Monitoring of sea trout post-smolts, 2020

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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 fish farms and sea trout, with regard to sea lice (Marshall 2003; WSFT 2020).

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. No fish were tagged during 2020.

The occurrence of Covid-19 during 2020 affected this sweep net programme. As a result of the lockdown, sweep netting could not be undertaken during April, May or June. This resulted in the programme missing the smolt run and has affected the comparison of results with previous years, as well as reducing the benefits to the Area Management Agreements. Our ability to monitor the different sites from July onwards was also impacted as we tried to maintain social distancing and the safety of our volunteers. However, the results obtained during this survey have enabled some assessment of the populations.

Materials & Methods

Three estuaries, Laxford Bay, the Polla estuary and the Kyle of Durness were sampled monthly where possible from July to October, at low tide. 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 and anaesthetised with 2-Phenoxyethanol. Their length (± 1 mm) and weight (± 1 g) were recorded and scales removed. The fish were examined for the presence of sea lice, which were counted and roughly staged, i.e. chalimus, mobile, adult and gravid female.

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 = $(((\ln(\text{final wt}) - \ln(\text{initial wt}))*100)/\text{time})$, where weight is in grams and time in days.

Results and Discussion

The largest catch within a single sweep was 48 fish in the Kyle of Durness during October (Table 1). This contrasts to previous years in both number and location but reflects the fact that the largest catches are normally found in May when no sweep netting was undertaken. 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 mature mullet taken in the Kyle of Durness during September and October.

Within the Laxford, the sweeps failed to cover the channel due to depth. As such, the small numbers of fish captured are a reflection of the unsuccessful sweep rather than the absence of fish within the area. The reason for the difficulties experienced within the Laxford is unknown and has not happened previously.

Table 1 The number of fish examined by estuary and month

Month	Laxford Bay	Polla estuary	Kyle of Durness
July	-	-	15
August	1	40	13
September	0	-	27
October	1	22	48

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 in the rivers of 2 years (S2), although there were a number of S3's also present. S1's were also observed in small numbers in both the Polla and Kyle of Durness. The length distribution of fish within the estuaries was also similar (Fig. 2), with post-smolts dominating each estuary. There were several mature fish taken in both estuaries, with the largest being seen in the Polla.

Table 2 The percentage of post-smolts within the catch

Month	Laxford Bay	Polla estuary	Kyle of Durness
July	-	-	100
August	100	73	77
September	-	-	87
October	100	70	80

The presence of post-smolts at all sites throughout the year indicates a heavy usage of estuaries by this group, presumably for feeding and shelter. Further information on the usage of the estuary by sea trout can be seen in the Laxford sea trout tracking project undertaken in 2018 and available at https://www.wsft.org.uk/images/pdf/Laxford_sea_trout_tracking.pdf

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 Kyle of Durness. The condition index was good, although it was not possible to record weights on all sampling occasions.

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.)
July	-	-	-
August	214	-	-
September	-	-	-
October	114	60	4.05

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.)
July	-	-	-
August	224.68 ± 35.12	143.74 ± 58.29	1.20 ± 0.31
September	-	-	-
October	266.14 ± 41.40	232.86 ± 76.95	1.19 ± 0.15

Table 3c The mean length, weight, and condition index of the post-smolts in Kyle of Durness, per month

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
July	191.30 ± 36.61	76.70 ± 52.31	0.99 ± 0.13
August	205.89 ± 19.87	-	-
September	209.85 ± 39.10	-	-
October	235.34 ± 25.28	149.97 ± 40.39	1.15 ± 0.31

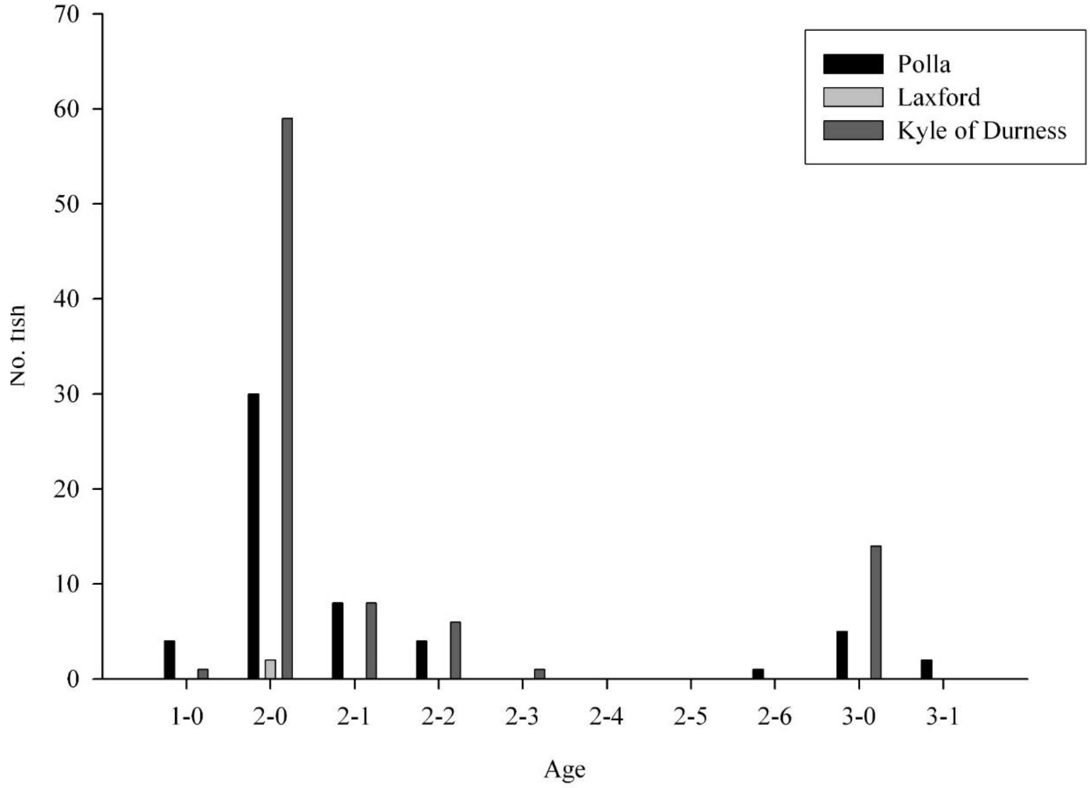

Fig. 1 The number of fish of each age taken in the estuaries

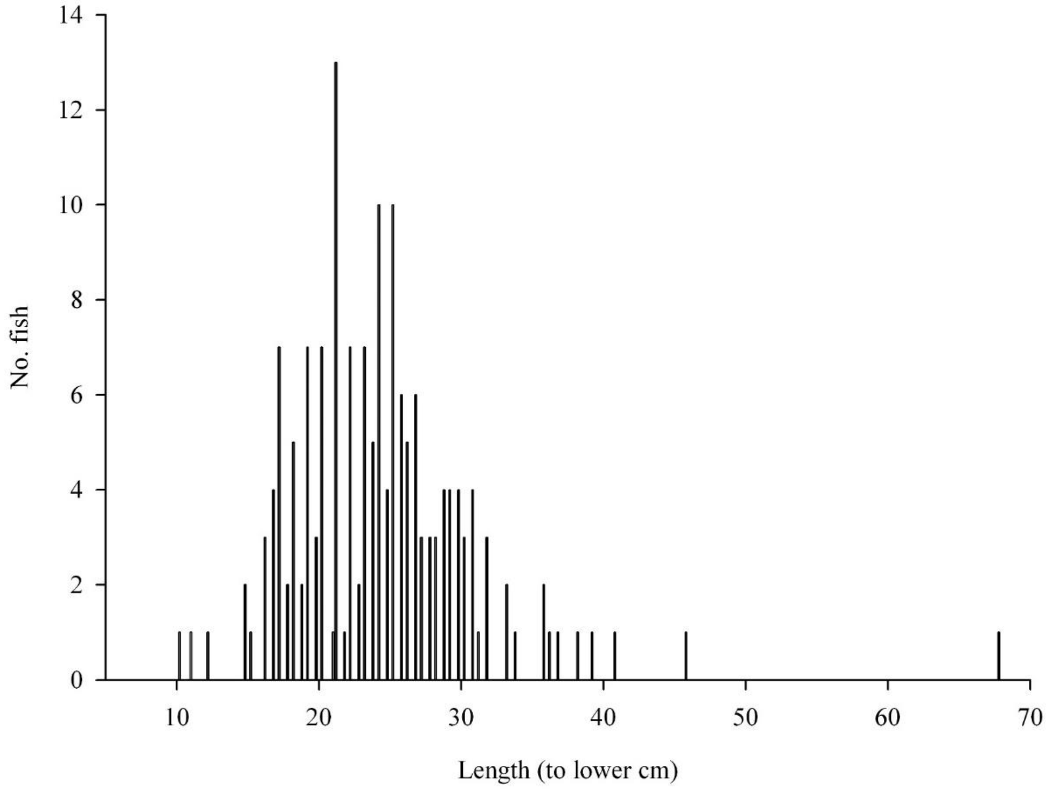

Fig. 2 The number of fish of each length taken in the estuaries

Sea Lice Infestations

Sea lice were present to a varying degree in both the Kyle of Durness and the Polla estuary (Table 4), throughout the year. The exception to this was July in the Kyle of Durness when no lice were observed. No sea lice were seen on the Laxford fish, but the catch was particularly low with only one fish on each occasion. Each estuary showed a mixture of lice stages, although Chalimus were only present on one occasion in both estuaries (Fig. 3). Lice numbers showed an increasing trend with time in the Kyle of Durness, while this declined in the Polla. 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 4 The percentage of sea trout with the salmon louse, by estuary and month

Month	Laxford Bay	Polla estuary	Kyle of Durness
July	-	-	0
August	0	80	77
September	-	-	93
October	0	86	83

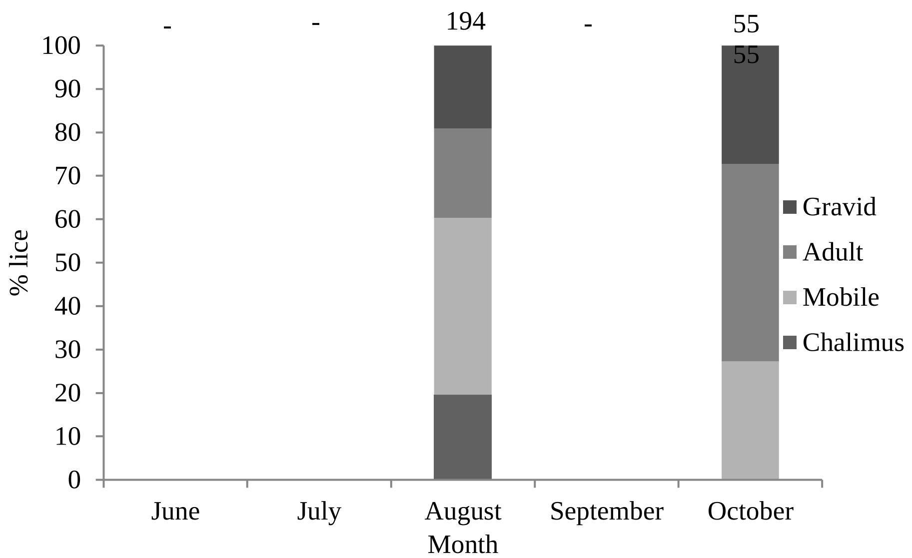

Fig. 3a Showing the proportion of each stage of lice within the Polla estuary samples, by month. The total number of lice is given at the top.

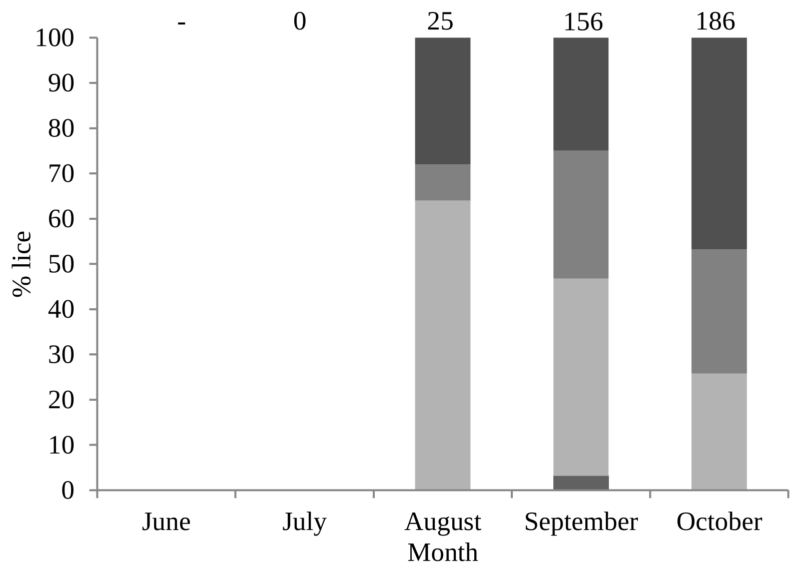

Fig. 3b Showing the proportion of each stage of lice within the Kyle of Durness samples, by month. The total number of lice is given at the top.

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 5 (Laxford), 6 (Polla) & 7 (Kyle of Durness)). 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

There were no lice present within the Laxford (Table 5), although only 1 fish was observed in each month. No *Caligus* were observed either.

The neighbouring cages were stocked for the period of the survey. *Lepeophtheirus* numbers were zero or very low throughout the year. However, *Caligus* dominated the population with numbers increasing throughout the year.

Table 5 The abundance, intensity and median value of the salmon louse 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
July	-	-	-	-	-
August	0	0	0	0	0
September	-	-	-	-	
October	0	0	0	0	0

Polla

Lice were present in both months surveyed (Table 6), although in much lower numbers than in 2019. The abundance dropped between August and October, as did the maximum number of lice per fish. *Caligus* were also present in both months, again declining in October, both in number of lice and number of infected fish.

Table 6 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
July	-	-	-	-	-
August	4.85	0 - 32	6.06	1 - 32	3
September	-	-	-	-	-
October	2.50	0 - 6	2.89	1 - 6	2

Within the neighbouring cages, Sian was stocked in April, while Kempie remained fallow until October. There were no adult lice at Sian until August, when they started to appear, although remaining at low densities. Adult lice were present at Kempie in October, indicating potential transfer of mobile stages between the sites.

Kyle of Durness

Lice were present within the Kyle of Durness sample (Table 8) with the exception of July. Densities varied by month, with no pattern discernible. There were no *Caligus* present on the fish sampled.

Table 8 The abundance, intensity and median value of the salmon louse on wild sea trout in Kyle of Durness, 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
July	0	0	0	0	0
August	1.92	0 - 4	2.5	1 - 4	2
September	5.78	0 - 17	6.24	1 - 17	5
October	3.88	0 - 13	4.65	1 - 13	3

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. Thus, 0.1 – 0.2 lice/g will give a 20% increased risk of mortality to a salmonid of < 150g. In order to determine the likely population effect, the proportion of fish within the population appearing in each band is calculated and a population risk determined. Fig. 4 gives the results by year for each estuary, with the banding indicating whether the risk is low (green), moderate (yellow) or high (red). Within the green zone it can be taken that there is minimal risk to the population, while the yellow and red zones show potentially population altering impacts.

From this, it can be seen that the potential risk in the Polla estuary during 2020 was considered to be medium, indicating that there are potentially population changing effects likely to have occurred in this area. However, this is a significant decline from the potential impacts observed in 2019. In contrast, the Laxford and Kyle of Durness showed a low potential risk, although the Laxford is based on a particularly small sample size. The Kyle of Durness results, while still green, show an increase from 2019.

The Laxford and Polla data continue to show a biannual pattern in risk, reflecting the stage of production within the farm. While sampling within the Kyle of Durness has been less regular over time than the other 2 estuaries, there would appear to be no real pattern within the data. However, the peaks in potential risk did appear to follow the Laxford more closely than the Polla, with 2020 negating this pattern. While not significant, it may reflect the tidal flows around the west coast.

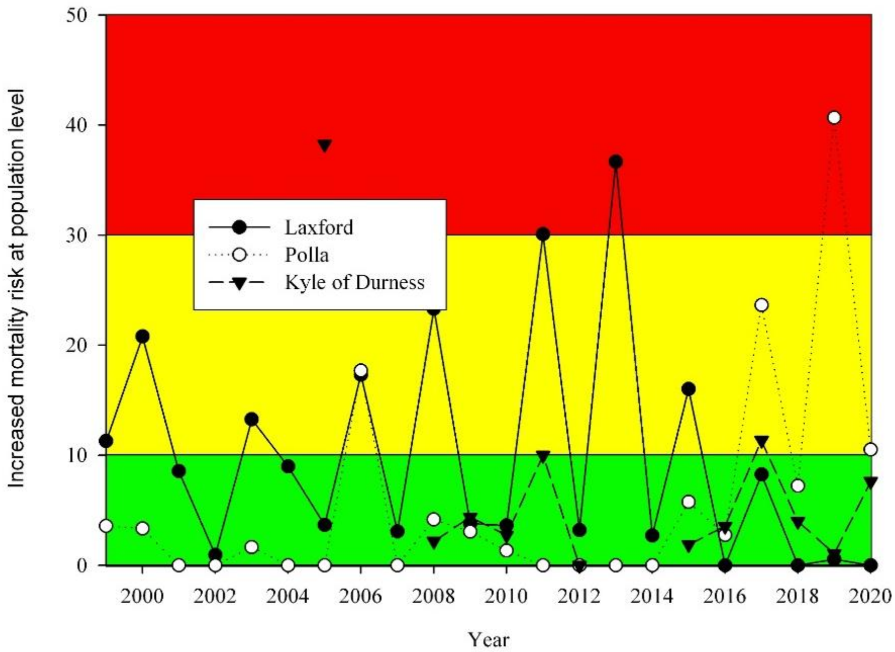

Fig. 4 Showing the increased mortality risk at population level created by sea lice

Recommendations for further research

1. It is recommended that the current programme be continued in order to maintain the existing dataset.
2. 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.
3. It is recommended that additional research on the sea lice population be undertaken. In particular the development of lice dispersal models may help to understand the dynamics within the area.

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