REVIEW OF MIXED STOCK FISHERIES

FOR ATLANTIC SALMON

IN EUROPEAN COMMUNITY WATERS,

EXCLUDING THE BALTIC SEA

Preparatory paper

by

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This report does not necessarily reflect the view of the European Commission and in no way anticipates the Commission's future policy in this area.

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EXECUTIVE SUMMARY

Background on salmon stocks and fisheries

1. The migratory behaviour of the anadromous Atlantic salmon presents many opportunities for their exploitation, and a wide range of fisheries have developed, operating in rivers, estuaries, coastal waters and the open ocean.

2. In many areas, there is a public right to fish for salmon, although exercise of this right is generally restricted by licence and further regulated by byelaws. In other areas fisheries are privately owned, although they are still generally subject to statutory regulations.

3. A salmon 'stock' is a unit of a size which provides a practical basis for fishery managers, while still helping to ensure the conservation of the contributing populations; a range of 'stock' units have been used in the management of salmon, but the primary management unit is generally taken to be the 'river stock'.

4. Some EU Member States permit the operation of fisheries in coastal waters which harvest salmon stocks originating from rivers in other Member States. The Commission has come under criticism for continuing to allow the operation of these fisheries.

Management principles for mixed stock salmon fisheries

5. There is no agreed definition of mixed stock fisheries (MSFs) for salmon. Any definition should be related to the primary fishery management objective, which is to maintain river stocks within precautionary limits. MSFs might therefore be defined as any fisheries for salmon operating outside estuary limits.

6. MSFs make salmon fishery management more complicated because it is difficult to identify or control how many fish are being taken from each river stock. They may also result in the harvesting of fish from stocks outside the sphere of jurisdiction of the management agency.

7. Unless management measures in an MSF allow for a high probability of meeting conservation limits in smaller stock units (e.g. rivers), or at least the possibility of effective rebuilding of weaker stocks or populations, the fishery may have undesirable and irreversible impacts.

8. There should be a general presumption against operating MSFs unless they can be shown not to contravene basic conservation policies. Exceptions might be permitted if there is an essential socio-economic requirement that has been clearly identified, although it is imperative that the risk of stocks falling outside or remaining outside safe biological limits are evaluated and balanced against the socio-economic objective.

9. It is possible that where only a small number of stocks are known to be exploited by a MSF, for example within an isolated geographic area, it may be possible to manage the fishery on the basis of protecting the weakest stock(s).

Mixed stock salmon fisheries in the Community waters

10. The average annual declared catch of salmon in homewater MSFs throughout the North Atlantic between 2000 and 2004 was 1320 t. EU Member States accounted for about 50% of this catch while the remainder was mainly taken in Norway and Russia. The majority of the legal salmon catch in Community coastal waters was taken in Ireland (450 t) and in the three UK jurisdictions (total 208 t). Very small coastal catches have been reported for Sweden.

11. In Ireland, only drift nets are operated outside estuaries and therefore conform to the definition of salmon MSFs; these nets accounted for 72% of the total Irish catch in 2004. Fish from virtually any Irish can be taken by drift nets in all district fisheries, allthough exploitation is generally highest the closer to the river of origin the fishery operates. Salmon from UK (Northern Ireland, Scotland, England and Wales), Spain, Germany and Denmark have also been taken in the Irish fishery. Current exploitation rates on four stocks from England and Wales range from <1% to >10%.

12. In England and Wales, there were 10 fisheries operating in coastal waters in the early 1990s. The largest of these was the North East Coast fishery which accounted for about 66% of the total national catch between 1985-89. In 1996, a national policy was adopted to phase out fisheries which could be shown to exploit predominantly mixed stocks. The phase-out has been completed for seven of the coastal fisheries, but for the larger fisheries is still on-going. Approximately 36% of the total catch in England and Wales was made in coastal fisheries in 2004.

13. In Northern Ireland, there are salmon fisheries operating in coastal waters and the estuary of the river Foyle. Considerable progress has been made in recent years to reduce the impact of MSFs. Further efforts are being made to negotiate buy-outs and other voluntary measures with remaining fishery operators. Approximately, 50% of the total national landings were made in coastal MSFs in 2004.

14. In Scotland, salmon fishing rights, both in freshwater and in the sea, are private heritable titles which may be held separately from any land. For the coastally operated fixed engines there has been a 93% reduction in fishing effort between the periods 1952-56 and 2000-04, and approximately 21% of the total national catch was made by these nets in 2004. An unknown amount of netting by ‘net and coble’ also takes place in coastal waters. There are continuing and on-going efforts by angling interest to buy out netting rights in different areas, and in 2005, a substantial number of the remaining fishing stations in the North-East Region were purchased.

15. Commercial fisheries occur along the Swedish coast, and about 90% of the coastal catch is recorded by commercial fishermen who operate different kinds of trap nets. The Swedish mixed stock fishery has been declining in recent years with 16% of the total national catch taken in coastal waters in 2004.

Effects and implications of reducing Mixed Stock Fisheries

16. The immediate effect of closing an MSF for salmon will be to increase catches in estuary and river fisheries. Fishing effort in the licensed fisheries might be expected to increase, although limits on the available time or locations to fish may restrict any significant increase in fishing effort by traditional methods.

17. If exploitation rates within the estuary and river fisheries did not change, the spawning escapement would also be expected to increase by the same proportion as the catches. This would be expected to have immediate beneficial effects to the stock status and the river ecology.

18. In stocks that are currently meeting their conservation limits, removal of an MSF might generate a large exploitable surplus which would not be harvested without an increase in the level of exploitation. This may permit a relaxation of existing regulations while still providing a high probability of meeting conservation limits, although conflicts may occur between net and rod interests and between existing and new fishermen.

19. Depending upon the nature of the stock and recruitment relationship in these rivers, there is a possibility that increasing numbers of spawning fish would be sufficient to inhibit production, if in-river exploitation was not increased to utilise part of the surplus.

20. Illegal fishing may increase following the removal of an MSF. In most jurisdictions, legislation is in place to control the sale of illegally caught fish, but there will almost certainly be a need for an increase in enforcement activity.

21. Where interest groups contribute to the buy-out of a fishery, they may consider that they have a greater right to benefit from the increased stocks than those who have not contributed.

22. MSFs should be replaced with well managed river/estuary fisheries, regulated to meet the objective of ensuring that river stocks exceed their conservation limits. The balance of the harvest assigned to the commercial and recreational interests may be determined on socio-economic grounds.

23. It is generally agreed that the capital value of the recreational fisheries exceeds that of the net fisheries often by a substantial margin. However, there is an important difference between the value of commercial and recreational fisheries for salmon which must be taken into account. Quite small catches of salmon can make a significant contribution to a netsman's income. Some commercial fisheries may be considered to have a heritage value.

Options for improving MSF management in Community waters

24. A range of approaches may be considered for reducing or eliminating the impacts of MSFs operating in coastal waters, although there should be a general presumption against operating MSFs unless they can be shown not to contravene basic conservation policies.

25. It might be possible to manage MSFs if sufficient information was available on the stocks being exploited by the fishery. Options, such as tagging or Genetic Stock Identification, may permit stocks to be identified in order that exploitation can be adjusted within precautionary limits. However, the cost of such approaches may be prohibitive.

26. The number of stocks exploited in an MSF may be reduced, or the predominance of one stock in the catch may be increased, by limiting the areas where, or time when, the fishery may operate.

27. It may be possible to limit closures of an MSF to fixed periods, to allow stocks to rebuild to levels where some exploitation may be possible or to allow the collection of more detailed information on the patterns of exploitation by the fishery.

28. In order to close an MSF, the act of fishing for salmon in coastal waters or keeping any salmon caught in nets or traps fished for other species could be made illegal, but powers to impose such restrictions may be constrained within some jurisdictions

29. Where a decision is made to close an MSF, the impact on fishermen may be significantly reduced by phasing it over an extended period rather than instigating an immediate closure, for example by reducing the numbers of fishermen that may operate as existing participants retire.

30. Buy-out or compensation arrangements may be employed in a variety of situations to encourage fishermen to give up their rights to fish or to accelerate phase-out procedures.

1 INTRODUCTION

Atlantic salmon (*Salmo salar*, L.) have historically been present in rivers in all EU Member States bordering the North Atlantic, from Portugal in the south to Finland in the north. However, many of these river stocks are now in a severely depleted state and some have been lost entirely. The objective of the North Atlantic Salmon Conservation Organisation (NASCO) is to contribute through consultation and co-operation to the conservation, restoration, enhancement and rational management of wild Atlantic salmon stocks throughout their natural range. The EU has been a leading member of the organisation since its foundation in 1983; about 36% of all rivers supporting Atlantic salmon stocks are now within the EU; and in the past 5 years, Member States have taken about 45% of the total nominal catch of salmon in the North Atlantic (ICES, 2005).

The NASCO Convention (NASCO, 1988) applies throughout the migratory range of wild salmon beyond the areas of jurisdiction of Coastal States of the Atlantic Ocean. The organisation has been very active in promoting good practice in the management of Atlantic salmon and is responsible for determining regulatory measures for fisheries operated by one Party that exploit salmon originating from the rivers of another Party. NASCO has also developed comprehensive plans to aid managers in implementing a precautionary approach to salmon fisheries management and the conservation and restoration of salmon habitats. Furthermore, the NASCO Council has expressed a desire to demonstrate balance and fairness between management of the fisheries that are subject to NASCO regulation (distant-water fisheries) and those that are not (homewater fisheries) (NASCO, 2005).

In accordance with the NASCO Convention, vessels registered in EU Member States are not permitted to fish for salmon outside 12 mile limits or land salmon caught in such areas. However, some EU Member States permit the operation of fisheries within their 12 miles limits which harvest salmon originating from rivers in other Member States in addition to local stocks. Since these fisheries do not generally take salmon from the rivers of other Contracting Parties to NASCO (EU is a single Party), they are not subject to NASCO regulatory measures. In recent years, however, and particularly with the establishment of river specific conservation limits to provide an objective basis for assessing the status of stocks, the Commission has come under criticism for continuing to allow the operation of these fisheries. This criticism has come particularly from Non-Governmental Organisations (NGOs), but also from other Member States and other NASCO Parties. Particular concerns have been expressed about fisheries that may be taking salmon from rivers whose stocks are outside precautionary limits.

This report provides a review of this issue. It considers: how to define interceptory or mixed stock fisheries; the problems they pose for the conservation and rational management of salmon; the extent of mixed stock fisheries currently operated by EU Member States; and the measures which should be considered by the Commission to manage them.

The report does not consider the management of salmon fisheries in the Baltic, because salmon stocks in that area are dominated by hatchery-reared fish and the fisheries operate under different management criteria to those in the Atlantic. They

also fall outside the NASCO Convention area. Furthermore, the report does not consider fisheries that only take salmon as a by-catch

2 BACKGROUND ON SALMON STOCKS AND FISHERIES

2.1 The salmon life cycle

The Atlantic salmon is an anadromous species, which means that the fish spawn in freshwater but migrate to sea for part of their life to grow and mature.

Adult salmon lay their eggs in freshwater in the autumn or winter by burying their eggs in gravel 'redds'. After the eggs hatch, the embryonic alevins remain in the gravel, drawing nourishment from their yolk sacs. When their yolk reserve is almost exhausted the young fish (fry) emerge from the gravel, disperse and begin to feed, growing into 'parr'. The juveniles set up territories in suitable fast-flowing water, which they defend against competitors; this tends to impose a limit on the population size, often referred to as the 'carrying capacity' of the stream. Once they attain a size of 10 to 20 cm - usually after one to three years - the parr undergo morphological, physiological and behavioural changes to become 'smolts' in preparation for migrating to sea in the spring.

The precise migration routes of salmon smolts after they enter the sea are not known. They appear to move rapidly away from the coast towards areas of the ocean where prey species may be more plentiful or conditions more suitable for rapid growth. Smolts emigrating from European rivers appear to move northwards towards the Northern Norwegian Sea; thereafter their migration routes are poorly understood, although some fish migrate as far as the western coast of Greenland.

Salmon return to freshwater after one to three (or occasionally more) years at sea; those that return after one year are referred to as 'one-sea-winter' (1SW) fish while the older fish are called 'multi-sea-winter' (MSW) salmon. [The terms 'grilse' and 'salmon' may also be applied to small and large size classes of fish, roughly equivalent to the 1SW and MSW groups.] Salmon of different sea-ages tend to return at different times of year and often spawn in different parts of a river. The age structure of the stock is therefore an important part of its diversity which may support both optimum production throughout the system and provide fishing opportunities over a large part of the year. Large spring-running MSW salmon are particularly highly prized and have been in more serious decline than other stock components in recent years.

2.2 Salmon stocks and populations

In order to avoid confusion, terms are required to describe groups of fish where these have biological significance and/or where they need to be defined for management purposes. NASCO has previously sought advice from ICES on the criteria for defining such terms. ICES (1996) noted that the terms 'population' and 'stock' had previously been given a variety of meanings and had sometimes been used interchangeably.

ICES (1996) therefore proposed adopting the following definitions:

- a ‘population’ (more correctly termed a ‘Mendelian population’ to distinguish it from the popular usage of the term population as applied to assemblages of individuals) describes a group of sexually out-breeding individuals which possess a common gene pool; and

- a ‘stock’ describes a unit of a size (encompassing one or more populations) which provides a practical basis for the fishery managers, while still helping to ensure the conservation of the contributing populations.

The salmon’s homing behaviour results in relatively distinct groups of individuals returning to reproduce in their natal rivers and streams. Within any given river, sub-groups may also develop (e.g. within tributaries), and natural selection acts to adapt the salmon of these groups to the conditions that they will face in the home river and along their migration routes. As a result, they become the best equipped to survive and reproduce, and they may differ from fish originating in other tributaries which have become adapted to a different set of conditions. These sub-groups comprise genetically distinct ‘populations’. Analysis of enzyme variants (allozymes) shows that approximately one third of the total genetic diversity of Atlantic salmon results from genetic differences between populations (Crozier et al 2003).

The ‘population’ is therefore the basic biological unit of the salmon species, and might ideally be defined as the fundamental management unit. However, in most instances it is not possible to demarcate clear population boundaries within a river, and even the number of distinct populations that are present is difficult to determine. Thus, while there is a need to protect the sustainability of these units, in order to maintain the diversity and differentiation of the species, they do not generally provide practical units for management purposes.

A range of ‘stock’ units have been used in the management of salmon stocks in the North Atlantic, but the primary management unit (e.g. for reporting statistics and regulating fishing) is generally taken to be the ‘river stock’, comprising all fish originating from eggs laid within the river. This is generally the lowest level at which catches in most fisheries could practically be differentiated. There are of the order of 2200 salmon river stocks around the North Atlantic, with about 800 (36%) in EU Member States. While larger assemblages of fish, such as those exploited by the West Greenland fishery, may also be termed a ‘stock’ in the context of the management of that fishery, they are more often referred to as ‘stock complexes’ or ‘stock groupings’ to avoid confusion.

2.3 Where and how are salmon caught?

The migratory habit of salmon provides many opportunities for fisheries, particularly in coastal waters, estuaries and freshwater, but also on the oceanic feeding grounds. Reflecting these diverse fishing opportunities and the very long period (>1000 years) over which the fisheries have developed, there has been an extensive evolution of fishing techniques applied to Atlantic salmon.

The fishing methods currently used range from ‘drift netting’ and ‘long lining’ in the distant water fisheries at West Greenland and Faroes, respectively, to ‘traps’ and various types of ‘gilling’, ‘encircling’ and ‘hand-held’ nets operated mainly in coastal and estuarine waters, and ‘rod and line’ used principally in freshwater. More detailed description of some of the specific nets and traps is provided in Annex 1.

Not only are a large number of different methods used to catch salmon, but similar types of net may be operated in different ways in different locations to accommodate local conditions. The way these methods catch fish has implications for management options, but for the purposes of this report, it is sufficient to consider the four general categories of commercial homewater fishing methods mentioned above.

'Gilling nets', whether fixed or drifting, are set like a curtain hanging in the water and generally catch fish by enmeshing them. These nets are most frequently used in coastal waters and the open sea. The fish swim into the wall of netting, usually penetrating part way through a mesh and becoming held by the net behind the gills. In some nets (e.g. Irish snap nets, UK trammel nets) the fish may not be enmeshed but are wrapped by the net or held within a pocket of netting. Fish that are enmeshed may be damaged by the net, and cannot generally be released unharmed, unless they are taken out within seconds of capture. Even in such cases, they may not survive due to scale loss from the nets or the effects of handling. Fish are known to escape from these nets as there are numerous reports annually of net marked salmon in freshwater with varying degrees and severity of net marking. The scale loss alone may provide a focus for infection.

'Encircling nets' include a range of draft and seine nets mainly used from beaches in estuaries, but occasionally also in coastal areas or freshwater. The nets employ heavier twine and smaller meshes than gilling nets, and are designed to encircle but not enmesh fish. The net is generally paid out from a small boat as it is rowed in a circle from the shore; the net is then drawn to the shore to land any fish that have been encircled. Such nets usually cause very little damage to fish and may provide an opportunity to release fish in good condition, provided bruising and scale loss is minimal. The survival of fish that escape from these nets would be expected to be high.

'Hand-held nets' are operated by an individual fisherman and may be used passively or actively. Passively operated nets are held in the water until a fish swims in, when they are lifted out of the water. Actively operated nets are used to scoop fish out of the water and are usually operated on shallow sand banks where the fish can be seen and the fishermen can stalk them. These nets cause very little damage to the fish that are caught.

'Traps' take a wide variety of forms; they may be used in coastal waters, estuaries and freshwater; with the design of some traps dating back many hundreds of years. Traps made from netting (e.g. bag net, T&J nets, etc) are usually operated in coastal waters and generally include some form of natural or net 'leader' to guide the fish towards a trap often in the form of a netting cage. The trap generally has some form of funnel entrance to make it more difficult for the fish to find their way out. Where the traps are operated in shallow tidal conditions, the fish may become stranded on the ebb tide; trapping nets operated in deeper water will generally keep fish immersed in a sufficient volume of water to allow them to be removed in good condition. This also provides an opportunity to release fish with a good chance of subsequent survival, and it is also likely that survival of any fish escaping from these traps would be high.

There are also a large number of different rigid trap designs, many being developed for use at specific locations and being very individual in design (e.g. putchers, cribs, garths). Rigid trap structures are generally operated in estuaries or freshwater and work by sieving part of the river flow; there are generally regulations restricting the proportion of the river that can be obstructed. Fish that are intercepted may be held by the structure (e.g. poke nets and putchers) or be guided into any area where they will become stranded or from which they can be removed with a hand-net.

'Rod fisheries' are (or have been) operated on most rivers supporting salmon stocks, although a range of different baits and lures may be permitted; lures include artificial flies, spinners, spoons and plugs, while baits include shrimps, prawns and worms. There has been a growing tendency in recent years for anglers to release all or a part of their catch of salmon as a result of personal preference, statutory regulations, or voluntary measures introduced by fishery owners or associations. In 2004, the proportion of national rod catches that were released ranged from 16% in Iceland to 76% in Russia. Provided the fish are handled carefully, for example catching them using artificial flies (with barbless hooks), and they are unhooked without being removed from the water, survival to spawning can be high (>80%) (Webb, 1998). However, the time taken to land the fish and the water temperature both have a significant effect on the likelihood of subsequent survival, and in Canada, for example, compulsory catch and release is operated only when temperatures are suitable. Fish which escape from rod and line before being landed generally have a good chance of survival.

In many areas, the fisheries that take salmon, whether commercially or recreationally, also target sea trout (*Salmo trutta* L.). However, slightly different methods (e.g. net meshes or lures) may be more effective for each species, and so, where sea trout predominate, the methods may be designed to target that species.

2.4 Fishing rights

The operation of fisheries in different countries is founded to a large extent on the fundamental principle of who owns the right to fish. In many countries, especially in the case of fishing in the sea, there is a public right to fish, although access to this right may be controlled by licensing schemes.

Where licensing systems are in place, it is normally an offence to fish without a licence. The licences may also impose additional restrictions on the fishing activities of the holder, and these may be further controlled by separate statutes or voluntary agreements. The process for issuing netting licences is often controlled in such a way that the net operator effectively 'owns' the licence for as long as he wishes to use it; in some cases his heir or partner may also retain preferential rights to the licence after the original licence-holder has relinquished it.

In some countries, there is a mixture of public and private fisheries. Thus, for example in England and Wales, most fisheries in inland waters are privately owned and it is an offence to fish without the owner's permission; a public right of fishing exists in all tidal waters, except in certain circumstances, for example where private rights were acquired pre-Magna Carta in 1225. In Scotland, however, all fishing rights for salmon and freshwater fish, for both recreational and commercial fisheries, are privately owned and there is no licensing system. Fishing rights may be bought

and sold separately or in conjunction with adjoining land. This is discussed further in relation to the fisheries in each jurisdiction in Sections 5-8.

2.5 What are 'mixed stock'/'interceptory' salmon fisheries?

The concept of 'mixed stock' salmon fisheries should not be confused with the same term used in the context of marine fisheries. In the latter case, it refers to fisheries which target one species (e.g. herring or cod) but which also catch other species (e.g. mackerel or other white fish). Thus, the mixed stocks in these marine fisheries generally refer to 'mixed species'. In the case of mixed stock salmon fisheries, however, the term has been used in various ways to describe the exploitation of salmon originating from several different areas.

For salmon fisheries, there is no agreed definition of 'interceptory' or 'mixed stock fisheries' (MSFs), although the terms have been widely used, mainly to describe offshore fisheries in both distant and home waters. The term 'interceptory' has been most commonly used by those with management or ownership interests within individual rivers and has therefore been used to describe fisheries that intercept salmon on their return migration to their home river. However, given that a fish on its spawning migration is trying to return to a particular spawning area, the term could equally be applied to many of the fisheries, both rod and net, that operate within the river.

'Mixed stock salmon fisheries' have also been referred to for many years although there is no single clear definition. This has partly been because of the vague and variable use of the term 'stock', but also because the extent of mixing may vary both in terms of the total number of stocks exploited and the predominance of one (or more) stocks in the catch. Most fisheries, even within rivers, take salmon from more than one 'population', and many, even those operating in estuaries and the lower reaches of rivers, take salmon returning to more than one river. This is because fish migrating along a coastline towards their 'home' river often stray into foreign estuaries for variable periods. However, the degree of 'mixing' may be difficult to define since it may be measured in terms of the number of stocks exploited, the relative levels of exploitation on them or their relative contribution to catches.

When fisheries operate close to a river mouth, the local river stock will often predominate in the catch, because the fish may congregate outside the river mouth or in the estuary waiting for suitable conditions before moving upstream. Further from the river, and further offshore, there may be less predominance of single river stocks, and the degree of stock mixing generally increases. However, these general rules may be significantly affected by the relative size of the different river stocks in the area, their migration routes and the local topography.

It would be appropriate for the definition of MSFs to be related to the primary fishery management objectives determined by NASCO. Thus, if the principal management objective is to maintain river stocks within precautionary limits, then MSFs might be considered to be 'those fisheries exploiting salmon from more than one river'. There are some dangers with this argument because the definition of the river stock as the primary management unit was itself predicated on the difficulties of managing at finer scales. However, such a definition on MSFs would clearly include nearly all fisheries operating in coastal and oceanic waters, but would also encompass many fisheries operating in estuaries and the lower reaches of rivers, since even when these take

fish predominantly from a single river, they also frequently take occasional fish returning to neighbouring systems. Determining the point at which such interceptions may be of concern will depend on various factors, including the relative size and status of the stocks, and the absolute and relative levels of exploitation on them. Collecting such information for every estuary fishery, to decide whether it conforms to a predetermined definition of an MSF, would be difficult and costly.

For current purposes, a more pragmatic approach is required and this could be based upon topography, and MSFs might be defined as any fisheries operating outside estuary limits. The majority of fisheries operating outside river estuaries are known to take salmon from more than one river stock, while within estuary limits, it is unusual (where data are available) for fisheries not to be taking predominantly fish from a single river. This conforms to ICES (2005) advice which states that fisheries in estuaries and rivers are more likely to fulfil the requirement of targeting stocks that have been shown to be within precautionary limits.

In order to apply the definition consistently, a 'river' should be regarded as the whole water system discharging through a single estuary (including where two or more water courses discharging through this estuary have been given different river names). The precise geographical limits of any river estuary, and thus the fisheries that it encompasses, may sometimes be difficult to define, especially on a coastline with large inlets or fjords, as on the west coast of Scotland. Such limits will therefore need to be defined by the local jurisdiction. Similarly, there are likely to be borderline cases which require special attention. Thus there will certainly be some estuary fisheries which catch significant numbers of fish from neighbouring rivers and some coastal fisheries which exploit predominantly a single stock. Specific management approaches may be required, or justified, by national or local managers in such cases.

For fisheries operating within a river system and its estuary, there is still a need to protect the diversity of the stock and its populations. In particular, the effect of fisheries on different sea age groups requires particular attention because they may be selectively affected by both natural and anthropogenic factors as a result, for example, of the different timing or routes of their migrations. Management authorities have the responsibility of ensuring that due protection is afforded to all populations within the river. In a small number of cases, fisheries within a single river may be managed by more than one authority or even jurisdiction. Where this is the case there is particular need for co-operation, and particular attention may need to be given to the assessment and regulation of fishing activities.

3 MANAGEMENT OF ATLANTIC SALMON

3.1 Overall management objectives and approaches

The overall vision of NASCO is to develop sustainable salmon stocks and fisheries that give the maximum social and economic benefit (NASCO, 2005). The primary management objective is 'to contribute through consultation and co-operation to the conservation, restoration, enhancement and rational management of salmon stocks taking into account the best scientific advice available'. NASCO has also adopted the Agreement on the Adoption of a Precautionary Approach (NASCO, 1998) which states that an objective for the management of salmon fisheries is to provide for 'the

diversity and abundance of salmon stocks' and 'to maintain both the productive capacity and diversity of salmon stocks'. Consistent with this, NASCO has recommended 'that conservation limits and management targets be set for each river and combined as appropriate for the management of different stock groupings defined by managers' and 'that stocks be maintained above conservation limits by means of management targets' (NASCO, 1998).

In practical terms, these objectives must be based on ensuring that actions are taken to protect and restore habitats in order to provide suitable environments for all life stages of the fish and to limit fishing mortality in order that sufficient fish are enabled to spawn throughout each river . Allocation of the potential catch between different stakeholder groups is a secondary consideration because it is dependent upon first deciding how many fish can safely be caught above the required spawning escapement. This distinction is clear-cut biologically, because the conservation of the resource will not be affected by who kills the fish, but by the overall numbers that they kill – or, more precisely, the number they do not kill. Ensuring that stocks achieve appropriate conservation levels has therefore to be the primary goal of salmonid fishery management activities.

3.2 Conservation limits for Atlantic salmon

Biological reference points (BRP) are quantities that describe the state of a population or stock and which are calculated from the life history characteristics of the stock (Anon. 1998). There are two types of BRP:

- A **limit** (sometimes referred to as a **threshold**) is a boundary which, ideally, should not be crossed, and so **limit reference points** are used to demarcate undesirable stock levels or levels of fishing activity. The ultimate objective when managing stocks and regulating fisheries will generally be to ensure that there is a high probability that these boundaries are not crossed (e.g. spawning numbers should not fall below a stock limit).

- A **target,** on the other hand, is a point to aim at, and a **target reference point** may therefore provide the basis for optimising a particular measurable outcome (e.g. spawning escapement). Various uncertainties in biological processes and management outcomes will make it impossible to hit a target every year, but the observed stock size will be expected to fluctuate around this level.

There is no single, best method for estimating critical spawning stock levels for fish stocks, or for selecting appropriate reference points (ICES, 1997a; Caddy, 1998). A particular problem faced in the management of salmon is that there are over 2000 river stocks around the North Atlantic, and there is a need for a consistent and objective approach for setting the reference points used in international management activities (Potter et al 2003).

ICES (1995) therefore determined that conservation limits for Atlantic salmon stocks and stock complexes should be defined relative to the level of stock (number of spawners) that will achieve long-term average maximum sustainable yield (MSY) to fisheries, as derived from the adult-to-adult stock and recruitment relationship. ICES considered that maintaining stocks above this level (S_{MSY}) would optimise yields as well as ensuring long-term sustainability. The sustainability of a stock is at greater

risk if it falls below S_{MSY} than when it is above this level; below this level a given reduction in stock will result in a greater reduction in recruitment. ICES therefore proposed S_{MSY} as a limit reference point (S_{lim}) which should be avoided with high probability. This standard definition of the conservation limit for salmon stocks has also been adopted by NASCO (1998).

The management advice provided by ICES for Atlantic salmon is therefore referenced to the S_{lim} conservation limit, and stocks are reported as being outside precautionary limits when the confidence limits of the most recent stock estimate includes S_{lim}. Management targets have not yet been set for many salmon stocks; where they have been developed (e.g. in England and Wales), they are being used to assist in ensuring that there is a high probability of stocks exceeding their conservation limits.

The practical effects of maintaining stocks above conservation limits, and the average stock size that will be achieved over the longer term, will be determined by the risk (or probability) level that is considered to be acceptable for stocks falling below this threshold (Caddy and McGarvey, 1996). It is the responsibility of managers to agree upon the level of risk that they consider appropriate (NASCO, 1998a). However, for the catch advice on fish exploited at West Greenland, ICES (2003) has used a 75% probability of the stock exceeding the conservation limit, and applies the same level of risk aversion for catch advice for homewater fisheries on the North American stock complex. Various national authorities have also proposed or adopted similar probability levels. Thus, the standing Scientific Committee of the Irish National Salmon Commission has provided catch advice based upon a 75% probability level, and in England and Wales, compliance criteria are designed to ensure an 80% probability of river stocks exceeding their conservation limits (i.e. four years out of five) (Environment Agency, 1998).

The above conservation limits have been established for salmon stocks to provide a basis for the sustainable management of fisheries. However, it is important to note that stocks may be biologically sustainable at levels below these conservation limits, whether this condition results from high fishing mortality or natural mortality. No attempts have been made to establish reference points to define critical stock levels for salmon at which there may be a high risk of extinction in the short term. Many stocks have persisted at lower relative levels for long periods, although the risks will have been much greater. This may be a particular concern for some small salmon stocks which may comprise only 10s or a few 100s of individuals.

3.3 Management issues relating to MSFs

NASCO and its contracting parties have agreed to limit catches of salmon so that there is a high probability of stocks exceeding their conservation limits (S_{lim}). MSFs make salmon fishery management more complicated because it is difficult to identify or control how many fish are being taken from each river stock. The fishery may therefore need to be regulated without full knowledge of the status of all the stocks being exploited or the potential impact of the fishery upon them. Even where studies are undertaken to estimate these impacts, inter-annual variation in the size of stocks, their run-timing and other factors, such as weather conditions, may add significant uncertainty to the assessments.

MSFs frequently result in the harvesting of fish from stocks outside the sphere of authority of the management agency. Thus the fisheries can have adverse effects on stocks in another region or Member State and may conflict with management objectives being applied to those stocks (e.g. if one jurisdiction has closed all fisheries in order to meet conservation objectives).

Unless management measures in an MSF allow for a high probability of meeting conservation limits in smaller stock units (e.g. rivers), or at least the possibility of effective rebuilding of weaker stocks or populations, the fishery may have undesirable and irreversible impacts. The most obvious example is where at least one of the exploited river stocks is well below its conservation limit, and managers have determined that it should not be exploited at all. Assuming the MSF in question cannot avoid capturing these stocks, it would need to be closed if the management objective was to be realised.

It is possible that where only a small number of stocks are known to be exploited by a fishery, for example within an isolated geographic area, it may be possible to manage the fishery on the basis of protecting the weakest stock(s), provided annual assessments are available on the size of the spawning stock relative to the conservation limit. Alternatively it may be possible to modify the fishery to operate outside the time of the main runs of the sensitive stocks. However, such exploitation will always present greater risks than when stocks are exploited separately because of uncertainties, or variability, in the proportion of the catch originating from the weak stock(s).

Further complications arise where large numbers of stocks are exploited by a fishery. Considering the current information on the status of most North Atlantic stocks, it is quite likely that one or more of the exploited river stocks will be below its conservation limit. Thus the continued operation of the MSF almost inevitably results in contravention of the management objective.

Even where all exploited stocks are meeting their conservation limits, as may occur if we return to conditions of higher marine survival of salmon stocks, MSFs introduce greater uncertainty into predicting the effects of management measures and pose a greater threat to small stocks or populations, especially if these are of low relative productivity and/or subject to high exploitation. As the number of stocks (or populations) increases, the number of fish that must be released from the fisheries in order to meet conservation limits must also increase. When the number of populations is too large, it may be impossible to ensure a high probability of the simultaneous achievement of spawner requirements in each individual unit.

Thus there is an inherent contradiction in the operation of MSFs and the conservation of all stocks that contribute to it. Ultimately, fisheries managers must decide between two options (Crozier et al, 2003):

- mixed stock fisheries will be permitted but low productivity stocks will not receive the spawning escapement that would be optimal for their productivity levels (which would be contrary to NASCO objectives); or
- spawning requirements of individual rivers must be respected at all costs and mixed stock fisheries should be eliminated.

These concerns have repeatedly been reflected in management advice, for example from ICES. Thus, for all fisheries in 2005, ICES (2005) considered that management should be based upon assessments of the status of individual stocks, and noted that fisheries on mixed stocks, either in coastal waters or on the high seas, pose particular difficulties for management, as they cannot target only those stocks that are within precautionary limits. ICES also noted that conservation would be best achieved if fisheries can be targeted at stocks that have been shown to be within precautionary limits, and fisheries in estuaries and rivers are more likely to fulfil this requirement.

3.4 Management principles for MSFs

ICES has repeatedly advised that for all stock complexes and for both 1SW and MSW salmon, MSFs present particular threats to stocks which are below conservation limit and some of the reasons for this are discussed above. Thus, while MSFs need to be evaluated on a case-by-case basis, there should be a general presumption against operating such fisheries unless they can be shown not to contravene basic conservation policies. Exceptions might be permitted it there is an essential socio-economic requirement that has been clearly identified, as long as no stocks exploited by the fishery are under threat of serious depletion.

Socio-economic arguments should be very carefully considered if conservation requirements are to be superseded and should be restricted, as far as possible, to situations where all stocks being exploited originate from within the same jurisdiction. It is possible that different jurisdictions will apply different socio-economic valuations to fisheries and this may complicate the task of managing fisheries that intercept fish from other jurisdictions.

There should therefore be a responsibility on the jurisdiction in which the MSF operates to establish that the fishery does not pose unacceptable threats to stocks in another jurisdiction or to take measures which can be shown to significantly reduce these threats where these are identified. This may require an agreed collaborative assessment or an independent assessment carried out by parties acceptable to both jurisdictions.

Where fisheries are operated, precautionary management calls for the ‘appropriate placement of the burden of proof’, and this requires a reversal of the approach that has hitherto been common practice. Managers have traditionally faced strong socio-economic and political pressures to protect fishing interests, often leading them to seek clear evidence of a conservation need before they would introduce measures to protect stocks. The onus, based on the adoption of a precautionary approach, should now be placed on those wishing to maintain or develop a fishery, to demonstrate that the fishery will not have unacceptable effects. The precautionary approach also requires that decisions are not deferred simply on the basis of imperfect evidence.

Potential approaches for improving the management of MSFs are discussed in Section 11.

3.5 Application of the Habitats Directive.

The Atlantic salmon is one of a number of species afforded special protection, along with their habitats, under the EU Habitats and Species Directive (Council Directive 92/43/EEC). This Directive provides for the creation of a network of protected sites across the EU known as 'Natura 2000', and includes Special Areas of Conservation (SACs) designated for salmon. Specific rivers in many EU countries have been designated in the list of sites of Community importance mentioned in Article 4(2) of the Directive.

Articles 6 (2), (3) and (4) of the Directive have been considered of particular relevance as they compel Member States to take appropriate steps to avoid the deterioration of specific habitats within the SACs, as well as avoiding disturbance of the species for which the areas have been designated. It is also noted that any plan or project not directly connected with, or necessary to, the management of the site but likely to have a significant effect, either individually or in combination with other plans or projects, must be subject to an appropriate assessment of its implications. For a plan or project which may result in interference with the habitat or species in question to be permitted to proceed, the only considerations which may be raised are: those relating to human health or public safety; beneficial consequences of primary importance for the environment; or other imperative reasons of overriding public interest. The Commission now considers plans or projects to include factors outside the direct influences within the freshwater habitat, including the impacts and effects of MSFs.

4 HOMEWATER MIXED STOCK SALMON FISHERIES

ICES has compiled information on catches of salmon in river, estuary and coastal homewater fisheries for about the past 10 years, where available. In some cases the catch data could not be assigned precisely, but in general terms, the 'coastal' catches should provide a good approximation of the extent of fishing in MSFs, according to the definition developed above, by country (Table 4.1 and Figure 4.1).

The average annual declared salmon catch in all homewater MSFs around the North Atlantic in the past five years was 1320 t, of which nearly 99% was taken in the NASCO North East Atlantic Commission (NEAC) area. EU Member States accounted for about 50% of this catch while the remainder was mainly taken in Norway (45%) and Russia (5%).

The average annual catch of salmon in coastal waters of Community jurisdictions over the past five years has been 665 t. The majority of this catch has been taken in Ireland (450 t) and in the three UK jurisdictions (total 208 t). Very small coastal catches have been reported for Sweden and France. For Sweden, coastal and estuary catches have been reported as a combined figure. For France, the catches reported in Table 4.1 are illegal landings from unlicensed fisheries which have been estimated in some years. Such landings are not reported for other countries and are not addressed within this report because measures are in place to try to restrict or eliminate them.

Table 4.1 Nominal catches (tonnes round fresh weight) of salmon in coastal fisheries in all countries with wild Atlantic salmon stocks and proportion of total in EU Member States/jurisdictions, 1999-2004 and 5-yr averages (2000-04). (From: ICES 2005)

YEAR	Canada	Finland	France	Iceland	Ireland	Norway	Russia	Spain	Sweden*	UK(England & Wales)	UK(Northern Ireland)	UK(Scotland)	USA	ANNUAL TOTAL	%in EC waters
1999	7	0	0	0	335	483	48	0	5	101	44	35	**0**	**1,051**	49%
2000	11	0	0	0	440	619	64	0	10	157	63	76	**0**	**1,429**	52%
2001	13	0	0	0	551	696	70	0	9	129	41	77	**0**	**1,573**	51%
2002	12	0	1	0	514	596	62	0	7	108	48	55	**0**	**1,391**	53%
2003	17	0	-	0	403	597	58	0	4	42	28	83	**0**	**1,215**	46%
2004	24	0	-	0	342	469	46	0	3	39	48	45	**0**	**992**	48%
5yr Av.	**15**	**0**	**0**	**0**	**450**	**595**	**60**	**0**	**7**	**95**	**46**	**67**	**0**	**1320**	**50%**

* Includes estuarine catch
- = Unknown

The following sections therefore provide more details on the main MSFs for salmon in Community waters, namely in Ireland and the three UK jurisdictions. Limited additional information is available for the coastal fisheries operating Sweden.

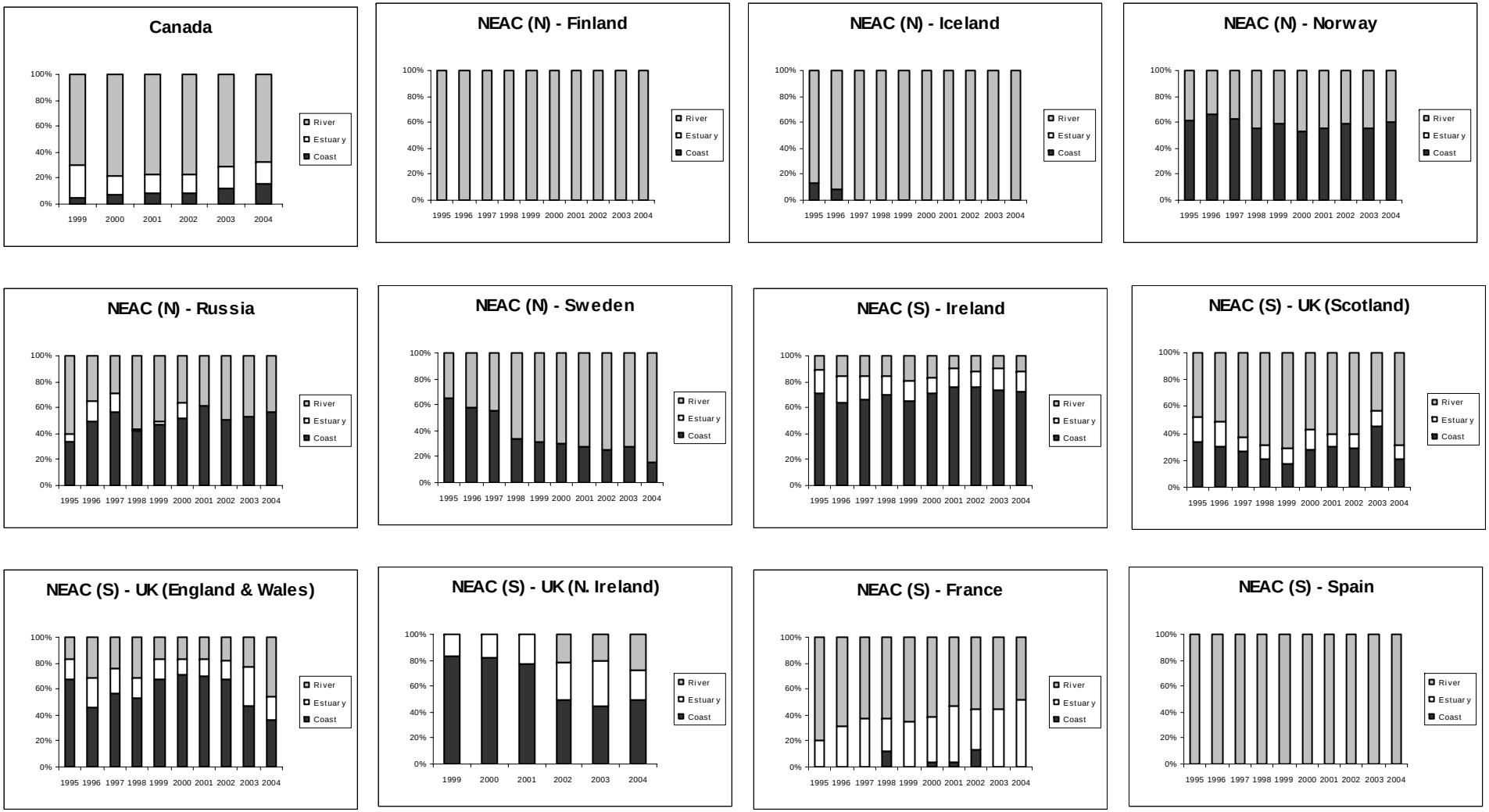
While Finland has no coastal fisheries for Atlantic salmon, it should be noted that the River Teno is a particularly large system, the largest Atlantic salmon river, which it might be appropriate to manage as a series of sub-units. This river also supports fisheries in its lower reaches which are operated by both Finland and Norway. The extent to which the management of these fisheries is coordinated is currently unclear and may deserve closer consideration.

5 MIXED STOCK SALMON FISHERIES IN IRELAND

5.1 Regulatory framework in Ireland

Responsibility for management of the salmon fishery in Ireland lies with the Department of Communications, Marine and Natural Resources (DCMNR) and is administered through the seven Regional Fisheries Boards (East, South, South West, Shannon, West, North West and North). The Boards enforce fisheries legislation and carry out inspection at sea and on inland waters. This surveillance is further enhanced by dedicated naval surveillance co-ordinated through the Central Fisheries Board. Each region is further sub-divided into Districts for administrative and management purposes; there are 17 salmon fishery Districts.

Figure 4.1 Percentage of nominal catch taken in coastal, estuarine and riverine fisheries by country for 1995-2004 (where available). (From ICES 2005)



The National Salmon Commission (NSC) was established under the 1999 Fisheries (Amendment) Act, to assist and advise the DCMNR on conservation, management protection and development and to recommend schemes including tagging of salmon, Total Allowable Catches (TACs) and quotas. The NSC is advised by its Standing Scientific Committee (SSC) also established under the 1999 Fisheries (Amendment) Act (No. 35, 55c) to "advise and assist the National Salmon Commission on all technical and scientific matters in relation to the performance of the Commissions functions". Since 2000, the SSC has provided catch advice on a national and district basis (Ó Maoiléidigh, *et al* 2004).

The Foyle Fisheries salmon fishery is administered by the Foyle, Carlingford and Irish Lights Commission (Loughs Agency) which is a North/South body established under the British/Irish Agreement Acts.

The 17 separate salmon fisheries districts in Ireland comprise a varying number of rivers (from only 1 individual river to 30 separate rivers). There are 173 rivers in total, including large tributaries. Conservation limits have been established for all rivers and aggregated into District conservation limits. Compliance with the District conservation limits is measured against the estimated spawning stock in each district on average for the previous 5-year period and the district catch advised is the catch which provides at least a 75% probability that there will be a simultaneous attainment of the conservation limit in each river in a given district.

In Ireland, while there are some completely private ("several") fisheries where the rights to fish are inherited, the majority of fishermen must have a state licence (commercial or recreational) to fish. In 1997 the number of public commercial fishing licences issued was capped at the 1995 level i.e. 775 public drift net licences, 464 draft net licences and 132 licences for other commercial fishing methods. This cap on licences did not include private or special local area licences (56 drift net licences, nine draft net licences and four other-method licences). In the case of commercial fishermen the licence entitles them to fish only within the district where the licence is issued and only within the season and with the fishing gear permitted. A public or special area local licence is not an inherited right and must be applied for annually. Provided the applicant held a licence for the previous season and has fished at least one of the previous three seasons (and has no convictions for fisheries offences) these licences will be renewed.

5.2 Summary of stock status in Ireland

District catch advice is predicated on the attainment of the 1SW salmon conservation limits only, as these comprise the vast bulk of the mixed stock fishery catch. Risk assessment of the catch advice process in 2004 have resulted in catch advice for 2005 being predicated on a 75% chance of meeting conservation limits in all rivers simultaneously in each district, taking into account variation in run size over the past five years.

Of the 17 fisheries districts in Ireland, there are eight districts, mainly located on the east and south coasts, where the conservation limit will probably not be met even in the absence of harvests of salmon. In six other districts, the average catch (2000 to 2004) if taken in 2005 would result in a less than 75% chance of meeting the conservation limit. The remaining districts are meeting or exceeding their conservation limits. In this instance, the average district catch is advised for 2005,

even where the harvest option providing a 75% chance of meeting the conservation limit is higher. This recognizes the fact that these are mixed stock fisheries which intercept salmon destined for districts which are below their conservation limit. The status of the stocks in these districts will be assessed on an ongoing basis, and the advice will change in line with any significant and consistent improvement in stock size.

In order to allow a 75% chance or greater of meeting the conservation limit in 2005, the SSC advised that the maximum harvest by all methods (commercial and recreational) for all districts combined should be no more than 122,541 one-sea winter salmon. Following consultations between the DCMNR, the National Salmon Commission and the Central and Regional Fisheries Boards, a commercial fishing TAC of 139,900 has been allocated in 2005. When combined with a potential rod catch of 27,500 salmon this is equivalent to a potential maximum harvest of 167,400 salmon or 37% higher than the scientific advice. This level of harvest provides about a 50% chance of meeting the conservation limit nationally, but ranges from 0% to 100% depending on the district. However, the commercial fishery has been reduced from 212,000 fish in 2002 with TACs of 182,000 in 2003, 162,000 in 2004 and the current TAC of 139,900 in 2005. The reductions in the district fisheries have as much as possible been aimed at those districts which were furthest below their conservation limit.

5.3 Mixed stock salmon fisheries in Ireland

The principal fishing methods used to catch salmon in Ireland are drift nets, draft nets and rod and line (Table 5.3.1). Only the drift nets are operated outside estuaries and therefore conform to the definition of salmon MSFs; these nets accounted for 72% of the total national salmon catch in 2004. The number of fishermen (i.e. employed in the fishery) is estimated from the ratios of numbers licensed to numbers employed in Whelan and O'Connor (1974).

Table 5.3.1 Summary information on fishing methods employed to catch salmon in Ireland in 2004

Fishing method	No. Licences issued	Estimated number of fishermen	% of total catch in 2004
Drift nets	848	2,376	72%
Draft nets	473	1632	14%
Snap nets	139	375	2%
Traps, bag nets, pole nets, loop nets, head weir	12	32	>1%
Rod	31,809	33,000	12%

From the early 1960s to the mid 1970s, the drift net catch increased rapidly, following the introduction of synthetic, and then monofilament, nets. This was probably responsible for the simultaneous decline in the draft net catch and resulted in the proportion of the catch taken by drift nets increasing from 20% to 70% during this period, while the proportion taken by draft nets declined from 50% to 20%.

Since 1990, reported catches by all methods have remained relatively stable at around 600t, which is about one third of the peak catch (2216t) recorded in 1975. Over this period, the proportion of the total catch taken by drift nets has varied between about 65% and 75%.

5.4 Stocks exploited by the Irish MSFs

The Irish national coded wire tag recovery programme was initiated in 1980 to estimate marine survival of Irish salmon stocks and the impacts of high seas and homewater commercial and recreational fisheries (Browne, 1982). Microtagging programmes have been carried out on a number of rivers on a consistent basis since this time. The majority of tagged fish have been hatchery-origin smolts (approximately 300,000 annually), although some tagging of wild smolts (approximately 3,500 annually) has also been undertaken, particularly on the River Corrib. Between 30% and 50% of the catch by the coastal drift nets is scanned in many locations around Ireland to identify returning tagged salmon.

Results clearly indicate that the coastal fishery is a mixed stock fishery and that tags from virtually any river where tagging occurs can be taken in all district fisheries either in one year or over a series of years. Approximately 50% of the tagged salmon are caught outside their district of origin. The results have also confirmed that exploitation on these tagged stocks generally declines the further away the fishery is from the river of origin. Currently, the coastal mixed stock fisheries (drift nets) take approximately 50% of the total stock returning to Irish rivers. Therefore, approximately 25% of any given stock may be intercepted outside the district of origin with a further 25% being taken within the district of origin

Table 5.4.1 Numbers of tags recovered in the Irish coastal drift net fishery by country of origin, in 5-year periods from 1985 to 2004.

YEAR	Northern Ireland	England/ Wales	Scotland	France	Spain	Norway	Denmark	Germany	Faroes Islands
1955-89	366	291	403	6	0	0	0	0	0
1990-94	941	456	148	8	12	1	0	0	1
1995-99	414	420	21	65	31	1	73	1	0
2000-04	528	242	6	1	50	0	2	2	0
TOTAL	**2249**	**1409**	**578**	**80**	**93**	**2**	**75**	**3**	**1**

Tagged salmon from UK (Northern Ireland, Scotland, England and Wales), Spain, Germany and Denmark have also been taken in the Irish fishery (Table 5.4.1). It is important to note, however, that the numbers of recaptures from different countries will be strongly influenced by the numbers of fish tagged and cannot be used to compare relative levels of interception of salmon from different countries in the Irish fishery. Thus, for example, the reduction in the numbers of recaptures from Scotland is largely due to a reduction in numbers of fished tagged, particularly in west coast sites.

In many cases numbers have been too small, or insufficient supporting information has been available, to estimate exploitation rates with any degree of precision. However, tagging of parr and smolts in English and Welsh rivers has demonstrated that salmon from all parts of those countries are exploited in the Irish coastal fishery. The levels of exploitation have varied between stocks from different regions and from year to year, and have also declined following the introduction of new management measures in the Irish fishery since 1997 (Table 5.4.2).

Table 5.4.2 Aggregated estimates of exploitation of 1SW salmon from four rivers in England and Wales in the Irish drift net fishery for years for which data are available before and after the introduction on 1997 management measures.

River	Pre 1997 management measures			Post 1997 management measures		
	Years	Expl. Rate	95% CL	Years	Expl. Rate	95% CL
Tyne - NE England	1986-96	1.4	± 0.4	1997	0.5	± 0.8
Wear - NE England	1986-96	0.9	± 0.2		No data	
Dee – N. Wales	1992-96	15.3	± 5.3	1997-2003	2	± 1.0
Taff – S. Wales	1991-96	22.0	± 6.8	1997-2003	9.8	± 4.2
Test – S. England	1991-96	28.4	± 5.9	1997-2000	11.9	± 4.2

It appears that prior to the introduction of the new management measures, exploitation rates in the Irish fishery were about 1% for stocks from the north east of England, higher (15 to 22%) for the two rivers in Wales, but highest (~28%) for the River Test in southern England. Since the introduction of the regulatory changes, exploitation rates have fallen to 0.5% for the Tyne (data for one year only), 2% to 10% for Welsh rivers and 12% for the River Test. While it was not possible to use the modelling approach to estimate exploitation rates for other stocks, the overall pattern of tag recapture rates for stocks around England and Wales is consistent with this regional pattern of exploitation.

The Irish drift net fishery currently only operates in June and July and cannot therefore exploit early running MSW salmon from any rivers.

5.5 Recent management measures and future plans for Irish MSFs

The Irish Government has stated (http://www.dcmnr.gov.ie/Marine/Inland+Fisheries /Inland+Fisheries.htm) that their overriding objective with respect to the management of wild salmon is to conserve the salmon resource both in its own right and for the benefit of the coastal and rural communities that it helps to support. The economic goals for a sustainable commercial salmon fishery are based on quality and value, rather than volume.

The current management plan envisages the following staged approach to achieving the management objectives of meeting conservation limits in all rivers:

- Monitoring of district catches by means of mandatory carcass tags and logbooks. There is currently a greater than 98% return of commercial fishing logbooks, while approximately 50% of recreational logbooks are returned. This has significantly improved the information on the removals of fish by all methods, as well as providing specific information on the distribution of the catch amongst licence holders. Information on the disposal of the catch (sales to licensed dealers, directly to shops, hotels, guest houses, private consumption, etc) provides an insight into the main markets for wild salmon.

- Continued assessment of exploitation rates on specific stocks using the National Coded Wire Tagging and Tag Recovery Programme. This allows the status of district stocks to be evaluated even when catches are subject to TACs, and also

indicates the level of mixed stock fishing taking place (including interception of salmon destined for other Member State countries).

- Evaluation of attainment of district conservation limits and provision of catch advice relative to the objective of meeting conservation limits .

- Setting district TACs which are in line with scientific advice and which take account of interceptions of fish in neighbouring districts and other Member States.

- Provision of catch advice for as many individual stocks as possible using automatic fish counters or in-river catches to estimate spawners and attainment of conservation limits.

- Establishment of a National Genetic Stock Identification (GSI) Programme to disaggregate the district catches by river of origin and identify those fisheries taking fish from rivers in other districts which are below conservation limit.

The ultimate objective is to manage the catches in order to have all rivers in all districts meeting their conservation limits within a reasonable time-frame, and that interception of fish from the rivers of other member states not meeting their conservation limits would be eliminated. Considering the status of stocks currently and the prognosis that the situation is unlikely to improve significantly in the short term, this will require significant reductions in fisheries or complete closure in as many as 8 of 17 districts in Ireland in the short term. It also requires continued and high level monitoring of catches and stocks, intensive policing and significant stock rebuilding.

The following conservation measures were introduced in 1997 aimed at reducing fishing effort:

- Cap on public commercial fishing licences for draft nets and drift nets
- Area of fishing at sea reduced from 12 to 6 nautical miles
- Drift net season constrained to 1st June to 31st July (previously February in some areas)
- Draft net fishery deferred to the 12th May to 31st July (previously February in some areas)
- Reduction to 4 days fishing per week (previously 5 days)
- Restriction on night time drift net fishing (0400 to 2100 hrs only)

Further measures have been put in place in the net fisheries since 2001:

- Introduction of mandatory carcass tagging and logbook scheme in 2001 (this applies to all sectors of the salmon fishery)
- TACs have been assessed and imposed annually 2002-05
- TAC to be consistent with the national scientific advice by 2007.

6 MIXED STOCK SALMON FISHERIES IN ENGLAND AND WALES

6.1 Regulatory framework

The Environment Agency (EA) and the Department for Environment, Food and Rural Affairs (Defra), or the Welsh Assembly Government (WAG) in Wales, each have roles in the management of salmon fisheries. Defra and WAG have overall responsibility for salmon within their areas of jurisdiction. They are jointly responsible for setting the statutory framework under which salmonid stocks and fisheries are managed, and the Secretary of State (England) and the National Assembly for Wales (Wales) have statutory responsibilities to consider the acceptability of all new fishery regulations and fishing licence duties proposed by the EA. The EA Regions prepare and submit proposals for local by-laws or Orders affecting individual rivers or fisheries, while the EA Head Office handles proposals for national measures.

Salmon fisheries in England and Wales are regulated by effort controls which specify the nature of the gear that may be operated, along with where, when and how it may be used. Anyone fishing for salmon with net or rod must have a licence, and numbers of net licences issued are limited by Net Limitation Orders (NLOs) which apply to individual fisheries (e.g. within each estuary). A small number of net fisheries are privately owned and are not subject to NLOs; these fisheries may be regulated by byelaws but the nature of the gear used cannot generally be altered. Although byelaws may be introduced to make immediate reductions in fishing effort (e.g length of seasons), reductions in licence numbers imposed under NLOs will not necessarily have immediate effect on the number of licences issued, because existing licensees who are dependent upon fishing for their livelihood retain the right to receive a licence as long as they continue operating.

Salmon Action Plans (SAPs), which include the establishment of conservation limits and management targets, have been developed for all the 64 principal salmon rivers in England and Wales. Development of management measures is based on the objective of exceeding conservation limits in at least four years out of five. The SAP consultation process reviews stock and fishery status (including the use of conservation limits), identifies factors limiting performance and lists a series of costed options to address these. The Final Plans contain agreed actions which must be addressed within 5 years and provide refined salmon conservation limits. SAPs are progressively reviewed as they pass their 5-year time-scales.

6.2 Summary of salmon stock status in England and Wales

In 2004, 37 of 62 assessed rivers (63%) exceeded their conservation limit, a marked improvement on 2003 (25%) and the highest proportion in about 10 years, although this reflects the good runs which resulted from the favourable river flows experienced for much of the fishing season in 2004. Overall, estimated egg deposition was above average (1994-2003). 11% of rivers in 2004 had less than half the egg deposition required to meet their conservation limit.

Though this suggests that the majority of salmon stocks in England and Wales are in a satisfactory state, the compliance assessment (which takes trends in egg deposition into account) indicates that only 10 rivers across England and Wales had a high probability of achieving the management objective to exceed the conservation limit in four years out of five, whilst 33 failed this compliance assessment, and the

remaining 19 rivers fell between a clear fail or pass. It is, therefore, too early to conclude that a stock recovery is underway.

Viewed against historical data, current stock estimates and catches provide ongoing cause for concern and the conservation of salmon (especially early-run MSW fish) remains a priority.

6.3 Salmon fisheries in England and Wales

Around 20 different fishing methods are employed in England and Wales for catching salmon (Annex 1). These may be grouped into the four main 'commercial' categories described in Section 2.3, plus recreational angling (Table 6.3.1). The number of licences issued for nets and fixed engines has been significantly reduced over the past 20 years as a result of measures taken to reduce levels of exploitation and phase out mixed stock fisheries as well as the declining commercial viability of some fisheries. Overall, the number of net licences issued has decreased from 1027 in 1985 to 394 in 2004, a 62% reduction. The largest reduction has been in the numbers of 'gilling nets' (73%), which have accounted for the majority of the catch in coastal waters, followed by encircling nets (67%) and hand-held nets (58%). It is likely that there were around 600 fishermen involved with commercial salmon fishing in 2004, although additional people may have assisted on an irregular basis.

Table 6.3.1 Summary information on fishing methods employed to catch salmon in England and Wales in 2004 (provisional data).

Category	Number of net licences	Estimated number of fishermen	Weight caught & retained (t) and % of total
Gilling nets	97*	~200	26.8 (25%)
Encircling nets	75	~175	6.2 (6%)
Hand held nets	157	~157	7.0 (6%)
Fixed engines/Trapping nets	65	~130	19.1 (18%)
Rod and line - short term - annual	10,272 20,622	~30,000	48.9 (45%)

* Including 5 combined licences for the use of drift and T/J nets and all (40) Anglian area nets.

About 39 t of salmon was taken by coastal MSFs in 2004, which was about 36% of the total catch for England and Wales of 108 t and comprised more than 75% of the catch by gilling nets and fixed engines/traps.

In the early 1990s, there were 10 fisheries operating in coastal waters in England and Wales, which therefore conformed to the definition of MSFs. The largest of these was the North East Coast fishery which accounted for 66% of the total England and Wales catch between 1985 and 1989. The main component of this fishery was based on drift nets operated up to 6 miles offshore, although a lesser number of traps ('T nets' or 'T/J nets') were also worked from specified beaches.

Eight of the remaining nine MSFs were quite small, and were thought to exploit mainly local stocks:

- The SW Cumbrian drift net fishery employed 4 drift nets in coastal waters off NW England;

- Five fisheries employed a total of about 25 encircling nets around the Welsh coast.
- One fishery, on the Anglian coast, targeted a range of species including sea trout, but took very few salmon (average ~10 fish per year) and employed mainly drift/gill nets.

The final MSF operates in the Severn Estuary and has in the past employed eight drift nets, up to four seine nets, a variable number of lave nets, and over 50 fixed engines. Eight salmon rivers flow into this estuary, and it is not obvious where the estuary limits might be drawn in order to define which of the fisheries conform to the MSF definition used in this report. However, the Environment Agency has drawn up a single Salmon Action Plan for the whole estuary and has determined that most parts of the fishery should either be closed or capped at the 2002 level. Only the seine nets, lave nets and five fixed engines operated in 2004 (EA, 2003).

6.4 Stocks exploited by MSFs in England and Wales

Tagging studies undertaken in the late 1970s and early 1980s indicated that a substantial proportion (~95%) of the salmon caught on the North East Coast of England were returning to Scottish rivers on the east and north-east coasts between the rivers Tweed and Dee. The exploitation rate on the river Tweed stock was estimated to be about 15%, decreasing on the more northerly river stocks to very low levels for the river Dee. Since that time there has been a substantial recovery of many rivers in north-east England, such that one of these (the Tyne) now supports the best rod catch in England and Wales. As a result the proportion of fish caught in the drift net fishery returning to local English rivers was estimated to have increased from around 5% to about 25%, with a consequent decline in the proportion returning to Scottish rivers.

The T&J nets operated on the North East coast are generally operated close to river mouths and tagging studies in the 1980s suggested that around 50% of the salmon caught were returning to local English rivers, with the remainder returning to Scottish rivers (mainly the river Tweed). This figure is also likely to have increased substantially in recent years due to the improvements in the local stocks.

The MSF operated on the Anglian coast exploits mainly sea trout, along with other marine species, and only small numbers of salmon (~10) are taken each year. It is not known to which rivers the salmon are returning although there are no currently recognised salmon rivers close to the fishery. The phase out of this fishery is intended to facilitate improved management of the sea trout which are returning to rivers in the North East of England and the river Tweed in Scotland.

The Severn estuary fishery exploits fish returning to several different rivers in England and Wales, including the rivers Taff, Ely, Rhymney, Ebbw and Parrett, as well as the Wye, Severn and Usk. Tagging work carried out in the 1960s (Swain 1982) demonstrated that returning salmon, tagged as smolts in the rivers Severn Wye or Usk, were recaptured in fisheries throughout the estuary. More recent microtagging studies carried out in Wales between 1984 and 1993 have confirmed these general findings (EA, 2003).

6.5 Recent management and current plans for MSFs

In 1993, a phase out of the North East Coast drift net fishery began based on the recognition that exploiting salmon in MSFs makes management of individual river stocks difficult and may prejudice their full protection (Anon, 1993). In the North East Coastal Fishery, this policy is restricted to the drift net fishery, and, where the opportunity existed, some fishermen were permitted to transfer to beach nets (T and J nets) which are known to exploit more local stocks.

Two successive Net Limitation Orders for the North East Drift Net Fishery (1992 and 2002) therefore have set to reduce the number of licences to zero, although the regulations permit existing dependent licence holders to retain their licences as long as they continue operating. The fisheries are therefore being phased out as fishermen retire. These Orders also capped the number of T/J nets licensed in each of seven districts in the North East Region.

In 1996, a policy for MSFs was adopted for the whole of England and Wales which stated that '…exploitation … should take place, as far as possible, where the stock of salmon is from a single river. In fisheries which can be shown to exploit predominantly mixed stocks, fishing will be phased out over an appropriate timescale' (NRA 1996). In 2000, the Salmon & Freshwater Fisheries Review (MAFF 2000) endorsed the policy of phasing out mixed stock fisheries in general. It also agreed that it was reasonable that this policy was not applied to estuary fisheries exploiting fish from a small number of rivers as long as these to could be managed to protect the weakest stock. The advice was accepted by both English & Welsh Governments (MAFF, 2001).

This policy has been applied to the ten coastal mixed stock fisheries in England and Wales and has been completed for seven of them (Table 6.5.1). In several cases, the phase-out has been accelerated by introducing compensation schemes to encourage fishermen to retire from the fishery early.

Significant advance was made with the phase-out of the North East Coast Salmon fishery in 2003. A £3.4 million buy-out, funded by the Department of Environment, Food and Rural Affairs (£1.25M) and the North Atlantic Salmon Fund UK (£2.15M), was agreed which resulted in 52 of the remaining 68 netsmen leaving the fishery. The average cost of each licence purchased was therefore ~ £60,000. When these fishermen left the fishery, their licences could not be reissued.

As a consequence, 16 drift net licences were issued in 2003 and 2004 compared with 69 in 2002 (-77%), and the number of drift net licences issued for the North East Coast Fishery has now been reduced by 89% since 1992. The remaining drift nets took a catch of 5,511 salmon compared with 27,685 in 2002 (-80%).

Some of these netsmen were able to remain in the fishery by switching to inshore T- or J- nets, which are known to exploit a higher proportion of local fish and a higher proportion of sea trout than salmon. This fishery has also benefited from the reduction in drift netting, and the catch by T/J nets rose from 3,295 in 2002 to around 5,000 fish in 2003 and 2004 (an increase of about 50%), taken by 41 and 46 nets (including combined drift and T&J net licences) respectively. The overall catch on the north east coast fell from around 31,000 in 2002 to around 11,000 in 2003 and 2004.

The current management plan is to continue the phase out of the North East coast drift nets and the Anglian nets as fishermen retire, although this policy will have to be reviewed at least every 10 years. The Environment Agency's Severn Estuary SAP (2003) sets out the principle of seeking to phase out exploitation by fisheries in the estuary over an appropriate time-scale. However, the unique ownership and rights that control the operation of the fixed engines restrict the management options available.

Table 6.5.1 Numbers of net licences issued to fish for salmon in ten MSFs in England and Wales 1992-2004.

	Fishery										
Year	**NE Coast**	**NE Coast**	**Anglian Coast**	**SW Wales coast**	**River Ogwen**	**R. Seiont**	**R.Clwyd**	**R Llyfni**	**R Dwyfawr**	**R Usk[1]**	**SW Cumbria**
Net type	Drift[2]	T&J	various	seine	seine	seine	sling	seine	seine	drift	drift
1992	142	31	129	17	2	2	2	0	2	8	4
1993	124	27	93	11	1	1	3	0	2	8	4
1994	114	24	72	16	2	2	2	0	2	8	4
1995	99	24	65	9	2	1	2	0	2	8	4
1996	89	19	59	0	2	1	2	1	2	8	4
1997	81	14	56	1	2	1	2	0	2	8	4
1998	75	13	54	0	2	0	0	0	1	8	4
1999	72	13	54		2				1	8	1
2000	71	13	46		1				0	0	1
2001	70	14	46		0						1
2002	69	17	46								1
2003	16	41	45								0
2004	16	50	40								

[1] part of the Severn Estuary Fishery
[2] some drift net licences also permit use of T-nets

7 MIXED STOCK SALMON FISHERIES IN NORTHERN IRELAND

7.1 Regulatory framework in Northern Ireland

The Department of Culture Arts and Leisure and its agent, the Fisheries Conservancy Board (FCB), have responsibility for conservation and protection of wild salmon fisheries in Northern Ireland, except for the Foyle and Carlingford areas that are the responsibility of the Loughs Agency of the Foyle, Carlingford and Irish Lights Commission (FCILC) (Figure 7.1.1), a cross border body established under the Good Friday Agreement. For the purposes of reporting to ICES/NASCO, 50% of the FCILC catch is allocated to the Irish catch record and 50% to the UK (NI) catch record.

The exploitation of salmon is strictly controlled through regulations made under the provisions of the Fisheries Act (NI) 1966 and the Foyle Fisheries Act 1952. All commercial salmon netsmen are required to hold licences. A carcass tagging and logbook scheme for all salmon fishing was introduced into both fishery areas of Northern Ireland for the first time during 2001. The scheme is designed *inter alia* to

improve records/returns for rod caught fish and to facilitate regulation of numbers caught (by quota) should this be necessary.

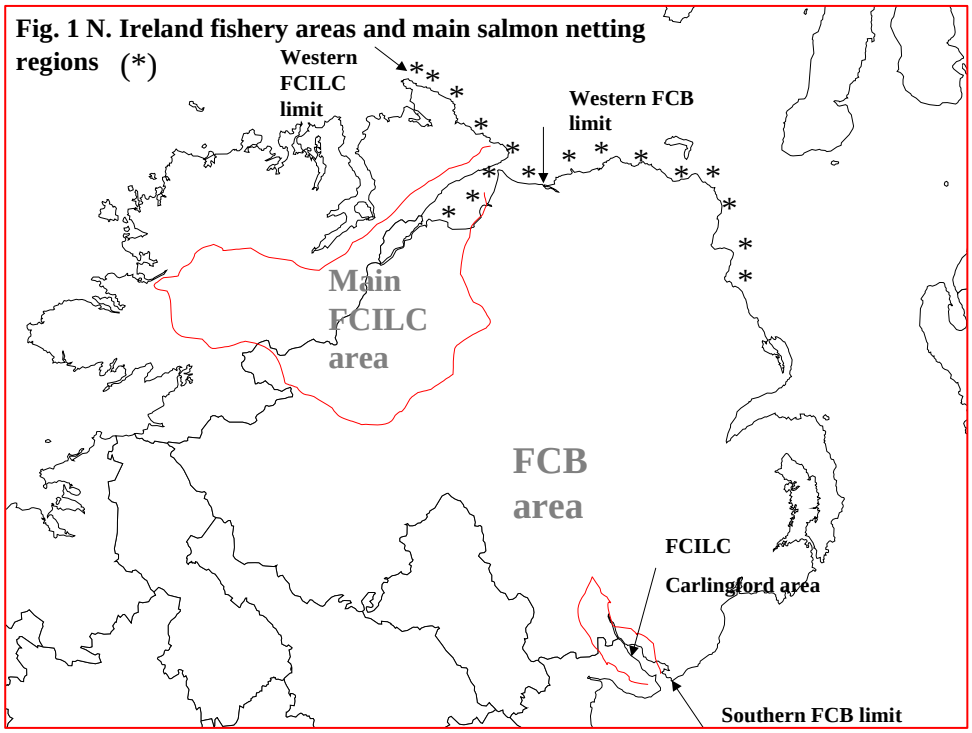


Figure 7.1.1 Map of Fisheries Conservancy Board (FCB) and Foyle, Carlingford and Irish Lights Commission (FCILC) areas and main salmon netting areas.

There are 27 salmon rivers in Northern Ireland, and conservation limits have been established for six of these. The River Foyle and its tributaries has recently been recommended as a Special Area of Conservation (SAC) under the EU Habitats Directive and it has been designated as an Area of Special Scientific Interest (ASSI).

7.2 Summary of salmon stock status in Northern Ireland

For the FCB area, specific conservation limits have been derived for the River Bush from a whole river stock/recruitment relationship, based on estimates of ova deposition and smolt counts. Work continues to extend conservation limit setting to all salmon producing rivers in the FCB area of Northern Ireland, and to install fish counters to enable compliance to be assessed in key indicator rivers.

The most comprehensively developed conservation limit for Northern Ireland at present is that for the R. Bush. In 2004, only 57% of target egg deposition was achieved from wild spawning, a reduction compared to the previous 10-year average (85%). The conservation limit on this river has been reached or exceeded in only 2 of the last 10 years. Recent information is available for three other rivers where compliance with the conservation limit can be assessed. Of these, two are below conservation limit (31% and 66% of conservation limit being attained) while the third is approximately 44% above conservation limit.

A spawning target based management system has been operating in the Foyle fishery area for many years, based on a scientific study of stock and recruitment relationships in the system (Elson & Tuomi, 1975). This was revised in 1998 and is

now based on juvenile salmonid habitat assessments. Associated management targets are operated on the basis that, if, at certain dates during the season, target numbers of fish have not been achieved at Sion Mills Weir (R. Mourne), and in two other rivers (R. Faughan & R. Roe), then specified closures of the angling and/or commercial fisheries take place. Conversely, if the in-seasonal management targets have been met by the normal end of the commercial netting season, an extension is granted. No extensions or closures were initiated in 2004. In the Foyle area, in 2004, most of the rivers with fish counters exceeded management targets based on egg deposition levels.

The Loughs Agency is in the process of establishing conservation limits and compliance monitoring for the other rivers that have counter sites within the catchment.

7.3 Description of the salmon fisheries in Northern Ireland

The fisheries in Northern Ireland comprise mainly drift nets, draft nets (Table 7.3.1), in addition to rod and line. A total of 156 licences were issued in 2004, while the number of fishermen (i.e. employed in the fishery) is estimated from the ratios of numbers licensed to numbers employed used by Whelan and O'Connor (1974).

Table 7.3.1 Summary information on commercial fishing methods employed to catch salmon in Northern Ireland in 2004 (provisional data)

Area	Category	Number of nets	Estimated number of fishermen	Weight caught (t) and % of total
Foyle	Drift	88	238	16 (34.7%)
	Draft	52	156	10 (21.5%)
FCB	Drift	2	5 to 6	)
	Draft	2	6	) 3 (5.8%)
	Bag	2	4 to 6	)
Combined	Rod & line	n/a	n/a	18 (38.0%)

Licence types are further broken down into 'Sea only', 'Lough and Sea' and 'Lough only' licences. The 'Lough and Sea' landings are not broken down into coastal and estuarine components. The total landings by the 'Sea only' licences in 2004 were 2,046 salmon. As half of these would be reported in the fishery statistics for the Republic of Ireland, the remaining half (1,023 salmon) would represent 5.4% of the Northern Ireland national catch.

In the FCB area a voluntary buy-out has resulted in a reduction in the number of licenses from 27 in 2000 to six in 2004. The remaining licence holders continue to operate with the voluntary restrictions introduced. (for the 2001 season i.e. that no net shall fish until the 1st June (season was previously 17th March to 15th September and holders of drift net licenses agreed to operate for only eight weeks during the period 1 June to 15 September, broken down into two four-week periods.

In the FCB area there are currently two driftnets and two fixed nets operating in coastal waters which conform to the definition of MSFs. Two tidal draft nets operate in the estuary and would not be considered as MSFs as defined in Section 2.5. The total catch in 2004 (including rod catch) was approximately 13 t. The rod catch

comprised 55% of the FCB total, with the coastal nets (i.e. the mixed stock fishery) comprising the bulk of the remainder.

There are 88 drift net licensees in the Foyle area but it is known from licence checks that not all of the licence holders fish. Of those fished, many operate within the Foyle estuary. This is a large estuary and its limits may be difficult to define. The nets operating outside the estuary can be considered as mixed stock fisheries. The total catch in the Foyle area in 2004 was estimated at 67 t, comprising 52% by drift nets (both coastal and estuarine), 32% draft nets (estuarine) and 16% rod catch.

Of the totals Northern Irish catch in 2004, 45 t (50%) was estimated to be taken in coastal waters, 11 t (23%) in estuaries and 13 t (27%) in rivers (ICES, 2005).

7.4 Stocks exploited by the MSFs in Northern Ireland

The only direct estimate of exploitation on stocks from Northern Ireland is for the River Bush. The average exploitation rates for wild 1SW salmon returning to the River Bush in homewater fisheries in 2000-04 were 30% in the FCB area, 13% in the Foyle area and 5% in the rest of Ireland. It is believed that the catch in the FCB and Foyle areas comprise principally fish destined for rivers in those areas respectively although some tagged salmon originating from rivers in Scotland, England and Wales have been taken.

Salmon tagged in England and Wales as part of the programmes described in Section 5.4 have also been recaptured in Northern Ireland. These recoveries are too few and too intermittent to provide good estimates of exploitation, but suggest that exploitation rates on these stocks in Northern Ireland are generally significantly lower than in Ireland.

7.5 Recent management and current plans for MSFs in Northern Ireland

<u>FCB Area</u>

The principal regulations governing the commercial salmon fishery in the FCB Area are:

- The fishing season is 18 March – 15 Sept
- Fishing is restricted to 5 days/week
- Monofilament netting is prohibited

In addition the following further measures were introduced in the commercial fisheries in 2001/02:

- net buy-out scheme (voluntary)
- Introduction of mandatory carcass tagging and log book scheme.

<u>Foyle Area</u>

The commercial season in the Foyle and Carlingford areas is restricted to 6 weeks (15 June-31 July), fishing is restricted to 4 days/week and drift net fishermen are only allowed to fish for 12 hours per day. There are also restrictions on length and depth of nets, boat size and use of monofilament net is prohibited. Other restrictions in the commercial fishery include:

- Drift netting - limited to with 6 miles of the coast
- Draft netting – restricted to the tidal part of River Foyle
- Season – 6 weeks (15 June – end July)
- Drift net fishery restricted to 4 days/week (Mon-Thur) and 12hr/day
- Draft net fishery restricted to 5 days/week

Considerable progress has been made in recent years to reduce the impact of mixed stock fisheries on stocks in the FCB area including the permanent removal of a significant number of coastal and estuarine fishing engines. This has resulted in a drop in catch from approximately 10,000 fish prior to 2000 to just over 2,500 in 2004. Further efforts are being made to negotiate buy-outs and other voluntary measures with remaining fishery operators.

The Foyle fisheries are operated on a real time management system which curtails fishing activity in line with returns through electronic fish counters and relative to the overall objective of meeting conservation limits in the Foyle. To this end stocks are at or close to attaining conservation limits in most years. Several more tributaries have been selected to act as monitored sites to assess compliance. A recent Genetic Stock Identification survey (GSI) has provided important information on the stock components being exploited by the fishery and timing and specific location where this exploitation takes place. This has identified those stocks which are exploited in the Foyle fishery. Further studies are required to examine exploitation on stocks originating outside the Foyle area. A three year programme is also being initiated to develop a Pre-Fishery Abundance model for the Foyle stocks.

8 MIXED STOCK SALMON FISHERIES IN SCOTLAND

8.1 Regulatory framework in Scotland

Under Scottish law, salmon are wild animals until captured. Once captured, the salmon belongs to the captor, but the right of ownership of the fish has been virtually eroded by numerous statutes forbidding the taking of salmon without right or written permission and by forfeitures imposed by statute. The effect of this is that it is not the salmon that is owned but the right to fish for them.

Thus, in Scotland, salmon fishing rights, both in freshwater and in the sea, are private heritable titles which may be held separately from any land. In order to fish for salmon, it is necessary to have the legal right to fish or written permission from the person having such right. All salmon fishing rights were originally vested in, and many are still owned by, the Crown. However, fishing rights may also be owned by private individuals, companies, institutions, Local Authorities and, in a few cases, by the Scottish Executive. These rights may be bought, sold or leased.

The responsibility for the management of salmon stocks rests with a number of bodies ranging from central government to private individuals. Scottish Ministers have overall responsibility for the stewardship of the freshwater fish resources and the fisheries that depend on them, and The Scottish Executive Environment and Rural Affairs Department (SEERAD) acts on behalf of Ministers to develop policy and legislation to protect the aquatic environment and to control the exploitation of stocks. SEERAD also works to ensure that Scotland plays her part in meeting conservation obligations placed on the UK by the EU.

8.2 Summary of salmon stock status in Scotland

River-specific conservation limits have not been developed for most Scottish salmon stocks because they are not considered appropriate; instead, alternative targets based upon seasonal patterns of catches are being developed. However the annual assessment undertaken by ICES suggests that overall the abundance of salmon returning to rivers in Scotland has roughly halved since the 1970s and 1980s, with a greater decline being observed in numbers of MSW salmon than of the 1SW fish. Over the past 30 years there has been a very marked decline in the catches by nets and fixed engines in coastal waters and estuaries. The numbers of salmon entering freshwater appears to have shown little trend over this period, and this seems to be confirmed by relatively stable rod catches (total retained and released). This suggests that the decline in the stocks has been compensated by the reduction in netting. Thus in 1980-84 the rod and line fisheries (including released fish) accounted for only 20% of the total catch compared to about 70% in 2000-04.

For about the last eight years the total number of returning salmon is estimated, from the current ICES model, to have been fluctuating close to the overall national conservation limit (ICES, 2005).

8.3 Salmon fisheries in Scotland

The two principal types of commercial fishing methods used for taking salmon in Scotland are 'net and coble' and 'fixed engines' (Annex 1 and Table 8.3.1), although hand-held 'haaf nets' and fixed 'poke nets' are also employed in the Solway Firth in the south-west (see Annex for details). The term 'net and coble' describes a type of encircling net similar to the draft and seine nets used elsewhere; these are generally operated in estuaries and the lower reaches of rivers, although small numbers are also used in coastal waters. The term 'fixed engine' covers two general types of trap net (bag and stake nets) which may only be operated outside estuary limits. In addition, recreational 'rod and line' fisheries operate extensively on all salmon rivers.

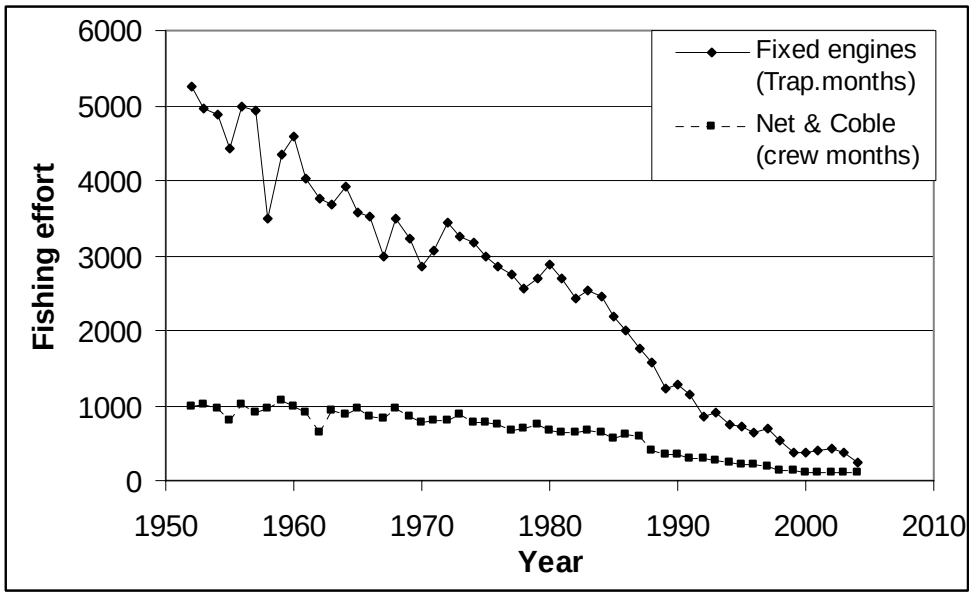


Figure 8.3.1 Changes in fishing effort in Scottish fixed engine (excluding Solway) and net and coble fisheries for salmon, 1952-2004

Fisheries are not licensed in Scotland, (except in respect of the catchment of the Border Esk, which is regulated under English law) and fishery operators can vary the numbers of traps or nets they operate at a particular location. National indices of fishing effort are therefore calculated annually for salmon netting in Scotland. Fixed engine fisheries report the minimum and maximum numbers of traps fished per month, and net and coble fisheries report the minimum and maximum numbers of crews that worked (daily) each month. These data are used to calculate median monthly effort data, in trap.months and crew.months respectively.

There has been a very substantial reduction in these effort indices over the past 50 years (Figure 8.3.1); for example, there has been an 93% reduction in the number of trap.months recorded for the coastally operated fixed engines between the period 1952-56 and 2000-04. These declines reflect both voluntary reductions in fishing effort, statutory changes and the buy-out of netting rights.

Table 8.3.1 Summary information on commercial fishing methods employed to catch salmon in Scotland in 2004 (provisional data)

Method	Number of traps/nets operated	Fishing effort index by traps/nets	Weight of salmon caught (t) and % of national catch
Net & coble	n/a	108 crew months	21 (10%)
Fixed engines	112*	239 trap months	45 (21%)
Rod and line	n/a	-	143 (69%)

* maximum number used in 2003

In 2004, the effort indices for the net and coble and fixed engine fisheries were 108 crew.months and 293 trap.months respectively (Table 8.3.1). All the fixed engines operate in coastal waters and therefore conform to to the definition of MSFs, and these nets accounted for 21% of the total national catch of 209 t, although this proportion may vary significantly between areas. No information is available on the number of net and coble fisheries operating in coastal waters, and the catch by this method (21 t) is not divided into coastal and estuarine components.

The location around the Scottish coast of the 112 fixed engines employed in 2003 (2004 data not available) is shown in Table 8.3.2 and Figure 8.3.2. The main concentrations of fixed engines were on the east coast around the North and South Esk and the river Dee, and on the north coast between the rivers Thurso and Naver.

Table 8.3.2 Numbers of fixed engines and net & coble fisheries operating in coastal waters in Scottish Regions in 2003

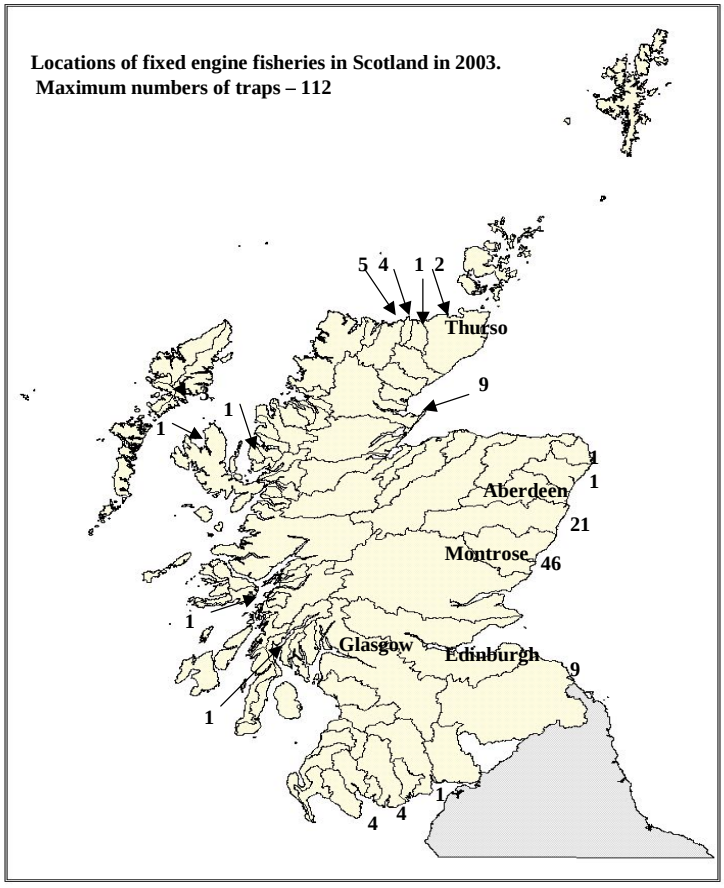
Region	Number of fixed engines (max)*	Proportion of Regional catch numbers (2003)
East	9	6%
North East	69	77%
Moray Firth and North	21	45%
Northwest & West	3	45%
Clyde coast	1	3%
Solway	9	47%
National total	112	46%

(Data from: Scottish Executive (2004)

The operation of the coastal fixed engines can vary significantly from year to year. Fishermen who own the fishing rights at particular locations may change the number of nets they operate; in practice, the number of nets operated may vary according to the perceived abundance of stocks and other logistic considerations.

In 2005, the Esk District Salmon Fishery Board completed the purchase of the netting rights on five miles of the coastline immediately to the north of the South Esk near Montrose at a cost of about £280k. The use of these nets is expected to be terminated within the next three years, although it remains possible for the new owners to bring them back into operation if they wish. The buy-out is expected to roughly halve the impact of the fixed engines in the Scottish North East Region.

Figure 8.3.2 Location of fixed engine fisheries in Scotland in 2003 (From: NASCO, 2004)



8.4 Stocks exploited by the MSFs in Scotland

A number of tagging studies were undertaken on salmon caught in Scottish fixed engine fisheries between the 1950s and 1980s. It should be noted that these data only provide an approximation of the distribution of the rivers of origin of the fish taken in these fixed engines because they cannot be corrected for differences in exploitation rates in the recapture fisheries. However, the pattern of recaptures for fish tagged from three fixed engines between 1977 and 1984 (Table 8.4.1) are broadly similar to those observed in other studies. Excluding interceptions in coastal waters, the largest numbers of recoveries (45-59%) were reported from estuary nets

or rods in one river, the North Esk; the remainder being recorded from estuaries/rivers up to about 150 km from the tagging locations.

Similar patterns of recoveries were recorded for tagging studies undertaken in other areas (Shearer, 1985). Tagging at the fisheries on the north and north-west coasts resulted in a wide distribution of small numbers of recaptures along both the west and east coasts, although the majority were still taken in the two or three rivers closest to the netting station.

Table 8.4.1 Results of salmon tagging studies undertaken at three fixed engine fisheries on the Scottish east coast (1977-84)

Tagging location		**Watermouth**[1]	**Kirkside**[2]	**Rockhall**[3]
Year		1983/84	1984	1977/78
No. tagged		235	401	457
Recoveries				
Coastal F/Es		54	76	130
N&C	R. Naver	1		
& rods	R. Spey		3	6
	R. Don	1		
	R. Dee		3	9
	North Esk	10	26	46
	South Esk	3	6	7
	R. Tay	6	9	8
	R. Tweed	1	3	2
Total recoveries in rivers		22	50	78
% recap's in predominant river		45%	52%	59%

[1] fixed engine <1 km south of North Esk

[2] fixed engine ~1 km north of North Esk

[3] fixed engine ~5 km north of North Esk

[Data from: Fisheries Research Services, Montrose; Shearer (1985)

8.5 Recent management and current plans for MSFs in Scotland

As in other countries, a range of regulatory measures are in place to restrict when different fishing methods may be used and how the gear may be constructed. In the early 1960s, a drift net fishery for salmon was started off the Scottish coast, but the method was prohibited in 1962, and the ban remains in force. Subsequent legislation was introduced to prohibit the use of any form of gill net to catch salmon, and to prohibit the landing of any salmon caught by unlawful methods. In order to ensure that the permitted nets and fixed engines do not catch fish by gilling, the minimum mesh size permitted is 90 mm (stretched mesh), the minimum twine thickness is 0.9 mm, and no part of any net may be constructed using monofilament twine.

Over the past 50 years there have been a range of actions taken to reduce fishing effort by both fixed engines and net & coble (Figure 8.3.1) including both statutory and voluntary reductions in the fishing season, and the buy-out of netting rights by interests (e.g. angling) that no longer wish to operate them. For the coastally operated fixed engines fishing effort had declined by 93% between 1952-56 and 2000-04. In recent years, members of the Salmon Net Fishing Association of

Scotland have voluntarily deferred the start of their fishing activities for 6 weeks to allow early running MSW salmon to pass the netting zone before they start fishing.

There are continuing and on-going efforts by angling interest to buy out netting rights in different areas. In 2005, a substantial number of fishing stations in the North-East Region were purchased, and it is expected that they will cease to operate within three years. One of the remaining fixed engines operated in the North Region is owned by SEERAD, and will decide whether to relet it when the current lease expires in 2007.

In order to protect early-running MSW salmon entering the North and South Esk in eastern Scotland, the annual close time for netting was extended in 2005 until 30 April by means of an Annual Close Time Order, and mandatory catch and release until end of May was imposed on the rod fishery by means of Salmon Conservation Regulations. The effort in both fixed engine and net and coble fisheries was capped at the average recorded during the last ten years. The Order and Regulations will remain in force for 5 years.

In Scotland, there is the possibility of making Salmon Conservation Regulations where it is deemed necessary or expedient for the conservation of salmon. Regulations may be made where they also have management implications, but there must be a conservation case. This line fits in with the Scottish view that there is a strong case, and preference, for adopting temporal measures to restrict fisheries rather than geographical ones. The main management concern relates to early-running MSW salmon, and that concern applies over a very wide geographical range.

9 MIXED STOCK SALMON FISHERIES IN SWEDEN

9.1 Regulatory framework in Sweden

The central administration of fisheries policy is divided between the Ministry of Agriculture and the National Board of Fisheries (NBF). The Ministry draws up the framework of the fishery policy and represents Sweden at international negotiations. The NBF is the executive branch of the administration and responsible for the implementation of the fisheries policy and for giving technical advice to the government. At the regional level, the 21 county administrative boards include fisheries experts.

A large part of the fisheries research and development is carried out by the NBF at its three institutes of marine, coastal and freshwater research. Research is also undertaken at the universities and other public institutions. The Coast Guard carries out the fisheries control and surveillance at sea and in harbours in cooperation with the NBF. In public waters, the responsibility for management lies with the government and the regional or local authorities. Normally, waters around the coast and in the lakes are privately owned up to 300 meters from the shoreline meaning that conservation and management rests on the owners. In lakes, many private water-owners have created fishing management areas with uniform fishing rules and marketing of recreational opportunities for the public. Angling is allowed along the coast and in the four big lakes. Along the western and southern coast, fishing is

allowed for the public and for professional fishers in privately owned waters with a limited number of gears.

9.2 Summary of stock status in Sweden

There are approximately 23 Atlantic salmon rivers in Sweden. Conservation Limits have not been set for any of these rivers as there are regularly acidified and limed and this alters the natural rate of production. There is only one index river, River Ätran, where a smolt count is available from a partial smolt trap in the major tributary Högvadsån. The trap count in 2004 was 2040 smolts. The number of ascending adults was 100 grilse and 186 MSW salmon, in total 286 fish. It is not reported if this index rivers is meeting its Conservation Limit. Plans have been made by the Swedish Authorities to develop a River Classification System to aid setting of targets for parr and spawners and it has been proposed that in the interim the use of Norwegian R. Imsa SR study will be considered for Swedish Rivers.

Although not used for management purposes, based on the National conservation limit model (ICES 2005), the Swedish national Atlantic salmon stock is within safe biological limits.

9.3 Mixed stock salmon fisheries in Sweden

Commercial fisheries occur along the coast, while angling is the main method of fishing in rivers. About 90% of the coastal catch is recorded by commercial fishermen who are operating different kinds of trap nets. It is assumed that these nets intercept salmon from several rivers and are not river specific. The number of trapnets has decreased almost continually for a long period and only 13 coastal trapnets operated in year 2004. The Swedish mixed stock fishery has been declining in recent years with less than 20% of the catch taken in coastal waters. The majority of fishing takes place in the Rivers.

The proportion of the catch taken in rivers continued to increase. In year 2004 the riverine catch was 16 tonnes and the coastal catch was 3 tonnes and the corresponding figures in 2003 were 18 and 7 tonnes. The estuarine catch is included in the coastal catch and the unreported catch in year 2004 was guesstimated to be 2 tonnes or about 10 % of the national catch.

9.4 Stocks exploited by the Swedish MSFs

There is no information available on the specific stocks intercepted in Swedish coastal fisheries. A previous assessment (ICES 1994) suggested a low level of interception of Norwegian salmon in Swedish MSFs and it is likely that the fishery comprises mainly mixed stocks from Swedish rivers.

9.5 Recent management measures and future plans for Swedish MSFs

No new regulations of the fishery have been implemented in the last two years. The last changes were introduced in the fishery in 2002. Fifteen new protected areas were established outside small sea trout rivers. In addition a number of existing protected areas outside individual salmon rivers were merged into larger units. For some of these larger protected areas, greater responsibility was given to county

administrations to provide establishment of a trap net fishery and net fishery in other parts of the areas. The boundaries of a protected area in Kungsbackafjorden- were also changed to coincide with boundaries of Natura 2000-areas and angling and net fisheries were allowed in the outer parts of the protected area. From the beginning of 2003 the salmon fishery in rivers is closed from 1st October to 31st March (previously 1st October- last day of February). There is no biological monitoring programme for commercial fisheries (Crozier, et al 2003).

10 EFFECTS AND IMPLICATIONS OF REDUCING MIXED STOCK FISHERIES

10.1 Effects on fisheries

The immediate effect of closing a mixed stock fishery for salmon will be to increase catches in estuary and river fisheries. The effects will be greatest in the most local rivers and are likely to diminish in those further from the fishery. Where estimates of the current level of exploitation are available, these effects can be predicted reasonably accurately. Thus, in the case of the Irish coastal fisheries, which take about 50% of returning Irish 1SW salmon, the numbers of these fish available to return to Irish rivers would be expected to double, although the effects in individual rivers would vary around this level. Catches in estuary fisheries are likely to increase proportionally, although the level of improvement may vary through the season depending on the operation of the fisheries. Increases on this scale should be immediately apparent, and are likely to have significant effects on the activities of both licensed and unlicensed fishermen.

Fishing effort in the licensed fisheries might be expected to increase, particularly in areas where fishing is currently uneconomical at certain times. However, in other fisheries, limits on the available time or locations to fish may restrict any increase in fishing effort by traditional methods. Thus, for example, in some estuary fisheries, fishermen have to take turns to fish at certain times of year; in such situations there may be little opportunity to increase fishing effort. The imposition of TACs and quotas may also prevent increases in catches.

Increased profitability in the fishery might also increase the number of applications for licences, although in some jurisdictions the number of licences that can be issued is capped (e.g. by Net Limitation Orders in England). Where this is the case there will be opportunities to control the increased fishing pressure and consider the appropriate balance between different fishing methods. In some instances, fishermen leaving the MSF might be precluded from applying for licences in the estuary fishery, for example if they have received compensation payments to give up their coastal netting licences. However, in other circumstances this will be the most likely area for them to seek alternative employment. In theory, it may be possible to allow additional fishermen to enter the fishery as well as allowing existing fishermen to maintain or increase their catches. In practice this may be difficult to achieve, and the perceptions of individual fishermen may also be quite different. This may lead to conflicts between establish fishermen and new entrants to the fishery.

Where the exploitation rate by the MSF is lower (e.g. the exploitation of the Irish fishery on more distant stocks such as those in UK), the effect of removing the fishery will clearly be smaller and may be difficult to detect over the normal annual and seasonal variation in catch levels. Fishermen may change their behaviour in

anticipation of increased stocks, but will ultimately be influenced by observed changes in runs.

The effects on rod fisheries may be more difficult to predict because the success of these fisheries can be very susceptible to river conditions, but in general, similar improvements might be expected to those observed in the net fisheries. In many of the situations where MSFs have been removed or reduced to date, recreational fishing interests have made significant financial contributions to the process (e.g. buy-out of drift nets in North East England). In such situations, those who have contributed may consider that they have a greater right to benefit from the increased stocks than those who have not contributed. However, those who have not contributed are also likely to benefit unless their fishing opportunities (e.g. duration of fishing seasons) are reduced. Such issues should be addressed and resolved in advance of the closure; if not they may cause conflicts between the netting and angling interests subsequently.

Illegal fishing may also increase both because it becomes easier, with increased stocks entering freshwater, and because loss of landings from the MSF may create a demand in the local markets. In most jurisdictions, legislation is in place to control the sale of illegally caught fish (e.g. carcass tagging in Ireland), but there will almost certainly be a need for an increase in enforcement activity which will place an additional burden on the management authorities.

10.2 Effects on salmon stocks

If exploitation rates within the estuary and river fisheries did not change, the spawning escapement would also be expected to increase by the same proportion as the catches. This would mean, in the case of the Irish fishery, for example, that any local river stocks that are currently well below their conservation limits (up to 50%) might be expected to meet or exceed their conservation limits. Clearly this would be expected to have immediate beneficial effects to the stock status and the river ecology.

Of course, stocks that are currently meeting their conservation limits might be expected to exceed this level, in some cases by a substantial margin. This could generate a large exploitable surplus of salmon in some rivers which would not be harvested without an increase in the level of exploitation. As indicated above, this may permit a relaxation of existing regulations, such as shortening the close periods or permitting more fishermen to operate, while still providing a high probability of meeting conservation limits. In such circumstances, conflicts may occur between net and rod interests and between existing and new fishermen.

Depending upon the nature of the stock and recruitment relationship in these rivers, there is a possibility that increasing numbers of spawning fish would be sufficient to inhibit production, through negative depensatory effects, if in-river exploitation was not increased to utilise part of the surplus. This is unlikely to be a major problem with the current scenario of poor marine survival of salmon stocks throughout much of their range, but where there are large surpluses above conservation limits it should be investigated. While it is desirable to have all rivers exceeding their conservation limits, the management of the surplus being generated will still require monitoring and assessment. Ideally, the mixed stock fishery should be replaced with well managed river fishery, regulated to meet the objective of ensuring that river stocks

exceed their conservation limits. The balance of the harvest assigned to the commercial and recreational interests may be determined on socio-economic grounds, although it should be noted that rod fisheries on their own are not efficient at harvesting salmon, and this may limit the extent to which they can benefit from the removal of large MSFs.

10.3 Social and economic consequences

This report is not designed to address social and economic issues in any detail since this is a complex area which requires specialist input. The economics of salmon fisheries have been the subject of much debate. Individual wild salmon can command a high price, and since the commercial fishing methods used can be relatively cheap to operate compared, for example, to trawl fisheries, quite small catches can make a significant contribution to a fisherman's income. The majority of the economic value of the salmon resource, is normally considered to be derived from the operation of recreational fisheries. However estimates of the value of commercial and recreational fisheries vary widely and may be dependent upon a wide range of factors. Nevertheless, it is generally agreed that the capital value of the recreational fisheries (e.g. at a national level) exceeds that of the net fisheries often by a substantial margin. However, there is an important distinction between the value of commercial and recreational fisheries for salmon. The value of the former is related principally to the size and quality of the catch, while the value of recreational fisheries may be related, at least in part, to the provision of fishing opportunities and the 'potential' to catch fish. Thus, the effect of increasing or decreasing catch levels on the value of a recreational fishery will not be as easy to predict as it will be for a net fishery.

The effects of removing a MSF will clearly depend on a number of factors, not least of which is the size of the fishery and the current status of the stocks that it exploits. Other factors having socio-economic consequences, include the availability of alternative employment opportunities, both in fishing and other trades.

Socio-economic factors will also have an influence on the levels of illegal and unreported fishing. Thus, the developed of salmon farming was thought to have been partly responsible for a reduction in illegal fishing because the price of salmon went down. However, wild salmon has a premium value, and there is no doubt that elimination of large coastal fisheries will increase the price of reduced illegal. Similarly, where fishermen own the fishing rights or have exclusive leases, they may be particularly vigilant in guarding their properties or leases to ensure that nobody else fishes there.

The large variety of fishing methods used to catch salmon includes some that are used in few, or sometimes only one, locations and there may be few practitioners. Some management authorities have determined that these methods have a heritage value and that they should therefore be permitted to continue operating. This has, for example, been identified as an issue in the management of the Severn Estuary fisheries in England and Wales (EA, 2003).

11 OPTIONS FOR IMPROVING MSF MANAGEMENT IN COMMUNITY WATERS

The following sub-sections consider a range of approaches that may be considered for reducing or eliminating the impacts of MSFs operating in coastal waters, although there should be a general presumption against operating MSFs unless they can be shown not to contravene basic conservation policies. The appropriateness of these options will depend on a number of factors including the nature of the fishery, its licensing arrangements and the regulatory framework in place within different jurisdictions. In addition, the socio-economic implications of any change will need to be considered more fully than is possible in this report.

11.1 Improved information for management

MSFs for salmon are widely considered to be inappropriate because the lack of information on the stocks being exploited make the conservation and rational management of individual river stocks more difficult. If this is the case, it might in theory be possible to manage the MSF in conjunction with other single stock fisheries, if sufficient information was available on the stocks being exploited by the fishery. Options may exist, or be developed, to improve the information-base used to manage the fishery such that all stocks are identified and levels of exploitation are adjusted within precautionary limits. For example, tagging studies or Genetic Stock Identification (GSI) might be used to provide specific information on the composition of the catch in the fishery over space and time, and to assess the effects on individual river stocks.

Of course, the first prerequisite is that there should be zero or minimal exploitation of stocks that are failing to meet management objectives with respect to conservation limits. Assuming this is the case, the amount of information required could be balanced against the anticipated level of exploitation: thus one might require fairly precise information if the level of exploitation was between 10 and 20% but accept much less precise information if the exploitation was between 1 and 2%.

A range of tagging techniques has been used in fishery management, and have been widely employed to provide information for salmon fishery management. Smolt tagging programmes using coded wire microtags (CWTs) are extensively employed in the management of the Irish fisheries and have been used to provide baseline information for the management of UK fisheries which are intercepted in Irish fisheries. However, an obvious limitation of this approach is that reliable information is only obtained for stocks from which the tagged smolts originate. While the effects on some other stocks may be inferred or estimated, little information will be provided on possible interceptions of stocks from other areas. In addition, tagging studies, whether they be on emigrating smolts or returning adult fish, can be very expensive to run and may not therefore be a practical on-going management option when balanced against the value of the fisheries.

GSI techniques are being developed for salmon and have been used to identify the origin of salmon within some clearly defined areas such as the Bay of Fundy and the River Foyle estuary (Northern Ireland). Further work is required to establish the baseline genetic profiles to apply these techniques more widely, and depending upon the size of the fishery, such approaches are likely to require extensive and costly monitoring and analysis. Such work is on-going in UK, Ireland and elsewhere and is

being co-ordinated, for example through the EU InterReg 'Atlantic Salmon Arc Project'.

Even if it was possible to obtain information on the composition of the catches in a MSF, it may be difficult to reduce the risks of over-exploiting individual stocks without significantly reducing overall yields. The fishery would need to be managed on the basis of the weakest stock(s) being exploited in, for example, an average year. Annual variation in the numbers of returning fish, their return times and migration routes of different stocks will also affect the certainty with which such approaches can be applied. Thus this approach is only likely to provide an acceptable management solution where the MSF exploits a very small number of river stocks, as may be the case for some fisheries operating within or very close to estuaries.

11.2 Restricted fishing methods, areas or times

The number of stocks exploited in an MSF may be reduced, or the predominance of one stock in the catch may be increased, by limiting the areas where, or time when, the fishery may operate. For example, moving a drift-net fishery closer to the shore or a trap fishery closer to a river-mouth may have such an effect. However, such actions are unlikely to stop the fishery exploiting multiple river stocks, and their efficacy would need to be assessed on a case-by-case basis.

This approach was adopted in Ireland in 1997, when coastal net fisheries were restricted to operating within 6 miles of baselines rather than 12 miles. While this appears to have resulted in a reduction in the overall exploitation of UK stocks on average, the fisheries within each District still take fish from a large number of different rivers. Furthermore, the possibility of high interceptions in individual years or for specific UK, or Irish, stocks cannot be ruled out, and the measure are probably insufficient on its own to ensure an acceptable level of risk to these affected populations.

The fishing methods currently used in coastal waters, such as drift nets and fixed engines, could not generally be transferred into estuaries because of the nature of their operation. Even if it was possible they would almost certainly come into conflict with existing estuary and/or river fisheries. Thus, in many situations, this is likely to be only an interim measure or, at the least, would need to be monitored on a regular basis to ensure that exploitation of non-target stocks did not increase.

11.3 Moratoria or temporary closure

In some instances it may be possible to limit closures of the fishery to fixed periods, to allow stocks to rebuild to levels where some exploitation may be possible or to allow the collection of more detailed information on the patterns of exploitation by the fishery. This would involve obtaining a statutory closure, a commitment from fishermen not to fish or a specific buy-out for a set period . The disadvantage with this is that expected returns and rebuilding may not materialise and it will still require significant fisheries restrictions and close monitoring to ensure that all stock components being exploited are meeting conservation limits. The time scale for such a moratorium could also be excessively long as recent stock projection simulations (ICES 2005) suggest that a minimum time period of 7 years would be required to generate complete recruitment for one stock cohort, and depending on the productivity of the stocks and how far below the conservation limit they were to begin

with, rebuilding periods of between 10 and 50 years (over 50 years in some instances) would be required. Thus, some stocks (e.g. river Tyne, England) have shown very significant improvements following measure to clean their estuaries , while others have shown little sign of improvement despite major restoration action (e.g. USA rivers). The time taken for stocks to recover will be dependent upon a range of other local factors and over the longer-term could be influenced by climate change.

In some instances a fixed-term moratorium on fishing for salmon may be feasible allowing stocks to rebuild to level where some exploitation may be possible. This would involve obtaining a commitment from fishermen not to fish, a specific buy-out for a set period (e.g. set-aside) or a mandatory closure. Where districts or rivers in a district are close to their conservation limit, full attainment or even exceeding conservation limits could occur within one season. However, several years may be required before this could be sustained from year to year. The subsequent re-introduction of the fishery would need to be based on the guiding principals outlined above, i.e that fisheries should only take place in situations where there is a surplus of fish over the required spawner requirement in each stock and that the catch is regulated relative to this surplus. In most instances, the only fisheries that could be operated at acceptable costs of monitoring and acceptable risks to all stocks are likely to be based on the exploitation of single stocks. Even in these circumstances there will still be a risk of under-escaping some component populations.

11.4 Statutory closure

Where appropriate primary legislation is in place, the act of fishing for salmon in coastal waters or keeping any salmon caught in nets or traps fished for other species could be made illegal. Alternatively, individual fisheries could be targeted and closed by byelaw. In the absence of appropriate primary legislation, new statutes would be required. Depending upon the size of the fishery, immediate closure can have significant socio-economic implications within local areas.

In some jurisdictions, current legislation may only provide the regulatory authorities with powers to restrict fishing if there is a conservation or management requirement. Thus, measures to curb coastal fisheries may be subject to challenge if they were considered to be beyond the scope of the legislation or unreasonable. The closure of MSFs in line with general management principles may not be seen as falling within this area, and the imposition of management controls may lead to compensation claims. Ultimately, challenges might be taken to the European Court, if plaintiffs considered that their Human Rights had been violated. However, this is outside the scope of this report.

Situations where this approach has previously been adopted include the banning of coastal drift nets in Norway in 1989 and Scotland in 1962.

11.5 Phase-out of fishing effort

Where a decision is made to close an MSF, the impact on fishermen may be significantly reduced by phasing it over an extended period rather than instigating an immediate closure. This may be achieved by reducing the numbers of fishermen that may operate as existing participants retire. Such an approach may nevertheless have consequences for fishing communities because there is often an

assumption that some children will follow their parent into the fishing industry. Phase-out procedures have been implemented in various mixed stock fisheries in England and Wales. In the North East coast drift net fishery, about 50% of the licence holders retired from the fishery in the first 10 years of the phase-out. However, this approach can also extend the closure over a very long period, possibly of at least 30-40 years if there are some young fishermen operating.

It may therefore be desirable to use the phase-out simply as a means to provide due warning and opportunity for fishermen to diversify into other fisheries or find alternative employment. Thus the phase-out might be operated over a 5-10 years period, with a complete closure after this time. Alternatively there could be a progressive reduction in the number of licenses that may be issued. With the latter approach, a mechanism would be required to determine who would be required to leave the fishery first; such an approach is therefore likely to be quite divisive.

Where phase-out arrangements are instigated in a large fishery they might also be adjusted to take account of regional differences in both biological (e.g. the status of stocks) and socio economic factors.

11.6 Buy-outs and compensation

Buy out or compensation arrangements may be employed in a variety of situations to encourage fishermen to give up their rights to fish. The first requirement however is that someone must have 'ownership' of the fishing right which they can effectively sell. Where fisheries are privately owned, as in Scotland, they can be bought and sold. This therefore provides a mechanism by which an interest group or authority may buy the fishing rights with the intention of closing the fishery, although this alone would not extinguish the fishing right.

Compensation arrangements may also be used to accelerate phase-out procedures. Where a phase-out procedure has been put in place, it may be possible to accelerate the process by paying individuals to leave the fishery early.

Such mechanisms allow for other interest groups to participate in or contribute to the phase-out procedure by providing financial contributions to a buy-out scheme. These arrangements will normally be accompanied by an undertaking from the fishermen not to seek to return to the fishery or by regulatory arrangements that prohibits this.

Compensation schemes have been widely used in the UK to buy-out fishing effort both for short periods (e.g. individual seasons) or permanently (see Section for NI and E&W). Where fisheries are managed by quota, compensation may also be used on a short-term basis to pay fishermen not to take their quota.

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ANNEX 1. NETS AND FIXED ENGINES USED FOR TAKING SALMON IN UK AND IRELAND

The following are generalised descriptions of the nets and fixed engines used to catch salmon in UK and Ireland. There is considerable regional variation in the precise mode of operation of specific gears and in the dimensions and mesh sizes of the nets, which have evolved to suit local conditions and may be regulated by local byelaws. The term fixed engine is an ancient one used as a general descriptor of stationary fishing gears in the UK.

Gilling nets:

Coastal net (ENGLAND AND WALES) A loose term used to describe the nets used in the fishery off the East Anglian coast. In practice, various methods of fishing have been employed, including seine nets and drift nets.

Coracle net (England and Wales) These nets are only used in parts of Wales. Short lengths of trammel net are suspended between two coracles (small boats), which then drift downstream with the net strung across the current.

Drift net (England and Wales, and Northern Ireland), Ireland) A drift net consists of a sheet of netting which hangs from a floated head rope to a weighted foot rope and is designed to drift with the current or tide. The length of netting used is usually regulated and may vary from around 100m if the net is used in a estuary to at least a kilometre in the open sea. Regional names in England and Wales include: hang, whammel, sling and tuck nets.

Snap nets (Ireland): Operated within estuaries in the Waterford and Lismore districts. The net is fished between two small boats or “cots” each fisherman holding both the head rope and lead rope in one hand and an oar in the other to control the direction of the boat and keep the net fishing between the boats. Fishing against the current in either the ebb or flowing tide, the net forms a bag projecting backwards against the tidal flow. A fish striking the net alerts the fishermen who then “snap” the lead rope sharply upwards and over the head rope wrapping the fish in the bag.

Trammel net (England and Wales) Trammel nets are similar to drift nets but are modified by the addition of sheets of larger mesh netting on one or both sides of the net. Such nets are referred to as being ‘armoured’. A fish striking a trammel net pushes the small mesh net through one of the large meshes in the adjoining net and is caught in the resultant pocket. Sometimes known locally as tuck nets.

Encircling nets:

Draft nets (Ireland & Northern Ireland): As seine nets.

Net and coble (Scotland): A sweep net, paid out from a boat, and worked from the bank or shore or from waters adjacent to the bank or shore, whereby salmon are surrounded by the net and drawn to the bank or shore. Nearly all net and cobles are operated within estuaries.

Seine net (England and Wales) A seine net (also known as a draft or draw net)

consists of a wall of netting with a weighted foot rope and floated head rope. One end is held on the shore while the rest is paid out from a boat to enclose an area of water between two points on the shore. The net is then retrieved and any fish enclosed drawn up onto the shore. Seine nets normally operate within estuaries, although some are also fished off coastal beaches.

Sling net (England and Wales) The sling net is a type of drift net used exclusively on the river Clwyd in North Wales. It differs from other drift nets only in so far as the nets are permitted to carry weights (not exceeding 9 lbs) at either end, designed to retard the drift.

Wade net (England and Wales) A wade net consists of a short (~30 m) single sheet of netting which is attached to a pole at each end, and is pulled along the foreshore parallel to the beach by two men, one wading and the other on the beach. Nets are 'beached' at regular intervals, or when a fish strikes, in much the same way as a seine net.

Hand nets:

Haaf or heave net (England and Wales, Scotland) These one-man-operated nets are operated in the north-west of England and south-west of Scotland. The gear consists of a rectangular net hung from a horizontal wooden beam up to 5.5m wide. A central pole permits the netsmen to stand in the tideway holding the net facing the current with the netting streaming behind him. The net is lifted when a fish strikes the net. It is usual for several netsmen to work together line-abreast.

Lave (or dip) net (England and Wales) Lave nets, one regional variety of similar hand-held, one-man-operated nets, consist of a large Y-shaped wooden frame supporting a net, similar in design to an angler's landing net, but measuring up to 2 m across. The netsman actively stalks fish in estuary pools or shallows at low tide.

Loop nets (Ireland) A curved landing net fished in deep soft muddy conditions in the Lough Swilly estuary.

Pole nets (Ireland) A type of landing net fished actively in weirs or pools

Traps/Fixed engines:

Basket trap (England and Wales) This is a type of fixed engine which has only been used on the river Conwy in North Wales. It consists of a metal basket set between two boulders, which is designed to catch salmon and sea trout which fall back when attempting to ascend a small waterfall.

Compass net (England and Wales) These nets are operated from a boat held stationary against the current. A net is hung between two long poles lashed together in a V-shape and held over the side of the boat so that the net streams out underneath the boat. When a fish strikes the net, the poles are pivoted upwards with the aid of counter-balancing weights.

Crib (or Coop)) (England and Wales, Ireland) These ancient fixed engines consist of stone buttresses set across a river, the gaps between the buttresses being filled by

box-like traps made of either wood or metal with in-scale entrances. The river Eden cribs were built in 1133 A.D. by monks, although the river Derwent cribs are of more recent construction.

Headweir (Ireland) These weirs are erected between tide marks is such a way as to trap fish on a falling tide. They are generally considered hazardous to navigation and as a result only one is generally fished now.

Poke nets (England and Wales) Poke nets consist of a series of pockets of net mounted in lines on poles and set across the tide. Salmon are trapped in the pockets as the tide recedes.

Putchers (and Putts) (England and Wales) Putchers are wickerwork or metal conical baskets which, when erected on stages, form putcher ranks (containing up to 800 putchers). This type of fixed engine is peculiar to the Bristol Channel and is dependent upon the high turbidity and large tidal range which occurs in this area. Each putcher has a mouth from 3 to 5 feet wide, tapering to a narrow point which will prevent fish of moderate size from passing through. A netting leader is often used to guide fish into the putchers. Putts are of similar design to putchers, only larger.

T-net (England and Wales) T-nets are fixed engines operated close to the shore, usually in specific berths. They comprise a 'leader', usually about 200 m in length, stretching out from the beach to a 'headpiece', which contains two traps with funnel entrances. Some fish may become enmeshed or entangled in the leader of the net, but the majority are taken, free-swimming, in the traps.

'T or J'-net (England and Wales) 'T or J'-nets consist of plain sheets of netting on a floated head rope which hang vertically in the water by means of a weighted foot rope and are set from the shore in the shape of a 'T', 'J' or 'P'. These nets are usually operated as fixed engines, held stationary by means of weights, anchors or stakes, but can also be drifted with weights used to retard the rate of movement. Fish can only be caught in a 'T or 'J' net by becoming enmeshed or entangled in the walls of the net.

Bag nets (Scotland, Ireland) The net comprises a leader stretching from the shore and a trap (head), and held in a fixed position by anchors and buoys. The trap is chambered, with inward pointing sheets of netting, known as in-scales, leading fish eventually into the "fish court", where they remain free-swimming until they are removed by the fishermen. The net is also supported by three wooden poles, which do not reach the seabed. The net frame is attached to the bottom and top of each of the poles to hold it open vertically. The net is fished from a small boat (coble), using a crew of between four and six. At the weekly close time (6 pm on Friday until 6 am on the following Monday), the leader is completely removed.

Stake nets (Scotland, Ireland) The two forms of stake net, fly nets and jumper nets, take the same basic shape as bag nets. However, unlike bag nets, these nets are usually erected on sandy beaches, supported on stakes driven into the sand. The trap of a **Fly net** is supported by 10 or 12 stakes, while the number of stakes supporting the leader depends on its length. Each net is fished by a single fisherman, although several men cooperate to erect the net at the start of the fishing season, and to dismantle it at the end. When fishing the net, the fisherman climbs

along the leader using hand and foot ropes to reach the trap. During the weekly close time, the trap of the net is lowered and tied down so that any salmon that move seaward along the leader do not encounter a trap. The **jumper net** is a variation of the fly net, but used usually on more steeply-sloping beaches. The trap is supported by only three stakes, and the leader is allowed to rise and fall with the tide, the action which gives the net its name. During the weekly close time, the seaward end of the fish court is opened to allow any fish entering the trap to pass straight through.