Off the table.

Powered by WildFish.

Image captured on a Loch Duart salmon farm, July 24

The reality gap:

An examination of Scottish farmed salmon

Introduction

Salmon is one of the UK's most popular fish to eat, and one of the 'big five' (cod, tuna, prawns, salmon and haddock) which together represent 62-80% of the UK's total fish consumption [1], [2], [3]. However, most consumers do not realise that almost all the salmon we eat in the UK is farmed – in Scotland, Norway, the Faroe Islands and Iceland (as well as Chile and Canada, although these don't typically export to the UK) – and that just a handful of international corporations own the vast majority of the industry. A survey carried out by Scottish environmental NGO, Fidra, in 2021 found that only 6% of consumers were aware that Scottish salmon is farmed in the UK [4], [5].

In Scotland, the growth of the salmon farming industry has historically been viewed as an economic success story, and one which will provide a key economic pillar for Scottish independence. Yet, in recent years there has been growing concern about the high environmental costs of intensive salmon farming, the welfare issues on the farms themselves and the sustainability of farming a carnivorous fish species (in other words, a predatory fish that consumes other wild fish).

Farmed salmon take roughly three to four years to grow; from freshwater 'hatcheries', through to open-net pen structures along Scotland's west coast and islands. During the marine stage (which typically lasts 18-24 months), the farmed fish, and the sea lochs they're typically sited within, are exposed to a host of environmental and welfare issues. These include outbreaks of parasitic sea lice, which impact on wild fish populations; outbreaks of disease leading to high mortality rates on the farms; and use of chemicals, which impact the surrounding seabed ecosystems and harm wild species such as crustaceans (lobsters, crabs, prawns).

Image captured on a Loch Duart salmon farm, July 24

The Scottish salmon farming industry began in the 1970s as a small-scale, cottage-style industry. There were few farms, owned locally, but from the 1990s this ownership was increasingly consolidated into a small number of companies. As of 2024, there are seven companies operating in Scotland, six of which own the overwhelming majority of the industry. Mowi, Bakkafrost, Scottish Sea Farms and Cooke Aquaculture are all international corporations with overseas headquarters [6]; Wester Ross Fisheries, based in the northwest of Scotland, has been owned by Mowi since 2022; and Loch Duart has been majority owned by a US investment fund since 2020. The seventh company, Organic Sea Harvest, operates two farms off the coast of Skye in northwest Scotland.

The industry now produces roughly 200,000 tonnes of farmed salmon per year. With this expansion has come increased industrialisation, increased impact on the environment, increased mortality – and an increasingly unsustainable food production system.

This report first gives an overview of the various marketing tools used by the Scottish salmon farming industry to represent farmed salmon as a sustainable, healthy and eco-friendly protein choice. It then examines the environmental and welfare performance of Scotland's seven salmon farming companies, all widely used in the hospitality and retail sectors.

Through analysis of publicly available data and company information, the report explores the contrast between the marketing used by the Scottish salmon industry to promote its products, and the reality of the industry's huge negative environmental and welfare impacts.*

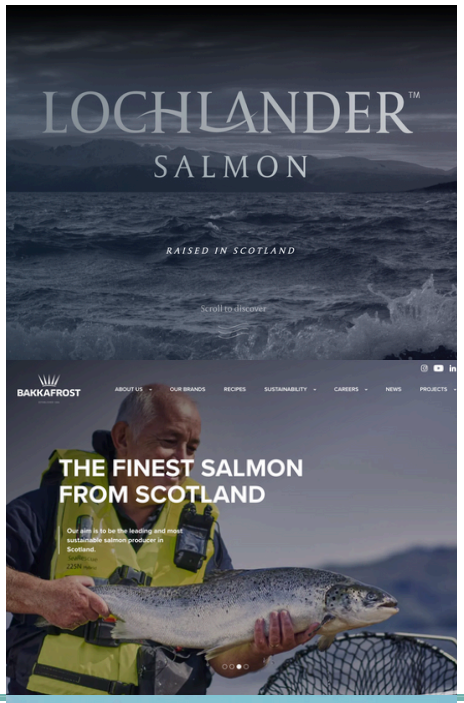
The report finds that, despite assurances from certification schemes and celebrity endorsements, none of the seven salmon farming companies in Scotland has shown the ability to operate in such a way that protects wild fish, the environment – both immediate and global – and farmed fish welfare. Across the world, open-net salmon farming is in a perilous state, with increased scrutiny on its high mortality rates and environmental costs. The Scottish salmon farming industry is no different, with record mortalities (an estimated 17.4 million farmed salmon died on Scottish farms in 2023); a continued reliance on chemicals; and an inability to contain outbreaks of diseases and sea lice parasites, contributing to a reality that is far removed from the industry marketing.

** This report does not address the significant sustainability issues related to use of wild caught fish to feed farmed salmon; it also does not cover the welfare impacts of physical sea lice treatments, or ecological issues related to use of cleaner fish. For further information on these issues see https://feedbackglobal.org/campaigns/#farmed-fish and https://wildfish.org/wp-content/uploads/2024/09/Open-Net-Salmon-Farming_Literature-Review_Updated-160924.pdf*

Image captured on a Mowi salmon farm, August 24

Section 1: The marketing

The Scottish salmon farming industry uses several marketing tools to encourage widespread consumption of farmed salmon – both via the hospitality sector and retailers, as well as direct communications with the public. The following analysis focuses on the tools primarily used for the hospitality trade (business to business sales), although there will undoubtedly be crossover into consumer communications (for example, with certification schemes). Through use of these multiple tools, the Scottish salmon farming industry is able to market farmed fish as a product far removed from the industrial process by which they were raised – one with sustainability plaudits, high-welfare certification and, in some cases, implied wild origins.



Scotland's natural heritage

First and foremost, the Scottish salmon farming industry utilises the powerful imagery of Scotland's natural heritage and rich biodiversity to communicate about its products. This can be seen across all companies' individual marketing.

However, there is constant tension between this marketing tactic and the realities of an increasingly industrialised food production system. This can be seen in the case of Wester Ross, a formerly independently owned company that was purchased by Mowi – the world's largest salmon farming company – in 2022.

Wester Ross continues to promote itself as an artisanal, small-scale fish farming operation with an emphasis on 'hand rearing', whilst at the same time pursuing an expansionist agenda – including attempting to install an automated diesel-powered feed barge on Loch Broom, a Marine Protected Area, despite vocal local opposition [7].

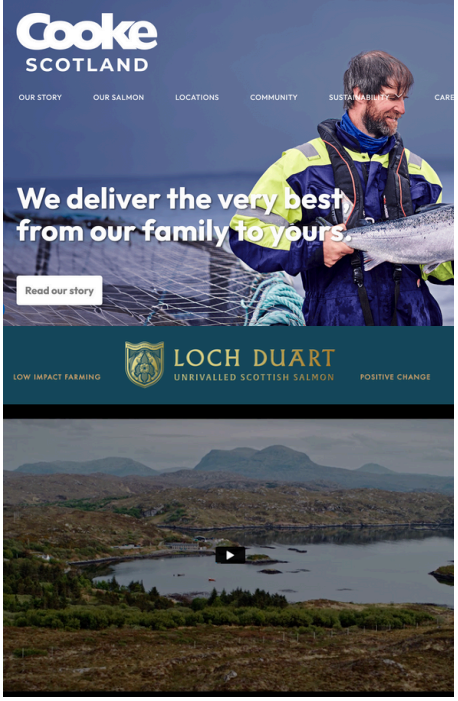
Since Mowi's purchase of Wester Ross, claims in relation to 'hand rearing' have been subtly altered on Wester Ross' website to reflect a drive towards automated feeding. Whereas the website had previously stated: "Our fish are hand reared and purposefully slowly grown, we don't use unnatural management or **artificial feeding regimes**", in early 2024 the wording was edited to instead read: "we don't use... **excessive feeding regimes**" [8].

We operate in **pristine marine environments**, rely on science and experts to ensure sustainability, use feed from sustainable resources, and constantly search for ways to reduce our carbon footprint. We're proud of the fact that we don't take shortcuts.

Cooke Aquaculture Scotland

Welcome to Wester Ross; an area of spectacular natural beauty in the northwest Highlands of Scotland, and the place from where we take our name, and root our heritage.

Here, in the wilderness of the west coast, amid the sparkling tidal waters of the Scottish lochs, we grow a salmon that is second to none. Read our story and unique approach, to learn about our unparalleled stewardship and understand exactly why, Wester Ross Salmon can bring something truly exceptional to your table.



A number of producers own several brands through which they sell their farmed salmon. Bakkafrost owns both Native Hebridean Scottish Salmon and Lochlander, which allows for greater leeway when it comes to creative marketing. For example, Lochlander salmon, which targets the US market, leans much more heavily on Scotland's natural and cultural heritage than the parent company site. With statements such as: "In the remote Western Highlands & Islands of Scotland time seems to move more slowly… Lochlander Salmon are nurtured by our dedicated Scottish Salmon Masters" and: "It is the sea lochs of the Scottish Highlands and Islands that have shaped our landscape, heritage and people for hundreds of years. And it's here, within these cold, deep waters, that our salmon's journey begins, and where they too are shaped by the unique waters" [9], Bakkafrost is leaning heavily on Scottish national heritage and the country's almost mythical natural environment (not to mention the migration journey of wild salmon) to sell its farmed salmon to an overseas market.

These standalone brands also allow greater flexibility to market farmed salmon in such a way that could lead to consumer confusion or misunderstanding about whether the fish is farmed or wild. Bakkafrost's Native Hebridean Salmon website makes just one reference on its landing page to fish being 'raised' (not 'farmed'): "Native Hebridean Salmon are a truly unique breed, descending from the wild salmon of rugged and remote North Uist in the Outer Hebrides and raised on the Hebridean Islands and West Coast of Scotland."*

Third-party supplier websites (for example, fishmongers and retailer sites) provide further leeway for marketing claims. Messaging around sustainability and provenance is often more strident on third-party supplier websites than the companies' parent sites (see also section on smoked salmon, below). For example, the smokehouse brand Smokin' Brothers (which sources from Wester Ross) states on its website that its smoked salmon is "crafted with truly sustainable salmon" [10]. However, the Wester Ross website refers only to 'sustainable farming' – perhaps reflective of an increasing scrutiny of 'green' claims being made by salmon farming companies in recent years.

In 2019, Loch Duart stopped advertising itself as 'the sustainable salmon company', following a complaint to the Advertising Standards Authority (ASA) [11]. Similarly, Mowi USA settled a class action lawsuit in 2021 over allegations that a brand owned by the company had misled consumers in describing its salmon products as all natural, sustainably sourced and from Maine [12]. In 2023, WildFish and Coastal Communities Network submitted a legal complaint to the Competition & Markets Authority (CMA) in relation to sustainability claims made by the industry trade body Salmon Scotland [13].

Within this context, Scottish salmon farming companies will sometimes describe their products as 'sustainably produced' – not 'sustainable'. However, this is not the case with third-party sites, which will often describe their Scottish salmon products as 'sustainable'. This seemingly small tweak in language contributes to a much larger shift in consumer perception of farmed salmon; particularly when viewed in combination with certification schemes.

**For an overview of the environmental and welfare performance of Bakkafrost farms in 2023 and 2024 see Section 2.*

Certification

Soil Association and organic certification*

A number of 'high-end' retailers and hospitality outlets will specify that the salmon they sell and/or serve is organic. However, organic certification of open-net farmed salmon has always been a controversial issue, due to the very nature of how salmon are farmed.

In the UK, the Soil Association created its organic certification for aquaculture (including farmed salmon) in 2006. The introduction of the scheme prompted a former chairman of the Association's Standards Committee to state that "salmon farming in cages has nothing to do with organic principles" [14].

Similarly, Iain Tolhurst, a key figure in the foundation of the modern British organic movement, was reported to have stated: "So-called 'organic' salmon is making a mockery of organic standards [15]." In April 2024, one of the individuals involved in establishing the Soil Association organic standard for farmed salmon also wrote: "My mistake was in thinking that the sustainability challenges of salmon-farming were soluble in practice. If they are, 20 years later it has yet to be shown" [16].

The Soil Association summarises organic farming in the following way: "Organic farmers aim to produce high-quality food, using methods that benefit our whole food system, from people to planet, plant health to animal welfare" [17].

Contrary to this fundamental principle, certified 'organic' salmon are reared using a very similar production method as uncertified farms; reared in open-net cages, the waste from the fish and chemicals used to treat them discharge directly into the surrounding environment.

In contrast to other organic certified food products, the organic standard for farmed salmon does not prohibit the use of pesticides, instead limiting them to a certain number of uses within a production cycle. However, at least one certified organic farm (Mowi's Camas Glas site) has treated its fish significantly more than the permitted amount, reporting nine parasitic treatments to FHI and SEPA between November 2022 and August 2023. Additionally, use of the organophosphate pesticide azamethiphos on organic-certified farms increased by 454% from 2022 (3685g) to 2023 (20400g).**

WildFish analysis of sea lice numbers and mortalities on Soil Association organic farms found negligible differences between certified and non-certified farms. Mortalities on Soil Association organic farms constituted around 10% of the total figure for 2023 (1,722,790, out of an estimated total of 17.4 million fish) and certified farms reported an average weekly lice count of 0.44, as opposed to 0.48 on non-organic certified farms.**

In January 2024, an open letter co-signed by 30 community groups and NGOs, including WildFish, called publicly on Soil Association to reconsider its organic certification for farmed salmon [18]. Soil Association is currently conducting an internal review of its aquaculture standard (which includes farmed salmon); this is expected to conclude by early 2025.

A total of 14 seawater salmon farms in Scotland are currently organic certified – seven Mowi Scotland farms, five farms run by Cooke Aquaculture and two farms run by Organic Sea Harvest Ltd. A further nine freshwater salmon farms and hatcheries are Soil Association organic certified in Scotland.

**This report does not cover Aquaculture Stewardship Council (ASC) certification. For more information on ASC, see: Responsibly Farmed? Investigating the certification of Scottish farmed salmon (WildFish, 2023).*

***References and calculation available on request.*

RSPCA Assured

The RPSCA Assured salmon standard was established, initially as “Freedom Food”, in 2002. It is the most widely used certification scheme for Scottish salmon. Every salmon farming company that operates in Scotland has RSPCA Assured certification for at least some of their farms, except for Loch Duart. Loch Duart was the first Scottish salmon farming company to obtain RSPCA Assured certification but ultimately left the scheme in January 2024 stating: “The scheme no longer holds the same significance that it once did”, due to its “application towards mass-produced salmon” [19].

As a welfare-focused certification scheme, the absence of any limit on mortality permitted on certified farms has been a source of criticism in recent years. Although the certification includes guidelines around mortality rates on farms, the only requirements of companies are that mortality incidents be reported within 72 hours and that the farm has a plan to address the cause of mortality. This means that farms reporting mortality rates upwards of 80% over the marine production cycle can retain their certification status.

Concerns with the scheme also extend to compliance. Three sites run by Scottish Sea Farms were suspended from the scheme in September 2024, after video footage emerged documenting welfare breaches. Shortly after this, RSPCA announced it was launching its own investigation into the performance of the RSPCA Assured scheme, after another external investigation of around 40 farms certified by the scheme (including salmon) also documented welfare issues [20]. Sir Brian May stepped down as RSPCA vice-president in September 2024 over 'damning evidence' of welfare failings related to the RSPCA Assured scheme; Chris Packham and Caroline Lucas followed suit, resigning from their roles as president and vice-president, in December 2024 [21], [22].

PGI

Protected Geographical Indication (PGI) is designed to protect certain products against misuse or imitation of the registered name and guarantee the true origin of the product to consumers [23].

PGIs are used in the EU and wider export market to communicate to consumers the authenticity of products known for the region in which they are made, such as Cornish pasties, Parma ham and Stornoway black pudding.

Scottish Farmed Salmon has had a PGI since 2004. In July 2023 the Scottish trade body Salmon Scotland made an application to the UK Government to change this PGI to simply ‘Scottish salmon’, dropping the ‘farmed’ description from the name. This request was approved by the UK Department for Environment, Food and Rural Affairs (Defra) in March 2023.

The decision was appealed by WildFish and animal welfare NGO Animal Equality, on the basis that the name change was likely to mislead consumers and did not meet legal UK legal obligations on quality schemes for agricultural products and foodstuffs. The Tribunal ruled against this appeal in January 2025.

PGIs generally carry weight in the international market; this is significant within the context of the Scottish salmon farming industry eyeing up further international expansion in the coming years.

Industry sponsorship and endorsement

A common tactic for salmon farming companies to promote their brand and boost their image is to use sponsorships and partnerships with well-known figures in food and hospitality. Using celebrity chefs, food writers/influencers and restaurants to advertise their products allows salmon companies to harness their power and influence over forming positive public opinion. With these influencers' perceived knowledge on responsible sourcing and endorsing a farm's sustainability credentials, this practice serves to normalise eating salmon and contributes to greenwashing of a damaging industry [24].

For example, in 2023 Mowi sponsored a new cooking programme starring top chefs including Gordon Ramsay, the motivation for which was to "inspire a significant proportion of UK consumers to cook with Scottish salmon" [25]. Gordon Ramsay also serves Loch Duart salmon in his restaurant Savoy Grill [26], along with long-time proponent of 'sustainable' seafood, Rick Stein, who offers it in both his Cornwall-based restaurant chain and online shop [27].

Wester Ross also utilises many industry links, including promotion by 'brand ambassador' and chef Shaun Rankin [28] and was featured on the Great British Bake Off's Nadiya Hussein's BBC2 programme in 2019 'Nadiyah's Time to Eat'. This included a demonstration of 'artisanal' hand-feeding [29], which the company heavily references as an example of its 'artisan' approach (despite an ongoing move towards automation, as outlined on page 3).

Introducing Shaun Rankin

Originally from Yorkshire, Shaun honed his skills at The Mayfair Hotel in London. His love of the sea originally took him to the Channel Islands where he very quickly earned his first Michelin star in 2005. He was British Chef of the year in 2006 and shot to culinary fame in 2009 in BBC Two's Great British Menu. In 2010 he launched his TV Series, Island Feast accompanied by the cookbook Seasoned Islands. On opening the highly

"Wester Ross salmon is superior in every way, is responsibly and sustainably farmed and I am delighted to be associated with this brand"

Harrods proudly serves Glenarm Organic Salmon (from Northern Ireland) on its fresh fish counter at its famous London store, promoting this on social media [30]. In 2023, Selfridges was forced to revise sustainability claims around Loch Duart salmon served on its own fresh fish counter [31]. Organic Sea Harvest, despite being one of the newest farms in Scotland, has been endorsed by HRH King Charles III, arguably one of the most high-profile sustainability advocates in the UK. Salmon from the company's first harvest was sent directly to Buckingham Palace and Clarence House in 2021 [32], with then-Prince Charles subsequently paying a visit later that year [33]. Both stories were widely publicised by Organic Sea Harvest.

Smoked salmon

Smokehouses play an integral role in the premium salmon supply chain, with smoked salmon commanding a premium price compared to other salmon products. Smokehouses are often small, independent businesses whose branding centres on hand-crafted or artisanal products.

Whilst the craft of smoking is generally a small-scale process, the farmed salmon itself (if being marketed as 'Scottish smoked salmon') will be sourced from the same companies as those outlined in Section 2. However, the additional branding given to these products further obscures the salmon's industrial farmed origins and gives an illusion of localism, speciality and luxury.

Some examples include:

Severn & Wye Smokery, Gloucestershire – sourced from Organic Sea Harvest [32]

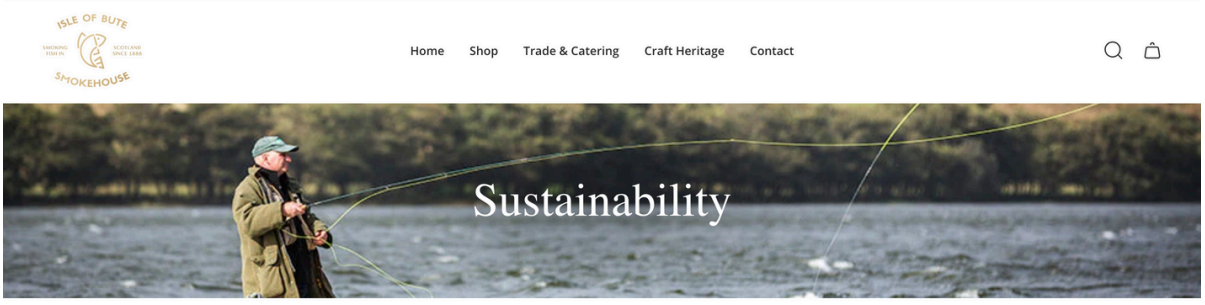
Belhaven Smokehouse, Dunbar – 'sourced from RSPCA accredited farms in Orkney/Shetland' [34]

Inverawe Smokehouse, Argyll – sourced from Wester Ross [35]

Forman & Son, London – claims its "world's finest smoked salmon" is "part of the heritage of London's food culture" [36]. They offer both farmed products from Loch Hourn (now owned by Mowi) as well as offering net-caught endangered wild Atlantic salmon caught in the Tweed River in the Scottish Borders [37]

Smokin' Brothers, Gloucestershire – sourced from Wester Ross [38]

Some smokehouses, such as Severn & Wye and Isle of Bute Smokehouse, use imagery relating to fishing in their marketing, arguably causing further confusion for consumers (the majority of whom do not realise that salmon is farmed) [4], [5].



Section 2: The reality

The following company profiles give an overview of the environmental and welfare performance of Scotland's seven salmon farming companies. The research was compiled using publicly available company information, and publicly disclosed data, focusing on the following environmental and welfare issues.*

Mortality

The rising number of farmed salmon dying prematurely on Scottish salmon farms has been increasingly in the spotlight in recent years. In 2023, record mortalities were reported on Scottish salmon farms, with an estimated 17.4 million farmed salmon dying prematurely. Mortality rates are a recognised indicator of fish welfare and can signify poor environmental performance.

Sources: *Fish Health Inspectorate (FHI), Salmon Scotland*

Disease

These profiles give an overview of diseases identified on farms run by the seven salmon farming companies between January 2023 and June 2024. For further information about these diseases, see Appendix A.

Sources: *FHI*

Sea lice

Sea lice parasites are widely recognised as one of the most pressing environmental and welfare issues for open-net salmon farming. A type of marine parasite, sea lice proliferate on salmon farms due to the large number of fish ('hosts') in the cages.

They can cause serious welfare issues for the farmed fish, feeding on their mucous, skin and underlying tissue [39] and can also transfer to young migrating wild salmon, with fatal consequences [40], [41]. The industry's Code of Good Practice (CoGP) guidelines stipulate that on-farm lice levels should be 0.5 lice per fish during the migratory period for wild Atlantic salmon (1 February to 30 June) and 1.0 lice per fish at other times of the year.

In January 2024, the Scottish Environment Protection Agency (SEPA) released details of 19 salmon farms in Scotland that it has assessed as being 'high risk' to migrating wild salmon.

Sources: *Scottish Environment Protection Agency (SEPA)*

**Sources are listed; full data available on request*


Image captured on a Loch Duart salmon farm, July 24

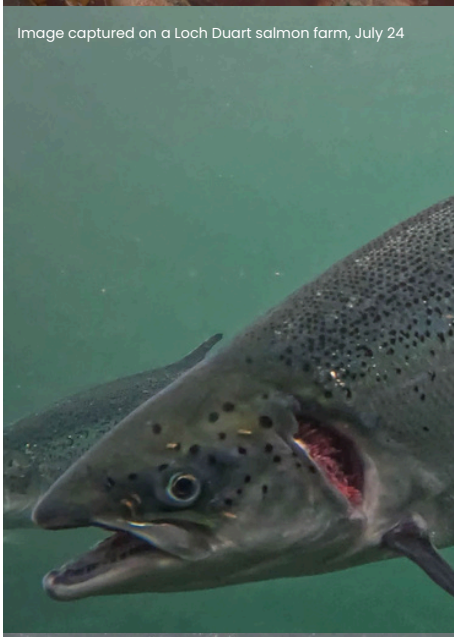


Image captured on a Loch Duart salmon farm, July 24

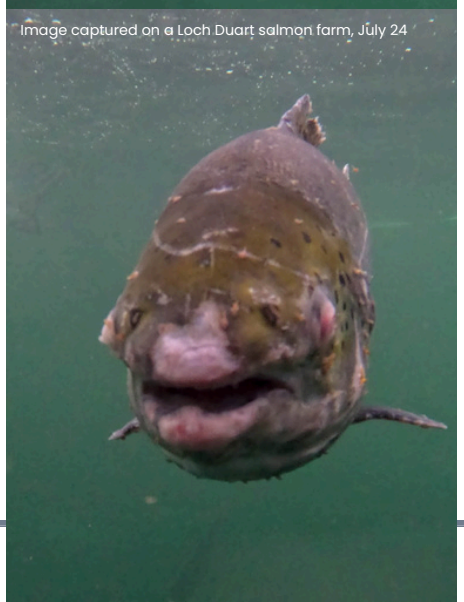


Image captured on a Loch Duart salmon farm, July 24

Chemicals

The salmon farming industry uses a host of toxic chemicals, for treatment of sea lice parasites and diseases. Use of emamectin benzoate, azamethiphos and deltamethrin is regulated by SEPA; use of hydrogen peroxide is reported but not regulated.

Sources: *Aquaculture Scotland, SEPA*

Image captured on a Mowi salmon farm, August 24

Emamectin benzoate

An in-feed treatment used for control of sea lice parasites, the pesticide emamectin benzoate is often referred to by its commercial name, SLICE. In recent years its popularity has waned (although quantities used within the industry have remained consistent since 2018), as sea lice have increasingly developed resistance [42].

Released into the environment via fish faeces and uneaten food, emamectin benzoate is known to be toxic to crustaceans, including lobsters, crabs and prawns; it has been found to have negative impacts on benthic communities even at low levels [43].

SEPA announced eight years ago that it would be introducing stricter limits on its use, initially suggesting an outright ban; however, this regulatory change has seen substantial watering down and delay, concurrent with heavy lobbying by the major salmon farming companies in Scotland [44].

Deltamethrin

This pesticide, used for sea lice infestations, is administered via bath treatment. Once the treatment is complete, the water containing chemical residues is released into the surrounding environment (sea lochs and coastal waters).

Deltamethrin is acutely toxic to lobsters and can spread up to 39km² around salmon farms [45]. The use of deltamethrin, azamethiphos and hydrogen peroxide bath treatments has been regulated in Norway since 2019 and is not permitted within 500m of known shrimp areas [46].

Azamethiphos

As with deltamethrin, the pesticide azamethiphos is also administered as a bath treatment, either in a well boat or via the use of a tarpaulin curtain around the fish pens. Azamethiphos is also known to be highly toxic to lobsters and other crustaceans [47].

Hydrogen peroxide

The licensed veterinary medicine, Paramove, contains 50% hydrogen peroxide – the same ingredient used in bleach. It is used to bathe fish suffering from infestations with sea lice and gill parasites. After use, it is discharged directly into the surrounding marine environment; it is also associated with high levels of fish mortality after treatment [48]. Information released by SEPA under freedom of information law suggests that more than 40 million litres of hydrogen peroxide were discharged by Scottish salmon farming companies between 2016 and 2021 [49].

Scottish Sea Farms claims that hydrogen peroxide "rapidly breaks down into just water and oxygen" [50]. However, numerous scientific research papers have shown that this degradation is highly dependent on specific conditions. The chemical degrades by 67% at 15°C temperatures after seven days; breakdown in colder waterbodies, such as those in Scotland, will be slower [51], [52].

Hydrogen peroxide is highly damaging to kelp and shrimp; with impacts on the latter occurring up to 1km away from a treated salmon farm [53], [54]. The far-reaching impacts of this non-regulated chemical on ecosystems across Scotland is highly concerning, considering the key role shrimp and kelp play in these environments and ecosystems.

Company name: Mowi

"We raise our salmon in cold and clear Scottish Highland waters."

- 48 farms in Scotland; 68,000 tonnes annual production.
- Certified by Aquaculture Stewardship Council, Soil Association, RSPCA Assured.

- Supplies Tesco, Asda, Sainsbury's, Ocado.
- Holds a Royal Warrant for supplying goods to the Royal Household.
- Sponsors Gordon Ramsay's Next Level Chef.

Mortality

Reported 4,731,560 deaths to the FHI in 2023; almost one million (946,005) premature salmon deaths were reported on one farm alone (Seaforth), attributed to low oxygen, amoebic gill disease (AGD) and mortality from treatment for sea lice. Two Mowi farms (Stulaigh, South Uist and Hellisay, off the Isle of Barra) reported overall production mortality of more than 50% in 2023.

Diseases reported*

Renibacterium salmoninarum (BKD), Yersinia ruckeri, Vibrio sp., Moritella viscosa, Shewanella sp., Salmon gill poxvirus (SGPV), Piscine myocarditis virus (CMS/PMCV), Infectious pancreatic necrosis (IPN), Infectious salmon anaemia virus (ISA), Salmonid alphavirus (SAV), Neoparamoeba perurans (AGD), Paranucleospora theridion. Two Mowi farms (Caolas A Deas and Seaforth) were served a Confirmed Designation Notice in May 2024 because of the presence of bacterial kidney disease (BKD).

Sea lice

In May 2024 one Mowi farm (Camas Glas) reported 5.44 lice per fish. Four further farms reported sea lice levels between 4.10 and 5.40 across 2023. Thirteen Mowi farms have been identified as 'high risk' for impacting on wild fish populations by SEPA.

Chemical use**

In 2023, Mowi reported using 127,830 grams of Azamethiphos on its farms, as well as 3,398 grams of Deltamethrin and 8,736 grams of Emamectin Benzoate. Between 2013 and 2023, Mowi has doubled its use of Azamethiphos.

Hydrogen peroxide use***

Mowi reported using 1,303,069 litres of hydrogen peroxide in 2023.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

Company name: Wester Ross

(owned by Mowi since 2022)

"Welcome to Wester Ross; an area of spectacular natural beauty in the northwest Highlands of Scotland, and the place from where we take our name, and root our heritage…. Here, in the wilderness of the west coast, amid the sparkling tidal waters of our Scottish lochs, we grow a salmon that is second to none."

- 3 farms in Scotland; 2,000 tonnes annual production.
- In July 2024, Mowi announced plans to convert two Mowi farms (Loch Alsh and Loch Torridon) to the Wester Ross brand, trebling its capacity.
- Certified by RSPCA Assured, Friend of the Sea.

- Supplies Leon, Smokin' Brothers and Inverawe Smokehouse (see Section 1); Shaun Rankin is a Brand Ambassador.
- Has a large export market in the US.

Mortality

Reported 26,845 premature salmon deaths to FHI in 2023 and 104,087 in 2022. The company's Ardmair site reported a production cycle mortality of 29.7% in May 2023.

Diseases reported*

Piscine myocarditis virus (CMS/PMCV) and Neoparamoeba perurans (AGD).

Sea lice

Wester Ross has reported some of the highest sea lice levels in 2024, with its Armair site reporting 5.15 lice per fish in January 2024.

Chemical use**

No reported use of Azamethiphos, Deltamethrin or Emamectin Benzoate in 2023.

Hydrogen peroxide use***

Wester Ross reported using 6,672 litres of hydrogen peroxide in 2023 - despite claims that it does not use any medicines on its farms.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

Company name: Loch Duart

"Raised from wild Scottish ancestors, our salmon grow up to three months longer than average in crystal clear waters. With a natural as possible diet and space to swim, each fish grows fitter and healthier every day."

- 8 sea sites in Scotland; 6,000 tonnes annual production.
- Certified by Label Rouge, Global GAP.
- Withdrew from RSPCA Assured scheme in January 2024.

- Supplies Selfridges.
- Endorsed by The Hebridean Baker and Thomas Leatherbarrow.

Mortality

One Loch Duart farm (Loch Carnan, off South Uist in the Outer Hebrides) reported 76.8% mortality for its production cycle ending in May 2023. In one single month (September 2022), more than half of the fish on the farm died. Two further Loch Duart farms (Loch Laxford and Sound of Harris) reported production mortality rates of almost 50% in 2023 (47.9% and 48.2% respectively).

Diseases reported*

Piscirickettsia salmonis (SRS), Vibrio sp., Aeromonas sp., Salmon gill poxvirus (SGPV), Infectious salmon anaemia virus (ISA), Neoparamoeba perurans (AGD), Paranucleospora theridion.

Sea lice

In 2022, more than one third of Loch Duart's sea lice counts breached CoGP guidelines. Across 2022 and 2023, sites reported sea lice levels between 1.63 and 2.29. Since January 2023, Loch Duart has failed to disclose sea lice numbers on its farms for 26.8% of its government-mandated counts.

Chemical use**

In 2023, Loch Duart reported using 3,370 grams of Azamethiphos on its farms.

Hydrogen peroxide use***

Loch Duart reported using 41,250 litres of hydrogen peroxide in 2023.

Data collected between January 2023 and June 2024 unless otherwise specified.
** For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated.*
**** Hydrogen peroxide use is reported but not regulated.*

Company name: Cooke Aquaculture

"Our salmon are farm-raised with care in Orkney and Shetland in the far north of Scotland: cold, fast-flowing seawater from north Atlantic ocean provide the perfect conditions for our salmon to become firm and muscular."

- More than 40 seawater sites in Orkney and Shetland; 27,000 gutted weight tonnes annual production.
- Certified by Label Rouge, Soil Association.

- Supplies Waitrose (Duchy range), Yo! Sushi.
- Sponsored Taste of Shetland Festival in 2023.

Mortality

In 2023, Cooke reported 432,371 premature deaths to FHI. Three Cooke sites (Bay of Vady, East Skelwick and Bow of Hascosay) reported production cycle mortality rates of 39.5%, 47.3% and 40.6% respectively in 2023. Despite a requirement to report mass mortality events to the FHI within a month, around 25% of mortalities on Cooke farms are not reported until months or even years later.

Diseases reported*

Renibacterium salmoninarum (BKD), Piscine myocarditis virus (CMS/PMCV), Paranucleospora theridion. Meil Bay was served a Confirmed Designation Notice in May 2024 because of the presence of bacterial kidney disease (BKD).

Sea lice

Cooke reported sea lice levels between 4.83 and 5.60 on five farms in 2023. Across 2023, the company failed to disclose sea lice levels for 25.36% of its government-mandated counts.

Chemical use**

In 2023, Cooke reported using 14,400 grams of Azamethiphos on its farms, as well as 3,863 grams of Emamectin Benzoate. Between 2018 and 2023, Cooke's use of Azamethiphos has increased 15-fold.

Hydrogen peroxide use***

Cooke reported using 36,333 litres of hydrogen peroxide in 2023.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

Company name:
Organic Sea Harvest

"We focus solely on producing the finest organic salmon, fresh from the waters of the Isle of Skye in Scotland."

- 2 seawater sites in Scotland; licensed for 5,000 tonnes annual production.
- Certified organic by Soil Association, BioSuisse, Canada Organic.
- Certified by RSPCA Assured, Label Rouge.

- Supplies North Coast Seafoods (US).
- Served at the Royal Household.

Mortality

Despite operating only two farms, in 2022, Organic Sea Harvest reported the premature death of 559,113 farmed salmon to the FHI. The company's Invertote site reported a production cycle mortality rate of 40.1% in August 2023. The Culnacoc site reported a production mortality of 86.8% in July 2024.

Diseases reported*

Piscirickettsia salmonis (SRS), Piscine myocarditis virus (CMS/PMCV), Neoparamoeba perurans (AGD).

Sea lice

Between January 2023 and June 2024, Organic Sea Harvest failed to disclose sea lice numbers on its farms for 34.7% of its government-mandated counts (double the industry average of 17.6%). Between January and June 2024, the company failed to disclose sea lice levels for 40.38% of its counts.

Chemical use**

Despite holding numerous organic certifications (including Soil Assocation), Organic Sea Harvest has reported use of Deltamethrin in 3 of its 4 years of production to date.

Hydrogen peroxide use***

Organic Sea Harvest did not report the use of any hydrogen peroxide in 2023.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

Company name: Bakkafrost

(formerly Scottish Salmon Company)

"Native Hebridean Salmon are a truly unique breed, descending from the wild salmon of rugged and remote North Uist in the Outer Hebrides and raised on the Hebridean Islands and West Coast of Scotland. Robust, lean and noticeably firmer, Native Hebridean Salmon offer a distinctive succulent and sea fresh taste of the Scottish Hebridean Islands."

- 60 sites in Scotland; produced 27,000 tonnes in 2022.
- Owns Lochlander, Native Hebridean Salmon and Harris & Lewis Smokehouse brands.

- Native Hebridean Salmon is endorsed by Gary Maclean and Jack Stein.
- In 2023 it was served at 10 Downing Street for Burns Night.

Mortality

Bakkafrost reported 2,230,110 premature deaths to FHI in 2023, and 3,522,143 premature deaths in 2022. Two Bakkafrost farms have suffered mortalities of 80% and upwards in recent years. The company's Druimyeon Bay farm has experienced 82.1% and 82.3% mortalities during its last two production cycles (ending December 2021 and August 2023). Bakkafrost's East Tarbet farm reported 80.2% mortality across its production cycle ending January 2022.

Diseases reported*

Piscirickettsia salmonis (SRS), Yersinia ruckeri, Vibrio sp., Aeromonas sp., Salmon gill poxvirus (SGPV), Infectious pancreatic necrosis (IPN), Infectious salmon anaemia virus (ISA), Salmonid alphavirus (SAV), Neoparamoeba perurans (AGD), Paranucleospora theridion.

Sea lice

Five farms run by Bakkafrost reported sea lice levels between 2.15 and 2.59 in 2023. Six of Bakkafrost's farms (including five in Loch Fyne, namechecked in promotional materials for 'Lochlander salmon') have been identified as 'high risk' for impacting on wild fish populations by SEPA.

Chemical use**

Bakkafrost reported using 12,748 grams of Emamectin Benzoate in 2023. Between 2013 and 2023, the company has consistently reported using between 12,000 and 23,000 grams of Emamectin every year, peaking in 2015 and 2017 with 23,157 grams and 20,248 grams respectively.

Hydrogen peroxide use***

Bakkafrost did not report the use of any hydrogen peroxide in 2023.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

Company name:
Scottish Sea Farms

"Premium farmed salmon, raised with care."

- 46 seawater sites in Scotland; produced 25,100 tonnes in 2023.
- Certified by RSPCA Assured, Global GAP and Label Rouge.

- Supplies Marks & Spencer, Waitrose, Co-op.

Mortality

Reported 2,362,804 premature fish deaths to FHI in 2023, and 2,639,320 in 2022. Between November 2022 and September 2023, five Scottish Sea Farms farms reported production cycle mortality rates between 48.2% and 64.3%.

Diseases reported*

Yersinia ruckeri, Vibrio sp., Moritella viscosa, Salmon gill poxvirus (SGPV), Piscine myocarditis virus (CMS/PMCV), Infectious pancreatic necrosis (IPN), Infectious salmon anaemia virus (ISA), Neoparamoeba perurans (AGD) and Paranucleospora theridion.

Sea lice

In 2023 and 2024, five farms run by Scottish Sea Farms reported sea lice levels of between 4.22 and 4.80. Between January 2023 and June 2024, Scottish Sea Farms failed to disclose sea lice numbers on its farms for 25.9% of its government-mandated counts. In the 2024 Sensitive Period, 24.01% of sea lice counts were above CoGP limits.

Chemical use**

Reported using 9,003 grams of Emamectin Benzoate in 2023. The company's use of Azamethiphos has fluctuated over the past decade, reaching 40,430 grams in 2021 and 52,150 grams in 2015.

Hydrogen peroxide use***

Scottish Sea Farms reported using 982,755 litres of hydrogen peroxide in 2023.

*Data collected between January 2023 and June 2024 unless otherwise specified. * For more information about specific diseases, see Appendix 1. ** Refers to chemical use that is regulated. *** Hydrogen peroxide use is reported but not regulated.*

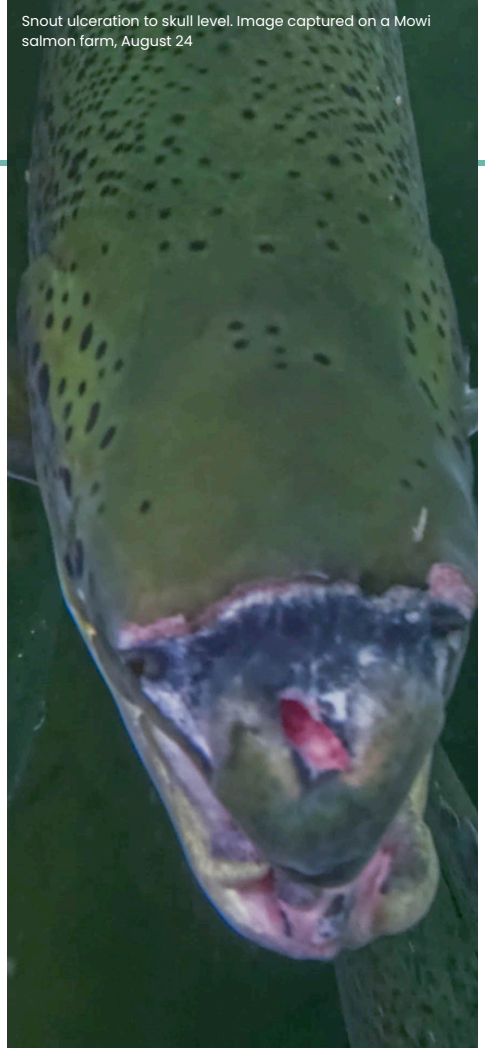
Conclusion

Through layers of marketing and certification schemes, Scottish salmon farming companies are able to portray a product far removed from its industrial method of production. Salmon raised on farms suffering from high mortality, sea lice infestations or using chemicals that damage the local marine environment and surrounding aquatic wildlife, are morphed into certified 'high welfare', sustainably produced (or even 'sustainable') fish that, in some cases, consumers might be forgiven for assuming have been wild caught.

This comparison of Scotland's salmon farming companies demonstrates that, across the board, there is no company currently operating in a way that both protects the environment and promotes good fish welfare. Even companies positioned as 'premium' suppliers are not immune to the widespread issues; whilst some perform better in some areas than others, there is a clear, and continual, trade-off taking place.

Mortality within the Scottish salmon farming industry has increased fourfold between 2018 and 2023, with a record estimated 17.4 million fish dying prematurely in 2023 alone. Disease on salmon farms is ubiquitous; sea lice treatments – to protect farmed fish welfare and the survival of wild salmonids – result in toxic chemicals being spewed into surrounding lochs and coastal waters, with severe negative and potentially long-term impacts on delicate ecosystems. Chemical use within the industry has failed to decline even as the industry increasingly seeks alternative solutions, such as physical treatments or the use of wild-caught 'cleaner fish' for sea lice control, both of which come with additional welfare and/or ecological costs.

Intermediate bulk container of hydrogen peroxide


Snout ulceration to skull level. Image captured on a Mowi salmon farm, August 24

These issues are not unique to Scotland; indeed, they are ubiquitous across all countries where open-net salmon farming is in operation. In 2024, the Norwegian industry – another key farmed salmon producer for the UK market – made global headlines for issues including huge sea lice numbers and the high levels of mortality, triggering protests by scientists and technologists working within the industry [55], [56].

Scottish farmed salmon is widely used within the hospitality sector, and the seven companies detailed in this report supply farmed salmon to supermarkets and retailers, Michelin-starred restaurants, chain restaurants, catering firms and more. The industry's expansion is celebrated as an economic success story for Scotland. However, this report demonstrates that where the industry success story really lies is with its effective marketing, certification and strategic partnerships with chefs and celebrities. It is only when these layers of marketing are stripped away that consumers (and industry customers) can see the reality of the product that they are purchasing, serving and eating, and understand the far-reaching environmental and welfare impacts of the industry's operations.

Appendix A

Common diseases of Atlantic salmon that are found in aquaculture environments due to movement of pathogens between aquaculture facilities and wild fish.

Disease	Cause	Symptoms	Literature
Amoebic gill disease	The causative agent is the protozoan parasite *Neoparamoeba perurans*. It is widespread throughout many fish species.	Causes proliferative gill disease, leading to increased gill mucus, and patches of swollen tissue. Fish may swim close to the surface and breath rapidly.	Marine Scotland Directorate
Bacterial coldwater disease	Caused by the bacterium *Flavobacterium psychrophilum.* There is no effective treatment and growing antibiotic resistance, and new strains are emerging in aquaculture settings.	Juvenile fish have exophthalmia, haemorrhaging of abdominal areas, frayed fins and tail rot.	(Bruce et al., 2021; Staliper, 2011).
Bacterial Kidney Disease	The causative agent is the bacterium *Renibactterium salmoninarum* which can be transmitted horizontally by contact with infected fish, or vertically through eggs or sperm. There is no licensed treatment, so control on movement of fish is used. Identification of BKD is also challenging.	There may be no external symptoms, but symptoms include protruding eyes, darkening of skins, haemorrhage at the base of fins, pale anaemic gills and erratic behaviour. Internally there may be fluid accumulation in the abdominal cavity and kidney enlargement with cream/grey nodule on the kidney and possibly other organs.	(Jaramillo et al., 2017) *and* Marine Scotland Directorate
Cardiomyopathy Syndrome	The causative agent is piscine myocarditis virus thought to be related to the *Totiviridae* family. It was first identified in Norwegian aquaculture but has spread globally and into wild populations. It is still not well understood.	Fish often remain in good condition, and show little sign of infection before death, as symptoms are primarily internal. Diagnosis is based on lesions in the heart.	(Garseth et al., 2017a) *and* Marine Scotland Directorate
Diplostomum spathaceum	The causative agent is *Diplostomum spathaceum,* a parasitic fluke that lives in the eyes of freshwater fish towards the end of its life cycle.	Causes the development of cataracts, dark colouration and can lead to mortality	(Klemme, Hyvärinen and Karvonen, 2021) *and* Marine Scotland Directorate
Enteric Redmouth/ Yersinosis	The causative agent is the bacterium *Yersinosis ruckeri.* This affects many salmonid species. There is an available vaccine.	Effects vary from unnoticeable to death. Infected fish show haemorrhaging at the tips if gills, ulceration and a red mouth caused venous and capillary congestion.	(Nguyen et al., 2018) *and* Marine Scotland Directorate
Epipheliocystis	This is a freshwater disease caused by primarily by chlamydia bacteria, but also several other pathogenic bacteria in at least 90 species of fish including Atlantic salmon. This is usually a benign infection.	Causes respiratory problems due to cysts on the gills and lesions, with high rates of mortality. Development is related to stress from unfavourable environmental conditions.	(Blandford et al., 2018) *and* Marine Scotland Directorate
Furunculosis	The causative agent is the bacterium *Aeromonas salmonicida* is airborne/ waterborne and can be introduced by healthy carrier fish. There is a vaccine, and antimicrobials can be used for treatment, and selective breeding has created resistance.	Causes septicaemia followed by boil like inflammatory lesions (furuncles) and death. Death can occur in cases with no outward signs. This was a major pathogen of aquaculture but is less challenging following effective management.	(Drangsholt et al., 2011) *and* Marine Scotland Directorate
Complex Gill Disease	There are at least seven known causes of gill disease (amoebic, parasitic, viral, bacterial, zooplanktonic, harmful algal, and chemical/toxin). When the cause is not obvious gill disease is referred to as complex gill disease. When multiple causative agents are acting simultaneously it is multifactorial gill disease.	Gill diseases are usually associated with impaired respiratory function from damage to the gills, and often mortality.	(Boerlage et al., 2020)
Gill Pox Virus	The causative agent is a large DNA virus that infects Atlantic salmon gills.	Causes damage to the gills which leads to a high mortality and lasting damage in fish that recover.	(Gjessing et al., 2020)
Gyrodactylus Salaris	The small parasite *Gyrodactylus salaris* is present in much of Europe but not Scotland.	Infects parr, can cause a greyish appearance. Has been known to lead to 98% mortality in infected wild populations.	Marine Scotland Directorate
Heart and Skeletal Muscle Inflammation	The causative agent is Piscine orthoreovirus 1. Different strains of PRV-1 have different effects, only recent Norwegian strains of RPV-1 cause HSMI.	Typically occurs a few months following transfer to marine environment. Causes	(Wessel et al., 2020; Wessel et al., 2017)

		lesions on and inflammation of the heart, and necrosis of the red skeletal muscle.	
Infectious Haematopoietic Necrosis	The causative agent is a virus of the genus *Novirhabdovirus*, and transmitted through water, contact with contaminated untreated waste material, and equipment. Infected fish that survive act as carriers of the disease. It was first identified in American rainbow trout and now has been found infecting almost all salmonids around the world.	Causes lethargy with bouts of frenzy, dark colour, exophthalmia, pale gills, haemorrhaging at the base of fins, swollen abdomen.	Marine Scotland Directorate.
Infectious Pancreatic Necrosis	Caused by infectious pancreatic necrosis virus, an aquabirnavirus, it affects numerous species of fish and shellfish around the world. It can be transmitted horizontally in fresh and saltwater, through waste and in dead bodies, and vertically. It is highly infectious.	Mortality occurs predominantly in juvenile stages, recently including post-smolts. All age groups and both freshwater and marine environments can sustain infection. It is often present asymptomatically. Causes abdominal swelling and internal pancreatic necrosis, and infected groups can suffer 80-90% mortality.	(Dopazo, 2020) *and* Marine Scotland Directorate
Infectious Salmon Anaemia	The causative agent is the orthomyxovirus, infectious salmon anaemia virus. Only Atlantic salmon are susceptible, but rainbow trout and brown trout can be carriers. Transmitted through water, but primarily through live fish and discharge of untreated blood. No vaccine and no treatment are available.	There are two classes of ISAV: the nonvirulent ISAV-HPR0 and the virulent ISAV-HPRΔ. ISAV-HPR0 is widespread in farmed salmon. ISVA-HPRΔ causes severe anaemia, haemorrhage in internal organs, ascites, darkening of the liver. The development of ISAV-HPR0 into ISVA-HPRΔ is facilitated under aquaculture conditions.	(Rimstad and Markussen, 2020; Nylund et al., 2019) *and* Marine Scotland Directorate
Proliferative Kidney Disease	The causative agent is the myxozoan endoparasite *Tetracapsuloides bryosalmonae.* The parasite is widespread throughout salmonids in Europe and North America.	The development of PKD is temperature dependent, leading to concerns it will become more prevalent with climate change. Fish are dark, show exophthalmia, pale gills, distended abdomen, and poor development of the kidneys.	(Lauringson et al., 2021) *and* Marine Scotland Directorate
Red Vent Syndrome	The causative agent is suspected to be larvae of the parasitic nematode *Anisakis simplex* which is widespread in the digestive systems of wild salmon but causes disease at an abnormally high abundance in the event region.	RVS was first recorded in 2015 on returning salmon and has only been recorded in wild salmon to date but is suspected to have been caused by changes in parasite - host dynamics relating to warming ocean surface temperatures. RVS causes inflamed, bleeding vents and is most common in one sea winter returning salmon.	(Kent et al., 2020) *and* Marine Scotland Directorate
Salmoid Rickettsial Septicaemia/ Piscirickettsiosis	The bacterium *Piscicickettsia salmonis* is the causative agent of salmon rickettsial septicaemia, which is a major disease in Chilean aquaculture, and present but less severe elsewhere. It can survive for several weeks in seawater without a host. There are several vaccines, but their efficacy is questionable.	Causes lethargy, erratic behaviour, lack of appetite, darkening, skin lesions and ulcers. Clinical signs may be absent in infected fish. Cumulative mortality across grow-out cycles has been recorded as high as 90%.	(Jones, 2019)
Salmonid alphavirus	7 genetic subtypes of the genus *Alphavirus* in the family *Togaviridae* are serious pathogens of farmed Atlantic salmon and other salmonids in Europe. SAV2 and 3 are the causative agent of Pancreas Disease (PD) in salmon in Norway, and SAV1, 4, 5, and 6 in the UK. It is transmitted through water.	In salmon SAV causes pancreas disease which results in lethargy, loss of appetite, abnormal swimming, high mortality, and in rainbow trout SAV2 causes rainbow trout sleeping disease. Mortality from PD can be up to 63%, and sublethal effects include significantly lower growth rates.	(Aslam et al., 2020) *and* Marine Scotland Directorate
Saprolegnia	*Saprolegnia* is a freshwater eukaryotic pathogen and an oomycetes which are related to Chromista, chromophyte algae, and other Protista, not the fungi to which they are often compared. *Saprolegnia parasitica* is the most common causative agent.	*Saprolegnia* often occurs following vaccination of pre-smolt salmon against other diseases. It causes cotton wool like tufts growing from crescent shaped lesions and from the gills. This leads to lethargy, osmotic stress, and mortality.	(Beckmann et al., 2020) *and* Marine Scotland Directorate
Tenacibaculosis/ yellow mouth/ mouth rot	Tenacibaculosis is caused by members of the flavobacteriaceae family, notably *Tenacibaculum maritimum, T. dicentrarchi* and *T. finnmerkense*. It affects multiple marine species including Atlantic salmon and is, responsible for considerable aquaculture losses. There is no vaccine, it is treated with antibiotics.	Causes erosion and haemorrhaging of the mouth, development of yellow plaques around the mouth, ulcerative skin lesions, frayed fins, tail rot.	(Nowlan et al., 2021) *and* Marine Scotland Directorate

Vibrosis	Vibrosis is caused by bacteria in the genus Vibrio, mostly commonly by *Listonella (Vibrio) anguillarum* in saltwater or brackish environments. *Vibrio* are a normal part of the gut microflora, but poor water quality and temperature changes trigger clinical outbreaks. Coldwater vibrosis (Hitra disease) is caused by *Allivibro salmonicida*, and many other *Vibrios* have been linked to fish diseases. An effective vaccine is widely used but does not prevent all outbreaks. Following outbreaks antibacterial treatments are used.	Causes haemorrhagic septicaemia, muscle necrosis, anaemia, and skin lesions that rupture spreading blood and bacteria into the water. This eventually leads to mortality. Cold water vibrosis is less well understood, but also causes haemorrhagic septicaemia and high levels of mortality.	(Higuera et al., 2013; Nørstebø et al., 2018) *and* Marine Scotland Directorate
Viral Haemorrhagic Septicaemia	Viral haemorrhagic septicaemia virus is widespread through many wild fish populations and in farmed Atlantic salmon. Virus can be transmitted through water without direct contact.	Causes haemorrhaging in the eyes, kidneys, around the fin base and in muscles, connective tissues inflammation, a dark dorsal discolouration, and mortality.	(Lovy et al., 2013; Karreman et al., 2015) *and* Marine Scotland Directorate
Winter ulcer disease	Caused by *Moritella viscosa* among others. An effective vaccination against *M. viscosa* exists that protects against both development of symptoms and mortality.	Causes the development of ulcers on the skin, primarily the dorsal surface which grow gradually, and can lead to mortality.	(Karlsen et al., 2017)

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