Code of Good Practice for Freshwater Fisheries Management

Part 1: Salmon and Brown Trout

Produced by Scottish Branch of Institute of Fisheries Management 2012

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Foreword

This Code of Good Practice has been produced by the Institute of Fisheries Management (Scottish Branch). It is the first in a series that is hoped will ultimately cover the management of all freshwater fish in Scotland. Its origins lie in the decision of the Scottish Freshwater Fisheries Forum that a Code of Good Practice for local managers should be produced.

1. Who will use this Code?

It is hoped that this Code will be used by:

- Managers involved in the freshwater fisheries sector; for example angling club committee members, Fishery Board members, Fisheries Trust trustees, river owners, and other fishery proprietors including netting station owners.

- Anglers and netsmen, as they finance both directly and indirectly much of freshwater fisheries management. It is intended that this Code should foster a good appreciation of what fisheries management is, its best practice and its limitations.

- Professional managers, for whom it should be a useful summary of the principles of good practice as provided for in the publications of their professional bodies and relevant public agencies.

It should be noted that whilst this Code is a wide-ranging guide, it should not be taken as being exhaustive. After reading it, further reading in the wide range of more specialised published research material may be needed. Research into fisheries management is continuous and new material is frequently published.

2. Introduction

The goal of fisheries management is to enable the freshwater fish resources of Scotland to be used and enjoyed by both this and future generations.

To achieve this, the key principles that have to underpin fisheries management are:

- To value, appreciate, protect and conserve Scotland's high quality freshwater environment, biodiversity and fisheries;

- To maintain and develop the economic benefit and potential of all of Scotland's distinctive fish and fisheries and recognise the value and contribution of each;

- To recognise the necessity of understanding a resource or a situation before taking action and that sometimes doing nothing may be the best policy;

- To recognise that good bio-security is fundamental to the long term sustainability of Scotland's fisheries and the protection of Scotland's native biodiversity.

3. The Native Fish of Scotland

With so much emphasis presently given to the importance of "biological diversity" and "species richness" it may seem strange to say that what is fascinating about Scotland's native fish community is actually its very low number of species!

Unlike the land-animal community which was originally the same as Continental Europe, due to the land bridges across the English Channel at the end of the last Ice Age, there was never a "freshwater bridge" connecting Scotland and the Continent, so the only fish species that could reach this country were those that could make a crossing of salt or brackish water.

This made Scotland's native fish community very different from south east England, which did have freshwater connections at that time as the River Thames was a tributary of the River Rhine. In fact a river ran down what is now the English Channel, and the southern North Sea was a freshwater lagoon or marsh. Through these connections, purely freshwater fish species could move in to what became southern England, making its native fish the same as that of the nearby continent.

The common characteristic of Scotland's native fish species is therefore that they can (as adults or juveniles or both) live in salt or brackish water either at present or did so under past conditions.

Other freshwater fish such as the Arctic char, the brook lamprey and the brown trout are actually offshoots of migratory forms and are therefore derived from species with marine stages.

It is just possible however, that some of the purely freshwater fish species that now live here could have arrived by natural processes and eggs sticking to the feet of water birds is an often-quoted possibility. However, since even the smallest and apparently most insignificant of these fish have been used by humans in the past as food or bait there is a strong likelihood of artificial introduction.

Over the last few hundred years and particularly since the coming of the railways and motor vehicles made travel much easier, this distinctive Scottish "island" fish community has been

disappearing at an increasing rate. Fish species have been either deliberately introduced (e.g. grayling and pike) or accidentally spread (e.g. ruffe, bullheads).

It has to be remembered that ecology is about communities of animals and plants and that distinctive local communities can become extinct in the same way as individual species. It can therefore be strongly argued that the native fish species community of Scotland is on the verge of extinction.

There are now few lochs or rivers left where only the native species exist. The spread of minnows through the Highlands over the last 40 years or so has been the main cause of this. They have recently spread into Wester Ross where they have displaced trout juveniles from loch shores and have now reached the Outer Hebrides, so even the islands can no longer be considered as safe for our native fish community.

One of the huge environmental problems with non-native fish is that once they are into a water system it is almost impossible to remove them and therefore any damage is irreversible.

The extinction of Scotland's native fish community would not only be a loss to the natural identity of this country, it would be a loss to the biodiversity of Europe as a whole.

4. Fisheries Management: The Basics

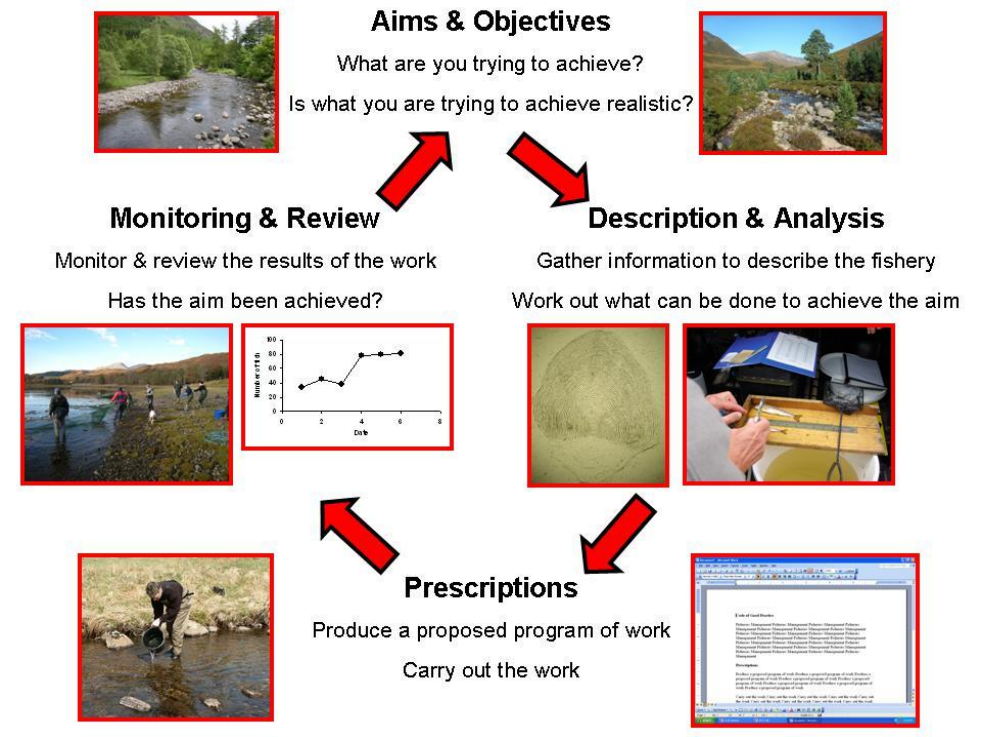
4.1 The Importance of Planning

The production of a plan for the management of any fishery is the essential first step. Making one ensures that the necessary data is collected, analysed and thought about so that the actions resulting from the plan are realistic and directed towards the most important issues.

This can be a major process, for example when a Fisheries Trust produces a regional Fishery Management Plan, or a relatively simple operation, when a plan for the management of a small stillwater fishery is made. However, the principles remain the same.

The diagram below outlines the thought process that leads from gathering information / describing the fishery, through to the production of work programmes and then monitoring to ensure that the aims of the plan are achieved. It also emphasises how the evidence and experience gained during management work feed back into the process to give continuous improvements to the system.

Figure 4.1.1: Fishery Management Planning Cycle



4.2 Getting Started

As with any other sort of management, fisheries management is about (A) finding out where you are, then (B) defining where you want to be. Once you know this you can start making a workable plan to get you from A to B. Following the guide below will let you define A and B for your fishery and then help you work out your plan.

Different situations require different sorts of management, which is why it is so important to work out where you are starting from.

Where your starting point is poor, more intensive and expensive sorts of management are needed, but if you are starting out in a good situation, you may need to do very little and simply concentrate on protecting what you have got.

Getting this wrong, and using expensive management techniques (e.g. stocking) in situations that do not need it is a complete waste of resources and may well do biological damage.

4.3 Carrying Capacity

A basic understanding of carrying capacity is fundamental to good fisheries management. In its simplest terms the carrying capacity for fish in a stretch of river or in a loch is the number of fish that can naturally live there. This can be high or low depending on the quality of the habitat.

It is very important to understand that in some situations the carrying capacity is naturally low and that the resulting low numbers of fish are not therefore reflecting any “problem”, just the limitations of the habitat. If this is not understood, a lot of time and money can be wasted in trying to create a fish population that cannot be supported by its habitat.
Most anglers and fishery proprietors would like to increase the number of fish that are available to be caught, and one of the most obvious ways to do this might appear to be to stock more fish. However, if the number of fish already present is the maximum number the water can support naturally, introducing more fish can actually have negative consequences.

So what can a fishery manager do to increase fish populations? If a population is at carrying capacity, one answer is to try and increase the carrying capacity by improving the habitat, thus allowing more fish to survive naturally; this sounds simple and in the case of certain fish species in certain locations, it is – but it can be expensive.

Brown trout, for example, have been well studied and their habitat preferences are well understood. If a river section has been badly managed, so that much of the bank-side vegetation has been removed and the bed has been dredged regularly then the carrying capacity will be very low. Stocking fish into this area will have little effect as the introduced fish will find no protective in-stream or bank side cover and little food. They will quickly move away in an attempt to find better conditions - assuming they do not get immediately eaten by predators. If, however, you can restore a diversity of stream types – pools / glides / runs / riffles - and improve bankside vegetation by planting or by removing / reducing grazing pressure then the carrying capacity of your stretch of river will go up. As long as there are brown trout reproducing upstream or downstream they will then re-colonise the river naturally and “restocking” will probably not be necessary at all.

4.4 The Importance of Environment

Fish are the products of their environment –

- The richness of its feeding.
- The average temperature of its waters. Fish are cold blooded, so the temperature of the water has huge effects on their growth and productivity.

- The aquatic vegetation.
- The quality and quantity of its water. A reduction in the quality or quantity of water will affect the natural fish stocks.
- The state of the river and stream channels that the water flows in.
- The general land-use in the catchment of a river or loch. This can have major effects on fish through silt levels, acidification, fertiliser run-off etc.

So understanding the environment in which your fish live is essential if you are to understand your fish and their problems – and strengths.

4.5 The Genetic Structure of your Stocks

After the last Ice Age, salmon and trout re-colonised Scottish rivers. The stocks in different rivers are now known to be genetically distinctive reflecting the fact that salmon and trout survived the Ice Age in several different places to the south and east, so re-colonisation to the north and west could come from different sources and our stocks still reflect this. There has also been long-term adaptation to local conditions since re-colonisation, adding a further source of difference.

A key point about both trout and salmon is that they (mostly) return to where they came from to breed, so are more likely to mate with a relative in some degree than with a complete stranger. As the ones that survive to breed are the ones that did best as juveniles in their nursery areas, any useful adaptations they had to local conditions will be conserved and passed on to the next generation

Recent research has shown that crossing different stocks of salmon (even from neighbouring rivers) produces “hybrid” young that are not as fit as either of their parent stocks and so producing such hybrids (if they survive at all) damages productivity. This is called “Outbreeding Depression”. These hybrid juveniles fail because they do not have the local adaptations that help the young of natural breeding to survive in their local nursery areas.

Introducing fish from different areas in a catchment, or mixing and interbreeding of farmed salmon and trout with wild fish, can also be damaging to wild stocks.

4.6 The State of your Nursery Areas

Healthy stocks of fish can only come from healthy spawning and nursery areas, which means much more than simply having a good chemical quality of water.

The physical forms and shapes of streams and rivers are crucial. Larger fish need deeper water but young fry need shallower areas. Therefore the ratio and mix of stream types, of pools, glides, runs and riffles, is vital if every life-cycle stage is to find enough of the right conditions.

Overgrazing weakens and destroys the bank-side turf that separates soils from flood waters and so accelerates bank erosion. This in turn makes streams become wider and shallower and therefore less suitable for older fish and for young fish during spates and droughts.

Over shading by dense trees kills off bank side vegetation and so has the same effect as overgrazing.

Even the best quality of habitat is useless to fish if they cannot reach it to spawn. Because of this, clear access to spawning grounds is actually more important for management than habitat quality. A large area of poor quality habitat can still produce more fish than a small area of high quality.

4.7 The State of your Juvenile Stocks

Big fish come from little fish, so monitoring the abundance of juveniles in your nursery areas is necessary to show how well the spawning areas are being filled with young.

Poorer numbers in particular areas also serve to indicate where there can be access problems or where habitat restoration may be required.

Knowledge of how the abundance of juveniles varies from area to area is necessary if those that need restoration are to be distinguished from those that do not, or are just naturally poor.

The level of predation on juvenile fish also needs to be monitored, particularly on the older stages (the one and two year old fish) as these are the survivors that are most likely to contribute to adult stocks.

For example, salmon smolts are the “end-product” of up to three years of freshwater life, so any losses to predation at this stage are irrecoverable and will result in fewer adult salmon returning to the river.

4.8 Your Catch Records and History

Historic records show how the sizes and run timings of fish vary over the years and give the essential background for assessing today's situation. This knowledge of trends and cycles in catches allows annual figures to be judged in a much wider and more balanced way.

Establishing long term trends shows if there are any large-scale changes or cycles underway. These cannot be countered, though they can be managed. Variation outside known ranges from the past could be a warning sign of problems.

There is a need to consider the historical changes in both fishing practices and effort and the usefulness of Catch per Unit Effort (CPUE) when comparing catches between years and fisheries.

CPUE is the number of fish caught by an angler per hour or per day. However it should also be remembered that CPUE does not take into account angler expertise, weather conditions etc, and therefore need to be used with care.

4.9 The Exploitation Rates of your Stocks

This is the proportion of your stock that is being caught. Knowing whether your catches represent 50% of your fish or 5% is crucial in order to understand your situation and get your management right.

For example, if more breeding fish are needed for spawning, then reducing losses to fishing is a very effective (and cheap and easy) way of providing them. Catch and release allows angling without reducing the number of fish for spawning and is therefore the best policy where little is known about the strength of fish stocks or it is suspected that stocks are having problems.

With this aim, netsmen have delayed the start of their season by six weeks to protect the spring salmon which is the component of the salmon stock under most pressure and in several districts they also release salmon but take the sea-trout till the end of the spring salmon run. Catch and release is also now common with trout fishermen as well.

4.10 Enforcement

One of the most important aspects of fishery management is to protect the fish stocks from illegal or uncontrolled exploitation. This is particularly so with salmon and sea trout where protecting them from poaching both in coastal waters and in freshwater is essential to maximise the number of fish surviving to spawn.

Bailiffs are normally appointed by District Salmon Fishery Boards and their role is to enforce salmon fisheries legislation in Scotland. Many of the bailiff's powers are similar to those of the police in that they have, for example, the power of arrest, entry, seizure and search. Bailiffs are issued with a formal warrant card but first have to pass the Institute of Fisheries Management (Scottish Branch) training module in fisheries law. They also undertake continuing professional training throughout their employment. Again, much of this is organised by the Institute of Fisheries Management (Scottish Branch).

If an area is covered by a Protection Order, the owners of the fishing rights are allowed to nominate a **Warden** and these are then appointed by the Government. However, the Warden's powers are far more restricted than those of a Bailiff and only strictly relate to the provisions of the Protection Order and freshwater fish (not salmon and sea trout). They have no powers in relation to any other prohibitions or offences. For example, whilst they have the power to enter land this does not include property and although they can seize equipment used in a possible offence relating to the Protection Order they do not have the power of arrest.

Many bailiffs also carry out significant and very important fisheries management work such as surveys, removing blockages, etc. They are also extremely important as the 'eyes and ears' on the river, as they are often the first to notice problems on the river, as they carry out their patrols.

4.11 Invasive Non Native Species (INNS) and Bio-security

Bio-security is one of the biggest problems facing fisheries and fisheries managers in Scotland today. Invasive non-native species (INNS) are those that have been transported outside of their natural range and that damage our environment, the economy, our health or the way we live. Fishery managers should be aware of these issues and take appropriate precautions.

The main issues for fishery managers are:

- Unintended introductions, including "hitch hiking" (when a species is introduced accidentally as a by-product of another intended introduction) or escapes (when an introduced species escapes to a neighbouring watercourse from a supposedly bio-secure water).
- Alien species, such as signal crayfish, Australian stonecrop or zebra mussels, which can have devastating effects on the aquatic environment.
- Disease and parasites, such as *Gyrodactylus salaris* (Gs) which could wipe out the salmon fisheries of Scotland.
- Deliberate introductions by people breaking the law to create fisheries of species that they personally happen to like, regardless of the impact this will have on resident fish species or other wildlife.

Bio-security plans are being developed within the Fisheries Trust network of Scotland. These plans, viewable HERE, feature three key elements:

- Prevention.
- Early detection, surveillance, monitoring and rapid response.
- Mitigation, control and eradication.

As part of these plans, bio-security issues in the rivers and lochs of Scotland are considered in relation to the potential introduction and spread of a priority list of INNS and fish diseases.

INNS are seen as the second greatest threat to biodiversity and are capable of rapidly colonising a wide range of habitats and destroying the native flora and fauna. In fact, over the last 400 years INNS have contributed to 40% of the animal extinctions where the cause of extinction is known.

The threat from INNS is growing at an increasing rate, assisted by climate change, pollution and habitat disturbance. Many countries, including Scotland, are now facing complex and costly problems associated with invasive species.

There is also a growing recognition of the impacts of trans-located species. These are native species that have been transported outside of their natural range and they can also have severe ecological impacts.

Bio-security plans are the first step to try and control this problem at a local level. These local plans are part of a strategic and coordinated approach to INNS management being undertaken across Scotland.

5. SALMON

5.1 The Basics

The Atlantic salmon is an Arctic fish that comes south to find rivers that do not freeze solid in winter in which to breed. In Europe, their natural breeding range is from Portugal to northern Russia and they were once found in every suitable river between, migrating inland as far as Switzerland to breed. Many populations were destroyed from the mid 18th century onwards by pollution, over-fishing and the building of dams and weirs.

All that salmon need to breed successfully is clean water, clean gravel and a free run upriver. When these conditions have been restored the salmon has returned to many rivers from which it had been wiped out. In many cases they have done this naturally, without artificial stocking with the most recent examples being their return to the river Mersey in England and the river Seine in France.

5.2 Terminology & Life Cycle

Alevin	**Fry**	**Parr**
This is the stage that emerges from the egg, with an "egg sac" attached to it to provide it with food. They remain lying in the gravel for about a month after hatching out of the egg.	Fry are the first free-moving and feeding stage of the live cycle. In established populations huge numbers hatch, far beyond the carrying capacity of streams so about 90% die in the first three months due to competition for food and space.	After their first winter in the river, fry become "one year old parr" (I+) and later II+ parr and even III+ parr. As conditions warm, III+ parr are becoming rarer as more and more migrate after just one winter in the river.
Smolt	**Grilse**	**Salmon**
A smolt is the stage that becomes silvery and leaves the river to go down to the sea. Typically 12cms long and two years old: some are one year old and some three.	A grilse is a fish that returns to freshwater after just one winter at sea. Called a "One Sea Winter" fish or "1SW".	A salmon is a fish that spends more than one winter at sea. Called a "Multi-Sea-Winter" fish or "MSW". Depending on the number of winters spent at sea, these are abbreviated as 2SW, 3SW etc.
Growth patterns in the scales: As fish increase in size so do their scales. As growth is faster in warmer, summer conditions than in the winter, the growth rings on scales (just like those in trees) are further apart in summer than in winter. This means the number of seasons a fish has lived through can be read from its scales so the run a salmon belongs to can be found:		
Spring fish	**Summer fish**	**Autumn fish**
These have narrow, winter, growth rings at the edge of their scales, showing they had left their feeding grounds and started their migration in winter. In Scotland, they return to their rivers from November to June but do not spawn till the following autumn. They are all MSW fish.	Summer fish have wide, summer, growth rings at the edge of their scales as they leave the feeding grounds in summer. They return to Scottish rivers from May to September and can be either MSW or 1SW fish.	Autumn fish have narrow, winter-growth rings at the edge of their scales as they leave their feeding grounds when their growth has started to slow down as the next winter approaches. They return to their rivers from September to January and can be either 1SW or MSW fish.

5.3 The Salmon at Sea

A fundamental difference between a salmon/sea trout fishery and a non-migratory wild trout fishery is that its strength is highly dependent upon survival in the marine environment. Another difference between salmon and trout fisheries is that major salmon fisheries are often on the lower zones of rivers while most salmon production can be in the upper zones and tributaries. In large rivers, the same may also be true of brown trout, the best fisheries being in the lower river, while most breeding is in the tributaries and upper river.

There is little that fishery managers can do to influence survival at sea, although governments may be able to influence this through national and international agreements. However, many factors affect the marine survival of salmon and some, such as climate change, could be even more significant

The main thing that has driven the salmon catch over the last 50 years has been the huge reduction in the return rate of smolts. In 1964-68 (the first period for which data are available) 1 in 4, and sometimes 1 in 2 smolts, returned to home waters as adults. In comparison today's return rate may be as low as 1 in 20. There are no similar data for sea trout.

In terms of numbers this means that in the 1960s, 100,000 smolts would produce more than 25,000 adults back to home waters. Today the return from the same number of smolts will probably be less than 5,000 fish, however, managers should be very careful about taking the 1960s as their main reference date. There is evidence that this period was one of particular abundance in the marine environment for a number of fish species and not just salmon. This can be seen from longer term records extending back to the eighteenth century.

5.4 Salmon breeding

Even such a huge reduction in returning adults does not mean there will necessarily be a reduction in the number of smolts produced for the next generation, so long as a river's carrying capacity for eggs is met and juvenile deaths do not significantly increase.

Salmon produce huge numbers of eggs (rule of thumb: 200 x 8lb females = 1 million eggs), so adult stocks have to be very low before the number of juveniles they produce are also low. This means that a stock can be biologically sustainable even when the numbers of adults are well below what is needed to sustain fisheries for either anglers or netsmen.

That this is not understood by many people is clear from any reading of letters (and many articles) in the general media and angling press. This misunderstanding then leads to a demand for the artificial stocking of rivers whenever catches fall even slightly because it is thought that every drop in adult numbers means that there is unused space for juveniles that needs to be filled with stocking.

If female salmon had only 5 or 10 eggs each, then this would indeed be the situation as a lot of females would be needed to produce a lot of young. However, female salmon have thousands of eggs each so only a few hundred produce millions of young. This makes the relationship between numbers of spawning adults and numbers of juveniles in the next generation very indirect. It is only when numbers of spawning fish are at extremely low levels that egg number limits smolt production.

As said above there are two very different levels for “good” stocks, the angling/netting level and the biological/breeding level. Even though the numbers of adult salmon may fall below what is wanted for the first, the second level can still be greatly exceeded.

Stocking in response to a decline from the first level does not make sense while the second level is still being exceeded as the biological/breeding stock requirement is still being met.

It is only when the number of adults falls below the number needed for the lower, biological/breeding, level that empty space in the nursery areas will start to appear, creating places for stocked eggs or fry to be put in.

If those eggs or fry have first been taken out of a river that is at or below this lower, biological, level, just putting them back into the same river makes little sense. In fact there is a huge amount of evidence that hatchery produced fry do worse in the wild than naturally hatched fry so the effect of such stocking may actually even reduce the total number of juveniles in a river.

However it should always be remembered that the management of a salmon river is not simply about ensuring the biological minimum number of spawning fish need to maintain future generations. It is true that only a certain minimum number of returning adult fish are needed to maintain the next generation but a significant surplus above this will be needed to give good angling catches, as well as allowing for natural disasters or further changes in the survival rate at sea.

This is one of the major reasons that "catch and release" is such an important tool in salmon fisheries management. It makes sure that angling alone will not reduce the numbers of spawning fish to below the level needed, though other factors might do this. Where there is uncertainty over the state of a stock, it is also a good precautionary measure to take in the absence of hard information.

5.5 Maximising and Protecting Juvenile Salmon

The best way of maximising salmon production in a river is by opening up as much of a catchment as possible through effective fish passes or the removal of redundant obstacles such as unused weirs, caulds, culverts, fords etc. or natural / semi-natural timber jams, and then restoring habitats damaged by over-grazing or over-shading. The production achieved also has to be protected from predators - a salmon smolt is the product of one to four years of freshwater life but if it fails to get to the sea, it is wasted.

Downstream migration can be delayed or even halted at weirs and caulds by low water – too little water over the crest gives the smolt no way over them. Predatory fish and birds also get more chances to catch smolts when they are delayed on their migration. It is known that very high proportions of smolts can be lost if they have to migrate through large lochs or reservoirs that have predatory fish in them.

Similarly, delays to upstream migration at barriers gives predators, including poachers, more chance of taking fish. Water abstraction can also create barriers to migration by reducing flows in sections of river to levels that fish cannot pass through. Pollution too, can make barriers to fish migration and if an estuary is polluted, it can endanger the survival of the whole population.

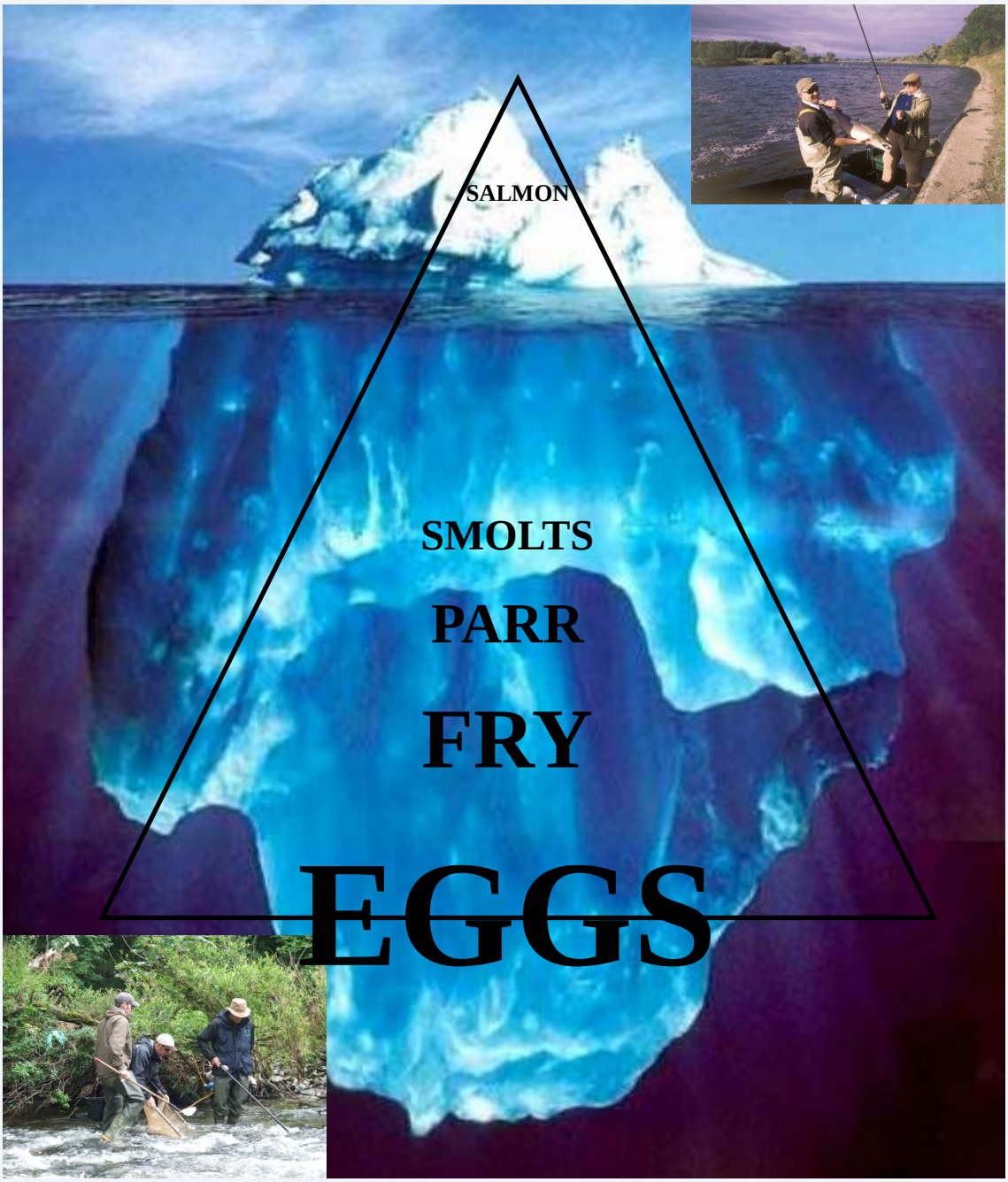
Barriers do not have to stop fish completely to be a problem, delays can have major impacts – and a series of barriers can cause a cumulative series of delays greatly increasing the chances of predators and poachers. The more delayed a fish is, the less far in to the spawning channels it will be able to go before spawning, so nursery area goes unused.

5.6 Salmon from Different Viewpoints

There is a source of confusion between anglers and salmon managers in the different parts of the salmon population that they see.

Anglers see the adults which are, in fact, only the very tip of the population pyramid. Fishery managers see the bottom of this pyramid, the broad base of eggs and fry – at any one time, over 90% of the Atlantic salmon alive in the world are under 12cms in length.

For anglers therefore, salmon are rare fish. For fishery managers salmon are the dominant and most abundant fish in their rivers.



5.7 Salmon “Ranching” - Desirable in Scotland?

The very different numbers of fish needed for breeding (low) and for commercial / angling purposes (high) raise the question as to whether it is possible to stock for purely angling/commercial purposes when there is no need for it in biological/breeding terms.

Stocking for such commercial purposes would have to depend on rearing to the smolt stage in hatcheries or in some other way outside the river - a system which is often called “smolt ranching” - as the river itself will be filled by natural spawning.

It would also be essential to keep the stock used for such a commercial operation completely separate from the natural, biological, stock. Hatchery reared smolts experience very different living conditions from those that grow up in a river. Natural smolts have undergone natural selection, so they are best suited to survive their local conditions. Hatchery smolts are unnaturally selected to survive in hatchery conditions and if they return and breed with natural fish, the result will be a part hatchery, part wild hybrid which is less fit for life in the wild than a purely wild fish. Such interbreeding reduces the success of breeding in the river, something that needs to be completely avoided.

This means that ranching of smolts for such commercial purposes either has to be done in rivers where there are no natural salmon at all (as in Iceland, where some rivers have no natural breeding) or where they can be completely removed to prevent them breeding in the wild.

At Burrishoole in the West of Ireland, for example, a ranched stock runs alongside a wild one, but there is a fish trap on the lower river which removes all the returning ranched fish (which are marked). The broodstock are only taken from ranched fish and over the years, the return rate of this ranched stock has improved as it has evolved to fit both hatchery conditions and marine life.

In any commercial Scottish salmon river however, the ranched fish could only be removed somewhere in the upper part of a river, because the angling beats below would have to have a chance catch them as they passed upstream This is where there would be a problem – how could it be certain that that all ranched fish did get removed and stopped from interbreeding with local stocks?

This is a key point as Scotland has a much greater diversity of salmon stocks than elsewhere. Here we have spring, summer and autumn salmon and also summer and autumn grilse giving us fishing seasons of nine or ten months – very different from the 90 day long season of Iceland, based almost entirely on grilse. Conserving the diversity of our stocks is therefore a key issue for us and as yet there is no way of producing fish of different stocks in hatcheries.

A very high proportion of the returning ranched fish would also have to be caught, as it is this that determines the success of such an operation. If 1 out of every 2 returning ranched fish is caught, then a lot fewer smolts are needed than if only 1 out of every 10 returning fish is caught. It should also be remembered that ranched fish are 10 times less likely to survive at sea than wild smolts. This makes a huge difference to costs.

In Scotland, only 10% - 20% wild summer or autumn fish are actually caught by anglers and this would be the same for ranched adults. There would therefore be huge economic waste as well as a biological danger from the uncaught fish cross-breeding with the wild fish.

In Iceland, very high catch rates of up to 50% are produced by releasing smolts from sites along the course of rather short rivers. As the returning fish do not generally pass upstream of their release

sites they remain in the angling areas. Arranging such release sites along a large river but then being able to catch and remove **all** the ranched fish so that they did not interbreed with the native stocks would not be possible.

Given that the major salmon rivers of Scotland are now European Special Areas of Conservation for Atlantic salmon, any move to start ranching salmon in them for angling purposes would create conflict. At present salmon management in these rivers is for the purposes of maintaining wild stocks, which matches their conservation requirements. A change from this towards ranching factory-reared salmon simply to produce larger numbers of fish for anglers would conflict with their conservation status.

6. Salmon Management Planning

6.1 The Starting Point - What State is your Salmon Fishery in Now?

The next sections form a check list of the information needed to work out your starting point. If you do not have the information, ask your local Fisheries Trust. Obviously, a fishery for migratory fish like salmon cannot simply be managed for a single beat, it has to be a collaboration with all the other fisheries of a river system.

6.2 Climate / Environment and General Information

- Are there long-term changes in your local climate that could be having an impact on your fish stocks and / or fishery?
- Are there alien invasive species in your river / loch or on its banks that could be impacting on your fish and fishery? A Bio-security Plan will exist for your local area listing such species present.
- Are there pollution / acidification problems in your area?
- How far upstream is your fishery? The further upstream, the fewer fish will be heading there and the later in the season they are likely to arrive. This will limit the potential of your fishery.
- Have there been any recent physical changes to the water course such as the construction of dams, fish passes or the abstraction of water?

6.3 Nature and Strength of your Stocks

- Has there been genetic analysis of the salmon stocks in your area?
- What runs of salmon do you have? Assessments have to be made for each stock in your river, spring, summer and autumn.

- How many eggs are deposited by salmon in your river? A very crude overall estimate can be made from the catch totals of a river. Assuming 10 % of the stock is caught by anglers the total stock can be calculated, and if half of this is female and the average number of eggs is taken as around 4,000 per female, then the total number of eggs laid in the catchment can be estimated. For example a river with a catch of 5,000 fish would have a spawning stock of 45,000 fish, of which 22,500 would be females, giving 88 million eggs. However, some runs will be stronger than others so this sort of estimate really needs to be done for spring, summer and autumn catches separately using appropriate data for each type.
- What proportion of salmon caught are released? Catch and release can have a significant role to play in increasing spawning stock.

6.4 Smolt Production

- Are the nursery areas for salmon of your river being surveyed and monitored?
- Have problems been identified in these nursery areas? There are a range of these that could be reducing juvenile production / survival in your river, with different solutions / mitigations for each. For example -

  Access for spawning fish
  Acidification
  Siltation
  Flow regulation / abstraction
  Nutrient status (impoverished or polluted)
  Degraded or damaged habitat

- What is the level of predation on salmon juveniles in your catchment?. It should be remembered that predation of salmon smolts can be critical as they represent the result of 1 to 4 years of freshwater life and are irreplaceable. For example in very dry springs you may lose more than 50% of the smolt run to predators in systems where there are many weirs or reservoirs.
- Is there salmon stocking in your catchment and if so, does the programme comply with current ASFB and RAFTS guidelines? In particular, are they marked or genetically typed? Doing this will let you find out how many of your stocked fish are actually caught compared to the numbers of wild fish. This will let you make more precise decisions about stocking in future and whether it is economically beneficial.

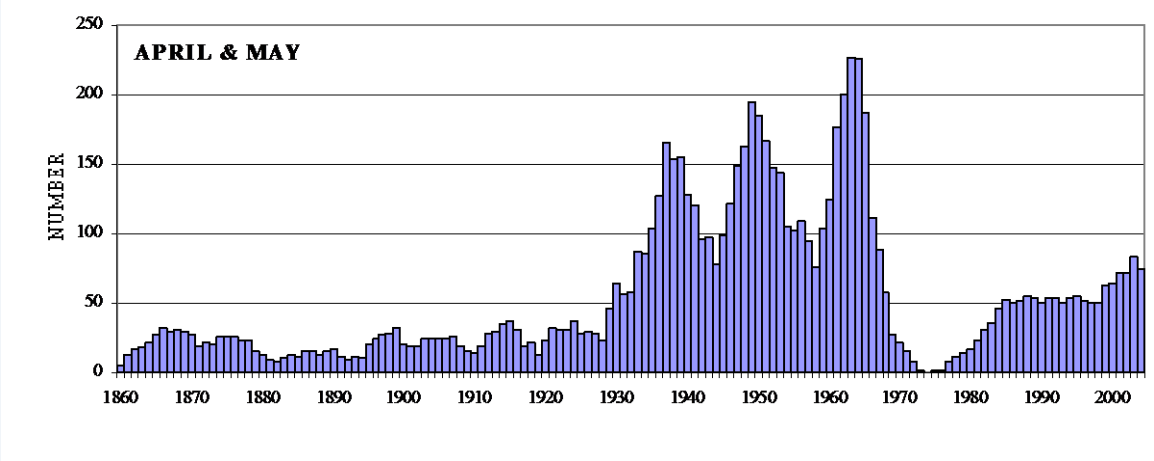
6.5 Fishery Records and Performance

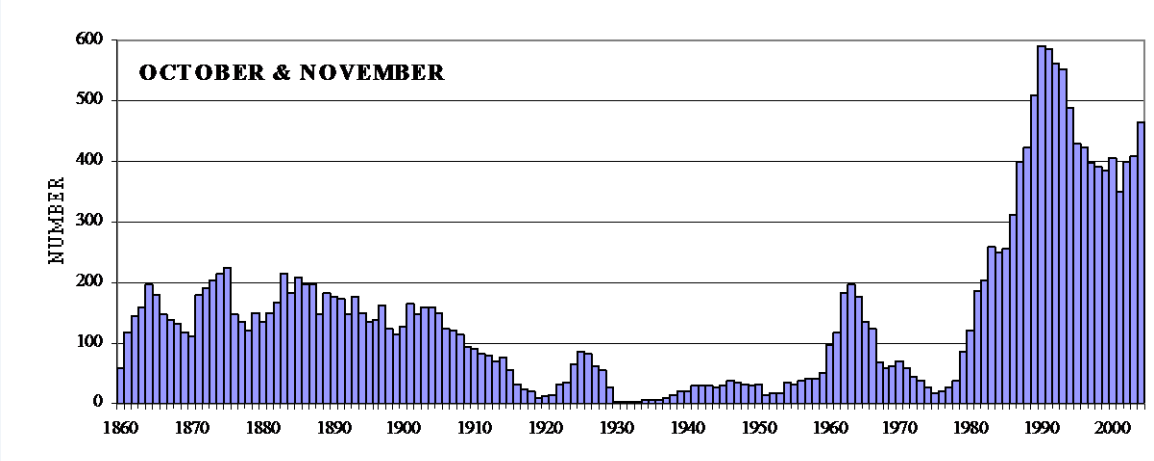
Good catch records show what the present and recent past has been like for salmon fishing in your water. Check them to see if:

- Catches are staying much the same for all the runs?
- Catches are falling, either overall or for some of the runs?
- Catches are increasing, either overall or for some of your runs?
- Catch levels are associated with conditions such as wet or dry fishing seasons?
- What is the normal variability of your catches in terms of numbers and time of the season at which they are caught?

There can be long term changes in the nature of salmon runs which salmon managers need to be aware of so that they do not mistake them for an immediate problem. If you have long term catch records, check them to see if catches were much different fifty or more years ago, either in timing or in seasonal numbers? Timing of main runs can vary greatly over the years and should not be expected to remain the same, as is shown below by two graphs of salmon catches from beats on the lower Tweed over the period 1860-2006.

Graph 6.5.1





There was a major change in salmon run timing just after the start of the 20th century when the majority started returning in spring. October / November catches fell while those of April/May increased. This was reversed around 1970, when the main run became an autumn one again.

Another change is not directly apparent from these graphs. Before 1920, most autumn catches were of multi-sea-winter salmon of 12lbs or more with fish of 20lbs or larger being common. After 1970, most autumn catches were of much smaller grilse. However, having a shorter life-cycle means that more survive at sea and this is one of the reasons for the increase in autumn catches.

There is always a need for caution here as salmon runs do not necessarily conform to the fishing season. Changes in the timing of runs could bias estimates of annual stock abundance based solely on catch data if many fish return outside of the fishing season.

When analysing catch records, you need to be aware of the factors that can affect them:

- Have the fishing methods or efforts changed? For example, has prawning or worming been banned?
- Have holding pools been lost due to gravel movements?
- Has there been a change in flow patterns due to changes in rainfall patterns or river regulation?
- Is there salmon farming in your area?
- Has there been greatly increased fishing pressure downstream of your fishery?
- Has there been large scale drainage or forestry upstream?
- Have there been any changes to the dates of the fishing season?
- Have the net fisheries in your district remained active?

6.6 Stock Monitoring and Strength

- What are the exploitation rates (the proportions of the assumed number of salmon that are available to the rod and line or net fisheries that are removed by each method) on your river? This is very important data as it shows the pressure being put on the stock by fishing. However, if catch and release predominates, knowing the angling exploitation rate is less critical than it was in the past.
- Are there fish counters on your river? Counter information can be a more reliable indicator of stock strength than angling catches as it is not affected by fishing conditions, season dates etc. If there is angling upstream of a counter on your river, you can work out the exploitation rate there from the numbers caught compared to the numbers counted.
- Are enough of the salmon in your river escaping capture by whatever means to maintain the fishery? This is called the "Minimum Spawning Requirement" and has to be met for each stock component (spring, summer, autumn salmon and grilse) both for a fishery to survive and to keep the conservation value of a salmon population.

Answering the above questions will let you see where your fishery is located on the grid below and therefore where you are starting from: tick the boxes that best describe your fishery and see in which column most of your answers fall. Your starting point will be the title of that column. If any of

this information is not available, then setting up systems or surveys to get it will be part of your first management plan.

Table 6.6.1: Scoring the Starting Condition of your Salmon River and Fishery

FINDING OUT YOUR STARTING POINTS:					
Starting points	**Extinct**	**Poor**	**Moderate**	**Good**	**Full capacity**
Environment	May be perfect but no fish for other reasons (e.g. pollution in the estuary).	Many water quality and quantity problems. Large alien species populations.	A few water quality and quantity problems. Some populations of alien species.	Almost no water quality or quantity problems, Only a few, small, alien species populations, if any.	No water quality or quantity problems. No alien species.
Stocks	None.	Heavy stocking with alien strains or mixing up of local strains.. Wild egg production low.	Some stocking with alien strains and mixing up of local strains. Sufficient wild egg production.	No recent history of stocking with alien strains or mixing of local strains. High wild egg production.	No history of stocking with alien strains or mixing up of local strains. High wild egg production.
Habitat	Habitat may be perfect but no fish for other reasons e.g. pollution in the estuary.	Many empty areas due to access problems / Many areas of degraded habitat. Other problems extensive.	Only a few, minor, access problems. Only a few areas of degraded habitat. Few other problems and only local in extent.	Almost no access problems. Almost no areas of degraded habitat. No other the problems.	No access problems. No areas of degraded habitat. No problems.
Juveniles	None.	Low number of juveniles everywhere that is accessible.	Most areas with good numbers, only a few with poor.	Almost all nursery areas with good numbers of juveniles.	All nursery areas with high numbers of juveniles.
Catches	None.	Only a few fish – but enough fishing effort to show this is actually the case.	Catches much the same over the years.	Catches increasing slightly over the years.	Long term and continuing high catches.
Stocks	None	High exploitation rate, taking more than 50%. Low counts of fish.	Exploitation rate around 25%. Adequate numbers of fish counted, some poorer years.	Exploitation rate 10-25%. Good counts of fish at counters. Occasional poor years.	Low exploitation rate, taking less than 10%. Consistently good counts of fish at counters.
Fish counts	None	Minimum spawning requirement not being met above any counters.	Minimum spawning escapement almost always being met at all counters.	Minimum spawning escapement always being met at all counters.	Minimum spawning requirement always well exceeded at all counters.

6.7 What would I like my salmon fishery to be like? Setting your objective.

6.8 What potential does it have?

What is your catchment like? This will determine the production of smolts and therefore the potential catches for your fishery. All rivers are not equal, and some are much better than others at producing salmon. If your river has low potential, this is not something that can be changed.

- **Size of river**: Is your river large with a lot of tributaries and spawning burns (e.g. most Scottish east coast rivers), a short, steep river with only a few spawning burns (e.g. most Scottish west coast rivers), or something in between. The first type will have a lot of spawning potential while the second type will have a lot less.
- **Access to spawning**: Are there a lot of obstacles, either man made or natural?
- **Altitude:** Is there a lot of high ground in your catchment? What is the highest point in your catchment?
- **Habitat:** Is there a good mix of different habitat types in your river i.e. pools, runs and riffles or are there long stretches of the same type?
- **Water chemistry and flow**: What is its water chemistry (acid or alkaline)? Is the flow regulated? (e.g. by a hydro scheme) Is water abstracted? (e.g. for irrigation and drinking water) Are freshwater shrimps present? If they are, then your water is not very acidic
- **Substrate:** What proportion of different substrate types are present? Is the river largely bedrock and boulders or are there frequent areas of gravel, pebbles and cobbles?
- **Banksides and land use**: Are bankside trees and bushes present or is it largely bare? What is the catchment land use? Is it all moorland and mountain or are there significant amounts of arable and natural woodland or large areas of conifer plantations?

Table 6.8.1: Scoring the Potential of your Salmon River and Fishery

SALMON POTENTIAL >>>>	Low	Moderate	Good
Catchment size	Small, no or few tributaries.	Medium, some spawning tributaries.	Large, with many spawning tributaries.
Fish access: general	Many obstacles, both natural and man-made.	Some obstacles and fish passes.	No or few obstacles or fish passes.
Fish access: dams, reservoirs, lochs & predators	Many dams, reservoirs and lochs. If many have predators then they are additional problems .	Some reservoirs and lochs with predators.	Few reservoirs or lochs with predators.
Altitude	A lot of ground over 500m in the catchment.	Some areas of ground over 500m.	Little or no ground over 500m in the catchment.
Habitat	A lot of uniform habitat in the river.	Long stretches of uniform habitat but some variety.	Well mixed habitat: runs, pools and riffles almost everywhere.
Water chemistry & flow	Very acid.	Acid to neutral.	Neutral to slightly alkaline, only small zones of acid water.
Substrate	A lot of bedrock and boulders, little gravel.	Significant areas of bedrock & boulders but also good areas of gravel & cobble.	Little bedrock, a lot of gravel and cobbles.
Bankside & land use	Treeless and heavily grazed. A lot of bare rock / Conifer plantations. Little or no arable land.	Some heavily grazed areas and conifer plantations. Some arable land.	Well vegetated banks, some conifer plantations and a lot of arable land.

The answers to these questions can be easily listed or worked out and will show the potential and nature of your fishery. You can then consider whether your expectations for your fishery are reasonable or not.

6.9 Are the Anglers' Expectations for your Fishery Realistic?

Unhappy anglers are anglers whose expectations of their fishing have not been met – but were their expectations realistic? You therefore need to know:

- What do your salmon anglers consider is a good day's fishing? Have you ever asked your anglers what they consider this to be? An example of a questionnaire for finding out what anglers want & think is given in Appendix B
- Do you consider their expectations to be realistic? Check these against historic catch records, against the situation in neighbouring rivers and in your region generally. If

they are not realistic, your anglers should be made aware of this and the reasons why. Do you publish your catch statistics? If not, how do your anglers know what to expect when fishing your water?

- What do you consider a “good” season to be for your fishery? Why do you think this and what is your evidence for thinking this? Do your anglers have the same view of what a “good” season is as you do? If not, consider why this is so.
- Summarise how your anglers’ expectations differ from or match the present state of your fishery.
- If expectations match present reality, the management aim of your fishery should be to maintain the present situation. In such a situation, this means protecting the environment and fish stocks and continuing to maintain good records.
- If the expectations are unrealistic, then rather than try to force your fishery to be something it cannot be, inform your anglers of the realities of the situation.

6.10 How do I get from A to B?

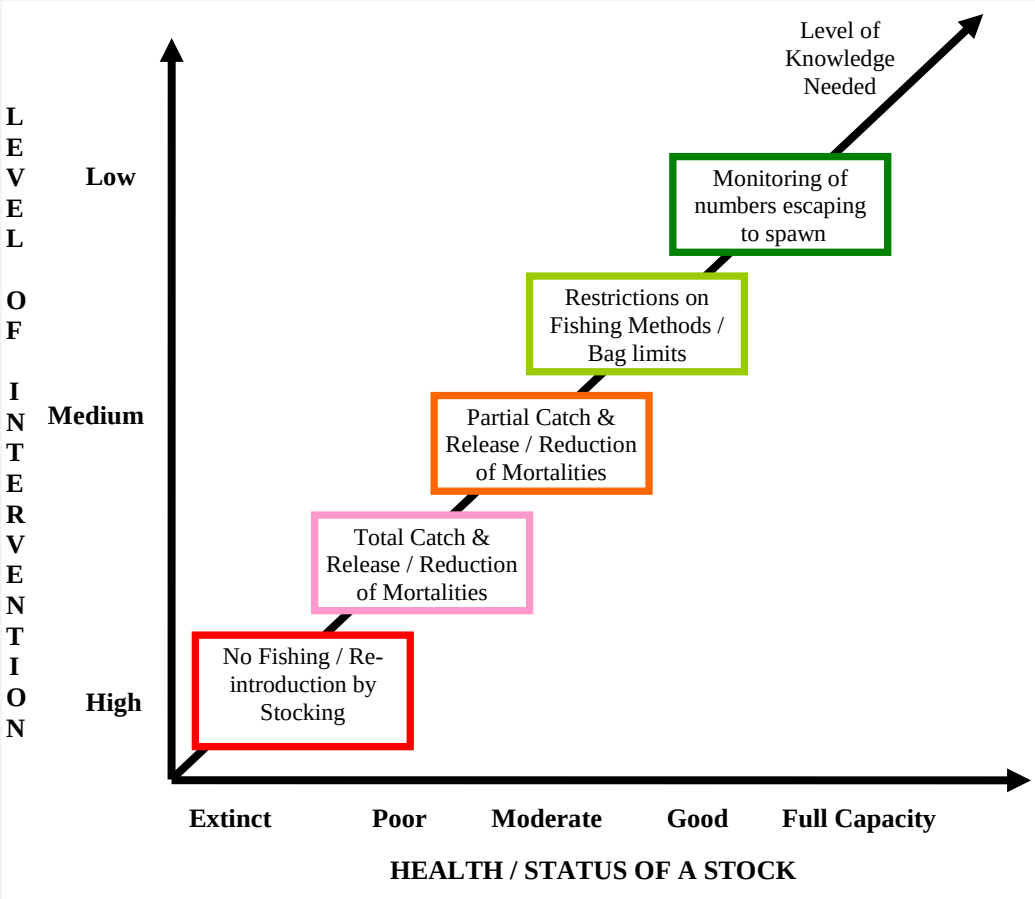
Once you have worked out where your salmon fishery is starting from and that there is potential for improvement, you can see what the appropriate stock management action for your river is from the diagram below.

The worse the situation, the more intervention (and expense) is needed. If a stock is extinct or at very low numbers, artificial stocking may be an appropriate management tool.

If the stock is in an intermediate condition, partial catch and release and / or changes to methods of fishing is the appropriate tool.

If your fishery is actually doing very well and has good stocks, the aim should be to keep it as it is, and that means having very good monitoring systems, both for adults and juveniles so that any changes can be detected quickly. The situation that gives you your good stocks is therefore known (in terms of juvenile numbers and distribution for example) so you will have a recovery target to aim at.

Diagram 6.10.1: The Management Levels for Salmon Rivers and their Fisheries



The plan should be to move from one situation to the next better, with the aim of being able to successively move from more intensive levels of management to less as the stocks get stronger.

It is important to use the right management tools for the right situation as mismatching can not only be expensive and useless, but may do actual harm.

If, for example, you have a stock in moderate condition, it is pointless spending money on stocking. The wild production of eggs will be in the millions and nothing a hatchery will do would be of any significance. It is now also known that hatchery produced fish are far less fit than wild produced

ones. Because of this, taking eggs out of a river, hatching them and then returning to the river is actually reducing the number of good-quality fry being produced by your stock.

It must always be remembered, however, that progress in rebuilding stocks can only be made once the original cause or causes that were depressing them have been sorted out.

Once the problems have been removed, the immense natural power of salmon reproduction will repair the stock. This is seen wherever fish re-colonise naturally after estuary pollution (e.g. the River Clyde and Northumberland Tyne) or physical access (e.g. the Whiteadder) problems are dealt with. If, however, there are no remaining native fish and the nearest other salmon rivers are far distant, artificial introduction will be needed to speed the process up.

The different policies in the diagram above are to ensure that angling does not delay (or reverse) this process. It should also be noted that the policies in the diagram are all to do with angling and stocks. This is because the habitat situation for different stock situations can be very variable, depending on what the problem is. If, for instance, the problem is pollution in the estuary that kills fish that try to get back up river or poorly managed or sited salmon farming that creates a mass of sea-lice which kills smolts, then river and stream habitat could well be perfect but the stock would still be very much reduced.

Only if poor habitat is wholly or partly the problem causing the reduction or limiting a stock will habitat restoration have any effect. If your stock is in good condition then, by definition, its habitat must also be in good condition. Your aim should be to keep it that way, perhaps by fencing river and stream banks to create buffer zones. Giving advice on specific habitat issues is beyond the scope of this Code and you will need to consult some of the manuals that are now available or obtain specialist advice.

It may be, however, that there are “blockers” on the progress you can make in management levels. These are problems that you cannot solve or are beyond your control such as dams, rivers or lochs with large populations of smolt eating predators, acidified spawning areas where eggs cannot hatch in the wild or badly located salmon farms off your coast, which infect your smolts with sea-lice so that few return as adults.

In these situations your management will not be able to get beyond Levels 1 or 2 and will have to remain intensive and expensive. Joint and concerted action with others suffering similar problems to make the Government or its agencies sort out these problems is your only real way forward in this sort of situation.

One of the functions of fisheries management is to produce better information through setting up systems to record and analyse data. Although your initial answers to the questions above may not have much information behind them (or you may not be able to answer some questions at all) this

will change over time as data is produced from the systems you establish as part of your fishery management or that you collect from your local Fisheries Trust.

7.

7. Brown Trout

7.1 The Basics

Young trout and salmon live in very similar environments and habitats, the difference being that trout (generally) spawn in smaller streams. The typical situation is of salmon spawning in the valley bottom streams while trout spawn in the tributary burns. As trout grow larger, most drop out of their burns and go to live in the deeper waters and some, of course, go to sea. Trout being smaller have fewer eggs, but the same points apply as for salmon: a relatively few adults can produce a lot of young.

The same factors and problems affect both young trout and salmon. Access for spawning adults is the key factor for trout as it is for salmon, but as trout use smaller burns and their value is not so well recognised, less has been (and is done) to keep their streams clear. As a general rule, every stream down to 50cms wide and not cut off by waterfalls should be regarded as a potential trout spawning burn unless proven otherwise. Track culverts are the great problem on such small streams and finding these and checking if they are barriers or not is a major part of any management for trout – too often the pipes are too small and block with debris / gravel or run too fast in spates. There is information available now on culverts and fish passage (e.g. in the Forests and Water Guidelines) that can be used to avoid such issues, but there is a long legacy of problems to be tackled throughout the country.

Sea trout are simply trout that go to sea to feed rather than stay in the river all their lives, which is what brown trout do. They are not different species, simply different lifestyles. Females are more likely to go to sea: in fact, in some trout populations, almost all the females go to sea whilst almost all the males stay behind as brown trout, meeting at spawning time to breed. Very generally though, about 70% of sea-trout are female – a female has to be big in order to have a lot of eggs but a male does not have to be in order to have a lot of milt (sperm). Therefore there is more value for a female to go to sea than for a male.

There has been much less research on trout than on salmon in Scotland and few trout populations have been thoroughly investigated. However, those that have been investigated have shown a wide range of characteristics. At spawning time, some runs can be made up of a few large female sea trout and a much larger number of small, male, brown trout while other runs can be 50:50 male and female brown trout, both reaching good sizes. Juvenile migration can be to the estuary and lower river as well as all the way to the sea and there are some records of trout moving widely through large river systems as well as of burn trout hardly moving from where they were spawned.

The biggest problem for trout management is that it is not possible to identify trout fry and parr as being either sea trout or brown trout and without knowing that, it is impossible to gauge the strength of either sort from electric-fishing surveys.

8. Trout Management Planning

8.1 The Starting Point – What State is your Trout Fishery in Now?

The next sections form a check list of the information needed to work out your starting point. If you do not have some of the information, ask your local Fisheries Trust.

8.2 Environment and General Information

Are there long-term changes in your local land use that could be having an impact on your fish stocks and / or fishery? Possibilities could be problems are:

- Large areas of conifer plantation. Newer plantations should be better designed than older and have track culverts installed according to the Forest & Water Guidelines. Older plantations will have trees planted right to stream edges, shading them heavily and culverts that can be barriers to fish. However, in acid soil areas, good design will not reduce the acidification problems caused by coniferous trees.
- Decrease in the liming of land (can be significant in acid areas).
- Large areas of wetland been drained.
- Increasingly heavy grazing grazing by sheep or by cattle (or, in some places, red deer).
- Are there alien invasive species in your river / loch or on its banks that could be impacting on your fish and fishery? A Bio-security plan will exist for your local area listing such species present.
- Are there pollution / acidification problems in your area?

8.3 Nature and strength of your stocks

- At what age and size do your female fish start to spawn? This is important information for setting your size limits. Trapping fish in spawning burns (*you will need legal authority to do this*) and / or scale reading will give this information. Scales can, with care, be taken from fish that are being released. Scales are designed to be lost by fish, it is a defence mechanism against predators that get a hold of them, so that they end up with a mouthful of scales rather than the fish.
- Are there sea trout spawning in your area? If so, many (or most) of your brown trout may actually be produced by sea-trout females. Because of the complex interaction of sea run and freshwater trout it is probably not possible to manage sea trout separately from brown trout. If sea trout are present, it means that many of the fry in your spawning burns will go to sea, effectively reducing the amount of nursery area that is producing brown trout for your fishery.
- Has there been a genetic analysis of the trout stocks in your area? Are they native or have they been replaced with an alien through years of stocking? Alien stocks may have inappropriate characteristics such as spawning at less suitable times of year than local stocks.

8.4 Juvenile production

- Are the nursery areas for trout of your river / loch being surveyed and monitored?
- If there are spawning burns that enter your loch or the part of a river where you have a fishery have you ever walked them to see what condition they are in and whether there are any blockages?
- Have problems been identified in these nursery areas? There are a range of these that could be reducing juvenile production/survival in your river. They will have different solutions for each problem. For example –
- Access problems for spawning fish. Brown trout spawn in very small burns so every road culvert can be a problem.
- Acidification.
- Inappropriate aquaculture practices in sea or freshwater.
- Siltation.
- Hydro-electric power generation.
- Pollution.
- Degraded or damaged bank side habitat.
- Predation.
- Inappropriate forestry and agricultural practices

The more of these problems that are present in your catchment and the more severe they are, the greater the difficulties for juvenile trout production.

Is there trout stocking on your river / loch and if so, are they marked? This is necessary to find out how many of your stocked fish are actually caught compared to the numbers of wild fish. This will let you make more precise decisions about stocking in future.

8.5 Fishery Records and Performance

Fisheries management depends upon being able to regulate fishing activities to enable the management of exploitation sustainably in relation to the fish stocks available.

- Is angling on your fishery well organised through permits etc or is there much uncontrolled fishing? Are there bag and size limits and how well are these observed?
- Do you have good catch recording so you actually know how your fishery is performing in terms of fish sizes (= ages) and the amount of angling time taken to catch them? Written records over five years at least are needed as memories are not reliable. Catch records usually give a good picture of the state of fish stocks.

If you do not have good catch records, a catch recording scheme for your fishery can be set up by following the examples given in Appendix A. Alternatively, the SFCC runs an online angling diary website (see HERE) on which anglers can keep a record of their fishing and catches (all species) which they can choose to keep private or to share. The site has been designed to help anglers increase the enjoyment and interest of their fishing by keeping their records, notes and photographs in a format that allows easy access. They can also use it to analyse their data to find out what their catch rates are or which methods give them most success, etc.

The data entered will be combined to give information on catch rates, fish sizes and so on for Scotland as a whole and its different regions and catchments. The biggest gap in fisheries management in Scotland is the lack of information on catches of fish other than salmon and this online diary scheme will be able to help fill that gap.

8.6 A Case Study of the Importance of Catch Records and their Context – The Lochs of Assynt

Accurate catch records for your fishery are very useful if sensible management decisions are to be taken. However it is also essential to look behind the figures otherwise big mistakes can be made. To illustrate this, a case study is presented looking at wild brown trout fisheries in West Sutherland.

In the mid 1980s the trout fisheries in Assynt appeared to be collapsing as evidenced by the catch records from the two local hotels. Fewer trout were being weighed in, and fewer anglers were fishing the vast variety of lochs in the area. However the average weight of the trout brought back to the hotels was increasing. A number of people put these facts together and came to the conclusion that the water quality was to blame and the fewer, larger fish being caught was apparently classic evidence of increasing acid conditions, caused by acid rain.

However following a two year investigation, there was no evidence of acidification; water quality and invertebrate populations were normal. The catch records from both hotels were examined in great detail - meticulous records going back to the 1870s. It was possible to break the records up into the most popular lochs visited and look at trends over more than a century.

The results were very interesting. It was not uncommon in the early 1900s for anglers to return to the hotel having fished one of the popular lochs with between 50 and 100 fish (sometimes more!), but the average weight was only 3 or 4 oz (100gm – 130 gm). In the period leading up to the investigation such lochs, if fished at all, would yield only half a dozen trout per visit but the average weight would be considerably higher. The picture was consistent across all the popular lochs in the area.

Having established there was nothing wrong with the water quality and the feeding for the trout, it was obvious that a thorough investigation of the facts behind the catch records was required. The following was discovered.

In the late Victorian era brown trout fishing in the Highlands was conducted in a very serious and rigorous way. The hotels provided experienced ghillies with one hotel once employing more than a dozen ghillies. The most popular lochs were fished by boat, with a gillie for between 6 and 8 hours a day. The anglers fishing tended to revisit the area every year and became expert in catching and, equally importantly, killing trout. In those days there was no regard to size limits, all fish caught were killed and returned to the hotel.

Contrast this situation with more modern times when anglers of vastly different experience and expertise fish the same waters without the local knowledge supplied either by a gillie and/or their own experience. Couple this with the fact that most fisheries impose a minimum size limit and therefore small trout are no longer killed and returned to the hotels.

As part of the study it was possible to work out for each loch the average size of the fish caught and how many it would be expected to catch in a day, and thus how many trout an averagely proficient fly fisher would catch per hour (this is known as the catch per unit effort – CPUE). It was decided to compare the Victorian CPUE and average size of trout with the situation a hundred years later at six of the most fished lochs by reproducing the Victorian fishing approach.

An angler who was seen to be “averagely proficient” fished in the Victorian manner and the results were illuminating. The CPUE and the average weights for each loch had not changed in over a century. In some lochs it could be expected to catch 4 trout an hour in others it was up to 10 trout per hour and the weights varied from 3oz to 8oz – but the conclusion was that the resource had not significantly changed since the beginning of last century.

The lesson from this is to be careful when using catch records as your only data when making future management decisions. If people had pressed on thinking there was an acid rain problem their management actions would have been potentially damaging and definitely a waste of money. As it turns out the wild trout populations of this part of West Sutherland are still in rude health.

Table 8.6.1: Scoring the Starting Condition of your Trout Fishery

FINDING OUT THE STARTING POINT FOR YOUR TROUT FISHERY				
Starting points >>>>	**Poor**	**Moderate**	**Good**	**Excellent**
Environment: Land-use	Large areas of old, badly designed plantations & track culverts. Large scale drainage & heavy grazing of banksides.	Many old-design plantations with problem culverts & much land drainage. Much heavy grazing of banksides.	More new than old plantations, no large scale, recent, land drainage. Grazing of banksides reduced by fencing or lower stock levels.	Little large scale coniferous plantation or all on non-acid soils and of modern design. No large scale (recent) land drainage. Banksides largely protected from grazing by fencing.
Environment: Aliens	Large alien species populations.	Some populations of alien species.	Only a few, small, alien species populations, if any.	No alien species.

Environment : Pollution, acidification & water abstraction	Many water quality and quantity problems.	A few water quality and quantity problems.	Almost no water quality or quantity problems,	No water quality or quantity problems.
Spawning age	Female fish are killed before they reach spawning size.	Some female fish are killed before reaching spawning size.	Females are not killed before they have spawned at least once.	
Sea-trout	*At present, too little is known about the relationship between brown trout and sea trout to say what the effect is of having a migratory option for trout, but the more fry go to sea, the fewer there will be to produce trout for your fishery*			
Genetics	Heavy stocking with alien strains or mixing up of local strains.. .	Some stocking with alien strains and mixing up of local strains. .	No recent history of stocking with alien strains or mixing of local strains.	No history of stocking with alien strains or mixing up of local strains.
Spawning access & other habitat factors	Many empty areas due to access problems / Many areas of degraded habitat. Other problems extensive.	Some access problems. Some areas of degraded habitat. A range of other adverse factors.	Almost no access problems. Almost no areas of degraded habitat. Few other problems.	No access problems. No areas of degraded habitat. No other problems .
Juveniles (*if no sea-trout access*)*	Low number of juveniles everywhere that is accessible.	Most areas with good numbers, only a few with poor.	Almost all nursery areas with good numbers of juveniles.	All nursery areas with high numbers of juveniles.
Organisation	The fishing is a free for all, with no controls.	Controls are in place but are often ignored.	Controls are usually observed.	Fishing is well organised, methods and bags are controlled.
Catch Records**	Only a few fish – but enough fishing effort to show this is actually the case.	Catches much the same over the years.	Catches stable or increasing slightly over the years.	Long term and continuing high catches.
* If sea trout do have access, it cannot be known if the juveniles in the spawning burns are from sea trout or brown trout females				
** If these are of wild fish only. Stocked fish should be marked so they can be identified as such.				

8.7 What would I like my trout fishery to be like? Setting your objective.

8.8 What potential does it have?

Answer the questions below and score them on the table to see what the potential of your fishery is:

Table 8.8.1

ASSESSING YOUR WILD TROUT LOCH FISHERY :

	Column A		Column B		Column C	
1 Water chemistry	Alkaline		Neutral		Acid	
2 Altitude	Low (0-250m)		Medium (250-400m)		High (over 400m)	
3 Water depth	Mainly shallow		Equal amounts		Mainly deep	
4 Low growing weed	A lot		Some		Very little	
5 High growing weed	A lot		Some		Very little	
6 Spawning burns	Just 1 or 2		Several		Lots / none	
***7* Freshwater shrimp**	Abundant		Some		Little or none	
8 Freshwater snails	Abundant		Some		Few, if any	
9 Bankside trees & bushes	25-50% of bank		10-25% of bank		None / completely shaded	
10 Predators	None / Some		Some		Abundant	

The more answers from Column A, the higher the potential of your fishery (i.e. the more chance of good numbers of fast growing fish).

The more answers from Column C, the less the potential (i.e. more likely to have large numbers of small fish and few large or few fish of any size).

1. If your fishery is a loch:

- What altitude is it at?
- What is its water chemistry (acid or alkaline)?
- Is there a high proportion of deep water (over 2m), or is it mainly shallow?
- Is there a lot of bottom growing weed in it?
- Is there weed growing up into the water or to the surface?
- Does it have many spawning burns feeding into it?
- Does it contain freshwater shrimp
- Are there freshwater snails in it?
- Does it have many bank side trees?
- What is the level of predation in the loch?

2. If your fishery is a river:

- What altitude is it at?
- What is its water chemistry (acid or alkaline)?
- How far upstream is the fishery?
- What is the proportion of deep water (pools) to shallow water?
- Is the flow regulated (e.g. by a hydro scheme)?
- Is the water subject to abstraction (e.g. for irrigation etc.)?
- What proportion of different river bed types are present?
- Is there a lot of weed growth in it?
- Does it have many spawning burns feeding into it?
- Do migratory fish enter it?

Table 8.8.2

ASSESSING YOUR WILD TROUT RIVER FISHERY'S POTENTIAL : What could your fishery be ?

	Column A		Column B		Column C	
1 Water chemistry	Alkaline		Neutral		Acid	
2 Altitude	Low (0-250m)		Medium (250-400m)		High (400m +)	
3 How far upstream?	Lower river		Middle river		Upper river	
4 Deep water	Many pools		Some pools		Few or no pools	
5 Regulated flow?	No		Some		Heavily	
6 Weed growth	A lot		Some		Little or none	
7 Spawning burns	Many		Some		A few / none	
***8* Freshwater shrimp**	Abundant		Some		None	
9 Bankside trees & bushes	25-50% of bank		10-25% of bank		None / 100% shaded	
10 Predators	None/Some		Some		Abundant	

The more answers from Column A, the higher the potential of your fishery (i.e. the more chance of good numbers of fast growing fish).
The more answers from Column C, the less the potential (i.e. more likely to have large numbers of small fish and few large or few fish of any size).

8.9 Are the Anglers' Expectations for your Fishery Realistic?

Unhappy anglers are anglers whose expectations of their fishing have not been met – but were their expectations realistic? You therefore need to know:

- What do they consider is a good day's fishing? Have you ever asked your anglers this? An example of a questionnaire for finding out what anglers want & think is given in Appendix B
- Do you consider their expectations to be realistic? Check these against historic catch records against the situation in neighbouring rivers/lochs and in your region generally. If they are not realistic, your anglers should be made aware of this and the reasons why.
- What do you consider a "good" season to be for your fishery? Why do you think this? What is your evidence for thinking this?
- Summarise how your anglers' expectations differ from / match the present state of your fishery.
- If expectations match present reality, the management aim of your fishery should be to maintain the present situation. In such a situation, this means protecting the environment and fish stocks and continuing to maintain good records.
- If expectations are realistic and the present performance of your fishery does not match these, then refer to Section C on what to do next.

8.10 How do I get from A to B?

Once you have worked out where your trout fishery is starting from you are then in a position to take any necessary action.

Remember that it is very important to first check your existing situation with any historic information. This will let you see if things have changed from how they were in the past and how they have changed or stayed the same.

Comparing your answers to Table 8.8.1 (your starting point) with your answers to Table 8.8.2 (your potential) will show you the sorts of things you will need to improve, or just maintain, in your fishery management plan

The situation for your fish stocks will probably be one of the following and the better the records you have, the better you will know the state of your stocks, which will help to show you what needs to be in your management plan:

(1) The population is dominated by older fish, with few younger ones.

The reasons for this could be:

- **Spawning burns.** Environmental improvements are needed to increase and maximise juvenile production. Access in to many small burns may be blocked by road culverts etc.
- **Spawning females.** Not enough mature, female, brown trout are surviving to spawn. Losses need to be reduced by, for example, catch and release or introducing "slot limits"
- **Losses of juveniles to predation.** Has the level of predation been assessed? What predators are there (e.g. birds, fish)? How many? Are they there all the time? Has there been any assessment of their impact (e.g. gut content analysis)? Are predator control/mitigation measures in place?
- **It is a natural situation.** It is important to realise that this situation may be entirely natural due to limited spawning. If it is, these special places need to be managed accordingly as the number of fish that may be removed from them without harming the population is limited. Trout populations cut off by waterfalls are like this, since large females from the sea or lower river cannot get to spawn in the area so all the eggs have to come from small, resident, females.

(2) A lot of young, small, fish and very few that are older and larger.

- **Are you sure these catches are a true reflection of the population?** What techniques do your anglers use? The techniques used can significantly affect the size of fish caught. For example on many rivers most people may fish wet fly yet the larger fish will be caught on dry fly or nymphs. Try different techniques to see how the catch varies and advise anglers accordingly.
- **If you are sure these catches represent the size of the fish in the population then:** Are

the eggs deposited in the burns in your area mainly from sea-trout? If so, then your juvenile fish are mainly young sea-trout and will migrate rather than grow to be large, resident brown-trout. This situation may change over the years, with waters changing between migratory trout and resident trout dominance, though this is not well understood. If your water is sea-trout dominated, then "catch and release" for those large, breeding resident trout that you do have could help maintain that side of your trout population.

- **For rivers:** Have you much deep water in your area in which larger, resident, brown-trout could actually live? Has this changed over the years? Have you lost deep water due to gravel movements or widening of the channel due to rapid bank erosion? Without historical data, this cannot be shown for certain. Make a baseline, photographic, record of your area that will show changes in the future. If gravel movements have filled in deep water in your river, this may be due to overgrazing upstream weakening the banks and acceleration erosion. Bank side protection can reduce this, but only in the long term.
- **For lochs:** (a) Fishing pressure or predation could be too heavy, so few fish survive to reach larger sizes. (b) Feeding in the loch could be poor, in which case some of the small, apparently young, fish could actually be quite old – scale reading is needed to check this.

(3) A lot of small fish of many ages, some very old

- **Your fishery is overcrowded,** with too many fish for the food supply, so they are stunted in growth and do not get large. A possible cause for this is that there is a huge amount of spawning area feeding into your loch or river, so the production of young fish each year is enormous.
- An appropriate management measure here could be to have no minimum size limit and to lift any restrictions on type of fishing, allowing bait fishing and spinning. If your preference is for fly-fishing only, a maximum size limit (requiring any larger trout caught to be returned) may also help in allowing some fish to reach large size and become cannibals of the smaller fish.
- In the past, barriers would be put on some of the burns to prevent them being used by spawning fish. However, this would not be legal in areas used by salmon and sea trout.
- **Restoring the original bankside vegetation** can significantly increase the food supply for the river or loch.

(4) Good numbers of fish, of a good mix of sizes and ages, with many young, small fish, and a good number of larger and older fish, making a "pyramid" of sizes

- **This is a good, natural, population** and your management needs to be aimed at protecting the present situation rather than trying to alter it.
- Your fishing may not appreciated by anglers however, as your fish will be generally small. Many anglers' perceptions and values have been changed by the large size of fish used in "Put and Take" fisheries and in order to appreciate wild trout fishing, they may need to have this pointed out.
- Historic records are again useful here as they show the sizes of fish caught in the past, which were generally small. A half pound wild brown trout is actually a very good size of fish to catch, and was thought to be so in the past, though many anglers today would not consider this to be so.

- It is important to understand in this situation that absolutely nothing is “wrong” with your trout stocks. It is anglers’ perceptions that need to be changed to fit the reality of wild brown trout populations.

(5) A few large, old fish.

In this scenario, your fishery is in serious danger and something is preventing young fish from being produced in your area. Possible causes are:

- **Acidification.** Acidification affects eggs and young fish much more severely than larger fish, so although the adults spawn, the young fish die. Broodstock can be collected from affected waters and bred in hatcheries. However it is essential to check the water supply in case it too is acidified. The resulting juveniles can then be stocked back in to the affected waters when they are large enough to be able to survive. Stocking is probably the only way of help this situation. However it obviously cannot cure it and the fish must go on being bred artificially.
- **Siltation or other problems with spawning gravels.** These will reduce the survival of eggs in the redds, which is normally very good. Stream surveys are needed to identify any such problems.
- **Access problems.** Spawning adults are being prevented from getting into your nursery areas in most years, so spawning is interrupted and may only happen very occasionally. Stream surveys are needed to identify any such problems.

(6) Very few fish of any size.

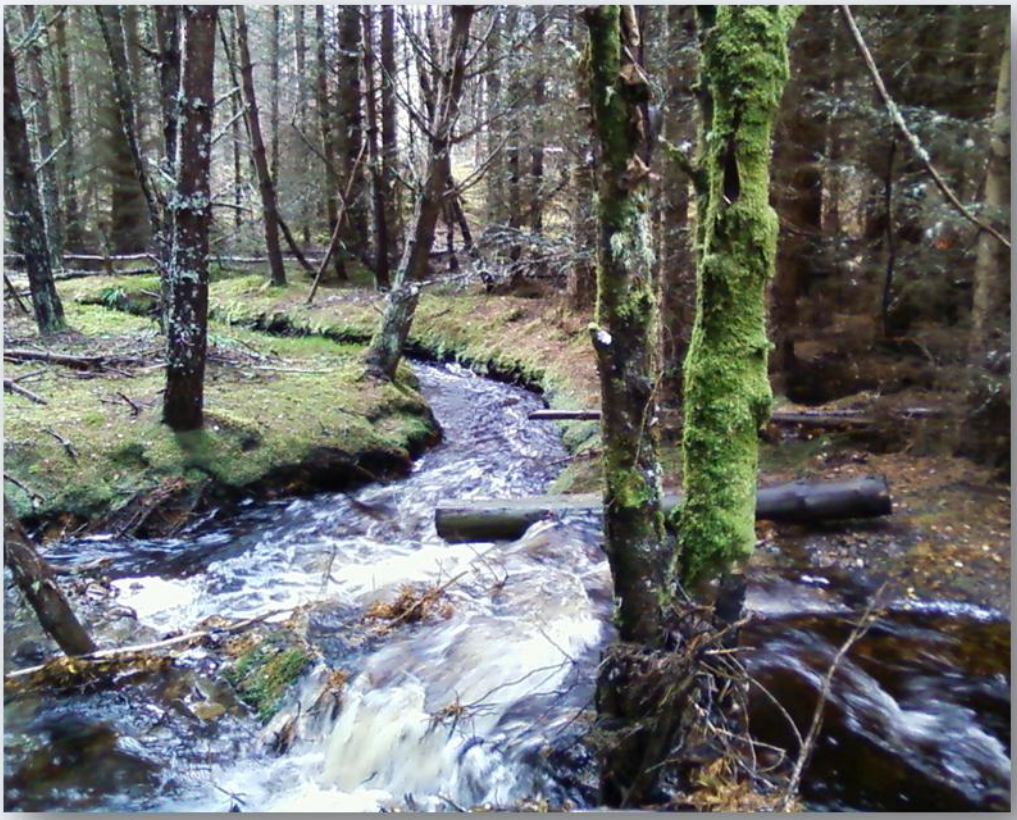
Again your fishery could be in serious danger of total collapse and it is essential to identify the causes as soon as you can. Possibilities are:

- **Chronic pollution.** May be indicated by long-term, persistent pollution and/or a history of fish kills**.** If there are water quality problems, press SEPA for action to improve conditions. It is essential that anglers report any sightings of dead fish to SEPA immediately. Check the insect populations of your water, if these are very poor, they could be indicating chronic but low-level pollution.
- **Lack of spawning nearby.** Where do your trout spawn? Are their spawning burns in your area or is there significant spawning in your actual water?
- If you have spawning burns – what state are they in? Can fish get into them? Spawning burn surveys may help identify useful improvements on how to improve fish access. Remember that even very small burns (as small as 50 cm wide) may be significant for trout spawning.
- If you do not have any spawning burns in your area, think where your trout are coming from. If you are on the lower part of a large river, your trout will be coming from spawning burns further upstream. Are these in the area of another angling club – if so, have they ever checked them?
- What fry and parr do the local spawning burns have in them? Are there a lot or are there very few? If there are a lot, most of them may be going to sea or to better feeding downriver rather than staying in your loch or area of river.

- If your area is rich and productive and there is a plentiful supply of fly life but there are still few fish, then consider whether migratory sea trout are the source of young trout in your area. If they are, then consider whether you are in a salmon farming area and whether reduced adult sea trout numbers may be due to sea lice problems associated with badly located or badly managed salmon farms.
- **Chronic overfishing.** This can be a problem where fishing is largely uncontrolled and bait is used a lot. Quite simply, the trout are not surviving long enough to spawn the several times that they should during their lives. The answer for this is to control and regulate the fishery so that mature fish can survive to spawn at least once.
- However, it must be remembered that some stocks are more fragile than others. For example, at cold, high, altitudes fish can be very slow growing and take a longer time to reach spawning size. In such situations, overfishing can result from even quite light fishing pressure.

A natural situation ?

- What is the environment like for trout in your area? Is it a rich and productive one or a poor and unproductive one? Are there waters with much better trout populations nearby? If there are, then it would suggest that your water has some particular problem. If all the rivers and lochs in your area have similarly poor trout populations to your fishery, this would suggest you are in an unproductive area, possibly due to an underlying geology of hard, acid, rock.
- A fly life survey will let you check the food supply. If it is poor, this may be for entirely natural reasons (acid water, a lot of bedrock etc.) or may be due to some problem.
- Is your area one of acid waters or alkaline? Check for the presence of freshwater shrimp. If it is absent, then your waters are below a pH of 5.6, are acidic and will be generally unproductive. Absence of freshwater snails is also an indicator of poor, acid, conditions.
- If your area is a poor, unproductive one, then the sparse number of fish is probably all that can be expected. The planting of bankside trees, if these are largely absent, and fencing off of banksides to increase vegetation and insect production on nearby land may help
- If your water is a cold, high altitude, loch, the fish will be very slow growing and may only be able to sustain a small, sparse, population.
- If there are no apparent problems to explain the lack of fish and it does not appear to be a natural situation, bring in catch and release measures and stop killing the breeding fish that you do have.
- Monitor the situation through catch recording and / or fishing open day. If there is no change, consider the options for stocking, although this may not help if there is some fundamental problem in your area that is reducing fish survival. Stocking can treat the symptoms of this lack of fish but not the underlying causes.



9 Annexes & Appendices

Annex 1 Protection Orders

Annex 2 Organisations concerned with fish and fisheries

Annex 3 Suggested Further Reading

Annex 4 Image acknowledgments

Appendix A: Catch Recording Systems, Formats and Examples

Appendix B: Example of an Angler Questionnaire

Annex 1: Protection Orders

The Protection Orders currently in force in Scotland:

- River Don Catchment Area (Part) Protection Order 1990
- River Clyde Catchment Area (Part) Protection Order 1994
- The Rivers Tweed and Eye Protection (Renewal) Order 1991 Variation Order 1994
- The River Tummel Catchment Area Protection (Renewal) Order 1991 Variation 1994
- The River Tay Catchment Area Protection (Renewal) Order 1993 Variation Order 1996
- The North West Sutherland Protection Order 1994
- The West Strathclyde Protection Order 1988
- The Upper Spey and Associated Waters Protection (Renewal) Order 1993 Variation Order 1996
- The Loch Morar and River Morar Protection Order 1992
- River Lunan Catchment Area Protection (Renewal) Order 1991 Variation Order 1994
- The Rivers Earn Catchment Area Protection Area Protection Order 1990
- The River Arkaig, Loch Arkaig and Associated Waters Protection Order 1995
- The Assynt - Coigach Area Protection Order 2004
- The Loch Awe and Associated Waters Protection Order 1992.

A map showing the boundaries of each Protection Order may be viewed HERE

Annex 2: Organisations

Association of Salmon Fishery Boards (ASFB)

The ASFB represent the 41 District Salmon Fishery Boards in Scotland which are the statutory bodies charged with the management and conservation of salmon and sea-trout stocks.

http://www.asfb.org.uk

Atlantic Salmon Trust (AST) - The AST is an Atlantic wide, UK based organisation which works for the restoration of wild salmon and sea trout stocks to sustainable levels. It champions the fish themselves. It conducts and supports marine and freshwater research and gives practical, independent advice to all from governments to ghillies.

http://www.atlanticsalmontrust.org

Consultative Committee on Protection Orders

This committee operates under the terms of the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003 giving advice to the Scottish Ministers on Protection Orders. The Committee contains representatives of game anglers and coarse anglers, and includes an environmental scientist. By virtue of the background of its members and as a result of its operation, the Committee has, in addition to knowledge of fisheries matters in general, significant knowledge of the uses and abuses of Protection Orders.

Environment Agency (EA) (with respect to the Border Esk)

The EA is a Government Agency responsible for the management of fisheries in England and Wales.

http://www.environment-agency.gov.uk

Institute of Fisheries Management (IFM)

IFM is an international organisation of persons sharing common interest in the modern management of recreational and commercial fisheries. Members are drawn from professional fisheries managers, research bodies, fishing and angling organisations, water companies, fish farms and private individuals whose interest in fisheries are represented at many levels within government and conservation bodies.

http://www.ifm.org.uk

Marine Scotland Science (MSS) (Formerly Fisheries Research Services (FRS))

The scientific arm of Marine Scotland, the freshwater laboratory of which is based in Pitlochry, conducts research into and monitors the freshwater and anadromous fishes and fisheries in Scotland and their environment. It provides expert scientific and technical advice to Government.

http://www.scotland.gov.uk/topics/marine

River Tweed Commission (RTC)

The River Tweed Commission, founded 1807, is the cross-border statutory fisheries management authority for the catchments of the rivers Tweed and Eye and their coastal waters. It has responsibility for all

freshwater fish species in its area, not only salmon and sea trout, and is the authority for giving consent to stocking in both the Scottish and English parts of the Tweed catchment.

http://www.rtc.org.uk/

Rivers and Fisheries Trusts of Scotland (RAFTS)

RAFTS is an unincorporated association registered as a charity, which represents Fisheries Trusts and River Foundations in Scotland. It is open to Fisheries Trusts and River Foundations in Scotland that are registered as charities and which share its objectives. RAFTS' prime objective is "the conservation and enhancement of all native species of freshwater fish and their environment in Scotland."

http://www.rafts.org.uk

Salmon and Trout Association (S&TA)

S&TA is a charitable conservation organisation which promotes the conservation of all wild fish in Scotland and throughout the rest of the UK. It works closely (and often in partnership) with all the main fisheries, environmental and training organisations in Scotland, for the benefit of fish and the public good.

http://www.salmon-trout.org

Salmon Net Fishing Association of Scotland (SNFAS)

The SNFAS represents proprietors and tenant netsmen in Scotland and is Scotland's oldest fisherman's organisation. Its objectives include defending, protecting and advancing the interests of salmon net fishing in Scotland, encouraging scientific research and providing both facilities and assistance to those engaged in this work.

Scottish Anglers National Association (SANA)

SANA are recognised by SportScotland as the governing body for game angling in Scotland. It works and consults with other related bodies, environmental interests and Government to protect and enhance the aquatic environment and sustainable game fishing for all ages and genders.

http://www.sana.org.uk

Scottish Environment Protection Agency (SEPA)

SEPA provide an efficient and integrated environmental protection system for Scotland that will both improve the environment and contribute to the Scottish Ministers goal of sustainable development. To monitor potential pollution to land, air and water, the storage, transport and disposal of controlled waste and safe keeping and disposal of radioactive materials. To provide environmental advice and information and works in partnership with many public, voluntary and private sector organisations. SEPA is accountable to the Scottish Ministers and, through them, to the Scottish Parliament.

http://www.sepa.org.uk/

Scottish Fisheries Co-ordination Centre (SFCC)

SFCC is an association of District Salmon Fishery Boards, Fisheries Trusts, MSS, the Scottish Government and others established in 1997 in order to help its members collect, collate, use, and provide information on freshwater fish, their habitats and fisheries. The SFCC provides a mechanism for local fisheries managers and biologists to standardise aspects of data collection, co-ordinates the supply of spatially related GIS data, provides a mechanism for scientific analysis of fish and habitat data and collates and provides fish and fisheries data at local, regional and national scales to inform policy decisions. Additionally, the SFCC co-ordinates relevant training courses and facilitates discussion and collaboration among local fisheries managers and biologists.

http://www.scotland.gov.uk/topics/marine/science/sfcc

Scottish Government - Marine Scotland - Salmon and Recreational Fisheries Team

This team's main purpose is to ensure that Scotland maintains populations of salmon and freshwater fish species that will support sustainable fisheries for the enjoyment of current and future generations of both Scots and visitors to Scotland.

http://www.scotland.gov.uk/About/Directorates/Wealthier-and-Fairer/marine-scotland

Scottish Natural Heritage (SNH)

SNH promote the protection and wise use of Scotland's natural heritage, including the conservation of Scotland's precious landscapes, flora, fauna and geological features, and the enjoyment of the countryside through informal recreation. They advise Scottish Ministers and others on all of these issues, and more generally on how they relate to sustainable development.

http://www.snh.gov.uk

Annex 3: Suggested Further Reading

All material listed in this section is accessible from the Marine Scotland Freshwater Laboratory library at Pitlochry.

General texts

Surprisingly few books provide the general background information on salmon and trout with a focus on practical management. Many of those available are rather old.

- ***Atlantic Salmon: An Illustrated History*** *Barbour, 1992, Canongate Press*
- ***Quantitative Ecology and the Brown Trout*** *Elliott, 1994, Oxford University Press*
- ***Ecology and Management of Atlantic Salmon*** *Mills, 1989, Chapman & Hall*
- ***The Atlantic Salmon: Natural History, Exploitation and Future Management*** *Shearer, 1992, Fishing News Books*
- ***The Lives of Salmon: An Illustrated Account of the Life-history of Atlantic Salmon*** *Youngson and Hay, 1996, Swan Hill Press*
- ***Freshwater Fishes of the British Isles****: Maitland & Campbell, 1992. Collins' New Naturalist Series No. 75, HarperCollins*

Wild Trout Trust publications

- *The Wild Trout Survival Guide*
- *Chalkstream Habitat Manual*
- *Upland Rivers Habitat Manual*
- *Urban Rivers Restoration Guidelines* See HERE for more details

Catch & Release – an Angler's guide (leaflet) See HERE for copy

Salmon Advisory Committee Reports (MAFF publications 1988 - 1997)

- *Assessment of stocking as a salmon management strategy*
- *Run timing of salmon*
- *Factors affecting emigrating smolts and returning adults*
- *Anti poaching measures*
- *The effects of predation on salmon fisheries*
- *Factors affecting natural smolt production*
- *Information on the status of salmon stocks*
- *The effects of fishing at low water levels*
- *The regulation of salmon angling in Great Britain*
- *Fish passes and screens for salmon*

CONTEMPORARY SCIENTIFIC REVIEWS - COLLECTIONS SUPPORTING SOUND MANAGEMENT

These volumes provide up-to-date authoritative scientific information that should form the platform for sound management. Many of these reviews comment extensively on the application of science to management of salmon and trout.

- ***Atlantic Salmon Ecology*** *Edited by Aas, Klemetsn, Einum and Skurdal, 2010, Wiley-Blackwell*
- ***Salmonid Fisheries: Freshwater Habitat Management*** *Edited by Kemp, 2010, Wiley-Blackwell*
- ***Sea Trout Biology, Conservation and Management*** *Edited by Harris and Milner, 2006, Blackwell Publishing*
- ***The Scientific Basis for Management of Salmonid Stocks in the British Isles (Salmonid 21C)*** *Edited by Solomon, 2003, Fisheries Research special issue,* ***62****, 109-234*
- ***The Atlantic Salmon: Genetics, Conservation and Management*** *Edited by Verspoor, Stradmeyer and Nielson, 2007, Blackwell Publishing*

Application of science to management

There is a collection of booklets and larger texts that focus strongly on applications of science to management and associated practicalities.

- ***Caring for the Wild Trout in Scotland*** *IFM Scottish Branch, Leaflet*
- ***The Wild Trout Survival Guide*** *Wild Trout Trust*
- ***Restocking of salmonids–opportunities and limitations*** *Aprahamian et al., 2003, Fisheries Research special issue,* ***62****, 211-227.*
- ***Conservation of Atlantic Salmon Habitat*** *Armstrong, 2008, Buckland Occasional Papers; No. 12. (Available from Marine Scotland Freshwater Laboratory, Pitlochry)*
- ***Trout and Salmon: Ecology, Conservation and Rehabilitation*** *Crisp, 2000, Fishing News Books, Blackwell Science.*
- ***Ecology of the Atlantic salmon Salmo salar*** *Hendry and Cragg-Hine, 2003, Conserving Natura 2000 Rivers, Ecology Series No. 7, English Nature, Peterborough See HERE*
- ***Brown Trout in Ireland*** *O'Grady et al., 2008, Central Fisheries Board, Dublin****Channels & Challenges: The enhancement of salmonid rivers*** *O'Grady 2006, Central Fisheries Board, Dublin*

Special topic series

Atlantic Salmon Trust blue books:

- ***Atlantic Salmon Facts*** *- Mills, Hadoke, Shelton and Read*
- ***Spring Salmon*** *– Youngson*
- ***Water Quality for Salmon and Trout*** *– Solbe*
- ***Salmon Fisheries in Scotland*** *- Williamson*

Environment Agency technical manuals

Restoration of Riverine Salmon Habitats, A Guidance Manual, Fisheries Technical Manual - R&D Technical Report W44

Annex 4 – image acknowledgements

Front Cover - trout in hands	*Ronald Campbell*
Inside cover - 27lb Brownie	*Aya Thorne*
Upland stream	*Simon McKelvey*
Underwater smolts	*Simon McKelvey*
Leaping salmon	*Stuart Brabbs*
Grazing Sheep	*Ronald Campbell*
Measuring fish	*Alastair Stephen*
Clunie Fish Pass	*Alastair Stephen*
Teviot Brown Trout	*Ronald Campbell*
Alevins	*Pete Minting*
Fionn Loch	*Alastair Stephen*
Forestry	*Simon McKelvey*
Back Cover – electrofishing	*Simon McKelvey*

Appendix A: Catch Recording Systems, Formats and Examples

Knowing what is caught in your fishery tells you about the sort of fish you have and how abundant they are, but this needs well designed and managed catch recording systems. There are five basic approaches to this:

- **Angling Diaries / Logbooks:** These are booklets in which anglers record the results of their fishing trips with details of how long they spent fishing, the methods they used etc. They are good for angling club members and anglers with a link to a particular area. They require a good level of commitment from those keeping them.
- **Angling Returns:** These are sheets for filling in by anglers visiting a fishery for a day or so, and are appropriate for anglers visiting an area.
- **Club Competitions:** The traditional source of catch information for clubs, but the type and detail of information recorded needs to be correct if these are to be of long-term use
- **Open Day Fishing / Competition:** This is a way of collecting information from areas that are little fished or where information is hard to come by using other methods. This method involves advertising a free day's fishing in return for a record of the catch made – prizes may or may not be offered as well.
- **Creel Census**: Involves a bank side collector approaching anglers and asking them a set of questions and taking measurements of any fish they have caught.

The key data to be collected by any of these methods is the same:

- The number of fish caught.
- The size of these fish.
- The time it took to catch them (the "catch effort" – number caught per hour spent fishing).
- The method used.

Other information is also useful (weather & water conditions etc.) but the four types above are the essentials. Templates for using these different methods are given below.

- **Historic Records:** These can greatly increase your understanding of your fish and fishery by giving a long perspective on the present. Many salmon fisheries have kept records for years and older trout fishing clubs often have competition records going back in to the 19th century. Local newspapers often carried very detailed records of the competitions run by clubs in their area, so even if local clubs have lost their records or have gone out of existence, some of their records may still be accessible. It is of great value to know what sizes of trout were being caught in your area even a century ago as this gives a baseline against which to judge the present situation.

Catch records have to be used with care, in particular the way the catches were made has to understood. Simply using the numbers without any context can lead to mistaken conclusions.

TEMPLATES FOR DIFFERENT METHODS OF CATCH RECORDING

A: Angling Diaries / Logbooks and Angling returns: The template shown below is a very basic one, to which further information on angling conditions and the sizes of fish caught could be added – if it was felt that this would be filled in. The more information asked for, the more complicated looking the sheet, the less likely it is to be filled in.

Name of Water			
Permit from:			
Date	DD	MM	YYYY
Time started (circle)	Morning	Afternoon	Evening
Time spent fishing (to nearest half hour)			
Methods (circle)	Dry Fly	Wet Fly	Nymphs
	Spinning	Bait	Other
Size limit on permit		Bag limit	
Blank - Tick if caught nothing at all, even undersize			

CATCHES	Brown Trout	Grayling
Total Undersized		
Oversized Killed		
Oversized Returned		

Additional information that could be asked for

SIZES	*Inches or*	*Weight*	
Biggest killed			
Biggest returned			
CONDITIONS (Circle)			
Weather	*Bright*	*Dull*	*Overcast*
Water (river)	*High*	*Steady*	*Falling*

Water (still)	*Waves*	*Rippling*	*Smooth*
Temperature (for time of year)	*Warm*	*Normal*	*Cold*
Wind	*Windy*	*Breezes*	*Still*
Colour	*Silty*	*Coloured*	*Clear*
	Peaty		
ANGLER			
No. years of fishing			
Fished here:-	*Often*	*Sometimes*	*Never*

B: CLUB COMPETITIONS / OPEN DAY COMPETITIONS. The form shown below is one that could be used by those running such events to collect catch information. The information on water and weather etc can be collected by the organizer

DATE	Day		Month		Year
WATER(S) FISHED					
START TIME		FINISH TIME			

TOTAL NUMBER OF COMPETITORS:

ANGLERS WEIGHING IN: (or Reporting, if Catch & Release)

No.	Name	Sizes of fish (largest first)														Undersized returned
1																
2																
3																
4																
5																
6																
7																
8																

9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																

Number of anglers who caught oversized fish but did not weight in

COMPETITION RULES

Method(s)	
Size limits	
Other rules	

FISHING CONDITIONS

Weather	Bright	Dull	Overcast	
Water (river)	High	Steady	Low	
Water (still)	Waves	Ripples	Calm	
Colour	Silty	Coloured	Clear	
	Peaty			
Temperature	Warm	Normal	Cold	for the time of year
Wind	Windy	Breezes	Calm	

C: CREEL CENSUS. As anglers are being interviewed, considerable detail can be recorded both about the fishing trip that is in progress (or has just been completed) and the fish caught, which it might be possible to measure, take scales from etc. The template shown below is therefore a minimal one

DATE	D	M	Y
WATER			
PLACE			

ANGLER			
Age		Years fishing	
Fished here before:-	Often	Sometimes	Never
Origins	Local	Visitor	

FISHING TRIP			
Time started		Hours fished	
Methods used			
Size Limit on Permit		Bag limit	

CATCHES			
Blank day?			
Total undersized returned			

	Species	Sizes	
Oversized returned			

Fish killed			

CONDITIONS (Circle)			
Weather	Bright	Dull	Overcast
Water (river)	High	Steady	Falling
Wind	Windy	Breezes	Calm
Water (still)	Waves	Rippling	Smooth
Temperature (for time of year)	Warm	Normal	Cold

APPENDIX B: EXAMPLE OF A QUESTIONNAIRE FOR FINDING OUT ABOUT ANGLERS, THEIR OPINIONS AND THEIR FISHING PREFERENCES.

Personal Details

Name	

Age	Under 18 ☐	18-30 ☐	31-50 ☐	51-64 ☐	65+ ☐

Gender	Male ☐	Female ☐

Fishing Clubs (if any)	

Address and/or e-mail address (optional - fill in if you want to receive a copy of the results of this survey)	

How did you learn to fish?	Self-taught ☐	Family member ☐	Friend ☐	On a course ☐

How long have you been fishing? (to the nearest 5 years)	

What type of angler are you?	Beginner ☐	Social ☐	Nature lover ☐	Serious ☐
	Obsessed ☐			

How do you rate yourself as an angler?	Beginner ☐	Intermediate, poor ☐	Intermediate, good ☐	Expert ☐

Why do you go fishing? (*you can tick more than one box*)	To catch fish ☐	To improve your angling ☐	To be in the countryside ☐
	To socialise with friends ☐	To get quiet time to yourself ☐	Other ☐

How often do you go fishing?	More than once a week ☐	Once a week ☐	One to three times a month ☐	Less than once a month ☐

On average, how long do you fish for?	Under 1 hour ☐	1 to 3 hours ☐	3 to 5 hours ☐	6 hours + ☐
When do you usually start fishing?	Morning ☐	Afternoon ☐	Evening ☐	Night ☐

What is your favourite fishing method at each of these times of year?	Spring - Summer - Autumn -

What other methods do you use? (*you can tick more than one box*)	Dry fly ☐	Wet fly/nymph ☐	Czech nymph ☐
	Mixed ☐	Maggot ☐	Dead bait ☐
	Worm ☐	Spinning ☐	Live bait ☐

When fishing do you : -	Always fish the same beats ☐	Usually fish the same beats ☐	Vary the beats you fish, but return to favourite beats ☐
	Greatly vary the areas you fish ☐		

How far are you willing to travel to fish ?	Local area only ☐	Anywhere in catchment ☐	Outside of catchment ☐

On average, how many takeable Trout do you catch per 4 hour fishing trip?	0		1 - 2		3 - 4		5+	

Do you release the Trout you catch?	Yes		Often		Sometimes		Never	

Do you use thigh or chest waders?	

Do you eat Trout that you kill yourself?	Yes		No	

If not, what do you do with the fish you kill?	

Do you tie your own flies?	Yes		No	

Your Opinions

In an average 4 hour fishing trip, how many wild Trout do you estimate <u>are</u> caught per angler?	

How many wild Trout do you think <u>should be</u> caught per angler?	

What do you estimate <u>is</u> the average size of the wild Trout caught? (in cm or inches)	
What do you think the average size of the wild Trout here <u>should be</u>? (in cm or inches)	

At what size do you think you <u>should</u> be able to kill a Trout?	

(in cm or inches)	
How many Trout do you think you <u>should</u> be able to kill per fishing trip?	

Would you rather fish a :-	Wild loch		Wild river		Stocked river		Stocked stillwater	

Do you prefer to fish for:-	Wild Trout		Grayling		Large Stock Trout		Other	

Do you get the same satisfaction from catching a stock Trout as get from catching a wild Trout:-	Yes		No		No difference	

Can you have a good day's Trout fishing without catching a Trout:-	Yes		No	

What else makes a good day's fishing?	

(The following 8 questions may not apply to younger anglers)

When compared to the past, do you think there are :-	More Trout		Less Trout		The same number of Trout		

When compared to the past, do you think the trout are:-	Larger ☐	Smaller ☐	The same size ☐
When compared to the past, do you think the fly life has:-	Increased ☐	Decreased ☐	Stayed the same ☐

When compared to the past, do you think the stretches of river you fish here have:-	More deep water ☐	Less deep water ☐	The same amount of deep water ☐
	More trees ☐	Less trees ☐	The same number of trees ☐
	More bankside vegetation ☐	Less bankside vegetation ☐	The same amount of bankside vegetation ☐
	More in-stream vegetation ☐	Less in-stream vegetation ☐	The same amount of in-stream vegetation ☐
	More bankside collapse ☐	Less bankside collapse ☐	The same amount of bankside collapse ☐

Do you recall any event or events that caused noticeable and obvious changes in the fish or the river ? If so, can you give approximate dates ?	

Mix and Match for a Perfect Day's Fishing

(Tick the boxes that make your perfect day's fishing; you can tick more than one box per question)

Travel time	Up to 10 minutes ☐	Up to half an hour ☐	Up to 1 hour ☐
	Up to 2 hours ☐	Over 2 hours ☐	
Fishing Time	Up to 30 minutes ☐	Up to an hour ☐	Up to 2 hours ☐
	Up to 4 hours ☐	All day ☐	Night fishing ☐
Company	Fish alone ☐	Fish with a friend ☐	Fish as part of a group ☐
Access	Close to road ☐	Short walk from car ☐	Long walk from car ☐
	Easy paths ☐	No paths ☐	Wilderness ☐
		Never far from facilities ☐	
Riverbank & Number of other anglers	Open banks for easy casting ☐	Reeds, rushes and tall grasses ☐	Trees and bushes, difficult casting ☐
	Many other anglers ☐	Occasional other anglers ☐	No Other anglers ☐
Fish & Fishing	A few big fish ☐	Lots of big fish ☐	Lots of small fish and a ☐

– what do you most like ? (*you can tick more than one box)*			few large fish ☐
	Size not important ☐	Grayling ☐	Trout ☐
	Wild ☐	Stockies ☐	Able to use any fishing method ☐
	Fly only ☐		
Bag limits	Catch and release ☐	1 - 2 ☐	3 - 5 ☐
	6 - 10 ☐	None ☐	
Size limits	10+ inches (25+ cm) ☐	9 inches (23cm) ☐	8 inches (20cm) ☐
	Under 8 inches (20cm) ☐	None ☐	
Environment	Litter free riverbank ☐	Abundant wildlife ☐	Mountain views ☐
	Forest views ☐	Town views ☐	Farmland views ☐
How do you most like to feel after a day's fishing?	Tired after exercise ☐	Stress free ☐	Happy ☐
	Relaxed ☐	Carefree ☐	Excited about going fishing again ☐