Good ecological status?

Workshop on salmon and sea trout and their habitats

Loch Torridon Community Centre
23rd April 2024

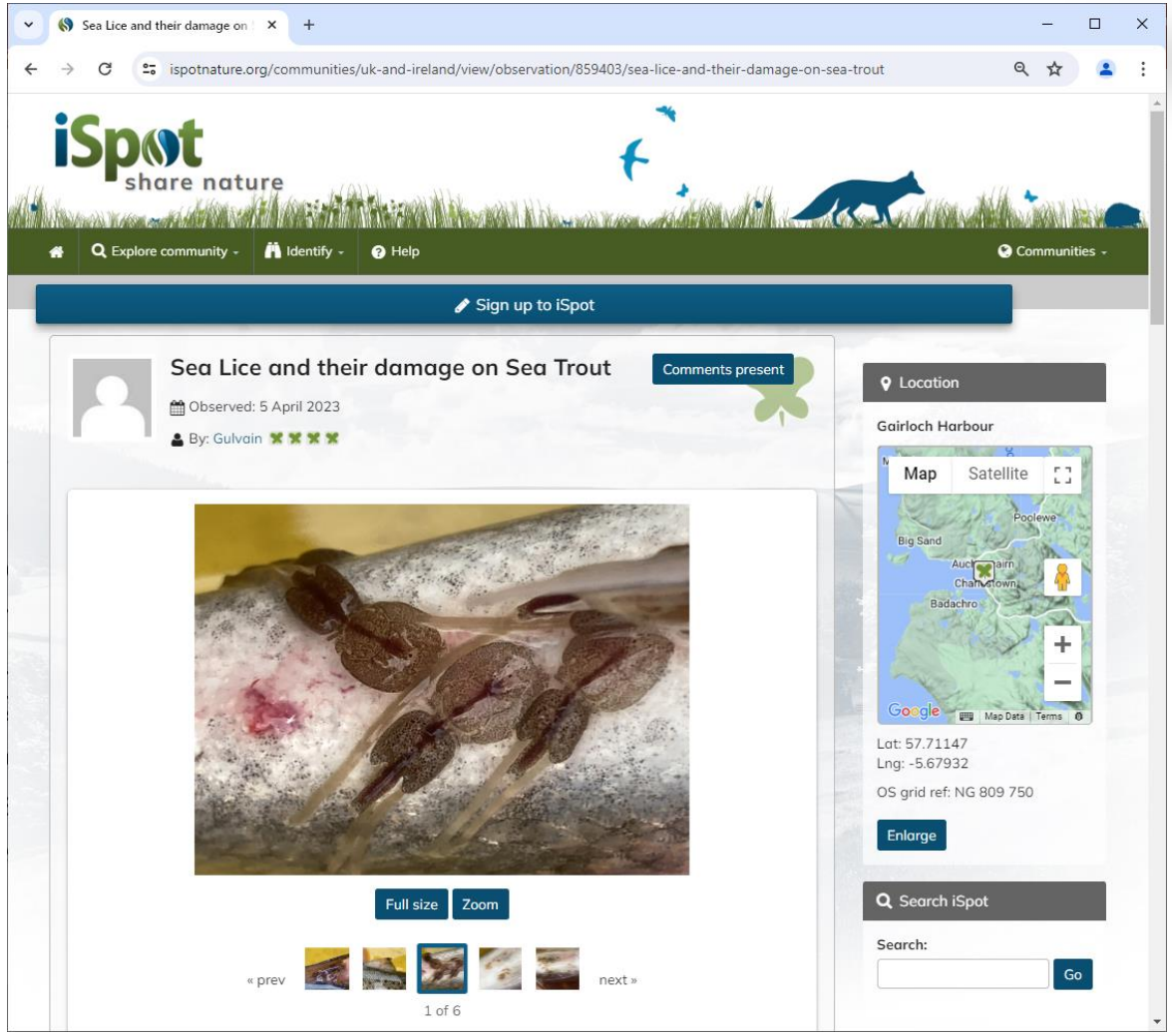
https://www.facebook.com/WRFT22

www.wrft.org.uk

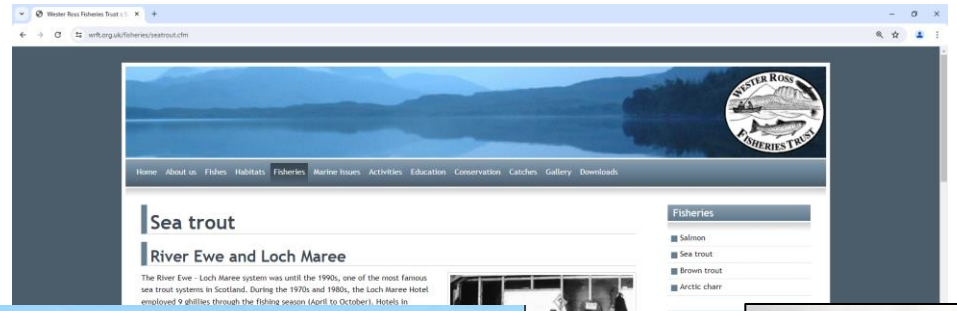
Still too many sea lice in coastal waters? . . .

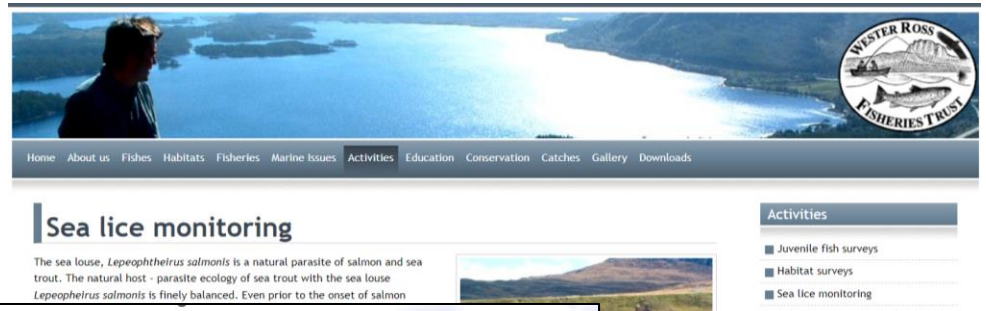
Peter Cunningham (WRFT Biologist)

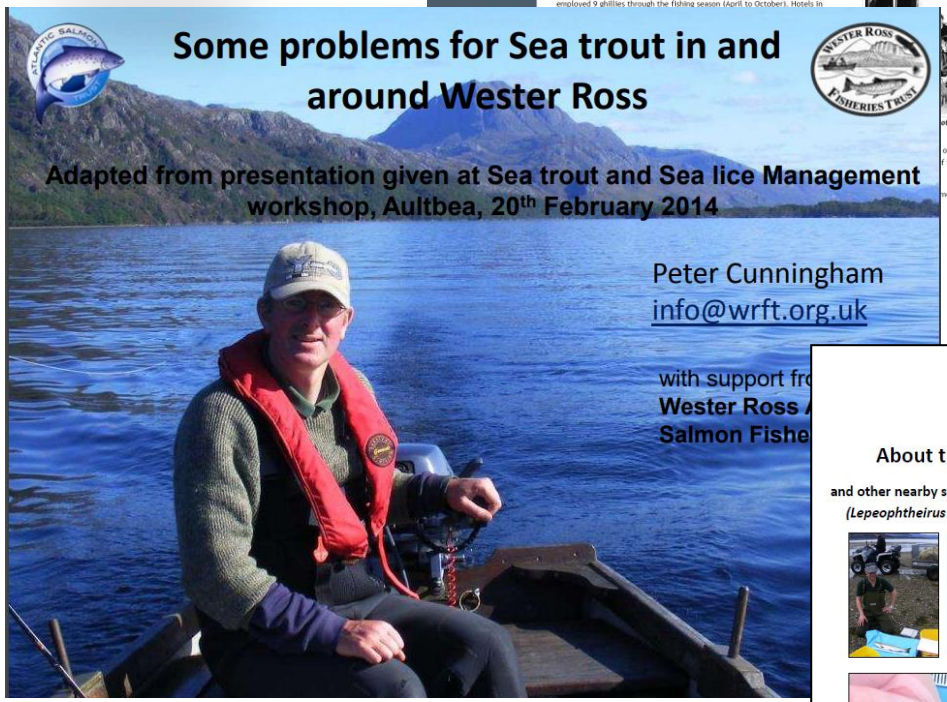
- What is a sea louse?
- What is a sea trout?
- Why are sea lice a problem for wild sea trout and salmon?
- Sea louse monitoring results for 2023
- Sea lice regulation to protect wild fish?
- Future prospects . . .

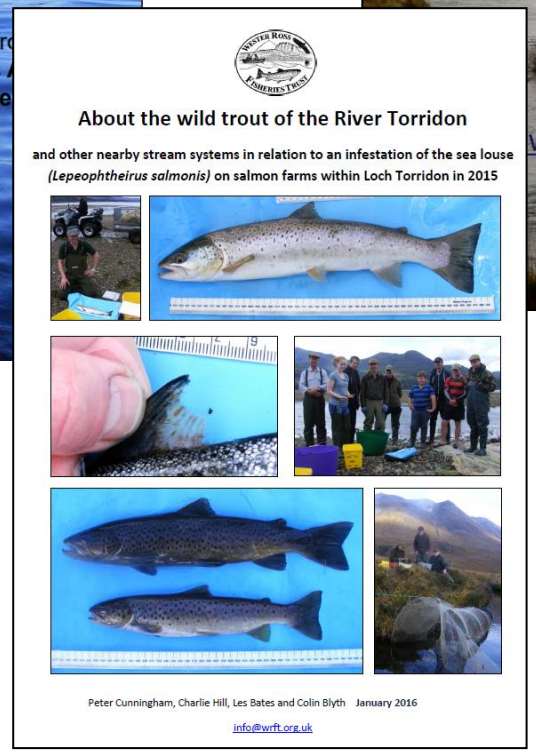


Adult female sea lice on a Gairloch sea trout (Gulvain, aka Roger Mclachlan)



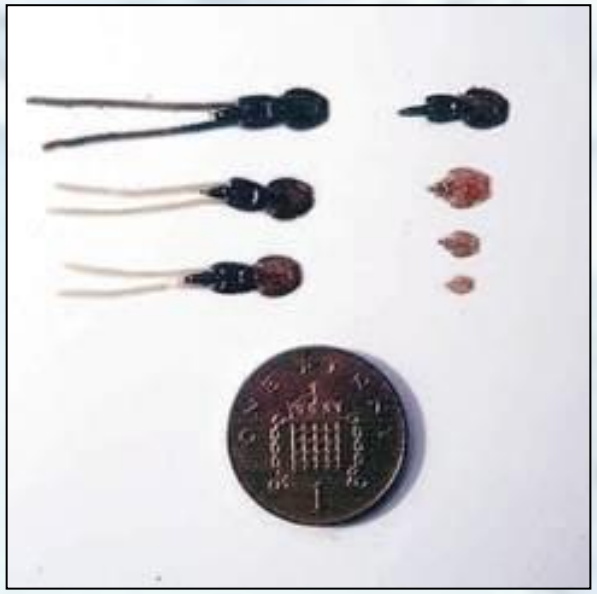






Please see [WRFT website](#) for lots of previous studies and presentations

- Sea lice are naturally occurring parasites of fish.
- Larval *Lepeophtheirus salmonis* attach to salmon and sea trout and grow by eating the mucus, blood and skin of their host fish.

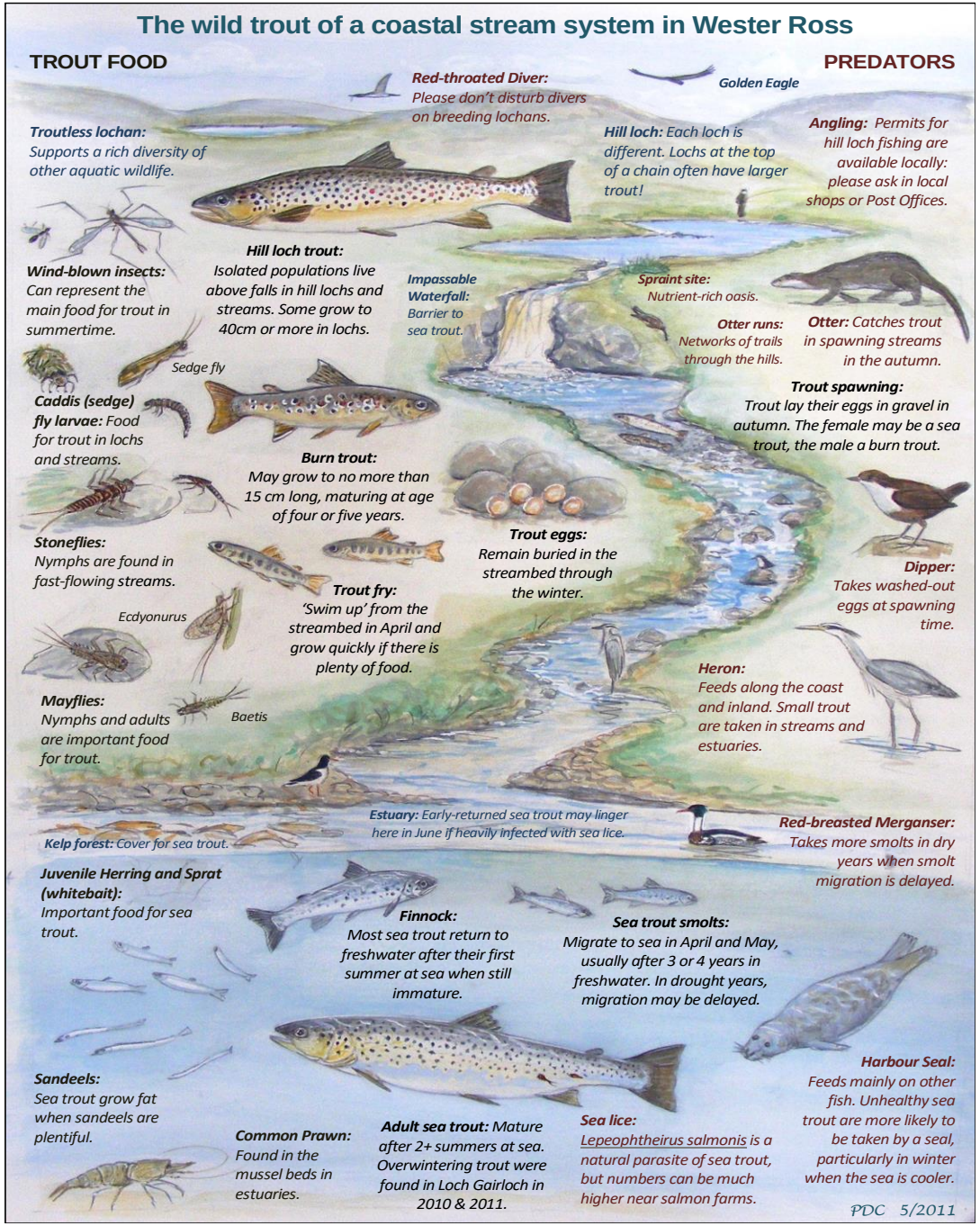


Lepeophtheirus salmonis (James Butler)

Sea trout of 281mm taken in the sweep net at Flowerdale on 19th May 2015. This fish carried an estimated 500 mostly chalimus stag lice. Note the descaled area below the dorsal fin associated with a bird attack (photo by James Merryweather).

What is a sea trout?

- A sea trout is a Brown trout (*Salmo trutta*) which spends part of its life in the sea.
- After 2 to 4 years in freshwater, sea trout tend to go to sea for the first time, when they are about 12cm to 18cm long.
- Most sea trout spend at least summer months in the sea; they return to rivers in the autumn to spawn and may over winter in freshwater or in the sea.
- Sea trout may survive to spawn many times.



Wester Ross Wild Trout diversity

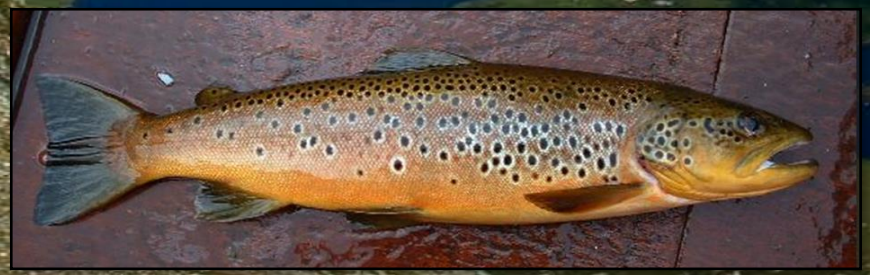
illustrated by Paul Vecsei

https://www.flickr.com/photos/fishasart/

The Fionn Loch

Fionn Loch brown trout, Sept 2017

A special place for conserving wild fish genetic diversity . . .



Trout caught by Ala Mackenzie, 2004

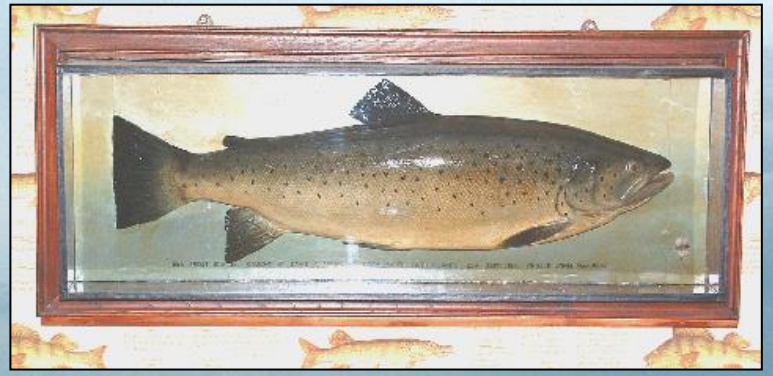
Piscivorous trout and prey:
juvenile char, salmon & trout
Fionn Loch, Sept 2017

Fionn Loch from Beinn Airigh charr

The Loch Maree Sea trout Fishery

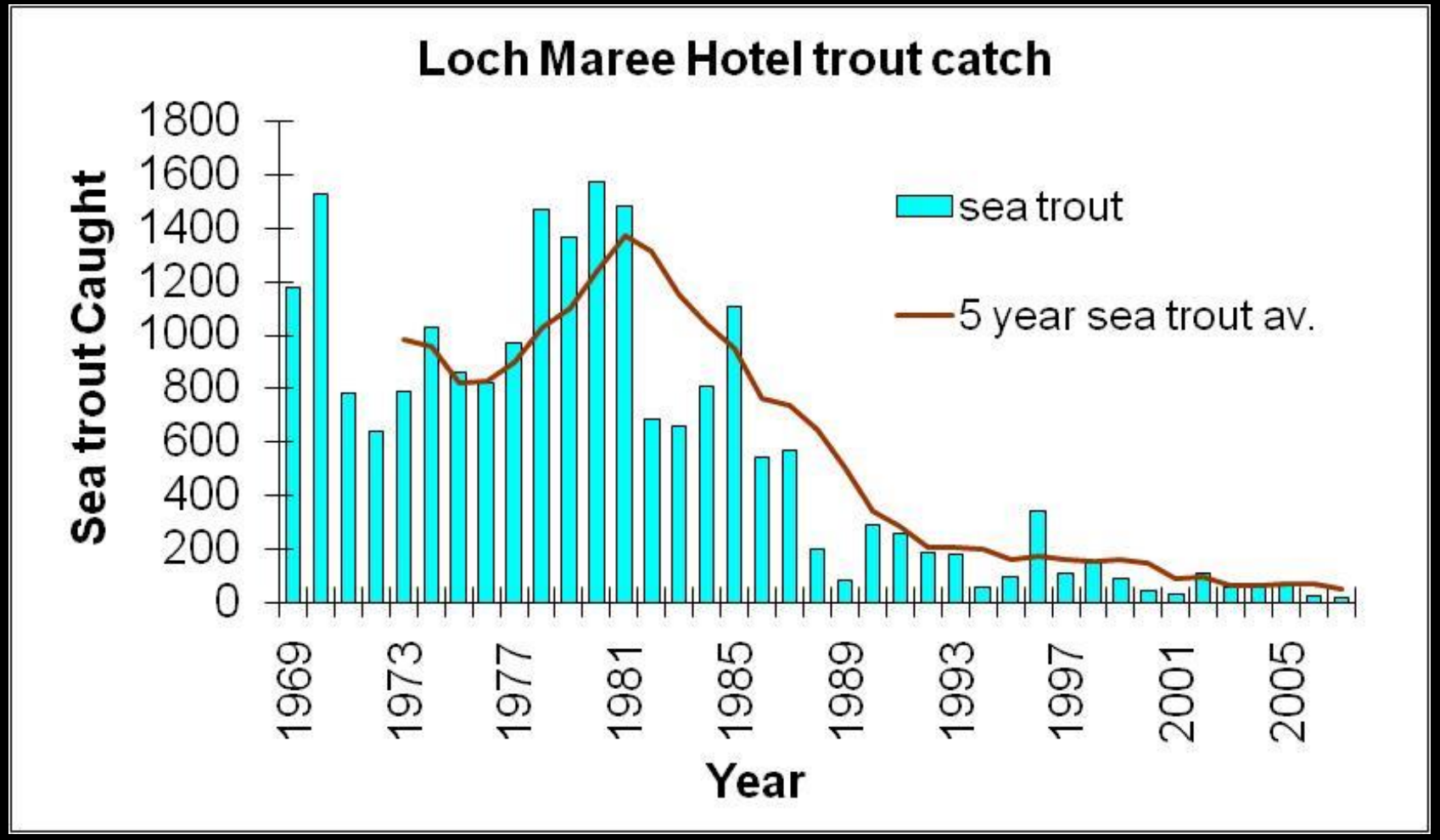
15+ boats with ghillies through summer and early autumn

Loch Maree had a reputation for large sea trout



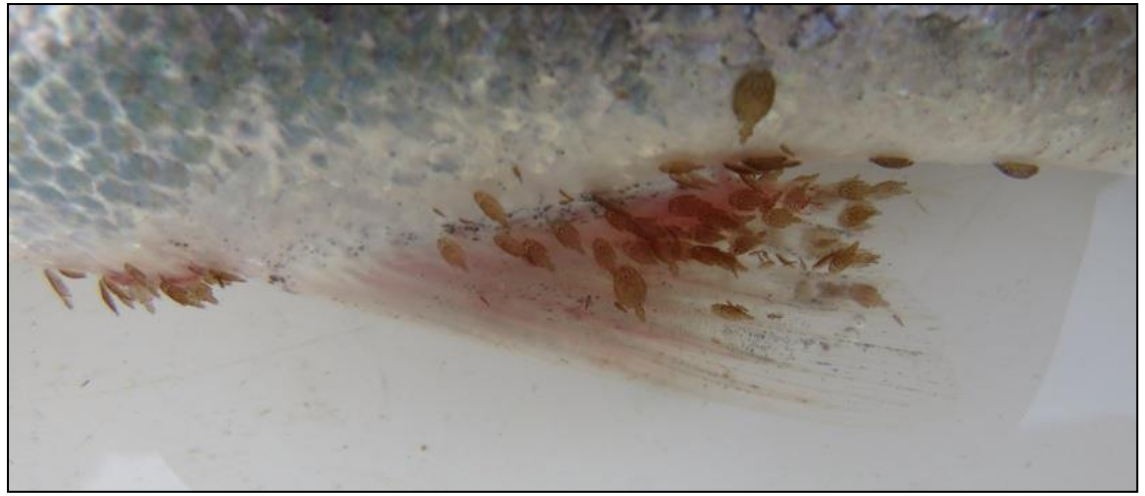
Former British record rod caught sea trout

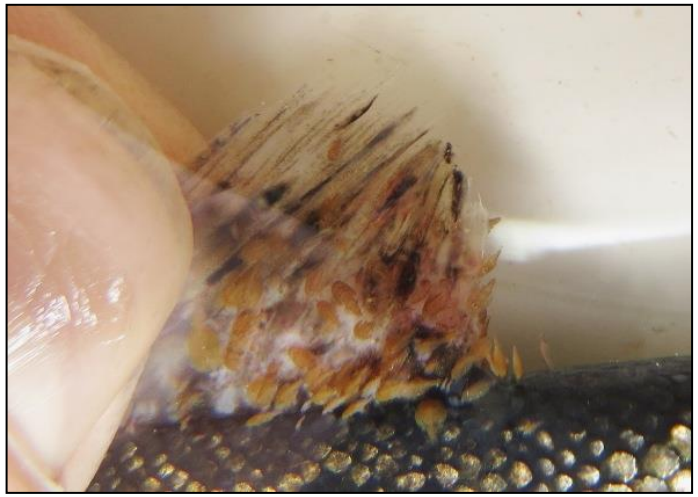
The Loch Maree sea trout fishery collapsed at the end of the 1980s.
The big sea trout have never reappeared. fishing effort has been much less in recent years than in the 1980s.



Why are sea lice a problem?

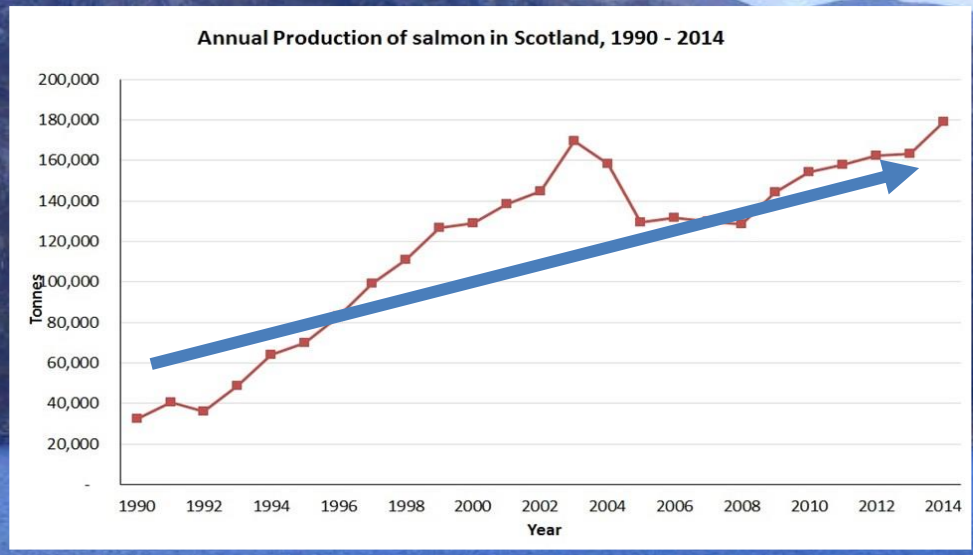
Loch Gairloch Sea trout, 19th May 2015: approximately **500 lice** . . .





Why are sea lice a problem?

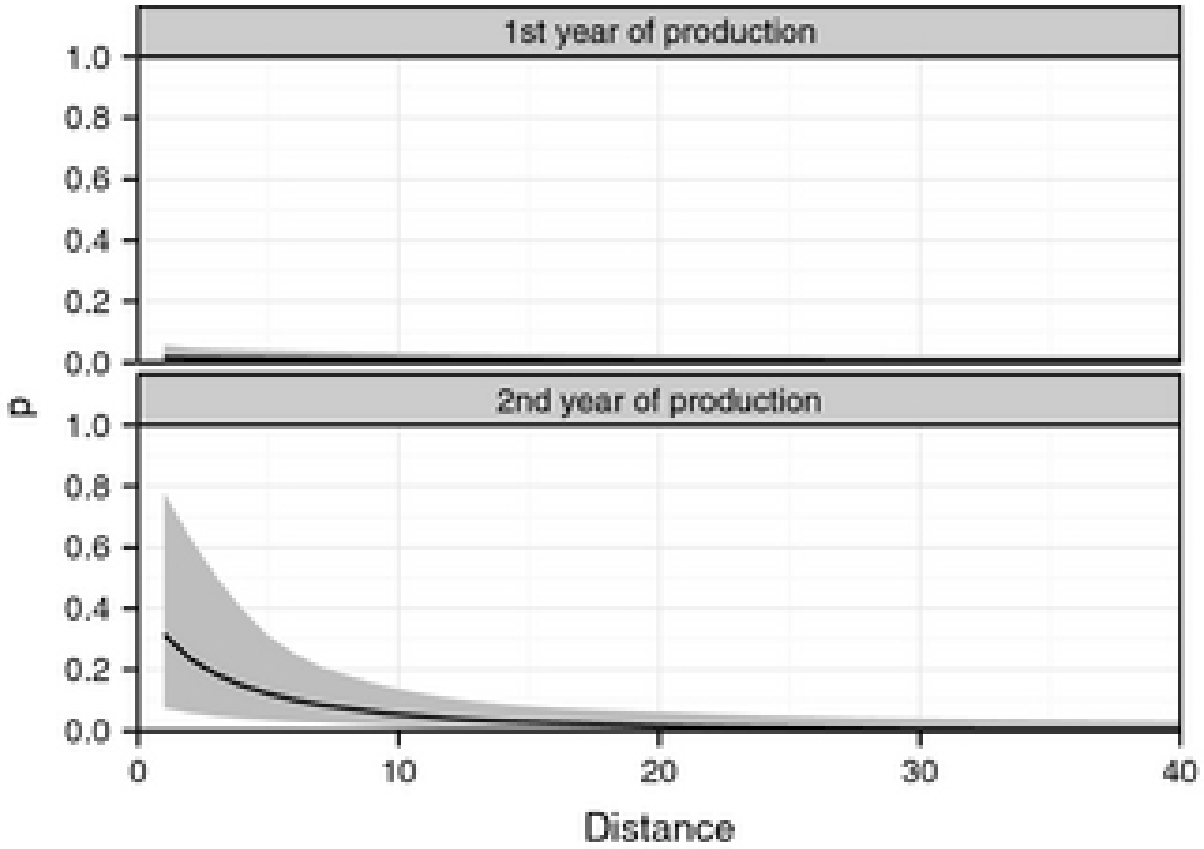
Numbers of farmed salmon in Scotland have increased greatly in the past 30 years providing many more hosts for parasitic sea lice . . .



but sea lice numbers have not been controlled to protect wild fish

Aird salmon farm,
Loch Torridon October 2016

Middlemas *et al* 2012 analysed fishery trust data and showed that there was a **correlation between lice levels on sea trout post-smolts and the proximity of salmon farms in the 2nd year of the farm salmon production cycle.**



Relationship between sea lice levels on sea trout and fish farm activity in western Scotland, Figure 4: Fitted relationships between the probability of sea trout exceeding the critical lice burden (p) and distance to nearest farm (in km) calculated using the median fork length of sea trout (160 mm). Relationships are presented using the typical weight of individual salmon on farms in the first (0.2 kg) and second (3 kg) years of production. The line shows the fitted relationship with the shaded areas representing the 95% pointwise likelihood bands.

Fisheries Management and Ecology
Volume 20, Issue 1, pages 68-74, 5 NOV 2012 DOI: 10.1111/fme.12010
http://onlinelibrary.wiley.com/doi/10.1111/fme.12010/full#fme12010-fig-0004

Marine Directorate scientists are currently writing up results from many years of research and monitoring in Loch Torridon . . .

Aquaculture Interactions: Shield

www.gov.scot/publications/aquaculture-interactions-shieldaig-field-station/pages/introduction/

Scottish Government
Riaghaltas na h-Alba

Search

About | Topics | News | Publications | Statistics and research | Consultations | Blogs

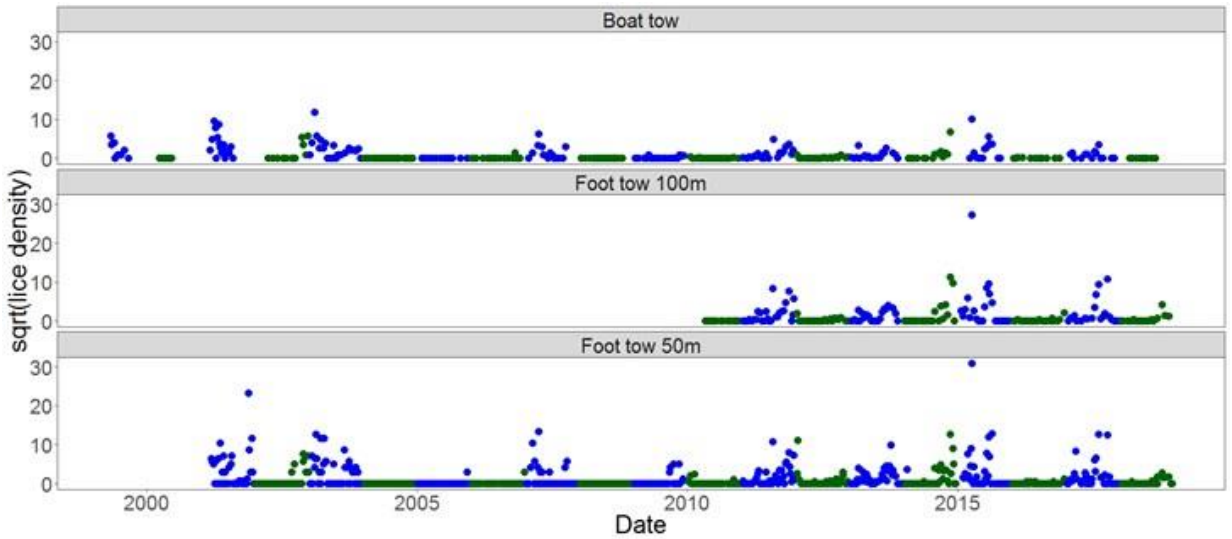
Home › Publications

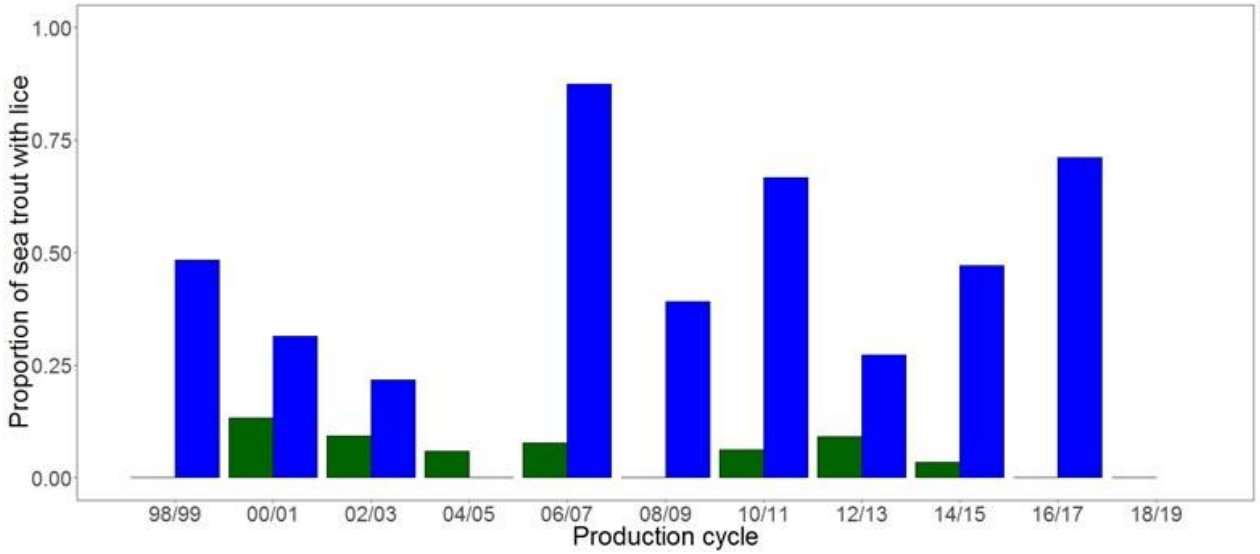
Publication - Research and analysis

Aquaculture Interactions: Shieldaig Field Station

Published: **16 September 2014**
Directorate: Marine Directorate
Part of: Marine and fisheries

Concerns regarding declining sea trout populations on the West Coast of Scotland in the late 1980s and early 1990s led Scottish Government to set up a long term monitoring programme on the River Shieldaig.



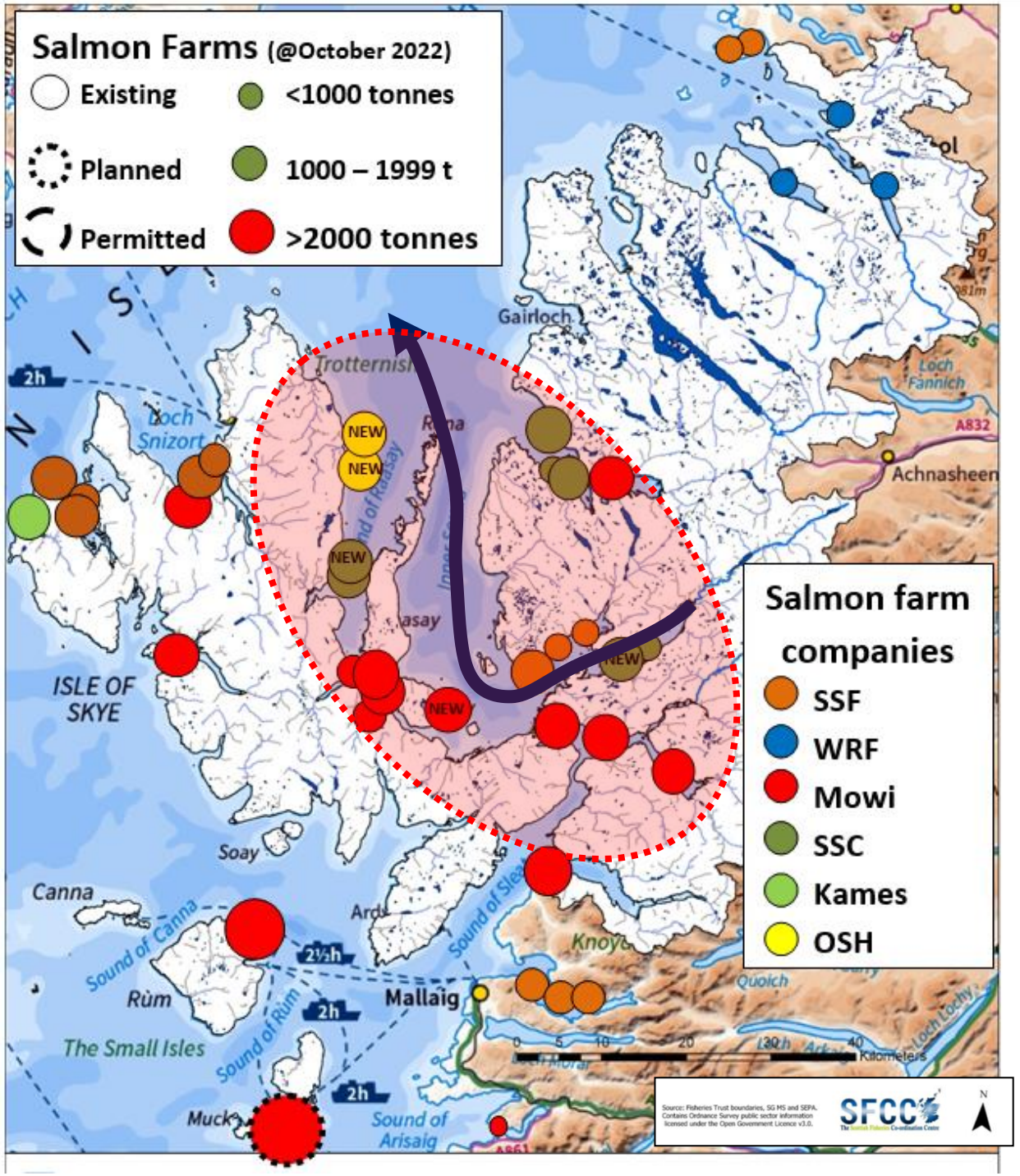


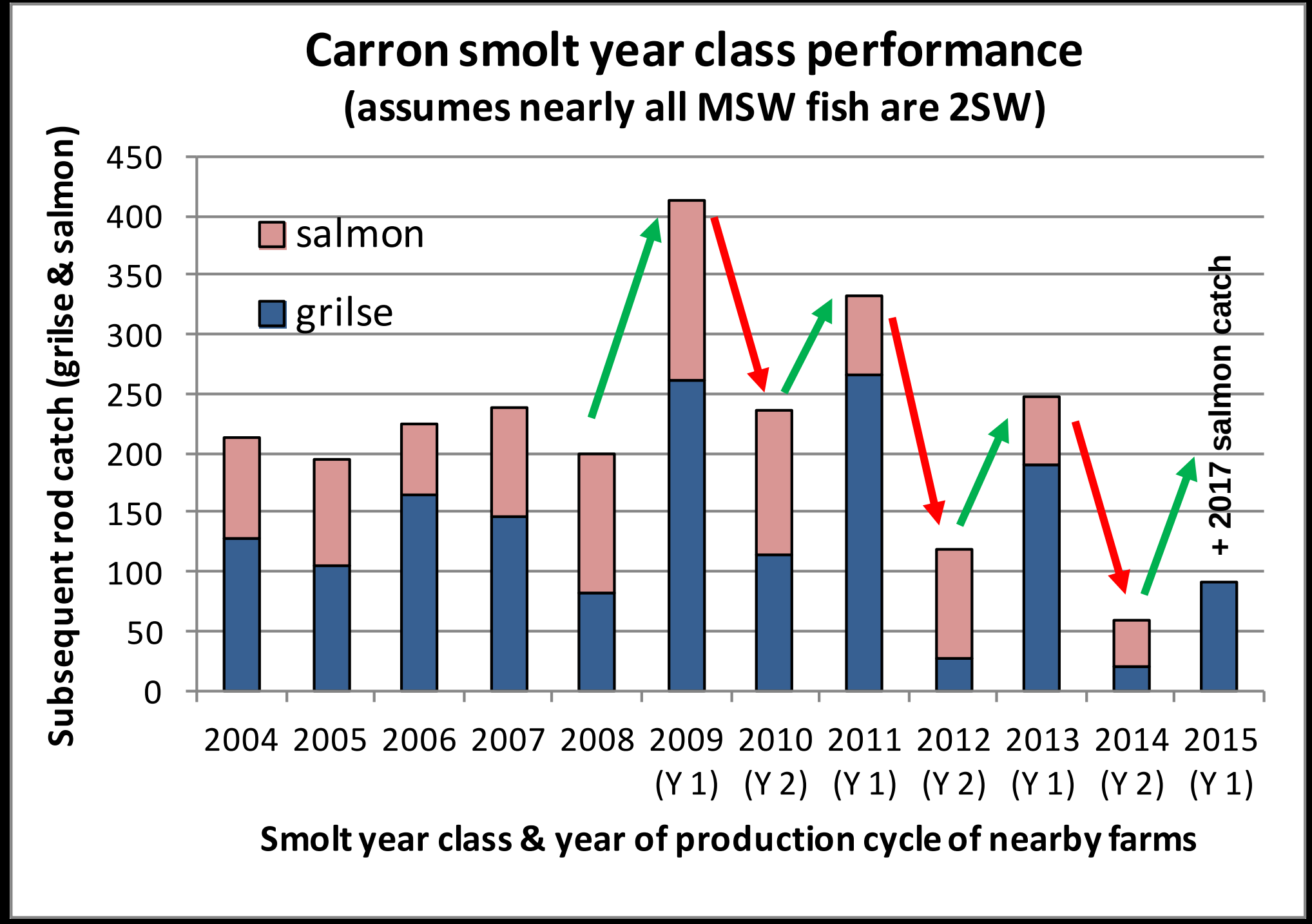
Wild salmon post-smolts are also infected by sea lice.

For example, young salmon from the River Carron have to pass many active salmon farms as they head out into the Minch.

These fish may be exposed to very high numbers of sea lice.

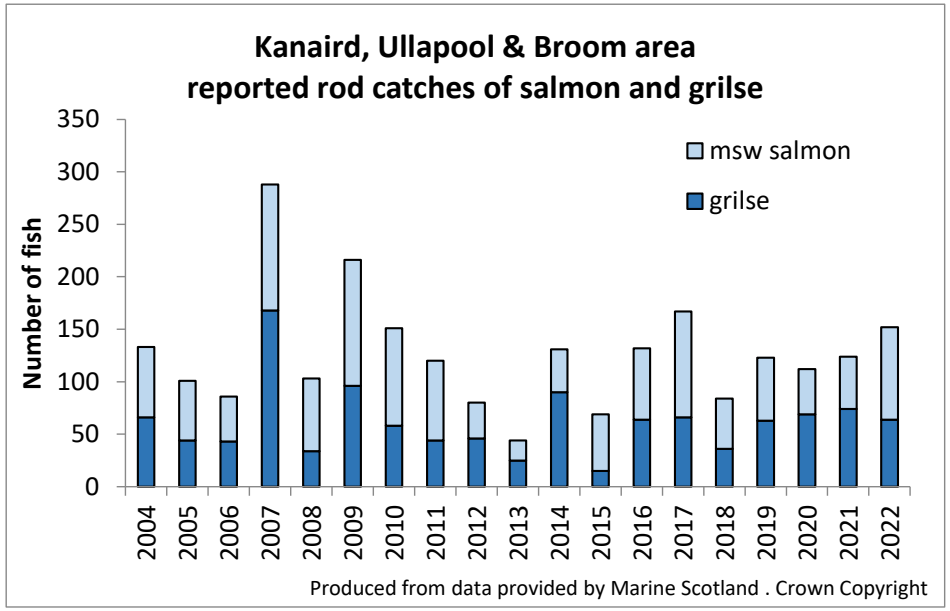
Unlike sea trout, post-smolt salmon do not return to freshwater if they get too many sea lice on them.

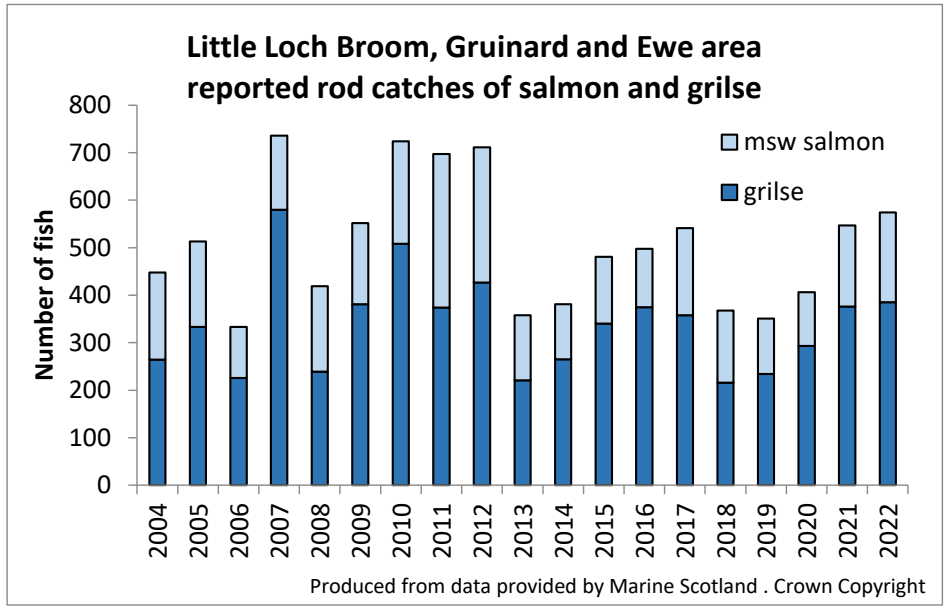


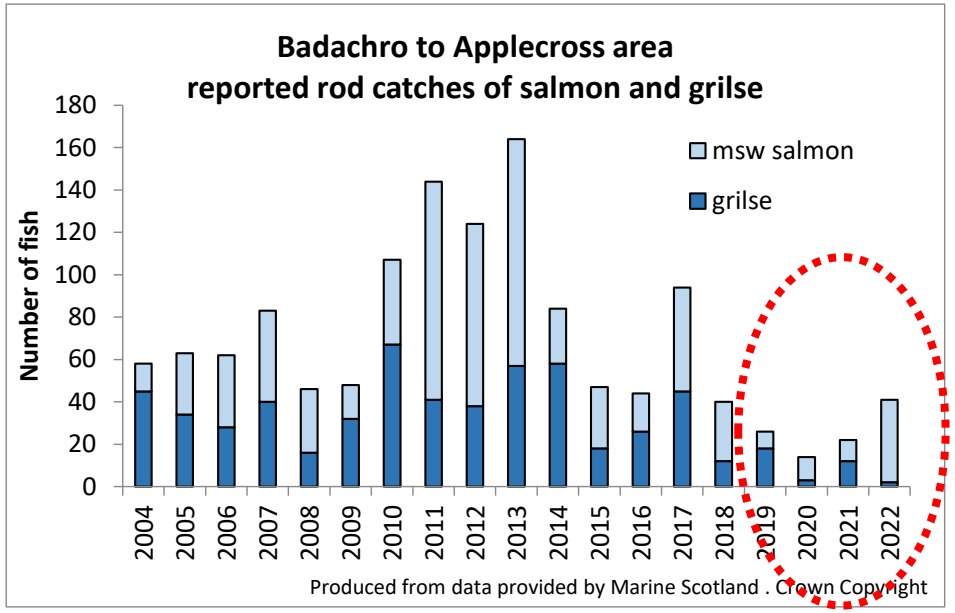

Carron smolt year class performance
(assumes nearly all MSW fish are 2SW)
Subsequent rod catch (grilse & salmon)
450
400
350
300
250
200
150
100
50
0
salmon
grilse
+ 2017 salmon catch
2004
2005
2006
2007
2008
2009 (Y 1)
2010 (Y 2)
2011 (Y 1)
2012 (Y 2)
2013 (Y 1)
2014 (Y 2)
2015 (Y 1)
Smolt year class & year of production cycle of nearby farms

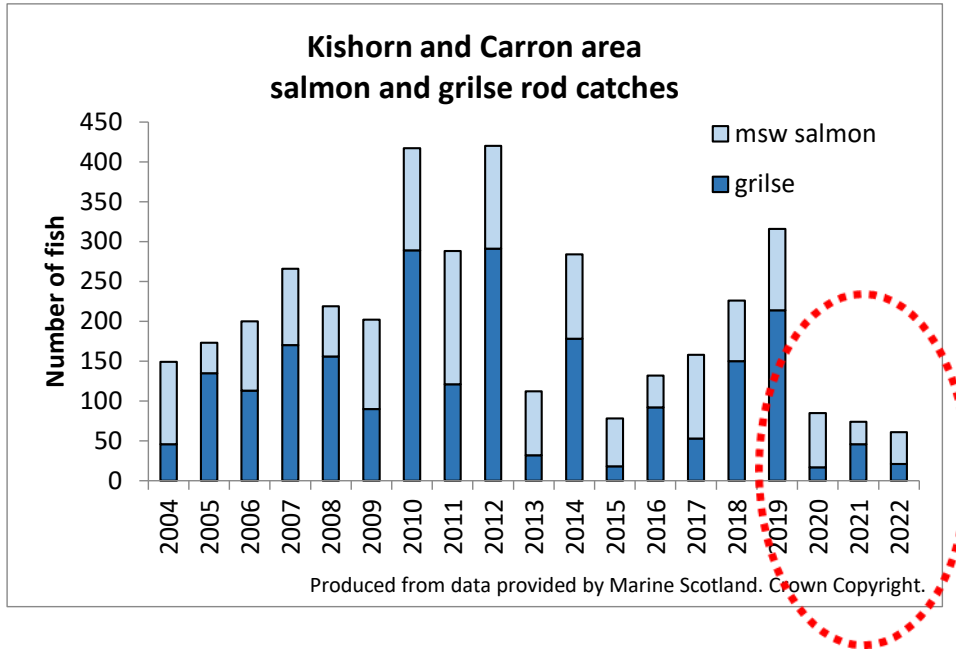
Rod catches of wild salmon are collapsing where there are many farmed salmon.

Some native, locally adapted wild salmon populations are now critically endangered, if not already gone.

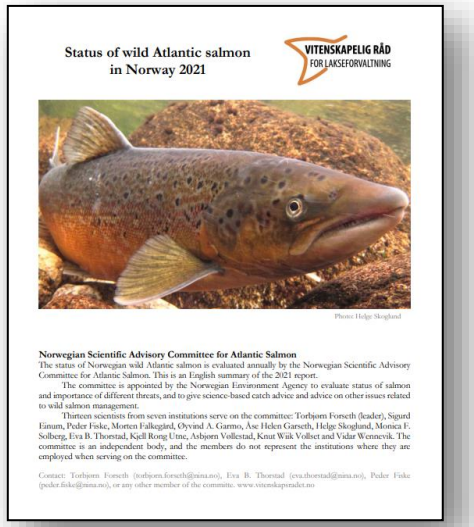








In Norway scientists have been able to quantify the impact of sea lice on wild salmon numbers . . .



Status of wild Atlantic salmon in Norway 2021

VITENSKAPELIG RÅD FOR LAKSEFORVALTNING

Photo: Helge Skoglund

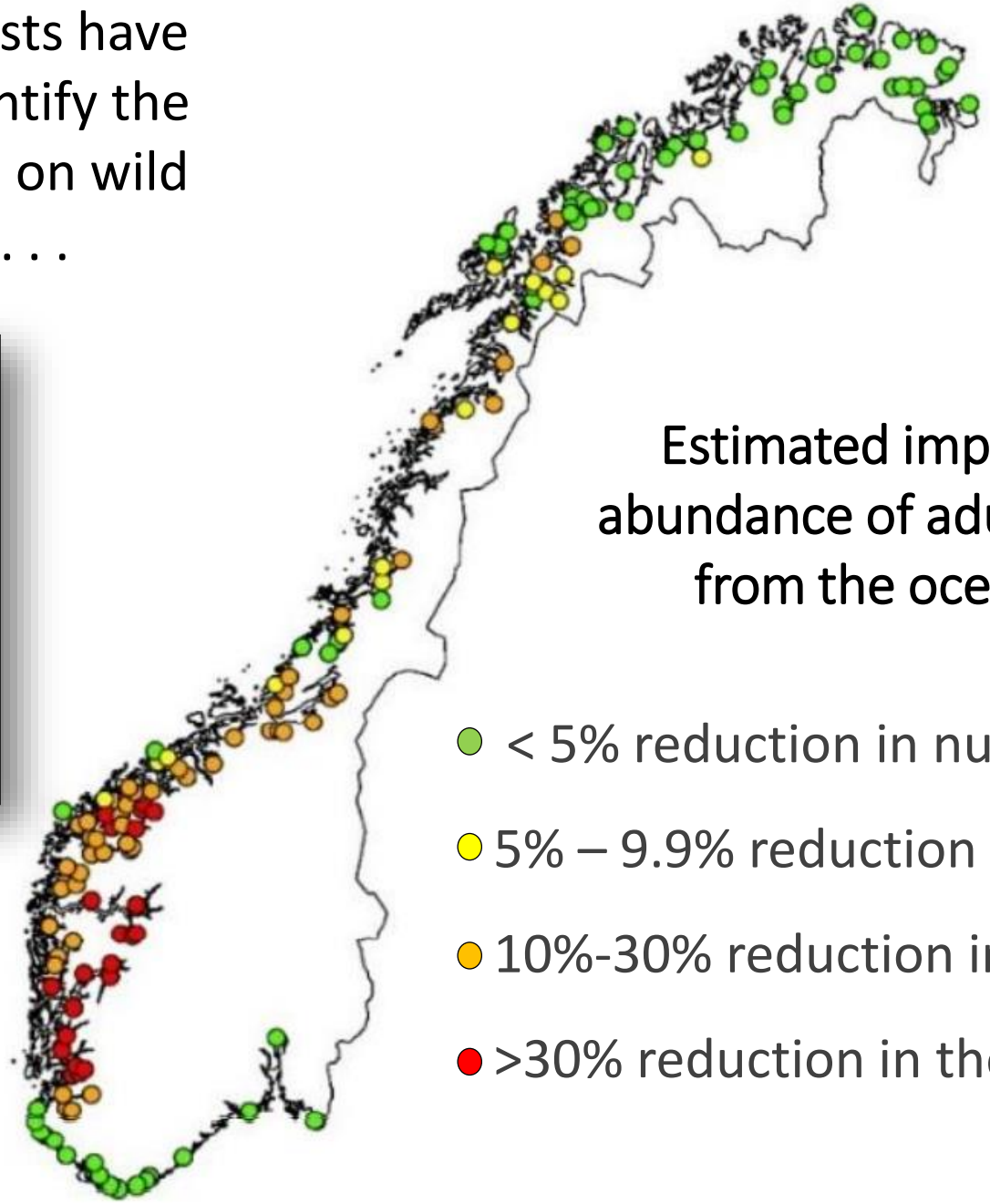
Norwegian Scientific Advisory Committee for Atlantic Salmon

The status of Norwegian wild Atlantic salmon is evaluated annually by the Norwegian Scientific Advisory Committee for Atlantic Salmon. This is an English summary of the 2021 report.

The committee is appointed by the Norwegian Environment Agency to evaluate status of salmon and importance of different threats, and to give science-based catch advice and advice on other issues related to wild salmon management.

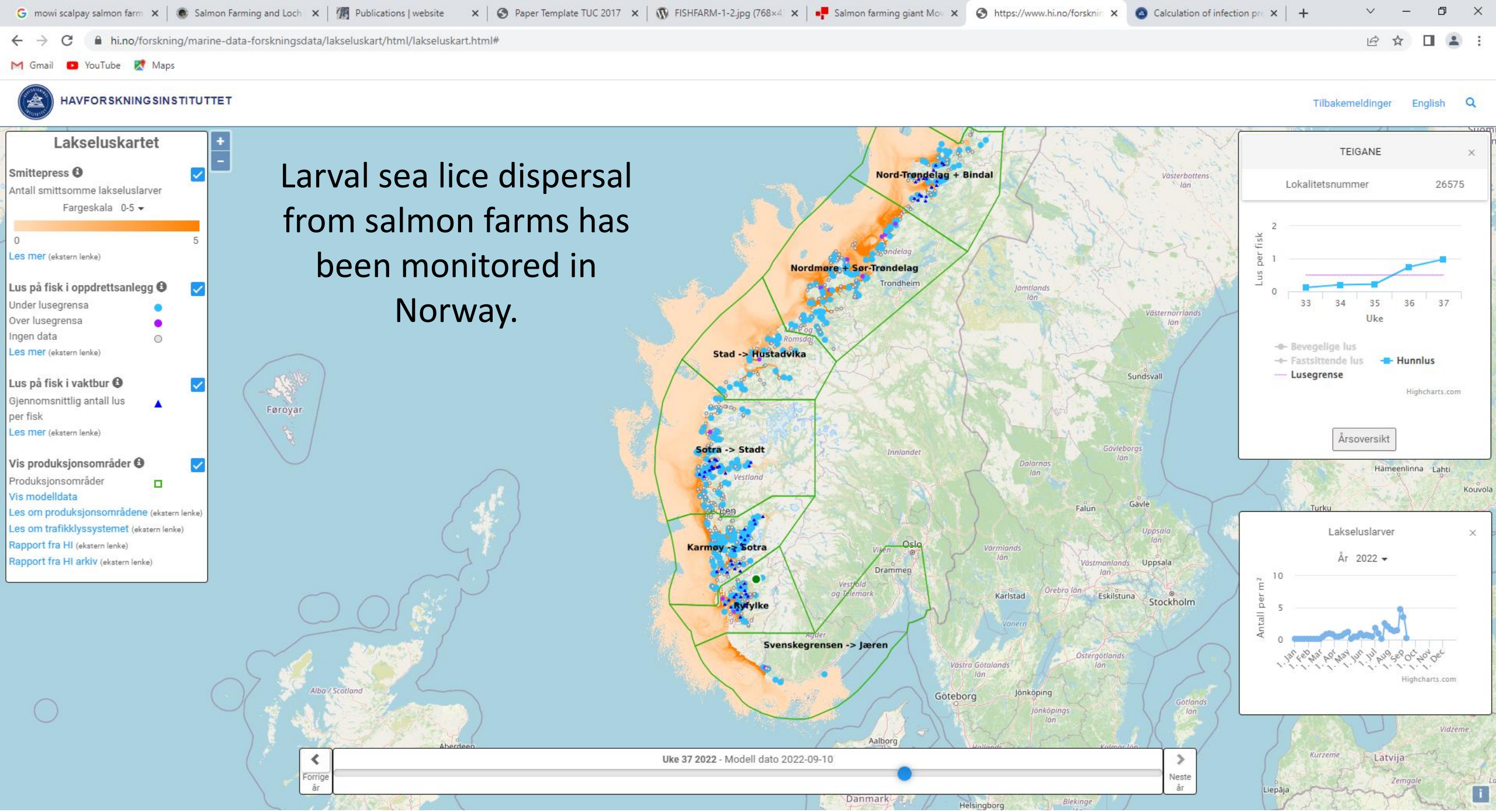
Thirteen scientists from seven institutions serve on the committee: Torbjørn Forseth (leader), Sigurd Einum, Peder Fiske, Morten Falkegård, Øyvind A. Garmo, Åse Helen Garseth, Helge Skoglund, Monica F. Solberg, Eva B. Thorstad, Kjell Rong Utne, Asbjørn Vollestad, Knut Wiik Vollset and Vidar Wennevik. The committee is an independent body, and the members do not represent the institutions where they are employed when serving on the committee.

Contact: Torbjørn Forseth (torbjorn.forseth@nina.no), Eva B. Thorstad (eva.thorstad@nina.no), Peder Fiske (peder.fiske@nina.no), or any other member of the committe. www.vitenskapsradet.no



Estimated impacts of salmon lice on the abundance of adult Atlantic salmon returning from the ocean for spawning in 2019

- < 5% reduction in numbers of returning spawners
- 5% – 9.9% reduction in numbers of returning spawners
- 10%-30% reduction in the number of returning spawners
- >30% reduction in the number of returning spawners



http://www.imr.no/lakseluskart/html/lakseluskart.html

Sea lice monitoring by WRFT in 2023

- Kanaird estuary - sweep netting
- Loch Ewe (Boor) - coastal fyke net
- Gairloch (Flowerdale) - sweep netting
- Applecross - sweep netting

Applecross 25th May 2023

Applecross sea trout 2023

For Caol Mor Salmon farming EMP

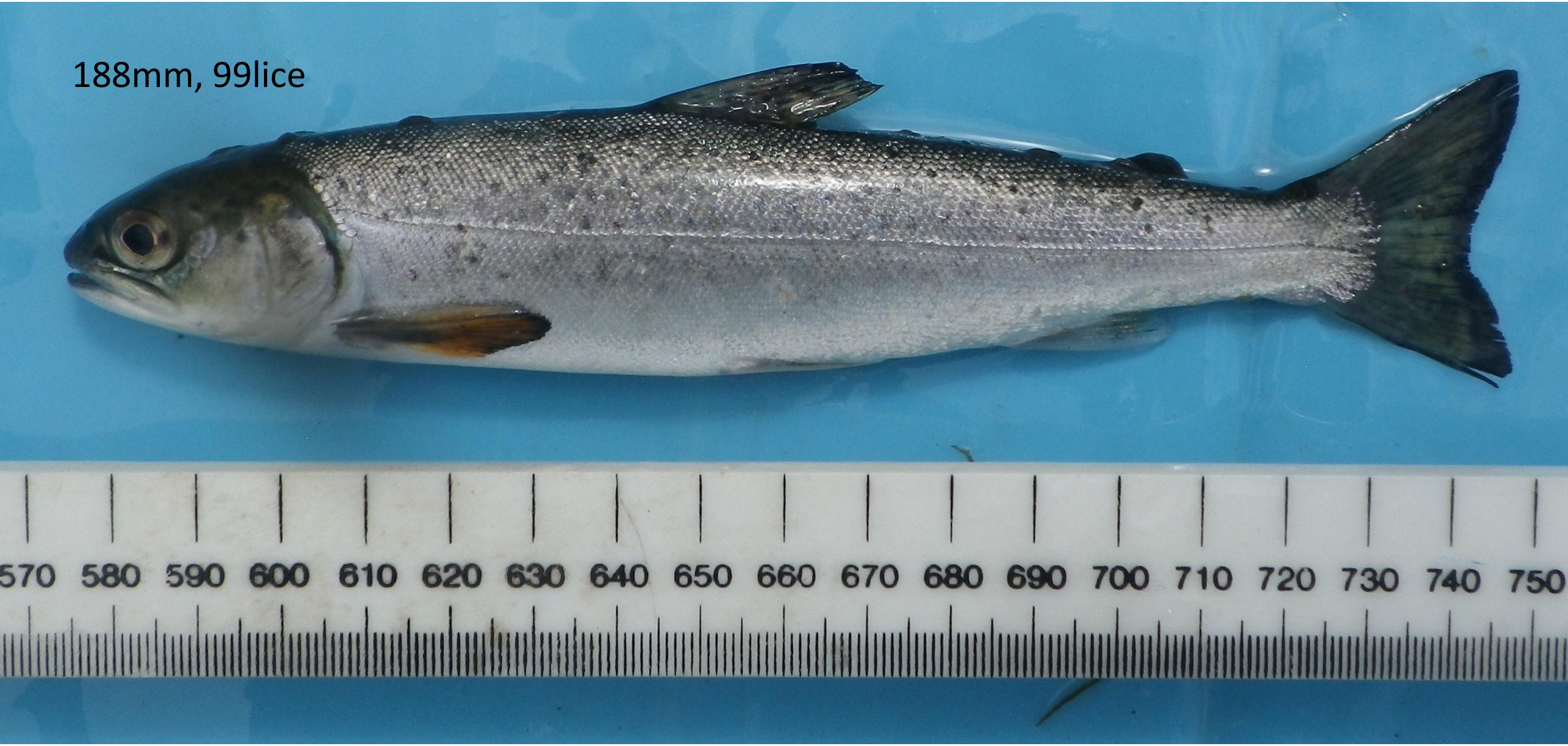
Sample #1: 25th May 2023

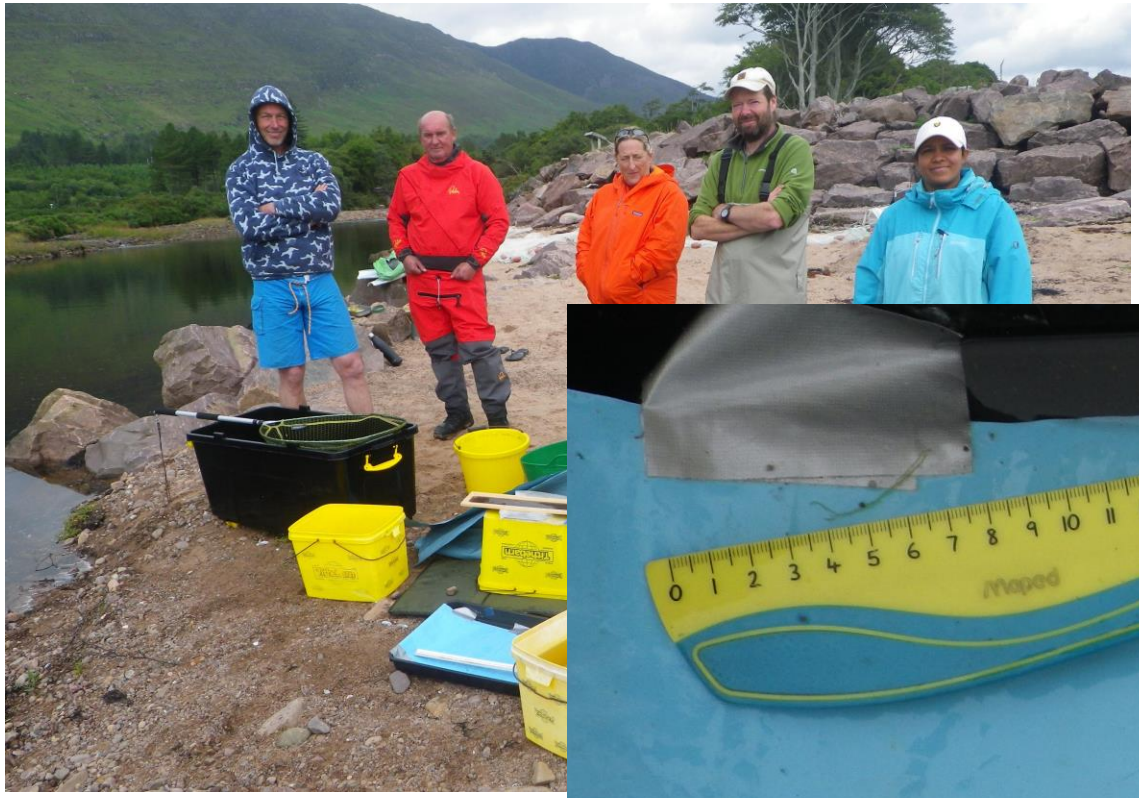
Most of the larger sea trout in the sample had over 0.3 sea lice per gram

					Lepeophtheirus salmonis																		
Fish number on field sheet	Fish	length (mm)	Recorded weight or *estimated weight (g)	Recorded condition factor or *projected condition factor	Copepodid & Chalimus	Pre-adult & adult	Ovigerous females	Total L. s	*estimated lice/g fish weight	^Dorsal fin damage score	*Cryptocotyle ligua* spots per cm2 of caudal fin	Predator damage	Photo	Scale sample	Comments	≥13 lice/fish ?	Lice/g fish weight	Range	Mortality					Projected mortality %
1	Sea trout	397	612	0.98	360	0	0	**360**	0.588	3	0	n	y	y	photo of dorsal fin	Yes	0.588	>0.3	100%	16	42	38.10	38.10	
2	Sea trout	313	274	0.89	300	0	0	**300**	1.095	3	4	y	y	y	bird beak scar	Yes	1.095	0.2-0.3	50%	2		4.76	2.38	
3	Sea trout	503	1085	0.85	60	0	0	**60**	0.055	3	0	n	y	y	at least 200 lice spots on ta	Yes	0.055	0.1-0.2	20%	1		2.38	0.48	
4	Sea trout	283	185	0.82	5	2	0	**7**	0.038	1	0	n	y	y		No	0.038	<0.1	0%	23		54.76	0.00	**40.95**
5	Sea trout	333	363	0.98	300	1	0	**301**	0.829	2	0	n	y	y	caudal fin eroded	Yes	0.829							
6	Sea trout	362	408	0.86	200	0	0	**200**	0.490	2	1	n	y	y		Yes	0.490							
7	Sea trout	330	280	0.78	0	0	0	**0**	0.000	0	1	n	y	y		No	0.000							
8	Sea trout	308	260	0.89	0	0	0	**0**	0.000	1	0	n	y	y	lice off (lice spots)	No	0.000							
9	Sea trout	305	236	0.83	55	0	0	**55**	0.233	2.5	1	y	y	y	old predator damage	Yes	0.233							
12	Sea trout	275	174	0.84	55	0	0	**55**	0.316	2	2	y	y	y	old predator damage	Yes	0.316							
13	Sea trout	350	382	0.89	350	0	0	**350**	0.916	1.5	1	n	y	y		Yes	0.916							
14	Sea trout	299	235.2	0.88	550	0	0	**550**	2.338	1.5	0	n	y	y	smart phone photos	Yes	2.338							
15	Sea trout	305	256	0.90	250	0	0	**250**	0.977	2	0	n	y	y		Yes	0.977							
16	Sea trout	315	271	0.87	88	0	0	**88**	0.325	1	0	n	y	y		Yes	0.325							
17	Sea trout	335	340	0.90	120	0	0	**120**	0.353	2	10	n	y	y	many lice spots (lice off)	Yes	0.353							
18	Sea trout	297	230	0.88	20	1	0	**21**	0.091	1	0	n	y	y		Yes	0.091							
19	Sea trout	320	262	0.80	0	0	0	**0**	0.000	0.5	3	n	y	y	lice off (lice spots)	No	0.000							
20	Sea trout	292	170	0.68	5	1	0	**6**	0.035	2.5	0	y	y	y	tail damaged, lice off	No	0.035							
26	Sea trout	340	395	1.00	60	0	0	**60**	0.152	2	0	n	y	y	lice off, fatter fish	Yes	0.152							
27	Sea trout	352	360	0.83	180	0	0	**180**	0.500	2	0	n	y	y	?2 photos of fish	Yes	0.500							
28	Sea trout	365	530	1.09	180	0	0	**180**	0.340	2	0	y	y	y	bird; chunky fish	Yes	0.340							
29	Sea trout	336	330	0.87	0	0	0	**0**	0.000	1.5	0	y	y	y	bird beak damage; lice off	No	0.000							
30	Sea trout	363	465	0.97	420	0	0	**420**	0.903	2	0	n	y	y		Yes	0.903							
31	Sea trout	307	260	0.90	3	0	0	**3**	0.012	1	0	n	y	y	lice off, healed	No	0.012							
32	Sea trout	320	283	0.86	3	1	0	**4**	0.014	3	0	y	y	y	minor predator damage	No	0.014							
33	Sea trout	293	221.4	0.88	100	0	0	**100**	0.452	2	0	n	y	y		Yes	0.452							
34	Sea trout	296	228.2	0.88	400	0	0	**400**	1.753	2	0	n	y	y		Yes	1.753							
35	Sea trout	342	352.0	0.88	220	1	0	**221**	0.628	2	2	y	y	y	old predator damage	Yes	0.628							
36	Sea trout	294	223.6	0.88	0	0	0	**0**	0.000	1	3	n	y	y		No	0.000							
37	Sea trout	306	252.1	0.88	10	1	0	**11**	0.044	1	0	n	y	y		No	0.044							
38	Sea trout	295	225.9	0.88	0	0	0	**0**	0.000	1.5	1	n	y	y	lice off (lice spots)	No	0.000							
Averages for sea trout >200mm in length			**327**	**0.88**	**139**	**0**	**0**	**139**	**0.435**	**1.76**	**0.94**													
Smolts and recent post-smolts (less than 200mm in length)																								
10	Sea trout	162	37	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
11	Estuary trout	154	32	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
21	Sea trout	143	26	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
22	Sea trout	160	36	0.88	0	0	0	**0**	0.000	0	0	n	y	y	stocked?	No	0.000							
24	Sea trout	170	43	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
25	Sea trout	155	33	0.88	0	0	0	**0**	0.000	0	0	n	y	y	hook scar deformity	No	0.000							
40	Sea trout	140	24	0.88	5	0	0	**5**	0.207	0	0	n	y	y		No	0.207							
41	Estuary trout	155	33	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
42	Estuary trout	145	27	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							
Brown trout																								
39	Brown trout	230	107	0.88	0	0	0	**0**	0.000	0	0	n	y	y	another parasite protrudir	No	0.000							
23	Brown trout	140	24	0.88	0	0	0	**0**	0.000	0	0	n	y	y		No	0.000							

Applecross
21st June 2023

Applecross 21st June2023





Applecross 19th
July 2023

Where did the lice on sea trout at Applecross in May and June 2023 come from?

Figure 3. Reproduced from Figure 1 from Gillibrand (2019) Modelling the Dispersal of Sea Lice Larvae from Scalpay Salmon Farm. MOWI Scotland Ltd. Note the location of the modelled sea lice 'hotspot', just 5km to the west of Applecross.

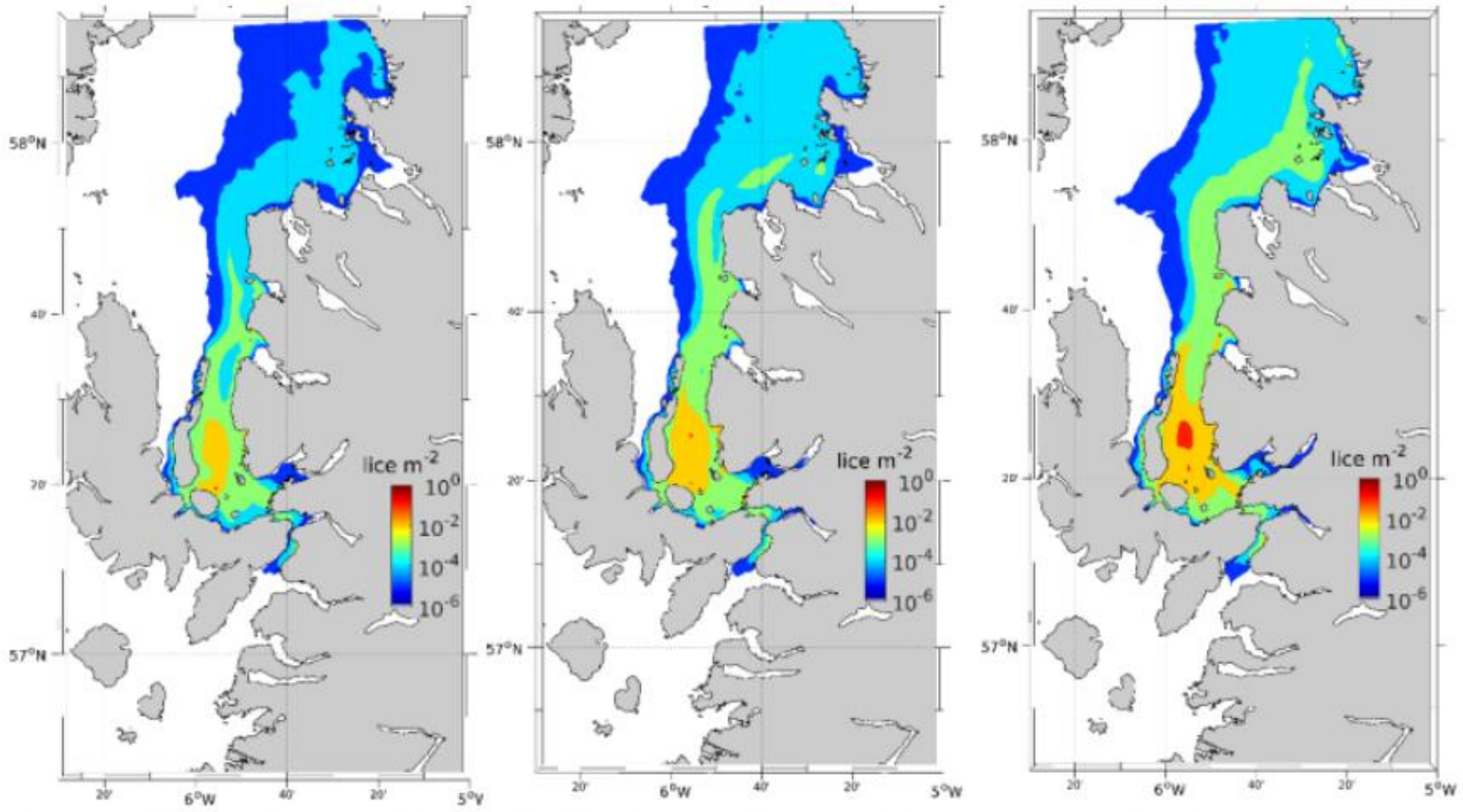


Figure 1. Predicted mean lice density (lice m^{-2}) for April – June from Simulation 1 (Scalpay only) with average adult female lice count of 0.2 (left), 0.5 (middle) and 1.0 (right). Note that the colour scale is logarithmic, indicating orders of magnitude of density, with a highest value of 1 copepodid per m^2.

Where did the lice on sea trout at Applecross in May and June 2023 come from?

Caol Mor Environmental Monitoring Programme

Sea Lice Dispersal Modelling, April – June 2023

Introduction

Mowi undertook modelling of the dispersal of sea lice larvae from the four EMP sites at Scalpay, Maol Ban, Caridh and Sconser Quarry for the period 1st March – 23rd June 2023. The modelling approach used a particle tracking model coupled to the output from an independent hydrodynamic model WestCOMS, operated by the Scottish Association for Marine Science (SAMS; Aleynik et al., 2016). The particle tracking model was Mowi's in-house model, UnPTRACK (Gillibrand, 2022), which has been developed over the past twenty years. The sources of lice larvae input to the particle tracking model were taken from weekly farm lice counts during March – June 2023. Outputs form the modelling show the predicted densities of *infective* sea lice larvae, both as spatial maps and as time series at areas of interest e.g. at Applecross.

Inputs

Hydrodynamic Model: WestCOMS (SAMS), March – June 2023 (hourly 3D velocity, temperature, salinity, turbulence). The hourly 3D velocity, temperature and salinity fields for March – June 2023 were obtained from the SAMS THREDDS server: https://thredds.sams.ac.uk/thredds/catalog/catalog.html

Lice Counts: Weekly farm lice counts from the four EMP sites (Figure 2) were used together with weekly numbers of fish from each site.

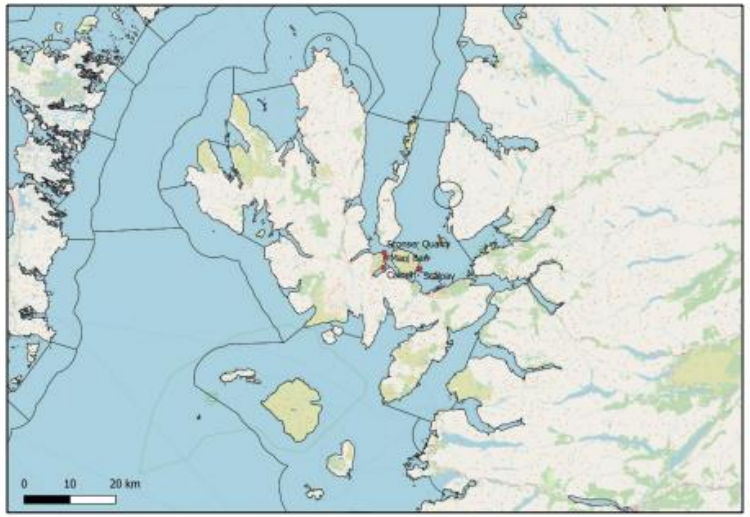


Figure 1. Location of the four EMP sites at Caol Mor, and the location of the Applecross time series output (◯).

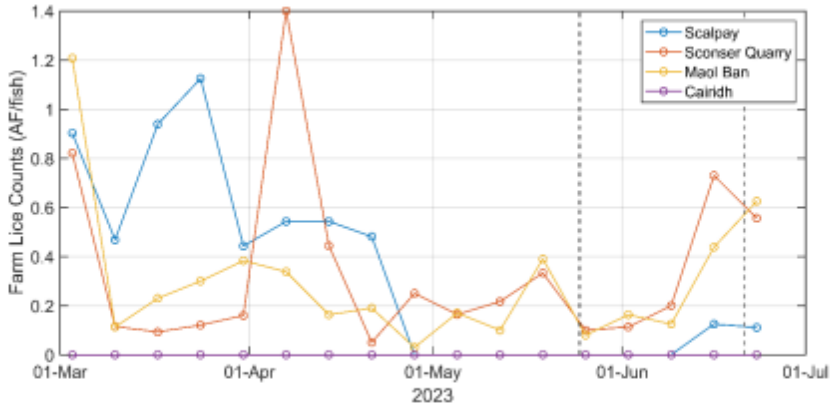


Figure 2. Weekly farm lice counts (adult females per fish) at the Caol Mor sites for March – June 2023.

Model Results

The mean modelled copepodid density arising from the EMP sites is shown in Figure 1. The results show a plume of lice from the EMP sites extending northwards with mean densities between 0.01 lice m^{-2} and 0.1 lice m^{-2}. The plume does not impact Applecross Bay. Small areas of mean predicted density exceeding 0.1 lice m^{-2} are located around the Caol Mor sites.

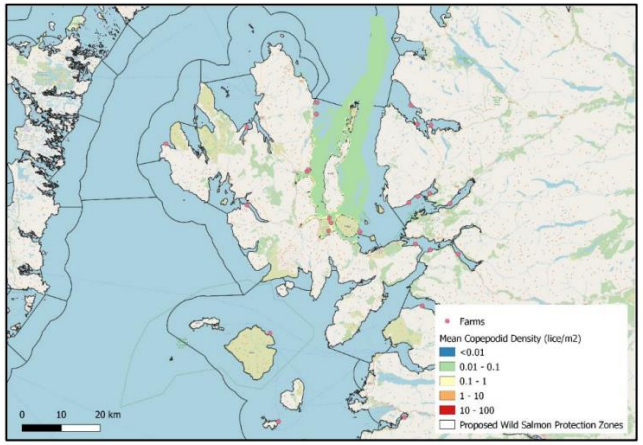


Figure 3. Mean modelled infective lice density from 1st April – 23rd June 2023.

MOWI assessment

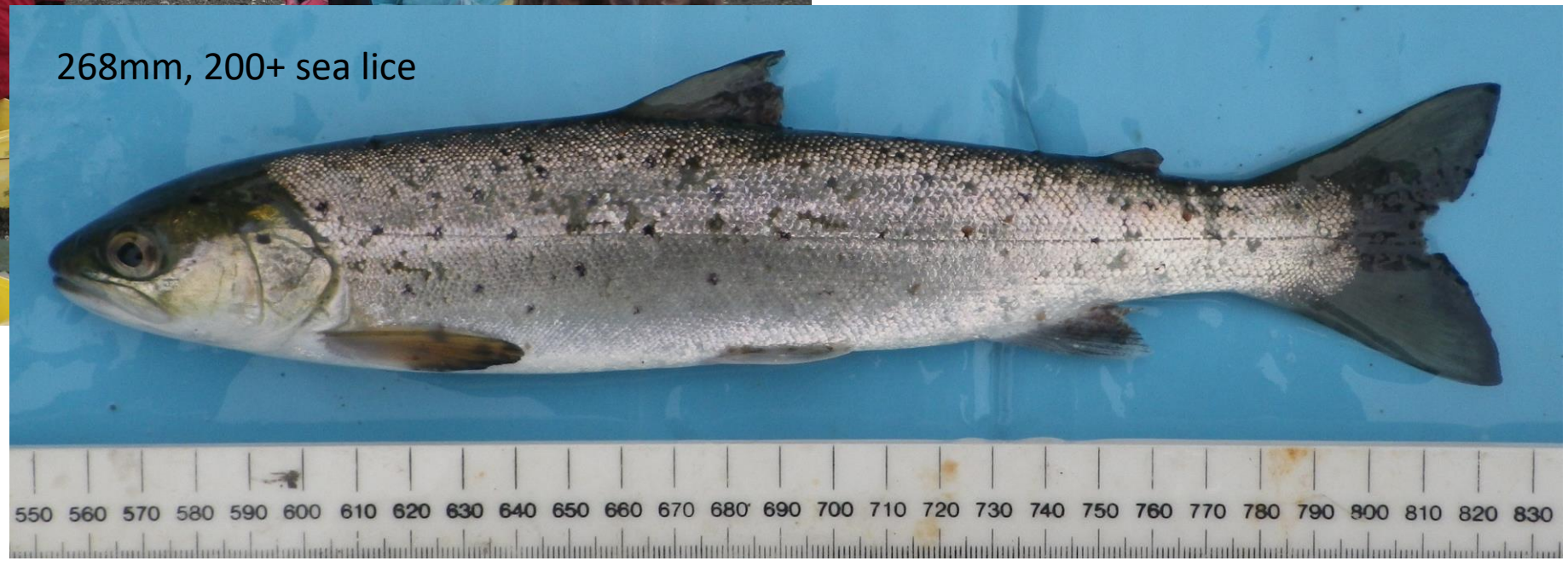
'For the Inner Sound wild salmon protection zone, which encompasses the Applecross river, and indeed all the zones in the area, the infection risk arising from the EMP sites is low (< 0.3 lice-days m-2).'

During the period 2008 – 2013 some of the largest sea trout in the Wester Ross area were taken in Loch Gairloch

(in front of the WRFT office!)

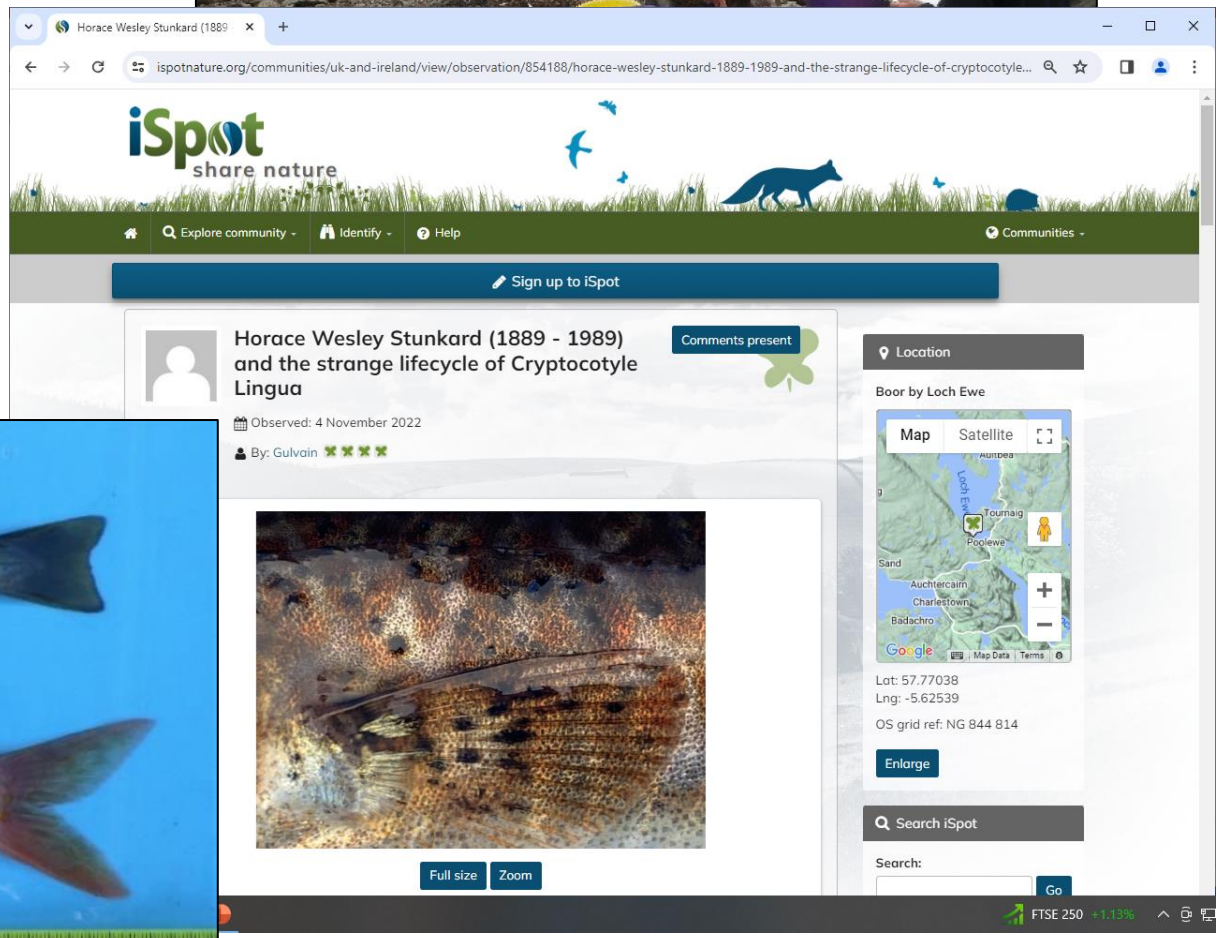
Sea trout, 580mm, taken in WRFT sweep net on 7th June 2010

Flowerdale, Gairloch 5th April 2023



Boor Bay, Loch Ewe, coastal fyke net (for sea trout)

Catch dominated by juvenile gadids (pollack, cod, coalfish, poor cod) carrying high infestation of *Cryptocotyle lingua*



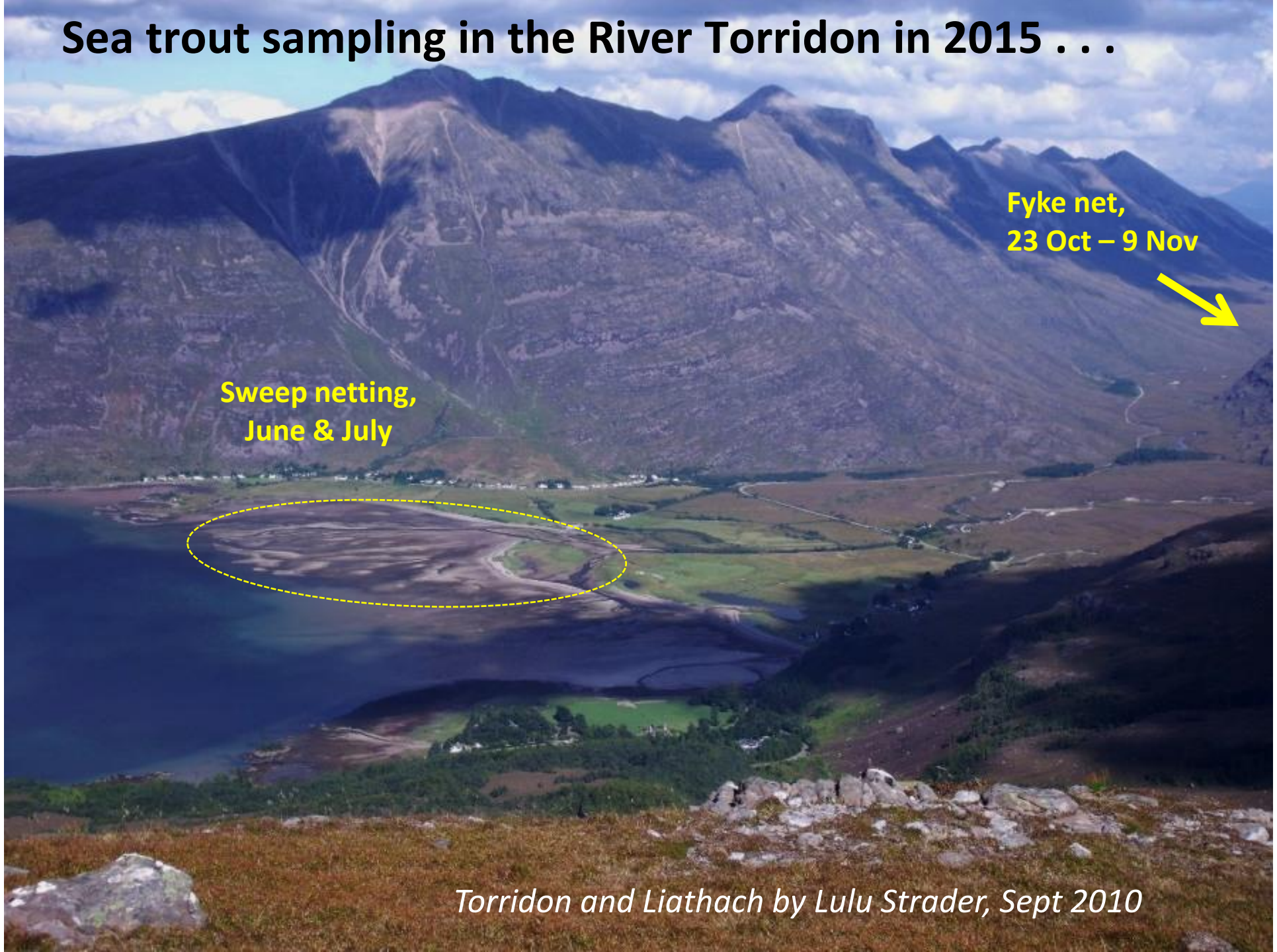
Kanaird, 6th June 2023

Sea lice monitoring 2023

Heavily lice infested sea trout in April 2023 at Gairloch and May 2023 at Applecross

Need to find a way to be able to share sea lice data from EMPs across Scotland to understand and analyse the regional sea lice situation in real time

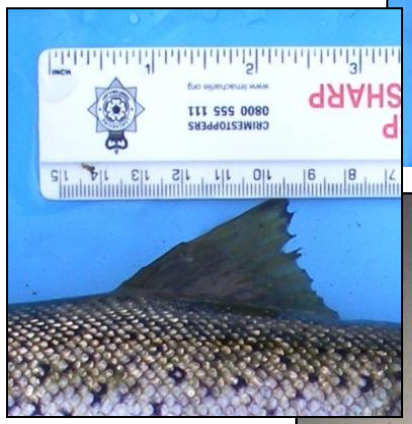
Sea trout sampling in the River Torridon in 2015 . . .

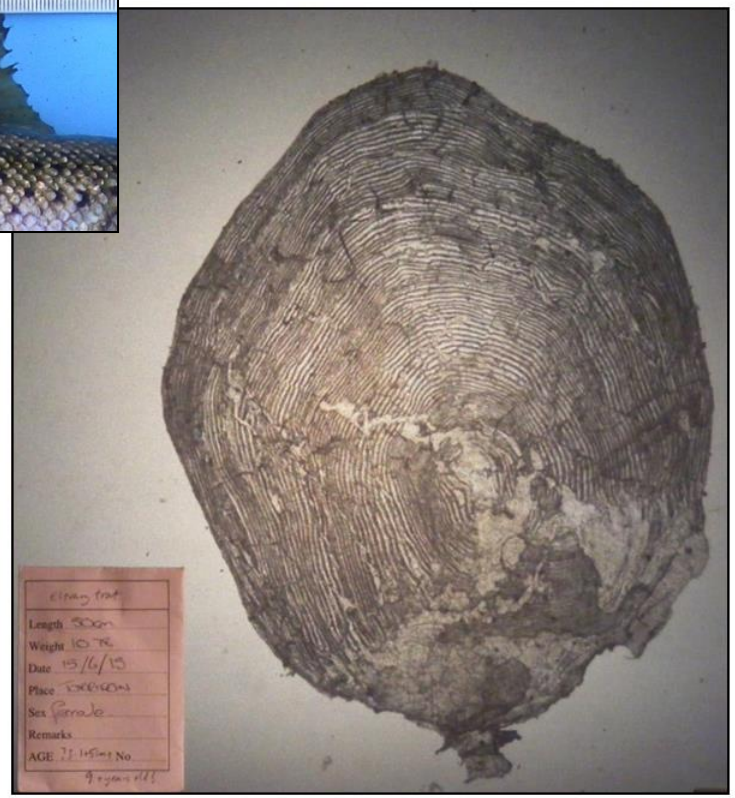


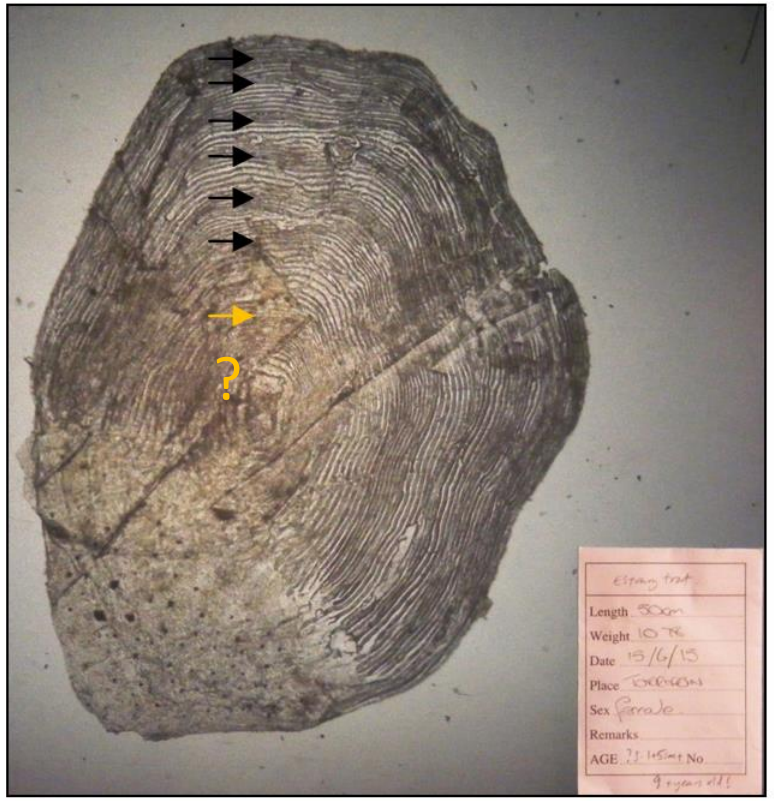
Torridon and Liathach by Lulu Strader, Sept 2010

Torridon estuary sweep netting, 15th June 2015 . . .

just one sea trout, 500mm , no sea lice.

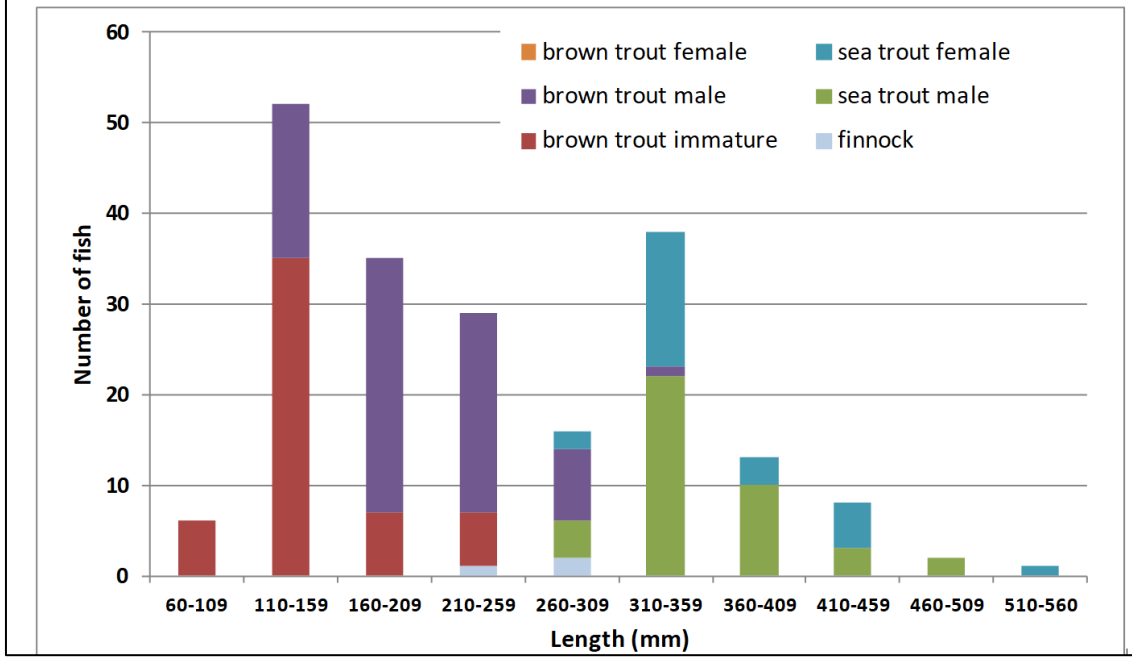






The River Torridon trout spawning burn fyke net project October – November 2015

Figure 3.3: Size – frequency graph showing the number of fish caught vs. respective categories.



Sea Lice Regulatory Framework

sepa.org.uk/regulations/water/aquaculture/sea-lice-regulatory-framework-implementation/

sepa

Search

Search

Menu

Home > Regulations > Water > Aquaculture

Back to Aquaculture

Contents

Sea Lice Regulatory Framework Implementation

We will take on lead regulatory responsibility for managing sea lice and wild salmon interactions from 1st February 2024 and for managing sea lice and sea trout interactions from March 2025.

Marine Directorate scientists are currently writing up results from many years of research and monitoring in Loch Torridon . . .

Aquaculture Interactions: Shield

www.gov.scot/publications/aquaculture-interactions-shieldaig-field-station/pages/introduction/

Scottish Government
Riaghaltas na h-Alba

Search

About | Topics | News | Publications | Statistics and research | Consultations | Blogs

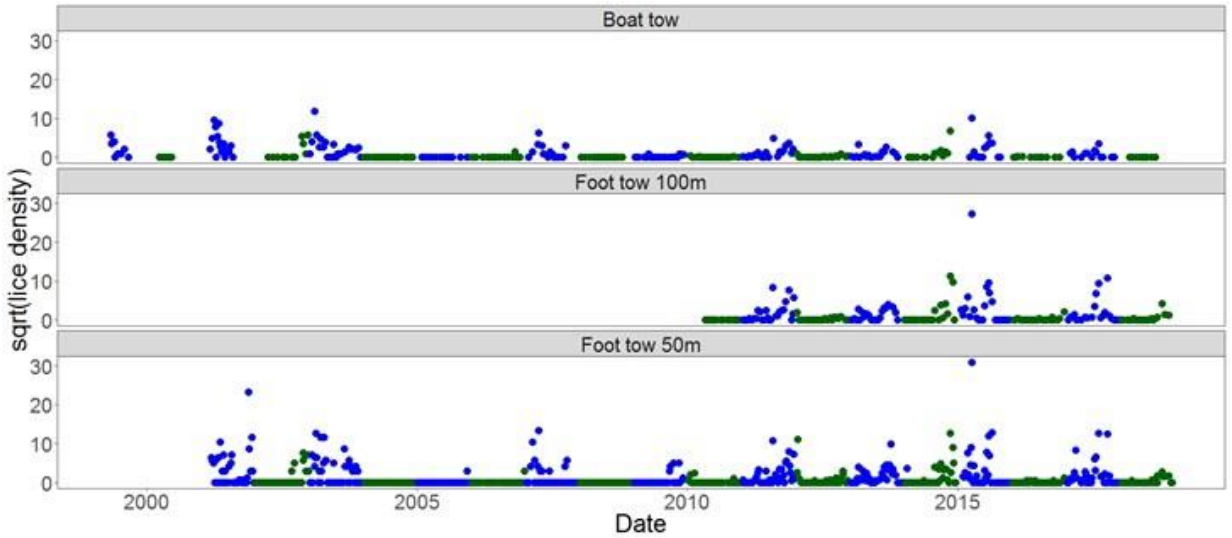
Home › Publications

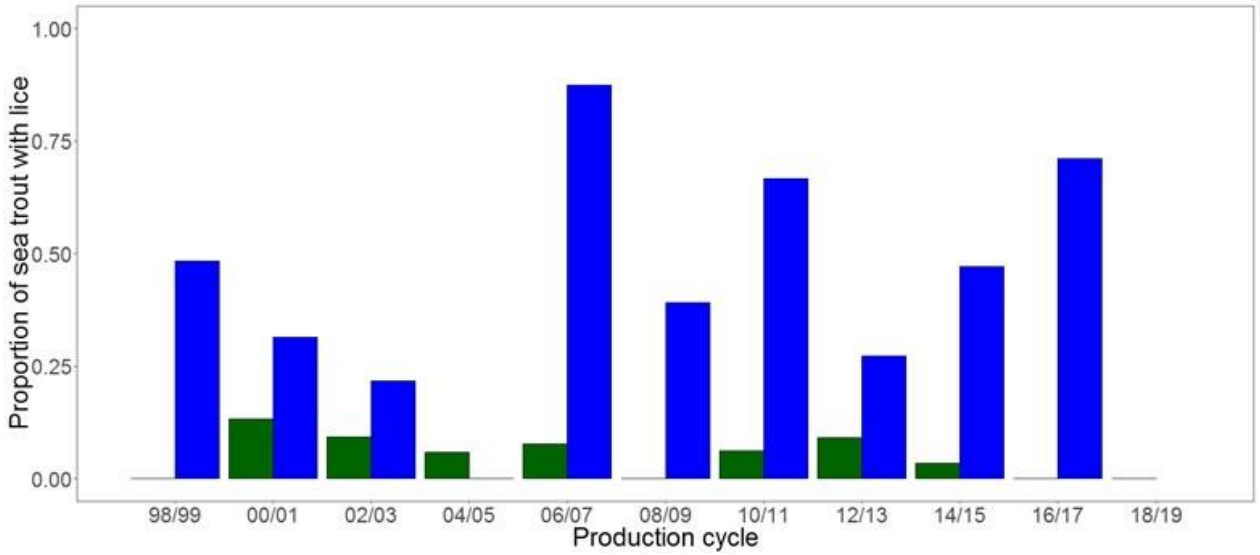
Publication - Research and analysis

Aquaculture Interactions: Shieldaig Field Station

Published: **16 September 2014**
Directorate: Marine Directorate
Part of: Marine and fisheries

Concerns regarding declining sea trout populations on the West Coast of Scotland in the late 1980s and early 1990s led Scottish Government to set up a long term monitoring programme on the River Shieldaig.



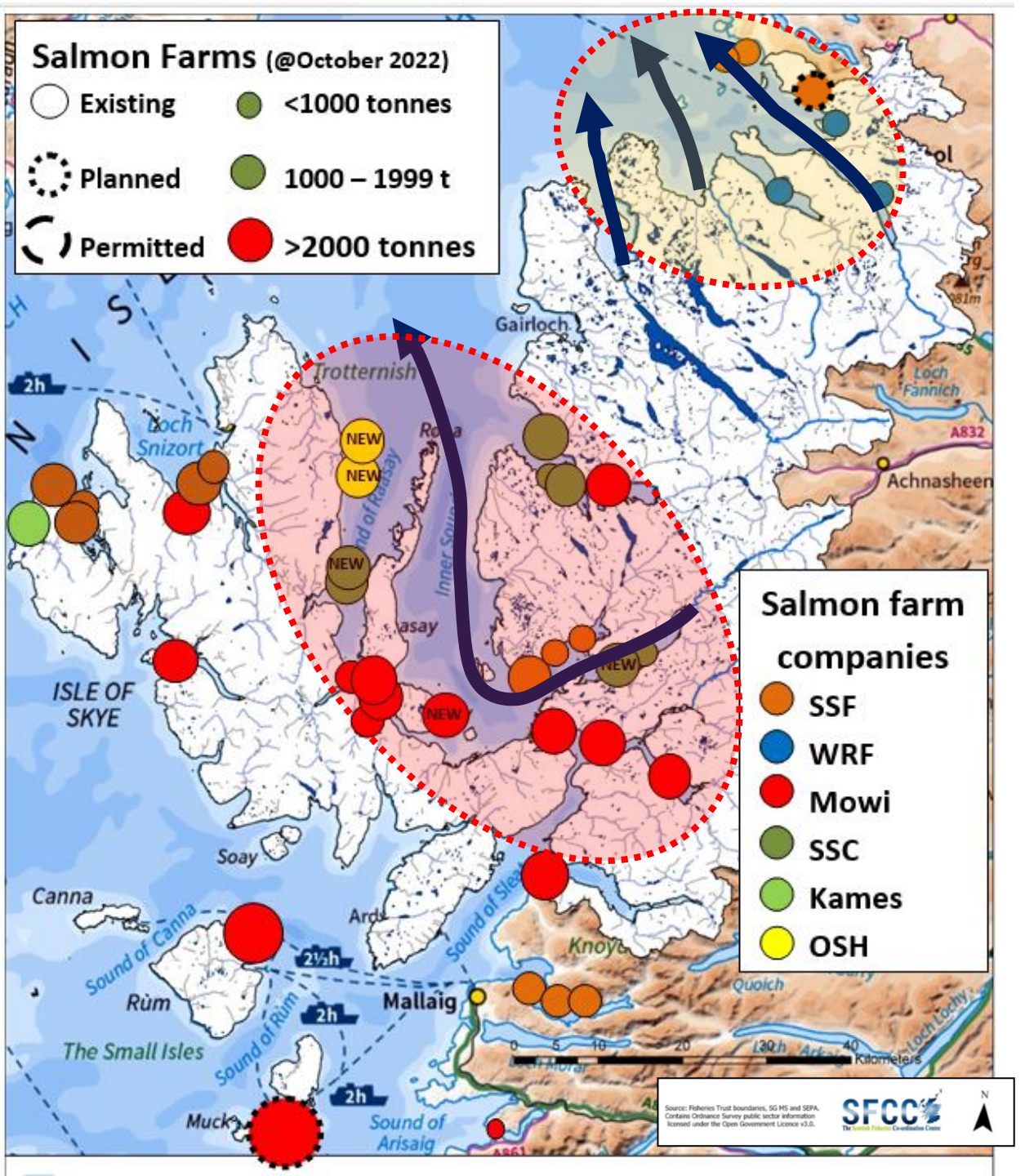


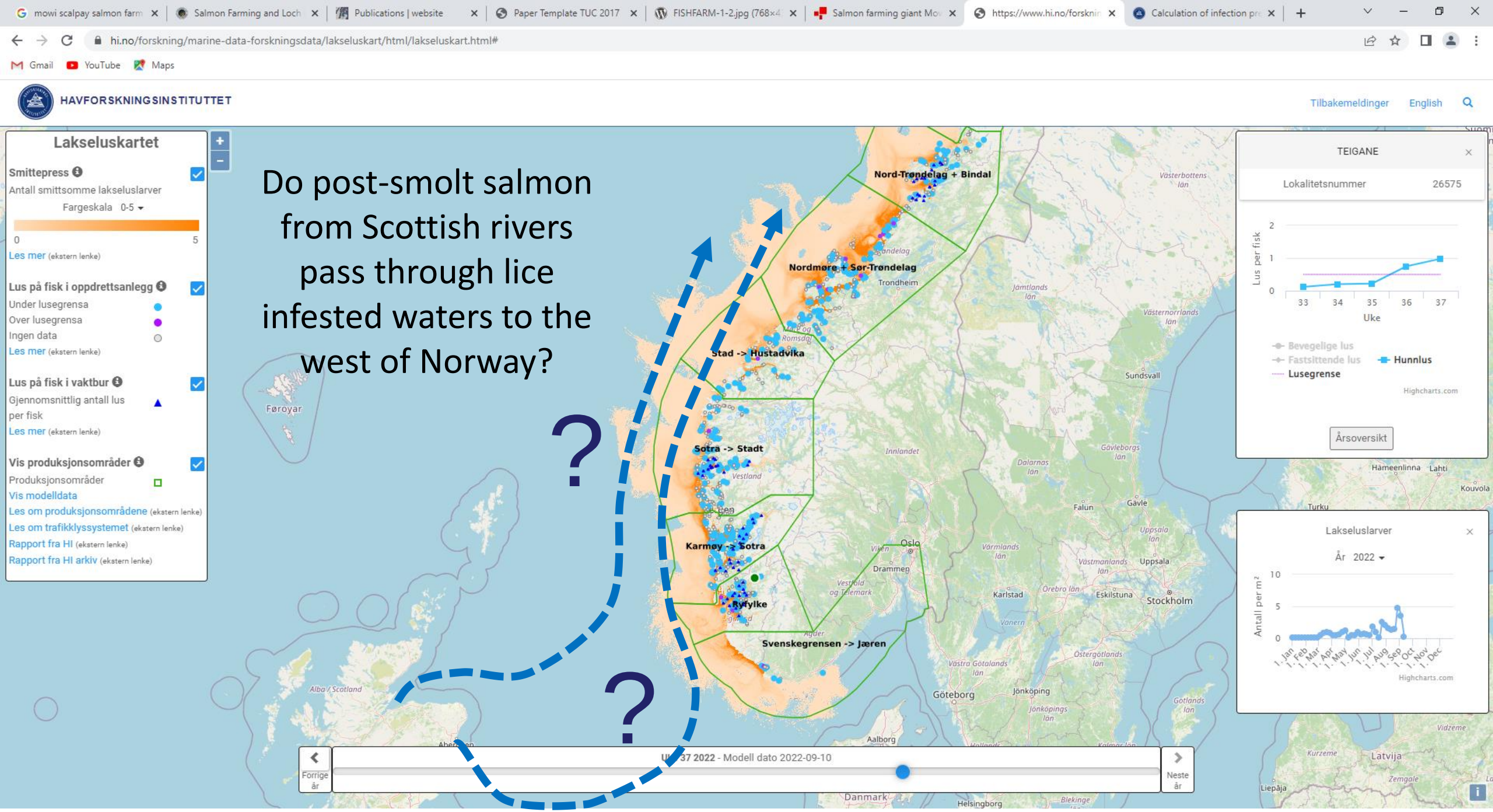
Wild salmon post-smolts are also infected by sea lice

Young salmon from the River Carron have to pass many active salmon farms as they head out into the Minch. These fish can be exposed to very high numbers of sea lice.

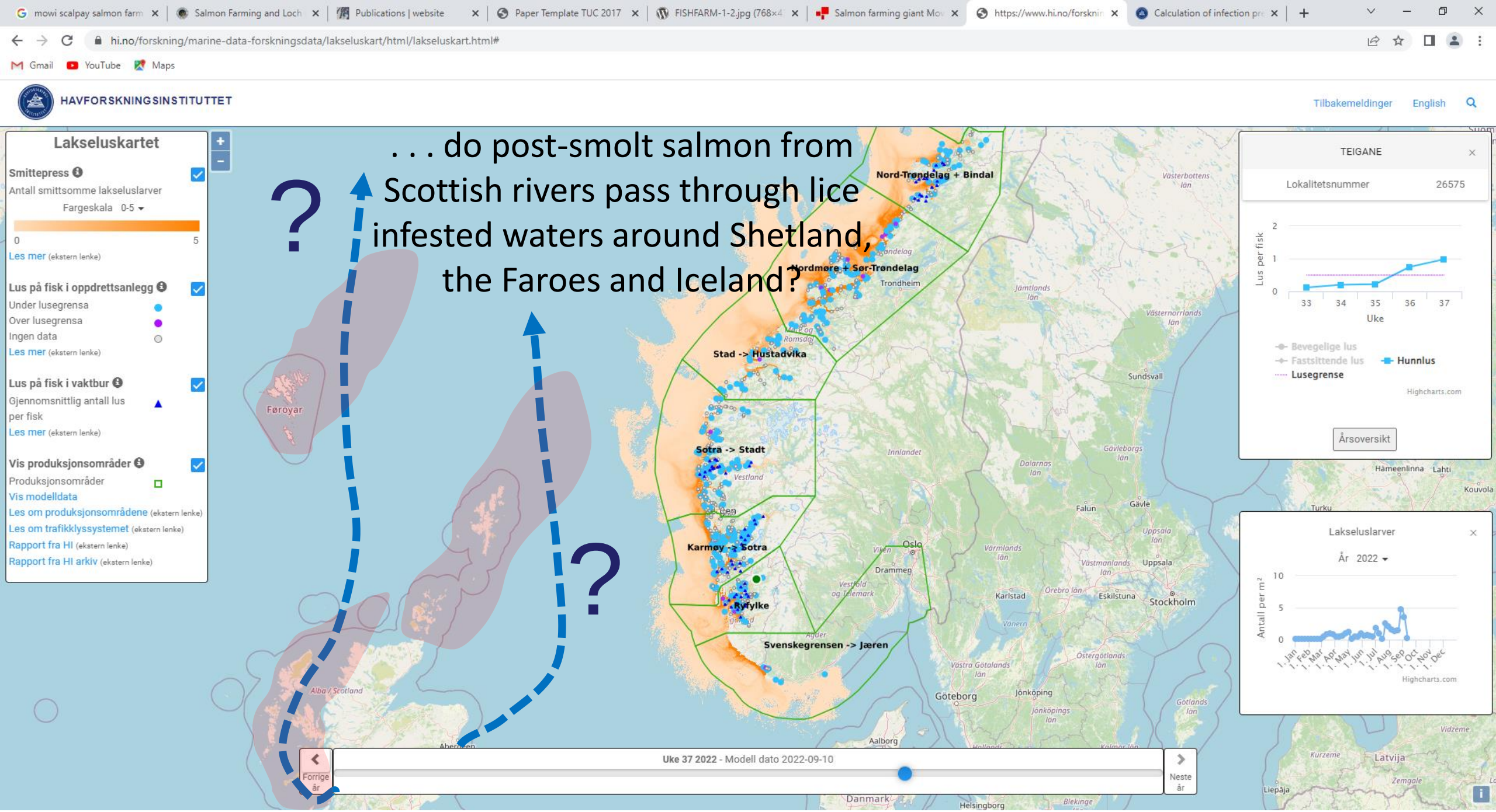
Currently, young salmon from the Rivers in the Wester Ross MPA have few active salmon farms to pass.

Can wild salmon from rivers in the Wester Ross MPA be given more protection than those from rivers further south?





http://www.imr.no/lakseluskart/html/lakseluskart.html



http://www.imr.no/lakseluskart/html/lakseluskart.html

Thank you to:

The Scottish Government

marinescotland science

Wester Ross Area Salmon Fishery Board

Fisheries Management Scotland

SFCC The Scottish Fisheries Co-ordination Centre

Wild Salmonid Support Fund

MOWI

NatureScot NàdarAlba

SEPA Scottish Environment Protection Agency

sse Renewables

Scottish Landfill Communities Fund

The Highland Council Comhairle na Gàidhealtachd

Middlesex University London

Loch Maree Wild Trout Project

THE CROWN ESTATE

the National Trust for Scotland
a place for everyone

and to estates, members, other supporters, and many volunteers for lots of in-kind help in 2023