Wild sea trout population monitoring for Loch Sunart Environmental Management Plan (EMP)

2024

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Contents

1 Introduction

Coastal seine net and coastal fyke net surveys were undertaken in 2024 within Loch Sunart Farm Management Area (FMA) M-34. These surveys were conducted to monitor for sea lice (*Lepeophtheirus salmonis*) infection pressure on local wild sea trout (*Salmo trutta*) populations. *L. salmonis* is a native copepod ectoparasite that naturally occurs in the marine environment and is host-specific to salmonid species.

Monitoring was undertaken at two separate locations within Loch Sunart FMA in support of Mowi's Loch Sunart Environmental Management Plan (EMP). Sea trout monitoring within Loch Sunart has been undertaken previously and historical data are available for comparison with data collected during 2024 surveys.

2 Methodology

Surveys were undertaken at two locations within Loch Sunart FMA: Laga Bay and Strontian (Figure 1). Surveys were carried out across both locations between 20th May and 30th August 2024 (Table 1), aiming to sample as may sea trout as possible and practicable.

At Laga Bay, a coastal fyke net was used for all surveys, with the net being deployed at two separate locations within the vicinity of Laga Bay. At both locations, the net was fixed to the shore and set at a perpendicular angle, with anchors used to secure the net in position. Support with setting, checking and lifting the fyke net was provided by the local Mowi finfish farm at Laga Bay.

At Strontian, a 52m x 2.8m seine net was used for all surveys. The seine net was deployed from the shore using a rowing boat to set the net in a semi-circle before being retrieved from the shore. As many sweeps of the net as possible and practicable were completed on each visit, with surveys timed to coincide with favourable tidal conditions.

All surveys were undertaken according to the relevant coastal fyke nets Standard Operating Procedure (Lochaber Fisheries Trust, 2020) and sweep netting protocol (SFCC, 2007).

Trout were anaesthetised prior to data collection on length, weight and counts of sea lice. Following processing all trout were allowed to fully recover before being returned. Any non-target species were recorded and immediately returned to the area of capture.

Data on the physical characteristics and sea lice burdens of the trout sampled were recorded to calculate the following:

Prevalence of lice – percentage of trout sampled with a sea lice burden.
Abundance of lice – the average (mean) number of sea lice per trout.
Intensity of infection – the average (mean) number of sea lice per infected trout.

Lice were categorised into one of four life stages: the two attached stages copepodid and chalimus; the mobile stage (sub-adults and adults) and the ovigerous stage (gravid females with egg strings). Additional information was recorded on sea lice grazing damage and physical damage caused by predators on the seat trout.

Analysis was carried out using the Taranger *et al*. (2015) risk assessment framework which aims to categorise the increased lice-related risk of mortality to individual trout according to the number of lice present in relation to the body weight of the fish (no. lice/g).

The Taranger risk assessment framework assumes that small sea trout post-smolts (<150g body weight) will suffer 100% lice-related marine mortality, or premature return to freshwater, if they are infected with >0.3 lice/g fish weight. Furthermore, the lice-related marine mortality is estimated to be 50% if the infection is between 0.2 and 0.3 lice/g fish weight, 20% if the infection rate is between 0.1 and 0.2 lice/g fish weight, and finally 0% lice-related mortality if the salmon lice infection is <0.1 lice/g fish weight.

For larger sea trout (over 150g) the risk analysis assumes that increased lice-related mortality or compromised reproduction will be 100% in the group if they have >0.15 lice/g fish weight, 75% for lice infections between 0.10 and 0.15 lice/g fish weight, 50% for lice infections between 0.05 and 0.10 lice/g fish weight, 20% for lice infections between 0.01 and 0.05 lice/g fish weight and 0% if the salmon lice infection is <0.01 lice/g fish weight.

Total increased lice-related mortality risk or premature return to freshwater is calculated as the sum of the increased mortalities for each of the different “infection classes” in the sample, reflecting the distribution of the intensity of salmon lice infections of the different individuals sampled. The total risk to each infection class was further scored according to the system proposed by Taranger as low (up to 10% estimated increase in mortality), moderate (between 10 and 30% increase), and high (if the increase is calculated as 30% or more).

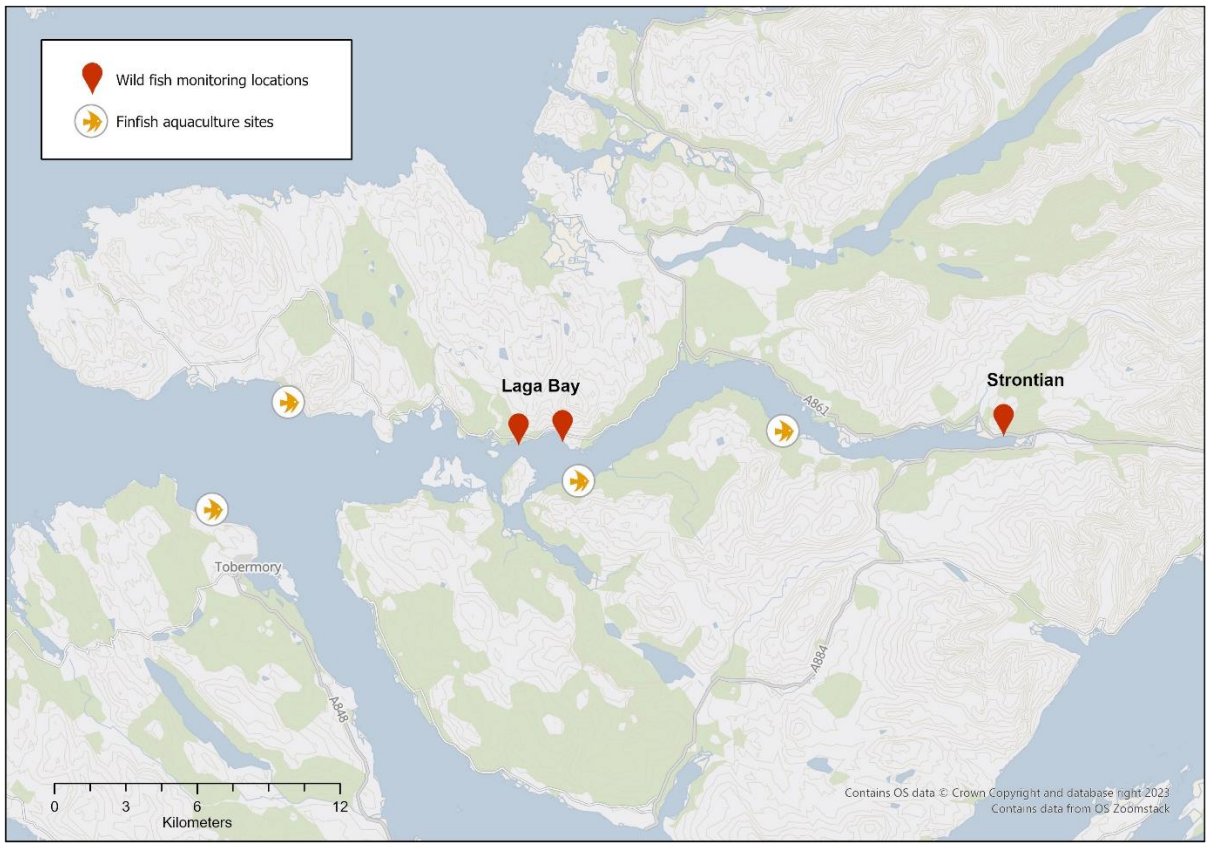

Figure 1. Coastal netting sites and finfish aquaculture sites (Scotland’s Aquaculture, 2024), Loch Sunart.

Table 1. Coastal netting sites’ locations and dates surveyed.

Site	Grid reference		Date surveyed
	X	Y	
Laga Bay fyke net	162091	760364	03/06/2024 - 06/06/2024
	163939	760507	08/07/2024 - 11/07/2024
	162091	760364	26/08/2024 - 29/08/2024
Strontian seine net	182476	760757	20/05/2024
			10/06/2024
			05/07/2024
			07/08/2024
			30/08/2024

3 Results

A total of three coastal fyke netting surveys were completed at Laga Bay, and five seine netting surveys were completed at Strontian throughout the monitoring period 20th May – 30th August.

Data for all sea trout captured have been divided into two categories for analyses and presentation of results, trout <150g and trout >150g, in accordance with the Taranger analysis approach as described above. Raw data from all surveys are included in Appendix A.

3.1 Sea trout numbers

A single sea trout >150g was recorded in all surveys at Laga Bay, whilst a total of 47 trout were recorded from all surveys at Strontian, with the highest number in the first survey on 20th May, when 20 individuals were captured (Table 2).

Table 2. Sea trout numbers per survey, per site.

Site	Date surveyed	Sea trout totals		
		<150g	>150g	Total
Laga Bay fyke net	03/06/2024 - 06/06/2024	0	0	0
	08/07/2024 - 11/07/2024	0	0	0
	26/08/2024 - 29/08/2024	0	1	1
Strontian seine net	20/05/2024	20	0	20
	10/06/2024	11	1	12
	05/07/2024	5	0	5
	07/08/2024	2	1	3
	30/08/2024	7	0	7

3.2 Sea lice prevalence, abundance and intensity

Sea lice prevalence (% of fish infected with lice), abundance (mean number of lice per fish) and intensity (mean number of lice per infected fish) were calculated for trout <150g and >150g in each survey throughout the monitoring period at both sites, including all life stages of lice recorded (Table 3, and for Strontian, Figure 2, Figure 3 and Figure 4).

Table 3. Sea lice prevalence, abundance and intensity per survey, per site.

Site	Date	Prevalence (% of trout infected)		Abundance (Mean number of lice per trout)		Intensity (Mean number of lice per infected trout)	
		<150g	>150g	<150g	>150g	<150g	>150g
Laga Bay	27/08/2024	-	100.00	-	15.00	-	15.00
Strontian	20/05/2024	25.00	-	1.15	-	4.60	-
	10/06/2024	18.18	100.00	0.91	10.00	5.00	10.00
	05/07/2024	0.00	-	0.00	-	0.00	-
	07/08/2024	0.00	100.00	0.00	2.00	0.00	2.00
	30/08/2024	0.00	-	0.00	-	0.00	-

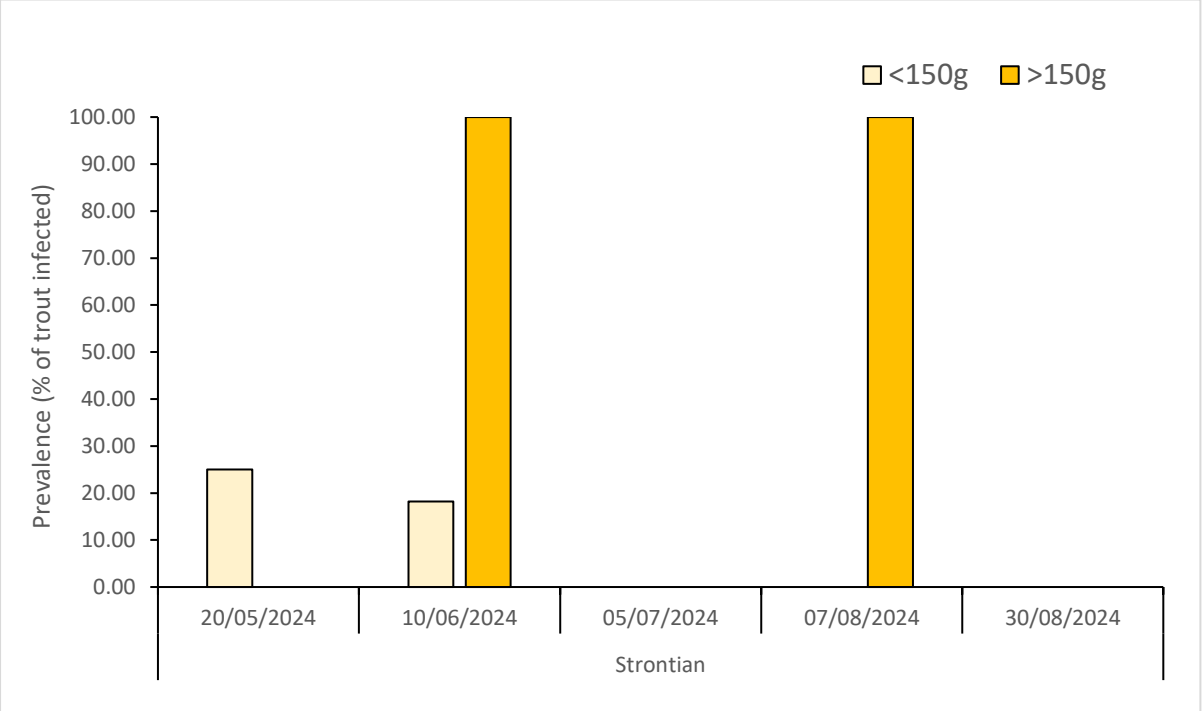

Figure 2. Sea lice prevalence of trout <150g and >150g per survey at Strontian.

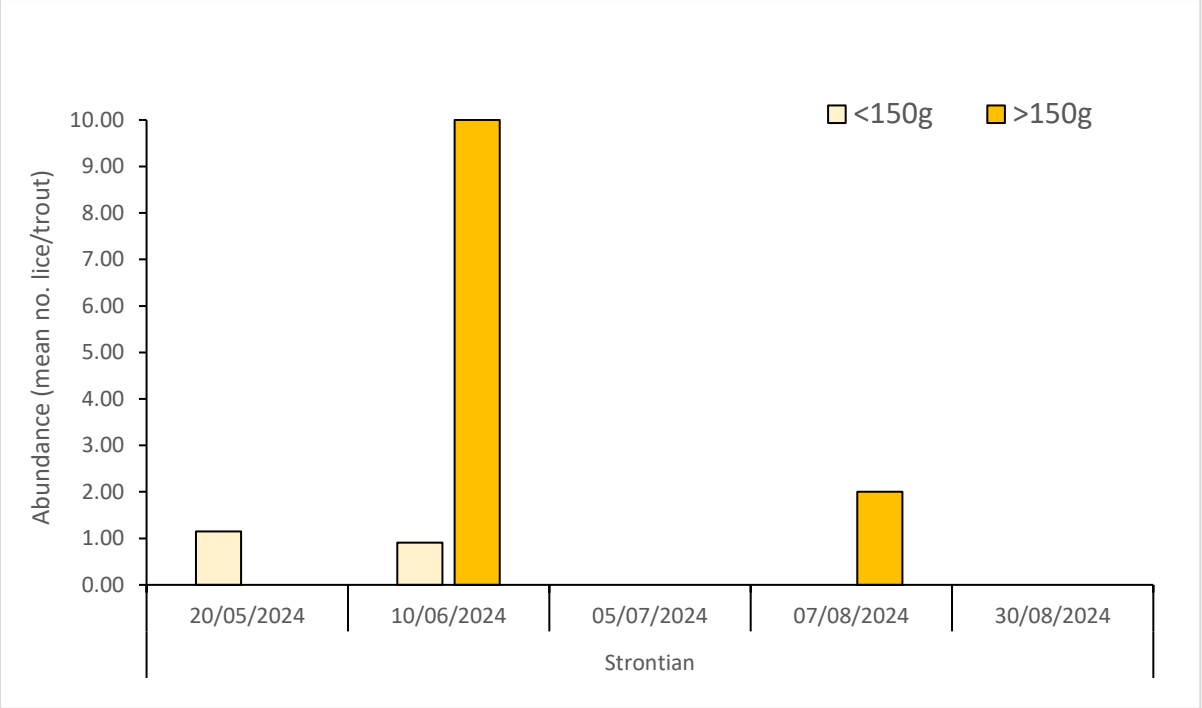

Figure 3. Sea lice abundance of trout <150g and >150g per survey at Strontian.

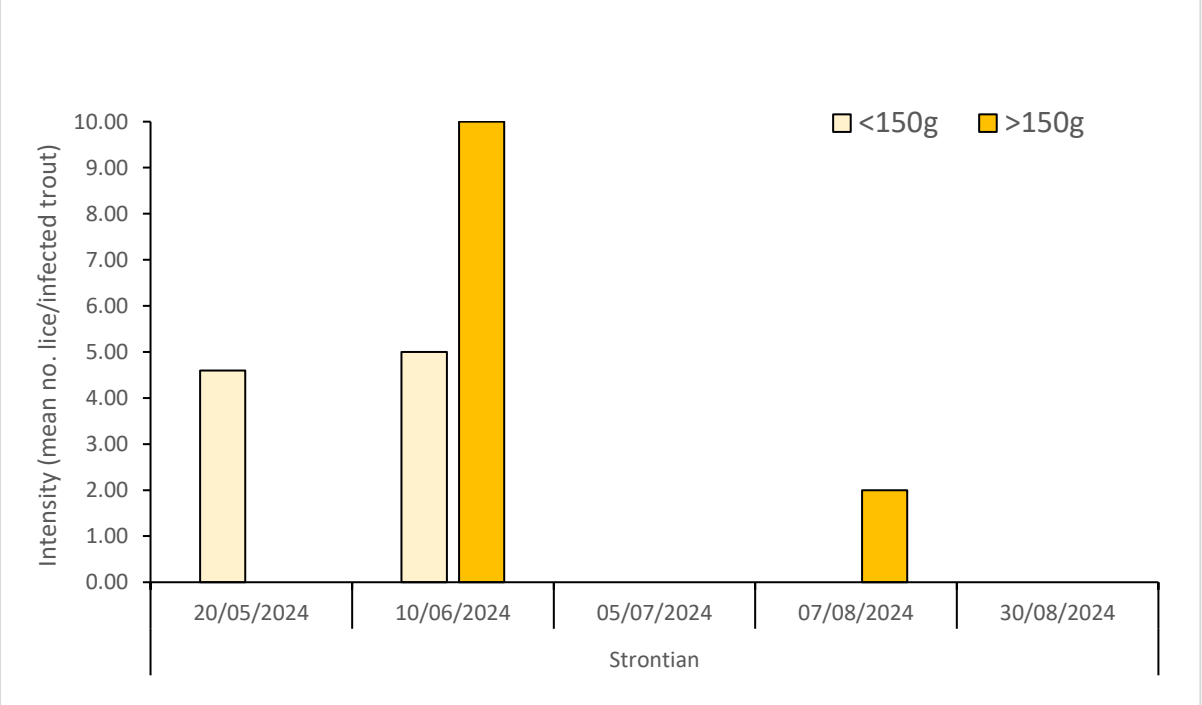

Figure 4. Sea lice intensity of trout <150g and >150g per survey at Strontian.

3.3 Risk assessment

Survey data were assessed against the risk index proposed by Taranger *et al*. (2015). The Taranger threshold ranges and associated percentage risk categories are described in the Methodology section above and are also included in Appendix B.

The proportion (%) of trout within each risk assessment category, along with total risk scores (%), are summarised for trout <150g recorded at Strontian (Table 4 and Figure 5), and for trout >150g recorded at Laga Bay and Strontian (Table 5).

Additionally, the proportion (%) of trout <150g per risk assessment category, along with total risk score, are summarised for all surveys combined throughout the monitoring period at Strontian (Table 6).

Table 4. Proportion (%) of trout <150g per risk category, per survey at Strontian.

Site	Date	Proportion (%) of trout <150g per category				Total risk (%)
		<0.1	0.1 - 0.2	0.2 - 0.3	>0.3	
Strontian	20/05/2024	90.00	5.00	5.00	0.00	3.50
	10/06/2024	90.91	9.09	0.00	0.00	1.82
	05/07/2024	100.00	0.00	0.00	0.00	0.00
	07/08/2024	100.00	0.00	0.00	0.00	0.00
	30/08/2024	100.00	0.00	0.00	0.00	0.00

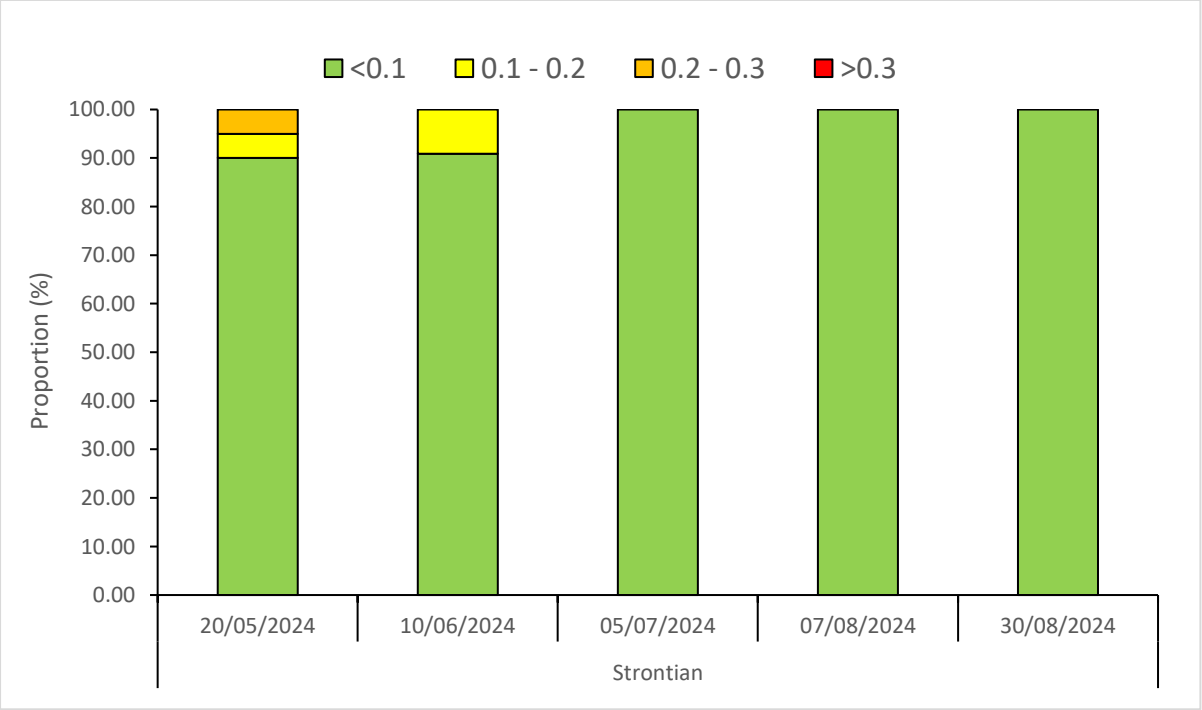

Figure 5. Proportion (%) of trout <150g per risk category, per survey at Strontian.

Table 5. Proportion (%) of trout >150g per risk category, per survey at Laga Bay and Strontian.

Site	Date	Proportion (%) of trout >150g per category per survey					Total risk (%)
		<0.01	0.01 - 0.05	0.05 - 0.10	0.10 - 0.15	>0.15	
Laga Bay	27/08/2024	0.00	0.00	100.00	0.00	0.00	50.00
Strontian	10/06/2024	0.00	100.00	0.00	0.00	0.00	20.00
	07/08/2024	0.00	100.00	0.00	0.00	0.00	20.00

Table 6. Proportion (%) of trout <150g per risk category for all surveys combined at Strontian.

Site	Proportion (%) of trout <150g per category				Total risk (%)
	<0.1	0.1 - 0.2	0.2 - 0.3	>0.3	
Strontian	93.33	4.44	2.22	0.00	2.00

3.4 Historical data

Historical data are available for Laga Bay and Strontian and were summarised alongside data collected in 2024 surveys, comparing total number of trout <150g and >150g recorded at each site per year (Table 7), and sea lice prevalence, abundance and intensity for each site, per year (Table 8).

Table 7. Total number of trout <150g and >150g per year at Laga Bay and Strontian.

Year	Laga Bay		Strontian	
	<150g	>150g	<150g	>150g
2012	-	-	1	0
2013	-	-	5	4
2014	-	-	1	0
2016	-	-	2	2
2017	-	-	29	3
2022	1	0	4	1
2023	-	-	1	1
2024	0	1	45	2

Table 8. Annual sea lice prevalence, abundance and intensity, Laga Bay and Strontian.

Site	Year	Prevalence (% of trout infected)		Abundance (Mean number of lice per trout)		Intensity (Mean number of lice per infected trout)	
		<150g	>150g	<150g	>150g	<150g	>150g
Laga Bay	2022	0.00	-	0.00	-	0.00	-
	2024	-	100.00	-	15.00	-	15.00
Strontian	2012	100.00	-	1.00	-	1.00	-
	2013	0.00	0.00	0.00	0.00	0.00	0.00
	2014	0.00	-	0.00	-	0.00	-
	2016	100.00	100.00	36.00	49.00	36.00	49.00
	2017	58.62	66.67	15.48	12.00	26.41	18.00
	2022	75.00	100.00	17.50	3.00	23.33	3.00
	2023	0.00	100.00	0.00	6.00	0.00	6.00
	2024	15.56	100.00	0.73	6.00	4.71	6.00

The proportion (%) of trout within each Taranger risk assessment category, including total risk scores (%), from historical data were summarised for comparison with data collected at Strontian in 2024, for trout <150g (Table 9 and Figure 6), and trout >150g (Table 10 and Figure 7).

Table 9. Proportion (%) of trout <150g per risk category, per year, including total risk scores, Strontian.

Site	Year	Proportion (%) of trout <150g per category				Total risk (%)
		<0.1	0.1 - 0.2	0.2 - 0.3	>0.3	
Strontian	2012	100.00	0.00	0.00	0.00	0.00
	2013	100.00	0.00	0.00	0.00	0.00
	2014	100.00	0.00	0.00	0.00	0.00
	2016	0.00	0.00	0.00	100.00	100.00
	2017	48.28	3.45	0.00	48.28	48.97
	2022	50.00	25.00	0.00	25.00	30.00
	2023	100.00	0.00	0.00	0.00	0.00
	2024	93.33	4.44	2.22	0.00	2.00

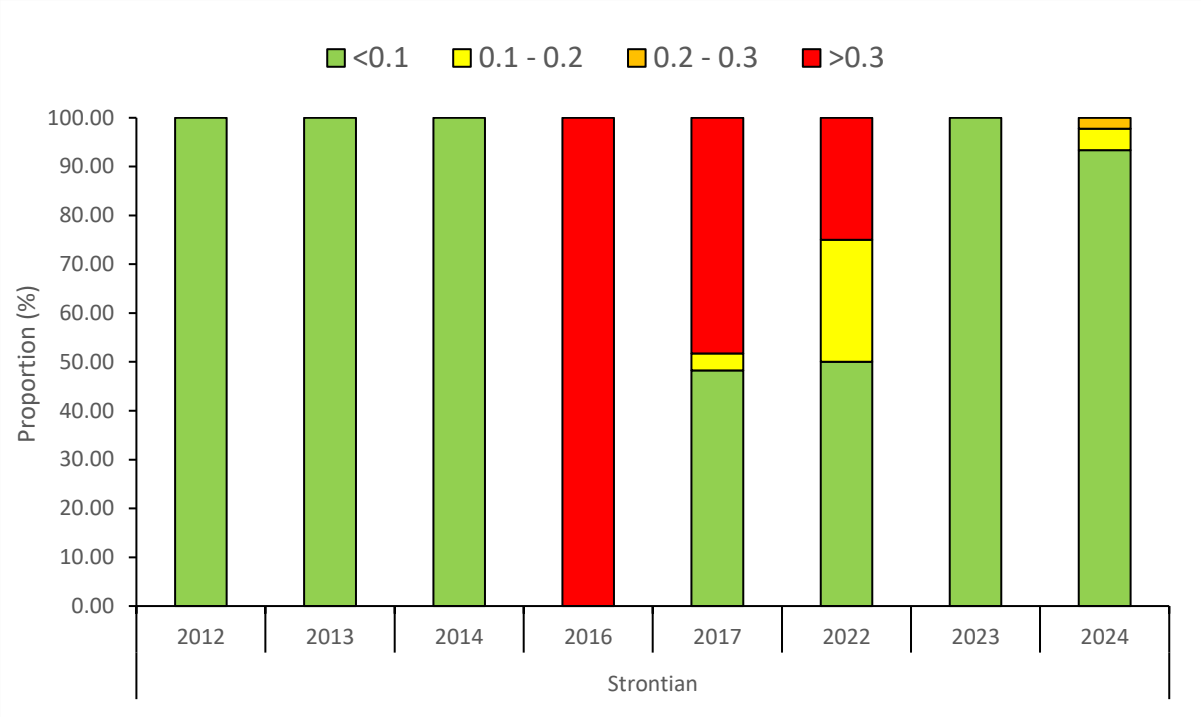

Figure 6. Proportion (%) of trout <150g per risk category, per year, Strontian.

Table 10. Proportion (%) of trout >150g per risk category, per year, including total risk scores, Strontian.

Site	Year	Proportion (%) of trout >150g per category					Total risk (%)
		<0.01	0.01 - 0.05	0.05 - 0.10	0.10 - 0.15	>0.15	
Strontian	2013	100.00	0.00	0.00	0.00	0.00	0.00
	2016	0.00	0.00	50.00	0.00	50.00	75.00
	2017	33.33	0.00	33.33	33.33	0.00	41.67
	2022	0.00	100.00	0.00	0.00	0.00	20.00
	2023	0.00	100.00	0.00	0.00	0.00	20.00
	2024	0.00	100.00	0.00	0.00	0.00	20.00

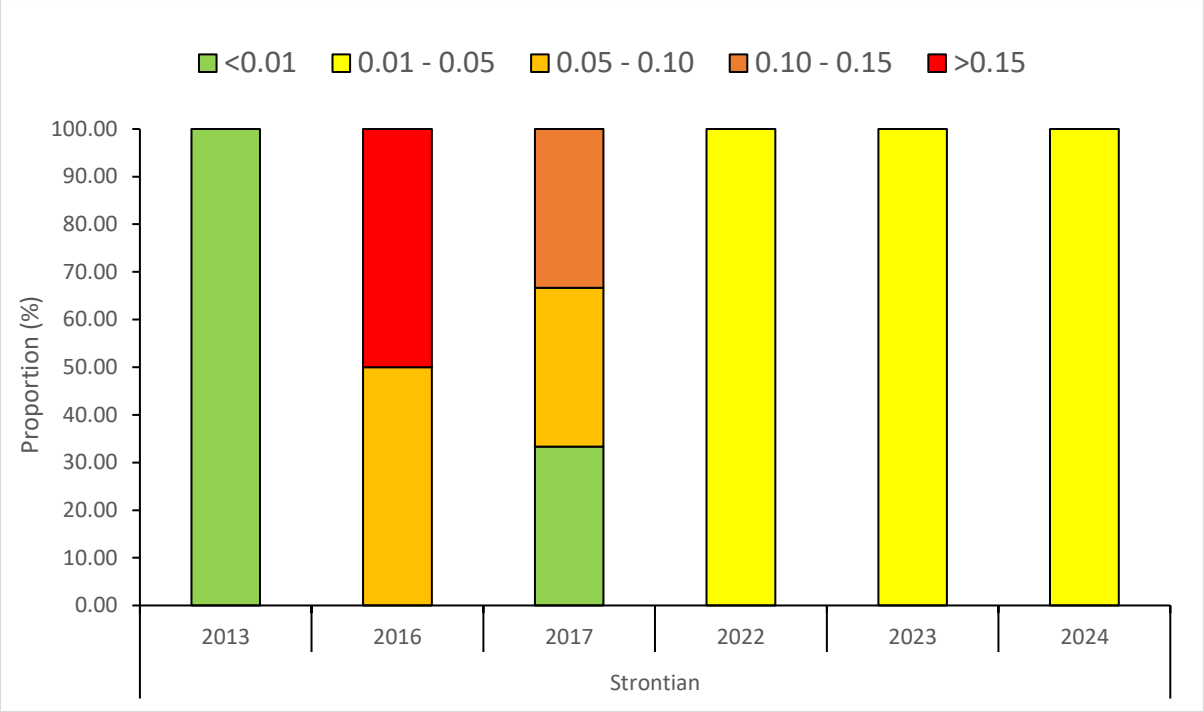

Figure 7. Proportion (%) of trout >150g per risk category, per year, Strontian.

4 Discussion

A total of 47 sea trout were recorded this year across all surveys at Strontian, with the highest numbers in the first two surveys on 20th May and 10th June, when 20 and 12 trout were recorded, respectively.

In contrast, a single trout was recorded from all surveys this year at Laga Bay. The fyke net was deployed in two separate locations at Laga Bay in an attempt to increase sample sizes. Other fish species were recorded in each survey, indicating the fyke net was fishing effectively. The location where the sea trout was captured was the same location as where the sea trout was captured in the 2022 survey. Additionally, during the survey at the second fyke net site this year it is believed that the net was subject to a predator attack. Therefore, for future monitoring it is recommended to continue with the site where sea trout were recorded and where there were no apparent predator-related issues. Another option would be to deploy the net at new locations, which may help to improve sample sizes in future surveys, subject to relevant permissions and conservation considerations.

The number and size of trout sampled at sites may have been influenced by several factors related to seasonal movements, environmental conditions, availability of prey items in the marine environment and sea lice burden.

At Strontian, for sampled trout <150g, sea lice prevalence (% of fish infected) was 25.00% in the first survey on 20th May, decreasing to 18.18% in the following survey on 10th June, then dropping to 0.00% for the remaining three surveys between 5th July and 30th August. Sea lice abundance (mean number of lice per fish) was 1.15 lice per fish on 20th May, decreasing to 0.91 on 10th June, then 0.00 lice per fish for all remaining surveys. Sea lice intensity (mean number of lice per infected fish) was

4.60 lice per infected fish on 20th May, increasing to 5.00 lice per infected fish on 10th June, then decreasing to 0.00 lice per infected fish for the remaining three surveys.

For sampled trout >150g at Strontian, prevalence was 100.00% on 10th June and 7th August, when fish in this weight category were captured, whilst abundance and intensity were both 10.00 lice per fish/lice per infected fish, respectively, on 10th June and 2.00 lice per fish/lice per infected fish, respectively, on 7th August.

At Laga Bay, for the one sampled trout >150g recorded on 27th August, sea lice prevalence was 100.00%, whilst abundance and intensity were both 15.00 lice per fish/lice per infected fish, respectively.

It should be noted that total numbers of sea trout >150g caught throughout the monitoring period at each site were relatively low, with one fish in this size range at Laga Bay and two at Strontian.

Using the Taranger analysis for trout <150g at Strontian, the total estimated increase in lice-related mortality risk of sampled trout was 3.50% in the first survey, decreasing to 1.82% in the second survey, then 0.00% in the last three surveys. This equates to a 'low' risk in all surveys. For all surveys combined the total estimated increase in lice-related mortality risk or premature return to freshwater of sampled trout <150g was 2.00%, equating to a 'low' total risk throughout the monitoring period.

For sampled trout >150g at Strontian, the total estimated increase in lice-related mortality risk was 20.00% in the 10th June and 7th August surveys. This equates to a 'moderate' total risk in both surveys. For all surveys combined the total estimated increase in lice-related mortality risk or compromised reproduction for sampled trout >150g was 20.00%, equating to a 'moderate' total risk throughout the monitoring period.

Using the Taranger risk analysis for trout >150g at Laga Bay, the estimated increase in lice-related mortality risk or compromised reproduction of the sampled trout was 50.00%, equating to a 'moderate' total risk.

Considering the historical data at Strontian, the 47 trout captured this year was a notable increase on the previous two years monitoring when two trout were recorded in 2023 and five in 2022. It is also the highest number of trout recorded in a year at this site compared to historical totals. At Laga Bay, the single trout captured this year is consistent with the last time this location was monitored in 2022, when only one trout was recorded. The trout captured this year was >150g whilst the trout captured in 2022 was <150g, preventing direct comparisons between years.

This year's data at Strontian suggest sea trout abundance may be higher at this site earlier in the season than later. Adjusting timings of surveys at Strontian for future monitoring could lead to greater sample sizes by concentrating survey effort in the earlier part of the season. Increasing samples sizes would increase the robustness of future analyses and results.

5 References

Lochaber Fisheries Trust (2020) *Deployment of Coastal Fyke Nets Standard Operating Procedure*. Available at: https://fms.scot/wp-content/uploads/2021/12/200403-Aqua-Fixed-Net-Deployment-SOP.pdf (Accessed: 10 December 2024).

Scotland's aquaculture (2024) *Scotland's aquaculture - sea lice data.* Available at: https://scottishepa.maps.arcgis.com/apps/webappviewer/index.html?id=2218824350e5470e8026076d4138da58 (Accessed: 10 December 2024).

Scottish Fisheries Coordination Centre (2007) SFCC: A standard sweep netting protocol for management. Marine Scotland Science. Pitlochry.

Taranger G L, Karlsen Ø, Bannister R J, Glover K A, Husa V, Karlsbakk E, Kvamme B O, Boxaspen K K, Bjørn P A, Finstad B, Madhun A S, Morton H C, Svåsand T (2015) Risk assessment of the environmental impact of Norwegian Atlantic salmon farming. *ICES Journal of Marine Science*, Volume 72, (Issue 3), pp 997 – 1021.

Appendix A – All survey data

Site	Date	Fish no.	Length (mm)	Weight (g)	Sea lice (*L Salmonis*) count				
					Cop.	Chal.	Mobile	Ovig.	Total
Laga Bay	04/06/24	0	-	-	-	-	-	-	0
	06/06/24	0	-	-	-	-	-	-	0
	09/07/24	0	-	-	-	-	-	-	0
	10/07/24	0	-	-	-	-	-	-	0
	11/07/24	0	-	-	-	-	-	-	0
	27/08/24	1	268	189.2	0	6	8	1	15
	28/08/24	0	-	-	-	-	-	-	0
	29/08/24	0	-	-	-	-	-	-	0
Strontian	20/05/24	1	129	24.2	0	0	0	0	0
		2	152	37.9	0	3	0	0	3
		3	135	28.4	0	0	0	0	0
		4	139	27.1	0	0	0	0	0
		5	164	46.7	0	10	0	0	10
		6	166	50.8	0	7	0	0	7
		7	154	39.4	0	2	0	0	2
		8	121	19.6	0	0	0	0	0
		9	146	34.6	0	0	0	0	0
		10	143	32.1	0	0	0	0	0
		11	143	32.5	0	0	0	0	0
		12	137	28.6	0	0	0	0	0
		13	134	26.4	0	0	0	0	0
		14	115	16.0	0	0	0	0	0
		15	124	21.6	0	0	0	0	0
		16	130	22.7	0	0	0	0	0
		17	115	15.9	0	0	0	0	0
		18	143	32.6	0	0	1	0	1
		19	134	26.3	0	0	0	0	0
		20	150	41.9	0	0	0	0	0
	10/06/24	1	166	52.3	0	7	1	1	9
		2	142	32.3	0	1	0	0	1
		3	155	44.3	0	0	0	0	0
		4	157	48.1	0	0	0	0	0
		5	166	52.6	0	0	0	0	0
		6	178	69.2	0	0	0	0	0
		7	175	66.5	0	0	0	0	0
		8	145	39.0	0	0	0	0	0
		9	171	64.0	0	0	0	0	0
		10	157	46.6	0	0	0	0	0

		11	157	45.4	0	0	0	0	0
		12	307	320.5	0	3	0	7	10
	05/07/24	1	164	52.0	0	0	0	0	0
		2	134	27.1	0	0	0	0	0
		3	170	58.1	0	0	0	0	0
		4	164	50.0	0	0	0	0	0
		5	181	69.0	0	0	0	0	0
	07/08/24	1	200	89.2	0	0	0	0	0
		2	160	45.9	0	0	0	0	0
		3	248	154.2	0	0	1	1	2
	30/08/24	1	202	90.0	0	0	0	0	0
		2	196	78.9	0	0	0	0	0
		3	182	72.4	0	0	0	0	0
		4	221	117.8	0	0	0	0	0
		5	193	85.1	0	0	0	0	0
		6	220	115.5	0	0	0	0	0
		7	192	77.2	0	0	0	0	0

Appendix B – Taranger risk assessment categories

Taranger risk assessment categories for sea trout <150g and >150g (Taranger *et al.,* 2015).

Salmonids <150g		**Salmonids >150g**	
Lice per g/fish weight	Estimated increase in lice-related mortality or premature return to freshwater (%)	Lice per g/fish weight	Estimated increase in lice-related mortality or compromised reproduction (%)
>0.3	100	>0.15	100
0.2 - 0.3	50	0.10 - 0.15	75
0.1 - 0.2	20	0.05 - 0.10	50
<0.1	0	0.01 - 0.05	20
		<0.01	0