Monitoring of sea trout post-smolts, 2007

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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 particular regard to sea lice (Marshall 2003).

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.

Materials & Methods

Two estuaries, Laxford Bay and the Polla estuary, should be sampled monthly where possible from March to October, at low tide. Sampling was performed using a 50 m sweep net with a stretched mesh size of 15 mm to give one sweep of the area. Differences between the number examined and tagged (Table 1) reflect the presence of re-captures, the small size of trout involved or difficulties in loading the injector. Where trout <15 cm are involved, injection of the tags can prove difficult with only a thin membrane available to hold the tag and is therefore not undertaken.

All sea trout were removed and anaesthetised with 2-Phenoxyethanol. The length (± 1 mm) and weight (± 1 g) were recorded, scales removed and a visible impact (VI) tag implanted behind the eye. The fish were also 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(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 252 fish in the Laxford estuary during May (Table 1). A comparison of the catches with time in both 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 both estuaries was as expected from previous years, with few species and low numbers observed.

Unfortunately, this years sampling was heavily impacted by the bad weather which persisted through out the sampling period. Heavy rain falls made it impossible to net the estuaries as much as normal, with the Laxford being netted 4 times out of the potential 8, and the Polla only 3 times.

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

	Laxford Bay		Polla estuary	
Month	No. examined	No. tagged	No. examined	No. tagged
March	-	-	-	-
April	[+]51	45	26	20
May	[*]85	69	6	2
June	[*+]17	11	9	5
July	13	12	0	0
August	-	-	-	-
September	-	-	-	-
October	-	-	-	-

([+]100 returned; [*]167 returned, 10 salmon smolts; [*+]includes 3 salmon smolts;)

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 two estuaries was similar (Fig. 1). From Fig. 1 the predominant smolt age in all rivers is 2 years (S2), although there was a number of S3's also present. The length of fish in each estuary was similar although there was a greater proportion of larger fish in the Polla (Fig. 2). In particular, through the presence of a 75 cm fish within the Polla.

Of the fish examined a proportion was from previous smolt runs (Fig. 1; Table 2). There does not appear to be a pattern in the proportion of post-smolts within the samples, but they dominated the catches in the Laxford. A May smolt run is normally found in both estuaries (WSFT 2006), this year it could only be observed within the Laxford estuary.

Table 2 The percentage of smolts within the catch

Month	Laxford Bay	Polla estuary
March	-	-
April	65	46
May	89	0
June	86	0
July	100	-
August	-	-
September	-	-
October	-	-

The presence of post-smolts throughout the year in the Laxford indicates a heavy usage of this estuary by this group, presumably for feeding and shelter, normally this can also be seen in the Polla estuary (WSFT 2006), although this was not observed in 2007, possibly as a result of the low number of samples taken. That the sea trout populations are relatively static can be inferred from the information on recaptures, where tagged fish have been predominately recaptured in the same location as originally tagged.

The mean length, weight and condition index, ± s.d., of post smolts per month are given in Table 3a, for Laxford Bay, and Table 3b for the Polla estuary. No pattern in condition index can be seen in the Polla estuary as not enough samples were taken. The one measurement which was taken in April shows a better condition index than that of the Laxford for the same month. Within the Laxford it can be seen that the condition index increases from May to July. In 2006 it was shown that the length and weight of fish in the Laxford continued to increase from May to September suggesting that the Laxford population is growing within the bay throughout the year, with little movement into and out of the area. In 2007 an increase can be seen until July, after which no more samples were taken.

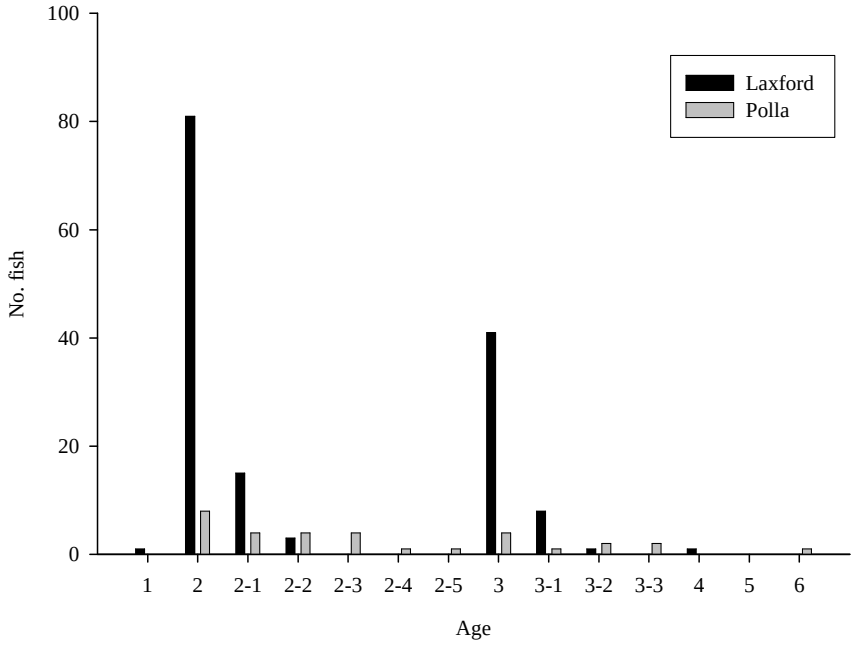

Fig. 1 The number of fish of each age taken in the estuaries

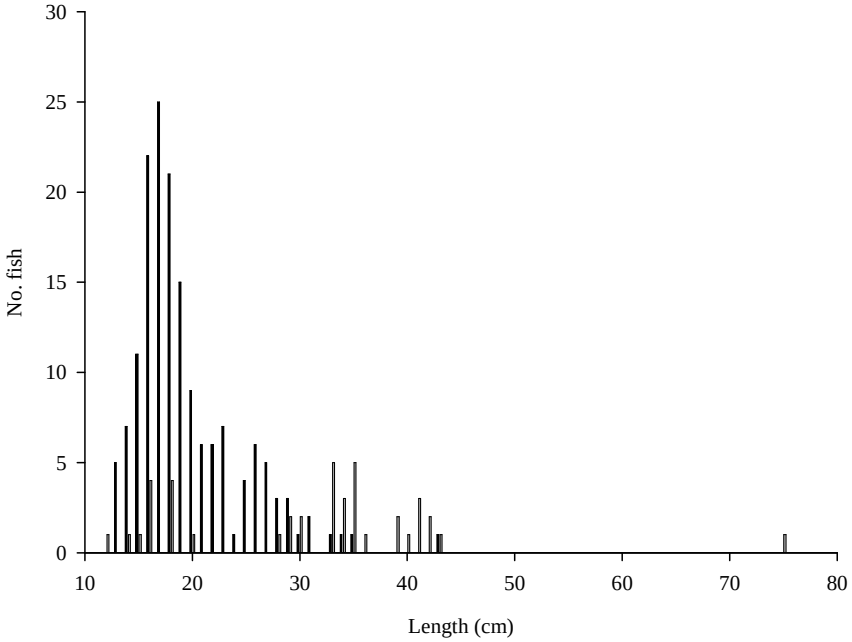

Fig. 2 The number of fish of each length taken in the estuaries

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

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
March	-	-	-
April	195.73 ± 32.60	78.07 ± 35.53	0.99 ± 0.10
May	172.81 ± 16.66	52.31 ± 15.57	0.99 ± 0.11
June	176.25 ± 26.97	63.42 ± 24.84	1.10 ± 0.07
July	204.15 ± 36.12	101.46 ± 54.81	1.11 ± 0.13
August	-	-	-
September	-	-	-
October	-	-	-

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

Month	Mean length (± s.d.) (mm)	Mean weight (± s.d.) (g)	Mean Condition Index (± s.d.)
March	-	-	-
April	175.5 ± 40.44	64.58 ± 53.63	1.06 ± 0.07
May	-	-	-
June	-	-	-
July	-	-	-
August	-	-	-
September	-	-	-
October	-	-	-

Recaptures

There were 17 recaptures during 2007, all within the estuary netting. The growth of recaptured trout is shown in Table 4a, for the Polla estuary, and Table 4b, for Laxford Bay. Fish K56 has been recaptured in the Polla for the second time in 2007. When recaptured in 2006 it had put on 120mm and 400g from the time it was tagged (WSFT 2006), whilst between 2006 and 2007 it had gained 151 mm and 494 g.

The average growth, per month, is 5.8 mm, and 8.05 g within the Laxford which is much smaller growth rate than that of 2006 (WSFT 2006), and 6.90 mm and 23.39 g in the Polla which shows that length is down on last year, but weight has gone up slightly. This demonstrates a difference between the 2 populations, with Polla fish on this occasion showing a greater growth than those in the Laxford, this is the opposite of what was observed last year (WSFT 2006). While based on a small sample size, this indicates that a greater variability in growth rates exists within a system, and suggests that growth may not be the only factor influencing the variations reported in catches.

The majority of fish were recaptured in the area of tagging, demonstrating that most sea trout remain within a small area. However, there were a proportion of the recaptures that had moved within the area – particularly J19. As in previous years, more than one of the fish was recaptured more than one year after initial tagging. This gives yet more information on sustained growth rates and demonstrates the potential effectiveness of the tagging programme.

Figure 3 shows that the growth rate in both estuaries had fallen since 2006 but was at a similar level for the Laxford and the Polla in 2007. In both estuaries there is a trend of a high year for growth rate following a low year, this is especially obvious in the Laxford. The years with lower growth rates in the Laxford tend to be the years with a higher growth rates in the Polla and visa versa. This demonstrates the complexity of trout population dynamics and the interactions with external factors, such as food supply and temperature.

Table 4a The lengths and weights of recaptured trout within the Polla estuary

Tag number		Tagged	Recaptured	Differences
J01	Date	28.3.05	16.4.07	25 mths
	Length (mm)	266	391	125
	Weight (g)	188	612	424
*J19	Date	23.5.05	16.4.07	23 mths
	Length (mm)	180	424	244
	Weight (g)	57	688	631
K56	Date	19.8.05	16.4.07	20 mths
	Length (mm)	267	418	151
	Weight (g)	236	730	494
L97	Date	25.5.06	16.4.07	11 mths
	Length (mm)	230	336	106
	Weight (g)	139	338	199
O50	Date	16.4.07	16.5.07	1 mth
	Length (mm)	338	350	12
	Weight (g)	340	406	66
P09	Date	23.8.06	16.5.07	9 mths
	Length (mm)	264	338	74
	Weight (g)	200	444	244
I71	Date	3.8.04	16.5.07	33 mths
	Length (mm)	214	431	217
	Weight (g)	112	796	684
X74	Date	16.6.03	16.5.07	47
	Length (mm)	252	412	160
	Weight (g)	185	993	808
O52	Date	16.4.07	13.6.07	2 mths
	Length (mm)	296	355	59
	Weight (g)	267	573	306
P09	Date	23.8.06	13.6.07	10 mths
	Length (mm)	264	365	101
	Weight (g)	200	577	377

*Tagged in Laxford Bay

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

Tag number		Tagged	Recaptured	Differences
J28	Date	23.5.05	18.4.07	23 mths
	Length (mm)	161	290	129
	Weight (g)	46	210	164
R32	Date	27.6.06	17.5.07	11 mths
	Length (mm)	196	278	82
	Weight (g)	88	200	112
P27	Date	25.8.06	17.5.07	9 mths
	Length (mm)	246	283	37
	Weight (g)	152	228	76
P86	Date	25.8.06	17.5.07	9 mths
	Length (mm)	252	261	9
	Weight (g)	163	169	6
J64	Date	23.5.05	17.5.07	24 mths
	Length (mm)	169	295	126
	Weight (g)	50	220	170
O95	Date	18.4.07	14.6.07	2 mths
	Length (mm)	178	203	25
	Weight (g)	70	98	28
N32	Date	17.5.07	17.7.07	2 mths
	Length (mm)	179	236	57
	Weight (g)	53	141	88

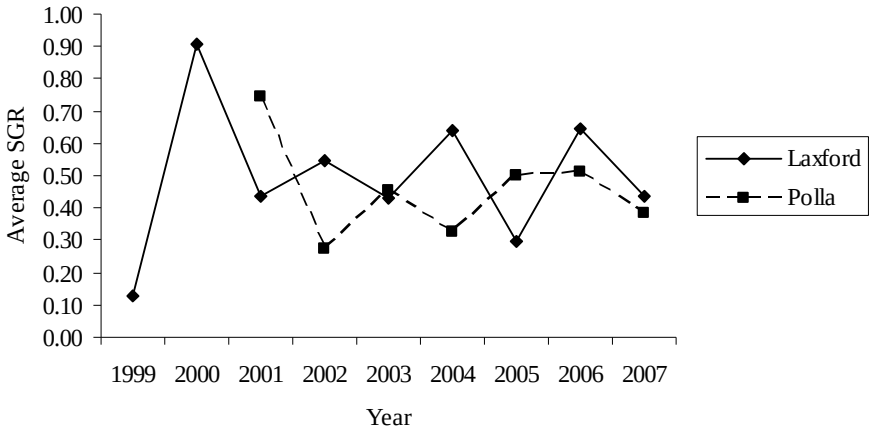

Fig. 3 Showing the average SGR for fish within the Laxford and Polla estuaries, by year

Sea Lice Infestations

Sea lice were present to a variable degree throughout the year in both estuaries, although more prevalent within the Polla (Table 5). No lice were found in the Laxford in April, and only very low numbers were found in the Polla. Chalimus stages dominated the Laxford samples (Fig. 4a) every month, with gravid females only appearing in small numbers in July. Lice numbers were generally low in both estuaries, being lowest in the Laxford, with June being the month where most lice were found in both estuaries.

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

Month	Laxford Bay	Polla estuary
March	-	-
April	0	12
May	11	33
June	43	89
July	31	-
August	-	-
September	-	-

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 on the fish (Tables 6 (Laxford) & 7 (Polla)). The use of intensity will give a more accurate impression of the degree of infestations, 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 farm 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 from a single heavily infected individual.

Laxford

Table 6 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
March	-	-	-	-	-
April	0	0	0	0	0
May	2.59	0 - 115	24.44	1 - 115	0
June	8.29	0 - 91	19.33	1 - 91	0
July	6.00	0 - 72	19.50	1 - 72	0
August	-	-	-	-	-
September	-	-	-	-	-

The pattern of lice abundance within the Laxford samples is similar to that in previous years, rising through the year, before dropping again (Marshall 2003; WSFT 2006). The low median values would indicate that the abundance recorded refer to a few more heavily infested fish rather than a heavily infested population. Lice numbers on neighbouring cages were low and no correlation can be seen between them and those found on wild fish.

Polla

The abundance of lice shown in Table 7 indicates a generally increasing lice population within the estuary over the three months that samples were taken. Figure 4b shows that mobile stages dominated the catches in all months, this was also seen in 2006 (WSFT 2006), gravid lice were only are present in very small numbers in April, absent in May, then present again in June. Lice numbers on neighbouring cages were very low and no correlation can be seen between them and those found on wild fish.

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
March	-	-	-	-	-
April	0.31	0 - 6	2.27	1 - 6	0
May	0.83	0 - 4	2.50	1 - 4	0
June	8.22	0 - 26	9.25	1 - 26	3
July	-	-	-	-	-
August	-	-	-	-	-
September	-	-	-	-	-

Lice abundance, and intensity in both estuaries is much lower than it was in 2006, though extremely high densities of were recorded on other sites on the West coast of Scotland (pers. comm. WIFT, AFT, FRS Shieldaig).

References

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Acknowledgements

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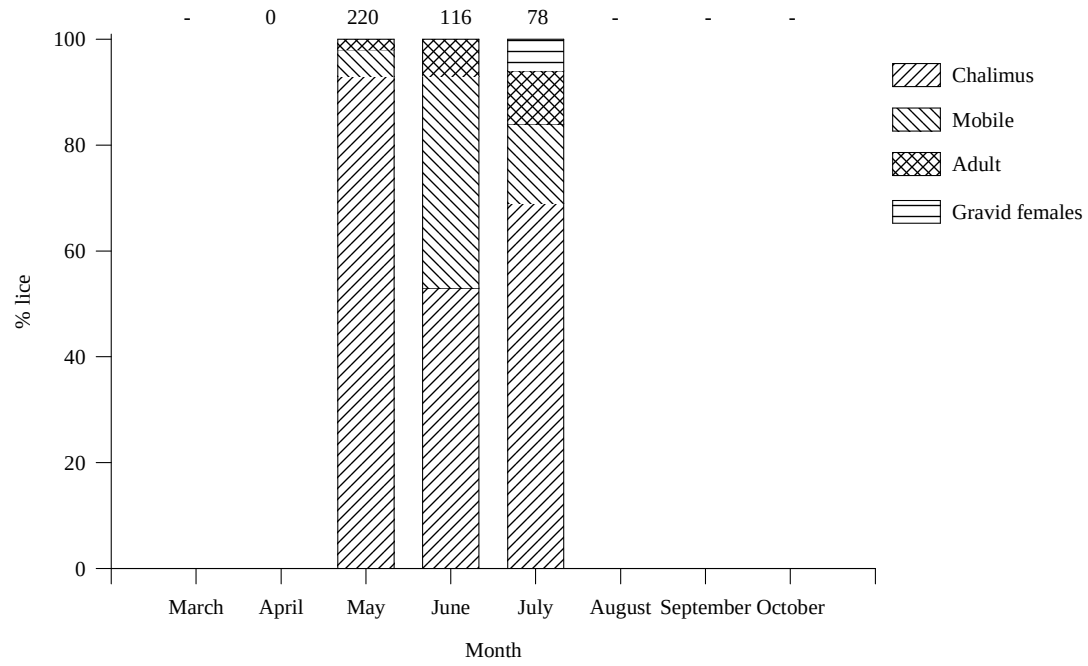

Fig. 4a Showing the proportion of each stage of lice within the Laxford samples, by month. The total number of lice is given at the top.

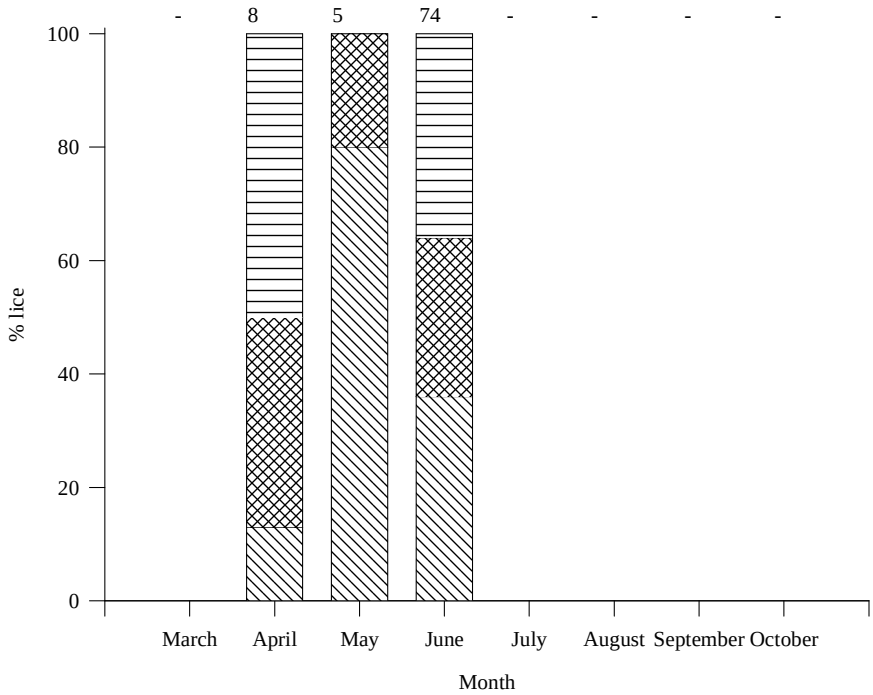

Fig. 4b Showing the proportion of each stage of lice within the Polla samples, by month. The total number of lice is given at the top.