Executive Summary Of The Nine Technical Fishery Management Plans Covering The Water of App, Water of Luce & Piltanton Burn, Bladnoch, Cree, Water of Fleet, Kirkcudbrightshire Dee And Urr

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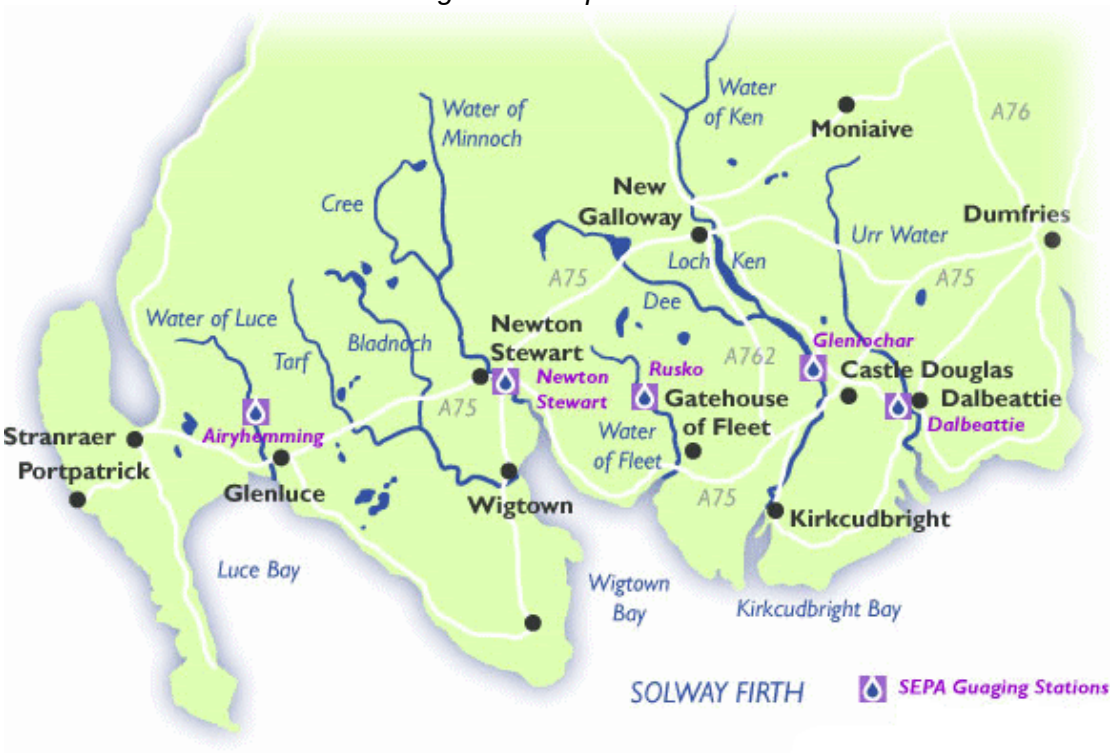
Introduction

This document is an executive summary of the nine separate detailed Technical Fishery Management Plans (FMPs) which have been produced by the Galloway Fisheries Trust (GFT) covering all the catchments to the west of the Dumfries and Galloway Region (Figure 1). The plans cover both running waters and stillwaters. The Technical Plan Series is the:

- Water of App (all species) FMP
- Water of Luce & Piltanton Burn (all species) FMP
- Bladnoch Salmon Management Plan*
- Bladnoch (all species apart from salmon) FMP
- Cree & Palnure Burn (all species) FMP
- Water of Fleet & Skyre Burn (all species) FMP
- Kirkcudbrightshire Dee Salmon Management Plan*
- Kirkcudbrightshire Dee & Tarf (all species apart from salmon) FMP
- Urr (all species) FMP

* - Separate salmon plans have been produced for the a) Bladnoch as it is designated as a Special Area of Conservation for Atlantic Salmon (published by Scottish Natural Heritage (SNH)) b) Kirkcudbrightshire Dee to try and address the specific fish access and water flow issues associated with the Galloway Hydro Scheme.

Figure 1: Map of area



The primary objective of the technical plans are to provide plans for the management of fish and fishing on each of the main river catchments between 2009 and 2013. Through the effective implementation of these plans, it is believed that all native fish stocks and their associated habitats will be conserved and enhanced.

- The plans provide background information, describe problems on the rivers and set out solutions and actions to be undertaken during the lifetime of the plans (2009 to 2013).
- The plans will assist the District Salmon Fishery Boards (DSFBs) and GFT with their short-term and long-term planning of resources.
- The plans will assist in securing funding towards the future management of fish stocks and their habitats.
- The plans aim to cover the management of all species of fish together, thus ensuring the long term survival of all fish species in the catchments.

The information contained within the plans will assist DSFBs and GFT in inputting effectively to the Solway Tweed Area Advisory Group throughout the river basin planning process.

These plans are focussed on the freshwater system and inner estuary of the rivers and their associated tributaries. They do not review the marine environment or the marine life-stage of migratory fish species although, naturally, the lower river is influenced by estuarine and tidal effects. The plans are designed to be working documents, with reviews and updates carried out as required. It is envisaged that post 2013, management plans for the following five years will be produced.

Each FMP has been produced in consultation with a wide range of organisations and individuals including Scottish Environmental Protection Agency (SEPA), SNH, Dumfries & Galloway Council, Forestry Commission (Scotland), DSFBs, angling clubs and Scottish Power. Copies of the individual Technical Fishery Management Plans have been circulated round each catchment and are also available on request from the GFT.

Who manages the fisheries

The GFT, Luce DSFB, Bladnoch DSFB, Cree DSFB, Fleet DSFB, Dee DSFB and Urr DSFB are all actively involved in fish and fisheries management on the running waters across the areas covered in the plans.

The DSFBs are constituted under the terms of the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Each Boards membership is re-constituted through a tri-ennial election process as required by the Act and each Board presents a statement of audited accounts and report on an annual basis to the qualified proprietors, again defined in the Act.

Figure 2: Fishing on the lower Cree

GFT is a charitable environmental Trust. One of its key roles is to provide scientific advice and undertake scientific research on behalf of local DSFBs. GFT also undertakes a range of fisheries management activities including running stocking programmes and habitat enhancement works. Usually the GFT employs between 5 and 7 members of staff at any one time.

Stillwaters are usually run either by private individuals or small syndicates. GFT have a good working relationship with most stillwater managers and are involved in providing advice, undertaking enhancement works and undertaking monitoring surveys. Some of the larger stillwater fisheries (commercial) are run by angling clubs which include Stranraer & District Angling Club (Soulseat Loch, Dindinnie Reservoir, Penwhirn, Knockquhassen), Glenluce Angling Club (Whitefield Loch), Newton Stewart Angling Association (Wee Glenamour, Loch Fyntalloch, Kirriereoch Loch, Bruntis Loch, Loch Ochiltree, Loch Dee), Dalbeattie Angling Club (Buittle Reservoir), Castle Douglas and District Angling Association (Loch Roan), Gatehouse & Kirkcudbright Angling Association (Lochenbrech & Loch Whinyeon), New Galloway Angling Association (Clattingshaws, parts of Loch Ken) and Dalry Angling Association (Caaf Reservoir). Forestry Commission (Scotland) also own and manage various stillwaters including Spectacle Loch, Loch Stroan, Garwachie Loch, Eldrig Loch and Loch of the Lowes.

Physical catchment characteristics

Description of the area

The area covered by these plans is a mix of lowland and upland land, with some rivers originating in the uplands (Cree, Fleet, Kirkcudbrightshire Dee) and some being mainly lowland rivers (Water of App, Piltanton Burn, Luce, Bladnoch, Urr). There are 10 square miles of lochs within Dumfries and Galloway, the majority of which lie to the west of Dumfries in the area covered by these plans. The most notable loch is Loch Ken on the Kirkcudbrightshire Dee, which lies in a north west/south east orientation and extends for a length of nearly 15 km. Some of the lochs in the area have been created to store water for anthropogenic reasons, an example being the Galloway Hydro Scheme (on the Kirkcudbrightshire Dee system).

Large granite intrusions contribute significantly to the landscape of Dumfries and Galloway and highland areas within the GFT area include Cairnsmore of Fleet, the Merrick and the Rhins of Kells. The highest peak in the GFT area is the Merrick at 843 m. Below the higher granite hills the landscape is mainly made up of glacio-fluvial deposits creating some productive agricultural ground.

The landscape of the area is cut through by the rivers, which generally run in a southerly direction. It has been suggested that the current river courses and drainage patterns date back to the Tertiary period and have remained relatively unchanged since then, despite much glaciation of the area. Some river valleys contain deposits of alluvium, glacial melt-water deposits and some raised beach deposits. As southern Scotland has relatively high rainfall this has facilitated peat growth, and raised bogs and marshes are common on upland plateaux, bogs on lower slopes and on valley floors where they are known as 'flowes'. On some of the higher ground blanket bog and heather moors are present. Salt marsh, known as 'merse', is common along the coastline, especially where rivers have formed wide estuaries and estuarine mud flats.

Figure 3: Loch Dee

Within the GFT area there are many species and landscape designations. Of particular note and relevance is the River Bladnoch Special Area of Conservation (SAC) for Atlantic salmon, Luce Bay and sands SAC, the lower Cree SSSI, Cree estuary SSSI and River Dee [Kirkcudbrightshire] Parton to Crossmicheal SSSI. For up to date information on National and European designations see:

http://gateway.snh.gov.uk/portal/page?_pageid=53,910284,53_920288&_dad=portal&_schema=PORTAL

Geological information

The geology of the Trust area is dominated by Silurian Llandovery sedimentary rock (mainly greywackes and shales) in the lower and mid catchment areas and Ordovician sedimentary Ashgill and Caradoc in the northern areas. The harder Ordovician and Silurian sediments in the northern reaches of the area have been relatively resistant to erosion and now form part of the Southern Uplands. This range of hills is characterised by conical domed peaks some of which are incised by deep valleys forming the upper reaches of some river catchments. Throughout the area the solid geology displays areas where igneous volcanic intrusions have formed sills

and dykes of basalt, dolerite, rhyolite, porphyrite and diorite. These are limited in extent but affect some tributaries of rivers (for example the Kirkcudbrightshire Dee) in forming waterfalls, some impassable to migratory fish.

Along with the backdrop of the larger granite intrusions, the geological drift deposits in the area characterise the land. The lowland 'peninsulas' are separated into three main named districts: from the west, the Rhins (includes the Mull of Galloway peninsula to the south and Corsewall headland to the north), then the Machars (a generally low lying area of thick glacial drift, characterised by extensive drumlin features (around which the lower Bladnoch meanders), extending south from Wigtown, and including an extensive headland coastline), and Stewartry and the Glenkens (lying further to the east and characterised by a mix of upland and lowland).

Figure 4: Finnarts Bay (where Water of App enters the sea)

Along the coastline, the large rocky headlands are interspersed with low bays of softer rock. Luce Bay, formed from a sunken basin of Permian sandstone, is perhaps the most notable of these, having the most extensive sand dune system in Galloway with some dunes being over 15 m high.

The majority of the rivers flow over Ordovician Ashgill and Caradoc however the catchment of the Piltanton Burn stands out as it lies over Permian sandstone – the only river to do within the area. Some rivers drain granite out crops e.g. upper Fleet and Black Water of Dee, and these very poorly buffered waters are particularly vulnerable to acidification.

Land use

Agricultural land lies in the lowland Rhins, Machars and the more productive lowland areas of the Glenkens as well as the lowland river valleys. Agriculture in the region is dominated by dairy cattle farming (grazed primarily on improved grassland) and the production of beef cattle and sheep. Sheep are usually farmed on rougher pasture at higher altitudes and plateau areas. Within the Dumfries and Galloway region over 90% of the available agricultural land is pasture or rough grazing. Arable farming is limited within the area, with some crops produced on lowland areas, particularly in the west around the Piltanton Burn and in the Kirkcudbrightshire Dee valley.

Figure 5: Forestry surrounding the upper Fleet

Forests or woodland amount to approximately 25% of the land use in Dumfries and Galloway. This includes commercial forestry plantations. Some native woodland exists in the area, most notably in the Fleet valley and Cree valley, where native, semi-natural and historical woodlands (particularly oak) are carefully managed.

Commercial forestry plantations generally lie within mid and upper river catchments of the area and these comprise the majority of the forested area of the region. Many hectares of land, particularly lying in the northern centre of the area, have been developed into commercial forestry plantations by Forestry Commission (Scotland) and many private forestry interests. The largest forested area is known as the Galloway Forest Park which is managed both for timber production and recreational activities (footpaths, mountain bike trails, etc).

Present status of fish and fisheries

The main fish species present in each main river catchment in the area are listed below. Detailed distribution, stock information, biological characteristics, details of exploited stocks and trends in abundance are presented for each fish species in each catchment in the relevant technical FMP.

Table 1: Fish species recorded during GFT surveys in each catchment

Catchment	Species present	Native / non-native
Water of App	Atlantic salmon	Native
	Sea/brown trout	Native
	European eel	Native
	Three-spined stickleback	Native
	Lamprey species	Native
Piltanton Burn	Atlantic salmon	Native
	Sea/brown trout	Native
	Minnow	Native
	Three-spined stickleback	Native
	Lamprey species	Native

	European eel	Native
River Luce	Atlantic salmon	Native
	Sea/brown trout	Native
	Three-spined stickleback	Native
	Lamprey species	Native
	European eel	Native
River Bladnoch	Atlantic salmon	Native
	Sea/brown trout	Native
	Three-spined stickleback	Native
	Rainbow trout	Non-native
	Lamprey species	Native
	European eel	Native
	Pike	Native
	Perch	Native
	Roach	Non-native
	Bream	Non-native
River Cree	Atlantic salmon	Native
	Sea/brown trout	Native
	Three-spined stickleback	Native
	European eel	Native
	Lamprey species	Native
	Pike	Native
	Perch	Non-native
	Minnow	Native
	Sparling	Native
River Fleet	Atlantic salmon	Native
	Sea/brown trout	Native
	Lamprey species	Native
	European eel	Native
	Minnow	Native
	American signal crayfish	Non-native
	Three-spined stickleback	Native
River Dee*	Atlantic salmon	Native
	Sea/brown trout	Native
	Pike	Native
	Perch	Native
	Roach	Native
	Three-spined stickleback	Native
	European eel	Native
	Minnow	Native
	Stone loach	Native
	Rainbow trout	Non-native
	American signal crayfish	Non-native
River Urr	Atlantic salmon	Native
	Brown/sea trout	Native
	Lamprey species	Native

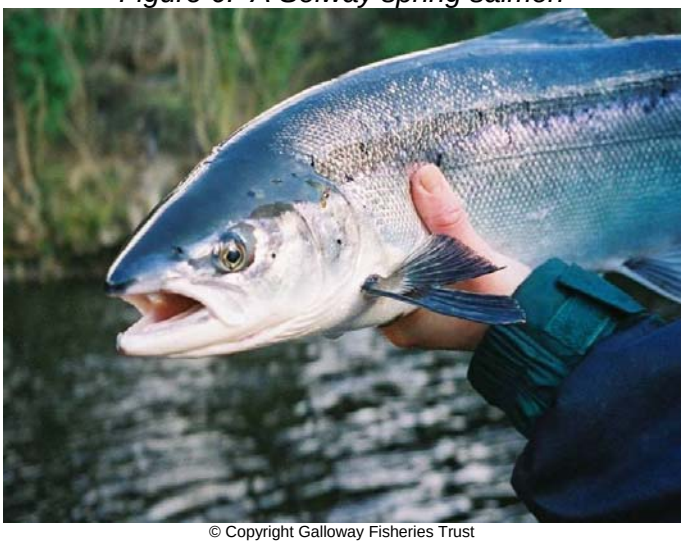
	Three-spined sticklebacks	Native
	European eel	Native
	Minnow	Native
	Stone loach	Native
	Perch	Native
	Rainbow trout	Non-native
	Pike	Native

*Loch Ken also contains a wide range of introduced coarse fish species but these have not been surveyed or verified as present to date.

Salmon catches across the Solway

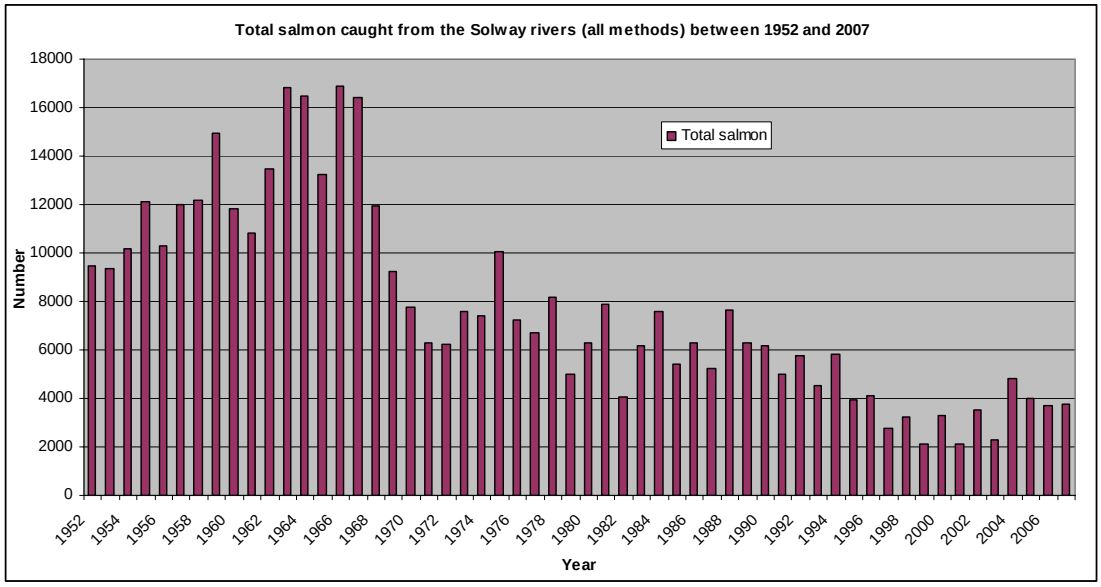
Overall the official catch statistics (produced by Marine Scotland (Figure 7) for all Scottish Solway rivers combined suggests that a decrease in recent catches are a concern although there appear to have been signs of a minor recovery since 2004. It is important to remember that changes in fishing effort (especially the reduction in netting effort) are not recorded and this is likely to have had a marked effect on catches. The individual Technical FMPs consider the catch statistics for each catchment in more detail (e.g. rod and line versus other methods, changes in netting effort over time and run timings).

Figure 6: A Solway spring salmon



No official catch statistics are available for the Water of App. Although the Water of App lies within the Stinchar DSFB jurisdiction they do not submit an official catch return as no angling takes place.

Figure 7: Solway catches of salmon and grilse between 1952 and 2007 (all methods)



Sea trout catches across the Solway

Overall the official catch statistics (produced by Marine Scotland) (Figure 8) for all Scottish Solway rivers combined suggests that the decline in recent catches are a major concern as there has been a continuous and significant decline in the sea trout catch since 2000. Prior to the decline there had been about 10 years of stable catches after previous significant declines. It is important to remember that changes in fishing effort (especially the reduction in netting effort) are not recorded and is likely to have had an effect on catches. The decline in recent sea trout catch is being reported UK wide, with the Marine Scotland Science official Catch Statistics reporting that the 2007 sea trout catch for Scotland was the lowest recorded since records began in 1952.

Figure 8: Total Solway sea trout catch between 1952 and 2007 (all methods)

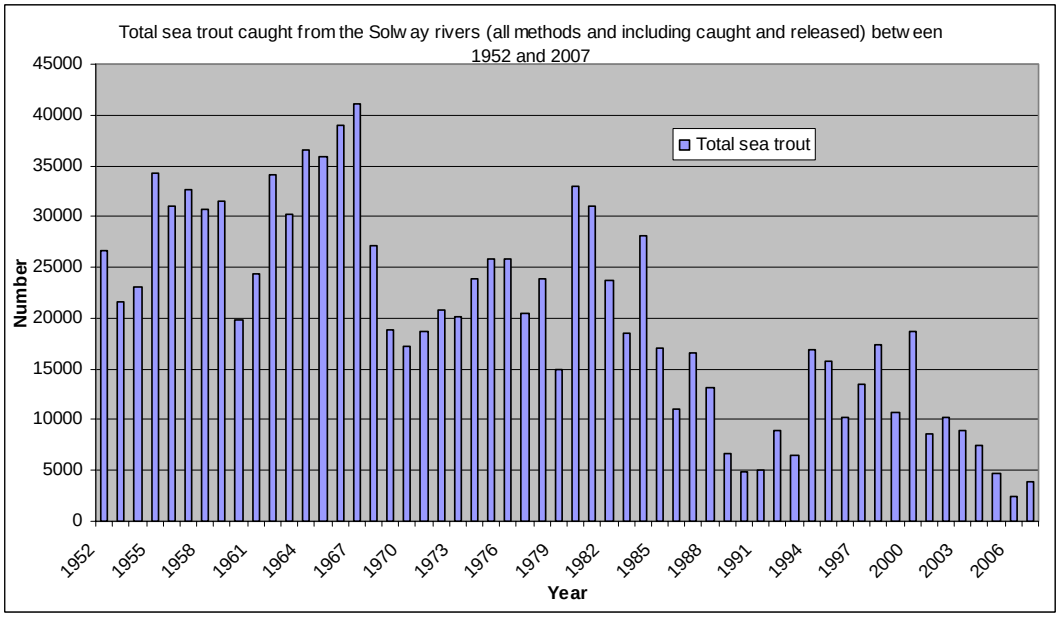


Figure 9: A good sea trout caught for broodstock

Present fisheries management activities undertaken across the area

The rationale behind the various fisheries management activities which are presently undertaken across the freshwaters of the area are described in each Technical FMP. These vary for each catchment and the main over arching ones are listed below:

Predator Control

Although predators are not considered a significant overall pressure to fish populations there can be localised problems. At present there are no predatory bird (cormorant or saw bill duck) culls undertaken although their populations are now being monitored closely. Mink trapping is undertaken on some fisheries. Seal control is focussed mainly on the Cree where rogue seals can cause damage at the netting stations. Management of pike populations in certain fisheries is undertaken to protect other important fish stocks e.g. Atlantic salmon on the Bladnoch.

Figure 10: Large rod caught pike from the Bladnoch

Habitat intervention

GFT, as part of their remit, have worked closely with DSFBs and landowners to undertake habitat improvements and remedial works in areas where degrading or destruction of the habitat has taken place. This has included all the river catchments and many tributaries of stillwater systems. GFT have completed full catchment habitat surveys (using SFCC protocol and adapted Hendry and Cragg-Hine walk-over surveys) have been undertaken on most river systems in order to identify and prioritise problems and degraded areas which would benefit from habitat improvement works. The measures undertaken include riparian, bankside and instream habitat works. Habitat works completed include: the addition of rock in dredged areas; addition of larger substrates where they have been removed; erosion control (using soft and hard engineering techniques where appropriate); erection of stock exclusion fencing in sensitive riparian zones; deciduous tree planting in riparian areas previously planted with clearfelled coniferous forestry plantations; brashing work in areas overshaded by coniferous trees and willow work to help stabilise unstable and collapsing banksides.

GFT monitor the success of the habitat works by undertaking habitat assessments and electrofishing surveys where appropriate.

Stocking

Stocking programmes, using salmon and sea trout fry, have been undertaken on most of the river systems since at least 1992, occasionally considerably longer. Many stillwaters across the area have been stocked with coarse fish species which are not considered native to the region and there are a number of commercial or recreational rainbow trout fisheries.

Exploitation control

Each DSFB in the area has a set of river rules which they review annually. No DSFB has made any conservation measures true by-laws, however measures have been agreed and signed up to by all involved. Voluntary conservation measures are put in place by DSFBs as a voluntary code of practice for different species at different times of year e.g. on the Bladnoch there is ‘no killing of hen salmon’ in the last month of the season. Moreover, many individual fishing beats have beat rules and conservation measures in place such as early closing e.g. most beats on the Water of Minnoch (River Cree) stop fishing two weeks early to help conserve earlier spawning salmon.

The killing of spring salmon on all local rivers is strongly discouraged. Since 2001 GFT have organised a catch and release initiative for the return of rod caught spring salmon on the River Bladnoch, River Cree (the two main rivers with remnant spring runs of salmon) and have more recently included the River Urr. The Bladnoch and Cree DSFBs offer the various estuarine netting stations in their districts a discount on their levy if they agree to defer setting their nets for a set period after the season begins (usually a few months) in order to help conserve spring fish.

Figure 11: River netting

In terms of stillwater trout fisheries, most have a maximum bag and minimum size policy in place. Fish other than salmonids have no real conservation limits enforced in the area. Larger pike benefit indirectly from salmon conservation in the River Bladnoch catchment, as anglers are strongly encouraged to release pike if they weigh over 5 lb. GFT, however, encourages individual anglers to practice catch and release when fishing for both game and coarse fish (excluding pike of under 5 lb on the River Bladnoch).

Easing of barriers

Larger barriers to fish movement were present on most river systems across the area and GFT has in most cases breached the most problematic of these or install fish passes to facilitate fish movement past the barriers. The full catchment habitat surveys have identified most of these barriers. Other, non-permanent barriers to fish movement, such as debris dams, fallen trees have also been worked on. Generally more of these types of barriers have been dealt with as removal / ease of passage past these are very cost effective. The breaching of dams, removal of weirs and installation of fish passes is generally very expensive in terms of time and money so work on these structures has to be carefully planned and costs justified in terms of fish benefits. GFT has removed/eased the passage over several barriers to fish movement in the past; these are detailed in Table 2.

Figure 12: Denil fish pass fitted on the Polbae Dam

Table 2: Barriers to fish movement recently breached / eased by GFT (not including habitat related barriers such as fallen trees and debris dams)

Catchment	Location	Date completed	Type of works	Description
Water of App	Main river	2001	Weir removal	Redundant weir located in lower reaches of river which was impassable to migratory fish was removed
River Luce	Upper main river	2002	Breaching of Lagafater Dam	Redundant large earth dam for old reservoir was breached to allow access by migratory fish
River Bladnoch	Polbae Burn	2007	Denil fish pass installation	Severe problematic dam for fish passage eased significantly for access by installing denil fish pass into structure
River Bladnoch	Polbae Burn	2008	Irish bridge removal	Irish bridge causing problem for fish passage removed and reinforced log bridge installed in place
River Cree	Castle Stewart Burn	2006	Irish bridge adapted and crump weir built	Irish bridge with fish pass removed as was complete barrier to fish access. Crump weir with flume installed in place to allow fish passage as well as allowing retention of existing small loch
River Cree	Challoch Burn	2005	Bridge apron alteration	Installation of baffles on problematic bridge apron to allow concentration of water flows in low flow and access for fish
River Luce	Gabsnout Burn	2008	Fish pass built	Installation of baffles on problematic bridge apron and cutting away of concrete step to allow concentration of water flows in low flow and access for fish

Poaching control

Each of the individual DSFBs have dedicated and trained water bailiffs to look after the river on their behalf. As poaching is not perceived to be a large scale problem in the area (although in reality the actual level of poaching is very difficult to ascertain) the limited resources of the local DSFBs appear to be adequate to control illegal poaching. There is a degree of crossover of bailiffing expertise where neighbouring rivers assist each other if a larger bailiffing force is required or news has reached them of a potentially imminent poaching problem. Some of this bailiffing work is seasonal, for example some DSFBs employ water bailiffs to police key areas of their catchment only for the last two months of the season. Individual fishing beats or angling clubs may also employ bailiffs, sometimes seasonally, to patrol their waters.

Consultation for management

A significant amount of GFT time is allocated to consultation. Nationally, GFT responds to consultations such as proposed Scottish Government legislation and, as well as representing the views of GFT, often include views on behalf of the DSFBs. GFT feels it is important to have input to national strategies and plans as it allows the GFT and DSFBs to have a voice on national issues which may be applicable locally.

Locally, GFT is often asked to provide expert fisheries advice on local planning issues by the Council. GFT responds to various plans such as bridge upgrading, road development and drainage and sewage schemes. GFT is also consulted on and provide advice for urban developments such as new housing schemes and business developments, providing each of these could have potential effects on the riverine environment.

GFT sits on the Galloway Forest District Forestry Environmental Panel in order to provide input to forest design plans. This is an important part of GFT work as a large proportion of the area is afforested with commercial forestry plantations. Input to the Environmental Panel is key in highlighting to the Forestry Commission (Scotland) which fish species are present within their specified design plans, areas of sensitivity, potential areas where they could be best placed to consider opening up riparian areas etc. GFT is also able to comment on felling proposals and replanting plans at any time and are able to contribute fish data and information regarding sensitivities of resident fish species, instream and bankside habitats.

Figure 13: Artfield Windfarm

GFT also contributes time to responding in detail to potential wind farm, small-scale hydro developments and energy park applications in the area. Contribution is often made at the scoping stage of such applications, or by providing comments to the Environmental Statements and Environmental Impact Assessments.

Alien species control

Some limited alien species control has been undertaken at particular times, namely North American signal crayfish (ASC). GFT has previously undertaken work for SNH on the control of ASC on the Kirkcudbrightshire Dee system. GFT has the necessary

trapping licences, issued by the Scottish Government, to allow trapping activities to be undertaken.

For a number of years there has been a Japanese knotweed group, based on the River Fleet to monitor the ongoing problem of knotweed along the riparian areas of the river. The group sources volunteers to map knotweed and sources funds to eradicate them from key areas. This is a small community group with limited access to grants and thus only small scale spraying has been attempted.

Assessment of factors limiting fish production and fishery performance

The GFT has undertaken an assessment of the factors which are limiting fish production and thus fishery performance. These factors may be presently affecting the fish populations or could potentially have an effect. These factors generally differ for each catchment and the relevant factors are listed in each Technical FMP. The main over arching issues are listed below:

1) Acidification

Parts of Galloway which have poorly buffered, base-poor underlying geology and soils are prone to surface water acidification. Atmospheric deposition occurs and the soils are unable to neutralise the acidic inputs. In Galloway, acid loading is further increased when sea spray from the Atlantic is picked up by the wind and carried into clouds. Sea salts subsequently deposited on land displace acidic particles from soils, releasing these to watercourses, adding further to the acidic loading. The headwaters of the Luce, Bladnoch, Cree, Water of Fleet and Kirkcudbrightshire Dee are particularly susceptible due to the underlying poor buffering capacity.

Forested areas exacerbate the process of acidification. Coniferous trees are particularly efficient at scavenging and filtering acidity so that it flows through to the soil and water beneath them. Furthermore turbulence in air travelling over forest canopies increases dry and occult deposition. The effect is more pronounced where the trees are taller. Thus the acidic loading referred to in the previous paragraph is greatly exacerbated by conifer forests, particularly as they mature. The heavily afforested headwater areas of many local rivers are exactly where the acidification problems occur. Older forests were planted when there was poor understanding of the impact that forestry has on surface waters but the present re-structuring process should take account of the research and ensure replanting levels are only permitted at levels which will allow water quality to recover. In acid-sensitive areas, the risk of acidification is increased when large areas of forest are clear felled (particularly if >20% of a catchment is felled over a three year period) due to the short-term release of nitrate.

Figure 14: Poor forest practice

Atmospheric pollution is brought in on weather systems from national and international sources. Acidification is derived from one of three processes: wet deposition in which pollutants are transferred by rain; occult deposition where clouds or mist interact with the ground; dry deposition where acidic ions are carried in by air. Typically acid flushes occur as an episodic event, closely linked to water flow. Prolonged acidic episodes are usually only present in headwater areas, although even here, pH levels will fluctuate depending on rainfall and water flows. This is an important consideration when monitoring pH. At national and international levels, steps are being taken to address the problem of acidic air pollution, which is an important part of addressing acidification.

The actual effects of surface water acidification on fish varies with each species. Salmon and trout populations are considered particularly sensitive and are often used as an indicator species. Effects of acidification on fish will depend on many factors, but research has shown that if the pH falls below 5.5, long term damage will occur to fish populations. Furthermore, it can be difficult to predict acidification affects due to the episodic nature of acid events. Juvenile life stages (principally eggs and alevins) of salmonids are particularly sensitive and exposure to low pH may lead to total recruitment failure. When the pH of a watercourse is low, toxic forms of aluminium may also be released, which may also lead to mortality of older fish.

It is believed that approximately 80% of Scotland's acidification is in Galloway. SEPA WFD Characterisation Report used acidification to label many of Galloway's upland running waters as 'at risk'. The draft Solway-Tweed River Basin Management Plan identifies acidification as a significant local problem, requiring action. In these acidified watercourses, GFT electrofishing results show severely impacted fish populations or the total extinction of fish. Salmon are known to be particularly sensitive to low pH and usually die out quickly from waters considered acidified. There is a wide range of data and information collected across the acidified watercourses by many organisations which all detail the acidification problems.

GFT have undertaken egg box experiments at a number of locations where low pH is believed to be impacting on salmonid egg survival. Salmon are used as they are considered a key sensitive indicator species. Egg box experiments involve burying three egg boxes into suitable substrate at each test location. Each egg box contains 100 eyed salmon eggs and gravel and is sealed to ensure hatched alevins cannot

escape. The eggs are retrieved once hatching is predicted to have occurred and they are examined to see what percentage of eggs have successfully hatched - the hatching life stage is considered particularly vulnerable to acidification. The results are used to examine the success of egg hatching in areas of questionable water quality and to help direct forestry restructuring.

Figure 15: Contents of an egg box (control site)

In order to protect watercourses and their associated flora and fauna, Forestry Commission (Scotland) identify areas where watercourses are most at risk from the scavenging effect of forests, including new planting and those existing forests being replanted. The Critical Load Analysis (CLA) is used for this purpose. The Critical Load (CL) is a water chemistry model applied to watercourses deemed to be at risk of acidification. The CL model is derived from factors including base conditions, the Acid Neutralising Capacity (ANC) and the run-off of a watercourse (which is always tested at peak flows when the CL is lowest). The ANC is itself a model which, although largely based on chemical factors, was developed only partially taking fish populations into account. After water analysis, if the CL threshold is exceeded then it is deemed an acidified watercourse.

At present, 10 km 'Critical Load squares' where the CL is at risk of being exceeded have been calculated and are shown in map form in the Forests and Water Guidelines (Fourth Edition). Within the CL squares and all squares adjacent to them, the impacts of new forest planting and the replanting of existing forests needs to be carefully considered. Within these CL squares the risk of acidification to watercourses is based on a sub catchment assessment.

Whilst the CLA allows an assessment to be made of the risk of acidifying a watercourse by conifer tree planting, the GFT believe the threshold is not set at a sensitive enough level. That results in conifers continuing to be planted in areas suffering from acidification. A further problem with the use of CLA to try and control acidification is that the CLA is only required to be considered for forests present at altitudes exceeding 300 m. There appears to have been an incorrect assumption that acidification only occurs at these higher altitudes. In Galloway, nearly all acidified running waters, where forestry is believed to be a significant contributing factor, lie under this 300 m altitude threshold, e.g. in the heavily acidified Fleet catchment, only 1.3% of the conifer planting lies above 300 m. The 300 m altitude

rule is yet another reason why the CLA is not 'fit for purpose' as a method to address the impact of conifer afforestation on acidification in Galloway.

2) Barrier and potential barriers to fish movement (anthropogenic)

Natural and artificial barriers may impede or prevent fish passage. Most fish species wish to undertake a degree of migration within watercourses at some point during their life history, especially at spawning time. For many species it is essential to be able to migrate upstream to spawn e.g. salmon, sea trout, eel and lamprey species. Barriers to migration can include natural obstructions such as waterfalls, or man-made structures such as dams, weirs and culverts. Salmon can negotiate certain barriers, such as small waterfalls, but large barriers will prevent migration and influence the natural distribution of migratory species. Genetically distinct populations, especially seen in brown trout, may evolve independently above natural barriers and these should not be circumvented. Accumulations of coarse woody debris can also impede fish passage but as woody debris can provide vital cover for fish and other wildlife careful consideration must be made before removing it. Downstream migration of kelts and smolts must also be considered, which is a particular problem for the Kirkcudbrightshire Dee due to the poorly designed Galloway Hydro Scheme. Engineered structures such as dams, weirs, fords and culverts may all cause problems and require alteration. Natural waterfalls tend to occur in the headwaters of some tributaries but these can be out with the areas used by migratory fish for spawning.

3) Degraded instream habitat (including spawning substrates)

A natural river channel should have a diverse range of physical features (particularly water depths, flow type, velocity and substrate types). This range of micro-habitats will provide suitable places to live for a varied mix of flora and fauna. It must be remembered that rivers are natural substrate transporters; the action of light to moderate erosion and deposition are wholly natural and an essential part of river processes.

The different life-stages of fish all have different optimal habitat requirements in the riverine environment. For example, juvenile lampreys require fine grade sediments whilst juvenile salmonids require coarse, larger sized substrates in which to live; trout tend to favour slightly different habitats than salmon, particularly when parr aged. For a healthy salmon and trout population it is essential that there are a good quantity and range of suitable habitat types available for all life-stages.

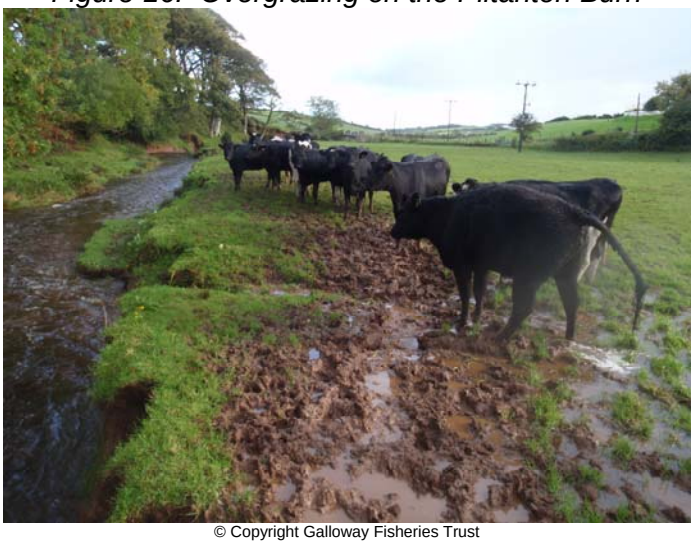
4) Degraded riparian habitats

Natural riparian vegetation assists in the continued stabilisation of the banksides and provides important habitat for fish. Furthermore, overhanging and draped vegetation provides fish with shade and protection from predation, habitat in which to live and helps to limit excessive algae and instream plant growth. A diverse, well vegetated riparian zone will facilitate the addition of invertebrates to the watercourse as a food source for fish. A well established riparian zone with varied vegetation will be stabilised by extensive root structures, with the vegetation acting as an important buffer between the water and the erodable soil surface.

The loss of natural riparian vegetation can have detrimental impacts on watercourses, including increased erosion and siltation, nutrient loading and changes to stream hydrology and channel morphology. This loss can be attributed to factors such as overgrazing by livestock (one of the most common causes of riparian

vegetation loss), overshading (especially from conifer trees) or alien plant species out-competing native vegetation. Limited grazing within the riparian zone can however be beneficial and may encourage greater plant diversity. It can also limit the encroachment of scrub and rank vegetation which may choke up smaller watercourses.

Figure 16: Overgrazing on the Piltanton Burn



5) Alien non-native species

An alien non-native species is a species which is not native to the local area / region or Scotland. In terms of the Technical FMPs, the main alien species that could potentially limit the productivity of fish included non-native fish species (e.g. ruffe), alien plants (including Japanese knotweed and Giant hogweed) and invertebrates (including North American signal crayfish). The introduction of an alien species, either as a deliberate release or inadvertently through escapes can disrupt the natural balance of an ecosystem. Direct effects of an introduced species may include predation, habitat loss or augmentation, or competition for habitat and food resources. Indirect effects from alien species include the introduction and / or spread of diseases and parasites. Most non-native species are very difficult and expensive to eradicate or control once established.

Under the Nature Conservation (Scotland) Act 2004 it is an offence to release any non-native species into the wild – even without the intention to do so.

Figure 17: North American Signal crayfish

The introduction of other fish species into the catchment is a potential threat, especially since all the river catchment possess many stillwaters. The most likely illegal source of new fish species is from anglers. The use of live-bait was banned in 2007 (the Aquaculture and Fisheries (Scotland) Bill amended the existing provisions in the Salmon & Freshwater Fisheries (Consolidation) (Scotland) Act 2003, relating to the use of live vertebrates as bait).

6) Over exploitation of adult fish

For any fishery to remain viable it must be exploited sustainably (i.e. enough fish must survive to spawn and produce enough young for the population to survive in the long term). Legal exploitation includes angling, net and cobble, haaf netting and fixed engine nets. Illegal exploitation (poaching) may include netting, certain types of angling or poisoning. For migratory species (such as salmon and sea trout) exploitation in the marine environment (such as coastal nets) must also be considered. To manage a fishery sustainably it is essential to know the size and structure of the fish stocks and their distribution.

7) Predation

Predation on fish is always present to some degree, but it is not considered a particularly significant problem in the area, although localised problems may occur. There are a range of predators that feed on all life stages of all fish species. In freshwaters, juvenile fish can be eaten by other fish (such as eels and trout), birds (particularly sawbill ducks, heron and cormorants) and mammals (otters and mink). Adult salmon and sea trout are at risk when they enter the river from otters and mink, or at the river mouth from seals. Seals (mostly Grey seals with a few Common seals) are present in good numbers around the coastline. It is assumed that their impact on salmon and sea trout stocks is limited in the open seas but that they can have a significant impact if they hunt in the waters near to shore, the estuary and lower river environment.

Predation is a natural occurrence; predators and prey having co-existed in ecological balance over millennia although, in the past, fish stocks would have been at higher levels and thus more able to withstand predation. Predation of early life stages may have little effect as the population can compensate for the losses through improved growth and survival of those that remain. As fish reach older life stages (e.g. parr

and smolt stages), the population reduces its ability to compensate for losses due to predation.

Figure 18: A trapped American mink

8) Pollution (not including acidification)

To survive and flourish, fish require well oxygenated waters which are free of toxic and organic pollution. Freshwater invertebrates, the base of the aquatic food chain, also require good quality clean water and are similarly very sensitive, even to minor changes in water quality. The many possible sources of pollution all arise from human activity of one kind or another. Organic pollution (e.g. excess fertiliser) may be washed off into field drains resulting in increased levels of algal growth which deplete oxygen levels by increasing the amount of bacterial activity. Toxic pollution is most likely to occur through accidental spillage of chemicals used either in agriculture or during construction operations. The possibility of pollution from sheep dip is always a risk as even extremely low concentrations such as the drips from the fleece after dipping can have devastating effects. Forestry is the major land use in many of the upper catchments and many of these trees were originally planted too close to the watercourses. Although these plantations are in the process of being restructured to higher environmental standards, there is a high risk of silt entering watercourses when surrounding coups are felled after the first rotation, as little or no riparian buffer zone exists to capture silt released from felling sites. Silt can also be a particular problem where soils are very thin, upper Water of Fleet, so when trees are felled or new roads constructed, the disturbed ground can be highly erodible. As you move down the catchments agriculture becomes increasingly important and there are various potential point pollution and diffuse pollution sources (e.g. failed slurry storage, silage effluent) which need to be considered.

Figure 19: Severe siltation problems caused by a pipe crossing

9) Reduced survival in the marine environment

This pressure is limited to migratory fish and is pertinent but not exclusive to fish in the area. Research has shown that across Scotland, salmon smolt survival rates have been declining in recent years. Work completed by Marine Scotland on the North Esk has found that between 1964 and 2006 the marine mortality of salmon smolts has doubled.

Declining numbers of returning adult sea trout are causing concern throughout the UK. There is no evidence that the freshwater environment used by juvenile sea trout has declined in quality or quantity in recent years across the local rivers. It has to be assumed that the recent decline in sea trout is due to a reduction in survival rates in the marine environment whether through lack of feeding, disease or predation.

There are concerns the European eel numbers are falling. Although the scale or cause of the declining stocks is not known (although over fishing could be a factor), it can be assumed that reduced survival at sea could be contributing to the decline.

10) Parasites and diseases

Parasites and diseases are an ever present threat to fish species residing in a river system. The introduction of alien species can also introduce new parasites and diseases as well as being vectors of already present threats.

Gyrodactylus salaris (GS) is a freshwater ecto-parasite that infects Atlantic salmon and some other salmonid species. The parasite is less than 1 mm long and infests the skin, fins and gills which eventually kills its salmon host. An infestation of GS in a river will threaten the existence of any salmon population. At the present time this parasite is restricted to Norway, Sweden, Finland, Russia and some other Baltic countries but importantly has not yet occurred in the UK. There are various ways in which GS could be introduced into the UK, although the most likely route would be through water or fish from infected areas but there is also a risk from contaminated equipment from anglers and any other freshwater recreational activity (canoes, diving gear, etc). Farmed fish are a potential route by which disease can enter wild fish populations. GS is, at present, considered to be a great threat to fish in UK rivers.

11) Reduced water flow

Natural variations in water flow occur in times of flood or drought, but human activities such as river regulation, abstraction, water transfers and land drainage exacerbate these variations. Low flows during the summer may result in elevated water temperatures and low dissolved oxygen which can kill fish. Additional impacts include loss of spawning areas and juvenile rearing habitat, and impeding fish passage.

Prioritising the factors limiting fish production and fishery performance

Each of the Technical FMP Series prioritises which factors are most significant regarding their impact on fish production on each of the river catchments (1 being most important). These are listed below for each individual catchments.

Water of App

1. Degraded riparian habitat
2. Degraded instream habitat
3. Alien and non-native species (existing)
4. Barriers to migration
5. Alien and non-native species (new introductions)
6. Predation
7. Pollution
8. Parasites and disease
9. Reduced survival in marine environment

Luce

1. Acidification
2. Degraded riparian habitat
3. Alien non-native species
4. Barriers to fish movement
5. Reduced survival at sea
6. Predation
7. Degraded instream habitat
8. Reduced flow
9. Parasites and disease
10. Pollution
11. Exploitation

Piltanton Burn

1. Degraded instream habitat
2. Reduced survival at sea
3. Pollution
4. Degraded riparian habitat
5. Alien non-native species
6. Parasites and disease
7. Predation
8. Exploitation

Bladnoch

1. Acidification
2. Degraded instream habitat
3. Degraded riparian habitat
4. Alien and non-native species
5. Parasites and diseases
6. Barriers to migration
7. Pollution
8. Predation
9. Reduced survival in marine environment

Cree

1. Acidification
2. Degraded instream habitat
3. Alien non-native species
4. Degraded riparian habitat
5. Reduced survival at sea
6. Exploitation
7. Predation
8. Pollution
9. Barriers to fish movement
10. Parasites and disease

Water of Fleet

1. Acidification
2. Degraded instream habitat
3. Degraded riparian habitat
4. Alien non-native species
5. Barriers to fish movement
6. Reduced survival at sea
7. Predation
8. Parasites and disease
9. Pollution
10. Exploitation

Kirkcudbrightshire Dee

1. Barriers to fish movement
2. Alien non-native species
3. Reduced flow
4. Acidification
5. Exploitation
6. Degraded instream habitat
7. Reduced survival at sea
8. Predation
9. Degraded riparian habitat
10. Pollution
11. Parasites and disease

Urr

1. Degraded riparian habitat
2. Degraded instream habitat

3. Pollution
4. Barriers to fish movement
5. Alien non-native species
6. Parasites and disease
7. Over-exploitation
8. Reduced survival at sea
9. Predation

Management actions required to address the prioritised factors limiting fish production and fishery performance

Following on from undertaking an assessment and prioritisation of the factors which are limiting fish production and thus fishery performance in each catchment, each Technical FMP suggests management actions to address these issues. Up to 60 actions are listed per catchment FMP to be addressed over the next five years. The main actions and solutions under each issue are listed below:

Acidification

There are six main points GFT feels are required to start to address acidification on a national scale. These have not been prioritised as they are linked and equally pertinent to addressing the acidification issue as a whole:

- There needs to be a method devised which can accurately identify watercourses and sub-catchments which are currently acidified, sensitive to acidification events, and those at risk of becoming acidified. The CLA aims to do this but GFT has concerns that it is not accurate enough.
- Along with other biological data, Scottish (preferably Galloway) fish populations should be taken into account when assessing the sensitivity of a watercourse to acidification (CLA is mainly based on chemical data).
- The 300 m rule needs to be reconsidered. Currently the Forests and Water Guidelines (Fourth Edition) states that CLA is unlikely to be required for forest replanting schemes at elevations of less than 300 m (the '300 m rule'), unless the area lies within an SAC or cSAC. Thus CLA does not have to be considered when replanting most of the acidified areas of Galloway.
- Watercourses should be ranked when determining if they exceed the CL. At present the CLA has a threshold – a watercourse either falls below this threshold, or above it. No recognition is made to whether the sample is close to the threshold or well away from it. A traffic light system should be adopted to show when watercourses exceeded the CL threshold, which were close to it (and thus at risk from becoming acidified) and those which lie well below the threshold and are therefore not at risk.
- A method or model should to be developed to identify the percentage level of closed canopy forestry possible in a sub-catchment before it becomes at risk of acidification. This needs to take account of the sub catchment's existing buffering capacity, which is linked to soils and underlying geology. If areas are subsequently deemed to be more at risk of acidification in terms of their level of closed canopy, then the restructuring of these areas should be brought forward rather than waiting until the end of the original rotation.

- Common to all the points above is the need for the relevant forestry organisations, along with others (especially SEPA and GFT), to agree on how to calculate sub catchment size. For example, if a tributary of the Fleet suffers from a degree of acidification and it has a smaller inflowing tributary which itself is severely acidified, would the 'sub-catchment' be the severely acidified watercourse only, or the complete sub-catchment affected. Sub catchment size is vital to addressing the level of deforestation and replanting that should occur in areas deemed at risk from acidification.

Further to these points, more localised actions to address acidification include:

- The headwaters of the Cross Water of Luce, Bladnoch, High Cree, Water of Fleet and sections of the Kirkcudbrightshire Dee are affected by fairly widespread acidification in both the tributaries and the main rivers. Work must continue to be undertaken with the forestry authorities on the restructuring of the forests and aim to significantly reduce closed conifer cover in sensitive sub-catchments.
- The monitoring of juvenile salmonids (egg boxes and electrofishing) and water pH (using constant monitoring equipment) in acidified areas should continue.
- The standards outlined in the most recent edition (at the time of press this is the Fourth Edition) Forests and Water Guidelines must be treated as a minimum and adhered to or surpassed at all times during the felling or restructuring of forests.
- The joint project (SEPA, FCS and GFT) of the sampling of acidified waters in the area must be continued to assess levels of acidification at critical times of year and to improve the CLA model. Water, invertebrate and fish sampling should also be carried out in the future and the results of such sampling should be circulated round relevant organisations and interested parties.
- The application of lime, targeted to areas susceptible to or suffering from acidification should be considered. This could potentially accelerate the recovery of acidified watercourses. The creation of limestone gravel spawning beds and erosive material in key locations should be considered.
- Continue with focussed salmon and sea trout stocking programmes (only using natal stock) to ameliorate the effects of acidification.

<u>Barrier and potential barriers to fish movement (anthropogenic</u>)

- Consider the removal of various redundant problematic weirs.
- Consider fitting baffles to various problematic road bridge aprons.
- Undertake habitat survey of small watercourses (<1 m wide) which were not examined in previous habitat surveys. This is required to look for further barriers on these watercourses, which can be particularly important for trout, which may require action.
- Selectively remove debris dams, particularly in forestry clear fell sites. For each blockage an assessment will need to be made regarding the benefits of the potential habitat it provides versus fish access issues.
- Continue to investigate and lobby relevant organisations regarding the fitting of fish passes on Penwhirn Dam (Luce) and on various dams on the Dee system.

- Monitor the success of the recently fitted fish passes e.g. on the Gabsnout Burn on the Luce.
- Undertake studies on the effectiveness of fish ladders (e.g. Tongland fish pass on the Dee) and any necessary repairs to fish passes (e.g. Dalnigap fish ladder on the Luce).
- All Irish Bridges should be examined to consider fish access and if necessary replaced or modified.

Degraded instream habitat (including spawning substrates)

- Undertake habitat survey of small watercourses (<1 m wide) which were not examined in previous habitat surveys. This is required to look for degraded instream habitat on these watercourses, which can be particularly important for trout, which may require action.
- Assess the pros and cons of removing fallen trees from watercourses. Fallen trees can cause additional and/or excessive erosion to surrounding banksides. Large woody debris can also create important habitat for fish so it is important to consider each large fallen tree on a case by case basis.
- Consider undertaking spawning bed improvement work which may include adding gravel, undertake gravel loosening or adding gravel traps.
- Consider the creation of parr habitat in areas where suitable habitat has been lost, this could include the addition of boulders or woody debris.
- Work towards addressing any excessive bankside erosion which is not inputting important spawning gravels.
- Undertake works to protect sensitive banksides from erosion and to provide important bankside cover for fish. Possible techniques to include log and Christmas tree work, armour rock placement and willow weaving.
- Undertake restoration work on watercourses where dredging is known to have degraded instream habitats.
- At sensitive locations work with the relevant landowners / organisations to reduce the level of silt and fine substrates entering watercourses.
- Ensure no inappropriate instream gravel extraction occurs.
- Undertake geo-morphological survey to investigate how the Galloway Hydro Scheme (on the Dee) is impeding the downstream movement of smaller substrates.

Degraded riparian habitats

- Organise the eradication of riparian Japanese knotweed, Himalayan balsam and Giant hogweed. Treatment will need to be undertaken for a number of years to ensure total eradication.
- Continue to encourage the fencing off of sensitive riparian zones. Some limited grazing may be beneficial so a grazing programme should be agreed in certain cases. Dedicated schemes or agri-environmental schemes could fund this work.
- Continue to undertake deciduous tree planting in riparian zones where there is a distinct lack of suitable trees.

- Undertake habitat survey of small watercourses (<1 m wide) which were not examined in previous habitat surveys. This is required to look for degraded riparian habitat on these watercourses, which can be particularly important for trout, which may require action.
- In any areas of long-term retention forestry, brashing of the trees (removal of the lower branches) alongside watercourses should be undertaken as this can be done up to a height of 5 m, allowing a great deal more light to penetrate to the riparian zone.
- The selective removal of trees, shrubs or limbs should be undertaken in areas highlighted as suffering from overshading by deciduous trees or Rhododendron.
- Liaise with forestry interests to, as priority, remove all coniferous trees, planted prior to the Forests and Water Guidelines, which exceeds the minimum distance allowed between the water and planted trees. This distance ranges from 5 m to 20 m depending on burn width.

Alien non-native species

- Various problematic non-native plants should be controlled and where possible eradicated including Japanese knotweed, Himalyan balsam, Giant hogweed and *Elodea Canadensis*.
- Consider control of North American signal crayfish in the Kirkcudbrightshire Dee and possible eradication techniques in the Skyre Burn.
- Produce educational material on how to prevent the spread of various alien non-native species. This should be disseminated to landowners, riparian owners and fishery owners. Publicise locally that under the Nature Conservation (Scotland) Act 2004 it is an offence to release any non-native species into the wild – even without the intention to do so.
- Continue to be vigilant regarding other alien non-native species becoming established particularly North American signal crayfish.
- Produce a bio-security plan to cover all local rivers, which would highlight the presence of non-natives, threats from non-natives and to co-ordinate large scale eradication programmes where necessary.
- Investigate all stillwater outflows across the area to ensure they comply with the dams and screens act. Adequate screening is required to ensure no escape of stocked fish into nearby river systems. Any fish farm outflows should also be monitored.
- Undertake a co-ordinated mink trapping projects across all catchments in the area using the Game and Wildlife Conservation Trust (GWCT) mink rafts.

Over exploitation of adult fish

- The importance of catch and release (particularly for spring salmon) should be publicised widely in order to encourage a greater level of catch and release to be practised.
- Continue hatchery programmes where it is proven there are overall benefits.

- Further conservation measures should be considered by DSFBs to conserve salmon and sea trout – this may include official conservation measures or adapting voluntary river rules.
- Investigate the exploitation of migratory fish stocks by Solway net fisheries. Some Solway netting stations are thought to constitute mixed stock fisheries.
- Juvenile salmonid surveys should continue to be undertaken to monitor the presence and survival rates of juvenile fish.
- The use of water bailiffs should continue. Poaching is not considered a large problem, however it is still known to happen and the presence of water bailiffs in key areas at specific times of year will help to prevent fish from being taken illegally from the river.
- The installation of further fish counters on the areas rivers should be considered to and provide data supplement the information from the Dee Vaki counter.
- Educational projects such as 'Salmon In The Classroom' should continue to be run in schools across the area to highlight the problems of over exploitation and to instil in younger generations the concept of retaining a sustainable fishing resource for the future.
- Discourage the use of indiscriminate coastal gill nets (set for bass and mullet) which kill sea trout and salmon as by-catch.
- Undertake genetic profiling of sub-populations of Atlantic salmon across all local rivers.

Predation

- Undertake a co-ordinated mink trapping projects across all catchments in the area using the GWCT mink rafts.
- Numbers of predatory birds (sawbill ducks, cormorants and herons) should be monitored to consider whether non-lethal and lethal control may be necessary. A licence would be required from the Scottish Government for any lethal control.
- The presence of seals in the lower rivers will be monitored. If problem seals are found at sensitive times of year then control will be considered (various legislation will need to be considered) using an approved marksman.
- Continue pike management policy (i.e. releasing pike over 5 lb) in waters where predation on other sensitive species needs to be managed.

Pollution (not including acidification)

- Continue to work closely with SEPA to assess potential pollution sources across all catchments and ensure information flow between all parties.
- Ensure that adequate silt control measures are in place during any forestry operations undertaken near watercourses in the area. The most recent Forests and Water Guidelines (currently the Fourth Edition) controls should be treated as the minimum standards.

- If any significant construction is undertaken in the catchments (e.g. wind farms or road improvements) it must be ensured that the companies or individuals involved liaise fully with wild fish interests.

Reduced survival in the marine environment

- As the scale of the problem of reduced sea survival is not known for the local fish populations, it is not appropriate to have management actions allocated. Various actions for research are detailed later.
- GFT to keep all interested parties up to date on the findings and discussions of the Solway Sea Trout Group (membership: GFT, ASFB, Esk and Liddle Improvements Association, Environment Agency, some DSFBs) who meet annually to assess the ongoing problem of the declining numbers of sea trout in the region.

Parasites and diseases

- Guidance from ASFB, Rivers and Fisheries Trusts Scotland (RAFTS) and the Scottish Government on preventing *Gyrodactylus salaris* from entering the UK should be strongly adhered to. This should include disinfecting any canoes, fishing equipment and GFT fish surveying equipment if used in other catchments. Further educational material should continue to be produced and the potential threat of this parasite publicised throughout the catchment.
- A bio-security plan will be produced to cover all rivers in the area to highlight risk of parasites and diseases.
- Ensure all local rivers are monitored periodically as part of the Marine Scotland wild fish health checks across Scotland.

Reduced water flow

- Continue to lobby Scottish Water and SEPA regarding increasing the compensation flow from Penwhirn Dam.
- Many proposals are included in the Kirkcudbrightshire Dee plan associated with increasing the compensation flow at various key locations of the Galloway Hydro Scheme.
- Investigate the Lochenkit outflow sluice (Urr) to ensure the best use of this waterflow by the two receiving burns.

Research, Monitoring, Education and Development

It is important that the Technical FMP Series also identifies any research requirements that are necessary to fully understand the fish populations and their habitats. This research may be required to be undertaken locally are alternatively could be of a more general nature and thus could also be undertaken on other rivers in Scotland.

Each individual FMP identifies various research projects together with a justification and an assessment of options for data collection with considerations of the existing legislative framework.

It is important to note that in the opinion of GFT there is a clear difference regarding what is accurate 'scientific research' and what is 'research for management' work to be used at a local level to guide and monitor management solutions. An important consideration for future research work is the Animal (Scientific Procedures) Act 1986 which covers scientific research involving animals and came into force in 1 January 1987 (http://www.archive.official-documents.co.uk/document/hoc/321/321-xa.htm).

Some of the key areas of research planned for the next five years include:

- Identifying sea trout spawning locations
- Studying the movement of sea trout smolts, post smolts and adults while at sea
- Undertake genetic profiling of local sea trout stocks
- Undertake a large specialised juvenile lamprey survey across all rivers
- Increase the understanding of local European eel populations
- Undertake fish surveys of all local large stillwaters

Figure 20: Sampling salmon genetics

It is essential to ensure that there is a robust and well thought out monitoring programme in place to continue to examine the health of the river and its fish populations. In addition, as the programme of actions are put into place it is important to ensure that these measures are having the desired effects and to understand the degree at which they are addressing the problems. A well planned electrofishing survey is essential to be undertaken during the life of the plan. Baseline data should be gathered prior to actions being undertaken. This then allows post work monitoring to assess the levels of success of the various works carried out. Each Technical FMP outlines a suggested five year monitoring strategy for each catchment which is heavily dependent on the actions which are to be undertaken.

Educational projects aimed at all ages and abilities will be encouraged across the area. There are recognised local school projects, particularly the GFT 'Salmon in the Classroom' project. Across the area the freshwaters will be used for educational purposes whenever suitable opportunities arise.

Each FMP also considers the opportunities for further developing the river and still water fisheries in a sustainable manner. The increased use of internet marketing and angling websites are also explored further.

Figure 21: Electrofishing

Implementation of the Technical FMP Series

The successful implementation of the Technical FMP Series must be carefully considered. It is all too common with 'plans' that once written they simply sit on a shelf gathering dust and never get enacted. These plans lay out an ambitious five year programme of works which if undertaken will produce real and sustainable improvements to the fish populations and habitats across local waters. Each plan summarises all the catchment actions and gives a ranking to each action dependent on how urgent it is required.

The key bodies required to implement the FMPs will be the DSFBs, GFT, various forestry organisations and SEPA. Other bodies will have a role to play at times e.g. SNH, local DSFB water bailiffs, Scottish Water and Amey Highways. It has been advised to have regular meetings (probably annual) between the key bodies to discuss progress against suggested actions and to explore possible funding sources if required.

When considering and prioritising the work programme it is sensible to undertake a financial cost-benefit analysis to ensure that any limited funds are directed effectively.

There is a wide range of potential funding sources which may be able to assist with implementing some of the management options. However it is important to note that these funding sources, their budgets and funding priorities are forever changing and cannot be relied upon over the long term.

To assist in the implementation of the Technical FMP Series it is necessary for GFT to review and further develop our Geographical Information Systems, databases and data holdings. Ensuring that staff skills and training are adequate to deliver the proposed management and research actions are important and require careful planning. Again training to ensure good data analysis and data presentation is important. When necessary, outside expertise will be brought in to provide additional information, skills or knowledge e.g. structural engineers to design fish passes or the River Restoration Centre for riffle bed creation.