SEPA 2nd Consultation

Response from Callander McDowell

September 2023

Introduction

In their response to the first consultation on the introduction of a regulatory regime to control sea lice loss from fish farms, SEPA state Scottish Ministers have determined that there is a risk that fish farms impact populations of wild salmon and sea trout on the west coast of Scotland and that there is evidence of population impacts in similar salmon producing nations so they do not intend to revisit any discussion of the scientific basis of the regulatory framework.

Whilst SEPA say that Scottish Ministers have determined that there is an impact and that there is evidence of populations impacts from Norway, no actual evidence has been cited. Any evidence is simply circumstantial.

Peter Pollard, Head of Ecology at SEPA, told the West Highland Free Press that 'As Scotland's environmental watchdog, SEPA's new responsibilities on managing the risk to wild salmon and sea trout from sea lice offer an opportunity for a fresh, proportionate, and **evidence-based approach** to working together on the shared challenge.

Since the launch of this consultation, SEPA's partner Marine Scotland has become the Marine Directorate and Marine Scotland Science has become 'Science, Evidence, Data and Digital' changing the emphasis away from science to science and evidence, stressing the need for evidence as well as pure science.

The intention of this response to the second consultation on the sea lice risk framework is to focus on actual Scottish evidence regarding the alleged impacts of sea lice from salmon farms on wild salmon and sea trout. This will focus on the section of the consultation titled 'Environmental monitoring'.

It is hoped that SEPA will properly consider the evidence presented in this response even if it doesn't fit in with their modelling and narrative.

The evidence considered includes:

Sentinel cage data – The plans for the proposed Sea Lice Risk Assessed Framework include using sentinel cages to measure the risk. The evidence of two historic studies would suggest that sentinel cages are not an effective method to measure risk. The presence of adult sea lice on sentinel cage fish indicates that sea lice infestations cannot be exclusively waterborne. These adult lice must have transferred from passing fish, which raises the question whether other lice stages could have transferred in the same way. Evidence from Wester Ross Fisheries Trust shows that infested sea trout can lose sea lice, probably to other fish. Adult salmon have also been observed with early life stages despite being at sea for over a year. The sentinel cage data also shows that at the time of highest risk, infestation rates have been low.

Identification of larval sea lice in the water column – The fundamental theory of sea lice dispersal modelling is that larval sea lice are released from salmon farms into the water column, spreading away by wind and currents. As yet, the only evidence would suggest that any larval sea lice are at so low concentrations the chances of infesting any wild fish are almost zero. Several studies from Norway, Scotland, and Ireland have identified only very few larval sea lice in the water column.

Knowledge of general parasite biology and ecology would suggest that sea lice do not locate new hosts by seawater dispersal, which is probably why so few sea lice have been located.

Sea lice infestation on wild fish – Although Sea trout have been sampled across the west coast since 1997, no major analyse had been conducted on the full data set. Analysis of the data shows that the majority of sea trout sampled have no, or very few lice, whilst just a few hosts are highly infested. It is these few highly infested fish that are promoted as having a negative impact on would fish populations, whereas the evidence shows the opposite. This over dispersion of sea lice on host fish is called an aggregated distribution, which is recognised as a defining feature of what is a parasite.

Trends in west coast fish stocks as a whole and locally – Data from rod and nets catches has been collected annually for all fishery districts across Scotland but has seemingly never been analysed separately, except by some of the individual fishery boards. However, the fishery board data is no longer published by Fisheries Management Scotland due to significant discrepancies with Scottish Government data. Analyses of west coast fishery district catch data shows clear trends of long-term decline which began long before the arrival of salmon farming to Scotland. Attempts to link changes in catches to local salmon farm activity appears to show that there is no obvious connection between salmon farm activity and changes to local salmon stocks.

The combined evidence would suggest that none of the proposed methods will identify impacts of sea lice allegedly coming from salmon farms on wild fish stocks.

The only conclusion from this collected evidence is that the proposed Sea Lice Risk Framework will do nothing to safeguard the future of wild salmon on Scotland's west coast and that a new and different approach is required.

Validation of the models

In a review of the book 'Escape from Model Land' Felix Martin writing in the Guardian describes models as" the hypothetical worlds we construct in order to explore the future that have no practical value until their analyses and predictions are applied in real life."

The SPILLS (Salmon Parasite Interactions in Linnhe, Lorn, and Shuna) project is mentioned twice in the SEPA consultation document. The reference appears on page 23 and states that "The development of refined models will be able to draw on research in Norway and Scotland (including the recent SPILLS project). The second reference to the project is on page 74 as an example of collaborative working.

The consultation document does not refer to the aims of the SPILLS project which The Scottish Government website states focussed on testing and improving sea lice dispersal monitoring and modelling techniques. The consultation document fails to mention that the SPILLS project did not successfully validate any model through the testing programme.

The key section of 8.4.3: Sea lice infestation pressure in WSPZs.

This begins with the statement that ‘obtaining a measure of sea lice infestation pressure across a WSPZ is needed for a fully validated refined model’.

More importantly, it is needed for a fully validated screening model. If the screening model is not fully validated then as the review of the book ‘Escape from Model Land’ points out, it has no practical value until its analysis and predictions are applied in real life. SEPA run the risk of spending much time and money on the development of models which cannot be validated and without validation, the risk assessed framework has no value.

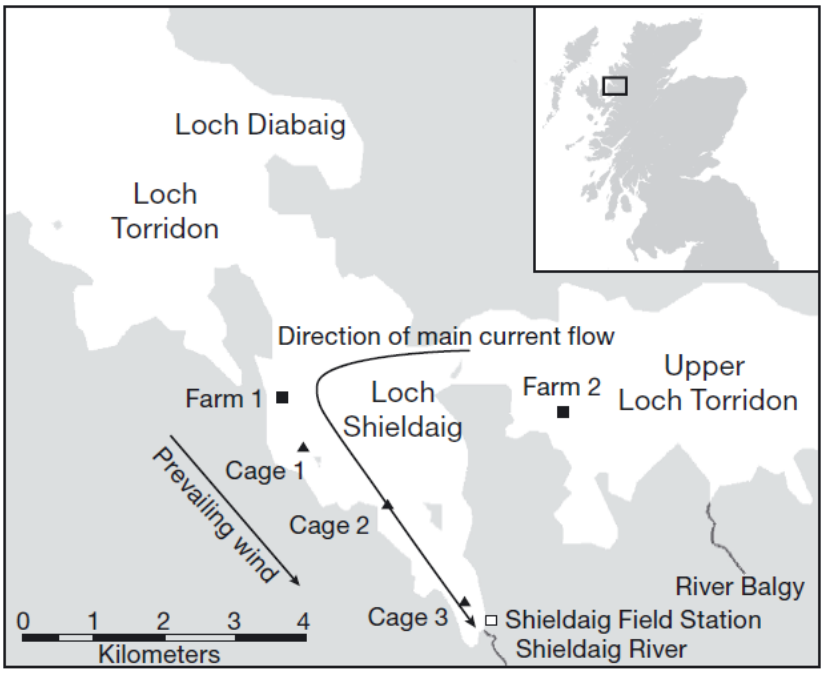
The Scottish Government website states that the SPILLS project focussed on testing and improving sea lice monitoring, which is relevant to this section of the consultation document, but SEPA gloss over the project, which would appear to be major omission given that validation of the model is crucial to the success of the risk assessed framework.

The SPILLS project focussed on the same three measures of potential sea lice infestation pressure as outline in section 8.4.3. In SPILLS these measures were part of different work packages.

Sentinel cage studies

The SEPA consultation document states that “currently the most effective way to obtain a measure of sea lice infestation pressure is using sentinel cage studies”. This statement is linked to a paper by Pert and others from 2014. However, the abstract of this paper states “these findings suggest that although aquaculture is a contributor of sea lice larvae in to the Torridon system, further work is required to determine factors influencing the relationship between farm sea lice levels and infestation pressure in the wider environment”. This contradicts the statement in the consultation document that sentinel cage studies are the most effective way to obtain a measure of sea lice infestation pressure.

Whilst the Pert study is being used to promote the use of sentinel cages, the reality is that Loch Shieldaig is not really suite for demonstrating whether sentinel cages are effective of not. This is because as Fig 1 of the paper shows the prevailing current is towards a river mouth and not flowing away from it towards the open sea. If the flow away from the river is along the east bank of the loch, any sea lice larvae could be in perpetual circulation around the loch. In addition, the loch is quite short.

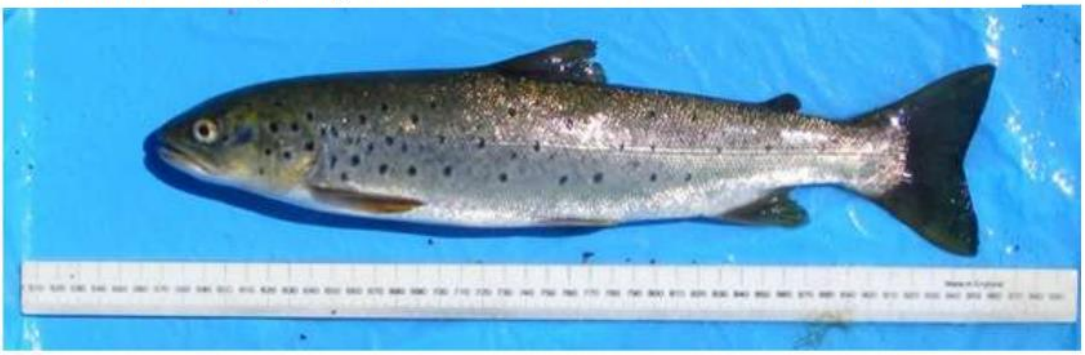


There are four aspects of the results from this paper that bring into question the effectiveness of sentinel cages to measure infestation pressure.

1. It has been suggested form other Scottish research that sampled fish are more likely to suffer higher infestation the closer they are to a farm. Thus, cage 1 should potentially have the highest infestation, followed by cage 2 and then cage 3. In fact, cage 3 had the highest infestation followed by cage 2 and then cage 1, although the difference between 1 and 2 was small.
2. Cage 3 reached peak infestation in July 2007 whilst cages 1 and 2 peaked their lower peak in August of that year. Farm 1 reached peak infestation of less than one gravid female in May 2007 whist Farm 2 reached peak infestation of over 4 gravid females in September. Thus, the sentinel cages reached peak infestation one to two months before the farmed salmon reached their peak infestation.
3. The Pert paper states that the deployment of each sentinel cage lasted just seven days to ensure that settled lice did not complete their lifecycle so any mobile stages of pre-adult or adult must have been transported directly to the sentinel cage. The paper states that just 12 pre-adults and 12 adults were recorded on sentinel fish. In fact, the raw data supplied by Marine Scotland Science identified just 11 pre-adults and 12 adults making 23 in total. The paper concludes that these mobile lice cannot have developed on the fish and therefore must have arrived by some other means such as wild fish. The main focus on infestation has been through sea lice dispersal models without consideration of other means of infestation. These adults would indicate that although few in number, there are other routes available for infestation. The transfer of lice from wild fish has not been explored. In 2012, Wester Ross Fisheries Trust caught a lice infested sea trout that had been initially caught 42 days previously. The fish had in June 2012 carried 120 lice but on recapture the number of lice was just 10. Whilst some lice may have died, other could have passed to other fish and had sentinel cages being in place locally, there is no reason they could not have been passed to the sentinel fish.

In 2012, some larger sea trout taken in the Kanaird estuary survived and grew

Sea trout of 375mm, 532g with 120 chalimus lice taken on 5th June 2012



Recaptured sea trout, now 390mm, 640g, with only 10 lice taken on 17th July 2012

4. Pert quotes an earlier paper by McKibben & Hay (2004) which reports high sea lice concentrations of up to 143 lice/m^3 near the river Shieldaig estuary. However, the authors appear unaware that river estuaries may be the preferred location for sea lice to naturally encounter new hosts in the wild.

   The SPILLS project used sentinel cage data from the LLBSBP data from 2011 and 2103 to validate their various models.

   The SPILLS report concluded that the models worked reasonably well when evaluated against sentinel data when lice were relatively abundant (autumn 2011 in the Loch Linnhe study area). The report suggests that sentinel cage currently provide the best data validation of sea lice dispersal predictions. This view is echoed in the SEPA consultation document. However, whilst the researchers claim that validation of the models with the sentinel cage data has worked reasonably well, the use of the data has been extremely selective.

   The LLBSDP project ran for three years with a focus on two periods (May and October) each year leading to six experimental periods.

   The total sea lice count on sentinel cage fish for each of the six periods is shown in the following table:

	2011	2012	2013
May	127	43	204
Oct	3786	66	1706

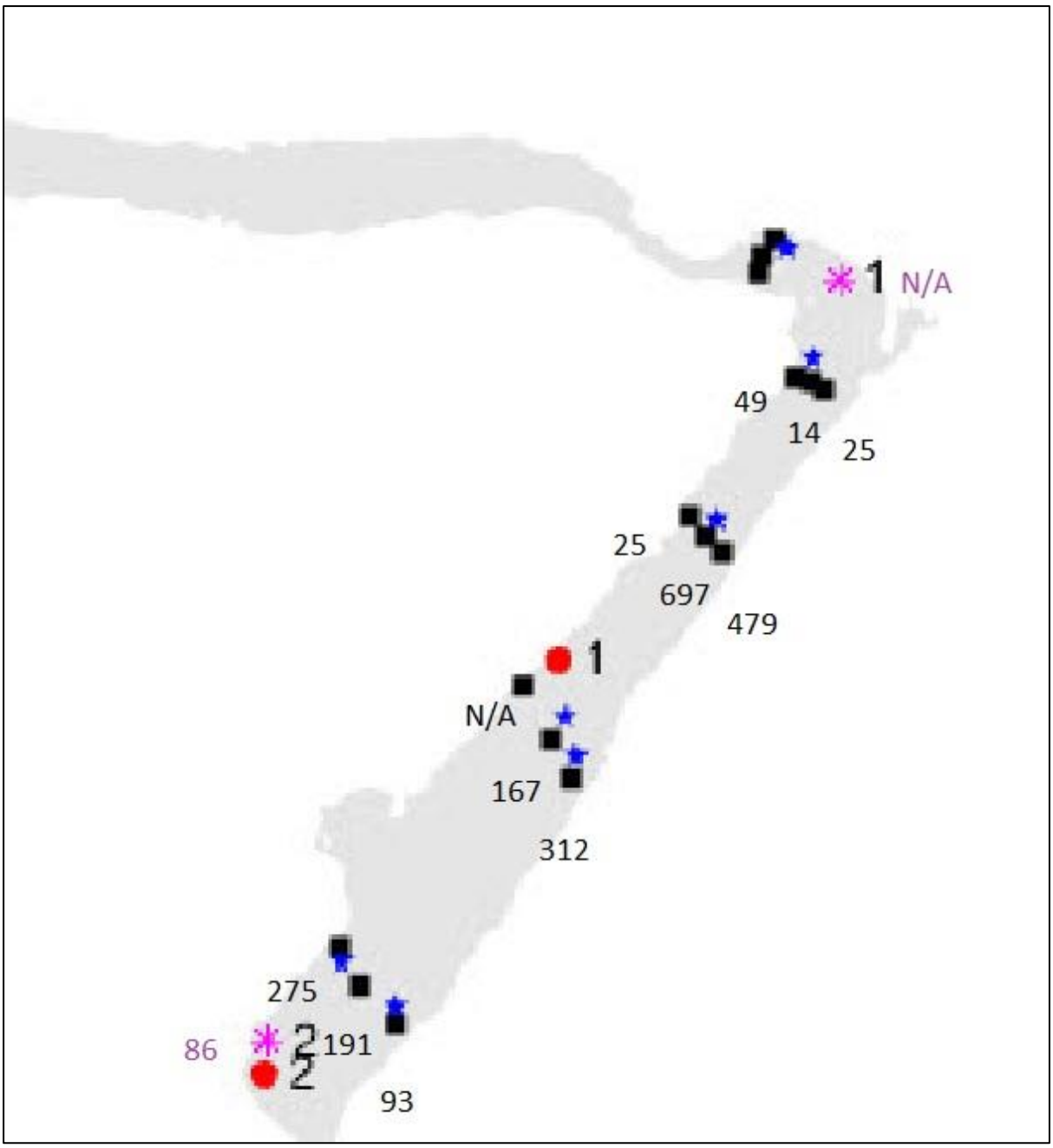
The highest counts were detected in Autumn 2011 and then in Autumn 2013. The other four periods were all very low. The smolt migration is during the spring period thus indicating the risk to these fish from sea lice is extremely low.

By comparison, the lice counts were high in autumn 2011, less so in 2013 and very low in 2012.

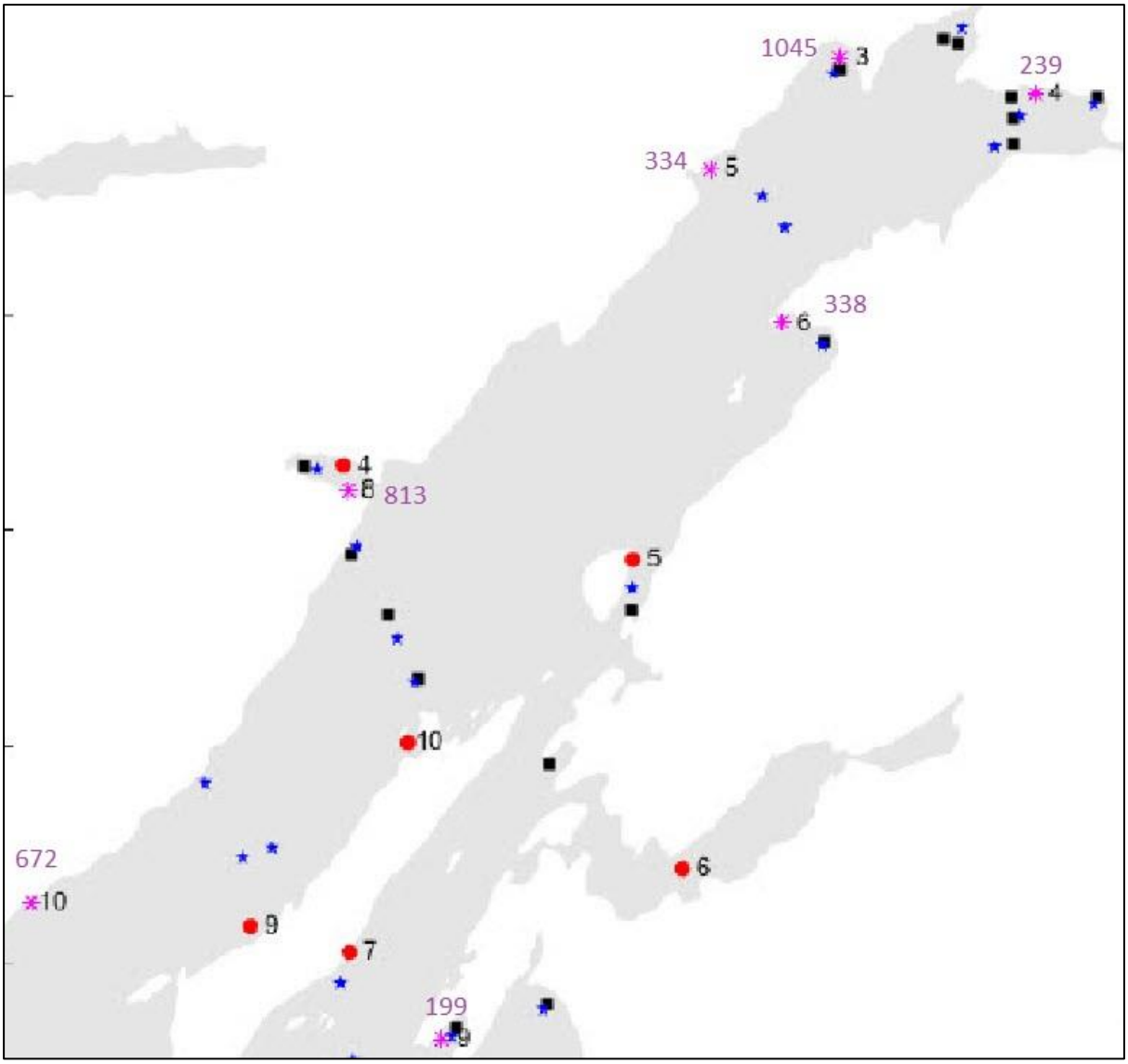
Cage	2011	2012	2013
1		4	332
2	86	8	329
3B	1045	6	103
4	239	5	148
5	334	2	82
6	388	0	273
8	813	2	0
9	199	32	471
10	672	7	0

Most of the lice can be attributed to just three of the cages – 3B, 8 and 10. They are all located on the west coast of the lower loch south of the Corran Narrows through to the Sound of Mull. Sentinel cage 3B also has adult lice for all three of the years. Cages 6 and 9 have adult lice for two of the years whilst two cages (1 and 2) were found to have adult lice in just the final year. Adult lice can only have come from passing wild fish questioning how many other lice arrived with wild fish especially given the very low larval sea lice numbers present in the water column.

The following two maps show the location of sea lice trawl locations and the sentinel cages together with the number of lice identified in each location (trawls in black, sentinel in purple/pink).



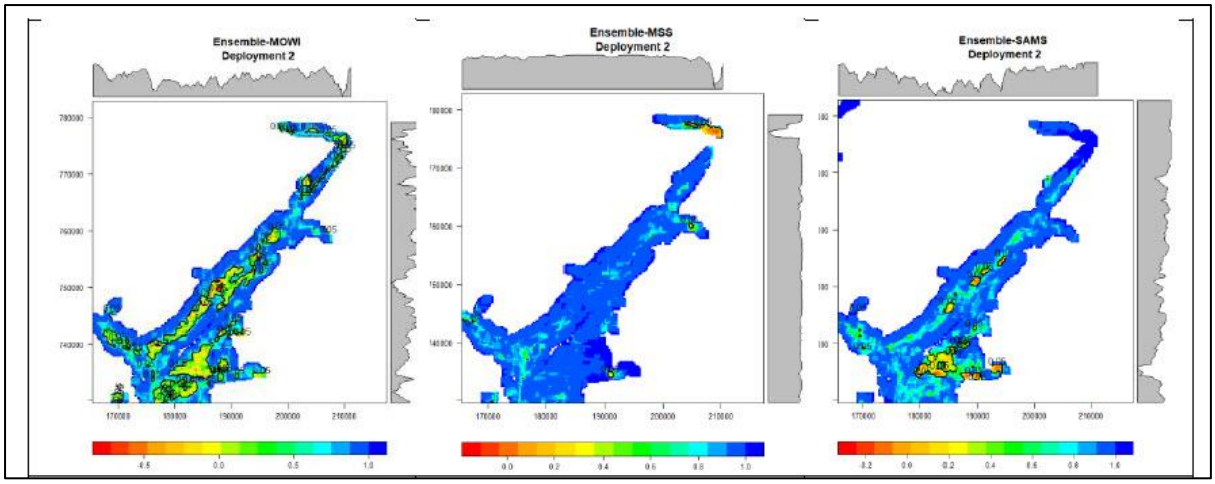
The lice count in these three cages decrease the further their distance from the Corran Narrows during the autumn of 2011. The other sentinel cages whilst comparatively low, are higher than at other times during the project.



There are a number of observations of sentinel cage infestation which require further exploration.

Firstly, the three higher-liced sentinel cages are located along the western edge of Loch Linnhe south of the Corran Narrows. One of the modellers has suggested that the modelled lice flow In Loch Linnhe indicates that the sea lice tend towards the shorelines on both sides and that the central channel of the loch displays very low mean densities of lice. Lower Loch Linnhe is quite wide, and the circulation in wide fjords is known to push surface material towards the sides. This is known as the Coriolis force.

However, the images of the models published in the SPILLS report Work Package 4 suggests that two of the models show that the central channel of the lower loch would experience high lice densities during the second deployment when higher lice levels were recorded.



All three models do show that the area where these sentinel cages are located are exposed to low sea lice densities which is contrary to the observed lice levels.

The second observation is that whilst the three sentinel cages are infested with decreasing numbers of lice with increasing distance from the head of the loch, there is fourth sentinel cage (no 5) sited between cages 3B and 8. This is infested with about a third of the number of lice as cage 3B and half that of cage 8. The expectation should be that the lice count would be around 925 lice whereas it recorded just 334. Cage 5 does not fit into the pattern of other sentinel cages infestations on the west bank of the loch. This anomaly remains an unanswered question.

The trawl data shows that lice were detected in the water column at sites 7-15 in the area north of the Corran Narrows. These higher levels of lice were only identified during deployment 2 in Autum 2011. At no other time during the project (Spring and Autum 2011, 2012 and 2013) were such lice levels detected. The maximum being 22 lice.

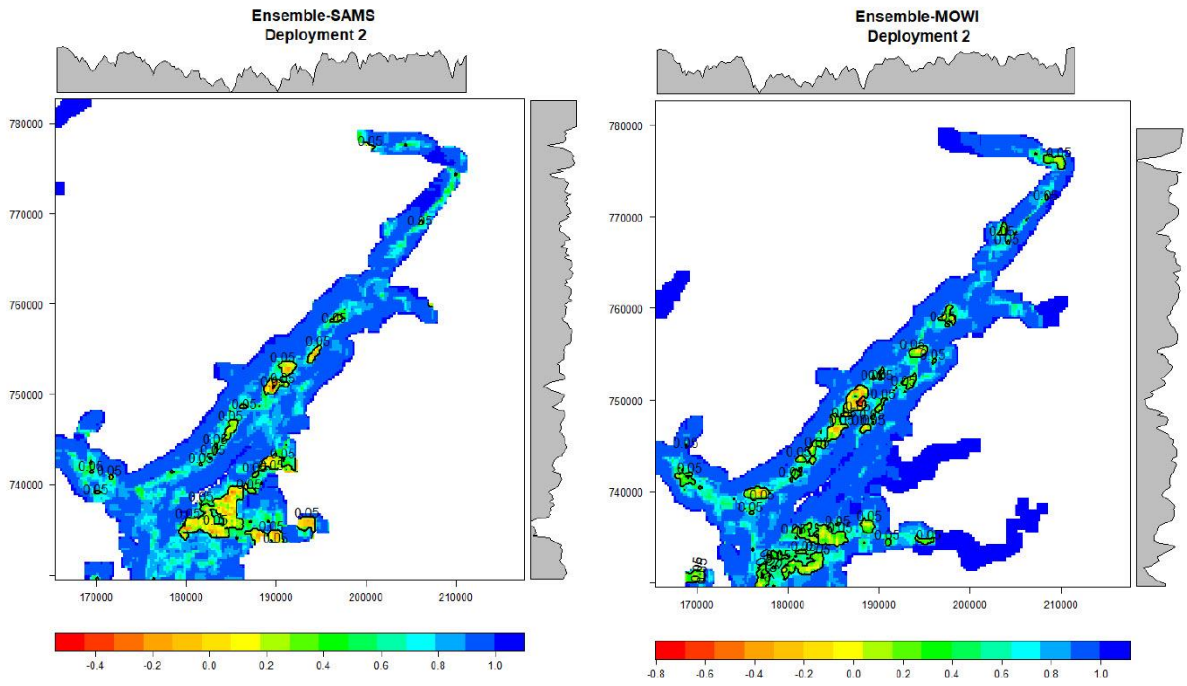
	2011	2012	2013
Spring	7	3	12
Autumn	697	11	22

As shown previously, the higher lice count occurred only during the second week of the Autum deployment. The SPILLS report includes images of the MOWI and SAMS models for the second week deployment showing greater detail.

The SAMS model does not show any elevation in predicted lice counts in the area of the upper loch, whilst the MOWI model does show one very small are of elevated lice levels just south of the farm that is highest up the loch.

These predictions do not match the actual lice levels detected during the trawl. Other areas of predicted higher lice levels in the whole loch system are not matched by the trawl results. It is just this one area that is affected.

All the trawl sites with elevated lice levels are in close proximity to a salmon farm (500m – 1000m). Trawl sites situated further away from a farm did not detect any high lice levels (range 0-22 lice).



In 2011-2013, there were three farms operating in Loch Linnhe, all situated on the west bank. These are shown as red circles and numbered 1, 2 and 4.

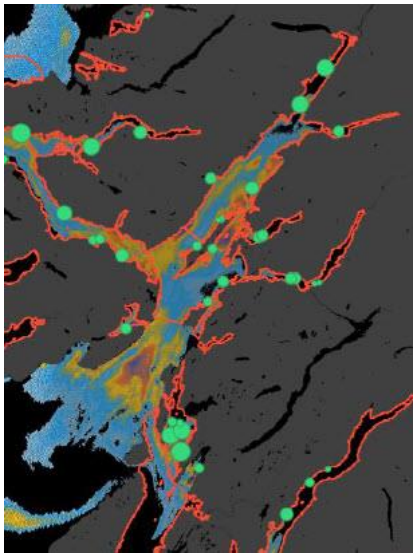
Farm 4, which is located well down the lower loch, was fallow during this period.

Farm 2, which is located just north of the Corran Narrows and Farm 1 halfway up towards Fort William recorded adult female lice and gravid female lice well below the 2 lice limit which would require notification to the Scottish Government. Farm 1 did experience a slight elevation of lice counts to the notification level for one week, two weeks before deployment 1 and three weeks before deployment 2 but the number of lice was only fractionally above the notification point. At no time during either deployment, did lice reach a level of six female lice that required Scottish Government intervention. The farm counts were well below any level that would be of concern, and if lice count in the water column are related to farm lice counts, this does not explain why the trawl counts were high during deployment. These observations were not repeated at any other time during the LLBSBP or the SPILLS projects including during the spring deployment when on farm lice were at similar levels. The high lice levels recorded in the loch during autumn 2011 must be considered an anomaly that should have required further investigation.

The presence of the Corran Narrows in Loch Linnhe makes the loch unrepresentative of modelled sea lice dispersal as the narrows create localised flows travelling in the opposite direction.

SEPA model

The SEPA model shows high lice levels during the smolt migration at various points down Loch Linnhe and beyond, however, these do not appear to be in agreement with the other models or the available data.

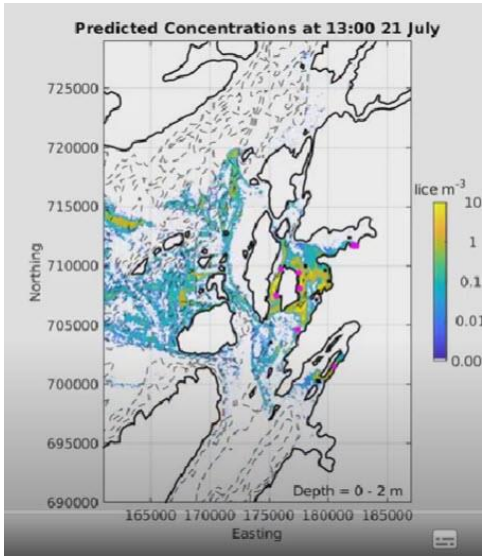


Direct monitoring of sea lice

To monitor anything in the sea, there needs to be an understanding of an approximation of where they will be found. Despite claims by the anti-salmon farming lobby that the seas around Scotland are either a soup of sea lice or sea lice clouds, the consultation states that sea lice could be patchily distributed in the environment in space and time although no reference is cited. Whilst the SPILLS final project report states that modelling results suggest that sea lice distributions are patchy and transient and that observed larval lice are also patchy. However, the SPILLS report does not offer any evidence that the two are connected.

Without any other knowledge, the model predicts where in the sea that sea lice larvae should be should. Identification of sea lice from the area predicted by the model would validate the model, however if no sea lice larvae were found, then the validity of the model should be questioned.

The Marine Directorate produced a six-month long animation showing the changes in predicted sea lice concentration in the area investigated area by the SPILLS team - https://www.youtube.com/watch?v=MD_cRMySYow



The animation highlights the location of the eight local farms (pink) and the six locations used to sample for larval sea lice (black squares). The six locations are identified in the following image:

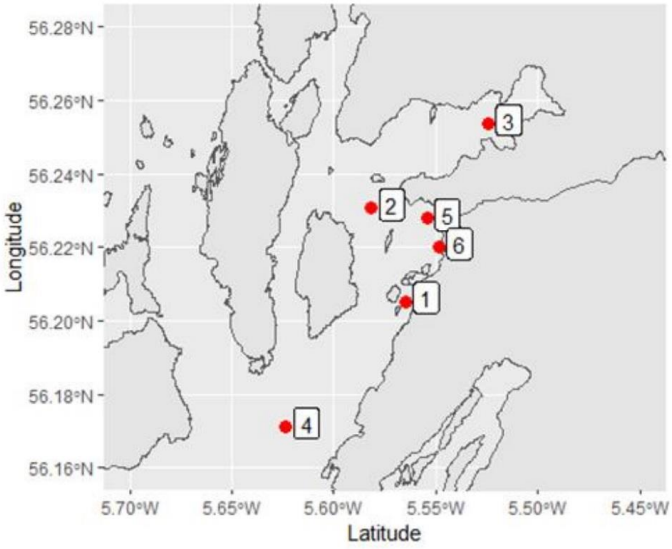
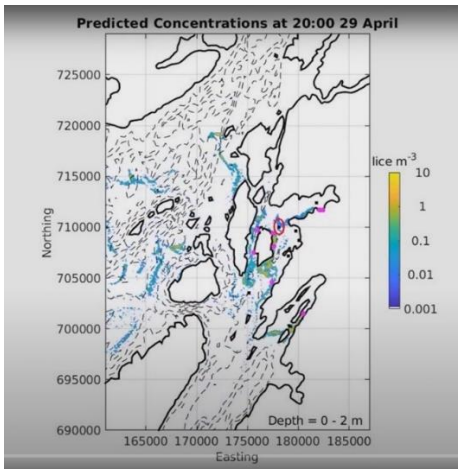


Figure 3. Locations of pelagic sea lice larvae sampling. Red circles indicate the locations of sampling: 1: Eilean Arsa; 2: Northeast Shuna; 3: Loch Melfort; 4: Southern Approaches to the Sound of Shuna; 5: Asknish Bay; and 6: Musgan, shallow southern shore of Asknish Bay.

Although the webpage states that the animation runs from 1st April, the version posted on the webpage actually starts on 26th April. This means the predicted location of larval sea lice is missing of 18th April, which was when the first trawl took place.

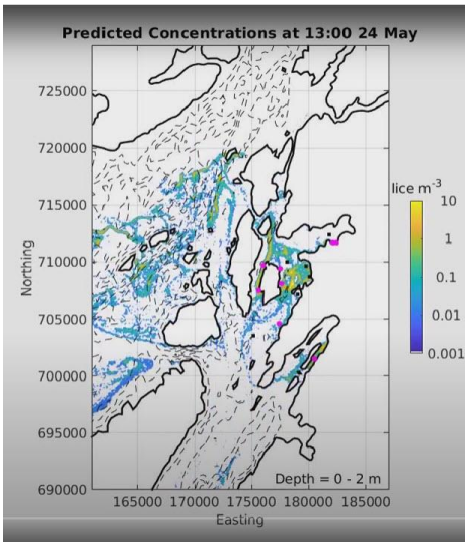
On the 18th of April, 12 trawls were carried out around Eilean Arsa, and no larval sea lice were detected. Without the detail of the animation, it is unclear where larval sea lice were predicted to be present at high levels at this location on this day.

The second trawl occurred on 29th April and the following image is taken from the animation for that date.



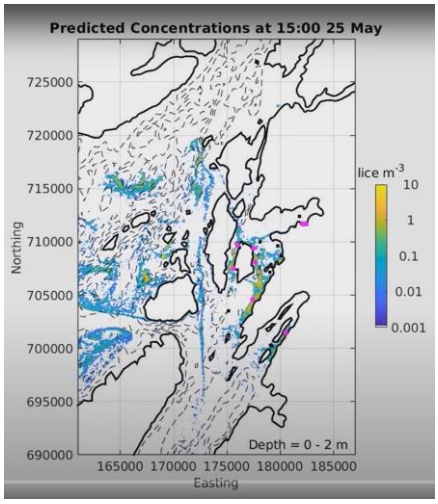
On 29th April, 3 trawls were carried out at each of the six sampling locations. The model only predicted a very low concentration at just one of the locations, NE Shuna (circled in red). One larval louse was detected at Asknish Bay, although no lice were predicted by the model for that location.

The next attempt to identify larval sea lice took place on 24th May at three locations, Loch Melfort, NE Shuna, and Eilean Arsa with six runs at each. These were not trawls but involve the use of the pump instead.



The model predicts lice at three of the locations, of which only one is sampled. Loch Melfort and Eilean Arsa are sampled despite no larval sea lice being predicted. Of the eighteen runs at the three locations, one resulted in the detection of a copepod sea louse. This was at Eilean Arsa. The animation prediction should have resulted in the detection of many more lice on the 24th of May at NE Shuna. Two other sites were also predicted to encounter higher densities of larval lice, but neither were sampled.

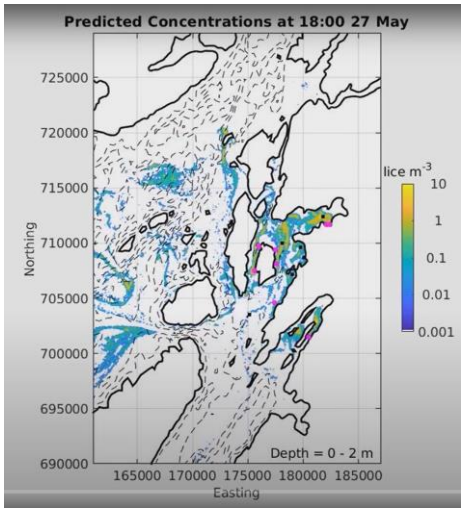
Two more locations were sampled the next day – 25th May. These were also sampled by pump. Southern Approaches was sampled six times and Arknish Bay five times. Neither location was predicted by the animation to encounter lice on that day, although the location at Musgan was.



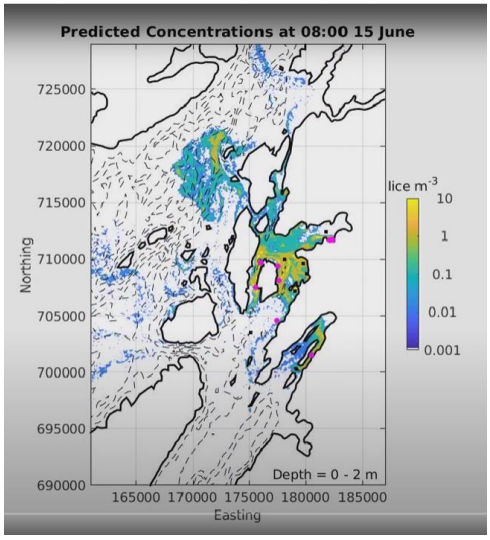
One run at Southern Approaches detected a sea lice nauplii and one run at Arknish Bay detected a copepod.

On the 27th of May, trawling was again used to detect the larval sea lice. All six locations were sampled, each three times. All locations were predicted to encounter larval sea lice with the exception of the Southern Approaches which appear as being lice free. Loch Melfort was predicted to record the highest levels of larval sea lice.

No lice were detected at any location.

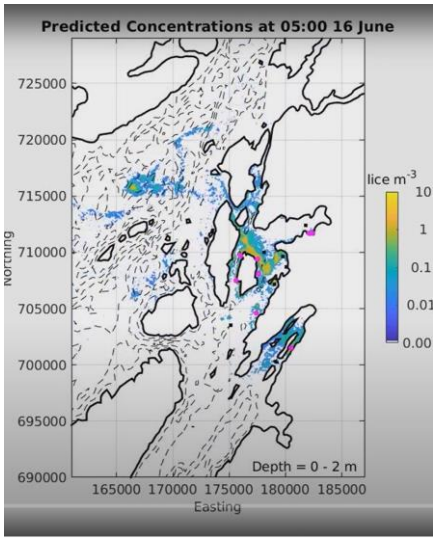


The next round of sampling took place on 15th June. This used pumps to sample at two locations, the Southern Approaches and Loch Melfort. The Southern Approaches was sampled six times, whilst Loch Melfort was sampled eleven times in total. The animation shows high concentrations of larval sea lice at the other four locations but the two sampled on 15th June were predicted to be sea lice free.



No lice were detected at either of the two locations.

The sampling continued on the next day 16th June at just two locations, NE Shuna and Arknish Bay. Both locations were sampled ten times; nine using pump and one each with a trawl.



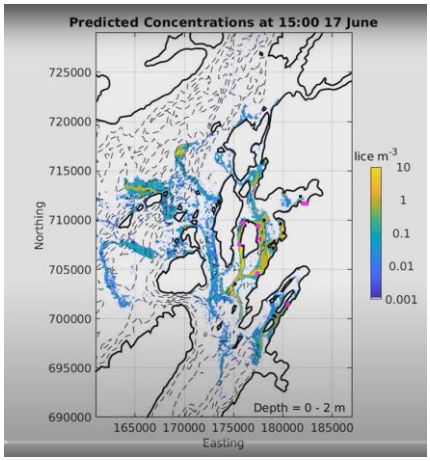
Both locations were predicted to have high lice densities. Eilean Arsa also was alas predicted to encounter lice whilst the other three locations were predicted to be lice free.

Despite the predictions of high lice concentrations, no larval sea lice were detected at either location.

Sampling continued for a third day on 17th June at all six sites. However, the number of runs and the method of sampling varied between the locations.

All six locations were trawled three times. In addition, Eilean Arsa was sampled by pump a further nine times and by trawl once more whilst Arknish Bay was trawled a further three with making a total of six trawls.

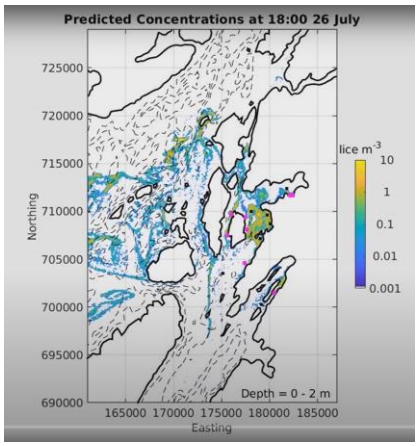
High larval sea lice concentrations were predicted at all locations except Loch Melfort.



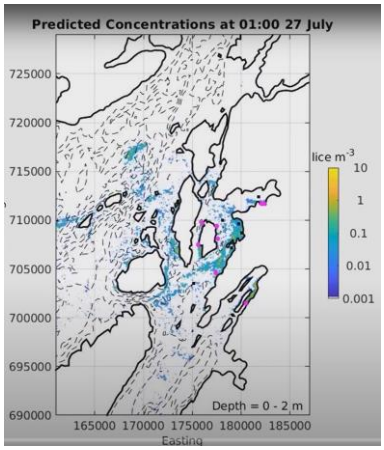
Two copepod lice were detected at Eilean Arsa on separate runs of sampling by pump. No other lice were detected despite the high predicted concentrations.

Sampling resumed on 26th July using pumps to sample two locations, the Southern Approaches with six runs and Eilean Arsa with nine.

High larval sea lice concentrations were predicted at the four locations east of Shuna. Loch Melfort and the Southern Approaches were predicted to be lice free. Two copepod larvae and one nauplii were detected at the Southern Approach in two runs, one producing the two copepods. The Eilean Arsa location with predicted high lice concentrations produced no lice.



Sampling by pump continued the next day, 27th July at a further two sites, Loch Melfort, and NE Shuna both with nine runs each.

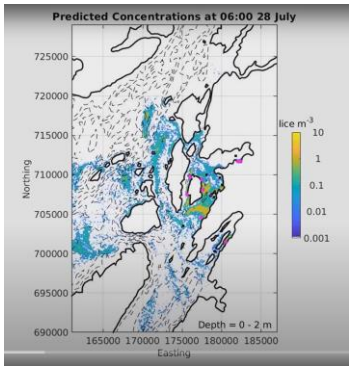


Neither of the two locations were predicted to have any larval sea lice whilst the three coastal sites which were not sampled were predicted to have medium concentrations of larvae.

No sea lice were detected at either location.

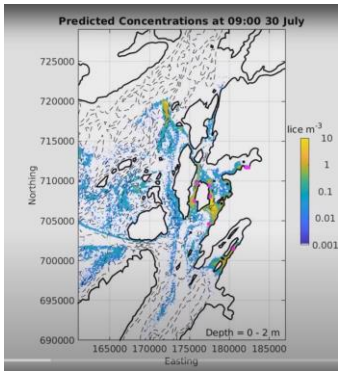
Sampling continued for a third day. 28th July with nine runs of sampling by pump at Arknish Bay.

Although there were high concentrations of lice predicted to flow through the area, the Arknish Bay location was on the fringe of the higher concentrations, whilst other locations were in the middle of the predicted higher levels.



No lice were detected.

Sampling returned on the 30th of July after a day's absence with three trawls taking place at all six locations.

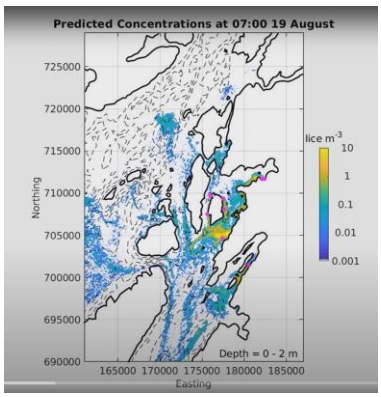


Most of the higher lice concentrations were predicted to occur just south of the sampling locations although this included Eilean Arsa. Other locations near Shuna were predicted to have moderate concentrations.

No lice were detected.

As sampling moved into August, there was a major attempt to detect lice with 36 runs on 19th August. These were all sampling by pump with nine runs each at the four locations of Loch Melfort, NE Shuna, Eilean Arsa, and Asknish Bay.

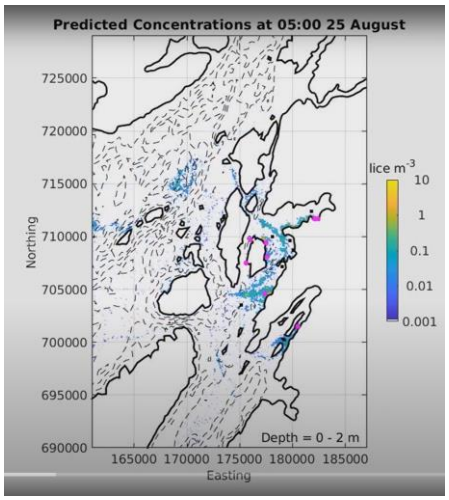
The three locations east of Shuna were predicted to encounter the highest larval sea lice concentrations but only two were sampled.



This effort resulted in the detection of the most lice in one day. One nauplii was detected at Loch Melfort, two copepods at Arknish Bay on separate runs and one preadult at Eilean Arsa.

Sampling resumed on 25th August with three trawl runs each at all six sampling locations.

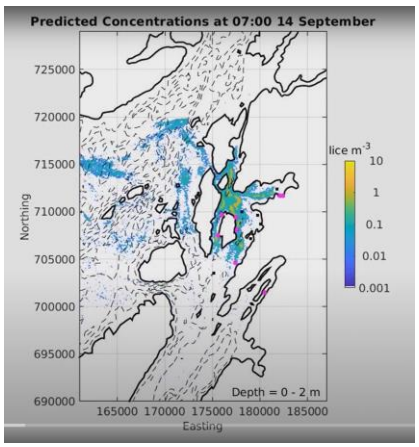
The model animation predicted very low or no larval sea lice concentrations at any of the six locations.



No lice were detected.

The sampling by trawl was repeated again on the 14th of September with three trawls each at all six sampling locations.

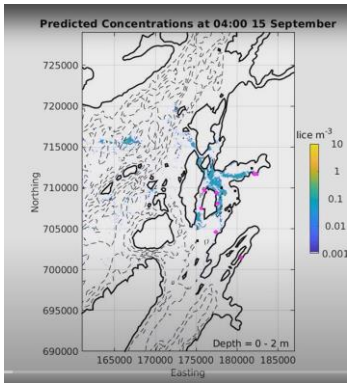
The higher lice concentrations were only predicted by the model to reach NE Shuna. The other locations were predicted with no lice or very low concentrations.



No lice were detected.

Sampling resumed the next day 15th September with sampling by pump at two locations, Loch Melfort, and NE Shuna with nine runs at each location.

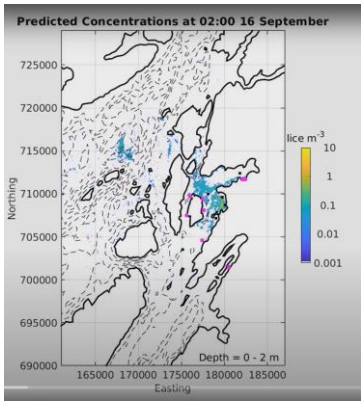
The model predicted low lice concentrations at NE Shuna and Loch Melfort as lice free.



No lice were detected.

Sampling continued on the next day, 16th September with sampling by pump at two locations. Southern Approaches had six runs whilst Asknish Bay had nine runs.

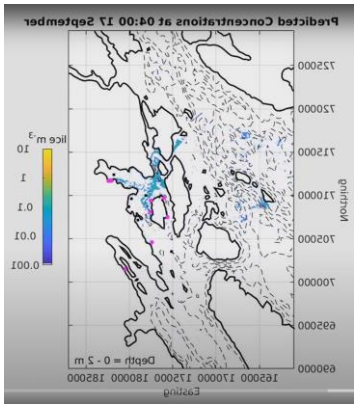
Southern Approaches was predicted by the model to be lice free whilst Arknish Bay was on the edge of a higher concentration of larval sea lice.



One larval sea lice copepod was detected at Southern Approaches.

There was one final sampling in September on the 17th. This focused on Eilean Arsa and was sampled by pump a total of nine times.

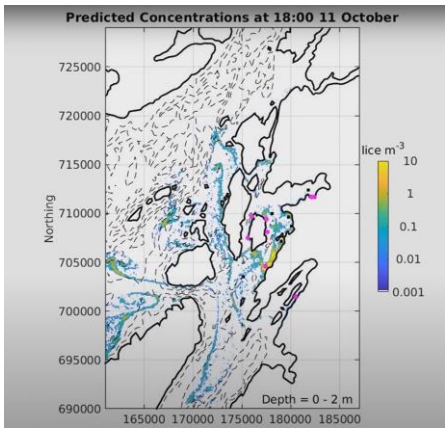
The model predicted very low concentrations of larval sea lice, but only around NE Shuna. Eilean Arsa was predicted to be lice free.



No lice were detected.

Three final days of sampling took place in October beginning on the 11th with three sample trawls each at the six locations.

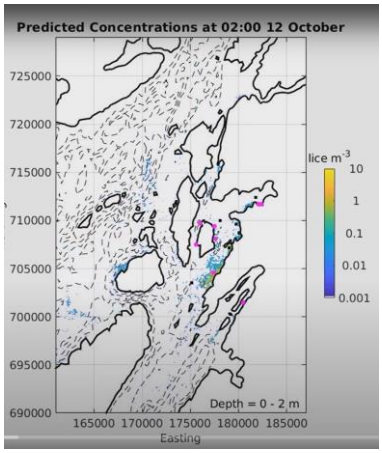
Low larval lice concentrations were predicted for east of Shuna with higher concentrations south of Eilean Arsa.



One copepod sea louse was detected in the trawl at NE Shuna. No other lice were detected.

The following day, 12th October, sampling by pump took place at two locations, Southern Approaches with six runs and Eilean Arsa with three. A further six runs were not recorded.

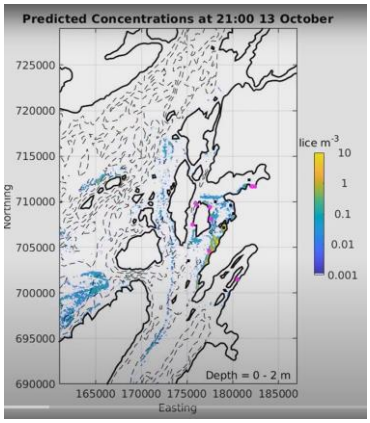
Low larval sea lice concentrations were predicted between the two locations with a slight increase around Eilean Arsa.



One copepod louse was detected each at both locations.

The final sampling of 2021 occurred on the 13th of October with more sampling by pump. Nine runs were carried out at Loch Melfort. Nine runs at NE Shuna, and three at Asknish Bay.

Loch Melfort was predicted to be free of lice, whilst the other two locations were predicted to encounter low concentrations of larval sea lice. Higher concentrations were predicted ta Eilean Arsa, but this location was not sampled.



One copepod louse was detected at Loch Melfort and two on the same run at Asknish Bay.

On page 79, in the section headed ‘Direct monitoring of sea lice’, the consultation document states:

When suitable techniques are available, we will replace sentinel cage studies with direct measurement of sea lice concentrations in the environment. Sea lice distributions in the environment are predicted to be patchy in space and time. As a result, current water sampling techniques do not provide a suitably time integrated measure of sea lice concentrations.

The paragraph is accompanied to a link to the SPILLS project final report from which this paragraph is constructed.

However, first it is important to restate the main objectives of the SPILLS project relating to sea lice monitoring. This is:

‘To assess the performance of the models against planktonic sea lice data collected by SAMS at sites in Shuna Sound 2021.’

As the previous discussion highlights, the SPILLS teams failed to assess the performance of the models using planktonic sea lice data.

This failure is attributed to the patchiness and transient movement and low overall abundance in the water column. Yet the report of Work Package 1 states that tracking sea lice in the wild is also challenging because of the large numbers of larvae that are produced. The NGO Wild Fish has estimated that farms emit about 2 billion larval lice a week. The area around Shuna is home to six farms, resulting in a potential 12 billion lice larvae in the water column every week. Yet, in total, the SPILLS project detected just 21 lice.

There is another possibility as identified by Adams et al. (2012) and that is an inadequacy of the models.

The SPILLS project sampled lice at six locations around Shuna and varying times throughout the year. Comparing these sampling periods with predicted lice densities from the model highlights that many of the attempts to detect lice were doomed to failure due to predictions of zero lice by the model.

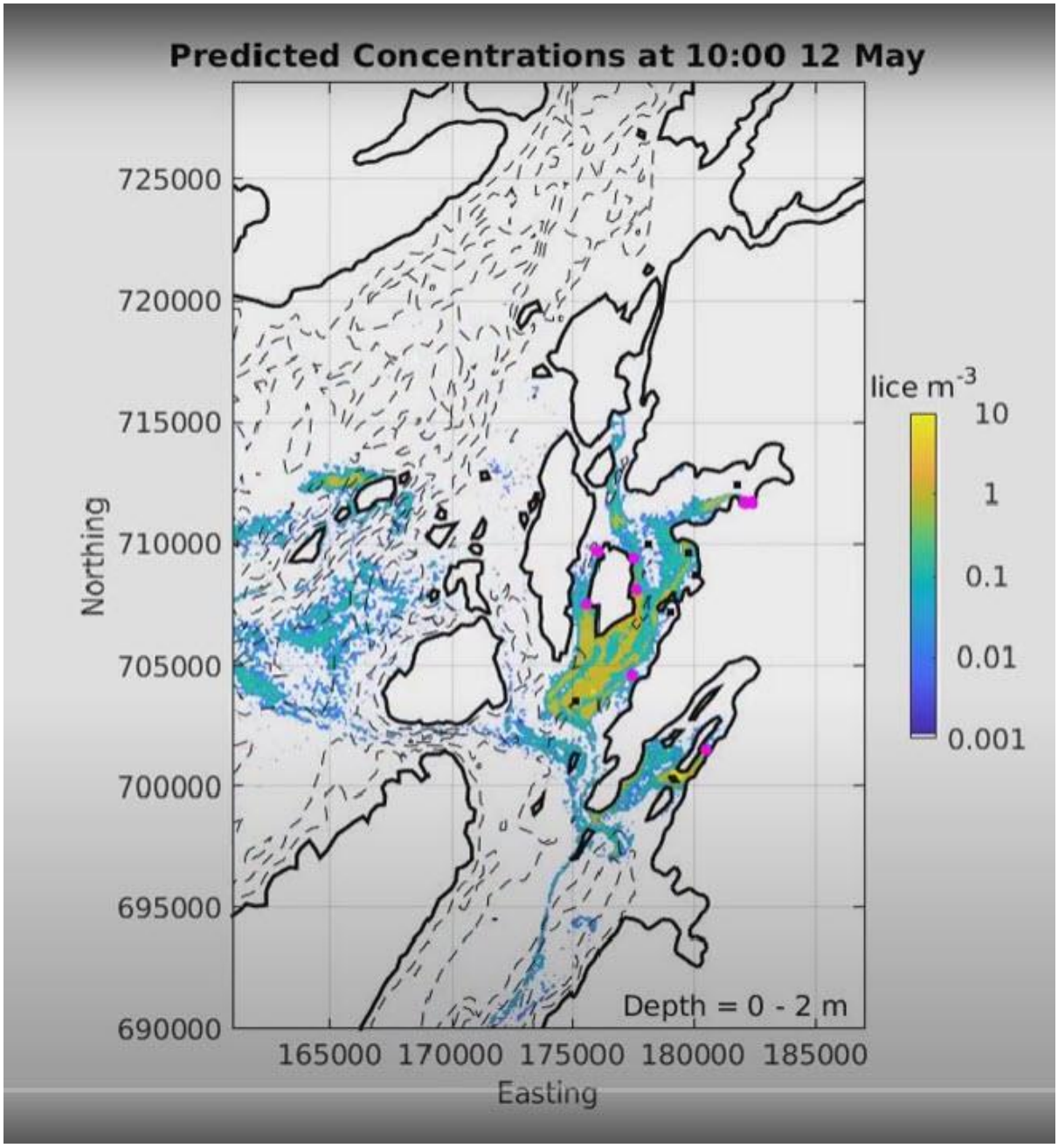
The SPILLS project over-complicated lice sampling and model validation.

Running the model animation for the full time period highlights areas where sea lice densities are repeatedly high. One such area is south of the Island of Luing.

One fixed sampling location could have been established and concentrated sampling effort focused on the various time periods that high lice densities were predicted. Sampling could have been imitated ahead of the predicted high infestation and continued until after the high predicted densities had been predicted to have dispersed. This repeated sampling could continue for 24 hours or more.

Clearly, if large numbers of lice were detected then this would validate the model. If not, then the model would be shown to be wrong.

The image below shows a high lice density occurring south of the Island of Luing.



Under the heading 'Observations of pelagic sea lice larvae concentration obtained using the implemented techniques are not suitable for use in validating sea lice dispersal models' the SPILLS project report stated that methods of sampling for sea lice currently used means that achieving good agreement between observed sea lice concentrations and model predictions is probably unrealistic.

It also states that capturing planktonic sea lice larvae and identification by microscope is very resource intensive due to the small size of the larvae, and the relative low average abundance within high density and diverse zooplankton communities.

This conclusion is a total puzzle.

Between 2004 and 2011, Michael J Penston of Marine Scotland Science, formerly known as Fisheries Research Services, published five papers along with various colleagues all relating to larval sea lice abundance in Loch Shieldaig and Loch Torridon on the west coast of Scotland. These papers describe catching and identifying sea lice larvae in areas around salmon farms. These papers are widely cited in many other published studies.

The author of the SPILLS final report on sampling and analysing sea lice larvae in the Shuna Sound region was also a named co-author of the first paper from 2004.

Michael J Penston is also named on a conference paper titled Sea Lice Dispersal in Loch Linnhe given at the 2011 MASTS conference at Herriot Watt University in Edinburgh in 2011. One of the co-authors of this paper is named as a project lead for the SPILLS project.

It is inconceivable that these two researchers were not unaware of the methods and results of Michael J Penston and his team, yet not one of the papers is cited in the SPILLS final report on sampling and analysing sea lice larvae in the Shuna Sound region.

The Scottish Government has also posted details of this work on their website – Lice Levels in Loch Shieldaig - https://www.gov.scot/publications/aquaculture-interactions-shieldaig-field-station/pages/introduction/

The SPILLS final report on sampling also fails to cite any of five papers by Mark Costelloe and his colleagues of Aqua-Fact International Ireland that were published between 1995 and 1999 that all looked at the dispersion of planktonic sea lice. These works found high levels of sea lice near salmon cages but at very low levels with increasing distance.

Although this work is now nearly twenty-five years old, one of the Irish team is still working and has recommended the following sources to help with sea lice identification, only one of which is cited by the SPILLS final report:

Kabata, Z. 1979. Parasitic Copepoda of British Fishes. Vol. 152. British Museum, England. (See pps 196 – 197 and plates 689 – 700.

Schram, T.A. Practical identification of pelagic sea lice larvae. 2004. Journal of the Marine Biological Association of the United Kingdom , Volume 84 , Issue 1 , pp. 103 – 110.

Eichner C., Hamre, L. and Nilsen, F. 2015. Instar growth and moult increments in *Lepeophtheirus salmonis* (Copepoda: Caligidae) chalimus larvae. Parasitology International, 64: 86 – 96.

His comment was that “anyone worth their salt should be able to identify the different larval *Lepeophtheirus* stages – to suggest otherwise is nonsense”.

With regard to detection and identification of larval sea lice, the SPILLS final report cites a paper by Emily Nelson and her colleagues in Canada. The paper is mentioned only in context of the sampling strategies but there is no reference to the results which were that high lice densities were found adjacent to salmon cages, but the density had diminished by many factors within 100 metres of the salmon farm.

To suggest that current means of monitoring of sea lice is not suitable for validating sea lice dispersal models is simply untrue and reflects failings of the model rather than the sampling. These failings are due to the lack of input of knowledge of parasite ecology into the model. Sea lice larvae are not inert particles and are simply not dispersed as the model predicts. This can be clearly observed from the results of the SPILLS project. The SEPA consultation does not mention the SPILLS project except with reference to the development of refined models but makes no mention of the failure of the SPILLS monitoring programme to validate the models.

The SPILLS final report also makes reference to a paper by Skogen, and others from 2022. This suggests that field data is both limited and biased. The SPILLS team use this paper to justify their claim that failure to capture and quantify sea lice larvae does not equate to an absence in the water column.

However, it should be noted that all 12 co-authors of this paper are modellers and thus have a single view of the relationship between models and what happens in the sea. The SPILLS final report does not offer a balancing view from those involved in sampling. They thus can conclude that the problem is with the sampling and not the model.

August 2023 development

The results of a new study undertaken for a master’s degree at the Norwegian University of Science and Technology have just been publicised. The project supervised by Professor Bengt Finstad, a leading expert on sea lice looked at sampling larval sea lice in the major salmon farming area of the Hardangerfjord.

Sampling took place at two locations over a period of a month and in total just 44 larval sea lice were identified confirming the findings of previous studies that sea lice are not present in the sea as predicted.

Pre-SPILLS (LLBSDP 2011-2013)

The Loch Linnhe Biological Sampling Data Products (2011-2013).

The SPILLS report also failed to reference the LLBSDP project with regard to monitoring larval lice. However, the Scottish Government website relating to the project provides data on sentinel cage trials and also on trawling for larval lice. The SPILLS project chose not to conduct sentinel cage trials as part of their project preferring to use the data from the LLBSDP project. However, whilst opting to use this old data for sentinel cage trials, they ran new trials for sea lice detection in the water column and wild fish sampling.

The SPILLS project detected a total of 21 lice of all stages in 372 runs from six sampling sites, whilst the LLBSDP project detected 3,156 lice in 562 trawls from 31 sampling sites in 2013. On the basis of success of detection, the LLBSDP produced a much greater range of results, yet Unlike the SPILLS project, not report was published. Instead, the LLBSDP website states that the data was directly used in two published papers.

Salama et al. (2013) only reference to the tows is:

“The plankton tows resulted in lice in half (15) of the station samples of which the majority were copepodids and early chalimus stages with few adults (Fig. 6).”

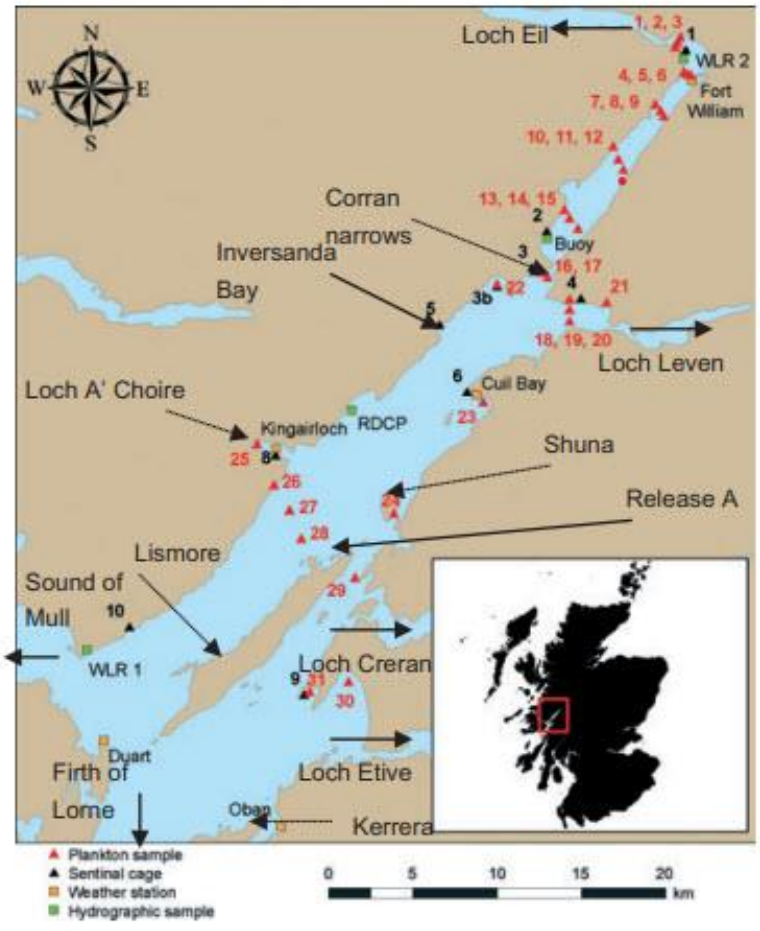
However, the caption to figure 6 states:

“Figure 6 The proportion of each of the lice stages sampled on sentinel cage fish during May 2011.”

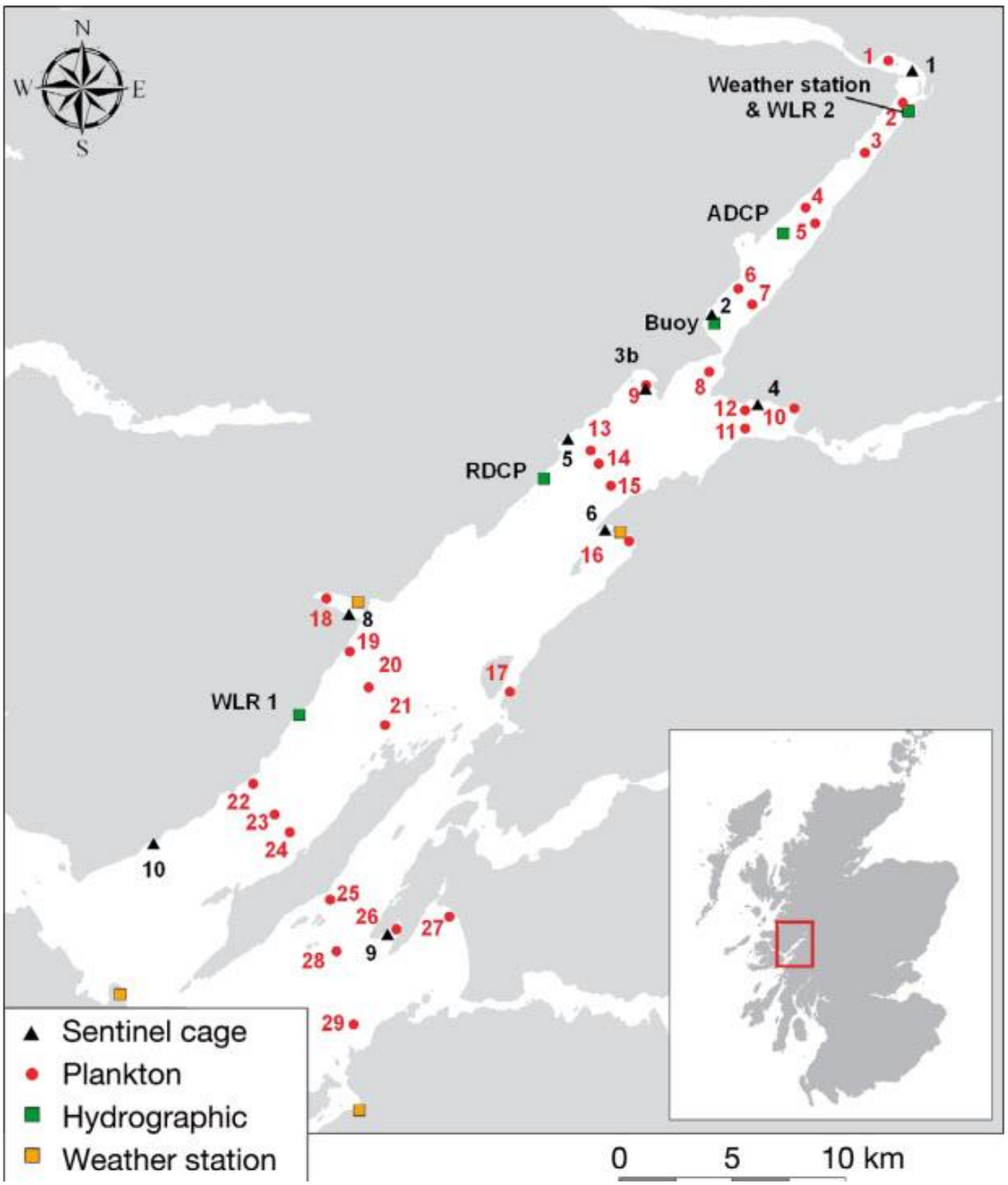
The second paper, Salama et al. (2018) supplied less information on the results of the plankton trawls.

However, as stated, the raw data is published on the LLBSDP website for the 31 sample sites.

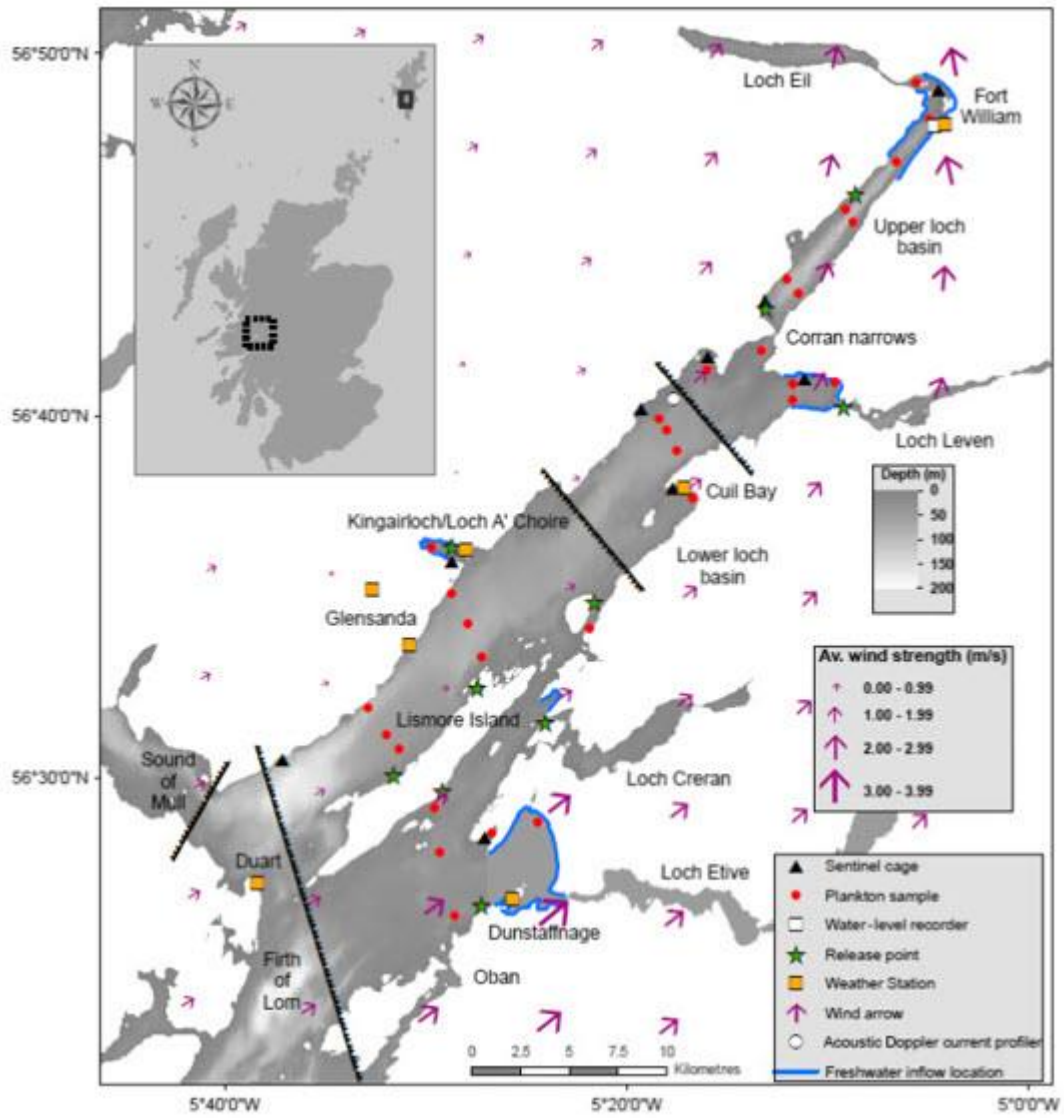
Salama et al. 2013 includes a map of the sampling locations. The sites in red are those used to trawl for sea lice.



Another map appears in a second Salama paper with B. Rabe from 2013.



Whilst a third version was published in a later by paper also by Salama et al. in 2018.



The locations of the various sampling stations have been checked and appear to be in accordance with the first paper. However, why the other two papers show a different arrangement of sampling site is unclear but to the academic scientist, it might suggest a lack of attention to detail, leading to questions about the validity of the different papers.

The data supplied on the LLBSDP website has been analysed and falls into six seasonal groups – May and Oct/Nov for 2011, 2012 and 2013. The number of lice detected for each season can be summarised as:

	2011	2012	2013
May	38	11	82
Oct	2795	103	127

The first and more important point is that the lice count from spring for all three years are extremely low. This is time of the smolt migration which is when the fish are supposed to be at greatest risk from sea lice infestation. Over three years 131 lice were detected from 252 trawls. By comparison, 3025 lice were detected from 310 trawls during October and November, when the risk to small migrating salmon had long passed.

The second point is that although the detection of lice was greater in Autumn, almost all of the lice were detected just in 2011. The lice count for the other two years were almost as low as the spring counts for all three years.

The question is whether the detections made in Autumn 2011 were representative of typical sea lice numbers or whether 2011 was an unexplained outlier.

The third point is that. Lice detections were high at the sampling sites numbered 7 to 14 (possibly including 15) during Autumn 2011.

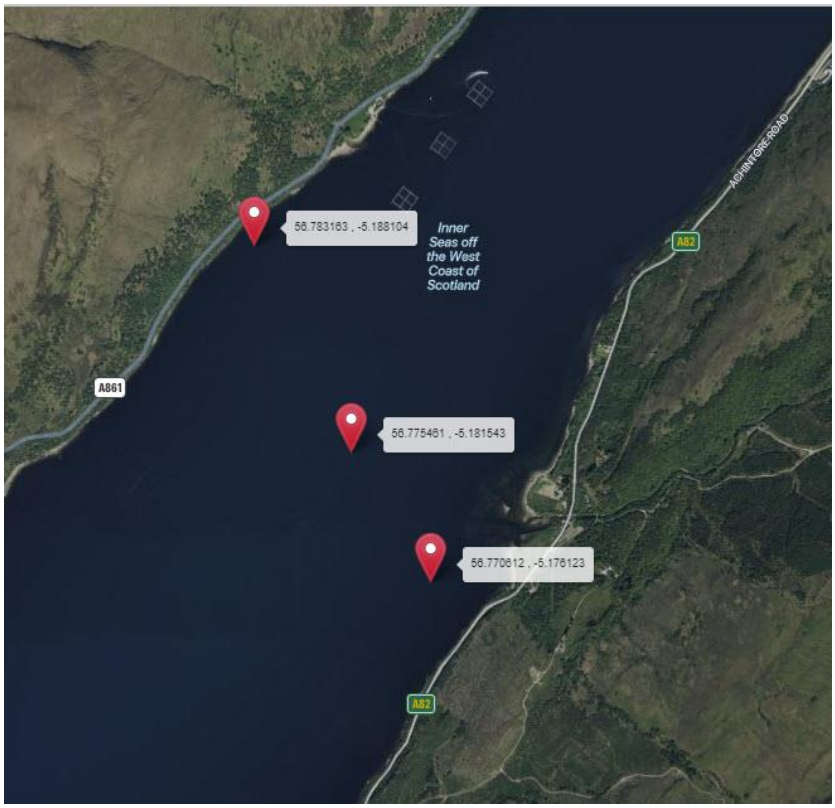
The breakdown of lice detections at each site can be seen in the following table:

	May-11		Nov-11	
Site	No of trawls	No of lice	No of trawls	No of lice
1	2	0	N/A	N/A
2	2	0	N/A	N/A
3	2	N/A	N/A	N/A
4	2	0	3	49
5	2	1	3	14
6	2	N/A	3	25
7	2	2	3	25
8	2	1	6	697
9	2	2	6	479
10	2	2	N/A	N/A
11	2	0	3	167
12	2	0	3	312
13	2	1	6	275
14	2	4	6	191
15	2	1	6	93
16	2	1	N/A	N/A
17	2	7	N/A	N/A
18	2	1	3	4
19	2	0	3	15
20	2	1	3	12
21	2	0	3	22
22	2	1	3	14
23	2	6	N/A	N/A
24	2	1	N/A	N/A
25	2	0	3	27
26	4	0	3	1
27	4	0	3	11
28	4	0	3	22
29	4	5	N/A	N/A
30	4	1	N/A	N/A
31	4	0	N/A	N/A

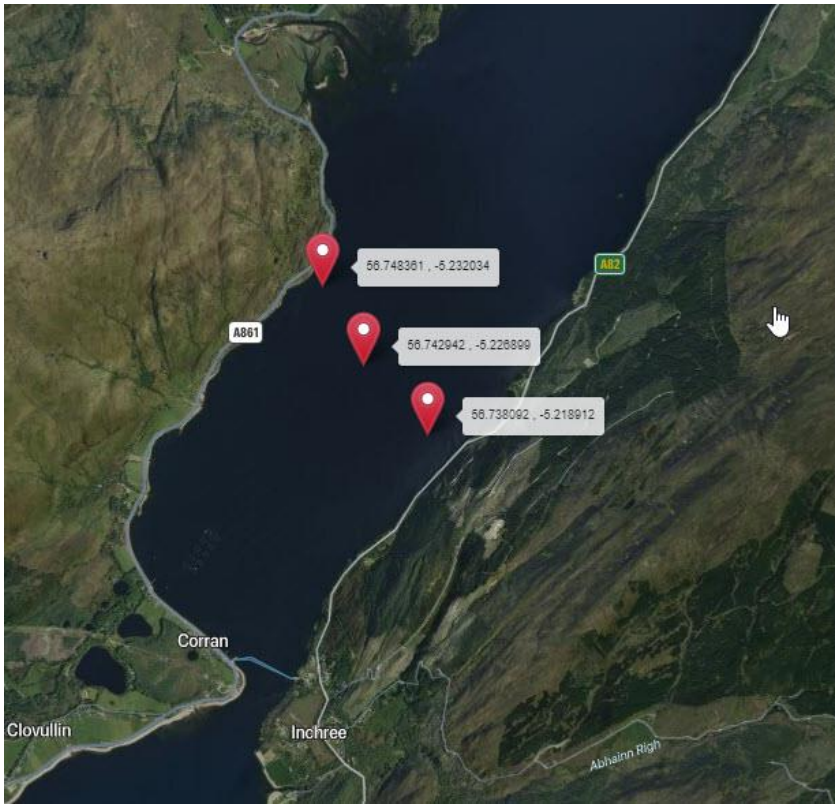
The actual sampling locations, rather than those shown on the various maps are shown in the following images:

The first image shows locations 7,8, and 9.

The second image shows location 10,11, and 12.



The third image shows sampling sites 13, 14, and 15.



All nine sites are located within around 1000 metres from a salmon farm.

In the case of sites 7, 8, and 9, they are all upstream of the farm.

The final point is that whilst lice counts were high in Autumn 2011, the detections were made over two weeks and only one of these resulted in high lice counts. There are no readings for sampling site 10.

Site	Deployment 1	Deployment 2
	Oct-11	Nov-11
7	28	339
8	11	686
9	7	472
11		167
12		312
13	5	270
14	7	184

The Salama et al (2013) paper only considered the lice counts in May 2011, whilst the 2018 combined all the readings for all years so did not appear to consider the reason why the results for the second deployment were so high compared to all other runs over the three-year period.

It should be noted that the Corran Narrows creates a restriction in the flow of water out of the loch and that together with tides, a bore is created that pushes water back up the loch towards Fort William. This creates a stratified circulation in the upper loch with freshwater travelling down Loch

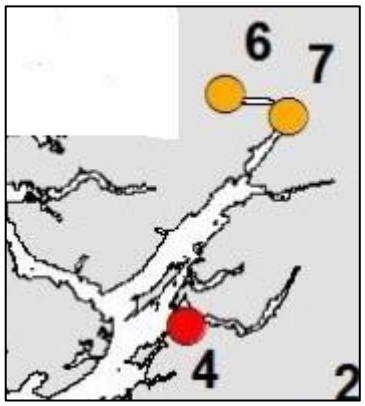
Linnhe travelling on top of a saline layer moving in the opposite direction. This means that any sea lice detected in the water column may not have originated from local farms.

Monitoring sea lice on wild salmonids

The SEPA consultation document states that information on sea lice burdens on sea trout can provide an indication of variation in general infestation pressure overtime. However, they say that without information on the movement history of the sampled fish, the data cannot be used to infer the infestation pressure to which wild salmon post smolts may be subjected. The document says that SEPA would like to develop approaches to monitoring and interpreting sea lice burdens through working with others. Such an approach to interpretation was detailed in the response to the first consultation but was ignored. This is explored further here.

The consultation document highlights that the local Fisheries Trusts undertake annual programmes of sea lice monitoring funded by Marine Scotland Science.

Three sites are monitored in the Loch Linnhe area. Number 6 (Kinlocheil) and 7 (Camas na Gaul) are monitored by the Lochaber FT whilst number 4 (Dunstaffnage) is monitored by the Argyll FT. Sea lice counts on wild sea trout were recorded for the spring of 2011, 2012, and 2013 for all three sites but not as part of the LLBSDP.

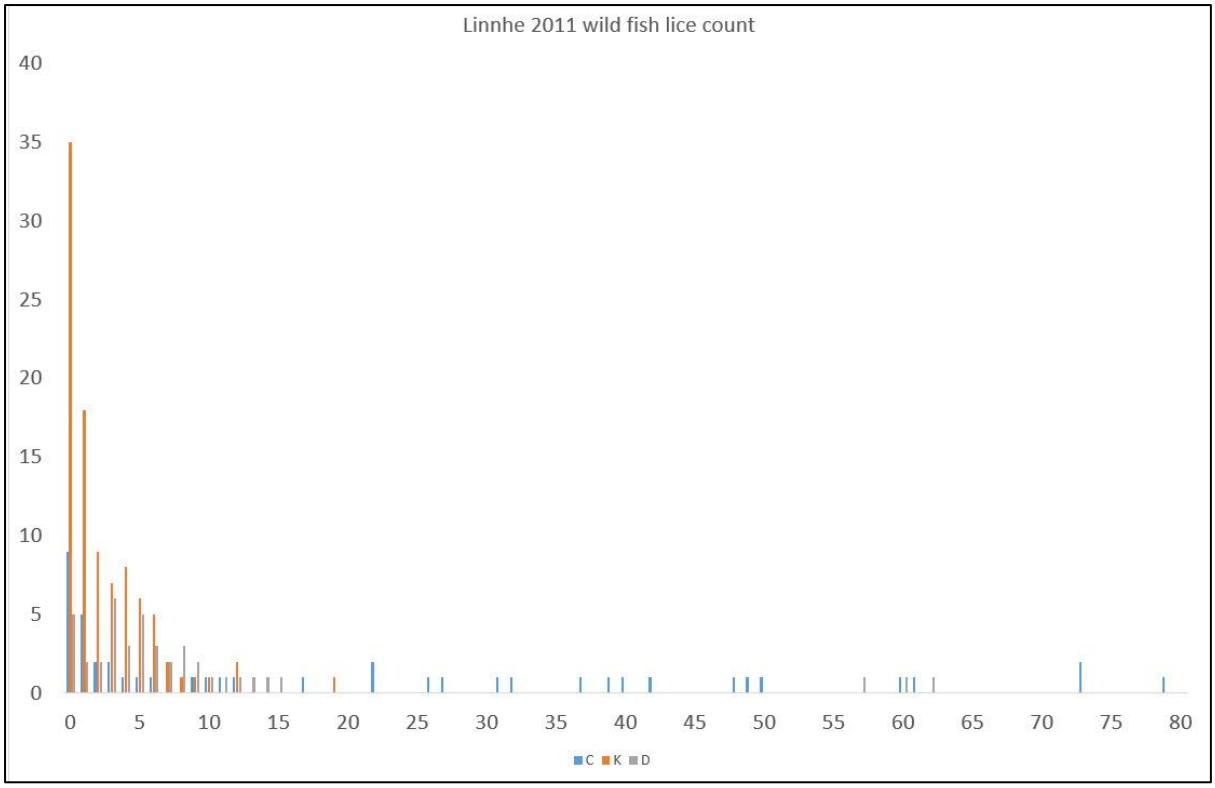


A total of 528 sea trout were sampled between the three sites over the three years. The breakdown of fish sampled each year is in the following table:

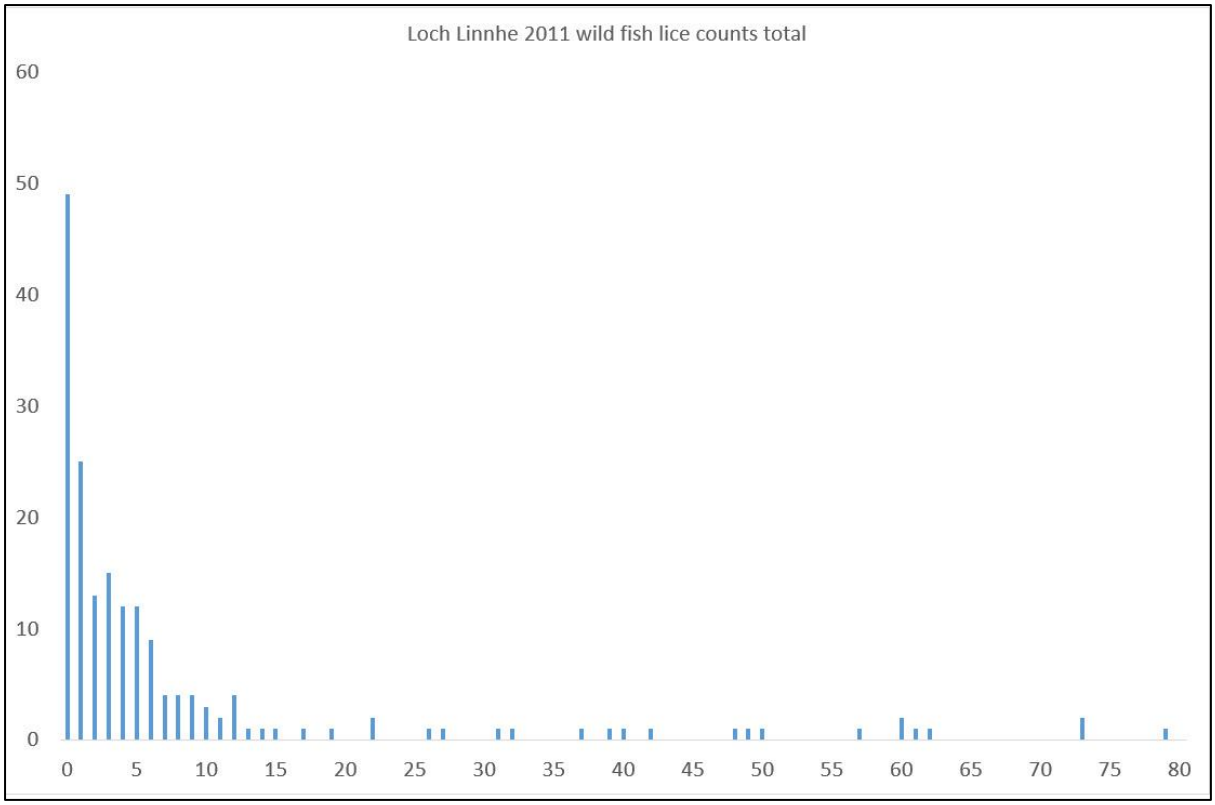
	2011	2012	2013
Camas	47	112	40
Dunstaffnage	42	39	21
Kinlocheil	96	100	31
Total	185	251	92

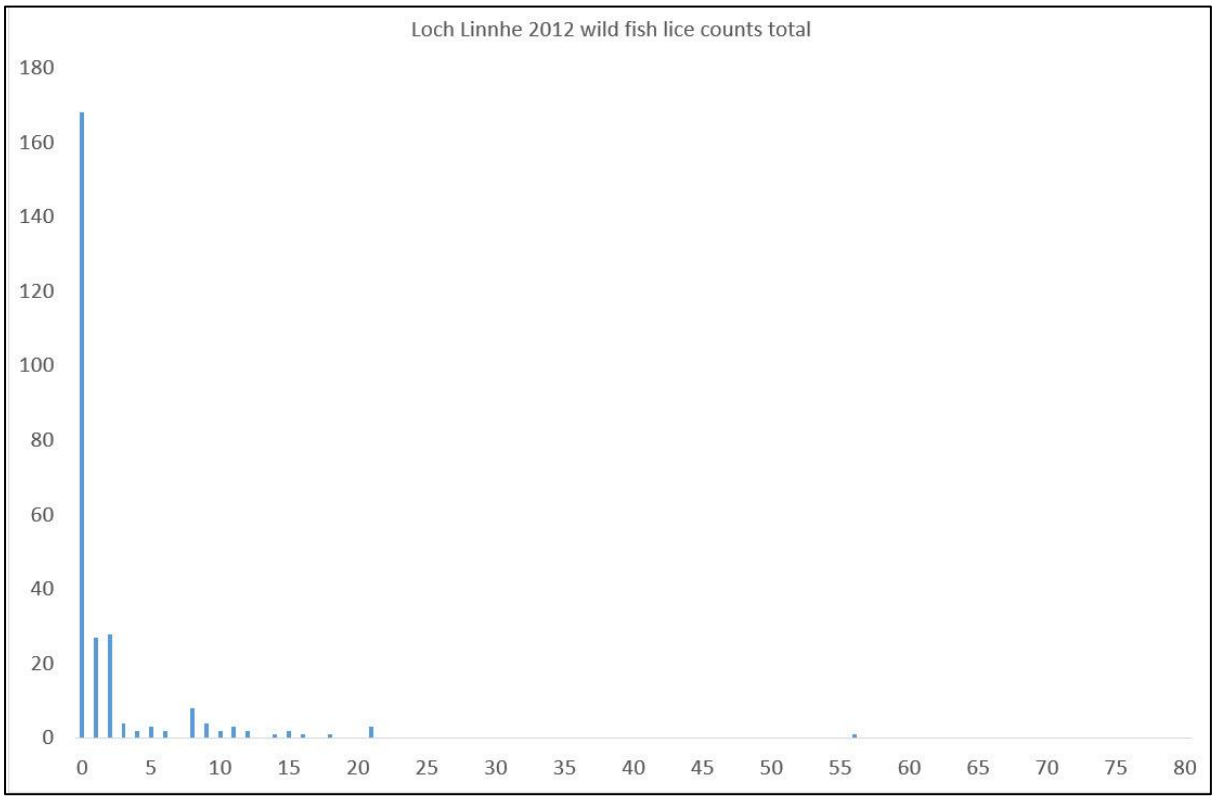
Analysis of the sea lice data produces a typical parasite aggregated distribution showing most host fish carry no or few sea lice whilst a very few fish have high lice counts. (One fish had 120 lice but is not shown on these graphs.)

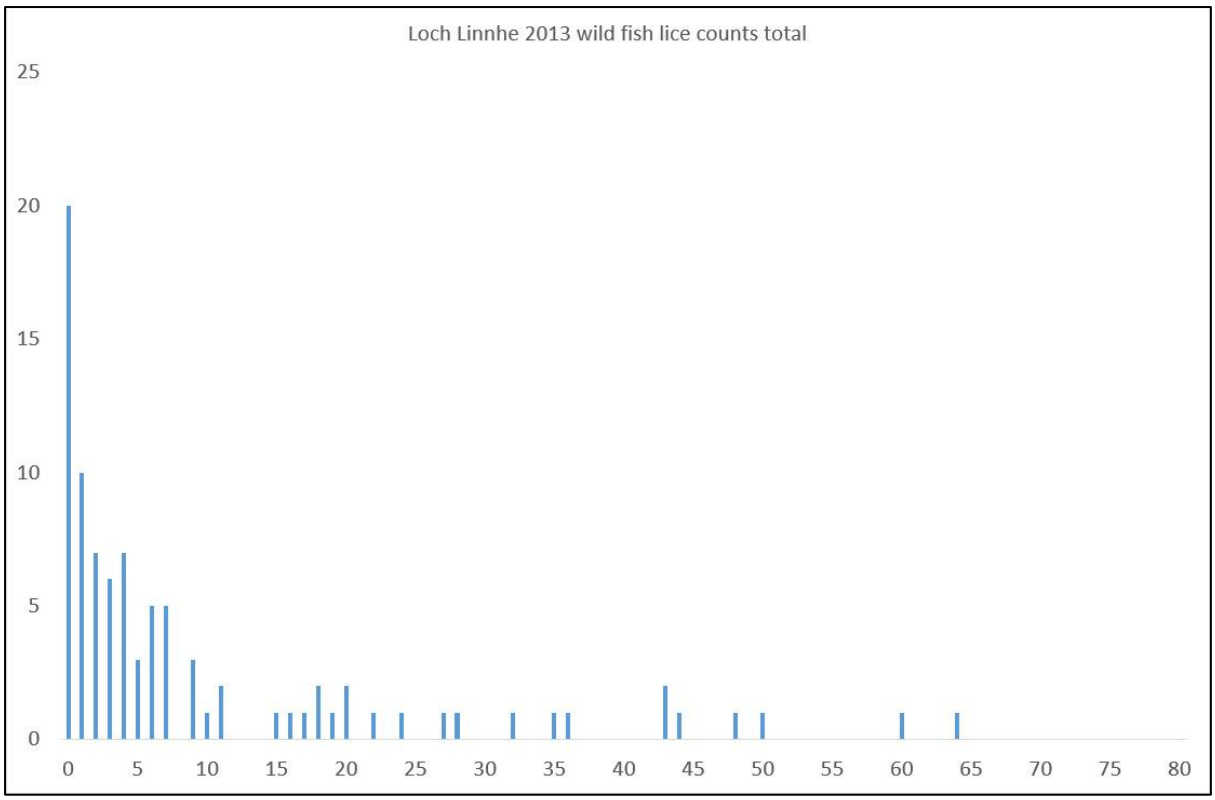
The first graph shows the counts at all three sampling sites (Blue - Camas na Gaul, Orange -Kinlocheil and Gray – Dunstaffnage). All sites had aggregated distributions of lice of varying magnitude.



The following three graphs show the total ice counts for all three sites combined for each year. All show an aggregated distribution of varying magnitude.


Loch Linnhe 2011 wild fish lice counts total
60
50
40
30
20
10
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80


Loch Linnhe 2012 wild fish lice counts total
180
160
140
120
100
80
60
40
20
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80



In total, 217 sea trout were free of lice equating to about 40% of the fish sampled. The variation in magnitude for each year ranged from 21% lice free for 2013, 26% for 2011 and 67% for 2013. It might be considered that this variation will relate to the lice infestation on nearby farms. However, it is more likely the result of sample size.

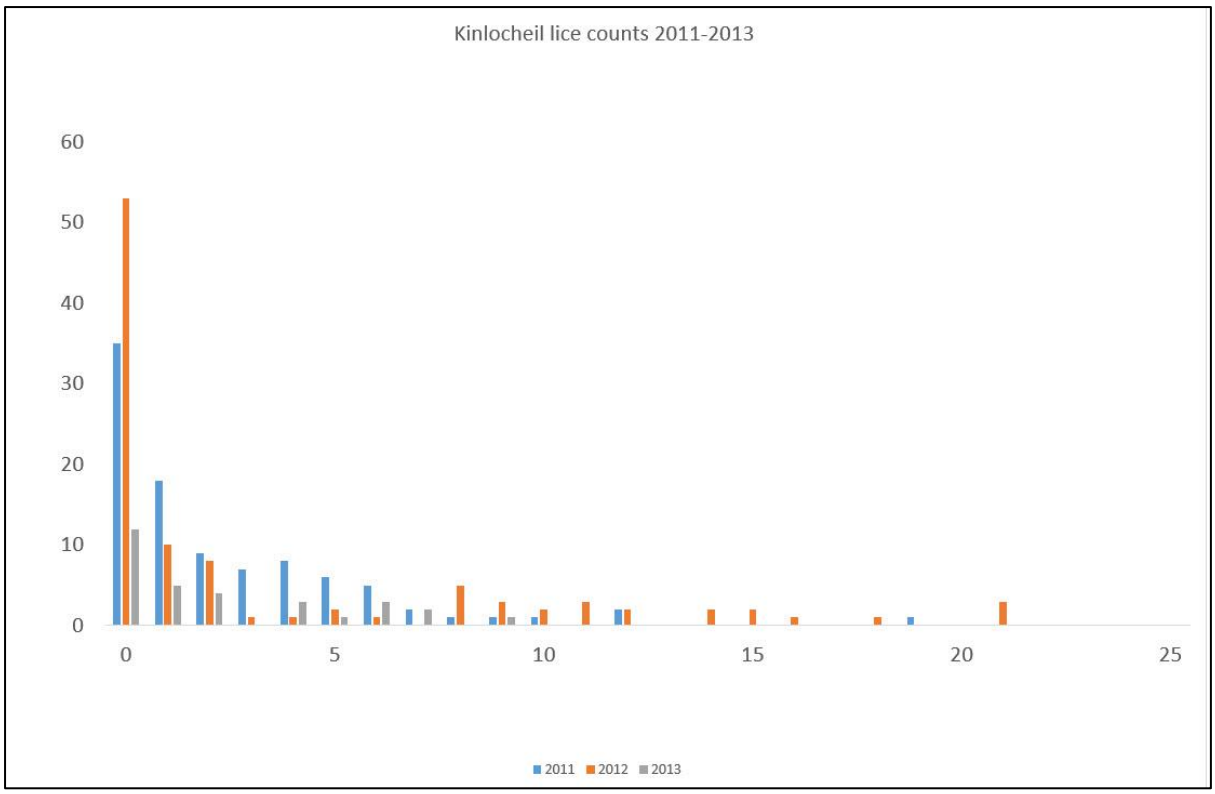
There is a protocol in place for the sampling of sea trout for sea lice which puts the minimum sample size as 30 fish. This is overseen by Fisheries Management Scotland who now manage the data for Marine Scotland Science.

Over the three years, a total of 29 nettings occurred of which just 5 caught sufficient fish to meet the 30 fish protocol. This means that 24 nettings failed to meet the required protocol. These ranged from 1 to 27 fish with an average of just 11 fish.

2012 had the best capture rate with three nettings out of 9 that met the protocol. This is reflected in the higher number of fish with zero lice,

Although some fisheries trusts' sample into autumn, no autumn sampling took place at the three sites during 2011-2013.

The following graph shows the sea lice counts on sea trout caught at the Kinlocheil sampling site during the spring of 2011-2012 and 2013. As with the other graphs, the aggregated distribution is apparent with a few fish showing higher lice counts every year.



At the comparable time, all sentinel counts, and trawl data showed extremely low levels of lice suggesting that there was minimal if no infestation pressure, yet some of these fish had lice levels that would be considered harmful. However, the wild fish data provided by Marine Scotland Science does not include the weight of the fish so no estimation of the Taranger risk can be made.

The Kinlocheil sampling site is about 8.5 km north and west of the farm that is highest up the loch. These fish cannot have been infested by larval sea lice in the water column as proposed in the model.

Application of Taranger 2015

As part of the SPILLS project Argyll Fisheries Trust undertook the sampling of sea trout around the Sound of Shuna in 2021. In total they sampled three sites using a seine net and a further three using a fyke net.

In total 13 sea trout were caught, 4 by seine netting and 9 using the Fyke net. These were caught over five netting occasions with three catching two fish, one three fish and another with four fish.

The Scottish Fisheries Cordination Centre (part of Fisheries management Scotland) operate a protocol for netting of a minimum sample size of 30 fish. These samples fall well short of the protocol.

Although only 13 fish were caught, the Argyll Fisheries Trust do not record the actual sea lice counts per fish. Instead, they provide data on abundance, prevalence, and intensity, all of which are meaningless for such small samples.

As well as these measures, Argyll Fisheries Trust have applied the Taranger risk assessment. They state:

The framework assumes that small sea trout post-smolts (<150 g body weight) will suffer 100% lice-related marine mortality, or compromised reproduction potential, if they are infected with >0.3 lice g−1 fish weight. Furthermore, the lice-related marine mortality is estimated to be 50% if the infection is between 0.2 and 0.3 lice g−1 fish weight, 20% if the infection rate is between 0.1 and 0.2 lice g−1 fish weight, and finally 0% lice-related mortality if the salmon lice infection is <0.1 lice g−1 fish weight.

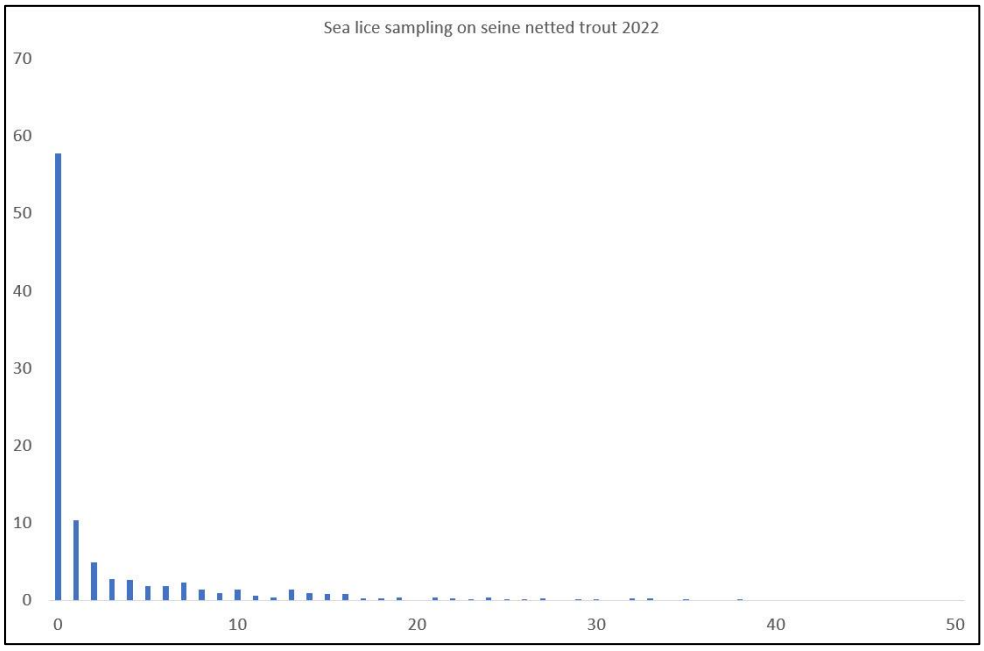
For larger sea trout (over 150 g) the risk analysis assumes that increased lice-related mortality or compromised reproduction will be 100% in the group if they have >0.15 lice g−1 fish weight, 75% for lice infections between 0.10 and 0.15 lice g−1 fish weight, 50% for lice infections between 0.05 and 0.10 lice g−1 fish weight, 20% for lice infections between 0.05 and 0.01 lice g−1 group, and 0% if the salmon lice infection is <0.01 lice g−1 fish weight.

As a result, they have calculated a total mortality of 52,9% for small trout and 33.3% for larger trout. Without the original data, it is difficult to work out how they arrived at these numbers. This appears to mean that 2 small fish and 3 larger fish are predicted to die as a consequence of sea lice infestation. The Argyll Fisheries Trust conclude that the low number of samples make firm conclusions difficult to be drawn but the limited data suggests that there is a lice related risk to sea trout in the Sound of Shuna.

Whilst the wild fish sector including the Argyll Fisheries Trust are keen to promote the Taranger risk assessment, they have ignored the guidelines set out in the original work by Taranger. This recommends that the sample size should be a minimum of 100 fish and that they be caught in open water, not by the shoreline. This means that the Argyll Fisheries Trust's interpretation of the data is invalid.

Although wild trout have been sampled across the west coast since 1997, the weight of the fish has not been recorded until recently. The latest sampling data available is for 2022.

Ten different sites were sampled between three and six times each during 2022 (3x3, 2x4, 3x5, 2x6) catching by seine net a total of 1162 fish of which 671 were lice free. The distribution of lice across the 491 infested fish can be seen in the following graph:



Eighty percent of the fish carry no, or between 1 and 5 lice. 90% fall below the Wells Threshold, although this figure is subject to significant questions.

The 2022 sampling were weighed which means the Taranger assessment can be applied. However, it must be pointed out that this is a theoretical number and has not been proven.

Using the formula stated by the Argyll Fisheries Trust 62 fish under 150g could be prone to mortality. The number of fish over 150 at risk of mortality is 12 making a total of 74 fish. This equates to 6.4% of the fish sampled. As yet, there is no evidence that any of this fish would actually die.

As all the Fisheries Trust only apply Taranger to a small sample of fish, their claims of risk are highly overstated.

Wild fish infestation

Between 1998 and 2005, Todd and his colleagues sampled wild salmon returning from their feeding grounds for sea lice. In total 403 fish were trapped at Strathy Point, most of which would be destined for east coast rivers, and all were infested with sea lice in all years. The total abundance varied from year to year with a minimum number of 17 and a maximum of 31 lice.

A more detailed examination of the lice infestation was conducted for the years 1998 and 1999. The mean abundance of lice was 19 and 24 with 85% and 93% of the lice being adults. This means that 15% and 7% were other life stages including pre-adult stages. Of the adults 68% and 69% were female.

Finally, two sea winter fish carried more lice (30) than one sea winter grilse.

Todd and his colleagues conclude form the study that together the 100% prevalence of both 1SW and 2SW fish and the observations of young chalimus stages with greater numbers of lice on older fish strongly suggests that reinfestation is a persistent feature of fish in their oceanic feeding grounds. This is based on the observation that fish will have been most recently infected 4 to 6 weeks before capture.

Monitoring the health of wild salmon populations

The SEPA consultation document includes a section on monitoring the health of wild salmonid population which they say will rely on advice from the new Scientific Advisory Board that will be established as part of the Wild Salmon Strategy. It would be hoped that this will include more than one representative of the salmon farming industry as to date the wild fish sector has not proved itself reliable in terms of monitoring the state of wild fish stocks. One example is that the number of wild fish caught in Scotland as reported by Fisheries Management Scotland in their Annual Review (not 2023 onwards) is very different to the number reported by the Scottish Government even though the data comes from the same sources.

Marine Scotland Science has written that rod catches are the most comprehensive indicator of stock status in terms of temporal and geographic coverage and in many areas are the only information available (MSS Report 01/15 Status of Scottish Salmon and Sea Trout Stocks 2014). Thus, if FMS and

MSS cannot agree on the number of fish caught then they surely do not agree on the status of specific stocks.

For example, the 2018 FMS Annual Review which provides a report of the 2017 catch includes the catch data for the river Tay catchment (West coast data is not as well reported). The FMS Annual Review reports 5171 salmon and 1425 sea trout caught in 2017. The Marine Scotland Science spreadsheet lists a total of 5650 salmon (a difference of 479 fish (9.2%)) and 1847 (a difference of 422 fish (29.6%)). In this example, MSS data exceeds that of FMS but there are other examples where the FMS data exceeds that from Marine Scotland.

SEPA say that their fish ecologists will work with other to help implement any monitoring plans in rivers of concern. They have already identified eight Wild Salmon Protection Zones requiring further assessment. Yet, there is already seventy years of data available from Marine Scotland plus other sources of information to help assess the impacts of salmon farming on the wild fish populations in these eight prioritised protection zones.

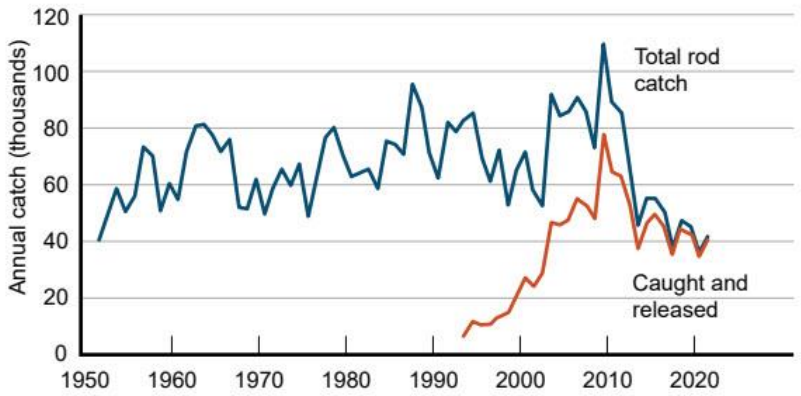
National wild fish trends

Prior to assessing/monitoring what is happening to wild fish stocks in the Wild Fish Protection Zones, consideration should be given to the national trends.

Marine Scotland Science published their report on the Status of Scottish Salmon and Sea Trout Stocks 2013 as MSS Report 03/14. This states:

“Rod catches have traditionally been used to assess the status of salmon in Scotland. An underlying assumption in the use of these data is that there is no consistent change in the percentage of available 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. This limitation should be considered when interpreting rod catch data. However, rod catches are the most comprehensive potential indicator of stock status in terms of temporal and geographical coverage, and in many areas may be the only information available.”

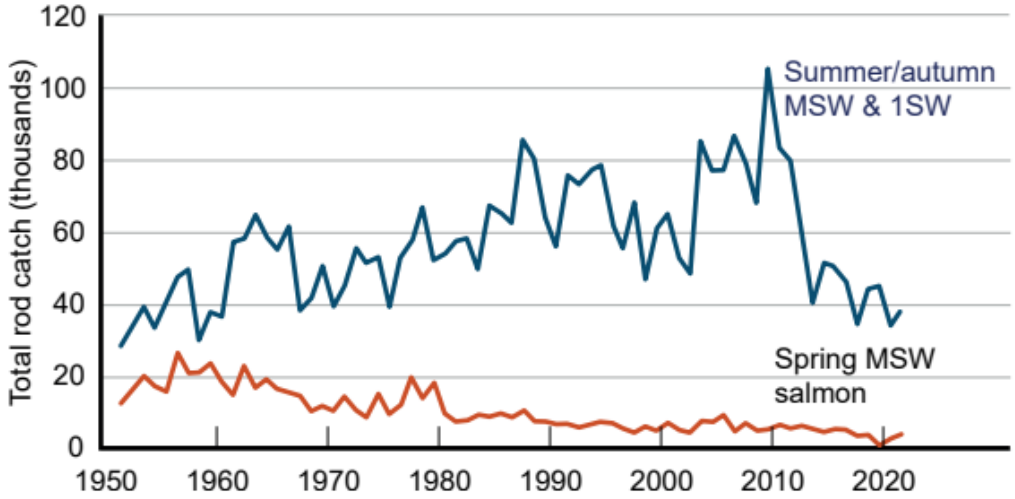
The Scottish Government publishes the salmon and sea trout catch statistics on an annual basis. The main focus is now on rod catch as netting is largely banned. The latest report includes the following graph, which shows that after years of increased catches, they have now collapsed.



The 2013 report explains that until 2011 catches had increased because there were more salmon due to fewer operational nets:

“Overall catches of adult salmon returning to Scottish rivers are at historically high levels. This conclusion may initially seem surprising given generally downward trends in marine survival between the late 1960’s and 2000. However, this apparent contradiction likely reflects reductions in the netting industry over this period, which has allowed a greater proportion of fish to enter rivers and hence increased rod fisheries and spawner escapement.”

The annual statistics also includes a graph showing the difference between spring catches and those during the rest of the fishing season.

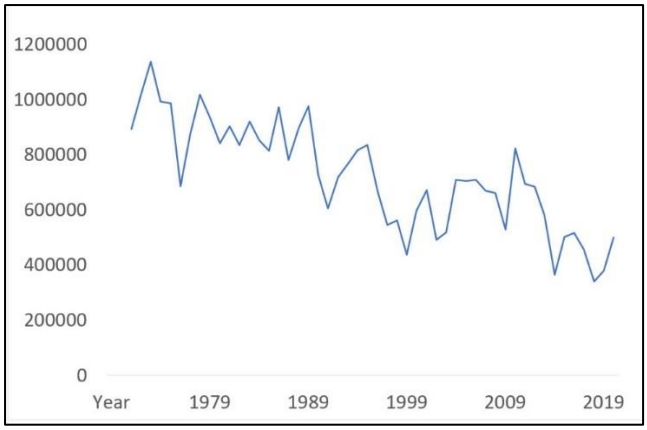


Prior to the introduction of the current conservation regulations, the Scottish Government published two annual reports (2013 and 2014) providing more detailed information on catches. This included a focus on ‘Spatial and temporal variability in rod and line catches’ which looked at spring, summer and autumn catches showing their relationship to the total catch and the areas in Scotland where that part of the stock had increased or declined.

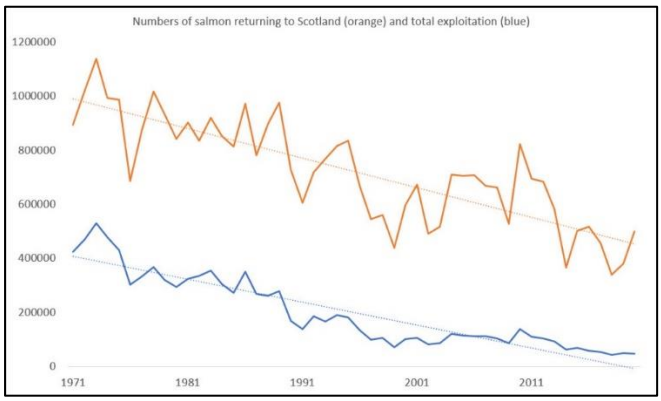
Historically, the annual catch reports included details of net catches by fixed engine and net and coble, but these now form a minor part of the report and the graphs that used to be included are provided as supplementary information in data form.

What these reports do not include is a wider picture of what has, and is, happening to wild salmon in Scotland.

ICES produce an assessment of salmon returning to Scottish water for NASCO. The following graph summarises the overall situation.

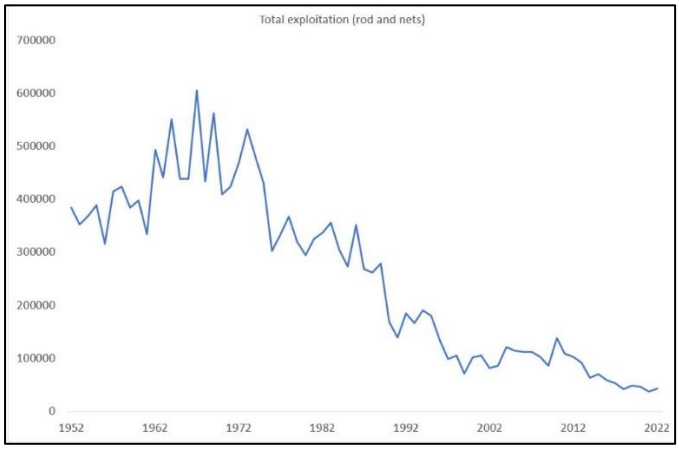


The tendency for the Scottish Government to produce separate graphs showing the historical catch trends for rod, fixed engine and net and coble exploitation has masked the overall trend. When all methods of exploitation are combined the over trend plotted against the ICES data is as follows:

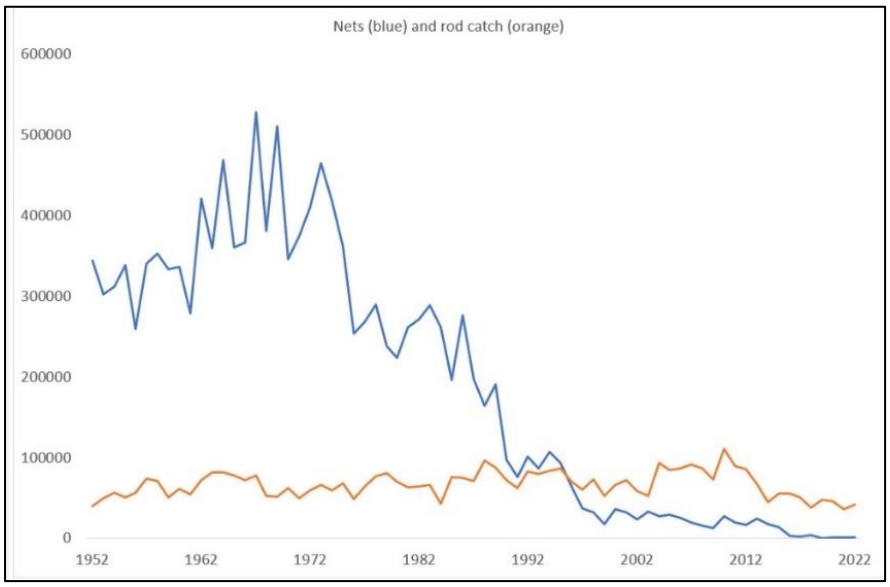


It can be seen that the overall trend lines are almost parallel, and that exploitation has matched the declines in returning salmon. That is not to say that exploitation is the major cause of why salmon have failed to return form the marine feeding grounds. However, it would have been an interesting experiment to see that if exploitation had been banned in the 1980s, whether stocks would have recovered?

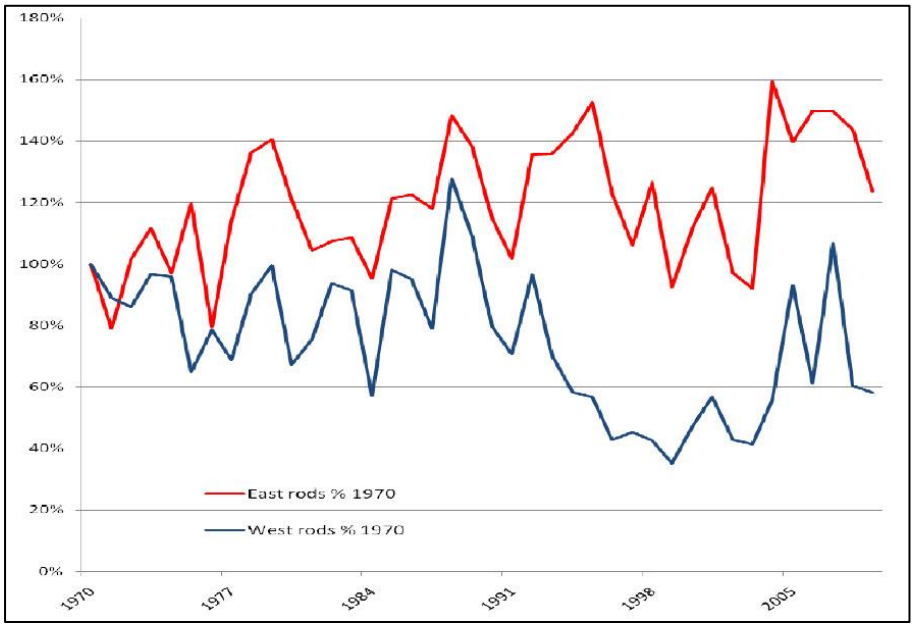
Analysis of the catch data shows that catches began to decline, after a short period of increases, in the early 1970s and has been in decline ever since.



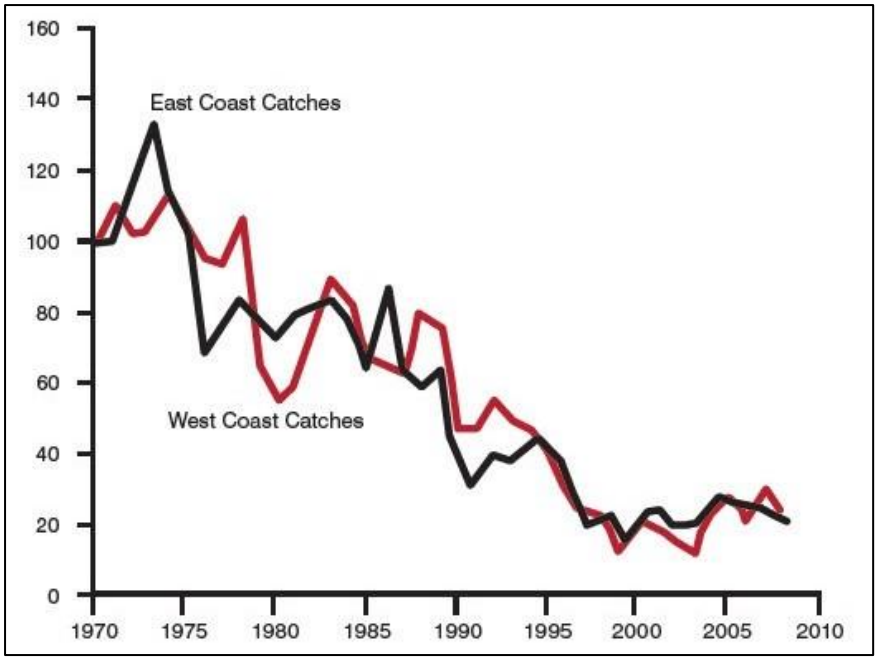
For reference, it is possible to see the relationship between net exploitation and exploitation by rod and line.



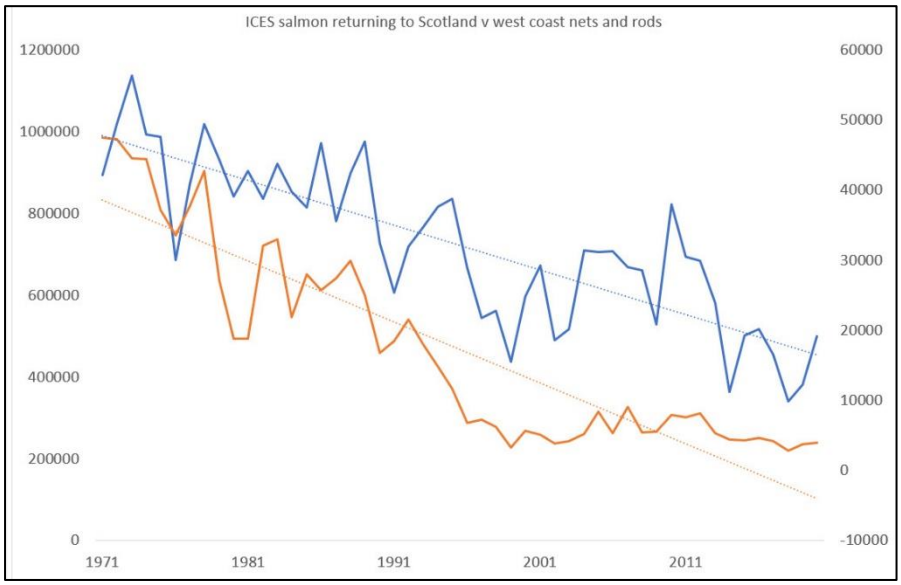
In 2011, the Rivers & Fisheries Trusts of Scotland produced the following graph based on percentage change from 1970 of catches from both east and west coast. They argued that whilst east coast catches had increased (which we know was due to a reduction in net exploitation), the catches from around salmon farms had declined which they said must be due to the impact of aquaculture (red – east coast, blue west coast).



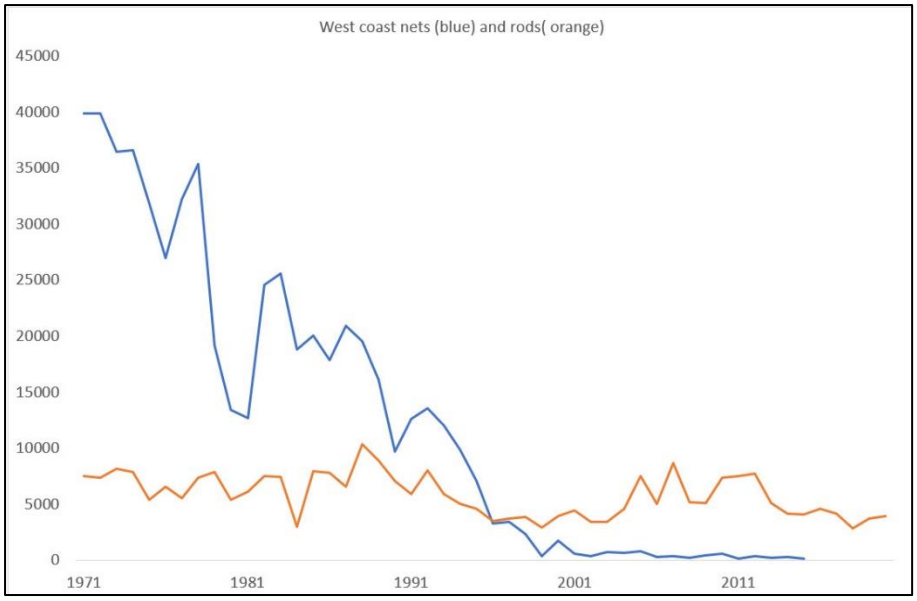
However, comparison of exploitation of both coasts using rod catch data is misleading since netting has had a major impact on stocks. The following graph shows that that the decline in total catches for the west coast is almost a mirror of that of east coast stocks.



When the total exploitation of west coast stocks is compared to the ICES decline of returning salmon, the decline of west coast stocks can be seen to be greater when trend lines are compared. However, the number of west coast salmon exploited by nets and rods has remained relatively stable since the mid-1990s. This would imply that aquaculture has had a neutral impact on stocks during the period of greatest expansion.



The final graph shows the changes in exploitation rate for both nets and rods on the west coast. The rod catch has remained relatively stable for most of the period since 1952. There has been a slight decline in more recent times, but this is not unexpected given that the east coast stocks have collapsed during the same period. Salmon stocks across all of Scotland are suffering from reduced numbers of fish.



It is worth including the following graphs from the 2015 fisheries statistics report which included graphs of fixed engine and net and coble catches. Marine Scotland Science have also included fishing effort on these graphs which might suggest that catches have declined because of reduced fishing effort but more likely is that fishing effort has declined because the netsmen are not catching sufficient fish to make fishing economically viable.

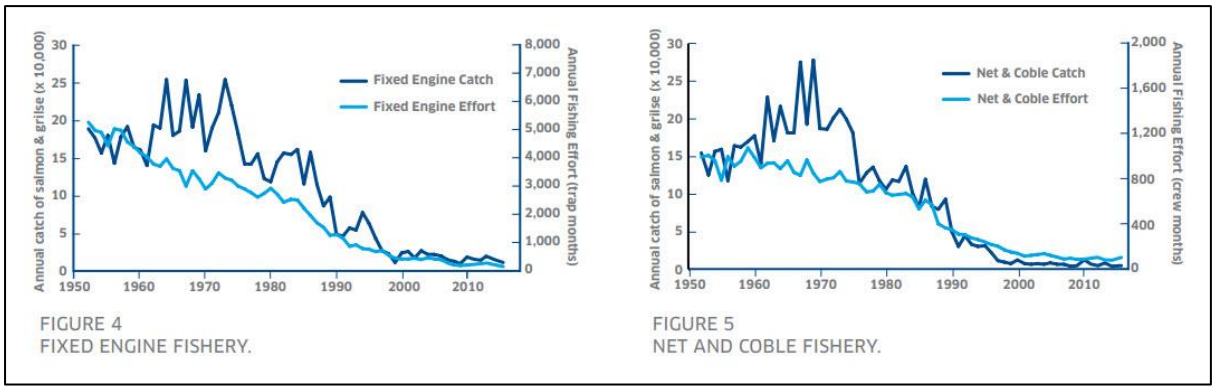


FIGURE 4
FIXED ENGINE FISHERY.

FIGURE 5
NET AND COBLE FISHERY.

Priority Wild Salmon Protection Zones

SEPA's consultation document highlights 8 wild salmon protection zones that they say are of special concern. The follow review considers what we know about wild salmon in these zones. The following information is supplied where available. These include:

For each river within a zone, the Scottish Government's recent catch data graph

A description from the most two recent angling guides. Mills & Graesser (1981) and Bruce Sandison (2013). This edition is update from 1997 although many of the entries remain the same. Mr Sandison was a very vocal critic of salmon farming writing about the alleged negative impacts of salmon in the angling press. His guide includes many references associating the declines of wild fish to salmon farming. The entry for the river Applecross states that the river has been closed to fishing of the past 10 years; almost certainly, in this writer's opinion, caused by sea lice infestation from fish farms.

When challenged, Mr Sandison could not provide a shred of evidence to support this claim. Undoubtedly, the claims made in the guide are just Mr Sandison's opinion.

The rod catch data for the fishery district. The Scottish Government only publish catch data for fishery districts and requests for river specific data have been declined and referred to the Information Commissioner. No proper assessment of salmon rivers can be made without detailed information about catches. The Scottish Government have written that such catch data is the only way that stocks of salmon can be assessed in many Scottish rivers.

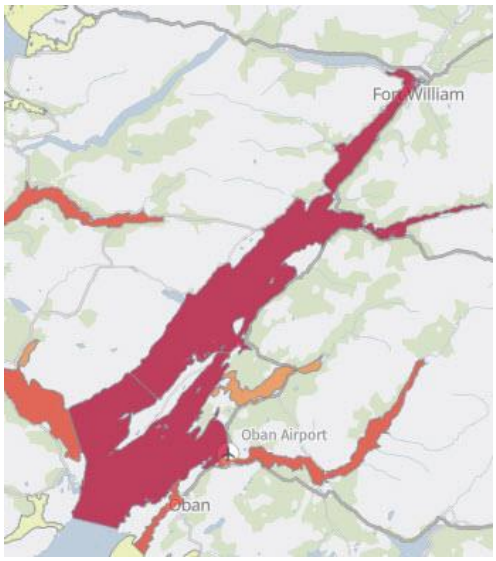
The net catch data, although not river specific, shows extensive depletion of fish stocks over many years. Netting continued on the west coast until 2015.

The rod catch data for sea trout for relevant fishery districts.

Sea lice sampling data in those zones where sampling has occurred. The data is taken from the Scottish Government's list of sampling from 1997 to 2019. In some cases, sampling occurred over a short period with only small numbers of fish being caught. Across the west coast, an average of just under 50% of sea trout caught are lice free with many more carrying just one or two lice. Fish carrying high numbers of lice, often prompted by the wild fish sector as proof of damage are very much a minority. Sea lice amongst host fish are distributed as an aggregated distribution in which the majority of hosts carry the minimum number of parasites, and the minority of hosts carry the majority of parastates. This is the definition of what is a parasite.

1. Loch Linnhe System WSPZ

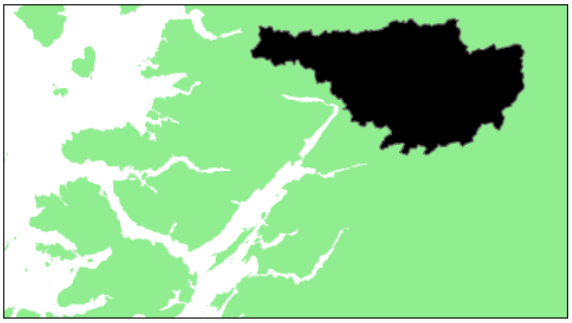
The exact boundaries of the Loch Linnhe System are unclear.



Lochy Fishery District

The Lochy Fishery District is unusual as it is not continuous with separate areas at the head of the loch and on both east and west banks. Definition of exactly which rivers fall within any fishery district are hard to come by but there are three rivers that are of interest to salmon anglers, the Lochy, The Spean, and the Nevis.

River Lochy



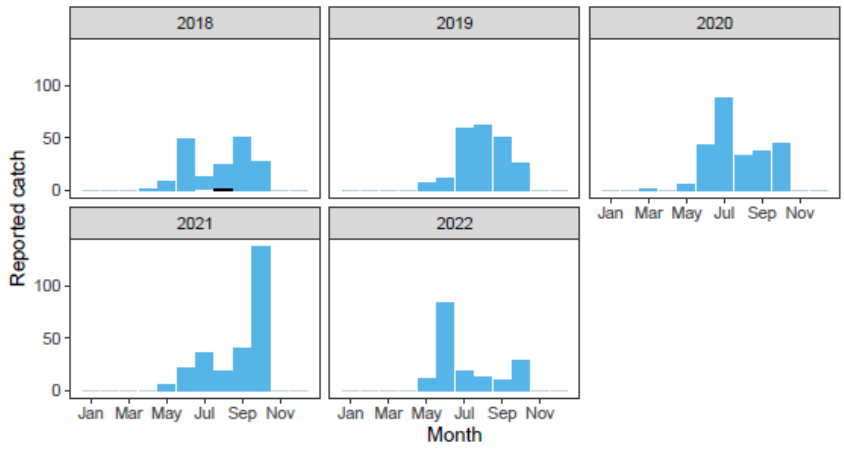
The preeminent salmon river of the Linnhe System is the river Lochy. Fish Pal, the leading salmon fishing booking site currently describes the Lochy as:

There are few rivers in Scotland that can rival the river Lochy and what it offers to the salmon angler. From its majestic views of Ben Nevis and the surrounding mountain landscape to its choppy gravelly runs, beautiful clear deep pools, and tantalising glides, it's quite simply a fly-fisherman's paradise. If you seek variety, space, seclusion, and tranquillity then it's all here in abundance. However, salmon fishing on the Lochy is not all about relaxation and admiring the views. This river has some seriously big salmon running its course. These fresh run fish represent the greatest challenge in salmon fishing; hooking them isn't easy but landing them is even harder. It takes skill and patience, but this is what salmon fishing is all about.

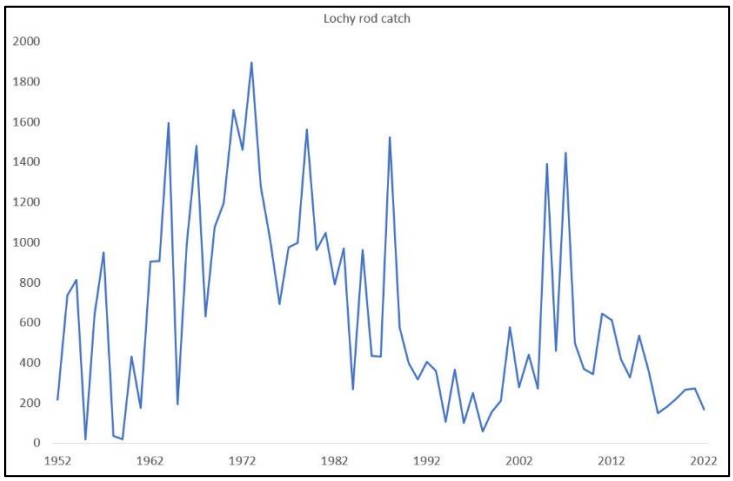
It is little wonder that the late great John Ashley-Cooper crowned the Lochy the "Queen of Scottish Rivers".

There is no indication that the river has suffered as a result of the presence of salmon farms in the Linnhe System. There are three farms currently in the Linnhe System that were established during the 1980s. These are Linnhe in May 1983, Kingairloch in May 1984, and Gorsten in October 1985. There is an older farm in the Leven, and offshoot of the Linnhe which was established in September 1980. This will be considered with the river Leven.

The catch data for all rivers in the Lochy Fisheries District are combined but Marine Scotland Science consider requests for individual river data to be 'manifestly unreasonable'. However, Marine Scotland Science have provided the catch data for the river Lochy since 2018 as a graph as part of the conservation grading process. The black line represents retained fish.



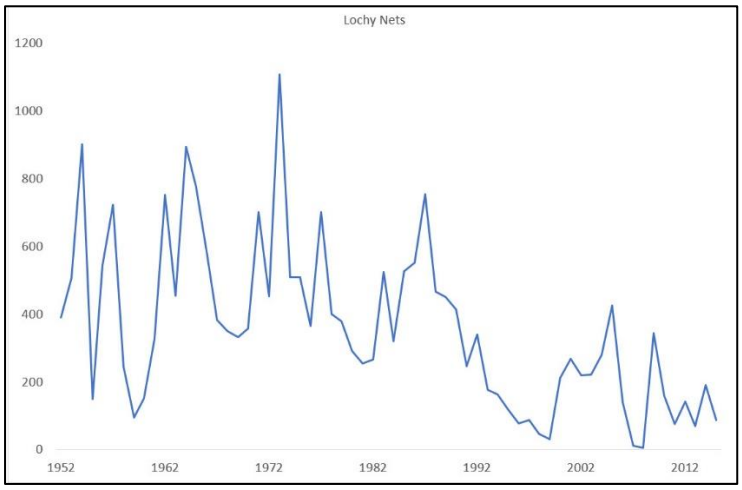
In the absence of river specific catch data for the period since records began in 1952, the following graph shows the rod catch for the Lochy Fishery District.



This data can be considered in a number of ways. The dip in the late 1990s is not unique to the Lochy but is repeated across the whole Aquaculture Zone. Marine Scotland Science have written that this drop is consistent with there being an impact of salmon farming on wild salmon (Middlemas, Smith and Armstong 2016) but even their report shows a subsequent increase in catches as illustrated by the Lochy. If salmon farms are having an impact, then why has this impact not been reflected in salmon catches since? Had Marine Scotland Science collected angling effort, they might have seen that the lower catches during the 1990s were more likely to be due to reduced presence of anglers. Some of the angling organisations had suggested that salmon farming had caused a stock collapse on the west coast, and they therefore chose to fish in rivers elsewhere which might be more reliable in producing a catch. Reports later filtered through that the fishing was still good on the west coast so anglers began to return and catches improved. The likelihood of all farms producing high lice numbers alleged to kill wild fish at the same time, is remote.

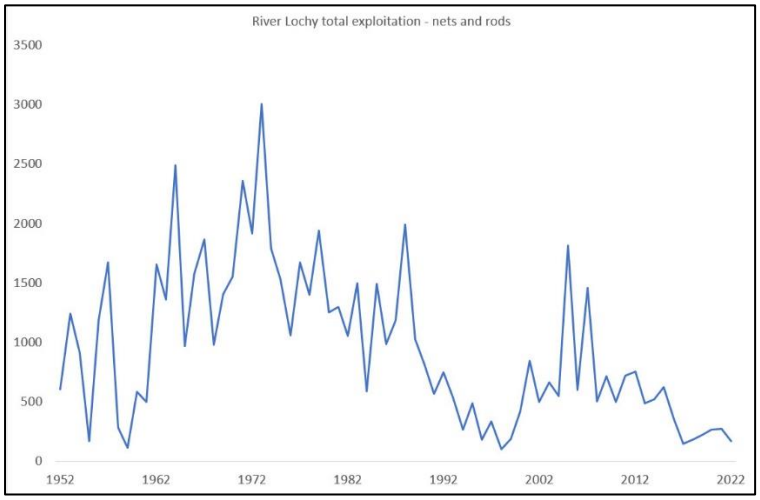
However, the most obvious trend is the decline in catches from the early 1970s, at least ten years before salmon farming arrived in the Linnhe System.

These catches cannot be viewed in isolation as there has been another form of exploitation that has been ignored in the debate over the impact of salmon farming. This is commercial netting, which continued in the Lochy Fishery District until 2015.



As with rods, the netting has also declined from the early 1970s with a small resurgence in the 2000s. Since records began in 1952, a total of 46,061 fish have been removed from the Lochy Fishery District by netting. More significantly, 16,214 adult fish have been removed since salmon farming was established in the Linnhe System. A further 8,248 have been removed by anglers using rod and line. This means that the Lochy has lost 24,462 adult salmon and grilse since salmon farming appeared in the Linnhe System.

The total exploitation of the Lochy can be seen in this final graph:



This confirms that although there was a slight resurgence during the 2000s, and despite the presence of salmon farms, this resurgence has now disappeared. The river is now classified as Grade Three.

There are a number of books detailing salmon fishing in Scottish rivers. They can provide a glimpse of the status of any river at a moment in time. The most recent is by Bruce Sandison – Rivers and Lochs of Scotland. It is worth noting that Bruce was an active campaigner against salmon farming and his views, not supported by facts, are reflected in his book. The second edition (2014) states that the river provides fishing for salmon and sea trout, although he says that there are very few sea trout now caught due to the impact of factory salmon farming (and he refers to Loch Shiel and Loch Eilt as examples). Regarding salmon he says that a restoration programme has resulted in a significant number of salmon returning to the river including fish of over 25lb. He adds that escaped farmed salmon are still a problem, but the river has recovered much of its former status as one of the most useful salmon rivers in the area.

However, despite the restoration programme, catches have continued to fall much in line with declines across all of Scotland.

Mills & Graesser – The Salmon Rivers of Scotland, also refer to the Lochy (1981). They make the point that anglers often congregate not far up the river near the tailrace from the Aluminium smelter as the water flow is often much better there. The smelter was opened in 1929 and is fed by a 24km long pipe from Loch Treig. There is not much reference to this smelt although a second one on the Leven has been blamed on reductions of fish numbers.

Mills & Graesser make reference to the salmon recorded at the Mucomir Power Station counter providing a table of numbers that show a clear decline.

	Salmon		Salmon
1963	951	1972	652
1964	621	1973	601
1965	959	1974	444
1966	576	1975	455
1967	553	1976	463
1968	286	1977	262
1969	676	1978	231
1970	550	1979	184
1971	615		

The book also references sea trout numbers in the Lochy which they suggest offers a good run of fish. However, Picken (1987) points out that the river had been harnessed during the 1960s for hydro power with the construction of the Mucomir Power Station. Picken includes a graph that indicates a steady decline of sea trout and a note that most of the fish are finnock.

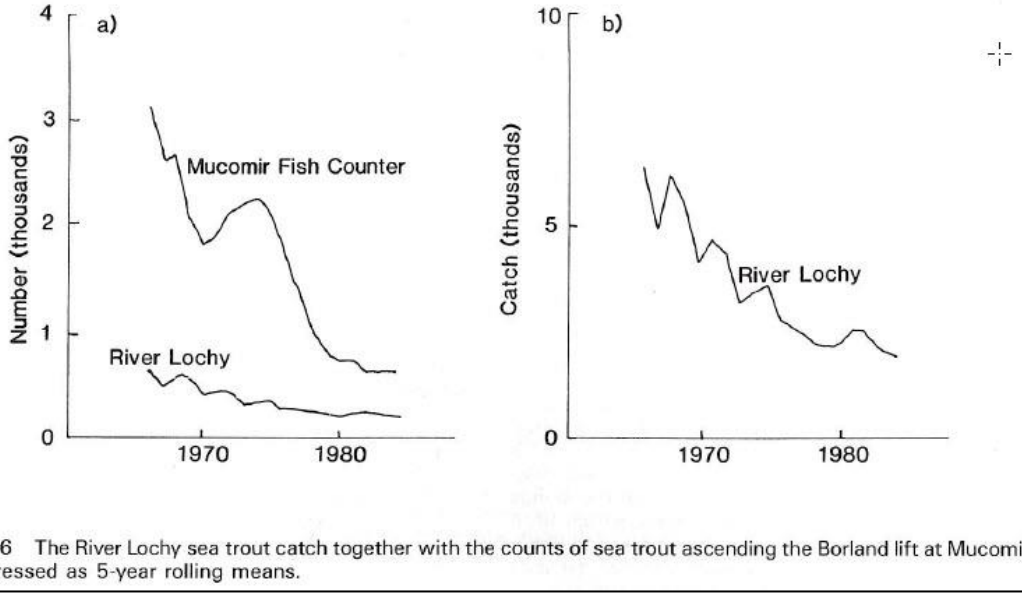
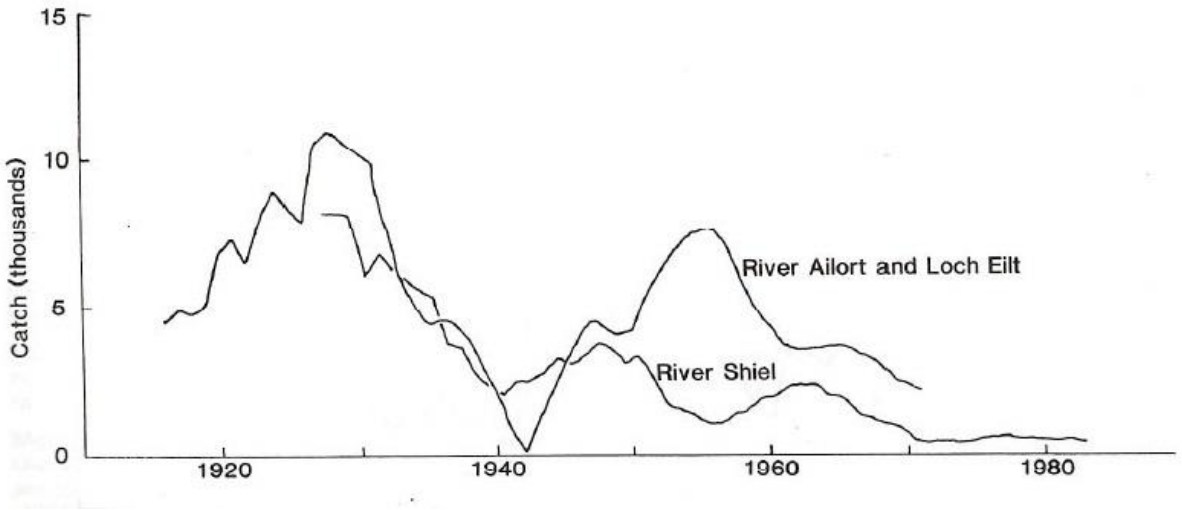


Fig. 6 The River Lochy sea trout catch together with the counts of sea trout ascending the Borland lift at Mucomir expressed as 5-year rolling means.

Picken also includes a graph of sea trout catches of sea trout catches at Loch Eilt. This is the loch that Bruce Sandison referred to as an example of a collapsed fish stock due to the influence of salmon farming.

The entry in his book specific to Loch Eilt states that 'This once famous sea trout fishery has been ruined in recent years because fish farm sea lice attack on wild salmonids. It is now only worth fishing for brown trout.' He also writes about Loch Shiel that the 'loch and the river used to be world famous fisheries particularly for sea trout, but recent years have seen a catastrophic decline in salmonid numbers. Catch numbers on the river are insignificant. Pollution and disease from fish farms on this migratory route of Shiel fish has been blamed for this disaster.'

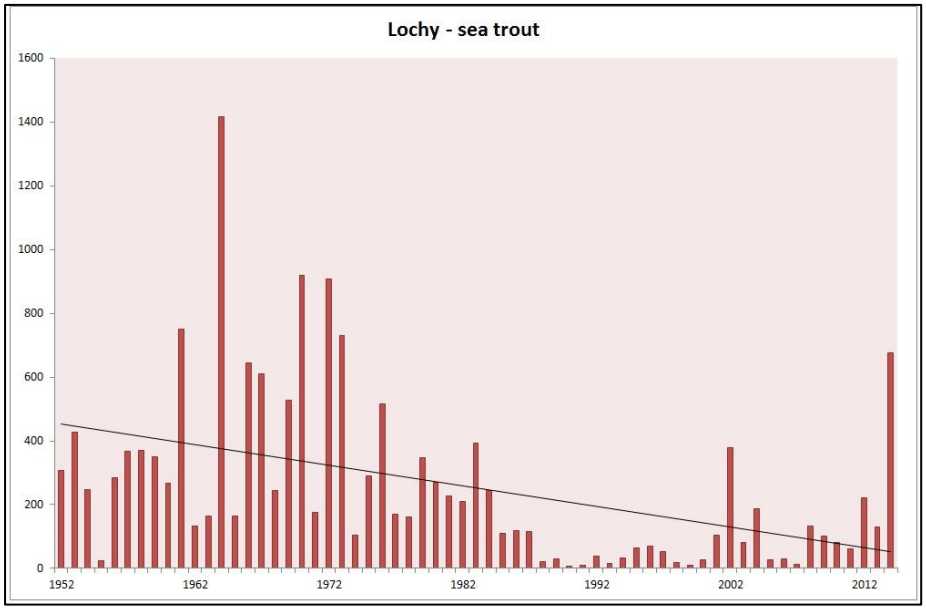
Picken also includes a graph of sea trout catches from both the Shiel and the Eilt. The graph was drawn up before the arrival of any farm (Except the original test farm in 1968) in the area and shows that sea trout have been in long term decline in these fisheries.



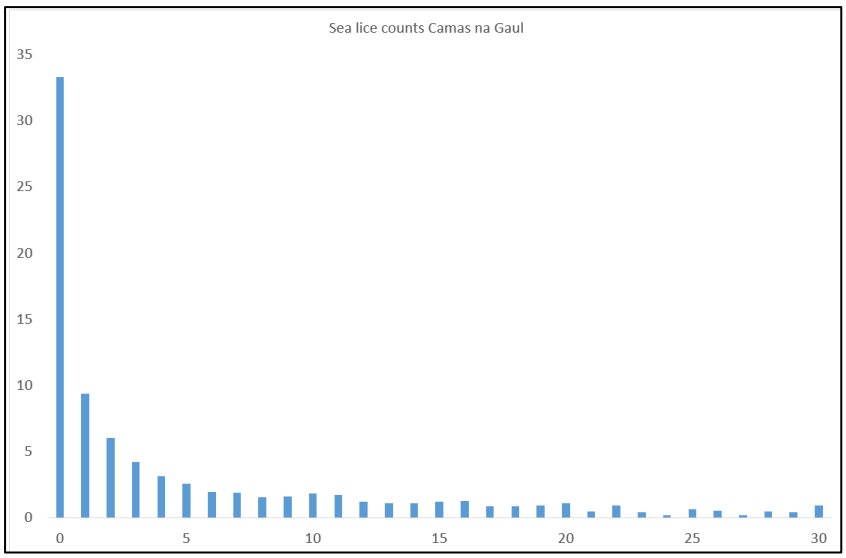
This illustrates the unsubstantiated blame placed on the salmon farming industry for collapses of would fish numbers that occurred long before the arrival of salmon farming.

Mills & Graesser mention that the River Lochy Association have the rights to net the river but choose not to do so. However, there is one net and coble fishery at the head of Loch Eil and a bag station at Corran.

Sea trout catches can be seen to have declined before salmon farming arrived in Loch Linnhe in line with regional declines.



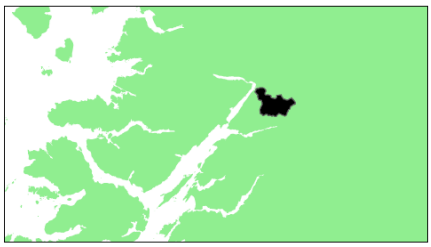
The local fishery trusts have been sampling various locations around Loch Linnhe for sea lice infestation on sea trout. The site at Camas na Gaul opposite Fort William has been sampled for 17 years. The graph shows the average percentage level of increasing lice infestation. The percentage of lice free fish for all sites can vary depending on the number of times sampled and the sample size.

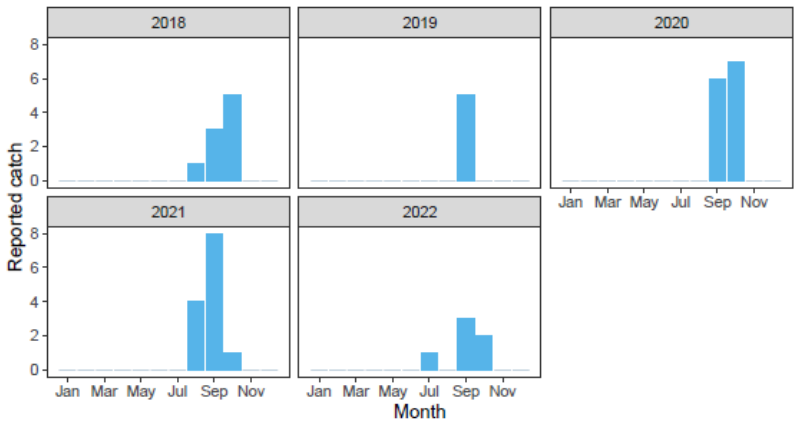


River Spean

Both Brice Sandison and Mills & Graesser agree that the salmon fishing in the river Spean was terminally damaged in the 1920s when the headwaters were impounded by the Aluminium Co and used to feed their smelter in Fort William. There is no compensation water. Fish might enter the river from the river Roy which enters the river above Spean Bridge.

River Nevis

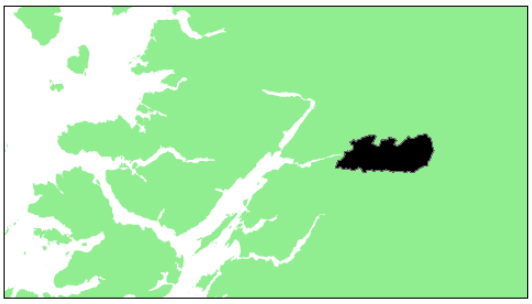


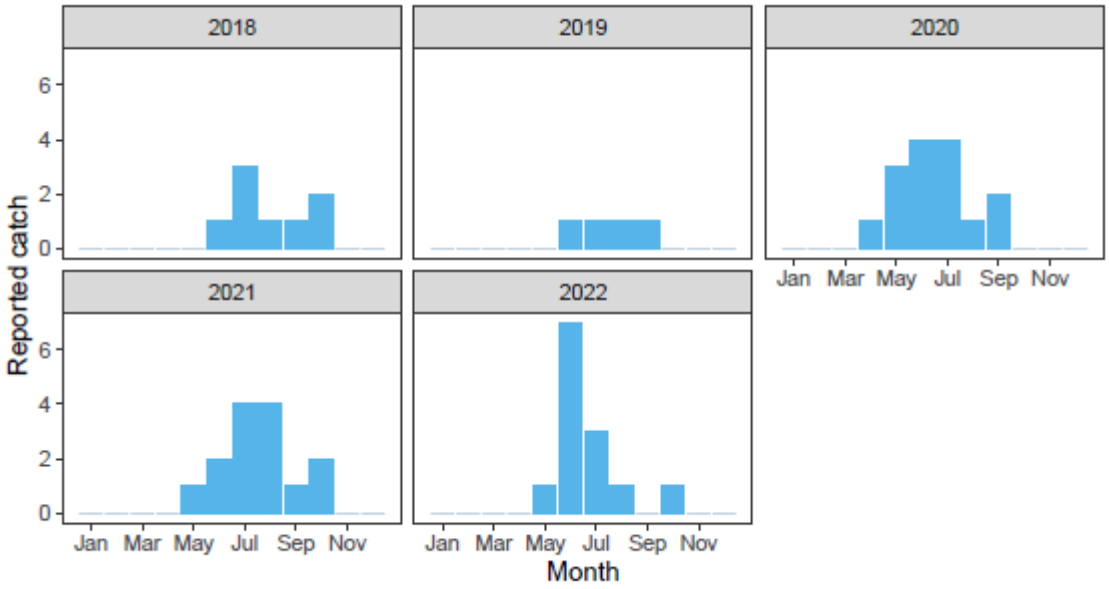


The river is a short river that flows directly into Loch Linnhe. Bruce Sandison writes that a in a good year, 20 fish may be taken but he blames the lack of sea trout on the presence of salmon farms. The most recent catch data suggests otherwise with a maximum of 8 salmon a year. The river is now classified as Grade Three.

Leven Fishery District

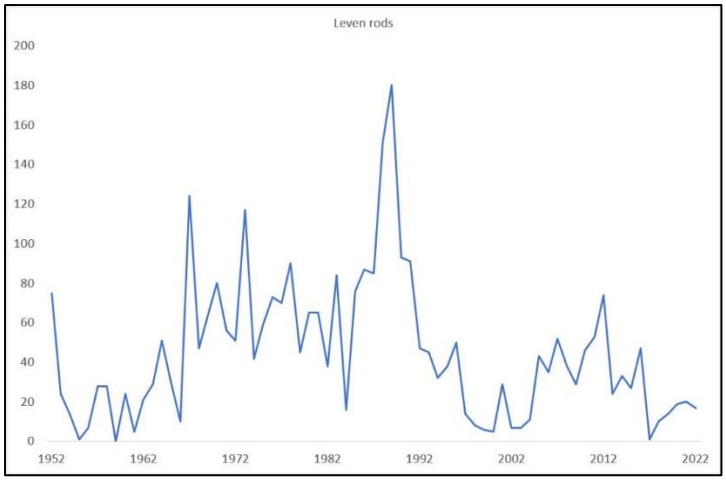
River Leven





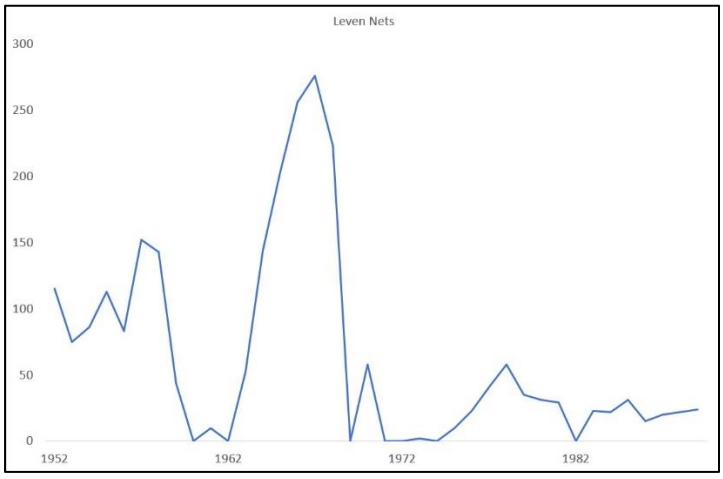
The river Leven has been classified as a Grade One River for the 2024 season. Until the 2021 season, the river was a Grade Three river but for 2022 it was upgraded and now it is considered to be of the highest conservation status. Catches of salmon from the river are compatible with those from the nearby river Nevis which is a Grade Three river.

The number of fish caught for the whole Leven Fishery District by rod and line are shown in the following graph:



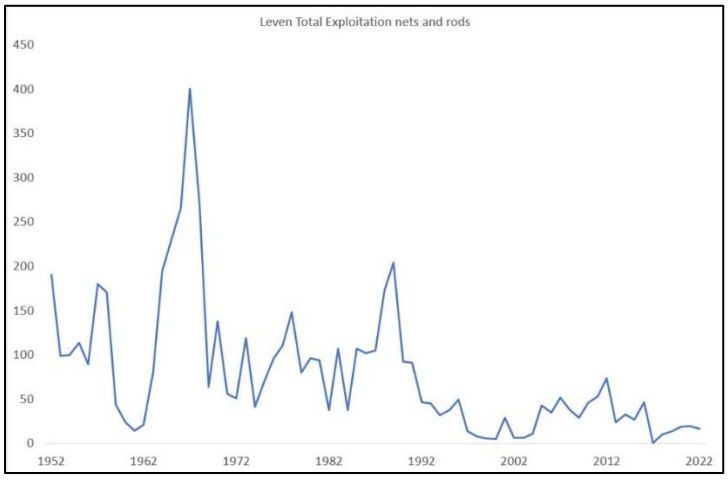
It might be suggested that the catches have declined since the arrival of salmon farming to Loch Leven in September 1980. However, catches did not start to decline until twelve years after the farm was established.

Loch Leven has also been exploited by netting as the following graph shows:



The netting has been subjected to peaks and troughs with some years where the nets were not operated.

The total exploitation of Loch Leven by nets and rods is illustrated as follows:

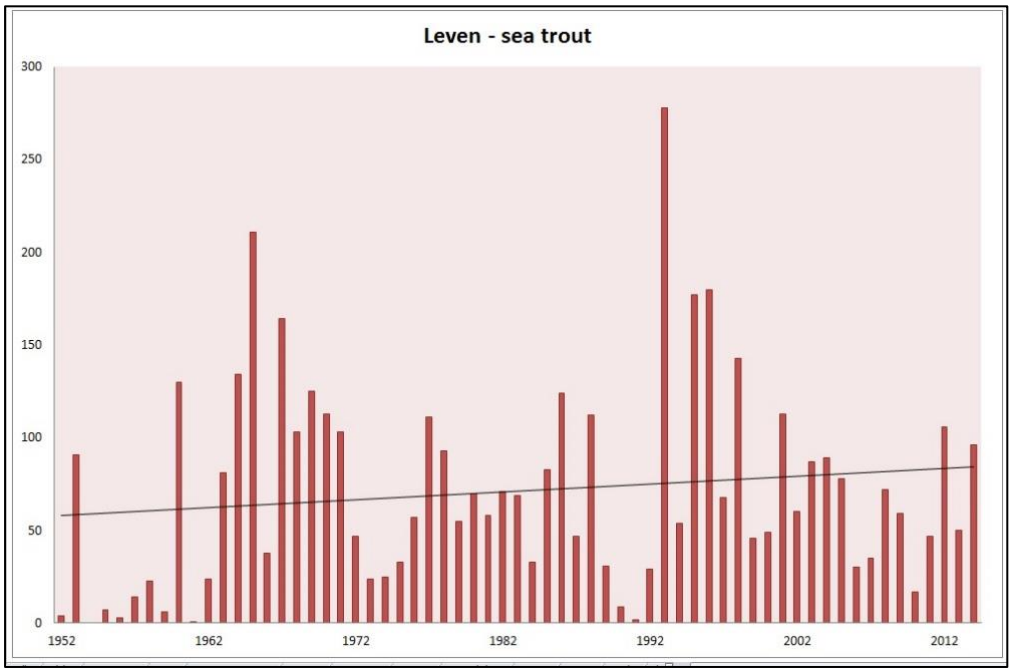


With the exception of a couple of peaks, the Loch Leven Fishery District catches have been in decline since records began in 1952. How this is now classified as a Grade One river is unclear.

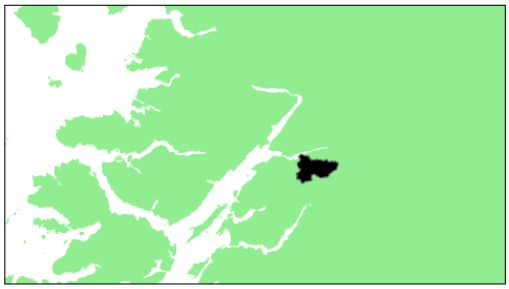
Mills & Graesser point out that much of the river Leven's course is now taken up by the Blackwater Reservoir which was formed to supply water to the Aluminium factory at Kinlochleven which was opened in 1907. They say that the main run of fish is in September but the impacts of water impoundment, poaching and sea netting means that the runs are not even as good as they were in the 1950s.

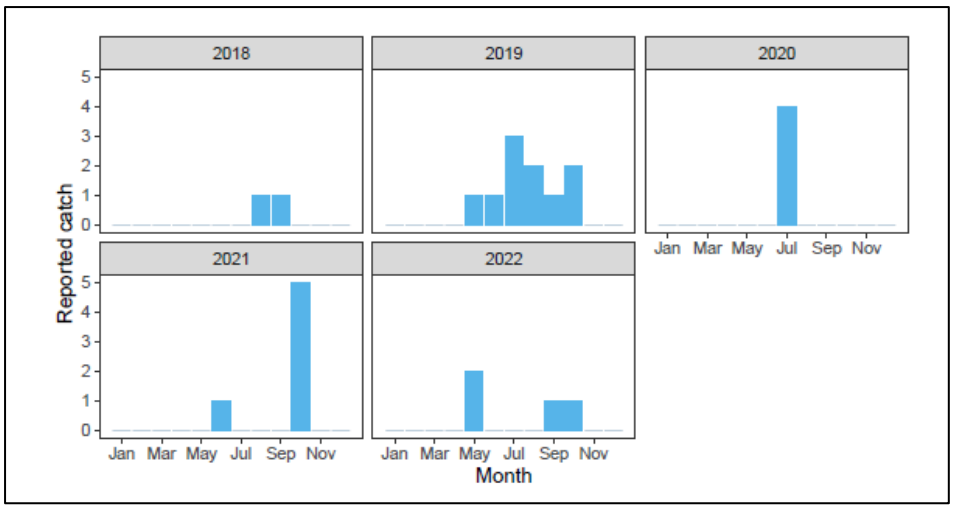
Bruce Sandison suggests that in a good year 20 fish could be caught but he says that the river is a poor shadow of its former glory, He suggest that now that the smelter is closed, the situation for salmon may improve provided they can survive fish farm pollution and disease.

Overall sea trout catches have increased during the time salmon farms have been in the vicinity. This has bucked the national trend.



River Coe

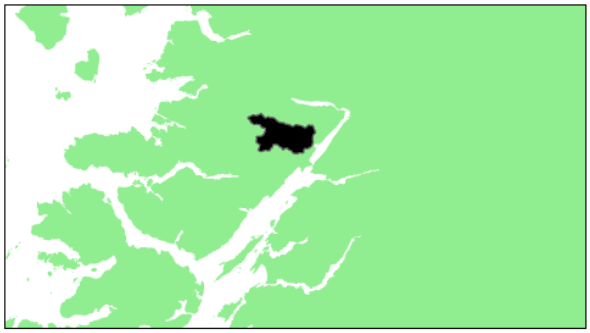




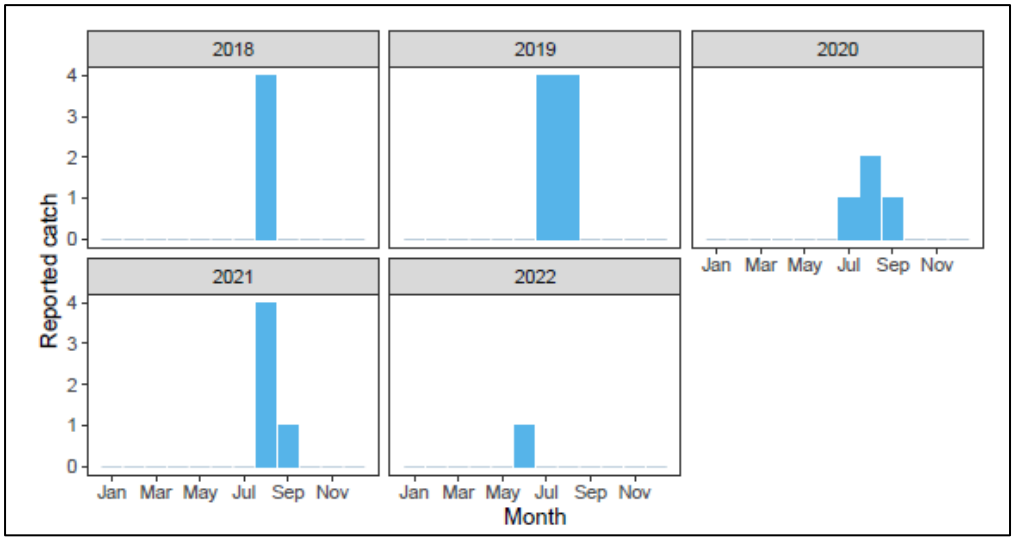
Bruce Sandison describes the river Coe as a little spate stream that reaches the sea at Glencoe. He says that salmon runs have collapsed in recent years and that few fish are seen, let alone caught.

Scaddle Fishery District

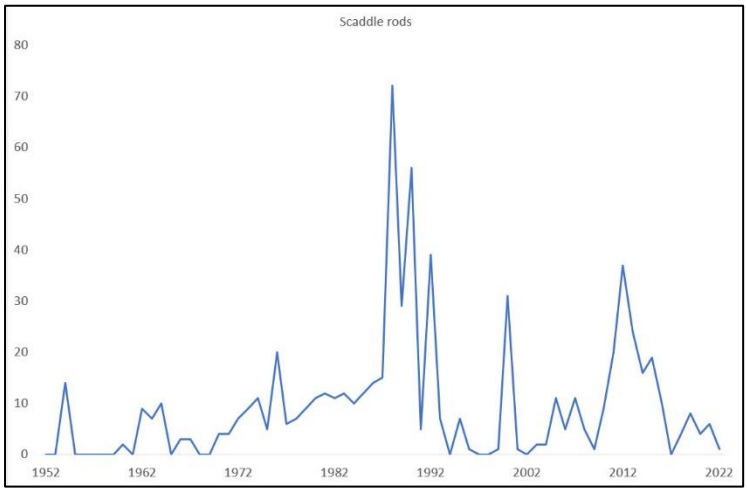
River Scaddle



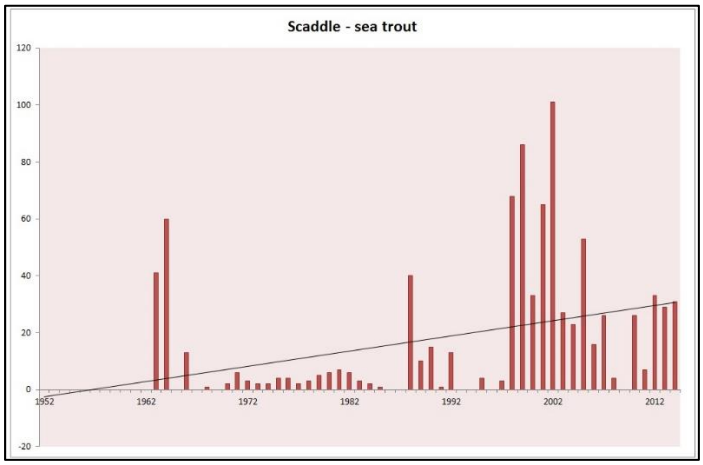
There is almost no information about the Scaddle Fishery District except that the neighbouring Ardgour Estate says that it managed two adjacent river systems. The river does not feature in any of the angling books on fishing for salmon in Scotland.



Although catches on the Scaddle are now low, they did jump significantly in the late 1980s, early 1990s which was well after salmon farming had appeared in the loch.



Sea trout catches were low long before salmon farming arrived in the loch but grew significantly after salmon farms began operations.



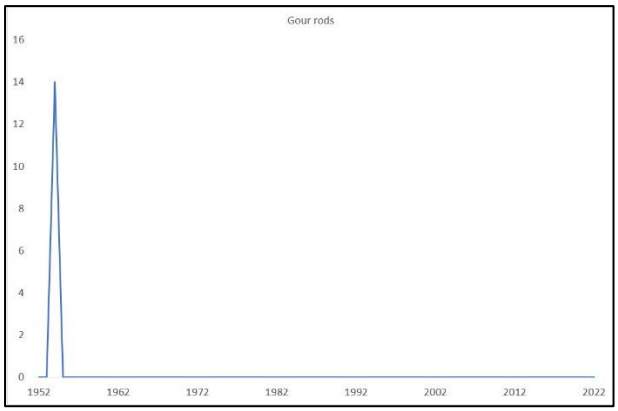
Gour Fishery District

River Gour

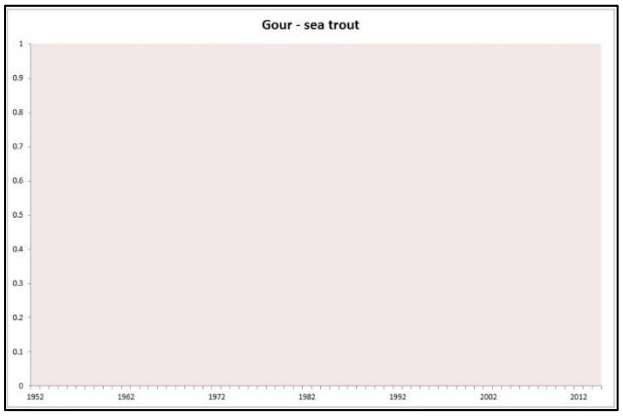
Like the Scaddle, the adjacent River Gour is not mentioned in any of the fishing books. In addition, the Scottish Government do not collect any fishing data for the river.

District	River Name	Outflow point	2019	2020	2021	2022	2023	2024 - Proposed	Change
Gour	No individual river data held		No data	No data	No data	No data	No data	No data	No change

The historic catch statistics do however record a catch during the 1950s.



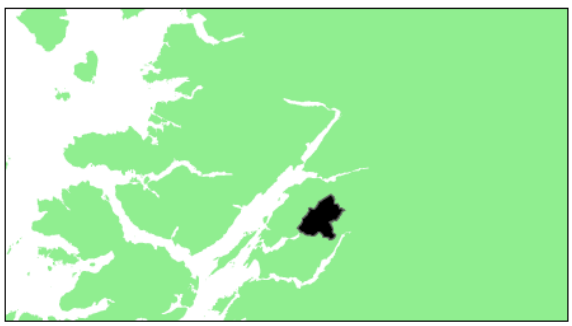
The Ardgour Estate discusses the 12-mile-long river Gour on its website. Its states that ‘At the river mouth, sea trout are a common catch. In recent years salmon have been caught in ever increasing numbers.’ This is despite the river being downstream of a long-established salmon farm.

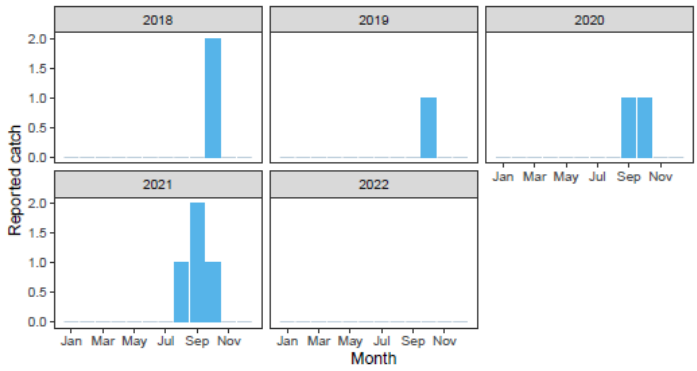


Other fishery districts

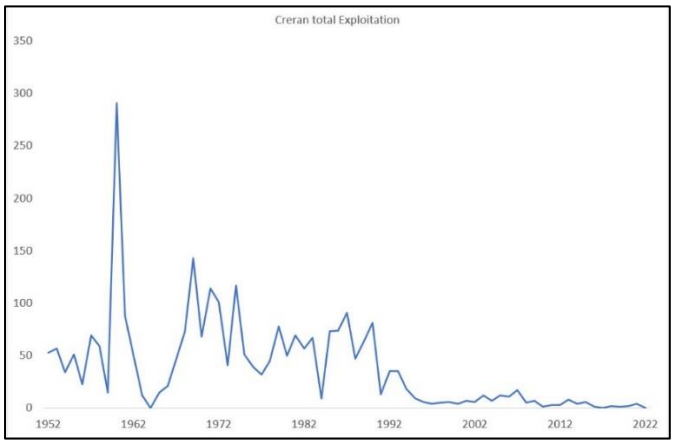
Other fishery Districts border the Loch Linnhe System, especially towards the open sea. All are rated at a lower risk than the main body of the Loch Linnhe. These include Creran, Awe, Lussa, Aline, and Nell. The river Etive is treated separately by the Marine Directorate but is art of the Awe Fishery District.

Creran Fishery District





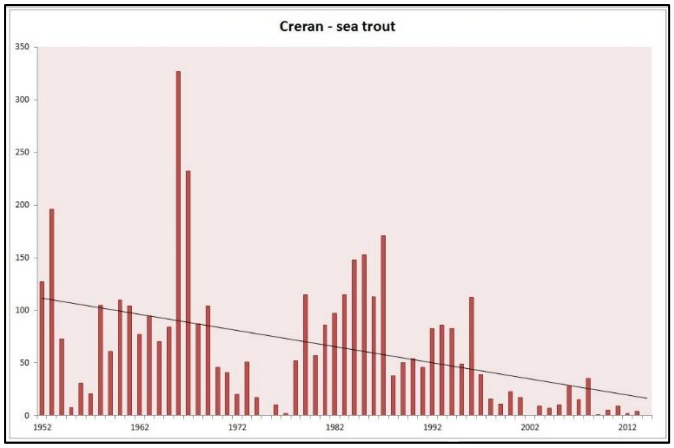
The nearest farm was established in 1983.



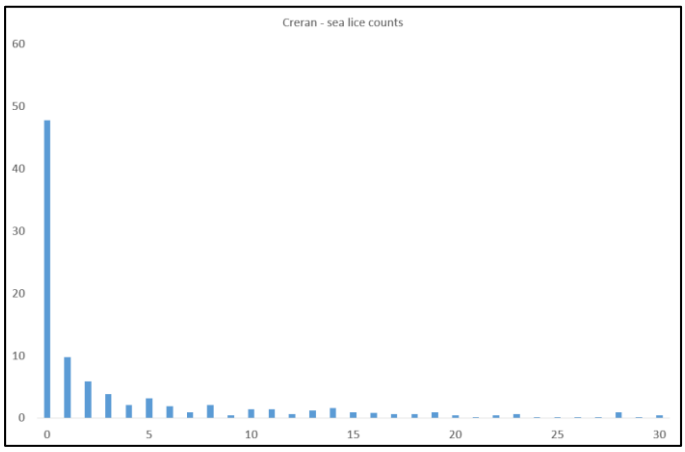
As might be expected, Bruce Sandison writes that 'Sadly however because of the impact of fish farms, wild fish numbers have collapsed in recent years, although he also says that accurate catch statistics are not available. The graph shows that salmon farms operate for at least ten years in the loch before wild fish numbers collapsed.

Mills & Graesser point out that the freshwater loch on the river is prone to silting up, with a negative impact on the river. They say that with proper management the fishing in the river could be substantially improved.

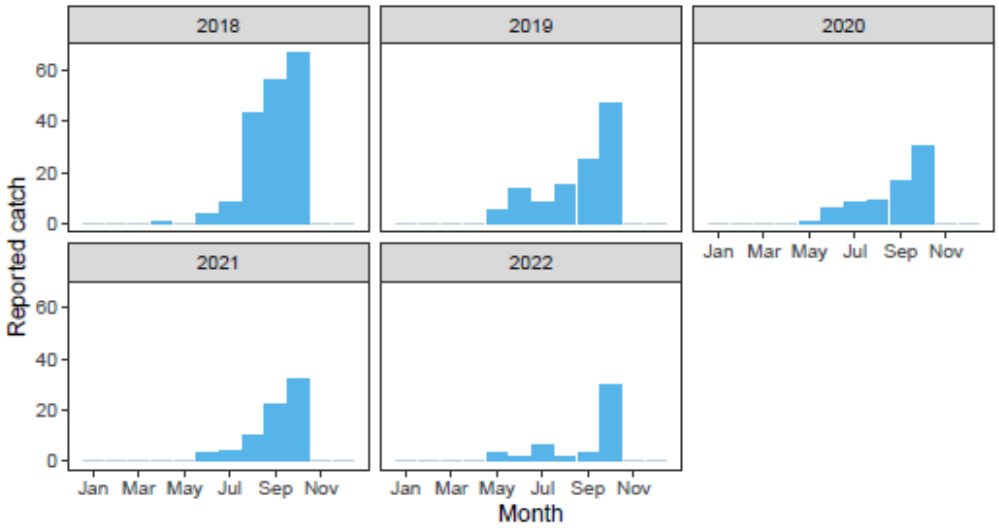
Sea trout catches have decline in the area in line with regional trends.



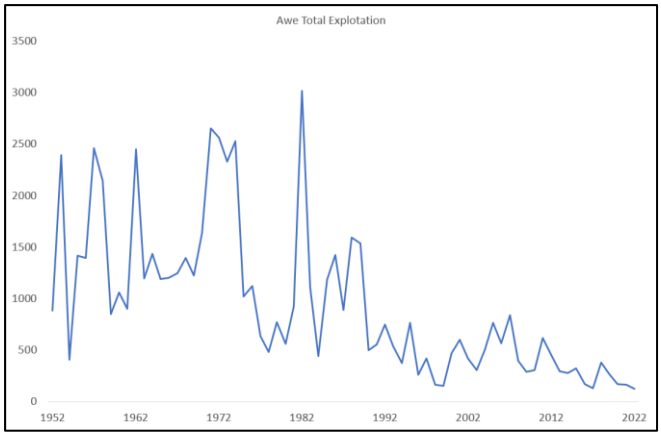
Sea lice sampling in Loch Creran for seven years from 2003 showed nearly half the fish sampled had no sea lice infestation and levels of remaining fish were mostly very low.



Awe Fishery District



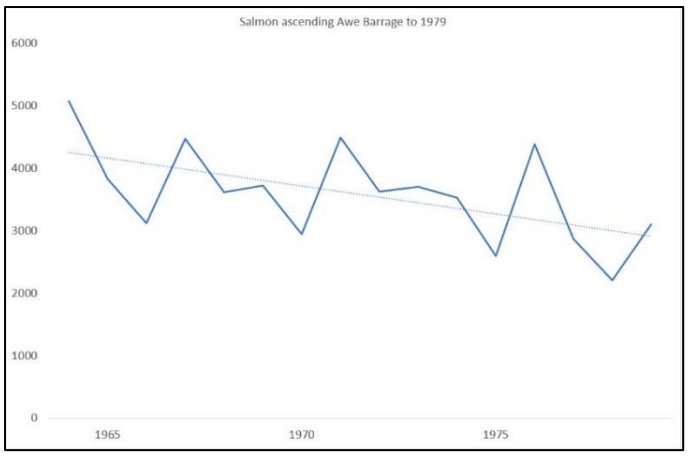
The earliest farm was established at Dunstaffnage in 1987 although it is some distance from the river mouth.



Bruce Sandison writes of the river Awe used to be famous for the size and quality of its salmon. Awe fish are now of a more modest size. In the 1960s, a barrage was built across the river to impound the river for hydroelectric power generation. This has altered the character of the river. He makes no reference to salmon farming.

Mills & Graesser highlight that there are also two other hydroelectric schemes on the Awe system.

They record annual counts of salmon ascending the Awe barrage from 1964 to 1979 which shows a clear decline.



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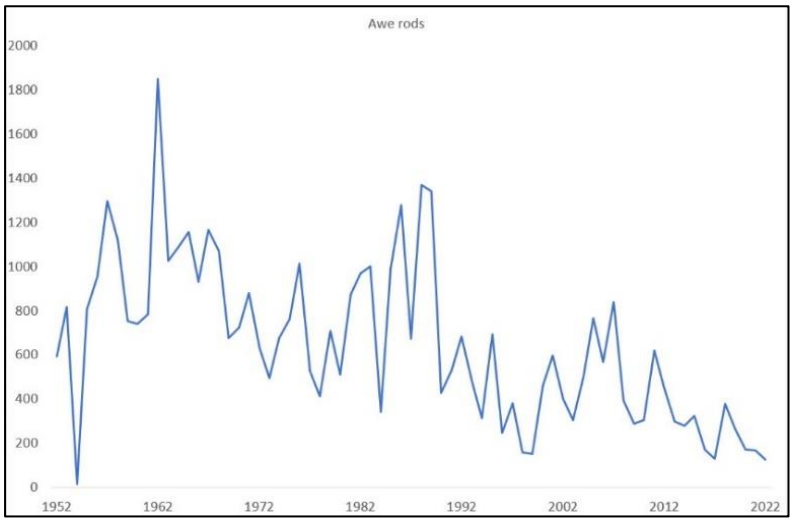
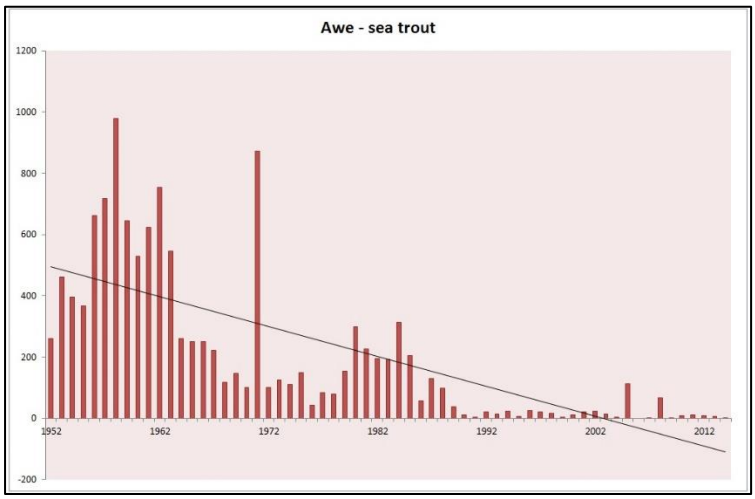
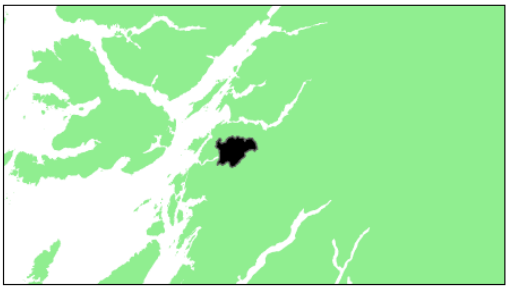
This decline is also apparent from rod catches (rather than total exploitation).

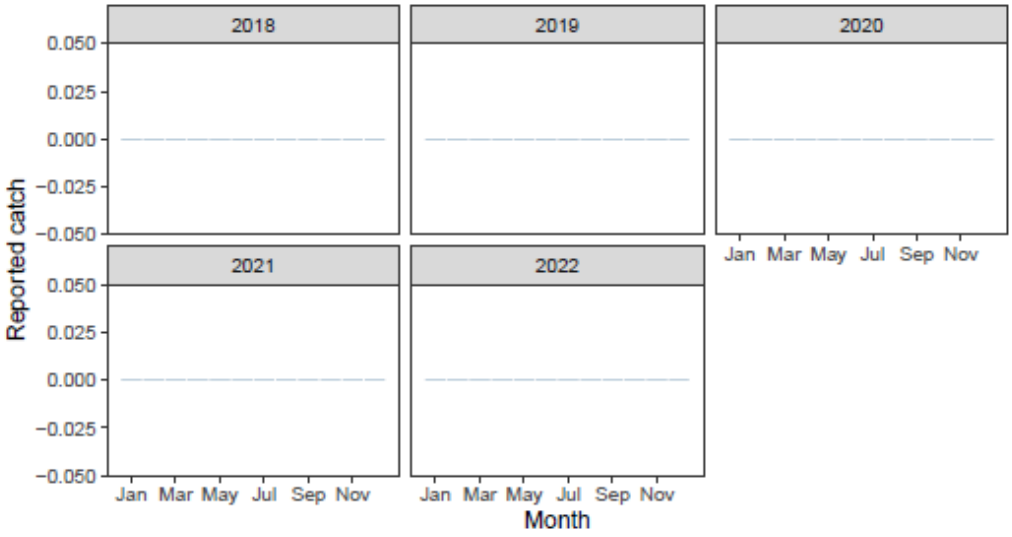


These declines occurred long before the advent of salmon farming. Sea trout declines also began long before ethe arrival of salmon farming to the area.

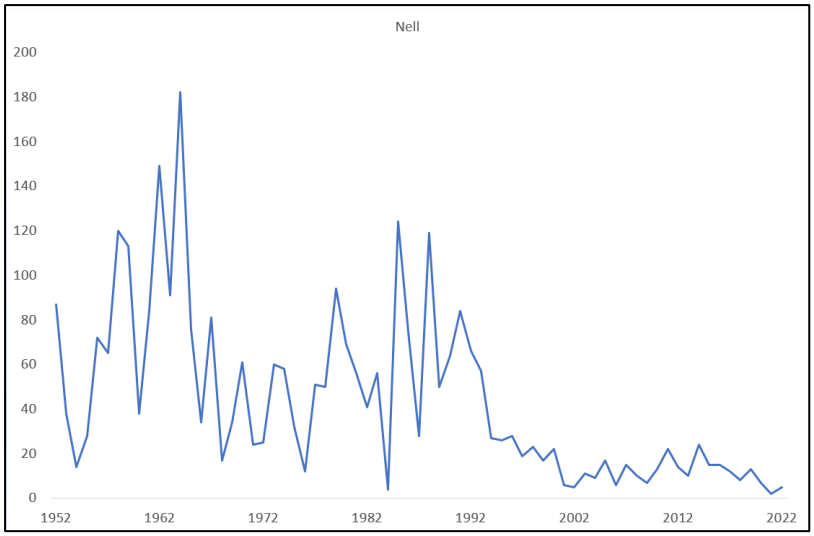


Nell Fishery District





No obvious nearby farms until late in the 1990s.

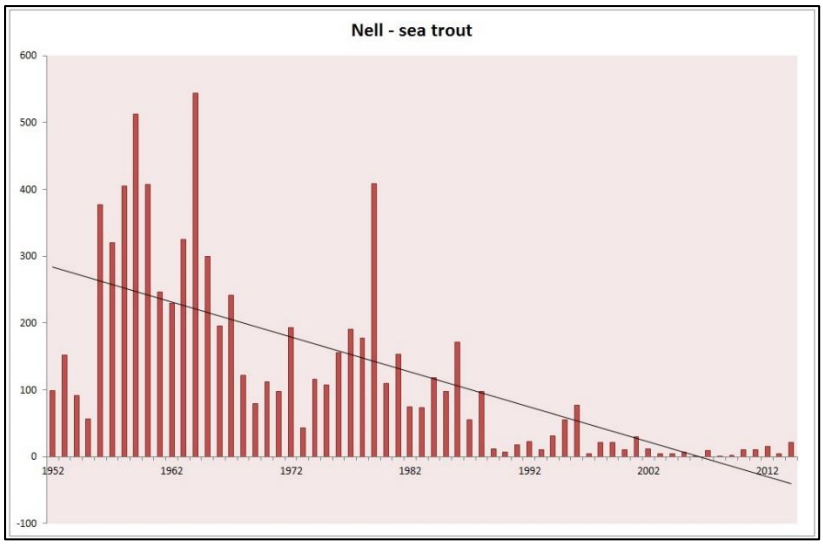


The river Nell is dominated by Loch Nell and its tributary Feochan Bheag. Bruce Sandison makes no comment on the fishing.

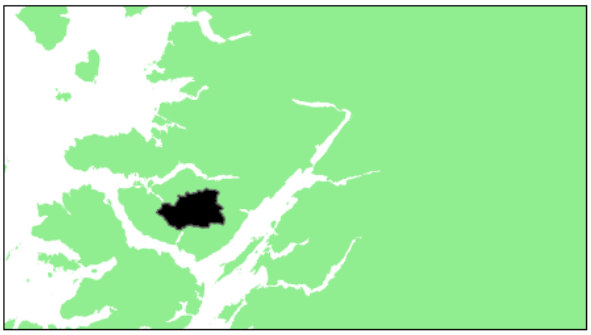
Mills & Graesser mention that since 1969, the river has been subject to an abstraction order to supply water to the town of Oban. The fishing has replied since on a compensation flow. In the mid-1970s, this flow was not enacted leaving the river dry.

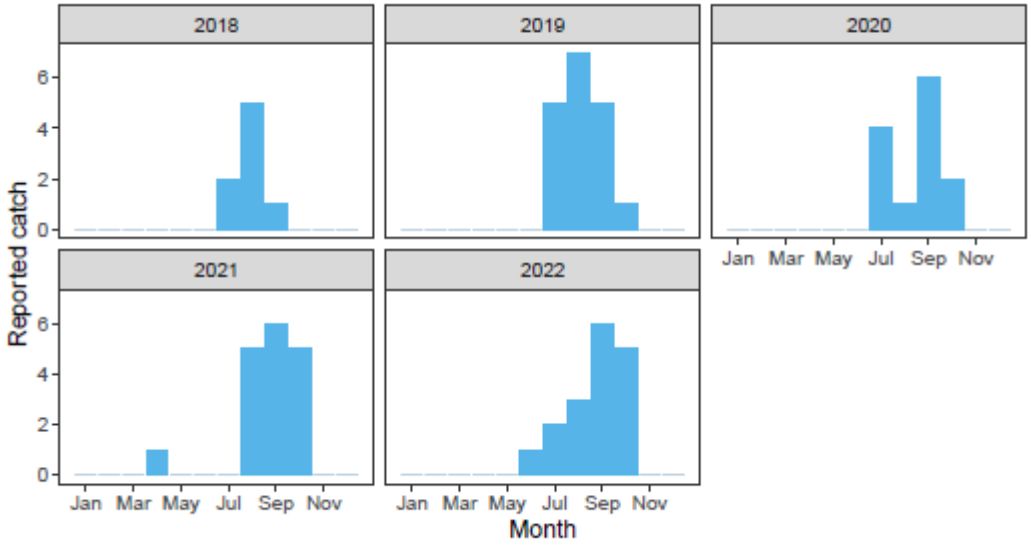
The Nell is a short river, but net and coble fishing took place in in Loch Feochan (Fixed engine netting occurred until at least 2001).

Sea trout catches have been in long-term decline from the 1950s.

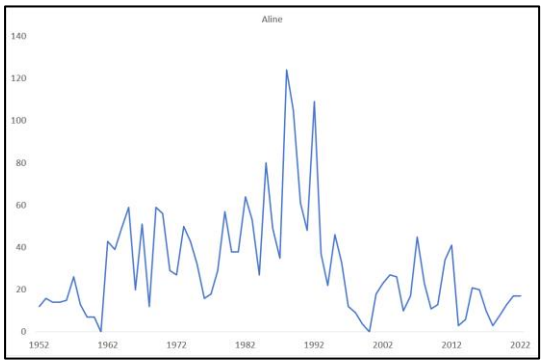


Aline Fishery District





The nearest farm was established in 1983.

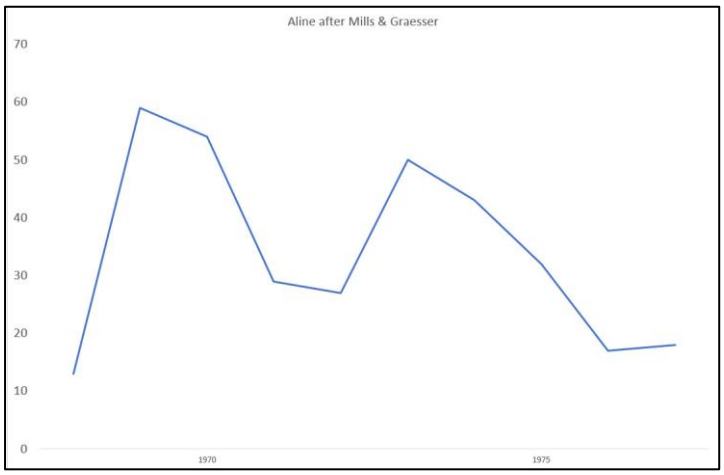


Salmon & grilse catches did not start to decline until at least ten years after the arrival of salmon farming to the area.

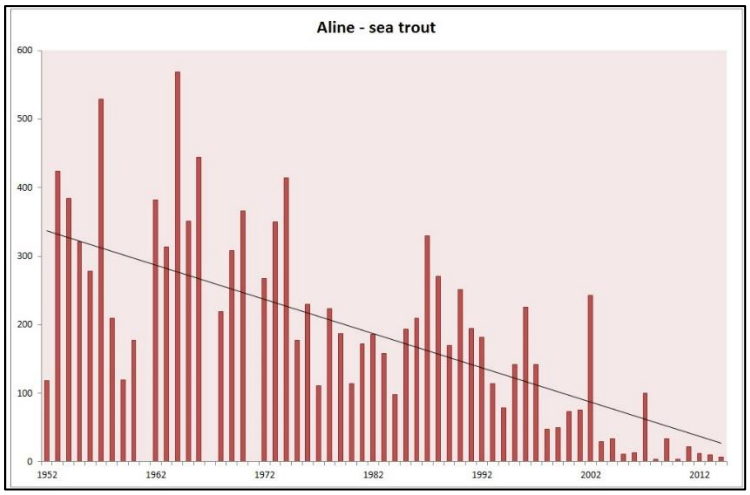
Bruce Sandison writes that the impact of salmon farming has seriously reduced the number of salmon and sea trout running this once famous little stream.

Mills & Graesser write that since the 1960s, eggs and fry were planted out into the river and in 1969 a dam was erected reducing the height of the falls and since then there has been a good run of fish.

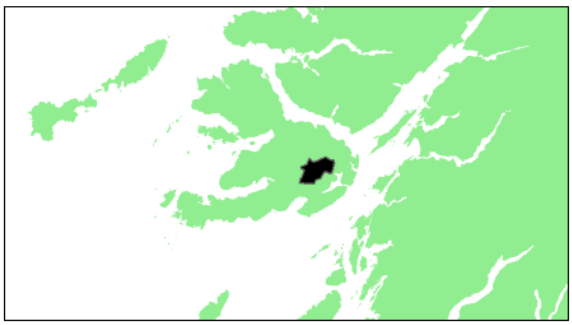
In 1974 a second dam was erected to improve the run further although with not as great a result. The authors include catch data from 1968 to 1977.

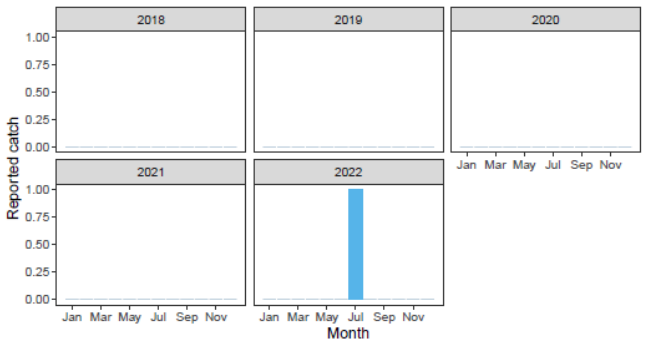


Sea trout catches have been in long-term decline since the 1950s.

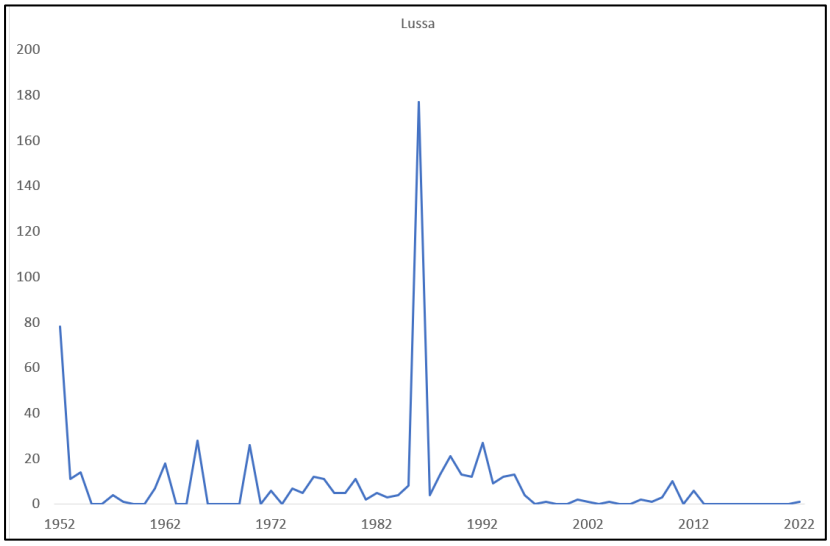


Lussa Fishery District





The nearest farm was established in 1983.

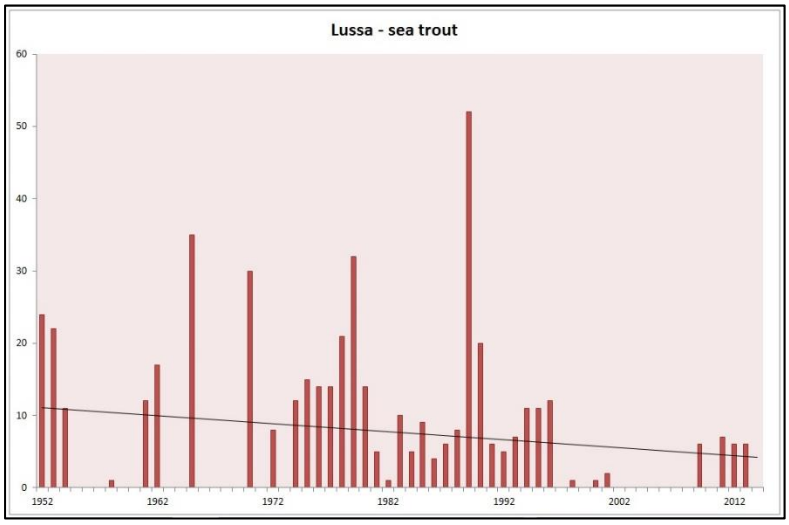


Other than one year with an unusually high catch, the Lussa has always produced low catches. The river declines from mid 1990s over ten years from the arrival of the nearby salmon farm.

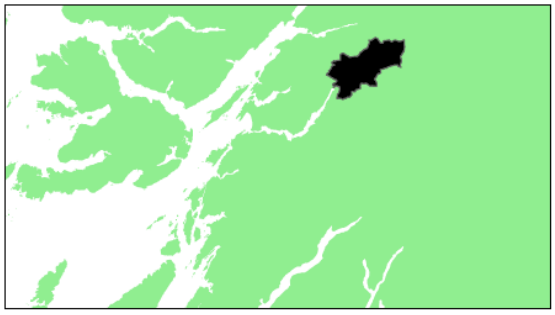
Bruce Sandison writes about the declines but makes no mention of salmon farming.

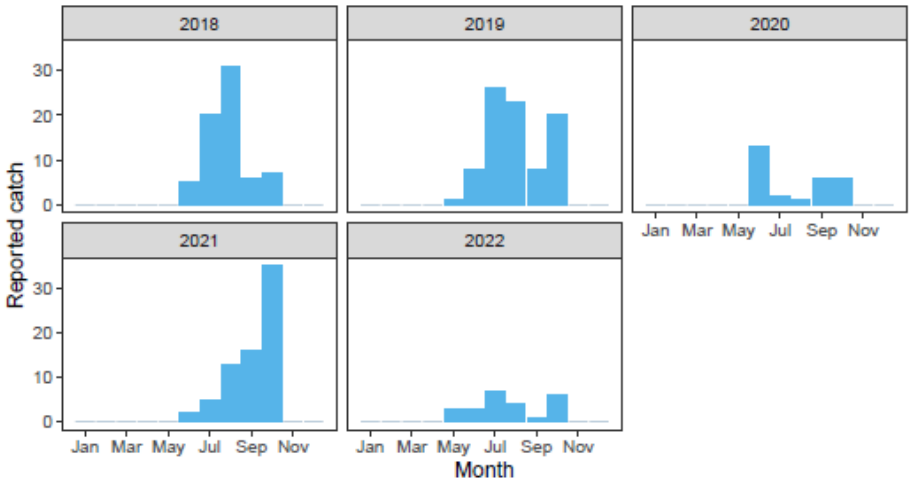
Mills & Graesser simply describe the fishing in the river.

Sea trout catches have been very sporadic without showing any trend.



Etive (part of the Awe fishery district)





The Etive system is part of the Awe Fishery District and thus does not have any separate record of fish catches except as part of the Scottish Government conservation assessment as above.

Bruce Sandison writes that because of the impact of fish farming, salmonid numbers have collapsed in recent years. Numbers of salmon caught are from 40 upwards.

Mills & Graesser mention that the river is privately fished but the owner has tried to restock the river from time to time to boost poor catches. The area is subject to poaching.

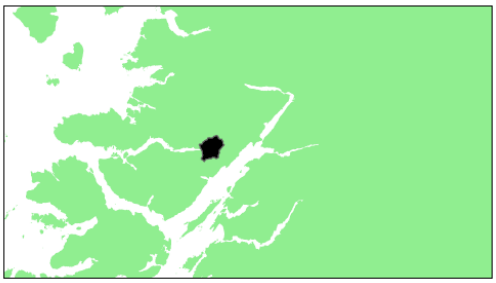
There is no clear link between any salmon stock decline and the arrival of nearby farm in the Linnhe System

1. Loch Sunart WSPZ

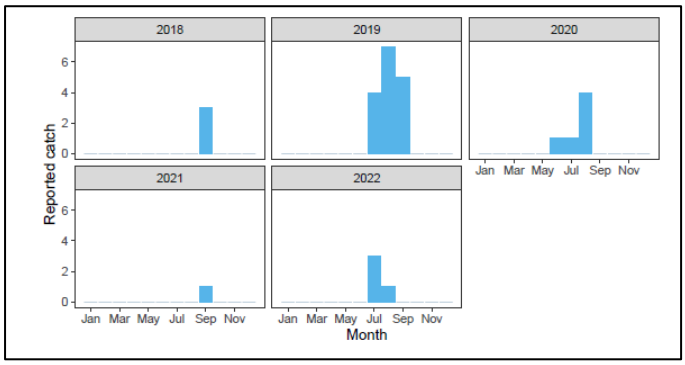
Sunart Fishery District

Carnoch River

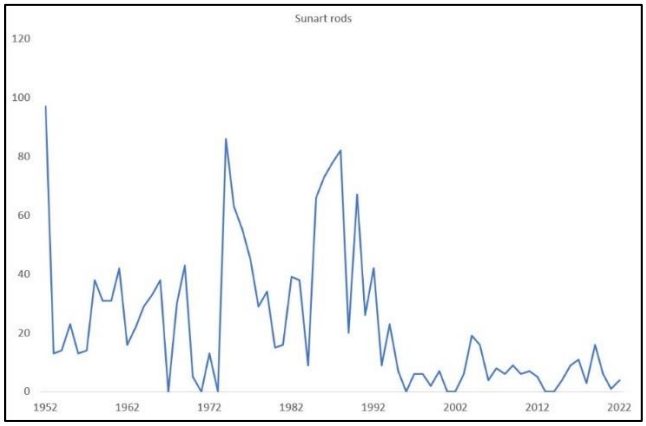
Due to its sheltered position, Loch Sunart was one of the first lochs to be selected for salmon farming. The oldest existing farm was established in 1985. There are currently four farms in the loch with another three sites no longer active. Despite its length, Loch Sunart is not fed by any major salmon rivers. The most significant is the 4-mile-long river Carnoch.



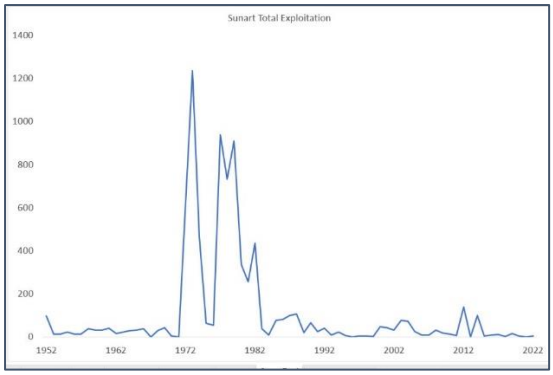
Recent catches from the river have been minimal.



The long-term rod catch form the whole Sunart Fishery District show catches peaked in the 1970s and 1980s and have fallen from an average of 40 fish during the 1990s, to about 20 fish and this is blamed on the presence of salmon farming.



However, when rod catches peaked, in the 1970s and 80s, netting in the loch also peaked with catches of over 1,000 salmon a year, which appears dipropionate to rod catches. In the years just before salmon farming arrived in Loch Sunart, the nets took over 5,000 salmon with an additional 604 killed after salmon farming came to the Loch with netting ending in the loch as late as 2014.

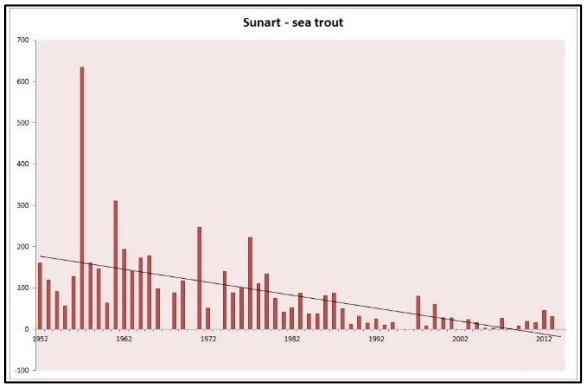


The river Carnoch is only mentioned by Bruce Sandison who blames salmon farming as the reason for the poor catches.

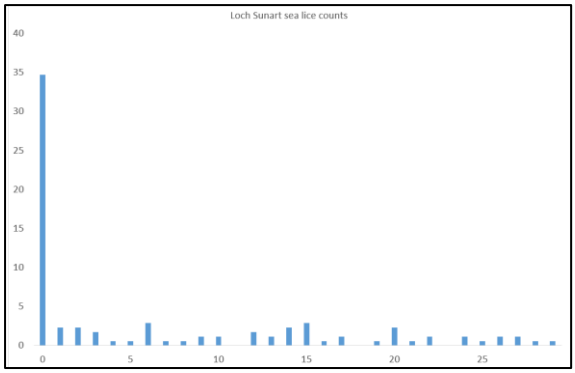
River Strontian

The river Strontian is another small spate river that enters Loch Sunart but is not featured in any of the fishing books. Fishing is still available to buy despite few fish being caught.

Sea trout catches have been in long-term decline since the 1950s.



The small sample and sampling numbers is reflected in the lower percentage of fish carrying no sea lice. There were more fish with higher counts but still in very low numbers.

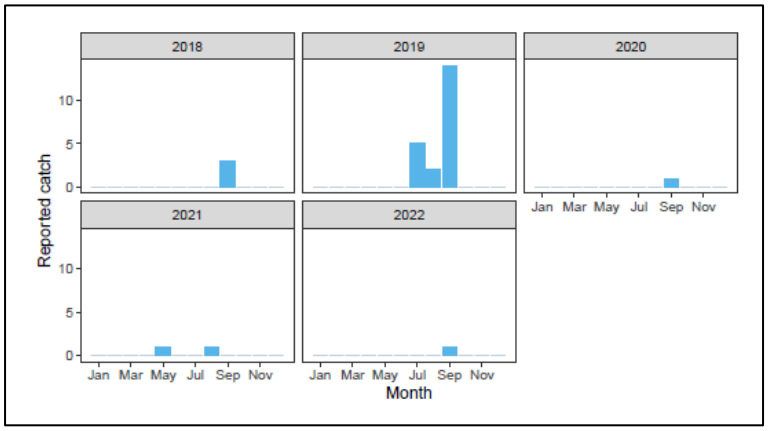


Loch Nevis WSPZ

Loch Nevis has been prioritised as a higher risk wild salmon protection zone, although the risk is coded as lower than other more high-risk areas.

Kilchoan Fishery District

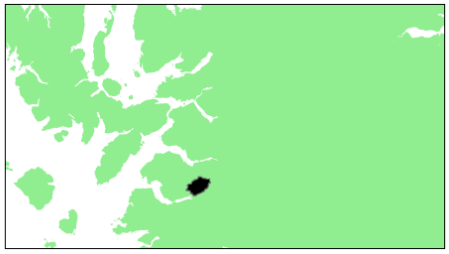
Rivers Inverie and Guiserein

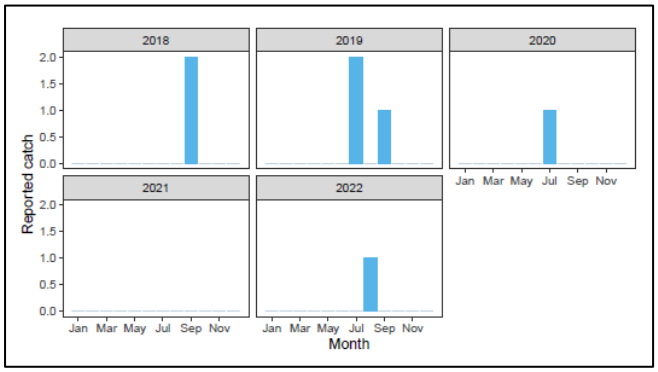


In his book, Bruce Sandison suggests that 50 salmon can be taken from these rivers, and this was 23 years after the farms were established in the loch. It is only recently catches have declined to current low levels. He does say that sea trout numbers have been impacted by nearby salmon farms but that recent reports suggest that this position is now much improved.

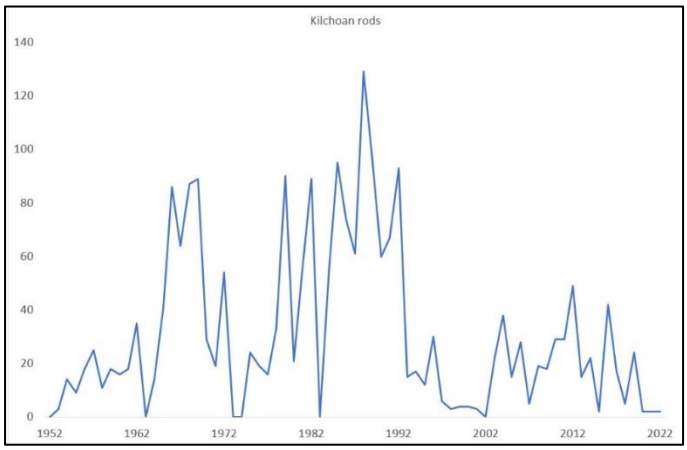
Mills & Graesser suggest that catches have been impacted by commercial netting ta the mouth of the river and that bag nets are set along the side of the loch.

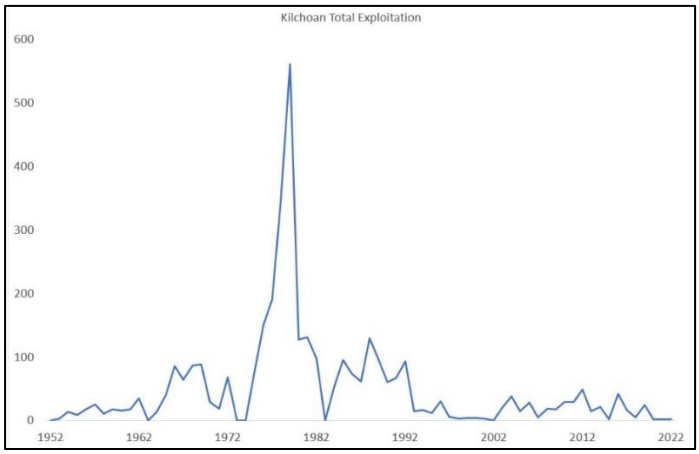
River Carnach





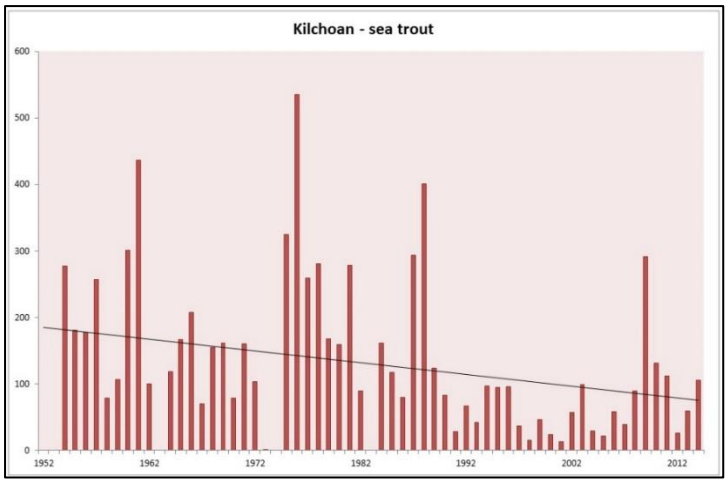
Mills & Graesser say that this river is a small stream with very few fish as it is heavily poached. There is also significant predation by seals that are found in Loch Nevis.





Commercial netting ended in the fishery district in 1982.

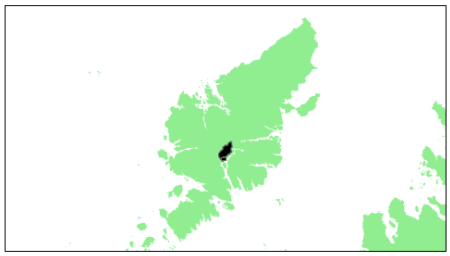
Sea trout catches have experienced a number of peak years whilst also in long-term decline.

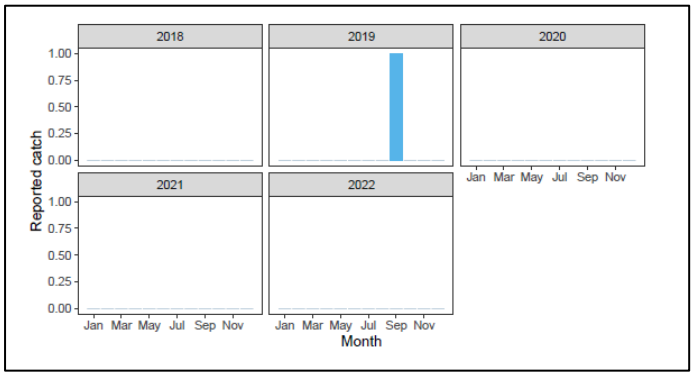


Loch Seaforth WSPZ

Creed Fishery District

Aline Estate





Rivers Scaladale & Tiorsdam

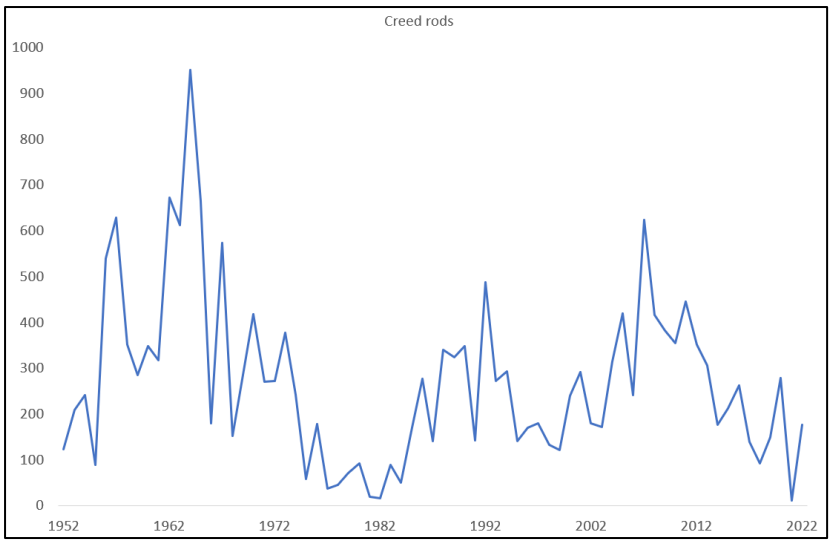
The rivers that flow into Loch Seaforth are: Scaladale & Tiorsdam (both on Aline Estate).

Bruce Sandison devotes space in his book to these two small rivers with 80 salmon caught annually. There is no mention of salmon farming or a negative impact even though salmon farming came to Loch Seaforth in 1984.

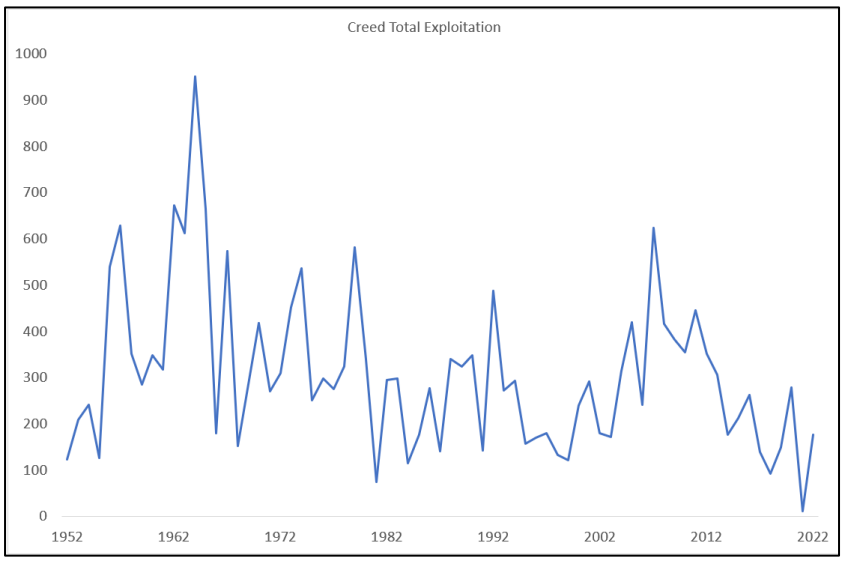
Rod catches are seen to have improved after the arrival of salmon farming but the wider exploitation by nets can be seen to have had a negative impact since the late 1960s.

Mills & Graesser do not cover these rivers.

The rod catch has shown significant variation with recent declines in line with national trends.

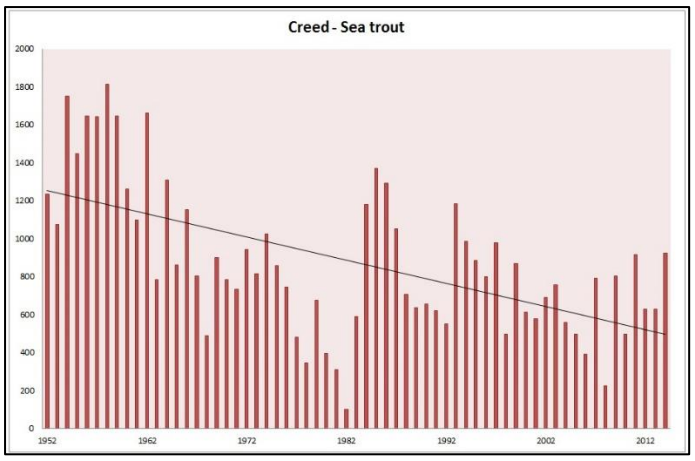


Total exploitation shows a long-term decline.

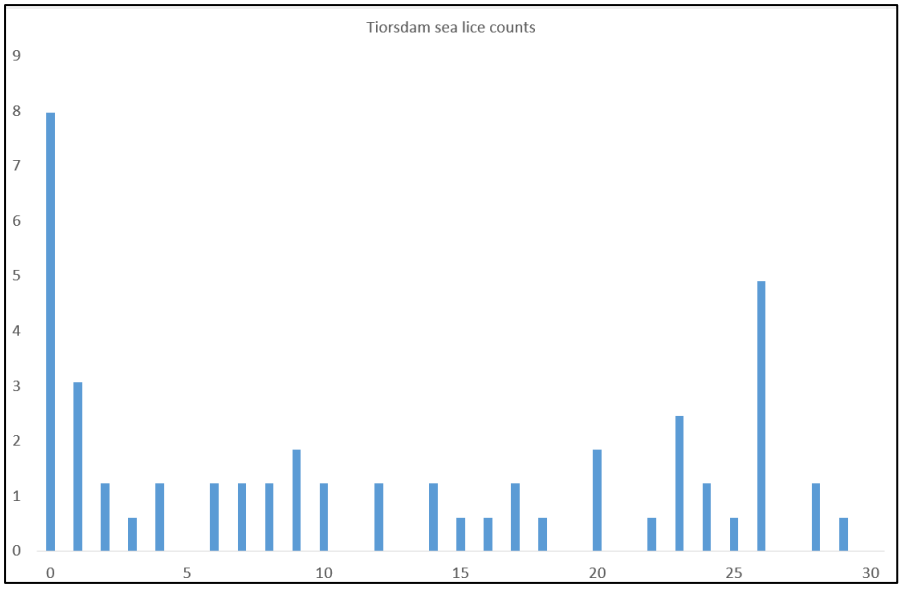


Commercial netting ended in the Creed fishery district in 1995.

Sea trout catches have shown a long-term decline since the 1950s.

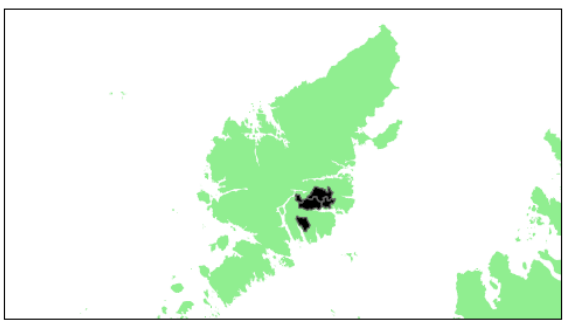


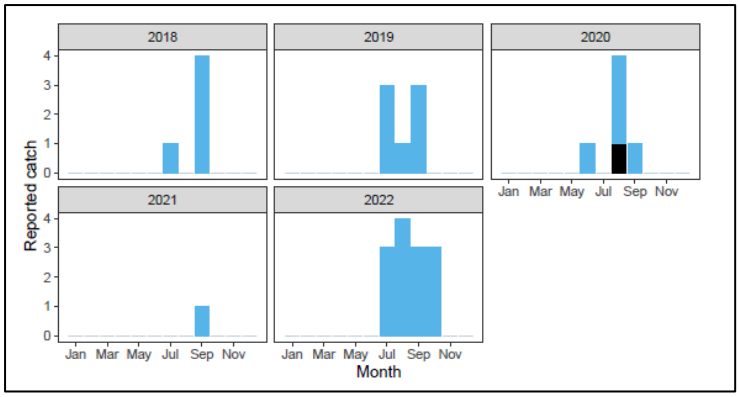
The small samples of sea liced sea trout collected over a period of five years are reflected in the less formed appearance of the aggregated distribution.



Clayburn Fishery District

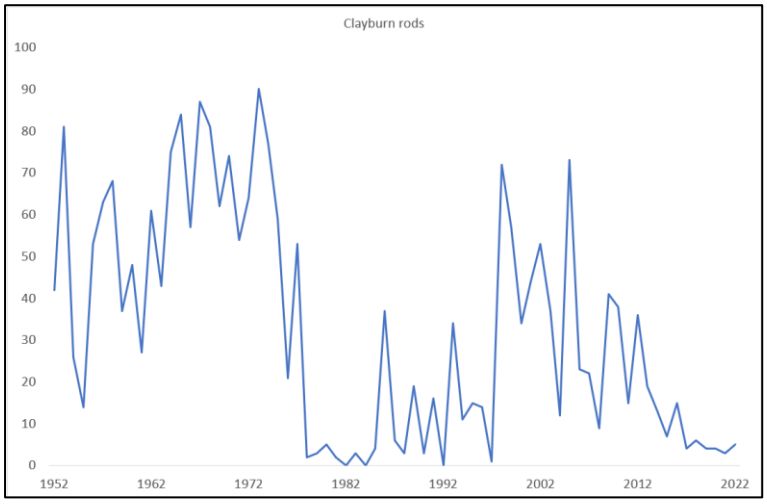
Eishken Estate

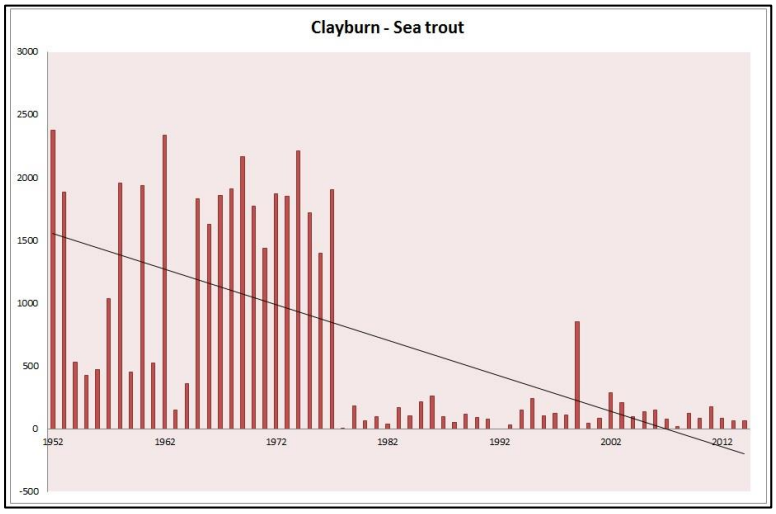




Sgibacleit river

Bruce Sandison estimates catches of 100 salmon a year for this river and loch even though catches for the whole fishery district have never reached 75 fish. Catches of salmon in the fishery district collapsed in the late 1970s and in the case of salmon have shown some signs of recovery. Sea trout catches collapsed at the same time and have never recovered. No investigation of the collapse ever took place and the reasons for the collapse remain a mystery. This was at least four years prior to the arrival of salmon farming to the area. Bruce Sandison makes no mention of salmon farming.

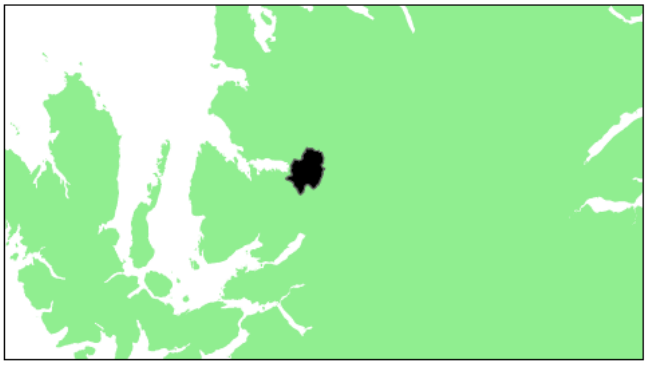


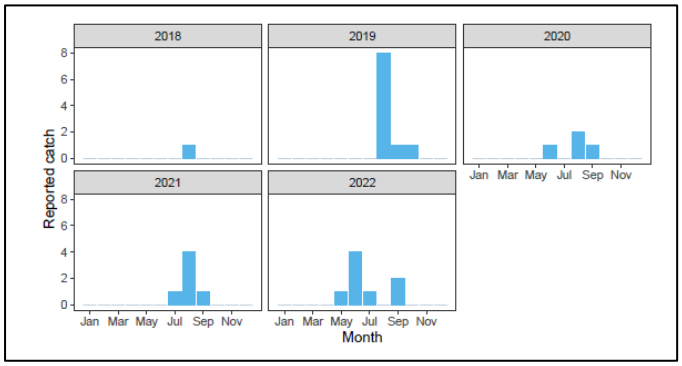


Loch Torridon WSPZ

Torridon Fishery District

River Torridon

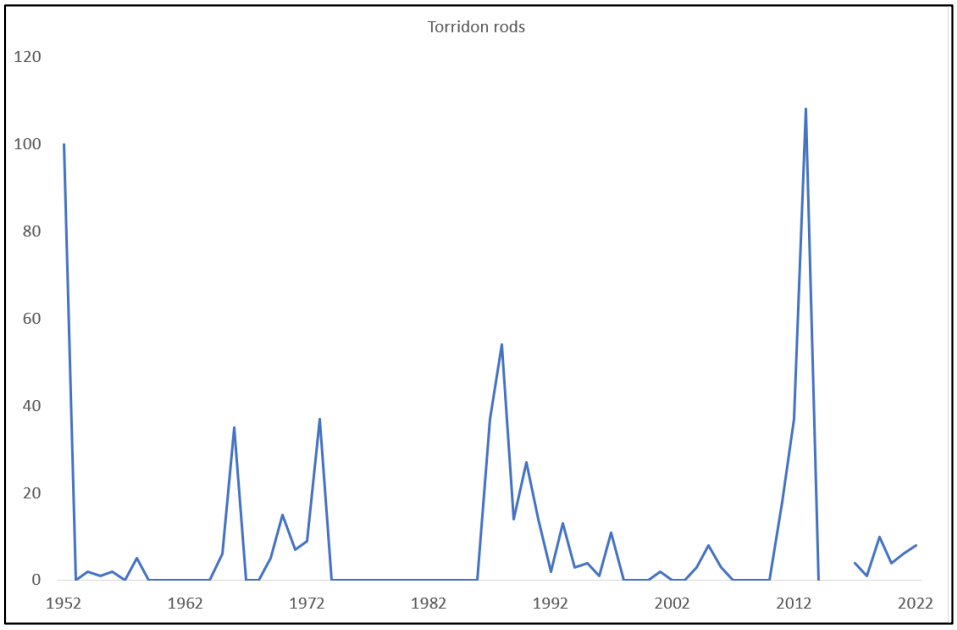




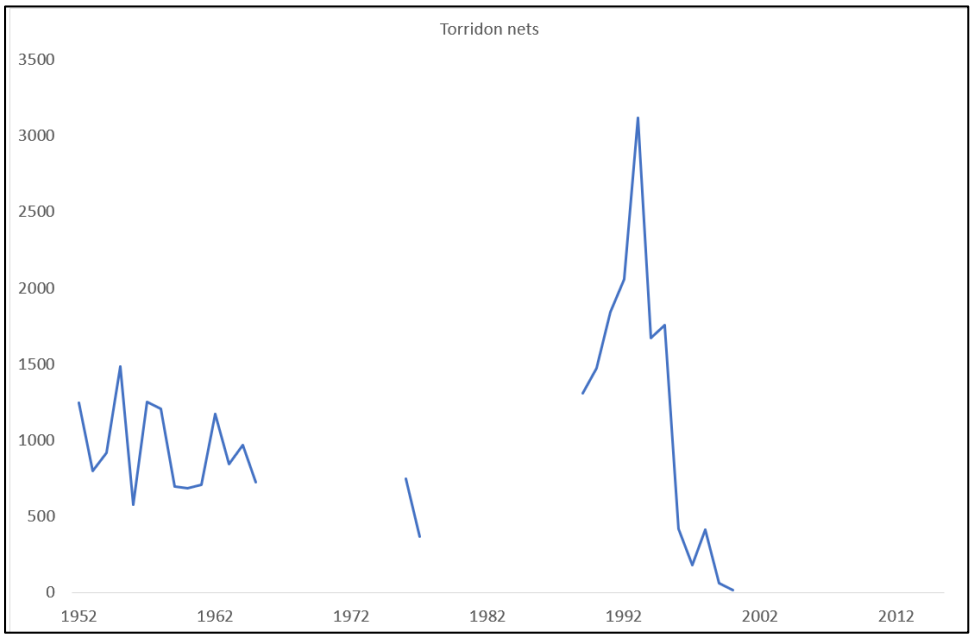
Bruce Sandison writes that about 20 salmon are caught annually but sea trout are absent probably due to sea lice infestation from salmon farms although the catch data tells a different story. In addition, there are periods of time when no catches have been reported and whether this is because there has been no fishing or because the catch forms were not submitted is unclear.

Mills & Graesser describe the river but provide no other information.

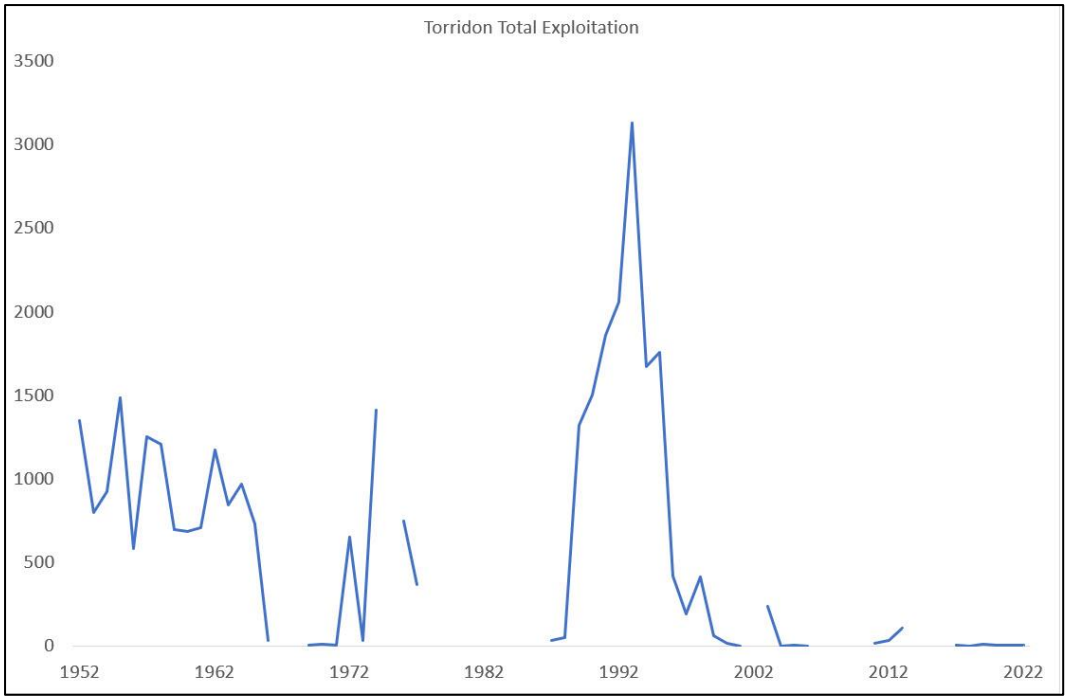
The first farm was established in the loch in 1982 after which catches rose, especially by the nets which took over 3,000 fish in one season, depleting the rivers of the local fishery districts of significant numbers of breeding adult fish.



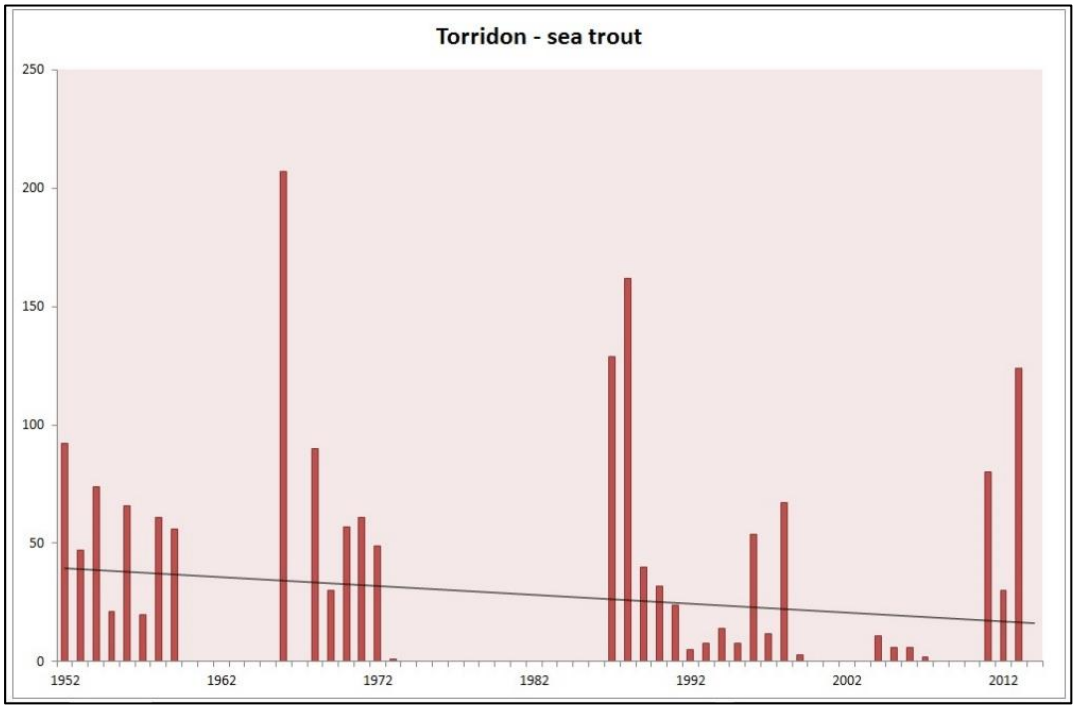
For such a small river, a surprising number of fish have been taken by commercial netting. Commercial netting ended in 2003.



Total exploitation of the Torridon fishery district is shown in the following graph.



Sea trout catches are too few in number to infer any clear trend.



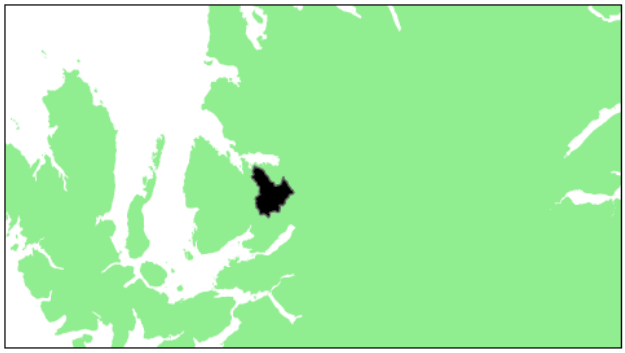
River Shieldaig

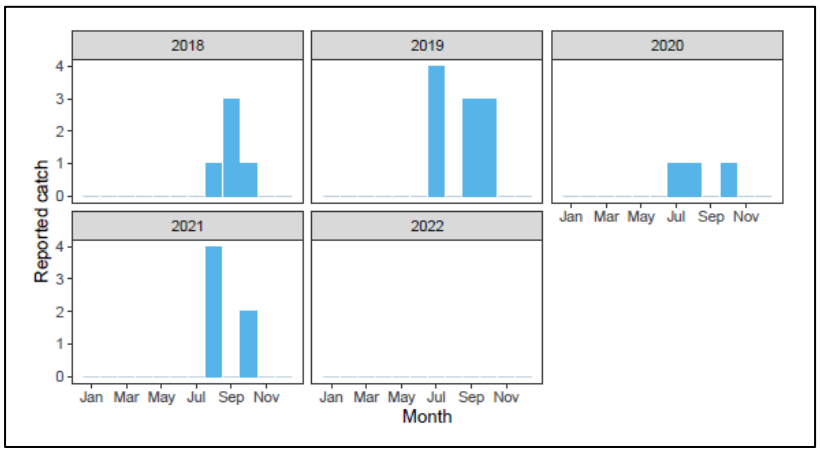
Bruce Sandison does not comment on this river because it is fished privately.

Mills & Graesser confirm the private fishing but suggest that just a few fish are caught annually due to the small size and the spate nature of this river.

Balgy Fishery District

River Balgy

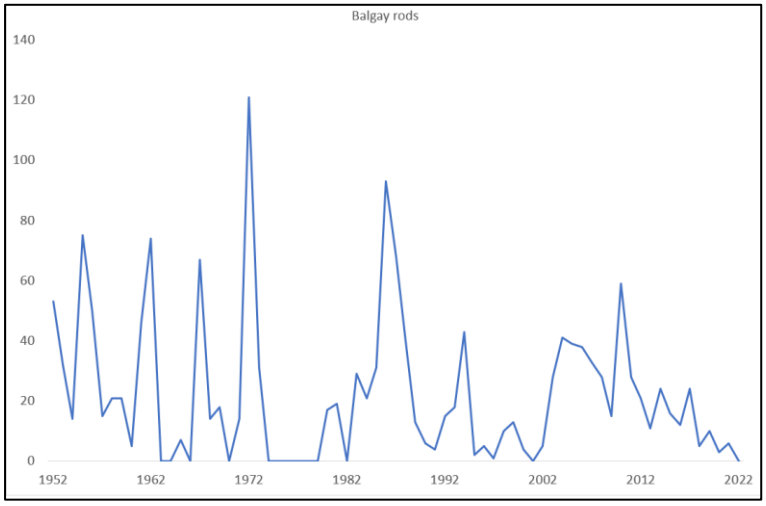




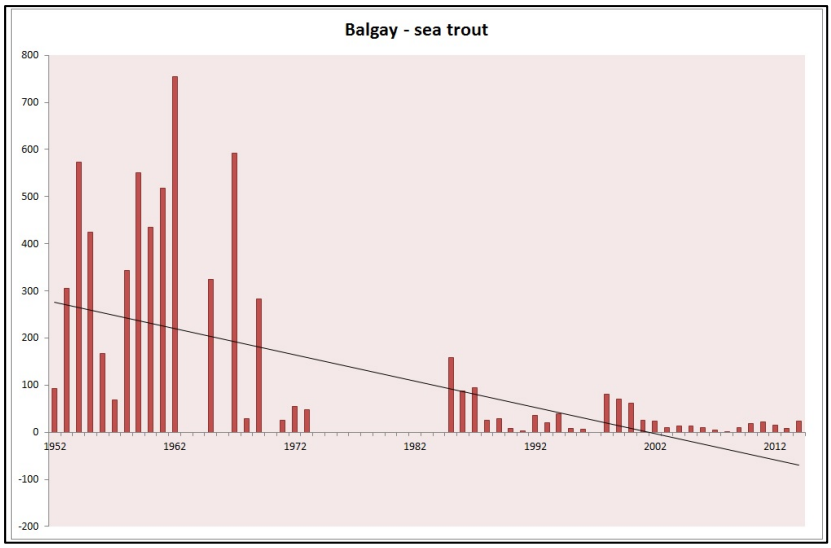
Bruce Sandison says that because of the impact of disease and pollution form fish farms, fewer salmonids are caught today.

Mills & Graesser say that the fishing on the river is private but that it has suffered flooding which has washed away the riverbed and that attempts have been made to try to prevent this happening.

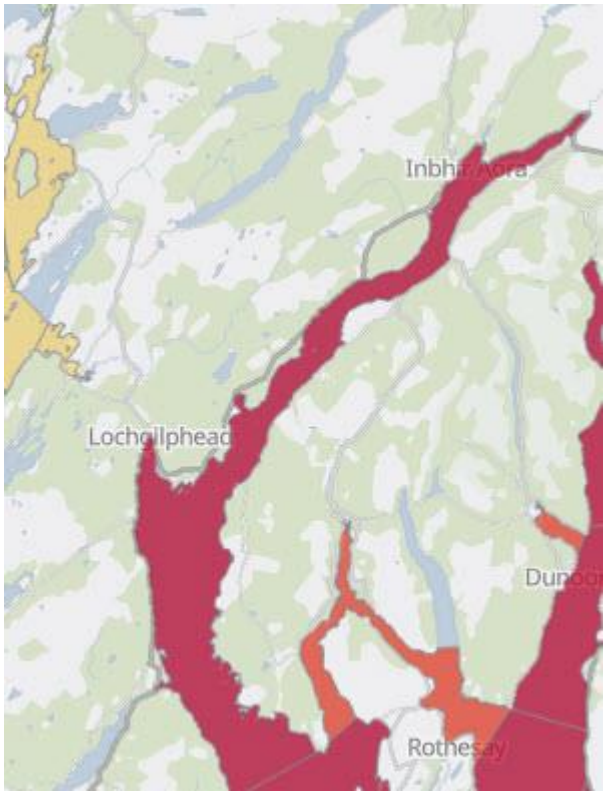
The Balgy is located in Upper loch Torridon and thus has been exposed to the same netting pressures as the Torridon Fishery District. It can also be seen that sea trout catches collapsed before salmon farms arrived in the locality.



Sea trout catches diminished long before the arrival of salmon farming in the area.



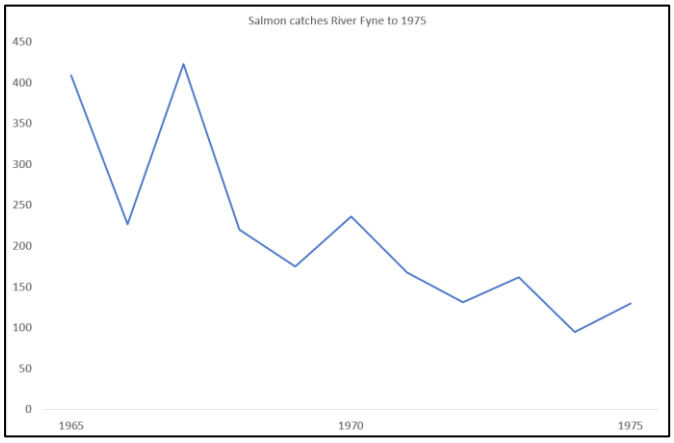
Loch Fyne System WSPZ



Fyne Fishery District

River Fyne

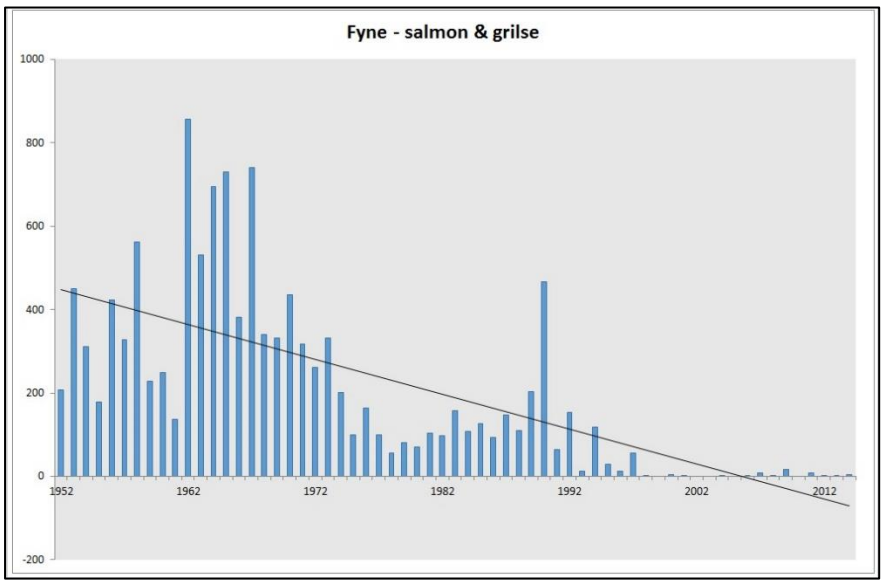
The river Fyne is not included in the 2024 salmon conservation assessments. In 1950, the river was subjected to a major hydroelectric scheme, which clearly change its nature becoming as described by Mills and Graesser as artificial. Later changes allowed some flow to run through the river, so fish were able to run. The authors provide details of salmon catches on the river from 1962 to 1975.



Bruce Sandison writes that up to 1989, the Fyne was capable of producing up to 250 salmon in spite of the impoundment of the headwaters for hydroelectric power generation. However recent years have seen the catastrophic collapse in salmon and sea trout numbers caused by the prevalence of factory salmon farming in the loch Fyne which have brought the wild stocks in the river to the point of extinction.

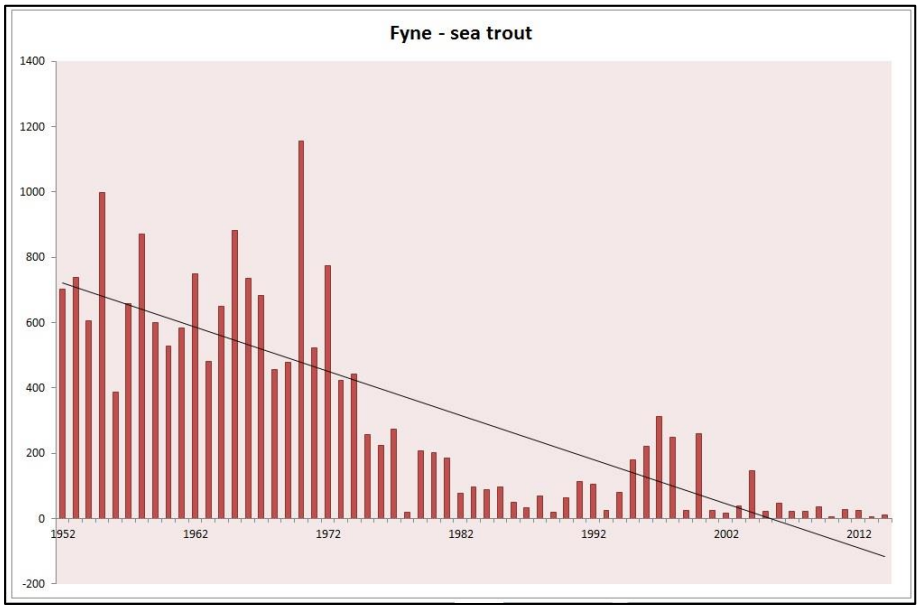
The river is now closed to fishing.

According to the Scotland Aquaculture website the first farm came to Loch Fyne in 1988, however that information is incorrect as there was a site in operation at the head of the loch earlier than this date. This certainly had no impact on wild fish from sea lice as it was low salinity due to the proximity of the river mouth. As can be seen, catches declined long before the arrival of salmon farms.

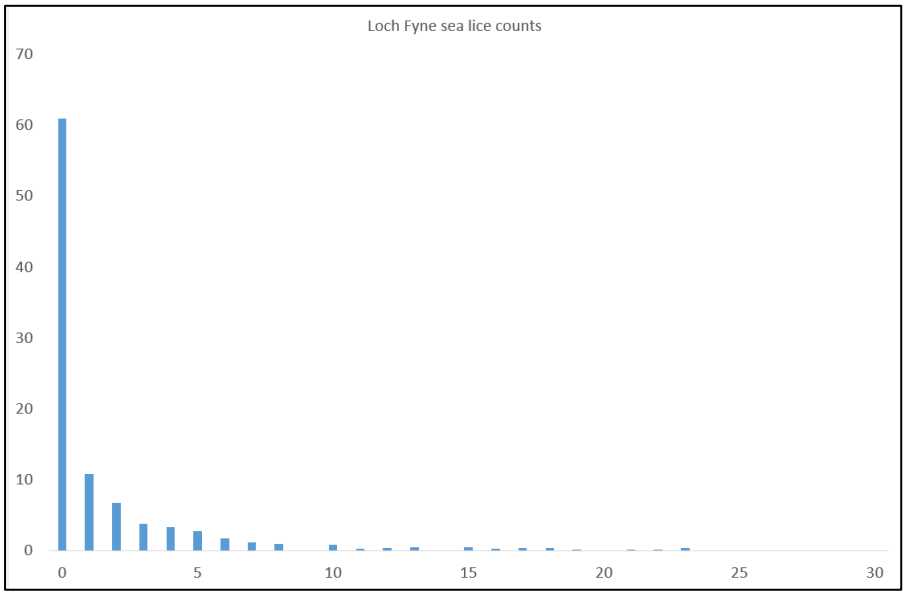


Although rod catches in the Fyne fishery district declined in the 1990s, commercial netting continued until 2004.

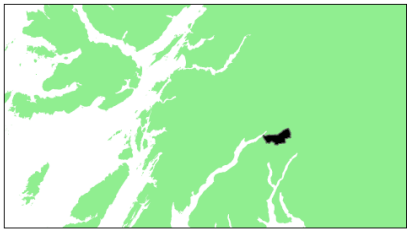
Sea trout catches declined before the arrival of salmon farming.

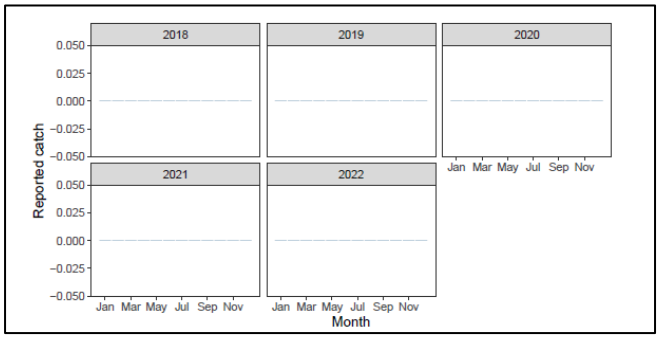


Sixty-one percent of the fish sampled for sea lice at two sites in Loch Fyne from 2005 to 2019 were lice free. Most of the fish infested with lice carried very low numbers.



KInglas Water

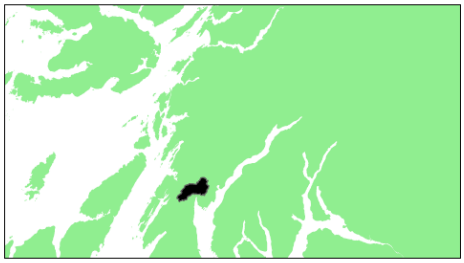


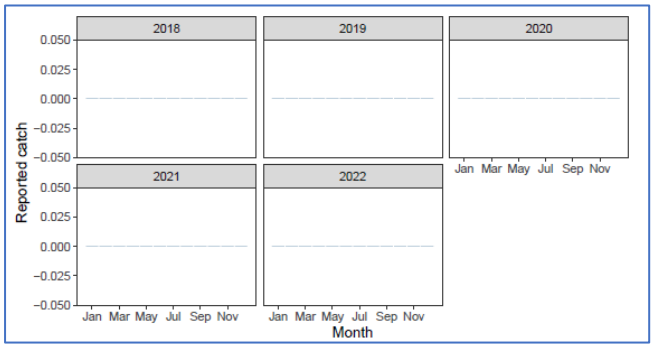


Mills & Graesser report that the catch from the Kinglas has rarely been more than 30 fish. The river enters Loch Fyne near the head of the loch. They also mention that a salmon hatchery was built nearly by Golden Sea Produce, one of their only references to the beginnings of the salmon farming industry.

Bruce Sandison says that the river is close to fishing as numbers of fish have declined in recent years. Due to the impact of fish farming in Loch Fyne but given spate conditions a few fish still run up the stream to the associated loch which is fished.

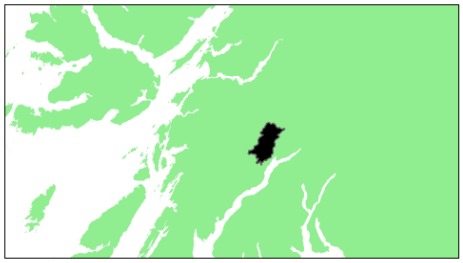
Cuilarstich Burn

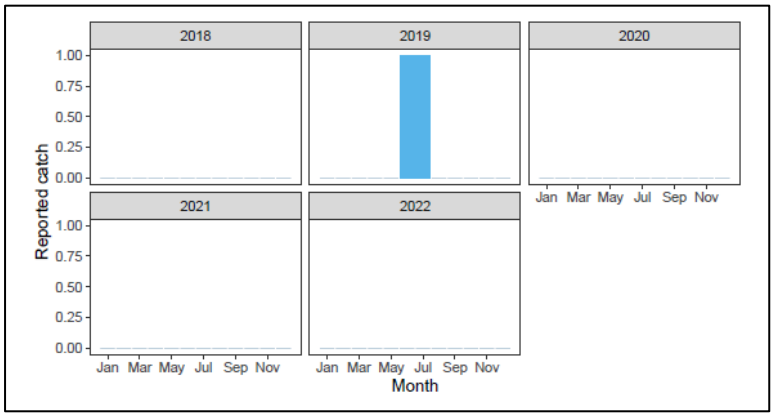




This burn is not mentioned in angling guide. NASCO appear to have a photo on their website but with no information. It is unclear why this burn is included in the conservation assessment especially given that no fish are caught there.

River Aray





Mills & Graesser say that the river has been manicured as it passes through the grounds of Inverary Castle. Higher up the river has been affected by afforestation which has changed the flow making it run faster.

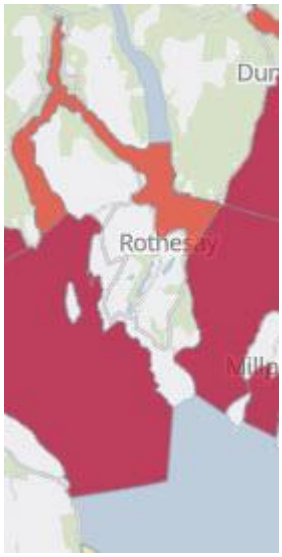
Bruce Sandison discusses the river Aray along with the river Shira and Douglas Water, all of which enter Loch Fyne in the same vicinity.

River Shira & Douglas Water

Bruce Sandison simply says that the river Shira has been impounded for a hydroelectric scheme and due to the collapse of salmon and sea trout numbers these rivers (including the Array) are closed to fishing.

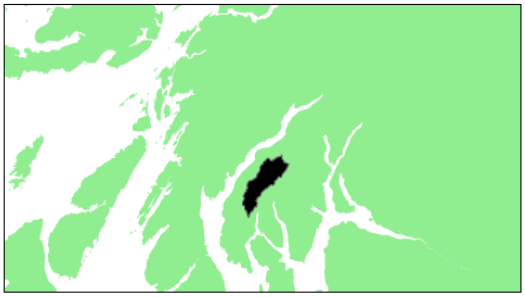
Mills & Graesser also refer to the hydroelectric scheme and say that even in 1916 the river was not considered to be a good salmon river.

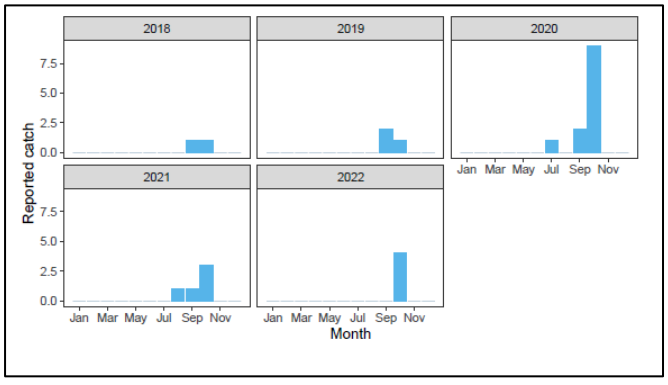
Kyles of Bute WSFZ



Ruel Fishery District

River Ruel



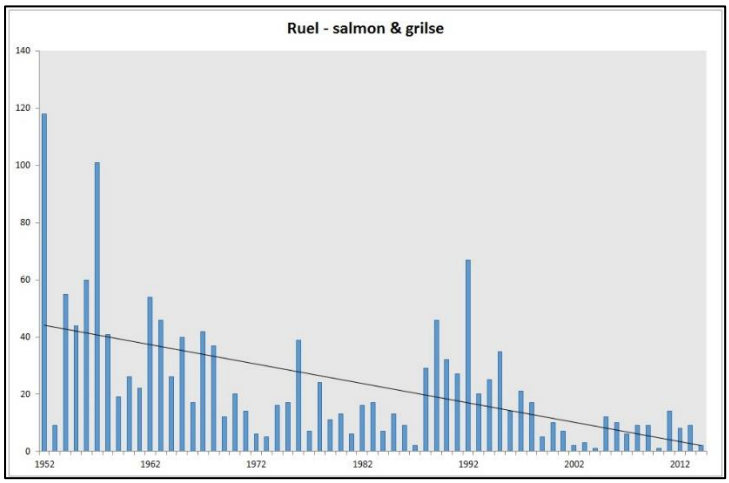


Mills & Graesser say that since afforestation began in 1948, the river has tended to become increasingly flashy in nature due to drainage operations. In addition, water has been abstracted by the Hydroelectric Board to power the station at the head of Loch Striven.

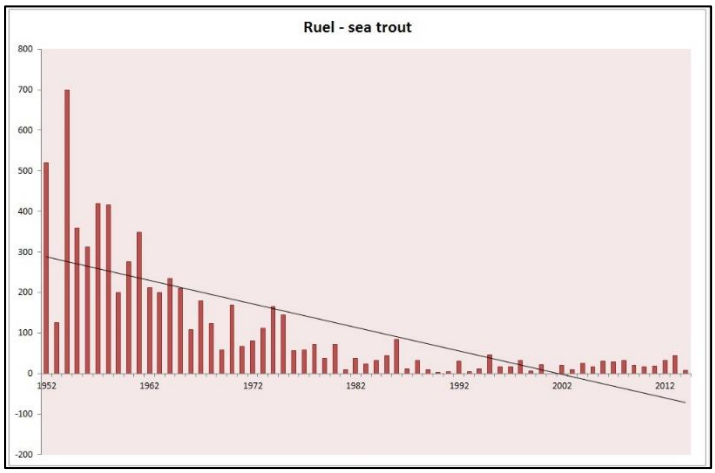
They say that the proprietors have taken up the commercial fishing but only occasionally to conserve the fish. However, there is no official record.

Bruce Sandison echoes the views of Mills and Graesser on afforestation however he also says that numbers of salmonid fish have been greatly reduced due to the impact of salmon farm sea lice. He says in a good season up to 40 fish can be caught.

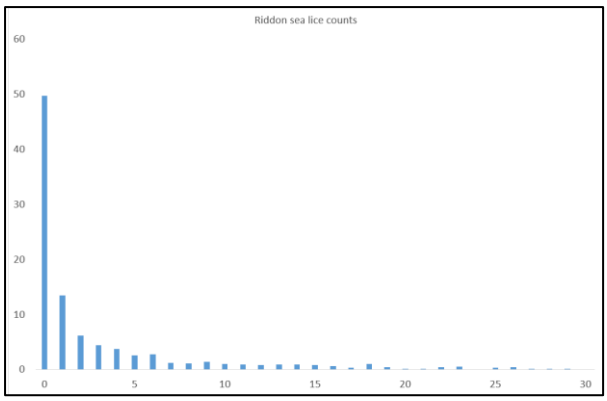
Salmon farming began in the area around 1985.



Both salmon and sea trout catches have been in decline in the river Ruel for many years and long before salmon farming arrived in the area.

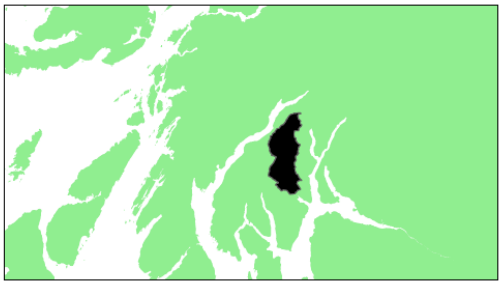


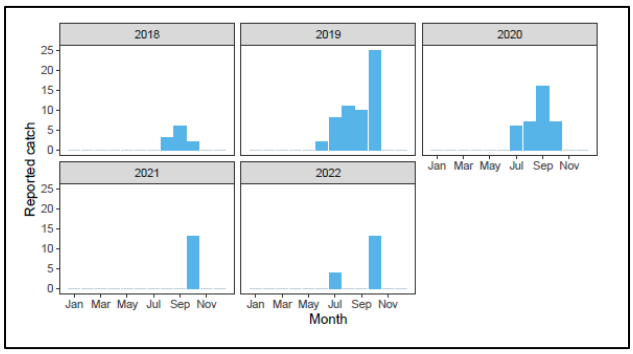
Sampling of sea trout for sea lice showed that 50% of the fish sampled were lice free with most fish carrying lice infested with low numbers. Sampling took place for 15 years to 2019 at three different sites on Loch Ruel (Riddon).



Eachaig Fishery District

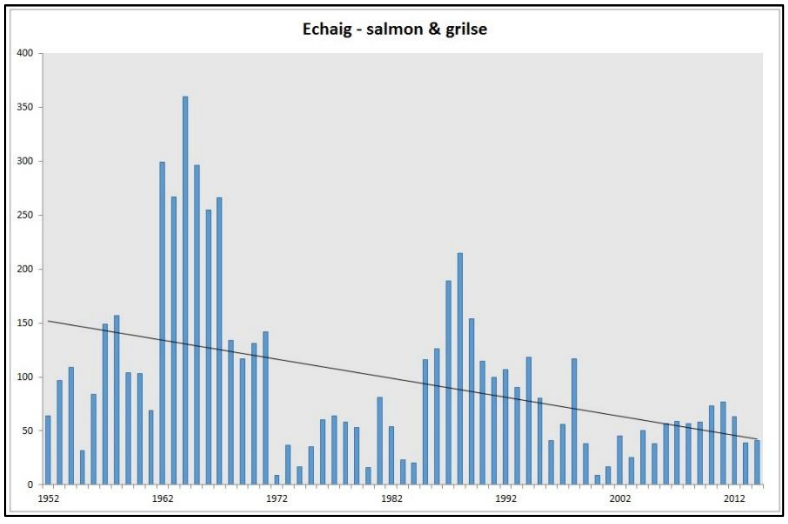
River Eachaig





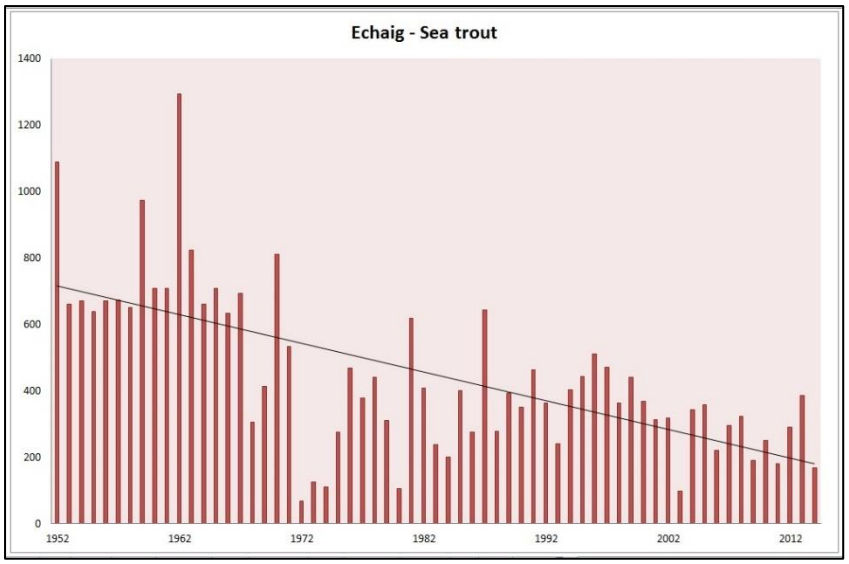
Mills & Graesser say that the Eachaig is more of a sea trout river than for salmon although they say salmon have increased in number (1970s). There is a water scheme at Loch Eck with a barrage although a compensation flow is in operation, which may not be sufficient at times of low water.

Bruce Sandison suggest that 20-30 salmon are taken annually with 300 to 400 sea trout. He makes no mention of any decline or potential cause of any decline.

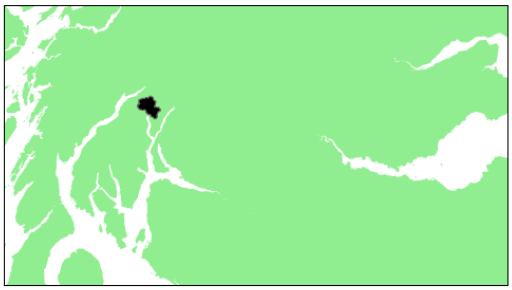


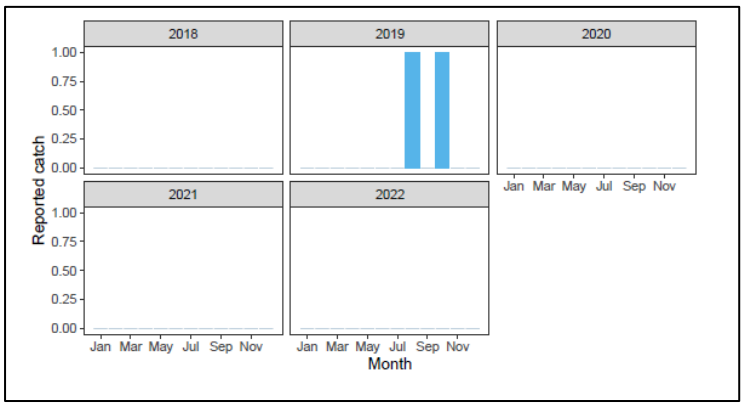
Commercial netting in the Eachaig fishery district ended in 1998.

Sea trout catches are exhibiting long-term declines from before the arrival of salmon farming.

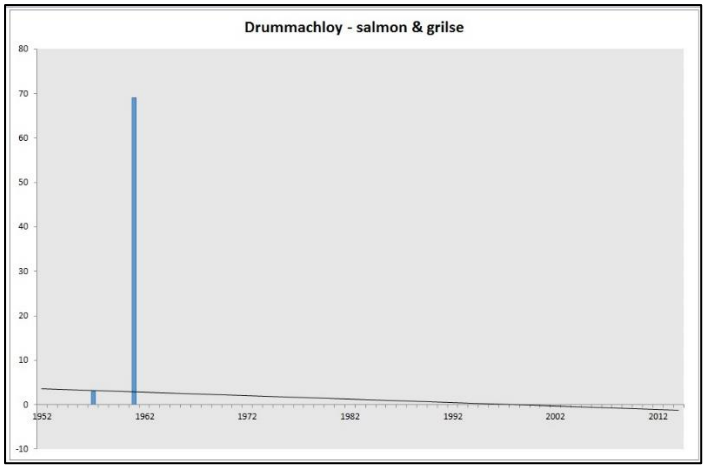


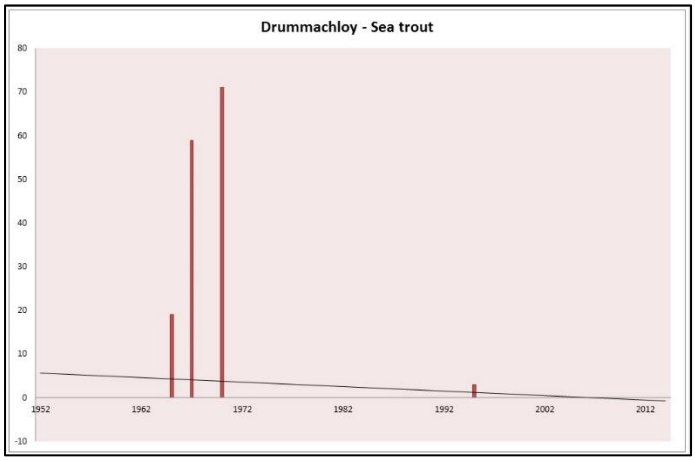
Drumnachloy Fishery District



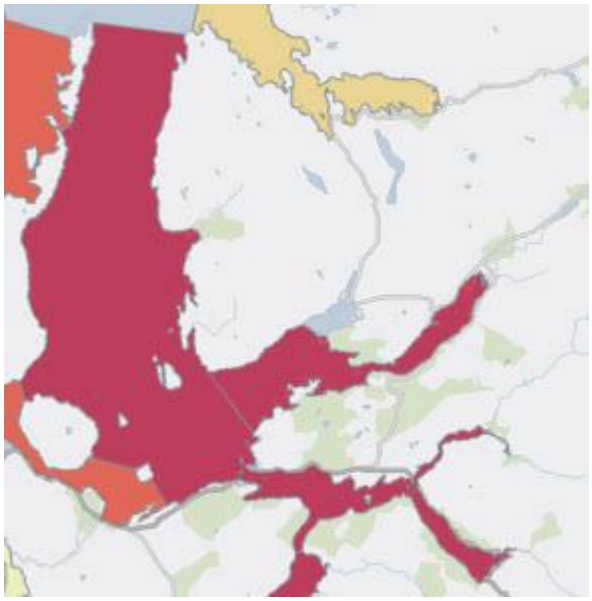


There is no mention of this location in any fishing guides. Clearly, it is rarely fished.



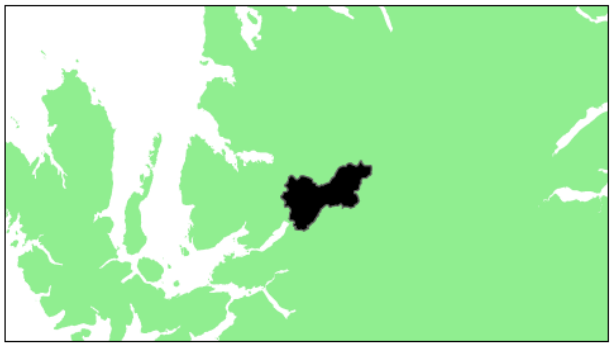


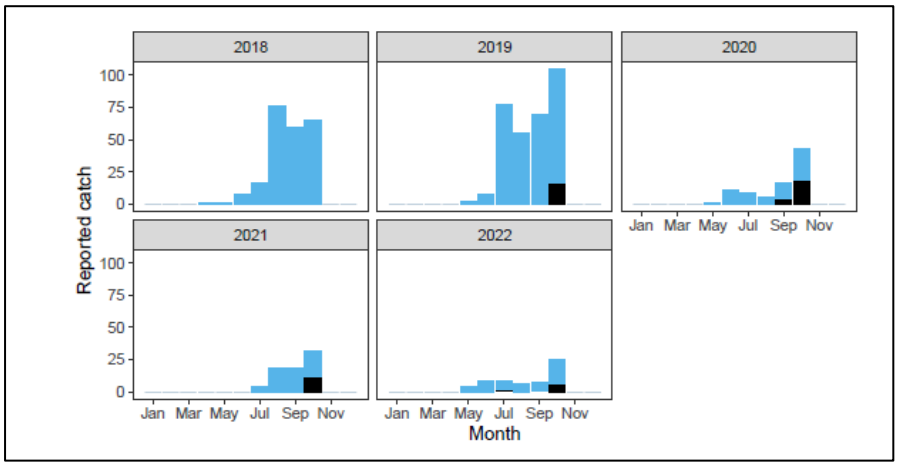
Loch Carron & East Skye System WSPZ



Carron Fishery District

River Carron





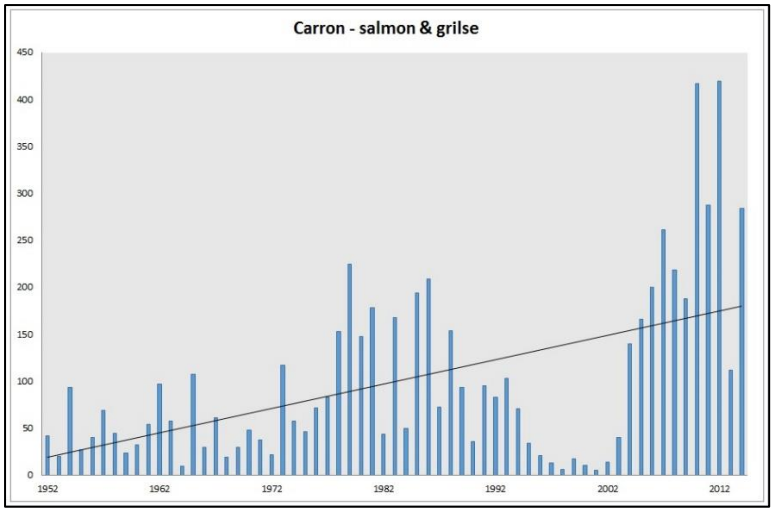
Mills & Graesser only refer to the changing fishing runs with the disappearance of an early run. They stress the spate nature of the river.

Bruce Sandison writes that salmon and sea trout numbers have decline drastically in recent year probably due to the effect of sea lice infestation from factory salmon farming. He also says that smolt rearing cages in the lochs do not improve the overall ambience of the fishing experience.

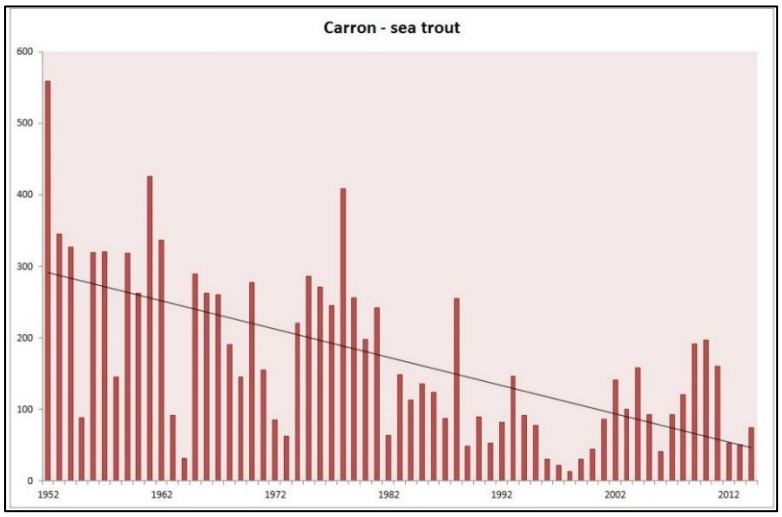
However, although this edition was published in 2013 Mr Sandison has ignored the resurgence in catches of salmon aided by the river Carron restocking programme with record catches despite the nearby presence of one of the largest aquaculture hubs on the west coast.

Salmon farming came to the locality in 1985.

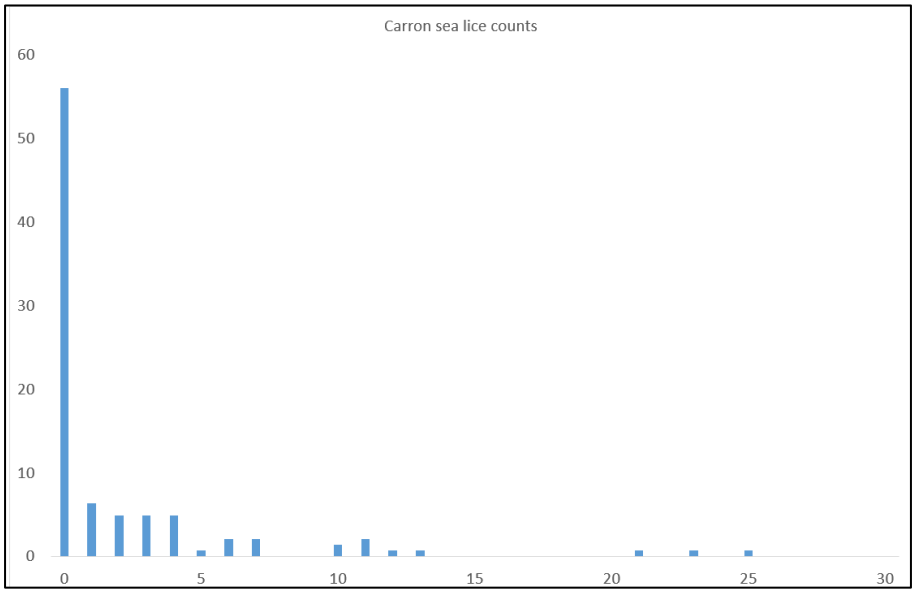
Commercial netting ended in the Carron fishery district in 1997.



Sea trout catches have shown long-term declines from the 1950s.

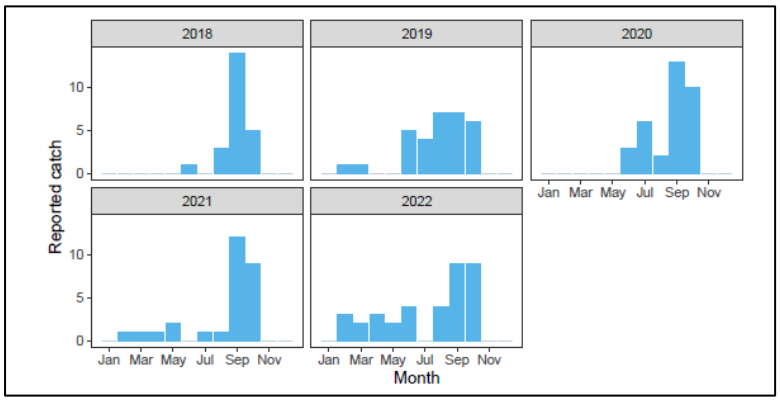


The Carron exhibited a high percentage of sampled fish with no lice at all. Sampling was conducted over three years.



Loch Long Fishery District

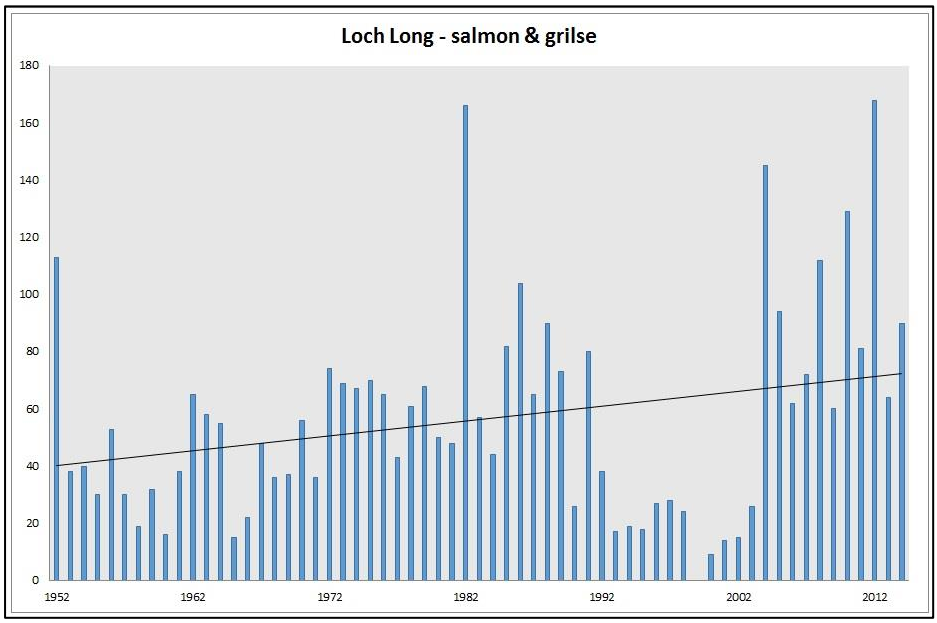
Ling & Elchaig



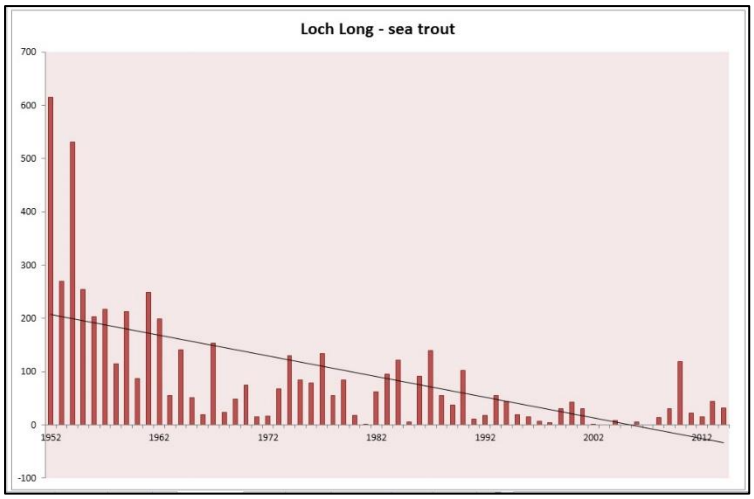
Mills & Graesser say that the Ling is unusual in the runs of salmon start as early as February.

A commercial fishery operated on Loch Long, ending as late as 2012.

Bruce Sandison does not mention either of these rivers in his guide. The Elchaig is privately fished but the Ling is not.

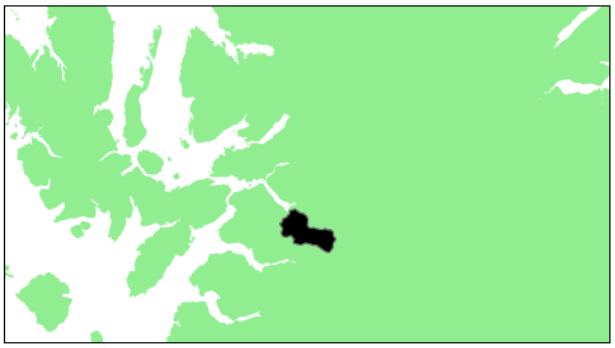


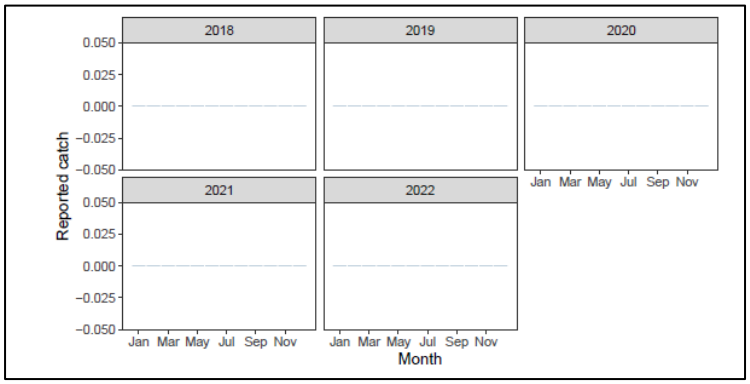
Sea trout catches in Loch Long have been in long-terms decline since the 1950s.



Croe Fishery District

River Shiel (Shiel Bridge)





The Scottish Government conservation assessment lists on the river Shiel for the Croe fishery district whilst the river Croe does not seem to be included.

Mills & Graesser's main comment is that salmon catches have declined but they suggest that this may be due to reduced fishing effort. This is also confirmed by Bruce Sandison who writes that there is no meaningful catch data available.

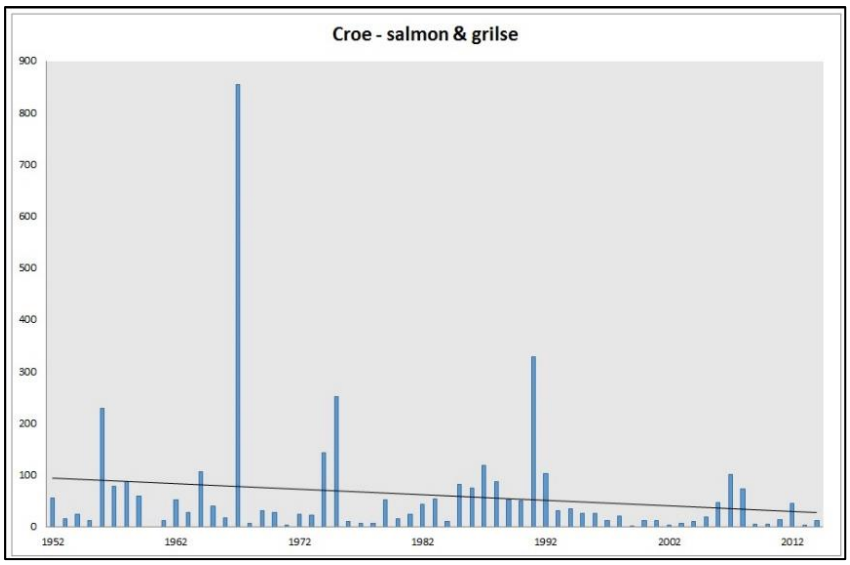
River Croe

Mills & Graesser say that there has been a decline in salmon and sea trout numbers in recent years and that catches in 1977 were extremely poor. There is also a fair amount of poaching in the river with fish easy to catch in nets in the deep pools in which they lie.

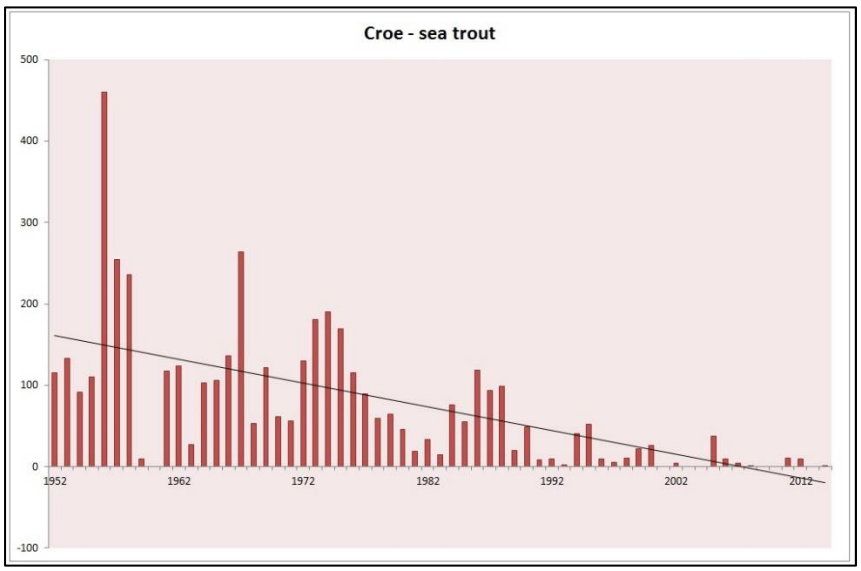
Bruce Sandison blames the lack of any fish on sea lice infestation from nearby salmon factory farms. He says the river is closed to fishing.

Salmon farming came to Loch Duich in 1981.

Commercial netting ended in the Croe fishery district in 2002.

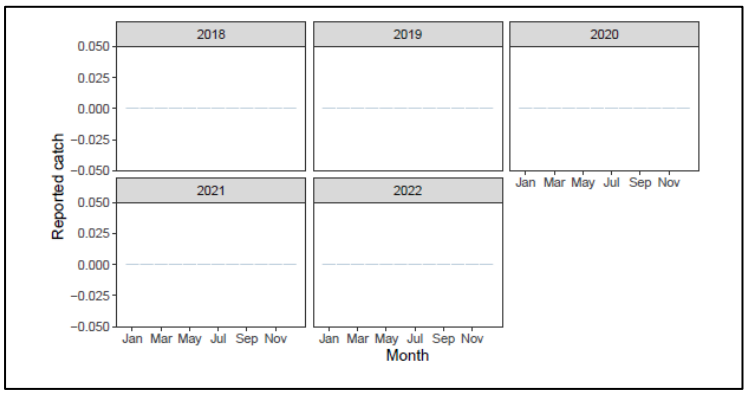


Sea trout catches show a long-term decline over many years.



Glenelg Fishery District

Glenmore River

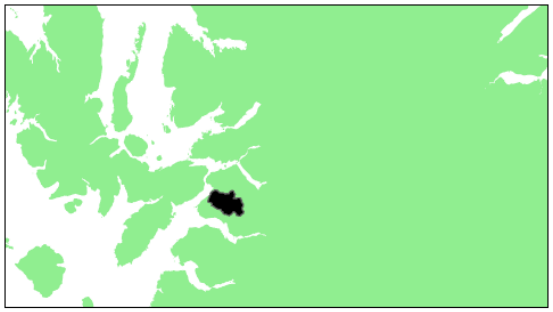


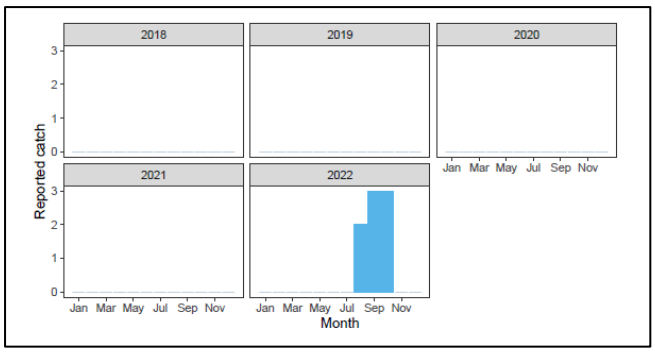
Glenmore River

Mills & Graesser devote a page to a description of the Glenmore River taken from another book. They say that double the number of fish taken from the Glenbeg (12-30) are taken every year which would be 24-60 fish. The river has netting rights, and these are exercised by the owner. However, the river suffers from poachers.

Bruce Sandison says that in days past this delightful little spate salmon steam was noted for the quality of its fishing and for its great scenic beauty. The latter is still the same but sadly the salmon fishing is a poor shadow of its former glory. A few salmon are taken but very few sea trout due to sea lice infestation from factory salmon farms. In a good year perhaps 5/10 salmon are taken.

River Gleann Beag River

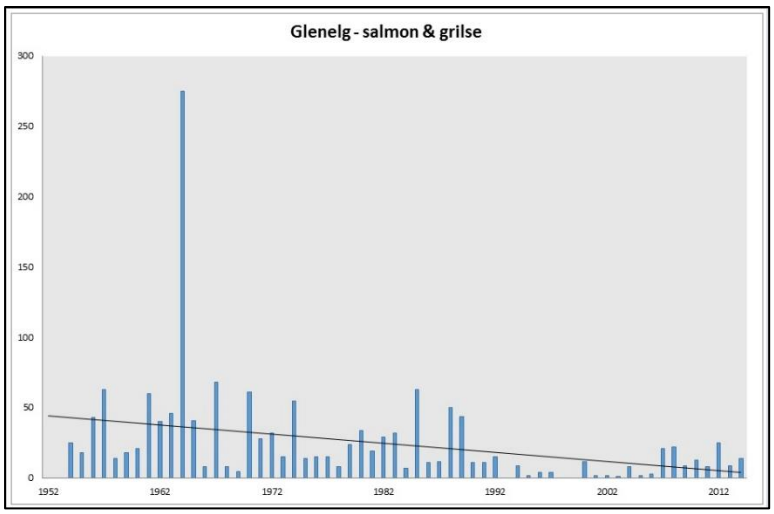




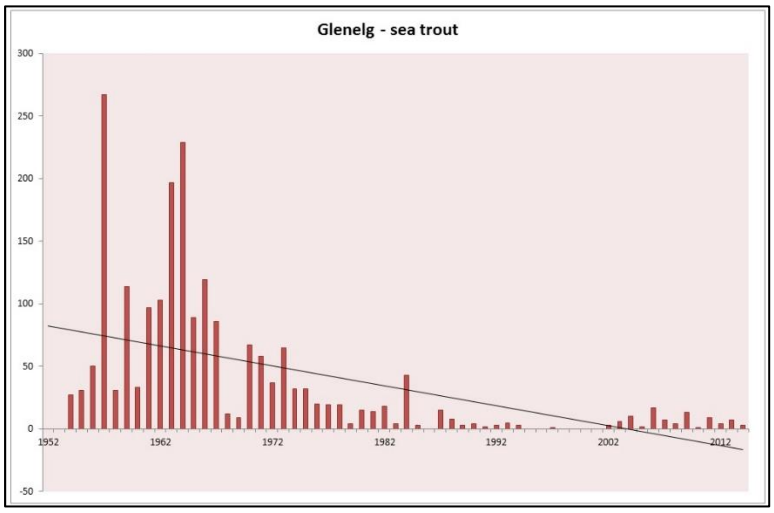
Mills & Graesser say that provided there is water the fish enter the river in June and in a good year 12-30 salmon are caught. The river has been improved with the addition of croys creating excellent holding pools. The river is often the target of poachers, especially at the river mouth.

Bruce Sandison does not include this river, but he does write that with the exception of the river Glenmore all rivers towards Loch Hourn are private and not generally available to the public.

These rivers are not directly exposed to salmon farming, but nearby farms were established as early as 1985. There was commercial netting around these rivers until 1992.

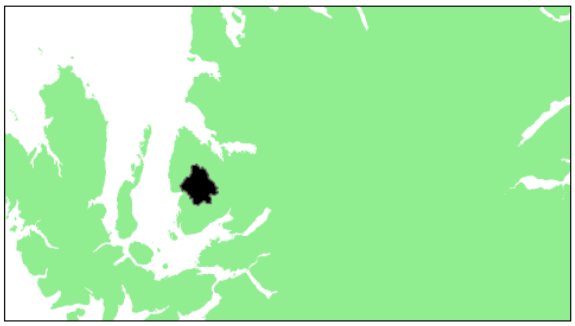


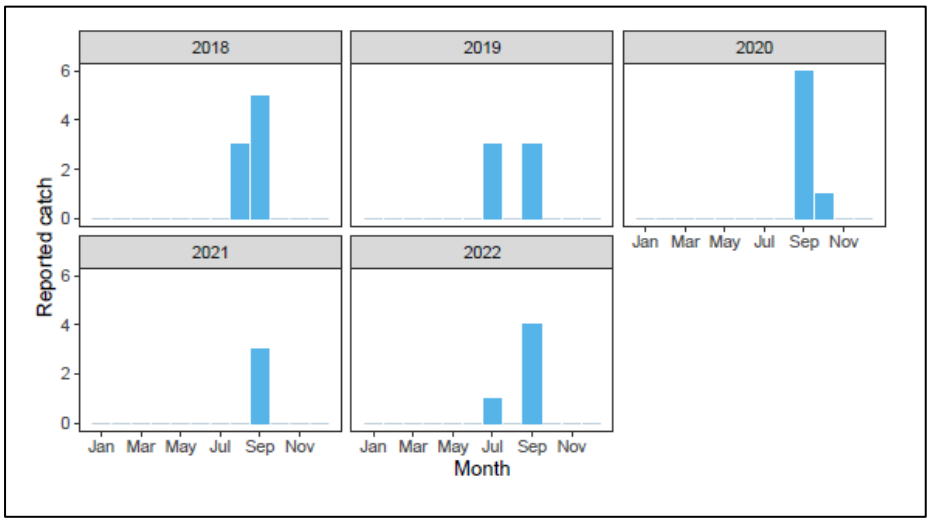
Sea trout catches have been in long-term decline since the early 1960s.



Applecross Fishery District

River Applecross

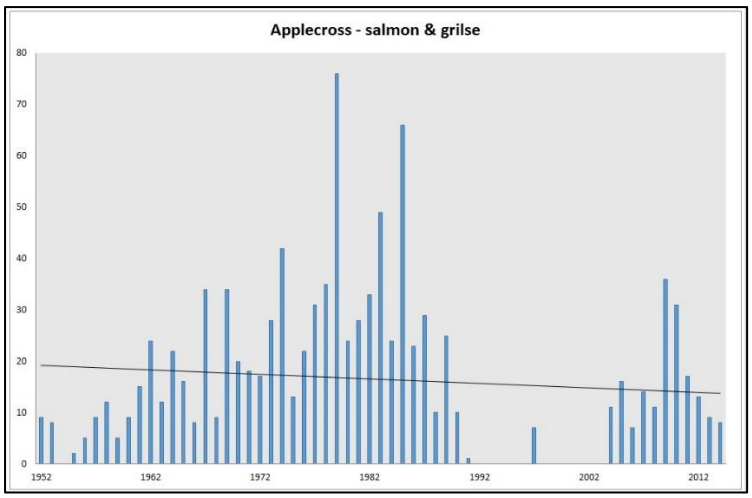




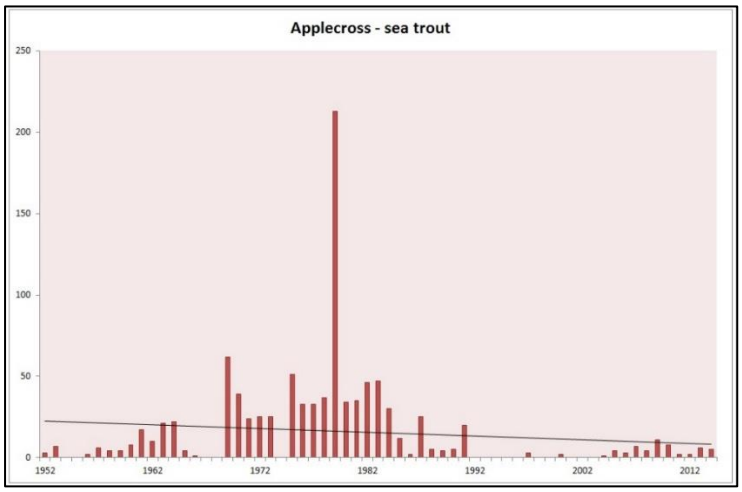
Mills & Graesser say that the river has been subjected to two major floods requiring the Dept of Fisheries to undertake large river retraining and bank strengthening schemes. They say that the average rod catch has been about 100 salmon and 50 sea trout, and that netting has only been exercised twice since 1961.

Bruce Sandison writes that the river has been closed to fishing for 10 years (2013) and in his opinion, this has been caused by sea lice infestation from fish farms in the vicinity.

The river is not directly exposed to fish farming activity. Nearby farms were established in 1990 with more distant farms in 1986.



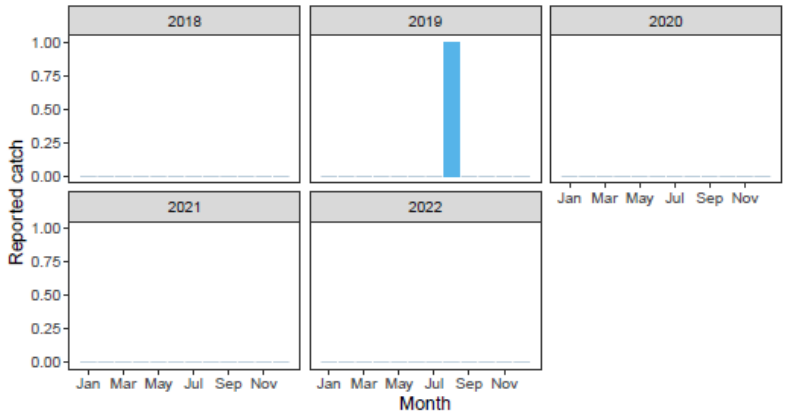
Sea trout catch trends are inconclusive.



Sligachen Fishery District

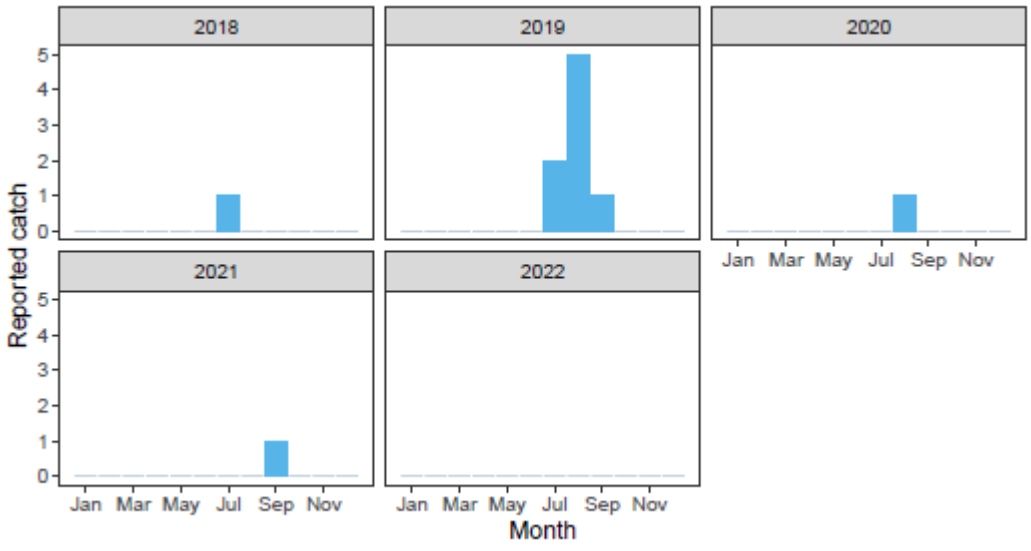
Mills & Graesser say that salmon angling is not one of Skye's main attractions, The Varagill is one of the better rivers, but most are small spate streams`

Broadford River



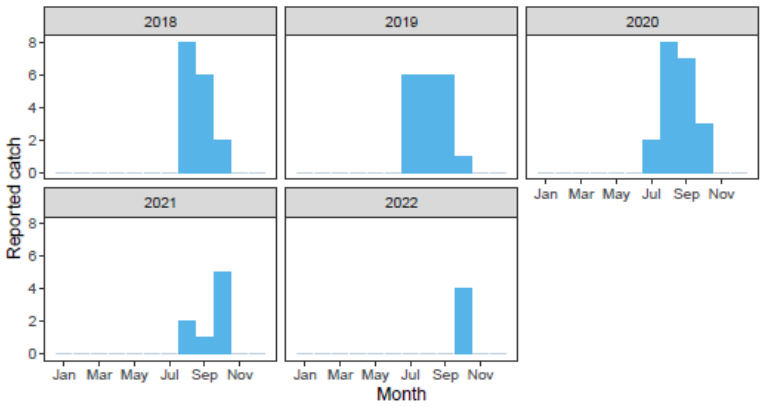
Bruce Sandison writes that this stream almost disappears without rain.

River Sligachan

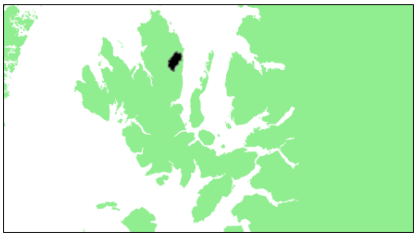


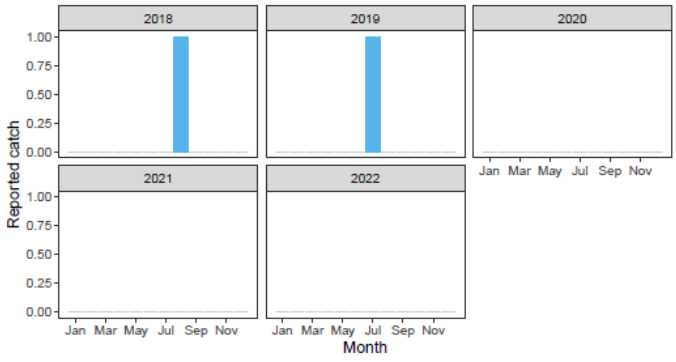
Bruce Sandison writes that the river needs heavy rain to allow fish to enter.

River Varragill



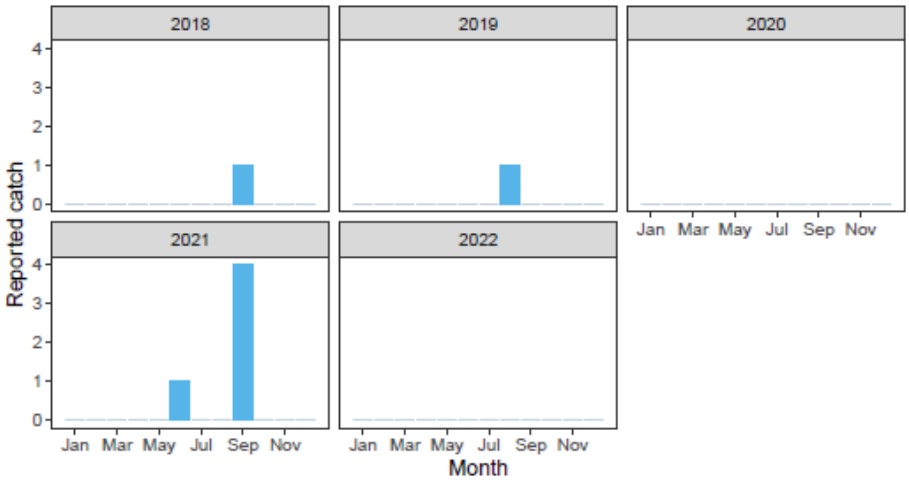
Bruce Sandison writes that this river is fished privately.



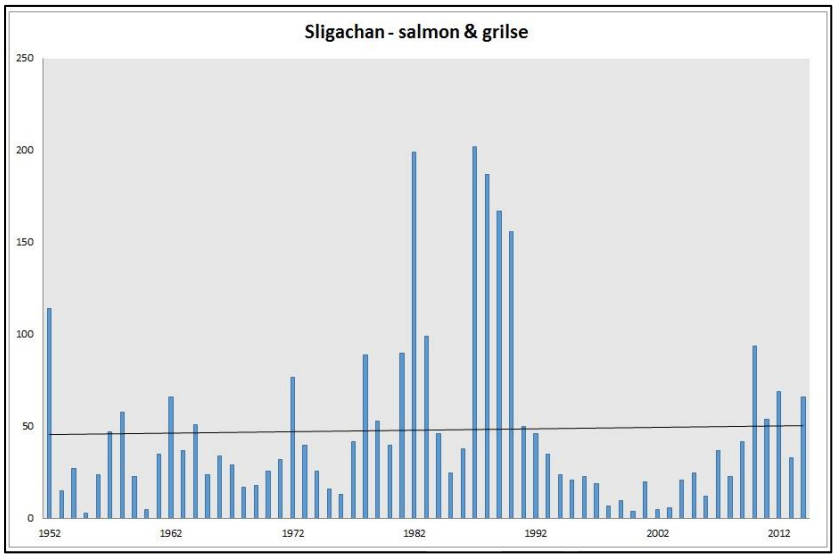


A waterfall prevents fish running far up this river.

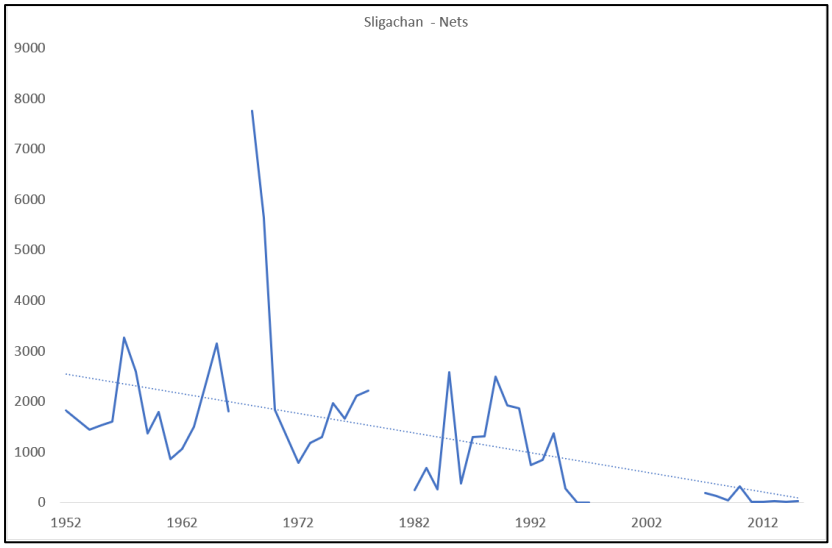
Brogaig, Stenscholl and Kilmaluag



Very small streams that offer limited fishing and mainly after heavy rain.



Although the fishery district consists of a number of small streams, netting continued in the district until 2015. Whereas the rod fishery was taking 200 fish a year, the nets were taking around 2,500 peaking at just under 8,000 in 1968.



Sea trout catches show a long-term decline from the mid-1950s.