

# THE WELFARE STATUS OF SALMON FARMS AND COMPANIES IN SCOTLAND

A REPORT BY ONEKIND



**OneKind**

Ending cruelty to Scotland's animals



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## 1 Introduction

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There are serious fish welfare concerns on Scotland's salmon farms. We believe that these issues need to be urgently addressed so that fish involved in salmon farming live good lives that are free from suffering. To deliver this, a new approach needs to be taken by the industry, which puts high standards of welfare at the front and centre of everything, meeting demands by consumers and the Scottish public.

This report aims to encourage this transition by assessing the welfare performance of every salmon farm and every salmon farming company in Scotland relative to each other. The analysis is

based entirely on publicly available data, most of which is published via the multi-government agency initiative *Scotland's Aquaculture*. Short of visiting and assessing every salmon farm in the country, this is the only objective means by which stakeholders can assess relative welfare performance.

We hope that the results of this analysis will act as a reminder to the industry, government, stakeholders, and the public of the importance of fish welfare, and that, alongside other initiatives in this field, it will encourage improvement of fish welfare on salmon farms in Scotland.

## 2 Our approach

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OneKind has collated publicly available data on mortalities, escapes, biomass exceedance, seal shooting and sea lice burdens for each salmon farm operating in Scotland in 2017. This data has allowed us to create a “league table” that ranks both farms and companies by their performance, based on these criteria. We intend on updating the league tables and publishing them on an annual basis hereafter.

### 2.1 The welfare issues considered in the league tables

The league tables presented in this report are built on data relating to the following five welfare criteria. They have been selected partly because this is the data that is publicly available, but taken together we consider them to be good proxies of the level of suffering and animal welfare issues on individual salmon farms.

#### 2.1.1 Mortality

High mortality levels indicate severe welfare problems on salmon farms, as death is rarely instantaneous (Ellis *et al.* 2012). In 2016, 10 million salmon died on seawater farms in Scotland, and this is estimated to have increased to over 11 million in 2017 (Marine Scotland Science, 2016; Scotland’s Aquaculture, 2017).

#### 2.1.2 Escapes

Farmed salmon that escape suffer as they are no longer well adapted to the wild. Many are deaf, have deformed heart shapes and spinal deformities (Reimer *et al.* 2017, Poppe *et al.* 2003, Sambraus *et al.* 2014). This means that once they have escaped, they will struggle to survive. That being said, there is evidence that escaped farmed salmon can compete and interbreed with wild individuals (Karlsson *et al.* 2016). This compromises the health of wild populations as it leads to the creation of offspring with reduced fitness.

#### 2.1.3 Exceeding biomass limits

Biomass limits are set by the Scottish Environment Protection Agency (SEPA) and are determined through the use of mathematical modelling. Currently, the maximum biomass that farms are allowed is 2,500 tonnes (estimated 500,000 to 2.5 million fish, depending on their weight<sup>1</sup>). Exceeding biomass limits compromises the welfare of salmon

as it reduces the amount of space available for each fish. This can lead to increased aggression, increased disease spread and reduced water quality (Canon-Jones *et al.* 2011, Sunberg *et al.* 2016, Kolarevic *et al.* 2012).

#### 2.1.4 Seal shooting

The control of predators, primarily seals, by lethal means whilst not a fish welfare problem, has been included into our league table due to the significant public concern about seal killing, and the wider animal welfare implications. Whilst the number of seals shot in Scotland has declined as a result of the introduction of licensing under the Marine (Scotland) Act 2010, it does little to protect the seals that are shot. Research by Nunny *et al.* (2016) has shown that seals have been shot whilst in the water which increases the time to death, seals have been shot multiple times, and pregnant and lactating mothers have been shot, with implications for dependent young.

#### 2.1.5 Sea lice burdens

Sea lice are parasites that feed on the flesh, scales, tissues and muscle of salmon. This creates physical damage, leaving tissues exposed. This causes direct suffering to the salmon, but also creates an entrance for disease, as well as disrupting osmoregulation (water and salt levels) (Thorstad *et al.* 2015). Research has shown that sea lice can cause high levels of stress, as well as mortality in salmon (Mustafa *et al.* 2000, Thorstad and Finstad, 2018).

There are two trigger levels that relate to sea lice, those set by the Code of Good Practice for Finfish Aquaculture (CoGP), and those set by the Scottish Government. The CoGP sets trigger levels for treatment of an average female lice burden of 0.5 or 1, depending on the time of year. The Scottish Government trigger levels, introduced in 2016, set trigger levels of an average adult female lice burden of three (for the completion of a sea lice “action plan”) and eight (for enforcement action). For our league tables, we counted the number of times that farms exceeded trigger levels of an average burden of three adult female lice, as this level has previously been used to identify good and bad performers (Salmon and Trout Conservation Trust, 2018).

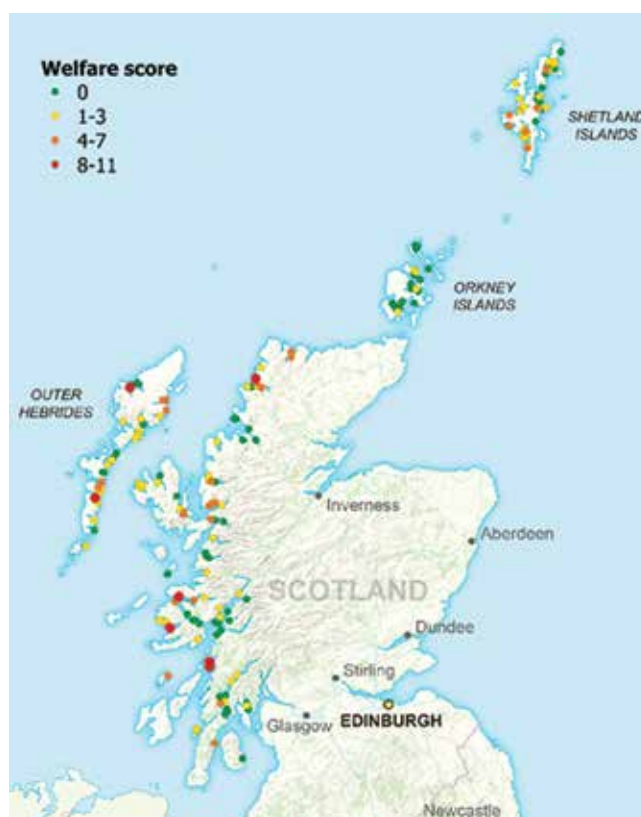
<sup>1</sup> Lower limit assumes all salmon weigh 5kg, upper limit assumes all salmon weigh 1kg

### 3 The salmon farm league table

The complete league table with all salmon farms active in 2017 can be found in Annex 1 to this report, with farm locations shown in Figure 1 (right). Please note that the lower the score, the higher the welfare standards on the farm.

Our analysis shows that in 2017, 79 (43 %) salmon farms in Scotland had no incidents of seal shooting, escapes, average female sea lice burdens of greater than 3, exceedance of biomass and monthly mortality of  $\geq 10\%$ . Whilst this does not rule out that these farms may compromise animal welfare in other ways (e.g. cleaner fish welfare) it does suggest that, at least for the criteria we analysed, some salmon farms can be a lot better for animal welfare.

From our analysis, seven farms stood out as having the most welfare issues (Table 1, Figure 1). Of these seven, Poll na Gille, operated by Marine Harvest, was ranked to be poorest for animal welfare in 2017 (Table 1).



**Figure 1.** Location of active salmon farms in 2017, showing their rank in the league table  
 Source: Scotland's Aquaculture website  
 Contains OS data © Crown copyright and database right (2018)

**Table 1.** The top 7 worst performing salmon farms for animal welfare in 2017.

Rank	Farm	Company	Mortality score	Escape score	Biomass score	Seal score	Sea lice score	Welfare score
1	Poll na Gille	Marine Harvest	0	3	3	3	2	11
2	MacLean's Nose	Marine Harvest	3	3	0	3	0	9
=	Bagh Dail nan Ceann	Marine Harvest	0	0	3	3	3	9
=	Vuia Beag	The Scottish Salmon Co.	3	3	0	3	0	9
3	Inch Kenneth	The Scottish Salmon Co.	3	0	0	3	2	8
=	Badcall Bay	Loch Duart Ltd.	3	0	0	3	2	8
=	Loch Carnan	Loch Duart Ltd.	3	0	0	3	2	8

We also looked into the geographic distribution of farms in Scotland, analysing welfare performance by local authority area (purely for clarity of geographic categorisation - local authorities do not inspect or monitor salmon farms). From this we found that on average, salmon farms located in the Highlands and Eilean Siar were worse for animal welfare (Table 2).

**Table 2.** Local authority areas ranked by their animal welfare score.

Local authority	No. of farms	Average welfare score
Highland	49	2.63
Eilean Siar	33	2.63
Argyll and Bute	37	2.46
Shetland	43	2.19
Orkney	22	0.55
North Ayrshire	1	0



## 4 The salmon farming company league table

The table below shows how the eight salmon farming companies in Scotland compared on welfare performance. To account for the varying sizes of companies, we calculated an average welfare score per fish farm (see Annex 2 for further information). The variation between companies is significant and does not appear to be linked to the overall size of the company. Indeed, the company with the worst average animal welfare score in 2017 was Loch Duart Ltd., a small company, and Cooke Aquaculture, a large company, was amongst the top performers. Of the four large salmon farming companies in Scotland, Marine Harvest scored the worst for animal welfare in 2017.

**Table 3.** Average welfare score of salmon farming companies, in 2017, ranked from best to worst performing.

Rank	Company	No. of salmon farms 2017	No. of times monthly mortality was $\geq 10\%$	No. of escapes	No. of times biomass limits exceeded	No. of Seals shot	No. of sea lice trigger level breaches	Avg. welfare score
1 (Best)	Wester Ross Fisheries	3	0	0	0	0	0	0.0
	Cooke Aquaculture Scotland	33	9	0	0	1	30	1.3
	Scottish Sea Farms Ltd.	42	12	2	0	12	91	1.6
	Kames Fish Farming	1	0	0	0	0	2	2.0
	Grieg Seafood Shetland Ltd.	18	3	1	0	1	193	2.3
	The Scottish Salmon Co. Ltd.	41	23	2	0	7	133	2.5
	Marine Harvest (Scotland) Ltd.	37	11	8	11	13	64	3.1
8 (worst)	Loch Duart Ltd.	10	10	0	0	10	39	4.0

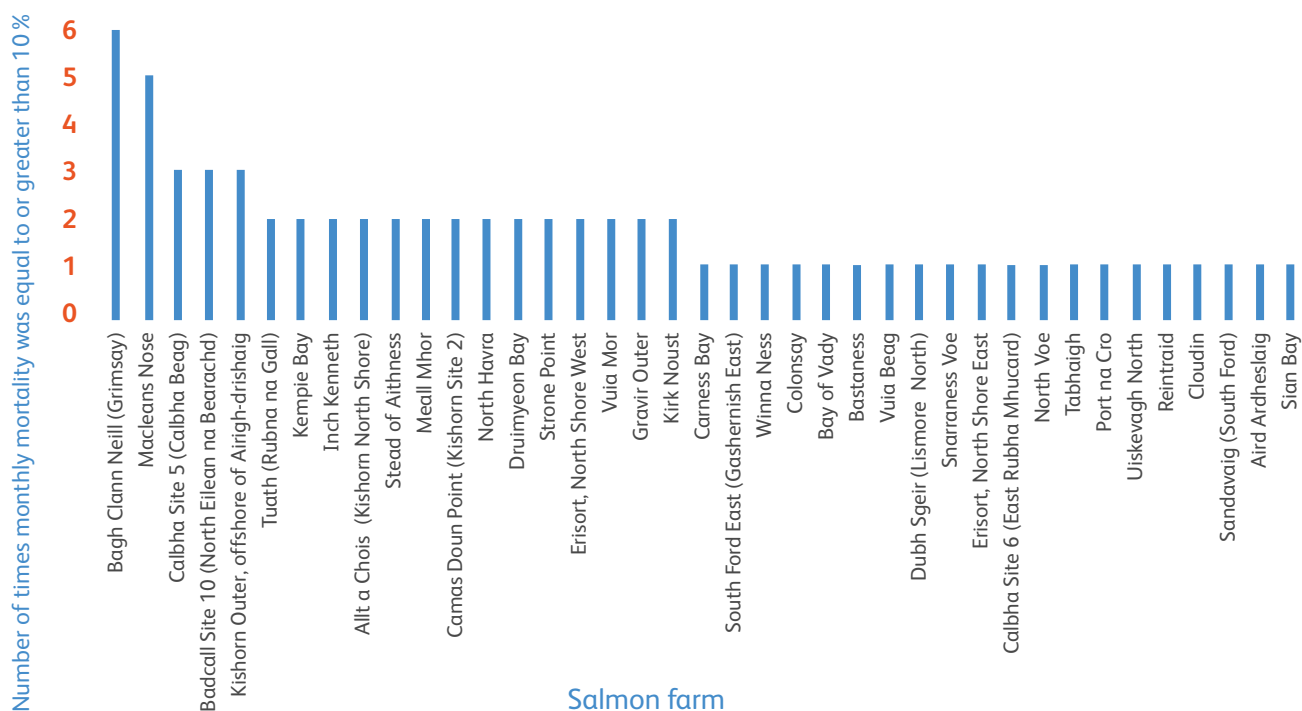
Wester Ross Fisheries is by far the standout company in 2017 for animal welfare. Across all three sites operating in 2017, there were no incidents of escapes, high sea lice levels, seal shooting, incidents of exceeding biomass limits or monthly mortality rates of  $\geq 10\%$ . Of the five larger companies, Cooke Aquaculture stands out as, on average, having sites that are better for animal welfare, with an average welfare score of 1.4 (Table 3).

## 5 Performance on key animal welfare criteria

### 5.1 Mortality

#### At the farm level

Total mortality in 2017 is estimated to be over 11 million individual salmon. There were 68 incidents of monthly mortality rates of  $\geq 10\%$  of biomass on site. The farm that documented the most incidents of monthly mortality of  $\geq 10\%$  in 2017 was Bagh Clann Neill (Grimsay), operated by The Scottish Salmon Company, with 6 months having mortality that was  $\geq 10\%$  biomass on site. This is closely followed by MacLean's Nose, operated by Marine Harvest, with 5 months of mortality of  $\geq 10\%$  (Figure 2).



**Figure 2.** Salmon farms with the greatest number of instances of monthly mortality of  $\geq 10\%$  of biomass on site.

#### At the company level

Of the 68 incidents of monthly mortality of  $\geq 10\%$  of biomass, The Scottish Salmon Company had the largest proportion of these by far (34%) (Table 4).

Accounting for size variation, farms operated by Loch Duart Ltd. had the greatest number of months with mortality rates of  $\geq 10\%$  (Table 4).

**Table 4.** Number of times monthly mortality was greater than or equal to 10% of biomass by company in 2017.

Company	No. of times monthly mortality was $\geq 10\%$	Average/farm
The Scottish Salmon Co. Ltd.	23	0.53
Scottish Sea Farms Ltd.	12	0.3
Marine Harvest (Scotland) Ltd.	11	0.31
Loch Duart Ltd.	10	1
Cooke Aquaculture Scotland	9	0.29
Grieg Seafood Shetland Ltd.	3	0.09
Wester Ross Fisheries	0	0



## 5.2 Escapes

### At the farm level

There were 14 escape events involving 30,948 fish (salmon and cleaner fish), in 2017, from 12 salmon farms. This means that most farms (94 %) did not report escapes. Of those that did report escapes, most (86 %) only had one escape event, but two sites- Poll na Gille and Bloody Bay- reported two escape events.

### At the company level

Of 14 escape events in 2017, Marine Harvest was responsible for most (57 %) of these, with 8 escape events (Table 5).

**Table 5.** The number of fish escape events by salmon farming company, in 2017. \*Sunbeam Aquaculture Ltd. is not included in the overall league table as mortality data is not available for this company.

Company	No. of escape events 2017
Marine Harvest (Scotland) Ltd.	8
The Scottish Salmon Company	2
Scottish Sea Farms Ltd.	2
Grieg Seafood Shetland Ltd.	1
Sunbeam Aquaculture Ltd*	1

## 5.3 Exceeding biomass limits

### At the farm level

Only two sites exceeded biomass limits in 2017: Poll na Gille and Bagh Dail nan Ceann, both operated by Marine Harvest. Poll na Gille breached biomass limits 6 times in 2017, sometimes by up to 50 %. Bagh Dail nan Ceann breached biomass limits 5 times, with the largest amount exceeded being 18 % more biomass than licensed on site, in October.

### At the company level

Marine Harvest was the only company that operated sites that breached biomass limits in 2017. Overall, two sites operated by Marine Harvest exceeded biomass limits 11 times.

## 5.4 Seal shooting

### At the farm level

Twenty- six salmon farms shot at least one seal in 2017, totalling 49 seals shot. The farm that shot the most seals was Loch Carnan, operated by Loch Duart Ltd., which shot 9 seals. As well as this farm, 6 others shot more than one seal in 2017 (Table 6).

**Table 6.** Sites that shot the most seals in 2017.

Farm	Company	Seals shot		Total
		Common	Grey	
Loch Carnan	Loch Duart Ltd.	2	7	9
Vuia Beag	The Scottish Salmon Co.	0	6	6
Dury Voe	Scottish Sea Farms Ltd.	0	4	4
Bloody Bay	Scottish Sea Farms Ltd.	3	0	3
Slocka Ronas Voe	Scottish Sea Farms Ltd.	0	2	2
Greshornish	Marine Harvest (Scotland) Ltd.	0	2	2
Loch A Chairn Bhain	Loch Duart Ltd.	2	0	2

## At the company level

Marine Harvest shot the most (27 %) seals in 2017, shooting 13 seals, though this is closely followed by Scottish Sea Farms which shot 12 seals (Table 7).

However, when accounting for size variation of companies, Loch Duart Ltd. shot the most seals for its size (Table 7).

**Table 7.** The number of seals shot by salmon farming company, in 2017.

Company	Seals shot		Total	Average number of seals shot/farm
	Common	Grey		
Marine Harvest (Scotland) Ltd.	3	10	13	0.36
Scottish Sea Farms Ltd.	5	7	12	0.3
Loch Duart Ltd.	2	8	10	1
The Scottish Salmon Co.	1	6	7	0.16
Grieg Seafood Shetland Ltd.	0	1	1	0.06
Cooke Aquaculture Scotland	0	1	1	0.03
Wester Ross Fisheries	0	0	0	0
Kames Fish Farming Ltd.	0	0	0	0

## 5.5 Sea lice burdens

### At the farm level

77 sites breached sea lice trigger levels of an average female lice count of more than 3, in 2017. The farm that breached trigger levels the most was Score Holms, which breached trigger levels 28 times in 2017 (Table 8).

**Table 8.** Sites that breached trigger levels the most in 2017.

Farm	Company	Number of times trigger levels (>3 average female sea lice) were breached in 2017
Score Holms	Grieg Seafood Shetland Ltd.	28
Spoose Holm	Grieg Seafood Shetland Ltd.	25
North Papa	Grieg Seafood Shetland Ltd.	22
Dury Voe	Scottish Sea Farms Ltd.	20
North Havra	Grieg Seafood Shetland Ltd.	20
Loch Laxford	Loch Duart Ltd.	20
Langa Isle (East)	Grieg Seafood Shetland Ltd.	19
Gob Na Hoe	Grieg Seafood Shetland Ltd.	18
Sian Bay	Scottish Sea Farms	18
West of Burwick	Grieg Seafood Shetland Ltd.	17

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## At the company level

Farms operated by Grieg Seafood breached sea lice trigger levels of an average female lice count of 3 the most in 2017, compared to other companies, with farms owned by Grieg Seafood breaching trigger levels for a total number of 193 times in 2017 (Table 9).

**Table 9.** The number of times salmon farming companies exceeded sea lice trigger levels in 2017.

Company	Total number of times average sea lice burdens were >3 adult females	Average number of breaches/farm
Grieg Seafood Shetland Ltd.	193	10.7
The Scottish Salmon Company	135	3.1
Scottish Sea Farms Ltd.	91	2.3
Marine Harvest (Scotland) Ltd.	64	1.8
Loch Duart Ltd.	39	3.9
Cooke Aquaculture Scotland Ltd.	30	0.9
Kames Fish Farming Ltd.	2	2
Wester Ross Fisheries	0	0

## 6 Conclusions

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This is the first time that the animal welfare performance of Scotland's salmon farms and salmon farming companies has been ranked. We hope to further refine our approach in future years with feedback from stakeholders and the industry and as more data is made publicly available. From our initial analysis key observations include:

- There is significant range in performance, with the best farms and the best companies clearly experiencing lower mortality, disease and sea lice infestation rates.
- Some companies and many salmon farms killed no seals at all in 2017, questioning the need for others to continue with this practice.

This project aimed to compile league tables and in doing so to understand the range in performance between farms and companies. As part of the next stage, we hope to build an understanding of the reasons behind this variation, and to identify what can be learnt from the best and worst performers.

## 7 Annex 1: The salmon farm league table

Site	Company	Mortality score	Escape score	Biomass score	Seal score	Sea lice score	Total welfare score
Poll na Gille	Marine Harvest (Scotland) Ltd.	0	3	3	3	2	11
MacLeans Nose	Marine Harvest (Scotland) Ltd.	3	3	0	3	0	9
Bagh Dail nan Ceann	Marine Harvest (Scotland) Ltd.	0	0	3	3	3	9
Vuiabeag	The Scottish Salmon Company	3	3	0	3	0	9
Badcall Bay	Loch Duart Ltd.	3	0	0	3	2	8
Loch Carnan	Loch Duart Ltd.	3	0	0	3	2	8
Inch Kenneth	The Scottish Salmon Company	3	0	0	3	2	8
Bastaness	Cooke Aquaculture Scotland Ltd.	3	0	0	0	3	6
Cloudin	Cooke Aquaculture Scotland Ltd.	3	0	0	0	3	6
North Havra	Grieg Seafood Shetland Ltd.	3	0	0	0	3	6
Calva Bay	Loch Duart Ltd.	3	0	0	3	0	6
Loch a Chairn Bhain	Loch Duart Ltd.	3	0	0	3	0	6
Colonsay	Marine Harvest (Scotland) Ltd.	3	3	0	0	0	6
Eilean Grianain	Marine Harvest (Scotland) Ltd.	0	0	0	3	3	6
Cairidh	Marine Harvest (Scotland) Ltd.	0	0	0	3	3	6
Sian Bay	Scottish Sea Farms Ltd.	3	0	0	0	3	6
Dury Voe (North Nesting Site 2)	Scottish Sea Farms Ltd.	0	0	0	3	3	6
Teisti Geo	Scottish Sea Farms Ltd.	0	0	0	3	3	6
Bloody Bay	Scottish Sea Farms Ltd.	0	3	0	3	0	6
Bagh Chlann Neil	The Scottish Salmon Company	3	0	0	0	3	6
Gravir Outer	The Scottish Salmon Company	3	0	0	0	3	6
North Uiskevagh	The Scottish Salmon Company	3	0	0	0	3	6

Tabhaigh	Marine Harvest (Scotland) Ltd.	3	0	0	0	2	5
Port na Cro	Marine Harvest (Scotland) Ltd.	3	0	0	0	2	5
Loch Alsh (Sron)	Marine Harvest (Scotland) Ltd.	0	3	0	0	2	5
North Shore	Marine Harvest (Scotland) Ltd.	0	3	0	0	2	5
Maol Ban	Marine Harvest (Scotland) Ltd.	0	0	0	3	2	5
Camas Glas	Marine Harvest (Scotland) Ltd.	0	0	0	3	2	5
Kishorn West (Outer)	Scottish Sea Farms Ltd.	3	0	0	0	2	5
Kishorn B (Allt a Chois)	Scottish Sea Farms Ltd.	3	0	0	0	2	5
Kempie bay	Scottish Sea Farms Ltd.	3	0	0	0	2	5
Kishorn A	Scottish Sea Farms Ltd.	3	0	0	0	2	5
Snaranness Voe	Scottish Sea Farms Ltd.	3	0	0	0	2	5
Meall Mhor	The Scottish Salmon Company	3	0	0	0	2	5
Aird	The Scottish Salmon Company	3	0	0	0	2	5
Geasgill	The Scottish Salmon Company	0	3	0	0	2	5
Kirk Noust	Cooke Aquaculture Scotland Ltd.	3	0	0	0	0	3
Stead of Aithness	Cooke Aquaculture Scotland Ltd.	3	0	0	0	0	3
Bay of Vady	Cooke Aquaculture Scotland Ltd.	3	0	0	0	0	3
Carness Bay	Cooke Aquaculture Scotland Ltd.	3	0	0	0	0	3
Winna Ness	Cooke Aquaculture Scotland Ltd.	3	0	0	0	0	3
Vee Taing	Cooke Aquaculture Scotland Ltd.	0	0	0	0	3	3
Uyea Isle	Cooke Aquaculture Scotland Ltd.	0	0	0	0	3	3
West Fara	Cooke Aquaculture Scotland Ltd.	0	0	0	3	0	3
North Voe	Grieg Seafood Shetland Ltd.	3	0	0	0	0	3

Score Holms	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Spoose Holm	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
North Papa	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Langa Isle (East)	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Gob na Hoe	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
West of Burwick	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Leinish	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Corlarach	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
East of Papa	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Cole Deep	Grieg Seafood Shetland Ltd.	0	0	0	0	3	3
Setterness North (Bomlo)	Grieg Seafood Shetland Ltd.	0	3	0	0	0	3
Loch Laxford	Loch Duart Ltd.	0	0	0	0	3	3
Clashnessie bay/ Oldany	Loch Duart Ltd.	0	0	0	0	3	3
Outer Bay (Loch Droighniche)	Loch Duart Ltd.	0	0	0	3	0	3
Lochmaddy (Loch Portain and ferramus)	Loch Duart Ltd.	0	0	0	3	0	3
Hellisay	Marine Harvest (Scotland) Ltd.	0	0	0	0	3	3
Soay Sound	Marine Harvest (Scotland) Ltd.	0	0	0	0	3	3
Greshornish	Marine Harvest (Scotland) Ltd.	0	0	0	3	0	3
Scotasay	Marine Harvest (Scotland) Ltd.	0	0	0	3	0	3
Isle Ewe	Marine Harvest (Scotland) Ltd.	0	0	0	3	0	3
Sconser	Marine Harvest (Scotland) Ltd.	0	0	0	3	0	3
Ardnish	Marine Harvest (Scotland) Ltd.	0	0	0	3	0	3
Creag an T'Sagairt	Marine Harvest (Scotland) Ltd.	0	3	0	0	0	3

Invasion Bay	Marine Harvest (Scotland) Ltd.	0	3	0	0	0	3
Lismore North	Scottish Sea Farms Ltd.	3	0	0	0	0	3
Loura Voe	Scottish Sea Farms Ltd.	0	0	0	0	3	3
Holms Geo	Scottish Sea Farms Ltd.	0	0	0	0	3	3
Foreholm	Scottish Sea Farms Ltd.	0	0	0	0	3	3
Slocka Ronas Voe	Scottish Sea Farms Ltd.	0	0	0	3	0	3
Loch Spelve	Scottish Sea Farms Ltd.	0	0	0	3	0	3
Druimyeon Bay	The Scottish Salmon Company	3	0	0	0	0	3
Strone Point	The Scottish Salmon Company	3	0	0	0	0	3
Tuath (Rubha na Gall)	The Scottish Salmon Company	3	0	0	0	0	3
Vuia Mor	The Scottish Salmon Company	3	0	0	0	0	3
Reibinish	The Scottish Salmon Company	0	0	0	0	3	3
Ardcastle	The Scottish Salmon Company	0	0	0	0	3	3
Greanamul	The Scottish Salmon Company	0	0	0	0	3	3
Strome	The Scottish Salmon Company	0	0	0	0	3	3
Kilervagh (Petersport)	The Scottish Salmon Company	0	0	0	0	3	3
Plocrapol	The Scottish Salmon Company	0	0	0	0	3	3
Scadabay	The Scottish Salmon Company	0	0	0	0	3	3
Quarry Point	The Scottish Salmon Company	0	0	0	0	3	3
Gob a Bharra	The Scottish Salmon Company	0	0	0	0	3	3
Sgeir Dughall	The Scottish Salmon Company	0	0	0	0	3	3
Turness	Cooke Aquaculture Scotland Ltd.	0	0	0	0	2	2

Djuba Wick	Cooke Aquaculture Scotland Ltd.	0	0	0	0	2	2
Wick of Belmont	Cooke Aquaculture Scotland Ltd.	0	0	0	0	2	2
Shuna SW (Rubha an Trilleachain)	Kames Fish Farming Ltd.	0	0	0	0	2	2
Caolas a Deas	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
Groatay	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
Stulaigh	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
Linnhe	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
Ornish Island (Skipport Outer)	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
Kingairloch	Marine Harvest (Scotland) Ltd.	0	0	0	0	2	2
South Sound, Mangaster Voe	Scottish Sea Farms Ltd.	0	0	0	0	2	2
Trilleachan Mor	The Scottish Salmon Company	0	0	0	0	2	2
East Tarbert Bay	The Scottish Salmon Company	0	0	0	0	2	2
Gometra	The Scottish Salmon Company	0	0	0	0	2	2
Maragay Mor	The Scottish Salmon Company	0	0	0	0	2	2
Kenmore Bay	The Scottish Salmon Company	0	0	0	0	2	2
Balta Island	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Basta Voe North West (Kirkabister)	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Bay of Cleat	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Bay of Meil	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Bow of Hascosay	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Burrastow	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Cava South	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0



Chalmers Hope	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Flaeshins	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Lyrawa Bay	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Ness of Copister	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
North Sandwick	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Ouseness	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Pegal Bay	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Point of Burkwell (Site 5)	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Quanterness	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Vestness	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Wick of Vatsetter	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Bay of Cleat North	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
Bay of Ham	Cooke Aquaculture Scotland Ltd.	0	0	0	0	0	0
East of Langa	Grieg Seafood Shetland Ltd.	0	0	0	0	0	0
Linga (South of Linga)	Grieg Seafood Shetland Ltd.	0	0	0	0	0	0
Ru Chorachan	Grieg Seafood Shetland Ltd.	0	0	0	0	0	0
Swining Voe Site 3 (collafirth Ness)	Grieg Seafood Shetland Ltd.	0	0	0	0	0	0
Taing of Railsborough	Grieg Seafood Shetland Ltd.	0	0	0	0	0	0
Drumbeg	Loch Duart Ltd.	0	0	0	0	0	0
Sound of Harris	Loch Duart Ltd.	0	0	0	0	0	0
Seaforth	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Am Maol, Isle of Muck	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0

Ardintoul	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Callert (Leven)	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Camas an Leim (Torridon)	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Duich	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Grey Horse Channel	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Marulaig Bay	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Noster	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Gorsten	Marine Harvest (Scotland) Ltd.	0	0	0	0	0	0
Nevis B (Stoull)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Vidlin North	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Tanera	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Achnacroish (Walters, Lismore East)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Nevis C (Ardintigh)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Bellister	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Bring Head	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Charlottes Bay (Kerrara B)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Creran B	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Dunstaffnage	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Earnsaig (Nevis A)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Eday Sound (Noust Geo)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Eilean Fada Mor	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Fishnish A	Scottish Sea Farms Ltd.	0	0	0	0	0	0

Fishnish B	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Fiunary	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Lismore West (Port nan Ledaig)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Puldrite Bay	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Scallastle Bay	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Shuna	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Toyness	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Veantraw Bay	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Westerbister	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Wyre (Gairsay)	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Creran A	Scottish Sea Farms Ltd.	0	0	0	0	0	0
Strondoir Bay	The Scottish Salmon Company	0	0	0	0	0	0
Ardgaddan	The Scottish Salmon Company	0	0	0	0	0	0
Ardyne (Baigh au Sgairbh)	The Scottish Salmon Company	0	0	0	0	0	0
Eilean Treanay	The Scottish Salmon Company	0	0	0	0	0	0
Eport Outer (Sgeir n Lolla)	The Scottish Salmon Company	0	0	0	0	0	0
Glenan Bay	The Scottish Salmon Company	0	0	0	0	0	0
Kyles Vuia East	The Scottish Salmon Company	0	0	0	0	0	0
Loch Portree (Torvaig)	The Scottish Salmon Company	0	0	0	0	0	0
Rubha Stillaig	The Scottish Salmon Company	0	0	0	0	0	0
Sgian Dubh	The Scottish Salmon Company	0	0	0	0	0	0
St Molios	The Scottish Salmon Company	0	0	0	0	0	0
Taranaish	The Scottish Salmon Company	0	0	0	0	0	0

Tarbert South	The Scottish Salmon Company	0	0	0	0	0	0
Vacasay, Roag	The Scottish Salmon Company	0	0	0	0	0	0
Ardessie A	Wester Ross Fisheries	0	0	0	0	0	0
Ardmair (Isle Martin)	Wester Ross Fisheries	0	0	0	0	0	0
Ardmair (Isle Martin)	Wester Ross Fisheries	0	0	0	0	0	0
Corry, Loch Broom	Wester Ross Fisheries	0	0	0	0	0	0



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## 8 Annex 2: Methodology for assessing the welfare status of Scotland's salmon farms

We looked at publicly available data relating to fish welfare on salmon farms in Scotland for 2017. A league table was produced for each of the five criteria, and to develop a consolidated league table we assigned each fish farm a score for each criterion.

### Mortalities:

We calculated monthly mortality (%) using site mortality (Kg) and monthly biomass (the maximum tonnage of fish held on site during the month) data published on the Scottish Aquaculture website. The number of times that sites had a monthly mortality of  $\geq 10\%$  of biomass on site was recorded, and this was used in the league table.

Some sites have multiple areas licensed within them, and therefore have multiple biomass and mortality reports, which were added together to provide one mortality figure, and one biomass figure. The following salmon farms are structured in this way:

- Loch Carnan, comprises of: South Ford (Gashernish), Sandavaig (South Ford) and South Ford East (Gashernish East)
- Badcall Bay, comprises of sites 9, 10, 11 and 12
- Eilean Grianain includes Carradale North and South
- Loch a Chairn Bhain includes Torgawn and Reintraid
- Lochmaddy includes Caolas Loch Portain and Ferramus
- Loch Laxford, includes sites 1, 2, 3 and 4
- North shore includes Erisort West and Erisort East
- Tanera includes Tanera 1 and Tanera 2
- Caolas a Deas includes Caolas a Deas West and East
- Vidlin North includes Vidlin North and Vidlin Outer
- Kishorn A includes Achintraid (Kishorn Site 1) and Camas Doun Point (Kishorn Site 2)
- Calva Bay (Calbha Beag) includes Calbha sites 5, 6, 7 and 8
- Lismore North includes Port na Moralachd (Lismore A) and Dubh Sgeir (Lismore North)

### Escapes:

Data on escapes was obtained from the Scottish Aquaculture website which includes escapes of both

salmon and cleaner fish and provides the cause of the escape.

### Biomass:

The number of times biomass limits were exceeded was obtained from the Scottish Aquaculture website. This data refers only to farmed fish biomass and does not include cleaner fish weight.

### Seal Shooting:

Data on the number of seals shot on salmon farms was obtained from the Seal Licensing page on the Scottish Government website.

### Sea lice:

Sea lice data for 2018 is now published by the Scottish Salmon Producers Organisation. Any data on sea lice prior to this point is only available from published FOI's (with week 46 missing) which we used to create our league table.

This information provides us with the number of times that each site exceeded the Scottish Government's trigger level of an average sea lice burden of 3 adult female sea lice per fish, on a weekly basis.

### Developing the consolidated league table

To develop a consolidated league table, we scored each fish farm for each of the five welfare criteria. This was done by scoring farms based on their position within the distribution of values (Table 10).

Each farm was assigned a score for each category, with a score between 0 and 3, with 3 indicating poorer welfare. As there are five categories within the league table, the maximum welfare score a farm could achieve is 15, with higher scores indicating poorer welfare.

**Table 10.** How percentile values correspond to league table ranks.

Percentile	Score
<0.25	0
0.25 <0.5	1
0.5 <0.75	2
>0.75	3

## 9 Annex 3: Methodology for assessing the welfare status of companies

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As well as completing a league table for individual farms, we also created 2017 and 2013-2017 league tables for companies. This was done by finding the average welfare score of farms operated by different companies.

To do this we totalled up scores for each salmon farm within a company, using the methodology outlined in Appendix 1. To account for variation in the size of companies, we then divided this total by the number of salmon farms that each company operated in 2017. Higher welfare scores indicate greater animal welfare issues.

## 10 References

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- Canon-Jones, H.A., Noble, C., Damsgard, B. and Pearce, P.P., 2011. Social network analysis of the behavioural interactions that influence the development of fin damage in Atlantic salmon parr (*Salmo salar*) held at different stocking densities. *Applied Animal Behaviour Science*, 133(1), pp.117-126.
- Ellis, T., Berrill, I., Lines, J., Turnbull, J.F. and Knowles, T.G., 2011. Mortality and fish welfare. *Current Views on Fish Welfare*, pp.189-199.
- Karlsson, S., Diserud, O.H., Fiske, P. and Hindar, K., 2016. Widespread genetic introgression of escaped farmed Atlantic salmon in wild salmon populations. *ICES Journal of Marine Science: Journal du Conseil*, 73(10), pp.2488-2498.
- Kolarevic, J., Selset, R., Felip, O., Good, C., Snekvik, K., Takle, H., Ytteborg, E., Baeverfjord, G., Åsgård, T. and Terjesen, B.F., 2012. Influence of long term ammonia exposure on Atlantic salmon (*Salmo salar* L.) parr growth and welfare. *Aquaculture Research*.
- Marine Scotland Science. 2016. Scottish Fish Farm Production Survey 2016.
- Mustafa, A., MacWilliams, C., Fernandez, N., Matchett, K., Conboy, G. and Burka, J. 2000. Effects of sea lice (*Lepeophtheirus salmonis* Krøyer, 1837) infestation on macrophage functions in Atlantic salmon (*Salmo salar* L.). *Fish & Shellfish Immunology*, 10(1), pp.47-59.
- Nunny, L., Langford, F. and Simmonds, M.P., 2016. Does the Seal Licensing System in Scotland Have a Negative Impact on Seal Welfare? *Frontiers in Marine Science*, 3.
- Poppe, T., Johansen, R., Gunnes, G. and Tørud, B., 2003. Heart morphology in wild and farmed Atlantic salmon *Salmo salar* and rainbow trout *Oncorhynchus mykiss*. *Diseases of Aquatic Organisms*, 57, pp.103-108.
- Reimer, T., Dempster, T., Wargelius, A., Fjellidal, P.G., Hansen, T., Glover, K.A., Solberg, M.F. and Swearer, S.E., 2017. Rapid growth causes abnormal vaterite formation in farmed fish otoliths. *The Journal of Experimental Biology*, 220(16), pp.2965-2969.
- Salmon and Trout Conservation Trust. 2018. Sea Lice Breaching Farm List. <https://www.salmon-trout.org/wp-content/uploads/2017/11/NewLiceBreachingList.pdf>
- Sambraus, F., Glover, K.A., Hansen, T., Fraser, T.W.K., Solberg, M.F. and Fjellidal, P.G., 2014. Vertebra deformities in wild Atlantic salmon caught in the Figgjo River, southwest Norway. *Journal of Applied Ichthyology*, 30(4), pp.777-782.
- Scotland's Aquaculture. 2018. Scotland's Aquaculture | Home. [online] Available at: <http://aquaculture.scotland.gov.uk/> [Accessed 20 Jul. 2018].
- Sundberg, L-R., Ketola, T., Laanto, E., Kinnula, H., Bamford, J.K.H., Penttinen, R. and Mappes, J., 2016. Intensive aquaculture selects for increased virulence and interference competition in bacteria. *Proceedings of the Royal Society B: Biological Sciences*, 283(1826), p.20153069.
- Thorstad, E. and Finstad, B. 2018. Impacts of salmon lice emanating from salmon farms on wild Atlantic salmon and sea trout. Norwegian Institute for Nature Research.
- Thorstad, E., Todd, C., Uglem, I., Bjørn, P., Gargan, P., Vollset, K., Halttunen, E., Kålås, S., Berg, M. and Finstad, B. 2015. Effects of salmon lice *Lepeophtheirus salmonis* on wild sea trout *Salmo trutta*—a literature review. *Aquaculture Environment Interactions*, 7(2), pp.91-113.





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