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National Survey of Sea Lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2013

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INTRODUCTION

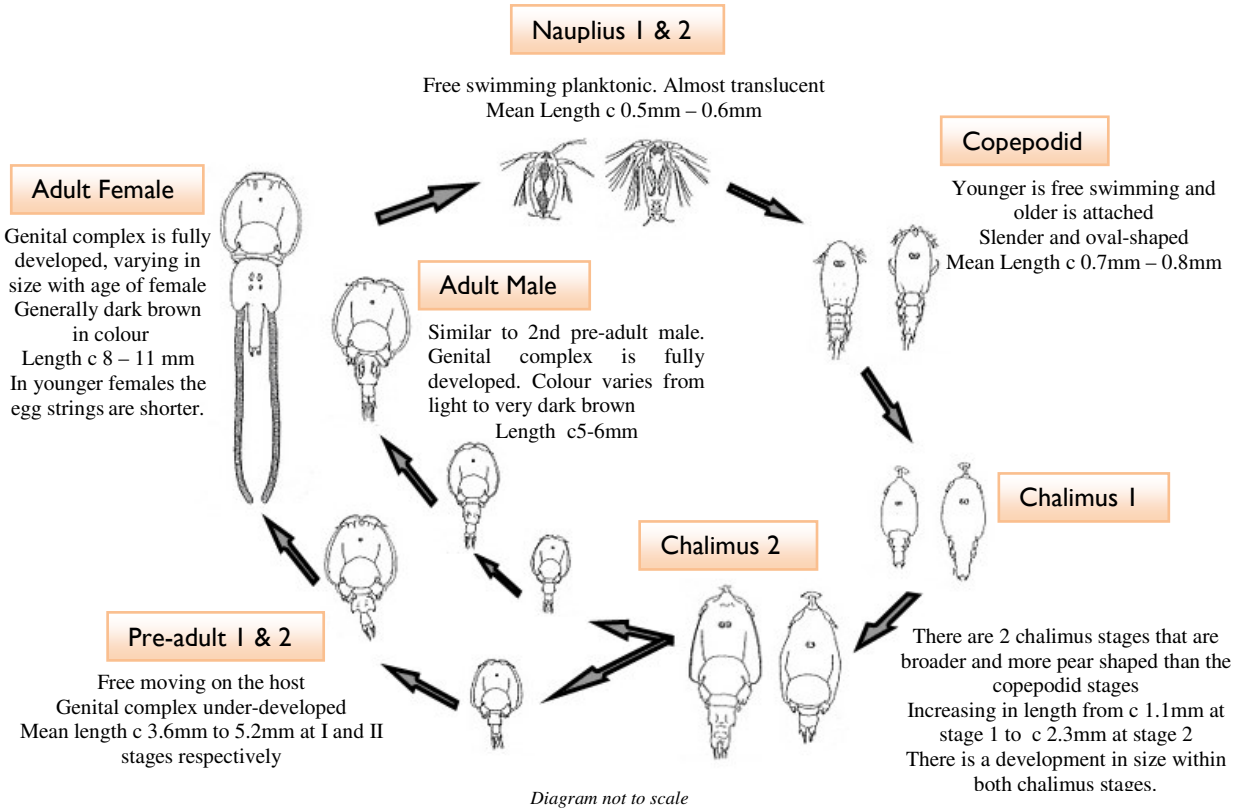
Sea lice are caligid, copepod, marine ectoparasites which occur on many species of fish. There are estimated to be approximately 559 species made up of 37 genera (Ahyong *et al*., 2011), including 162 *Lepeophtheirus* species (Chad & Goeff, 2011) and 268 *Caligus* species (Boxshall 2011). Two main species of sea lice are found in Ireland on wild and cultured salmonids, *Caligus elongatus* Nordmann and *Lepeophtheirus salmonis* Krøyer. *L. salmonis* is the larger, and is regarded as the more damaging parasite of the two species; endemic at a high prevalence (>90%) within wild populations (Jackson *et al.,* 2013a), and occurring frequently on farmed Atlantic salmon and rainbow trout (Jackson and Minchin, 1992; Jackson *et al.,* 2005). *L salmonis* infests only salmonids, while *C elongatus* is known to parasitise over 80 different species of marine fish.

Sea lice infestation as a source of marine mortality of outwardly migrating ranched Atlantic salmon smolts has been investigated in long term studies in Ireland (Jackson *et al*., 2013b) and Norway (Skilbrei *et al.,* 2013) with both studies generating similar results. In Ireland marine mortality data on 352,142 migrating salmon from twenty-eight releases, at eight locations along Ireland's south and west coasts covering a 9-year period (2001 to 2009) was reviewed. The results though significant suggest that sea lice infestation is a minor and irregular source of marine mortality in the stocks studied indicating it is unlikely to be a significant factor influencing conservation status of stocks of wild salmon in Ireland. Full details of the study and data are set out in *Irish Fisheries Bulletin No. 43* (Jackson *et al*., 2013c).

To date the lifecycle of *L. salmonis* has been described by Johnson & Albright (1991) and Schram (1993) as comprising 10 stages. Recent research from Hamre *et al.* (2013) indicates there are only 8 stages, with no proper moult between the chalimus I and chalimus II stages and similarly none between chalimus III and chalimus stages IV. The lifecycle thus comprises of nauplius 1 and 2, copepodid, chalimus 1 and 2, preadult 1 and 2 and the adult stages. The nauplius 1 stage hatches from paired egg-strings and is dispersed in the plankton. It moults to nauplius 2, also planktonic, which is followed by a copepodid, the infective stage where attachment to the host takes place. The copepodid then moults through the attached chalimus stages before becoming a mobile pre-adult. There are two pre-adult stages before maturing to the adult phase. The adult female can produce a number of batches of paired egg-strings, which in turn hatch into the water column to give rise to the next generation (Kabata, 1979; Schram, 1993). *L. salmonis* has a single host in its

lifecycle. The mean length for an adult female is 8mm-11mm and an adult male is 5mm-6mm (Schram, 1993).

Figure 1. Life cycle of *Lepeophtheirus salmonis* (after Schram, 1993)



The fact that *C. elongatus* is not as host specific as *L. salmonis* (Kabata, 1979) and that the hosts migrate widely is thought to account for the highly variable levels on farmed salmonids at different times of the year. *C. elongatus* is smaller in size than *L. salmonis* averaging approximately 6-8mm in length (Hogans & Trudeau, 1989).

In 1991, the Department of the Marine instigated a Sea Lice Monitoring Programme for finfish farms in Ireland (Jackson & Minchin, 1993) and in 1993 monitoring was expanded nationwide (Jackson *et al.*, 2002; Jackson *et al.*, 2005). In May 2000 the protocol for sea lice monitoring was formally published (*Monitoring Protocol No.3 for Offshore Finfish Farms – Sea Lice Monitoring and Control*) by the Department of Marine and Natural Resources.

In 2008, the Department of Agriculture, Fisheries and Food (DAFF) published "*A strategy for the improved pest control on Irish salmon farms*". The strategy outlines a comprehensive range of measures to provide for enhanced sea lice control and was developed by a joint DAFF, Marine Institute and Bord Iascaigh Mhara workgroup in response to difficulties experienced by farms in achieving the low levels of infestation required by the national

control programme. These measures draw on the on-going Single Bay Management process and, through a comprehensive action plan and list of recommendations, seek to advance the suite of tools necessary for improved sea lice control on farms.

The objectives of the National Sea Lice Monitoring Programme are:

- To provide an objective measurement of infestation levels on farms.
- To investigate the nature of infestations.
- To provide management information to drive the implementation of control and management strategies.
- To facilitate further development and refinement of this strategy.

The sea lice control and management strategy has five principal components:

- Separation of generations.
- Annual fallowing of sites.
- Early harvest of two-sea-winter fish.
- Targeted treatment regimes, including synchronous treatments.
- Agreed husbandry practises.

These components combine to reduce the development of sea lice infestations and to ensure the most effective treatment of sea lice. They seek to minimise sea lice levels whilst minimising reliance on, and reducing the use of, veterinary medicines. Separation of generations and annual fallowing prevent the vertical transmission of infestations from one generation to the next. The early harvest of two-sea-winter fish removes a potential reservoir of sea lice, while the agreed husbandry practises and targeted treatments enhance the efficacy of treatment regimes. One important aspect of targeted treatments is carrying out of synchronized autumn/winter treatments to reduce sea lice burdens to as close to zero as practicable, on all fish which are to be over-wintered. This is fundamental to achieving near zero egg-bearing sea lice in spring. The agreed husbandry practises cover a range of related fish health, quality and environmental issues in addition to those specifically related to sea lice control. The Single Bay Management Programme serves to facilitate this and provides a forum for exchange of information between farmers.

In late winter and early spring seawater temperatures are at a minimum and the development rate of sea lice is slower. Rising water temperatures in spring tend to synchronise the development of sea lice larvae. A strategic treatment at this time can break the cycle of infection. Ovigerous female sea lice are those which produce the infective larvae and treatments are timed to remove adult females before they can release larvae. Setting the treatment trigger at 0.5 ovigerous *L. salmonis* per fish in spring ensures that treatments are carried out when a maximum of half of the fish examined have one

ovigerous sea lice. This is an optimum time to interrupt sea lice development. Later in the year, the development of new generations are not as synchronised and automatic intervention at a sea lice level of 0.5 ovigerous by way of treatment is not justified. A level of 2.0 ovigerous sea lice per fish has been shown to be a pragmatic level at which intervention by way of treatment is advisable. Levels of mobile and juvenile sea lice are important in advising fish health professionals in developing a sea lice control strategy. However, they are not of themselves appropriate measures upon which to trigger mandatory treatments.

Results of the monitoring programme are sent to the relevant farm within 5-10 days of each inspection. A monthly report of results is circulated to relevant parties and the data is published annually (Copley *et al.*, 2001; McCarney *et al.*, 2002; O'Donohoe *et al.*, 2003-2013).

Table 1 shows a list of the animal medicines and other remedies available to assist in the control of sea lice in Ireland.

Table 1. *Treatments available to assist in the control of sea lice on Atlantic salmon in Ireland.*

Compound	*Trade Name*	*Licensing status*	*Delivery Method*	*Group*	*Mode of action*	*Stages targeted*	*Withdrawal period*
Animal medicines							
Cypermethrin	Excis® (product is not available)	Full MA	Bath	Pyrethroid	Interferes with nerve transmission by blocking sodium channels in nerve cells	Adults, Preadults, Chalimus III-IV	10 degree-days
Deltamethrin	AMX® Alpha Max®	Full MA	Bath	Pyrethroid	Interferes with nerve transmission by blocking sodium channels in nerve cells	Adults, Preadults. Chalimus unknown	5 degree-days
Emamectin benzoate	Slice®	Full MA	In-feed	Avermectin	Interferes with neurotranmission disrupting nerve cells causing paralysis and death. Effective at 3-15℃. Protects fish for up to 11 weeks post treatment.	All stages	Zero
Hydrogen peroxide	Paramove 50®	Full MA	Bath	Oxidizer	Gas embolism	Adults, Preadults	Zero
Teflubenzuron	Calicide®	Full MA	In-feed	Insect Growth Regulator	Inhibits chitin synthesis preventing moulting and growth. Limited efficacy beyond medication period. Not authorized for use below 9℃	Moulting stages - Chalimus, Preadults only	45 degree-days
Others							
Wrasse			In cage		Cleaner fish	Adults, Preadults	

MA - marketing authorisation from the Irish Medicines Board.

METHODOLOGY

Farmed stocks of Atlantic salmon and trout in Ireland are inspected on 14 occasions throughout the year to monitor sea lice levels. Follow-up inspections may be carried out when it is deemed appropriate. Sea lice inspections take place twice per month in March, April and May (the Spring period) and then monthly for the remainder of the year. December and January are combined and only one inspection is carried out.

At each inspection two samples are taken for each generation of fish on site, a sample from a Standard cage, which is sampled at each subsequent inspection, and a sample from a Random cage, which is selected on the day of the inspection. Thirty fish are examined for each sample by anaesthetising using tricaine methane sulphonate (MS222) in seawater. The seawater is sieved for any detached lice at the end of each sample. Each fish is examined individually for all mobile lice. Lice are removed and preserved in 70% ethanol. In the laboratory the species, quantity and life-stage of the sea lice are determined and recorded. The mean number of sea lice per fish is calculated (including the number of detached sea lice from the sieved seawater). Results presented are mean ovigerous sea lice levels and mean total mobile sea lice levels for *L. salmonis* and *C. elongatus* per fish.

Ovigerous sea lice levels estimate the breeding female population and Total mobile levels estimate successful infestation levels. The information gathered aims to evaluate the level of sea lice on the fish and to inform the farmer on a sea lice management strategy. Effective parasite control is characterised by a drop in sea lice levels on the subsequent inspection.

In 2013, salmonid farms were producing 5 different stocks of fish, namely: 2011 Atlantic salmon, *Salmo salar* L. (two-sea-winter salmon), 2012 Atlantic salmon (one-sea-winter salmon); 2013 Atlantic salmon (smolts); 2012 rainbow trout, *Oncorhynchus mykiss* Walbaum (rainbow trout first inspected in 2012); and 2013 rainbow trout (rainbow trout first inspected in 2013);

There are three distinct regions in Ireland where salmonid farming is carried out; the Southwest (Counties Cork and Kerry), the West (Counties Mayo and Galway) and the Northwest (Co. Donegal). These regions are geographically separate from each other with distances between regions of *c.*160 km from Northwest to West and *c.*200 km from West to Southwest. In 2013 a total number of 24 sites were inspected around Ireland, see Figure 2.

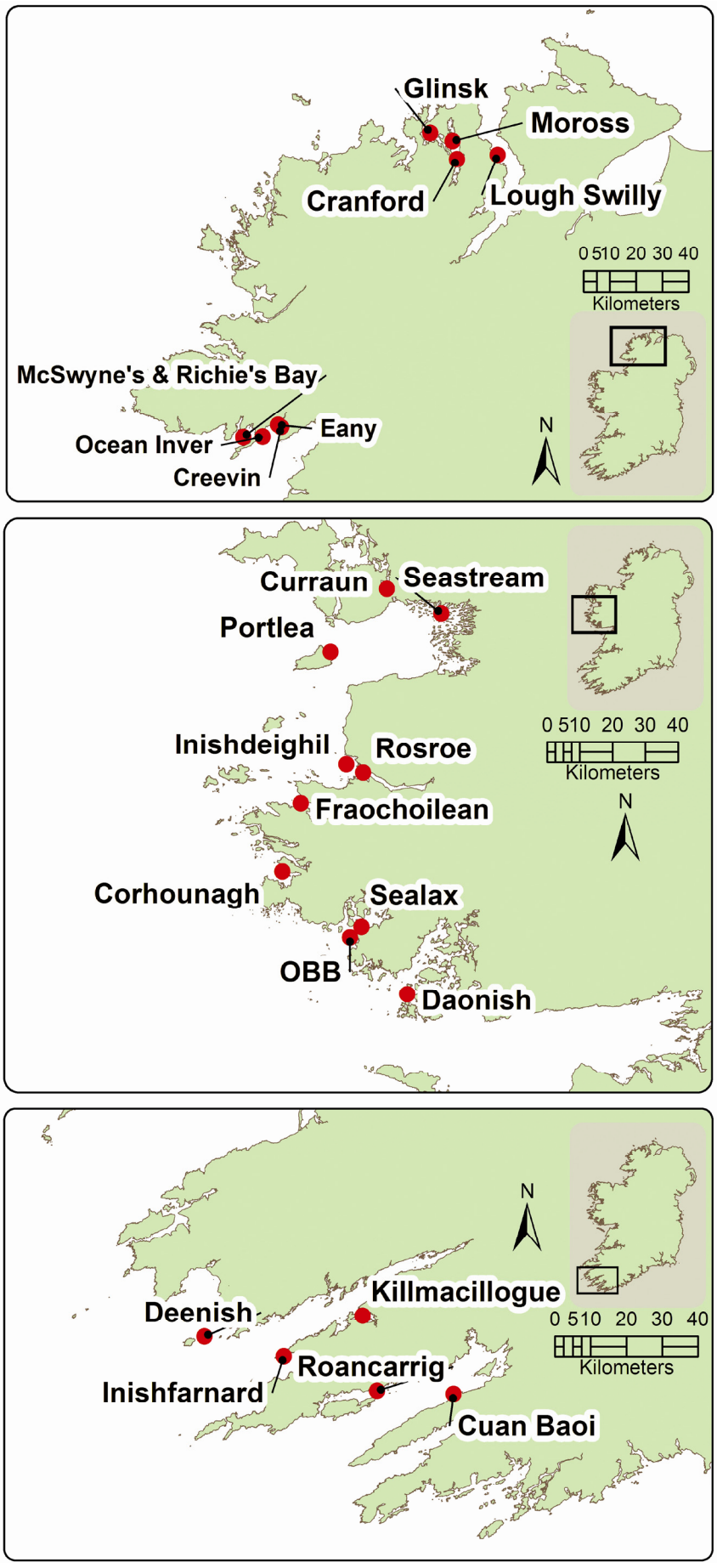


Figure 2. Locations of fish farm sites.

RESULTS

During 2013 a total of 238 sea lice inspections were carried out on the 24 active salmonid sites. Over 91% of Atlantic salmon samples and all of rainbow trout samples were below the Treatment Trigger Levels (TTL) as outlined in the Monitoring Protocol No.3 for Offshore Finfish Farms – Sea Lice Monitoring and Control, Department of Marine and Natural Resources (2000). All of the 109 inspections carried out on salmon smolts were below the TTL, 82% of the 102 inspections carried out on one-sea-winter salmon were below TTL and the one inspection to two-sea-winter salmon was above TTL.

Results of 2013 sea lice inspections for all active salmonid sites for each month are presented in Appendix 1.

Atlantic salmon 2011 (two-sea-winter salmon)

At the beginning of 2012, two-sea-winter salmon were stocked in 1 site: Portlea, Clew Bay. Table 2 contains the number of inspections and number of inspections exceeding the treatment trigger levels.

Table 2. *National breakdown of inspections for 2011 salmon on fish farm sites in 2013.*

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Clare Island seafarms Ltd	**Portlea**	0	0	1	1	1	1	0%	100%	100%
West		0	0	1	1	1	1	0%	100%	100%
National Totals		0	0	1	1	1	1	0%	100%	100%

Atlantic salmon 2012 (one-sea-winter salmon)

One-sea-winter salmon were stocked in a total of 14 sites in 8 bays in 2013. One hundred and two visits were undertaken to this generation of fish. No site continued to stock one-sea-winter salmon at the end of 2013.

Ovigerous *L. salmonis* levels greater than the TTL were recorded in a total of 18 inspections (18%) on one-sea-winter fish (Table 3). Within the critical spring period sea lice levels were in excess of 0.5 ovigerous females per fish on 5 inspections (9%) and outside of the spring period 13 inspections (28%) were in excess of 2.0 ovigerous female *L. salmonis* per fish.

Table 3. *National breakdown of inspections for 2012 salmon on all fish farm sites in 2013.*

	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
National Totals	56	5	46	13	102	18	9%	28%	18%

C. elongatus levels were recorded at numbers greater than 10 individuals per fish on 14 inspections to these fish, mainly in the southwest, throughout the year.

Southwest Region

In the Southwest there were no recorded instances of *L. salmonis* levels greater than the treatment trigger levels (Table 4).

Table 4. *Breakdown of inspections for 2012 salmon for Southwest sites in 2013.*

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Murphy's Irish Seafood Ltd	**Cuan Baoi**	6	0	4	0	10	0	0%	0%	0%
Marine Harvest Ireland	**Roancarraig**	6	0	3	0	9	0	0%	0%	0%
	Inishfarnard	6	0	5	0	11	0	0%	0%	0%
	Deenish	0	0	2	0	2	0	0%	0%	0%
Southwest	**Totals**	18	0	14	0	32	0	0%	0%	0%

West Region

In the West, *L. salmonis* infestation levels greater than the treatment trigger were recorded on 4 out of 18 inspections (22%) in the spring period and on 8 out of 17 inspections (47%) outside the spring period (Table 5).

Table 5. *Breakdown of inspections for 2012 salmon on West sites in 2013.*

Company		Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Comhlucht Bradain Chonamara Teo	**Sealax**	0	0	2	0	2	0	0%	0%	0%
Mannin Bay Salmon Co Ltd	**Corhounagh**	6	0	2	1	8	1	0%	50%	13%
Rosroe Salmon Ltd	**Inishdeighil**	0	0	1	0	1	0	0%	0%	0%
	Rosroe	6	1	6	4	12	5	17%	67%	42%
Clare Island Seafarms Ltd	**Seastream Inner**	6	3	6	3	12	6	50%	50%	50%
West	**Totals**	18	4	17	8	35	12	22%	47%	34%

At Seastream Inner, Clew Bay, *L. salmonis* exceeded treatment trigger levels for 3 of the 6 inspections in the spring and also 3 of the 6 inspections outside the spring period. Levels at Rosroe, Killary Harbour, were above treatment trigger levels for 1 of the 6 inspections in the spring and 4 of the 6 inspections outside the spring.

Northwest Region

The treatment trigger levels were exceeded on 1 of the 20 inspections in the spring and 5 of the 15 inspections outside the spring period in the Northwest (Table 6).

Table 6. *Breakdown of inspections for 2012 salmon on Northwest sites in 2013.*

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Ocean Farm Ltd.	**OceanInver**	6	0	3	0	9	0	0%	0%	0%
	Richie's Bay	3	0	3	0	6	0	0%	0%	0%
Marine Harvest Ireland	**Cranford A**	0	0	1	1	1	1	0%	100%	100%
	Moross 1	5	1	1	0	6	1	20%	0%	17%
	Glinsk	6	0	7	4	13	4	0%	57%	31%
Northwest	**Totals**	20	1	15	5	35	6	5%	33%	17%

Glinsk, Mulroy Bay, exceeded treatment trigger levels on none of the 6 spring inspections, but on 4 of the 7 inspections outside the spring period.

Atlantic salmon 2013 (smolts)

A total of 109 inspections were made to 12 sites stocking Atlantic salmon 2013 S1 and S½ smolts during the year 2013. *L. salmonis* levels were below the TTL of 0.5 ovigerous female lice per fish for all of the 41 inspections in the spring period and also for all of the 68 samples outside of this period (Table 7).

Table 7. *National breakdown of inspections for 2013 salmon on fish farm sites in 2013.*

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Murphy's Irish Seafood Ltd	**Cuan Baoi**	0	0	6	0	6	0	0%	0%	0%
	Killmacillogue	6	0	1	0	7	0	0%	0%	0%
Marine Harvest Ireland	**Roancarraig**	6	0	8	0	14	0	0%	0%	0%
	Deenish	0	0	6	0	6	0	0%	0%	0%
Southwest	**Totals**	12	0	21	0	33	0	0%	0%	0%
Bradan Beo Teo	**Daonish**	6	0	8	0	14	0	0%	0%	0%
Comhlucht Bradain Chonamara Teo	**OBB**	0	0	3	0	3	0	0%	0%	0%
	Sealax	3	0	3	0	6	0	0%	0%	0%
Bifand Ltd	**Fraochoilean**	6	0	8	0	14	0	0%	0%	0%
Clare Island Seafarms Ltd	**Portlea**	2	0	6	0	8	0	0%	0%	0%
West	**Totals**	17	0	28	0	45	0	0%	0%	0%
Ocean Farm Ltd.	**Mc Swyne's**	2	0	6	0	8	0	0%	0%	0%
Marine Harvest	**Creevin**	4	0	6	0	10	0	0%	0%	0%
	Eany	6	0	7	0	13	0	0%	0%	0%
Northwest	**Totals**	12	0	19	0	31	0	0%	0%	0%
National Totals		41	0	68	0	109	0	0%	0%	0%

C. elongatus levels were greater than 10 individuals per fish on 3 occasions in July on these fish.

Rainbow trout

In 2013 there was 2 year-classes of rainbow trout, 2012 and 2013 rainbow trout, stocked between 2 sites, in 2 bays (Table 8). There were 15 inspections carried out on 2012 rainbow trout, none of which exceeded treatment trigger levels. A total of 11 inspections were carried out on the 2013 rainbow trout stock and again no inspection exceeded treatment trigger levels.

Table 8. *National breakdown of inspections for Rainbow Trout on fish farm sites in 2013.*

Rainbow Trout 2012 stocked in 2013

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Curraun Blue Ltd	**Curraun**	6	0	2	0	8	0	0%	0%	0%
West		6	0	2	0	8	0	0%	0%	0%
Eany Fish Products Ltd	**Eany**	5	0	2	0	7	0	0%	0%	0%
Northwest	**Totals**	5	0	2	0	7	0	0%	0%	0%
National Totals		11	0	4	0	15	0	0%	0%	0%

Rainbow Trout 2013 stocked in 2013

Company	Site	Samples in Spring	Over in Spring	Samples outside Spring	Over outside Spring	Total Samples	Total Over	% over in Spring	% over outside Spring	% over total
Curraun Blue Ltd	**Curraun**	6	0	5	0	11	0	0%	0%	0%
West		6	0	5	0	11	0	0%	0%	0%
National Totals		6	0	5	0	11	0	0%	0%	0%

Sampling record

All samples were obtained during the 2013 sampling year.

One-sea-winter salmon monthly trend by Bay

Mean ovigerous and mean mobile *L. salmonis* and *C. elongatus* levels for each bay are shown in Table 9 for one-sea-winter salmon throughout the year. Monthly ovigerous *L. salmonis* levels were greater than the spring TTL of 0.5 ovigerous sea lice per fish on 2 of the 21 occasions during the spring period on a bay basis. On 13 out of 41 inspections, outside of the spring period, mean ovigerous levels of 2.0 ovigerous females per fish or greater were recorded. These occurred in Mulroy Bay (5 occasions), Killary Harbour (4 occasions), Clew Bay (3 occasions) and Mannin Bay (1 occasion).

Mean mobile levels per bay in excess of 10 *L. salmonis* per fish were recorded on 12 occasions and 7 of these instances had means of greater than 20 mobile lice per fish. The maximum level recorded was 84.02 mobile sea lice per fish.

Table 9. Mean ovigerous and mean mobile *Lepeophtheirus salmonis* and *Caligus elongatus* levels per month, for one-sea-winter salmon, for each bay inspected in the year 2013.

Mean ovigerous *L. salmonis*

	Dec/Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Bantry Bay	0.01	0.04	0.00	0.03	0.08	0.00	0.33	HO			
Kenmare Bay	0.00	0.34	0.01	0.00	0.02	0.02	0.03	0.26	0.23	0.23	HO
Bertraghboy Bay	0.32	0.43	HO								
Mannin Bay			0.09	0.08	0.19	0.64	3.25	HO			
Killary Harbour	0.10	0.06	0.08	0.42	0.18	0.68	4.75	4.32	7.81	10.65	HO
Clew Bay	1.05	0.66	0.24	0.53	0.63	0.13	10.67	18.02	24.56	HO	
Donegal Bay	0.61	0.10	0.01	0.03	0.09	0.41	0.13	0.60	1.80	HO	
Mulroy Bay	4.71	1.50	0.31	0.21	0.16	0.28	3.88	13.74	11.02	7.69	HO

Mean mobile *L. salmonis*

	Dec/Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Bantry Bay	0.04	0.09	0.09	0.13	0.31	0.15	0.42	HO			
Kenmare Bay	0.17	2.18	0.02	0.02	0.18	0.28	0.16	0.58	0.48	1.80	HO
Bertraghboy Bay	1.62	1.07	HO								
Mannin Bay			0.66	0.70	0.97	3.65	6.04	HO			
Killary Harbour	0.35	0.08	1.11	0.94	0.97	4.52	16.66	15.80	14.05	20.53	HO
Clew Bay	2.52	2.07	1.37	2.98	1.34	0.77	22.05	39.30	53.01	HO	
Donegal Bay	1.79	0.21	0.03	0.13	0.44	1.28	0.88	1.27	5.80	HO	
Mulroy Bay	19.97	7.06	1.72	0.94	1.84	1.86	14.14	76.81	74.60	84.02	HO

Mean ovigerous *C. elongatus*

	Dec/Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Bantry Bay	0.56	3.60	6.23	4.27	5.24	2.58	1.42	HO			
Kenmare Bay	0.25	1.17	0.00	0.36	5.16	7.83	1.13	0.74	0.68	4.60	HO
Bertraghboy Bay	2.68	1.07	HO								
Mannin Bay			0.20	0.11	0.12	0.23	0.00	HO			
Killary Harbour	0.44	0.08	0.65	0.19	0.04	0.11	0.00	0.00	0.00	0.42	HO
Clew Bay	0.04	0.08	0.01	0.00	0.00	0.00	1.41	1.24	0.68	HO	
Donegal Bay	0.32	0.00	0.26	1.01	11.50	31.59	0.88	0.93	1.30	HO	
Mulroy Bay	0.00	0.01	0.01	0.04	0.06	0.10	0.51	0.13	0.02	0.20	HO

Mean mobile *C. elongatus*

	Dec/Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Bantry Bay	1.55	8.43	16.17	9.11	18.59	5.05	7.00	HO			
Kenmare Bay	0.67	2.32	0.05	1.40	12.46	21.24	2.91	1.52	1.14	10.37	HO
Bertraghboy Bay	3.75	1.54	HO								
Mannin Bay			0.42	0.37	0.26	0.41	0.00	HO			
Killary Harbour	0.76	0.19	1.20	0.38	0.09	0.19	0.00	0.00	0.00	0.65	HO
Clew Bay	0.04	0.08	0.02	0.07	0.00	0.00	1.96	1.48	1.11	HO	
Donegal Bay	0.61	0.02	0.57	2.97	18.78	51.00	2.13	1.33	1.50	HO	
Mulroy Bay	0.02	0.02	0.01	0.06	0.11	0.18	1.03	0.21	0.04	0.56	HO

HO = Harvested out TO =Transferred out

Regional monthly means for one-sea-winter salmon

L. salmonis ovigerous and mobile monthly mean data for one-sea-winter salmon regionally are shown in Figures 3 and 4. In the spring period of 2013 the ovigerous mean levels did not reach TTL at all in the any of the regions.

Outside the spring regional mean ovigerous *L. salmonis* levels were in excess of TTL in January and from July to harvest in November in the Northwest and also from July to November in the West.

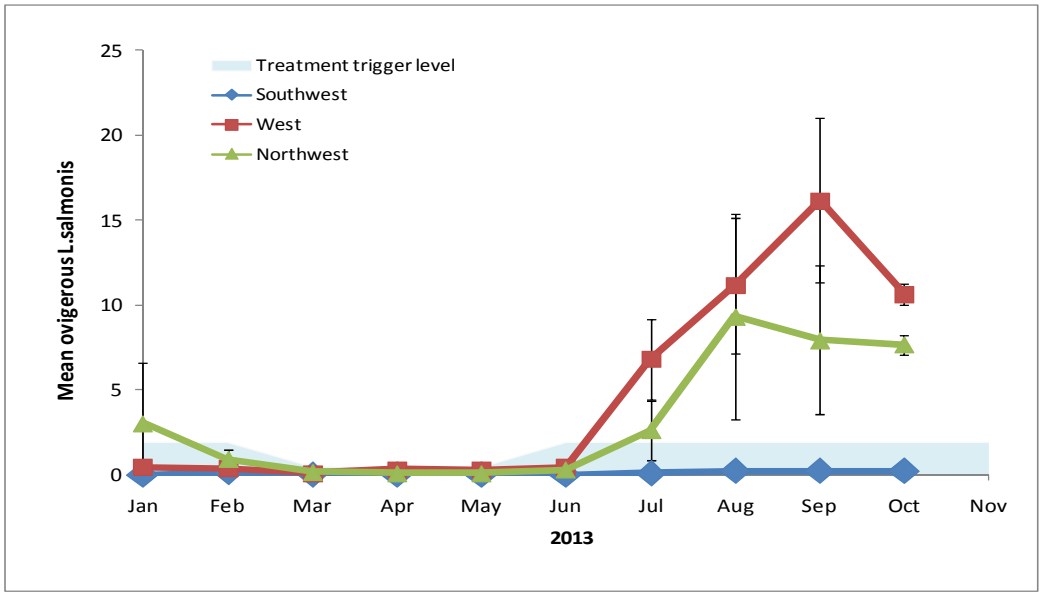


Figure 3. Mean (SE) ovigerous *L. salmonis* per month per region in 2013 on one-sea-winter fish.

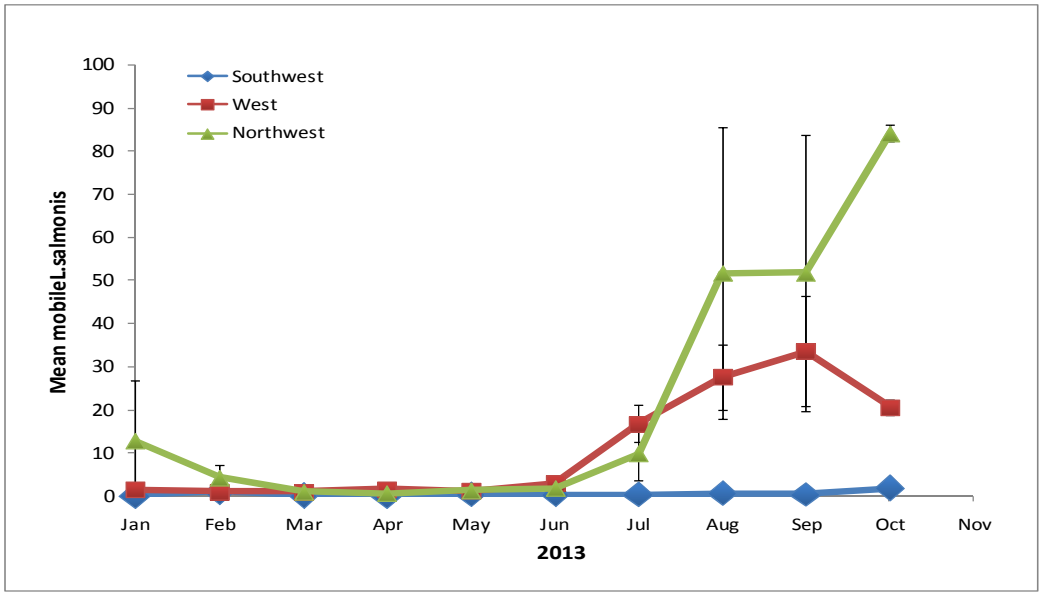


Figure 4. Mean (SE) mobile *L. salmonis* per month per region in 2013 on one-sea-winter fish.

Total mobile *L. salmonis* levels exceeded 10 sea lice per fish in January, August, September and October in the Northwest and in July, August, September and October in the West. Total regional mean mobile *L. salmonis* levels peaked at 1.80 mobile sea lice per fish in the Southwest, 33.53 mobile sea lice per fish in the West and at 84.02 mobile sea lice per fish in October in the Northwest.

Annual trends

The annual trends of *L. salmonis* ovigerous and mobile sea lice levels are compared in Figures 5 and 6 for one-sea-winter salmon in the month of May from 1991 to 2013.

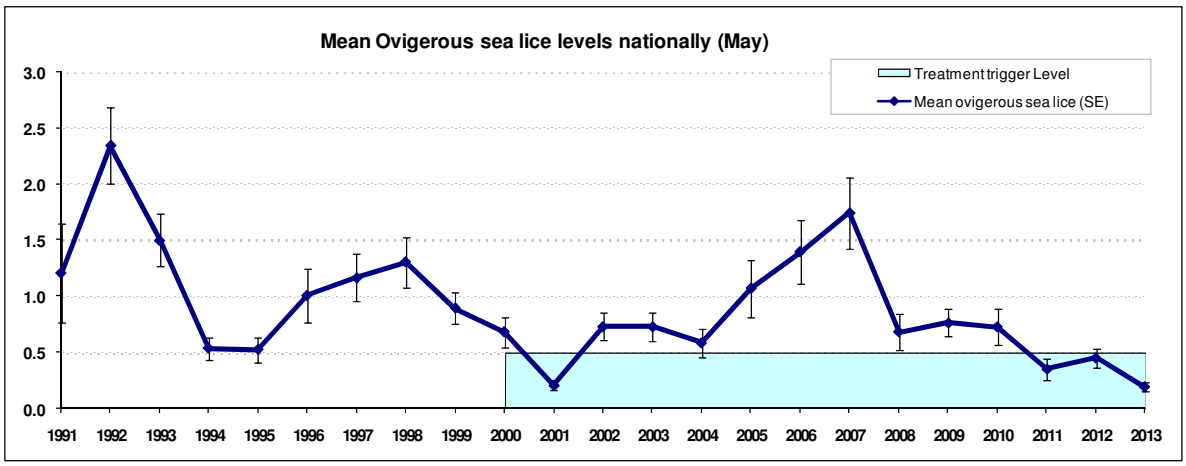


Figure 5. Annual trend (May mean) (SE) ovigerous *L. salmonis* on one-sea-winter salmon.

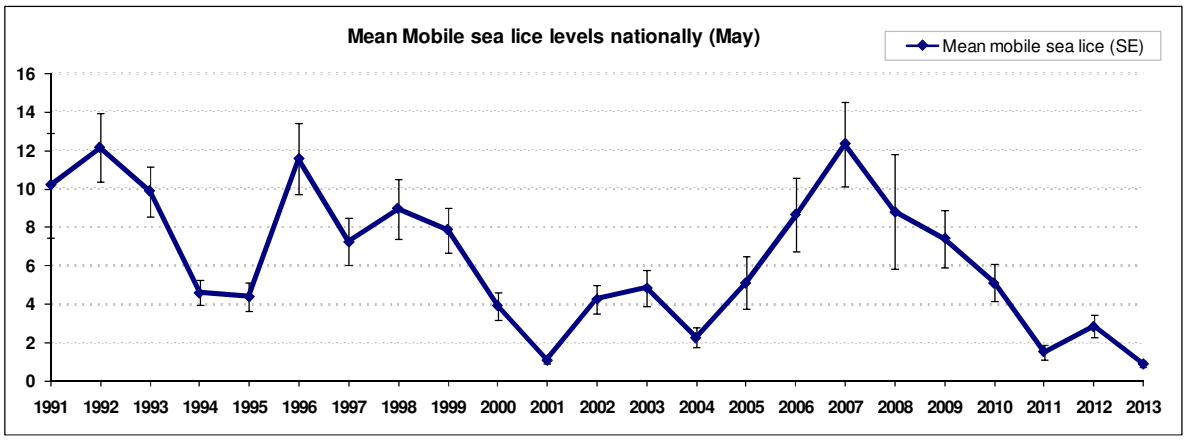


Figure 6. Annual trend (May mean) (SE) mobile *L. salmonis* on one-sea-winter salmon.

Mean ovigerous *L. salmonis* levels in 2013 are the lowest on record at 0.19 *L. salmonis* per fish, slightly lower than the previous year's. Total mobile levels also decreased from 2.84 total mobile sea lice per fish in 2012 to 0.89 total mobile sea lice per fish in 2013, also the lowest on record.

DISCUSSION

Sea lice levels on smolts in 2013 continue to show low levels of infestation as has been the case in previous years. One hundred percent of sea lice inspections on smolts were below the Treatment Trigger Levels (TTL), this compares with 98 % in 2012 and 97% in 2011.

On one-sea-winter, 82% of inspections were below TTL compared to 74% in 2012 and 80% in 2011. Sea lice levels on one-sea-winter salmon during the critical spring period were below TTL for 78% of inspections in the West, 95% in the Northwest and 100% in the Southwest. This is an improvement in the West from 72% below TTL in 2012 and in the Northwest a significant improvement from 58%. The Southwest continued to have no breaches of protocol levels in 2013, continuing this trend since 2010.

The levels for one-sea-winter salmon outside the spring period show that 53% of inspections were below TTL in the West, 67% were below in the Northwest and 100% in the Southwest. These compare to 58% in the West, 56% below in the Northwest and 100% in the Southwest during 2012.

Sea lice levels in excess of 10 *L. salmonis* mobiles per fish on one-sea-winter fish nationally were recorded on 13 occasions compared to 17 occasions in 2012 and 21 in 2011, 8 of these inspections had means of greater than 20 mobile *L. salmonis* per fish which was similar to 2012, when 9 inspection recorded lice levels in excess of 20 mobile *L. salmonis* per fish. Five of these inspections had levels greater than 40 *L. salmonis* per fish. The highest mean sea lice level recorded for one-sea-winter salmon was 84.02 mobile *L. salmonis* per fish, this compares to 71.72 mobile *L. salmonis* per fish in 2012 and 43.36 mobile *L. salmonis* per fish in 2011.

One inspection of two-sea-winter salmon was carried out, this exceeded treatment trigger levels. These fish were subsequently harvested out prior to the next scheduled inspection.

The May mean annual trends of *L. salmonis* ovigerous sea lice levels for one sea winter remains within the TTL set out in the Monitoring protocol and is the lowest level recorded since the Sea Lice Monitoring Programme began in 1991.

The regional sea lice levels in 2013 show good control in the first half of the year, with numbers increasing on some sites in late summer and autumn. This is a similar trend to 2012.

Caligus elongatus levels reached unusually high numbers on some sites in 2013, mainly in the Southwest and Donegal Bay. The maximum number recorded was 51 individuals per fish, compared to 18.16 individuals per fish in 2012 and 25.47 individuals per fish in 2011. Peaks occurred mainly in May and June. *Caligus* numbers are often associated with an influx of other pelagic fish in a bay, such as mackerel or herring.

Sea lice levels were low at most sites for most of the year, with the exception of three, where numbers increased significantly from mid-summer onwards. This highlights the importance and effectiveness of a synchronised autumn/winter treatment at sites and within bays to ensure levels are low on fish before temperatures begin to increase.

Factors that contributed to difficulties in controlling sea lice levels in 2013 included fish health problems, jellyfish blooms and high water temperatures in late summer and early autumn. Higher water temperature result in a shorter generation time for sea lice and also make treating the fish for sea lice more difficult.

Most farms have an on-farm sea lice monitoring programme and this, combined with a proactive treatment regime has proven to be an essential tool to prevent the increase of sea lice populations. Having the foresight and capacity to treat fish early in the sea lice population development is critical to managing sea lice numbers, especially when temperatures are high. Alternating the use of treatments and targeting treatments effectively on developing sea lice infestations is vital to achieving a successful result and in prolonging the effective life of the treatments. Co-operation between farms via the Single Bay Management Process is crucial to achieving successful sea lice control as synchronous bay-wide treatments are key for maximum effectiveness. Fallowing, separation of generations and the early harvest of two-sea-winter fish have also proven to be key elements in an integrated approach to sea lice control.

GLOSSARY

Grower:	A fish which has been at sea for one complete year or longer.
Mobile lice:	All sea lice that are mobile – male and female (pre-adult and adult stages) sea lice that have developed beyond the attached larval stages.
n<10	Ten fish or less were inspected in one or both cages sampled.
Ovigerous lice:	An egg bearing adult female sea lice.
Random (Ran.) Cage:	A cage which is selected by the Inspector on the day of inspection.
Salmonids:	A fish of the family (Salmonidae). It includes salmon, trout and charr.
Standard (Std.) Cage:	The selected cage which is sampled at each inspection.
S1 Smolt:	This pertains to a stage in the life cycle of the salmon when it changes from being a freshwater fish to a seawater fish, a process known as smoltification. These fish are transported to the saltwater environment in the spring, which is approximately 15 months after they were hatched.
S½ Smolt:	These fish are exposed to manipulated photoperiods to hasten the onset of smoltification. Hence an S½ smolt is ready to go to sea during the Autumn/Winter, approximately 11 months after hatching. Also known as S0 (S zero) smolts.
SE:	Standard error (error bars in the graphs) is the standard error of the mean of a sample from a population with a normal distribution, which is equal to the standard deviation of the normal distribution divided by the square root of the sample size.

REFERENCES

Ahyong ST, Lowry JK, Alonso M, Bamber RN, Boxshall GA, Castro P, Gerken S, Karaman GS, Goy JW, Jones DS, Meland K, Rogers DC & Svavarsson J 2011. In: *Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness*. Ed; Z-Q Zhang. *Zootaxa* 3148: 165–191.

Boxshall G 2011. "*Caligus* O.F. Müller, 1785". In: *World Copepoda database. World Register of Marine Species*. TC Walter & G Boxshall.

Chad WT & Geoff G 2011 . "*Lepeophtheirus* von Nordmann, 1832". In T. C. Walter & G. Boxshall. *World Copepoda database*. World Register of Marine Species.

Copley L, McCarney P, Jackson D, Hasset D, Kennedy S & Nulty C 2001. The occurrence of Sea lice (*Lepeophtheirus salmonis* Krøyer) on Farmed Salmon in Ireland (1995 to 2000). *Marine Resource Series, No.17. Marine Institute*.

Department of the Marine and Natural Resources 2000. Monitoring Protocol No. 3: Offshore Finfish Farms - Sea Lice Monitoring and Control.

Hamre LA, Eichner C, Caipang CMA, Dalvin ST, Bron JE, Nilsen F, Boxshall G, Skern-Mauritzen R 2013. The Salmon Louse *Lepeophtheirus salmonis* (Copepoda: Caligidae) Life Cycle Has Only Two Chalimus Stages. PLoS ONE 8(9): e73539. doi:10.1371/journal.pone.0073539

Hogans WE & DJ Trudeau 1989. Preliminary studies on the biology of sea lice, *Caligus elongatus*, *Caligus curtus* and *Lepeophtheirus salmonis* (Copepoda: Caligoida) parasitic on cage-cultured salmonids in the Lower Bay of Fundy. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1715**:** 14 pp.

Jackson D, Copley L, Kane F, Naughton O, Kennedy S & O'Donohoe P 2005. Thirteen years of monitoring sea lice in farmed salmonids. *In 'Long-term monitoring; Why, What, Where, When & How?'* Edited by John Solbé*, Proceedings of 'The importance of long-term monitoring of the environment' conference. Sherkin Island Marine Station, Ireland.* pp 92-105.

Jackson D & Minchin D 1992. Aspects of the reproductive output of two caligid copepod species on cultivated salmon. *Invertebrate Reproductive Development*, 22**:** 87-90.

Jackson D & Minchin D 1993. Lice infestations of farmed salmon in Ireland. In: *Pathogens of wild and farmed fish* Ed; GA Boxshall & D Defaye, Ellis Horwood Ltd, London, UK. pp. 188–201.

Jackson D, Hassett D & Copley L 2002. Integrated lice management on Irish Salmon farms. *Fish Veterinary Journal*, **(6)** 28-38.

Jackson D, Kane F, O'Donohoe P, Mc Dermott T, Kelly S, Drumm A & Newell J 2013a, Sea lice levels on wild Atlantic salmon, *Salmo salar* L., returning to the coast of Ireland. *Journal of Fish Diseases, 36: 293–298. doi: 10.1111/jfd.12059*

Jackson D, Cotter D, Newell J, McEvoy S, O'Donohoe P, Kane F, McDermott T, Kelly S & Drumm A 2013b. Impact of *Lepeophtheirus salmonis* infestations on migrating Atlantic salmon, *Salmo salar* L., smolts at eight locations in Ireland with an analysis of lice-induced marine mortality. *Journal of Fish Diseases, 36: 273–281. doi: 10.1111/jfd.12054.*

Jackson D, O'Donohoe P, McDermott T, Kane F, Kelly S & Drumm A 2013c. Report on Sea Lice Epidemiology and Management in Ireland with particular reference to potential interactions with wild Salmon (Salmo salar) and Freshwater Pearl Mussel (Margaritifera margaritifera) populations. *Irish Fisheries Bulletin No 43, Marine Institute*.

Johnson SC & Albright LJ 1991. The development stages of *L. salmonis* (Kroyer, 1837)(Copepoda, Caligidae). *Can. J. Zool* 69: 929-950. Doi: 10.1139/z91-138.

Kabata Z 1979. *Parasitic Copepoda of British Fishes*. The Ray Society, London.

McCarney P, Copley L, Kennedy S, Nulty C & Jackson D 2002. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2001. *Fisheries Leaflet 181, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, McDermott T, Drumm A & Jackson D 2012. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2011. *Irish Fisheries Bulletin No 40, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, McDermott T, Drumm A & Jackson D 2013. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2012. *Irish Fisheries Bulletin No 41, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, McDermott T, Drumm A & Jackson D 2011. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2010. *Irish Fisheries Bulletin No 34, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, Nixon P, Power A, McDermott T, Drumm A & Jackson D 2010. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2009. *Irish Fisheries Bulletin No 33, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, Nixon P, Power A, Naughton O, Tully D & Jackson D 2009. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2008. *Irish Fisheries Bulletin No 32, Marine Institute.*

O'Donohoe P, Kane F, Kelly S, Nixon P, Power A, Naughton O & Jackson D 2008. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2007. *Irish Fisheries Bulletin No 31, Marine Institute.*

O'Donohoe P, Kennedy S, Kane F, Naughton O, Nixon P, Power A & Jackson D 2007. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2006. *Irish Fisheries Bulletin No 28, Marine Institute.*

O'Donohoe P, Kennedy S, Kane F, Naughton O, Nixon P, Power A & Jackson D 2006. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2005. *Irish Fisheries Bulletin No 24, Marine Institute.*

O'Donohoe P, Kennedy S, Kane F, Naughton O, Tierney D & Jackson D 2005. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2004. *Irish Fisheries Bulletin No 22, Marine Institute.*

O'Donohoe P, Kennedy S, Kane F, Naughton O, Tierney D, Copley L & Jackson D 2004. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2003. *Fisheries Leaflet 184, Marine Institute.*

O'Donohoe P, Kennedy S, Copley L, Kane F, Naughton O & Jackson D 2003. National Survey of Sea lice (*Lepeophtheirus salmonis* Krøyer and *Caligus elongatus* Nordmann) on Fish Farms in Ireland - 2002. *Fisheries Leaflet 183, Marine Institute.*

Schram TA 1993. Supplementary descriptions of the developmental stages of *Lepeophtheirus salmonis* (Krøyer, 1837) (Copepoda: Caligidae). In: *Pathogens of wild and farmed fish* Ed; GA Boxshall & D Defaye, Ellis Horwood Ltd, London, UK. pp. 30-47.

Skilbrei OT, Finstad B, Urdal K, Bakke G, Kroglund F & Strand R 2013. Impact of early salmon louse, *Lepeophtheirus salmonis*, infestation and differences in survival and marine growth of sea-ranched Atlantic salmon, *Salmo salar* L., smolts 1997–2009. *Journal of Fish Diseases, 36: 249–260. http://dx.doi.org/10.1111/jfd.12052*

APPENDIX 1. MEAN SEA LICE LEVELS ON SALMONID FARMS IN 2013.

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
BANTRY BAY					
MURPHY'S IRISH SEAFOOD LTD.					
Cuan Baoi					
Atlantic Salmon, 2012 S1/2	10/12/2012	0.00	0.00	0.65	2.58
	14/02/2013	0.09	0.18	7.73	16.00
	13/03/2013	0.00	0.00	3.37	6.27
	27/03/2013	0.00	0.11	2.07	6.67
	10/04/2013	0.00	0.00	1.22	3.56
	25/04/2013	0.03	0.17	1.27	3.10
	16/05/2013	0.30	0.90	7.40	46.50
	30/05/2013	0.00	0.48	10.30	21.30
	19/06/2013	0.00	0.29	2.21	5.21
	09/07/2013	0.33	0.42	1.42	7.00
			Harvested out		
Atlantic Salmon, 2013	19/06/2013	0.00	0.00	0.17	0.66
	09/07/2013	0.00	0.03	3.13	12.10
	22/08/2013	0.00	0.00	0.21	0.48
	11/09/2013	0.00	0.00	0.06	0.13
	09/10/2013	0.00	0.03	0.03	0.06
	25/11/2013		Sampled Atlantic Salmon 2013 S1/2		
Atlantic Salmon, 2013 S1/2	19/06/2013	0.00	0.00	3.25	9.54
	09/07/2013	0.00	0.00	4.22	14.26
	22/08/2013	0.00	0.00	0.13	0.19
	11/09/2013	0.00	0.04	1.59	3.30
	09/10/2013	0.00	0.00	0.23	0.53
	25/11/2013	0.00	0.00	1.35	2.88

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*		
		F + eggs	Total	F + eggs	Total	
MARINE HARVEST IRL.						
Roancarraig						
Atlantic Salmon, 2012 S1/2	11/12/2012	0.02	0.06	0.52	1.04	
	14/02/2013	0.02	0.05	1.53	4.65	
	14/03/2013	0.00	0.08	4.18	14.41	
	26/03/2013	0.00	0.14	11.80	27.62	
	11/04/2013	0.03	0.21	6.26	13.25	
	24/04/2013	0.05	0.09	5.32	10.76	
	16/05/2013	0.03	0.07	2.93	7.87	
	29/05/2013	0.03	0.03	2.65	9.39	
	20/06/2013	0.00	0.00	2.95	4.89	
			Harvested out.			
Atlantic Salmon, 2013 S1/2	11/12/2012	0.00	0.03	0.41	1.75	n<10
	14/02/2013	0.00	0.02	0.00	0.00	
	14/03/2013	0.00	0.00	0.94	5.17	
	26/03/2013	0.00	0.00	1.60	4.83	
	11/04/2013	0.00	0.04	1.76	5.14	
	24/04/2013	0.02	0.03	1.59	4.56	
	16/05/2013	0.00	0.03	1.39	2.80	
	29/05/2013	0.00	0.00	0.82	2.84	
	20/06/2013	0.00	0.05	0.16	0.38	
	10/07/2013	0.00	0.09	1.57	16.78	
	23/08/2013	0.02	0.02	0.06	0.16	
	12/09/2013	0.00	0.02	2.78	5.95	
	10/10/2013	0.00	0.00	1.06	1.97	
	26/11/2013	0.00	0.00	0.29	0.55	

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
KENMARE BAY					
MARINE HARVEST IRL.					
Deenish					
Atlantic Salmon, 2012	11/12/2012	0.00	0.17	0.25	0.67
	15/02/2013	0.34	2.18	1.17	2.32
			Transferred to Inishfarnard		
Atlantic Salmon, 2013	19/06/2013	0.00	0.00	0.13	0.32
	09/07/2013	0.02	0.03	0.78	2.58
	22/08/2013	0.00	0.02	0.06	0.42
	11/09/2013	0.01	0.05	1.51	3.03
	09/10/2013	0.00	0.02	0.00	0.08
	27/11/2013	0.02	0.10	0.66	1.57
Inishfarnard					
Atlantic Salmon, 2012	14/03/2013	0.03	0.03	0.00	0.00
	26/03/2013	0.00	0.02	0.00	0.10
	11/04/2013	0.00	0.00	0.12	0.36
	25/04/2013	0.00	0.03	0.60	2.44
	17/05/2013	0.00	0.17	4.76	13.35
	29/05/2013	0.04	0.19	5.57	11.57
	20/06/2013	0.02	0.28	7.83	21.24
	10/07/2013	0.03	0.16	1.13	2.91
	23/08/2013	0.26	0.58	0.74	1.52
	12/09/2013	0.23	0.48	0.68	1.14
	10/10/2013	0.23	1.80	4.60	10.37
			Harvested Out		
MURPHY'S IRISH SEAFOOD LTD.					
Kilmacillogue					
Atlantic Salmon, 2013	30/05/2013	0.00	0.00	0.00	0.00
			Transferred to Cuan Baoi		
Atlantic Salmon, 2013 S1/2	14/02/2013	0.00	0.13	0.08	1.25
	13/03/2013	0.00	0.09	0.03	0.39
	27/03/2013	0.00	0.08	0.26	0.62
	10/04/2013	0.00	0.08	0.13	0.18
	24/04/2013	0.00	0.11	0.04	0.04
	17/05/2013	0.00	0.04	0.00	0.02
	30/05/2013	0.00	0.07	0.04	0.07
			Transferred to Cuan Baoi		

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
KILKIERAN BAY					
BRADAN BEO TEO.					
Daonish					
Atlantic Salmon, 2013 S1/2	16/01/2013	0.00	0.05	0.07	0.20
	26/02/2013	0.00	0.00	0.08	0.28
	13/03/2013	0.00	0.04	0.02	0.04
	27/03/2013	0.00	0.02	0.00	0.00
	12/04/2013	0.00	0.00	0.00	0.00
	25/04/2013	0.00	0.02	0.00	0.02
	17/05/2013	0.00	0.02	0.00	0.02
	24/05/2013	0.00	0.00	0.00	0.07
	13/06/2013	0.00	0.00	0.46	1.41
	09/07/2013	0.00	0.02	0.00	0.00
	22/08/2013	0.05	0.12	0.35	1.09
	27/09/2013	0.14	0.23	0.00	0.00
	17/10/2013	0.12	0.15	0.00	0.00
	21/11/2013	0.26	0.82	0.08	0.10
BERTRAGHBOY BAY					
COMHLUCHT BRADAIN CHONAMARA TEO					
Outer Bertraghboy Bay					
Atlantic Salmon, 2013	11/07/2013	0.00	0.02	1.95	3.50
	27/08/2013	0.00	0.02	1.08	1.59
	25/09/2013	0.02	0.11	0.42	1.15
			Transferred to Sealax		
Sealax					
Atlantic Salmon, 2012 S1/2	12/12/2012	0.32	1.62	2.68	3.75
	12/02/2013	0.43	1.07	1.07	1.54
			Transferred to Corhounagh		
Atlantic Salmon, 2013	24/04/2013	0.00	0.00	0.00	0.00
	16/05/2013	0.00	0.00	0.00	0.08
	31/05/2013	0.00	0.00	0.02	0.06
	12/06/2013	0.00	0.00	0.02	0.07
			Transferred to Outer Bertraghboy Bay		
Atlantic Salmon, 2013b	24/10/2013	0.00	0.07	1.06	1.65
	22/11/2013	0.02	0.04	1.35	2.12

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
MANNIN BAY					
MANNIN BAY SALMON COMPANY LTD.					
Corhounagh					
Atlantic Salmon, 2011			Harvested Out		
Atlantic Salmon, 2012 S1/2	05/03/2013	0.11	0.56	0.16	0.49
	20/03/2013	0.07	0.77	0.24	0.35
	03/04/2013	0.03	0.64	0.12	0.35
	25/04/2013	0.14	0.76	0.10	0.40
	02/05/2013	0.11	0.79	0.11	0.34
	21/05/2013	0.28	1.15	0.13	0.19
	06/06/2013	0.64	3.65	0.23	0.41
	24/07/2013	3.25	6.04	0.00	0.00
			Harvested Out		
BALLINAKILL HARBOUR					
BIFAND LTD.					
Fraochoilean					
Atlantic Salmon, 2013 S1/2	11/12/2012	0.00	0.03	0.03	0.17
	15/02/2013	0.00	0.08	0.09	0.24
	05/03/2013	0.00	0.06	0.12	0.17
	25/03/2013	0.00	0.05	0.06	0.22
	09/04/2013	0.00	0.00	0.11	0.16
	23/04/2013	0.00	0.01	0.18	0.30
	15/05/2013	0.00	0.03	0.14	0.24
	30/05/2013	0.01	0.02	0.05	0.07
	12/06/2013	0.01	0.14	0.23	0.43
	10/07/2013	0.02	0.05	0.30	0.62
	21/08/2013	0.07	0.33	0.00	0.00
	26/09/2013	0.02	0.27	0.00	0.02
	17/10/2013	0.87	3.28	0.83	1.27
	28/11/2013	0.41	4.85	0.26	0.50

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
KILLARY HARBOUR					
ROSROE SALMON LTD.					
Inishdeighil					
Atlantic Salmon, 2012	09/01/2013	0.10	0.35	0.44	0.76
			Transferred to Rosroe		
Rosroe					
Atlantic Salmon, 2012	08/02/2013	0.06	0.08	0.08	0.19
	06/03/2013	0.03	0.99	0.24	0.79
	26/03/2013	0.13	1.24	1.06	1.61
	10/04/2013	0.55	1.24	0.38	0.74
	29/04/2013	0.30	0.63	0.00	0.02
	07/05/2013	0.22	0.57	0.02	0.02
	27/05/2013	0.14	1.37	0.06	0.16
	07/06/2013	0.68	4.52	0.11	0.19
	26/07/2013	4.75	16.66	0.00	0.00
	30/08/2013	4.32	15.80	0.00	0.00
	30/09/2013	7.81	14.05	0.00	0.00
	29/10/2013	10.65	20.53	0.42	0.65
			On starve for harvest		

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
CLEW BAY					
CLARE ISLAND SEAFARMS LTD.					
Portlea					
Atlantic Salmon, 2011	11/01/2013	2.62	5.54	0.56	1.00
			Transferred to Millstone for harvest		
Atlantic Salmon, 2013	08/05/2013	0.00	0.00	0.00	0.18
	30/05/2013	0.00	0.03	0.06	0.15
	19/06/2013	0.00	0.05	0.43	0.99
	23/07/2013	0.00	0.15	8.93	15.35
	27/08/2013	0.15	0.70	1.45	3.03
	27/09/2013	0.18	0.73	0.34	0.57
	11/10/2013	0.24	1.05	0.46	0.78
	15/11/2013	0.63	2.18	0.82	1.45
Seastream Inner (Inishcoragh)					
Atlantic Salmon, 2012	23/01/2013	1.05	2.52	0.04	0.04
	15/02/2013	0.66	2.07	0.08	0.08
	07/03/2013	0.23	1.04	0.02	0.02
	20/03/2013	0.25	1.70	0.00	0.02
	05/04/2013	0.46	1.77	0.00	0.00
	22/04/2013	0.60	4.18	0.00	0.14
	17/05/2013	0.55	1.30	0.00	0.00
	21/05/2013	0.70	1.38	0.00	0.00
	14/06/2013	0.13	0.77	0.00	0.00
	26/07/2013	10.67	22.05	1.41	1.96
	30/08/2013	18.02	39.30	1.24	1.48
	30/09/2013	24.56	53.01	0.68	1.11
			Harvested Out		

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
BEALACRAGHER BAY					
CURRAUN BLUE LTD.					
Curraun					
Rainbow Trout, 2012 (1)	18/01/2013	0.41	0.83	0.00	0.00
	26/02/2013	0.13	0.60	0.00	0.00
	13/03/2013	0.07	0.67	0.00	0.00
	27/03/2013	0.11	0.70	0.00	0.00
	10/04/2013	0.07	0.63	0.00	0.03
	19/04/2013	0.23	0.47	0.00	0.03
	10/05/2013	0.00	0.26	0.00	0.00
	24/05/2013	0.15	0.85	0.00	0.00
			Harvested Out		
Rainbow Trout, 2013 (1)	18/01/2013	0.00	0.33	0.00	0.00
	26/02/2013	0.07	0.20	0.00	0.00
	13/03/2013	0.03	0.47	0.00	0.00
	27/03/2013	0.04	0.21	0.00	0.00
	10/04/2013	0.00	0.29	0.00	0.00
	19/04/2013	0.10	0.47	0.00	0.03
	10/05/2013	0.00	0.10	0.03	0.03
	24/05/2013	0.00	0.30	0.00	0.00
	28/06/2013	0.21	1.00	0.00	0.00
			Harvested Out		
Rainbow Trout, 2013 (2)	17/10/2013	0.00	0.00	0.00	0.00
	18/11/2013	0.04	0.18	0.00	0.00

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
DONEGAL BAY					
EANY FISH PRODUCTS LTD.					
Eany					
Rainbow Trout, 2012 (2)	11/01/2013	0.23	1.83	0.02	0.05
	12/02/2013	0.30	2.22	0.05	0.10
	07/03/2013	0.03	1.67	0.03	0.07
	20/03/2013	0.07	1.03	0.21	0.34
	04/04/2013	0.43	1.40	0.07	0.50
	24/04/2013	0.21	2.52	0.69	3.07
	09/05/2013	0.35	1.29	0.74	1.45
			Harvested Out		
MARINE HARVEST IRL.					
Creevin					
Atlantic Salmon, 2013	04/04/2013	0.00	0.01	0.00	0.00
	24/04/2013	0.00	0.01	0.00	0.12
	09/05/2013	0.00	0.02	0.00	0.09
	23/05/2013	0.00	0.00	0.08	0.08
	06/06/2013	0.00	0.00	0.05	0.05
	11/07/2013	0.02	0.13	0.42	0.63
	22/08/2013	0.36	1.11	0.30	0.51
	26/09/2013	0.19	0.64	0.00	0.07
	15/10/2013	0.35	3.01	0.04	0.07
	22/11/2013	1.07	2.86	0.02	0.03
Eany					
Atlantic Salmon, 2013 S1/2	12/02/2013	0.03	0.33	0.02	0.16
	07/03/2013	0.02	0.96	0.04	0.37
	20/03/2013	0.00	0.59	0.15	0.37
	04/04/2013	0.00	0.61	0.06	0.74
	24/04/2013	0.00	0.12	0.30	1.35
	09/05/2013	0.00	0.27	1.12	2.35
	23/05/2013	0.02	0.51	1.38	2.22
	06/06/2013	0.05	0.25	1.87	2.65
	11/07/2013	0.07	0.45	0.30	0.53
	22/08/2013	0.59	1.93	0.66	1.08
	26/09/2013	0.60	2.00	0.12	0.17
	15/10/2013	0.37	1.46	0.00	0.00
	22/11/2013	1.86	9.61	0.00	0.02

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
OCEAN FARM LTD.					
Mc Swynes					
Atlantic Salmon, 2011			Harvested Out		
Atlantic Salmon, 2013	08/05/2013	0.00	0.00	0.08	0.25
	22/05/2013	0.00	0.00	0.14	0.16
	05/06/2013	0.00	0.02	0.20	0.47
	18/07/2013	0.00	0.00	0.08	0.10
	23/08/2013	0.04	0.12	0.14	0.18
	26/09/2013	0.07	0.22	0.00	0.02
	15/10/2013	0.07	0.98	0.17	0.31
	22/11/2013	0.89	5.58	1.03	1.83
Ocean Inver					
Atlantic Salmon, 2012	11/01/2013	0.61	1.79	0.32	0.61
	12/02/2013	0.10	0.21	0.00	0.02
	07/03/2013	0.00	0.02	0.00	0.02
	20/03/2013	0.02	0.04	0.52	1.11
	03/04/2013	0.05	0.08	0.49	1.43
	23/04/2013	0.03	0.21	1.82	5.55
	08/05/2013	0.09	0.50	7.27	11.32
	22/05/2013	0.19	0.65	24.16	36.52
	05/06/2013	0.41	1.28	31.59	51.00
			Transferred to Richie's Bay		
Richie's Bay					
Atlantic Salmon, 2012	03/04/2013	0.00	0.00	0.21	0.36
	23/04/2013	0.00	0.29	2.06	6.06
	08/05/2013	0.00	0.17	3.08	8.50
			Harvested Out		
Atlantic Salmon, 2012b	18/07/2013	0.13	0.88	0.88	2.13
	23/08/2013	0.60	1.27	0.93	1.33
	26/09/2013	1.80	5.80	1.30	1.50
			Harvested Out		

	Date	*Lepeophtheirus salmonis*		*Caligus elongatus*	
		F + eggs	Total	F + eggs	Total
MULROY BAY					
MARINE HARVEST IRL.					
Cranford A					
Atlantic Salmon, 2012 S1/2	10/01/2013	12.50	49.71	0.00	0.07
			Transferred to Moross 1		
Moross 1					
Atlantic Salmon, 2012 S1/2	13/02/2013	1.68	10.77	0.00	0.03
	08/03/2013	0.87	4.32	0.00	0.00
	21/03/2013	0.32	1.71	0.00	0.00
	05/04/2013	0.37	1.20	0.00	0.03
	24/04/2013	0.27	0.80	0.07	0.07
	14/05/2013	0.23	4.31	0.08	0.15
			Harvested Out		
Glinsk					
Atlantic Salmon, 2012	10/01/2013	0.82	5.10	0.00	0.00
	13/02/2013	1.41	5.20	0.02	0.02
	08/03/2013	0.22	1.28	0.00	0.00
	21/03/2013	0.13	0.87	0.02	0.03
	05/04/2013	0.13	1.00	0.07	0.12
	24/04/2013	0.18	0.83	0.00	0.02
	14/05/2013	0.18	1.85	0.10	0.20
	23/05/2013	0.12	0.61	0.00	0.00
	06/06/2013	0.28	1.86	0.10	0.18
	18/07/2013	3.88	14.14	0.51	1.03
	22/08/2013	13.74	76.81	0.13	0.21
	30/09/2013	11.02	74.60	0.02	0.04
	24/10/2013	7.69	84.02	0.20	0.56
			Harvested out		
LOUGH SWILLY					
Lough Swilly					
Atlantic Salmon, 2011			Harvested Out		

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