Electrofishing Review 1997 - 2013

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Introduction

Electrofishing surveys have taken place on the Annan on a regular basis since 1997. Prior to that there were ad hoc surveys carried out for differing reasons such as the proposed construction of a reservoir to supply a Chapelcross B reactor and surveys carried out by the Freshwater Fisheries Laboratory in Pitlochry as part of a national project. Whilst we have this data it is not compared in this report as the methods and equipment used were not standardised. Since 1997 however all surveys have followed a protocol set out by the Scottish Fisheries Co-ordination Centre (SFCC). The SFCC provides a mechanism for fisheries managers to standardise data collection and storage methods. Software development is co-ordinated in a cost-effective manner and members are supplied with spatial data (GIS mapping information detailing geology, land use, terrain etc) relevant to the freshwater environment within their catchment. The Annan has been a member since 1998. More information about this organisation can be found on their website, www.sfcc.co.uk.

The surveys on the Annan have been carried out for a variety of reasons since this date. There is a small core of monitoring sites that are looking for general population changes (on sites where no intervention activity is planned) while in addition monitoring has taken place at a number of sites for commercial companies to monitor the effects of construction (mainly wind farms and small hydro schemes) and at other sites to monitor the effects interventions such as habitat improvements and hatchery introductions.

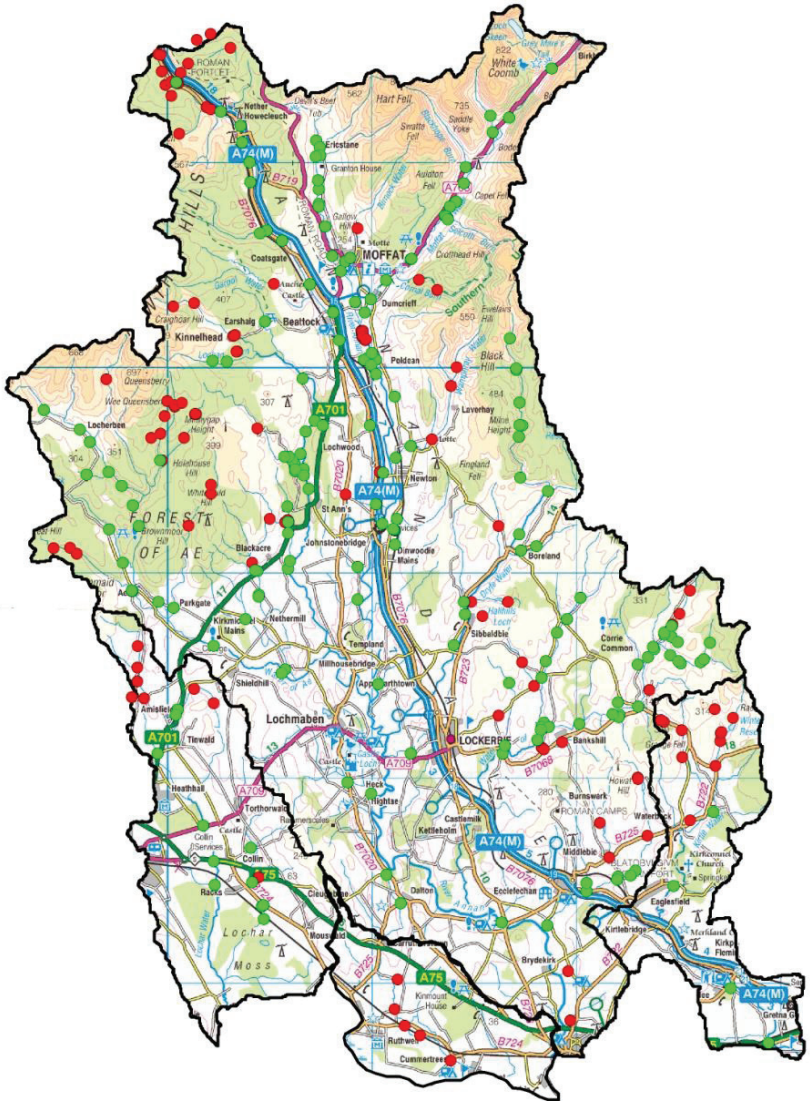
Three types of survey are used: single run semi-quantitative surveys that describe the number of fish present as a minimum density per 100m2; multiple run fully quantitative surveys where the total number of fish present is described as a density per 100m2; and timed surveys where the number of fish caught per minute is described. For the purposes of this report we will be using data from all of the single run semi quantitative fishing's and the 1st run of fully quantitative surveys as these make up the bulk of the data base and can be compared easily with each other. Surveys carried out specifically to monitor whether stocked fish are present have been disregarded. The timed surveys are not going to be described in this report as they are relatively few in number and have been carried out for very specific purposes. Consideration will be given as to whether or not more of these types of surveys will be used in the future.

Electrofishing is also carried out for other fish species such as lamprey and eels. These surveys are again relatively few in number and whilst they are important in their own right this review relates solely solely to the numbers and distribution of salmon and trout. With trout we are not able to say whether a juvenile trout is likely to become a brown trout or a sea trout. We can however make a judgement call where we know the makeup of the spawning stock of trout in specific parts of the catchment.

The review will look at data collected at 299 locations throughout the jurisdiction of the River Annan DSFB and sift approximately 1,000 actual fishing events. It will mostly combine large groups of electrofishing data with the addition of some case studies on separate tributaries. Fish will be split into four categories 0+ salmon (salmon fry in their first year since hatching), 0+ trout (trout fry in their first year since hatching) 1++ salmon (salmon parr that will be in either their second, third or fourth year since hatching) and 1++ trout (trout parr that will be in either their second, third or fourth year since hatching). Larger adult fish are occasionally caught during electrofishing but these captures are very ad hoc and they are not included in this report.

General Picture

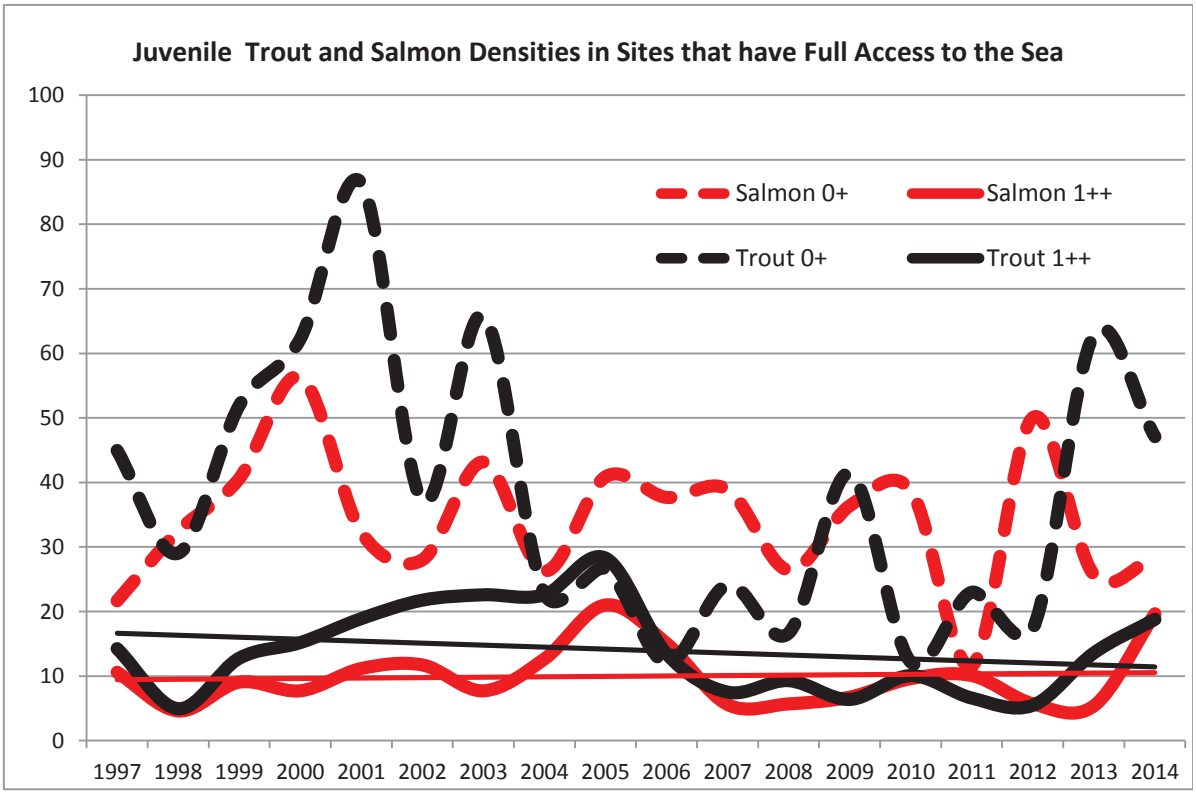
Electrofishing is at its most efficient when channel width is less than 10 metres. Once the channel becomes significantly wider than this larger fish such as parr will evade capture by going around the operatives and the densities of fish found may be a significant underestimate (fry do not feel the effect of the charge until it is too late for them to evade capture). In these situations timed fishing may be used but only fry captures are likely to be accurate which gives a false impression of the number of fish present. On the map below the sites marked in green show sites where salmon access is present and likely. Adult salmon tend to prefer larger watercourses for spawning compared to sea trout and in general juvenile salmon will be absent or in very low numbers once the width of the watercourse is less than 1-2 metres depending on how far the site is from a significantly larger watercourse. Parr in will often venture further than fry up these smaller watercourses. Fry on the other hand tend not to travel very far from the area they have hatched in. As can be seen the expected distribution of salmon in the Annan system is wide, this is because there are very few barriers to salmon migration within the system until we are into small burns where salmon would not be expected to be present.



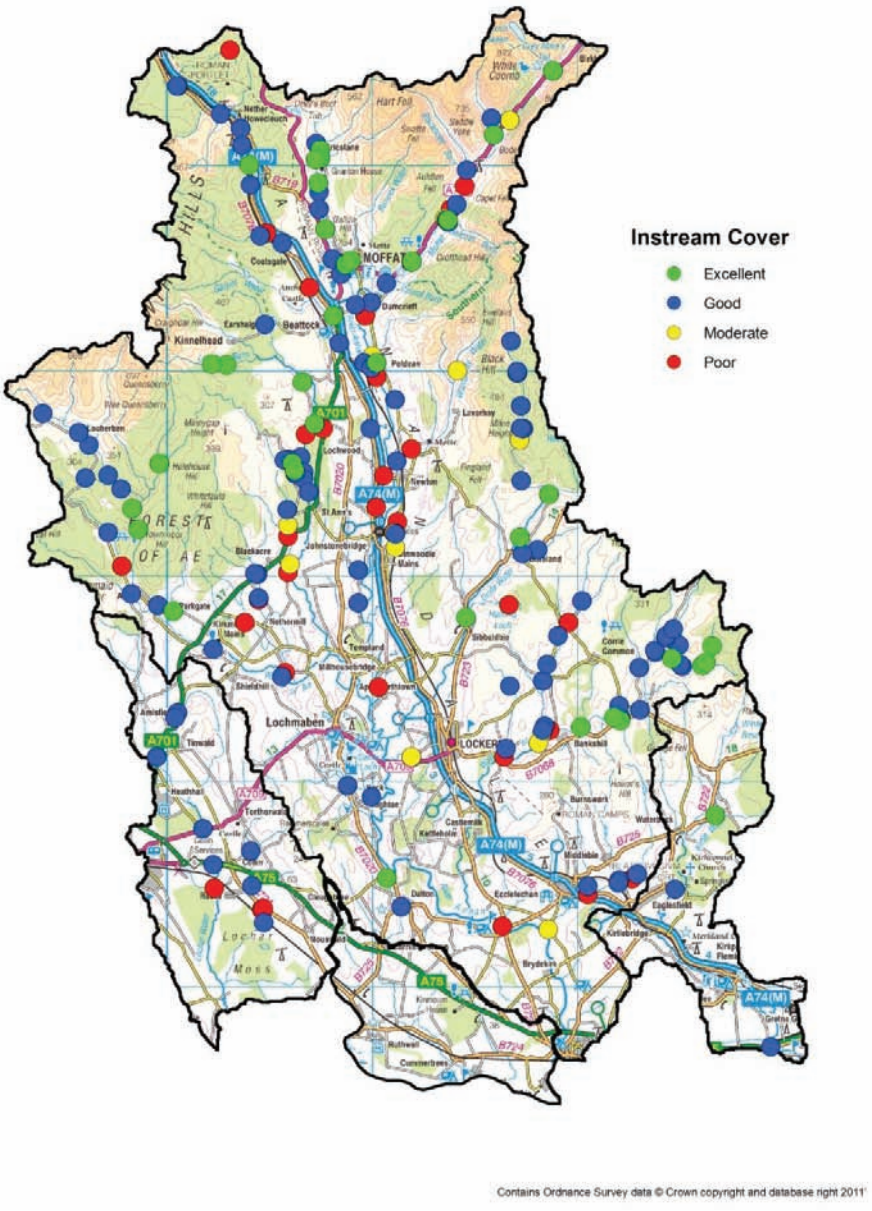
Trout are more problematic as their distribution will be wider and it is known that trout can pass natural barriers that would be insurmountable to salmon. Trout are present in practically all the sites coloured red as well as green but many of them are isolated populations that have no access to the sea or main river. For the purposes of this report the trout densities will be compared where we know for definite that access to the sea or the main river fishery is possible, i.e. the 'green' sites.

The plasticity of trout populations does cause issues. Trout in one electrofishing site may exhibit several life style traits. Fully resident within the burn, migration into the river or migration to sea. We know that some parts of the river are extremely important for brown trout, the Evan Water is the best known and we also know that other tributaries are very important for sea trout: the Milk, the Kinnel and the Ae are good examples of this. We are less sure about others though.

From a fishery perspective it is important to note that when anglers are fishing for Brown trout they may be fishing for trout from any of the populations. Very few male trout migrate to sea whilst the majority of females from the known important sea trout areas will go to sea. The males staying in the river become part of the brown trout fishery. The important population is not the one being caught by anglers but the one which actually breeds at spawning time.



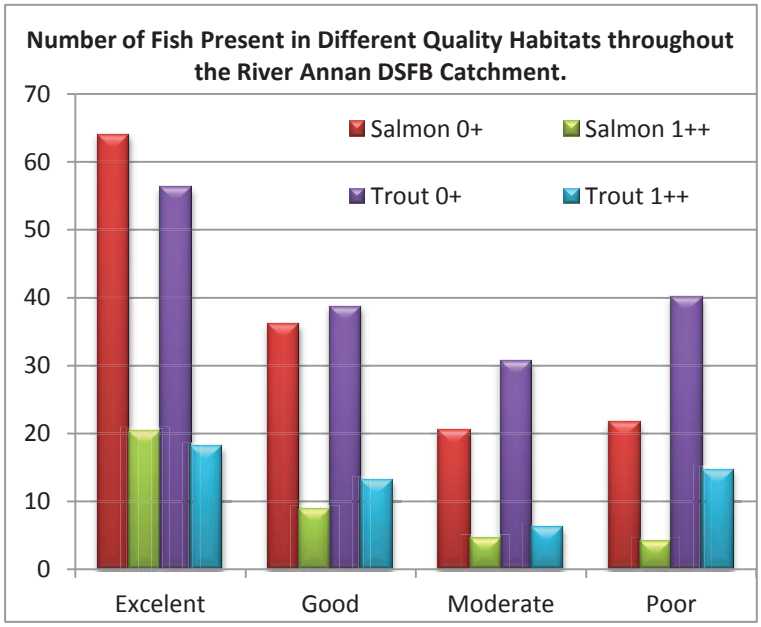
The chart above represents the densities found at electrofishing sites each year across the whole of the data set where full access is known to be present. The first thing that is noticeable is the highly variable nature of the data. This will be due to a number of reasons. For example, fry density is highly dependent upon the number of Adult fish making it into the spawning burns each year, indeed in a previous electrofishing fishing report written by James Grubb we showed a an extremely strong relationship between salmon caught on rod and line in one year and the salmon fry densities found in the subsequent year. It is also noticeable that salmon numbers, in general, appear to be less volatile than those of trout, perhaps unsurprisingly with the collapse of sea trout runs in recent years. Parr densities are often regarded as more important. The mortality of fry of both species is massive with as many as 98% of those that hatch of them succumbing by the first winter. This mortality is not consistent however as it is based upon the amount of habitat that is available for colonisation. In years where there are fewer fry hatching the mortality is likely to be slightly lower. The mortality of parr will be significantly lower and the number of parr present has a strong relationship with smolt output. For the management of migratory fish at a local level increasing smolt output, where possible, should be our aim. In general whilst there has been some variation in salmon parr numbers there is no real trend either way. With trout parr there is a slight trend downwards over the



time series but it would be difficult to argue that this is significant as the variation is somewhat greater. It is noticeable that for both salmon and trout parr the numbers peak dramatically in 2005. It should however be pointed out that because we measure the number of fish by 100/m2 that we can get a significant variation due to weather conditions. 2005 was a relatively dry year (certainly at the time of electrofishing) and stream widths were reduced on electrofishing sites. Reach length was broadly the same but the m2 covered at each site will have dropped. This can have a huge effect on the number of fish recorded as the density will invariably be higher during these periods.

The density of fish found within the river is heavily determined by the quality of the habitat found at a location. Poor quality habitat will suppress the number of fish present and high quality habitat will increase the number of fish present. When we are electrofishing we carry out a number of measurements of habitat but one of the most important measure is highly subjective as it involves a visual scoring system where the in stream habitat is scored from excellent to poor. In stream habitat is critically important to salmon but less so for trout where bankside habitat is more important. The scoring system is based upon the habitat requirements for salmon parr. High quality salmon parr habitat will have lots of variable stone sizes, a fairly swift current with lots of variation and be relatively shallow (less than 40cm deep). Slower deeper water will tend to favour trout. It should be noted that the quality of the habitat may be damaged due to anthropogenic effects or it may be naturally of poor quality for salmonids. The map below describes the quality of the habitat on the electrofishing sites sifted for this report.

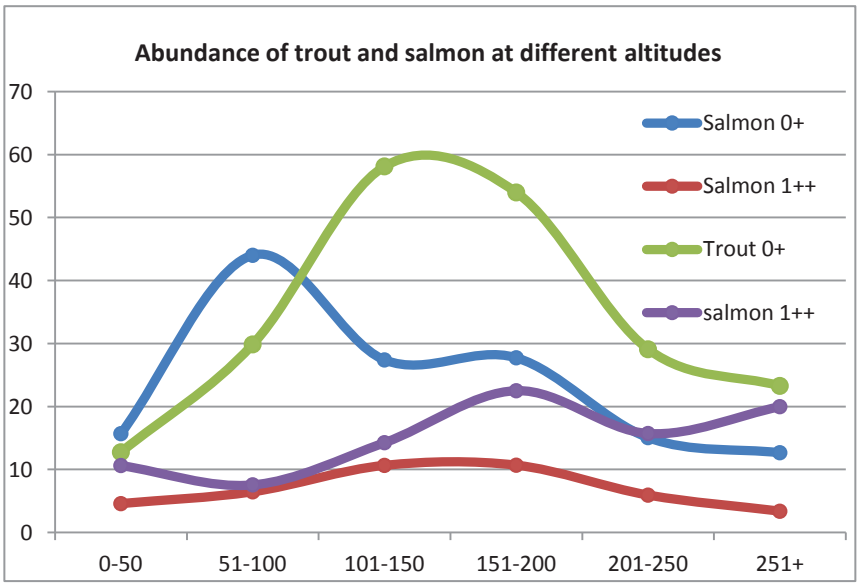
As can be seen the majority of sites have habitat that can best be described as good and in general the reaches which have habitat described as moderate or poor are in the lower reaches of the river. This is in areas where agriculture is more intensive and often significant changes have been made to the morphology of the river through either dredging, straightening or over grazing.



We need to be confident that these visual assessments are robust due to importance of habitat to the number of fish present. The chart below indicates that we are pretty good at getting this assessment right despite the opinion of several people being involved in surveys since 1997. There does however seem to be some ambiguity between what is described as poor habitat and as moderate habitat and it could be argued that we should combine both categories as poor and just have three ranges.

As the map shows that the poor quality habitats tend to be in the lower reaches it is worth looking at how altitude affects abundance of fish.

As can be seen at very low altitude, less than 50m above sea level the abundance of young salmon and trout is generally very low. Salmon fry abundance is at its highest between 50 and 200m although interestingly the parr numbers do not reach over 10 fish/100m2 until we get into the 100-150 altitude. This may not be a true reflection of abundance as we know from work carried out in the late 90s that a high proportion of the smolt output from our lowest altitude areas leave as S1 fish (fish that have only spent 1 winter in the river) well before summer electrofishing commences. Trout production peaks at higher altitudes which is not surprising as they do tend to penetrate further up the river. Production in the highest altitude areas is lower. This will be due to intermittent access issues; in some years it will not be possible for fish to use the fullest extent of the river if we experience low water at the wrong time of year.

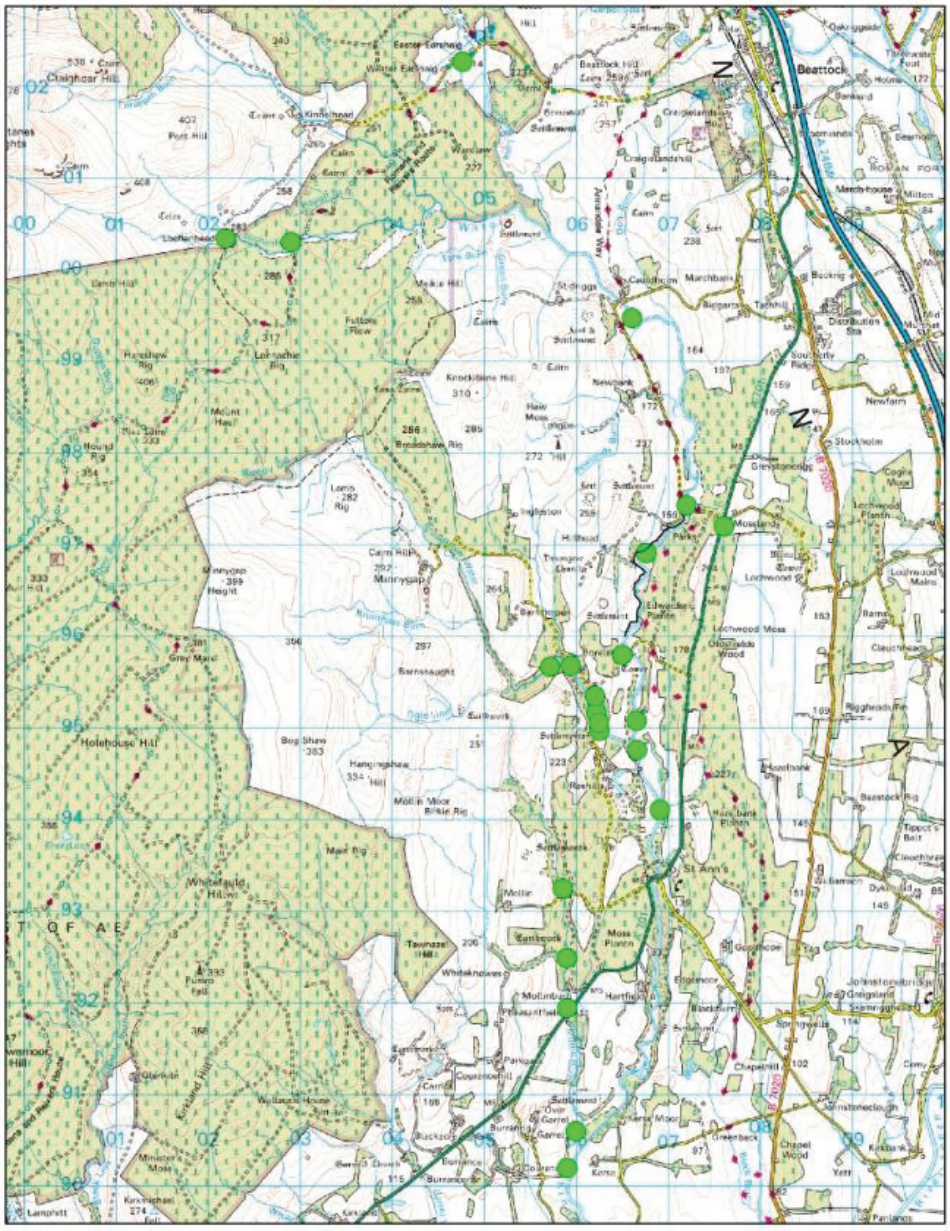


Tributary Specific Variation

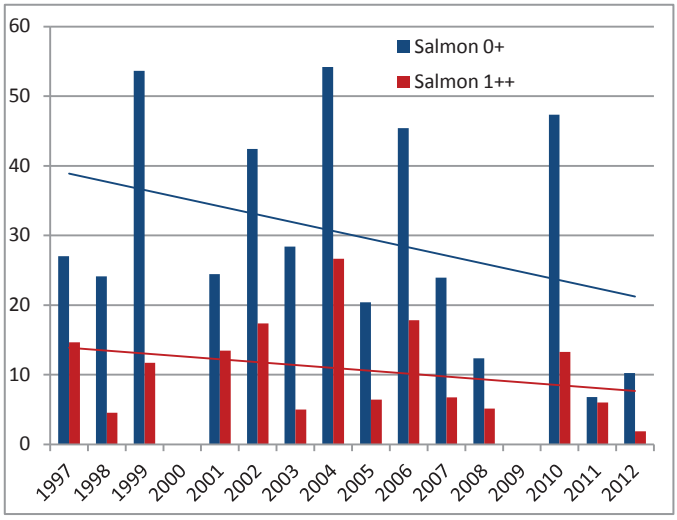
In some years weather conditions and/or limited resources mean that not all tributaries get fished each year so there are some gaps in knowledge on some of the tributaries. We know that different tributaries contain stocks of both trout and salmon which have differing traits. Genetic work carried out by Prof Andy Ferguson at Queens University Belfast demonstrated that the Evan Trout population was highly distinctive compared to other parts of the river, field observations have also noted this. Field observations have also noted that the Moffat Water is very important for early running salmon and that the lower parts of the Water of Dryfe are important for very late running salmon. Field observations and genetics can only tell us so much but it is clear that the highly variable stock structure within the river is likely to mean that there will be changes to populations at a local level.

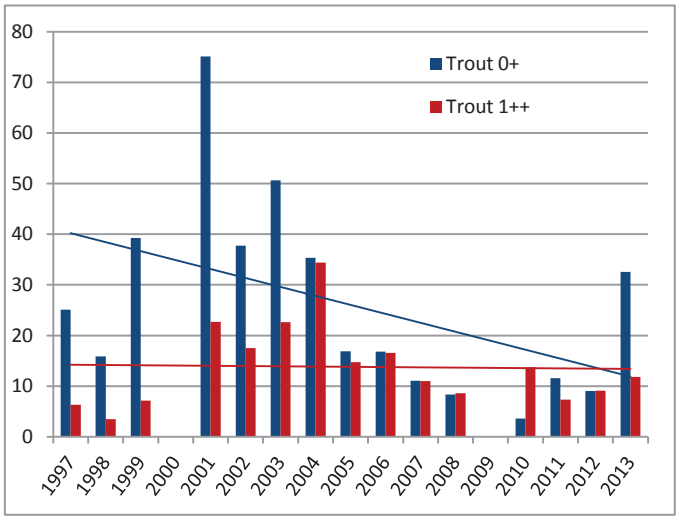
The drivers for these changes are likely to be a combination of local and global environmental conditions and genetics. A sudden change in characteristics in a stream can severely effect fish assemblages. A big change in environmental conditions at sea can affect the sea survival of the whole population or, more likely, affect the survival of certain stock components. Declines in the sea trout population on the Annan (and other Solway rivers) have been well documented as has the change in the run timing of fish entering the river over the last 50 or so years. As we know trout and salmon tend to breed in distinct populations with only limited mixing. These changes are bound to lead to changes in the numbers of adult fish utilising individual tributaries and can, if the effect is severe, impact upon the number of juvenile fish present.

Kinnel



The Kinnel is the biggest of the Annan's tributaries and has another significant tributary entering it, being the Water of Ae. The electrofishing results here do not describe the sites in the Ae which will be dealt with separately. The land use is a mixture of commercial forestry and livestock agriculture. A significant amount of money was spent on fencing on this tributary during 1997, 1998 and 2007. The Upper Kinnel (Kinnel Head) was stocked during 2006-11 with the adult brood fish being taken from areas near the North of the map. The stocked sites are not on this map as they are above natural waterfalls and would not ordinarily have any natural salmon production.



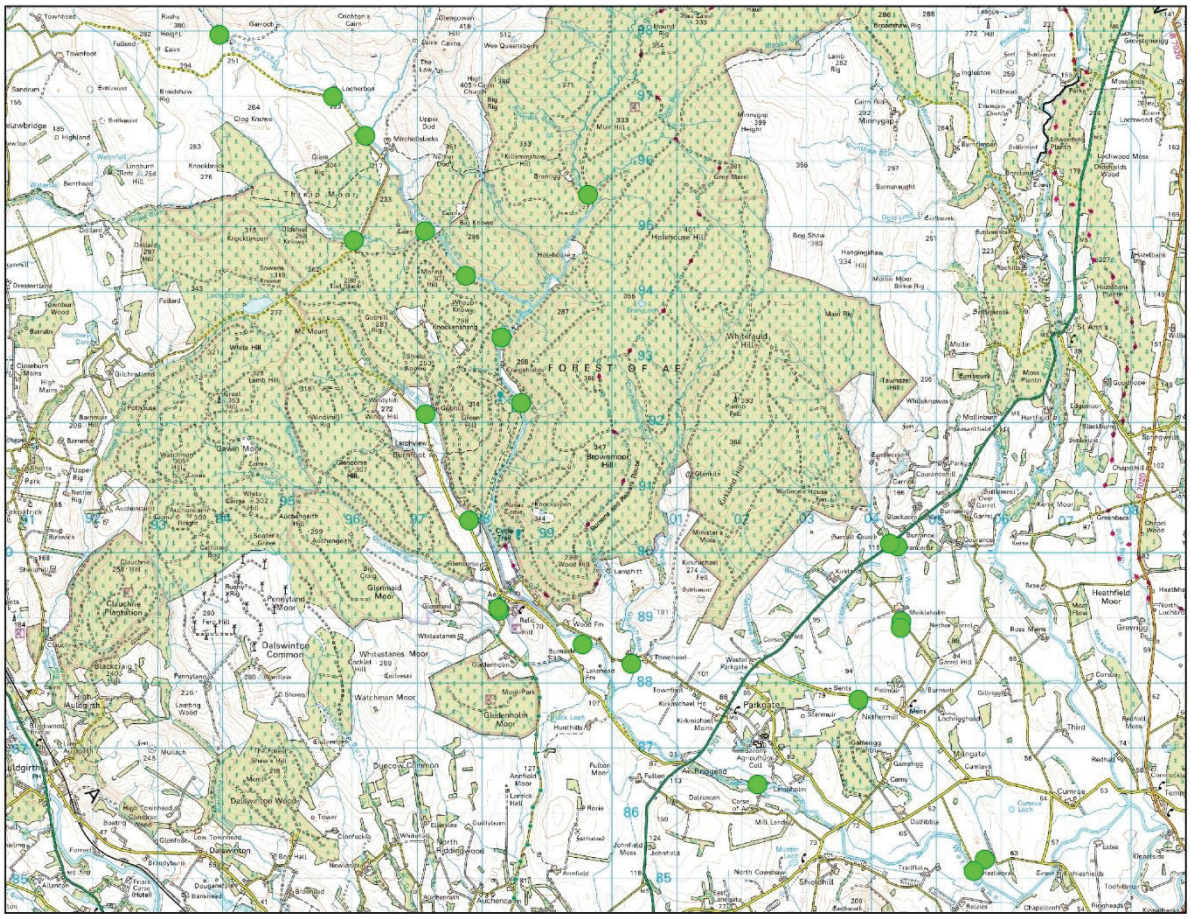


As can be seen on the chart on the right salmon numbers in the Kinnel appear to have dropped in recent years despite rising for a period in the 2004s. The reasons for this are unclear as several years ago the Kinnel was one of the most productive salmon spawning areas on the Annan. Very little has changed in terms of land use and no new barriers have been added into the river (in 2013 a fish pass was added on a large tributary, the Duff Kinnel). Fry production seems to have dropped the most in the sections up from St Ann's Bridge for a mile or two upstream but it then recovers further upstream

Trout fry production on the Kinnel also appears to be down considerably since the late 90s, indeed the fall is very stark, although there is some evidence that a few more adult fish are now entering this tributary as fry numbers appear to once again be growing. We are confident that the majority of these spawning adults are sea trout. Parr numbers over the whole piece have been roughly stable but there is a clear growth in numbers in the early 00s that has not been sustained.

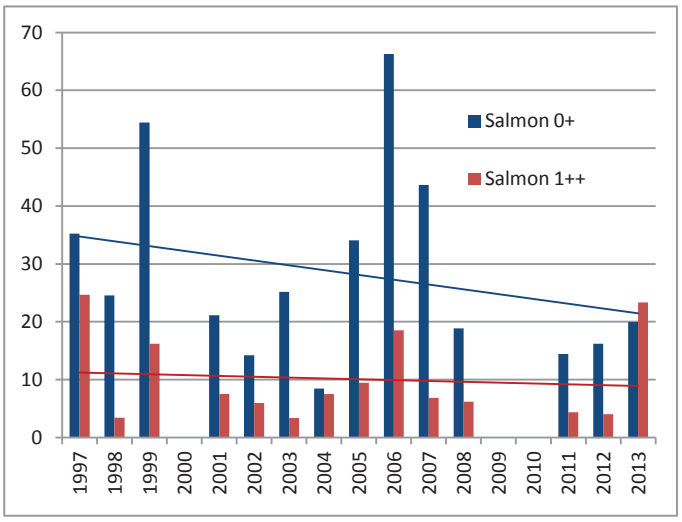
Overall as little has changed to land use etc in this area it would appear that more spawning adults of either species entering the burn would have a positive effect on the numbers of fish present.

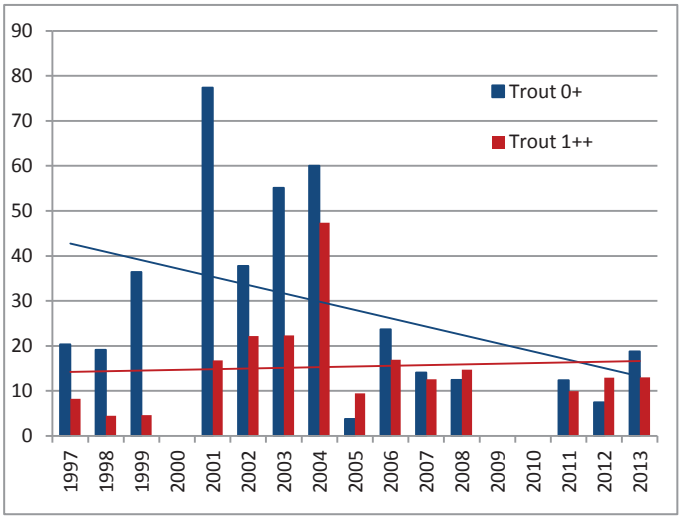
Ae



The Ae is a large tributary of the Kinnel. Land use is split with a mixture of arable and livestock farming in the lower reaches and large areas of commercial forestry in the upper reaches. The lower reaches of the Ae are often blighted by the removal of large quantities of gravel which culminated in a successful court case against the Barony College a few years ago. The gravel removal work continues now under SEPA licences which the Board opposes.

A large wind farm, Harestanes, has been constructed here during 2012 and 2013. There were a great many silt incidents through that time which may have affected production.

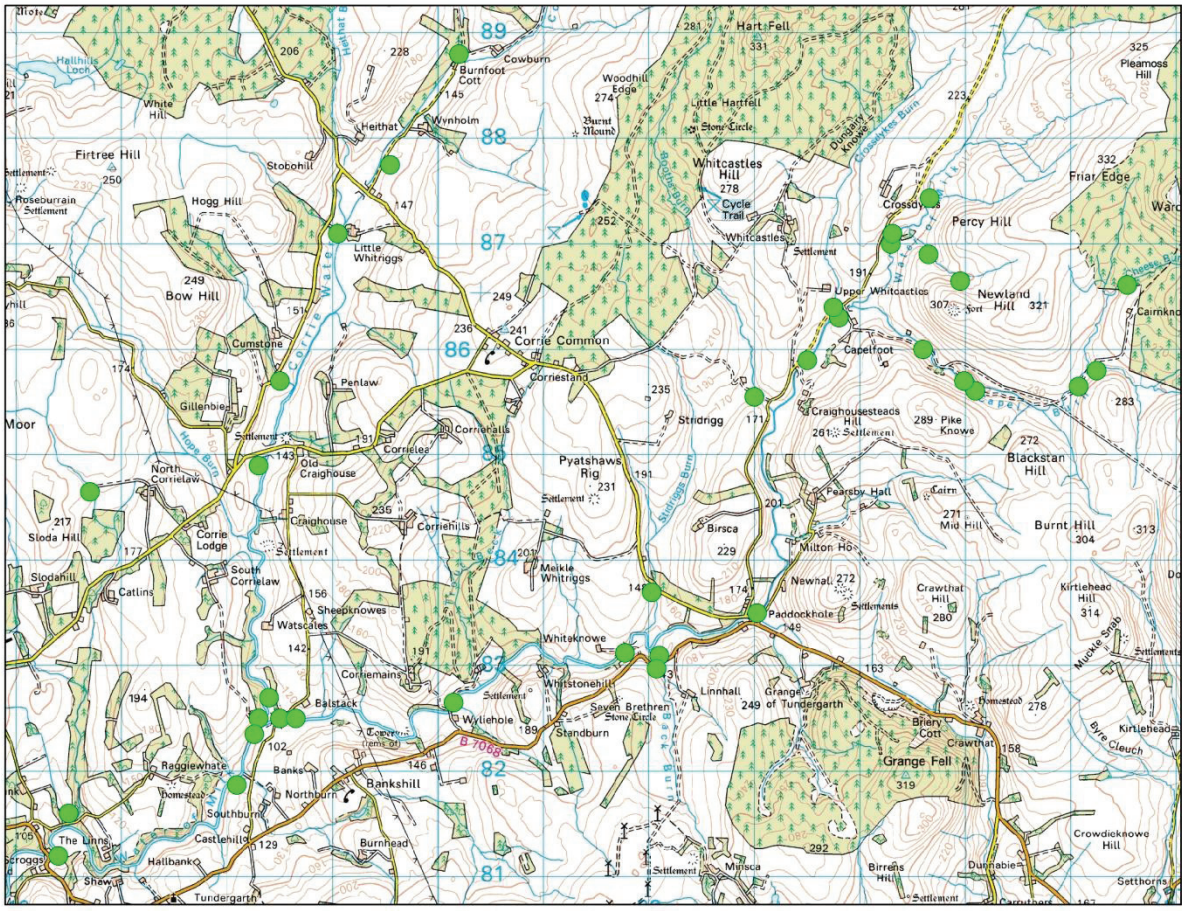




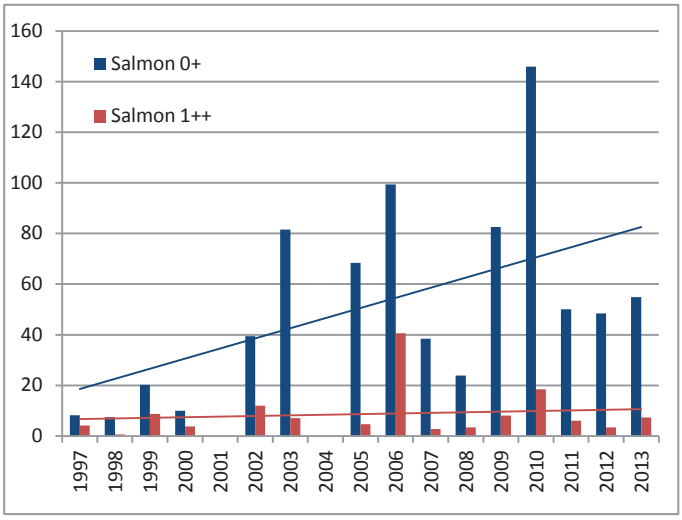
Fry production tends to be a good representation of the number of spawning adults that ascend a watercourse in the preceding year. As can be seen from the chart on the right this seems to have been very variable with a slight decline over the study period. The numbers peaked in the mid 00s but 2008 the numbers had fallen back. Parr numbers also show a great deal of variation but overall there is no significant trend ether way and numbers seem to be stable.

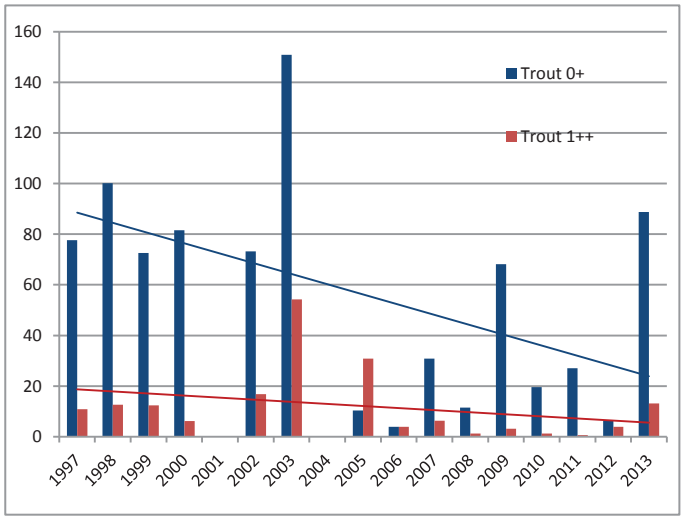
The Ae is historically an important spawning area for sea trout and it is clear that the numbers of spawning fish entering this part of the river has dropped dramatically in recent years, This is in line with the poor catches experienced on the Annan (and other Solway rivers). The parr numbers have been a bit more stable although at the peaks of the mid 00s indicate that it was once far more productive.

Water of Milk



The Milk is the second largest tributary on the Annan. Land use is primarily livestock agriculture although there are some areas of commercial forestry. The Sulwath Project, 2007-2010 invested considerable sums of money into habitat works on the Milk and its major tributary the Corrie Water. There are two significant barriers on the bottom of the milk that make life difficult for migratory fish. These barriers were eased in 1994 but continue to pose a risk if the water flow is not perfect.





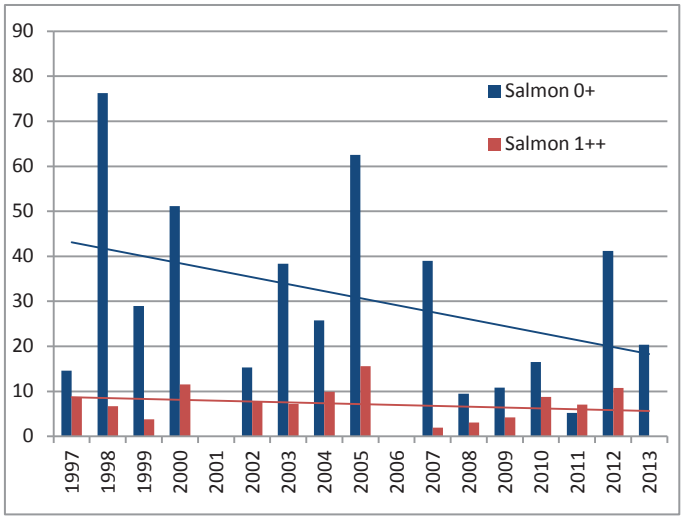
The number of spawning adult salmon entering the Milk is very large and over the time series has increased significantly. Visual observation from staff and members of public confirm this. Parr numbers have remained relatively stable (possibly increased slightly). Once salmon can get past the weirs at the bottom of the Milk access is pretty good throughout however almost all of the Milk salmon production comes from the main channel, The Corrie in particular seems to be more important for sea trout.

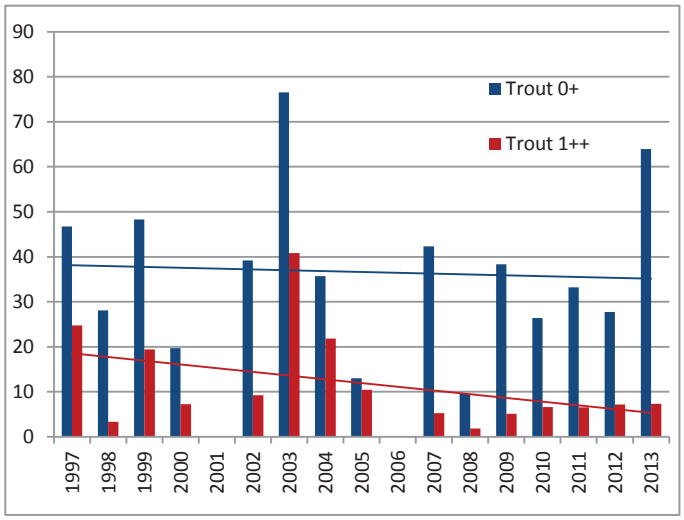
The Milks catchment's importance for sea trout has long been known and the chart on the left reflects the problem that we have with low numbers of returning adult fish. Fry densities in the 90s and early 00s were relatively consistent, reflecting robust sea trout runs into the main river. The inconsistent and occasional very poor returns are indicative of the poor returns we have had in recent years. 2013s results are encouraging but we have seen this in the past, 2009, only to return to low numbers. The decline in the parr numbers is particularly worrying, again 2013 is slightly better.

Overall the Milk needs more spawning fish, trout in particular to fulfil its full potential. The barriers at the bottom of the river may well cause issues in some years to salmon such as in a very dry autumn but removing them would be a major exercise which would be difficult to fund.

Water of Dryfe

The Water of Dryfe enters the river just north of Lockerbie via a narrow valley. There are no major tributaries to it and the shape of the landscape it goes through means that most of the small burns entering it swiftly become impassable to fish due to natural waterfalls. The steepness of the gradient of this watercourse means it can rise and fall very quickly, indeed there have been several very violent floods which have caused huge amounts of gravel to wash out, the last one in 2007. The head waters are dominated by commercial forestry plantations with the middle and lower sections passing through livestock farms. There is one slightly significant barrier at Water Head of Dryfe that makes the last km or so difficult for fish to enter. In 2010 a significant fish kill from cypromethrin (used to kill pine weevils on conifers) caused damage to the upper sections. The watercourse has since recovered.

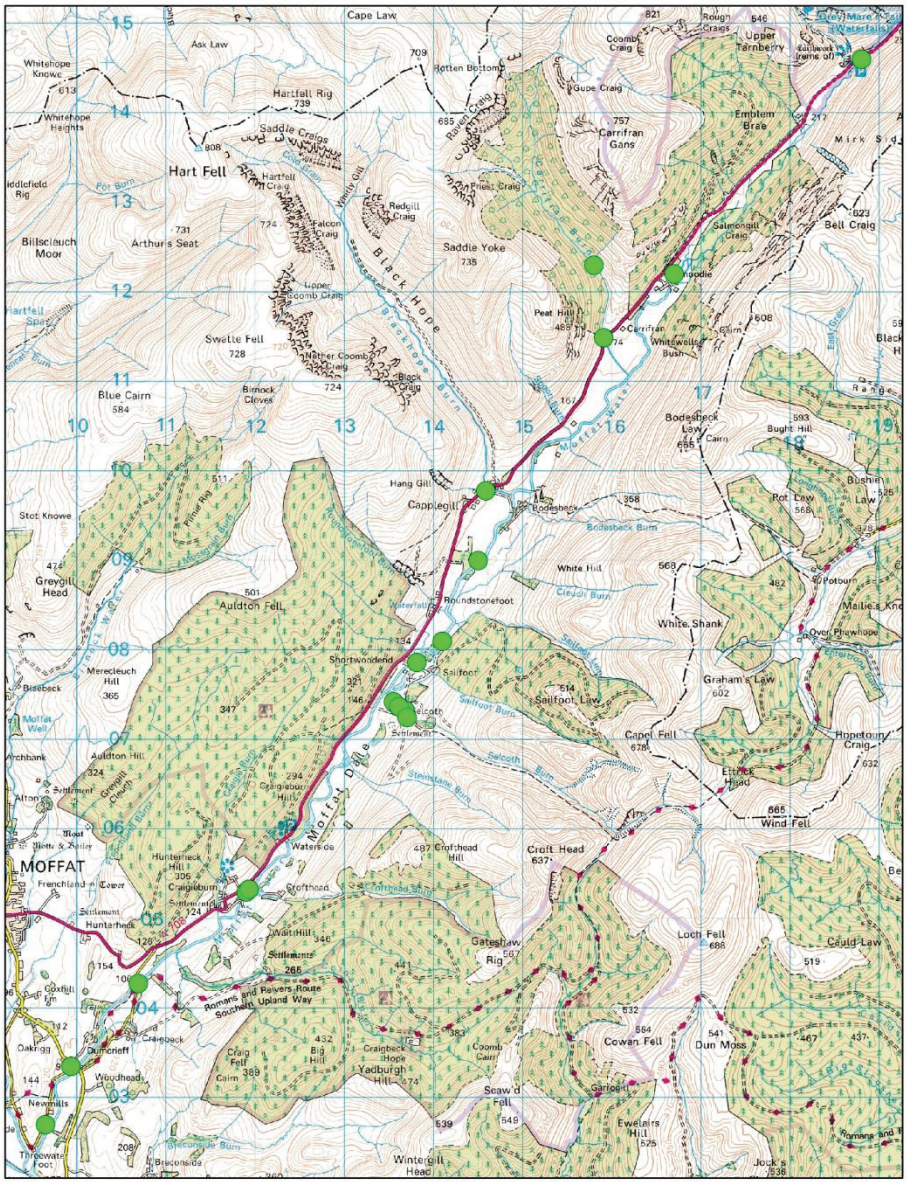




Whilst there has clearly been a steep decline in the number of adult fish spawning in this tributary but numbers seem to be recovering in recent years. It is possible that large floods affect this tributary more than any other part of the river, this may well be why parr numbers dropped in the late 00s but again there seem to have recovered since. The lower end of the Dryfe seems to be very important for very late running fish with fish being seen spawning in late December in this section on a regular basis.

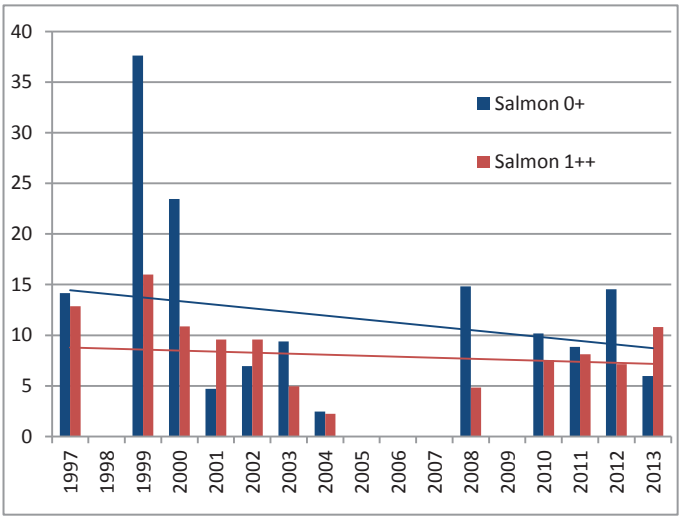
It is thought that the Dryfe is more important for sea trout than brown trout. Although there may well be a resident population as well, we do not have the same certainty about this as we do on some of the other tributaries. Fry numbers in the Dryfe have not shown the same collapse that has been seen on other watercourses that are frequented by sea trout. Interestingly though parr numbers have gone down quiet why is unclear although habitat changing floods may well be at fault.

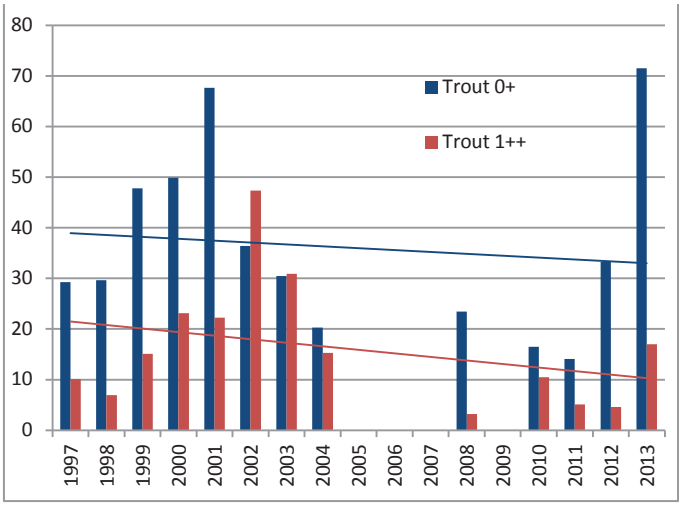
Moffat Water



The Moffat water has the distinction of being the coolest part of the river. It lies in a very steep deeply incised valley. Whilst there are a number of sizable burns entering it most of them come down very steep inclines and natural waterfalls stop the ingress of all migratory fish. The landscape is mostly rough pasture but there are also significant parts of the catchment with commercial forestry present. The watercourse has some of the lowest conductivity rates on the river. Conductivity is, in effect a measure of how many things are dissolved in the water. This means that the Moffat as well as being cool it is also naturally unproductive.

Studies carried out in 1997 and 1998 indicate that the Moffat water is an important area for the residual elements of the Spring salmon stock in the river. Historically other parts of the river will have been used and to a certain extent probably still are. The cool unproductive the water means that some of the oldest salmon smolts in the river emanate from this water course with S3 fish being relatively common and S4 smolts not unknown.



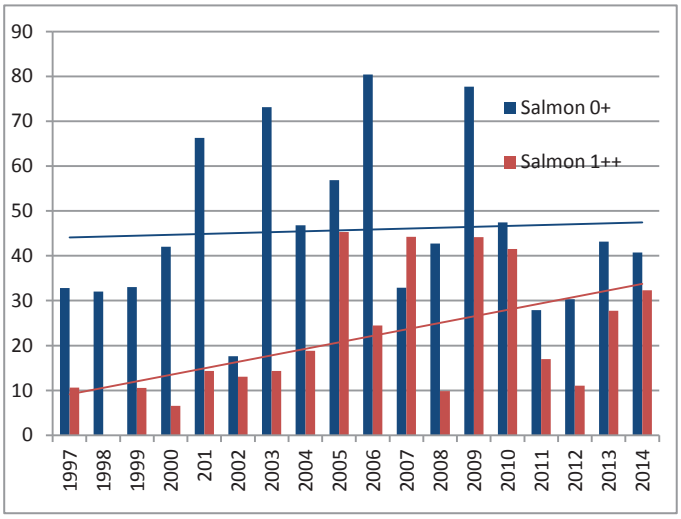


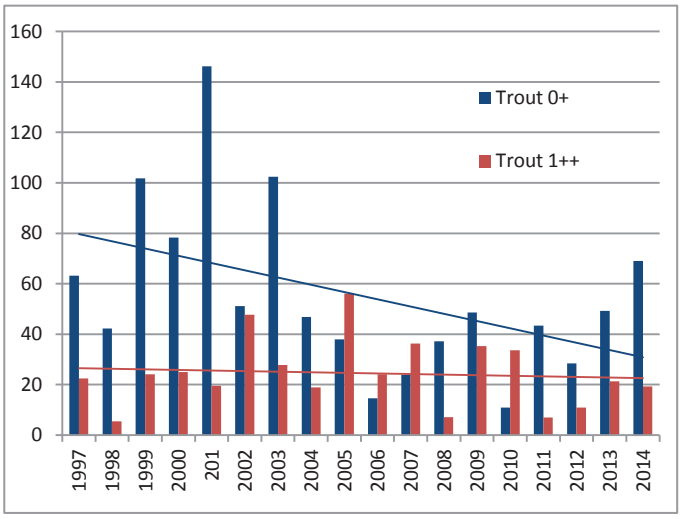
Salmon numbers have remained relatively consistent in this watercourse although there is huge variance with the numbers of spawning adults reaching the area year upon year. As we know that this is important for spring stocks the scarcity of these fish may well be the reason for this. Because fish can live an extra year or two in this tributary before leaving for sea the relationship between 0+ fish and 1++ fish the following year is very weak.

We are pretty certain that the dominant form of trout that use this tributary are sea trout. Significant declines of fish entering are apparent in the early 00s but there does seem to be improving recruitment in the last few years. As with salmon the coldness of this part of the river means that the smolts that leave here tend to be older than many other parts of the river, hence the very weak relationship with 0+ fish and 1++ fish.

Annan Water

The Annan Water (also known as the Little Annan) rises out of the Devils Beef Tub and is considered to be the source of the river. It flows through rough pasture land before passing through Moffat and entering the main river in the centre of Three Waters Meet. It has one large tributary, the Birnock Water that enters it in the South of Moffat. A large waterfall on this tributary means that virtually all of the production is in the town itself. A large amount of fencing and in stream works was completed in 2002 & 2003 on this tributary. The conductivity of the watercourse is considerably higher than its easterly neighbour. The relatively large population that lives alongside the Annan Water may contribute to this.

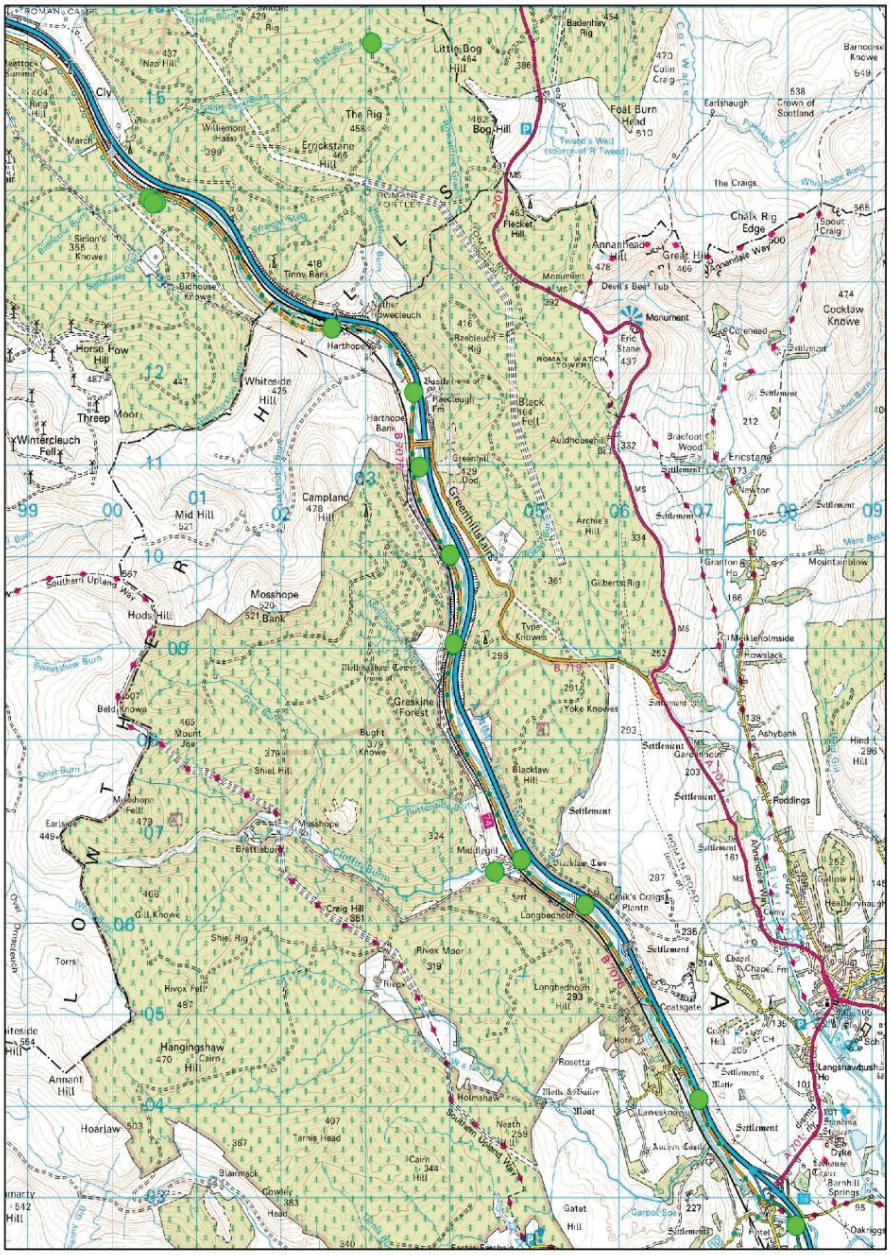




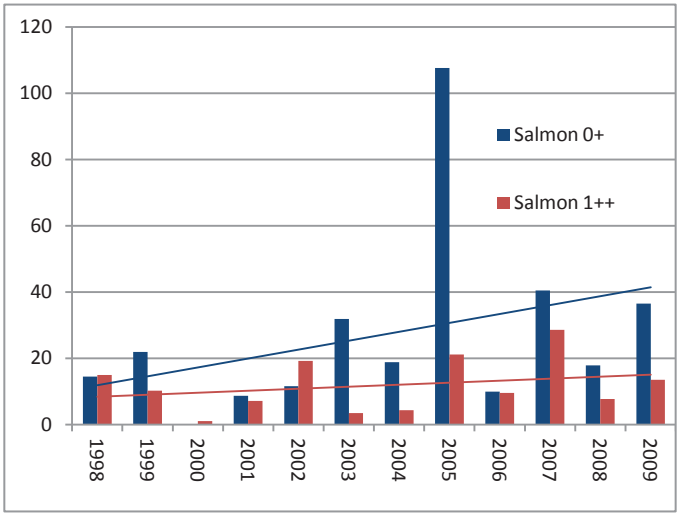
The densities of salmon found within the Annan Water are consistently some of the highest we find anywhere in the catchment. In the centre of Moffat in particular fry and parr densities are some of the highest found anywhere in Scotland. There must be a relatively large number of fish spawning under the noses of the population but when residents are asked they have never seen a fish! Whilst the little Annan is relatively small it is a very significant producer of Annan salmon.

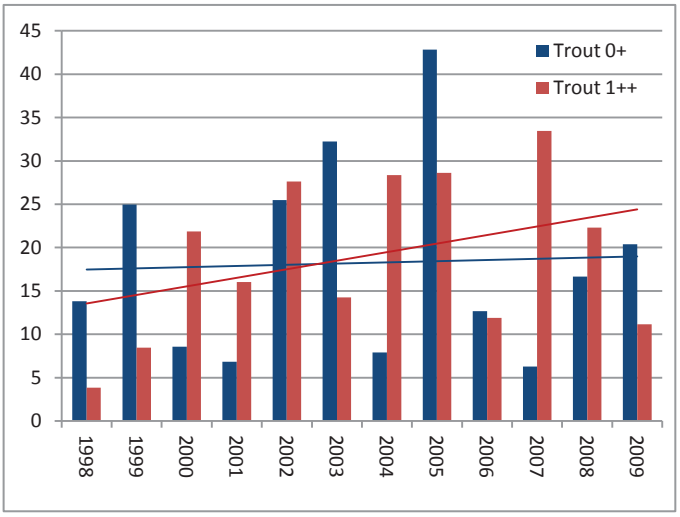
We are not entirely sure whether the spawning trout in the Annan Water are resident or migratory, there may be more than one stock. Whilst salmon numbers have gone up dramatically in this tributary adult spawners seem to have reduced somewhat which tends to lead us to think that sea trout are important here. The Parr numbers have remained fairly stable so this has not impacted dramatically on production and increases over the last couple of years in fry production are encouraging.

Evan Water



The Evan Water contains the most northerly point on the Annan and is fed by the Clydes Burn. The Clydes burn may well have been a tributary of the Clyde at one point but has switched courses to form the headwaters of the Evan. Whether this was natural or created by man is not known. The Evan has been heavily engineered on several occasions as Scotland's busiest transport route travels up its valley. The earliest diversions we are aware of were in the 19th century to facilitate the building of the West Coast mainline and the most recent was in 1999 to build the M74. The valley is fairly steep sided and production from it side burns is limited due to natural waterfalls. There is also a viaduct at the north on Beatock Summit which is owned by Network Rail that stops all migratory fish. Close proximity to the Clyde and its Crayfish population is the biggest danger this tributary faces, hence the construction of the crayfish barrier in 2011.





Weather conditions and increased work load meant that the Evan Water has missed out on being surveyed for a while, this will be addressed in 2014. In general though the salmon population appears to be relatively healthy and interestingly the Evan Water shows a particularly high spike in 2005 as a result of the very high numbers of fish that entered the river during the 2004 season. 1998, 1999 and 2000 may well have been affected by the road construction that was ongoing until 1999.

We know that the Evan Water is particularly important for large resident brown trout and less so for sea trout (although undoubtedly a few enter it). The trout fry numbers have remained remarkably stable here for many years, although there is a stark rise in the number of parr. The reasons for this are unclear, although the peculiarities of the Evan trout stock may mean that the parr are likely to stay in the tributary longer before leaving for the main river. We certainly find the oldest trout in the river in this tributary.

Conclusions

The electrofishing surveys are a useful indicator to the health of the river. There can be huge variance year on year but this is inevitable. Rivers are highly dynamic environments and the type and quality of habitat available to fish can change dramatically. For example a fallen tree rolling into a survey site in between years can offer a huge amount of instream cover that may be gone within a year. Gravel movement and scour can change the physical characteristics of the reach dramatically, changing a site from good salmon habitat to poor (or the other way round). A large number of sites have been used in this desk top study but it is a moot point whether or not we should have more sites. In order to manage fish stock we need to ask the question: “are enough fish entering the river and surviving to spawn to populate all of the juvenile habitat?” This study does give an insight into this but it is a mixed bag. More sites would definitely give greater resolution and consistency but this is very labour intensive and would stretch resources.

The results do indicate that in some parts of the river insufficient fish are making it through to spawn; this is very clear. The Annan stock is pretty much unmanipulated by large scale stocking over many years so the populations of fish found within it are likely to exhibit different traits (run timing, grilsing etc). This diversity is very good as it will protect us to a certain extent from big environmental changes that affect sea survival of differing stocks. What is clear though is that we are often teetering on the edge of sustainability. Whilst some stocks such as those in the Annan Water and the Water of Milk are showing signs of increase others have diminished. Anglers and nets men cannot chose which stocks of fish they are fishing for therefore stock exploitation is difficult to manage. Sea trout stocks are particularly vulnerable although there does seem to be a few more fry about over the last 2 years.

Overall throughout Scotland salmon and sea trout stocks are in decline and have been for some time. On the Annan we have had good periods of both species across this time series but they have not been sustained. The Board and Trust cannot do anything about sea survival and the condition of our oceans but we can look after what is in the river. Since 1997 we have spent many £100s of thousands of pounds on habitat work, principally fencing but this is to little avail if there are insufficient adult fish to populate the improved areas.

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