Monitoring of sea trout post-smolts, 2025

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Introduction

Started in 1997, this project has enabled the establishment of a good database of the population dynamics of sea trout within the area. Additional information about lice burdens on the trout within the estuaries has also provided an analysis of the relationship between sea lice on fish farms and sea trout (Marshall 2003; WSFT 2025).

The monitoring of post-smolts was originally designed to give an indication of the migrations and growth of sea trout within the area. The individual tagging of fish, combined with the measurements taken at capture, gave a baseline from which to assess these parameters following re-capture by nets or rod and line. In addition to these data, the numbers of sea lice were also assessed. This has now progressed, such that sea lice counts are the main part of the project, with the tagging of fish giving additional information. As gill health has increasing become a problem within the aquaculture industry an assessment of the gills has also been added to the sampling programme.

Materials & Methods

Two estuaries, Laxford Bay and Polla estuary, were sampled monthly where possible from April to September at low tide. The Hope estuary was sampled 3 times over the season. Sampling was performed using a 50 m sweep net with a stretched mesh size of 15 mm, hand pulled in a large circle to give one sweep of the area.

All sea trout were removed, with an aim of 30 fish to be anaesthetised with Tricaine Pharmaq and examined. Their length (± 1 mm) and weight (± 1 g) were recorded, scales removed, and a visible implant (VI) tag implanted behind the eye. The fish were examined for the presence of sea lice, which were counted and staged, i.e. chalimus, mobile, adult and gravid female, and the gills visually assessed for disease. Differences between the number examined and tagged (Table 1) reflect the presence of recaptures, the size of trout involved or difficulties in loading the injector. Injection of the tags in fish <15 cm can prove difficult with only a thin membrane available to hold the tag and is therefore not undertaken.

The condition index for the trout was calculated from the length and weight such that:

Condition Index = $100W/L^3$, where weight is in grams and length in cm.

Throughout this document, post-smolts are defined as fish that went to sea in this year. Adults refer to fish that have had one year or more at sea.

The Specific Growth Rate (SGR) was calculated for the recaptured fish to give annual variations, such that:

SGR = (((ln(final wt) – ln(initial wt))*100)/time), where weight is in grams and time in days.

Results and Discussion

The largest catch within a single sweep was 499 fish in the Laxford during September (Table 1). This is a departure from previous years, when the greatest catch was routinely in May, although similar to 2024 when the largest catch was also later in the year. A comparison of the catches with time in all estuaries demonstrates the variability in the abundance of fish within the sample sites and the difficulties in using these results to demonstrate population size.

The by-catch from the netting in each area was as expected from previous years, with few species and low numbers observed. The exception to this was the Polla in September, when a large number of sprat were captured.

Table 1: The number of fish examined and tagged by estuary and month

	Laxford Bay		Polla estuary		Hope estuary	
Month	No. examined	No. tagged	No. examined	No. tagged	No. examined	No. tagged
April	6	1	-	-	-	-
May	30	1	44	5	37	28
June	-	-	-	-	-	-
July	0	0	[x]7	4	30	25
August	1	0	[+]31	5	-	-
September	[*]30	0	[a]31	18	[b]34	21

([*]plus 469 released & 1 salmon; [x] plus 2 released & 2 salmon; [+]plus 142 released; [a]plus 23 released; [b]plus 14 released)

Age, Length, Weight and Condition of Fish Captured

The fish caught were of varied age (Fig. 1) and length (Fig. 2), reflecting a mixed population structure. The age structure in the estuaries was similar, with a predominant smolt age of 2 years (S2), although there were a large number of S3s also present. In addition, a small number of S1s were observed in the Polla. A greater range of lengths was observed within the Hope, with the Laxford and Polla comprising of a similar range of sizes (Fig. 2).

Table 2: The percentage of post-smolts within the catch

Month	Laxford Bay	Polla estuary	Hope estuary
April	100	-	-
May	46	98	97
June	-	-	-
July	100	83	89
August	-	96	-
September	63	88	97

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

The mean length, weight and condition index, ± s.d. of post smolts per month are given in Table 3a for Laxford Bay, Table 3b for the Polla estuary and Table 3c for the Hope estuary.

Table 3a: The mean length, weight, and condition index of the post-smolts in Laxford Bay, per month

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
April	169.67 ± 288.74	45.50 ± 21.96	0.85 ± 0.05
May	205.92 ± 23.44	96.83 ± 29.29	1.09 ± 0.13
June	-	-	-
July	-	-	-
August	202	56	0.68
September	271.94 ± 16.22	207.41 ± 37.19	1.03 ± 0.12

Table 3b: The mean length, weight, and condition index of the post-smolts in Polla estuary, per month

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
April	-	-	-
May	144.08 ± 23.59	36.15 ± 27.00	1.10 ± 0.10
June	-	-	-
July	213.20 ± 41.28	95.40 ± 54.25	0.87 ± 0.11
August	239.60 ± 50.05	-	-
September	275.09 ± 41.69	250.68 ± 102.50	1.13 ± 0.12

Table 3c: The mean length, weight, and condition index of the post-smolts in Hope estuary, per month

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
April	-	-	-
May	177.44 ± 29.08	70.91 ± 73.86	1.18 ± 1.21
June	-	-	-
July	238.16 ± 35.25	108.96 ± 54.34	0.73 ± 0.34
August	-	-	-
September	233.59 ± 56.00	159.07 ± 95.02	1.09 ± 0.26

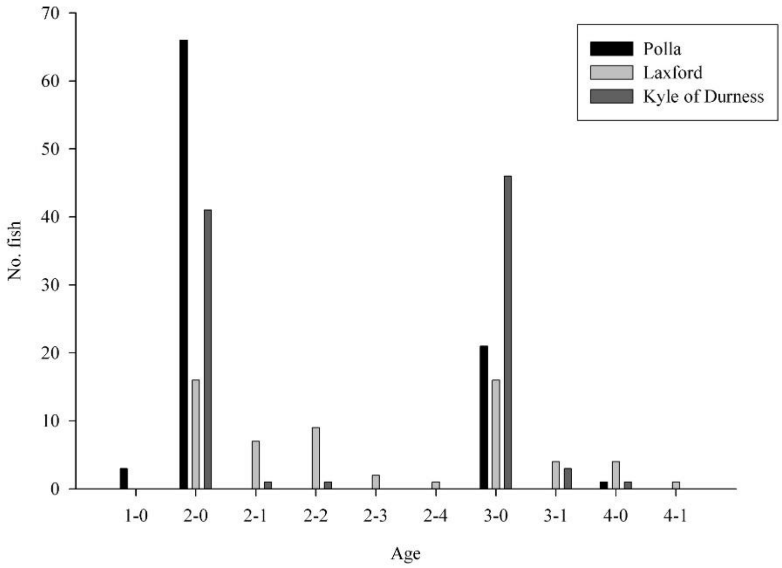

Fig. 1 The number of fish of each age taken in the estuaries

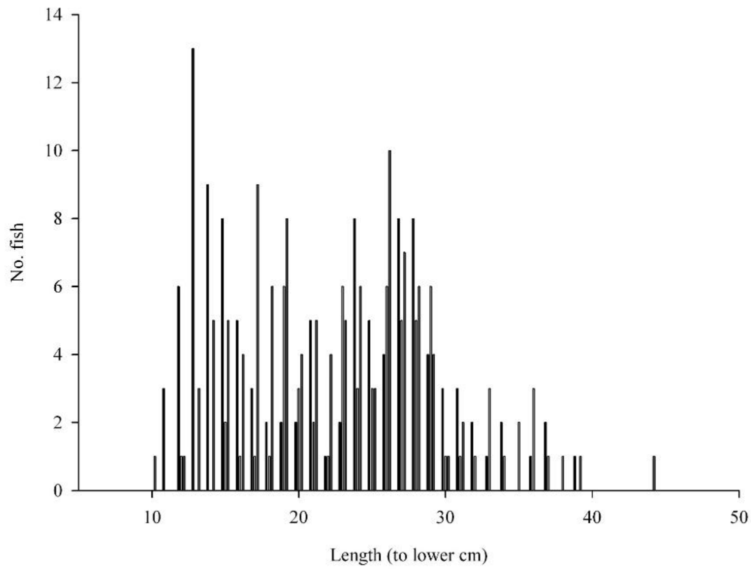

Fig. 2 The number of fish of each length taken in the estuaries

Recaptures

There were 2 recaptures during 2025, all within the Polla estuary. The growth of recaptured trout is shown in Table 4. All were tagged and re-captured in the same location. This pattern is common to the sampling programme over the past 28 years and demonstrates that the majority of sea trout do not stray far from their home rivers. This is further supported by tracking studies in Laxford Bay, showing the migrations within and out of the sea loch (https://wsft.org.uk/images/pdf/Laxford_sea_trout_tracking.pdf).

Average monthly growth rates within the Polla were 8 mm and 18 g respectively.

Table 4: The lengths and weights of recaptured trout within Laxford Bay

Tag number		Tagged	Recaptured	Difference
M84	Date	22.7.25	26.8.25	1 mth
	Length (mm)	376	390	14
	Weight (g)	380	-	-
M86	Date	26.8.25	8.9.25	2 wks
	Length (mm)	241	242	1
	Weight (g)	146	155	9

Figure 3 shows that the specific growth rate (SGR) was average for this estuary. Interactions with external factors, such as food supply and temperature will cause variations in specific growth rate, as will changes in the stage of reproduction over the period.

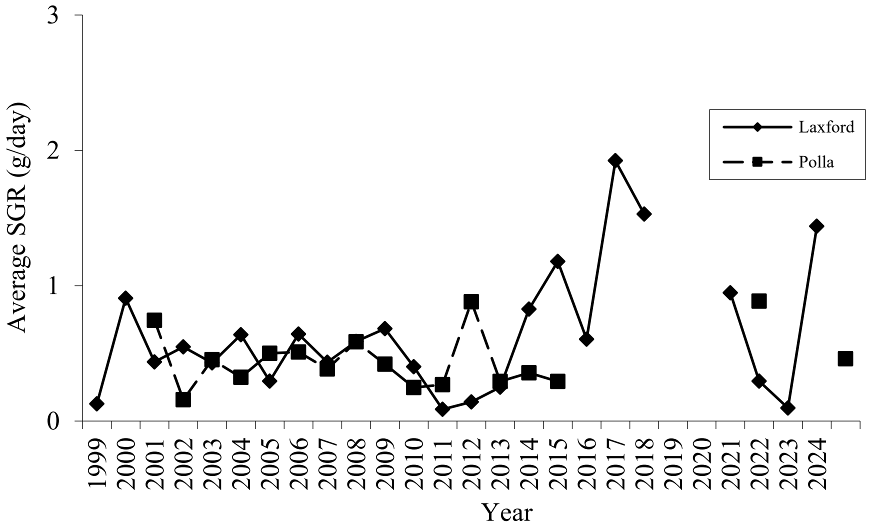

Fig. 3: Showing the average SGR for fish within the Laxford and Polla estuaries, by year

Sea Lice Infestations

Sea lice were present to a varying degree in each location (Table 5). All estuaries showed a mixture of lice stages (Fig. 4a - c). The highest numbers were seen in the Laxford during May. However, the total lice number per sample is dependent on sample size and the use of abundance and intensity data give a better assessment of the situation.

Table 5: The percentage of sea trout with the salmon louse, by estuary and month

Month	Laxford Bay	Polla estuary	Hope estuary
April	17	-	-
May	87	33	14
June	-	-	-
July	-	71	80
August	0	77	-
September	50	90	29

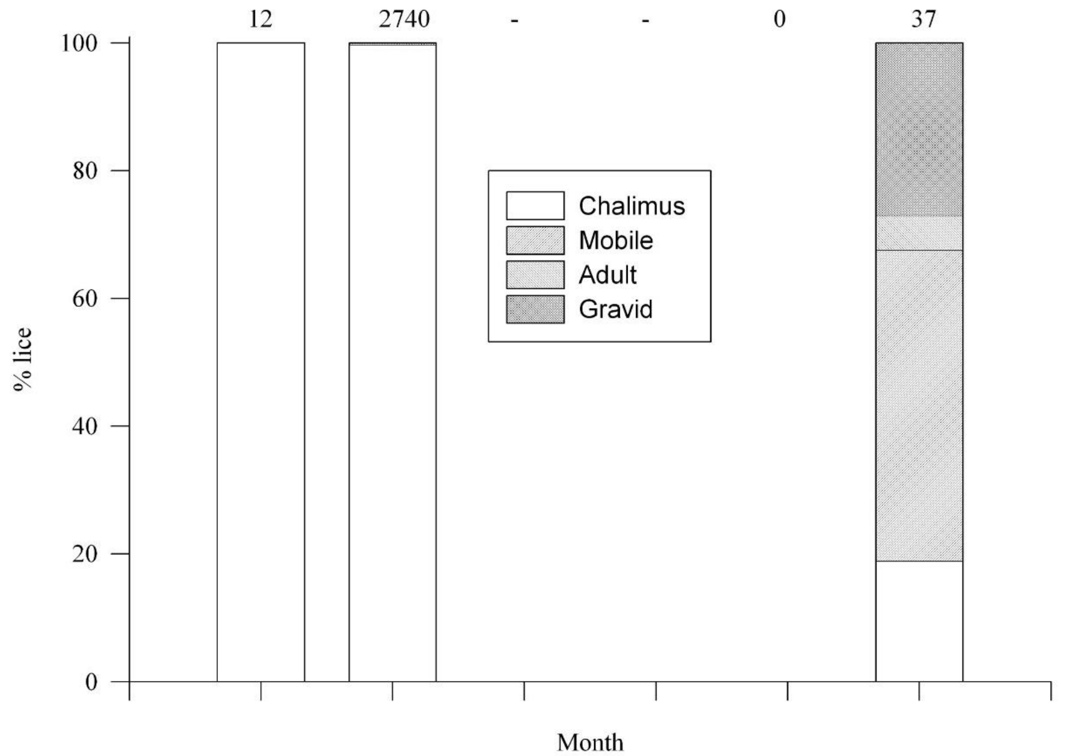

Fig. 4a Showing the proportion of each stage of lice within the Laxford samples, by month. The total number of lice is given at the top.

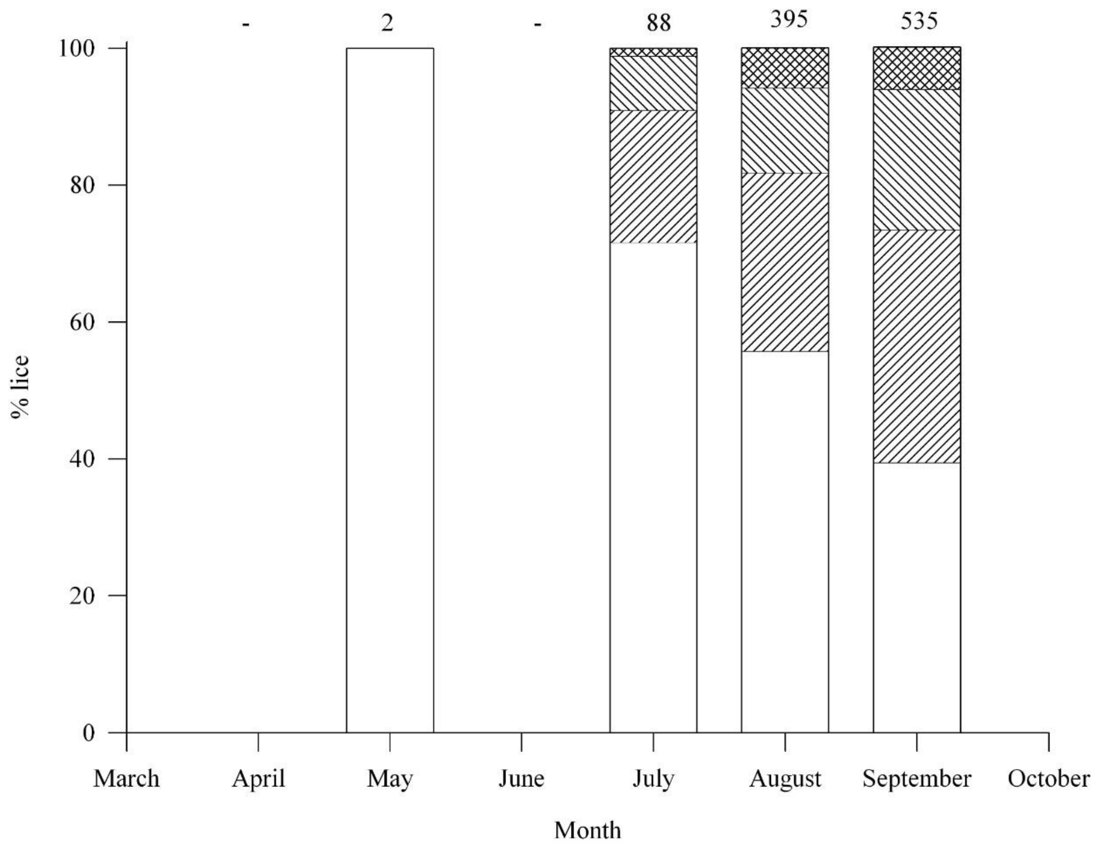

Fig. 4b Showing the proportion of each stage of lice within the Polla samples, by month. The total number of lice is given at the top.

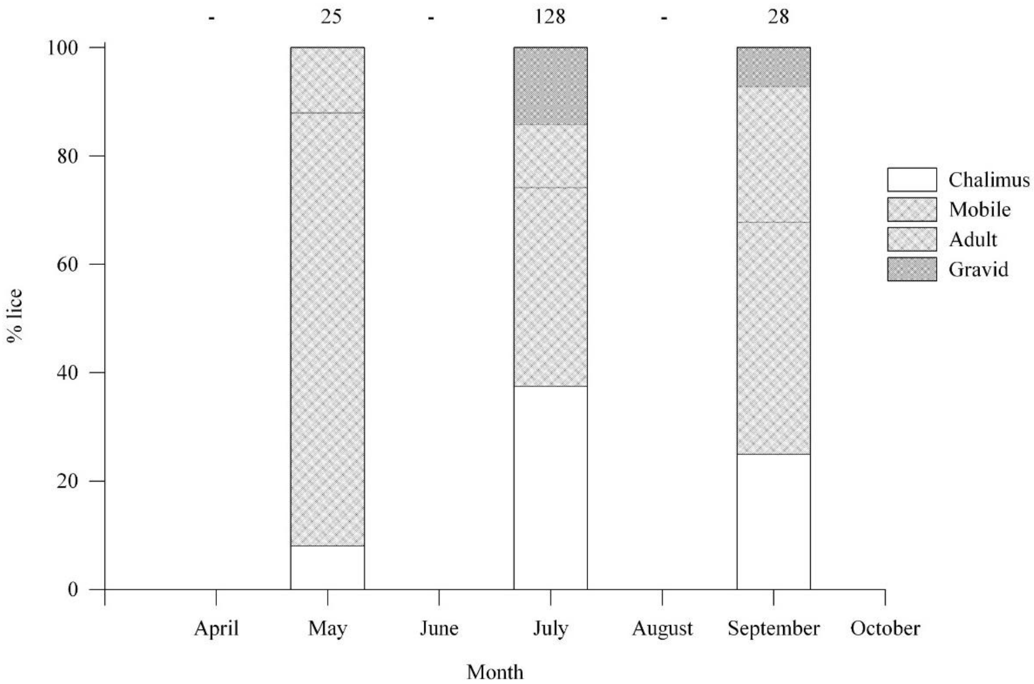

Fig. 4c Showing the proportion of each stage of lice within the Hope samples, by month. The total number of lice is given at the top.

In order to determine the potential impacts of sea lice on fish it is important to know the number of lice present per fish, as well as their occurrence (Tables 6 (Laxford), 7 (Polla) & 8 (Hope)). The use of intensity will give a more accurate impression of the degree of infestation, being the number of lice on the infected fish, but abundance gives a better impression of the lice within the population. In addition, abundance is used in several studies, including Butler (2002), and is the preferred method of recording within the neighbouring farms and is therefore given here. The use of the median value, being the middle value if they are ranked numerically, also gives an indication of the degree of infestation within the population, while removing the bias created by a single heavily infected individual.

Laxford

Lice were present on each sampling occasion, with the exception of August when only 1 fish was caught (Table 6), with abundance peaking in May. *Caligus* were present in May and September on a small number of fish.

The neighbouring cages were fallowed in June 2025. Prior to this, *Lepeophtheirus* numbers were above code of good practice levels. *Caligus* were also present in high numbers.

Table 6: The abundance, intensity and median number salmon lice on wild sea trout in Laxford Bay, where abundance is the mean number of lice per fish and intensity is the mean number of lice per infected fish.

	Abundance		Intensity		
Month	mean	range	mean	range	Median
April	2.00	0 - 12	12.00	12	0
May	91.33	0 - 350	105.38	1 - 350	83
June	-	-	-	-	-
July	-	-	-	-	-
August	0	0	0	0	0
September	1.19	0 - 9	2.47	1 - 9	0

Polla

Lice were present throughout the year (Table 7), with the highest abundance found in September. *Caligus* were also present in July, August and September.

Within the neighbouring cages, Sian was stocked in January, while Kempie remained fallow throughout the year. Numbers of adult females remained low, being below 0.5 throughout the survey period.

Table 7: The abundance, intensity and median value of the salmon louse on wild sea trout in Polla estuary, where abundance is the mean number of lice per fish and intensity is the mean number of lice per infected fish.

	Abundance		Intensity		
Month	mean	range	mean	range	Median
April	-	-	-	-	-
May	0.05	0 - 2	2.00	2	0
June	-	-	-	-	-
July	12.57	0 - 46	17.60	2 - 46	2
August	12.74	0 - 88	16.46	1 - 88	5
September	17.26	0 - 54	19.11	1 - 54	13

Hope

Lice were present throughout the year (Table 7), with the highest abundance found in July. *Caligus* were also present in July and September.

There are no cages within outer Loch Eriboll, so the nearest aquaculture site is Sian Bay. Numbers of adult lice at this site are low.

Table 7: The abundance, intensity and median value of the salmon louse on wild sea trout in Polla estuary, where abundance is the mean number of lice per fish and intensity is the mean number of lice per infected fish.

	Abundance		Intensity		
Month	mean	range	mean	range	Median
April	-	-	-	-	-
May	0.68	0 - 13	5.00	1 - 13	0
June	-	-	-	-	-
July	4.27	0 - 23	5.33	1 - 23	3
August	-	-	-	-	-
September	0.82	0 - 8	2.80	1 - 8	0

Gill condition

Gill health, primarily Amoebic Gill Disease, and gill damage are becoming increasingly problematic within the aquaculture industry. However, from papers and discussions with professionals it appears that wild fish are not a significant reservoir for *Paramoeba perurans*. This pathogen seems key in driving gill disease outbreaks in farms, even if other pathogens will also contribute to poor gill health, so its absence in wild fish may reduce vulnerability to gill disease. Further, wild fish are at a lower density and can avoid the environmental conditions likely to trigger poor gill health, i.e. plankton blooms and poor water quality. Thus, gill disease is not seen as a concern within wild fish populations although the need for more information is noted. As part of this the decision was taken to visually assess the gills during this survey.

Gill health issues were identified in all estuaries on a small number of fish. Within the Polla AGD was identified in 7 fish, while non-AGD related damage was identified in a further 7. Within the Laxford, no fish were identified with AGD but 2 did show short and scarred gill filaments. The Hope also had AGD identified in 10 fish, while a further 3 had non-AGD related damage. In all cases of AGD the levels were recorded as 1 on the 1 – 5 scale used by the neighbouring fish farm. Non-AGD damage was primarily recorded as 1 on this scale, with the exception of 1 in the Polla and 1 in the Hope, both of which recorded a level 2.

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

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

The data are treated differently depending on fish size and give a potential increased risk of mortality to each fish, with increasing risk as the number of lice increase. To determine the likely population effect, the proportion of fish within the population appearing in each band is calculated and a population risk determined. Fig. 5 gives the results by year for each estuary, with the banding indicating whether the risk is low (green), moderate (yellow) or high (red). Within the green zone it can be taken that there is minimal risk to the population, while the yellow and red zones show potentially population altering impacts.

From this, the potential risk of increased mortality in the Laxford, at 32.16, is high while the Polla, at 16.55, is medium. The Hope, at 2.63 shows low risk. In the case of the Polla, malfunctioning of the weigh scales in August resulted in those fish not being included within the analysis.

The Laxford and Polla data continue to show a biennial pattern in risk, reflecting the stage of production within the farm in the main. There is an exception from this year, when the Polla showed an increase in risk, but the cages are within the 1st year of production.

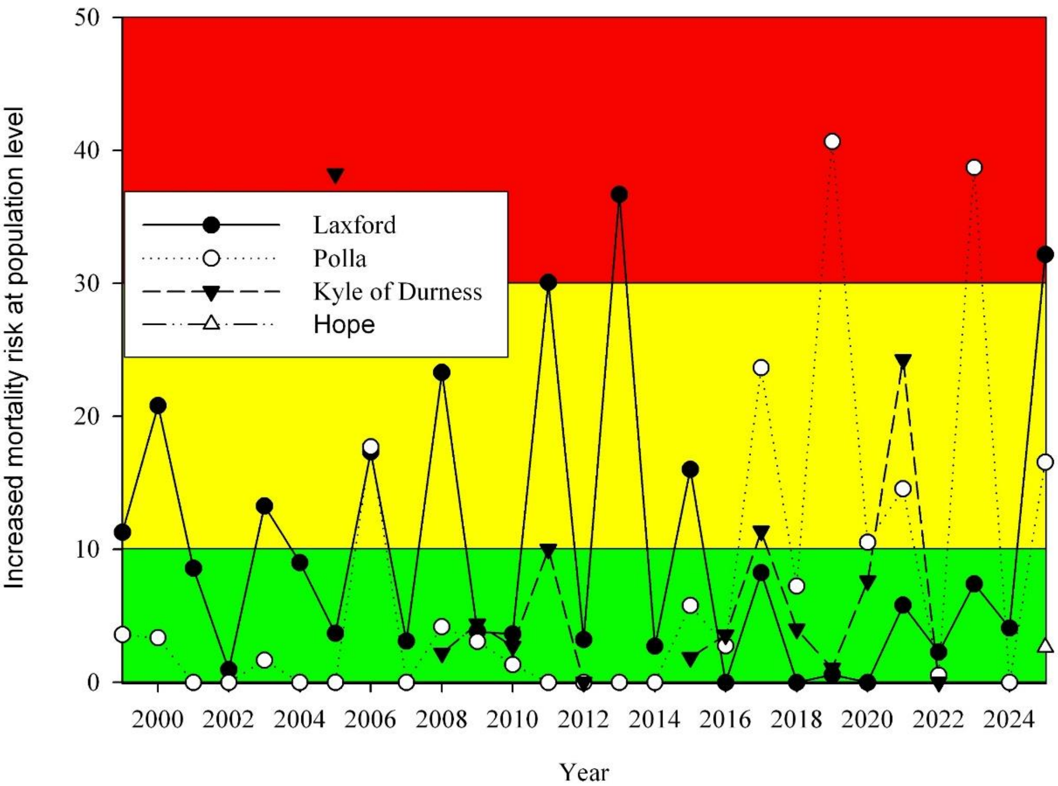

Fig. 5: Showing the increased mortality risk at population level created by sea lice.

Recommendations for further research

1. It is recommended that the current programme be continued to maintain the existing dataset.
2. It is recommended that gill disease continues to be assessed. If possible, this should be extended to other areas.
3. It is recommended that further research into the dynamics of the sea trout population in both marine and freshwaters be undertaken. This should also examine the relationship between the resident and migratory components of the population.

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