SECTION 3: THE FISHES OF THE TWEED AND THE EYE

A.2: Sea-trout & Brown trout
Salmo trutta trutta & Salmo trutta fario

(A) The life-histories of the Trout: The life cycle of trout is much more varied and complex than that of Salmon as it includes "variants" for fish to be entirely freshwater throughout their lives (Brown trout) or to smolt and go to sea to live as adults (Sea-trout) or even to go in to salt water as adult Brown trout ("Slob" trout). Within the Brown trout variation, fish can stay and mature in small streams and burns (Burn trout) or migrate out in to the main channel returning to their native burns to spawn (River trout). Sea-trout "options" include varying the time of the first return to spawn (one, two or more years after smolting) and the number of times spawning returns are made (up to five times is known from scale reading Tweed Sea-trout).

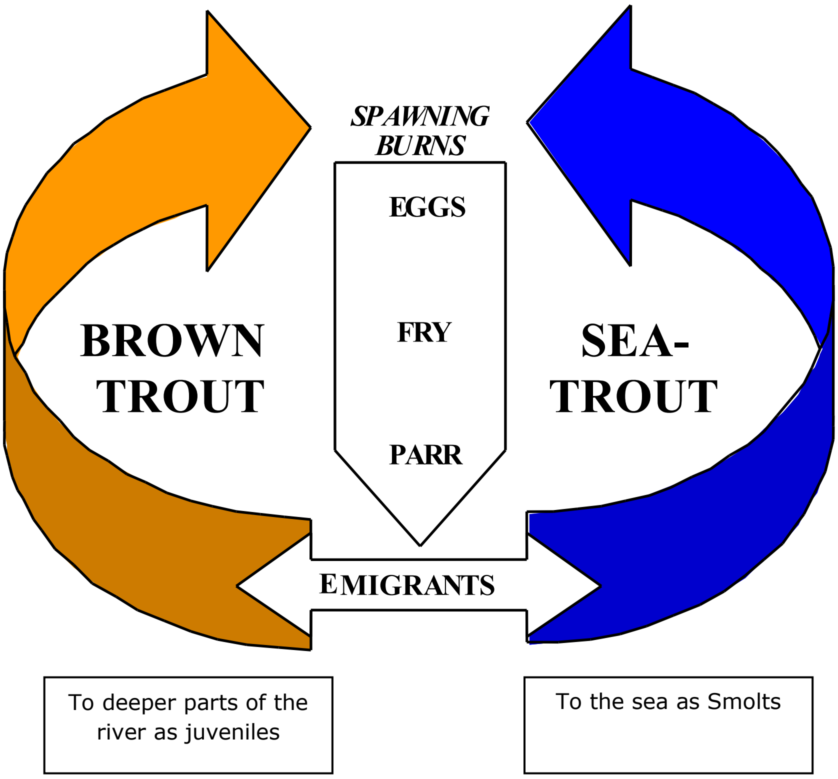


Diagram A.2.1: The life cycle variations of trout

Photo A.2.1: A silvered trout juvenile on its way to the sea as a smolt, and one that is retaining its camouflage colours but moving to deeper water

The best recent account of the variety of trout life histories is given in Walker (1990) who concluded that the Sea- and Brown trout of his study areas comprised single populations and that the two forms appeared to exist in a dynamic equilibrium. The rearing and transplanting work carried out as part of this study showed that young of Sea-trout parents stocked into a fishless burn upstream of a waterfall turned in to both Sea-trout (recaptured downstream) and resident Brown trout (recaptured mainly above the waterfall, but some from downstream) and when marked young of Sea-trout parents were transplanted into a trout burn in which Sea-trout were naturally uncommon, just over half their recaptures as adults were as Sea-trout, showing an inheritable tendency to go to sea. The reverse translocation, of the young of Brown trout parents stocked into a Sea-trout burn, however, produced only recaptures of adult Brown trout. His conclusions were:

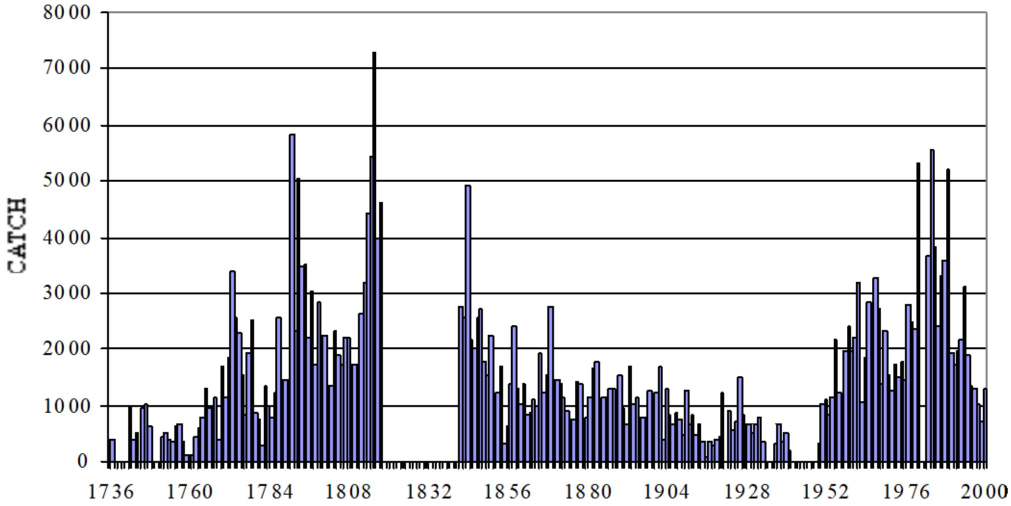
> "*Both environmental and genetic effects will influence the proportions of the juveniles which adopt burn residence, river residence or migration to the sea. At one extreme there are above falls stocks which may have lost the capacity to produce migrants, at the other are stocks where all the juveniles migrate*" and that "*the potential to produce Sea-trout or Brown trout is influenced .... by short term environmental oscillation. Therefore, any attempts to manage or enhance individual components of the overall trout stock will have to take this in to account*"

That Sea-trout are less common at some times than at others is suggested by some comments from the late 18th and early 19th centuries:-

1802 *"On my first coming to the Tweed here in 1802, the old fishers spoke of the bull trout as a monster of very casual appearance, under the name of square tail or round tail, meeting with one or two only in a whole season; and they supposed it a hybrid between the salmon and large common river trout… It has multiplied gradually since, however, until now it is by far the most plentiful of all the migrating salmon in our river, and is found of all sizes, from the grilse state, when it is named the sea trout, to sometimes to twenty five pounds.* (Younger 1847)

1820's *"The Bull-trout (*large Sea-trout*) ….is, comparatively speaking, a recent invader of our Border river. The old fishermen affirm that, thirty years ago, it was looked upon as a rare fish"* - T.T. Stoddart, writing in 1853 (Maxwell 1923)

It is interesting to look at the long-term variation in Sea-trout net catches and the comments from the early 19th century (above) in the light of the patterns outlined by Walker (1990).



Graph A.2.1: Catches of Sea-trout at the Sandstell netting station 1736-2000

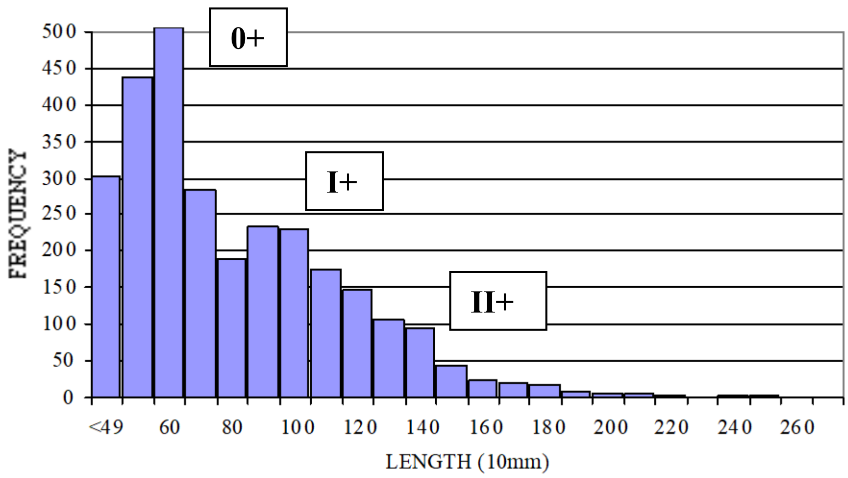
NOTE: The regulations controlling netting changed at times between 1736 and 2000: e.g. there was netting into October until 1858 and the weekly slap (=close time, when the nets were not allowed to work) increased by 14% of the week in 1988 so the figures are not directly comparable over the whole of this period, but the general pattern should not be greatly affected.

As can be seen from this graph, the latter half of the 18th century did see a significant increase in Sea-trout numbers, which supports the comments quoted above. The drop in catches after the 1850's may partly reflect the environmental problems that started to afflict the Tweed catchment in the latter 19th century: caulds and weirs blocking off spawning burns and severe pollution in patches. If migration was made more difficult by these problems, then the "advantage" would swing towards a sedentary, purely freshwater life, i.e. towards Brown trout. On the other hand, the peaks in the 1810's and 1980's and trough in the 1920's-30's might reflect some large-scale environmental factor changing the balance of the "see-saw" between Brown trout and Sea-trout patterns – when one was up, the other would have to be down. There is, after all, a finite amount of trout spawning and nursery area within the catchment, so if more of it was producing Sea-trout, then less must produce Brown trout, and *vice-versa*. It is very unfortunate that there are no Brown trout catch records that could be compared with these Sea-trout statistics.

(B) Distribution of uvenile Trout on Tweed: Until those fish that are going to go to sea turn silver and become smolts, it is not possible to tell Brown trout and Sea-trout juveniles apart, so all trout fry and parr have to be treated as a single group. As trout spawn in the smaller tributaries and burns, their distribution is well covered by the Tweed Foundation's electro-fishing survey work. Of the 152 sites in medium-sized channels electro-fished quantitatively over the whole Tweed catchment between 1992 and 1997, juvenile trout were found in 98.1% (second most frequent were Salmon at 85.2% and third, Eel at 74.8%). Of the 408 sites in smaller burns electro-fished between 1993 and 1998, trout were found at 88.7% (second most frequent were Eel at 40.0% and Salmon at 21.7%). The lower occurrence in small burns than in medium sized channels is due to the fact that sites upstream of waterfalls were included in the former survey and some of these places were fishless. There was only quantitative surveying in the Eye catchment, in 1994 and 95, but trout were present at 100% of these sites (as well as Eel, with Beardie and Baggie at 80% of sites). Trout of either form are therefore, as is clear from these survey results, by far the most widespread fish in the Tweed and Eye catchments.

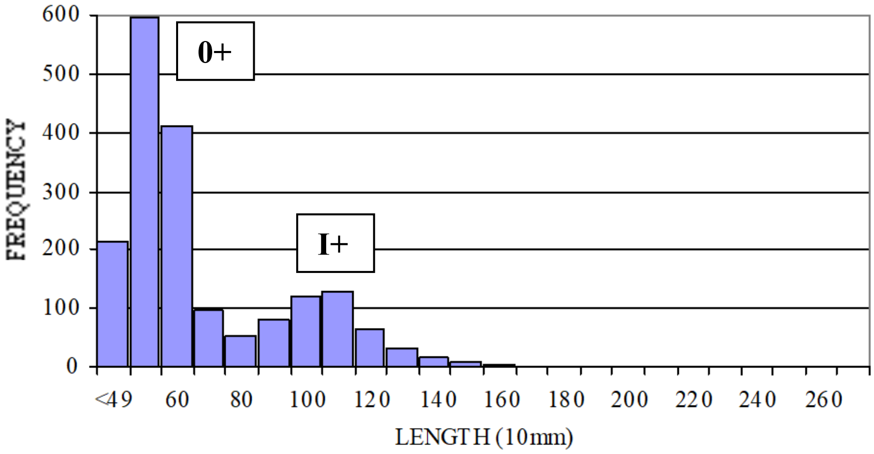
(C) Sizes and numbers of juvenile Trout on Tweed: Small burns do not, generally, have much deep water, which limits the size of fish they can hold, so although these are the areas where much of the trout spawning in the catchment takes place, the young fish have to leave as they get larger, as shown in Graph A.2.2 (and Photo A.2.2). Here, the main peak, at 60mm length is of the "*young of the year*", the fry hatched a few months before the sampling in summer. As these have not passed their first winter, they are called "0+". The second peak, at 90/100mm represents fish that are in their second summer and having passed their first winter are designated "I+". The fall in numbers after 140mm shows the size by which most have dropped downstream into larger channels, when they are in their third summer (II+). Young trout drop downstream at all ages and sizes, as can be shown from trapping (see below) because as fish grow they need more food and space. A burn generally supports more small trout than large as it has more shallow water than deep so as the fish grow, the number of available territories decreases, forcing unsuccessful fish out.

Photo A.2.2: The pattern of trout sizes in smaller burns is usually of several year classes of juveniles – there are three shown here, 0+, I+ and II+ - no "medium sized" fish and then, at spawning time, returning mature fish This example is from a burn in the Cheviots



Graph A.2.2: The sizes of juvenile trout at 218 three-minute electric fishing samples taken in the burns and tributaries of the Upper Tweed

This pattern is even clearer in similar samples from the upper Teviot Water, though the size peaks are at smaller lengths (50mm for 0+ and 110 and I+) and no fish over 160mm were found.



Graph A.2.3: The sizes of juvenile trout in 74 three-minute electric fishing samples from the Teviot upstream of the Rule Water

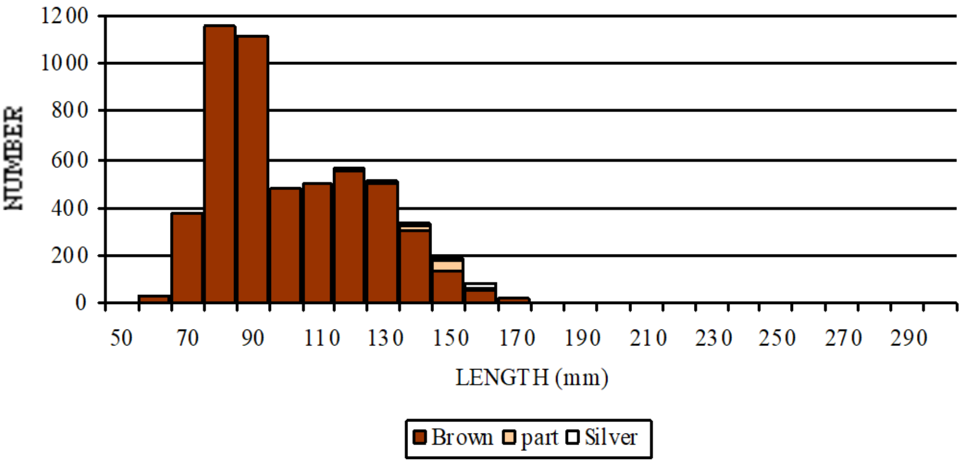
As well as variation in sizes and ages, juvenile trout can also vary greatly in numbers as shown in Table A.2.1. More information on this is given in Appendix C1.

UPPER TWEED						UPPER TEVIOT	
Lower Burns av.	18.68	Middle Burns	11.46	Upper Burns	17.54	Allan Water	4.65
Caddon Water	13.85	Glensax Burn	15.65	Lyne Water	12.22	Slitrig Water	11.61
Quair Water	16.45	Eddleston W	15.17	Biggar Water	11.04	Borthwick W	7.40
Leithen Water	8.02	Manor W	11.00			Burns	7.28

Table A.2.1: Number of seconds taken to electric-fish one juvenile trout in different parts of the upper Tweed and upper Teviot

The reasons as to why numbers should vary so much, e.g. between 1 fish per 4.5 seconds and 18.5 seconds in Table A.2.1 are important for management. The natural carrying capacity of streams can vary considerably - those with good amounts of cover and food can support higher numbers of fish than bare streams with little food. The key information needed for management therefore is whether an area with low numbers of trout is simply a poor area unable to carry a high stock of fish or whether its population is being depressed by some problem that could be corrected – lack of cover due to over-grazing, lack of access for spawning fish, etc.

As shown in Graphs A.2.2 and A.2.3, most trout do not stay on in their little spawning burns as adults, but migrate, Brown trout to larger channels and the main river and Sea-trout to the sea. Two larger burns of the upper Tweed have had traps on them since 2000 in which these emigrants are caught and the results are shown in the two graphs below.



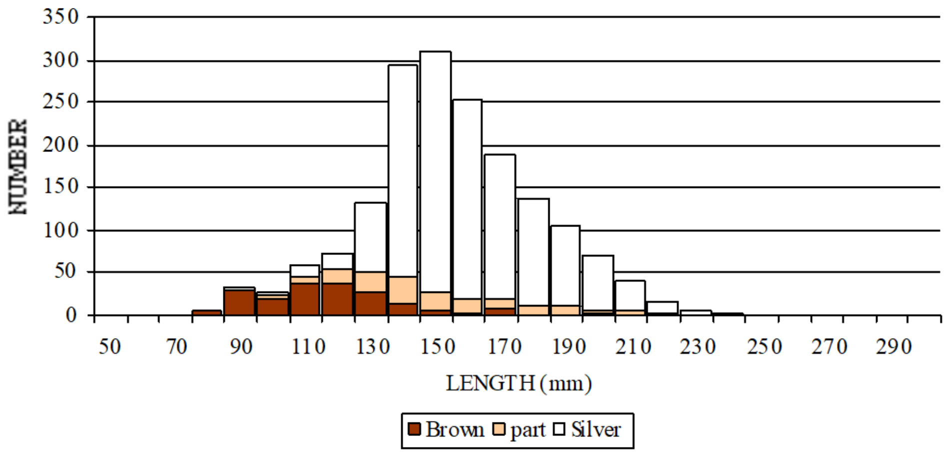
Graph A.2.4: The sizes of juvenile trout emigrating out of a burn near Tweedsmuir 2000-04

In the Tweedsmuir trap, most emigrants are just 80 to 90mm in length and are one year old, with a substantial group of two year olds at around 120mm. Almost all are brown coloured, with only a very few being partly or wholly silver which suggests that very few of these fish are Sea-trout smolts on their way to the sea, though, of course, they might become so later after a year or two in the main river. Photo A.2.3 shows a typical sample from this trap.

Photo A.2.3: A typical sample of the trout that leave a burn near Tweedsmuir
Small, brown coloured emigrants dominate, 80-100mm in length

The emigrants found in the other trap, on a burn only 20kms or so downriver from Tweedsmuir, at Peebles, are quite different in size and appearance. Most are around 150mm in length, two years old and bright silver in colouration, with only the smaller individuals being brown (Graph A.2.5, Photo A.2.4); the great bulk of these emigrants would therefore appear to be Sea-trout smolts on their way to the sea.

The timing of emigration is also different between these two burns. At Tweedsmuir, the peak in numbers is in April, with a much smaller peak in late October/early November and with some fish being taken in every month of the year (and sometimes in considerable numbers in January and February). At Peebles, however, when trapping is started in March, little is caught until late April and numbers peak in May. Little is caught by the middle of June. This trap is not run all year round like the other and could not, in fact, be operated in autumn due to the amount of leaves in the burn at that time. However, emigration does appear to be over a quite short period.



Graph A.2.5: The sizes of juvenile trout emigrating out of a burn near Peebles 2000-04

Photo A.2.4: A typical sample of the trout that leave a burn near Peebles
Silvery fish of around 150mm length dominate

The differences between the emigrants of these two burns illustrate the difficulty of working out the status of trout in burns, which, it appears can be either largely Browntrout or Sea-trout, and not necessarily a mix of the two as might be expected. However, until more burns can be trapped it cannot be said how representative these two burns are of the trout of the catchment as a whole.

The next parts of the trout life cycle are more difficult to sample and monitor as the Brown trout are in the deeper waters of the larger stream and river channels and the Sea-trout are in the sea.

A.2a: **Sea-trout**
Salmo trutta trutta

Photo A.2a.1: A Sea-trout from the Eye Water

(A) Sea-trout smolting ages: *(the age at which they turn silver and migrate out of their spawning burns).* Two sets of data on this are available at present, both from reading scales taken from Sea-trout caught in the nets at Berwick, firstly from 1928 (Nall, 1929) and secondly from 1994 onwards as part of continuing work by the Tweed Foundation. A sample from the trap near Peebles also gives the results for an individual population belonging to a particular burn for comparison with the two, whole-catchment, general samples.

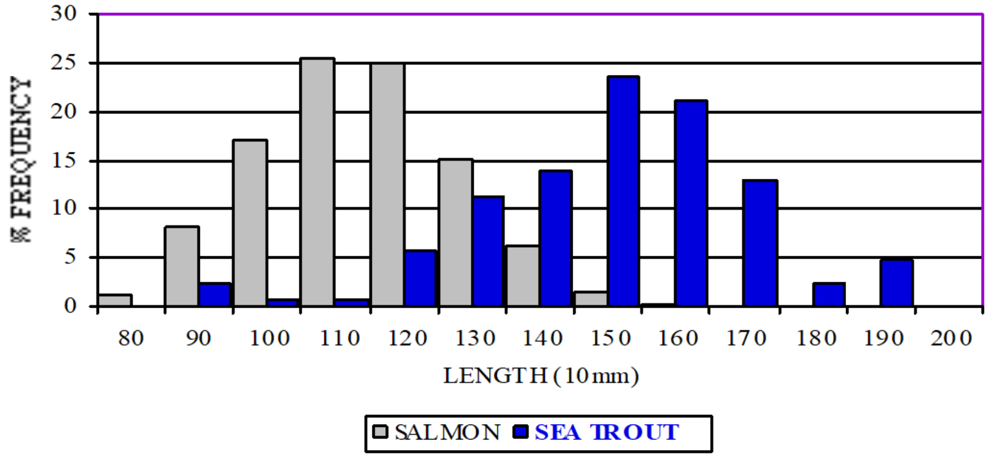
Age at Smolting	1928-29 (%)	1994- (%)	Peebles trap, 2000
1	0.06	2.33	-
2	79.11	78.50	65
3	19.61	18.60	33
4	1.19	0.58	2
5	0.03	0.00	-
Sample size	3,197	223	

Table A.2a.1: Ages of smolting read from adult Sea-trout scales in 1928-29 & recent years

Apart from the recent sample having slightly higher proportions of S1's and slightly lower proportions of S4's, the results are almost identical. However, the changes in the age of Salmon smolts over this period (see Table A.1.3), means that it can not actually be assumed that Sea-trout have had identical smolt ages over the whole of seventy or so years between the two samples. By comparison with Salmon, S1's are less frequent and S3's are more common. The data from the Peebles trap, for an individual population, shows some differences from the 1920's and recent general samples, particularly in the much higher proportion of S3's.

(B) Sea-trout smolt sizes: The size at which Tweed Sea-trout smolt and go to sea is shown in Graph A.2a.1, which is based on samples from the lower Gala Water in 1997 and the lower Leader Water in 1999 and 2000. The sizes of the Salmon smolts taken in the same samples are shown for comparison. The first external distinction between juvenile Sea-trout and Brown trout is when the former smolt and become silver, though Walker (1990) noted that the young of Brown trout can also become silver to a lesser extent during the Spring, which blurs the distinction between the two. However, it can be seen that the peak in numbers in these Leader and Gala samples falls at 150mm, which is also the peak length for the silver smolts trapped in an upper Tweed burn near Peebles (Graph A.2.4) but very different from the brown coloured emigrants trapped in a burn near

Tweedsmuir (Graph A.2.3) which peak at both 80 and 120mm. The main length peak in the Leader and Gala samples is for 2-year-old fish, but there is a small peak at 190mm representing three year olds.



Graph A.2a.1: The sizes of Leader and Gala trout and Salmon smolts

The overlap in size between Salmon and Trout smolts is quite small, only over the 30mm from 120 to 150mm: 52% of Salmon smolts are smaller than the smallest Trout smolts, while 41% of Trout smolts are larger than the largest Salmon smolt.

(C) The length of time spent at sea and the number of spawning returns of Tweed Sea-trout: The 1920's samples and the recent ones from the Berwick nets were taken at different times of year. The 1920's samples come from the whole netting season of 1928, (14th February to 14th September), plus 30 from August 31st 1927 and 590 samples from out of season sampling from October 1928 to January 1929. The recent samples are, however, largely from September and October (76% of total). This difference in when the samples were taken must affect the data on sea life as trout of different sea-ages may return at different seasons of the year and this has to be kept in mind when comparing the information from the two samples.

Winters at sea:	**0**	**1**	**2**	**3**	**4**	Sample size
1928-29	*16.24*	35.65	47.06	1.05	0.00	2673
1994-	1.5%	47%	48%	2.5%	1%	203
		Data from the Peebles trap				
2000	5	11	84	-	-	64

Table A.2a.2: The percentages of Sea-trout spending different numbers of years at sea before returning to the river for the first time

The main difference between the samples is in the much higher proportion of fish returning without having spent a full winter in the sea ("Finnock" or "0SW") in the 1920's study. However, these fish are probably from the winter sample of 1928-29 and their capture during netting in the estuary does not necessarily mean that they were back in the river to spawn. The 1920's data also records how many fish returned to spawn again after spawning for a first time at "0" (as shown by marks on the scales) and this is actually very small, only 28 fish out of 2,915 repeat spawners. This does suggest that most of the 1928-29 sample were not, in fact, returning to actually spawn when captured but were simply feeding in the estuary and lower river. Other than this, the general samples agree in showing that the great majority of Tweed Sea-trout return to spawn after either one or two winters at sea. The Peebles sample shows a much lower proportion of fish returning after just one year at sea and a much higher level at two compared to the two general samples.

	First	Second	Third	Fourth	Fifth	Sixth	Sample Size
1928-29	90.25	8.26	1.20	0.16	0.04	0.0	2481
1994-	79.00	19.70	0.99	-	-	0.5	203
		Data from the Peebles trap					
2000	85	15					

Table A.2a.3: The percentages of Sea-trout returning to spawn for different numbers of times

The main difference between the two samples is in the proportion returning for the second time. This is probably due to the difference in sampling season, as repeat spawners return later than first spawners (See Appendix A2). The Peebles sample matches the general samples in the lack of spawners returning for more than a second time.

(D) The upriver migration patterns of Tweed Sea-trout: A small number of Sea-trout were radio-tagged during the 1994-96 project on Salmon and two complete records (from estuary to spawning site and back to the estuary) were obtained:

Ref No	Date Tagged	At Horncliffe	Furthest upstream record	At Horncliffe
002	11th October 94	**15th October**	**6th November** Colterscleuch, (top of Teviot)	**7th December**
003	11th October 94	**25th October**	**10th November**, Fairnilee, upper Tweed	**12th December**

No. 002 was Female, 67cms in length, and returning for the first time after 3 winters at sea
No. 003 was Female, 79cms in length, and was returning to spawn for the fourth time.

Table A.2a.4: Movements of radio-tagged Sea-trout within the Tweed

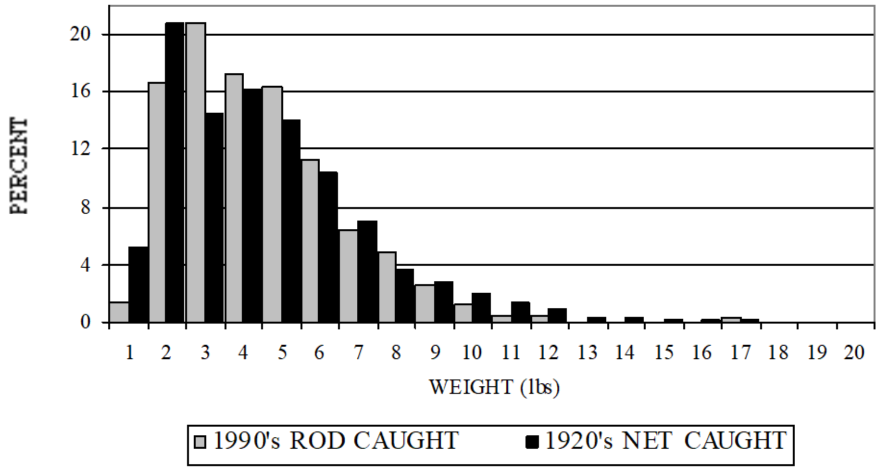
From this it can be seen that these autumn Sea-trout spent little time in the river: No. 002 took 53 days to go from Horncliffe (the first monitoring station) to its spawning area and back, while No. 003 took only 48 days.

(E) Exploitation of Sea-trout by anglers: As shown in Appendix E2, this is very low for early autumn fish, at less than 2%.

(F) The sizes of Sea-trout on Tweed: This actually differs between different areas of the catchment and strongly suggests that there are distinct populations of Tweed Sea-trout, a topic covered in Appendix A2. The lengths of Sea-trout caught upstream of the Till range from 260mm to 880mm with a single peak at 530mm (21") (Appendix A2 Graph A2.1) but those caught in the Till show a very different pattern): two peaks, at 460mm and 610mm and a minimal number of fish at 530mm, the most common size seen on the main Tweed (Appendix A2, Graph A2.2)

Other evidence of different stocks of Sea-trout within the catchment come from the recaptures of tagged fish at sea; sizes and growth patterns and these are all covered in Appendix A2.

(G) Sizes of Tweed Sea-trout over the 20th century: Direct comparisons between the lengths of Sea-trout caught at present and those caught in the 1928-29 sample analysed by Nall (1929) cannot be made as his length data is not presented in suitable form, but a comparison of weights can be made and is shown in Graph 2a.4. As Nall's sample was taken from the nets and so does not include October or November fish, these have been excluded from the 1990's rod sample for comparison:



Graph A.2a.4: Percentage of Sea-trout of different weights caught by Tweed and Till rod fisheries from February to September in the 1990's and sampled from netting stations in 1928-29

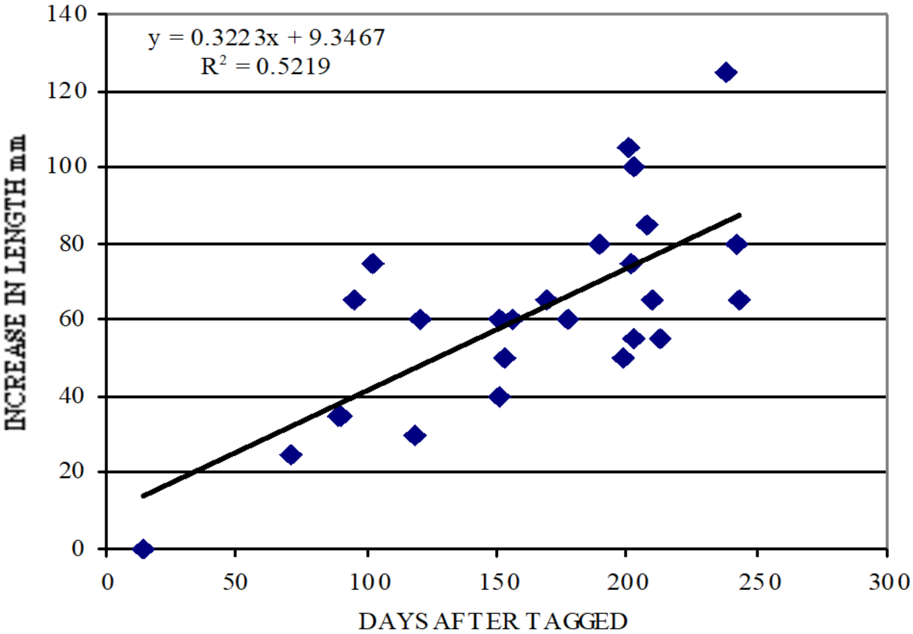
As can be seen from this, the sizes are generally very similar, despite the 70 or so years between the samples and the different methods and places of capture. The only significant differences are at two and three pounds and these may be due to the different sampling methods. On the whole, weights from 4 to 8 lbs are slightly more common in the recent sample and weights over 8lbs are slightly more so in the 1928 sample, but this may simply be due to the difference in sample size - the 1928 sample contained 2,497 fish, the 1990's sample only 595 and the rarer, larger, fish are more likely to turn up in a large sample than in a small.

(H) Tweed Sea-trout at sea: The growth put on during the time spent at sea can be seen in Graph A.2a.5 which plots the increase in size against number of days absent for Sea-trout tagged as kelts and then recaptured back in the Tweed (data is from the 1920's to the 1990's). The recorded times taken to leave the Tweed as kelts and return as fresh, mended, fish varies from 89 to 243 days. The relationship shown is quite strong, and from this it can be worked out that a Tweed Sea-trout will increase in length by roughly 10mm for every 30 days absence at sea (although the sample size is small). Some individual examples of growth of kelts returning as mended Sea-trout are given in Table A.2a.4.

TAGGED AS KELTS			RECAPTURED AS SEA-TROUT			Days
Date	Netting Station	mm	Date	Netting Station	mm	absent
1994/04/21	Whitesands	430	1994/07/20	Sandstell	465	90
1994/04/28	Whitesands	560	1994/08/01	Toddles	625	95
1994/04/28	Whitesands	460	1994/08/08	Sandstell	535	102
1995/03/31	Gardo	540	1995/06/28	Gardo	575	89
1995/04/03	Canny	510	1995/06/13	Toddles	535	61
1996/04/15	Canny	605	1996/08/14	Sandstell	665	121

Table A.2a.4: Growth of fish tagged as kelts and returning as mended Sea-trout

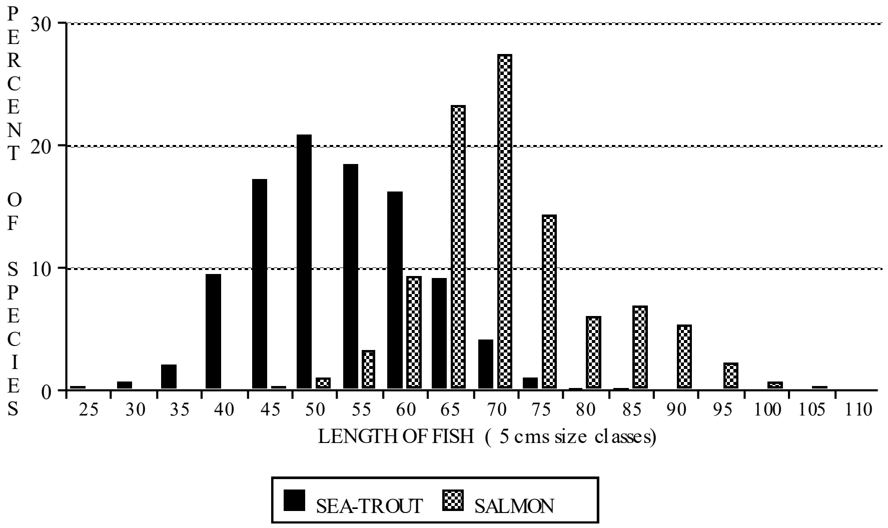
The marine migration routes and destinations of Tweed Sea-trout also seem to show distinct differences between different populations and are covered in Appendix A2.



Graph A.2a.5: The relationship between the number of days absence from the Tweed and the amount of growth put on in the sea

(I) Sea-trout isolated from Salmon above waterfalls: The unusual situation of a Sea-trout population being isolated from Salmon by a waterfall that the trout can surmount but Salmon cannot is found in the College Burn, a tributary of the Glen/Bowmont (the main tributary of the Till) above Hethpool Linns. An account of the monitoring and study of this population is given in Appendix A2 as it appears to illustrate a distinctive population.

(J) Size overlap of Tweed Sea-trout and Salmon: As well as large Sea-trout, the Tweed has many small Salmon so the overlap between the species is considerable, as shown in Graph A.2a.6. Most of the overlap lies between 50 and 75 cm, with 60 to 64 cm being the greatest area for this: 16% of Tweed rod caught Sea-trout fall into this size class along with 9% of Tweed rod-caught Salmon. In the next size class up, 65 to 69 cms, there are 9% of Tweed Sea-trout and 23% of the Salmon. This overlap is an important factor in selecting fish counters for use on the Tweed: to be usable, the data generated by a counter has to capable of being divided into separate totals for the two species.



Graph A.2a.6: The size overlap between rod caught Tweed Salmon and Sea-trout

A.2b: **Brown trout**
Salmo trutta fario

Photo A.2b.1: River Brown-trout from the Blackadder

(A) Ages and sizes at which juvenile Brown trout move into larger channels: The best information on this comes from the trap near Tweedsmuir, the results of which showed that juvenile trout start to drop down to the main channel just after their first Winter (as I+) at around 80mm in length and most have gone by the spring after their second winter (as II+) (see Graph A.2.4 above). This is confirmed by the electro-fishing surveys of small burns, which find few trout older than II+ (see Graphs A.2.2 & A.2.3 above). The pattern of movement is of a main period from March to May, with April being the peak month and then of a minor period from September to November, with July being the low point. The numbers moving can be quite considerable and concentrated on spates. At this trap, 1,276 trout were caught on the 29th April 2004, of which 962 were under 100mm in length.

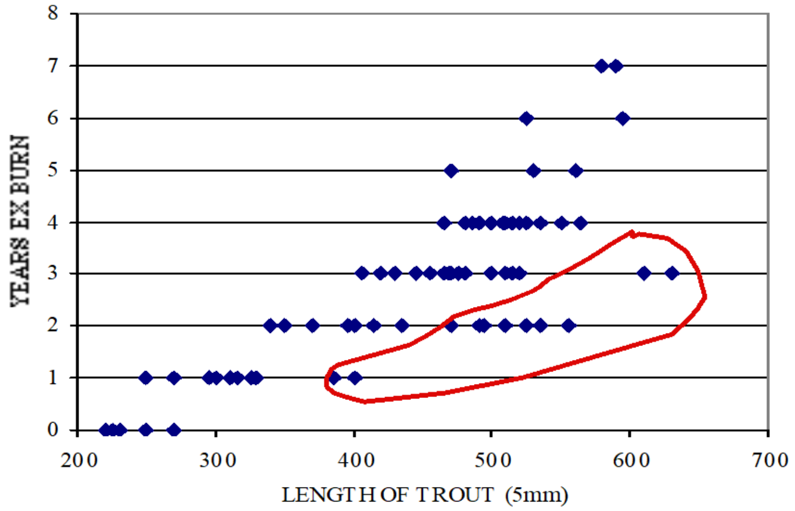
	2003	2004
JAN	108	41
FEB	46	94
MAR	399	489
APR	2,540	1,274
MAY	360	735
JUN	52	156
JUL	26	6
AUG	3	122
SEP	172	31
OCT	29	113
NOV	231	30
DEC	8	23
TOTAL	**3,974**	**3,114**

Table A.2b.1: Seasonal migration of juvenile Browntrout out of a burn near Tweedsmuir

The catchment area of the burn upstream of this trap is 15.74 km^2, so the average yield for the years 2003 and 2004 has been 225 young trout per km^2. It is not known how typical this yield is of Tweed burns, but it does show that large numbers of juvenile trout can be produced to stock the main river from natural spawning.

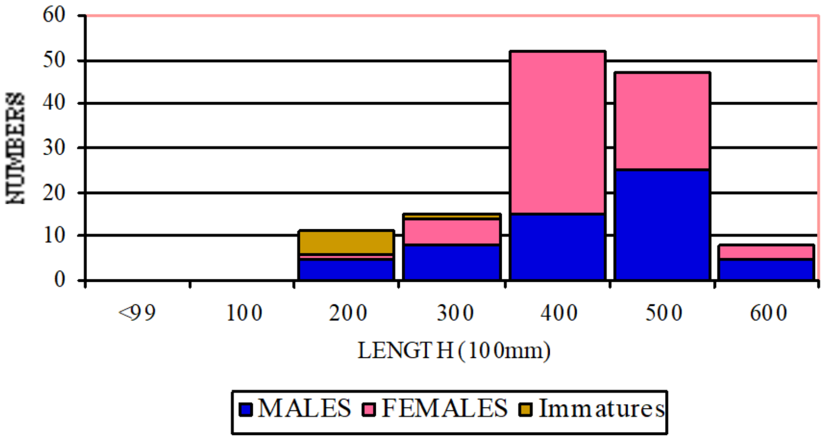
(B) Age of maturity and number of spawnings of Brown trout: Spawning marks on the scales of Brown trout are less obvious and more difficult to identify than those on Sea-trout scales. This is because large Sea-trout do not feed in freshwater and nourish themselves by re-absorbing body tissues, including roots of their scales, making their edges ragged and uneven. These areas of re-absorption remain visible in the scales as scars when growth starts again and can be counted as "spawning marks". Brown trout, however, do not go through this period of starvation, so their spawning marks are much less obvious, if they exist at all.

The best information on this collected so far comes from the trap near Tweedsmuir, where scales were taken from all the trout coming upstream to spawn in Autumn 2000 and their ages read. In Graph A.2b.1, the "ex-burn" years (the number of winters since a fish left the burn and entered the main river) are shown on the vertical scale and the length of the fish when trapped on the horizontal. As can be seen in the graph, fish first appear in the spawning run at between 200 and 300mm, when they have either not yet spent a full year in the main river or only one year. Between 300 and 400mm, the fish are mainly those that have been away for two years and so on. Trout around 500mm are mainly those that have been in the main river for three or four years while the oldest fish at 550 to 600mm in length have been five to seven years in the main channels. The group of fish circled in red are Sea-trout, which are much younger for their size than Brown trout as they grow faster in the richer feeding of the sea. There is, however, in this population some difficulty in distinguishing "*two adult year*" fish in the 300-500mm length as either Sea or Brown trout: there could be an intermediate group here of fish that go down to the lower Tweed or estuary and then return at a larger size than the locally feeding trout but not as large as Sea-trout proper. The total ages of these fish are one to three years greater that their 'ex-burn' ages, that being the range of years spent in the burn before migration.



Graph A.2b.1: The ages and sizes of trout spawning in a burn near Tweedsmuir in 2000

Although spawning marks on Brown trout scales are difficult to read, the probability is that these fish spawn every year, with the males beginning at smaller sizes than the females. As shown in Graph A.2b.2 almost all the trout under 300mm taken in this trap are either Male or Immature.



Graph A.2b.2: The sexes of different sizes of Trout spawning in a burn near Tweedsmuir in Autumn 2000

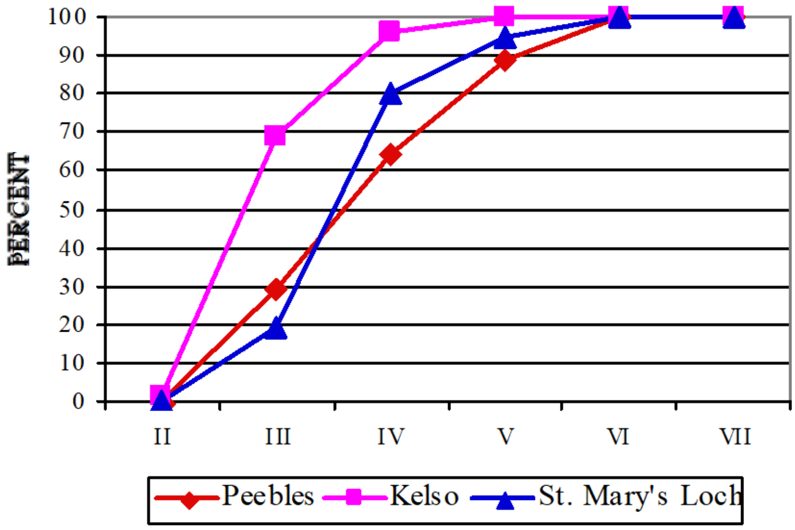
(C) Movements within the catchment and spawning migrations: The best information available at present comes from a trap run on the Kirkburn at Cardrona in the 1970's by an Edinburgh University student (Campbell, 1977):

TRAPPING DETAILS		**ANGLING RECAPTURE DETAILS**		
Date	Length (mm)	Locations	Date	Distance (kms)
1970.10.30	259	Howford	1971.07.10	8.1
1970.11.26	253	St. Boswells	1971.05.10	46.7
1971.11.05	275	Innerleithen	1972.05.06	11.3
1971.11.24	323	St. Boswells	1972.07.07	46.7
1971.11.25	246	Traquair	1972.04.20	9.7
1971.11.25	205	Horsburgh Ford	1972.04.17	3.2
1971.11.26	221	Melrose	1972.04.01	40.3
1971.12.11	213	Innerleithen	1972.06.01	11.3
1971.12.14	262	Horsburgh Ford	1972.04.16	3.2

Table A.2b.2: Movements of Brown-trout Tagged as Spawning Adults in the Kirkburn, near Peebles, within the Tweed in 1970 and 1971

Long-distance movements of Brown trout within river systems are also known elsewhere (Walker 1990).

(D) Sizes and ages of Tweed Brown trout: The first information on this comes from a 1970's survey (Mills *et al*, 1972), in which the ages of trout that had reached 200mm (8") or more were calculated for samples from the Peebles and Kelso sections of the Tweed and for St. Mary's Loch (Graph A.2b.3).



Graph A.2b.3: The ages of trout of 200mm (8") or more in different areas

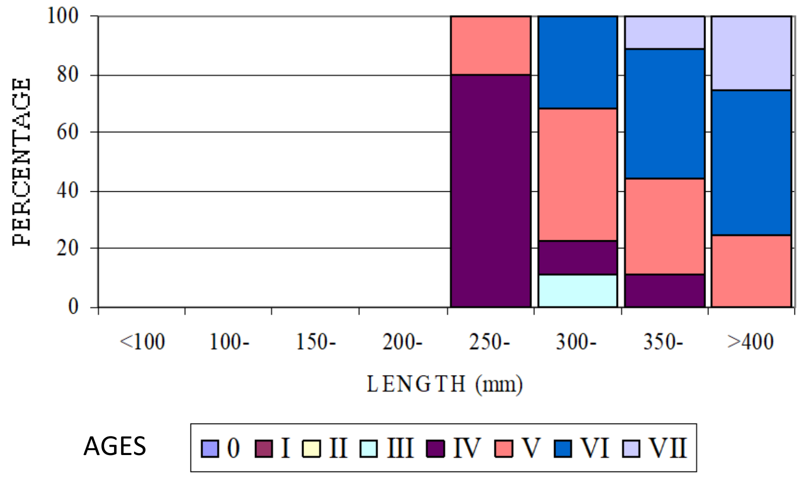
From this it can be seen that the trout from the Kelso area are the fastest growing, with 70% of three year olds having reached 200mm compared to 30% for the Peebles fish and 20% for the St. Mary's Loch sample. While almost all four year olds at Kelso had reached 200m, only 65% of the Peebles fish had though 80% of the St. Mary's Loch fish had reached that size.

The average size of trout of different ages was worked out for the Eden Water in the 1970's (Greendale, 1975), as shown in Table A.2b.3. While growth was very rapid up to age III, it reduced afterwards, possibly because fish are beginning to spawn at around that age, which diverts energy into producing eggs and milt.

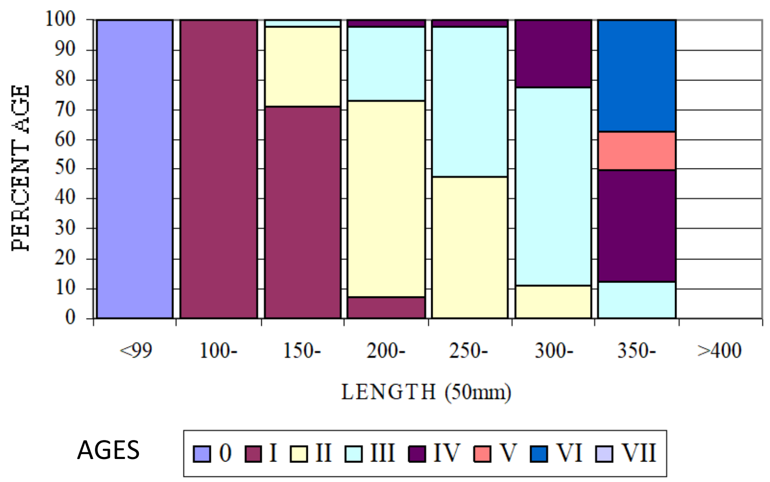
Age	Av Length mm	Number
I	94.6	14
II	155.5	34
III	276.9	38
IV	304.6	18
V	342.8	5

Table A.2b.3: Average lengths of trout of different ages in the Eden Water in the 1970's

More recent studies have given information on the trout of St. Mary's Loch (Young, 1991) and the Whiteadder (Fairgrieve, 1992), Graphs A.2b.4 & A.2b.5. differences in growth rate are again apparent: fish of 250-299mm length in St. Mary's Loch are 80% four year olds and 20% 5 year olds, while the same size class of Whiteadder trout are 47.4% two year olds, 50% three year olds and only 2.6% four year olds. The Eden Water trout (Table A.2b.3) match the Whiteadder trout, the average length of a three year old there being 276mm.



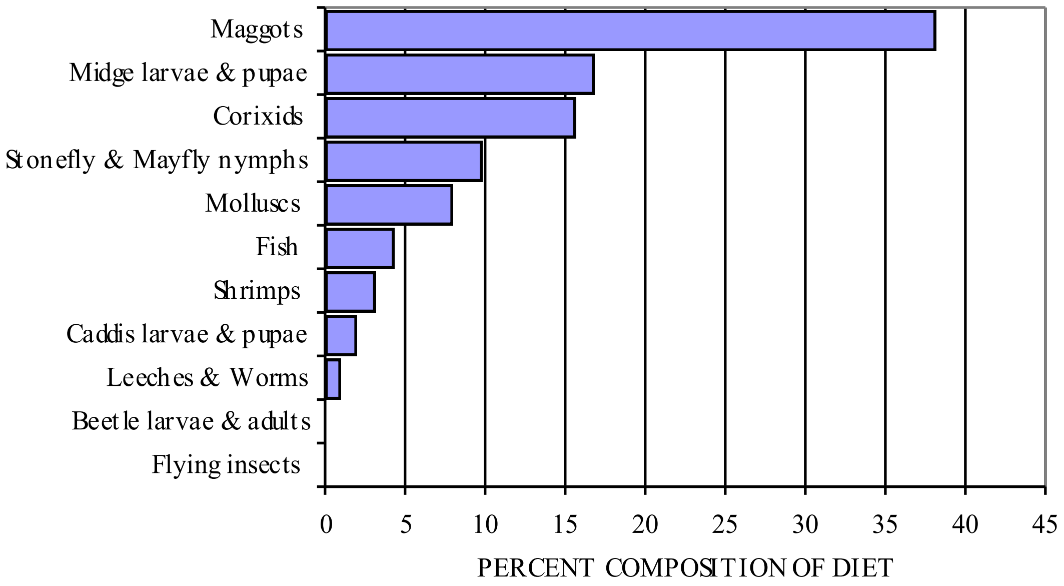
Graph A.2b.4: The age composition of different length classes of St. Mary's Loch trout, 1991 (Angling sample of 53 fish)



Graph A.2b.5: The age composition of different length classes of Whiteadder trout, 1991-92 (Electro-fishing and angling sample of 166 fish)

Such growth differences can be expected between a rich, warm, lowland, river and a poor, cold, upland loch.

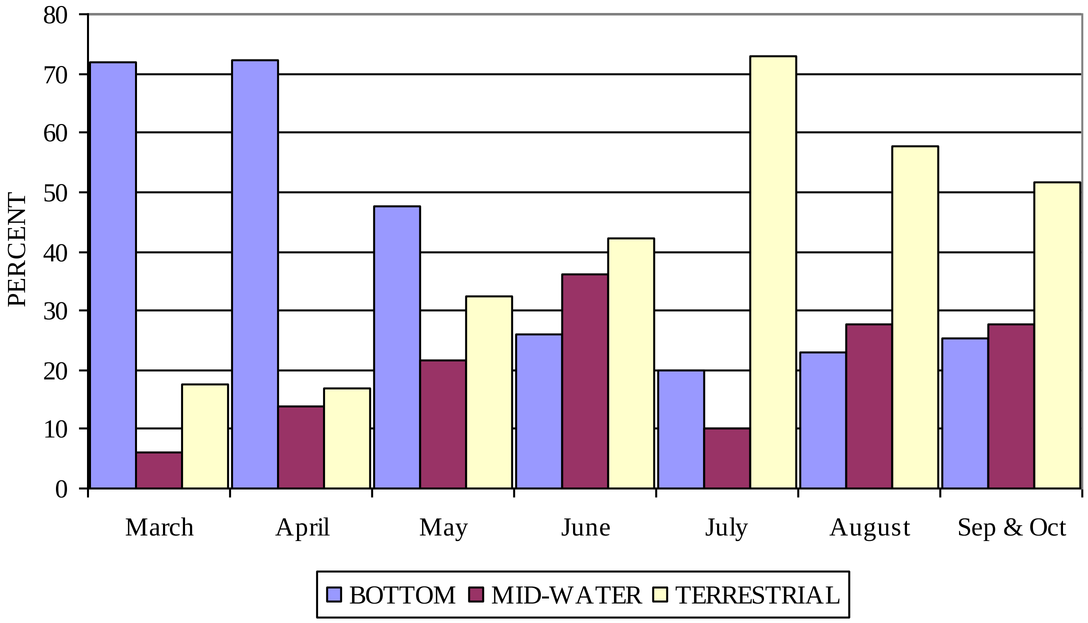
(E) Diet of Tweed Brown-trout: Considerable variation in the feeding available to trout can also be expected in a large catchment like the Tweed that includes both upland and lowland zones, though there is little information on this. The diet of a small sample of trout from the bottom of the river around Norham is shown in Graph A.2b.6, though this is rather distorted by the large number of maggots used as ground-bait by anglers in this area at that time, when Roach fishing was popular. The overall diet of trout here is dominated by Midge larvae and pupae (fed on as they emerge), with Corixids (Water-boatmen) another important prey. Stoneflies and Mayflies made up only 10% of the diet, though would probably have been more important in Spring months.



NOTE: The maggots found in the stomachs came from anglers' ground baiting

Graph A.2b.6: The diet of a sample of 36 trout ranging from 100mm to 250mm in length from around Norham and the Chain Bridge taken from March 1974 to March 1975 (Starkie, 1975)

At the other end of the catchment, there has been a study of the diet of trout in St. Mary's Loch (Young, 1991), the results of which are shown in Graph A.2b.7. The organisms found in the stomachs have been grouped according to whether they are bottom living (shrimps, snails, insect larvae and nymphs); free-swimming in mid-water (water-beetles, Corixids [Water-boatmen] or emerging insects rising to the surface) and terrestrial animals (spiders, beetles, etc.) blown onto the water.



Graph A.2b.7: The percent origin of diet of trout in St. Mary's Loch through the year

A strong seasonal pattern in source of food can be seen: in March and April, 70% of the diet is being taken off the bottom, but as insect larvae and nymphs emerge as adults to lay their eggs, this proportion falls rapidly until it is only 25% in June. At the same time the proportion of Mid-water and Terrestrial animals increases, till by July 70% of the diet is actually coming from the land rather than the loch. This is quite a common pattern in Scottish hill lochs, and is even more extreme in situations where there are no "permanent" aquatic animals (shrimps, snails, etc.) to provide food when the insects have emerged to lay their eggs, sometimes called the "August Famine". As the new generation of insects grows to be large enough to be fed on by fish, however, the feeding pattern returns to bottom food.