



SECTION 4: BROWN TROUT

INPUT 4A.1: DETERMINING AND DEFINING THE STOCKS OF BROWN TROUT WITHIN THE TWEED SYSTEM AND THEIR LIFE-HISTORIES

Rationale: Just as for Salmon and Sea-trout it is necessary to know what the Brown trout of the Tweed catchment actually are as a base for any sort of management. Are the Brown trout of the Tweed divided up into genetically distinctive stocks or do they all belong to one, large, interbreeding pool? If they are separated into many stocks, do these have different characteristics (growth patterns, migrations, etc.) and what areas of the catchment do they occupy? The key question is how the Brown trout relate to the Sea-trout of the catchment: the evidence from the traps on spawning burns is that, in most cases, breeding in these small burns is between smaller, male, Brown trout and larger, female, Sea-trout. This suggests that there may not actually be separate Brown and Sea-trout populations, simply trout populations. The sex-ratios of Brown trout and Sea-trout are important information on this point: if these are not balanced within each type, then the "deficit" must be being filled from the other, showing an overlap between the two. Until these questions are answered, it is difficult to determine what management is appropriate for Brown trout as they are, basically, an unknown quantity.

If there are genetically distinctive stocks of Brown trout within the catchment, and these are not "self-contained" but are interconnected with their local Sea-trout, then the situation must be that there are distinctive stocks of "trout" within the catchment, each of which has its own resident (Brown trout) and migratory (Sea-trout) components, with the proportional split between the two forms perhaps varying between these distinctive populations.

Results from previous editions of the Management Plan:

- a. Genetics research has shown that the trout of the Tweed originate from three different lineages that colonised the catchment after the Ice Age, and that fish from different tributaries can be distinctive. Research has also shown that 20% of the trout examined had an Atlantic Salmon gene in them and that there were high rates of first generation trout-salmon hybrids in the samples.*
- b. Collection of scales has given basic information on growth patterns and provided a source for more detailed investigations.*
- c. Results from the trapping of spawning burns has shown two quite different forms of trout spawning population. At four burns, the great majority of eggs have come from a few, larger, female, Sea-trout, fertilised by more numerous but smaller male Brown trout. 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.*

Policies for the next five years:

Policy 4A.1 – Devise a large-scale genetics survey for the Tweed and Eye catchments to extend the work undertaken under the Living North Sea programme and make a comprehensive trout genetic map. (Such work could be undertaken as an extension of the genetics work on Salmon presently being undertaken with RAFTS and the FASMOP programme, if other Fishery Trusts have similar interests). This work would show:-

- (i) How many different stocks of trout there are and whether Sea- and Brown trout belong to the same stocks.
- (ii) What areas they occupy.
- (iii) Whether the number of juvenile sampling sites within each stock's area is adequate to show trends in their numbers.



Policy 4A.2 - Continue to investigate Brown trout growth patterns and size ranges throughout the catchment

- a. Continue collection of Brown trout scales and measurements from throughout the Tweed and Eye catchments and analyse these for:-
 - (i) Geographical pattern and age structure.
 - (ii) Relationships to lengths and weights of the sample fish.
 - (iii) Patterns of growth.
 - (iv) Use the Scales Database to identify areas of the catchment which are poorly represented in the collection so far and ensure that sufficient scales are collected from the trout of any such areas.
 - (v) (Scale collection is by all available methods: from electro-fishing and netting surveys (4C.1 & 2); Angling Catch logbooks and creel surveys (4D.2 a & b) and traps (4F.1).

Policy 4A.3 – Establish the movement patterns/migrations of Brown trout within the catchment by tracking individual fish (*this will use the acoustic tracking equipment bought for the Living North Sea work on Sea-trout after that is finished*)

- a. Track kelts from spawning burn traps to find where the adults of these particular spawning populations go outside the spawning season. This will show whether Brown trout from the upper river visit the lower river or the estuary, as is suspected. (This suspicion comes from the angler catch logbook data, which clearly shows that while many small trout are caught in the middle and upper Tweed and tributaries, fewer are caught in the lower Tweed, which is, however, much better for medium and larger sized trout. The fish counters also show significant numbers of Brown trout returning to the Ettrick and Gala at spawning time.)
- b. Relate the patterns seen on the scales of tracked fish to the movements shown by the tracking so that the scale patterns produced by different life-histories can be identified, e.g. if fish from the upper Tweed visit the lower Tweed/estuary, this should show up as a particular growth pattern on the scales. Defining this pattern would then mean that it could be identified on the scales of fish that were not tracked.
- c. Track individual trout caught by angling in the main channels during the fishing season to show:-
 - (i) How trout react to "catch and release".
 - (ii) Habitat use by larger trout in the main channels to allow identification of key habitat types that could be improved or restored.

Policy 4A.4 – Establish the structure of the trout spawning populations on a representative sample of burns

- a. Set up temporary traps on small burns where suitable sites can be found and volunteers are available. Two to three years should be sufficient to show:-
 - (i) Whether the population using the burn is of the fewer, larger, female Sea-trout & numerous smaller, male, Brown trout type or the 50:50 large male and female Brown trout type (or of some other form not yet seen).
 - (ii) The sex-ratio of the spawning fish.
 - (iii) The minimum spawning size of the trout in that area.
 - (iv) The size of the spawning population.

INPUT 4B: INVENTORY THE QUANTITY AND QUALITY OF HABITAT FOR BROWN TROUT

Rationale: Whilst this is largely the same as for Salmon and Sea-trout, there is a difference in that adult Brown trout do not go to sea and so must find suitable habitat within their river systems. It appears that long-range migrations can be made along main channels though little is known about how far trout generally travel from their spawning burns. Deeper water and good cover is a critical need for these larger, mature fish - the broodstock of the populations - and their lack has been identified as the cause of extinctions: The American Fisheries Society has actually identified loss of overhanging banks due to overgrazing as "*one of the principal factors contributing to the decline of native trout in the West*" (American Fisheries Society 1991). Brown trout



are therefore more severely affected by the loss of deeper water and bankside cover through overshadowing or overgrazing than Salmon or Sea-trout.

Results from previous editions: *As for Salmon and Sea-trout, with the addition of:*

- a. Brown trout use much smaller burns than Salmon or large Sea-trout but the habitat surveys omitted burns under 2m wide to reduce the amount of work to manageable levels. Most small burns go through one or more road culverts which can be obstacles to spawning trout moving upstream. A map study to list all the road and other culverts in the Tweed and Eye catchments started in 2000 and there is now an extensive map / database of these. Many have been visited and assessed, though many still remain to be checked. Habitat quantity, is, as always, a greater priority than habitat quality as even poor habitat can produce some fish, while even the best habitat can produce nothing if the fish cannot get to it to spawn in it.*
- b. As part of the TTGI, baseline photographic surveys have been made of larger channels, where adult trout live, against which future changes can be judged. Historic photographs have also been collected to give older baseline information.*
- c. Existing data on invertebrates from SEPA and other sources has been collated as a baseline for trout food sampling programmes. A programme of sampling has been set up as part of the TTGI.*

Policies for the next five years:

Policy 4B.1 - Survey and map Brown-trout spawning and juvenile habitat (TTGI Spawning Burn Surveys)

- a. Continue surveys of the smaller spawning burns that have not yet been visited. Any obstacles found will be added to the Obstacles Database and appropriate measures to ensure fish passage devised, if the blockage is significant.
 - (i) Organise Angling Clubs to survey habitat and obstacles in small burns not previously covered.
 - (ii) Set up habitat survey training days for Club members with the Wild Trout Trust.
 - (iii) **LNS:** Analyse survey results with Clubs and the Wild Trout Trust and formulate restoration plans for damaged areas.
- b. During the trapping of spawning burns, large, sometimes very large numbers of immature trout have been found heading upstream along with the spawners. Why this migration should occur is not known. It may be that smaller burns are important winter habitat for trout parr that otherwise live in the larger channels. The first point to establish about this movement is the length of time that these small fish spend up the burns and this could be found by acoustic tagging a sample. It could be that the abundances of parr found in smaller burns during summer electro-fishings tell only part of the story of how these areas are utilised by trout. Such tagging should be possible after the Living North Sea tagging work is completed.

Policy 4B.2 - Survey, assess and monitor adult Brown trout habitat (TTGI Baseline Photographic Surveys)

- a. Continue to collect and collate historical evidence for changes in the amount of deeper water in the larger channels and establish the present day, baseline, state.
 - (i) Continue to collect historic photographs and anecdotes on gravel movement and loss of deeper waters.
 - (ii) Continue photographic and video surveys of each Club's area of water to show present day distribution of gravel and pools and establish baseline points for monitoring gravel movements.



Policy 4B.3 - Inspect the culverts and road crossings for which investigation is thought necessary, as listed under Policy 4B.1 and prepare plans for easing, if appropriate

- a. Ease obstacles to Brown trout spawning migration:
 - (i) Have all culverts and road-crossings listed as a result of previous work inspected according to a standard protocol. **(Inspections will be made by the RTC Bailiffs.)**
 - (ii) Maintain a list of those that appear to require a more detailed investigation or electro-fishing surveys to show whether they are problems or not. These surveys consist of six three-minute samples upstream and downstream of a possible barrier, any differences showing up the effect of the obstacle.
 - (iii) Evaluate those culverts and road crossings shown to be obstacles in terms of the value of the spawning that would be opened up if they were eased and whether easing would result in the spread of introduced species into an area that they had been barred from. Where remedial works are undertaken, the aim should be to allow access to fish that can jump, such as Trout and Salmon, or can otherwise get over, such as Eels and Lamprey but not allow access to introduced species and so allow them to spread to hitherto inaccessible areas. Even quite small barriers can prevent the upstream movement of Signal Crayfish or Bullheads.
 - (iv) Prepare work plans to ease those culverts identified as blocking access to valuable spawning areas and set up a programme to undertake these.
 - (v) Before easing any culverts, undertake "before" electro-fishing so changes upstream after the work can be assessed and monitored.
 - (vi) Take any opportunities that arise through the Riverworks Group or through wind farm or other developments to improve native fish access.
- b. Ensure the access problems of the past for Brown trout do not recur:
 - (i) Collect information from the UK and abroad on best practice road-building in relation to waters and fish populations.
 - (ii) Disseminate this information amongst local land-users and provide practical advice on its implementation.

Policy 4B.4 - Restore areas of damaged spawning and nursery habitat identified through Input 4B.1

- a. Organise training of Club members in restoration techniques with the Wild Trout Trust.
- b. Organise restoration of damaged habitat with Club members on the basis of the surveys and restoration plans made under Policy 4B.1.
- c. Ensure habitat problems for juvenile Brown trout do not recur:
 - (i) Collect information from the UK and abroad on best practice forestry and farming in relation to waters and fish populations.
 - (ii) Disseminate this information amongst local land-users and provide practical advice on its implementation.

Policy 4B.5 - Survey and assess invertebrate food supplies for Trout (TTGI Fly-life Surveys)

- a. Continue the monitoring of each Club's area of water to show present day levels of invertebrates and species distribution and record places and dates of hatches of particular species:
 - (i) Collect historic evidences of insect hatches and timings as a baseline against which to judge the present day situation.
 - (ii) From time to time, set up training days in invertebrate identification and sampling techniques for Club members.
- b. Where opportunities arise, record the contents of trout stomachs.



INPUT 4C - MONITOR THE BROWN TROUT POPULATIONS THROUGHOUT THE TWEED AND EYE CATCHMENTS, ANALYSE THE INFLUENCE OF HABITAT CHARACTERISTICS ON THEM AND ASSESS THE EFFECTS OF PREDATION

Rationale: As for Salmon.

Results from previous editions: As for Sea-trout.

- a. It has been found possible to electro-fish long sections (500m) of medium-sized (3 to 8m wide) channels for two-year and older trout, where there are no large areas of inaccessible deep water as a way of looking at their populations and collecting scales for information on growth.*
- b. It has also been found possible, under low flow conditions, to net sections of the main channels and sample adult Brown trout. This sampling is, however, limited to areas with smooth channel bottoms and so cannot cover the best areas for trout, where there is cover from boulders, wood debris, etc.*

Policies for the next five years:

Policy 4C.1 - Monitor juvenile Trout throughout the Tweed and Eye catchments (TTGI Electro-fishing surveys)

- a. LNS:** Continue the timed electro-fishing of juveniles in burns for comparison against the baseline surveys made in the 1990's, covering the same zones of the catchment as the Salmon juvenile electro-fishing surveys of the year.
- b.** Analyse results against the 1990's baseline to show trends and changes.
 - (i) Relate results to the habitat characteristics of sample sites to give information on the habitat preferences of juvenile trout.
- c. LNS:** Continue to identify and survey electro-fishing sections in "medium-sized" channels.
 - (i) Relate results to the habitat characteristics of sample sites to give information on the habitat preferences of older trout.

Policy 4C.2 - Monitor adult Trout throughout the Tweed and Eye catchments

- a.** Continue the netting in main channels to give:
 - (i) Minimum densities of adult Brown trout in angling areas.
 - (ii) Scales for information on growth patterns and ages. (If a method for the non-lethal determination of sex can be found, then fish caught in this way will also provide data for Policy 4A.1 d.)

INPUT 4D - COLLECT DATA ON, AND ANALYSE TRENDS IN, THE ROD CATCHES OF BROWN TROUT

Rationale: Monitoring the catches and fishing efforts of a sample of anglers is the only way in which a reasonable indication of the state of the trout fishing can be produced. The recording of the amount of effort and the methods that produced catches also means that they can be compared over the years. The sizes and ages of the trout being caught are also indicators of the state of stocks. Without a sound and reliable knowledge of the past nature and state of the Brown trout stocks of the Tweed it is impossible to properly evaluate their present state.

In recent years there has been a perceived decline in the trout fishing, though the lack of systematically kept records means that this has been based on opinion and memory rather than on statistics. Understanding whether or not this perceived decline is due to an actual reduction in the abundance of Brown trout within the catchment; changes in catch regulations and angling culture or simply a form of nostalgia is of crucial importance - if it is the first of these, then action is required, if the others, it is better catch recording and reporting methods that are needed so anglers can have a better understanding both of the present and the past. As trout catches have not been of commercial importance, records such as those available for Salmon do



not exist, so historical trends and changes have to be reconstructed from club competition records; angling diaries and published accounts. The present pressures on the stock also need to be known so that clubs can be advised on appropriate catch regulations.

The most basic need of a stock is that enough fish should escape all the pressures on them to spawn and fully seed their nursery areas for the next generation. Pressure on a fish population can be shown by changes in sizes and in age of maturity as well as by numbers, and if good baselines of the sizes and ages of each stock of Brown trout being caught by anglers can be established, changes in these over the years can be monitored as indicators of pressure on the stocks.

Results from previous editions:

- a. A history of the Brown trout stocks and fishing has been compiled from published sources (Chapter 4.2 Brown-trout Fisheries).*
- b. Competition catch records of the Ellem, Kelso, Selkirk, Greenlaw, Hownam & Border have been computerised and analysed (Chapter 4.2 Brown-trout Fisheries).*
- c. Three angling diaries, covering 1900-1928; 1951-1991 and 1967-1990 have been computerised and analysed (Chapter 4.2 Brown-trout Fisheries).*
- d. A Trout catch diary recording scheme was started in 1991 in which a sample of anglers record their catches. This was suspended in 2000 to make way for a national catch recording scheme organised by the SFCC. A local version of this was produced in 2006 and is being used to record catches each season.*
- e. A questionnaire for anglers was distributed in 2007 & 2008 from which information on what anglers want from their fishing was gathered. The results of this are given in Chapter 4.2 Brown trout Fisheries).*

Policies for the next five years:

Policy 4D.1 - Analyse the history of Brown trout catches of the different sectors of the Tweed and of the Eye for as far back as possible

- a.** Continue the collection of Tweed Brown trout records and references in published sources.
- b.** Continue the collection and computerisation of angling club competition records.
- c.** Continue the collection and computerisation of angling diaries.
- d.** Establish any historic trends apparent in these sources.

Policy 4D.2 - Monitor present day Brown trout catches and their composition (TTGI Trout Catch Monitoring programme)

- a.** Continue the trout catch logbook system and analyse the data to show:-
 - (i) Geographical patterns in catch rates and size of trout caught.
 - (ii) Relationships between fishing methods and conditions and catch rates of different sizes of trout.
 - (iii) Trends in catch rates and sizes.
 - (iv) Patterns in the use of the catchment by anglers, in particular identification of heavily fished areas.
- b.** Continue bankside creel surveys to gather data from anglers: this covers visiting anglers who are more difficult to include in logbook surveys.
- c.** Continue to organise Fishing Days in areas of the catchment where other sources of catch data are insufficient. (Anglers get free fishing for a day in return for providing information on their catches.)



INPUT 4E - ESTIMATE THE EXPLOITATION RATE OF BROWN-TROUT

Rationale for this work: As for Salmon and Sea-trout.

Results from previous edition:

None - this has not been possible due to lack of a good method for tagging adult Brown trout that live in rivers. Further attempts will be made to find suitable methods.

INPUT 4F - MONITOR ADULT BROWN TROUT POPULATIONS AND ESTABLISH TRENDS IN NUMBERS AND POPULATION CHARACTERISTICS.

Rationale: The most basic need of a stock is that enough fish should escape all the pressures on them to spawn and fully seed their nursery areas for the next generation. Pressure on a fish population can be shown by changes in sizes and in age of maturity as well as by numbers, giving various methods by which the health trout stocks can be assessed.

Results from previous editions:

- a. A trout trap was set up on a small Middle Tweed burn 1998 and has been operated by the St. Boswells Angling Association since then, producing annual counts of spawning runs (Appendix F). A similar trap on a small tributary of the Jed Water has been working effectively since 2002 (with the Jedforest Angling Association).*
- b. Two traps on larger burns of the upper Tweed came in to operation in 2001 and have produced annual counts for their Brown trout spawning runs since then (Appendix F). As these trap both adults migrating upstream and juveniles migrating downstream, their populations can be modelled. These monitored populations are taken as 'index' populations for the catchment as a whole.*
- c. One of these traps has shown that very large numbers of one and two year old parr can migrate out in spring, well before the usual start of electro-fishing in July. It follows from this that summer electro-fishing may well not reflect the numbers of trout parr actually produced in burns, especially where these leave after only one winter at a size of only 90mm or so.*

Policies for the next five years:

Policy 4F.1 - Establish spawning escapement targets for the Brown trout of the Upper Tweed index tributary and monitor the numbers of spawners and their age composition.

- a.** Monitor the adult numbers from year to year and find:-
 - (i) The effect of environmental conditions (water levels and temperatures) on the size of spawning runs.
 - (ii) The pattern of ages and sizes within the spawners to see if these change over the years (i.e. the more older fish there are, the better survival from year to year must be. If older fish were to start to disappear from these populations so that the spawners became increasingly younger and smaller, it would show that they were under stress).
 - (iii) The year-on-year mortality rates of the fish (i.e. the numbers surviving from being two years old, to three years old, three to four, four to five and so on. The rate of survival from one age to the next shows when fish are dying and if these rates can be established, increases in death rates in the future will show if pressure on the population is increasing and at what size/age).
- b.** Model the populations to relate adult numbers to the number of juveniles migrating out of these burns.
 - (i) Count the numbers of trout (identified as Brown or Sea through scale reading) running upstream to spawn each year.



- (ii) Count the numbers of juveniles (smolts and others) that move downstream each year and determine the proportions of different ages.
- (iii) Survey the burns upstream of the traps to estimate carrying capacity.
- (iv) Use this information to help interpretation of electro-fishing results from the catchment generally.

Policy 4F.2 - Construct a life-table or tables for Tweed Brown trout (*Life-tables show how many fish survive from one age to another e.g. how many 2 year olds survive to become 3 year olds; how many 3 year olds to 4 and so on. They thus show how large the losses are in a population and when they occur. This can change over time as fish find it easier or more difficult to survive and show where management help would be useful.*)

- a. The difficult in constructing life-tables is that they need either representative samples in which all sizes/ages are fairly represented or complete measurements of all the fish in a population unit. At present, only the data from Upper Tweed Brown trout trap is available for this: netting and angling samples are both unlikely to give representative samples of all ages and sizes.

WORK CALENDAR FOR SECTION 4:

| Policy | Description | Month | | | | | | | | | | | |
|------------|-----------------------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 4A.1 | Stock structure | | | | | | | | | | | | |
| | (a) Scales collection | A | | | F | F | F | F | F | F | F | F | A |
| | Tracking | | | | | | | | | | | | |
| | Genetics | | | | | | | | | | | | |
| 4B.1 | Spawning B surveys | F/A | F/A | F/A | F/A | | | | | | | | |
| 4B.2 | Adult Habitat | - | - | - | - | - | - | - | - | - | - | - | - |
| 4B.3 | Obstacles | F | F | F | | | I | I | I | | F | F | F |
| 4B.4 | Habitat Restoration | | | | O/F | O/F | O/F | O/F | O/F | | | | |
| 4B.5 | Fly Life | | | | F | A | | | | | F | A | |
| 4C.1 | Juvenile surveys | | | | | | O | F | F | F | A | | |
| 4C.2 | Adult surveys | | | | O | F | F | F | F | A | | | |
| 4D.1 | Historic Angling recs | - | - | - | - | - | - | - | - | - | - | - | - |
| 4D.2 | Angling monitoring | | | | | | | | | | | | |
| | (a) logbooks | A | O | O | | | | | | | A | A | A |
| | (b) creel surveys | | | | F | F | F | F | F | F | A | A | |
| 4F | Spawning burn traps | A | A | | | I | I | I | | | F | F | F |
| KEY | Not yet undertaken | | | | | | | | | | | | |
| | At any time | - | | | | | | | | | | | |
| | Organising | O | | | | | | | | | | | |
| | Fieldwork | F | | | | | | | | | | | |
| | Analysis & reporting | A | | | | | | | | | | | |
| | Instream works | I | | | | | | | | | | | |

BASIC RESEARCH NEEDS IDENTIFIED FOR BROWN TROUT

For Input 4A: 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 4E: A tag for Brown trout that is safe and efficient for fish that live in rivers. Ideally, the tag would be of a type that anglers could use themselves to tag fish that they had caught and released.



For Input 4F: Life-tables for Brown trout in a range of Scottish rivers. Life-tables show how many fish survive from one age to another e.g. how many 2 year olds survive to become 3 year olds; how many 3 year olds to 4 and so on. These tables thus show how large the losses are in a population and when they occur. This can change over time as fish find it easier or more difficult to survive and show where management help would be useful. While the construction of a Life-table for Tweed Brown trout is part of the work of this management plan, it would be useful to have similar tables for other rivers for comparison.