Rotary Screw Trap Data from the River Tromie 2009-2010

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Spey Foundation Report 05/10

Prepared for

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Scottish and Southern Energy
Cluny HQ
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CONTENTS

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SUMMARY

A 6ft rotary screw trap was installed on the lower River Tromie, an upper tributary of the Spey during Spring 2009 and 2010, although due to an extreme flood event in 2010 the trap was severely damaged and replaced by a 4ft one. Data on the run time and age structure of salmon smolts and trout was determined along with the effects of environmental parameters such as water flow during both years. Initial estimates of salmon and trout run size are also estimated through a mark and recapture approach and application of the Petersen method. Comparisons with smolt estimation produced through electrofishing data and desk based studies are also included. Some data on other fish species was also collected.

1. OBJECTIVES

The aim of this study was to:

1. Examine the feasibility of operating 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,
4. Collect additional data on other species that may be obtained as a by-catch.

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. It is essential that every effort is made to protect and where possible enhance the numbers of juvenile salmon produced by the Spey and its tributaries. To facilitate this high quality data is required to monitor the status of the salmon stocks.

Smolt data is considered to be the best measure of the health of salmon stocks in the river, but is hard to come by and usually requires the construction of an instream trap. Although this has proved successful in many areas it often requires a considerable amount of costly river engineering and has high staffing costs. However the recent development of rotary screw traps (Figures 1) offer a more cost-effective approach.

Traps of this kind have been used extensively in Canada and the USA and are now being utilised in a variety of rivers across Scotland and the UK. They offer several advantages; the trap requires little engineering other than suitable anchor points, it is relatively moveable from site to site and will also operate across a range of flows.

This reports details the results from the two years of installation of rotary screw traps in the River Tromie, an upper tributary of the Spey.

3. MATERIALS AND METHODS

Figure 1: Rotary screw trap (6ft) installed in the lower River Tromie March 2010.

3.1 Trap Installation

A 6ft rotary screw trap (RST) (Key Mill Construction Ltd, Ladysmith, BC, Canada) was installed in the lower River Tromie downstream close to the Scottish Environment Protect Agency (SEPA) river flow gauging station (278900, 799600).

The trap is constructed with two large floats supporting a rotating drum in the centre. The drum 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 daily, generally in the morning, and captured fish were removed for analysis. The trap was also cleaned daily using brushes. During periods of high spates which carry high debris loads the drum of the trap would be lifted to protect the device and avoid it being washed away. During these periods accessing the trap also was unsafe and some sampling time was lost until safe operation conditions returned.

During early April 2010 a large spate event washed the trap away and while it was recovered from further downstream at Loch Inch the rotating drum had sustained significant damage and was un-repairable. A replacement 4ft trap was borrowed from the Atlantic Salmon Trust and installed for the remainder of the smolt run.

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 0.5 - 1km 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 to be estimated.

3.2 Environmental Data

Mean daily river level data was provided by SEPA for their gauging station at Invertromie (278900, 799600) which monitors flows in the tributary. River temperature data was recorded each day typically between 08:00 and 11:00.

4. RESULTS

4.1 Site Selection

The 6ft rotary screw trap was installed in the lower river Tromie at Scottish Environment Protect Agency river flow gauging station (278900, 799600).

The monitoring site was immediately adjacent to the SEPA gauging station at Invertromie (278900, 799600) (Figure 1) and had a number of positive features for trap operation. Initial inspections of the site indicated that the water flow was channelled between the left bank and a natural rock feature on the right bank, with careful positioning the trap a good proportion of the flow should be covered. The smolts should be concentrated into this narrow channel increasing the chance of good capture rates. There was also plenty of nearby trees to provided anchor points and access for staff to and from the trap was also relatively straightforward.

During higher flows water begins to flow over the rock features on the right hand side of the channel which helps to reduce pressure on the trap. Weather forecasts are studied daily and if rain patterns look likely to produce a very high flow event the drum is lifted to protect the trap. However, this was not achieved during the spate event on the 6th April 2010 and the trap was lost. Apart from this loss the trap was operated across a range of flows and conditions and few operational problems were encountered.

During 2009 the trap was installed from 17th March to the 29th May a period of 73 days, of those it was actively fishing for 63 days with 10 days were lost due to spates. During 2010 the 6ft RST was installed on 23rd March but lost in a spate on the 6th April. A 4ft RST was borrowed and installed on the 12th April and operated until 3rd June 2010. The traps were installed for 72 days and fished for 59 days with 13 days lost due to spates.

4.2 Fish Data 2009

Table 1: Number, age, and mean length of salmon and trout captured in the lower River Tromie RST during 2009.

Salmon		**Trout**	
Smolt	4513	Silvery	8
Parr	39	Brown	756

Scale Samples Collected						
Salmon Smolts				**Trout**		
Age	**Number**	**%**	**Mean Length (mm)**	**Number**	**%**	**Mean Length (mm)**
1	0	0.0		2	2.1	81
2	53	36.8	112.0	32	33.0	115
3	65	45.1	126.0	31	32.0	163
4	0	0.0		9	0.1	206
5				4	0.04	269
6				2	0.02	317
7						
No Age Resolved	26	18.1		17	17.5	
Un Read	0	0.0		0	0.0	
Total	144			97		

Table 1 provides a summary of the salmon and trout captured descending the Tromie from 17th March to 29th May 2009. Salmon smolts were by far the most dominant fish type with 4513 captured (99.1%). A small quantity of salmon parr were also recorded (0.9%). Trout were also caught and these were visually assessed for silvery appearance indicating the fish may be smolting and therefore likely to become a sea trout. Table 1 indicates that 764 trout were captured and of these only 8 (1.0%) were considered to be showing signs of smoltification.

Scales were collected from 144 salmon smolts and scale readings indicated that 2 and 3 year olds dominated, 36.8% and 45.1% respectively. No other age classes were captured. Table 1 also indicate that older smolt age classes had a greater mean length.

Table 1 indicates that trout showed a much wider range of ages from 2 through to 6 year olds, with 2 and 3 year olds giving the greatest percentages at 33.0% and 32.0% respectively. The silvery trout were 2 and 3 year olds. Similar to salmon the mean lengths of trout increased with increasing age.

Table 2: Other fish species captured in the lower River Tromie RST during 2009.

Species	Total
Minnow	1
Eel	0
Brook Lamprey (Transformers)	0
Stickleback (3 Spine)	0

Table 2 indicates that only one other species of fish was captured in the lower Tromie RST, a minnow.

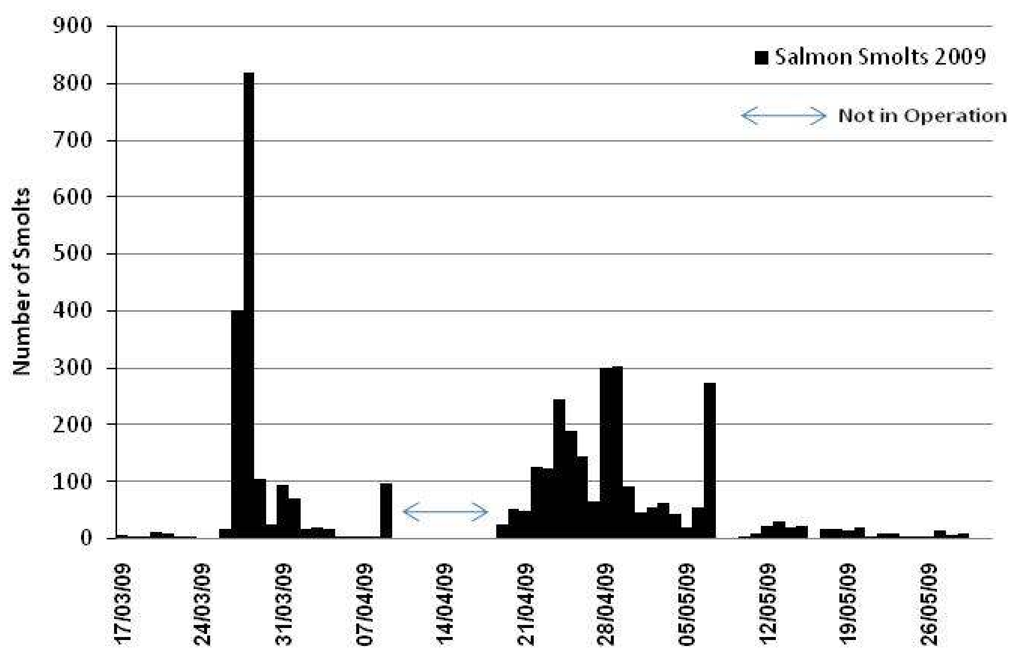

Figure 2: Daily salmon smolt capture in the River Tromie RST, 17th March to 29th May 2009.

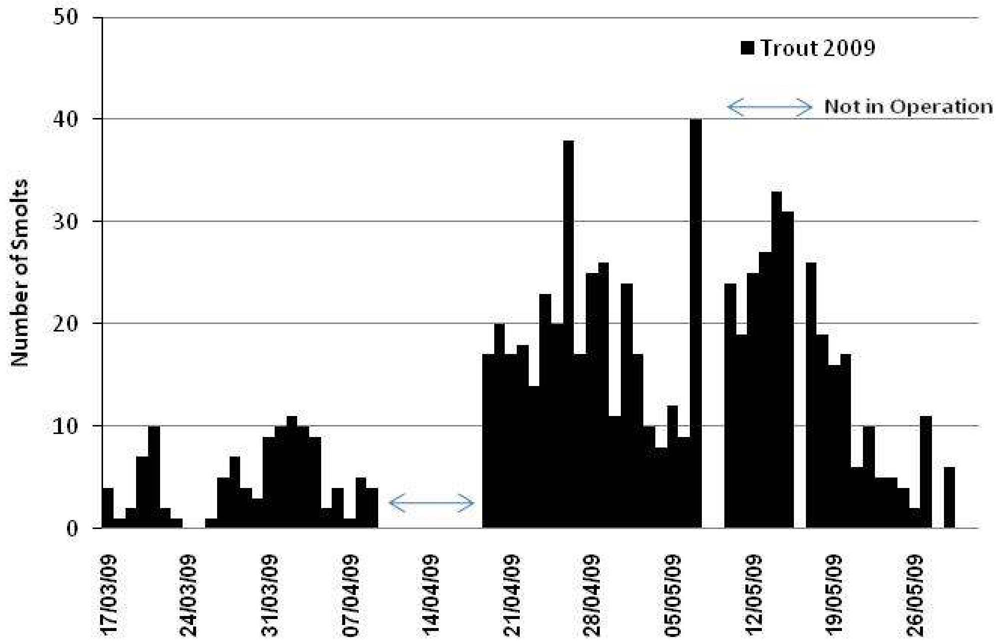

Figure 3: Daily trout capture in the River Tromie RST, 17th March to 29th May 2009.

Figures 2 and 3 indicate the daily catches of salmon smolts and trout respectively. The trap was not operated on the 24th March, between 10th and 17th April and the 8th May due to spate conditions but otherwise was operated continuously. Salmon smolts were captured on most days with the highest catch of 818 on the 28st March. Trout catches were also caught on most days with 40 trout being the highest daily catch on the 7th May 2009.

4.3 Fish Data 2010

Table 3: Number, age, and mean length of salmon and trout captured in the lower River Tromie RST during 2010.

Salmon				**Trout**		
Smolt			1294	Silvery		199
Parr			77	Brown		396
Scale Samples Collected						
Salmon Smolts				**Trout**		
Age	**Number**	**%**	**Mean Length (mm)**	**Number**	**%**	**Mean Length (mm)**
1	0	0.0		3	4.8	81
2	80	58.0	114	22	35.5	121
3	54	39.1	134	21	33.9	172
4	0	0.0		2	3.23	222
5				1	1.61	290
6				1	1.61	355
7				1	1.61	352
No Age Resolved	4	2.9		11	17.7	
Un Read	0	0.0		0	0.0	
Total	138	100		62	100	

Table 3 provides a summary of the salmon and trout captured descending the Tromie from 23rd March to 3rd June 2009. Similar to 2009 salmon smolts were by far the most dominant fish type. 1294 salmon smolts were captured (94.4%) and 77 salmon parr were captured (5.6%). Trout were also caught and these were visually assessed for silvery appearance indicating the fish may be smolting and therefore likely to become a sea trout. Table 1 indicates that 595 trout were captured and of these 199 (33.4%) were silvery and considered to be showing signs of smoltification. For both salmon and trout the numbers captured were less than in 2009.

Scales were collected from 138 salmon smolts and scale readings indicated that 2 year olds dominated at 58.0%, the remainder were 3 year olds 39.1%. No other age classes were captured. Table 3 also indicates that older smolt age classes had a greater mean length.

Table 3 indicates that trout showed a much wider range of ages from 2 through to 7 year olds, with 2 and 3 year olds giving the greatest percentages at 35.5% and 33.0% respectively. The silvery trout were generally 2 and 3 year olds. Similar to salmon the mean lengths of trout increased with increasing age.

Table 4: Other fish species captured in the lower Tromie RST during 2010.

Species	Total
Minnow	1
Eel	2
Brook Lamprey (Transformers)	0
Stickleback (3 Spine)	0

Table 4 indicates that two other species of fish were captured in the lower Tromie RST during 2010, a minnow and two eels.

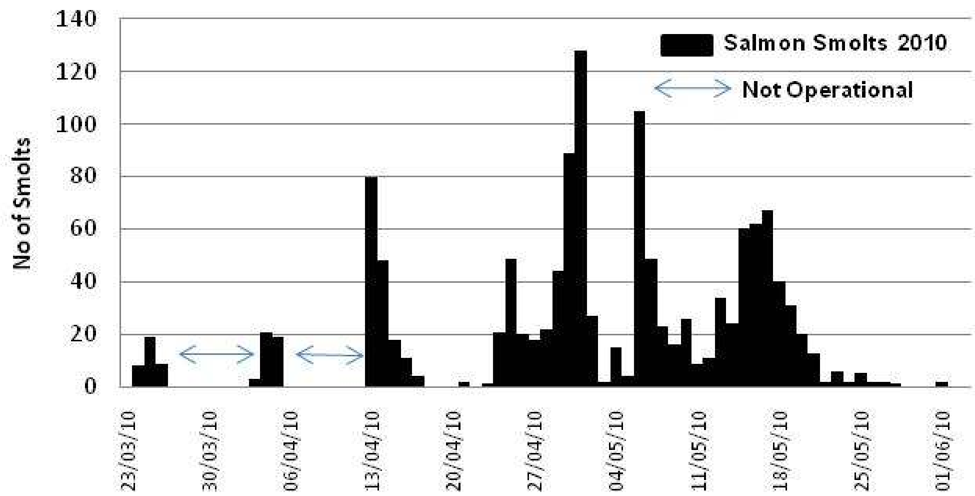

Figure 4: Daily salmon smolt capture in the River Tromie RST, 23rd March to 3rd June 2010.

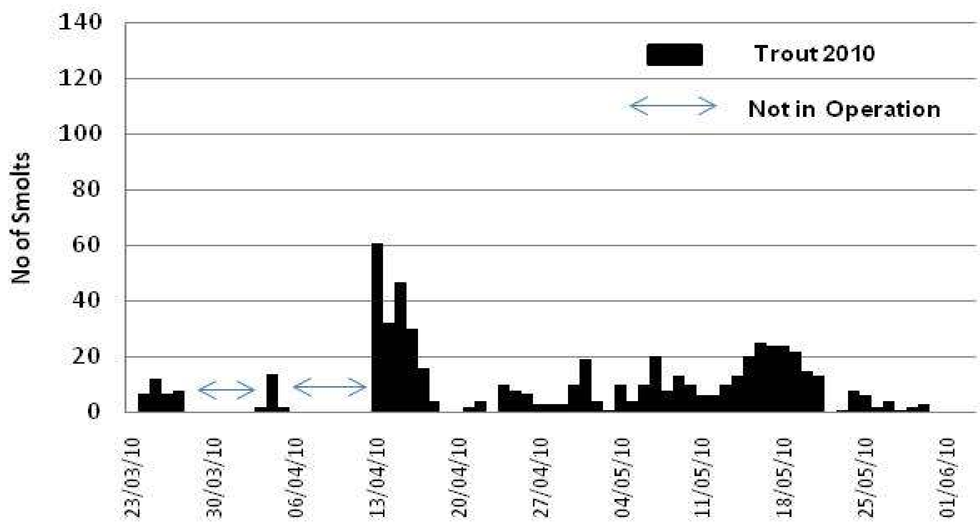

Figure 5: Daily trout capture in the River Tromie RST, 23rd March to 3rd June 2010.

Figures 4 and 5 indicate the daily catches of salmon smolts and trout respectively during 2010. The trap was not operated during 28th March to 2nd April and 6th April to the 12th April due to spate conditions but otherwise was operated continuously. Salmon smolts were captured on most days with the highest catch of 128 on the 1st May. Trout catches were also caught on most days with 61 trout being the highest daily catch on the 13th April 2010.

4.4 Salmon and Trout Capture and Environmental Parameters

Smolt Capture and River Temperature

Temperature data for the Tromie was recorded daily between 08:00 and 11:00 and is plotted with the daily catches of salmon smolts and trout in Appendix 1. It is difficult to see a clear relationship between river temperature and salmon smolt and trout capture although there is a slight suggestion that as water temperatures rise catches were higher.

Smolt Capture and River Flow

River level data from the SEPA gauging station on the Tromie, was obtained and are plotted with the salmon smolt and trout catch data in Appendix 2. River level data indicate that three sizeable spates occurred during the 2009 sampling period. The trap was operated throughout the first event (27/03/09) and the third event (08/05/09) but not through the second event (10/04/09). River levels in 2010 were characterised by one very large spate on 06/04/10 which washed the trap away! The remainder of the sampling period was generally stable with only a few small rises in levels.

It is evident from the figures in Appendix 2 that river flow influences the salmon smolt catch with higher catches of smolts recorded after a rise in water levels. To examine this further an analysis of the numbers of salmon smolts and trout captured during periods of elevated flow was conducted. High flows were defined as days when the river level was higher than the mean river level for the sampling period. The mean salmon smolt catch for the days with elevated flow was then calculated and compared with the mean smolt catch on days with average river levels or lower. The process was repeated for trout. The results are presented in Figures 6 and 7 respectively. Figure 6 indicates that for salmon smolts there is a clear pattern with more smolts captured on days with elevated flows in both 2009 and 2010. The pattern for trout is not so clear (Figure 7) with higher captures during low flow periods in 2009 and the opposite in 2010.

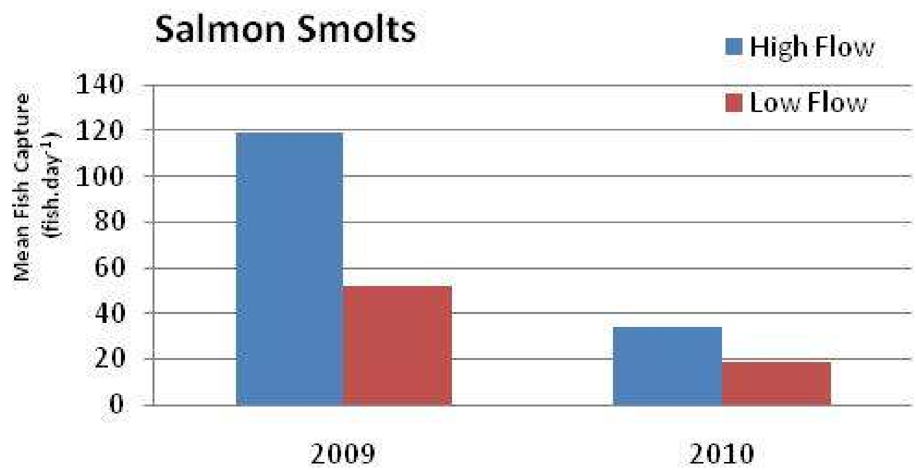

Figure 6: Salmon smolt capture during periods of high and low flow in the River Tromie 2009 - 2010.

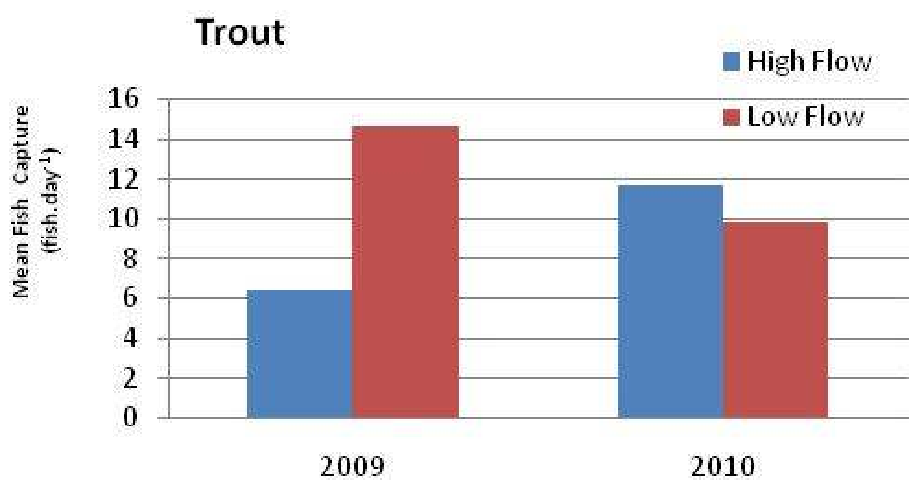

Figure 7: Trout capture during periods of high and low flow in the River Tromie 2009 - 2010.

4.5 Cumulative Salmon Smolt Catch

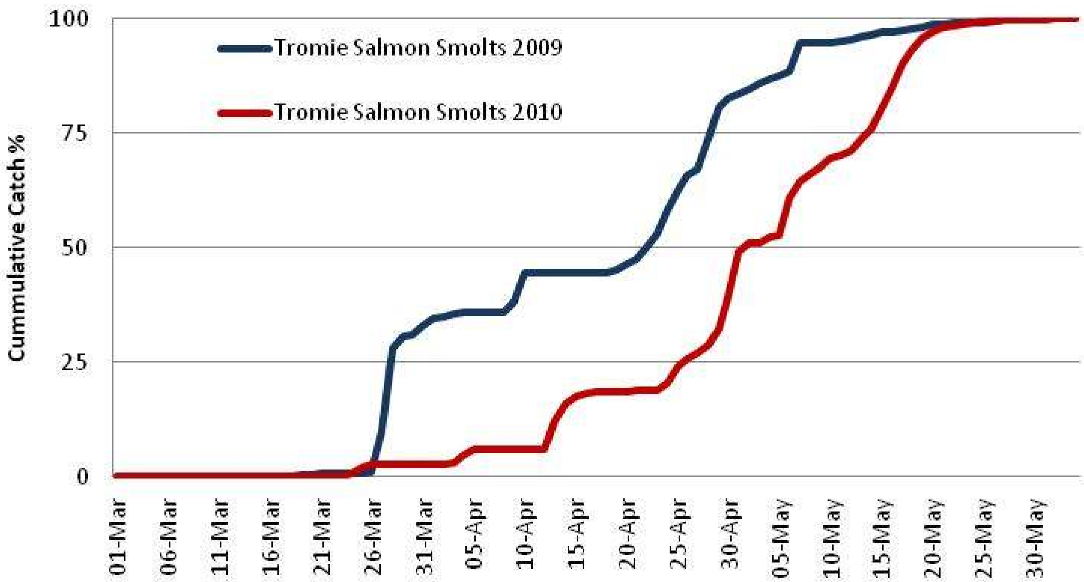

Figure 8: Cumulative salmon smolt catch (%) from 1st March during 2009 and 2010 on the River Tromie.

Figure 8 shows the cumulative smolt catch against the time from 1st March and it is evident that there was a distinct difference in the timing of the smolt runs between 2009 and 2010. The 2010 smolt run was later and slower than the run in 2009, 50% of the catch was reached on 22nd April 2009 while in 2010 this was only achieved by the 1st May. The smolt run was largely complete by 1st June in both years.

4.6 Estimating the Smolt Run for the Tromie

4.6.1 Using Electrofishing Data

One of the aims of this study was to estimate the numbers of salmon smolts originating from the Tromie. Using historical results from traps in the Spey catchment at Spey Dam, the Cally Burn and River Fiddich (Spey Fishery Board, 2005) it has been estimated that the maximum smolt output ranges between 2 and 5 smolts per 100m^2 of riverine habitat. Similar figures have been found by Marine Scotland on the Girnock Burn, Diver Dee, and by the Conon Fishery Board on the River Brahan (*Mckelvie, S. pers com.*).

The length of the Tromie utilised by salmon is approximately 18km while the mean wetted width is 10.5m (determined from electrofishing sites). So the area available for smolts is 189000m^2. Using the smolt output range of 2 and 5 smolts per 100m^2 we would predict the Tromie to produce between 3780 to 9450 smolts. This can be checked by using electrofishing survey data and the data from the rotary screw trap.

Table 3: Smolt estimation for the River Tromie using electrofishing data from 1990 to 2008.

Tromie Smolt Estimation from EF Data 1990-2008		
River Dimensions	Mean Width (m)	River Length (m)
	10.5	18000
Area (m^2)	**189000**	
Long term Mean Densities (m^{-2})	Salmon 1+	Salmon 2+
	0.107	0.033
Adjustment >90mm	Salmon 1+	Salmon 2+
	65%	100%
Adjusted Density (m^{-2})	**0.070**	**0.033**
Production	Salmon 1+	Salmon 2+
	13145	6237
Total	**19382**	
Over winter survival	50%	
Estimated Smolt Output	**9691**	

Table 3 illustrates how long term electrofishing data can be used to estimate salmon smolt output. The mean densities of salmon 1+ in the Tromie from 1990 to 2008 is $0.107m^{-2}$ while the mean density for salmon 2+ is lower at $0.03m^{-2}$. By examining length data from the electrofishing data, approximately 65% of the 1+ salmon are 90mm or above and so are likely to smolt the following spring. All the 2+ parr have reached 90mm and will potentially smolt. These figures are then multiplied by the tributary area to provide an estimate of production. Over winter mortality is also estimated at 50% and so using the electrofishing data we achieve an estimate of 9691 smolts (0.051 smolts per m^2) from the Tromie.

4.6.2 Using RST Smolt Data

To estimate the Tromie's salmon smolt run using the RST a mark-recapture scheme was initiated. Throughout the spring sampling periods a proportion of both salmon and trout smolts were marked using a simple Alcian Blue dye mark, transported approximately 1km upstream and released. The numbers of marked smolts recaptured were then recorded. Initially 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,

$$e_i = (m_i/M_i)$$

Data from the 2009 and 2010 sampling season was used with the Petersen method to estimate the salmon smolt output for the Tromie (Table 4). Table 4 indicates that the percentage recapture rates were good for salmon, 57.5% in 2009 and 30.2% in 2010. The lower efficiency in 2010 reflects the change from a 6ft trap in 2009 to a 4ft one in 2010. Using the Petersen method an estimated run of 7852 salmon smolts (0.042smolts per m^2) from the Tromie in 2009, while in 2010 the estimate was lower at 4283 smolts (0.023smolts per m^2) in 2010.

Table 5 applies the same approach for trout and it is evident that the recapture rates of trout were lower than those of salmon, 19.4% in 2009 and 16.4% in 2010. The run size for trout was estimated at 3941 fish in 2009 and 3627 fish in 2010.

Table 4: Salmon smolt run estimates for the River Tromie for 2009 and 2010 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

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

5. DISCUSSION

The use of rotary traps to estimate smolt outputs has increased considerably in the last few decades. The approach was initially developed in the USA and Canada (Volkhardt, *et al* 2007) and adopted in the UK during the 1990s. This report provides data for two years of RST operation on the River Tromie, an upper tributary of the Spey.

The site selected for the trap was beside the SEPA gauging station at Invertromie (278900, 799600) and had a number of positive features for trap operation. The water flow was channelled through a narrow rock feature and this appeared to also concentrate smolts increasing their chance of capture. There was also plenty of nearby trees to provided anchor points and access for staff to and from the trap was also relatively straightforward.

Spates are always problematic to any trapping system and the RST is no different. During larger spates the drum was raised to prevent damage. However, this was not achieved during the spate event on the 6th April 2010 and the trap was lost. Apart from this loss the trap was operated across a range of flows and conditions and few operational problems were encountered. Although the drum was lowered back into position as soon as possible after spates some smolts will be missed. Indeed Figures 8 and 9 indicate that when the trap was re-installed and started on the 12th April 2010 the catch of salmon smolts and trout was quite high for the next few days perhaps indicating that a sizeable number of smolts had emigrated from the Tromie after the spate on the 6th April 2010.

The site was easily accessible to the public with a popular nature trail passing close-by. In a similar previous study on the Fiddich this led to vandalism problems but no so far no such problems have been encountered at the Tromie site.

Six species of fish were captured by the trap, including salmon, trout, minnow, eel, stickleback and Brook lamprey. Salmon smolts were the most abundant followed by trout.

The vast majority of the salmon emigrants were smolts and two age classes were recorded. Three year old smolts were more prevalent in 2009 while the pattern changed in 2010 with two year olds more abundant. Output and age will vary from year to year and will be influenced by a range of environmental factors, currently it is not clear why there was substantial change in the age of the salmon smolt migrants from 2009 to 2010, a longer data set will be required to examine this further. The mean length of salmon smolts increased with increasing age. This is similar to data from other Highland Scottish tributaries such as the Water of Mark on the North Esk (McKay and Smith, 2007).

The numbers of trout captured during the study was a surprise since a similar recent study on the neighbouring River Truim has indicated much lower migrations of trout (Laughton, 2010). The three large lochs within the Tromie catchment may contribute to the higher numbers of trout emigrants. The mark-recapture approach was used for trout as well as salmon and indicated that recaptures ie, trap efficiency, was much less for trout than salmon smolts. This may result from differences in behaviour between the species; the salmon are on a definite seaward migration so after re-release above the trap they will be highly likely to migrate downstream again. Trout may not be as committed to downstream migration and so could move upstream from the trap instead. In addition salmon smolts tend to migrate higher in the water column (Moore, Potter, Milner and Bamber, 1995) so may be more susceptible to capture. The large trout may also be strong enough swimmers to avoid the sampling drum.

All the trout were visually assessed for silvery colouration indicating potential development to a smolt. However, only 1% in 2009 and 33% in 2010 were considered silvery in appearance and may have developed into a sea trout smolt. The majority of these trout smolts were 2 and 3 year olds but older trout, up to age 7, were also captured. Elliot (1994) indicated that sea trout smolts range from 140mm to 250mm for the British Isles and the size range observed for the Tromie is within this. Although the trout captured were silvery in appearance it is not clear whether they would have developed into sea trout smolts. Most trout populations will produce a proportion of sea trout and there are reports of occasional sea trout in the upper Spey. Brown trout also undergo migrations within the river and tagging studies have shown trout will travel from the upper tributaries downstream to the lower mainstem. For example, a brown trout (W1923) tagged on the Feshie in October 2005 was caught in June 2010 at Ballindalloch, over 50km downstream.

Smolt capture was during the night and on the occasions when the trap was inspected through the day no smolts were recorded. A number of studies have indicated that salmon smolts largely migrate during the night (Thorpe, Ross, Struthers and Watts, 1981; Moore, Ives, Mead and Talks, 1998) and the pattern of capture here supports this.

Environmental parameters also influenced the catches, in particular river flow. In general higher catches of salmon smolts were evident after a rise in water flow than in periods of more stable flows. This is similar to other studies such as Allen (1944); Hvidsen, Jensen, Vivas, Bakke and Heggberget, (1995). The loss of the temperature loggers left only daily spot records of temperature for analysis. There is a slight suggestion that capture rates were greater when river temperatures were higher. Temperature is an important factor in the development of smolts (Gurney, Bacon, Tyldesley and Youngson, 2008) and better long term data is required for the Tromie throughout the year, not just for the sampling period, to explore this factor further. .

The output of salmon smolts from a tributary can be predicted by estimating the stream area and applying smolt estimates from other rivers. This was used to predict a range of smolt outputs for the Tromie of 3780 to 9450 smolts. This was then tested using electro-fishing data and RST data.

Electrofishing data provided estimates which were towards the upper end of this predicted range, 9691smolts while the RST salmon smolt output estimates varied considerably between 2009 and 2010 (7852 smolts and 4283 respectively). It is not clear why there is a large difference between the two years, but environmental conditions such as the long cold winter through 2009/10 and the loss of the trap in early April may have affected the 2010 estimates. However, variations of this magnitude have been documented on other upland tributaries such as the Girnock Burn (Buck and Hay, 1984). The range of smolt outputs, $0.023m^{-2}$ to $0.042m^{-2}$, is lower than the $0.07m^{-2}$ documented in the Girnock (Buck and Hay, 1984) but similar to more recent data from the Water of Mark in the upper North Esk which produced 0.04smolts per m^2 in 2009 (G. Smith and F. Mackay, Marine Scotland Science, *pers com*), the Girnock Burn .

In general the smolt estimates were encouraging given the Tromie is affected by significant water abstraction for hydro-electric purposes. However, a number of problems are evident within this approach.

The simple Petersen mark-recapture model used here for smolt estimates depends on a number of assumptions including: the population is closed ie, there is no significant movement in or out of the population; all fish have the same probability of re-capture; all fish have an equal probability of capture in the first sample and similarly in the second sample; marking does not affect the catchability; fish don't lose their marks; and all recovered marked fish are reported. Not all these criteria are adequately met. It is debateable if a migratory smolt population can be considered as a closed population. Salmon are known to migrate as pre-smolts during the Autumn and data from the Girnock Burn indicate that this can be a significant portion of the population (Buck and Hay, 1984). Currently there is no data on this aspect of the smolt run available for the Tromie.

In general it is assumed that catchability remains the same between each sample and that that the dye marks used will remain on the fish for the short time period required. Trap operators were experienced in marking techniques and although some marked fish may have been missed, losses due to lack of observation is not thought to be significant. However other approaches to estimating smolt population such as installing paired traps and batch marking groups of fish are worth exploring as this would allow more sophisticated analysis models to be applied (see Bjorkstedt, 2000). However, to achieve this more resources and manpower would be required.

Trap efficiency will also vary throughout the sampling period (Schwarz and Dempson, 1994; Thedinga, Murphy, Johnson, Lorenz, and Koski, 1994) and can be related to environmental conditions such as water flow (Volkhardt, *et al* 2007). This provides a relationship which allows the prediction of catches to be developed and this can then be utilised when the trap is not operational due to debris jams etc. Inclusion of these estimates would further improve the overall population estimate. However, further data across a wider range of flow rates is required before a robust relationship of this kind can be fully developed for the Tromie.

The smolt prediction from electrofishing surveys was based on a long term dataset (1990-2008) and includes a range of survey sites across the length of the Tromie which are visited yearly. A whole range of factors affect electrofishing data such as habitat, flow rates, adult spawning success, operator efficiency, number of survey sites visited, etc, and further work to refine the smolt output prediction to account for some of the factors is required. Comparing the smolt output with the density of relevant age classes from the preceding year may also be more helpful than simply using averages. For example the smolts produced in 2010 should be compared with salmon parr densities from 2009. Nonetheless it is encouraging to report that both approaches are providing smolt estimates that are similar to the predicted range. As more data is collected from the RST this approach can be further developed and potentially a relationship between smolt output and elecrofishing densities developed for the Tromie. Collecting information on adult numbers and spawning in the Tromie would also be beneficial.

6. RECOMMENDATIONS

1. Continue sampling Tromie smolt runs using rotary screw trap (RST) at the SEPA Gauging Station 2011 onwards,
2. Further examine the effects of environmental parameters on the smolt run from the Tromie,
3. Explore and implement better population estimate techniques for the RST on the River Tromie,
4. Continue to develop area based estimates of smolt production from the Tromie using electrofishing data and compare with smolt trap estimates,
5. Explore the potential for installing a RST during Autumn on the River Tromie.

7. CONCLUSIONS

The rotary screw trap was successfully operated in the River Trome, an upper tributary of the Spey, during 2009 and 2010. Valuable data on the run time and age structure of salmon smolts was gathered along with the effects of environmental parameters such as water flow and temperature. Application of a simple mark and recapture approach allowed population estimates to be created and comparisons with predicted smolt outputs using desk-based estimates and electro-fishing data to be explored. The RSTs provided excellent data for salmon smolts and although trout were regularly caught the traps did not appear to be as good at trapping them. A small amount of data on minnows, eels, lamprey and sticklebacks was also collected.

The Tromie is a known spawning area for the vulnerable spring run adult salmon and the river is also subjected to water abstraction for hydro-generating purposes. Thus the smolt data will prove very valuable for the future management of the Spey SAC salmon stocks.

8. ACKNOWLEDGEMENTS

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Thanks must go to the following personnel: Steve Burns (Spey Foundation), Jim Reid (Spey Foundation) and Jason Hysert (Spey Fishery Board) who operated the trap for the season; Richard Whyte, Duncan Ferguson and Lindsay Grant, all from Spey Fishery Board, who very ably assisted with the installation and removal of the traps. Thanks also to Marcus McBain, Baldow Smithy, who attempted to repair to the trap after spate damage. I am also extremely grateful to the Atlantic Salmon Trust who allowed us to borrow their RST in 2010 and to Eddie Macarthy (Thurso DSFB) for his help and hospitality.

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Appendix 1: RST salmon smolt and trout capture with river temperature data for the River Tromie 2009 and 2010.

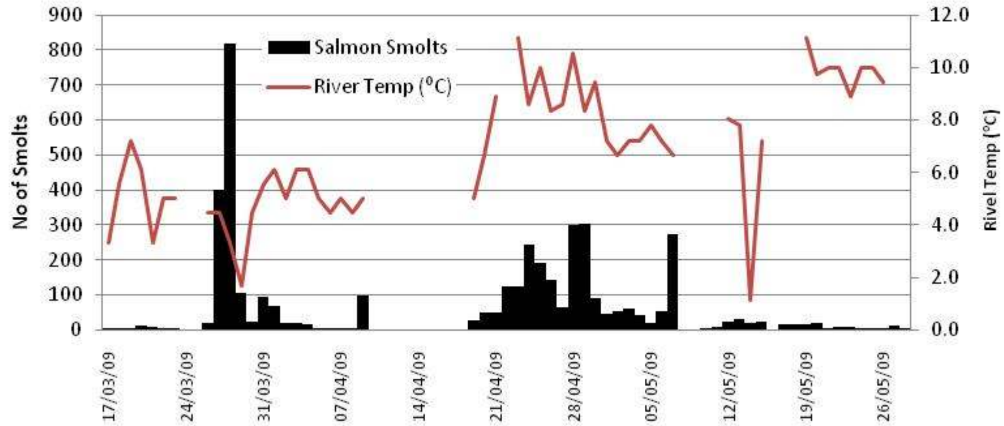

Figure 1:Salmon smolt capture and river temperature (^{0}C) during March to June 2009 on the River Tromie.

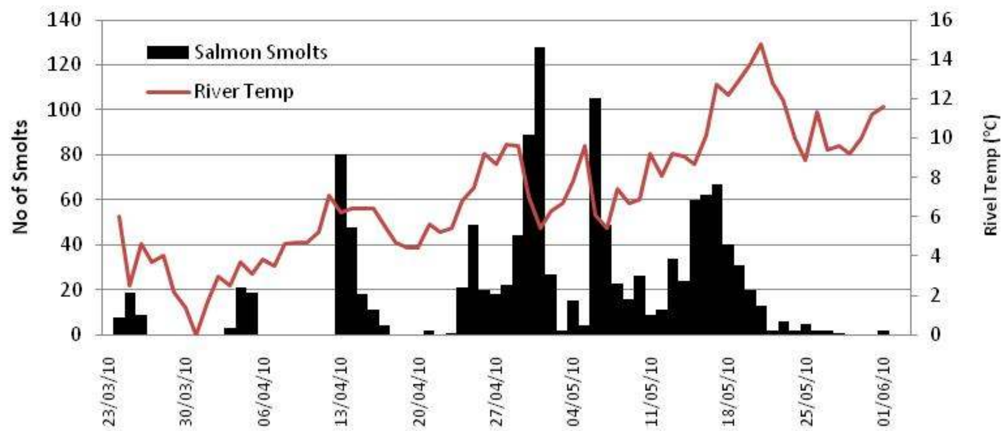

Figure 2: Salmon smolt capture and river temperature (°C) during March to June 2010 on the River Tromie.

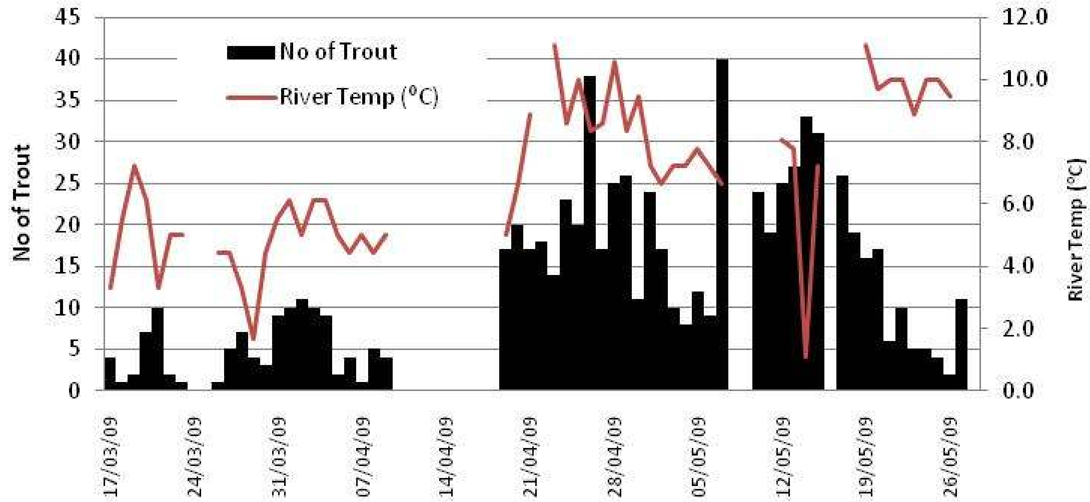

Figure 3: Trout smolt capture and river temperature (^{0}C) during March to June 2009 on the River Tromie.

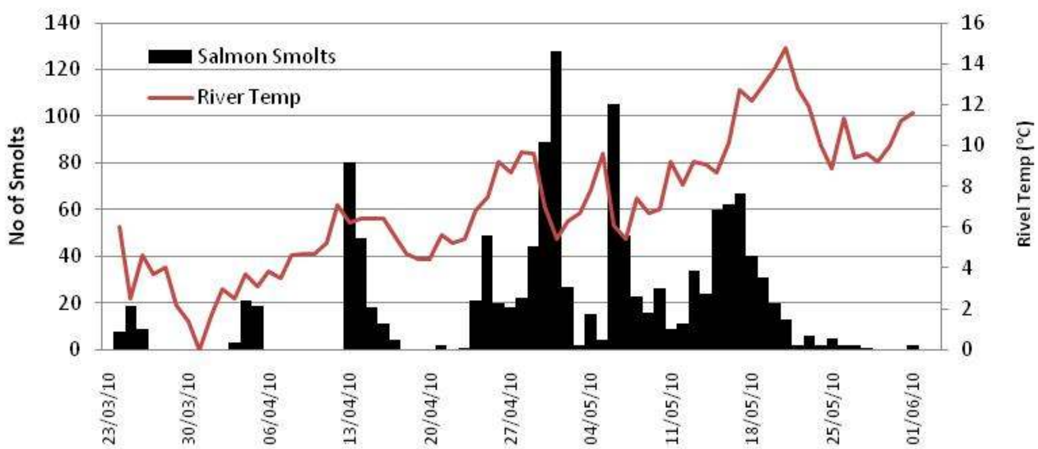

Figure 4: Trout smolt capture and river temperature ($^{\circ}$C) during March to June 2010 on the River Tromie.

Appendix 1: RST salmon smolt and trout capture with river level (m) data for the River Tromie 2009 and 2010.

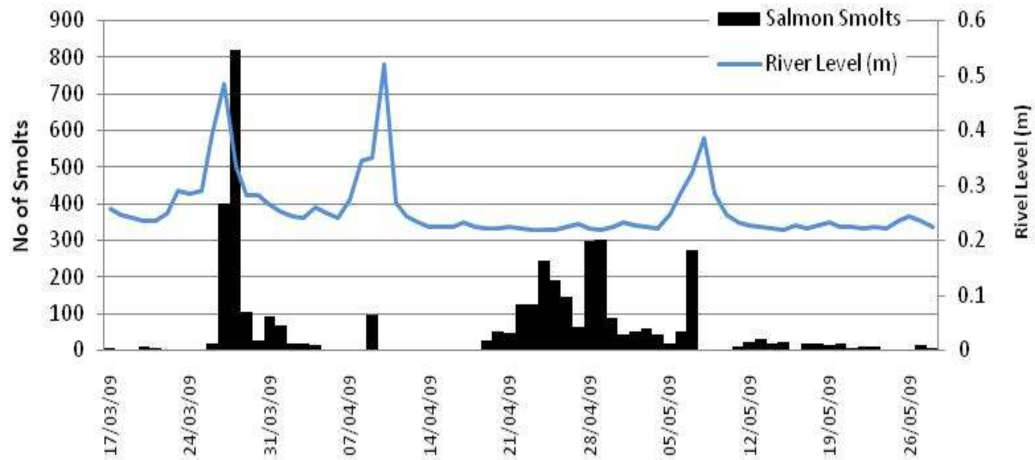

Figure 1: Salmon smolt capture and river level (m) during March to June 2009 on the River Tromie.

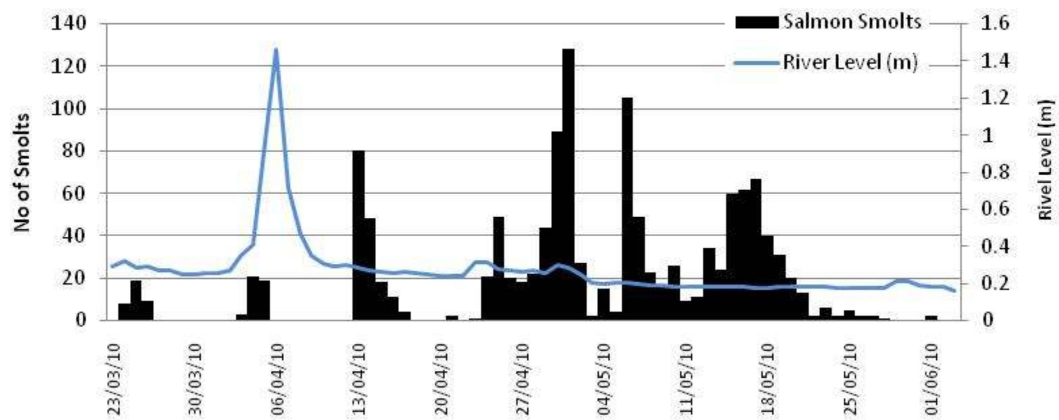

Figure 2: Salmon smolt capture and river level (m) during March to June 2010 on the River Tromie.

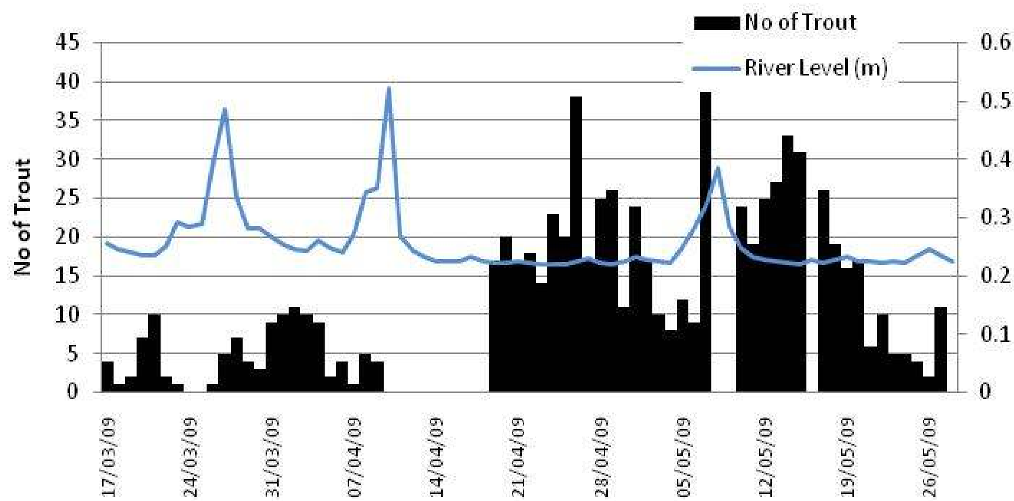

Figure 3: Trout capture and river level (m) during March to June 2009 on the River Tromie.

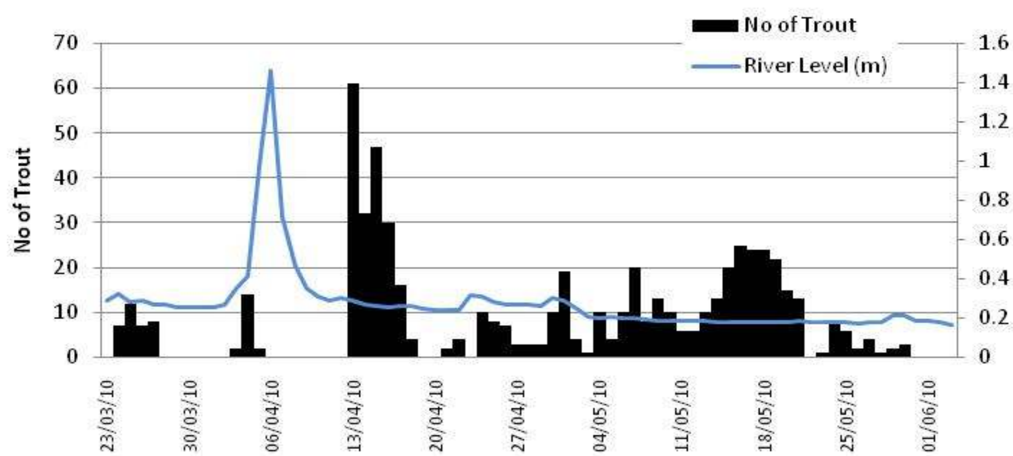

Figure 4: Trout capture and river level (m) during March to June 2010 on the River Tromie.