E:1 – build traps in at least one trout spawning burn in each Association's area – to monitor and identify trout spawning runs.

The Tweed Trout & Grayling Initiative

RESULTS FROM TRAPS ON TROUT SPAWNING BURNS

Summary

- The results from these five traps show that burns in the Tweed catchment can be dominated, in spawning terms, by Sea-trout and not necessarily be producing Brown-trout for the trout fishery, other than as the small resident males of Sea-trout populations.
- One trap did appear to be sampling a Brown-trout population and while these large Brown-trout, half of which were females, would be a prize for any angler, they would also appear to be rather rare fish for the Tweed catchment.
- These traps are very small sample, but the implications are critical – if four out of five of the burns in the Tweed catchment are not producing many female Brown-trout, then the situation for the Brown-trout fishery is quite different from that which might be imagined from looking at a map and seeing how many trout spawning burns there are.
- With four out of the five populations apparently producing mainly small male "Sea-trout" as Brown-trout and only one having a large, female, Brown-trout broodstock, the implications for trout angling management are significant.
- The pressure of angling exploitation should always fall most heavily on the strongest part of a stock, which would appear to be, in the case of non-migratory Tweed trout, smaller rather than larger trout. As it seems that more females than males migrate as Sea-trout (still being researched) this would mean that most Brown-trout in the river would be male. These, however, are the fish most protected by the current size limits of 8-10". Brown-trout larger than this, it seems, would have a significant proportion of actively breeding females amongst them, and these are the fish not protected by the current size limits. It might also be the case that those male Brown-trout that do grow large belong to populations like that found at the Tweedsmuir trap and should have some protection as well.
- This would require a changed approach to size limits for trout anglers, allowing the killing of fish between 8" and 12" but protecting those over this size. A trophy size limit, however, could also be applied, allowing the killing of trout over (for example) 20" as such fish would be nearing the end of their natural lifespan anyway and would be cannibals.
- This would create a size-range or "slot" of protected fish as broodstock, but allow the killing of fish under and over range.
- Other information from these traps shows how the numbers of fish returning to spawn can vary with the strengths of different age groups; if this sort of variation can be tracked at these traps over the years, then an insight will be gained as to the workings of the trout population and if reasons for the variation could be found, then predictions could be made about the strength of the stocks from year to year.
- The importance of good flows at the right times of year to get fish up these burns is shown, as is the need for spates in Spring to get juveniles downstream.
- With more data over time, it should be possible to find out the relationships between numbers of adults spawning and the resulting number of juveniles migrating downstream, which would show how many mature trout need to survive all the fisheries and other dangers to fully stock their nursery areas for the next generation.

A: Introduction: The results shown for each trap are:

1) A 'Population Profile'' – a graph of the proportion of fish caught and their sexes in 100mm length groups i.e. the numbers of males, females and uncategorised fish that are in each size group (100-199mm, 200-299mm, 300-399mm etc.) and showing each sex of each size group as a percentage of all the fish caught over all the seasons trapped..
2) A table of the catch at each trap for each year. The numbers of fish in each 100mm size class are given as well the overall percentage contributed by each size class over the years
3) The Sex Ratios for each Autumn's run, as well as the overall percentage of each sex over all the years.

The ability of spawning fish to get up their burns in dry weather is a matter of concern and interest. It is possible that in dry Autumns there is much less spawning area available to fish due to low flows (or dried out stretches) than in wet, so the next two categories of data record information on the time of year the fish run their burns and how concentrated the run is – a wet year should give more chances for fish to get upstream than a dry, so the run should be spread more widely over the spawning period in those seasons.

4) The Run Timing at each trap, which is represented by the date by which half the Male, Female and Uncategorised (= unidentified to sex) trout have passed upstream.
5) The Run Concentration, as shown by the proportion of the total run of a year that is made up of the two largest daily totals – for Males, Females and Uncategorised.

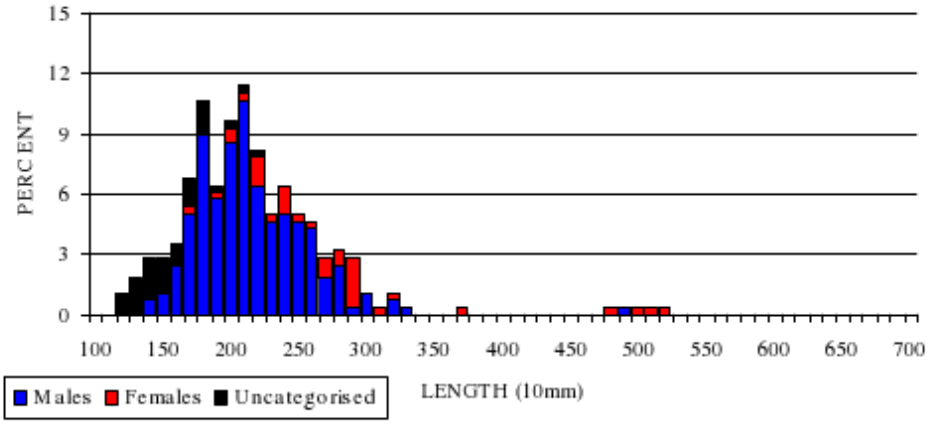
At the traps that catch juveniles emigrating downstream as well as returning adults, additional results given are: -

6) The length frequency and colour of the juveniles – the numbers in each 5mm length class and how many of each length class are "Silver'' (= Sea-trout smolts); "Part'' (=partly silvered fish which are probably going to become smolts) and "Brown'' (= young trout in their normal colours which are not going to become smolts that year or at all).
7) The annual results, broken down into months.

B: RESULTS FROM TWEED TROUT TRAPS

B1 The Trap at Cardrona (1970 & 1971 and 2007-): The 1970's data on this is from :- *Spawning characteristics of Brown trout and Sea trout (Salmo trutta. L.) in the Kirk Burn, River Tweed, Scotland by J.S.Campbell,* published in the Journal of Fisheries Biology 11, 1977

Graph B1.1a: Population Profile of the Kirkburn population 1970 & 71



Graph B1.1b: Population Profile of the Kirkburn population 2007

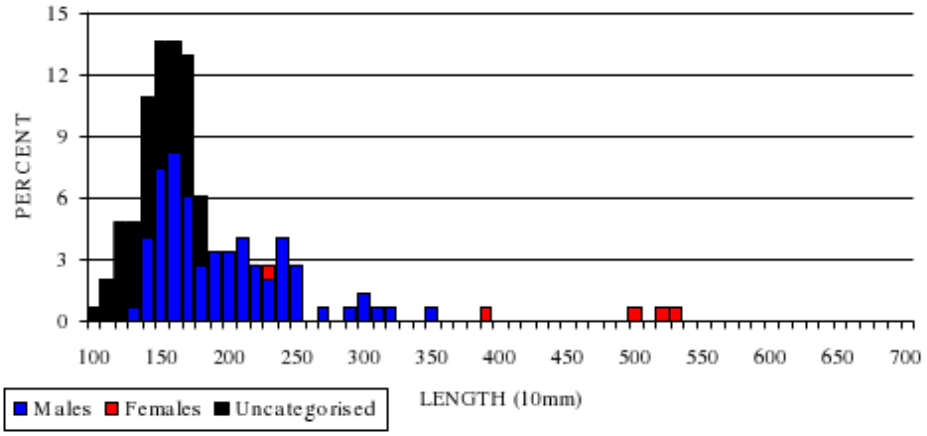


Table B1.1: Annual Results at the Kirkburn Trap

	LENGTH OF TROUT in 100mm length Classes:								ANNUAL
	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800+	TOTAL
Combined % (70 & 71)	36.07%	59.29%	3.21%	0.71%	0.71%	0.00%	0.00%		
1971	40	95	5	1	2	0	0		143
1970	61	71	4	1	0	0	0		137
Combined %(07 on)	72.79%	21.09%	4.08%	0.00%	2.04%	0.00%	0.00%		
2007	107	31	6	0	3	0	0		147
Lengths in Inches	*4" to 8"*	*to 12"*	*to 16"*	*to 20"*	*to 23.5"*	*to 27.5"*	*to 31.5"*	*Over 31.5"*	

Table B1.2: Sex Ratios at the Kirkburn Trap

	Males per 1 Female
1970	8.8
1971	4.8
2007	16.6

The 1970's results from this trap do not include data on the timing or daily numbers of the catches, so no information can be presented on these for those years.

Table B1.3: Run Timing at the Kirkburn Trap

	DATE ON WHICH 50% OF ANNUAL RUN ATTAINED			
	Male	Female	Uncategorised	Overall
2007	21st Nov	22nd Nov	28th Nov	21st Nov

Table B1.4: Run Concentration at the Kirkburn Trap

	PERCENTAGE OF TOTAL ANNUAL RUN TRAPPED ON THE DAYS WITH THE TWO HIGHEST TOTALS			
	Male	Female	Uncategorised	Overall
2007	32.5%	40[illegible]%	21.[illegible]%	2[illegible]%

Summary for the Kirkurn Trap: The 1970's Population Profile here shows the bulk of the run to be between 120 and 330 mm in length, with a gap in the sizes found till 480mm is reached. Most of the smaller trout are males, four out of the five in the group of larger fish "over the gap" being

females. This is a characteristic pattern of a Sea-trout population, with smaller "Brown-trout" males and larger Sea-trout females making up the spawning population. Numbers were very similar in the two years the trap was run, but the sex ratio shows the few, larger, females to be greatly outnumbered by the many smaller males.

B2 The trap near Maxton, on a small burn running directly into the Tweed (not a complete barrier to fish. The burn also suffered from a major pollution incident in 2004)

Graph B2.1: Population Profile of the Maxton population (runs of 2002 & 2003)

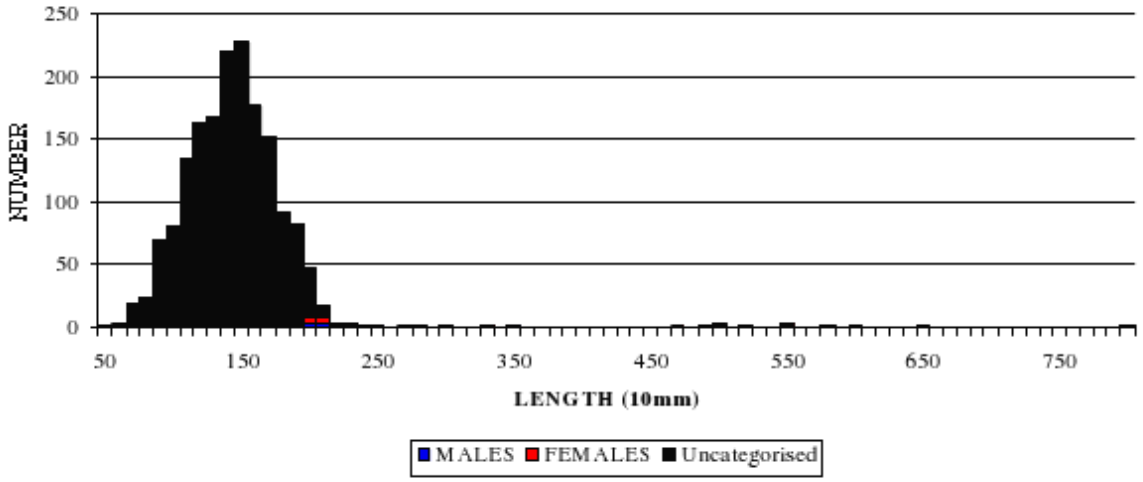


Table B2.1: Annual Results at the Maxton Trap

	LENGTH OF TROUT IN 100mm length Classes:									ANNUAL
	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	over 800	TOTAL
COMBINED %	6.85%	87.65%	4.45%	0.29%	0.12%	0.47%	0.12%	0.00%	0.06%	
2002	98	1324	67	3	0	2	0	0	0	1494
2003	19	174	9	2	2	6	2	0	1	215
2004										
2005										
2006										
2007										

Lengths in Inches *Under 4"* *to 8"* *to 12"* *to 16"* *to 20"* *to 23.5"* *to 27.5"* *to 31.5"* *Over 31.5"*

Table B2.2: Sex Ratios at the Maxton Trap

	Uncategorised	Male	Female
COMBINED %	96.90%	1.70%	1.40%
2002	1460	22	13
2003	197	7	11
2004			
2005			
2006			
2007			

Table B2.3: Run Timing at the Maxton Trap

	DATE ON WHICH 50% OF ANNUAL RUN ATTAINED			
	Uncategorised	Male	Female	Overall
2002	30 Oct	24 Oct	02 Dec	31 Oct
2003	27 Oct	02 Dec	30 Nov	27 Oct
2004				
2005				
2006				
2007				

Table B2.4: Run Concentration at the Maxton Trap

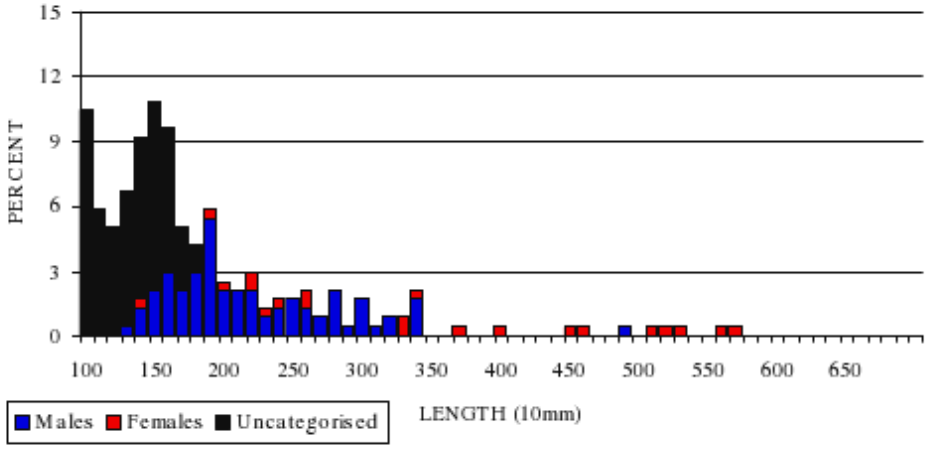
PERCENTAGE OF TOTAL ANNUAL RUN TRAPPED ON THE DAYS WITH THE TWO HIGHEST TOTALS

	Uncategorised	Male	Female	Overall
2002	24.7%	45.5%	23.1%	15.5%
2003	25.9%	85.7%	81.8%	25.9%
2004				
2005				
2006				
2007				

Summary for the Maxton Trap: The catches here are dominated by very large numbers of small fish under 200mm in length – in 2002, there were over 1400 of this size class. There is a scattering of fish from 200 to 350mm, then a gap and then a small number of large Sea-trout from 470 to 850mm. The large numbers of small trout heading up this burn in Autumn are probably leaving the main river and its spates for a quieter habitat in the burn over Winter – 247 were trapped in one day on October 24th 2002 and other days have also produced catches over 100, so movement seems to be large-scale and co-ordinated. The dry Autumn of 2003 however, reduced the numbers of these small fish considerably, but not the run of larger trout. It is not possible to sex such small fish easily, and all those killed and opened up for examination have been immature, but the sex ratios of the larger trout are almost equal. The effect of the dry Autumn of 2003 can be seen by the fact that over 80% of the identifiable males and females ran in just two days of the season.

B3: The trap near Jedburgh, on a small tributary of the Jed Water

Graph B3.1: Population Profile of the Jedburgh population (2002 –2006)



Note: Large trout were observed getting over the top of this trap during high flows in 2006

Table B3.1: Annual Results at the Jedburgh Trap

	LENGTH OF TROUT IN 100mm length Classes:								
	100-199	200-299	300-399	400-499	500-599	600-699	700-799	over 800	ANNUAL
COMBINED %	70.44%	18.61%	5.84%	1.46%	3.65%	0.00%	0.00%	0.00%	TOTAL
2002	74	26	9	0	2	0	0	0	111
2003	1	0	2	2	0	0	0	0	5
2004	19	6	1	1	2	0	0	0	29
2005	80	10	3	1	1	0	0	0	95
2006	19	9	1	0	5	0	0	0	34
2007									
	Under 4"	*to 8"*	*to 12"*	*to 16"*	*to 20"*	*to 23.5"*	*to 27.5"*	*to 31.5"*	*Over 31.5"*

Table B3.2: Sex Ratios at the Jedburgh Trap

	Males per 1 Female
2002	13.0
2003	0.3
2004	2.7
2005	2.7
2006	2.1
2007	

Table B3.3: Run Timing at the Jedburgh Trap

	DATE ON WHICH 50% OF ANNUAL RUN ATTAINED			
	Male	Female	Uncategorised	Overall
2002	31st Oct	6th Nov	26th Oct	26th Oct
2003	3rd Dec	3rd Nov	na	3rd Dec
2004	16th Oct	18th Oct	20th Oct	18th Oct
2005	22nd Oct	4th Nov	1st Oct	25th Oct
2006	26th Oct	12th Nov	8th Oct	25th Oct
2007				

Table B3.4: Run Concentration at the Jedburgh Trap

	PERCENTAGE OF TOTAL ANNUAL RUN TRAPPED ON THE DAYS WITH THE TWO HIGHEST TOTALS			
	Male	Female	Uncategorised	Overall
2002	48%	100%	75%	61%
2003	100%	100%	none	100%
2004	50%	50%	43%	38%
2005	63%	43%	42%	35%
2006	80%	57%	58%	62%
2007				

The trap near Jedburgh was also badly affected by the drought in Autumn 2003, and it is really only the 2002 run that shows the population's characteristics. Again, there are many small trout, though noticeably more in the catchable range of 200 to 350mm than at the Maxton trap. The "gap" is present though, but narrower, from 370mm to the Sea-trout at 450 to 550mm. Again, the smaller "Brown-trout" are mainly males while the larger Sea-trout are all females. Sex ratios are again unbalanced with many more males than females. The delay caused by the drought of 2003 was of around one month in the run timing and the concentration of the run was even greater than in 2002, with all the categories of fish running in just two days of the season.

B4 The trap near Peebles, on a tributary of the Upper Tweed.

Graph B4.1: Population Profile of the Peebles population (runs of 2001 to 2006)

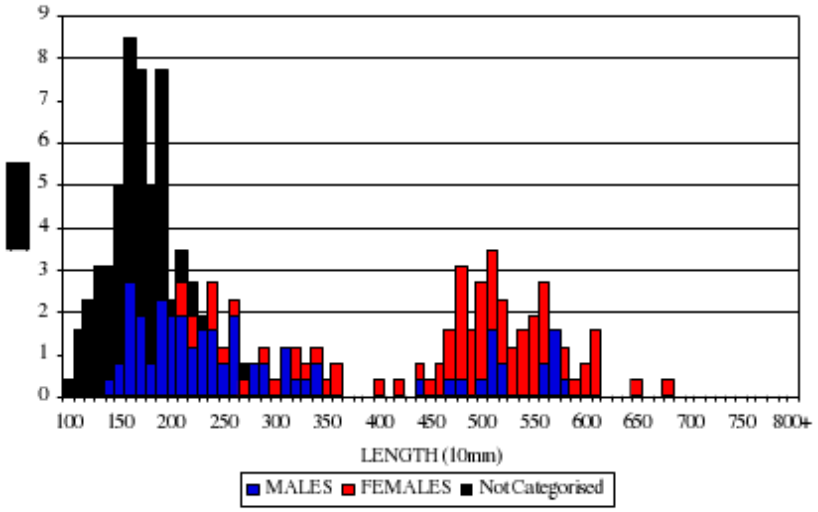


Table B4.1: Autumn Upstream Results at the Peebles Trap

COMBINED %	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800+	ANNUAL TOTAL
2001	26	22	2	9	14	1	0	0	76
2002	50	20	4	2	1	2	0	0	80
2003	0	5	2	5	12	0	0	0	24
2004	16	2	1	0	0	0	0	0	19
2005	11	0	4	3	2	0	0	0	20
2006	12	1	2	4	20	5	0	0	44
2007									
Lengths in Inches	*to 8"*	*to 12"*	*to 16"*	*to 20"*	*to 23.5"*	*to 27.5"*	*to 31.5"*	*Over 31.5"*	

Table B4.1a: Flows at the Peebles trap and local rainfall and river flow data:

	Average flow height over trap barrier		Average flows at the Peebles gauging station		Average rainfall at the	
	Mar – Jun	Oct – Dec	Mar-Jun	Oct - Dec	Mar-Jun	Oct - Dec
2001		na				
2002		na				
2003	7.89	9.4				
2004	11.71	17.2				
2005	9.34	18.1				
2006		19.95				
2007						

Table B4.2: Sex Ratios at the Peebles Trap

	Males per 1 Female
2001	0.54
2002	3.43
2003	0.86
2004	8.00
2005	1.00
2006	0.55

Table B4.3: Run Timing at the Peebles Trap

DATE ON WHICH 50% OF ANNUAL RUN ATTAINED

	Male	Female	Uncategorised	Overall
Av. days from 1st Oct	35	46	38	38
2001	19th Oct	20th Nov	8th Nov	6th Nov
2002	4th Nov	15th Nov	4th Nov	4th Nov
2003	29th Nov	30th Nov	na	29th Nov
2004	27th Oct	8th Nov	6th Nov	4th Nov
2005	29th Oct	4th Nov	30th Oct	30th Oct
2006	16th Nov	23rd Nov	6th Nov	17th Nov
2007				

Table B4.4: Run Concentration at the Peebles Trap

PERCENTAGE OF TOTAL ANNUAL RUN TRAPPED ON THE DAYS WITH THE TWO HIGHEST TOTALS

	Male	Female	Uncategorised	Overall
Average	51.4%	73.9%	51.7%	42%
2001	16.7%	27.3%	28.0%	15.8%
2002	37.5%	71.4%	31.5%	28.8%
2003	81.8%	76.9%	none	79.2%
2004	37.5	100	27.3	25.0
2005	33.3	66.7	60.0	36.4
2006	50.0	27.3	60.0	25.0
2007				

The Population Profile found at the Peebles trap is again split into two groups, though more nearly equal than at the other traps – the gap between them is also quite narrow. Again, most of the smaller fish are Males or are uncategorisable, while most of the large group are Sea-trout females, though there are some large Sea-trout Males as well. The drought of 2003 again affected the smaller trout (which generally run earlier) more than the larger – none were trapped in 2003 though the numbers of Sea-trout were much the same as in previous years. The sex ratios are highly variable and depend greatly on the number of small males that are trapped. The dry conditions of this year delayed the fish about a month and made the run highly concentrated. In general, the males run earlier than the females, the average number of days from the 1st of October for 50% of the males to have been trapped is 35 days (around Nov 4th) but for females, it is 46 days (around Nov 15th). In 2001, however, there was 32 days difference between these times but only one day in the drought year of 2003.

An interesting observation was made at this trap between 09.00 and 09.30 hrs on the 29th November, 2003 (a very dry Autumn). While the trap was being cleaned in the morning, the water suddenly rose to 15 on the gauge, up from 11, and became discoloured. Within 8 minutes, 5 Sea-trout had entered the trap, showing how quickly they can respond to a rise in the water when needing to get upstream.

B5: The Trap near Tweedsmuir

Graph B5.1: Population Profile of the Tweedsmuir population (runs of 2001 to 2003)

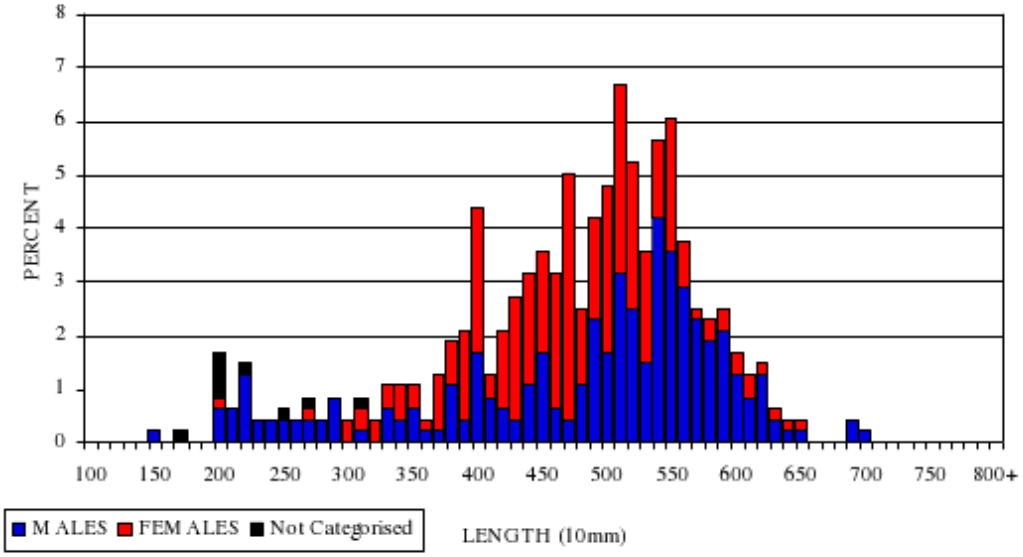


Table B5.1: Autumn Upstream Results at the Tweedsmuir Trap

COMBINED %	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800+	ANNUAL TOTAL
2001	1	9	8	33	35	4	0	0	90
2002	0	5	3	16	43	5	0	0	72
2003	1	8	11	17	42	2	0	0	81
2004	0	3	6	21	22	8	1	0	61
2005	0	1	7	14	17	3	1	0	46*
2006	Trap flooded – more caught going downstream than upstream								
2007									

* three mature fish were unmeasured

Lengths in Inches	*to 8"*	*to 12"*	*to 16"*	*to 20"*	*to 23.5"*	*to 27.5"*	*to 31.5"*	*Over 31.5"*

Table B5.1a Flows at the Tweedsmuir trap and local rainfall and river flow data :

	Average flow height over trap barrier		Average flows at the Cruik Inn gauging station		Average rainfall at the	
	Mar – Jun	Oct – Dec	Mar-Jun	Oct - Dec	Mar-Jun	Oct - Dec
2001						
2002						
2003		12.1				
2004		29.6				
2005		26.6				
2006		16.9				
2007						

Table B5.2: Sex Ratios at the Tweedsmuir Trap

	Males per 1 Female
2001	1.23
2002	1.18
2003	0.88
2004	1.54
2005	1.26
2006	3.00
2007	

Table B5.3: Run Timing at the Tweedsmuir Trap

	DATE ON WHICH 50% OF ANNUAL RUN ATTAINED			
	Male	Female	Overall	Uncategorised
2001	Oct 23rd	Oct 23rd	Nov 25th	Oct 23rd
2002	Nov 3rd	Nov 4th		Nov 4th
2003	Nov 5th	Nov 7th		Nov 7th
2004	Oct 25th	Oct 25th		Oct 25th
2005	Oct 26th	Oct 27th		Oct 27th
2006	Trap flooded over – more fish down than up			
2007	Trap flooded over – more fish down than up			

Table B5.4: Run Concentration at the Tweedsmuir Trap

	PERCENTAGE OF TOTAL ANNUAL RUN TRAPPED ON THE DAYS WITH THE TWO HIGHEST TOTALS			
	Male	Female	Uncategorised	Overall
Average	33.13%	29.35%		28.55%
2001	37.50%	41.03%	none	36.67%
2002	20.51%	18.18%	none	19.44%
2003	42.11%	27.91%	none	34.57%
2004	40.54%	33.33%	none	31.15%
2005	25.00%	26.32%	none	20.93%
2006	Trap flooded over – more fish down than up			
2007	Trap flooded over – more fish down than up			

The Tweedsmuir trap shows a quite different Population Profile from the others, with only one main size group, of larger trout, and no "gap". The drought of 2003 did not affect the numbers of fish running (Table 5.1), perhaps because they are almost all of the larger size classes that were less affected at the other traps as well. The sex ratios of the single group of larger fish that makes up this population are much more equal and regular, unlike at the other traps, possibly also due to the lack of the small males which can be very variable in number. The timing of the run is also different, in that there is no real difference between the sexes, the males being at most a day later, showing that both run upstream together. In terms of days from the 1st of October, the average for males to reach 50% of their run total is 28.8 days, while for females it is 29.6. Run concentration also appears to be less at this trap in general.

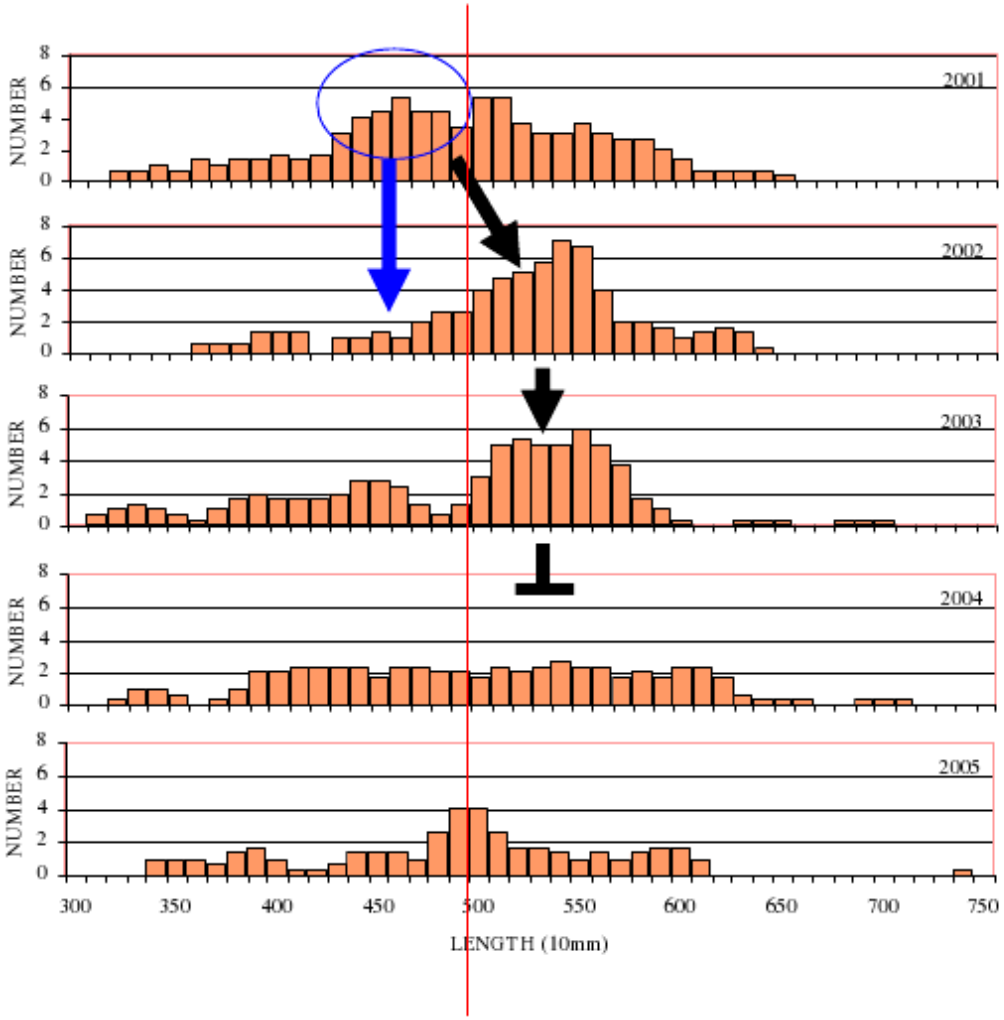
As can be seen from Table 5.1, the number of adult trout running upstream to spawn in this burn has been falling. Analysis of the sizes (=ages) of the fish, shows the reason for this. When the trapping started, there were a significant number of large, old fish, of 500mm and above (see Table 5.5) but, after 2001, many fewer fish below this size. As this original group of large, old, fish aged and died out over the next few years, the smaller number of younger fish following behind did not increase in numbers and so the total entering the trap each Autumn fell. Why there should have been fewer younger fish to replace the older ones as they faded out of the population is not known, but it suggests survival to breeding size was either poorer in more recent years or that it was unusually good about 10 years ago giving a particularly high number of larger, older, fish for a few years, before reverting to a more normal situation.

Table B5.5: The numbers of trout above and below 500mm in length trapped at Tweedsmuir

	Under 500mm	Over 500mm	Total
2001	41	39	80
2002	19	48	67
2003	28	44	72
2004	27	31	58
2005	21	21	42

This pattern is shown in more detail in Graph 5.2. The size classes have been "smoothed by three" to iron out minor differences and accentuate the overall pattern (i.e. the number of trout in each 10mm length class has been averaged with the number in the 10mm group just below it and with the number in the group just above).

Graph B5.2: Size Frequencies of upstream migrating trout at the Tweedsmuir trap 2001-2005



The thin red line over the graphs is the 500mm dividing line between "smaller, younger" and "larger, older" and the sizes circled in blue in the 2001 show the last numerous group of smaller, younger fish to turn up at the trap. These pass over the 500mm line and become larger, older fish in 2002 (black arrow). They sustain the "larger, older", element till 2003 after which they die out and do not appear in 2004 (black arrows and lines). What is very clear in the 2002 graph is that there is no numerical equivalent to the size group circled in blue in the 2001 graph (blue arrow) i.e. fewer smaller, younger, fish turned up that year, and the numbers of this size of fish turning up have remained at the 2002 level since.

While trap efficiency could affect the total numbers of fish being caught, it is very unlikely to be affecting the pattern of fish caught, i.e. the relative numbers of smaller, younger and larger, older, trout. This was quite different in 2001 compared to the subsequent years, so trap selectivity cannot be a major factor in the pattern shown here.

Upstream trapping Summary: It would appear that four out of these five traps are sampling similar populations, made up of a more numerous group of smaller, Brown-trout and a much smaller number of larger Sea-trout, with a gap in the middle where there are few "medium-sized" trout. As the small fish are mainly males, this gives spawning runs of many more males than females. At the Tweedsmuir trap, however, the population is quite different, being made up of almost equal numbers of males and females, all of larger sizes than generally found elsewhere and almost all Brown-trout. If this small sample of burns reflects the Tweed situation in general, it suggests that there may be relatively few actual Brown-trout populations (i.e. where the males and females are both not migratory) compared to the number of breeding populations were almost all the eggs that are deposited come from Sea-trout but are fertilised by smaller Brown-trout. If this were indeed the case, then a large proportion of the juvenile trout found in the burns of the Tweed system will go off to sea and will not stock the river for the Brown-trout fishery. This would also imply that the relatively few "medium-sized" Brown-trout in the system are more likely to be female than male and to belong the minority of spawning burns where Brown-trout dominate. Further evidence to support this scenario comes from the types of juveniles that are trapped moving downstream at the Peebles and Tweedsmuir traps.

C: Downstream migration of juveniles

When the downstream-catching sections of the Peebles and Tweedsmuir traps were first put into operation, it came as a surprise to find that the fish they caught were very different. Those from the Peebles trap were almost all silvery Sea-trout smolts, those from the Tweedsmuir trap were almost all yellow-brown Brown-trout, with no signs of silvering up – and many were small, obviously only one winter old. It was only in the second year of operation therefore that the colours of the juveniles were recorded to show this difference. The categories and definitions used are:

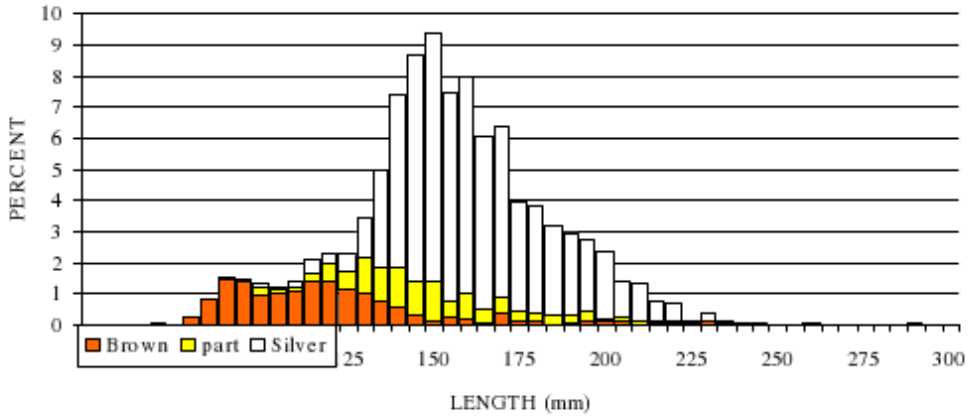
Table C.1

Colour Category	Definition
"Brown"	Yellow & Brown all over. All spots distinct
"part"	Some silvering over of the marks and spots, but generally brownish
"Silver"	Silver all over. Spots and other markings no longer visible.
	(See Photo C3.1)

Each juvenile recorded is now categorised into one of these groups as well as measured. The aim of this is not only to show the differences in the appearance (and likely life-history) of the juveniles emigrating from these two burns but to make it possible to record any changes there might be in the future.

C1: Downstream migration of juveniles through the Peebles trap.

Graph C1.1: The Population Profile of Juveniles at the Peebles trap



The juvenile trout that move down through the Peebles trap are almost all fully silvered and can be regarded as Sea-trout smolts (Photo C3.1) – this is not surprising, given that almost all the adult females caught at this trap are Sea-trout. The timing of the movement is also very restricted, occurring in April and May (the downstream part of this trap cannot be used in Autumn due to the amount of leaves in the stream then).

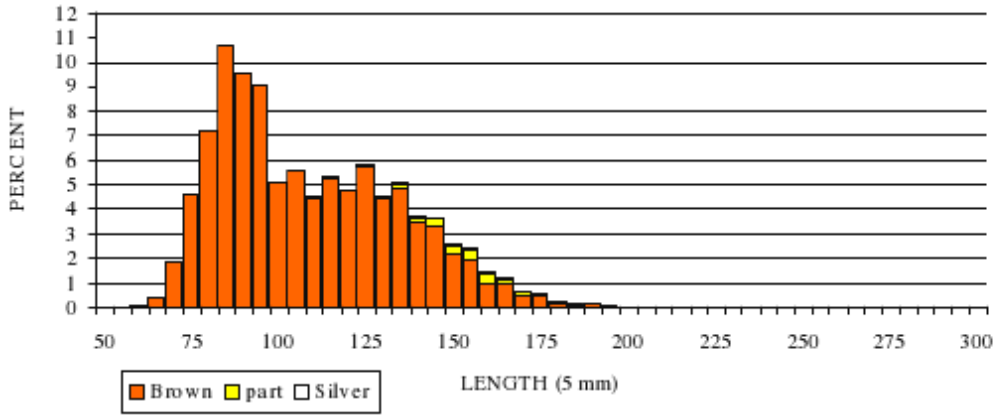
Table C1.1: The Annual Totals of emigrating juveniles at the Peebles Trap.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
2002			9	293	989	4							1295
2003			8	65	384	1							458
2004			6	254	26	25							311
2005			0	32	14	4							50
2006			18	9	0	0							27
2007													
NOTES: 2003 was not a full count of emigrants – it was a dry Spring, then there was one big spate which swamped the trap and on which the fish moved. 2006 No spate after March													

The numbers coming downstream have fallen over the past few years, but as the numbers of Sea-trout of mature size going upstream have been very variable, even zero in 2004, (Table B4.1) this is not surprising. With more data it may well be possible to work out the relationship between numbers of adult females going upstream and resulting juveniles going downstream. In some years, there has been no spate in the Spring to bring the smolts down. Artificial spates from the loch on the burn were tried at the end of May 2006, after there had been no natural spates since March, but with no response.

C2: The downstream migration of juveniles through the Tweedsmuir Trap

Graph C2.1: The Population Profile of Juveniles moving downstream through the Tweedsmuir Trap



The sort of juveniles coming out of this burn are obviously very different from those coming out of the Peebles trap burn. Almost all are brown coloured and there are two size peaks, one around 85mm and another around 125mm, which will correspond to one and two year old fish (Photo C3.2) There is a pattern to the sizes of juveniles emigrating from this burn that has not yet been explained. Every second year (even-numbered years), a large proportion of the total is made up of small fish, just over one winter old while in the alternate years, the proportions are more or less equal between one and two winter year old fish, as shown in Graph C2.2 . There is no obvious reason why the proportion of 1 year old emigrants should increase every second year: it does not appear to be related to the total number of fish leaving in a year, for example.

Graph C2.2: The size profiles of juveniles migrating downstream through the Tweedsmuir trap in each year from 2002

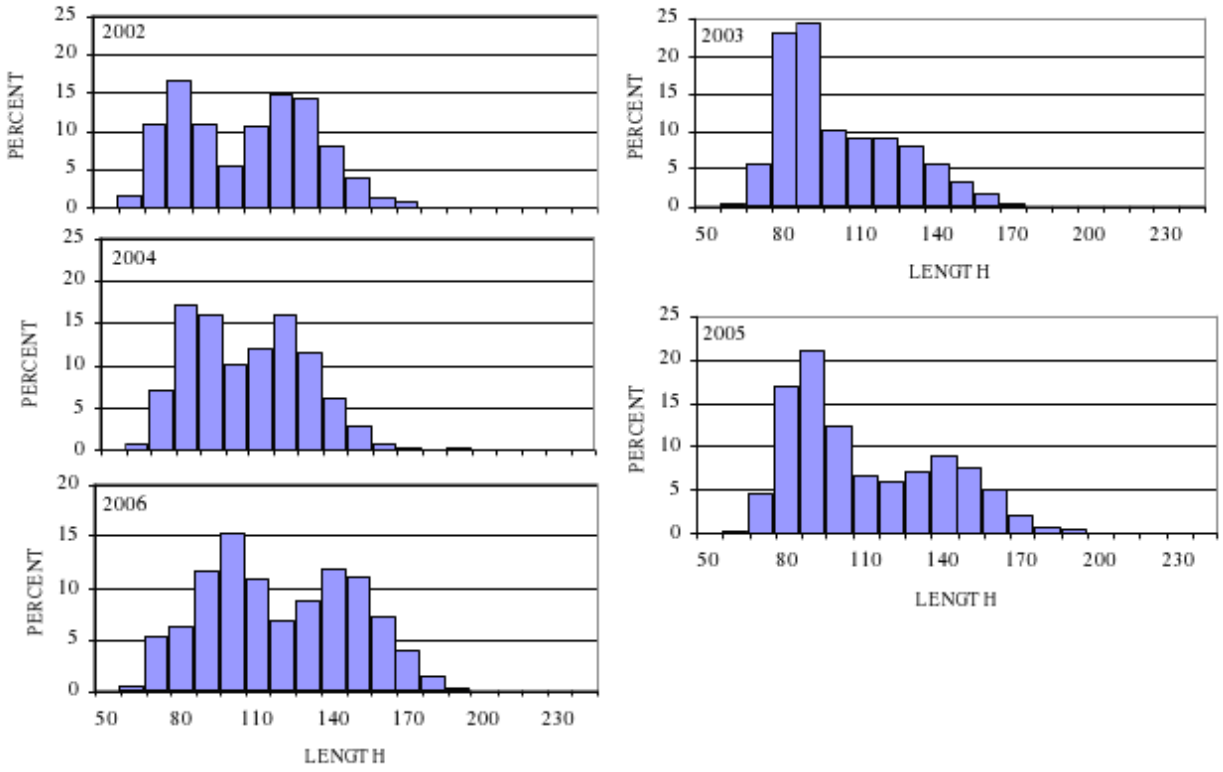


Table C2.1 The Annual Totals of emigrating juveniles at the Tweedsmuir Trap.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YEAR
2002	32	194	90	313	530	95	0	2	127	6	0	0	1389
2003	108	46	399	2540	360	52	26	3	172	29	231	8	3974
2004	41	94	489	1274	735	156	6	122	31	113	30	23	3114
2005	137	30	277	435	1035	84	3	26	27	167	3	0	2224
2006	2	0	157	179	781	43	1	119	0	23	11	0	1316
2007													

NOTES: From 2006, the sluice gate at this trap has been left open for a month after the 22nd December, to allow gravel to pass downstream.

Not only do the juveniles emigrating through the Tweedsmuir trap vary in appearance from those at the Peebles trap, the time of year that they leave is also different. Though there is a definite peak in March and April, fish are leaving all the year round (trapping through the summer was originally tried at Peebles, but nothing was caught).

From 2002 to 2006, 12,107 juvenile trout were trapped leaving this burn (this will be a minimum, occasional very large spates will have taken some over the trap), which works out an annual average of 2,403 fish per year moving down into the Tweed. As the catchment of the burn is 15.74 km^2, this works out at 153 per km^2 (1.53 per ha per year or 0.62 per acre per year). As yet, no figures have been found from elsewhere with which to make comparisons to see if this rate of production is good or poor. As there is no reason to believe that the burn the Tweedsmuir trap is on is any different from any other burn at the top of the Tweed, an estimate of the total amount of juvenile trout stocked into the upper Tweed from its burns can be made : the total area of the Tweed catchment upstream of the junction with the Holms Water is 188.75 km^2 and as the production per

km^2 for the Tweedsmuir trap is 153 per km^2 this gives an estimate of 28,820 young trout entering the upper Tweed, on average, each year.

C.3 Comparisons of juvenile emigrants: The emigrants from the Tweedsmuir trap are quite different from those of the Peebles trap – almost all are brown in colour, with very few silvered fish. About half are under 100mm in length and only one year old and the two year olds are around 120mm as opposed to 150mm at Peebles. Their run timing is also less restricted – hundreds can have left the stream before April and there is a second peak in movement in Autumn. Again, given the adults that run this burn, it is not surprising that the young that they produced would be resident Brown-trout rather than Sea-trout. The numbers of small trout emigrating through the Tweedsmuir trap have significant implications for the interpretation of electric-fishing results from similar burns as it appears that thousands of one and two year old parr can have emigrated early in the year before the normal summer electric-fishing season even starts. The differences between the juveniles found at these two traps are well illustrated by their photographs:

Photo C3.1 Typical emigrants of the type found at the Peebles trap, which are mainly Sea-trout smolts. The bottom fish would be categorised as "Brown". The appropriateness of the old local names "Yellow-fin" and "Orange-fin" for Sea-trout smolts can be seen from this picture.


Photo C3.2 Typical one year old emigrants from the Tweedsmuir trap

D: Summary

The results from these five traps show that burns in the Tweed catchment can be dominated, in spawning terms, by Sea-trout and not necessarily be producing Brown-trout for the trout fishery, other than as the small males of Sea-trout populations. The one trap that did appear to be sampling a Brown-trout population - in the sense that most of the eggs being deposited upstream were being produced by female Brown-trout - was quite exceptional in the quality of trout (in angling terms). While these large Brown-trout, half of which were females, would be a prize for any angler, they would also appear to be rather rare fish for the Tweed catchment.

With four out of the five populations apparently only producing small male "Sea-trout" as Brown-trout and only one having large, female, Brown-trout broodstock, the implications for trout angling management are significant. The pressure of angling exploitation should always fall most heavily on the strongest stock component, which would appear to be, in the case of non-migratory Tweed trout, smaller rather than larger trout. As it seems that more females than males migrate as Sea-trout (still being researched) this would mean that most Brown-trout in the river would be male. These are the fish protected by the current size limits of 8-10". Brown-trout larger than this, it seems, would have a significant proportion of actively breeding females amongst them, and these are the fish not protected by the current size limits. It might also be the case that those male Brown-trout that do grow large belong to populations like that found at the Tweedsmuir trap and should have some protection as well.

This would require a changed approach to size limits for trout anglers, allowing the killing of fish between 8" and 12" (which would include some females, but these would only be potential breeders rather than the active breeders that large females are) but protecting those over this size. A trophy size limit, however, could also be applied, allowing the killing of trout over (for example) 20" as such fish would be nearing the end of their natural lifespan anyway (see Graph B5.1 for how

numbers of trout over 550mm [21''] fall off at the Tweedsmuir trap). This would create a size-range or "slot" of protected fish as broodstock, but allow the killing of fish under and over range.

These traps are very small sample, but the implications are critical – if four out of five of the burns in the Tweed catchment are not producing many female Brown-trout, then the situation for the trout fishery is quite different from that which might be imagined from looking at a map and seeing how many trout spawning burns there are.

Other information from these traps shows how the numbers of fish returning to spawn can vary (e.g. Graph B5.2) with the strengths of different age groups. If this sort of variation can be tracked at these traps over the years, then an insight will be gained as to the workings of the trout population. If reasons for the variation could be found, then predictions could be made about the strength of the stocks from year to year. The importance of good flows at the right times of year to get fish up these burns as shown in particular at the Jedburgh and Peebles traps is also apparent –as is the need for spates in Spring to get juveniles downstream (Table C1.1)

With more data over time, it should be possible to find out the relationships between numbers of adults spawning and the resulting number of juveniles migrating downstream, which would show how many mature trout need to survive all the fisheries and other dangers to fully stock their nursery areas for the next generation.