Review of sea lice monitoring

and

seatrout/sealice database

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Executive Summary

- In February 1998, the Minister of State at the Department of the Marine requested that the Marine Institute, the Central Fisheries Board and the Salmon Research Agency review the effectiveness of the national sea trout research and monitoring programmes.

- A review group was established to:

  1. Identify steps to address any unidentified deficiencies in the programme
  2. Review the scientific database, methodologies and data collection/collation techniques
  3. Re-run of the data analysis in light of the previously commissioned independent reports and any subsequent responses from the various agencies involved in data collection

- A thorough re-examination of the sea lice sampling programme, including changes and improvements made since 1997, for sea trout was carried out and suggestions for improvements in this programme were made.

- A comprehensive examination of the sea lice/sea trout was carried out in light of the independent reports which identified discrepancies in the original data. Corrections were made where legitimate discrepancies were identified. However, it was noted that not all of the reported discrepancies were legitimate. The corrected data were added to the database for reanalysis.

- A comparison between the original database for 1992, 1993, 1994 and 1995 and the corrected database showed the changes to have little or no effect on the results of the analyses already published

- Examination of the new data for 1996 to 1999 showed they are consistent with the findings of the previous investigations and are included in this report.

- These data indicated that, while it was possible to show high and low mean lice levels on sea trout at sites close to fish farms, high lice levels were never recorded distant from fish farms.

- High infestations of sea lice on early returning sea trout post-smolt were characterised by high proportions of chalimus stages.

- Notwithstanding this, the following should be noted:

1 Due to the quality of the paper trail it is unlikely that there are significant 'unknown' or 'unreported' errors.
2 Previous caveats expressed in the published reports relating to small sample sizes and the use of the linear distance model are still valid. The group would caution against any simplistic use of the results or interpretations derived from sea lice infestation/linear distance models.

- More detailed modelling will require modification of the sampling programme to ensure validity of the statistical procedures.

- The present sampling programme has provided important baseline data on national trends in sea lice infestations on wild sea trout. It is felt that the current national sea trout sampling programme is not capable of being modified to sufficiently overcome the shortcomings of small sample sizes and a high coefficient of variation. To progress the management of sea trout stocks, a new approach involving the development of the current Single Bay Management (SBM) programme and monitoring the recovery of stocks by adult census techniques, coupled with a targeted sea trout research programme, is required. This research programme should include; focussed sampling of sea trout lice infestations in a small number of key estuaries and at sea.

1. Introduction

Over the past decade, with the highly publicised collapse of sea trout populations in the mid-west of Ireland, sea trout research and management issues have been co-ordinated by various groups set up by the Department of the Marine and Natural Resources (i.e. Sea Trout Working Group, the Sea Trout Task Force and the Sea Trout Management and Advisory Group). Each of these groups was responsible for the publication of reports for the DOMNR aimed at elucidating the nature and cause of this phenomenon. In 1997, concerns were raised as to the efficiency of the sea trout monitoring programme and the robustness of the sea trout/sea lice database (Cowx 1997; Rothschild 1997).

In February 1998, the Minister of State at the Department of the Marine requested that the Marine Institute, the Central Fisheries Board and the Salmon Research Agency review the effectiveness of the national sea trout research and monitoring programmes and the results and conclusions which had already been published. To undertake this examination, the MI, CFB and SRA agreed a collective approach based on the following five point plan:

1 Identify steps to address any unidentified deficiencies in the programme

2 Review of the scientific database, methodologies and data collection/collation techniques

3 Re-run of the data analysis in light of the previously commissioned independent reports and any subsequent responses from the various agencies involved in data collection

4 Recommend a future strategy for optimum management and monitoring of sea trout stocks and their environment

5 Ensure that the overall strategies provide value for money

The following report deals specifically with points 1 to 3 above. The two remaining will be addressed in light of this report.

Participants of the Review:

N. O' Maoileidigh, D. Jackson, R. Poole (Marine Institute)
P. Gargan (Central Fisheries Board)
M. Keatinge (Bord Iascaigh Mhara)

The review group met on a number of occasions over the review period July '99 to March 2000 to carry out its functions.

2. Review of methodologies and improvements implemented

Immediate action taken

Significant changes have taken place with regard to improvements in the sampling programme for sea trout. These derive mainly from improvements suggested in the joint MI/CFB (1998) Document "Review of the efficiency of the sea lice sampling programme" as well as criticisms of the programme (Cowx 1997, Rothschild 1997; Gargan & Forde 1997).

A new sampling form was issued in 1997 to all agencies and individuals involved in sea trout sampling. This form was used in 1997, 1998 and 1999. Each form carries a unique serial number and since 1997, all individuals involved in sampling have been given a training course by the CFB in interpreting and filling out the form. This course takes place in Athlone in April of each sampling year. New books are issued each year if required. There are three carbon copies of the form associated with each top copy. The top copy is detached and included with the samples to be sent to scientists analysing the data. A copy is retained by the Regional Fisheries Board carrying out the sampling. A second copy is forwarded to the sampling co-ordinator in the CFB and a final copy is sent to the Marine Institute for its records.

The sampling programme stipulates that all fish less than 26cm be retained in separate plastic bags. All of the individual fish are then placed in a labelled bag with the top copy of the sampling form and these are forwarded, as soon as possible, to the Zoology Department in Trinity College, Dublin for independent assessment of lice infestation parameters.

In 1997 sea trout lice sampling was carried out in conjunction with other disease monitoring programmes carried out by the Marine Institute. These lice results were incorporated in the database.

The river categories specified in previous surveys (Sea Trout Monitoring and Advisory Group Report, March 1996) were retained. A small number of rivers were excluded in latter years as there was not a long enough time series to warrant the continued expenditure of resources.

Despite some of the problems outlined and the ensuing recommendations, the review group are satisfied that significant improvements have been made in relation to the sampling programme from 1997 to date.

Recommendations for future sampling

The introduction of the new sampling form was recognised by the database review group as being a significant improvement over the previous system as it reduced the possibility of samples being misidentified or lost. This ensured traceability of individual samples from the person sampling to the person analysing the data and reporting the results during the season. It also ensured a more accountable record of data for any future analyses.

The time scale within which results were available was reviewed. Presently, the final sea trout sample is taken on the 15th of June each year. A three week analysis period is required before results are available. It is recommended that efforts should be made to reduce this. An inventory of samples taken, lengths of fish and lice counts should be made available to all participating sampling agencies within one month of sampling, ensuring that all samples could be accounted for quickly and avoid problems of samples being left long periods before being sent for analysis.

The size limit of the samples (i.e. fish less than 26cm to be retained) was reviewed. Migrating sea trout below this size limit are broadly indicative of post-smolts from most sea trout fisheries. However, the group felt that as scales could be taken from these fish that the actual age should be verified and used as the ultimate criterion for identifying post-smolts.

It is recommended by the database review group that all fish which do not meet the agreed sampling criteria be returned to the water. However, they should be measured and the lengths recorded in the form as this was not being done at present, thus providing a clearer idea of the age composition of the entire sample. A further suggestion is that the bagged fish could be measured in the bag without loss of any lice from the sample.

Summary recommendations:

- **It is recommended that all fish to be put back should be measured and the lengths recorded in the form**
- **It is recommended that the bagged fish could be measured in the bag without loss of any lice from the sample.**
- **It is felt essential that a biologist should form part of each sampling team.**
- **It is recommended that results from each batch of samples should be made available as soon as the lice counts had been carried out.**
- **It is recommended that scales should be read from all samples retained (particularly if they were close to the 26cm cut-off value) and used as the ultimate criterion for identifying post-smolts.**

These recommendations have been made in the context of this sampling programme being continued in the future. However, an alternative approach, which relies on Single Bay Management (SBM) and monitoring the recovery of stocks by adult census techniques should also be considered.

3. Review of the scientific database

It was agreed that on scientific grounds, re-analysis should not be carried out without a full review and acceptance of any changes which were made to the database. It was agreed that a systematic review of the changes would highlight the extent of the changes needed and also indicate their effect on the previous analyses. All of the changes made to the database were examined in a systematic fashion and the analyses were re-run accordingly. This process involved a review of the entire database with specific reference to the data highlighted in the independent evaluations cited below. The entire database was finally checked for each of the 4911 individual records.

The procedure adopted, therefore, was to review the 1992 to 1995 data in light of comments in the Cowx Report (Cowx 1997), the corrections and clarifications contained in Gargan and Forde (1997) and the original field sampling sheets. Many of the discrepancies noted in the independent evaluations were legitimate and subsequently corrected. Many of these corrections involved standardisation of river names and correction of dates. Some reported discrepancies were invalid and no changes were necessary. However, all such data were noted for future reference. In a small number of cases where there was uncertainty, the specific data were highlighted and examined to asses their impact on the results of the analysis. All of the changes and notes relating to the changes were recorded in the database. It was agreed to adopt the same procedure to review the 1996 data and the agreed changes were noted for inclusion in the database. While the data for 1997 to 1999 were not subject to comment in the independent reports they were also reviewed in light of the original field sampling sheets and the data analysed in the independently commissioned CFB reports (1997-1999). Again, any changes agreed were noted for inclusion in the Marine Institute Master Database and in the small number of cases where there was uncertainty, the specific data were also highlighted and examined to assess their impact on the results of the analysis.

While the existence of any 'unidentified' or 'unreported' discrepancies (i.e. systematic biases) cannot be discounted, it is thought unlikely that these would be significant.

4. Re-running of the analyses with the corrected data

As described in Section 3. a review was carried out on the entire database for 1992 to 1999 inclusive. Completed revised tables for infestation parameters for sea lice (*Lepeophtheirus salmonis*) infesting sea trout between 1992 and 1999 are shown in Tables 1-8.

Methodology for Sea trout sampling

Standardizing the collection of sea trout samples has always been a primary concern but has been difficult to achieve. This is of course a feature of most fishery related studies and particularly those relating to parasite infestations of fish populations. From May 1992 a sampling programme (intensified in 1993) was carried out to sample sea trout from rivers known to be affected by the sea trout collapse and rivers where populations had not collapsed. The programme was designed to ensure as much standardisation of sample material as possible and to allow comparisons to be made of the infestations of sea lice on sea trout from different river systems. This standardisation was continued in latter years including suggestions in the independent reviews (Cowx 1997, Rothschild 1997) described in Sect. 2 of this report. In designing the sampling protocol the sampling was standardised as follows:

1 Sites were restricted to brackish water or freshwater sites very close to estuary mouths. Attempts to sample wild sea trout at sea in previous years using fine meshed nets had

proved to be largely ineffective and therefore no attempt was made to obtain samples from the sea. However, the hypothesis was formulated to examine the relationship between lice infestation on early returning post-smolts and distance to fish farms. In this context, it must be pointed out that these samples are not designed to be representative of the overall sea trout population; they are, rather, a random sample of the early returning sea trout. Some late downstream smolt migrants may also be included in the samples as not all migrating smolts would have left freshwater by the 1st May.

Under the hypothesis that sea trout infested with lice return early to freshwater this sampling location would seem to be the most suitable. In fact concentrations of sea trout smolts infested with lice have been observed in these brackish locations since 1989.

2 Sites were chosen to be representative of sea trout rivers in general. However, the highest density of sea trout fisheries is concentrated on the west and north west seaboard of Ireland coinciding with the highest density of salmon farm installations. There are fewer sea trout rivers on the south and east coasts which, however, represent the most distant sites from fish farms. Many of these rivers (Boyne, Slaney, etc.) are larger rivers where sampling in the tidal zones is impractical and even dangerous.

3 Fish were sampled primarily by gill nets (~72%), beach seine (12%), electrofishing (~6%) or in the Invermore and Gowla traps (~6%). Samples were also obtained by angling and hand netting at night using strong lamps in 1992 and 1993 (~2%). The locations of the rivers sampled are shown in Figure 1. This figure does not include rivers where sampling was carried out but no samples were obtained.

The method of fish capture may have an effect on the recorded level of infestation and relative abundance of life-history stages of sea lice. However, in the present study infestations were not lower in samples captured by gill nets compared to those captured in upstream traps. Although a controlled experiment was not conducted it was suggested that gill nets did not lead to significant negative bias in the data or if bias exists it may have been similar for all methods (Tully *et al.*1999). Gill nets accounted for more than 72% of all fish captured and this should reduce some of the sampling effects.

4 In 1992, '93 and '94 rivers were sampled on a weekly basis where possible from 1 May to 15 June. It was hoped to obtain at least 30 fish from each sample site although this was not achieved at all locations.

In 1995 it was decided to reduce the numbers of rivers sampled and to target some rivers for more intensive sampling. Rivers were put into three categories, A, B & C depending on the sample size required and the frequency of sampling.

Category A. To be sampled four times, two weeks apart, and a sample of 20 fish taken each time.

Category B. To be sampled three times, two weeks apart, and a sample of 20 fish taken each time.

Category C. To be sampled twice over the sampling period and a sample of 15 fish taken each time.

Furthermore, to allow sufficient effort for the collection of each sample, each sample could be accrued over a period of 3 days if necessary. However, full samples were only

collected from 10 – 20% of rivers in any given year, because fish were not always present in the estuarine sampling locations.

5 All fish were removed from nets or handnets carefully (to avoid removing loosely attached lice), placed in individual plastic bags and deep frozen as soon as possible.

6 The samples were then semi-thawed and washed in alcohol to prevent any further decomposition of the lice. Lice were counted and staged as chalimus or postchalimus under dissection microscope.

Definitions

Throughout the text and the analyses, the following definitions are adhered to (Margolis ***et al.*** 1982).

Prevalence Number of individuals of a host species infected with a particular parasite species divided by the number of hosts examined, generally expressed as a percentage.

Intensity Total number of individuals of a particular parasite species in a sample of host species divided by the number of infected individuals of the host species in the sample (= mean number of individuals of a particular parasite species per infected host in a sample).

Abundance Total number of individuals of a particular parasite species in a sample of hosts divided by the total number of individuals of host species (infected + uninfected) in the sample (=- mean number of individuals of a particular parasite species per host examined). This in effect is equal to mean intensity multiplied by prevalence.

Statistical analyses

The sampling methods and the definitions of lice infestation parameters have been outlined above.

The following analyses were carried out.

- The relationship between abundance of all lice and distance to the nearest farm
- The relationship between abundance of chalimus stages only and distance to the nearest farm

Reviewing the composition of the data set, the review group recognized the inherent dangers (previously identified by the STWG) of working, in many instances, with small sample sizes. Valid fish for this analysis were defined as follows:

Only fish captured between the 1 May and 15 June inclusive
Only post-smolt included, fish <26cm except <28cm in Waterville and the Nanny
Valid samples must have 3 or more valid fish
Brown trout, salmon and marine samples taken in Clew Bay were excluded

Based on these restrictions a proportion of the original data set was deemed invalid for the purpose of this analysis. The total valid sample is shown, by fishery, in Tables 1-8.

In calculating abundance, only those sites with three or more valid fish were considered. While a larger sample size would have been preferable, this selection criterion was chosen to retain as many of the sample sites as possible. Of the sites included in the analyses some 30% had fewer than ten valid fish. Abundance summary statistics are shown in Tables 1-8.

As requested in the terms of reference, the original data collected and analyzed for the years 1992 to 1995 was compared directly with the corrected dataset in Figure 2, both as un-transformed and as natural log transformed data. The linear least squares regression lines were also fitted for both the old and new datasets in order to give the required comparison. In two cases the changes to the dataset strengthened the relationship and in two cases it weakened it, although these changes did not alter the overall significance level ($P < 0.01$).

The group examined the issue of the high coefficient of variation of the data as raised by the Cowx Report and agree that the analyses undertaken should only be used to focus attention towards possible relationships. The group would caution against any simplistic use of the results from these models. More detailed modelling would require the sampling programme to be modified to ensure validity of the statistical procedures. It should be noted, however, that because sampling sea trout in estuarine or marine conditions with a view to examining sea lice infestations (highly over-dispersed populations) has inherently large variation anyway in practical terms it would be difficult to reduce this coefficient of variation.

Mean total lice abundance and mean chalimus abundance on sea trout in relation to distance from fish farms are presented in Figures 3 & 4. The data show that while it was possible to show high and low mean lice levels on sea trout at sites close to fish farms, the high lice levels were never recorded at sites distant from fish farms.

Sea trout samples infested with high numbers of young infective stages indicate recent high rates of transmission, whereas infestations consisting predominantly of pre-adults and adults (post-chalimus) indicates that recent transmission rates were not high. A time series of such samples characterizes the patterns of transmission at these sites. The data presented compares the mean number of *L. salmonis* juveniles (chalimus) and adults (post-chalimus) infesting sea trout smolts in relation to distance categories to the nearest farm (Figure 5a), and also presents changes in the proportion of chalimus in the lice population infesting sea trout as a function of the distance to the nearest farm (Figure 5b). All dates and years are combined. Some annual variation in both lice infestation level and proportions of life stages was observed, but the pattern remained similar over the time period.

The review group are satisfied that:

- The quality audit of the database has not substantially altered the results of analyses undertaken in the original reports.

- The pattern of abundance and intensity of infection of lice infestation on sea trout in relation to proximity of fish farms is consistent over the period examined.

- These data indicated that, while it was possible to show high and low mean lice levels on sea trout at sites close to fish farms, the high lice levels were never recorded distant from fish farms.

- High infestations of sea lice on early returning sea trout post-smolt were characterised by high proportions of chalimus stages.

5. Conclusions and Recommendations

A thorough re-examination of the sea lice sampling programme for sea trout was carried out and suggestions for improvements in this programme were made. Many of these were implemented in the 1997 and subsequent sampling years. The review group carried out a comprehensive examination of the sea lice/sea trout database on the basis of previous independent reports to identify legitimate discrepancies and corrections were carried out. These corrected data were added to the database for reanalysis.

The comparison between the original database for 1992, 1993, 1994 and 1995 and the corrected database showed the changes to have had little or no effect on the analyses already published. Examination of the database has shown similar patterns of lice abundance and intensity of lice infestation on sea trout to those reported in previous published reports. Similar patterns have also been reported from both Scotland and Norway. It has been acknowledged that the level at which these patterns can be statistically modelled is found to be somewhat limited. The previous caveats in the published reports relating to, small sample sizes and the use of the linear distance model, are still valid even with the improved sampling programme in recent years

The present sampling programme has provided important baseline data on national trends in sea lice infestations on wild sea trout. It is felt that the current national sea trout sampling programme is not capable of being modified to sufficiently overcome the shortcomings of small sample sizes and a high coefficient of variation. To progress the management of sea trout stocks, a new approach involving the development of the current Single Bay Management (SBM) programme and monitoring the recovery of stocks by adult census techniques, coupled with a targeted sea trout research programme, is required. This research programme should include; focussed sampling of sea trout lice infestations in a small number of key estuaries and at sea.

References

Cowx, I.G. (1997) Sea Trout Monitoring programme – An Independent Evaluation. Commissioned Report, University of Hull. 24pp.

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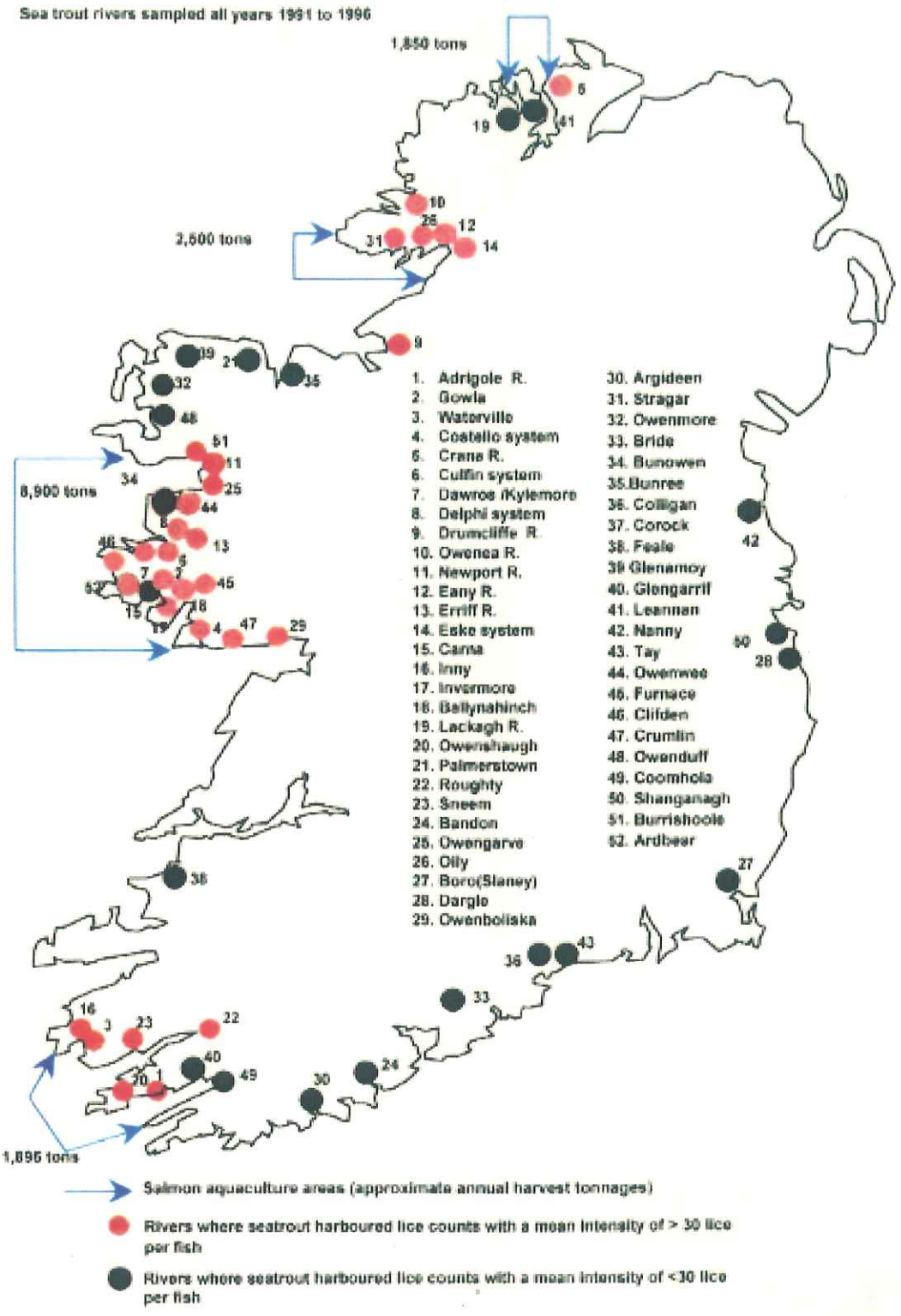


Figure 1. Map showing locations sampled for sea trout post smolts between 1991 and 1999.

Table 1. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1992 and 15 June 1992.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Argideen	60.00	19	15	78.95%	2		2	4	0	4	13.33%		13.33%	2.00		2.00	0.27	0.00	0.27
Ballynahinch	9.00	5	2	40.00%	1	1	1	21	2	23	50.00%	50.00%	50.00%	21.00	2.00	23.00	10.50	1.00	11.50
Burrishoole	7.00	7	7	100.00%	7	4	7	318	40	358	100.00%	57.14%	100.00%	45.43	10.00	51.14	45.43	5.71	51.14
Clifden	5.00	6	5	83.33%	5	4	5	367	84	451	100.00%	80.00%	100.00%	73.40	21.00	90.20	73.40	16.80	90.20
Costello	17.00	7	4	57.14%	2	2	3	328	36	364	50.00%	50.00%	75.00%	164.00	18.00	121.33	82.00	9.00	91.00
Dawros	5.00	15	14	93.33%	12	13	14	387	121	508	85.71%	92.86%	100.00%	32.25	9.31	36.29	27.64	8.64	36.29
Drumcliffe	60.00	7	3	42.86%				0	0	0							0.00	0.00	0.00
Erriff	15.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Gowla	3.00	14	13	92.86%	2	1	2	273	1	274	15.38%	7.69%	15.38%	136.50	1.00	137.00	21.00	0.08	21.08
Inny	12.00	73	59	80.82%	45	44	51	2328	420	2748	76.27%	74.58%	86.44%	51.73	9.55	53.88	39.46	7.12	46.58
Killary	9.00	28	21	75.00%	16	13	18	581	72	653	76.19%	61.90%	85.71%	36.31	5.54	36.28	27.67	3.43	31.10
Newport	7.00	7	4	57.14%	4	4	4	176	80	256	100.00%	100.00%	100.00%	44.00	20.00	64.00	44.00	20.00	64.00
Owengarve	6.00	45	32	71.11%	25	30	31	1366	653	2019	78.13%	93.75%	96.88%	54.64	21.77	65.13	42.69	20.41	63.09
Owenmore	40.00	6	6	100.00%	2	2	2	25	24	49	33.33%	33.33%	33.33%	12.50	12.00	24.50	4.17	4.00	8.17
Waterville	11.00	21	20	95.24%	6	5	7	233	41	274	30.00%	25.00%	35.00%	38.83	8.20	39.14	11.65	2.05	13.70

Legend for Tables:

Ch: Chalimus stages
PCh: Post-chalimus Stages
Tot: Total Lice Stages
Count Ch etc: Number of valid fish infected with Chalimus, etc
LC: Lice Count
Pr: Prevalence
Int: Intensity
Ab: Abundance

Table 2. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1993 and 15 June 1993.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Adrigole	5.00	4	1	25.00%	1		1	14	0	14	100.00%		100.00%	14.00		14.00	14.00	0.00	14.00
Argideen	60.00	3																	
Ballynahinch	9.00	8	6	75.00%	5	5	5	91	92	183	83.33%	83.33%	83.33%	18.20	18.40	36.60	15.17	15.33	30.50
Ballyveeney	43.00	3	3	100.00%				0	0	0							0.00	0.00	0.00
Bandon		1																	
Belclare		2	2	100.00%	2	2	2	4	5	9	100.00%	100.00%	100.00%	2.00	2.50	4.50	2.00	2.50	4.50
Boro	299.00	11																	
Bride	180.00	23	22	95.65%	1		1	2	0	2	4.55%		4.55%	2.00		2.00	0.09	0.00	0.09
Bunowen		2	2	100.00%	2	2	2	9	21	30	100.00%	100.00%	100.00%	4.50	10.50	15.00	4.50	10.50	15.00
Bunree	80.00	21	4	19.05%		1	1	0	3	3		25.00%	25.00%		3.00	3.00	0.00	0.75	0.75
Carna	7.00	3	3	100.00%	3	2	3	17	9	26	100.00%	66.67%	100.00%	5.67	4.50	8.67	5.67	3.00	8.67
Cloonee Lake		2	2	100.00%	2	2	2	146	64	210	100.00%	100.00%	100.00%	73.00	32.00	105.00	73.00	32.00	105.00
Colligan	202.00	28	28	100.00%				0	0	0							0.00	0.00	0.00
Coomhola		2	1	50.00%	1	1	1	13	26	39	100.00%	100.00%	100.00%	13.00	26.00	39.00	13.00	26.00	39.00
Corock	255.00	10	10	100.00%				0	0	0							0.00	0.00	0.00
Costello	18.00	27	21	77.78%	19	18	19	523	397	920	90.48%	85.71%	90.48%	27.53	22.06	48.42	24.90	18.90	43.81
Crana	6.00	32	21	65.63%	15	11	16	748	72	820	71.43%	52.38%	76.19%	49.87	6.55	51.25	35.62	3.43	39.05
Culfin		2	2	100.00%	2	1	2	15	6	21	100.00%	50.00%	100.00%	7.50	6.00	10.50	7.50	3.00	10.50
Dargle	210.00	18	10	55.56%	4	10	10	14	218	232	40.00%	100.00%	100.00%	3.50	21.80	23.20	1.40	21.80	23.20
Dawros	3.00	38	27	71.05%	24	15	25	599	123	722	88.89%	55.56%	92.59%	24.96	8.20	28.88	22.19	4.56	26.74
Delphi	9.00	19	8	42.11%	5	5	6	116	43	159	62.50%	62.50%	75.00%	23.20	8.60	26.50	14.50	5.38	19.88
Drumcliffe	60.00	34	11	32.35%	8	11	11	63	288	351	72.73%	100.00%	100.00%	7.88	26.18	31.91	5.73	26.18	31.91
Eany	2.00	39	37	94.87%	16	7	18	176	24	200	43.24%	18.92%	48.65%	11.00	3.43	11.11	4.76	0.65	5.41
Erriff	15.00	7	5	71.43%	5	3	5	165	11	176	100.00%	60.00%	100.00%	33.00	3.67	35.20	33.00	2.20	35.20
Eske	16.00	27	23	85.19%	16	13	16	537	80	617	69.57%	56.52%	69.57%	33.56	6.15	38.56	23.35	3.48	26.83
Feale	118.00	4																	
Glanmore	3.00	4	2	50.00%	2		2	49	0	49	100.00%		100.00%	24.50		24.50	24.50	0.00	24.50
Glenamoy	40.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Glengariff		1																	
Gowla	4.00	44	39	88.64%	38	36	38	1657	725	2382	97.44%	92.31%	97.44%	43.61	20.14	62.68	42.49	18.59	61.08
Inny	12.00	137	39	28.47%	31	12	31	777	67	844	79.49%	30.77%	79.49%	25.06	5.58	27.23	19.92	1.72	21.64
Invermore	9.00	39	36	92.31%	34	30	36	1147	552	1699	94.44%	83.33%	100.00%	33.74	18.40	47.19	31.86	15.33	47.19
Lackagh	35.00	4	2	50.00%	1	1	1	2	3	5	50.00%	50.00%	50.00%	2.00	3.00	5.00	1.00	1.50	2.50
Lacken		1																	
Leannan	16.00	31	18	58.06%	12	3	12	269	16	285	66.67%	16.67%	66.67%	22.42	5.33	23.75	14.94	0.89	15.83
Lough Fadda		1																	
Lower Brach		1	1	100.00%	1	1	1	16	29	45	100.00%	100.00%	100.00%	16.00	29.00	45.00	16.00	29.00	45.00
Mill		1																	

Continued on next page

Table 2 cont. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1993 and 15 June 1993.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Nanny	160.00	13	7	53.85%	6	4	6	12	95	107	85.71%	57.14%	85.71%	2.00	23.75	17.83	1.71	13.57	15.29
Newport	6.00	3	1	33.33%		1	1	0	1	1		100.00%	100.00%		1.00	1.00	0.00	1.00	1.00
Oily	3.00	16	16	100.00%	13	11	13	856	83	939	81.25%	68.75%	81.25%	65.85	7.55	72.23	53.50	5.19	58.69
Owenea	60.00	15	12	80.00%	2	2	3	80	7	87	16.67%	16.67%	25.00%	40.00	3.50	29.00	6.67	0.58	7.25
Owengarve	4.00	15	15	100.00%	3	3	3	111	51	162	20.00%	20.00%	20.00%	37.00	17.00	54.00	7.40	3.40	10.80
Owenmore	40.00	9	4	44.44%	1		1	3	0	3	25.00%		25.00%	3.00		3.00	0.75	0.00	0.75
Owenshaugh	3.00	9	9	100.00%	9	2	9	692	2	694	100.00%	22.22%	100.00%	76.89	1.00	77.11	76.89	0.22	77.11
Palmerstown	80.00	5	5	100.00%				0	0	0							0.00	0.00	0.00
Roughty	23.00	52	47	90.38%	41	27	42	1554	207	1761	87.23%	57.45%	89.36%	37.90	7.67	41.93	33.06	4.40	37.47
Sneem	6.00	13	12	92.31%	11	4	11	537	14	551	91.67%	33.33%	91.67%	48.82	3.50	50.09	44.75	1.17	45.92
Spiddal	30.00	7	7	100.00%	3	4	4	37	155	192	42.86%	57.14%	57.14%	12.33	38.75	48.00	5.29	22.14	27.43
Stragar	6.00	11	10	90.91%	5	5	5	249	52	301	50.00%	50.00%	50.00%	49.80	10.40	60.20	24.90	5.20	30.10
Tay	209.00	43	17	39.53%				0	0	0							0.00	0.00	0.00
Waterville	11.00	37	16	43.24%	13	15	16	538	589	1127	81.25%	93.75%	100.00%	41.38	39.27	70.44	33.63	36.81	70.44

Table 3. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1994 and 15 June 1994.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Adrigole		2	2	100.00%	2		2	59	0	59	100.00%		100.00%	29.50		29.50	29.50	0.00	29.50
Ardbear	3.00	4	3	75.00%				0	0	0							0.00	0.00	0.00
Argideen	60.00	5	5	100.00%				0	0	0							0.00	0.00	0.00
Belclare	20.00	26	18	69.23%	8	15	16	63	65	128	44.44%	83.33%	88.89%	7.88	4.33	8.00	3.50	3.61	7.11
Bunowen	8.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Carna	7.00	13	13	100.00%	9	3	9	198	11	209	69.23%	23.08%	69.23%	22.00	3.67	23.22	15.23	0.85	16.08
Clifden	2.00	34	28	82.35%	23	7	23	1731	11	1742	82.14%	25.00%	82.14%	75.26	1.57	75.74	61.82	0.39	62.21
Colligan	202.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Costello	20.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Crana		1	1	100.00%	1		1	3	0	3	100.00%		100.00%	3.00		3.00	3.00	0.00	3.00
Crumlin	23.00	7	6	85.71%	2	1	2	51	2	53	33.33%	16.67%	33.33%	25.50	2.00	26.50	8.50	0.33	8.83
Culfin	5.00	6	4	66.67%				0	0	0							0.00	0.00	0.00
Dargle	210.00	19	3	15.79%	1	1	1	3	9	12	33.33%	33.33%	33.33%	3.00	9.00	12.00	1.00	3.00	4.00
Dawros	21.00	36	22	61.11%	17	19	21	939	161	1100	77.27%	86.36%	95.45%	55.24	8.47	52.38	42.68	7.32	50.00
Delphi	9.00	13	8	61.54%				0	0	0							0.00	0.00	0.00
Eany	2.00	49	48	97.96%	17	4	21	171	10	181	35.42%	8.33%	43.75%	10.06	2.50	8.62	3.56	0.21	3.77
Erriff	15.00	15	12	80.00%	7	7	9	152	50	202	58.33%	58.33%	75.00%	21.71	7.14	22.44	12.67	4.17	16.83
Eske	16.00	6	6	100.00%				0	0	0							0.00	0.00	0.00
Furnace	9.00	8	8	100.00%	7	4	7	269	12	281	87.50%	50.00%	87.50%	38.43	3.00	40.14	33.63	1.50	35.13
Gowla	24.00	5	5	100.00%	3	2	3	104	14	118	60.00%	40.00%	60.00%	34.67	7.00	39.33	20.80	2.80	23.60
Inny	12.00	37	36	97.30%	12	3	15	78	3	210	33.33%	8.33%	41.67%	6.50	1.00	14.00	2.36	0.09	5.83
Invermore	11.00	37	37	100.00%	36	28	36	2324	461	2785	97.30%	75.68%	97.30%	64.56	16.46	77.36	62.81	12.46	75.27
Lackagh	35.00	10	10	100.00%	2	1	2	2	1	3	20.00%	10.00%	20.00%	1.00	1.00	1.50	0.20	0.10	0.30
Oily	3.00	21	21	100.00%	5	1	6	48	3	51	23.81%	4.76%	28.57%	9.60	3.00	8.50	2.29	0.14	2.43
Owenea	60.00	12	12	100.00%	1		1	2	0	2	8.33%		8.33%	2.00		2.00	0.17	0.00	0.17
Owengarve	4.00	34	34	100.00%	5	3	5	36	71	107	14.71%	8.82%	14.71%	7.20	23.67	21.40	1.06	2.09	3.15
Owenmore	40.00	17	14	82.35%				0	0	0							0.00	0.00	0.00
Owenshaugh	3.00	33	33	100.00%	29	8	29	1053	41	1094	87.88%	24.24%	87.88%	36.31	5.13	37.72	31.91	1.24	33.15
Palmerstown	80.00	21	21	100.00%				0	0	0							0.00	0.00	0.00
Roughty	23.00	37	36	97.30%	26	10	29	380	39	454	72.22%	27.78%	80.56%	14.62	3.90	15.66	11.52	1.18	12.61
Screebe		2	1	50.00%	1	1	1	53	86	139	100.00%	100.00%	100.00%	53.00	86.00	139.00	53.00	86.00	139.00
Sneem	7.00	31	30	96.77%	27	11	27	634	30	664	90.00%	36.67%	90.00%	23.48	2.73	24.59	21.13	1.00	22.13
Spiddal	32.00	12	12	100.00%	3	2	3	125	28	153	25.00%	16.67%	25.00%	41.67	14.00	51.00	10.42	2.33	12.75
Stragar	6.00	22	21	95.45%	4		4	14	0	14	19.05%		19.05%	3.50		3.50	0.67	0.00	0.67
Waterville	11.00	24	22	91.67%	11	8	14	65	18	83	50.00%	36.36%	63.64%	5.91	2.25	5.93	2.95	0.82	3.77

Table 4. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1995 and 15 June 1995.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Adrigole	5.00	10	9	90.00%	9	8	9	943	57	1000	100.00%	88.89%	100.00%	104.78	7.13	######	104.78	6.33	111.11
Ardbear	9.00	3	3	100.00%	3	2	3	28	18	46	100.00%	66.67%	100.00%	9.33	9.00	15.33	9.33	6.00	15.33
Argideen	60.00	6	6	100.00%				0	0	0							0.00	0.00	0.00
Ballynahinch		1	1	100.00%	1	1	1	3	48	51	100.00%	100.00%	100.00%	3.00	48.00	51.00	3.00	48.00	51.00
Belclare	20.00	15	13	86.67%	10	8	10	212	80	292	76.92%	61.54%	76.92%	21.20	10.00	29.20	16.31	6.15	22.46
Bride	180.00	8	8	100.00%				0	0	0							0.00	0.00	0.00
Bunowen	8.00	20	13	65.00%	10	10	12	263	69	332	76.92%	76.92%	92.31%	26.30	6.90	27.67	20.23	5.31	25.54
Carna		1	1	100.00%	1		1	5	0	5	100.00%		100.00%	5.00		5.00	5.00	0.00	5.00
Clifden	8.00	15																	
Colligan		2	2	100.00%				0	0	0							0.00	0.00	0.00
Costello		1																	
Crana	6.00	11	5	45.45%	3	1	3	274	1	275	60.00%	20.00%	60.00%	91.33	1.00	91.67	54.80	0.20	55.00
Crumlin	23.00	10	8	80.00%	1	2	3	10	21	31	12.50%	25.00%	37.50%	10.00	10.50	10.33	1.25	2.63	3.88
Culfin	5.00	22	17	77.27%	15	10	15	728	276	1004	88.24%	58.82%	88.24%	48.53	27.60	66.93	42.82	16.24	59.06
Dargle	210.00	5	5	100.00%	2	3	3	6	54	60	40.00%	60.00%	60.00%	3.00	18.00	20.00	1.20	10.80	12.00
Dawros	5.00	44	30	68.18%	27	22	27	510	134	644	90.00%	73.33%	90.00%	18.89	6.09	23.85	17.00	4.47	21.47
Delphi	9.00	110	53	48.18%	42	14	44	3191	255	3446	79.25%	26.42%	83.02%	75.98	18.21	78.32	60.21	4.81	65.02
Drumcliffe		2																	
Eany	2.00	13	12	92.31%	4	9	10	385	91	476	33.33%	75.00%	83.33%	96.25	10.11	47.60	32.08	7.58	39.67
Erriff	15.00	34	19	55.88%	14	11	14	684	56	740	73.68%	57.89%	73.68%	48.86	5.09	52.86	36.00	2.95	38.95
Eske	16.00	13	13	100.00%	10	11	11	267	206	473	76.92%	84.62%	84.62%	26.70	18.73	43.00	20.54	15.85	36.38
Furnace	19.00	4	4	100.00%	2	2	3	39	9	48	50.00%	50.00%	75.00%	19.50	4.50	16.00	9.75	2.25	12.00
Gowla		1																	
Inny	12.00	21	16	76.19%		2	2	0	5	5		12.50%	12.50%		2.50	2.50	0.00	0.31	0.31
Invermore	12.00	37	37	100.00%	31	35	35	242	728	970	83.78%	94.59%	94.59%	7.81	20.80	27.71	6.54	19.68	26.22
Lackagh		1	1	100.00%				0	0	0							0.00	0.00	0.00
Newport	6.00	15	8	53.33%	4	1	4	11	1	12	50.00%	12.50%	50.00%	2.75	1.00	3.00	1.38	0.13	1.50
Owenduff	40.00	14	8	57.14%	6	7	8	26	47	73	75.00%	87.50%	100.00%	4.33	6.71	9.13	3.25	5.88	9.13
Owenea	60.00	9	9	100.00%		1	1	0	1	1		11.11%	11.11%		1.00	1.00	0.00	0.11	0.11
Owengarve	4.00	86	83	96.51%	11	8	11	457	95	552	13.25%	9.64%	13.25%	41.55	11.88	50.18	5.51	1.14	6.65
Owenmore	40.00	27	7	25.93%	3	3	4	4	15	19	42.86%	42.86%	57.14%	1.33	5.00	4.75	0.57	2.14	2.71
Owenshaugh	3.00	18	17	94.44%	16	11	17	369	54	423	94.12%	64.71%	100.00%	23.06	4.91	24.88	21.71	3.18	24.88
Palmerstown	80.00	22	22	100.00%	1		1	2	0	2	4.55%		4.55%	2.00		2.00	0.09	0.00	0.09
Roughty	23.00	17	14	82.35%	5	4	9	16	6	22	35.71%	28.57%	64.29%	3.20	1.50	2.44	1.14	0.43	1.57
Shanganagh		1	1	100.00%				0	0	0							0.00	0.00	0.00
Sneem	7.00	15	15	100.00%	8	4	9	34	4	38	53.33%	26.67%	60.00%	4.25	1.00	4.22	2.27	0.27	2.53
Spiddal	32.00	16	15	93.75%				0	0	0							0.00	0.00	0.00
Stragar	6.00	19	19	100.00%	11	4	11	139	17	156	57.89%	21.05%	57.89%	12.64	4.25	14.18	7.32	0.89	8.21
Tay	209.00	9	9	100.00%	2	2	3	7	3	10	22.22%	22.22%	33.33%	3.50	1.50	3.33	0.78	0.33	1.11
Waterville	11.00	28	26	92.86%	4		4	19	0	19	15.38%		15.38%	4.75		4.75	0.73	0.00	0.73

Table 5. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1996 and 15 June 1996.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Adrigole		1																	
Ardbear	3.00	7	7	100.00%	6		6	301	0	301	85.71%		85.71%	50.17		50.17	43.00	0.00	43.00
Argideen	60.00	6	6	100.00%	1	3	3	2	5	7	16.67%	50.00%	50.00%	2.00	1.67	2.33	0.33	0.83	1.17
Bunowen	8.00	14	6	42.86%	4	3	4	27	47	74	66.67%	50.00%	66.67%	6.75	15.67	18.50	4.50	7.83	12.33
Clifden	2.00	12	11	91.67%	5	2	5	323	4	327	45.45%	18.18%	45.45%	64.60	2.00	65.40	29.36	0.36	29.73
Coomhola	5.00	3																	
Costello	12.00	3	2	66.67%	2	1	2	82	1	83	100.00%	50.00%	100.00%	41.00	1.00	41.50	41.00	0.50	41.50
Crana	6.00	13	10	76.92%	6	2	6	135	2	137	60.00%	20.00%	60.00%	22.50	1.00	22.83	13.50	0.20	13.70
Culfin	5.00	7	4	57.14%	4	2	4	250	37	287	100.00%	50.00%	100.00%	62.50	18.50	71.75	62.50	9.25	71.75
Dargle	210.00	45	44	97.78%	2	2	2	5	43	48	4.55%	4.55%	4.55%	2.50	21.50	24.00	0.11	0.98	1.09
Dawros		2																	
Delphi	9.00	10	6	60.00%	6	2	6	407	24	431	100.00%	33.33%	100.00%	67.83	12.00	71.83	67.83	4.00	71.83
Drumcliffe	60.00	5	4	80.00%	1	2	2	33	10	43	25.00%	50.00%	50.00%	33.00	5.00	21.50	8.25	2.50	10.75
Eany	2.00	39	39	100.00%	9	4	9	254	15	269	23.08%	10.26%	23.08%	28.22	3.75	29.89	6.51	0.38	6.90
Erriff	15.00	13	12	92.31%	12	4	12	1111	31	1142	100.00%	33.33%	100.00%	92.58	7.75	95.17	92.58	2.58	95.17
Eske	16.00	11	10	90.91%	3	2	3	196	4	200	30.00%	20.00%	30.00%	65.33	2.00	66.67	19.60	0.40	20.00
Furnace	9.00	28	27	96.43%	25	17	26	1463	91	1554	92.59%	62.96%	96.30%	58.52	5.35	59.77	54.19	3.37	57.56
Gowla		2																	
Inny	12.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Invermore	9.00	41	39	95.12%	36	29	37	2572	563	3135	92.31%	74.36%	94.87%	71.44	19.41	84.73	65.95	14.44	80.38
Killary	9.00	5	3	60.00%	3	3	3	236	120	356	100.00%	100.00%	100.00%	78.67	40.00	118.67	78.67	40.00	118.67
Lackagh	35.00	19	19	100.00%	11	1	11	28	2	30	57.89%	5.26%	57.89%	2.55	2.00	2.73	1.47	0.11	1.58
Leannan	16.00	38	35	92.11%	27	8	27	427	23	450	77.14%	22.86%	77.14%	15.81	2.88	16.67	12.20	0.66	12.86
Owenduff	40.00	3	3	100.00%	1	2	2	1	19	20	33.33%	66.67%	66.67%	1.00	9.50	10.00	0.33	6.33	6.67
Owenea	60.00	10	10	100.00%				0	0	0							0.00	0.00	0.00
Owengarve	4.00	25	25	100.00%	2	2	2	105	48	153	8.00%	8.00%	8.00%	52.50	24.00	76.50	4.20	1.92	6.12
Owenshaugh	3.00	16	15	93.75%	13	6	13	368	16	384	86.67%	40.00%	86.67%	28.31	2.67	29.54	24.53	1.07	25.60
Palmerstown	80.00	11	11	100.00%				0	0	0							0.00	0.00	0.00
Roughty	23.00	16	16	100.00%	3	1	3	23	1	24	18.75%	6.25%	18.75%	7.67	1.00	8.00	1.44	0.06	1.50
Sneem	7.00	16	16	100.00%	5	2	6	35	5	40	31.25%	12.50%	37.50%	7.00	2.50	6.67	2.19	0.31	2.50

Table 6. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1997 and 15 June 1997.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Ardbear	3.00	6	5	83.33%	4	3	4	148	20	168	80.00%	60.00%	80.00%	37.00	6.67	42.00	29.60	4.00	33.60
Argideen	60.00	40	40	100.00%	4	3	6	7	9	16	10.00%	7.50%	15.00%	1.75	3.00	2.67	0.18	0.23	0.40
Ballynahinch	9.00	21	17	80.95%	14	16	16	616	279	895	82.35%	94.12%	94.12%	44.00	17.44	55.94	36.24	16.41	52.65
Bride		1	1	100.00%				0	0	0							0.00	0.00	0.00
Bunowen		2	1	50.00%				0	0	0							0.00	0.00	0.00
Clifden	2.00	7	7	100.00%	3	1	3	41	36	77	42.86%	14.29%	42.86%	13.67	36.00	25.67	5.86	5.14	11.00
Costello	20.00	18	18	100.00%	12	9	12	557	40	597	66.67%	50.00%	66.67%	46.42	4.44	49.75	30.94	2.22	33.17
Crana	6.00	35	32	91.43%	28	20	28	1174	87	1261	87.50%	62.50%	87.50%	41.93	4.35	45.04	36.69	2.72	39.41
Crumlin	23.00	3	3	100.00%	3	2	3	61	6	67	100.00%	66.67%	100.00%	20.33	3.00	22.33	20.33	2.00	22.33
Culfin	5.00	6	4	66.67%	1	1	1	13	5	18	25.00%	25.00%	25.00%	13.00	5.00	18.00	3.25	1.25	4.50
Dawros	2.00	25	23	92.00%	20	16	21	437	154	591	86.96%	69.57%	91.30%	21.85	9.63	28.14	19.00	6.70	25.70
Drumcliffe	60.00	4	4	100.00%				0	0	0							0.00	0.00	0.00
Eany	2.00	4	4	100.00%	4	2	4	215	39	254	100.00%	50.00%	100.00%	53.75	19.50	63.50	53.75	9.75	63.50
Erriff	15.00	29	28	96.55%	22	18	23	553	50	603	78.57%	64.29%	82.14%	25.14	2.78	26.22	19.75	1.79	21.54
Eske	16.00	65	60	92.31%	35	17	36	672	78	750	58.33%	28.33%	60.00%	19.20	4.59	20.83	11.20	1.30	12.50
Furnace	13.00	50	47	94.00%	33	22	36	3491	60	3551	70.21%	46.81%	76.60%	105.79	2.73	98.64	74.28	1.28	75.55
Gowla	5.00	38	36	94.74%	15	10	15	507	138	645	41.67%	27.78%	41.67%	33.80	13.80	43.00	14.08	3.83	17.92
Illen		1	1	100.00%				0	0	0							0.00	0.00	0.00
Invermore	9.00	33	32	96.97%	27	24	27	2932	487	3419	84.38%	75.00%	84.38%	108.59	20.29	126.63	91.63	15.22	106.84
Lackagh	35.00	12	9	75.00%	1		1	5	0	5	11.11%		11.11%	5.00		5.00	0.56	0.00	0.56
Leannan	16.00	44	26	59.09%	20	4	20	540	9	549	76.92%	15.38%	76.92%	27.00	2.25	27.45	20.77	0.35	21.12
Newport		1	1	100.00%	1	1	1	19	3	22	100.00%	100.00%	100.00%	19.00	3.00	22.00	19.00	3.00	22.00
Owenduff	40.00	11	11	100.00%	1	2	2	2	5	7	9.09%	18.18%	18.18%	2.00	2.50	3.50	0.18	0.45	0.64
Owenea	60.00	20	18	90.00%	2	1	2	11	7	18	11.11%	5.56%	11.11%	5.50	7.00	9.00	0.61	0.39	1.00
Owengarve	4.00	17	17	100.00%	3	3	4	25	12	37	17.65%	17.65%	23.53%	8.33	4.00	9.25	1.47	0.71	2.18
Owenmore	40.00	21	18	85.71%	2	1	3	3	1	4	11.11%	5.56%	16.67%	1.50	1.00	1.33	0.17	0.06	0.22
Owenshaugh	3.00	10	10	100.00%	6	5	7	44	16	60	60.00%	50.00%	70.00%	7.33	3.20	8.57	4.40	1.60	6.00
Palmerstown		1	1	100.00%				0	0	0							0.00	0.00	0.00
Roughty	23.00	13	13	100.00%	2	6	6	4	12	16	15.38%	46.15%	46.15%	2.00	2.00	2.67	0.31	0.92	1.23
Sneem	7.00	8	7	87.50%	4	1	4	8	1	9	57.14%	14.29%	57.14%	2.00	1.00	2.25	1.14	0.14	1.29
Waterville	11.00	51	49	96.08%	15	8	17	112	15	127	30.61%	16.33%	34.69%	7.47	1.88	7.47	2.29	0.31	2.59

Table 7. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1998 and 15 June 1998.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Ardbear	3.00	14	13	92.86%	11	8	12	401	58	459	84.62%	61.54%	92.31%	36.45	7.25	38.25	30.85	4.46	35.31
Argideen	60.00	14	14	100.00%	2	4	4	14	8	22	14.29%	28.57%	28.57%	7.00	2.00	5.50	1.00	0.57	1.57
Ballynahinch	5.00	31	31	100.00%	24	14	24	1345	121	1466	77.42%	45.16%	77.42%	56.04	8.64	61.08	43.39	3.90	54.30
Belclare	20.00	3	3	100.00%	1	1	1	35	12	47	33.33%	33.33%	33.33%	35.00	12.00	47.00	11.67	4.00	15.67
Burrishoole	7.00	15	15	100.00%	15	15	15	475	301	776	100.00%	100.00%	100.00%	31.67	20.07	51.73	31.67	20.07	51.73
Clifden	2.00	9	9	100.00%	4	2	4	42	19	61	44.44%	22.22%	44.44%	10.50	9.50	15.25	4.67	2.11	6.78
Colligan	202.00	11	11	100.00%	4	2	4	22	9	31	36.36%	18.18%	36.36%	5.50	4.50	7.75	2.00	0.82	3.88
Costello	11.00	9	9	100.00%	6	3	6	118	12	130	66.67%	33.33%	66.67%	19.67	4.00	21.67	13.11	1.33	14.44
Crana	6.00	59	59	100.00%	32	24	41	166	44	210	54.24%	40.68%	69.49%	5.19	1.83	5.12	2.81	0.75	3.56
Crumlin		1	1	100.00%				0	0	0							0.00	0.00	0.00
Culfin	5.00	13	13	100.00%	3	1	3	56	23	79	23.08%	7.69%	23.08%	18.67	23.00	26.33	4.31	1.77	6.08
Dawros	21.00	22	20	90.91%	16	13	17	298	53	351	80.00%	65.00%	85.00%	18.63	4.08	20.65	14.90	2.65	17.55
Drumcliffe		1	1	100.00%	1	1	1	16	8	24	100.00%	100.00%	100.00%	16.00	8.00	24.00	16.00	8.00	24.00
Eany	2.00	58	57	98.28%	47	23	49	2001	110	2111	82.46%	40.35%	85.96%	42.57	4.78	43.08	35.11	1.93	37.04
Erriff	15.00	23	19	82.61%	10	7	11	146	63	209	52.63%	36.84%	57.89%	14.60	9.00	19.00	7.68	3.32	11.00
Eske	16.00	45	45	100.00%	28	26	35	545	68	613	62.22%	57.78%	77.78%	19.46	2.62	17.51	12.11	1.51	13.62
Furnace	13.00	40	40	100.00%	36	26	38	1274	196	1470	90.00%	65.00%	95.00%	35.39	7.54	38.68	31.85	4.90	36.75
Glenamoy	40.00	21	20	95.24%	1	2	2	3	2	5	5.00%	10.00%	10.00%	3.00	1.00	2.50	0.15	0.10	0.25
Gowla	5.00	32	20	62.50%	17	12	17	1064	211	1275	85.00%	60.00%	85.00%	62.59	17.58	75.00	53.20	10.55	63.75
Inny	12.00	23	22	95.65%	1		1	23	0	23	4.55%		4.55%	23.00		23.00	1.05	0.00	1.05
Invermore	9.00	36	36	100.00%	32	33	33	1466	927	2393	88.89%	91.67%	91.67%	45.81	28.09	72.52	40.72	25.75	66.47
Lackagh	35.00	28	28	100.00%	10	4	12	19	7	26	35.71%	14.29%	42.86%	1.90	1.75	2.17	0.68	0.25	0.93
Leannan		2	1	50.00%				0	0	0							0.00	0.00	0.00
Newport	6.00	88	86	97.73%	79	58	80	1732	376	2108	91.86%	67.44%	93.02%	21.92	6.48	26.35	20.14	4.37	24.51
Owengarve	4.00	40	27	67.50%	16	15	17	400	167	567	59.26%	55.56%	62.96%	25.00	11.13	33.35	14.81	6.19	21.00
Owenmore	40.00	23	23	100.00%	2	2	3	17	5	22	8.70%	8.70%	13.04%	8.50	2.50	7.33	0.74	0.22	0.96
Palmerstown	80.00	24	24	100.00%				0	0	0							0.00	0.00	0.00
Spiddal		1	1	100.00%	1		1	14	0	14	100.00%		100.00%	14.00		14.00	14.00	0.00	14.00
Tay	209.00	3	3	100.00%				0	0	0							0.00	0.00	0.00
Waterville	11.00	17	17	100.00%				0	0	0							0.00	0.00	0.00

Table 8. Lice (*Lepeophtheirus salmonis*) infestation data for sites sampled between 1 May 1999 and 15 June 1999.

Location	Distance	Fish	Valid	%Val	Count Ch	Count PCh	Count Tot	LC Ch	LC PCh	LC Tot	Pr Ch	Pr PCh	Pr Tot	Int Ch	Int Tot	Int Tot	Ab Ch	Ab PCh	Ab Tot
Adrigole	5.00	9	9	100.00%	9	5	9	423	29	452	100.00%	55.56%	100.00%	47.00	5.80	50.22	47.00	3.22	50.22
Ardbear	3.00	8	8	100.00%	3	3	3	116	18	134	37.50%	37.50%	37.50%	38.67	6.00	44.67	14.50	2.25	16.75
Ballynahinch		1	1	100.00%	1		1	8	0	8	100.00%		100.00%	8.00		8.00	8.00	0.00	8.00
Burrishoole	7.00	21	11	52.38%				0	0	0							0.00	0.00	0.00
Clifden		2	2	100.00%				0	0	0							0.00	0.00	0.00
Colligan	202.00	4	2	50.00%				0	0	0							0.00	0.00	0.00
Costello	12.00	3	3	100.00%	2		2	31	0	31	66.67%		66.67%	15.50		15.50	10.33	0.00	10.33
Crana	6.00	75	66	88.00%	63	61	66	3262	604	3866	95.45%	92.42%	100.00%	51.78	9.90	58.58	49.42	9.15	58.58
Dawros	21.00	13	13	100.00%	5	5	5	151	70	221	38.46%	38.46%	38.46%	30.20	14.00	44.20	11.62	5.38	17.00
Delphi	9.00	6	6	100.00%	6	6	6	394	133	527	100.00%	100.00%	100.00%	65.67	22.17	87.83	65.67	22.17	87.83
Drumcliffe	60.00	16	16	100.00%	7	3	7	102	24	126	43.75%	18.75%	43.75%	14.57	8.00	18.00	6.38	1.50	7.88
Eany	2.00	71	71	100.00%	55	9	55	2919	15	2934	77.46%	12.68%	77.46%	53.07	1.67	53.35	41.11	0.21	41.32
Erriff	15.00	22	22	100.00%	10	6	10	889	40	929	45.45%	27.27%	45.45%	88.90	6.67	92.90	40.41	1.82	42.23
Eske	16.00	28	20	71.43%	16	9	16	595	48	643	80.00%	45.00%	80.00%	37.19	5.33	40.19	29.75	2.40	32.15
Feale		2	2	100.00%				0	0	0							0.00	0.00	0.00
Furnace	13.00	44	43	97.73%	39	25	39	1862	128	1990	90.70%	58.14%	90.70%	47.74	5.12	51.03	43.30	2.98	46.28
Glenamoy	40.00	35	33	94.29%				0	0	0							0.00	0.00	0.00
Gowla	3.00	25	25	100.00%	23	23	24	584	425	1009	92.00%	92.00%	96.00%	25.39	18.48	42.04	23.36	17.00	40.36
Invermore	9.00	68	68	100.00%	62	54	62	2517	1058	3575	91.18%	79.41%	91.18%	40.60	19.59	57.66	37.01	15.56	52.57
Leannan	16.00	11	2	18.18%				0	0	0							0.00	0.00	0.00
Newport	6.00	7	2	28.57%	2	2	2	18	16	34	100.00%	100.00%	100.00%	9.00	8.00	17.00	9.00	8.00	17.00
Owenduff	40.00	55	33	60.00%	4	6	6	30	15	45	12.12%	18.18%	18.18%	7.50	2.50	7.50	0.91	0.45	1.36
Owenea		2																	
Owengarve	4.00	41	15	36.59%				0	0	0							0.00	0.00	0.00
Owenmore	40.00	37	15	40.54%	13	12	14	154	109	263	86.67%	80.00%	93.33%	11.85	9.08	18.79	10.27	7.27	17.53
Owenshaugh	3.00	15	15	100.00%	11	3	11	158	5	163	73.33%	20.00%	73.33%	14.36	1.67	14.82	10.53	0.33	10.87
Palmerstown	80.00	16	16	100.00%				0	0	0							0.00	0.00	0.00
Roughty	23.00	14	14	100.00%	9	6	9	14	22	36	64.29%	42.86%	64.29%	1.56	3.67	4.00	1.00	1.57	2.57
Sneem	7.00	15	15	100.00%	10	2	10	118	7	125	66.67%	13.33%	66.67%	11.80	3.50	12.50	7.87	0.47	8.33

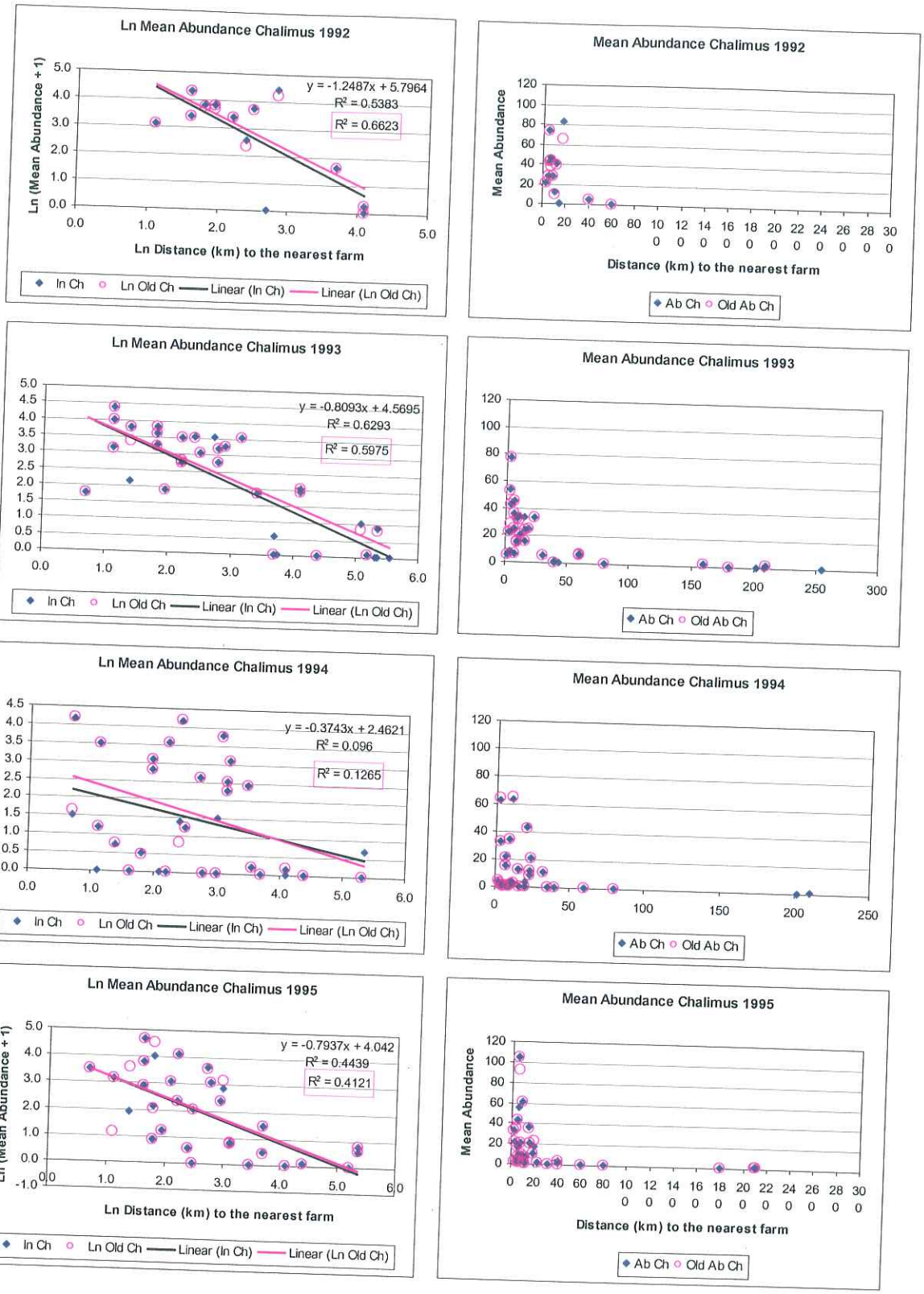


Figure 2. The relationship between lice abundance (chalimus stages) on sea trout and the distance to the nearest farm in 1992-1995. The original dataset ('old') compared with the cleaned dataset (blue), both natural log transformed and untransformed.

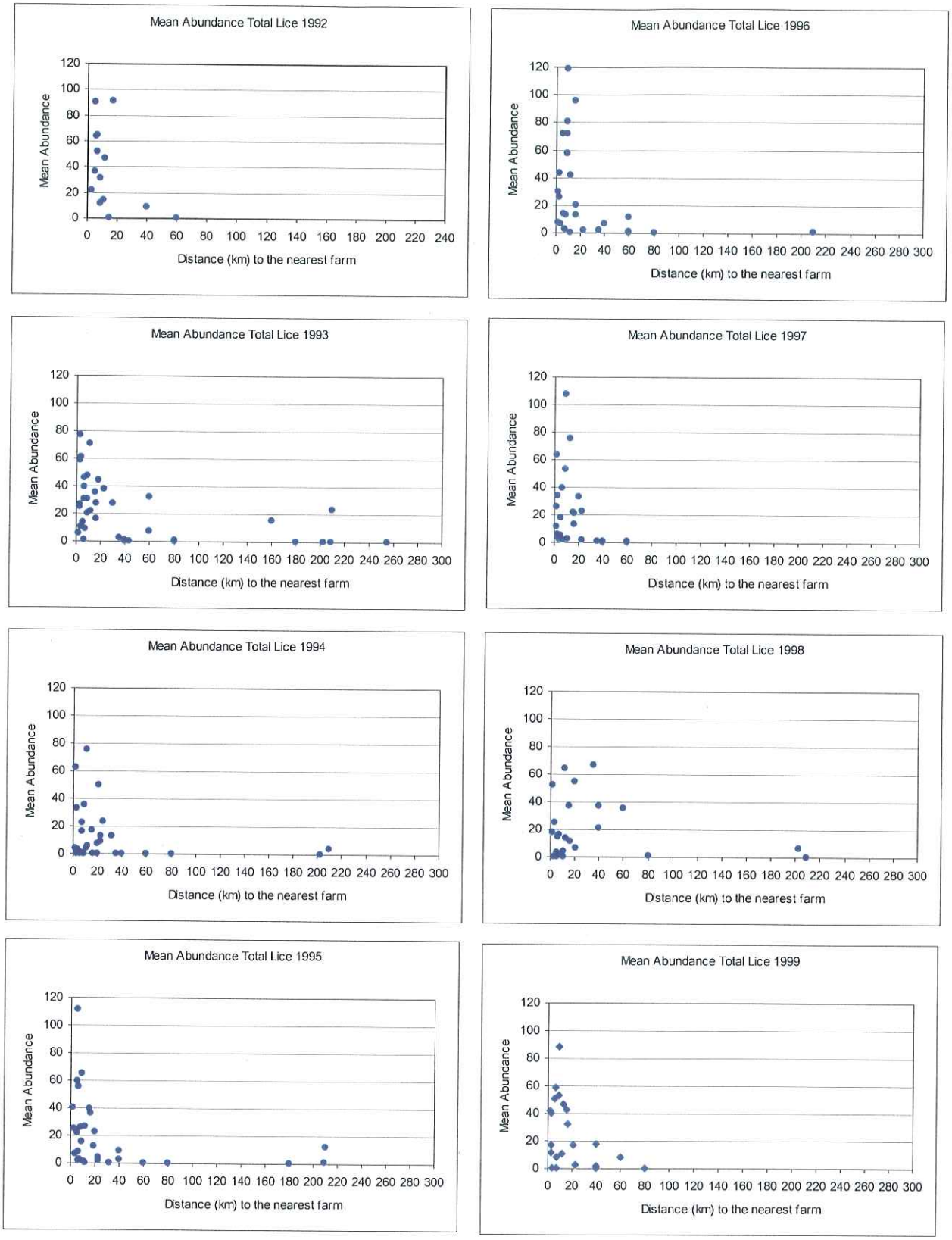


Figure 3. The relationship between total lice abundance (all stages) on sea trout and the distance to the nearest farm in 1992-1999.

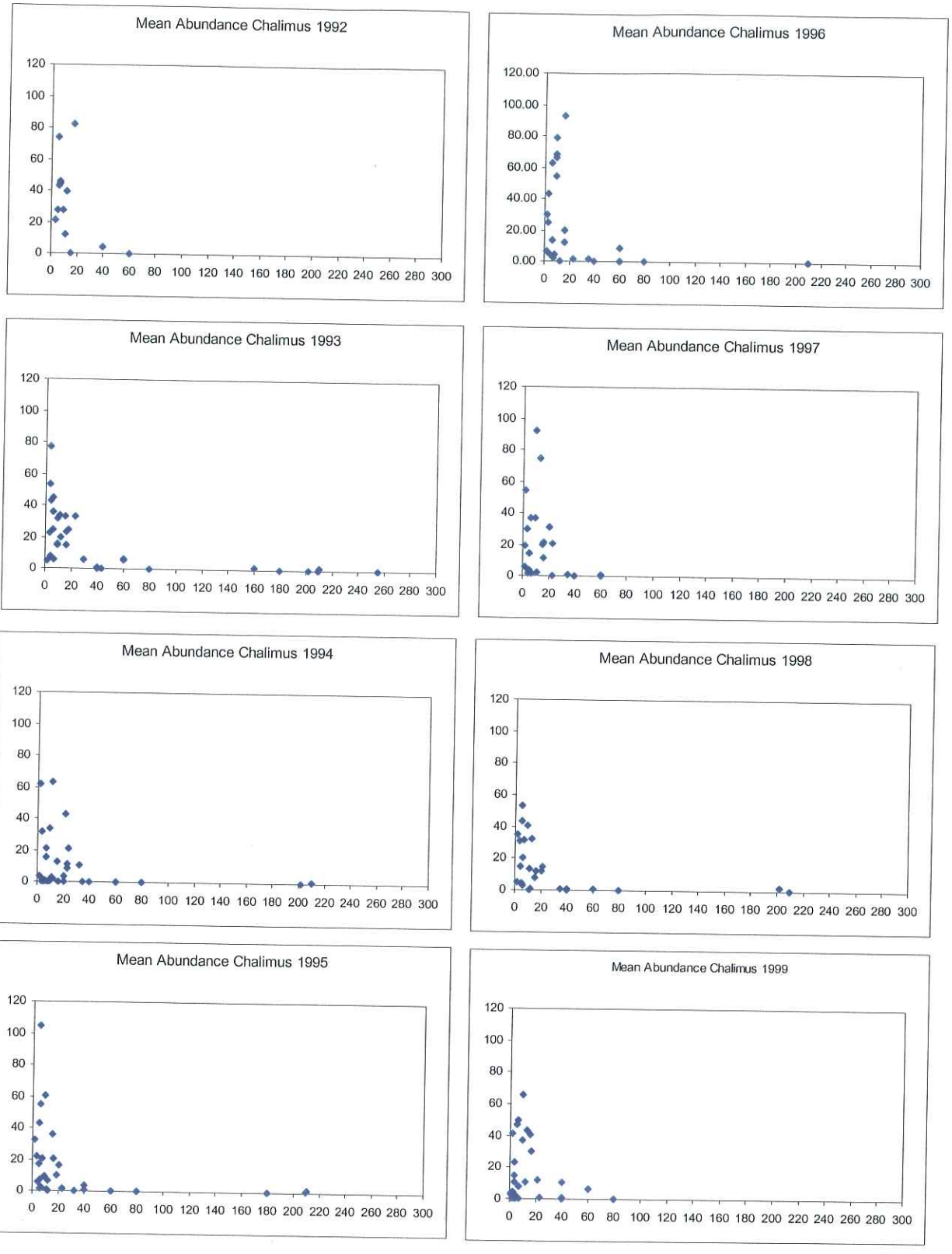
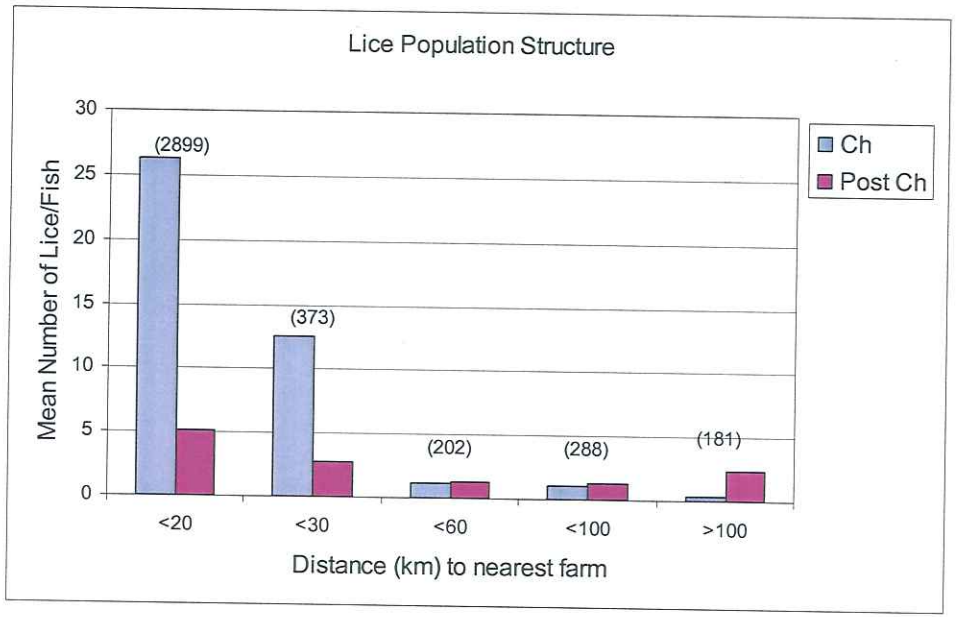


Figure 4. The relationship between lice abundance (chalimus stages) on sea trout and the distance to the nearest farm in 1992-1999.

A



B

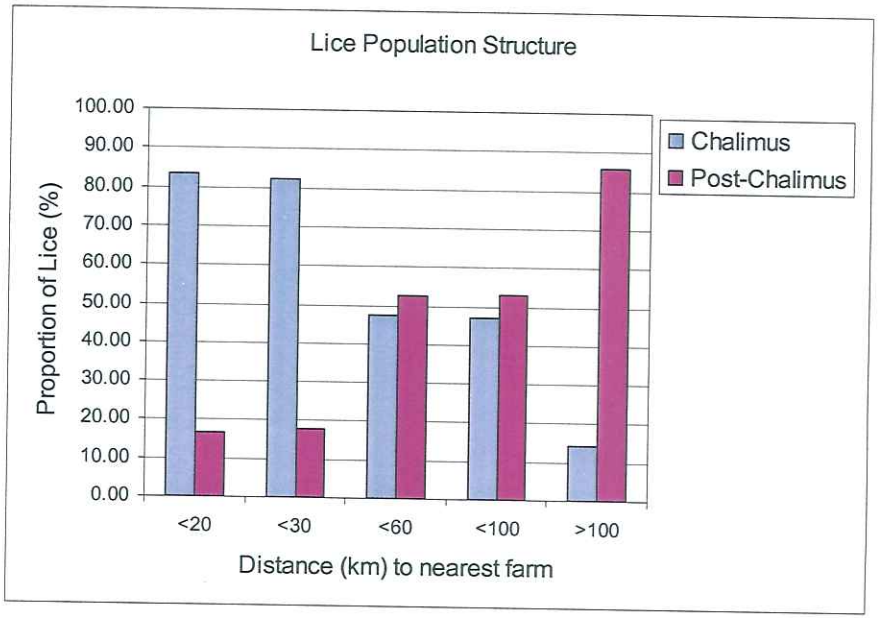


Figure 5A: the mean number of *L. salmonis* juveniles (chalimus) and adults (post-chalimus) infesting sea trout smolts in relation to distance categories to the nearest farm.

Figure 5B: the proportion of chalimus in the lice population infesting sea trout as a function of the distance to the nearest farm.