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THE STATUS OF SALMON AND SEA TROUT STOCKS IN THE WEST OF SCOTLAND

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Cover photograph of Loch Maree courtesy of A F Youngson

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1. INTRODUCTION

There has been increasing concern in recent years over the general decreased yield from fisheries and the perceived decline in abundance of both Atlantic salmon (*Salmo salar* L.) and sea trout (*Salmon trutta* L.), particularly in the west coast area of Scotland. A definitive account of the status of salmon and trout in the west of Scotland requires indices of abundance, at the appropriate scale, that can be compared across both spatial and temporal dimensions. The scale at which such indices are required is dictated by the organisational structure of the species with which we are concerned.

In salmon, there is now evidence that allozyme differences are maintained among groups of salmon inhabiting different locations within river catchments. (Jordan *et al.,* 1992; Jordan *et al.,* 1997). Such small scale structuring is maintained by precise homing and, as these populations are reproductively isolated from one another, they are thus capable of adapting to local environmental influences separately from each other.

Evidence for temporal structuring within annual runs of adult salmon also exists. For example, there is a seasonal distribution in the river and sea ages of salmon returning to the North Esk (Shearer, 1984, 1990, 1992; Dunkley, 1986, 1991) whereby older sea age groups return earlier in the year than younger ones and, within any sea age group, those fish derived from older smolts return earlier than those derived from the younger smolts. Furthermore, radio tracking studies in the rivers Dee and Spey (Hawkins and Smith, 1986; Laughton and Smith, 1992) have shown that, within any sea age group, those fish returning earlier in the year spawn higher up the system than those fish returning later in the year. Evidence of similar structuring has also been documented on a small west coast river, the Little Gruinard (Walker and Walker, 1992).

Genetic studies on trout (Ferguson, 1989; Ferguson and Taggart, 1991; Thompson; 1995) have demonstrated that the scale at which populations exist is of the same order as in salmon.

Thus, a definitive account of the status of these species requires time series information on the abundance of each functional unit, or population. There are two major constraints to achieving this goal. Firstly, while it is possible to identify distinct populations it is not possible to define their limits. Secondly, the large number of populations that are likely to exist in Scotland precludes a comprehensive description of all these functional units. Where there is information on the population(s) present in catchment areas, it is limited to (a) salmon and

(b) to sites on the east coast of Scotland (ie the North Esk catchment and the Girnock and Baddoch burns on the Aberdeenshire Dee). Therefore, any statement regarding the status of salmonids has to rely on the less than ideal abundance indicators that exist at present. These include catch records and juvenile density surveys. This report assembles the information available to the FL (Freshwater Laboratory) on west coast populations and reviews the evidence for changes in abundance in both species.

2. CATCH INFORMATION

Catch statistics for Scotland are collected under the provisions of the Salmon and Freshwater Fisheries (Protection) (Scotland) act 1951 (as amended by the Salmon Act, 1986). Catch information is obtained by an annual questionnaire that is targeted at all proprietors/occupiers of salmon and sea trout fisheries. It is recognised that such information may be compromised by many factors. For example, under-reporting, over-reporting, the misreporting of grilse as salmon, the inconsistent inclusion of finnock in the reported sea trout catch and the possible, and likely, inclusion of fish farm escapees in the reported salmon catch.

Scotland has been subdivided into 109 fishery districts (based on major catchment areas) for local management considerations and catch returns from individual fisheries are combined and summarised at the district level. Further amalgamation of adjacent districts allows catch trends to be presented from 11 major defined regions of Scotland.

Analyses have been restricted to rod catches for a number of reasons, primarily because rod-caught fish are more likely to be catchment specific, and hence relate to a more appropriate spatial scale, than net-caught fish. While rod effort may have declined somewhat over the period for which catch statistics are available due to loss of ghillie jobs, a reduction in night-time fishing for sea trout and the increasing adoption of catch and release policies, net effort has declined markedly. Thus, the interpretation of rod catches is likely to be more closely related to abundance changes than net catches. Furthermore, given the decreasing trend in net catches, any observed decline in rod catches is likely to be a conservative measure of the decline in the abundance of salmonid populations.

In recent years, there has been an increase in the practice of catch and release in rod fisheries. Details of the number of fish released from individual fisheries have been collected since 1994. Studies have shown that only a small percentage of released fish are subsequently recaptured and that released fish successfully reach their spawning grounds (Webb, 1998). Therefore, for the purposes of this report, the rod catches analysed include those fish caught and released (see also Discussion).

In this report, catches of spring salmon (defined as MSW salmon caught up to 30 April), summer salmon (MSW salmon caught from 1 May onwards), grilse (1SW salmon) and sea trout are described at two levels. Firstly, catches on the west coast of Scotland are described in relation to those on the east coast of Scotland to provide a broad overview of the components that are the most important to the west coast fisheries and to illustrate how this contrasts with the east coast fisheries. Secondly, catches in the five districts from which juvenile density estimates were obtained in 2001 are also described. To maintain the confidentiality of the data, catches at this scale are scaled to unity, the highest catch value within a district, irrespective of category, being allocated a value of 1. The interpretation of catch trends becomes more difficult at finer levels due to random variation and therefore records from individual fisheries were not examined in this report. The location of the regions and districts is shown in Figure 1.

2.1 Description of Catch Trends in the Two Major Geographic Areas of Scotland

Catch trends in the two main geographic areas of Scotland; the east area (East, North East, Moray Firth and North regions) and the west area (West, North West, Outer Hebrides Clyde Coast and Solway regions), are shown in Figure 2.

The relative abundance of the different components of the catch varies both with area and throughout the time series.

In the east coast area, summer salmon have been the largest component of the catch. The general pattern over the time series has been an increasing trend. Sea trout numbers have been the second largest component of the catch and have fluctuated by a factor of *ca* 3 over the period. However, no general trend is evident. In the first part of the series, spring salmon were present in relatively high numbers, often matching the summer salmon catch and often exceeding the sea trout catch. However, they exhibit a downward trend and are currently the smallest component of the catch. Grilse catches show an increasing trend throughout the series. Concentrating on the recent period (1990-2000), sea trout and grilse catches have remained stable, summer salmon catches increase until the mid-90s before decreasing and spring salmon numbers show a steady decline.

In the west coast area, the dominant component of the catch has been sea trout. Despite showing a decreasing trend over the period (of *ca* 2-3 times), they remain the major component of the rod fishery. Summer salmon and grilse, which are the next most important components in this area, show no marked trend over the period. Spring salmon catches have been present only in very small numbers throughout the period. In the recent period (1990-2000), sea trout catches have shown an increase, grilse catches have remained stable and summer salmon catches have decreased.

2.2 Catch Trends in Five West Coast Districts

Figure 3 shows the catch trends in the districts Hope, Ewe, Morar, Shiel and Echaig. Sea trout catches dominate the rod fishery in all five districts and different patterns are observed among the districts. In the Hope district, there is no overall trend, whereas in the Ewe, Morar and Shiel districts catches have declined, in an irregular manner, throughout the period. The Echaig district shows a different pattern, with catches decreasing until the early 1970s and increasing thereafter. Considering the latter part of the time series (1990-2000), there is evidence for an improvement in catches. Both the Hope and Echaig districts show an upward trend and the Ewe and Shiel districts may have stabilised, albeit at low numbers. The Morar district continues to show a downward trend.

Summer salmon and grilse catches can be described as having remained stable in the Ewe, Morar, Shiel and Echaig districts. In the Hope district, summer salmon have declined whereas grilse have increased. Over the period 1990-2000, there is evidence that these components of the fishery have suffered a downturn. Summer salmon show decreasing trends in all five districts. Grilse catches, while remaining stable in the Hope, Ewe and Morar districts, have decreased in the Shiel and Echaig districts.

2.3 Summary of Catch Information

Catch trends, and the relative abundance of the four fishery components examined, differ between the west and east coast areas of Scotland. In particular, rod fisheries on the west coast rely heavily on one component, sea trout, whereas all four components figure

significantly throughout most of the time series in the eastern area of Scotland. In the latter part of the time series, the long term increases in summer salmon and grilse numbers in the east have reached a plateau. In the west area, summer catches have begun to decline while sea trout catches show an upturn in the recent period.

Variation in catch trends is also evident among the five west coast districts examined. In particular, while two districts show an increase in sea trout catches, one district shows a continuing decreasing trend. No trend can be discerned in the remaining two districts, but both show marked annual fluctuations.

In conclusion, there is a general reduction in all components of the catch relative to historical levels, suggesting some large-scale driving factor(s) are implicated. In addition, variation in catch trends among districts provides evidence for more local (small-scale) influences on catch numbers and, by inference, on abundance.

3. JUVENILE SALMONID DENSITIES AT REPEAT SITES IN FIVE WEST COAST CATCHMENTS (AUTUMN, 2001)

As part of its ongoing assessment of salmon and sea trout stock levels, the FRS Freshwater Laboratory carried out a survey by electro-fishing in order to obtain data on juvenile densities in river catchments in north west Scotland during September and October in 2001. Sites in the selected rivers were last visited by the Laboratory in the early 1990s, when more comprehensive surveys were undertaken and reports prepared on behalf of individual District Salmon Fishery Boards, with the assistance of contracted students (Walker *et al*, 1993 a-d; Walker *et al*, 1995 a, b). In the limited 2001 survey, 13 sites in five river catchments, the River Hope, in Sutherland, River Ewe in Wester Ross, River Morar and Loch Shiel in Lochaber and the River Eachaig, which discharges to the Clyde Estuary, were revisited to provide a temporal comparison with the earlier data. The criteria used in choosing the repeat sites were that they should be broadly representative, ie unexceptional, for the catchments concerned, based on the larger data-sets from the earlier surveys. Also, there should be no obvious signs of physical change to the immediate environment of the sites, or indications of stocking that could compromise the results. In practice, however, juvenile surveys tend to reveal large variation in densities among sites. Therefore, it is very difficult to estimate how representative the data may be for individual catchments in the absence of a comprehensive sampling programme. On the other hand, repeat visits to smaller numbers of sites may indicate trends in stock abundance between years.

Electro-fishing was carried out as before using a bank-based generator, with a single, hand-held, anode. The sites were unstop-netted, but delineated by pegged strings. Fishings (2-4) were carried out in an across and upstream direction, with the fish being captured by single hand-nets and/or a banner net, appropriate to the stream flow conditions. Then they were transferred by bucket to fine-meshed keep-nets that were pegged outwith the sites, prior to anaesthetisation (2-Phenoxyethanol), examination and release back to the sites. Fish measurements and habitat details were recorded according to Scottish Fisheries Co-ordination guidelines (SFCC). The sites were photographed using a digital camera to aid later recognition and physical comparison. The locations of the selected sites are indicated in Figures 4a and b.

No account is taken of Fishery Trust biologist data held by the SFCC, despite the fact that Trust biologists may have sampled some of the same sites. A future exercise will focus on these data (see Discussion).

3.1 Comparison Between Present and Historical Juvenile Salmonid Densities

The estimated densities for salmon and trout juveniles in the repeat survey sites are presented in Table 1. Parr aged 1+ and over are combined (1++). Streams entering Lochs Morar and Shiel were visited in three years, the others (Hope, Ewe and Eachaig) in two years. A wide range of densities and variation in relative species prominence is apparent among the sites and catchments. This large amount of among-site variation tends to preclude comparison of the mean values for the densities of the salmon and trout fry and parr between years. However, examination of Table 1 indicates a broad similarity between years in the data obtained from most of the individual sites. Another way to make the comparison is to plot the old density values for individual sites against the new ones to see if there is any change (Figs 5a, b, c, d). In cases where surveys were carried out in three years, rather than two, the old value is taken to be the first year in the series (Morar and Shiel). The plots show a marked improvement in salmon fry densities at three sites, at Hope, Ewe and Morar and little change at the others. Trout fry densities are very similar between years except for a large increase at one site (Ewe). A marked reduction in salmon parr density is indicated at one site (Hope), whereas little change is apparent at the other sites. Trout parr densities show a marked decrease at four sites of the 12 sites, ie at Hope, Eachaig, Ewe and Morar.

3.2 Summary of Juvenile Salmonid Densities

The broad similarity in juvenile densities between years at individual sites, but large variation in stock levels among the sites, may be due largely to the particular nature of the available nursery habitat. Some sites, particularly those in wider streams, probably were more suited to salmon than trout and to parr rather than fry. Clearly, the choice of a sub-sample of sites from the larger surveys carried out in previous years could be critical to the findings. Therefore, in the repeat survey carried out in 2001, an attempt was made to choose sites where salmon were likely to predominate and balance this selection with others where the main species was likely to be trout. The selection was based on the earlier density data. Each site was believed to be reasonably accessible to both species during spates. The results indicated no evidence of an overall trend, either up or down, in the density levels of salmon or trout, although visits to larger numbers of sampling sites would have been preferred to make the findings more robust. Several sites that might have added to the survey were excluded because they have been compromised by recent stocking, for instance at the River Shieldaig, in Wester Ross. Also, in the 2001 survey, some of the sampling was carried out several weeks later in the autumn than in the earlier work (Hope and Ewe), so that there had been more opportunity there for stock levels to decline through natural mortality or downstream migration. Ideally, repeat surveys should be carried out at exactly the same time of year, but this was impracticable for four of the twelve sites. However, as noted above, there was a general resemblance of the juvenile densities found at the indicator sites in the early 1990s and in 2001, in spite of the delay in sampling.

4. SUMMARY

Catch and juvenile survey information were examined to address the current concerns regarding the status of the salmonid resources in the west coast of Scotland. In this area of the country, sea trout have historically dominated the rod fishery and spring salmon are present only in very low numbers. Sea trout numbers are currently below the levels recorded in the early part of the time series but have shown a sustained increase since the late 1980s/early 1990s when record lows were recorded. Catches of summer salmon and

grilse are also below the long-term averages. Recent trends have been downwards for both these components. Note, however, that Figure 2 contains information from southwest Scotland as well as the northwest coast. Analysis of catch trends at finer levels reveals dissimilarities among districts. Comparisons of juvenile density estimates obtained in the early 1990s with those obtained in 2001 showed no evidence of any increase or decrease over the last decade.

The evidence presented in this report suggests that overall, since the late 1980s/early 1990s, catches of sea trout have increased somewhat whereas salmon (summer salmon and grilse) catches have decreased, although in both instances numbers remain well below long-term historic averages. A further note of caution should be added here about the veracity of reported catch data given the increasing practice of catch-and-release.

If catches can be used as some sort of proxy for adult abundance then, from the juvenile surveys, it suggests that changes in catch of the magnitude observed have resulted in no change in juvenile densities. Thus, in the case of sea trout, the modest increase in adult abundance has not increased juvenile abundance, presumably because carrying capacity has already been reached. However, only a limited number of sites were electro-fished and, for obvious reasons, lochs were excluded. Furthermore, the survey does not address the decrease in mean size of sea trout that is evident in many angling records and is most clearly demonstrated in the Loch Ewe study (Walker, 1994). This will undoubtedly have adversely affected egg deposition over time. In the case of salmon, the decreasing trend in adult numbers appears not to have reached a level at which recruitment to juvenile stages has been depleted.

A further study, based on SFCC data holdings of west coast juvenile numbers, is planned in order to see if any additional information on stock status can be derived.

5. ACKNOWLEDGEMENTS

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Table 1. Juvenile Salmonid Densities at repeat sites

DATE	CATCHMENT	OS REF	REPEAT SITES	Stream Width (m)	DENSITY (100m2) S0+	S1++	T0+	T1++
2-8 Jul 1992	Hope	NC458456			14	144	23	18
19-Sep-01	Hope	NC458456	Repeat	4.3	31	77	13	10
2-8 Jul 1992	Hope	NC475569			0	7	14*	29
19-Sep-01	Hope	NC475569	Repeat	4.8	82	22	16	9
24-30 Jul 1992	Ewe	NG974678			0	4	20	7
26-Sep-01	Ewe	NG974678	Repeat	2.9	0*	2*	20	15
24-30 Jul 1992	Ewe	NH049611			0	14	11	7
25-Sep-01	Ewe	NH049611	Repeat	6.7	132	12	8	5*
24-30 Jul 1992	Ewe	NG888723			0	0	46	32
26-Sep-01	Ewe	NG888723	Repeat	2.6	0*	1*	127	6*
24-30 Jul 1992	Ewe	NH014638			3	1	23	3
25-Sep-01	Ewe	NH014638	Repeat	4.5	0*	2*	13	3
24-30 Jul 1992	Ewe	NH017547			107	7	85	1
26-Sep-01	Ewe	NH017547	Repeat	3.7	76	19	86	7*
14/8-17/9/94	Morar	NM699933			16	97	0	0
22/8-19/9/95	Morar	NM699933	Repeat		46	69	0	0
09-Oct-01	Morar	NM699933	Repeat	8.5	96	66	0	0
14/8-17/9/94	Morar	NM722927			0	0	292	42
22/8-19/9/95	Morar	NM722927	Repeat		0	0	89	22
09-Oct-01	Morar	NM722927	Repeat	2.4	0	0	108	14
11-20/Aug,92	Shiel	NM745687			289	23	111	4
4-12 Aug, 93	Shiel	NM745687	Repeat		235	14	58	7
11-20/Aug,92	Shiel	NM899806			28	27	0	0
4-12 Aug, 93	Shiel	NM899806	Repeat		22	17	1	3
08-Oct-01	Shiel	NM899806	Repeat	3.2	1*	6	1*	0
24-25 June 93	Eachaig	NS098997			13	24	31	13
11-Oct-01	Eachaig	NS098997	Repeat	5.1	19	13*	27	4*
24-25 June 93	Eachaig	NS119977			0	22	78	25
11-Oct-01	Eachaig	NS119977	Repeat	5.3	6*	12	78	2*

* Zippin estimate not accepted, therefore minimum densities are presented.
Data are excluded from a second site at Loch Shiel in another small stream that was close to NM745687 The new site contained large numbers of salmon fry but no parr and few trout fry or parr. Site location was hampered by a missing photograph.

Figure 1.

Location of Salmon Fishery Districts and Regions referred to in section 2.

Key

Regions

E = East
NE = North East
MF = Moray Firth
N = North
NW = North West
W = West
CC = Clyde Coast
S = Solway
OH = Outer Hebrides

Districts

1 = Hope
2 = Ewe
3 = Morar
4 = Shiel
5 = Echaig

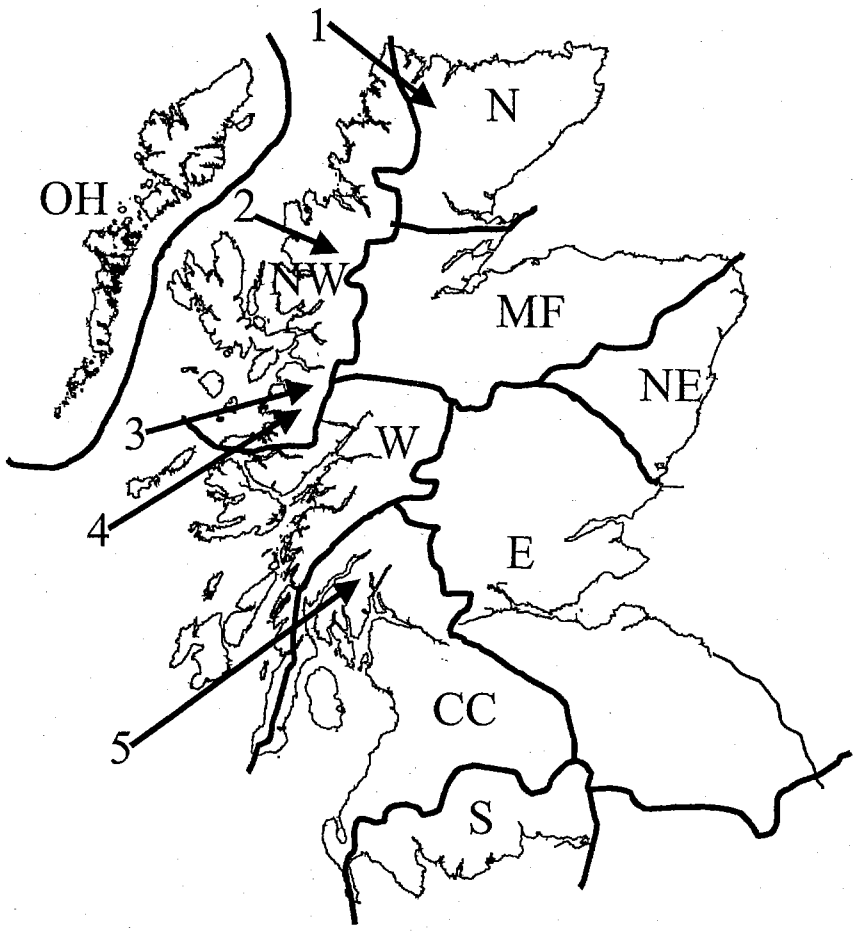
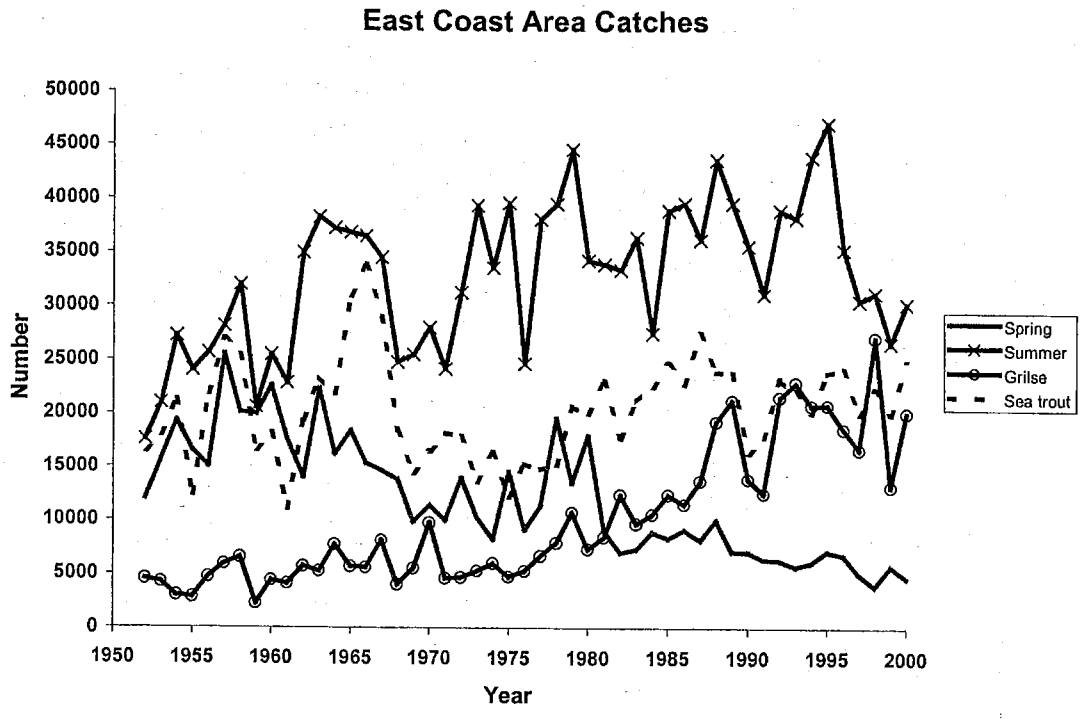


Figure 2.

Catch trends in the 2 main geographic areas of Scotland



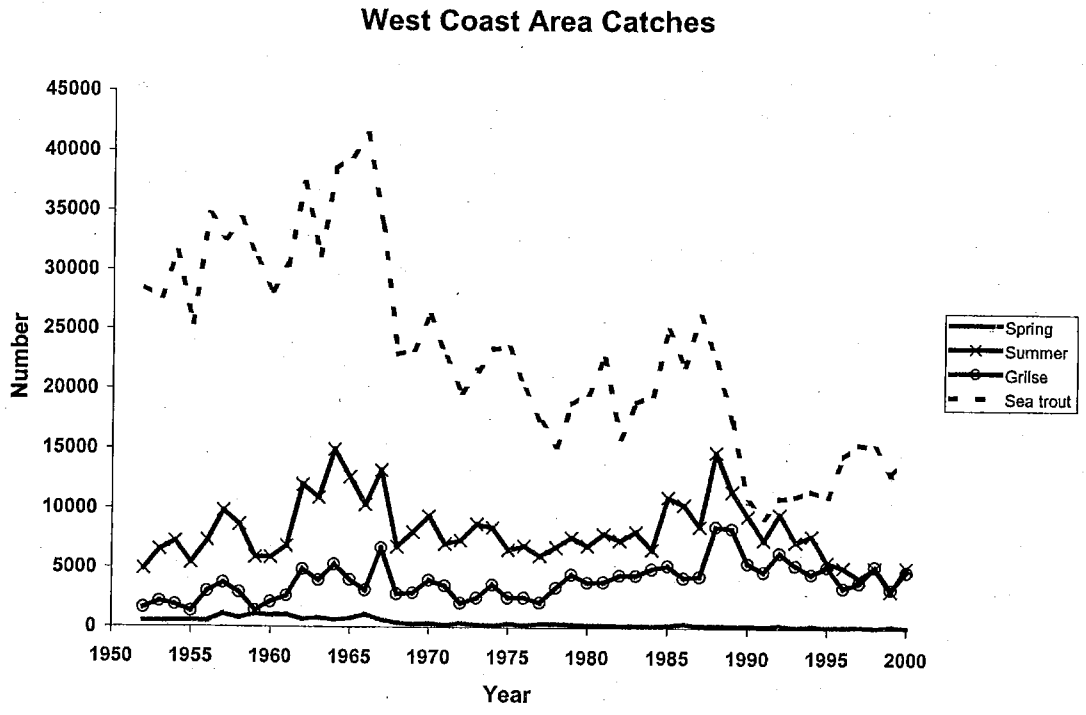
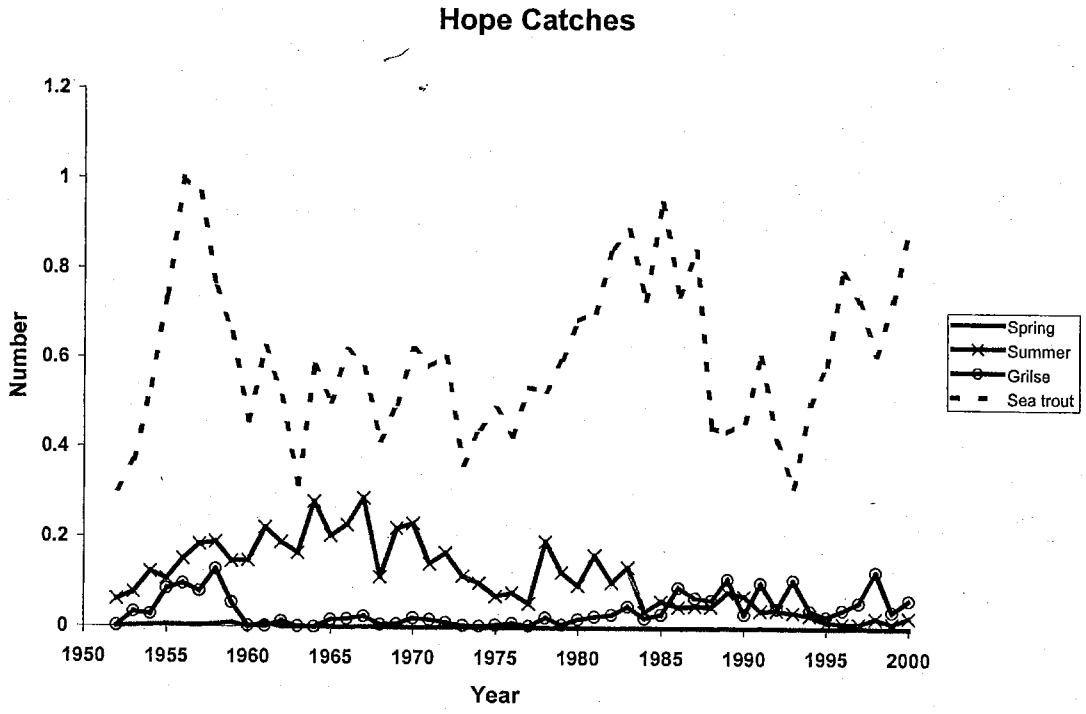


Figure 3.

Catch trends in the districts Hope, Ewe, Morar, Shiel and Echaig districts. (Note that catches at the district scale are scaled to unity, the highest catchvalue within a district, irrespective of category, being allocated a value of 1 to preserve



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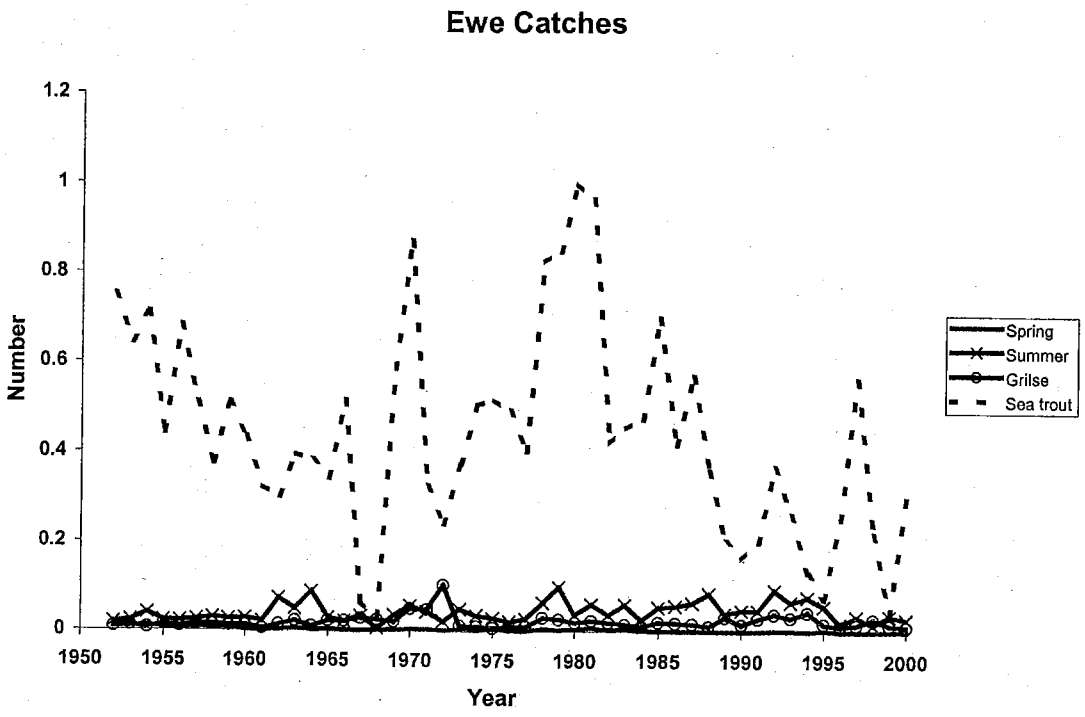
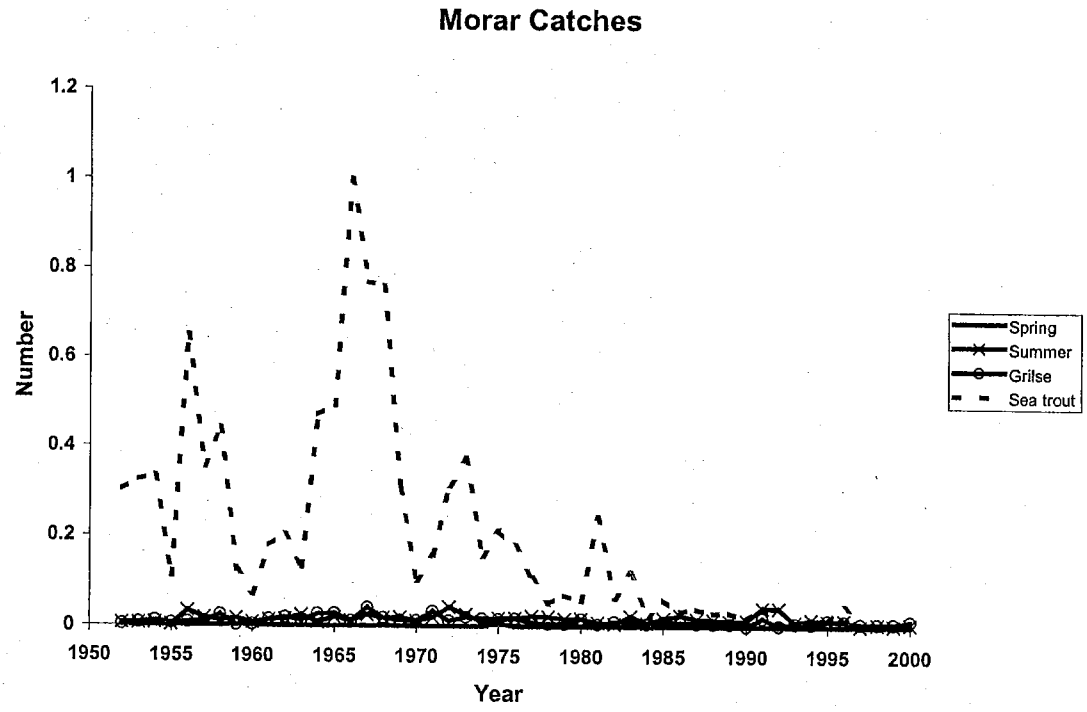


Figure 3. (continued)



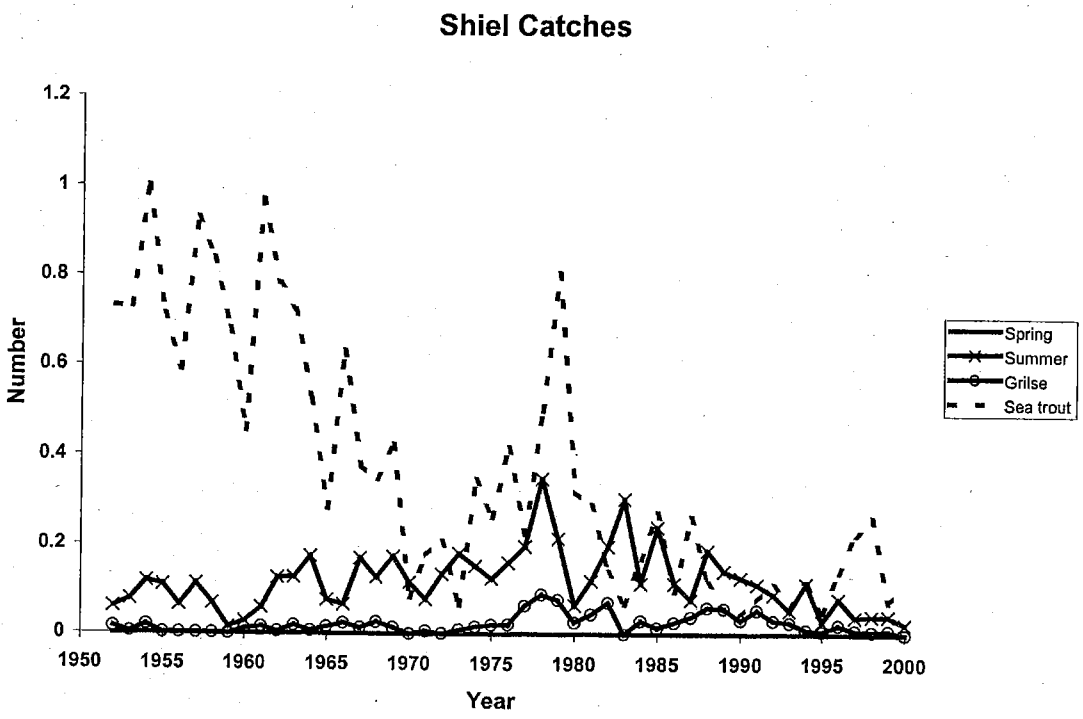


Figure 3. (continued)

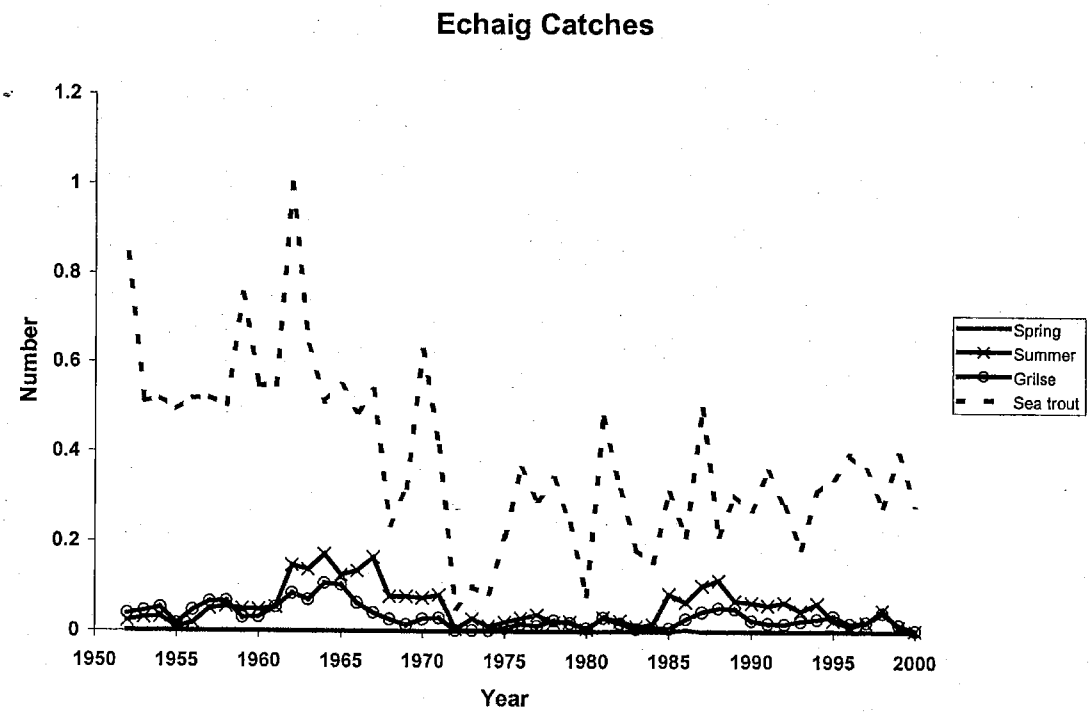
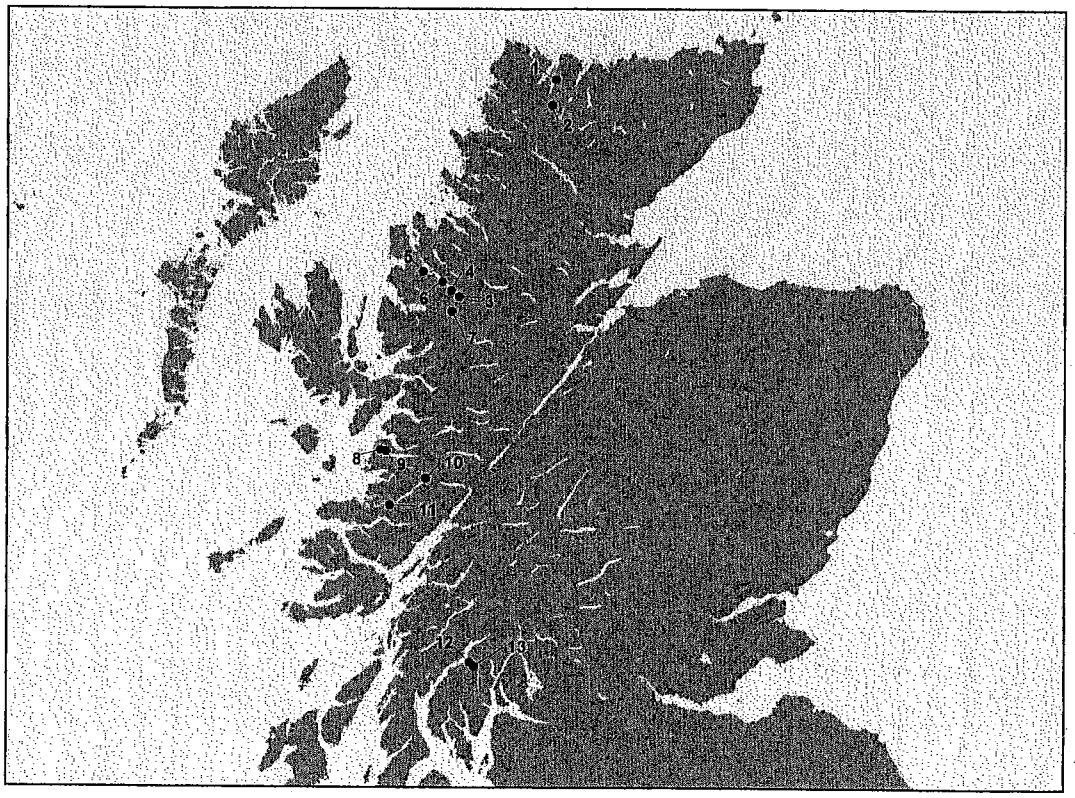


Figure 4.

The Electrofishing Sites in the 2001 Survey



River Hope System 1-2
River Ewe System 3-7
River Morar System 8-9
Loch Shiel System 10-11 (one site was not used)
River Eachaig System 12-13