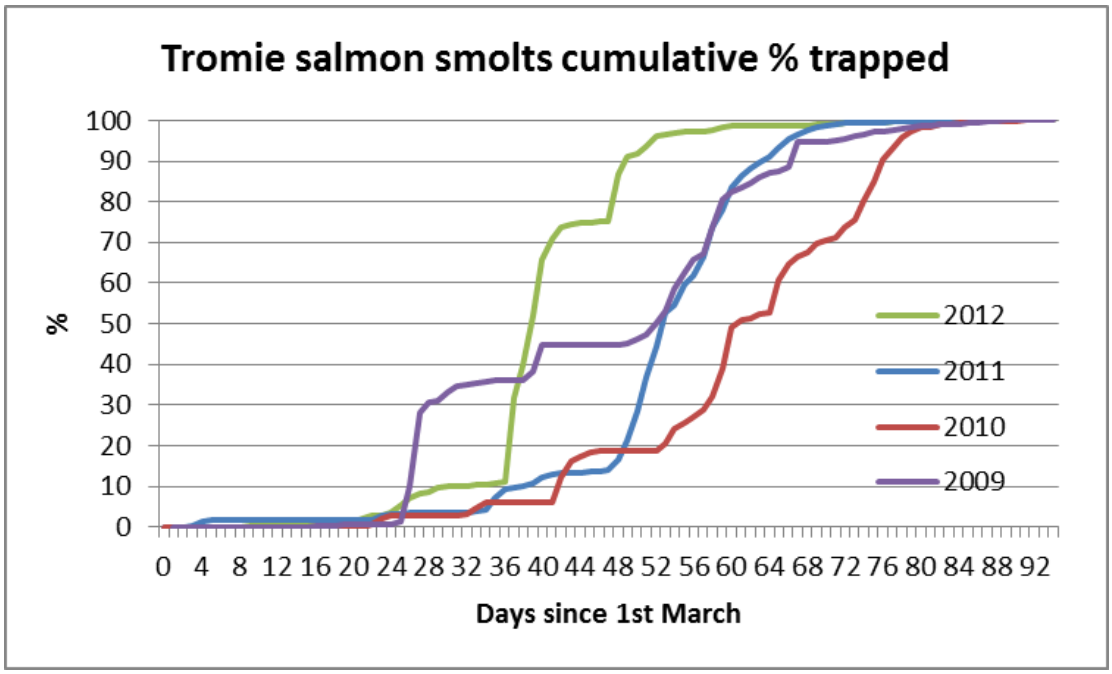


Figure 8: Cumulative salmon smolt catch (%) from 1st March during 2009, 2010 and 2011 on the River Tromie.

Figure 8 shows the cumulative smolt catch from 1st March for each of the study years 2009, 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 9th April in 2012, three weeks earlier than in 2010, with an even greater differential for the 90th percentile.

4.6 Estimating Tromie salmon smolt production

4.6.1 Mark and recapture

A mark and recapture technique was used to estimate the Tromie's 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 0.3km 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. During elevated river flows the efficiency of the trap may be reduced but the marking system used does not allow assessment of efficiency on a day to day basis. As runs of smolts trapped are highly correlated to river flows the overall efficiency measure is likely to be an underestimate.

Table 4 below shows the estimated salmon smolt productivity from the Tromie for 2009 to 2012 based on the RST results. In 2009 and 2012 a 6ft diameter RST was used and trap efficiency rates were significantly higher than those recorded in 20010/11 when a smaller 4ft diameter trap was deployed.

The estimated salmon smolt productivity of the Tromie in 2012 was considerably higher than estimated in previous years. The total number of salmon smolts caught in the trap in 2012 was actually higher than the highest previous estimate (8810 for 2011).

Using the same trap and techniques the trout production estimates are much more consistent, ranging from 3188 to 3941. The 2012 trout production estimate was lower than that recorded in 2009.

Table 4: Salmon smolt run estimates for the River Tromie for 2009 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)
2009	4513	2107	1211	7852	57.5

2010	1294	1208	365	4283	30.2
2011	2139	2014	489	8810	24.3
2012	9005	2954	1935	13770	65.5

Table 5: Trout run estimates for the River Tromie 2009 and 2010 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)
2009	764	521	101	3941	19.4
2010	595	506	83	3627	16.4
2011	528	477	79	3188	16.6
2012	1164	880	272	3701	30.9

4.6.2 Tromie Smolt productivity

Using the smolt population size estimates it is possible to estimate the salmon smolt productivity of the Tromie. Based on electrofishing site measurements across the Tromie and lengths measured on Google Earth the habitat area available for salmon smolt production (excluding loch area) is estimated to be 216,522m2 wetted area. Dividing the smolt population estimates by the available habitat resulted in a smolt productivity of 0.063/m2 in 2012. This 2012 estimate is three times higher than the lowest estimated production of 0.023/m2 from 2010.

Table 6: Tromie salmon smolt productivity estimations

River Tromie	**2009**		**2010**		**2011**		**2012**	
Population Estimates	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number Dye Marked	2107	521	1208	506	2014	477	2954	880
Recaptures	1211	101	365	83	489	79	1935	272
Percentage %	57.5	19.4	30.2	16.4	24.3	16.6	65.5	30.9
Petersen Method Estimate	**7348**	**3941**	**4283**	**3627**	**8810**	**3188**	**13770**	**3701**
Smolt production/m2	**0.034**	**0.018**	**0.023**	**0.023**	**0.041**	**0.015**	**0.063**	**0.017**

4.7 Comparison with previous years

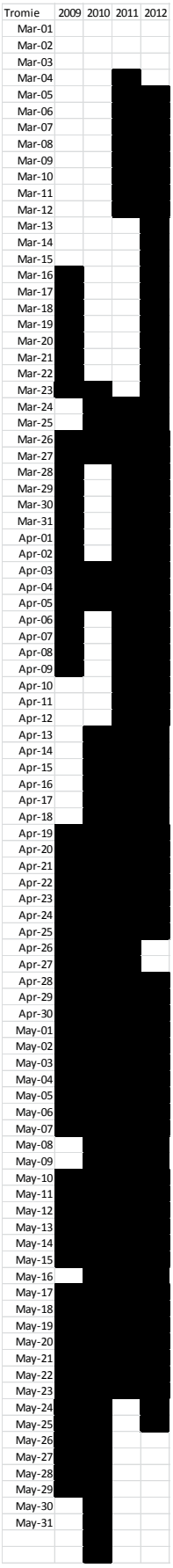
2012 was the fourth successive year of operation for the Tromie RST. The results from the four years are summarised in the table below. The number of salmon smolts captured in 2012 was approximately double the highest number recorded in the previous years. The ideal and consistent trapping conditions experienced in 2012 were undoubtedly a factor explaining the apparent increase in salmon smolt

productivity measured in 2012. Only 2 days were missed due to high water whereas in previous years at least 10 days have been missed each year, always during periods of high water when salmon smolts may have been expected to run. Operational periods for the Tromie RST are shown in Table 8 below. In 2009/10 non-operational periods in early April, a peak migration period in 2012, may have resulted in significant underestimates of total smolt outputs.

Table 7: Tromie salmon smolt and trout production estimates 2012

River Tromie	**2009**		**2010**		**2011**		**2012**	
Start Date	17/03/2009		23/03/2010		04/03/2011		05/03/2011	
End Date	29/05/2009		03/06/2010		24/05/2011		22/05/2011	
Operating Period (Days)	73		72		81		78	
Total Days Lost	10		13		12		2	
Actual Fishing Days	63		59		69		76	
Fish Data	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number smolts captured	4513	8	1294	199	2139	102	9005	164
Number parr captured	39	756	77	396	17	426	15	980
River Age	%	%	%	%	%	%	%	%
1	0	2.1	0.0	4.8	0.0	0.0	0.0	0.0
2	36.8	32.7	58.0	35.5	36.6	23.2	27.6	14.2
3	45.1	31.6	39.1	33.9	54.2	48.2	65.4	46.0
4	0	9.2	0.0	3.2	0.9	10.8	2.7	30.2
5+	0	6.1	0.0	4.8	0.0	8.9	0.0	9.6
No Age Resolved	18.1	18.3	2.9	17.8	8.3	8.9	4.3	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Population Estimates	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**	**Salmon**	**Trout**
Number Dye Marked	2107	521	1208	506	2014	477	2954	880
Recaptures	1211	101	365	83	489	79	1935	272
Percentage %	57.5	19.4	30.2	16.4	24.3	16.6	65.5	30.9
Petersen Method Estimate	**7348**	**3941**	**4283**	**3627**	**8810**	**3188**	**13770**	**3701**
Smolt production/m2	**0.034**	**0.018**	**0.023**	**0.023**	**0.041**	**0.015**	**0.063**	**0.017**

Table 8: Operational days for the Tromie RST 2009-2012



5. DISCUSSION

After four years of operation the deployment of the RST in the Tromie has become relatively routine for the Spey Foundation. The trapping season in 2012 provided almost ideal trapping conditions with stable flows throughout the period of peak smolt run with very few non-operational days. The number of salmon smolts trapped was almost double the highest number captured in earlier years.

Over 10000 salmon and trout were captured in the trap in 2012, almost 90% of which were salmon smolts. The calculated salmon smolt output for the Tromie in 2012 is 6.3 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 provide 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 peak migration period for salmon smolts was compressed with over 50% of the catch occurring in a four day period. 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 2009/10 on the profile of the salmon smolt capture pattern in those years must also be considered.

The key question arising from the trap results in 2012 is whether the 2012 Tromie salmon smolt results represent an actual increase in smolt production or did the ideal trapping conditions provide the first opportunity to capture the true productivity of the Tromie?

From Table 8 above it can be seen that there were 12 non-operational days in 2011 although 11 of these occurred in one block prior to the 24th March 2011. After the 24th March 2011 the operation of the trap was practically continuous. In 2012 2.9% of the salmon smolt catch occurred during the period from the commencement of trapping to the 24th March 2012. If the salmon smolt run timing in 2011 and 2012 had been similar then the block of non-operational days in March 2011 would have had a relatively insignificant impact of the assessment of smolt productivity.

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. Based on the salmon smolt run timing and average air temperatures there is nothing to suggest that the non-operational period in March 2011 was significant in terms of salmon smolts not captured.

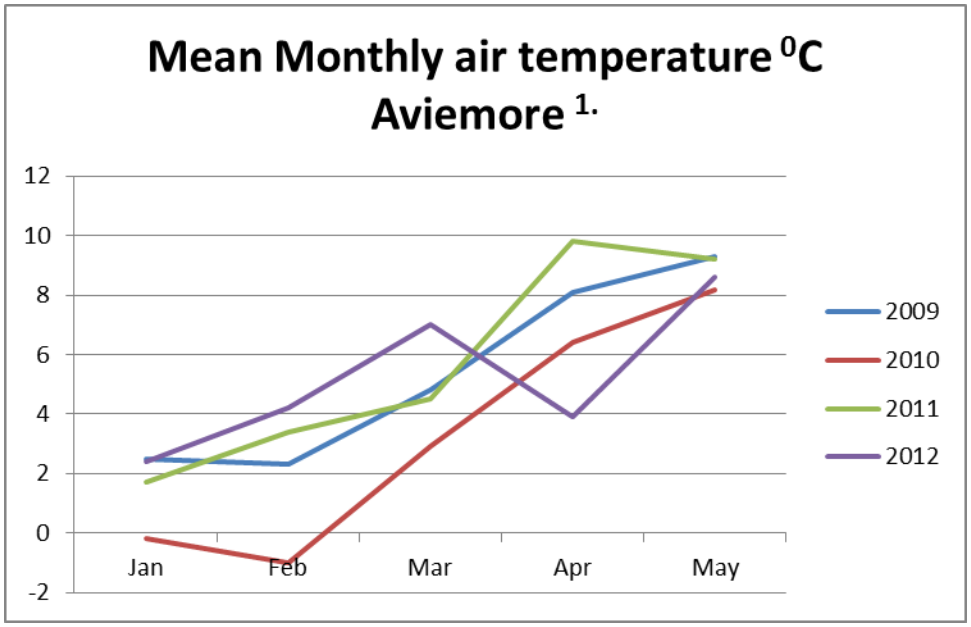


Figure 9: Mean monthly air temperatures Aviemore 2009-2012

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

There were lengthy non-operational periods in April 2009 and 2010 during periods when a significant proportion of the smolt run could have been missed, and this may have contributed to the low salmon smolt production estimates recorded during those years. The operational period of the trap in 2011 during the period when the main smolt run could have been expected was similar to that of 2012, suggesting that the almost 50% increase in the smolt run in 2012 is a true reflection of the size of the salmon smolt run.

The scale samples taken from salmon smolts found that 65% were three year old. This is the highest proportion of three year old smolts recorded during four years of trapping on the Tromie. 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 Tromie would grow slower and become smolts at an older age than those produced lower down the catchment.

Over the course of the four years monitoring on the Tromie the salmon smolt production estimates have varied by a factor of almost three, ranging from 2.3 to 6.3/100m^2. The trout smolt production estimates have been much more consistent ranging from 1.5 to 2.3/100m^2. Salmon smolt migration appears to be closely correlated with river flow and the challenges of operating a RST, even in a regulated river, will inevitably result in considerable variation in output estimates. The more consistent results for trout could be due to the less obvious correlation with river flow and the later migration period when river flows are often more stable.

6. CONCLUSIONS

The 2012 smolt trap season on the River Tromie was particularly successful with almost ideal trapping conditions throughout. The number of salmon smolts captured was almost double that captured in previous years and using a mark and recapture approach smolt production estimates were derived. At 6.3/100m2 wetted area the salmon smolt production estimate for the Tromie was within the normal range of production figures for Scotland, although for a high altitude tributary flowing off low productivity geology it could be considered to be at the upper end of expectations. Juvenile trout numbers captured were similar to those recorded in previous years.

7. ACKNOWLEDGEMENTS

This project was funded by Scottish and Southern energy (SSE) and particular thanks must go to Dr Alastair Stephen (SSE), for his continuing support.

The RST was operated mainly by Steve Burns and Jim Reid of the Spey Foundation. Their dedication and expertise is greatly appreciated. The River Spey Fishery Boards Bailiffs Richard Whyte, Jason Hysert, Ali Grant and Lindsay Grant, were all involved in installing and removing the traps as well as assisting with its operation.

I am also grateful to Joe Glennie from SEPA for supplying river level data for the Tromie Bridge gauging station.

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