European Offshore Wind Deployment Centre
Environmental Statement

Appendix 22.1: Salmon and Sea Trout Baseline Technical Report

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European Offshore Wind Deployment Centre Salmon and Sea Trout Ecology and Fisheries Baseline Assessment

Undertaken by
Brown & May Marine Ltd

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1.0 Introduction

The following document describes the current salmon and sea trout ecology and fisheries baseline assessment for the proposed European Offshore Wind Deployment Centre (EOWDC).

Scottish salmon populations are recognised as being of national and international importance (Malcolm *et al.*, 2010). In addition to their ecological value, salmon and sea trout are species of importance from a socioeconomic perspective on a local, regional and national level in Scotland.

2.0 Summary

2.1 Ecology

Salmon and sea trout smolts migrate seawards in the spring, generally from April to June. The seaward migration in both species is thought to be an active process with fish swimming close to the surface and it does not appear to be a period of acclimation when moving from fresh to salt water.

Salmon post-smolts make limited use of the estuarine environment moving quickly to the open sea towards their feeding grounds. Limited research carried out to date suggests post-smolts may travel relatively close to the coast in the initial phases of their migration.

Salmon originating in rivers from Aberdeenshire southwards are thought to migrate back from their feeding grounds through the North Sea, approaching the coast as far south as Northumberland and then start a northerly coastal migration towards their home rivers. Grilse (one sea winter salmon) enter the rivers from early summer until shortly before spawning in autumn, whilst multi sea winter salmon enter the rivers over a greater period of time.

Unlike salmon, sea trout post-smolts are not believed to travel to distant waters to feed; instead they generally remain in coastal waters. In the North East region sea trout generally enter the rivers from June to September with peak runs varying between rivers.

2.2 Fisheries

The right to fish for salmon in Scotland is a heritable right, whether in inland waters or at sea. The fisheries are managed by their owner or leaseholder under a framework of regulations laid down by central government. Under Scottish legislation the term salmon applies to both salmon and sea trout.

In the salmon fishery districts located in close proximity to the proposed EOWDC, the Ythan, Don and Dee, the majority of the total salmon and sea trout catch comes from the rod-and-line fishery. Net fisheries are however of relative importance in other districts within the regional area, such as the Ugie and more significantly the Esk.

The Don is the salmon fishery district located in the immediate vicinity of the proposed EOWDC. The majority of the reported catch in the district is by rod-and-line, a high percentage of which is by catch and release. Reported catches by the net fishery are comparatively low, with no net-and-coble currently taking place in the district and fixed engines recording very low reported catches in recent years.

3.0 Study Area

For the purposes of this assessment the study area has been defined on a local, regional and national scale (Figure 3.1). The local area comprises the zone relevant to the salmon fishery district located in the immediate vicinity of the EOWDC, the Don, whilst the regional area includes all the salmon fishery districts within the North East region; Ugie, Ythan, Don, Dee and Esk. Given the migratory behaviour of salmon and sea trout and the relative importance of the fishery across the country, a national focus has also been briefly described.

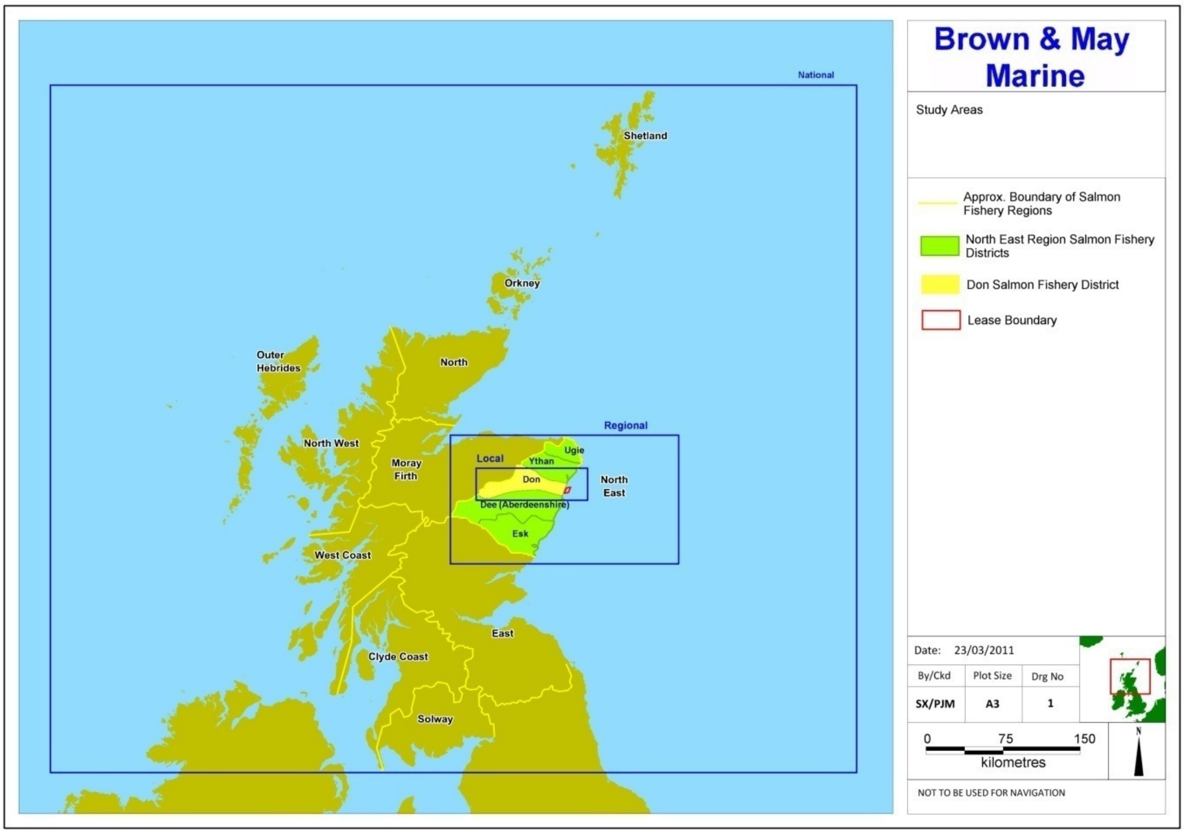


Figure 3.1 Study Areas

4.0 Methodology

4.1 Consultation

Consultation meetings were held with all the District Salmon Fishery Boards located within the North East region and with representatives of the netting fishery in the North East.

These were as follows:

- Ugie District Salmon Fishery Board (26/10/2010)
- Ythan District Salmon Fishery Board (26/10/2010)
- Don District Salmon Fishery Board (27/10/2010)
- Dee District Salmon Fishery Board (17/01/2011)
- Esk District Salmon Fishery Board (27/10/2010)
- Usan Fisheries (Montrose) (17/02/2011)

In addition to the above meetings, questionnaires were circulated to all the salmon district fishery boards in Scotland, through the Association of Salmon Fishery Boards (ASFB), and to netsmen, through the Salmon Net Fishing Association of Scotland. This process was aimed at gathering information at a national level and to note the main concerns of the boards and the netsmen with regards to wind farm developments in Scotland. At the time of writing, a sample of 14 salmon boards, netsmen and other organisations have completed and returned the questionnaires (See Appendix 01).

Consultation with coastal netting individual right holders will be undertaken once the location of the export cable is defined.

4.2 Key Guidance Documents

The following guidance documents have been used for undertaking this baseline assessment:

- Strategic Environmental Assessment (SEA) of Draft Plan for Offshore Wind Energy in Scottish Territorial Waters: Volume 1: Environmental Report; Marine Scotland 2010
- Offshore Wind Farms, Guidance Note for Environmental Impact Assessment in Respect of FEPA and CPA Requirements - Version 2; Cefas, MCUE, DTI, June 2004.
- Marine Scotland Scoping Response (December 2010 and January 2011 update)
- Scottish Natural Heritage Scoping Response (29/09/2010)
- Scottish Environment Protection Agency Scoping Response (24.09.2010)
- UK Offshore Energy – Strategic Environmental Assessment; DECC, January 2009
- Recommendations for Fisheries Liaison; FLOW, May 2008

4.3 Data and Information Sources

There is no standard guidance for the establishment of salmon and sea trout fisheries baseline assessments in relation to offshore wind farm developments. A range of different data and information sources have therefore been used to inform this assessment. These are as follows:

- Marine Scotland Science (MSS)
- Association of Salmon Fishery Boards (ASFB)
- Salmon Net Fishing Association of Scotland
- North East Region District Salmon Fishery Boards and Fisheries Trusts
- Atlantic Salmon Trust
- Scientific papers and other relevant publications

4.4 Data & Information Sensitivities, Limitations and Gaps

4.4.1 MSS Salmon & Sea Trout Fisheries Catch Statistics

MSS catch statistics divide salmon catches into “salmon” and “grilse”. In this context, the term salmon refers to multi-sea-winter salmon (MSW) whilst grilse refers to one-sea-winter salmon (1SW).

Each fishery in Scotland is required to provide the number and total weight of salmon and grilse and sea trout caught and retained in each month of the fishing season.

Rod and line fisheries are also required to provide the monthly numbers and total weight of those salmon, grilse and sea trout which were caught and released back into the river, this practice is known as “catch and release”. As a result, MSS catch data for the rod and line fishery is broken down into two categories, “rod and line” and “catch and release”. It should be noted that the total catch by the rod and line fishery is in effect the sum of the catches recorded in both categories. Where appropriate, data from both categories have been combined to give an indication of the total rod and line catch. Similarly, the catch by net and coble and fixed engines (bag and stake nets) has been combined in some instances to provide an indication of the total catch by the net fishery.

The catch data used for the purposes of this assessment are as reported. It is recognised that there may be a degree of error within the catch dataset due to misclassification of fish between the grilse and salmon categories. In addition, further errors as a result of misreporting of catches may also exist. The data used are as provided by Marine Scotland Science on 08/10/2010.

The catch data used in this report are Crown copyright, used with the permission of Marine Scotland Science. Marine Scotland is not responsible for interpretation of these data by third parties.

4.4.2 Salmon Fishery Regions and Districts

Each salmon fishery district applies its own voluntary or statutory conservation code, closure times, policies and regulations and has in place different management and conservation schemes (e.g hatcheries, fish counters, water quality control and monitoring schemes). In addition, different districts include varying numbers of rivers and tributaries within their jurisdictions and have different catchment areas.

The areas and names of some districts have changed over time. In the regional study area, for example, catch statistics are collected for the South Esk, North Esk and Bervie districts separately, however, these districts were superseded by the Esk Salmon Fishery District and abolished in 1988 (S.I, 1998/ 994). For the purposes of this assessment the former, smaller districts will be used as they provide a better spatial resolution for analysis of catch data.

The boundaries of the salmon fishery regions and districts could not be provided by MSS as GIS data layers as a result of third party copyright ownership of these data. The district and region boundaries shown in the charts provided in this report were produced by geo-referencing a raster image. These should therefore be taken as approximate and for illustrative purposes only.

4.4.3 Data Gaps

There is limited information available to date to accurately define the migratory routes and patterns of Scottish salmon and sea trout. Furthermore, the spatial resolution of the available data and information does not allow for the numbers and the origin of the fish potentially migrating through or near the proposed EOWDC to be evaluated.

It is also recognised, that current knowledge on salmon exceeds that of sea trout. As a result some aspects of the ecology assessment given below have been covered in greater detail for salmon than for sea trout.

5.0 Salmon & Sea Trout Ecology Baseline Assessment

5.1 Introduction

Atlantic salmon *(Salmo salar)* and sea trout *(Salmo trutta)* are anadromous migratory species which utilise both freshwater and marine habitats during their life cycles. Both are species of the family *Salmonidae*, being commonly referred to as salmonids.

Atlantic salmon is widely distributed within the EU, from Portugal in the south to Sweden and Finland in the north. The UK salmon population, however, comprises a significant proportion of the total European stock, with Scottish rivers being a European stronghold of the species (JNCC, 2010). The distribution of salmon rivers in Scotland is shown in Figure 5.1 below.

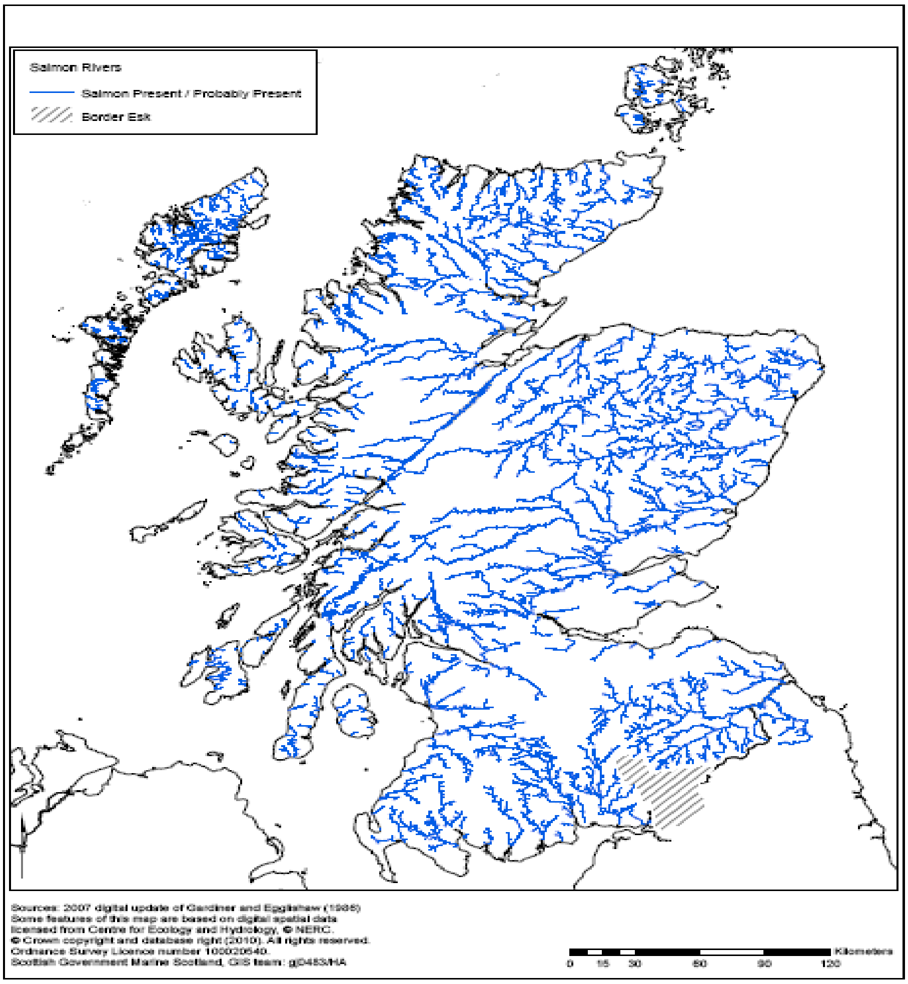


Figure 5.1 Distribution of Salmon Scottish Rivers. Updated from original salmon distribution map of Gardiner and Egglishaw (1985) (Source: Malcolm *et al*., 2010)

Sea trout is the migratory form of the common and widely distributed brown trout. Both forms are recognised as the same species and are present together with Atlantic salmon in many Scottish rivers. The distribution of sea trout in western Europe extends from north Portugal to the White Sea and Cheshkaya Gulf, including Iceland and the Baltic Sea (Elliott, 1994).

5.2 Life cycle

5.2.1 Salmon

The early development of Atlantic salmon takes place in freshwater, where they undergo a number of physiological changes to become 'smolts', the form in which they migrate to sea.

Spawning takes place in late autumn in the rivers. Eggs are deposited in redds (nests excavated by the females in gravelly substrates). The eggs hatch the following early spring.

Newly hatched salmon, known as 'alevins', remain hidden in the riverbed gravels feeding from the attached yolk sac. Once the yolk sac has been depleted the alevins are known as 'fry' and start feeding on small invertebrates. Salmon fry grow quickly during the first year increasing in size to become 'parr'.

Parr remain in the river for one to four or five years, depending on water temperatures and food availability. In Scottish rivers they most commonly stay in the river for two or three years

In spring, once parr have reached a length of 12-14 cm, they undergo a transformation both externally and internally, which allows them to adapt to salt water. They are then known as 'smolts'. Smolts move down rivers in April to June to start their oceanic migration. Once they enter the sea they are known as post-smolts, until the spring of the following year (Malcolm *et al*., 2010)

After one or more years feeding at sea salmon return to their home rivers to spawn, this generally occurs in late autumn or early winter. The amount of time spent at sea prior to the spawning migration varies from one winter for 'grilse' to up to four for 'multi-sea-winter' salmon (MSW).

Once they have spawned salmon are known as "kelt". Whilst the majority of Atlantic salmon (90-95%) die following their first spawning, some individuals survive and may spawn up to seven or more times during their lifetime. The majority of repeat spawners, however, survive to spawn only once or twice in their lifetime (Flemming, 1996). The survivors are predominantly female and return to sea to feed between spawning (Mills *et al*., 2003).

A summary of the basic salmon life-stage terminology is given in Table 5.1 below.

Table 5.1 Basic salmon life-stage terminology (Hendry & Cragg-Hine, 2003)

Development Stage		Description
1	Alevin	From hatching to end of dependence on yolk sac for primary nutrition
2	Fry	From independence of yolk sac to end of first summer
3	Parr	From end of first summer to migration as smolt
4	Smolt	Fully silvered juvenile salmon migrating to sea
5	Post-smolt	From departure from river to end of first winter in the sea
6	Grilse	Adult salmon after first winter in sea
	Multi-sea-winter (MSW)	Adult salmon after more than one winter in sea, commonly referred to as "spring" fish when entering river before June
7	Kelt	Spent or spawned adult

5.2.2 Sea trout

The life cycle of the sea trout is similar to that of Atlantic salmon. Spawning generally occurs between mid October and January. Smolting takes place in spring once a threshold size is reached. Most sea trout populations in the UK become smolts after two or three years in the river (AST, 2010a). Smolts leave the river around the same time as salmon, between April and early June (SNH, 2010). Female individuals are more likely to become smolts and migrate to sea (MSS, 2010a; SNH, 2010).

Most sea trout return to the rivers after twelve or more months at sea. These can be seen in the rivers between May and October (SNH, 2010) and are often found together in the same redds as brown trout as spawning time approaches in late autumn (MSS, 2010a).

Some immature fish return to the rivers after only a few months at sea, often in July and September (SNH, 2010). These are small fish, regionally known as 'finnock', 'herling' or 'whitling' and are found feeding in most Scottish estuaries as they move in and out with the tide (MSS, 2010a). Many gather in larger rivers and lochs, not necessarily in their natal systems, and over-winter in fresh water before returning to the sea in spring.

Unlike salmon, a significant proportion of spent sea trout kelts survive and make their way back to sea to recover and grow (SNH, 2010). Once they start to return they are annual spawners. There is however evidence of alternate year spawning as opposed to annual spawning in some stocks with long distance migrations (Solomon, 2007).

Some individuals return to the sea soon after spawning (mid October-December) whilst others remain in the rivers and estuaries, migrating out in the spring (AST, 2010a).

5.3 Migrations

A summary of the information currently available on salmon and sea trout migrations, primarily based on the review paper "Review of Migratory routes and behaviour of Atlantic salmon, sea trout and European eel in Scotland's coastal environment: implications for the development of marine renewables", recently published by MSS (Malcolm *et al.* 2010), including a number of other relevant research publications, is given below. The migratory patterns and behaviour of salmon and sea trout in the vicinity of the proposed EOWDC has been the primary focus.

5.3.1 Salmon

5.3.1.1 Smolt and Post-Smolt Migration

The beginning of the down river migration of smolts is thought to be related to environmental factors such as temperature and water flow (McCormick *et al.*, 1998). The importance of these factors may however be variable and stimulate migration in different ways (Carlsen *et al*., 2004). Downstream migration within the river is mainly nocturnal and often triggered by increases in flow (Hendry & Cragg-Hine, 2003; Moore *et al.*, 1998a). In addition, social factors, such as the presence of other migrants in the river, may also play a role (Hansen & Jonsson, 1985; Hvidsten *et al*., 1995).

It is believed that salmon smolts use environmental cues in the rivers related to favourable ocean conditions allowing them to arrive at sea at an appropriate time (Hvidsten *et al*., 2009). Smolts from upper tributaries generally start migration earlier than those from lower tributaries, resulting in a synchronised sea entry of smolts from the same watershed (Stewart *et al.* 2006). Timing in the spring migration may therefore play an important role in salmon post-smolt survival at sea (Aas *et al.*, 2011).

Studies of the movement of Atlantic salmon post-smolts indicate active, directed swimming during migration, rather than passive drifting, with fish generally moving close to the surface (Lacroix *et al*., 2005; Lacroix *et al.*, 2004). It is suggested that there is no apparent period of acclimation required when moving from fresh to saltwater (Moore *et al.*, 1998a; Lacroix and McCurdy, 1996). Post-smolts are believed to make limited use of the estuarine habitat, moving rapidly to the open ocean (Marschall *et al*., 1998; Moore *et al*., 1998a, Malcolm *et al*., 2010). Limited existing data suggest that they usually swim close to the surface (1-3m depth) and make irregular dives down to 6.5m depth (Davidsen *et al.* 2008). A preference for warmer water layers, irrespective of salinity concentrations, has also been suggested (Plantalech manel-la *et al*., 2009).

Studies undertaken within fjords in Norway (Thorstad *et al*., 2004) suggest salmon post-smolts do not use the immediate near-shore areas during migration, the mean reported distance to shore being 370m. Similarly, tagging experiments carried out by Finstad *et al*. (2005) in the same area, found salmon used the full width of the fjord and travelled rapidly. Further studies undertaken in Canada, (Lacroix *et al*., 2005) in the Bay of Fundy, showed that fish travelled near the coast at a distance 2.5-5km from shore.

It should be noted that the current knowledge on salmon post-smolt migration and behaviour is principally based on the results of experiments and research carried out in Canada and Norway which have been summarised above. The lack of data specific to salmon post-smolts originating from Scottish rivers makes predictions of their behaviour in coastal waters difficult and speculative. Furthermore, Scottish coastal waters, especially in the case of the east coast rivers where there are no substantial bays or sea lochs (fjords), differ substantially from the locations where studies have been carried out in Canada and Norway.

It is also recognised that the migratory behaviour of post-smolts may vary depending on their river of origin. A recent study undertaken by Plantalech manel-la *et al.* (2011) found differences in early marine migratory behaviour between salmon from two different stocks and it was suggested that the distance that a salmon travels to reach the open coastline may influence its early marine migratory behaviour and performance.

The information given above, despite its limitations, provides an indication of the likely behaviour of salmon post-smolts during migration. As identified in Malcolm *et al*. (2010*)* the common findings across the research carried out to date can be summarised as follows:

- Post-smolts were always observed to migrate rapidly and actively towards open marine areas after leaving their home river
- Post-smolts did not appear to follow nearby shores closely, although this may occur in areas where coastal currents are substantial.
- Limited information on swimming depths suggests post-smolts generally use shallow depths (generally 1-3m, but up to 6m).

Data and information are also lacking to accurately define the routes followed, the areas used and the behaviour of salmon post-smolts in distant waters. The available information on the distribution and abundance of salmon at sea is principally based on records of tagging experiments from the West Greenland and Faroese fisheries (Shelton *et al*., 1997; Malcolm *et al*., 2010). A summary of relevant available information on salmon distribution in the sea and their behaviour is given below.

Post-smolts are thought to move in schools whilst heading off to deep-sea feeding area (Shelton *et al.*, 1997; Mills *et al.*, 2003). The best known feeding locations are in the Norwegian Sea and the waters off southwest Greenland, however, there are believed to be many other sub-arctic feeding areas. MSW salmon undertake longer migrations than grilse, which tend not to travel beyond the Faroe Islands and the southern Norwegian Sea (Mills *et al*., 2003).

The results of tagging experiments of salmon post-smolts suggest they travel rapidly over long distances. Studies in the Faroe-Shetland Channel (Shelton *et al*, 1997) found minimum progression rates of 7-30km/day; similarly, data from the North Sea the Norwegian Sea and the Barents Sea, indicate minimum progression rates of between 6 and 24km/day (Holm *et al*., 2003).

Historic recapture data from smolts tagged in Scottish rivers (Dee, Tay and North Esk), and data from the Girnock Burn (a tributary of the Dee) recorded between 1968 and 1982, suggest that at least some of the Scottish MSW salmon use the north-western Atlantic Area, around West Greenland (Malcolm *et al*., 2010).

Data recorded from the East Greenland and Irminger Sea fisheries, suggest these areas are of less importance to Atlantic salmon in general, and Scottish salmon in particular. This should however be taken in the context of the limited data that are available for these areas (Malcolm *et al*., 2010).

Information derived from smolt and adult salmon tagging studies (Jakupsstovu, 1988; Hansen and Jacobsen, 2003) also suggest Scottish salmon make use of sea areas around the Faroes. Hansen and Jacobsen (2003) found Scottish salmon tend to be more prevalent around the Faroes in the autumn rather than in the winter, including fish from the Spey, Brora, Tay, North Esk and Dee. In addition, whilst the Scottish salmon found in West Greenland, East Greenland and Irminger are thought to mainly be MSW fish, studies carried out around the Faroes suggest that both 1SW (grilse) and MSW salmon occur in the area, depending on the zone fished and the time of the year (Malcolm *et al*., 2010).

5.3.1.2 Pre-spawning Migration

The timing and duration of the pre-spawning migration of Atlantic salmon varies from river to river. It depends on the distance from the sea to the spawning areas and the degree of interaction between hydrologic regimes, the geomorphology of the river network and stream temperatures (Tetzlaff *et al.*, 2008).

Salmon of different sea-ages tend to return at different times of year and often spawn in different parts of a river (Potter and Ó Maoiléidigh, 2006). In most countries salmon runs tend to only take place at specific times of the year, normally during late summer and autumn. In Scotland, however, salmon enter the rivers throughout the year, resulting in the existence of a range of salmon runs. This is of importance to the salmon fisheries as it provides fishing opportunities over extended periods of time (MSS, 2010b).

In Scotland, the majority of grilse (1SW salmon) enter the rivers from early summer until shortly before spawning in autumn and early winter. Many of the MSW salmon also enter rivers over that same period of time, however, for the Scottish MSW salmon class as a whole, river entry occurs over a greater period of time, extending back to the autumn months of the year before spawning (Youngson *et al*., 2002). Based on the time of the year when the fish enter the river, salmon can be broadly classified as winter, spring, summer and autumn salmon.

In addition the quality of salmon varies depending on the run, with large spring-running MSW salmon being particularly highly prized (Potter and Ó Maoiléidigh, 2006). In the past, spring salmon runs made a major contribution to the Scottish fisheries, especially to those of the east coast and its rivers. Concern on the state of this component of the stock has, however, risen in recent years, as it has declined more significantly than other stock components (Potter and Ó Maoiléidigh, 2006; MSS, 2003; Youngson *et al*., 2002; Smith *et al*., 1998).

River entry is thought to be highly dependent on flow conditions. Research undertaken in the late 1980s in the Fowey estuary, and more recently in the Avon, indicated that fish have to wait for suitable river conditions, particularly elevated flows, before they enter freshwater and that, provided there are suitable holding areas, fish may remain in the estuary for long periods (Potter and Dare, 2003; Potter, 1988). Studies carried out in the Dee (Smith & Johnstone, 1996) found that fish enter and ascend the river relatively quickly during elevated river flows and that river entry may be delayed during periods of drought. This scenario was also noted at consultation meetings with the North East Region Salmon Fishery Boards (Consultation meeting, 2010a-d; Consultation meeting, 2011a).

The return migration in adult salmon is, as described for post-smolts, an active process with fish generally being found swimming near the surface (1-5m depth) and occasionally diving to greater depths (Aas *et al*., 2011). There does not appear to be a required period of acclimation during the transition from salt to fresh water (Hogåsen, 1998) and provided that river conditions are favourable, river entry seems to take place quickly (Thorstad *et al.,* 1998).

Studies carried out in Iceland on the migratory pattern of homing Atlantic salmon in coastal waters (Sturlaugsson and Thorisson*,* 1997) found that salmon migrated close to the coast, with some individuals entering into estuaries (most often for brief periods), and even into rivers (for up to more than one day) on their way to their natal streams. The depth records suggested that in general salmon migrated in the uppermost few metres. A diurnal rhythm in vertical movements was also noted, with salmon staying deeper at night and closest to the surface at noon.

The review paper by Malcolm *et al.* (2010), suggests a range of potential migratory routes for salmon in Scottish coastal waters, primarily using the results of adult fish tagging studies and the spatial distribution of tag returns from adult fish tagged as smolts as they left Scottish rivers. In this exercise the assumption that fish would return to their river of origin is needed. A summary of the findings of Malcolm *et al.* (2010) is given below.

The spatial distribution of tag recaptures from fish caught and marked in the Northumberland drift net fishery during 1977 was studied by Potter and Swain (1982). Based on these data, it was found a strong northward migration of salmon from Northumberland as far north as Aberdeenshire, with decreasing recaptures in regions further north. Potter and Swain (1982) concluded that 94% of the fish caught in the North East of England drift net fishery were heading to Scottish rivers.

Similarly, salmon tagging studies carried out near Montrose (Pyefinch and Woodward, 1955; Shearer, 1958) also suggest a predominant northerly movement as far as the south of the Moray Firth.

Whilst the information provided above supports the idea of a general northward migration of salmon in coastal areas around the proposed EOWDC site, given that this information is based on recaptures of tagged adult fish, rather than smolts, it is not possible to be certain of the river of origin of the fish recaptured. The results of smolt tagging studies carried out in the Girnock Burn (1968-81) on the Aberdeenshire Dee, however, also suggest an overall northward direction of travel in coastal waters around the east coast of Scotland for both grilse (1SW salmon) and MSW salmon.

The northward movement based on the results of Potter and Swain (1982) and the tagging studies in the Girnock Burn (1968-81) is illustrated in Figure 5.2 and Figure 5.3 respectively, as presented in Malcolm *et al*. (2010).

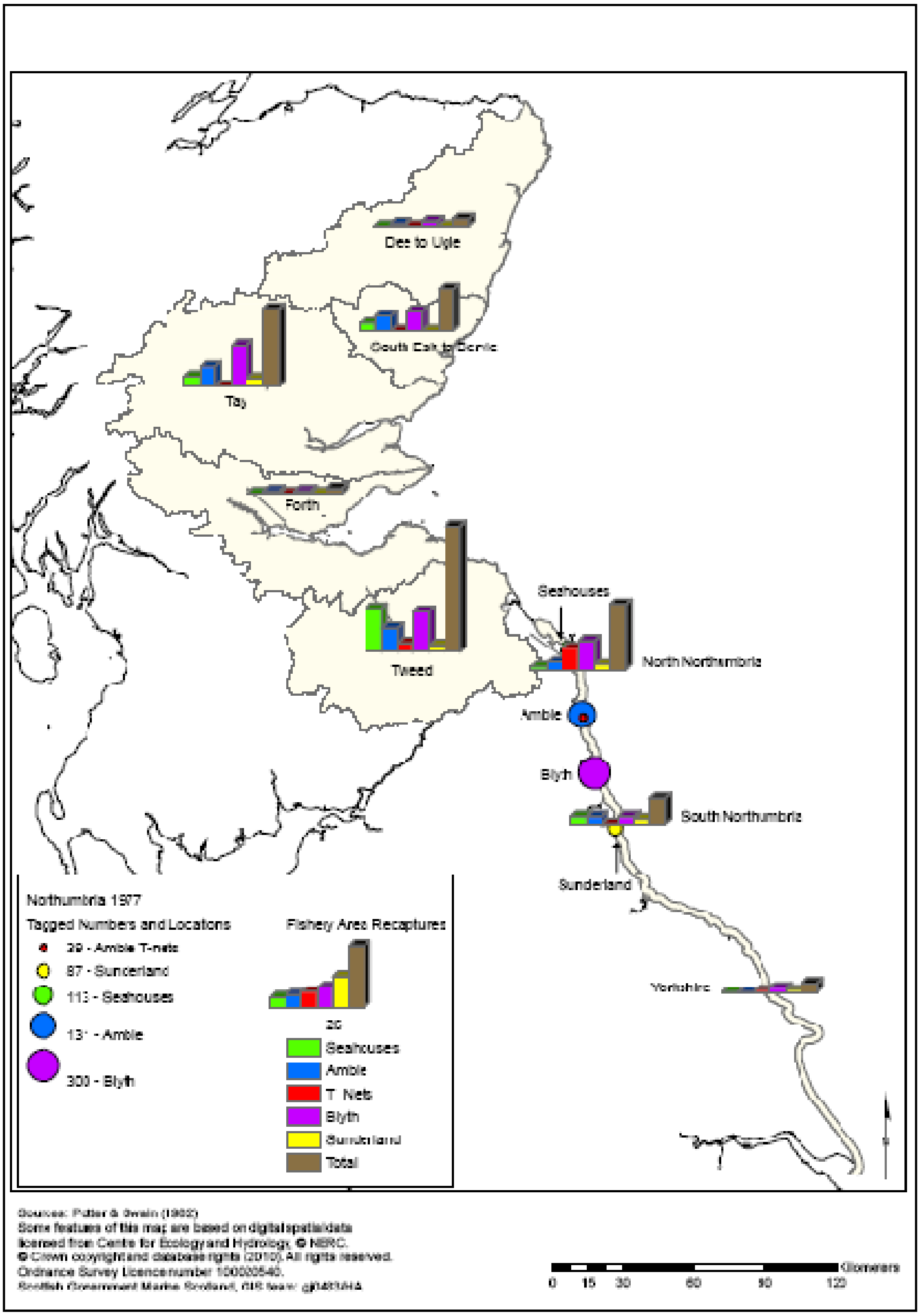


Figure 5.2 Coastal Movement of Salmon caught in the North East England Drift Net Fishery (after Potter and Swain, 1982). Tagging locations are shown as coloured circles; the size of circles is proportional to the number of fish tagged. Bar charts indicate the number of fish recaptured, colour coded by tag location (Source: Malcolm *et al*., 2010)

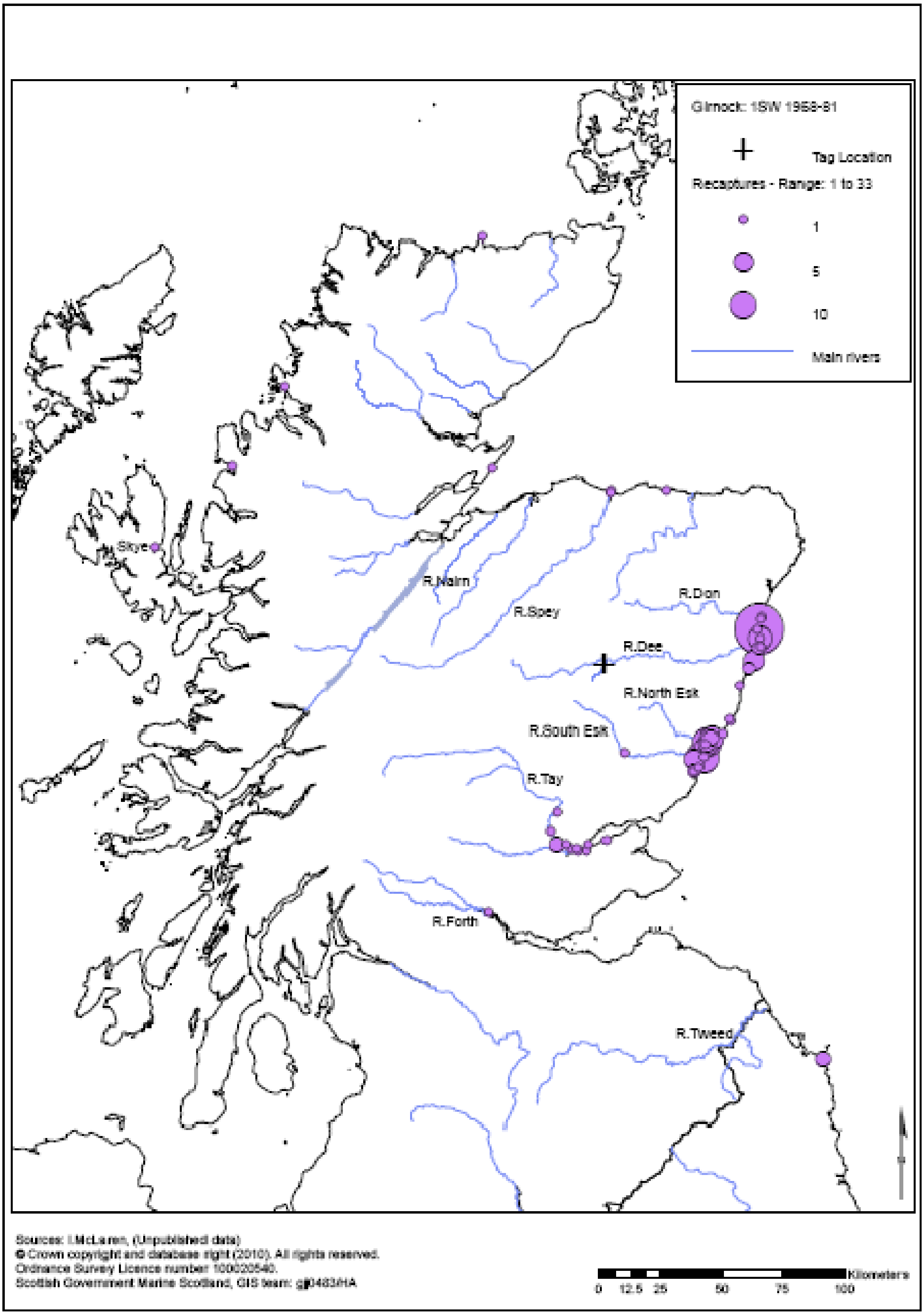


Figure 5.3 Distribution of Recaptures of 1SW (grilse) tagged in the Girnock Burn as Smolts (1986-81). Circle sizes are proportionate to the number of recaptures from a particular location (Source: Malcolm *et al.*, 2010)

Considering the results of the studies mentioned above, it appears reasonable to assume that for salmon originating in the North East coast rivers, the general direction of coastal movement is northerly and coastal migration may start as far south as the north east coast of England. This is in line with the model of adult salmon migration proposed by Shearer (1992) where it was suggested that from Aberdeenshire southwards, fish travel in a northerly direction having migrated south past their home rivers through the North Sea and approach the coast around Northumberland (Malcolm *et al*., 2010).

Whilst it is likely that the majority of salmon migrating in coastal waters around the proposed EOWDC originated in nearby rivers, given the complexity of the movements recorded from studies in other Scottish regions (Malcolm *et al*., 2010), where in some cases salmon were found migrating both northwards and southwards, it is difficult to assess the potential for this coastal area to be used by salmon originating elsewhere in Scotland. An indication of the general patterns of adult salmon movement around the Scottish coast based on the information provided above and further studies carried out in other regions around Scotland, is given in Figure 5.4 below (Source: Malcolm *et al*., 2010).

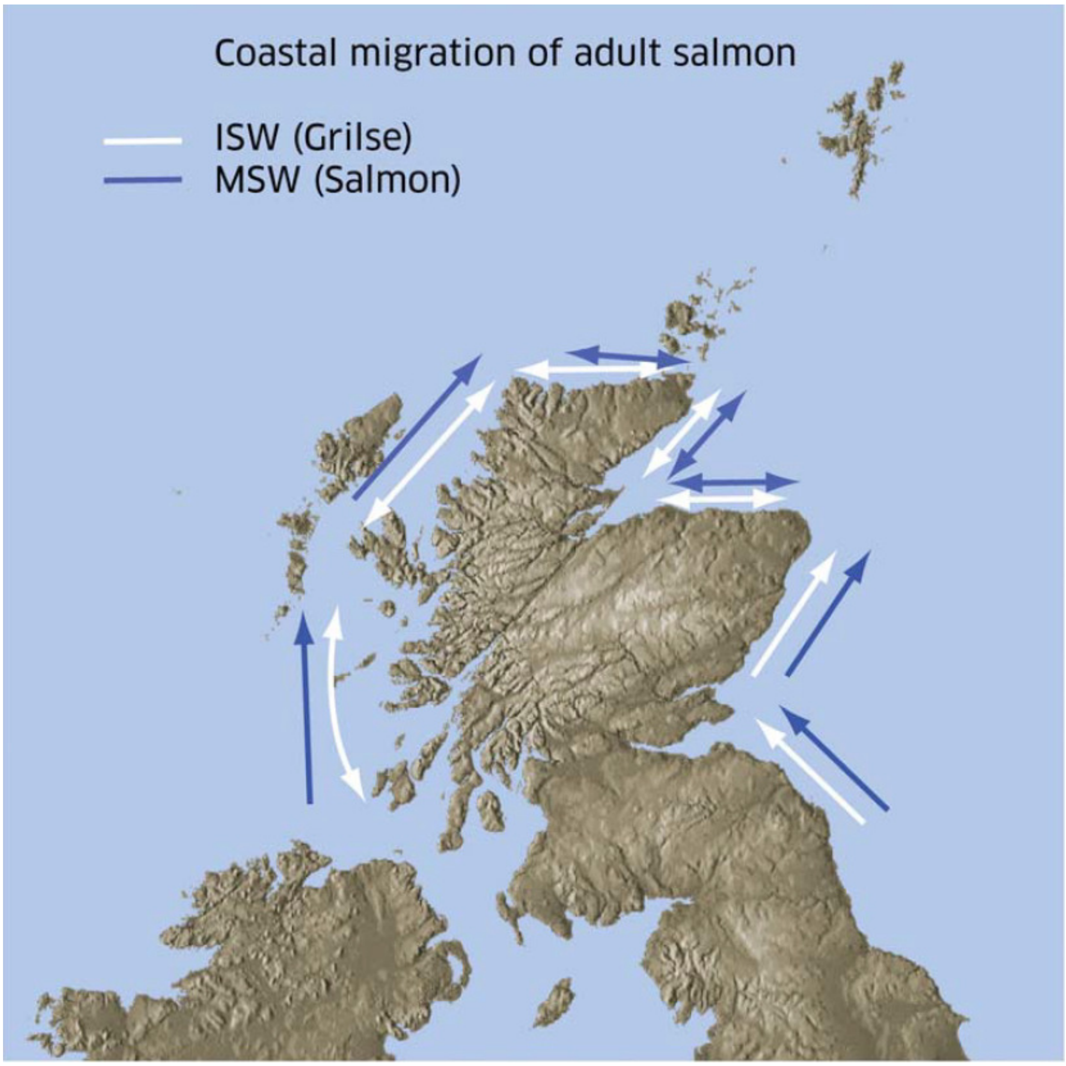


Figure 5.4 Dominant directions of Travel for Atlantic Salmon (1SW and MSW) in Scottish coastal waters based on tagging studies (Source: Malcolm *et al*., 2010)

5.3.2 Sea Trout

5.3.2.1 Smolt and Post-smolt Migration

Seaward migration in sea trout, like in salmon, is thought to be an active process (Thorstad *et al*., 2004; Thorstad *et al*., 2007). Tagging studies carried out in the River Conwy, North Wales (Moore *et al.,* 1998b) found sea trout smolts migrating seawards on ebb tides and swimming close to the surface. In addition, the movements in the lower portion of the estuary were found to be indicative of active directed swimming and it was suggested that there was no apparent period of acclimation when moving from fresh to saltwater.

As mentioned in Section 5.2.2 above, most sea trout smolts are thought to leave the river around April and early June. Information gathered by Pratten and Shearer (1983) in the River North Esk, found the peak of the sea trout smolt migration to occur usually in May or June.

Sea trout differ from Atlantic salmon in that generally they do not venture off to distant feeding grounds in the sea, but instead, remain in coastal areas. A range of migratory strategies have however been observed in sea trout stocks, including estuary residence, local coastal movements and extensive open sea migration (Solomon, 2007).

Detailed tracking studies on the migration of sea trout post-smolts have been carried out in sea lochs, in the west coast of Scotland (Pemberton, 1976a; Middlemas *et al*., 2009) and in Norwegian fjords (Finstand *et al*., 2005; Thorstad *et a*l., 2007). The results of these studies suggest a relatively local movement with sea trout remaining within sea lochs and fjords during the first couple of months at sea (Malcolm *et al*., 2010).

In the east coast of Scotland, data on sea trout post-smolts is scarce, being principally derived from tagging studies carried out in the North Esk. Studies by Pratten and Shearer (1983) found that the majority of reported recaptures were from the Montrose area, although numerous examples of tagged sea trout travelling appreciable distances (>100km) along the coast were also found. In addition, four tagged fish were recaptured in excess of 500km from the North Esk, three off the Scandinavian coast and one in the River Barvas, North West Lewis. Further research by Shearer (1990) in the North Esk, concluded that most sea trout post-smolts were probably staying within a short distance of the Esk rivers, although some recaptures were observed as far north as the river Spey and as far south as the River Tweed (Malcolm *et al*., 2010).

5.3.2.2 Spawning Migration

As previously discussed for salmon, river entry in sea trout is also thought to be related to flow conditions, with fish having to wait for suitable river conditions, particularly elevated flows, before entering the freshwater habitat (Potter and Dare, 2003; Consultation Meeting. 2010a-d; Consultation Meeting, 2011a).

Timing in river entry is also variable in sea trout. Based on information gathered in consultation meetings undertaken with the North East region Salmon Fishery Boards and the analysis of MSS salmon and sea trout catch statistics, it appears that the main sea trout runs in the North East salmon fishery region occur in the summer months from June to September, with peak runs varying between rivers. Similarly, information gathered in the North Esk (Pratten and Shearer, 1983) where the sea trout population was sampled by means of a stationary trap, found that finnock (post-smolts) returning to fresh water in the year of their smolt migration where moving upstream from July onwards, with a peak of movement occurring in the autumn. The same study found the main run of adult sea trout occurred between July and October.

The information available to date, does not allow for common patterns, behaviour or routes, either in general or for particular rivers, to be determined. Whilst tagging studies carried out in the east coast suggest that sea trout generally remain in their local area, it appears clear that sea trout exhibit a wide range of migrations (Malcolm *et al*., 2010). The findings of the principal studies carried out in the regional study area are summarised below.

Nall (1935) analysed the findings of tagging studies carried out between 1914 and 1935 along the east coast of Scotland. In the majority of cases, recaptures were made within the local estuarine, river or firth areas, with very few distant recaptures being observed (within 40 miles). As previously explained (Section 5.3.2.1), studies undertaken by Pratten and Shearer (1983) and Shearer (1990) in the Montrose area, found similar patterns, with the majority of fish being found in adjacent rivers, although longer migrations were also observed.

The distribution of sea trout recaptures from tagging programmes in the rivers North Esk, South Esk and Bervie is illustrated in Figure 5.5, as presented in Malcolm *et al.* (2010).

Little is known about the behaviour during migration around Scottish coastal and distant waters. Research carried out in Norway indicates a preference for swimming at depths below 3m, however, within the same study, records of sea trout at depths up to 28m were also observed (Rikardsen, 2007).

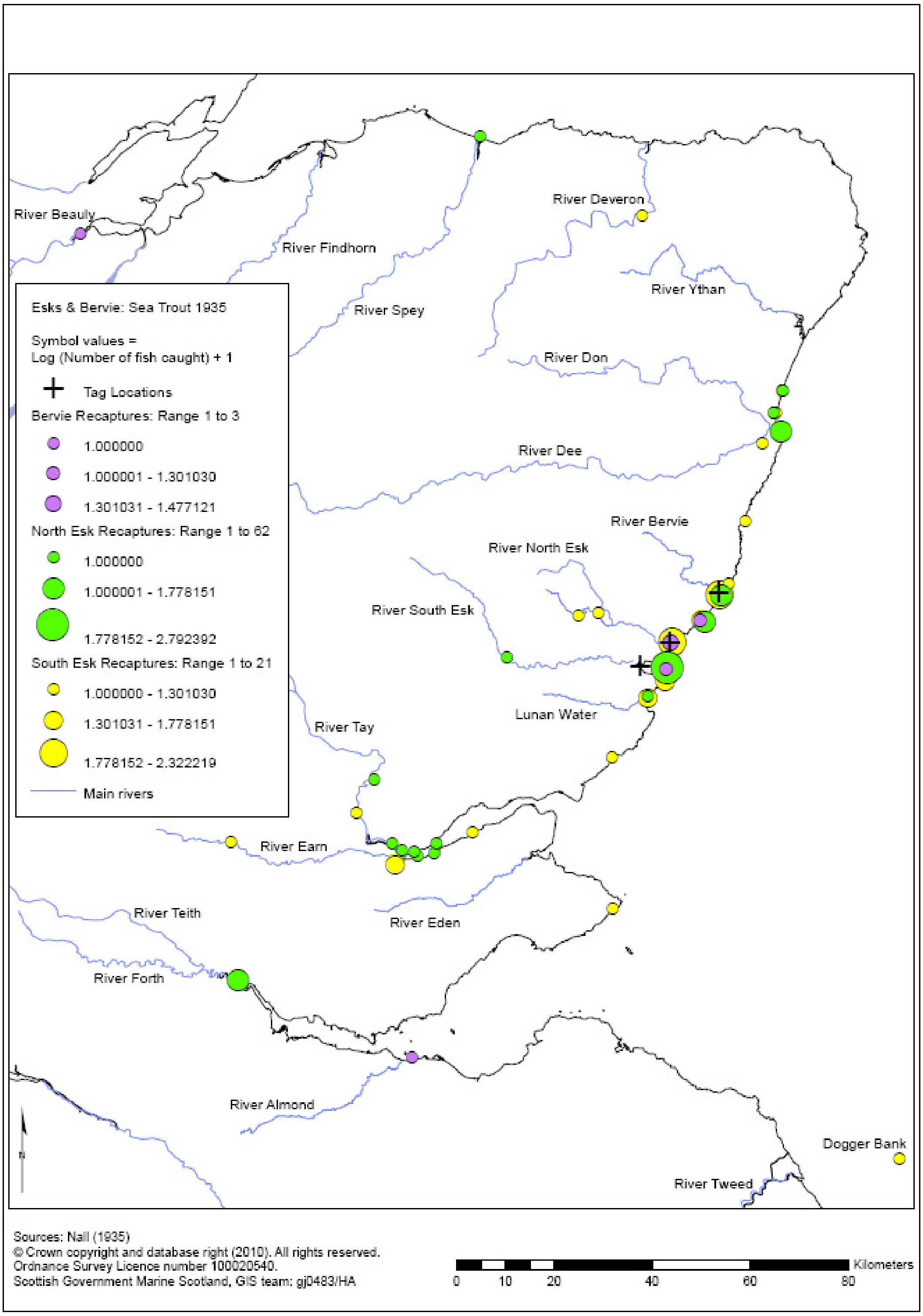


Figure 5.5 Map showing the distribution of sea trout recapture locations from tagging programmes in the rivers North Esk, South Esk and Bervie (Malcolm *et al.,* 2010)

5.3.3 Navigation and Orientation

Olfaction is thought to play an important role in the orientation of salmonids and it is widely accepted that the final phase of the spawning migration is primarily governed by olfactory discrimination of home-stream water (Hasler and Scholz, 1983; Døving *et al*., 1985).

In addition to olfactory stimuli, salmonids are known to be capable of sensing magnetic cues during certain types of spatial activity (Chew and Brown, 1989; Taylor, 1986). In Atlantic salmon, biomagnetic particles, particularly associated with the lateral line, which are of a size suitable for magnetoreception are believed to allow them to follow a rough compass heading, facilitating orientation with respect to the geomagnetic field during the oceanic phase of their migration (Potter and Dare, 2003; Lohmann *et al.,* 2008a).The presence of magnetoreceptors and the ability to use the geomagnetic field for spatial orientation has also been documented in sea trout (Formicki *et al.*, 1997; Formicki *et al.,* 2004).

Based on the ability of salmonids to identify both olfactory and magnetic cues, it has been hypothesised that both olfactory and magnetic mechanisms may play a role in navigation and orientation in salmonids, and that these may function sequentially over different spatial scales (Lohmann *et al*., 2008b).

In line with the above, research carried out in Norway (Hansen *et al.,* 1993) suggest the existence of two phases to the homing migration of maturing Atlantic salmon from the feeding areas to their home rivers; a first phase with crude navigation from the feeding areas toward the Norwegian coast and a second phase with more precise navigation in coastal and estuarine waters towards their home rivers. Similarly, research undertaken in Iceland (Sturlaugsson *et al*., 2009) suggests the existence of behavioural differences in salmon orientation in offshore and inshore areas related to increased use of olfactory sense in inshore areas. The study also found that fixed direction all the way from offshore areas to the home fjord area or home estuary could not explain their migration and it was suggested that shoreline orientation is of importance once the shore has been approached. Based on their findings, the authors recommend the spawning migration of salmon at sea to be divided into three phases in relation to the different orientation behaviour in offshore, inshore and estuarine areas.

It is recognised that there is limited information available to date to describe in detail the navigation and orientation mechanisms used by salmon and sea trout during their marine migration. Furthermore, comprehensive and robust scientific literature specific to salmon and sea trout originating from Scottish rivers is lacking in this field.

5.4 Feeding

Salmon and sea trout seaward migration is thought to be related to increased growth rates at sea derived from the existence of greater feeding opportunities in the marine environment (Haugland *et al.,* 2006; Rikardsen *et al*., 2006). A review of the feeding habits and diet of salmon and sea trout at sea is given below.

5.4.1 Salmon

Atlantic salmon are generalist and opportunistic predators of zooplankton and nekton at the ocean surface (Jacobsen and Hansen, 2001, Lacroix and Knox, 2005, Haugland *et al*., 2006). They feed on a variety of small fish including capelin, herring, sandeels and sprats in addition to other surface-living small components of the zooplankton, principally crustaceans (Mills *et al.,* 2003).

Studies carried out in fjords and coastal areas in Norway suggest salmon start to feed on marine organisms immediately after their transition to saltwater and found salmon post-smolts largely feeding on small fish (0-group), with sandeel and herring being of importance as prey items. Blue whiting was found to be of importance as a prey only in the slope current that transports larvae from its spawning areas west of UK into the North and Norwegian Seas (Haugland *et al*., 2006).

Research based on stomach contents of wild and escaped farmed salmon in the North East Atlantic (Jacobsen and Hansen, 2001) found evidence of selective foraging in salmon. Jacobsen and Hansen (2001) results suggest that fish species were preferred over crustaceans and amphipods over euphausiids. In addition, a relation between sea age and food habits was also found, where larger salmon (3+SW) tended to be more piscivorous than smaller fish.

Research carried out in the Baltic Sea (Karlsson *et al.,* 1999) also suggests seasonal changes in feeding habits, with salmon primarily feeding on sprat in the winter from January to April, and herring and spined stickleback later in the year.

Jacobsen and Hansen (2001) also found seasonal variations in feeding habits, with amphipods, euphausiids and mesopelagic shrimps being the principal food sources in autumn, whilst in the winter mesopelagic fish were important. It has been suggested (Rikardsen *et al*., 2004) that spatial and temporal differences in prey availability may be related to geographical differences in feeding habits in salmon.

5.4.2 Sea Trout

Sea trout at sea feed on a variety of organisms, changing gradually from small crustaceans to small fish such as sandeels and sprat (Potter and Dare, 2003; MSS, 2010a). Food preferences are thought to be dependent on habitat, season and fish size and age (Knutsen *et al*., 2001).

Studies carried out in Mulroy Bay in the Irish Sea, suggest that as sea trout increases in fork length their diet tends to include more fish and fewer crustaceans (Fahy, 1985). Similarly, investigations by Pemberton (1976b) in North Argyll sea lochs found that young fish, principally clupeids and sandeels, featured more in the diet of larger trout (≤21 cm) than in the smaller size range.

Seasonal studies of the feeding of sea trout in fjords in northern Norway (Rikardsen *et al.,* 2006) found sea trout feeding on marine crustaceans and polychaetes during early and late winter, whilst in summer and autumn their principal prey items were small fish such as juvenile herring. This is in line with the findings of Pemberton (1976b), which suggest that benthic feeding (crustacean and annelids) was more important in winter, while midwater and surface organisms (young fish and insects) were preferred in the summer. In addition, Pemberton (1976b) suggested a diel feeding pattern, with bottom feeding being greatest during the day and midwater and surface feeding increasing between sunset and sunrise.

5.5 Conservation Status

Atlantic salmon (*Salmo salar*) is listed in Annexes II and V of the EU Habitats Directive as a species of European importance and Annex III of the Bern Convention. The protection given to salmon through the Habitats Directive, however, is restricted to freshwater habitats, as marine and estuarine sites are excluded from selection. Similarly, salmon at sea is not protected under the Bern Convention.

Through the implementation of the Habitats Directive and as a result of the European importance of Scotland's salmon populations, 11 Scottish rivers have been designated as Special Areas of Conservation (SACs), with salmon being a primary reason for the selection of the site (Figure 5.6). Two of the aforementioned SACs are located within the regional study area: the River Dee and the River South Esk. These rivers' SACs support high quality salmon populations. Furthermore, as a result of a high proportion of the rivers being accessible to salmon, both the South Esk and the Dee support the full range of life-history salmon types found in Scotland with sub-populations of spring, summer salmon and grilse all being present (JNCC, 2010).

In addition to the protection given under the EC Habitats Directive, Atlantic salmon is listed as a UK Biodiversity Action Plan (BAP) priority species and is protected at the international level by the North Atlantic Salmon Conservation Organization (NASCO), an inter-governmental organisation devoted to the conservation, restoration, enhancement and rational management of wild salmon in the North Atlantic (Curd, 2010).

Sea trout (*Salmo trutta*) is not subject to the same level of protection as salmon in Europe, although it is listed as a UK BAP priority species and, in Scotland, is currently protected under the same conservation legislation as Atlantic salmon. This is a result of the definition of the term salmon in the Scottish legislation; under the Salmon (Scotland) Act (1986) salmon means: *"all migratory fish of the species Salmo salar and Salmo trutta and commonly known as salmon and sea trout respectively or any part of any such fish"*

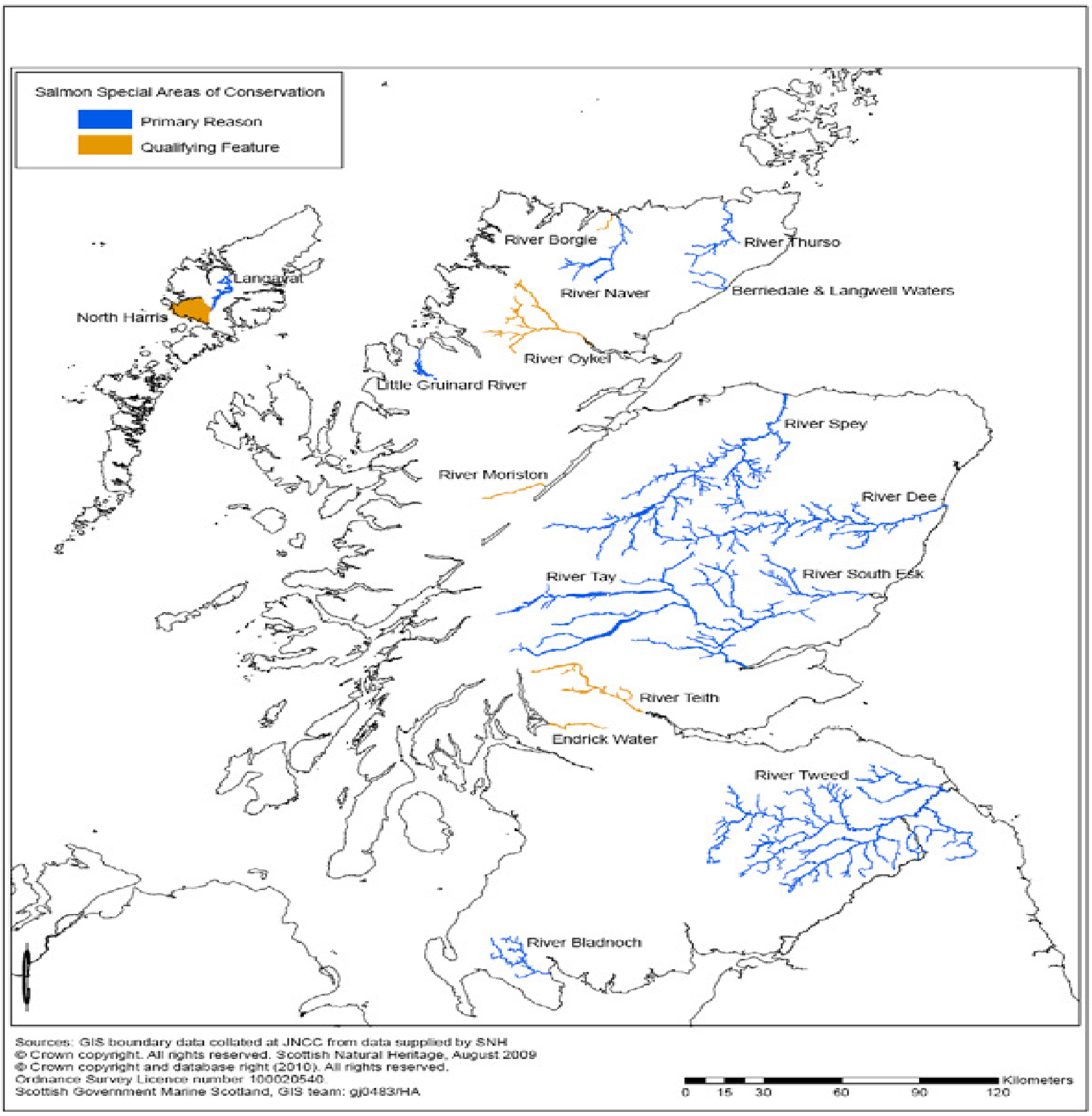


Figure 5.6 Distribution of Special Areas of Conservation (SACs) for Atlantic Salmon (Source: Malcolm *et al.*, 2010)

5.6 Threats to Salmon and Sea Trout

Salmon and sea trout populations are subject to a number of threats in both the freshwater and marine phases. In fresh water, degradation of juvenile and spawning habitat, and land use, in particular intensive agriculture, are thought to be having the greatest effect, whilst in the marine phase, there is concern over the recent decline in post-smolt marine survival rates (Hendry and Cragg-Hine, 2003; ICES, 2009). As a result, Atlantic salmon stocks are currently under threat across their northern hemisphere range and sea trout populations in decline throughout the United Kingdom (Crawley, 2010).

A summary of the main threats that salmon and sea trout are exposed to in the rivers, coastal and marine environments is given below (AST, 2010b; Curd, 2010).

Rivers

- Predation by birds
- Pollution and poor habitat
- Obstructions such as dams, weirs and culverts
- Disease
- Poor angling practices
- Poachers

On the coast

- Interceptory mixed stock nets
- Fish farms - sea lice, disease and escaped farmed salmon
- Pollution

At sea

- Climate changes affecting feeding and survival opportunities (e.g changes in sea surface temperatures)
- Increased predation by seals
- Fishing, including indirectly through over-exploitation of their food resource (e.g sandeel) and directly through unintentional capture when fishing for other species such as herring and mackerel.

The majority of threats to salmon and sea trout in the rivers are being addressed in Scotland through the implementation of river management and water quality schemes, the removal of obstructions, the establishment of fishing codes of practice and other such initiatives.

Efforts made within the rivers to maintain and conserve salmon and sea trout stocks are however limited in their effectiveness as a result of stock management measures implemented in coastal waters and in the high seas and by changes in the status of the stocks caused by sea mortality and other factors. In this context, two aspects of relevance are the persistence of Multi Stock Fisheries (MSFs) in Scotland, which target fish from more than one stock/river (e.g coastal netting), and the current trend of increased post-smolt mortality at sea (Hansen & Queen, 1999).

5.6.1 Multi Stock Fisheries

The exploitation of salmon and sea trout by MSFs holds particular problems to the implementation of management practices. The fisheries can be damaging because they have potential to intercept any salmon or sea trout in their vicinity, regardless of where those fish are heading or the strength of the population in their natal rivers (Crawley, 2010).

5.6.2 Increased Marine Mortality

Increased marine mortalities in post-smolts are thought to be related to climatic variations such as the increase in sea surface temperature (SST) (Beugrand and Reid, 2003; Friedland *et al*., 2009; Friedland *et al.,* 2000; Todd *et al.*, 2008).

Salmon populations are also of concern due to the sharp decline in growth condition observed in recent years in 1SW salmon (grilse) and MSW salmon (Todd *et a*l., 2008; Davidson and Cove, 2010). The growth reductions are thought to be indicative of recent and large-scale ecological shifts in the Easter North Atlantic epipelagic ecosystem and the likely importance of bottom-up control in the food web (Todd *et al*., 2008).

5.6.3 Current Research Initiatives

A number of initiatives have been implemented by NASCO and ICES to improve knowledge about the distribution and migration of salmon at sea, which in turn may help to understand mortality of salmon during their marine phase (ICES, 2009). The international co-operative SALSEA programme, adopted in 2004 was designed to improve the understanding of the migration and distribution of salmon at sea in relation to feeding opportunities and predation. In 2008, the SALSEA-Merge project was launched as part of the SALSEA Programme, aiming to advance understanding of stock specific migration and distribution patterns and overall ecology of the marine life of Atlantic salmon and gain an insight into the factors resulting in recent increases in marine mortality, by merging genetic and ecological investigations.

In line with the SALSEA-Merge project, Rivers and Fisheries Trusts of Scotland (RAFTS), the Scottish Government's Marine Scotland Directorate an all the fisheries Trusts around Scotland, have commenced a collaborative programme of genetic work, "Focusing Atlantic Salmon Management on Populations" (FASMOP), with the aim of understanding the structuring of river stocks of Atlantic salmon into breeding populations. In addition, MSS's Research Project "Development of a General Spatial Model of Within River Population Structuring in Scottish Atlantic salmon (POPMOD), using molecular genetic data on salmon information collected by MS, and through SALSEA-Merge and FASMOP, is anticipated to provide a general model which can be used to predict population structuring within any Scottish salmon river and evaluate the potential for using genetic estimates for monitoring the conservation status of breeding populations.

Research initiatives such as the Moray Firth Sea Trout Project (MFSTP) are also currently in place to address the decline in sea trout stocks and gather further information on the life history and the marine phase of this species.

6.0 Salmon and Sea Trout Fisheries Baseline Assessment

6.1 Introduction

Salmon and sea trout form an important part of Scotland's natural heritage. In addition, they support and maintain the existence of commercial and recreational fisheries which are of importance to the Scottish economy. A study undertaken by the Scottish Executive (Radford *et al.,* 2004) estimated that game and coarse anglers spent a total of £131m in Scotland of which 65% (£73m) corresponded to salmon and sea trout fishing. In 2008, the annual value of salmon fisheries to the Scottish economy was estimated at £120m (ASFB, 2010a).

It should be noted that the definition of salmon under the Salmon Act (1986) includes both Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*). Where applicable, the term may subsequently be used to describe both species.

6.2 Salmon Fishing Rights, Administration and Regulations

6.2.1 Fishing Rights

The right to fish for salmon in Scotland, whether in inland waters or at sea, is a heritable right. The taking of salmon without the right or written permission to do so is prohibited under the Salmon and Freshwater Fisheries (Protection) (Scotland) Act, 1951.

The rights originally belonged to the Crown Estate, however as with land, the Crown Estate has made grants of salmon fishing to others and ownership is now widely distributed among private individuals, companies, local authorities and others. The rights can be bought, sold or leased independently of land except in Orkney and the Shetlands (Williamson, 1991).

The Crown Estate still owns areas along the coast and in rivers, many of which are still let. Since the late 1980s, however, the Crown Estate has supported a policy of conservation by retaining coastal netting stations in hand and unlet. There are therefore, no longer any coastal netting stations let by the Crown Estate and none are actively fished (The Crown Estate, 2010); the existing working netting stations were therefore granted or sold the heritable title by the Crown Estate before the late 1980s (Crawley, 2010).

6.2.2 Fisheries Administration

Salmon fisheries in Scotland, both inland and at sea, are managed by their owner or leaseholder under a framework of regulations laid down by central government.

For the purposes of salmon fishery management Scotland is divided into 54 statutory Salmon Fishery Districts each with a catchment area including a river or group of rivers (ASFB, 2010b). Today, almost without exception, every district has formed a District Salmon Fisheries Board (DSFB) made up of the owners or leaseholders of the fishing rights. These boards manage the rivers and coastal netting zones, being able to appoint bailiffs with the power to enforce regulations and restrictions, as well as establishing other practices for improving and maintaining fish stocks, and monitoring and controlling river conditions. Each salmon fishery in each district has a value, which is calculated by the district assessor (Consultation Meeting, 2010b-c). Individual boards are self-financing and generally raise money by taxing rights' owners within their district. This often works on a sliding scale, according to the number of fish caught. In 1999 the government made a revision to the constitution of the boards to allow for wider representation, by bodies such as the Scottish Environment Protection Agency, Scottish Natural Heritage or others such as local angling clubs and associations (ASFB, 2010b).

Salmon fishery districts as formalised by the Salmon Fisheries (Scotland) Acts 1862-1868, are shown in Figure 6.1. As explained in Section 4.4.2 above, some districts have been joined together and superseded by larger districts, resulting in the current 54 districts.

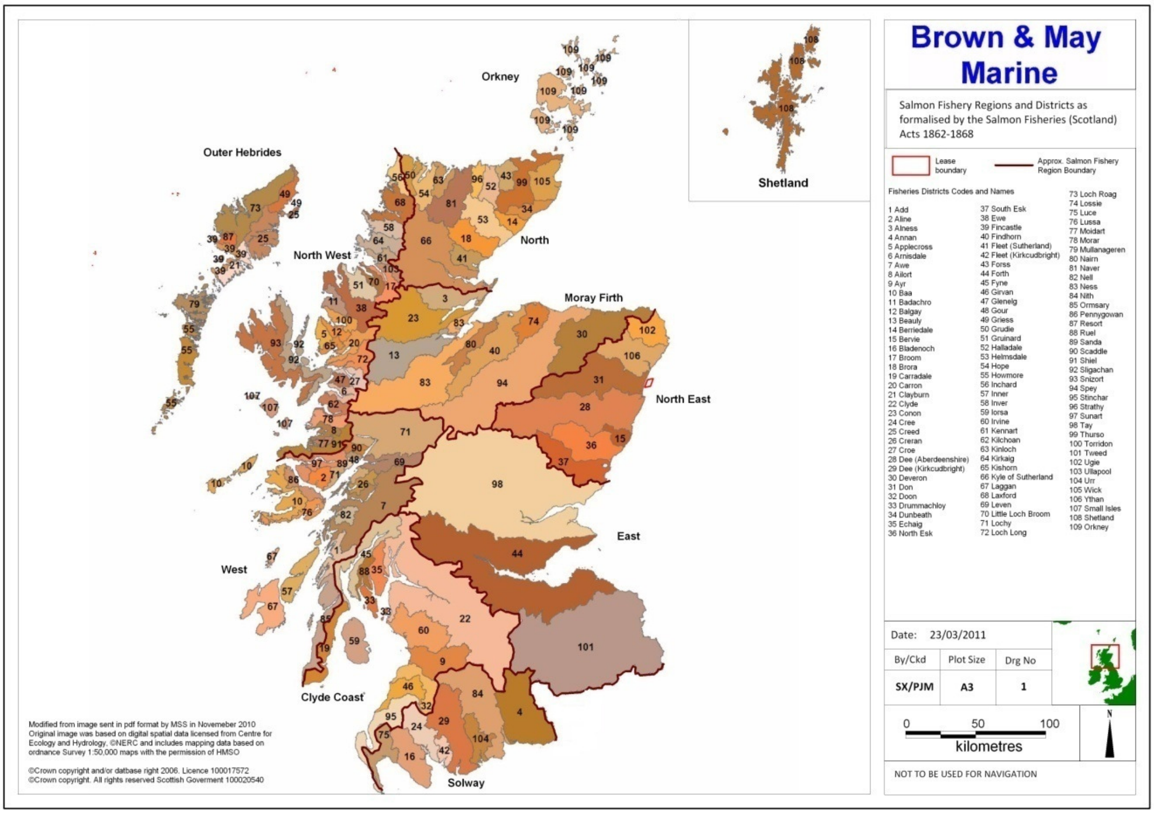


Figure 6.1 Salmon Fishery Regions and Districts in Scotland

Boards hold powers relating to the introduction of new regulations on the fishery, the purchase of property to acquire rod or net fisheries, the imposition of fishery assessments on the fishery proprietors, etc (SPICe, 2000). Whilst the Boards themselves have no ability to make legal restrictions on fishing, applications are made to Scottish Ministers by the boards for changes and new regulations to be introduced.

In addition to the Boards, the Scottish Executive Environment and Rural Affairs Department (SEERAD) oversees the fishery as a whole, promoting legislation and making regulations under the various Salmon and Fisheries Acts passed by the devolved government. The Inspector of Salmon and Freshwater Fisheries monitors the effects of legislation and the operation of the fisheries. Marine Scotland (who has taken on the roles and responsibilities of the former Scottish Fisheries Protection Agency) enforces regulations at sea and helps the District Boards with local, coastal enforcement (Williamson, 1991); Marine Scotland Science's Freshwater Fisheries Laboratory provides scientific advice on salmon and their fisheries.

6.3 Fisheries Regulations

6.3.1 General

All Scottish salmon fisheries are closed for a minimum of 168 days a year. Actual dates may vary but are mostly from late August to mid February, depending upon individual District Board policy.

Angling may continue for a few weeks either side of this. Weekly close times are also nationally enforced, being 24 hours (Sunday) in the case of angling and 60 hours for all other methods.

It is prohibited to take juvenile salmon (not including trout). There is a minimum mesh size of 90mm for nets, to enable smolts to escape.

There is no limitation on fishing effort within open fishing periods. There are however restrictions in place which act as indirect controls: restrictions imposed on the various fishing methods (discussed in Section 6.4); the exclusive right of the salmon fishermen through ownership or tenancy to decide fishing effort in their fishery; and regulations established and enforced by individual District Boards.

Salmon fisheries are saleable and netsmen or companies may acquire fishing rights over relatively large areas. Other interested parties may also purchase rights. For example, the Atlantic Salmon Conservation Trust has historically bought coastal sites to close them down as a conservation measure in order to halt coastal netting activities. Similarly, rod-and-line interests may buy up river netting rights to close them down, often through the district boards.

6.3.2 Inland waters

The only lawful fishing methods in inland waters are rod-and-line and net-and-coble. Fixed nets/engines are prohibited.

6.3.3 At sea

It is prohibited to catch fish by enmeshment. Troll or long-lining is also illegal. Effectively the only lawful methods are net-and-coble, fixed engines (bag and skate nets) or rod-and-line.

6.4 Fishing Methods

The principal legal methods for catching salmon in Scotland are as follows:

- Fixed Engines (Bag and Skate Nets)
- Net-and-coble
- Rod-and-line

In inland waters, salmon can also be caught using a cruive (a sort of trap) where expressly permitted by the Crown Estate. This is however, very rare (SPICe, 2000).

6.4.1 Fixed Engines (Bag and Stake Nets)

Bag and stake nets are the most common types of gear used to catch salmon in Scottish coastal waters and are commonly referred to as fixed engines. Salmon fishing using this method is not permitted in inland waters (rivers above the estuary limits).

Bag nets are set to fish just below the surface in rocky coasts where they will not ebb dry at low tide. They may be set singly or in a line extending seawards from the shore. The entire net or line of nets is not permitted to extend more than 1,300m from the mean low water mark, excluding mooring warps or anchors. The nets must not be operated between 6pm Friday until 6am Monday. Catches are generally removed from the nets at slack tide (Galbraith and Rice, 2004; SI 1992/1974).

No part of the nets may be set with the purpose of catching fish by entanglement. The minimum mesh net size is 90mm. Nets are designed to target fish swimming close to the surface while following the coastline. The gear is made up of two principal elements, the trap and the leader. The trap is approximately 13.5m wide and 4.5m deep at the mouth, tapering to about 3m in width and 2.5m in depth at the head. The leader may not exceed 300m in length.

Stake nets are similar in design and operation to the bag nets except that they are set on sandy beaches, supported on stakes driven into the sand, where the receding tide exposes the nets. The maximum allowed leader length and total gear length are similar to those specified for bag nets. The configuration of a typical bag net is shown in Figure 6.2 below.

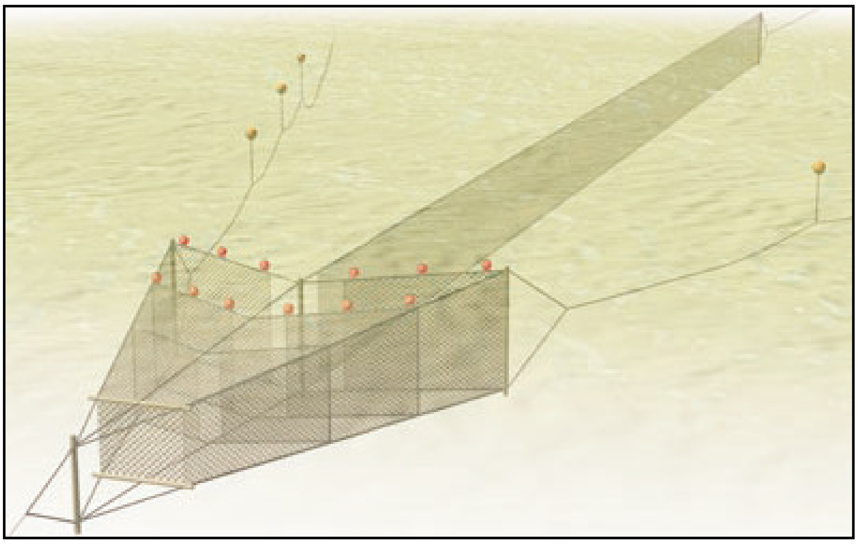


Figure 6.2 Bag Net showing the Trap, the Leader and Moorings

6.4.2 Net-and-Coble

Traditionally nets are operated from cobles, small flat bottomed, open boats, with a shore party assisting in operations. A member of the shore party holds the upstream hauling rope and the net is paid out from the stern of the vessel, as shown in Figure 6.3. The net must not be stationary or allowed to drift at any time and must be constantly 'swept', surrounding the fish and drawing them towards the shore. No other objects or obstructions may be used to aid fishing and adjacent netting operations must be at least 50m apart (Galbraith and Rice, 2004).

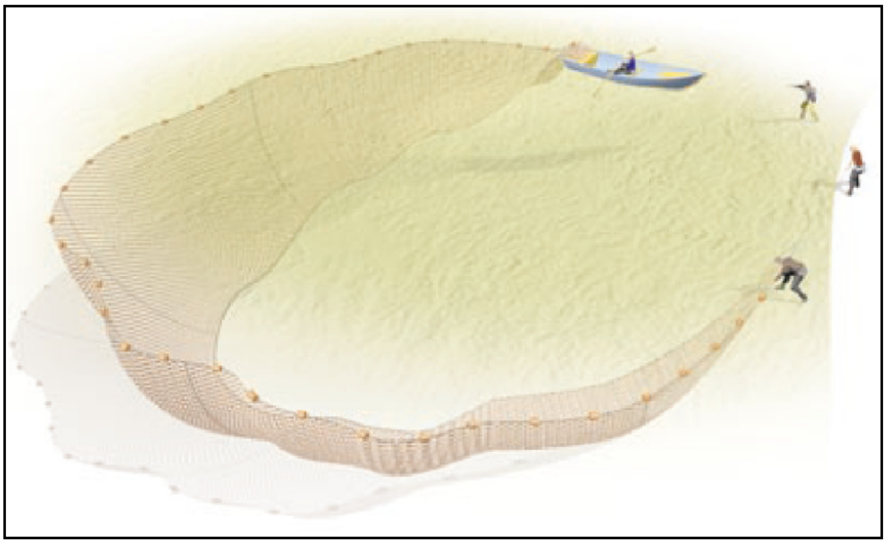


Figure 6.3 Net-and-coble Fishing

Net-and-cobles are generally operated in estuaries and the lower reaches of rivers, although small numbers are also used in coastal waters (Potter and Ó Maoiléidigh, 2006).

6.4.3 Rod and Line

At present, recreational rod-and-line fishing is the most common method of fishing for salmon. The Salmon and Freshwater Fisheries (Consolidation) (Protection) (Scotland) Act 2003, defines rod and line as: "*a single rod and line (used otherwise than as a set line or by way of pointing, or by striking or dragging for fish) with such bait or lure as is not prohibited".* DSFBs can apply to Scottish Ministers for regulations specifying baits and lures that may not be used for rod-and-line fishing in their district to be made whilst in some cases voluntary restrictions are set by the boards. Usually the restrictions prohibit the use of shrimps, prawns or worms as bait and the use of lures bearing multiple sets of hooks (SPICe, 2000). The use of fish roe, fire or light as bait or lure is also prohibited (Salmon and Freshwater Fisheries (Consolidation) (Protection) (Scotland), 2003)

Salmon and sea trout are generally not caught by rod-and-line at sea, but along river beats. Most DSFBs operate and police a catch and release policy. Due to increasing popularity, the sport makes a significant contribution to both local and regional economies.

6.5 Fisheries Data

The information given in this section is principally based on reported catches of salmon, grilse and sea trout recorded from 1952 to 2009 by region and by salmon fishery district within the North East region from 2000 to 2009. These were kindly provided by Marine Scotland Science. In addition, information gathered during the consultation process has also been included in this section where appropriate.

It should be noted that the analysis and interpretation of the fisheries statistics given below is not intended as an assessment of the abundance or state of the stocks but as an indication of the underlying population trends and the relative importance of the salmon and sea trout fisheries by region, fishery district and method.

6.5.1 National

6.5.1.1 Historical Data

This section provides an overview of historical catch data by species for the rod-and-line (including catch and release) and the net fishery (net-and-coble and fixed engines) in Scotland from 1952 to 2009.

Overall current salmon catches by rod-and-line (including catch and release) are in line with historical levels whilst for grilse there has been an increase in the total annual catch, especially during the second half of the data series. It is believed that increases in rod-and-line popularity may have to some extent kept catch values within historical levels. The overall trend in sea trout catches by the rod-and-line fishery, however, appears to be one of a decline (Figure 6.4).

Catches by the net fishery (net-and-coble and fixed engines), have also shown a marked decline in the last decades with respect to historical levels (Figure 6.5). The decline in catches observed for the net fishery is associated with a decrease in fishing effort most likely caused by, the buyout and closure of coastal netting stations, changes in abundance of salmon and the fall in the market price of wild salmon caused by competition from the aquaculture industry, among other factors (MSS, 2008). The decrease in netting effort may also have, to some extent, contributed to the catch levels observed in the rivers by the rod-and-line fishery.

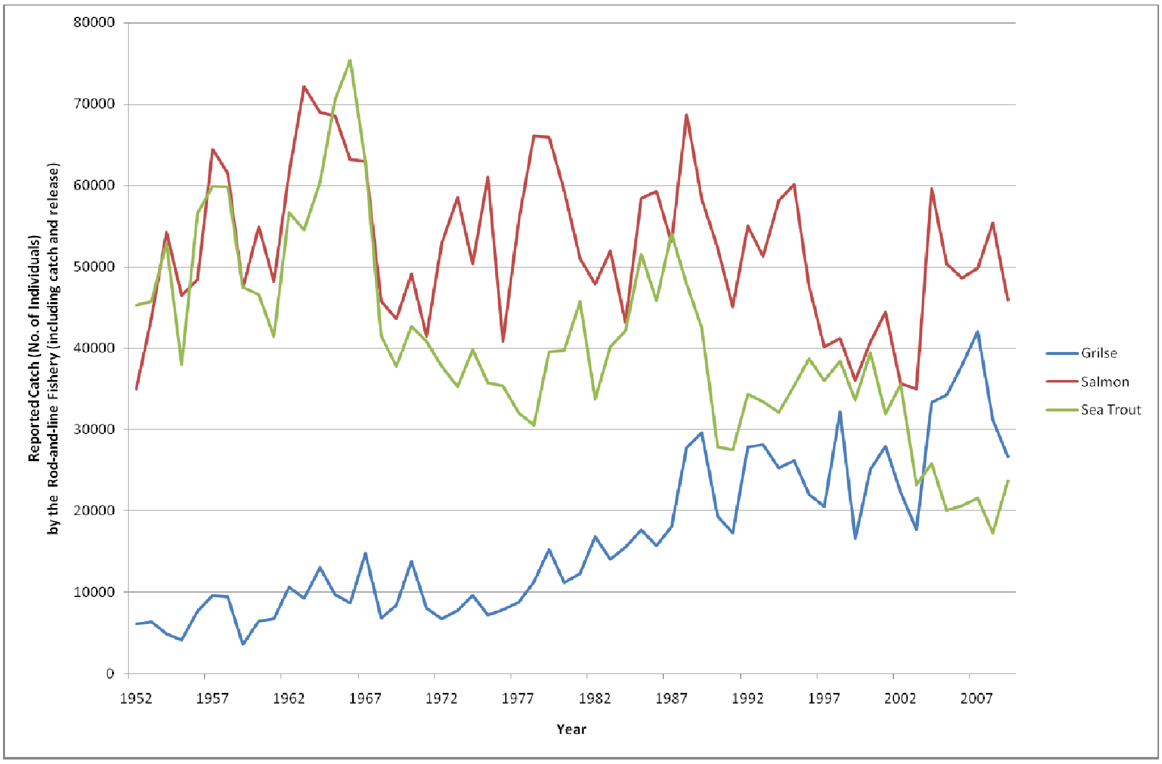


Figure 6.4 Rod-and-line Fishery (including Catch & Release) Reported Catches (1952-2009)

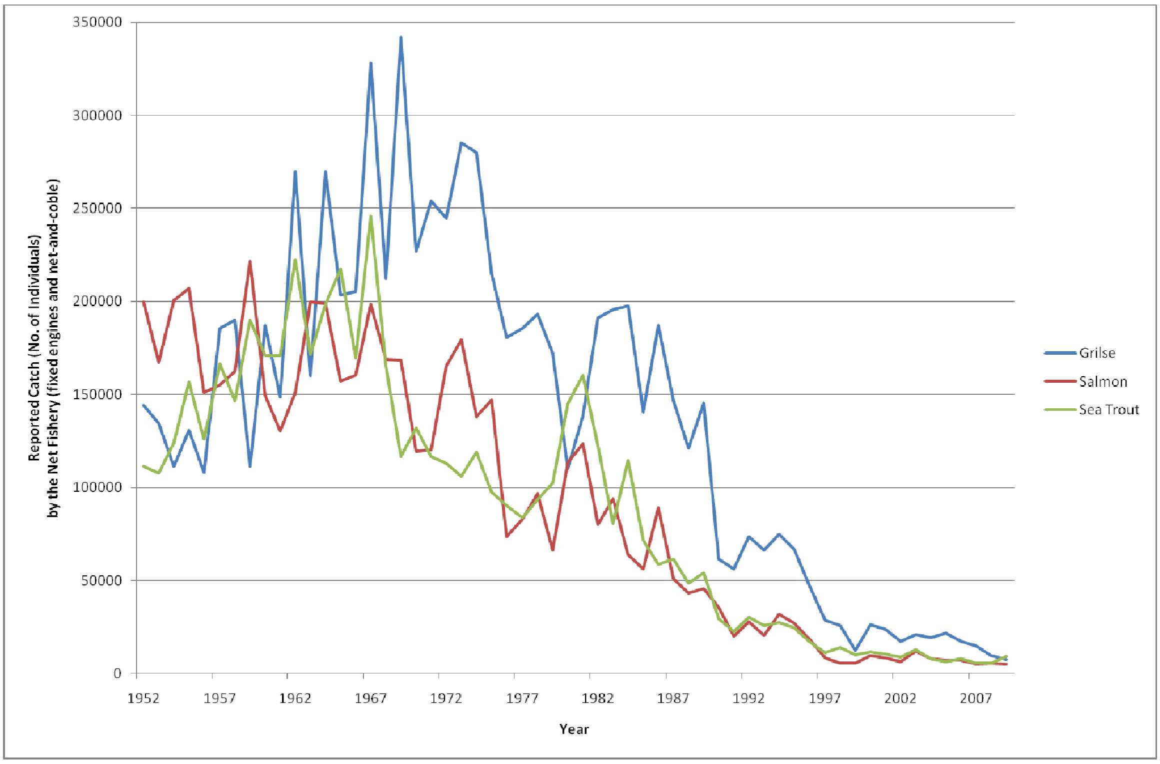


Figure 6.5 Net Fishery (Fixed Engines and Net-and-coble) Reported Catches (1952-2009)

6.5.1.2 Current Trends

An indication of the current salmon, grilse and sea trout catches by fishery region in the national context is given in Figure 6.6 below. This shows annual reported catches (average 2000-2009) for salmon, grilse and sea trout by fishery region.

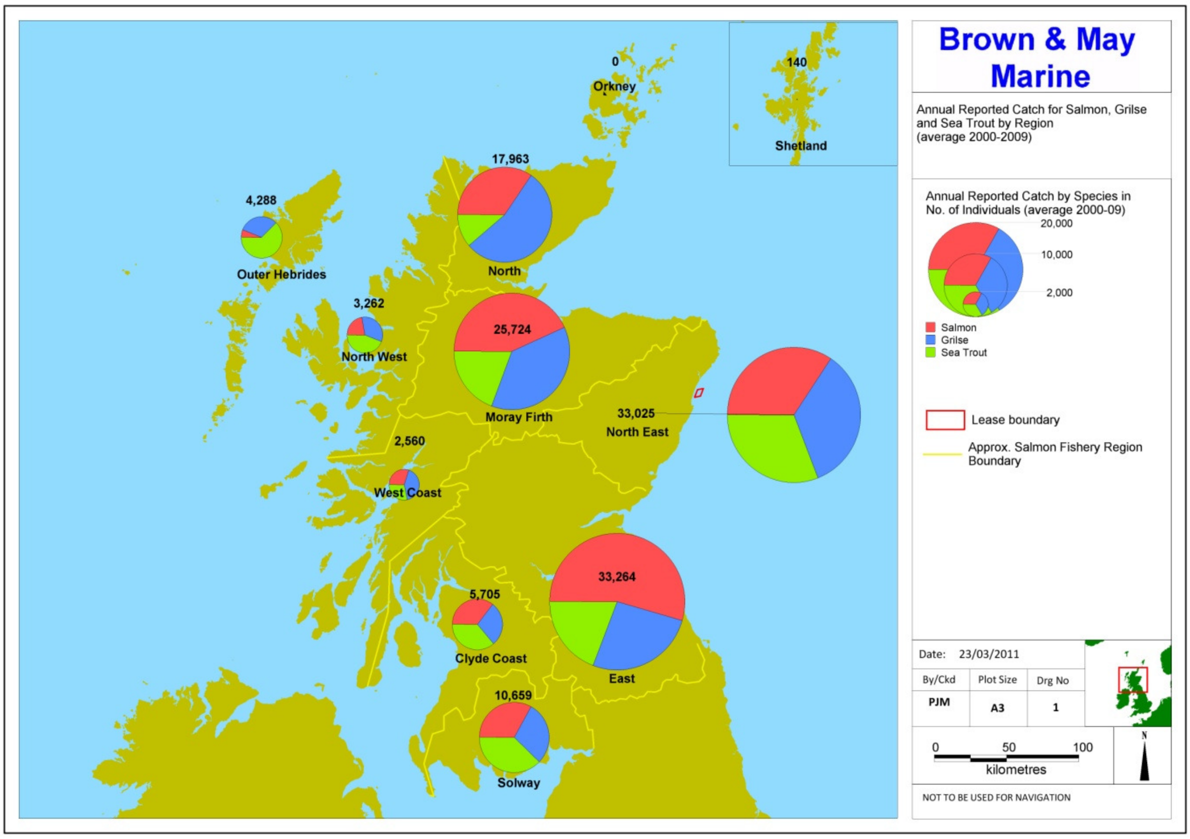


Figure 6.6 Annual Reported Catch (No. of Individuals) by Species and Region (average 2000-2009)

As it is apparent from Figure 6.6, reported catches are greater in the east coast of Scotland. The North East region shows the second highest annual catch (average 2000-2009) in Scotland.

The principal fishing methods used by fishery region are illustrated in Figure 6.7.This shows annual catch (all species combined) by method and region (average 2000-2009). Rod-and-line (including catch and release), accounts for the majority of the average annual catch in most regions, however netting by fixed engines and net-and-coble is also of relevance in some regions.

The netting component of the total catch is of special importance in the North East Region, where the combined catch by fixed engines and net-and-coble accounts for a similar percentage of the total catch (50.3%) than that recorded by the rod-and-line fishery (including catch and release) (49.7%). It should be noted that the majority of the catches by both fixed engines and net-and-coble in this region come from the Esk district. The current netting fishery in the Esk is discussed in further detail in 6.5.3 below.

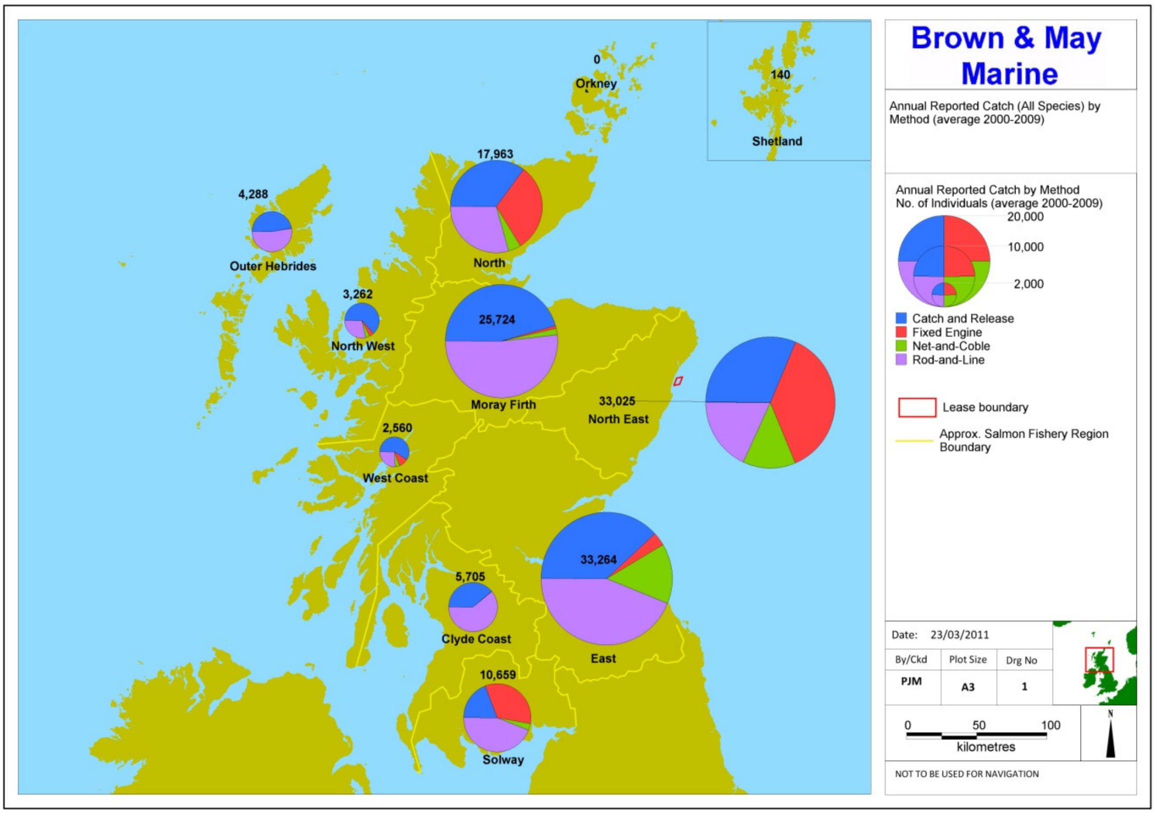


Figure 6.7 Annual Reported Catch (No. of Individuals) by Method and Region (average 2000-2009)

6.5.2 Regional

6.5.2.1 Catches by District

The annual reported catch (average 2000-2009) by salmon fishery district within the North East region is shown in Figure 6.8 and Figure 6.9 by species and method respectively. Note that for the Esk district, catch statistics are broken down by former district (North Esk, South Esk and Bervie).

The Esk and the Dee account for the majority of the catches for all species within the North East region. The Dee shows the highest annual catch for salmon whilst the North Esk and South Esk have the highest grilse catch.

Overall sea trout records catches are similar to those recorded for salmon in the region. In the Ythan and the Ugie, the two districts with the lowest annual catches however, sea trout accounts for a relatively high percentage of the total catch.

Rod-and-line is the principal fishing method in the Dee, the Don and the Ythan, a high percentage of which is by catch and release, particularly in the Dee and the Don.

Fixed engines account for the majority of the catch in the Esk district, especially in the South Esk. In the Don, the Ythan and to a lesser extent the Ugie, fixed engines also account for a relatively important percentage of the total catch. Net-and-coble represents a significant component of the North Esk's and Ugie's annual total catch. The Dee is the only district within the North East region where there is no netting activity, with no reported catches by either fixed engines or net-and-coble.

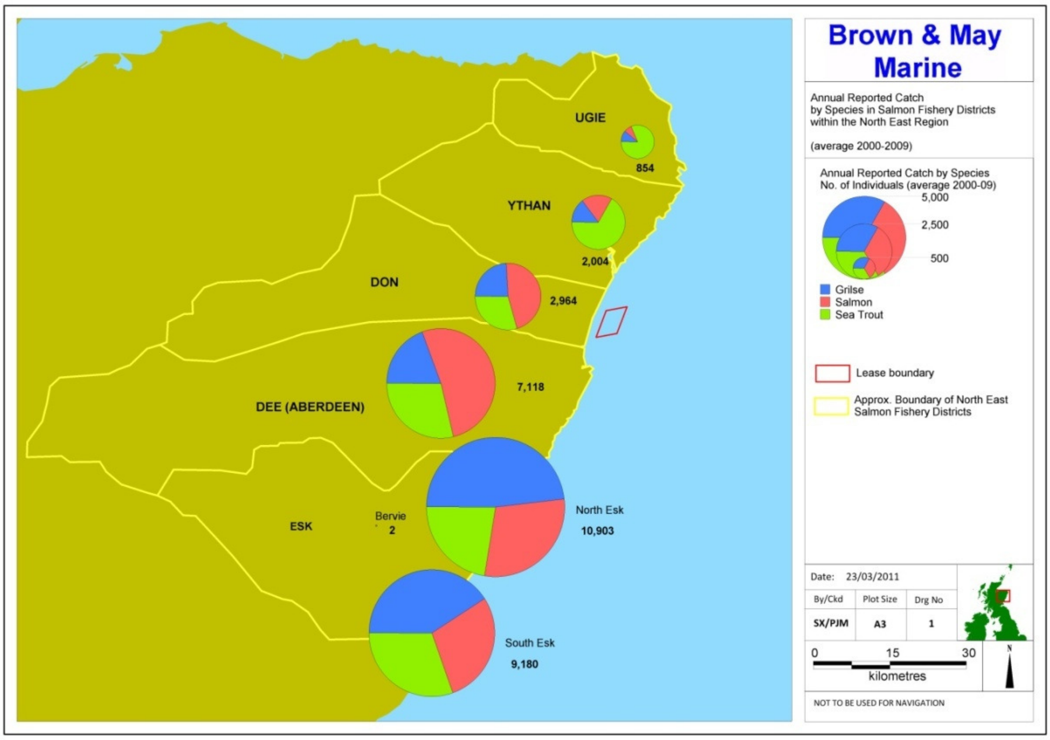


Figure 6.8 Annual Catch (No. of Individuals) by Species in Salmon Fishery Districts within the North East Region (average 2000-2009)

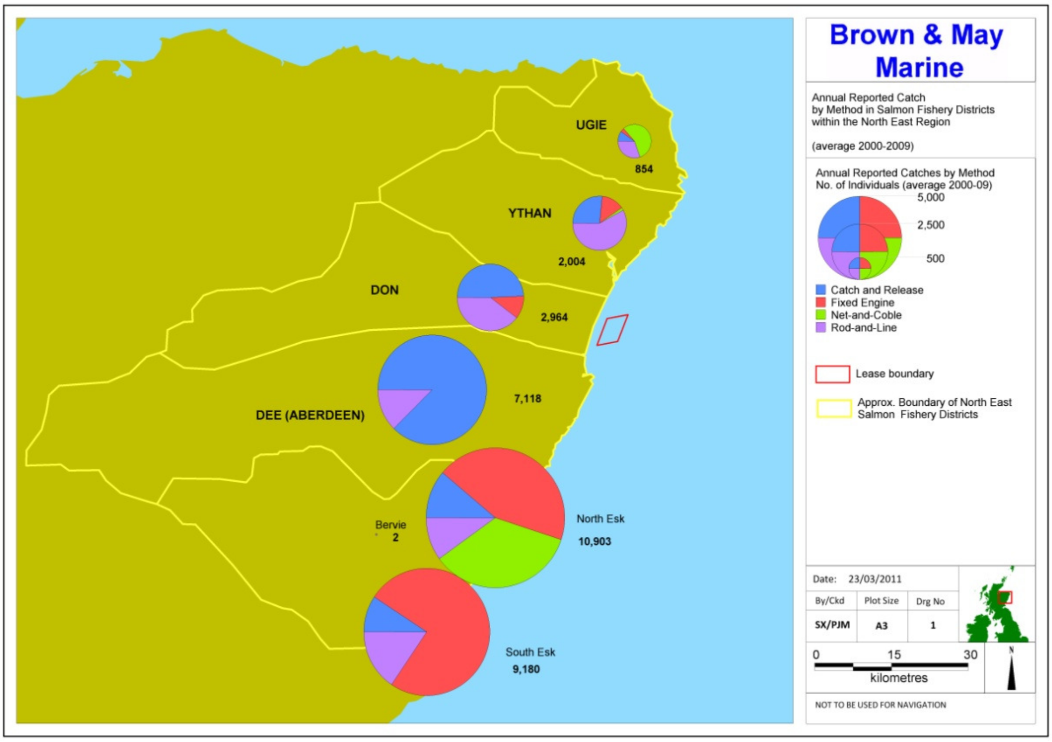


Figure 6.9 Annual Reported Catch (No. of Individuals) by Method in Salmon Fishery Districts within the North East Region (average 2000-2009)

6.5.2.2 Seasonality and Annual Variation

An indication of the seasonality and annual variation of the rod-and-line (including catch and release) and the net fisheries (separated into net-and-coble and fixed engines) by species and district is illustrated in Figure 6.10 to Figure 6.15 below, based on monthly reported catches averaged for the period 2000-2009 and total annual catches for the same period.

Rod-and-line Fishery Seasonality

Salmon catches peak in October in all the districts with the exception of the Dee, where peak catches are recorded in September. In the Dee, relatively high catch values are also shown from March to June, suggesting spring salmon runs to be of importance to the overall rod-and-line fishery in the district. The catch values recorded in the Don, the North Esk the South Esk during the spring also suggest that spring salmon account for a relatively important proportion of the total salmon catch in these districts.

Grilse are principally caught from June to October with peak catches recorded from August to October. Sea trout are caught from May to October with high catches recorded in June, July and August (Figure 6.10).

Rod-and-line Fishery Annual Variation

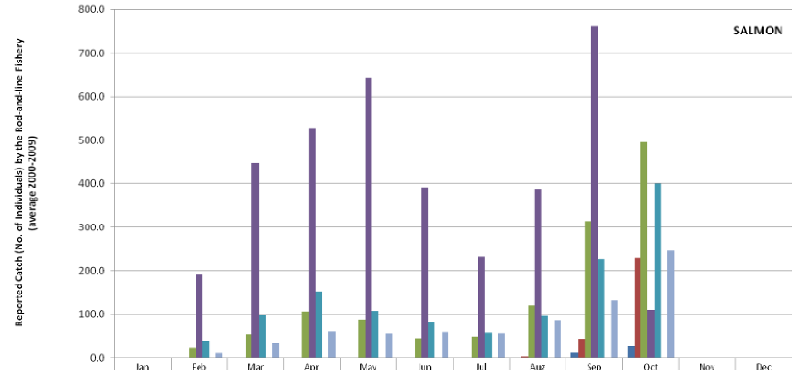
There has been a marked increase in the rod-and-line catches of salmon and grilse in the Dee. The total salmon catch in 2009 more than doubled that from 2000 in this district.

In the Don, overall, there has been a slight decrease in salmon catches whilst for grilse, catches have remained relatively constant. The highest catches for both salmon and grilse in the Don were recorded in 2004.

In the North Esk salmon catches have shown slight fluctuations over the years, whilst for grilse there has been a significant increase in the total catch by rod-and-line, with 172 grilse caught in 2000 compared to 1,144 in 2009.

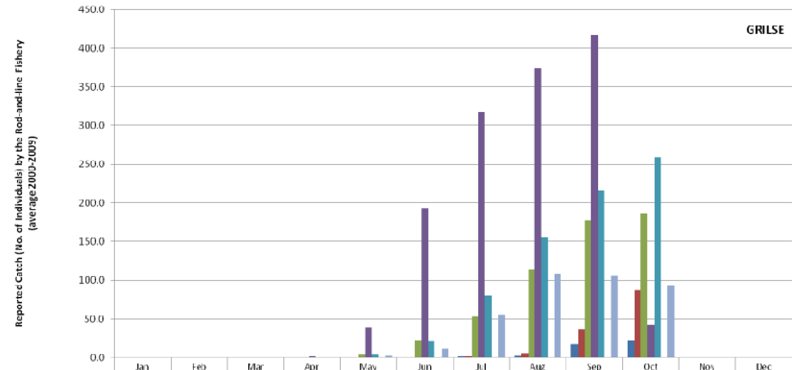
Salmon and grilse catches have remained relatively constant in the Ythan and the South Esk from 2000 to 2009, with high values recorded between 2004 and 2005.

The general trend in sea trout catches is one of a decline in all the districts, principally as a result of the decrease in catch values recorded between 2000 and 2003 (Figure 6.11).



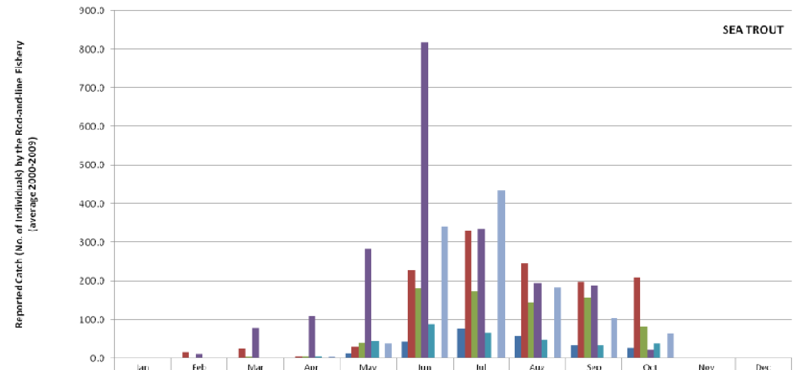
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.4	12.9	27.9	0.0	0.0
Ythan	0.0	0.2	0.1	0.0	0.8	0.0	0.5	2.8	43.6	228.6	0.0	0.0
Don	0.0	23.3	53.1	105.8	87.6	45.0	48.4	120.3	313.6	495.3	0.0	0.0
Dee (Aberdeenshire)	0.0	190.6	446.9	527.9	643.8	391.8	230.9	386.6	761.4	109.9	0.0	0.0
North Esk	0.0	39.2	97.3	152.1	108.1	82.8	59.1	96.7	226.7	400.2	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	0.0	0.0
South Esk	0.0	10.3	33.5	62.0	55.0	59.8	57.6	87.3	131.4	246.4	0.0	0.0

Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	0.3	0.5	1.7	2.6	18.1	22.5	0.0	0.0
Ythan	0.0	0.0	0.0	0.0	0.0	0.1	1.7	6.0	36.5	86.8	0.0	0.0
Don	0.0	0.0	0.0	0.7	4.2	22.3	52.9	113.6	177.3	186.3	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.1	1.6	38.9	193.9	317.0	374.7	416.9	42.8	0.0	0.0
North Esk	0.0	0.0	0.0	0.2	3.7	21.3	80.1	155.8	215.7	258.9	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
South Esk	0.0	0.0	0.0	0.3	2.5	11.1	55.7	108.5	106.2	92.7	0.0	0.0

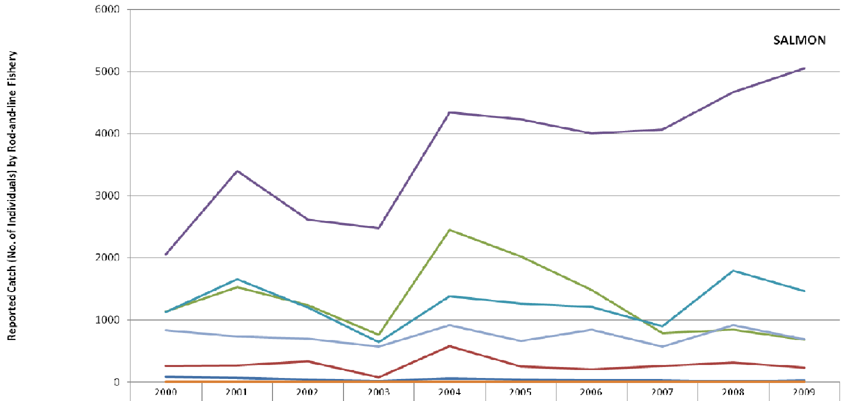
Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	1.0	0.9	1.4	13.3	43.7	76.3	58.0	34.7	26.0	0.0	0.0
Ythan	0.0	15.4	24.2	7.0	28.2	227.0	331.8	244.7	197.1	210.3	0.0	0.0
Don	0.0	0.7	3.1	6.7	40.3	179.8	172.6	144.5	154.6	83.4	0.0	0.0
Dee (Aberdeenshire)	0.0	11.5	77.3	109.6	284.2	818.6	335.4	195.2	189.2	21.0	0.0	0.0
North Esk	0.0	0.1	1.1	6.1	44.3	87.8	65.8	47.9	35.0	39.5	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.6	0.2	0.0	0.0
South Esk	0.0	0.2	1.6	4.7	39.0	341.1	434.4	183.6	103.5	65.7	0.0	0.0

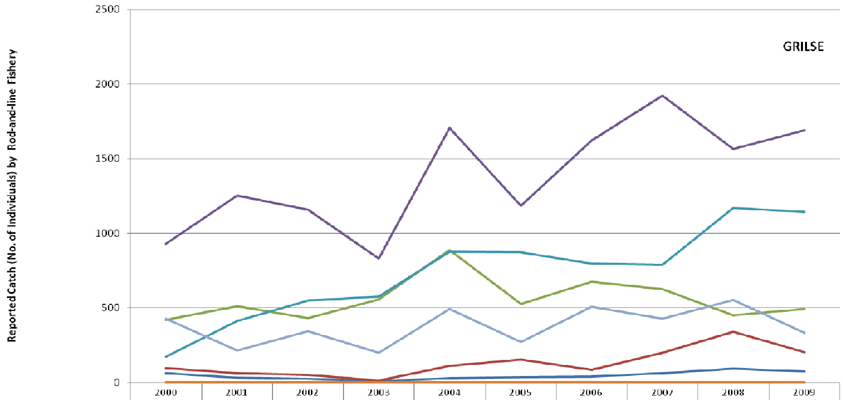
Month

Figure 6.10 Seasonality of the Catch (average 2000-09) by the Rod-and-Line Fishery (including catch and release)



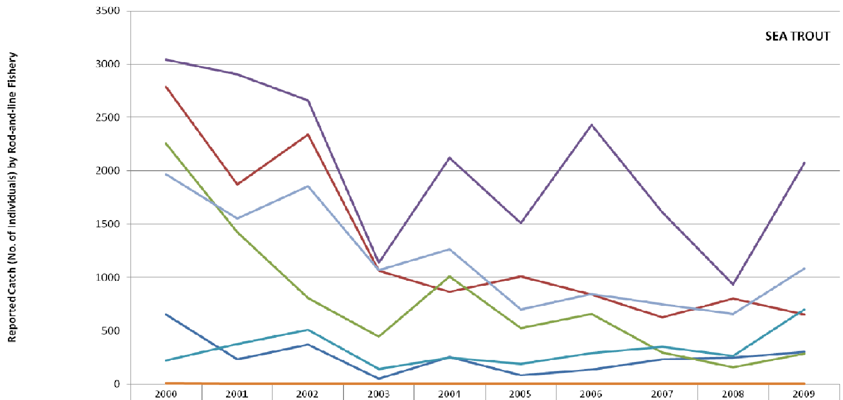
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	83	70	39	24	62	39	34	32	13	27
Ythan	258	264	332	79	576	251	206	261	310	229
Don	1133	1528	1235	761	2453	2025	1483	786	839	681
Dee (Aberdeenshire)	2054	3400	2612	2480	4339	4229	4000	4067	4669	5048
North Esk	1127	1660	1195	640	1379	1261	1210	895	1789	1466
Bervie	0	0	0	0	1	0	0	0	2	6
South Esk	832	736	699	572	917	663	842	574	913	685

Year



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	63	33	25	8	28	34	38	63	93	72
Ythan	97	61	50	12	112	153	87	198	339	202
Don	419	512	430	556	887	526	675	626	450	492
Dee (Aberdeenshire)	930	1254	1156	830	1707	1185	1620	1922	1563	1692
North Esk	172	412	551	576	875	873	795	789	1170	1144
Bervie	0	0	0	0	1	0	0	0	1	0
South Esk	428	213	345	200	492	272	506	429	554	331

Year



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	651	229	372	50	254	84	135	230	249	299
Ythan	2786	1870	2342	1063	866	1011	840	627	801	651
Don	2253	1425	807	445	1011	523	659	294	157	283
Dee (Aberdeenshire)	3045	2902	2660	1134	2122	1510	2428	1611	934	2074
North Esk	221	374	506	142	247	189	287	346	264	700
Bervie	6	1	0	0	0	0	0	0	0	2
South Esk	1968	1550	1855	1069	1266	699	844	747	657	1083

Year

Figure 6.11 Annual Variation (2000-2009) of Catches by the Rod-and-Line Fishery (including Catch and Release)

Net-and-coble Fishery Seasonality

As previously mentioned within the North East region, net-and coble principally takes place in the North Esk and to lesser extent in the Ugie and the Ythan (See Figure 6.9 above).

In the North Esk peak catches of salmon are recorded in May, however June, July and August also record relatively high catches. Similarly, grilse catches peak in July and August. The highest sea trout catches are recorded from May to July peaking in June.

In the Ugie the highest salmon and grilse catches are recorded in July and August. Sea trout, the species accounting for the majority of the catch in the district, is caught in relatively high numbers from May to July, peaking in June.

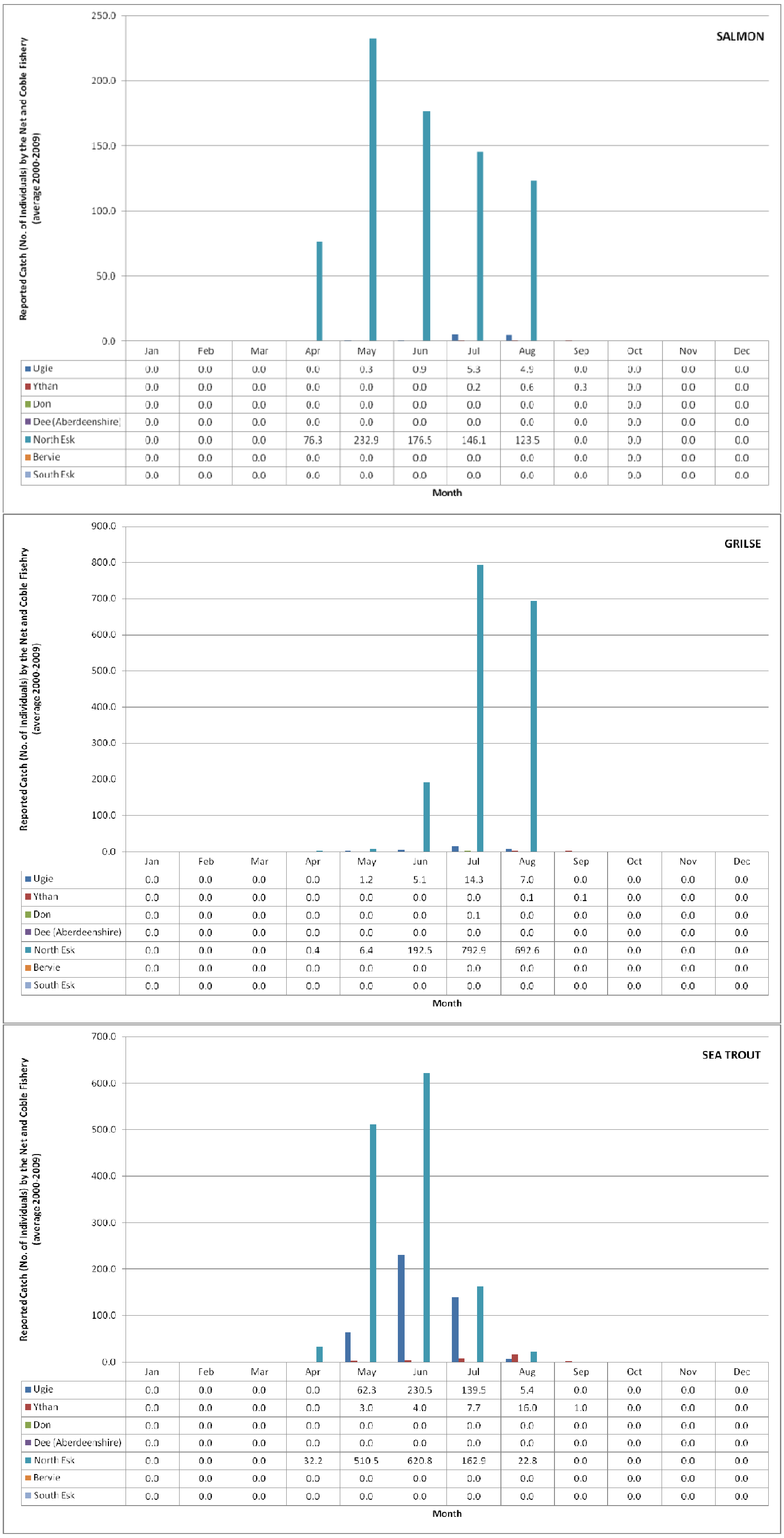
In the Ythan, salmon and grilse catches by net-and-coble are comparatively low. The limited catches recorded by this method in this district, correspond to sea trout principally, and are mainly recorded from May to September with peak catches in August (Figure 6.12).

Net-and-coble Fishery Annual Variation

In the North Esk, salmon catches by net-and-coble have fluctuated from 2000 to 2007, with a significant increase recorded in the last two years. Grilse catches have also changed over the years with peaks in 2000 and 2005, followed by lows in 2004 and 2007. Sea trout catches in this district showed a marked decreased from a peak in 2001 through 2005. The trend has been one of an increase since then, especially in the last year (2009) which records the highest annual catch in the ten year period under consideration.

In the Ugie, no salmon and grilse were caught from 2000 to 2003 by net-and-coble. Since 2004 both species have been caught in relatively low numbers, ranging from 9 to 27 fish per year for salmon and 14 to 127 fish per year for grilse. Sea trout, the principal species in terms of catch in the Ugie, was caught in relatively high numbers from 2000 to 2006 with annual catches ranging from 378 to 782 fish. The catch for this species has however decreased since 2006, with a total of 50 and 66 fish caught in 2008 and 2009, respectively.

In the Ythan, salmon and grilse catches by net-and-coble have been very low from 2000 to 2009, ranging from 0 to 6 fish caught per year. Sea trout catches, have also been relatively low, ranging from 56 to 0 fish caught per year. The lowest sea trout catches within the period under consideration have been recorded in 2008 and 2009 with 6 and 0 individuals caught respectively (Figure 6.13).



SALMON

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	0.3	0.9	5.3	4.9	0.0	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.3	0.0	0.0	0.0
Don	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	76.3	232.9	176.5	146.1	123.5	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

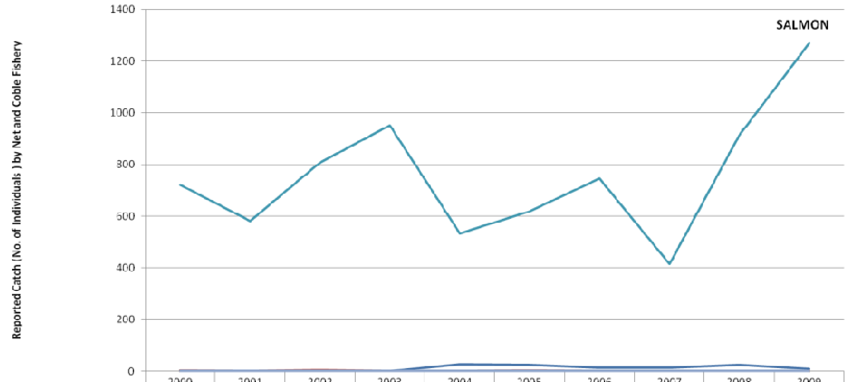
GRILSE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	1.2	5.1	14.3	7.0	0.0	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
Don	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	0.4	6.4	192.5	792.9	692.6	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SEA TROUT

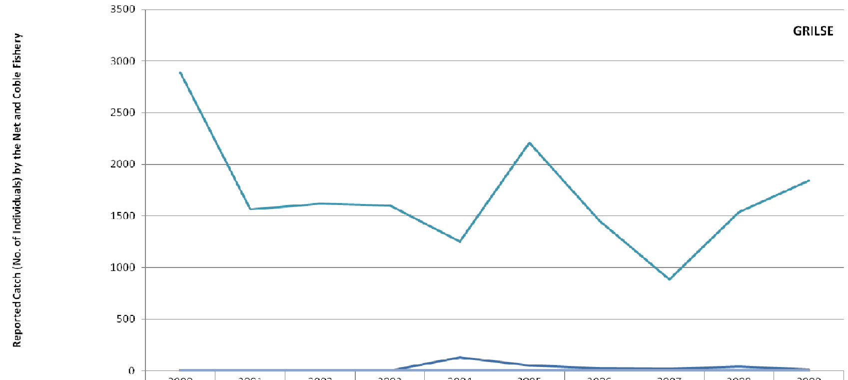
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	62.3	230.5	139.5	5.4	0.0	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	0.0	3.0	4.0	7.7	16.0	1.0	0.0	0.0	0.0
Don	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	32.2	510.5	620.8	162.9	22.8	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 6.12 Seasonality of the Catch (average 2000-2009) by the Net-and coble Fishery



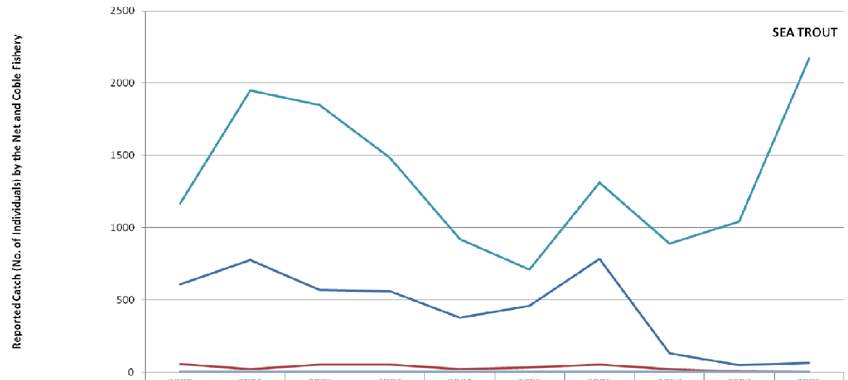
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	0	0	0	0	27	26	14	14	24	9
Ythan	3	0	6	0	0	2	0	0	0	0
Don	0	0	0	0	0	0	0	0	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	722	582	807	952	532	618	745	415	912	1268
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	0	0	0	0	0	0	0	0	0	0

Year



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	0	0	0	0	127	54	25	18	38	14
Ythan	1	0	0	1	0	0	0	0	0	0
Don	1	0	0	0	0	0	0	0	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	2888	1561	1617	1603	1252	2208	1454	886	1537	1842
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	0	0	0	0	0	0	0	0	0	0

Year



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	608	774	569	559	378	460	782	131	50	66
Ythan	56	23	54	52	20	33	53	20	5	0
Don	0	0	0	0	0	0	0	0	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	1167	1949	1848	1485	922	710	1310	888	1041	2172
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	0	0	0	0	0	0	0	0	0	0

Year

Figure 6.13 Annual Variation in Catches by the Net-and-coble Fishery by Species and District

Fixed Engines Seasonality

The principal fixed engine net fishery within North East region takes place in the Esk district, as it was also the case for net-and-coble. The use of fixed engines in the remaining districts appears to be comparatively low, with only the Ythan and the Don recording catches by this method in some numbers.

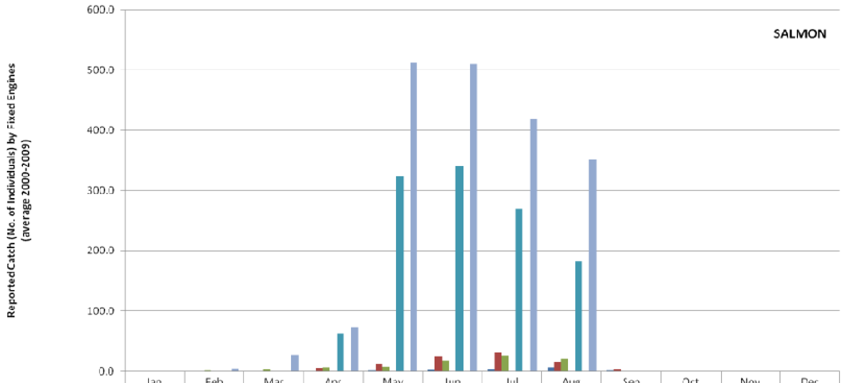
Overall peak catches by this method are recorded from May to August for salmon, July and August for grilse and May and June for sea trout (Figure 6.14).

Fixed Engines Annual Variation

As it is apparent from Figure 6.15, there has been a strong decline in the total catch by fixed engines in the North Esk over the years, more obvious since 2007. This is a result of the buyout of the North Esk's coastal netting stations by the Esk District Salmon Fishery Board.

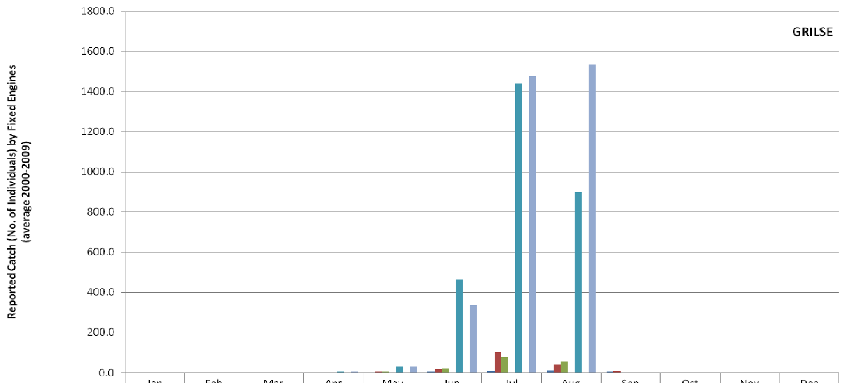
Despite the closure of the commercial coastal fishery in the North Esk, fixed engines are still commercially operational in the South Esk. The salmon catch in the South Esk by fixed engines has fluctuated over the ten year period under consideration, whilst for grilse the overall trend has been one of a decline, especially from 2007. Sea trout catches in the South Esk, have also fluctuated during the ten year period under consideration, with 2003 recording the highest catch (3,143 individuals) within the period.

In the Ythan the annual catch by fixed engines for all the species has been variable, with no clear trend shown from 2000 to 2009, whilst in the Don there is a clear trend towards a decrease in the annual total catch by fixed engines from 2004 onwards, with no fish being caught at all by this method in the last two years (2008 and 2009) (Figure 6.15).



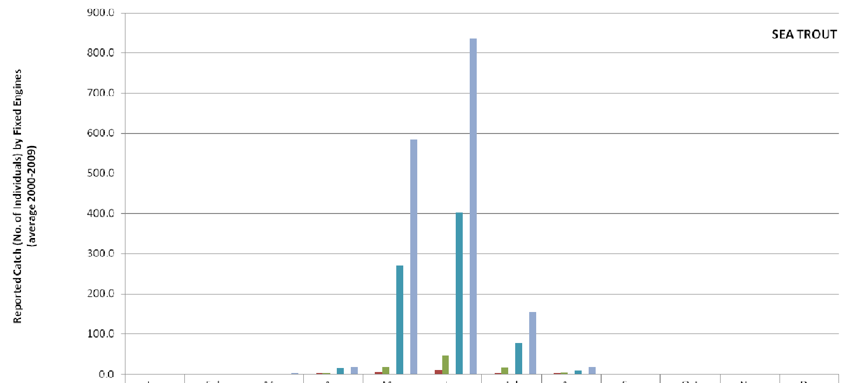
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	1.1	2.4	3.6	5.6	1.0	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	4.8	13.0	26.0	30.9	15.6	3.2	0.0	0.0	0.0
Don	0.0	1.7	3.2	6.1	7.2	17.1	26.9	20.3	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	62.2	323.3	340.6	269.5	181.5	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	4.4	27.2	73.4	511.5	510.4	417.8	351.2	0.0	0.0	0.0	0.0

Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	0.0	0.2	7.5	12.1	0.5	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	0.0	0.2	16.8	102.4	39.4	6.0	0.0	0.0	0.0
Don	0.0	0.0	0.0	0.0	0.3	22.1	81.1	54.9	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	0.2	29.8	462.1	1441.2	902.2	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	0.0	0.0	0.1	28.4	335.8	1478.1	1535.2	0.0	0.0	0.0	0.0

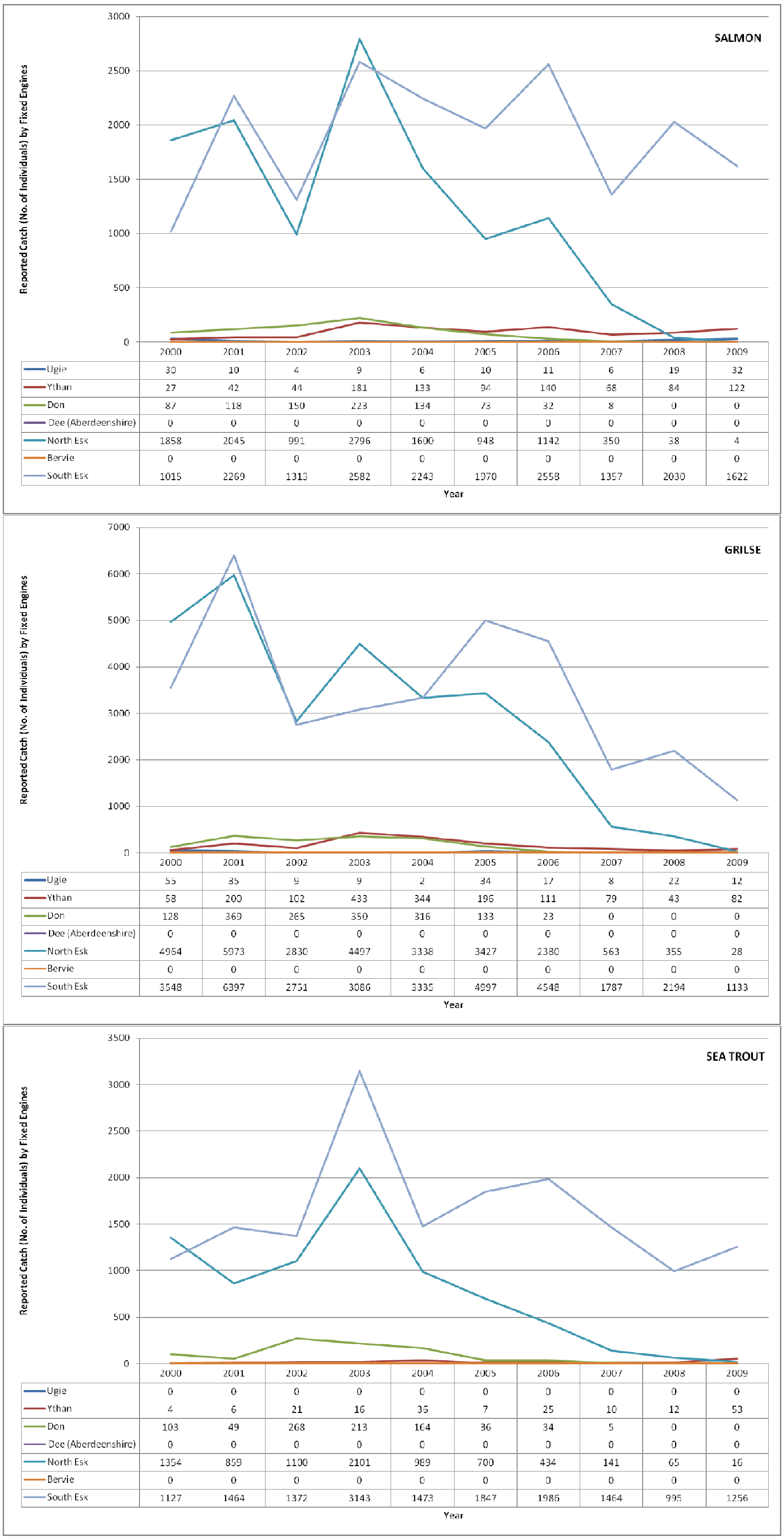
Month



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ugie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ythan	0.0	0.0	0.0	0.5	4.8	10.4	2.6	0.7	0.0	0.0	0.0	0.0
Don	0.0	0.0	0.0	1.3	18.7	47.6	16.4	3.2	0.0	0.0	0.0	0.0
Dee (Aberdeenshire)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Esk	0.0	0.0	0.0	15.2	270.0	403.5	78.1	9.1	0.0	0.0	0.0	0.0
Bervie	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South Esk	0.0	0.0	0.8	17.4	585.2	835.6	155.2	18.5	0.0	0.0	0.0	0.0

Month

Figure 6.14 Seasonality of the Catch (average 2000-2009) by Fixed Engines



SALMON

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	30	10	4	9	6	10	11	6	19	32
Ythan	27	42	44	181	133	94	140	68	84	122
Don	87	118	150	223	134	73	32	8	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	1858	2045	991	2796	1600	948	1142	350	38	4
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	1015	2269	1313	2582	2243	1970	2558	1357	2030	1622

GRILSE

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	55	35	9	9	2	34	17	8	22	12
Ythan	58	200	102	433	344	196	111	79	43	82
Don	128	360	265	350	316	133	23	0	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	4964	5973	2830	4497	3338	3427	2380	563	355	28
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	3548	6397	2751	3086	3335	4997	4548	1787	2194	1133

SEA TROUT

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Ugie	0	0	0	0	0	0	0	0	0	0
Ythan	4	6	21	16	36	7	25	10	12	53
Don	103	49	268	213	164	36	34	5	0	0
Dee (Aberdeenshire)	0	0	0	0	0	0	0	0	0	0
North Esk	1354	859	1100	2101	989	700	434	141	65	16
Bervie	0	0	0	0	0	0	0	0	0	0
South Esk	1127	1464	1372	3143	1473	1847	1986	1464	995	1256

Figure 6.15 Annual Variation in Catches by Fixed Engines by Species and District

6.5.3 The Esk District Net Fishery

The annual reported catches of the net fisheries by region in Scotland are illustrated in Figure 6.16 below. The catch in the North East region has been further broken down by individual district. The location of active net fisheries in Scotland in 2009 is also shown on the figure, based on graphical information provided by MSS.

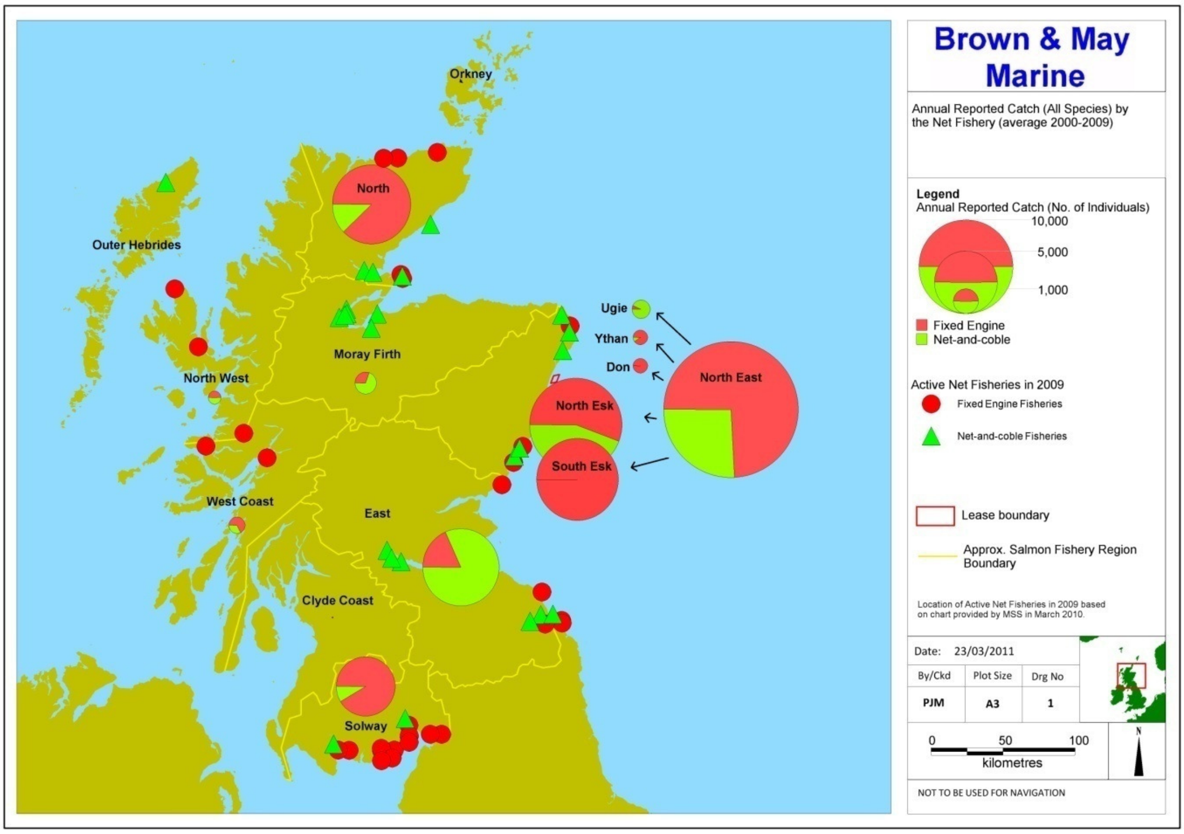


Figure 6.16 Annual (average 2000-2009) Reported Catch of Net Fisheries by Region

As it is apparent from Figure 6.16, the Esk district supports important net fisheries, accounting for the majority of the total net catch recorded in the North East and being of relevance in a national context.

In the South Esk, the principal fixed engine fishery currently active is the Usan Fishery. The Usan's heritable rights stretch between Scurdie Ness lighthouse to the north and Auchmethie Harbour near Arbroath to the south and it operates 8 netting stations. Fish caught by this fishery originate principally from the Tay up to the Dee and the Don (Consultation Meeting, 2011b).

As previously mentioned in Section 6.5.2.2, the fixed engine coastal fishery in the North Esk is currently closed as a result of the buyout of the coastal netting stations by the Esk Salmon Fishery Board. Net-and-coble, however, still takes place in the river. There is a net-and-coble station located at Kinnaber (Consultation Meeting, 2011b).

6.6 Local

6.6.1 Introduction

The following section provides reported catch data for the rod-and-line and the net fishery in the Don, the district located in the immediate vicinity of the proposed EOWDC and incorporates further information gathered through consultation with the Don District Salmon Fishery Board (DDSFB). As previously mentioned, consultation with individual coastal netting right holders will be undertaken once the location of the export cable has been defined.

6.6.2 Fishing Methods in the Don

The distribution of the reported catch (all species combined) in the district by fishing method from 2000 to 2009 is given in Figure 6.17. The majority of the catches in the Don are by rod-and-line, which accounts for 88.9% of the total catch, of which more than a half is by catch and release. The net fishery operates to a lower extent in the district, accounting for only 11.1% of the total reported catch. It should be noted that netting in the Don is only by fixed engines, with no net-and-coble currently taking place, although it existed in the past (Consultation Meeting, 2010c).

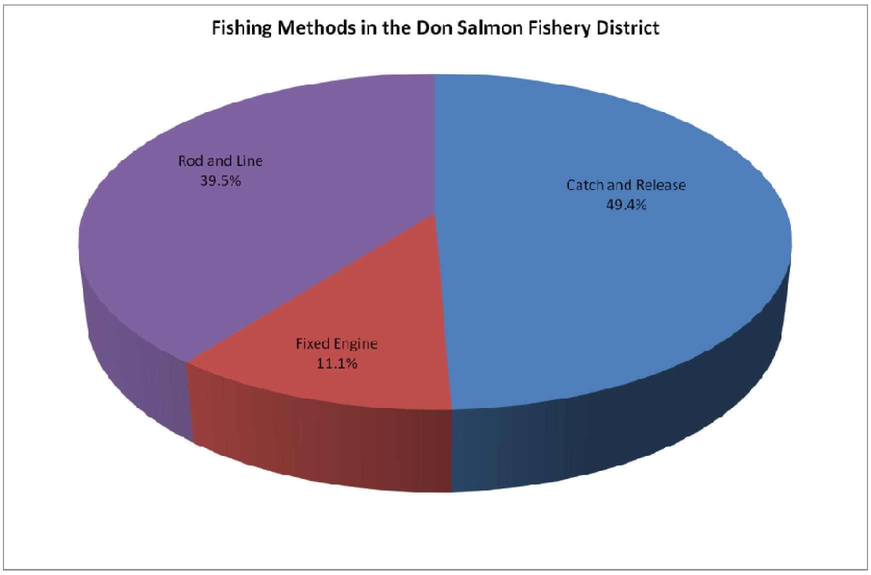


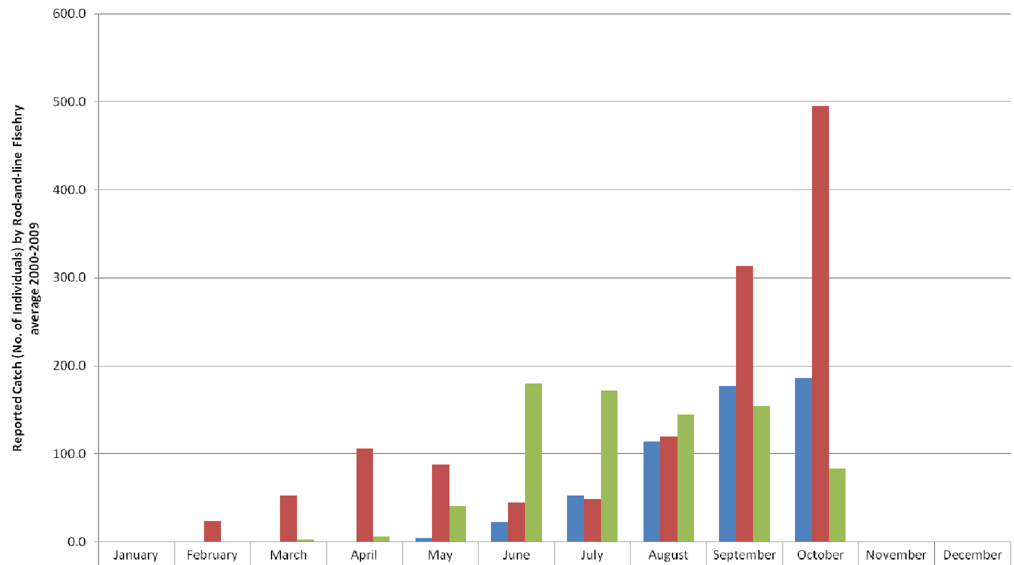
Figure 6.17 Distribution of the Catch by Method in the Don District (2000-2009)

6.6.3 Seasonality of the Fisheries and Main Runs

The netting season in the Don runs from 11th February to 26th August, whilst for rod-and-line the season lasts longer ending on 31st October (Consultation Meeting, 2010c). An indication of the seasonality of the catches by species is shown in Figure 6.18 and Figure 6.19 for the rod-and-line (including catch-and release) and net fishery (fixed engines) respectively, based on average monthly catches for the period 2000-2009.

6.6.3.1 Rod-and-line

The rod-and-line fishery records the highest reported catches from August to October for salmon and grilse, and between June and October for sea trout. It should be noted that earlier fish runs (eg. spring salmon) whilst recording lower catches are also of relative importance to the fishery as they allow for extended fishing seasons (Figure 6.18).



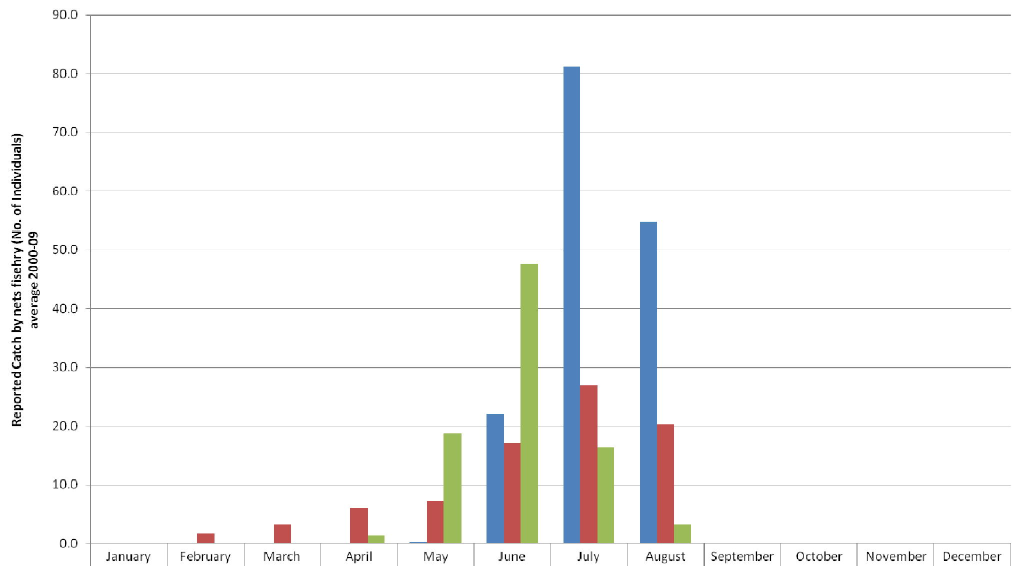
	January	February	March	April	May	June	July	August	September	October	November	December
Grilse	0.0	0.0	0.0	0.7	4.2	22.3	52.9	113.6	177.3	186.3	0.0	0.0
Salmon	0.0	23.3	53.1	105.8	87.6	45.0	48.4	120.3	313.6	495.3	0.0	0.0
Sea Trout	0.0	0.7	3.1	6.7	40.3	179.8	172.6	144.5	154.6	83.4	0.0	0.0

Month

Figure 6.18 Reported Catch by Rod-and-line (including catch and release)

6.6.3.2 Fixed Engines

The seasonality of reported catches in the net fishery is similar to that shown for rod-and-line. The highest catches in fixed engines are however recorded slightly earlier than by rod-and line. The seasonality of the captures by fixed engines reflects to some extent the timing of the coastal migration of adult salmon and sea trout before entering the river to spawn (Figure 6.19).



	January	February	March	April	May	June	July	August	September	October	November	December
Grilse	0.0	0.0	0.0	0.0	0.3	22.1	81.2	54.9	0.0	0.0	0.0	0.0
Salmon	0.0	1.7	3.2	6.1	7.2	17.1	26.9	20.3	0.0	0.0	0.0	0.0
Sea Trout	0.0	0.0	0.0	1.3	18.7	47.6	16.4	3.2	0.0	0.0	0.0	0.0

Month

Figure 6.19 Reported Catch by Fixed Engines

6.6.3.3 Principal Runs

The main runs of salmon and sea trout as specified by the DDSFB (Consultation Meeting, 2010c) in the Don are as follows:

- Spring salmon: mid December to April
- 2SW salmon: May-June
- Grilse: July to Mid October
- Sea trout: June to early August

In addition to the runs detailed above, there are two smolt runs in the Don. The first takes place in May through to early June and the second in September (Consultation Meeting, 2010c).

There has been a change in the timing of the grilse run in recent years. In the past, the bulk of the grilse run used to take place in July, however this now takes place later in the season with the peak run taking place in late August and continuing through until October ((Consultation Meeting, 2010c).

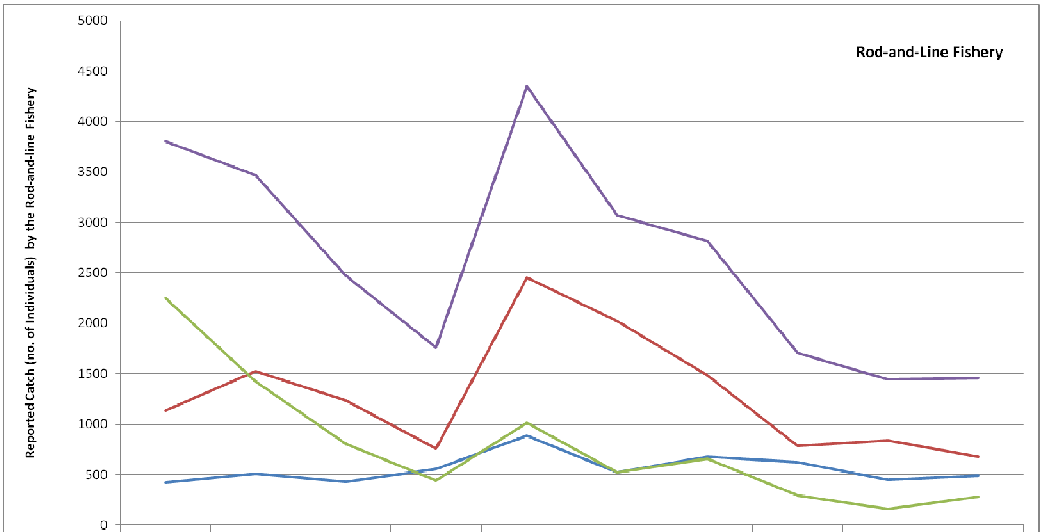
6.6.4 Annual Variation

An indication of the annual changes in the total catch by species from 2000 to 2009 in the Don is given in Figure 6.20 and Figure 6.21 for the rod-and-line fishery (including catch and release) and net fishery (fixed engines), respectively.

6.6.4.1 Rod-and-line

Salmon catches peaked in 2004, with a decline in the following years. 2009 recorded the lowest salmon catch in the district within the ten year period under consideration.

The grilse catch has fluctuated over the years, ranging from a minimum of 419 to a maximum of 887 fish reported per year, peak catches were recorded in 2004. The trend in sea trout catches has been one of a decline, particularly between 2000 and 2003, when a strong decrease in catches for this species was observed (2,253 fish caught in 2000 compared to 445 fish caught in 2003).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Grilse	419	512	430	556	887	526	675	626	450	492
Salmon	1133	1528	1235	761	2453	2025	1483	786	839	681
Sea Trout	2253	1425	807	445	1011	523	659	294	157	283
Total	3805	3465	2472	1762	4351	3074	2817	1706	1446	1456

Year

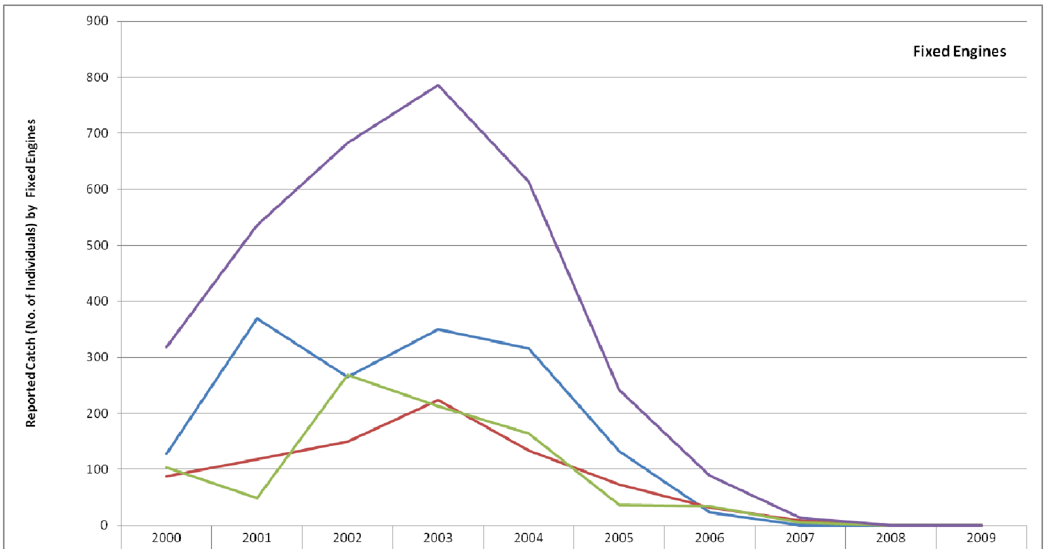
Figure 6.20 Annual Variation of the Rod-and-line Catch by Species in the Don District (2000 -2009)

DDSFB’s representatives indicated during consultation that the spring stock salmon fishery in the Don has shown a slight improvement two years running and that similarly, the grilse, autumn salmon and sea trout runs have also improved in the past few years (Consultation Meeting, 2010c).

6.6.4.2 Fixed Engines

As it is apparent from Figure 6.21 below, there has been a marked decrease in catches by fixed engines in the Don for all species in the last few years, especially since 2003-2004. It should be noted that no catches have been reported by this fishery in 2008 and 2009.

In line with this, anecdotal evidence suggests that the remaining netsmen in the local area operate on a part–time or hobby basis, with the closest commercial netting stations located to the south, in the Esk District near Montrose (MS, 2007).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Grilse	128	369	265	350	316	133	23	0	0	0
Salmon	87	118	150	223	134	73	32	8	0	0
Sea Trout	103	49	268	213	164	36	34	5	0	0
Total	318	536	683	786	614	242	89	13	0	0

Figure 6.21 Annual Variation of Fixed Engines Catch by Species in the Don District (2000 -2009)

6.6.5 Coastal Netting Stations in the Don

There are eight coastal netting stations in the Don district located in the immediate vicinity of the Aberdeen Offshore Wind Farm. Their locations and current owners are shown in Figure 6.22.

Three of the eight stations have been bought up by the DDSFB, the Atlantic Salmon Trust and Trump International and are not currently fished (Consultation Meeting, 2010c). The five remaining stations (shown in dark and light blue in Figure 6.22) are owned by two right holders. No catches have been reported in the last two years from these stations, suggesting that they are not currently fished. It should however be recognised that a degree of under-reporting may have occurred. In addition, netting activities may at any time recommence.

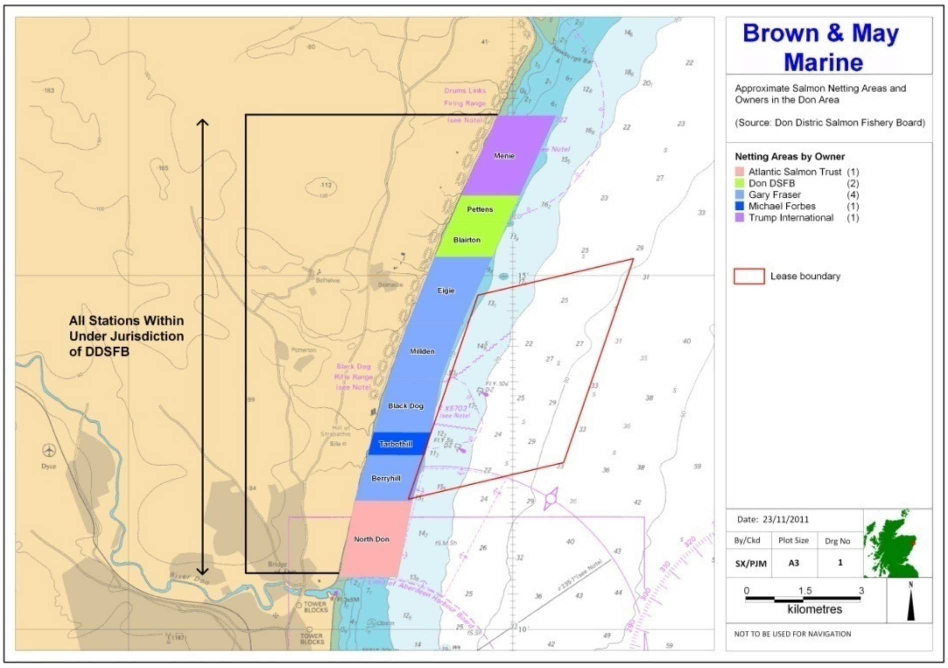


Figure 6.22 Coastal Netting Stations under jurisdiction of the Don District Salmon Fishery Board

6.7 Future Fisheries

As explained in Section 6.3, salmon fisheries are subject to a wide range of regulations and restrictions, from government through to individual districts. All the DSFBs in the North East region are making significant efforts to ensure the future of the industry and specifically the rod-and-line fishery with DSFBs, trusts and conservation groups implementing programmes to maintain and improve upon the number and quality of salmon and sea trout in their rivers. Catch and release policies are also increasingly closely monitored and hatcheries have been developed in some districts.

A priority for the majority of the Boards is the maintenance and development of rod-and-line fishing. It is expected that this trend will continue in the future, in line with the joint aims of the ASFB and other organisations. Parallel to the maintenance and development of the rod-and-line fisheries, a decrease in the costal netting activity in Scotland, either as a result of river and conservation interests buying up coastal stations, as well as increasing restrictions, has been the trend in the last decade. This will likely continue to be the case in the future.

Scotland, together with England, Norway and Northern Ireland has come under increasing international pressure to establish a policy for managing Multi Stock Fisheries (MSFs). This is of particular sensitivity in Scotland, as fishing is prosecuted under heritable property rights, rather than as an activity licensed by Government, as in most salmon producing countries (Crawley, 2010). International advice is that there should be a presumption against operating Multi Stock Fisheries, such as coastal netting, unless they can be shown not to contravene basic conservation policies (ASFB, AST and S&TA, 2009).

It should be noted that there are numerous constraints placed upon the degree to which potential losses and their significance to salmon and sea trout fisheries can be assessed over the operational life of the proposed EOWDC. As is the case with other commercial fishing activities, unpredictable and unrelated influencing variables such as natural fluctuations in stock levels or changes in legislation could significantly alter elements within the baseline.

As discussed in Section 5.6, both salmon and sea trout Scottish populations are currently subject to a number of threats. Whilst conservation measures to protect these species have increased in the last years, it is not possible to be certain of what the outcome of these will be and how this will be affected by natural fluctuations in stock levels during the life time of the proposed EOWDC.

6.8 Main Concerns raised by Fisheries Stakeholders

The main concerns expressed during consultation meetings and in questionnaires by fisheries stakeholders are as follows:

- Potential impact on migratory patterns and disturbance derived from EMFs
- Potential impact on migratory patterns and disturbance derived from underwater noise during construction
- Potential impact of sediment plumes derived from construction activities
- Potential for the proposed EOWDC to alter the path the salmon take to return to home rivers
- Indirect impacts caused by changes in prey availability, principally in relation to sandeels.
- Potential for the turbines to result in a physical barrier to migration

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APPENDIX 01- CONSULTATION

Questionnaires

Completed questionnaires have been received from the following fisheries stakeholders:

- District Salmon Fishery Boards
  - Don
  - Ythan
  - Dee
  - Brora
  - Kyle of Sutherland
  - Tweed
  - Caithness
  - Lossie
  - Cromarty
  - Ness/Beauly
  - Helmsdale

- Netsmen/Net Fisheries
  - Kincurdie Salmon Fishings-Patience Family Trust (Ness)
  - Wilkhaven and Castle Salmon Fishery - Ian N. Paterson (Cromarty)

- Moray Firth Sea Trout Project (MFSTP)

Consultation Meetings

Consultation meetings were carried out with the following District Salmon Fishery Boards and net fisheries:

- Ugie District Salmon Fishery Board (26/10/2010)
- Ythan District Salmon Fishery Board (26/10/2010)
- Don District Salmon Fishery Board (27/10/2010)
- Dee District Salmon Fishery Board (17/01/2011)
- Esk District Salmon Fishery Board (27/10/2010)
- Usan Fisheries (Montrose) (17/02/2011)