S&TC SEA LICE SUMMARIES

NOTE: The insight that follows comes with the following explanations and caveats.
Datasets published by SEPA, Marine Scotland, Fish Health Inspectorate, Crown Estate Scotland and the Scottish Salmon Producers Organisation have all been used. However, the great majority of this data is collected and reported by the salmon farming industry itself. There is no independent body which collects, verifies or audits any of the data. There is a lack of transparency with regard to methodologies used, and therefore the consistency of, sea lice count data. Where averages are used by the industry there is no transparency as to how these are derived. There is no information as to how any of these processes may have varied over time.

The view we have of the industry is the one it currently permits us to see.

Industry Overview

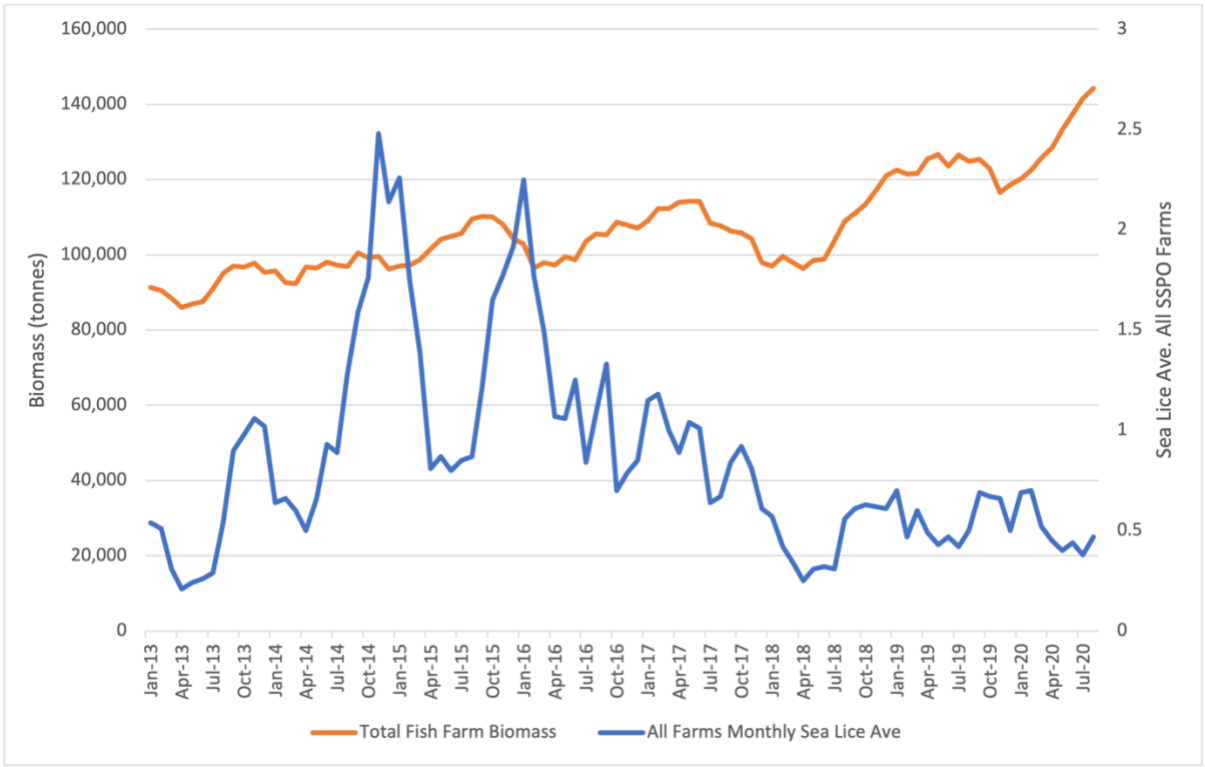
The following charts provide a very basic overview of the fish farming industry in Scotland and sea lice abundance.

The chart below plots a "monthly average sea lice" figure as published by the Scottish Salmon Producers Organisation (SSPO) for its members. This has been plotted alongside total fish farm biomass as published by the Scottish Environmental Protection Agency (SEPA).

It is not clear how the SSPO calculate this all-member average figure. There is some weighting in it, but no explanation is given. Their data only runs up to August 2020.

The average stated by SSPO in Aug 2020 is similar to that of January 2013, with falls in recent years. Presented in isolation, as it is by the industry, this could indicate some positive progress or create the impression that there is no worsening of the sea lice situation. However, since January 2013 biomass (the weight of fish in salmon farms) has increased by nearly 60%. Assuming this translates directly to numbers of fish, this would mean that the absolute numbers of sea lice would have increased by a similar amount.

In order to more accurately reflect emissions of sea lice by the industry, one has to account for changes in its scale and consider absolute sea lice numbers.

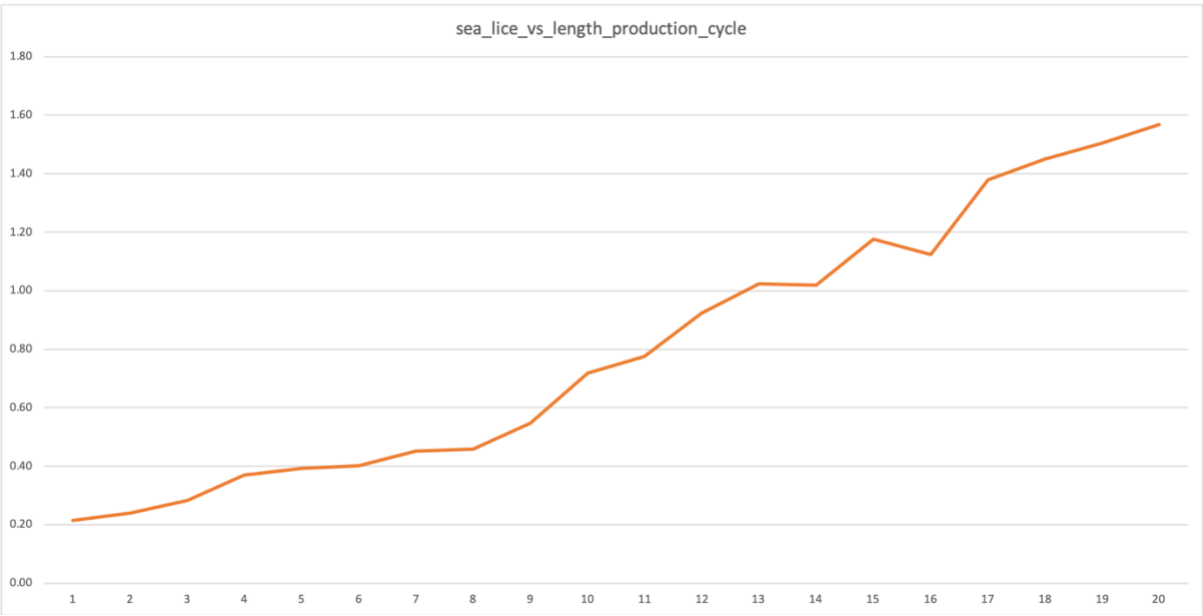


SEASONALITY ANALYSIS

This analysis examined the correlation of some factors with reported sea lice abundance on salmon farms. It uses data from 2018/19 (2020 data is not available as SEPA has yet to publish some data sets that are required).

This chart plots an average (straight) of reported monthly sea lice averages against calendar month. The intention is to identify to what extent sea lice are a seasonal occurrence.

This chart plots an average (straight) of reported monthly sea lice averages against stage of production cycle. The intention is to Identify whether sea lice abundance on salmon farms is more strongly correlated with seasons or stage of production cycle.

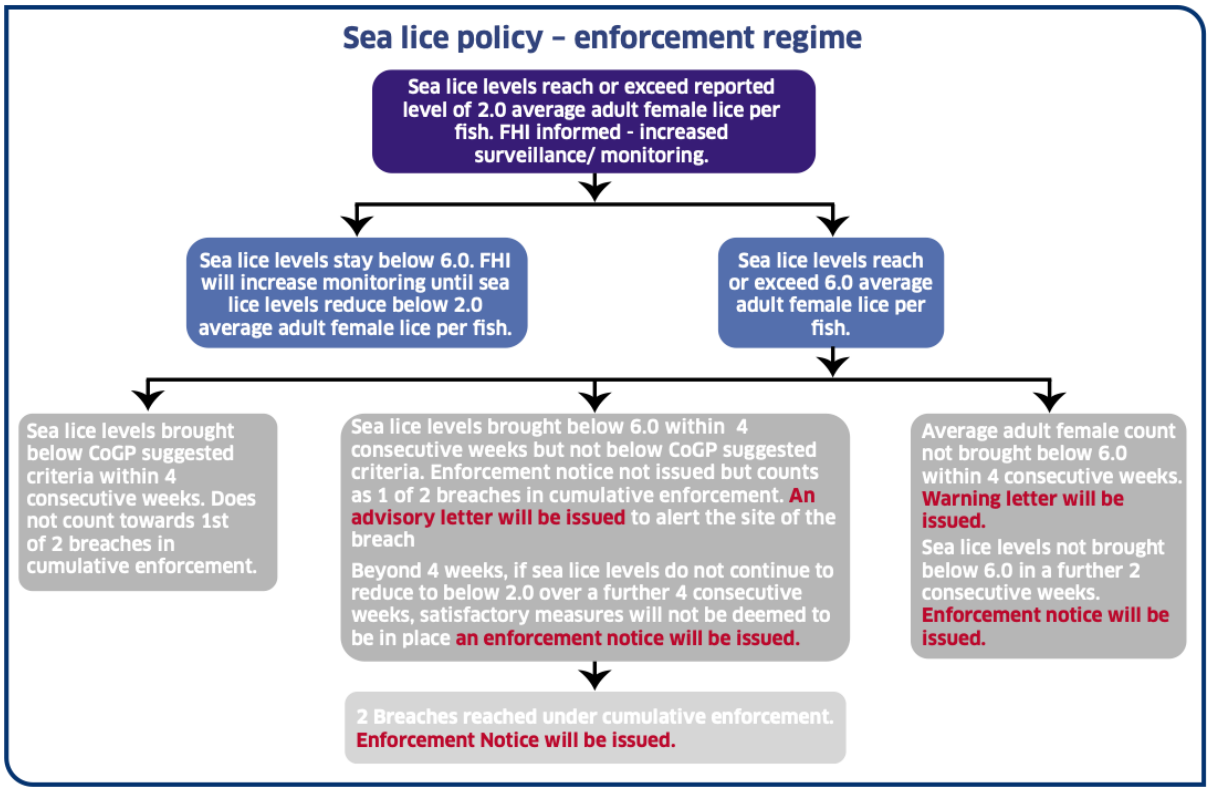


For a full analysis see: https://salmon-trout.org/2020/06/09/salmon-farmers-own-data-makes-the-case-for-much-lower-sea-lice-limits/

SEA LICE COMPLIANCE ANALYSIS

Sea lice abundance on salmon farms in Scotland is guided by two sets of guidelines.

1. *The Regulation of Sea Lice in Scotland*,



2. *The Code of Good Practice*

> ⓘ
> *In general, treatments should be guided by **the build-up of pre-adults** as indicated by weekly counts, the objective being **to prevent the development of gravid females**.*
> *Suggested criteria for the treatment of sea lice on individual farm sites are:*
> - *An average of 0.5 adult female L. salmonis per fish during the period 1st February to 30th June inclusive.*
> - *An average of 1.0 adult female L. salmonis per fish during the period 1st July to 31st January inclusive.*

Sea lice data is often presented by the industry according to calendar month. This may not be the most useful way to present data. Within each calendar month there will be fish farms which have been active for nearly two years as well as those that have been stocked for only a few weeks. With sea lice shown to be in far greater abundance in the second year of production, mixing data from these farms with those from the early stages of production is unhelpful.

The following table and charts analyse the performance of individual farms over the course of a discreet production cycle.

This table uses monthly sea lice average and mortality data published by the SSPO. It also makes use of datasets published by SEPA and Marine Scotland.

They are collected into a group of all farms that ended a production cycle at some point in 2020.

LIFECYCLE ANALYSIS OF SALMON FARMS THAT COMPLETED A PRODUCTION CYCLE IN 2020

	Company	Farm	Max monthly sea lice ave	Cycle length in months	No. months sea lice average >0.5	No. months sea lice average >1.0	No. months sea lice average >02.0	Total Stock Mortality %
1	Marine Harvest (Scotland) Ltd	Seaforth	8.25	16	9	8	4	23.2
2	Marine Harvest (Scotland) Ltd	Noster	7.4	15	8	6	4	23.2
3	Grieg Seafood Scotland Ltd	Corlarach	6.41	3	2	2	1	51.3
4	Scottish Sea Farms Ltd	Mangaster	5.44	15	7	6	6	27.2
5	Marine Harvest (Scotland) Ltd	Rum	5.42	23	10	7	6	25.5
6	Grieg Seafood Scotland Ltd	Coledeep	5.4	17	7	6	4	40.1
7	Grieg Seafood Scotland Ltd	Snizort East	5.1	10	10	10	10	25.8
8	Marine Harvest (Scotland) Ltd	Groatay	4.9	18	3	2	1	30.3
9	Grieg Seafood Scotland Ltd	East of Papa Little	4.81	18	8	6	5	14.8
10	Grieg Seafood Scotland Ltd	South of Linga	4.62	20	13	12	11	23.3
11	Cooke Aquaculture (Scotland)	Wick of Vatsetter	4.59	10	9	8	5	9.5
12	Scottish Sea Farms Ltd	Vidlin	4.47	18	11	10	8	17.3
13	Cooke Aquaculture (Scotland)	Bow of Hascosay	4.46	11	8	6	4	10.3
14	Marine Harvest (Scotland) Ltd	Greshornish	4.32	18	7	6	4	28.7
15	Marine Harvest (Scotland) Ltd	Camas Glas	4.26	19	12	7	5	28.6
16	Loch Duart Ltd	Lochmaddy	4.22	17	6	4	2	36.1
17	Scottish Sea Farms Ltd	Slocka Ronas Voe	4.19	18	8	4	2	16.0
18	Marine Harvest (Scotland) Ltd	Grey Horse Channel	4.07	19	5	3	2	17.1
19	Grieg Seafood Scotland Ltd	Setterness South	4.05	9	9	7	6	20.1
20	Cooke Aquaculture (Scotland)	Staid of Aithness	3.82	18	7	7	3	24.1
21	Cooke Aquaculture (Scotland)	Ness of Copister	3.82	10	4	2	1	12.6
22	Marine Harvest (Scotland) Ltd	North Shore East	3.68	16	5	5	2	35.2
23	Grieg Seafood Scotland Ltd	Swining 3	3.55	19	11	11	6	28.7
24	Marine Harvest (Scotland) Ltd	Macleans Nose	3.53	21	10	8	5	16.4
25	Grieg Seafood Scotland Ltd	Setterness North	3.52	9	9	9	6	26.1
26	Marine Harvest (Scotland) Ltd	Caolas a Deas East	3.47	16	6	5	3	31.4
27	Marine Harvest (Scotland) Ltd	North Shore	3.4	19	7	5	1	35.2
28	Grieg Seafood Scotland Ltd	Leinish	3.38	13	4	3	2	78.3

- ***Max monthly sea lice ave:*** This is the highest monthly sea lice average that was reported during the production cycle for a given calendar month.

- ***Cycle length in months:*** The number of months that the production cycle being analysed lasted. There may be some inaccuracies here because no agency or body receives a notification for when production cycles begin and end. Production cycles may only be separated by a matter of weeks, and it is difficult to discern a break in the data. So, a number of logic-based algorithms are used to make a best estimate at this.

- ***No. months sea lice average >0.5:*** Reports the number of months during the period of the production cycle that the reported monthly average sea lice number was greater than 0.5. (the months above the threshold will not necessarily be consecutive)

- ***No. months sea lice average >1.0:*** Reports the number of months during the period of the production cycle that the reported monthly average sea lice number was greater than 1.0. (the months above the threshold will not necessarily be consecutive)

- ***No. months sea lice average >2.0:*** Reports the number of months during the period of the production cycle that the reported monthly average sea lice number was greater than 2.0. (the months above the threshold will not necessarily be consecutive)

- ***Total Stock Mortality %:*** The percentage of stock that died during the whole production cycle in terms of numbers of fish.

One can consider the number of months some farms can remain in beach of the thresholds as some kind of indicator of the efficacy of the Scottish Government's sea lice policy to act as a deterrent. The policy uses a threshold of 2.0 for enforcement, albeit that this was only implemented in 2019 (reduced from 3.0) and some of these production cycles began before then.

LIFECYCLE ANALYSIS OF SALMON FARMS THAT COMPLETED A PRODUCTION CYCLE IN 2020

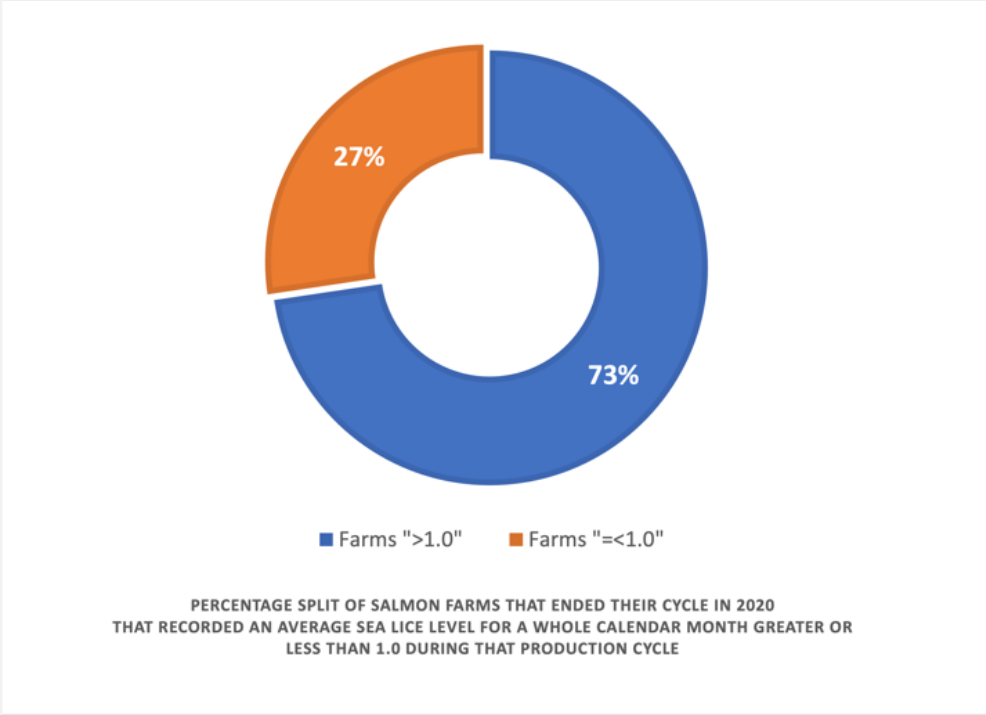
	Company	Farm	Max monthly sea lice ave	Cycle length in months	No. months sea lice average >0.5	No. months sea lice average >1.0	No. months sea lice average >02.0	Total Stock Mortality %
1	Grieg Seafood Scotland Ltd	South of Linga	4.62	20	13	12	11	23.3
2	Grieg Seafood Scotland Ltd	Snizort East	5.1	10	10	10	10	25.8
3	Scottish Sea Farms Ltd	Vidlin	4.47	18	11	10	8	17.3
4	Grieg Seafood Scotland Ltd	Foraness	3.26	17	12	10	6	17.8
5	Grieg Seafood Scotland Ltd	Swining 3	3.55	19	11	11	6	28.7
6	Marine Harvest (Scotland) Ltd	Rum	5.42	23	10	7	6	25.5
7	Grieg Seafood Scotland Ltd	Setterness South	4.05	9	9	7	6	20.1
8	Grieg Seafood Scotland Ltd	Setterness North	3.52	9	9	9	6	26.1
9	Scottish Sea Farms Ltd	Mangaster	5.44	15	7	6	6	27.2
10	Marine Harvest (Scotland) Ltd	Camas Glas	4.26	19	12	7	5	28.6
11	Marine Harvest (Scotland) Ltd	Macleans Nose	3.53	21	10	8	5	16.4
12	Cooke Aquaculture (Scotland)	Wick of Vatsetter	4.59	10	9	8	5	9.5
13	Grieg Seafood Scotland Ltd	East of Papa Little	4.81	18	8	6	5	14.8
14	Marine Harvest (Scotland) Ltd	Seaforth	8.25	16	9	8	4	23.2
15	Marine Harvest (Scotland) Ltd	Noster	7.4	15	8	6	4	23.2
16	Cooke Aquaculture (Scotland)	Bow of Hascosay	4.46	11	8	6	4	10.3
17	Grieg Seafood Scotland Ltd	Coledeep	5.4	17	7	6	4	40.1
18	Marine Harvest (Scotland) Ltd	Greshornish	4.32	18	7	6	4	28.7
19	Scottish Salmon Company Ltd	Trilleachan Mor	2.94	14	12	11	3	28.9
20	Marine Harvest (Scotland) Ltd	Loch Alsh	2.88	18	11	10	3	21.4
21	Cooke Aquaculture (Scotland)	Burkwell	2.83	11	9	8	3	7.8
22	Cooke Aquaculture (Scotland)	Staid of Aithness	3.82	18	7	7	3	24.1
23	Marine Harvest (Scotland) Ltd	Caolas a Deas East	3.47	16	6	5	3	31.4
24	Marine Harvest (Scotland) Ltd	Duich	2.35	19	9	6	2	19.3
25	Scottish Sea Farms Ltd	Slocka Ronas Voe	4.19	18	8	4	2	16.0
26	Marine Harvest (Scotland) Ltd	Caolas a Deas West	3.21	16	8	6	2	28.1
27	Marine Harvest (Scotland) Ltd	Ardintoul	2.51	18	8	6	2	27.0
28	Loch Duart Ltd	Lochmaddy	4.22	17	6	4	2	36.1
29	Marine Harvest (Scotland) Ltd	Loch Hourn	2.55	21	6	2	2	11.4
30	Marine Harvest (Scotland) Ltd	Grey Horse Channel	4.07	19	5	3	2	17.1
31	Marine Harvest (Scotland) Ltd	North Shore East	3.68	16	5	5	2	35.2
32	Grieg Seafood Scotland Ltd	Leinish	3.38	13	4	3	2	78.3
33	Scottish Salmon Company Ltd	Geasgill	2.22	20	14	10	1	18.4
34	Scottish Salmon Company Ltd	Gometra	2.19	20	12	8	1	18.8
35	Scottish Salmon Company Ltd	Eport Outer	3.3	26	9	4	1	12.3
36	Scottish Salmon Company Ltd	Vacasay	2.87	12	9	5	1	32.6
37	Scottish Salmon Company Ltd	Vuia Mor	2.88	20	8	5	1	26.4
38	Scottish Salmon Company Ltd	Taranaish	2.65	19	8	5	1	33.5
39	Cooke Aquaculture (Scotland)	Vee Taing	2.15	10	8	5	1	14.4
40	Marine Harvest (Scotland) Ltd	North Shore	3.4	19	7	5	1	35.2
1	Cooke Aquaculture (Scotland)	Bastaness	2.77	9	6	2	1	7.4
2	Cooke Aquaculture (Scotland)	Djubawick	2.66	9	6	3	1	11.3
3	Scottish Salmon Company Ltd	Gravir Outer	2.11	16	6	5	1	8.5
4	Marine Harvest (Scotland) Ltd	Greanem	2.42	12	5	2	1	15.8
5	Cooke Aquaculture (Scotland)	Ness of Copister	3.82	10	4	2	1	12.6
6	Marine Harvest (Scotland) Ltd	Groatay	4.9	18	3	2	1	30.3
7	Marine Harvest (Scotland) Ltd	Ardnish	2.85	32	3	2	1	6.4
8	Grieg Seafood Scotland Ltd	Corlarach	6.41	3	2	2	1	51.3
9	Marine Harvest (Scotland) Ltd	Carradale North	2.54	15	2	2	1	31.6
10	Marine Harvest (Scotland) Ltd	Carradale	2.32	15	2	2	1	26.7
11	Scottish Sea Farms Ltd	Fishnish (A)	1.85	18	13	7	0	6.7
12	Scottish Sea Farms Ltd	Scallastle	1.92	21	12	3	0	9.9
13	Marine Harvest (Scotland) Ltd	Invasion Bay	1.83	23	11	8	0	10.0
14	Scottish Salmon Company Ltd	Eughlam	1.6	19	10	4	0	9.0
15	Cooke Aquaculture (Scotland)	Uyea Isle	1.8	11	9	9	0	8.3
16	Scottish Salmon Company Ltd	Kyles Vuia	1.6	19	8	2	0	36.3
17	Cooke Aquaculture (Scotland)	Wick of Belmont	1.18	19	8	1	0	23.3
18	Marine Harvest (Scotland) Ltd	Muck	1.85	18	7	6	0	39.0
19	Scottish Salmon Company Ltd	Druimyeon Bay	1.69	18	6	6	0	25.6
20	Loch Duart Ltd	Sound of Harris	1.51	21	6	2	0	10.4
21	Scottish Sea Farms Ltd	Fishnish (B)	1.47	12	6	5	0	9.0
22	Scottish Sea Farms Ltd	Fiunary	1.4	19	6	1	0	14.8
23	Marine Harvest (Scotland) Ltd	Soay	1.96	15	5	1	0	24.0
24	Scottish Salmon Company Ltd	Portree Outer	1.55	29	5	1	0	14.7
25	Cooke Aquaculture (Scotland)	Winna Ness	1.2	4	4	2	0	40.1
26	Grieg Seafood Scotland Ltd	North Voe	0.99	13	4	0	0	34.5
27	Scottish Salmon Company Ltd	West Strome	1.92	34	3	1	0	13.0
28	Scottish Salmon Company Ltd	Portree	1.18	21	3	1	0	14.9
29	Loch Duart Ltd	Oldany	0.86	20	3	0	0	8.2
30	Scottish Sea Farms Ltd	Lismore East (Walters)	1.61	11	2	1	0	36.6
31	Marine Harvest (Scotland) Ltd	Isle Ewe	1.14	18	2	1	0	28.2
32	Cooke Aquaculture (Scotland)	North Sandwick	0.77	7	2	0	0	16.7
33	Loch Duart Ltd	Badcall	0.77	11	2	0	0	18.2
34	Scottish Sea Farms Ltd	Bloody Bay	0.93	15	1	0	0	12.7
35	Scottish Salmon Company Ltd	Grimsay	0.56	3	1	0	0	38.9
36	Scottish Sea Farms Ltd	Fada	0.37	9	0	0	0	5.5
37	Scottish Sea Farms Ltd	Tanera	0.28	19	0	0	0	3.6
38	Loch Duart Ltd	Calbha Bay	0.27	19	0	0	0	41.2
39	Marine Harvest (Scotland) Ltd	Stulaigh	0.23	13	0	0	0	36.8
40	Scottish Salmon Company Ltd	Ardyne	0.13	16	0	0	0	20.5
41	Scottish Salmon Company Ltd	Strone	0.1	18	0	0	0	41.5
42	Wester Ross Fisheries Ltd	Ardessie A	0.04	20	0	0	0	5.2
43	Scottish Sea Farms Ltd	Bring Head	0.03	15	0	0	0	12.9
44	Scottish Sea Farms Ltd	Westerbister	0.03	18	0	0	0	10.2
45	Scottish Salmon Company Ltd	Sgian Dubh	0.02	20	0	0	0	39.4
46	Scottish Sea Farms Ltd	Toyness	0.01	22	0	0	0	8.0
47	Cooke Aquaculture (Scotland)	Bay of Vady	0	8	0	0	0	0.7
48	Cooke Aquaculture (Scotland)	Chalmers Hope	0	14	0	0	0	3.4
49	Cooke Aquaculture (Scotland)	East Skelwick	0	10	0	0	0	1.1
50	Cooke Aquaculture (Scotland)	Lyrawa Bay	0	9	0	0	0	7.0
51	Cooke Aquaculture (Scotland)	Meil Bay	0	9	0	0	0	8.6
52	Cooke Aquaculture (Scotland)	Ouseness	0	7	0	0	0	0.7
53	Cooke Aquaculture (Scotland)	Quanterness	0	8	0	0	0	5.2
54	Cooke Aquaculture (Scotland)	South Cava	0	9	0	0	0	3.6
55	Cooke Aquaculture (Scotland)	Vestness	0	19	0	0	0	18.4

The following two charts, using this same dataset, show the percentage of salmon farms in this group (*Salmon farms that ended a production cycle at some point in 2020)* that reported a sea lice average, for an entire calendar month, in excess of either 1.0 or 2.0 sea lice per fish at any point in the production cycle.

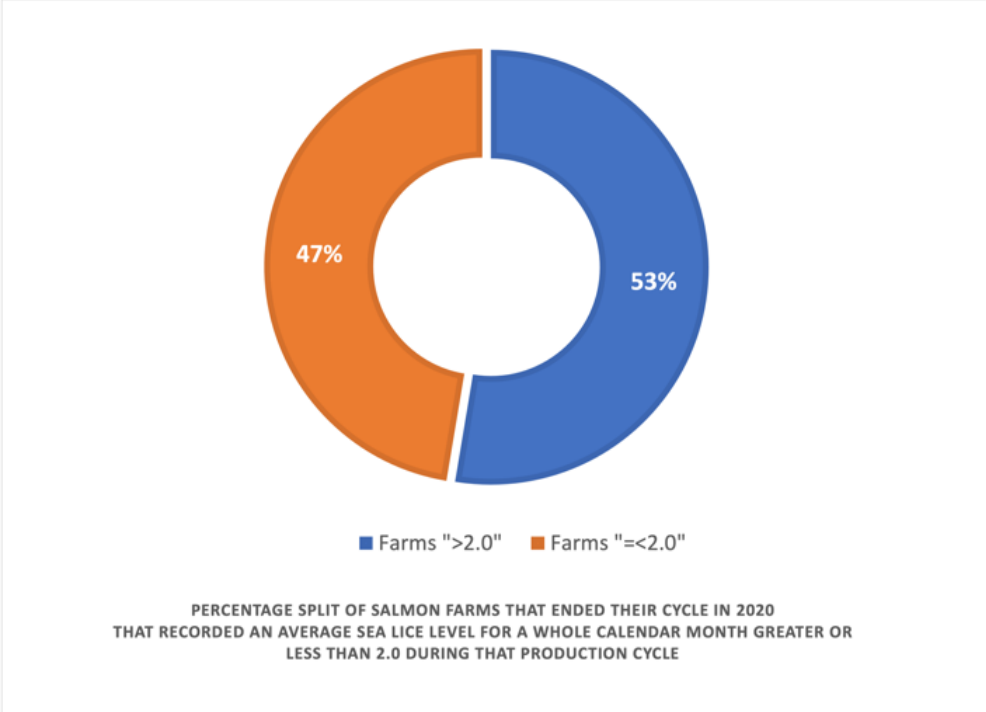
If representative of previous years, this shows that 73% of salmon farms are likely to breach a sea lice average of 1.0 during a production cycle for a calendar month at least once. 53% would breach a sea lice average of 2.0 for a calendar month at least once.

However, analysis shows that breaches are not evenly distributed. Some farms had almost no breaches at all, whereas others were in breach almost constantly.

Lifecycle analysis of the previous production cycles shows these same farms exhibit the same issues.



PERCENTAGE SPLIT OF SALMON FARMS THAT ENDED THEIR CYCLE IN 2020 THAT RECORDED AN AVERAGE SEA LICE LEVEL FOR A WHOLE CALENDAR MONTH GREATER OR LESS THAN 1.0 DURING THAT PRODUCTION CYCLE



PERCENTAGE SPLIT OF SALMON FARMS THAT ENDED THEIR CYCLE IN 2020 THAT RECORDED AN AVERAGE SEA LICE LEVEL FOR A WHOLE CALENDAR MONTH GREATER OR LESS THAN 2.0 DURING THAT PRODUCTION CYCLE

DIVING DEEPER

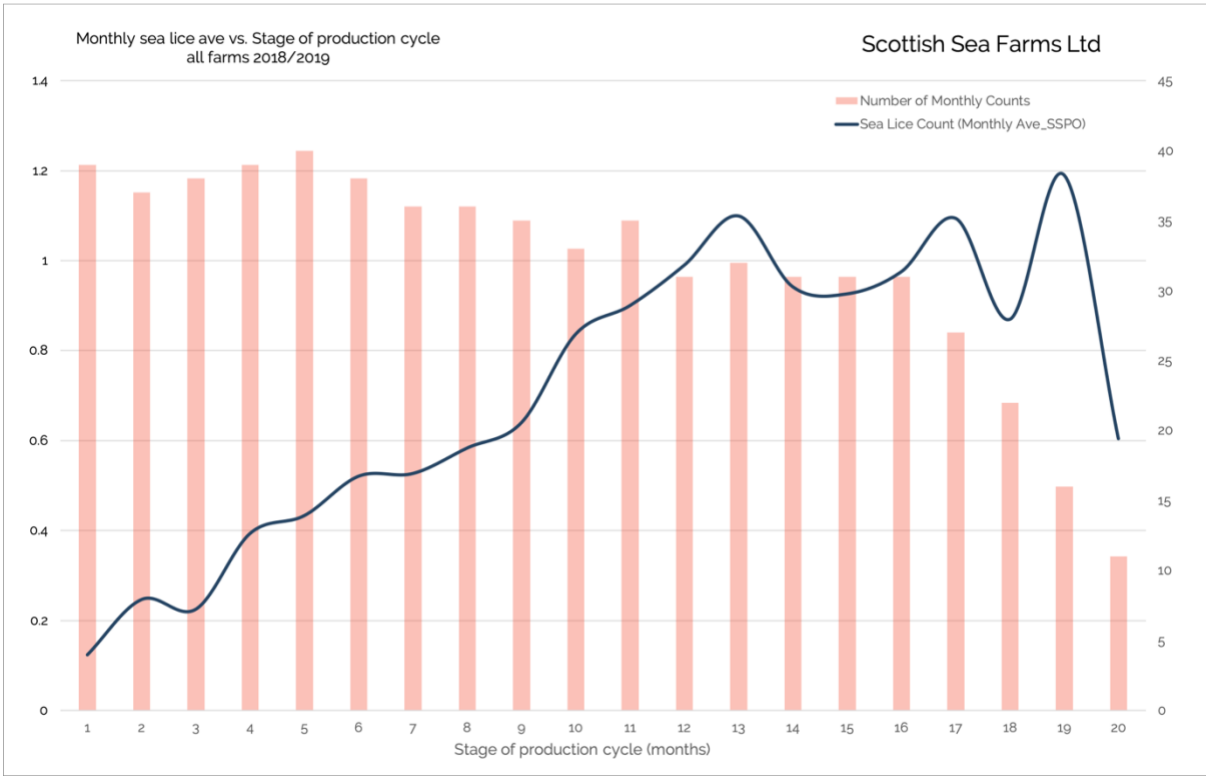
The following charts illustrate how this analysis can be extended given adequate resource.

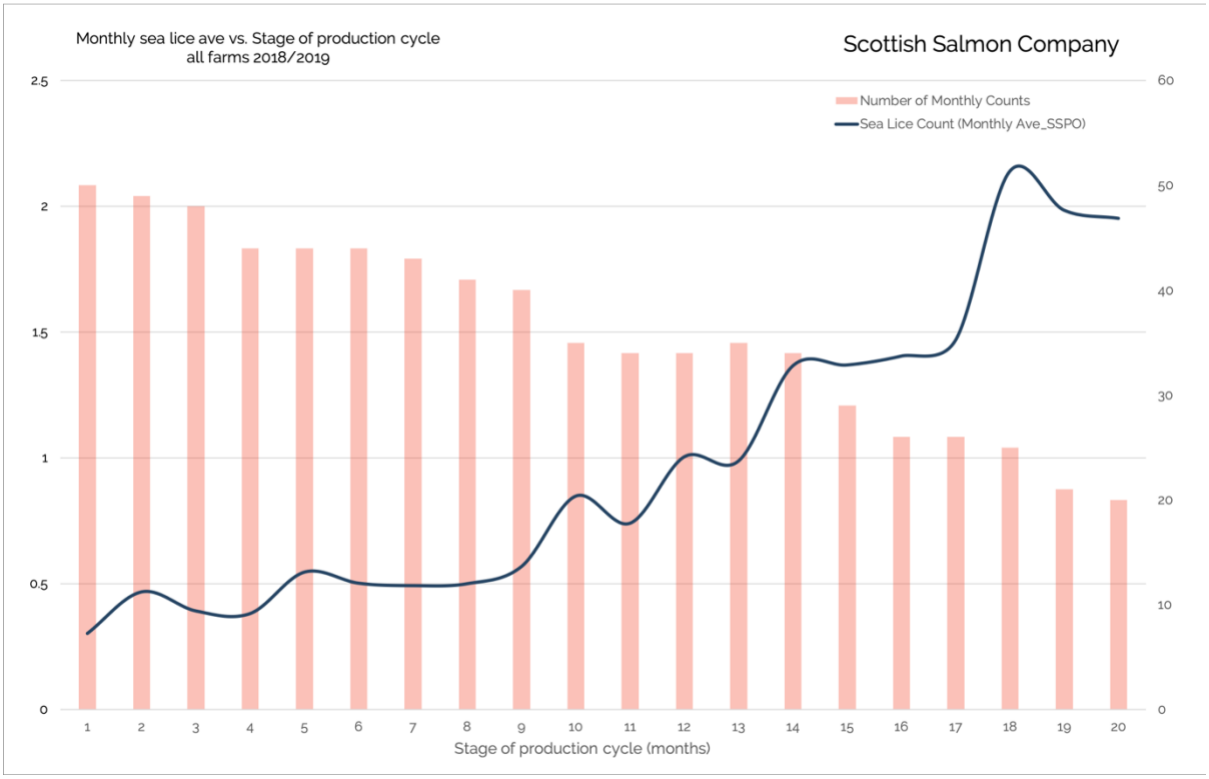
It is now possible, having combined a number of databases into a single proprietary database, to cut and slice data in a range of ways, more conducive to meaningful insight that can be used to lobby for policy change and/or action by managers of natural assets that interact with salmon farms.

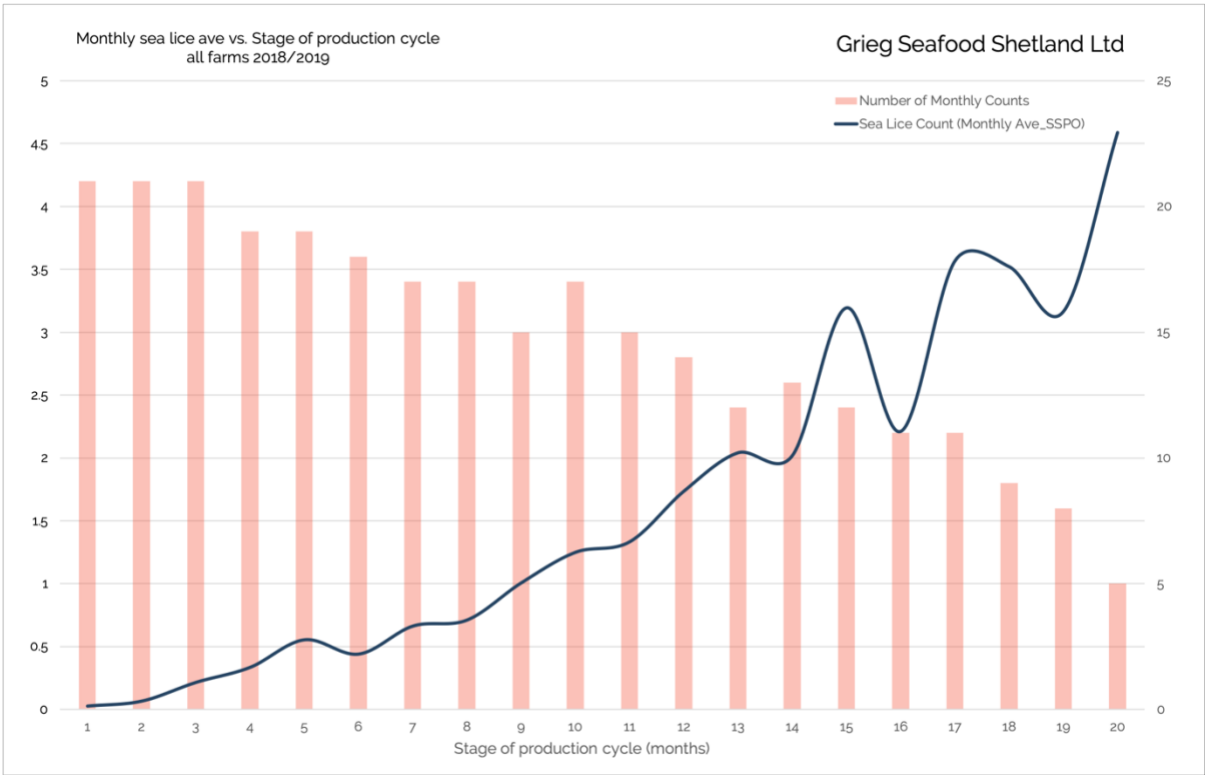
Data from 2018/19 is used (2020 data is not available as SEPA has yet to publish some data sets that are required).

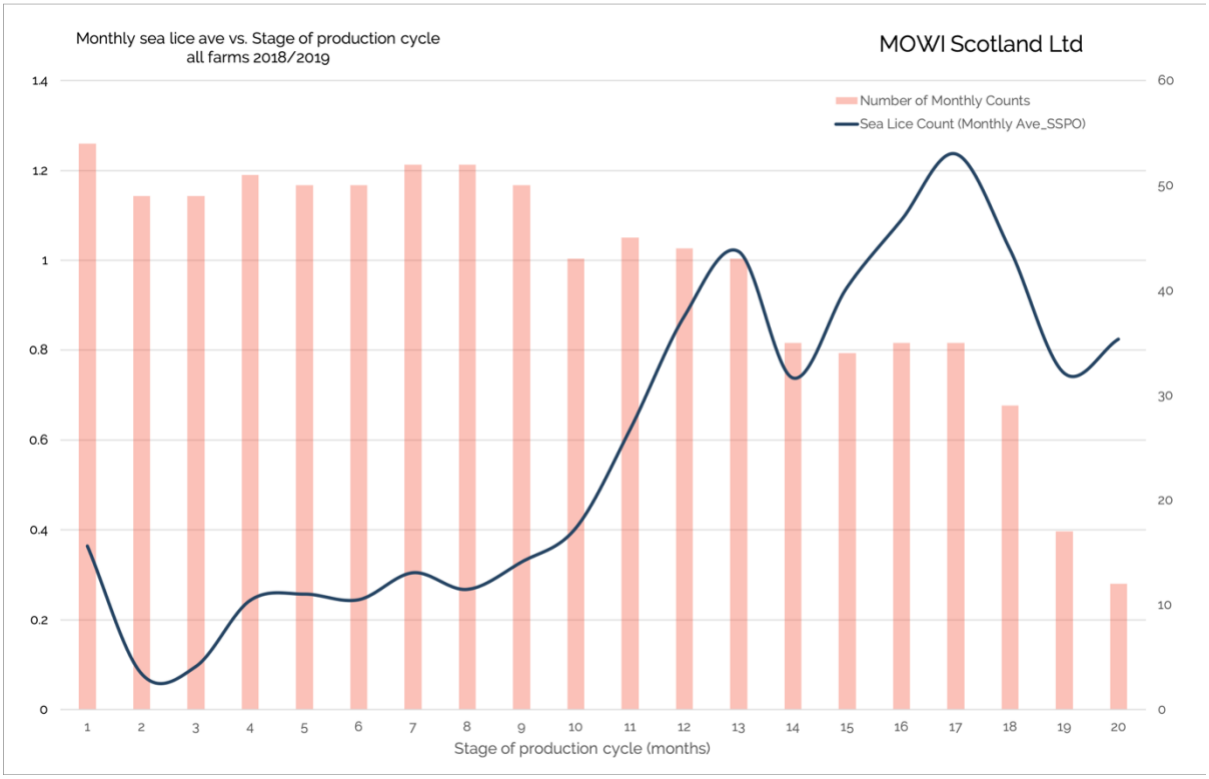
The charts below set average sea lice counts on salmon farms, per operator, throughout the production cycle.

The blue line chart shows the average sea lice level at this stage of the production cycle. The pink stacked chart shows the number of counts that were recorded for this stage in production.




Monthly sea lice ave vs. Stage of production cycle
all farms 2018/2019
Scottish Salmon Company
Number of Monthly Counts
Sea Lice Count (Monthly Ave_SSPO)
2.5
2
1.5
1
0.5
0
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Stage of production cycle (months)


Monthly sea lice ave vs. Stage of production cycle
all farms 2018/2019
Grieg Seafood Shetland Ltd
Number of Monthly Counts
Sea Lice Count (Monthly Ave_SSPO)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Stage of production cycle (months)



NOTE: The sharp drop in sea lice average after 20 months of production is owing to the difficulty of precisely identifying the beginning and end of production cycles in the datasets. Hence, the beginning of some cycles is incorrectly perceived by some of the algorithms to be the end of a cycle. The beginnings of cycles are generally associated with very low sea lice abundance, so this drags the average down, when included with true late cycle data. This will cease to be an issue in future years.