The Scottish Government
Riaghaltas na h-Alba

# Marine Scotland Science

Report 01/15

## Status of Scottish Salmon and Sea Trout Stocks 2014

Marine Scotland Science Report 01/15

# Status of Scottish Salmon and Sea Trout Stocks 2014

Published by Marine Scotland Science

Marine Scotland is the directorate of the Scottish Government responsible for the integrated management of Scotland's seas. Marine Scotland Science (formerly Fisheries Research Services) provides expert scientific and technical advice on marine and fisheries issues. *Marine Scotland Science Report* is a series of reports that publish results of research and monitoring carried out by Marine Scotland Science. These reports are not subject to formal external peer-review.

# Status of Scottish Salmon and Sea Trout Stocks 2014

Marine Scotland Science Freshwater Fisheries Laboratory

## Executive Summary

Adult salmon abundance can be estimated from reported rod catches, data from fish counters and fixed traps. Previous assessments using this information have suggested that the overall number of Atlantic salmon returning to Scottish rivers generally increased over recent decades with variation among stock components and regions. In particular, spring stocks had declined, stabilising at a low level in recent decades and limited information from fixed traps located on spring salmon tributaries suggested that the number of returning adult salmon was frequently below the level required to maximise production of juvenile emigrants. Consequently, spring salmon stocks were considered worthy of particular management consideration.

Rod catches in 2014 were particularly low across all seasons for the majority of Scotland and the MSS rod catch tool suggests evidence of widespread declines in recent years. These trends raise concerns that low survival rates of salmon at sea, which were largely compensated in Scotland by reductions in coastal netting activity, may now be affecting numbers of spawning salmon. However, limited catch independent data (from traps and validated counters) did not show the same major decline in salmon abundance between 2013 and 2014 suggesting that poor angling conditions may have also contributed to the low reported catches.

Rod catches indicate that the number of sea trout returning to Scottish rivers has probably been in decline for much of the period 1952-2014. While catches of sea trout in many areas of Scotland are at historically low levels, there have also been notable declines in the last 20 years in central-eastern, south west and north west areas of the country.

## Introduction

Assessment of the number of salmon and sea trout returning to Scottish rivers is important for determining conservation status and management of fisheries. For salmon, stock assessment is informed by a number of sources of scientifically useful information including reported rod catch, counters and fixed traps which provide indices of adult salmon abundance. Fixed traps may also provide data on juvenile emigrants. These data sources have different strengths and weaknesses.

Trap counts are generally accurate but localised to small tributaries, whereas rod catches are imprecise but geographically widespread. Counter data provide intermediate accuracy and at present, relatively low geographic coverage. Juvenile electrofishing surveys are relatively insensitive to variations in the numbers of spawning adults, until they decline to a particularly low level, due to density dependent mortality in early life stages. This process can result in similar numbers of juveniles being produced across a broad range of returning adult numbers. Furthermore, a strategically structured sample of juvenile salmon in Scotland is not currently available. Thus, consideration of rod catch, counter and trap data together provides the best option for interpreting the status of Scottish salmon stocks at the present time and it is these indices that we consider in this document.

Salmon generally home to the areas where they reared in fresh water and as a consequence they form geographically localised breeding groups that may evolve biological characteristics that are adapted to their specific local environment. Run-timing is one such character. Based on available data, earlier up-river migration tends to be associated with higher altitude spawning. Although it is not currently possible to manage salmon at the fine scale of specific breeding groups, run-timing groups are of significance to fisheries and offer a practical solution for separation of stocks. Through examination of different run-timing groups (stocks) it is possible to obtain insights into the likely relative status of salmon from different regions of river catchments. However, it should also be noted that run timing may vary from year to year. Here, abundance indices are considered as three broad run-timing groups referred to as spring (February-May), summer (June-August) and autumn (September-October) stocks.

Marine Scotland Science (MSS) do not have access to any reliable counter data where sea trout are clearly differentiated from salmon. In addition, although an experimental trapping facility on the River Shieldaig provides some local information on survival of trout at sea, there are no trap data from catchments supporting substantial or self-sustaining sea trout populations. Rod catches are, therefore, the

only available source of data for understanding the general status of Scottish sea trout stocks. Sea trout generally home to the areas where they reared in fresh water and, as with salmon, form distinct local stocks. However, there is no evidence linking run-timing to specific spawning areas and hence the rod catches are examined only in terms of the aggregated annual total.

The aim of this document is to present a simple summary of the various data collected by Scottish Government that indicate the status of adult salmon and sea trout stocks.

## Salmon

### Rod Catches

Rod catches have traditionally been used to assess the status of salmon in Scotland. An underlying assumption of catch based assessments is that there has been no consistent change in the percentage of salmon captured by the fisheries (exploitation rate) over time or among rivers. Exploitation rate may be influenced by a number of factors including river flow, fishing effort and fishing efficiency. It is also clear that the practice of catch and release can inflate catch figures by allowing re-exploitation of individual fish. In this report we account for the effect of catch and release using the methods presented by Smith *et al.* (2014). This correction requires knowledge of exploitation rates and the mortality associated with catch and release. The release mortality was assumed to be 10% (Smith *et al.* 2014). There are limited data on exploitation rates of salmon in Scotland, although they are known to vary between seasons and locations. This report adjusts reported rod catches using a range of plausible exploitation rates ranging from 5% to 35% (data for UK summarised by Thorley *et al.* 2007).

The potential limitations of rod catch data should be considered when interpreting catch based assessments. However, rod catches are the most comprehensive indicator of stock status in terms of temporal and geographical coverage, and in many areas are the only information available.

Marine Scotland Science has developed a tool that allows a simple, straightforward analysis of rod catch to highlight situations where there has been evidence of recent changes in salmon catches at a specified level of statistical significance. The rod catch tool examines the past twenty years of salmon catch data aggregated into seasonal groupings and determines whether or not there is evidence of a change. The tool uses a simple rule based system - with an 11% chance of a trend being

identified by chance. Conventionally, the tool was used to highlight areas where stocks may be in decline and thus where further investigation was considered prudent. However, it can also be used to identify those areas where reported catches may be increasing. Here we present information on recent temporal trends that can be either positive or negative.

Catch data were aggregated into 109 geographical districts, each corresponding to a single river catchment or to groups of neighbouring river catchments. Where possible, the rod catch tool was run using the last 20 years data (1995-2014) for the three seasonal stock components in each fishery district. District boundaries are shown in the accompanying figures. The rod catch tool was run using the catches corrected for minimum and maximum expected exploitation rates. Where the rod catch tool suggested an increase or a decline irrespective of the exploitation rate these trends are reported as an increase or decrease. Where the trend depends on the exploitation rate, the district is categorised as showing a possible increase/decrease.

**Annual Rod and Line Catch (Scotland)**

The total national reported catch (retained + released across all Scotland) of salmon by rod-and-line fisheries increased over the period 1952-2010. However since 2010 it has declined, with the uncorrected catch for 2014 being the second lowest on record (Figure 1). It is not clear at this stage whether this decline is part of a longer term trend or a short term fluctuation, as has been seen throughout the time series. While catch and release may have had a small effect on reported catch, it was not sufficient to change the overall trend. Catch and release may, however, have been sufficient to increase total catch in 2014 above the previous low seen in 1952, so 2014 may be a new all-time low.

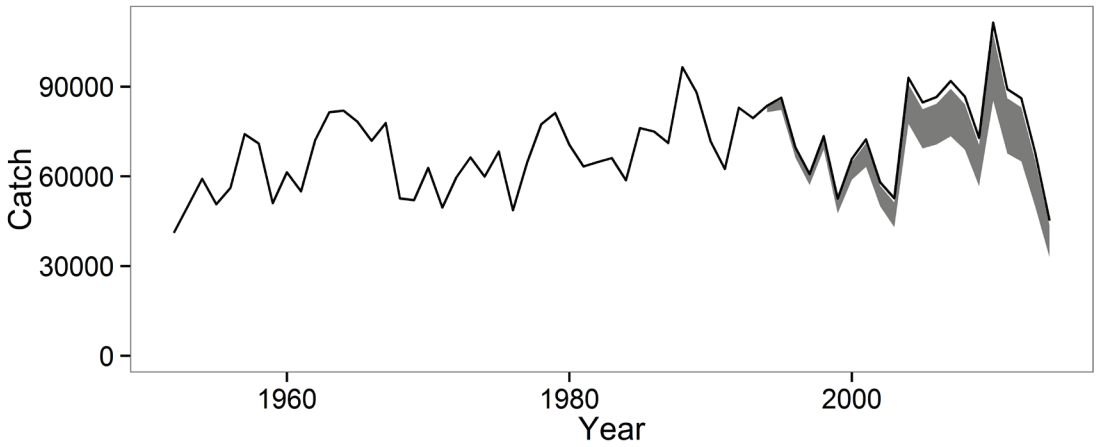


**Figure 1:** Total number of salmon reported to have been caught by rod-and-line fisheries in Scotland 1952-2014. The line indicates the total reported catch (retained and released) and the shaded area the catch corrected for the effect of catch and release.

Although the trend in annual catches is influenced by a number of factors, to some extent it reflects changes in distant water and coastal net fisheries. Hence, the trend of salmon returning to fresh water does not directly reflect survival at sea, but instead a combination of natural and fisheries mortality.

**Spatial and Temporal Variability in Rod and Line Catches**

**Spring**

At the national scale, reported catches of spring salmon have declined over much of the time since records began in 1952. Catches have stabilised in the past two decades, albeit at a lower level. The overall trend is similar after accounting for the impact of catch and release (Figure 2). Examination of the last 20 years of catches at a district scale reveals a varied picture, although there appears to be a cluster of rivers centred about the Spey which exhibit significant declines. Of those 37 districts where there were sufficient data to enable application of the rod catch tool, there is no evidence of a trend in the majority (22) of districts, declines in 13 and increases in two.

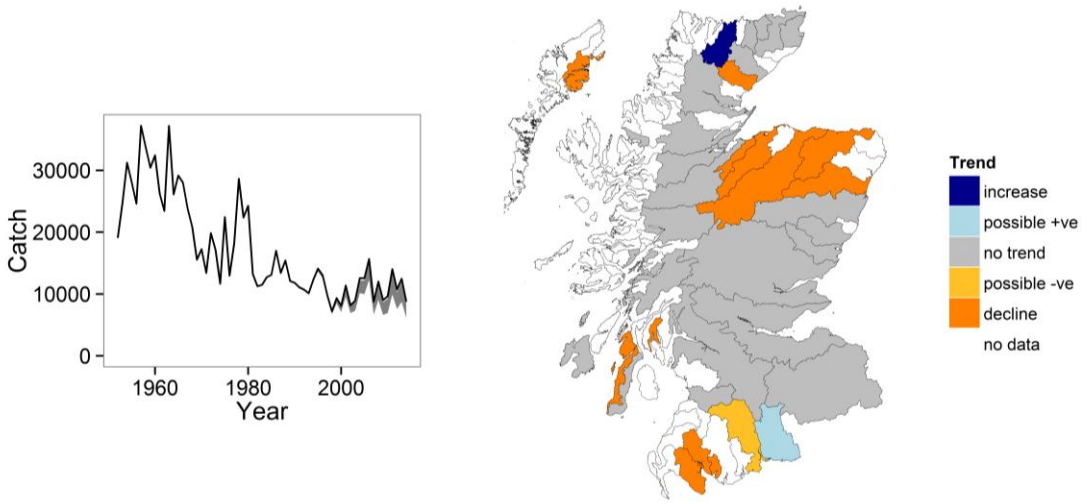


**Figure 2:** Trends in the reported catches of salmon during spring months (left). The line indicates the total reported catch (retained and released) and the shaded area the catch corrected for the effect of catch and release. The map (right) illustrates the results of the rod catch tool for spring salmon by statistical district.

**Summer**

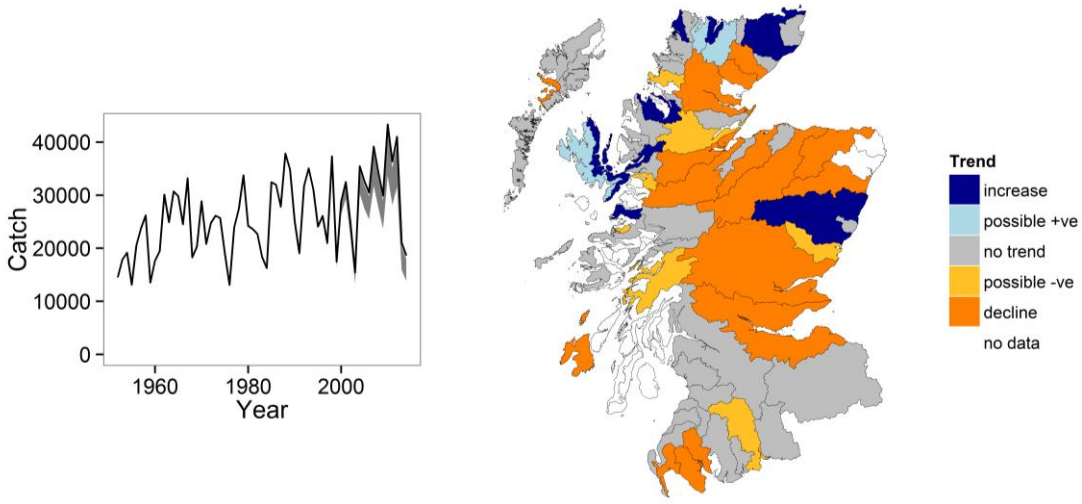


**Figure 3:** Trends in the reported catches of salmon during summer months (left). The line indicates the total reported catch (retained and released) and the shaded area the catch corrected for the effect of catch and release. The map (right) illustrates the results of the rod catch tool for summer salmon by statistical district.

Long term trends in the reported summer catches are more favourable than those for spring, with an increasing trend until 2012 followed by a decline (Figure 3). Although there was a marked decline in the past few years it is not possible to say if this is part of a longer term trend or a short term fluctuation. Consideration of the effects of catch and release reduce the estimated catch but do not alter the overall trend. The rod catch tool suggests evidence of recent increases in 17 districts with a further 36 showing no change and reductions in 23.

**Autumn**

In common with the overall reported catch, there was a strong positive trend in national autumn catches over much of the time series up until 2010 (Figure 4). There has since been a decline in catches that represents the largest downward trend in the time series. However, there was also substantial regional variation about this trend. Of the 82 districts examined, 20 were characterised by increases, in 35 there was no change and declines were evident in 27 districts.

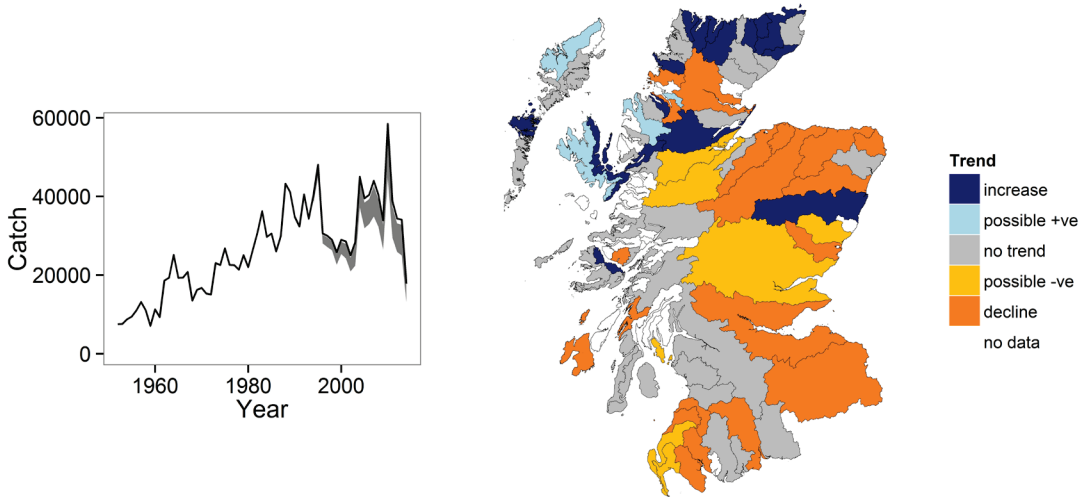


**Figure 4:** Trends in the reported catches of salmon during autumn months (left). The line indicates the total reported catch (retained and released) and the shaded area the catch corrected for the effect of catch and release. The map (right) illustrates the results of the rod catch tool for autumn salmon by statistical district.

### Counters

Counters can provide a valuable catch-independent indicator of salmon abundance, provided that they are subject to careful validation and quality control. Validation requires verification that apparent counts are genuinely fish and also that fish are not missed by the counter. Marine Scotland Science operates three counters across Scotland, two on the North Esk (Logie on the main-stem river and Westwater on a major tributary) and one, in collaboration with the Helmsdale District Salmon Fisheries Board, on the river Helmsdale. Careful validation and quality control have been undertaken only at the North Esk sites.

## Annual Counts

The annual upstream counts at Logie generally increased from the early 1980s. Recent years were largely characterised by high numbers of returning adults and, although numbers dropped sharply in 2012 and 2013, counts rose slightly in 2014 to median levels (Figure 5). The Westwater counts revealed no evidence of a long-term trend in salmon numbers. However, sharp declines in net upstream counts in 2012 and 2013 mirrored those at the Logie counter, as does the slight rise in 2014. Upstream counts on the Helmsdale show no clear trend over the relatively limited period of operation from 2001 onwards. Unlike the recent data from the North Esk, Helmsdale counts rose in 2013 followed by a sharp fall in 2014.

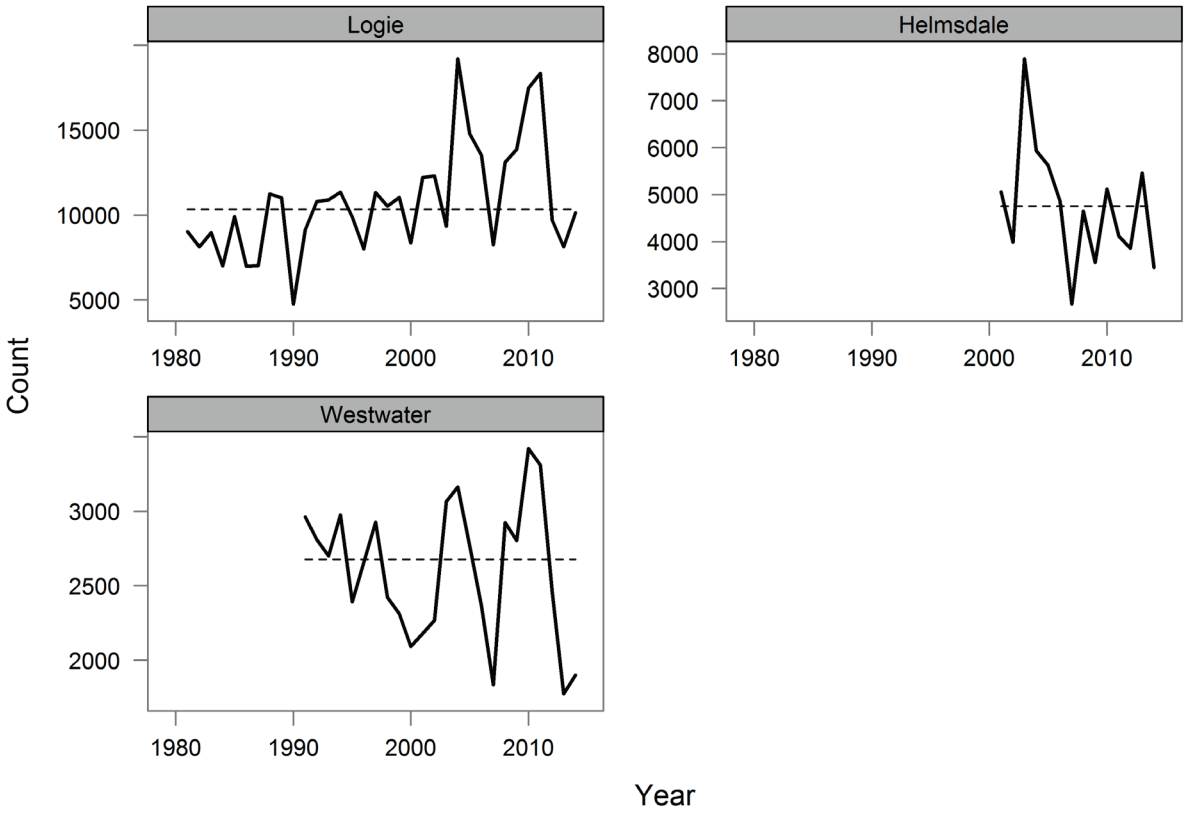


**Figure 5:** Annual net upstream counts of adult salmon at MSS counter sites

## Spring

Counts generally increased at Logie peaking in 2011 (Figure 6) before dropping to around the long-term median in the three subsequent years. There were no clear trends in the counts at Westwater or Helmsdale (Figure 6).

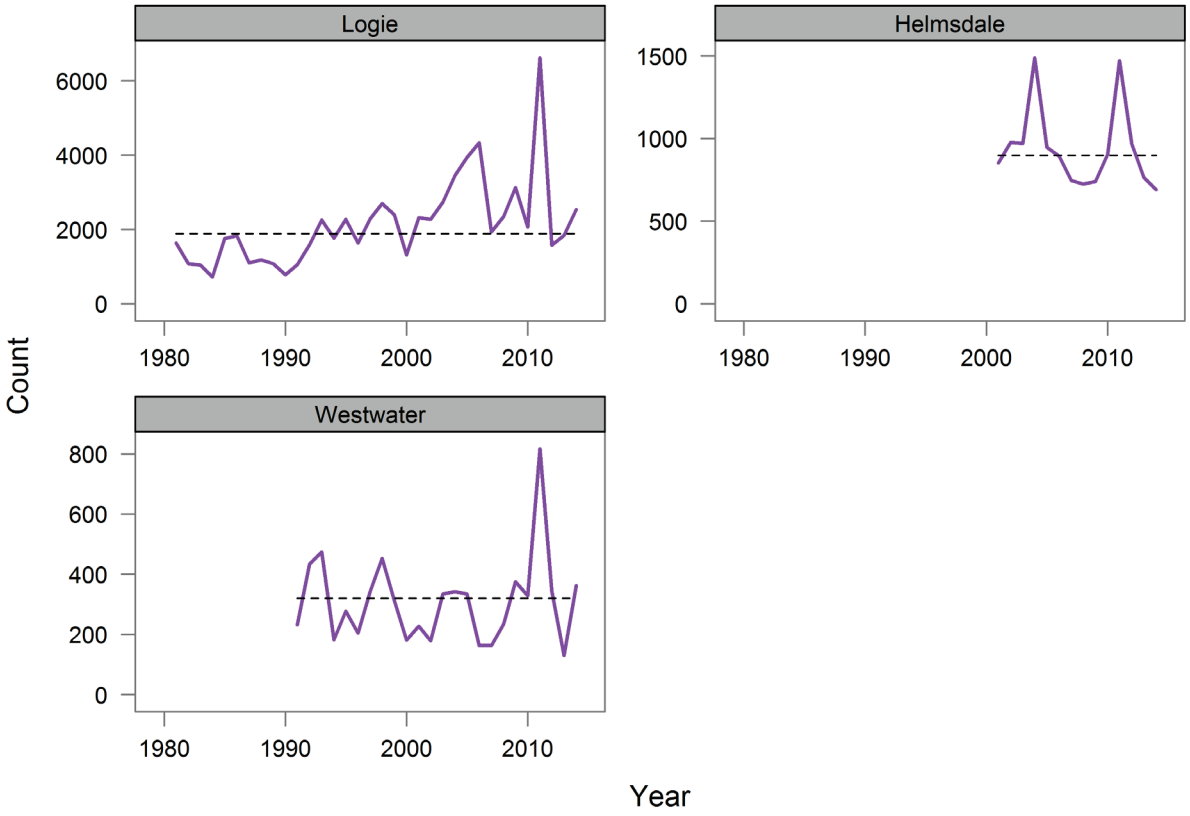


**Figure 6:** Net upstream counts of adult salmon at MSS counter sites during spring months.

## Summer

Summer counts at Logie trended upwards to a peak in 2010 (Figure 7) before dropping to around the long-term median in the last two years. There was no evidence of trends in the shorter term counts at the Westwater or Helmsdale (Figure 7).

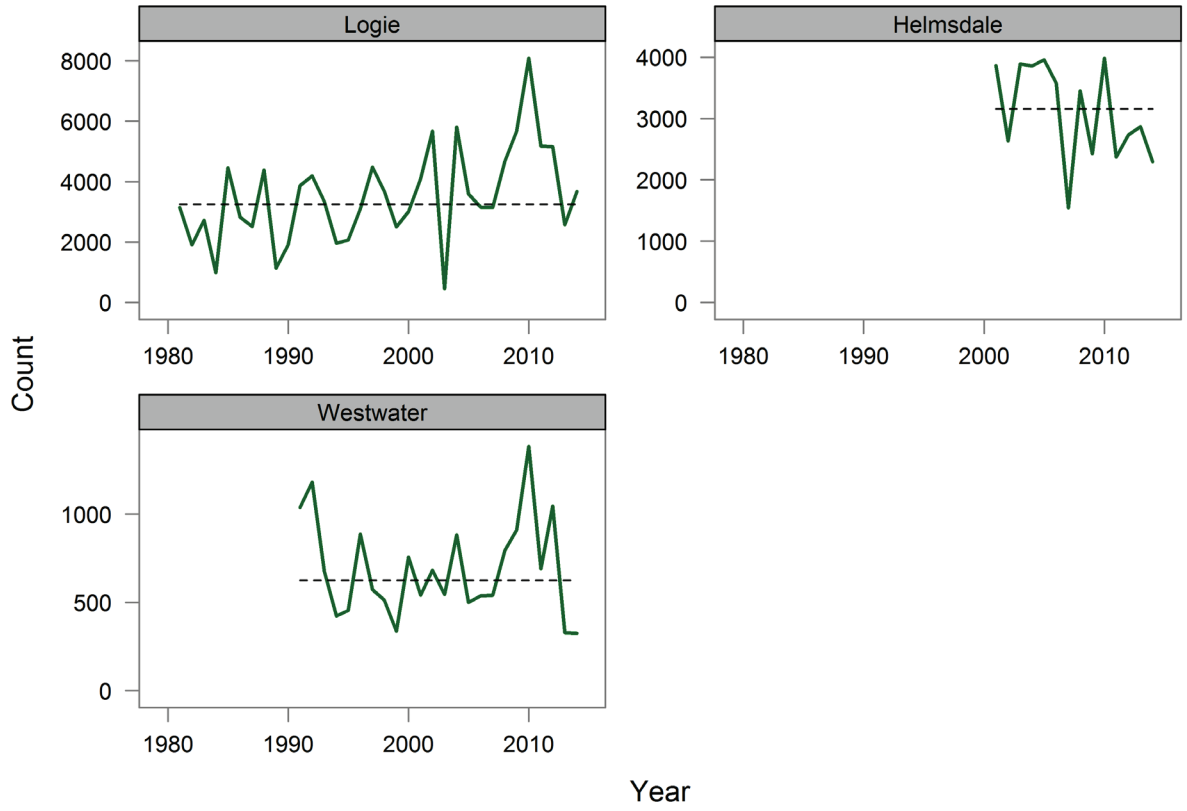


**Figure 7:** Net upstream counts of adult salmon at MSS counter sites during summer months.

## Autumn

In comparison to the spring and summer periods there were no clear long-term trends in the numbers of salmon passing any of the counters during autumn months (Figure 8). Counts in 2014 were close to the long term median for each of the sites.

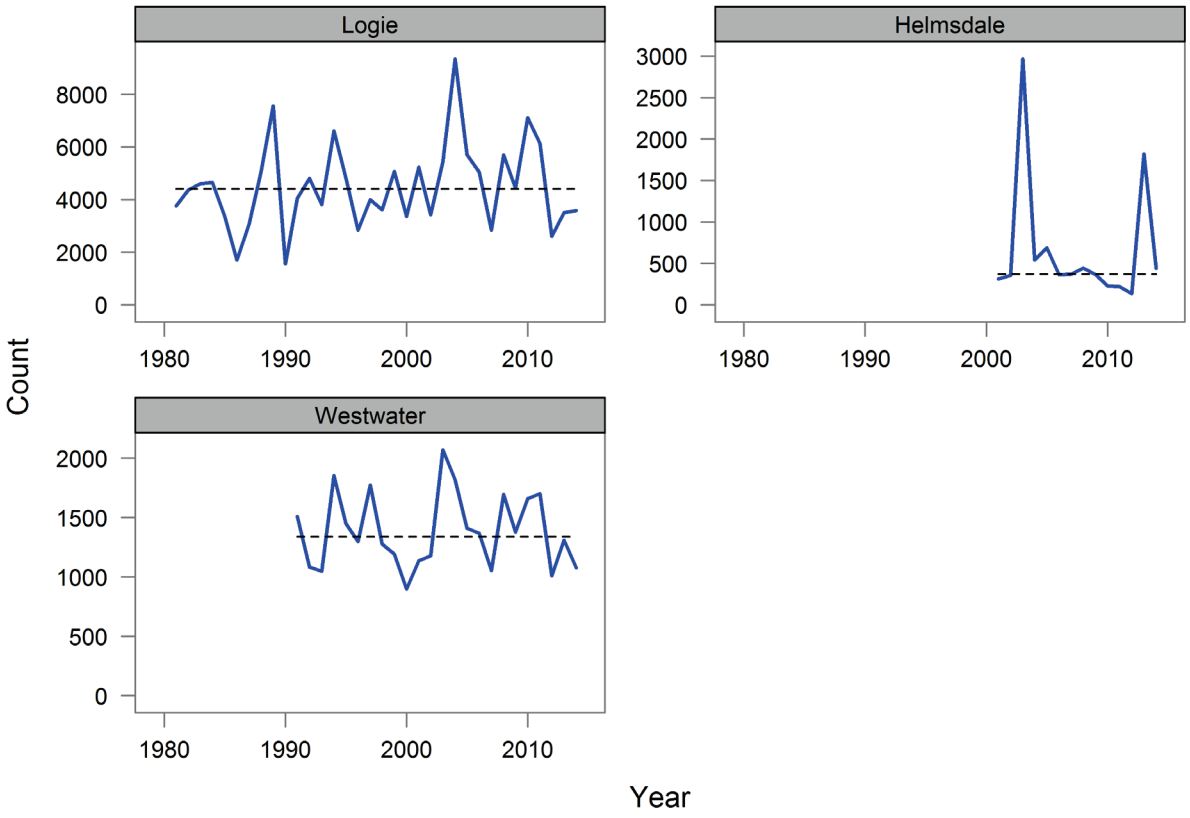


**Figure 8:** Net upstream counts of adult salmon at MSS counter sites during autumn months (including November).

## Traps

As with counters, fixed traps are a direct method of assessing numbers of returning adults and are not subject to uncertainties associated with rod catches. Marine Scotland Science operates traps on two upper tributaries of the Aberdeenshire Dee (the Girnock and Baddoch burns). These tributaries are dominated by early-running spring salmon (multi-sea winter fish), the stock component that has been of greatest concern in recent decades (see the section on spring catches). Although there are similar temporal trends in numbers of male and female salmon caught at the traps, only female numbers are plotted here, as availability of eggs is generally the limiting factor in the reproductive potential of the population.

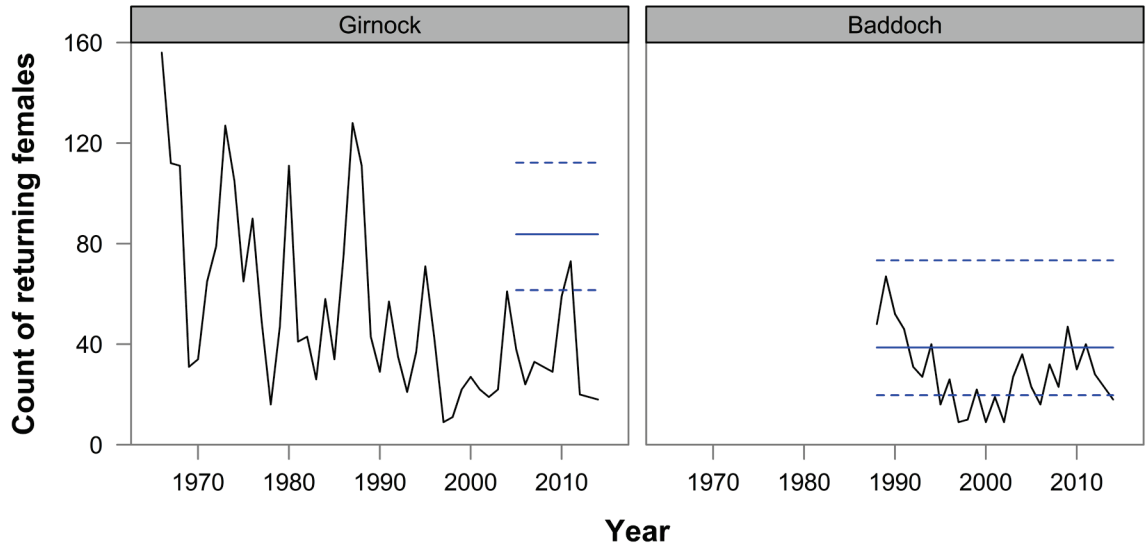


**Figure 9:** Numbers of adult females returning to the Girnock and Baddoch traps. The solid blue horizontal line represents the estimated stock level required to maximise production of emigrants (Smax) for each site, with the horizontal blue dashed lines indicating the error around these estimates (95% C.L.s). In the case of the Girnock Burn, estimates of Smax also reflect between year competition among salmon parr not considered for the Baddoch.

The number of female salmon that returned to the Girnock and Baddoch traps varied substantially among years over recent decades. However, there was an overall declining trend in female spawners up until 1997, after which numbers have stabilised or slightly increased. The 17 female salmon caught in the Girnock trap and 18 females caught in the Baddoch trap in 2014, are 32% and 62% of the long-term mean values respectively (Figure 9).

The Deeside traps allow counts and collection of associated biological data on ages and sizes of both returning adult and juvenile emigrant salmon. Using this information it is possible to establish the number of returning fish required to maintain maximum production of emigrants (Smax). For recent years it is estimated that 84 (95% Confidence Limits: 62-112) and 39 (95% C.L: 20-70) females would be required to maximise production of emigrants from the Girnock (Bacon *et al.*, in press) and Baddoch respectively. Although both sites fell short of these levels in 2013 and 2014, the number of females returning to the Baddoch was within the confidence intervals of Smax in 2013 and, therefore, maximum emigrant production may have been maintained in this year (Figure 9). In the case of the Girnock, returning female numbers were outside of the confidence limits for Smax (adjusted for between-year competition) and it can, therefore, be concluded that resulting

emigrant production will probably be below maximum levels for both 2013 and 2014 spawning years. While emigrant production will be lower than possible for these spawning years, this does not necessarily mean that the stocks will also be below conservation limits. Conservation limits can be defined in a number of different ways (e.g. maximum sustainable yield, Smax) and work is ongoing to define conservation limits for Scottish rivers.

**Survival Rates**

Given an estimate of emigrant production and the numbers and ages of returning adults it is possible to estimate the rates of return of emigrants to various stages in their life cycle. Depending on where the data were collected on the river system these return rates can provide estimates of marine survival (% return to the coast), the combined effects of marine survival, coastal and in-river net fisheries (% return to the river) or the combined effects of marine survival, coastal and in-river net fisheries and angling (% return to spawn). Data collected on the North Esk allows estimates of all three of these return rates to be calculated at the scale of a whole river catchment (Figure 10). Data from the Girnock and Baddoch traps provide an estimate of % return to spawn for two sub-catchments dominated by spring fish (Figure 11).

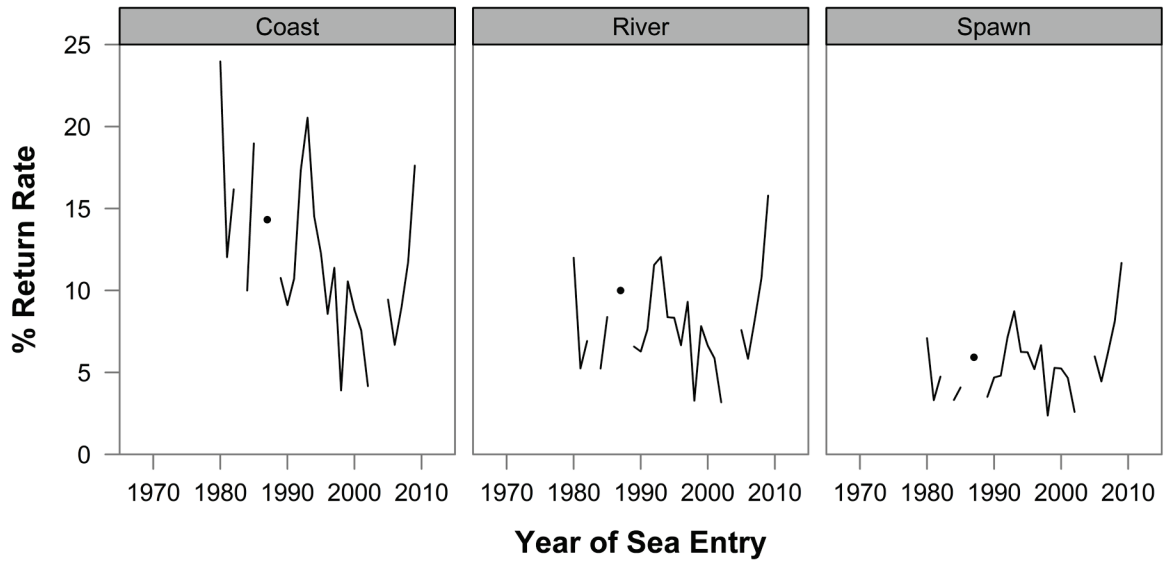


**Figure 10:** Percentage of North Esk juvenile emigrants (smolts) that return to the coast, to the river and to spawn. Emigrant numbers were estimated at Kinnaber Mill lade. Adult numbers were estimated using data from the Logie fish counter and information from local fisheries. The ages of returning fish were estimated from a sample of fish taken in the net and coble fishery.

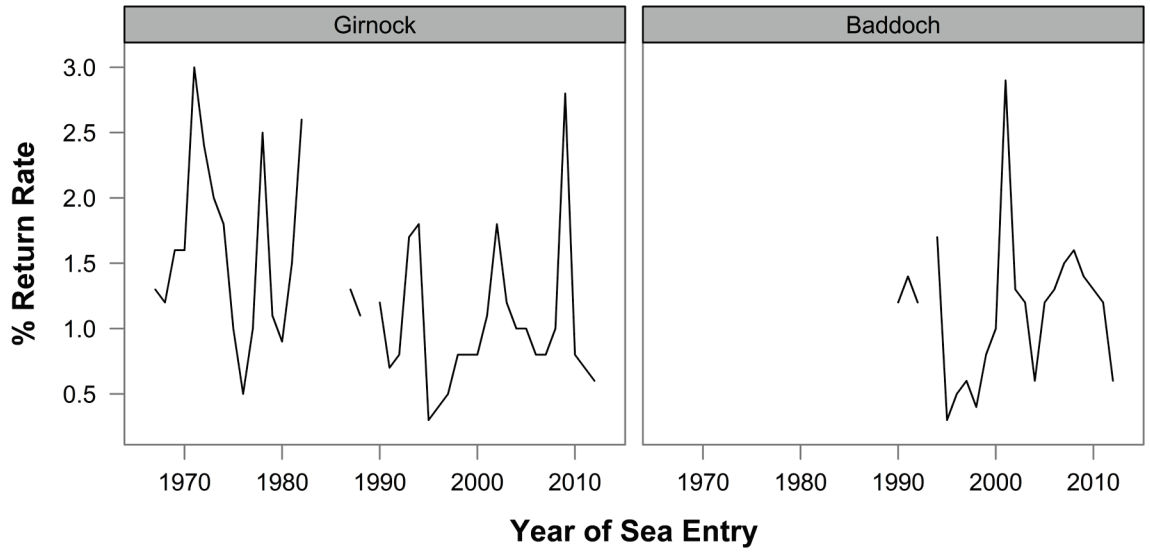


**Figure 11:** Percentage of juvenile emigrants (autumn parr and smolts) that return to the Girnock and Baddoch traps to spawn as adult females. Emigrant and female spawner numbers were obtained from direct counts at the traps. Ages of female fish were obtained from scale reading.

The return rates to the Coast for the North Esk are based on smolt estimates obtained at Kinnaber lade, and an estimate of adult numbers obtained from the Logie counter and the fisheries. There has been an overall downward trend in the return rate to the coast between the late 1970's and late 1990's and an increasing trend between 2006 and 2009 (Figure 10). Unfortunately, it was not possible to obtain reliable estimates of smolt numbers in all years and there has been no smolt count since 2009. Differences in the temporal trends shown by returns to the coast and those to the river or to spawn reflect the additional influence of fisheries. Consequently all three return rates become increasingly similar over time because of the decline in fishing mortality.

Return rates for the Girnock and Baddoch traps were calculated from a count of emigrants (autumn parr and smolts) leaving the catchment and adult female spawners returning to the traps. Temporal trends in return rates were broadly similar to those for adult returns at the Girnock and for return rates to the coast in the case of the North Esk. There was an overall downward trend between the 1970's and mid-1990's, followed by a small increase or stable conditions thereafter.

## Interpretation

A number of indicators can be used to assess stock status. These indicators have different strengths and weaknesses. Rod catch data provide broad geographic coverage and a long-term perspective on numbers of returning adult salmon, but not a direct measure of abundance nor the level at which returning numbers affect freshwater production of emigrants. Counters provide a catch-independent method of assessing adult returns where suitable quality control and validation occur and, potentially a direct measure of abundance of returning adults. However, counters do not currently provide broad spatial coverage and cannot be used on their own to derive spawning targets, since this process requires additional biological data. Fixed traps are also a useful catch-independent measure of numbers of returning adult salmon. In some circumstances trap data can be used to place returner numbers in the context of those required to maintain freshwater salmon production at a particular level. However, fixed traps are expensive to operate and thus cannot provide the large scale geographic coverage required for a comprehensive assessment of stock status across Scotland. Because of these particular strengths and weakness, an overall assessment using all data sources is stronger than any individual indicator.

Viewed in terms of a long-term trend over several decades, the numbers of adult salmon returning to Scottish rivers have increased. This patterns reflects a decline in marine survival being offset by reductions in the netting industry allowing a greater proportion of fish to enter rivers and hence increased rod fisheries. Given the increase in catch and release by the rod fisheries this has also led to greater spawner escapement. More recently, the sharp decline in reported catches is a cause for concern, although catch independent data suggest that particularly low catches in 2014 may have also been influenced by poor angling conditions leading to relatively low exploitation rates. Within this overall pattern, there are some clear variations in terms of stocks and regions, as follows:

## Spring Stocks

- Total catches of spring salmon have declined over the long-term, but stabilised in recent decades. The observation of a long-term decline in spring stocks, suggested by trends in rod catch, is paralleled by local catch independent data from fixed traps on Deeside. These data show that although adult returns have stabilised in recent years, they are on occasion, still below the level required to maintain maximum production of emigrants. The wider applicability of these findings for spring fish tributaries elsewhere in Scotland is currently unknown. Contrary to spring catches on the North Esk,

the Logie counter data show an increasing trend in recent decades and more recently a return to the median value. This observation may reflect local variation in trends in spring salmon numbers and potentially changes in exploitation rate over time. Evaluation of changes in exploitation rate is the subject of on-going detailed analysis.

**Summer Stocks**

- The decline in salmon numbers identified by the Logie counter in 2013 and 2014 is similar to that in rod catches, but less extreme. This would be consistent with a combination of weaker returns of salmon in recent years and lower rates of exploitation. A similar decline was evident on the Helmsdale counter but was less obvious on the Westwater where, given its tributary location, seasonal distinctions are likely to be blurred. Although a decline in catches of summer fish was not geographically uniform, there was a sharp increase in the numbers of regions in which the rod catch tool indicated statistically significant declines in catches over previous years.

**Autumn Stocks**

- Following a long-term increasing trend in autumn catches there was a steep decline in 2014 that generated considerable spatial variation in the results of the rod catch tool. This recent trend in catches contrasts with counter data, which have been relatively more stable. The rod catch tool indicates a growing number of regions in which there is a significant downward trend in catches particularly on the east coast and south west.

## Sea Trout

### Rod Catches

As with salmon, rod catches have traditionally been used to assess the status of sea trout in Scotland. Thus in the absence of fish count or trap data the following assessments are based on rod catch alone. Further, as we have no information on structured run-timing in sea trout stocks, analyses are based on annual catches. The rod catch tool has been applied to the last 20 years of sea trout catches to determine recent trends.

The number of sea trout reported to have been caught by rod fisheries across Scotland has decreased markedly over the entire data period 1952-2014 and over the most recent 20-year period (Figure 12).

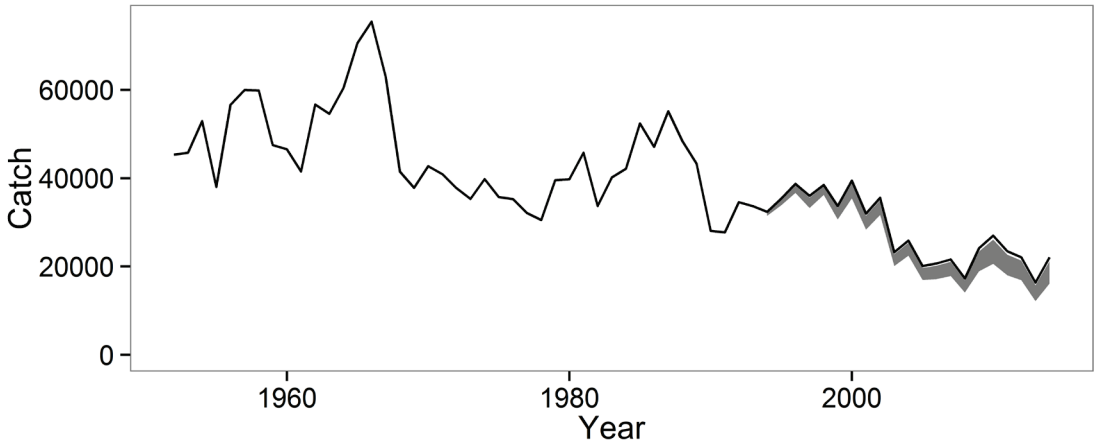


**Figure 12:** Annual reported catches of sea trout by rod-and-line fisheries in Scotland 1952-2014. The line indicates the total reported catch (retained and released) and the shaded area the catch corrected for the effect of catch and release

### Spatial Variability in Rod and Line Catches

Of the 85 districts where reported catches allowed for use of the rod catch tool, there is evidence of recent declines in 37 of the districts, no evidence of a change in 35, and evidence of recent increases in 13 (Figure 13).

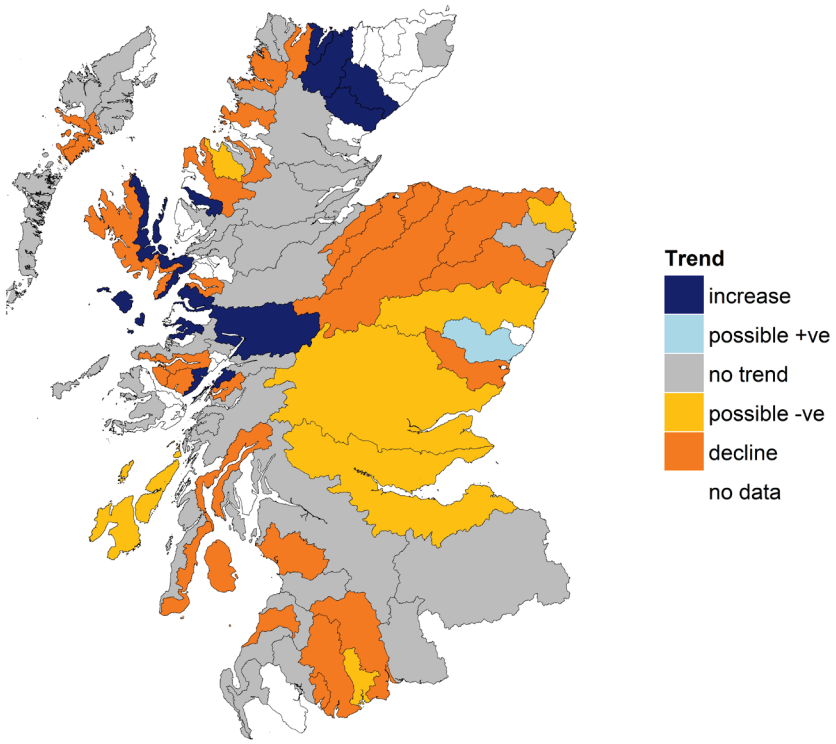


**Figure 13:** Trends in the reported catches of sea trout 1952-2014 by statistical district.

**Return Rates of Sea Trout**

A two-way fish trap has been operated on the River Shieldaig since 1999. This system allows the capture of sea trout as they migrate to sea and as they return to the river. Individually marking the fish (using VI tags in 1999 and PIT tags since 2000) enables calculation of the proportion of tagged emigrants that subsequently return to the river, providing an index of marine conditions.

Due to the small number of wild fish migrating from the system and the requirement for larger numbers to provide a more accurate measure of return rates, the Shieldaig system has been stocked since 1998. From 1997 to 2005 non-native trout were stocked into the river as fry and were identifiable by the presence of a clipped adipose fin (Hay & Hatton-Ellis 2006). During 2006-2008 stocking of eggs from a mix of native and non-native fish was undertaken, with eggs from known native origin fish being stocked from 2009 onwards. The return rates are, therefore, presented as

two separate time series, one for clipped fish, which originated from fry stocking, and one for unclipped fish, which originated from natural spawning and stocked eggs.

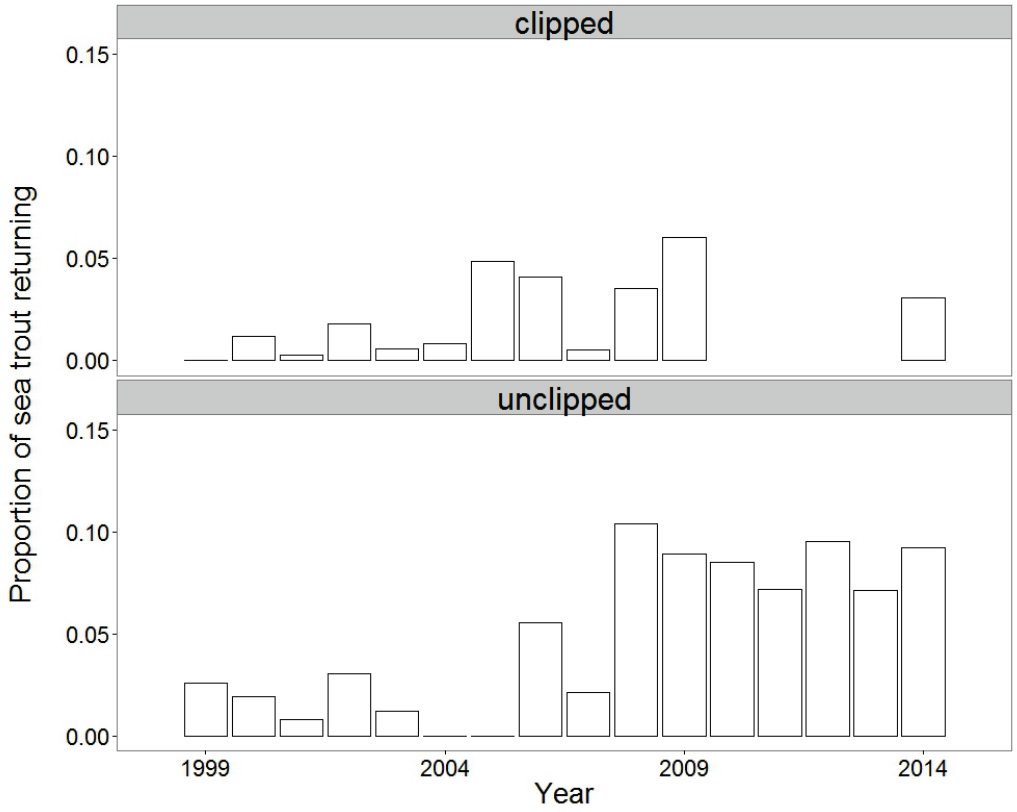


**Figure 14:** The proportion of marked sea trout of different origins returning to the River Shieldaig in relation to fish farm production cycles. Data for clipped fish span 1999-2009, unclipped 1999-2013.

The overall pattern shown by the data suggests an increase in return rates of sea trout at the Shieldaig site since the early 2000s, appearing to stabilise at a new, higher, level in recent years.

**Interpretation**

In assessing the status of sea trout stocks from rod catches it is important to acknowledge that such data provide broad geographic coverage and a long-term perspective on numbers of returning adult sea trout, but not a direct measure of abundance, nor the level at which returning numbers affect freshwater production of sea trout smolts. While catches provide a good indicator of the success of the fishery their use in assessing stock status is hindered by the absence of any direct measures of abundance from, for example, traps and counters. In addition, trout have a complex life cycle with both migratory (sea trout) and non-migratory (brown

trout) forms existing and potential plasticity in life history strategies. The dynamics of stocks that include both brown and sea trout is poorly understood and, therefore, the relationship between sea trout catch data and stock levels is uncertain.

With these provisos in mind, the picture is one of historically low levels of adult returns to rivers across the whole of Scotland. While many areas of Scotland are at historically low levels, the rod catch tool has highlighted additional notable declines in catches in recent years in the central-eastern, south west and north west areas of the country.

## Further Information

### Catches

Information on the salmon catch statistics, including how they are collected and up to date figures can be obtained at:

http://www.scotland.gov.uk/Topics/marine/science/Publications/stats/SalmonSeaTroutCatches

Detailed analysis of the rod catches are presented in the following papers:

Smith, G.W., Middlemas, S.J. and Maclean, J.C. (2014). Assessing the status of Scottish Atlantic salmon ( *Salmo salar* L.) stocks using reported catch data: a modelling approach to account for catch and release in the rod & line fishery. Scottish Marine and Freshwater Science 5 (11): 16pp.

Thorley, J.L., Youngson, A.F. and Laughton, R. (2007). Seasonal variation in rod recapture rates indicates differential exploitation of Atlantic salmon, *Salmo salar*, stock components. Fisheries Management and Ecology 14 (3), 191–198,

Youngson A.F, MacLean J.C, Fryer R.J (2002). Rod catch trends for early-running MSW salmon in Scottish rivers (1952–1997): divergence among stock components. *ICES J. Mar. Sci.* 59, 836–849.

Vøllestad L. A., Hirst D., L'Abee-Lund J. H., Armstrong J. D., MacLean J. C., Youngson A. F., Stenseth N. Chr. (2009). Divergent trends in anadromous salmonid populations in Norwegian and Scottish rivers. *Proceedings of the Royal Society, Series B* **276** 1021-1027.

The following report also contains a discussion over the relative merits of rod catches and juvenile sampling.

http://www.scotland.gov.uk/Resource/0041/00416335.pdf

### Counters

An information leaflet on fish counters can be obtained at:

http://www.scotland.gov.uk/Resource/Doc/295194/0099930.pdf

The following paper examined the relationship between rod catch and counter data:

Thorley J.L., Eatherley D.M.R., Stephen A.B., Simpson I., MacLean J.C., *et al.* (2005). Congruence between automatic fish counter data and rod catches of Atlantic salmon *Salmo salar* in Scottish rivers. *ICES J Mar Sci* 62: 809–817.

**Deeside Traps**

Information on the Girnock and Baddoch traps can be found in the following publication, and website

Bacon, P. J., I. A. Malcolm, R. J. Fryer, R. S. Glover, C. P. Millar, and A. F. Youngson. Can conservation stocking enhance juvenile emigrant production in wild Atlantic Salmon (*Salmo salar*)? (in press). *Transactions of the American Fisheries Society*.

http://www.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Monitoring/Traps

**Shieldaig Trap**

Information on the Shieldaig trap can be found in the following publication and website:

Shieldaig, Scotland. In *Sea trout: biology, conservation and management* (eds Harris, G. S., Milner, N. J.), pp. 349-355. Oxford, UK: Blackwell Publishing

http://www.gov.scot/Topics/marine/Salmon-Trout-Coarse/Freshwater/Research/Aqint/Shieldaig







This publication is available at **www.gov.scot**

Any enquiries regarding this publication should be sent to us at
The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-78544-306-0 (web only)

Published by The Scottish Government, April 2015

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS48585 (04/15)