West Sutherland Fisheries Trust

Loch Lurgain (S. Marshall)

2022 Annual Review

Contents

THE WEST SUTHERLAND FISHERIES TRUST

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Chairman's Foreword

In last year's review, I hoped for a better year for all of us in 2021, but Covid-19 would not let go, and we suffered another year of restrictions. While the last restrictions are being ended as I write this, Covid will still be with us.

In the course of last year, we paid back in full the precautionary Bounceback loan we had taken out and still maintained a sound financial position. But we have not made progress with converting to a SCIO.

Dirty camping and overcrowding of resources remained an issue for our area last year and new measures coming into operation for 2022 may yet face a stern test, as staycations may be very popular again.

At the end of the year, Charles Marsham died. Charles was one of the stalwarts of the Trust, serving for many years as a Trustee and as our longest serving Chair. My predecessor as Chair, Nick Joy, paid this tribute to Charles:- " He was a real character and led a swashbuckling life and I for one am glad that I knew him. It is rare when one meets a unique person and Charles was certainly so. There are many things I remember him for, but mostly sharing a bottle of wine with some interesting venison whilst he recounted his many stories". We shall all miss him.

Tony Rawlings stood down from the Board and as Treasurer at the end of the year, and I thank him for his wise control of our finances.

I thank my fellow trustees for their efforts over the year, our small staff for their hard work and fortitude and our supporters and volunteers for sticking with us.

Last year, I tempted fate by cautiously wishing for a better year. I will not repeat that mistake but will say that we look set to weather the year despite the very stormy first few months of it.

Simon Jeffreys

Charles was always happy to get his hands wet! Photos from left: S. Marshall, A. Graham-Stewart, S. Marshall

A summary of 2021

WSFT undertook a range of field work during 2021. In addition, we participated in a number of meetings and outreach events. Further details of the different projects are available in the rest of the document or from the Biologist.

Education

Assisted one school with an invasive species project

Juvenile surveys (♦) (p. 9)

A total of 74 sites over 14 catchments

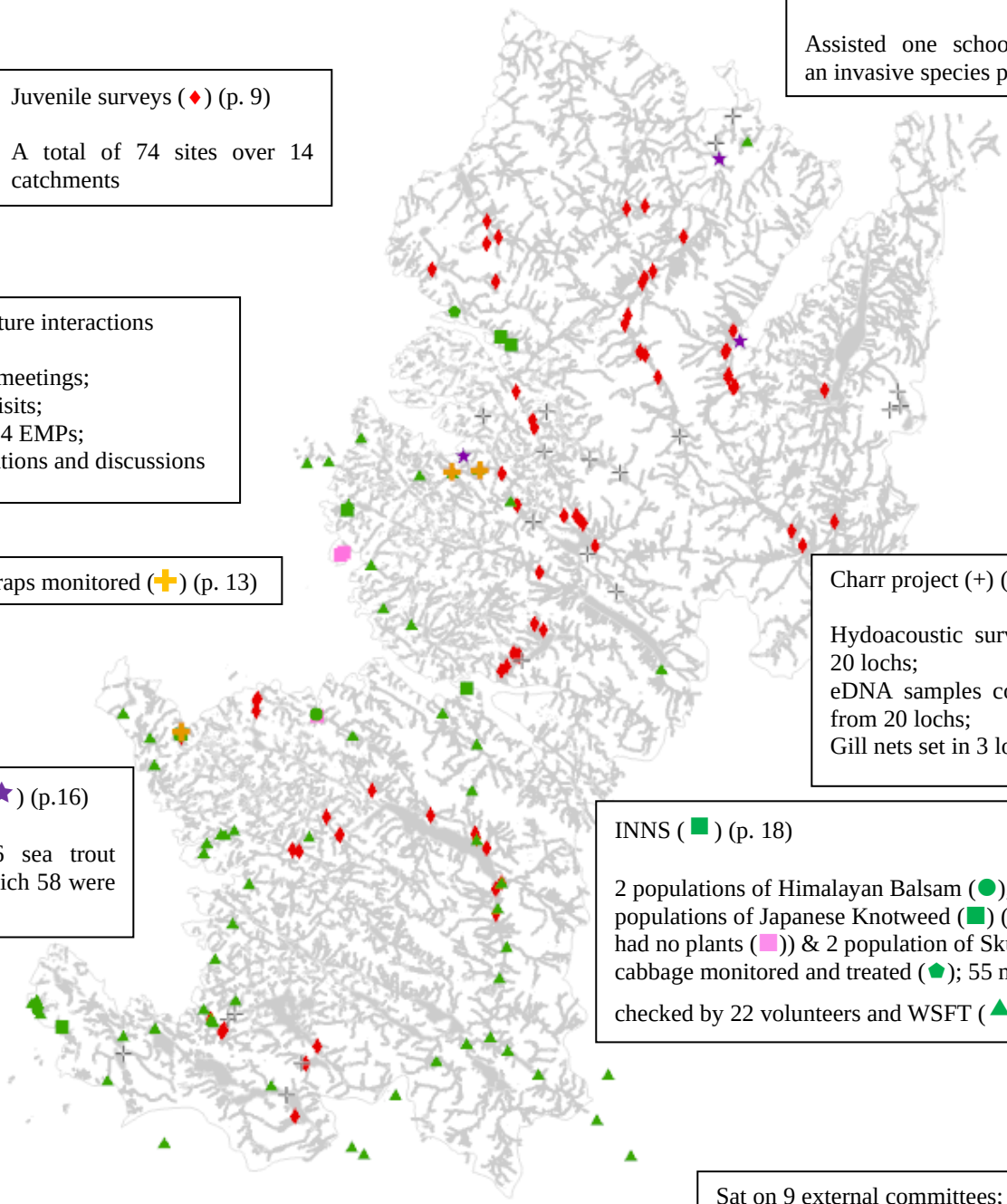
Aquaculture interactions

2 AMA meetings;
18 site visits;
Monitor 4 EMPs;
Consultations and discussions

3 Fish traps monitored (✚) (p. 13)

Charr project (+) (p. 21)

Hydoacoustic surveys of 20 lochs;
eDNA samples collected from 20 lochs;
Gill nets set in 3 lochs



Sweep netting (★) (p.16)

A total of 306 sea trout examined, of which 58 were tagged

INNS (■) (p. 18)

2 populations of Himalayan Balsam (●), 9 populations of Japanese Knotweed (■) (of which 3 had no plants (■)) & 2 population of Skunk cabbage monitored and treated (⬟); 55 mink rafts checked by 22 volunteers and WSFT (▲)

Sat on 9 external committees;
Participated in 4 multi-area projects

Introduction

The **West Sutherland Fisheries Trust** continues to work towards the conservation and restoration of fish populations. Now entering its twenty sixth year, the information database for the Trust area continues to grow and provide useful data for owners, managers and policy makers. In addition, the Trust retains strong links with a variety of organisations and individuals throughout Scotland and looks forward to cementing these links in the coming years. These links enable the Trust to move towards the integration of management within the Trust area.

Within the Trust area we are developing projects and practical management tools with a variety of local organisations, including Angling Clubs, the Highlife Highland Ranger Service, the school system, estates and community groups. These collaborative projects not only assist the Trust with its work but also further integrate it into the local communities, while taking us into a range of different habitats. It is to be hoped that the Trust will continue to be seen as a valuable resource within the community – both to managers and the general public – providing helpful advice and educational opportunities that can be called upon at any point.

Despite the restrictions in place as a result of Covid-19 we managed to complete an ambitious and extended work programme during 2021. While the necessary safety measures meant that outreach activities were cancelled and work protocols altered, we still managed to undertake a substantial range of activities, much of which is detailed within this report. The weather was kind, enabling a good electrofishing (see p. 9) and sweep netting (p. 16) season. However, this did have an unfortunate impact on the angling season and rod catches.

2021 saw the start of the West Coast Salmon Tracking Project (WCSTP), managed by the Atlantic Salmon Trust (AST) and involving a number of Fisheries Trust, including WSFT. After much training, and under the supervision of the AST, salmon were tagged with hydroacoustic tags from a number of catchments along the west coast of Scotland (see p. 20). AST set up a detailed array of receivers along the coast, able to detect the salmon as they swam past. Due to continue in 2022, this project is returning interesting information on marine migration routes along the west of Scotland.

The mink initiative, now part of the Scottish Invasive Species Initiative, continues to operate under the management of the Trust and we are extremely grateful to all our volunteers for making this possible. While there have been very few sightings, rapid reaction by two volunteers after their sightings did result in 2 captures. The volunteers always rally, increasing efforts following sightings and it is to their credit that we remain a relatively mink free area (see p. 18).

The Trust would like to take this opportunity to thank the many individuals who have given time and effort to assist with the work programme. Without these committed individuals we would not have the range of information and data currently existing and would therefore not be in the present position of offering advice and guidance to the many owners and managers within the area. In addition, much of the restoration work and biosecurity actions currently in progress would be much further behind.

Partnerships

The Trust continues to maintain a close relationship with partner organisations in Fisheries Management Scotland (FMS) and the Scottish Fisheries Co-ordination Centre (SFCC), and national organisations such as Marine Scotland Science (MSS), Scottish Environmental Protection Agency (SEPA) and Nature Scot (NS). This allows the Trust to access a vast wealth of expertise and information as well as enabling the targeting of research to better further our aims.

The Trust also works closely with the local District Salmon Fishery Board, and the local estates, in order to assist with the management of the area. By providing advice on local issues, as well as assisting with any statutory consultations that arise, we hope to ensure that the fish and their environment are supported and protected. In particular, we are able to provide advice and guidance on stocking, fish farm applications and the Conservation Limits, as well as the use of habitat improvements within the area.

The Future

The WSFT will continue with its current work, maintaining and developing the many datasets and using the data to inform management decisions. It is hoped that we can enlarge the research programme and enhance the many links currently in existence with individuals and organisations. In order to do this, it is reliant on the generosity, both in terms of time and financial aid, of its many supporters, enabling the Trust to move forward with the development of management policies within the area.

Biosecurity remains an important issue for the Trust, in an area that remains relatively free of invasive non-native species (INNS). We hope to keep it like this, operating to decrease the numbers and potentially make the area free of Himalayan Balsam and Japanese Knotweed (see p. 18). 2022 will see the continuation of the Scottish Invasive Species Initiative (SISI), an HLF funded programme of work managed by NS and involving a number of Trusts throughout Scotland. This will provide funding to enable us to increase our current programme and develop out educational role. In addition, the importance of volunteers to report sightings and locations cannot be over-emphasised. While we have hopes of eradicating some INNS, the presence of rhododendron is a larger problem. It will require a more intense effort from everyone, but the results will be worth it as the native vegetation returns and the rivers improve.

The Trust will continue to assist community groups and land managers with practical fisheries management and advice. It is hoped that restoration programmes, as laid out in the Catchment Management Plans, will be developed and progressed. The Trust is always available for discussion and should be contacted if you have any queries or suggestions.

The Trust would also like to further develop the educational aspects of our remit through talks, demonstrations and small “hands on” projects. As in previous years this is likely to involve the Ranger Service and schools, although it is hoped that other groups and individuals will also access this service. Shona is a Science and Engineering Ambassador and therefore can also be accessed through the STEMpoint network. This has the potential to extend our educational remit, and information about the Trust, beyond the local area.

2021 saw the establishment of a collaborative project between Atlantic Salmon Trust and Reay Forest Estate which aims to improve the health of the salmon and sea trout populations in the Laxford catchment, grounded by the most robust science and monitoring. This long-term project hopes to establish an index river, testing the impacts of management actions, linking to a network of similar rivers world-wide. The Trust is pleased to support this project, together with Marine Scotland Science, and are looking forward to working with Chris, Technical Project Manager (Project Laxford), in the future.

During 2021, Sam worked hard to establish a project examining the charr populations of the area (p. 21). We look forward to continuing this project in collaboration with Queens Mary University London, using eDNA techniques to determine the presence of charr within the Trust area.

The development of a project by Outer Hebrides Fisheries Trust, in conjunction with Southampton University, to examine the use of isotopes to determine the origin of sea lice on wild fish opens exciting possibilities to definitively address that perennial debate. WSFT are looking forward to help move this project forward in 2022 through the collection of samples during estuarine netting.

The emphasis will continue to be the wellbeing of native wild fish in the West Sutherland area and the Trust will represent them where required and defend their interests where it is felt that these are being ignored. The WSFT and its representatives feel that all populations are important, irrespective of size, and that their protection and enhancement are vital to the survival of these magnificent species.

Catches within the West Sutherland area

While catch statistics are generally used to determine the trends in salmonid populations, it must be recognised that there are a number of potential inaccuracies and inconsistencies inherent within this method. These include the following:

- The numbers of fish noted within the tables relate only to those fish recorded within the books. If anglers fail to report all or part of their catch then the figures will be an under-estimate of the total.
- Angling effort varies between years and is not recorded. A change in effort, either number of anglers, experience or time spent fishing, will be reflected in changes in the catch statistics.
- Weather and river conditions affect the number of fish within the systems and their catchability. Thus, a low catch in a dry year may not reflect a poor adult run, simply the timing of the run and the ability of the angler to catch fish.

This leads to the view that the relationship between catches and stocks is complex. Catch records do not reflect the number or quality of fish in the system, but rather the angler ability to catch them under the conditions experienced at that time. Catch figures are therefore most valuable when it comes to expressing long-term trends.

2020

The official catch statistics for salmon and sea trout in Scotland have been published (http://www.gov.scot/Topics/marine/Publications/stats/SalmonSeaTroutCatches/Data) and the data for the West Sutherland area are summarised below (Table 1). These statistics are frequently used to indicate long term trends in populations, by region. By extracting the data relevant to the WSFT area, we can gain a greater understanding of the situation, as represented within this area. The data are given as an amalgamation of several rivers, as previously reported by Marine Scotland (Fig. 1). This is the result of a requirement of the Scottish Executive to mask the catches from individual systems in order to retain the confidential nature of the data.

Table 1 The number of wild fish caught by rod and line, by Fishery district

Fishery Board		Salmon & Grilse	Sea Trout
Hope & Grudie	2020	168	826
	(2019)	(251)	(874)
	5 yr. ave.	*355.2*	*873.8*
Inchard – Kirkaig	2020	331	231
	(2019)	(309)	(291)
	5 yr. ave.	*365.8*	*289.0*

Fig. 1 Map showing the location of the WSFT area and the 2 areas described in the table (pale grey = Hope & Grudie; darker grey = Inchard – Kirkaig)

Total salmon catches within the area were down on the 2019 catches, with the greatest decrease in the Hope & Grudie area. Catches across the area remain below the 5-year average.

The release rate within the area was slightly higher than in 2019, at 97%, and very encouraging. As with the last few years, but contrary to historic patterns, the greatest proportion of salmon released (98%) were from Inchard – Kirkaig, with only 95% release in the northern area. This is still a high release rate and encouraging to see but it is to be hoped that it will increase in the future. While it is known that released fish can be re-captured on several occasions, thus influencing the suitability of catch returns to estimate adult runs, it is important at this time of low marine survival to release an increasing number of fish in order to increase the spawning stock. Remember, the fish in the freezer or on the table cannot breed!

Sea trout catches within the area showed a slight decrease compared to 2019, in both areas. There was 100% catch and release seen in the Hope & Grudie area, while a total of 11 (6%) fish were retained in the Inchard – Kirkaig area. This gives an overall total of 97% of fish released.

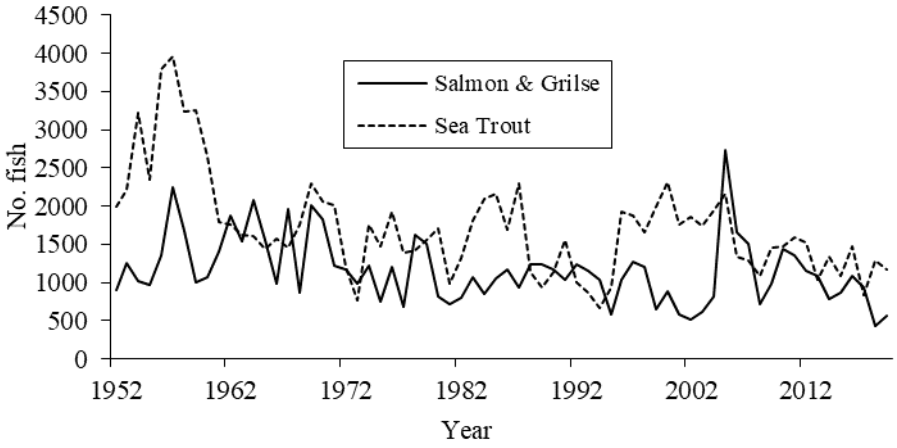


Fig. 2 Rod and line catches within the West Sutherland area, 1952 – 2020

2021

Catch data for the 2021 season are being compiled and will be produced by Marine Scotland Science in 2022. However, some information is available from angler logs and fishing books. Reports indicate that, with a drought over most of the summer, catches were poor across the area. Fish were caught in small numbers over the year, with better catches following the rain.

Catch and release continues to be an important fisheries management technique within the area and has been adopted by a number of estates. It is to be hoped that this continues to be used, and hopefully increased, by the various estates and their angling clients, adding as it does to efforts throughout the area to improve the situation for fish populations through biosecurity, removal of non-native species and habitat improvements amongst others.

The new conservation limits for the area have been produced, with few rivers moving category (see p. 22), although the Rivers Laxford and Gleann Dubh have moved down to category 3. The model has not been altered since 2020, so movement should reflect alterations in catches and a better understanding of the underlying figures within the model. It is to be hoped that all anglers will continue to return fish, despite these changes. While sea trout are not affected by this legislation, the continuing low levels of catches would suggest that catch and release is of equal importance to this species.

All information on the fish populations within lochs and rivers is important when undertaking fisheries management. Any further information that can be provided will be gratefully received, particularly on the brown trout lochs within the area.

A survey of juvenile abundance

Electrofishing surveys are designed to assess the juvenile populations within a system. The equipment operates by creating an electrical field within the water that at first attracts and subsequently stuns them for a brief period, at which point the fish can be netted out and examined under anaesthetic. The Trust has a rolling programme of surveys, with most sites visited every 2 years, while a small number may be sampled annually. When possible, all sites are revisited, although some may not be accessed due to time and flow constraints, while others may be added.

During 2021 WSFT again participated in the National Electrofishing Programme for Scotland (NEPS) under contract from Marine Scotland Science. A random 30 sites were assigned across the area, in locations believed to be accessible to salmon. In addition to these sites, we also undertook electrofishing at a number of other sites.

The average densities of fish within each catchment are summarised (Table 2). 'NEPS additional sites' is an amalgamation of catchments where only 1 or 2 sites surveyed – Grudie, Oldshoremore and Garvie. This allows comparison between the catchments, although it should be noted that temporal changes in density throughout the summer months and habitat differences between catchments are not considered in this table. The timing of sampling is important, with fish moving within the tributaries as a result of water height and temperature, food availability and size. Thus, sampling after a spate may give a low density as a result of washout, whilst drought may decrease density as fish move into deeper water to avoid predation or desiccation or may increase density as a result of concentration in severe cases. Similarly, densities will be greater shortly after hatching, reducing with time as the fish grow and require a larger territory for survival.

Table 2: Average densities of salmonids per catchment surveyed

	Average density (100 m^2)			
Catchment	**Salmon fry**	**Salmon parr**	**Trout fry**	**Trout parr**
Hope	12.69	2.69	1.77	3.97
Polla	7.63	8.21	16.69	13.80
Dionard	8.81	6.76	0.42	0.64
Rhiconich	30.10	10.64	2.28	0.94
Sandwood	4.23	2.28	12.68	3.04
Laxford	29.37	8.79	4.30	4.81
Maldie	0.00	0.00	23.07	10.91
Oldany	6.37	0.44	5.59	6.62
Clashnessie	0.00	0.00	16.82	22.96
Inver	16.98	22.37	8.49	6.38
Polly	14.91	5.44	8.71	4.92
NEPS additional sites	6.54	4.88	2.03	6.73
West Sutherland average	**11.47**	**6.04**	**8.57**	**7.14**

There is a good distribution of salmonid species throughout the West Sutherland area with trout present in every system surveyed. Within salmon dominated systems, juvenile salmon densities were largely moderate to excellent. However, a comparison of the area average with the SFCC absolute regional classification scheme for salmonids indicates that salmon densities for the area are moderate, while trout densities are good.

Within the individual catchments, historic trends indicate that most of the populations have remained relatively constant with time. However, 38% of both salmon and trout populations have shown an increase over time, with 8% and 6% respectively showing a decline in density.

While undertaking these surveys we also encounter other species within the sites. Trout can be seen to be present at the majority of sites surveyed, with only 5 catchments having sites that did not contain the species (Fig. 3). Salmon, in contrast, were only present at all sites in 2 catchments. Eels were present in all catchments, but only at all sites within 5 catchments, indicating some variability in distribution.

Minnows were also widespread throughout the area, although only present in 6 catchments, and at no more than 50% of sites in any one catchment. This is likely to reflect the location of the sites and the fact that the minnow is an introduced species and therefore more likely to be patchily distributed. Stickleback were only recorded in the Hope and Dionard on this occasion.

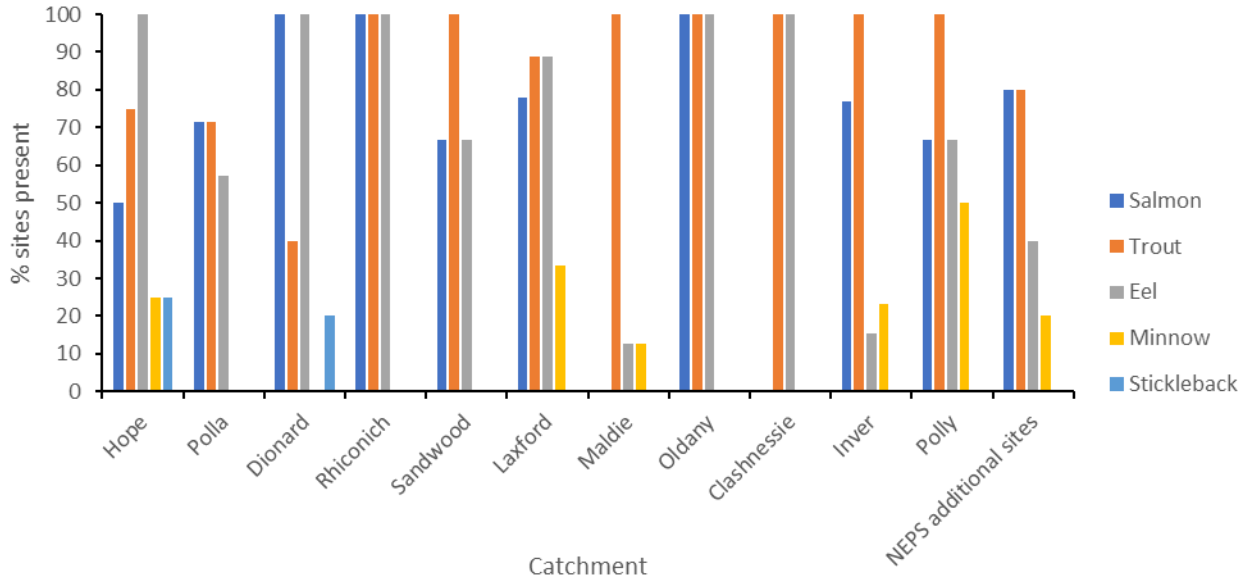


Fig. 3 Species composition and distribution per catchment

Discussion

Catchments surveyed during 2021 included 2 trout dominated systems, of which 1 is inaccessible to migratory fish. However, the majority are fully accessible and show a good mix of species which would suggest that the area average is a good reflection of the situation within West Sutherland and not dominated by catchment selection. This indicates that salmon have the greatest fry densities within the survey, and the greatest overall densities, although trout parr are more numerous than salmon parr. This reflects the sites surveyed and the fact that resident trout will result in a greater age range within the systems and therefore more parr.

Whilst instream habitat characteristics within the West Sutherland area are generally favourable for salmonids, strategic planting of mixed broadleaf trees within riparian zones and the addition of large woody debris to instream areas would undoubtedly improve fish cover, food availability, and bankside stability. With less than 50% of the sites showing moderate to excellent fish densities for both species and stages, improvements in habitat quality and therefore fish density, would be welcome.

The widespread occurrence of eels throughout the area is encouraging, particularly considering the endangered status of the species. While numbers were not high at most sites, the species was not being targeted and this is likely to have influenced these results. The spread of minnows within the area, in contrast, is of some concern and reflects angler practice to a large extent. Introduced historically as live bait, their spread partly reflects the accessibility of the sites, i.e. proximity to roads, and their relatively high reproductive rate. Where present they can out-compete salmonids, thus impacting on their population. That there are no historic records of the species at one of the sites where minnows were found in 2021 indicates that additional vigilance is required.

Arctic charr (Salvelinus alpinus) in spawning colours (Courtesy of I.J.Winfield, CEH)

What you looking at? (S. Marshall)

Modelling their biosecurity backpacks (K. Barnes-Miller)

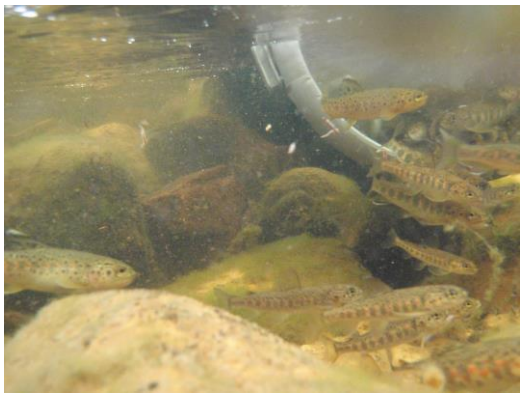
Dressed to kill! (S. Marshall)

Heading home (S. Marshall)

Beaten by the midges (S. Marshall)

A line-up of 'Freds' wanting fed (S. Marshall)

Freshwater pearl mussels in situ *(S. Marshall)*



A salmonid mixture (S. Marshall)

Fyke net and screw trap in situ *(S. Marshall)*

Ready to PIT tag (S. Marshall)

Biologists rest… (S. Marshall)

Smolt Traps

Counting the number of smolts leaving the river is a good way of determining the composition and health of the salmon and sea trout populations. Additional information can also be gained on the timing of the run and changes in the size composition.

During 2021 we operated 3 smolt traps within the area. Each had a different purpose, but all gave important information on the fish populations within the catchments.

1 Laxford

A mobile smolt trap was operated in the River Laxford from 7.4.21 to 28.5.21. A temperature recorder was placed in the trap, set to record hourly while the trap was installed. Fishing was undertaken with the use of a mixture of a Rotary Screw Trap (RST) and a fyke net, which alternated depending on river height, with the fyke net operating at lower flows. During 2021 the RST was operated for 23 days. All fish captured were removed and the species and length recorded. In addition, 96 salmon and 38 sea trout were acoustically tagged. The salmon formed part of the West Coast tracking project (see p. 20) while the sea trout were tagged (together with 62 from Bad na Baighe) as part of a project to examine the trout usage of Loch Laxford.

The majority of the fish captured were taken in the fyke net, which operated from 23.4.21 to 27.5.21 with the exception of 7.5.21 to 11.5.21. Salmon smolts dominated the catches within the river, while few brown trout were seen. Sea trout catches comprised a mix of kelts and smolts, with sizes ranging from 149 mm to 437 mm. In addition to salmon and trout, one minnow and 2 large eels (> 400 mm) were also taken in the fyke net.

The water temperature started cold, increasing with time but remaining relatively static over the period of maximum capture (Fig. 4). Salmonids require a temperature of about 7ºC before starting to move, and this is supported by the findings within this survey.

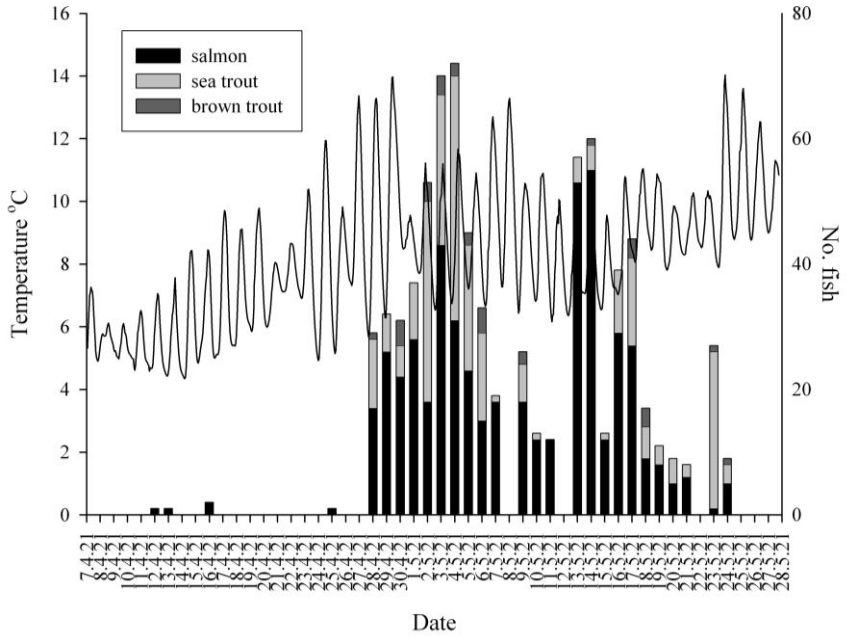


Fig. 4 Showing the temperature regime within the river (line) and no. of fish caught on each day (bar)

2 Bad na Baighe

A mobile smolt trap has been deployed annually in the Bad na Baighe catchment since 2012. A temperature recorder was placed in the trap, set to record hourly while the trap was installed.

In 2021, the trap was operated from 7.4.21 to 23.5.21. In addition to the normal monitoring of the trap, with species and length recorded, 62 sea trout and 4 salmon were also acoustically tagged. The salmon formed part of the West Coast tracking project (see p. 20) while the sea trout were tagged (together with 38 from the River Laxford) as part of a project to examine the trout usage of Loch Laxford.

The spring of 2021 was cold and relatively dry, although periods where the trap did not fish were limited. The lead line was seldom cleaned to allow damming of the trap and enable flow to be maintained. At no point did the lead line over top, something that is unusual for this particular trap.

The water temperature started cold but increased on 19.4.21, after which it remained relatively static until 15.5.21, with diurnal fluctuations dominating (Fig. 5). Salmonids require a temperature of about 7°C before starting to move, and this temperature was exceeded for most of the study period.

In contrast to the last 4 years, sea trout dominated the smolt run during 2021 (Fig. 5) and were found throughout the study period. Several sea trout kelts were captured, particularly during April, and were in very good condition.

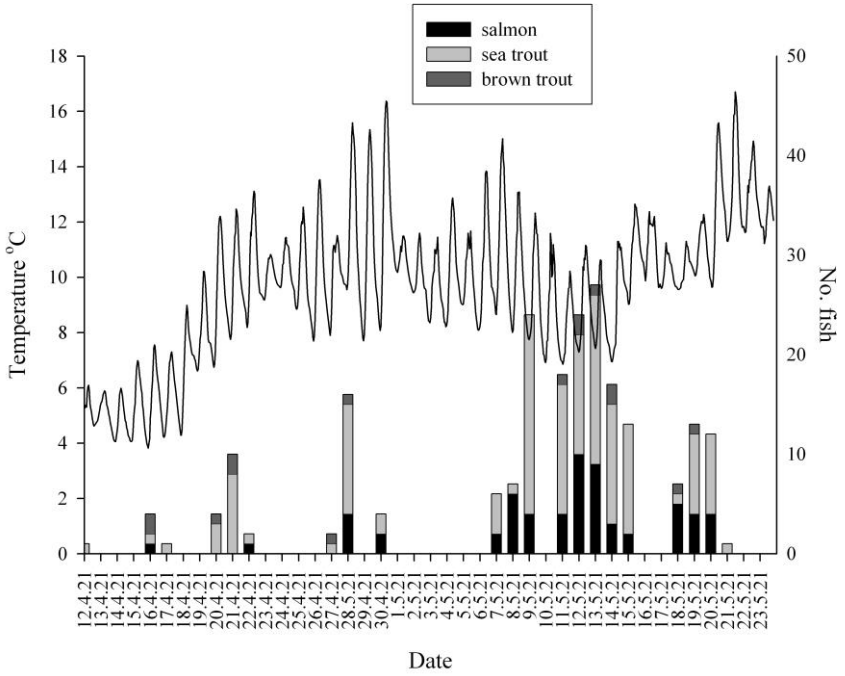


Fig. 5 Showing the temperature regime within the river (line) and no. of fish caught on each day (bar)

A comparison of catches over time indicates that salmon dominate the catches in 6 of the 10 years in which the trap has operated (Fig. 6). The actual number of fish captured will have varied depending on weather conditions, with very low flow stopping fish movement and resulting in removal of the trap and high flow causing over-topping of the lead net and the fish bypassing the trap.

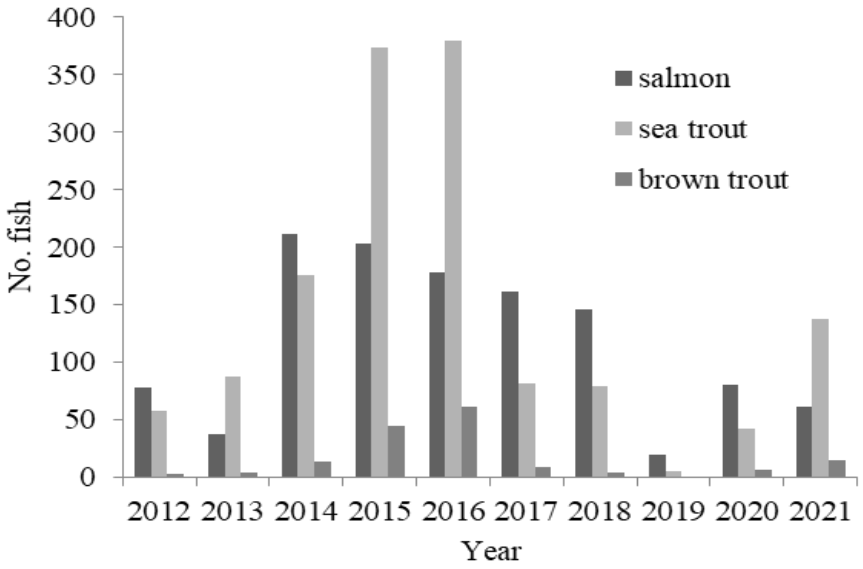


Fig. 6 Showing the annual catch within Badna Bay with time

3 Clashnessie

A mobile smolt trap was operated in the Clashnessie Burn from 16.4.21 to 30.5.21. The purpose of this trap was to determine the size and nature of the smolt run from this burn. Dry weather resulted in the trap ceasing to flow on 12.5.21.

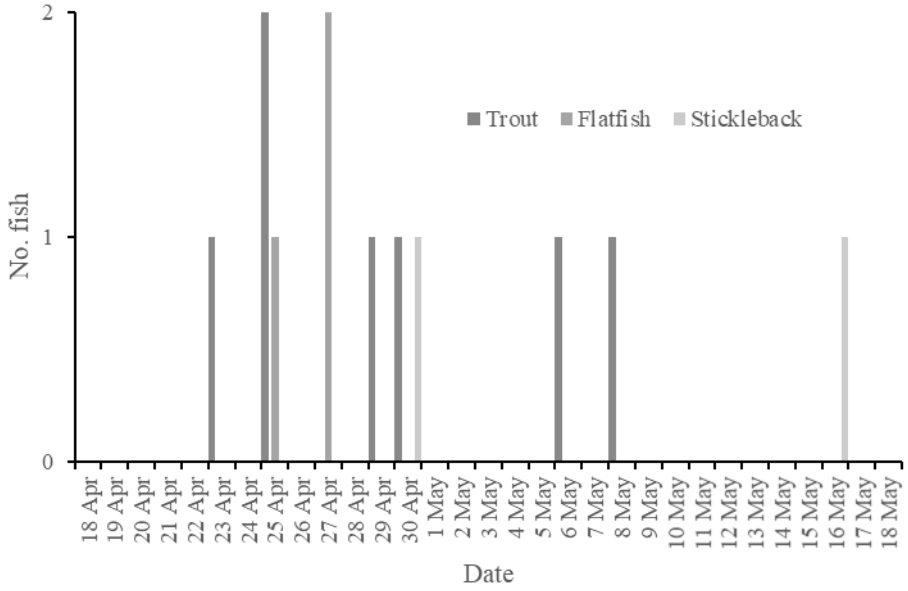


Fig. 7 Fish captures by species and date

While operating, a small number of fish were taken within the trap (Fig. 7). However, despite the presence of trout, there were no smolts seen. This would suggest that there is no regular migratory salmonid population within the Clashnessie burn and confirms the anecdotal information for the system.

Monitoring of sea trout post-smolts

Introduction

Started in 1997, this project was originally designed to give an indication of the migrations and growth of sea trout within the area. In addition to these data, the numbers of sea lice were also assessed. This has now progressed, such that sea lice counts are the most important part of the project.

Materials & Methods

Three estuaries, Laxford Bay, the Polla estuary and the Kyle of Durness were sampled monthly where possible from April to September, at low tide. A total of 306 fish were individually measured and scale samples taken. The fish were also examined for the presence of sea lice, which were counted and staged.

Results and Discussion

The fish caught were of varied age and length, reflecting a mixed population structure. The age structure in the estuaries was similar, with a predominant smolt age in the rivers of 2 years (S2), although there were a number of S3's also present. S1's were also observed in small numbers in both the Polla and Laxford. The length distribution of fish within the estuaries was also similar, although with a greater range in size in the Polla and Laxford. Post-smolts dominated the Polla and Laxford samples. There were several mature fish taken in all estuaries, with the largest being seen in the Polla.

The presence of post-smolts at all sites throughout the year indicates a heavy usage of estuaries by this group, presumably for feeding and shelter.

Recaptures

There were 4 recaptures during 2021, all within the Laxford estuary. Of the recaptured trout all were tagged in 2021 and were tagged and re-captured in the same location. This pattern is common to the sampling programme over the past 24 years and demonstrates that the majority of sea trout do not stray far from their home rivers.

Average growth rates within the Laxford were 17.75 mm, and 30.5 g per month.

Sea Lice Infestations

Sea lice were present to a varying degree at all sites throughout the year. Each estuary showed a mixture of lice stages, although Chalimus were not present in the Kyle of Durness. Lice numbers were variable over the year, with the highest numbers seen in July. However, the total lice number per sample is dependent on sample size and the use of abundance and intensity data give a better assessment of the situation.

Laxford

Lice were present throughout the year, with abundance decreasing from June to September. Caligus were present in April, June and July, on a small number of fish.

The neighbouring cages were fallowed from July. *Lepeophtheirus* numbers were zero or very low during April and May. An increase was noted after that, but values remained below Code of Good Practice levels, with the exception of the week commencing 14 June, when adult female levels rose to 0.70. However, *Caligus* dominated the population.

Polla

Lice were present throughout the year, with abundance declining from June. *Caligus* were also present each month, with the exception of June.

Within the neighbouring cages, the sites remained stocked for most of the survey period. Kempie was fallowed in the week commencing 30 August and Sian the week of 11 October. Adult females were

present at both sites throughout the period, while fish were present, at numbers near or above Code of Good Practice levels.

Kyle of Durness

Lice were present within the Kyle of Durness throughout the year. Densities varied by month, with no pattern discernible, but remained relatively high. In contrast to the other sites, there were no Chalimus found within the Kyle of Durness samples. *Caligus* were present on the fish during June and September.

A risk assessment of the lice numbers present within the wild trout

Taranger, *et al.* (2014) gives a method to assess the increased mortality risk to salmonid populations based on the number of lice present per gram of fish. This is based on physiological effects determined from laboratory experiments taken from literature, and the use of sentinel cages within fjords.

The data are treated differently depending on fish size and give a potential increased risk of mortality to each fish, with increasing risk as the number of lice increase. In order to determine the likely population effect, the proportion of fish within the population appearing in each band is calculated and a population risk determined. Fig. 8 gives the results by year for each estuary, with the banding indicating whether the risk is low (green), moderate (yellow) or high (red). Within the green zone it can be taken that there is minimal risk to the population, while the yellow and red zones show potentially population altering impacts.

From this, it can be seen that the potential risk relating to the Polla estuary and Kyle of Durness during 2021 was considered to be medium, indicating that there are potentially population changing effects likely to have occurred. In contrast, the Laxford showed a low potential risk for this year. The Laxford results do, however, show an increased risk when compared to 2020.

The Laxford and Polla data continue to show a biannual pattern in risk, reflecting the stage of production within the farm. While sampling within the Kyle of Durness has been less regular over time than the other 2 estuaries, there would appear to be no real pattern within the data. However, the peaks in potential risk do appear to follow the Laxford more closely than the Polla. While not significant, this may reflect the tidal flows around the west coast.

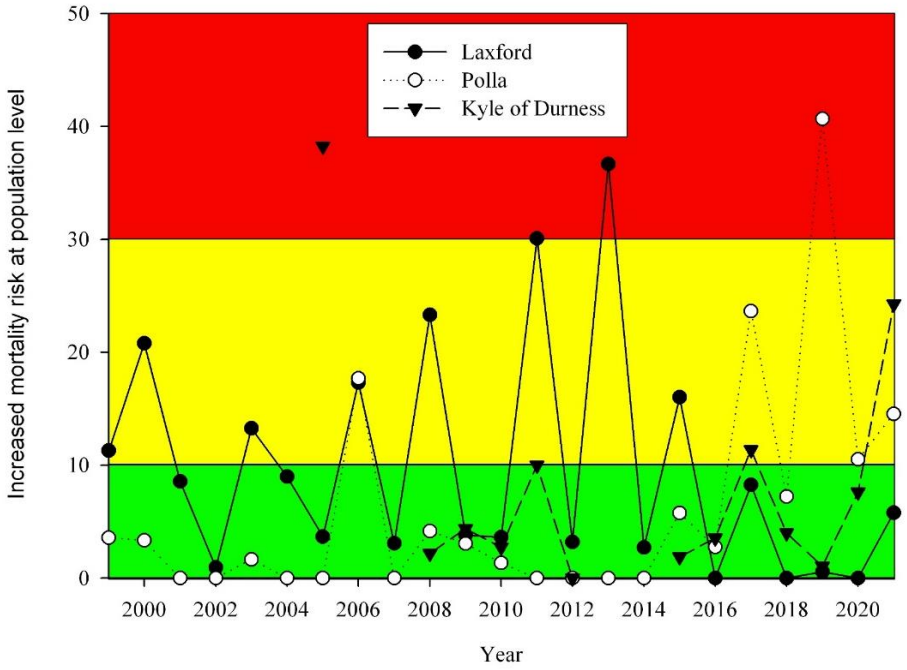


Fig. 8 Showing the increased mortality risk at population level created by sea lice

The full report of this project can be downloaded from the website or obtained by contacting the Biologist. Videos of the sweep netting process are also available to view on the website, Facebook or Youtube (https://www.youtube.com/user/WSFTrust).

Biosecurity Management

The Trust are partners in the Scottish Invasive Species Initiative (SISI), a 4-year partnership project covering an area of over 29,500km^2 and involving 10 fisheries trusts and boards. As part of the project, we will be continuing and developing the work started in 2009. SISI is being funded by the Heritage Lottery Fund and Scottish Natural Heritage.

Awareness Raising

As a result of Covid-19, all awareness raising of Biosecurity was undertaken through social media rather than face-to-face. However, we continued to raise the matter as and when we could. Biosecurity includes the use of the simple 'Check, Clean, Dry' method by anglers, walkers and other water users.

Biosecurity is an important issue within Sutherland as there are few non-native species compared to many other areas within the UK. This can make people blasé to the risks posed and the need for care and vigilance. It is important to prevent the spread of non-native species into the area and it is incumbent on all residents and water users to play their part. Gardens, ponds, fishing tackle and water sports equipment are all routes of infection and ones that should be easy to block if care is taken.

American Mink

A network of rafts and tunnels was established as part of the now obsolete Scottish Mink Initiative, monitored by volunteers and Trust staff. This network has been maintained and expanded in areas. During 2021 there have been a few sightings reported, with one animal captured. This would suggest that the population is currently small, possibly comprising of roaming males.

WSFT is extremely grateful to all our volunteers for their assistance with this project. Without the time and commitment donated by these individuals we would be less able to protect this area against this invasive species. If you would be able to look after a mink raft, then please contact the Biologist and we'll get you set up. Any mink sightings, or potential sightings, should be reported to the Biologist. This information will then be passed on to the relevant volunteers.

In addition to the mink rafts, WSFT have been trialling the use of trail cameras to monitor for mink. With camera's covering 2 systems we have thankfully not seen any mink, although have a surfeit of deer and sheep – together with star turns from other species, including heron, foxes, badger and the odd hardy angler! Funded by Nature Scot, this provides another means of monitoring in an area with a small human population and could be rolled out in other areas.

Himalayan Balsam, Japanese Knotweed & Skunk Cabbage

2021 saw the Biologists once again descend on Nedd and Clashnessie to remove any Balsam plants found within the catchment. It is encouraging to see that we are having increasing difficulties in finding the plants in the wider area around the 'starter' populations, although there was the odd eruption in some areas. This area has been treated since 2010 and it is good to see the success of the operation. While the resilience of the seed bank means that we will have to keep monitoring for a few more years we are all encouraged by the results and hope to make the area 'balsam free' if possible.

Japanese Knotweed is also present within the area, although in small patches. In 2015 it was decided to assess some of the know populations and put out requests for records of others. Treatment of several populations was then started. Treatment of these populations has continued, with a large decline in the number and size of plants observed. This has made for a more difficult treatment policy, with many of the plants too small to inject and therefore requiring spraying or spot treatment where possible. Treatment has also started on a number of other stands within the area. These plants appear to have a persistent seed, or root, bank and there will remain a need for vigilance in all areas. However, again the success of the treatment is encouraging with no plants found in 1/3 of the monitored plots this year.

Skunk cabbage was reported to us in 2017 and the first treatment carried out in 2018. While the treatment did not appear to show a major impact it is hoped that we can get on top of this as well by continual treatment. Some additional populations have also been treated this year. As with the other species, there are only a few populations within the area, although at least one is extensive, and all will be difficult to eradicate.

Pink salmon (*Oncorhynchus gorbuscha*)

Pink salmon have once again been spotted in Sutherland, and in higher numbers than those reported in 2017 and 2019. To date, only 'odd-year' fish have been seen in Britain, with this strain believed to have a greater adaptability than their even-year kin. With a strict 2-year life cycle, odd and even year salmon do not inter-breed. While pre-spawning behaviour was observed, there were no carcasses found in the following period.

Native to the Pacific and Arctic coastal waters where they breed in freshwater in mid - late summer, pink salmon will die shortly after spawning. After emerging, the young smolt will migrate to sea within weeks. They will remain at sea for 12 – 18 months before returning to freshwater to spawn.

Any interactions between pink salmon and native salmonids are unknown. There is the possibility of competition on the spawning grounds, with the more aggressive pink salmon disrupting trout and salmon spawning, competition for food on emergence, or competition for food in the marine. However, it is also possible that the eggs and emerging fry could provide a food source for salmon and trout. Similarly, as pink salmon die shortly after spawning, the impact of the rotting carcasses is unknown – providing additional food for invertebrates or deoxygenating the interstitial areas.

Plans for 2021

We will continue to push the issue of biosecurity and the need for everyone to play their part in the prevention of the spread of non-native species. At the same time, we will be monitoring the area for the presence of non-native species and would welcome reports from members of the public.

The mink monitoring network is an important part of the INNS work, and the Trust and our team of volunteers will continue to monitor rafts and respond to sightings. The Trust is a contact point for any new sightings or the collection of carcasses and is happy to respond to any calls. Carcasses will be sampled and passed to Aberdeen University for future genetic analysis.

SISI will continue to operate through the plant treatment phase of 2022. As such, we will be out during the summer months treating Himalayan balsam, Japanese knotweed and American skunk cabbage around the area. Volunteer assistance with this would be gratefully received, particularly with the treatment of American skunk cabbage. If you feel that you could help then please contact the Biologist.

The Check, Clean and Dry Campaign

Principles

- Non-native species could be spread in any water or material. If you are visiting a water body there is a real risk that you could spread harmful organisms unless you follow good biosecurity practice.
- Biosecurity means taking steps to make sure that good hygiene practices are in place to reduce and minimise the risk of spreading invasive non-native species. A good biosecurity routine is always essential, even if invasive non-native species are not always apparent.

Check, Clean, Dry disinfection procedure

- Check - All clothing and equipment should be thoroughly inspected and any visible debris (mud, plant or animal matter) should be removed and left at the water body where it was found. Particular attention must be paid to the seams and seals of boots and waders. Any pockets of pooled water should be emptied.
- Clean - Equipment should be hosed down or pressure-washed on site. If facilities are not available equipment should be carefully contained, e.g. in plastic bags, until they can be found. Washings should be left at the water body where the equipment was used, or contained and not allowed to enter any other watercourse or drainage system (i.e. do not put them down the drain or sink). Where possible, clean equipment should be dipped in disinfectant solution (e.g. Virkon) to kill diseases, but note this is unlikely to kill non-native species.
- Dry - Thoroughly drying is the best method for disinfecting clothing and equipment. Boots and nets should be hung-up to dry. Equipment should be thoroughly dry for 48 hours before it is used elsewhere. Some non-native species can survive for as many as 15 days in damp conditions and up to 2 days in dry conditions, so the drying process must be thorough.

Further details from: https://secure.fera.defra.gov.uk/nonnativespecies/checkcleandry/

West Coast Salmon Tracking Project

As anadromous fish, salmon have both a freshwater and a marine part to their life cycle. Relatively speaking, freshwater areas are straightforward to monitor, and much is known about this part of the life cycle. The difficulties come in looking at the marine phase – where salmon are more widespread and the monitoring area significantly larger.

Having left the freshwater, the fish migrate through the estuary and coastal waters, heading for their feeding grounds in the Norwegian Sea and around Greenland. This project aims to determine the routes used by the smolts as they move out of the estuaries and up the west coast of Scotland.

Running over 3-years, and managed and coordinated by the Atlantic Salmon Trust, the project is being delivered by partners from the Trust and Board network from Galloway to Sutherland. The data collected will ground truth the smolt migration model being developed by Marine Scotland Science. Full details of the project can be found at https://atlanticsalmontrust.org/our-work/the-west-coast-tracking-project/

By having an idea of the coastal migration routes, better management of the coastal waters for salmon will be possible. How do you know where to locate industrial developments – aquaculture, marine renewables, fishing, etc. – if you don't know the sensitive areas? This isn't to say that all the issues are in coastal waters or industrial, but it's the next step and something that we can address.

West Sutherland

During 2021, 96 salmon were acoustically tagged within the Laxford system, and a further 4 tagged from Badna Bay (see p. 13 for details of the traps used). Receivers were placed in the mouth of each river, with a further array of receivers spread through Loch Laxford and perpendicular to the coast near Oldshoremore. Each tag has a unique code and therefore the receivers will record the passage of individual fish through these areas and provide information on migration timings and routes.

The acoustic receiver, ready for deployment (S. Marshall)

West Sutherland Charr Project

In 2021 our seasonal assistant, Sam Poultney, developed and undertook a project on Arctic charr.

Arctic charr, *Salvelinus alpinus*, are the true aboriginal freshwater fish in Scotland, found in their current locations after closely following the retreat of the British-Irish ice sheet. Charr are the most northerly freshwater fish, have a broad Holarctic distribution and exhibit both anadromous and resident forms. Scottish populations' exhibit residency in lochs with some migrating into inflow burns to spawn. They have complex abiotic requirements - a low tolerance of temperatures above 16°C and a lethal oxygen saturation level of <3mg L^{-1}. With observed and predicted increases in surface temperatures due to climate change, plus the associated knock-on effect on hypolimnion O_2 levels; charr existence will be on a knife edge, as isolated lochs/lochans prevent the ability for populations to mitigate loch-based changes.

There is no or very limited population monitoring of charr in Scotland with many waterbodies having only outdated or anecdotal references. Historic information averages around 25 years with some last known records going to back to the 1940's. Due to their extreme morphological diversity and high intraspecific genetic diversity, they should be recognised as a significant contribution to impoverished northern aquatic biodiversity and have a place in future monitoring programmes. This current study aims to update the records on charr lochs within the Laxford and Naver Hydrometric Areas for which the last known record is more than 10 years old.

Traditionally, population monitoring would involve destructive methods such as gill netting in order to gain data on population dynamics and species presence. However, advances in technology means that non-lethal population monitoring can now be done, either by hydroacoustic surveys or environmental DNA (eDNA) sampling. Working in cooperation with Queen Mary University London (QMUL), a select number of lochs were surveyed for eDNA during this survey.

Initially, the lochs underwent a depth survey to find the deepest areas where charr might be found during the summer stratification period. Data was collected either by a GPS based hydroacoustic chart plotter attached to a boat and processed by third party cloud software (Fig. 9a) or via a handheld GPS and depth sounder using an inflatable pack raft. eDNA samples were collected by filtering 2l of water. The filters were sent to QMUL for later analysis. In addition, NORDIC gill netting was undertaken in a subsample of the lochs.

Bathymetric surveys were carried out on 20 lochs. Output varied depending on method used. Fig. 9b shows the pack-raft output with depth points approximately every 10m and Fig. 9c shows the highly detailed boat-based GPS chart plotter data.

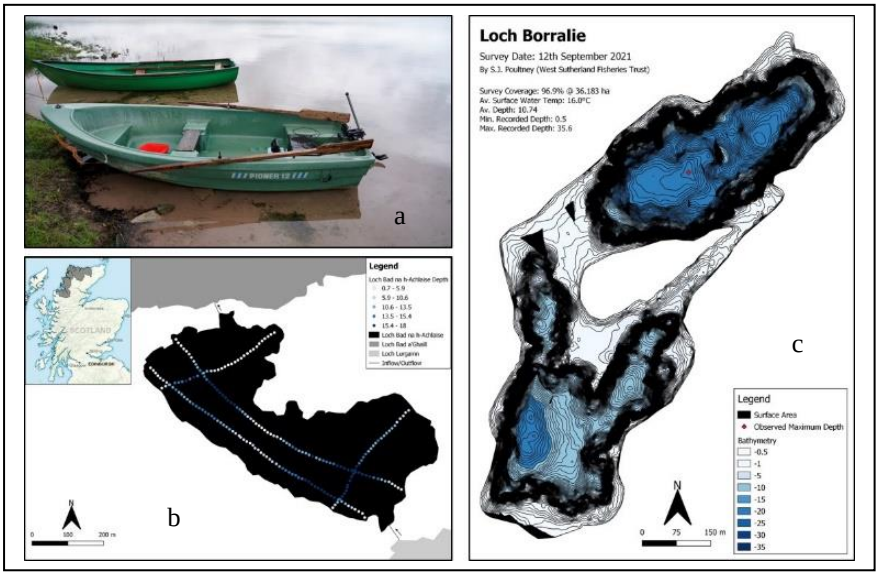


Fig. 9 An example of the methods and results of the bathymetric investigation a) the hydroacoustic survey equipment insitu *on a pioneer 12 rowing boat. b) the map output for the pack-raft based survey method, with data points approximately 10m apart. c) the hydroacoustic map output, with limited data gaps in coverage (black).*

Salmon conservation regulations

This policy was introduced during the 2016 season. It implemented a variety of measures, including:

- A ban on the taking of any salmon, by rod or net, before 1 April;
- A ban on fishing outwith estuary limits for a period of 3 years;
- The classification of rivers based on a model of population estimates, exploitation rates and biological recruitment. (Further information can be found at: http://www.gov.scot/Topics/marine/Salmon-Trout-Coarse/fishreform/licence/status)

The categories denote the conservation measures required such that, for West Sutherland during 2021:

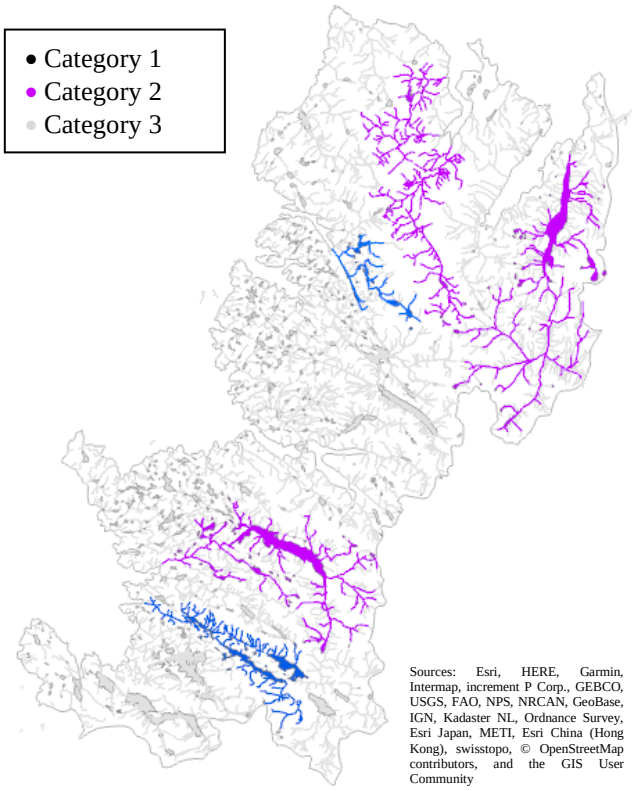
Category 1 – (Rivers Rhiconich and Kirkaig) where the conservation limit has been met on 4 of the last 5 years, exploitation is sustainable and therefore no additional management action is required.

Category 2 – (Rivers Hope, Grudie, Dionard, Daill and Inver) where the conservation limit has been met on 3 out of the past 5 years, meaning that management action is necessary to reduce exploitation. While mandatory catch and release will not be required in the first instance, this will be reviewed annually.

Category 3 – (Rivers Polla, Strath Shinary, Oldshoremore, Laxford, Duartmore, Gleann Dubh, Polly and Osgaig) where the conservation limit has not been met on 3 out of the past 5 years, meaning that exploitation is unsustainable and management actions are required to reduce exploitation for 1 year i.e. mandatory catch and release (all methods).

All systems not listed above have insufficient data and therefore will be classed as Category 3.

The Trust has assisted with the development of a 'pressure map' for Marine Scotland Science. Undertaken throughout Scotland, this digital resource aims to determine the impacts of a variety of factors on the salmon populations. The information is given by river reach rather than catchment and will help to build a national picture of impacts and issues for Atlantic salmon throughout Scotland. While centred on the freshwater, marine and coastal issues are also included, and areas requiring more data are also included.



Acknowledgements

The Trust would not be able to function without the assistance of an army of volunteers, many of whom give up substantial amounts of time to the Trust. Similarly, we would like to acknowledge those who support us financially and without whose help we would not be able to operate. Grateful thanks also for the assistance of the various estates. In particular, sincere thanks must be expressed to Reay Forest Estate and Scourie Estate for their donation of accommodation, and Adam and Liam Barnes for stepping up to the mark and assisting with field work throughout the year.

A number of other individuals have assisted the Trust with its work programme, some listed below. Apologies to those not mentioned by name, but our grateful thanks all the same.

Catches and Scale Reading

The WSFT acknowledges the assistance of hotels, estates and anglers in compiling catch records and collecting scale samples.

Monitoring of sea trout post-smolts

This work would not be capable of completion without the assistance of the Reay Forest Estate and Wildland Ltd. Also to Adam, Liam, Reg, Marie, Andy and Tony for all their assistance with the net.

Funding for this work comes from Marine Scotland Science and The North & West District Salmon Fishery Board.

Biosecurity Planning

Funding of the Scottish Invasive Species Initiative by the Heritage Lottery Fund is gratefully acknowledged. Thanks also to Nature Scot for their management of the project.

The following Charitable Trusts, Foundations, Estates and organisations have kindly donated funds or provided grant funding towards the West Sutherland Fisheries Trust. Our sincere thanks to all listed, and to the many individuals who will remain anonymous but have donated time and money to the Trust and its activities. Without all of this support we would not be able to operate.

Trusts & Organisations
Atlantic Salmon Trust
Heritage Lottery Fund
North & West District Salmon Fishery Board
Nature Scot
Scottish Government

Estates
Reay Forest Estate
Scourie Estate
Wildland Ltd

Businesses
Loch Duart Ltd