SECTION 3: SEA-TROUT

INPUT 3A: DETERMINE AND DEFINE THE STOCKS OF SEA-TROUT WITHIN THE TWEED SYSTEM AND THEIR SPAWNING LOCATIONS

Rationale: A basic question about the Sea-trout of the Tweed is their stock structure: Is there just one interbreeding stock of uniform characteristics throughout the whole catchment, or are there stocks differentiated by location and life-history and, if there are, can such differences be identified using genetics? If the full range of stocks and run-timings is to be maintained in the Tweed, then it is essential to know the exploitation rate of each stock and how well their spawning requirements are being met. If there are different, geographically based stocks, then the question of how these are related to the Brown trout in their home areas arises - are these too different "stocks" related more to the Sea-trout of their home areas than to the Brown trout of other areas?

The Current Situation: Scale reading of Sea-trout killed at sample rod fisheries and at the estuary has given basic information on life histories and sizes and has shown that a significant proportion of larger Sea-trout are repeat spawners. Till Sea-trout have proved to have a different size-range and structure to that of Tweed Sea-trout in general and counter data from the Whiteadder has shown that its Sea-trout can be regarded as "Whitling" like those on the Till. Genetics work undertaken as part of the Living North Seas programme identified the Sea-trout of the College Burn as being genetically distinct, though otherwise Tweed Sea-trout could not be distinguished from the trout of the Rivers Aln and the Coquet. The Sea-trout of the Eye Water are, however, genetically distinguishable. A few September Sea-trout were successfully Radio-tagged in 1994-96 which gave their pattern of upstream movement, spawning location and pattern of downstream movement. Tagging and recapture of Sea-trout kelts has shown that the period spent at sea between return and repeat spawning run can be only 3 to 4 months and that their growth rate at sea could be as much as 15mm per month.

Policies for the Next Five Years

Policy 3A.1 – Assess the potential for a large-scale genetics survey of the trout of the Tweed and Eye catchments to extend the work undertaken under the Living North Sea programme:

a. Use the results to identify genetically distinguishable stocks.
- (i) Map these throughout the catchment.
- (ii) With the techniques used so far, it is not possible to genetically distinguish the Sea-trout of the Tweed, Aln and Coquet (though Eye Water fish are distinct). Work to distinguish Tweed fish from the others should be undertaken if the opportunity arises for a joint study with other bodies.

b. From this map of trout stocks within the catchment, check that the existing electro-fishing sites adequately represent each stock in the survey work.

c. Assess the value any new techniques that might be developed for distinguishing trout fry of marine or freshwater origin for their use in the Tweed catchment.

Policy 3A.2 – Continue to collect scales and other data to investigate the stock structure and life-histories of the Sea-trout of the District:

a. Define geographical and temporal patterns in age and size structure.
- (i) Map these throughout the catchment.
- (ii) Relate these to information on genetic stocks.

b. Determine the sex-ratio of adult Sea-trout from scale samples taken from Sea-trout caught at the Paxton nets.
- (i) Identify any seasonal or other variation.

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c. Monitor developments in genetic identification of run-timing in salmonids and identify any opportunities to use such new techniques to define run timing stocks in Tweed Sea-trout.

Policy 3A.3 – Determine the fecundities of Sea-Trout

The fecundity of a fish is the number of eggs that it carries in relation to its size. This would require large samples of fish killed near spawning time. At present, these are not available, so fecundities are measured from whatever fish become available.

INPUT 3B: INVENTORY THE QUANTITY AND QUALITY OF NURSERY AREAS OF SEA-TROUT

Rationale: As for Salmon.

The Current Situation: The protection of watercourses through buffer strips and riparian tree planting has become a mainstream land management practice. There is a programme for the removal or easing of obstacles on smaller channels which benefits Sea-trout as well as Brown trout based on the results of the electro-fishing and other surveys. Repeated electro-fishing surveys have shown substantial and widespread juvenile trout populations throughout the smaller channels of the catchment including upstream of the Hethpool Linns on the College Burn which sees a major run of Whitling over it each year. It is as yet not possible to distinguish trout fry as being of Sea-trout or Brown trout origin, though **Policy 3.5A.1** is aimed at achieving this for at least part of the catchment.

Policies for the Next Five Years

Policy 3B.1: Collect and analyse historical data on the environment of the fisheries district:

a. Collect and map the locations of man-made barriers past and present and quantify the areas of spawning blocked or restricted by them. If possible, maps of the area open to Sea-trout spawning in 1800, 1850, 1900, 1950 and at present will be produced.

b. Continue analysis of long-term catch records and environmental data.

Policy 3B.2: Survey Sea-trout Spawning Areas:

a. New technologies of aerial river survey offer a much more objective and usable way to survey and analyse habitat data and the development of these will be monitored and, if the opportunity arises, applied to the catchment.

b. Where areas of weaker trout juvenile numbers are found during the electro-fishing surveys of Policy 3C.1, these should be investigated according to the Habitat Investigation Protocol (see below) and the reasons for such poorer results identified. If feasible, any problems identified should be removed or mitigated.

c. The Atlantic Salmon Trust's *Small Streams* Assessment system will be adopted for use in classifying the value and condition of small streams within the catchment including the coastal streams within the Tweed and Eye Fisheries District that are not part of the catchments of either the Tweed or the Eye.

Policy 3B.3: Monitor the effects of instream structures on fish passage:

a. Where obstacles to trout migration have been eased with fish passes or breaches rather than removed completely, monitoring is required to check that these continue to work properly – their passability can change as erosion changes the configuration and depth of the water downstream.
   (i) Continue electro-fishing surveys upstream and downstream of such structures.

Policy 3B.4: Ensure the access and habitat problems of the past do not recur:

a. Collect information from the UK and abroad on best practice in Farming, Forestry and Road-building in relation to waters and fish populations. There is often an assumption that small streams are not used by migratory fish but sea-trout can use very small channels.

b. Disseminate this information amongst local land-users and provide practical advice on its implementation.

INPUT 3C: MONITOR THE JUVENILE POPULATIONS OF EACH STOCK OF SEA-TROUT; THE INFLUENCE OF HABITAT CHARACTERISTICS ON THEM AND THE EFFECTS OF PREDATION

Rationale: Monitoring the abundances of juvenile trout in the different parts of the catchment shows how well the spawning areas are being filled with young, although it is not possible as yet to tell if these have come from Sea-trout or Brown trout eggs, although it is the aim of Policy 3.5A.1 to produce at least a broad-brush picture of where Sea and Brown trout spawning dominate within the catchment.

Consistently poorer numbers in particular areas also serve to indicate where there are access problems or where habitat restoration may be required. Knowledge of how abundances of juveniles varies from area to area and over time is necessary if those that need restoration are to be distinguished from those that are just naturally poor. The large number of sites covered using the Fry Index technique provides the data for such indications and analyses.

The Tweed & Eye Fisheries District is home to significant populations of fish eating birds – Goosander, Cormorant and Grey Heron. The first two are of much the greatest significance as they feed purely on fish (Herons eat significant amounts of frogs, ducklings, rodents and insects as well as fish); Goosanders and Cormorants are also gregarious rather than solitary feeders which means that considerable flocks can form where they find fish available. As Smolts are the "end-product" of up to three years of freshwater life, any loss to predation is irrecoverable and must result in fewer adult Sea-trout returning to the river.

The Current Situation: Timed electro-fishing surveys were made throughout the catchment from 1992 to 2000 to provide a baseline of juvenile trout distribution and numbers. In all, 460 locations on 350 streams were visited and trout were shown to be the most widespread fish species in both the Tweed and Eye catchments. A selection of these sites are re-surveyed on a three yearly basis as part of the general, annual, electro-fishing surveys.

Policy 3C.1: Monitor the densities of juvenile Trout at sites throughout the medium-sized channels of the catchment and survey a sample of smaller burns:

a. Continue the electro-fishing monitoring of juvenile trout abundances throughout the Tweed and Eye catchments on a rolling cycle: -

2018	**2019**	**2020**	**2021**	**2022**
Leader	Till	Whiteadder	Leader	Till
Gala	Teviot	Eye	Gala	Teviot
Upper Tweed	Middle Tweed	Leet	Upper Tweed	Middle Tweed
		Eden		
		Lower Tweed		

A third of the sites on the Ettrick and Yarrow are sampled every year

b. Continue analyses of electro-fishing results.
- (i) Maintain and develop the database holding the information from these surveys and linking this with physical, chemical and aerial survey data.
- (ii) Analyse this electro-fishing data to show areas of good and poor abundances of juveniles and related these to the habitat survey data gathered under **Policy 3B.2**. Where areas have no obvious explanation for having lower numbers of juveniles than the catchment in general, further investigations under **Policy 3B.2** using the Habitat Investigation Protocol are indicated.
- (iii) Identify where new sites could extend and improve coverage by the monitoring programme.

c. Continue the smaller burns electro-fishing surveys: These are repeats of the 1990s baseline samples, with appropriate additional sites. Sites selected so far are shown in Map 4.1 in Appendix 4.

Policy 3C.2: Collect Data on Predators and the Effects of Predation on Juvenile Trout, and on Sea-trout Smolts in particular:

a. Continue to count the numbers of Goosanders and Cormorants in January, April, May and October of each year.
- (i) Analyse the results of the counts to show any geographical pattern to the distribution of Goosanders along the river. If any locations are found where the birds are regularly clustered these could be "choke-points" where smolts are particularly vulnerable and special measures to protect such sites could be taken.
- (ii) Find additional methods of counting with which to extend the proportion of the catchment covered and supplement the existing methodology.
- (iii) Discuss methodologies and analyses with other Trusts and bodies to improve and co-ordinate these as much as possible.

b. Acoustic tag Sea-trout smolts where these can be trapped, such as at the Gala smolt trap, and track down to the sea:
- (i) Determine success rate in reaching the sea, taking account of any handling / tagging mortality.
- (ii) Determine causes of losses where possible and if there are particular parts of the main river in which losses are greater than in others.
- (iii) When enough data is collected, relate smolt movements and losses to the pattern of distribution of fish-eating birds on the main river.

c. Record damage types and their levels on smolts sampled at smolt traps. At present, the assessment of damage done by predators is based only on the numbers of smolts actually consumed, there being no estimates as yet of the effect of damage by unsuccessful attacks leading to delayed mortality or reduced ability to survive at sea.
- (i) Define the types of damage seen and the predators that were responsible.
- (ii) Determine the levels of each type of damage.

d. Investigate the habits and movements of fish predators within the catchment to see if these can show where and when predation on smolts is occurring.
- (i) Identify tagging methods and regulatory requirements for tagging and tracking Goosanders and Cormorants.
- (ii) Identify tagging methods and regulatory requirements for tagging large trout.

INPUT 3D: ANALYSE THE CATCH COMPOSITION AND TRENDS OF EACH STOCK OF SEA-TROUT

Rationale: Analysis of catches for their composition shows which stocks support the fisheries - and also what level of exploitation is being suffered by each stock. Knowledge of trends and cycles allows annual catches to be judged in a wider context.

The Current Situation: Scale reading has shown the age structure and life-histories of the Sea-trout caught in the rod fisheries. Of fish sampled at the nets, 79% were returning for the first time, 18% for the second and 1.5% for further times (Appendix 3D).

Analysis of long-term net catches of Sea-trout has shown that the run timing has remained centred in the middle of the year, but with more September fish in the later 19th century and more May and June fish in more recent times (Appendix 3D). RTC Assessment Records of Sea-trout rod catches have been collated and computerised (Appendix 3D). All available long series of Sea-trout catch records at individual fisheries were collected and computerised as part of the Catch Records Project 2001-04. These give sizes (weights) of fish and so provide more details than the RTC records.

Policies for the Next Five Years

Policy 3D.1 - Identification of long-term trends and changes:

a. Continue analyses of catch and environmental data to show any long-term trends or cycles.

Policy 3D.2 - Monitor catch composition:

a. Continue collection of Sea-trout scales from fisheries along the course of the main river and from the larger tributaries: -
  (i) Analyse these to show the different stocks and age classes of fish being caught. This shows how dependent catches are on particular ages of fish and how success or failure of particular spawning or smolt years can be reflected in the catches of the resultant adults.

Policy 3D.3: Monitor and analysis of catch trends:

a. Continue to analyse the rod and net catch records for trends and changes and improve catch recording detail if possible.
  (i) Improve the quality of rod catch records by recording the amount of fishing effort for at least a sample of fisheries - the same total of fish caught with a little effort indicates a very different situation than if caught with a lot of effort.

b. Continue the accumulation of data for modelling the Sea-trout stock(s) of the District and the collection of examples from elsewhere.

INPUT 3E: ESTIMATE THE EXPLOITATION RATE OF EACH STOCK OF SEA-TROUT

Rationale: If fish are tagged at the bottom of the river, the proportion then caught by anglers upstream will give an indication of the proportion of all fish entering the river that are caught by anglers. This then allows estimations to be made of the total number of fish of different stocks that run the river.

The Current Situation: Tagging Sea-trout in the estuary and lower river to find the number later caught by anglers has shown that the exploitation rate by the rod fisheries of Sea-trout is very low, only 2% or so (Appendix 3E), if the recaptures of tagged fish are being fully reported. While there are very high return rates of Salmon in Spring and Autumn, Sea-trout continue to be killed, but there are no indications that this could be a problem for their stocks with the possible exception of early, Spring, Sea-trout.

Policies for the Next Five Years

Policy 2E.1: Tag Sea-trout on the lower river to find their angling catch rates:

(This policy is suspended at present, as under the arrangement with the Paxton House Trust, almost all Sea-trout caught are killed. Any not required are, however, tagged.)

Policy 2E.2: Acoustic tag Sea-trout on the lower river and track them upstream to show: -

a. Relationships between the time of year fish are tagged and where they go in the catchment

b. Non-angler mortality. The ordinary, external, tagging shows the proportion caught by anglers, but cannot show what proportion die in the river due to other causes (predation, poaching, disease etc.). This was first done in 2010 /11 (published as ********). Results are given in Appendix 4E. During such tracking, data can also be collected on: -
  (i) The speed of movement upstream of Sea-trout and how this relates to water conditions.
  (ii) How their movements relate to the pattern of catches as shown on the FishTweed website.
  (iii) How quickly the fish pass obstacles/find and use fish-ladders.

INPUT 3F: COUNT AND ANALYSE SEA-TROUT SPAWNING POPULATIONS

Rationale: While counts of salmon at fish counters can be related to fry numbers upstream allowing populations to be modelled, this is not the case for Sea-trout as resident Brown trout upstream of a counter are also part of the local trout population. However, counts of Sea-trout passing upstream at a fish counter have a value in themselves in showing the numbers of fish that can be produced from areas of catchment e.g. between 1,100 and 1,900 Sea-trout go up the Gala Water each year and the annual fluctuation can help in interpreting Sea-trout catches**.** Other data can be collected at a counter: the seasonal timing of runs, the daily timing of fish passage, sizes, movements in relation to water flows and how the size of fish running one tributary compare to the sizes in others.

The Current Situation: The Tweed was well known for its large Sea-trout in the past, with specimen fish over 20lbs being taken by the nets. Angling catches of such fish are, however, rare which gives the impression, since netting largely ceased, that these large Sea-trout have disappeared. However, data from the Ettrick counter when it was in operation from 1998 to 2009 showed that 5 to 17 Sea-trout of 15-20lbs and 1 to 5 of 20lbs and over went up the Ettrick each year, the only exception being 2004 when no fish over 20lbs were recorded. Sea-trout are being counted at present at the Gala and Whiteadder counters and have shown the populations to be significantly different – the Whiteadder fish are smaller than the Gala trout, being in the same size range as the Whitling of the Till. This is because, as scale reading evidence has shown, the Whiteadder Sea-trout are early running fish, with little growth put on after their last winter in the sea, while the Gala fish are later running and so have a longer period of growth since their last sea winter.

Policies for the Next Five Years

Policy 3F.1: Continue counts and analyses of adult trout at fish counters:

- **a.** Analyse size and run-timing
  - (i) Compare and contrast sizes and run timings between tributaries
- **b.** Whenever possible, trap fish at counters to collect scales and other data to extend the value of the counts

Policy 3F.2: Monitor the Sea-trout population of the Gala Water as an index tributary for the catchment and the Ettrick Water:

- **a.** Trap Sea-trout smolts at the Gala smolt trap.
  - (i) Estimate total Sea-trout smolt numbers by marking a sample of those caught in the trap and releasing them upstream. The proportion of these marked fish that are recaptured in the trap will show the proportion of all smolts that is taken in the trap (*this is a standard technique*).
  - (ii) Measure and take scales from a sample of Sea-trout smolts to show their size and age structures.
  - (iii) Use scales (and possibly swabs of fish glaur/slime) for genetic analysis of sex to show the sex ratio of outgoing Sea-trout smolts.
- **b.** PIT* tag large samples of Sea-trout smolts of each age/size class and install PIT tag readers in the Gala fish pass so that tagged fish returning as adults will be detected. This will provide the potential to investigate:
  - (i) The number of adults produced from the known number of smolts tagged in any year. This would be found after two seasons – 1SW returns in the first year, 2SW in the second. Adding these two totals will give the total number of returns from the smolts tagged.
  - (ii) The relative proportions of 1SW and 2SW Sea-trout in the population each year – the PIT tags will show in what year a fish left – and the size ranges of 1SW and 2SW fish. *There may be older Sea-trout running the Gala Water as well – a 90cms / c.20lb fish was identified passing through the counter in October 2017, although on the Tweed a Sea-trout of this size can be a 2SW fish.*
  - (iii) Whether Sea-trout smolts of different sizes have different survival rates
  - (iv) Take tissue samples from PIT tagged smolts to show their sex ratio. When these return, this will also show the sex ratio of returning adults and whether this has changed from the smolt ratio.
  - (v) Whether size / age of smolt is related to return as 1SW or 2SW.

(vi) Whether lower or higher flows for smolt migration down the main river significantly affect return rates.
(vii) Numbers of repeat spawners.

INPUT 3G: COLLECT INFORMATION ON TWEED SEA-TROUT AT SEA: THEIR MIGRATION ROUTES, EXPLOITATION AND PREDATION

Rationale: As coastal and shallow sea feeders, Sea-trout are vulnerable to coastal fisheries, predators and to a wide range of estuary, coastal and off-shore developments. Unless their migration routes and feeding areas are known, it is not possible to assess the effects of these on Tweed Sea-trout nor to make adequate representations on such issues.

The Current Situation: The movements of Tweed Sea-trout at sea are known reasonably well due to tagging work stretching back to the 1850s and this tagging work is continuing. Collation of all the pre-1990 records of tagged and recaptured Sea-trout has shown that there is an apparent migration route along the English coast to the south, to East Anglia, the Frisian Islands and the Dutch and Danish coasts (appendix and reference?). This is a quite different pattern from those of the rivers to the north of the Tweed, whose Sea-trout appear to only come as far south as the Tweed estuary or Lindisfarne and generally occur equally north and south of their home rivers.

What is not known, however, is whether coastal recaptures in nets are because the fish move coastally or whether their movements are more widespread but only those at the coast get caught in nets. As part of the Living North Sea programme, trout populations around the North Sea were genetically distinguished but Tweed fish could not be identified to river level, only to a group including the Aln and the Coquet. Eye Water fish were, however, distinctive. Samples taken from netting stations down the East coast of England showed that this Tweed / Aln / Coquet group were the single largest component of catches at all the netting locations studied. Samples from nets in the Tweed estuary and on the lower river however, were almost entirely of Tweed fish (Appendix 3G for details).

Policy 3G.1: Collect and collate historic data on recaptures of tagged Tweed Sea-trout at sea:

a. Map locations of recaptures.

Policy 3G.2: Identify opportunities for identifying, tagging and tracking Tweed Sea-trout smolts and adults at sea:

a. Find opportunities to have Tweed Sea-trout genetically identified to river level so any captures at sea can be identified.

b. Consider Carlin tagging Sea-trout smolts at smolt traps (this would only be of use if coastal netting continues) were to restart.

c. Join any collaborative programmes to find out more about Sea-trout movements in the North Sea.

Policy 3G.3: Map locations of marine renewable developments, existing and planned, in relation to what is known of the distribution of Tweed Sea-trout at sea:

a. Collate research on the impacts of windfarms on smolt and adult migration, including their possible effects in attracting predators to previously open waters.
(This policy would be suitable as a student project)

Policy 3G.4: Collect and collate data on the types and frequencies of predator damage on Sea-trout returning to the Tweed:

a. Continue identifying and recording predator damage (including lamprey marks) on the Sea-trout netted at Paxton.

b. Collect and collate information on numbers of marine predators in the areas offshore of the Tweed.

Policy 3G.5: Collect and collate data on marine conditions in relation to the abundance of Tweed Sea-trout:

a. Identify sources of data for sea temperatures, plankton abundance etc.
(i) Determine any relationships between these factors and Tweed Sea-trout catches.

Policy 3G.6: Determine the relationships and connections of Tweed Sea-trout to other populations around the North Sea:

a. Determine if there are common patterns in catches with other populations around the North Sea.
(i) Identify the causes for any such common patterns.

Policy 3G.4: Collect and collate data on exploitation of Tweed salmon out with the Tweed River:

a. Collect and collate information and data on fisheries around the North Sea that can catch Sea-trout (existing data in Appendix 3G).
(i) Relate catches made in the North East England fisheries to Tweed catches.

BASIC RESEARCH NEEDS IDENTIFIED FOR SALMON:

For INPUT 3A
(1) A comprehensive genetics survey of the trout of the Tweed**.** To work out how many populations there might be and whether these are distinguished by particular life-histories.

For INPUT 3E
(1) A tag that anglers could safely and efficiently put on fish that had been caught and released.

SECTION 3.5: THE SEA-TROUT/ BROWN TROUT RELATIONSHIP

INPUT 3.5: DETERMINE THE DISTRIBUTION OF SEA AND BROWN TROUT SPAWNING AND POPULATIONS WITHIN THE TWEED AND EYE CATCHMENTS AND THE RELATIVE CONTRIBUTIONS MADE TO TROUT CATCHES.

Rationale: Another basic question about Sea-trout is how they relate to Brown trout and whether they can form distinct populations. Trapping of burns has shown that while most had spawning populations made up of a few large Sea-trout females and a much larger number of smaller Brown trout males, populations made up of equal numbers of large Brown trout males and females could also exist. New techniques that can show whether newly hatched fry have come from Sea or Brown trout eggs by identifying whether the chemical isotopes of Carbon and Nitrogen in their body tissue have come from the sea or from freshwater growth offer the prospect of determining the source of trout fry in a burn without the difficulties of trapping, and give the ability to map where Sea and Brown trout spawning dominates within the catchment (details in Appendix 3.5A).

A long term problem with the management of trout has been the inability to distinguish Brown trout and Sea-trout before the latter smolt and leave the river. Electro-fishing results for trout fry and parr cannot therefore be identified as being the young of either type, which makes it impossible to determine the sort of management needed if the results are poor – should Brown trout females be better protected or Sea-trout?

The Current Situation: Two approaches are being taken, the first to identify the origin of fry, whether they came from the eggs of Sea-trout or from those of Brown trout. The second is to look at the sex ratio of trout populations in spawning burns and in the catches of anglers. A new genetic test can show whether a trout is male or female and scales give sufficient material for this to be used, so sex can be determined outside of the breeding season without killing fish.

Results from the trapping of spawning burns has shown two quite different forms of trout spawning population. At six of the burns, the great majority of eggs have come from a few, large, female, Sea-trout, fertilised by more numerous but smaller male Brown trout ("Type II" populations). At one other burn however, the spawning population has been a 50:50 mix of male and female Brown trout of between 1 and 6lbs in size ("Type I populations").

This suggests that the large Brown trout that are of particular value to anglers could come from distinctive populations within the catchment and if this was the case then the large trout caught by anglers throughout the catchment should also have 50:50 sex ratio. If, on the other hand, Brown trout from the breeding of male Brown trout and Sea-trout also grew to large size, the sex ratio of Brown trout caught by anglers would have more males (70% of Sea-trout are female and so would not feature in their catches). This imbalance in the sex ratio of Sea-trout would also suggest that the majority of small trout caught by anglers would be male, with many coming from Sea-trout spawning.

Results so far have shown that the trout caught in St. Mary's Loch are a Brown trout population, not recruiting from any Sea-trout spawning. Fry numbers in the burns running in to St. Mary's are low and this suggests that there are not enough female Brown trout running the burns from the loch to fully stock them. Predation on small trout dropping down in to the loch from the burns by the Pike and Perch there now looks to be the factor limiting the trout population.

The closure of most salmon netting stations on the Tweed and off the Northumberland coast will have resulted in 10-20,000 more Sea-trout returning to spawn each year. These will have had to fit in to the existing trout spawning areas of the catchment, greatly increasing the numbers of eggs deposited and fry hatching. Competition for survival between trout fry for food and space will have increased therefore and according to some theories on the factors that determine whether a juvenile trout migrates or not such increased competition will increase the probability of emigration. Similarly, the greatly reduced proportion of Brown trout killed by anglers will have increased the number (and size) of Brown trout escaping to spawn, further increasing the competition between fry in the burns and, theoretically, further shifting the trout populations of the catchment towards emigration rather than residency.

Policy 3.5A.1 – Use Stable Isotopes analysis to distinguish fry of Sea and Brown trout origin:

a. Continue and complete the current programme of sampling and analyses.
  (i) Use the results to map where Sea and Brown trout spawning dominate in the areas sampled.
  (ii) Develop the technique further.

b. From the results of the current programme devise a programme to map Sea and Brown trout spawning in other areas of the catchment.

c. Assess the value any new techniques that might be developed for distinguishing trout fry of marine or freshwater origin for their use in the Tweed catchment.

Policy 3.5B.1 – Sample the structure of the trout spawning populations on more spawning burns. This can be done either by: -

a. Setting up a temporary trap for two or three years to show: -
  (i) Whether the population using the burn is of the fewer, larger, female Sea-trout & numerous smaller, male, Brown trout "Type II" or the 50:50 large male and female Brown trout "Type I" (or of some other form not yet seen). Develop the technique further.
  (ii) The sex-ratio of the spawning fish.
  (iii) The minimum spawning size of the trout in that area.
  (iv) The number in the spawning population.

OR

b. Electro-fishing a burn at spawning time to find if large male Brown trout are present as these are characteristic of Type I populations which have 50:50 sex-ratios of large Brown trout.

Policy 3.5B.2 – Find the sex ratios of Brown trout caught by anglers to determine whether the trout populations they are fishing are being produced by Sea or Brown trout spawning:

a. Collect scale samples from different zones of the river for genetic analysis.
- (i) Ensure that these include trout of all sizes, as the theory is that small undersized trout will be largely male, many coming from Sea-trout eggs while larger fish will be nearer 50:50 male and female, coming from Brown trout spawning.
- (ii) The sex-ratio of the spawning fish
- (iii) The minimum spawning size of the trout in that area
- (iv) The number in the spawning population

b. Determine sex directly from any trout killed by anglers.