

Summary Report

21st January 2016

Finfish Mortalities in Scotland

Project Code: 3RP005-502



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1 Overview

1.1 Background

Aquaculture is a growing industry in Scotland with farmed salmon being the largest food export from Scotland, accounting for around 40% of total value¹. A natural consequence of finfish farming is fish mortalities (morts). Morts are normally classed as category 2 animal by-products (ABPs) and must be disposed of in a safe and environmentally responsible manner in accordance with the Animal By-Product (Enforcement) (Scotland) Regulations 2013 (ABP(E)(S)). Examples of suitable disposal options are incineration, rendering, in vessel composting (IVC) or anaerobic digestion (AD), all of which must take place in plants approved under the ABP(E)(S) regulations or the Waste Incineration Directive.

In 2013, the Scottish Government implemented a derogation that allowed the disposal of ABPs by burning or burial on site or by other means under official supervision in remote areas. This meant that both terrestrial and aquatic mortalities generated within these ABP remote areas could be disposed at suitably supervised landfill sites. Since almost all fish farms in Scotland fall within these remote areas, some have taken the landfill option. However, the interpretation of this derogation has recently changed, and from 1st January 2016 it applied only to terrestrial livestock in the future. Under this policy, the aquaculture industry now need to ensure that fish farms located within the ABP remote areas are disposing of their waste in accordance with ABP legislation i.e. it can no longer be disposed of in a landfill site. Although this may present some immediate logistical challenges to the aquaculture sector, it should also present a number of opportunities through valorization of aquaculture wastes.

A full report is available from Zero Waste Scotland, which:

- Provides evidence for suitable ABP compliant disposal routes for Scottish finfish farming waste
- Reviews the capacity already existing in Scotland to receive and utilise this material and the logistics involved for the individual solutions identified
- Identifies other options for adding further value to this waste

This report focuses on finfish farming and does not include aquaculture as a whole i.e. does not include molluscs, crustaceans or seaweed. It also does not include waste from fish processing facilities (usually Category 3 waste). The full report details each section more fully, however a summary of the research is provided below.

2 The Fish Farming Industry and the Scale of Mortalities

The marine aquaculture sector (fish farming industry) has consolidated in recent years, leaving only a few larger farmers: there are only 6 companies operating > 10 sites and these together comprise 89% of all the active sites. The majority of the farms produce Atlantic salmon, many together with cleaner fish (wrasse and lumpsuckers) which act as a biological control for sea lice. There is some marine trout production and two farms produce halibut. The freshwater rainbow trout sector has 33 operators and 46 active sites i.e. it is highly unconsolidated compared with the marine sector.

As in other forms of animal production, aquaculture suffers stock mortalities (commonly referred to as morts). Since the majority of Scottish fish farm production is in the marine sector, this contributes the majority of the morts (Figure 1 below). On average, there are around 10,000 tonnes of morts from an average annual production of around 150,000 t, i.e. about 6.7%.

Marine trout production is ca. 1% of salmon production and has an average mortality rate of 5.6% of production. No data is collated and published on mortalities of freshwater production for any species.

¹ <http://scottishsalmon.co.uk/exports/>

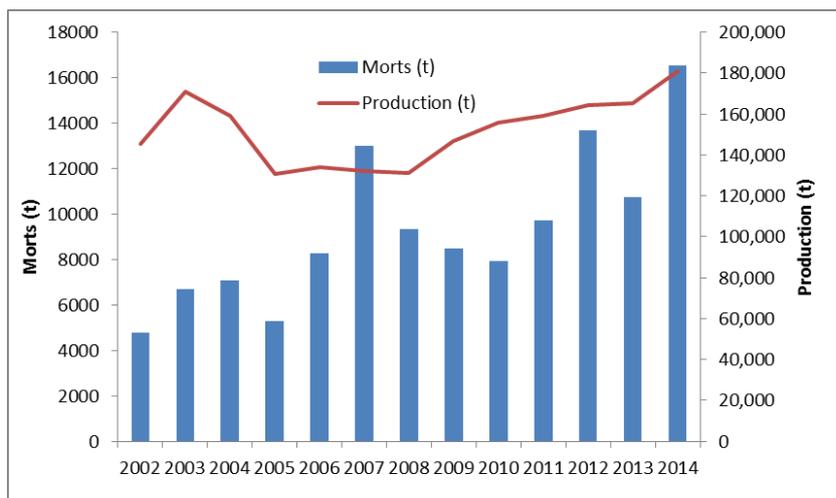


Figure 1 - Annual Scottish marine fish farm mortalities & production (Atlantic salmon & rainbow trout).

3 Options for disposing of fish mort's

3.1 Anaerobic Digestion (AD), In Vessel Composting (IVC) and capacity

AD and IVC sites processing ABP material to European standard and approved to do so by AHPA can accept and process cat 2 fish mortalities. It is the duty of the fish farm to produce commercial documents that comply with the ABP legislation ensuring the haulier receives a copy and the original is supplied to the destination premises, the haulier should ensure that the documentation is in place. However please note, Cat 2 fish mortalities that are produced as a result of notifiable disease will need to be disposed of in compliance with the legislation that applies for that disease in addition to the ABP legislation. During the course of this report, concerns have been raised that current pasteurisation processes used in AD and IVC facilities for Category 2 fish morts, may not meet the requirements of European regulations and from a hazard/risk assessment perspective may not be sufficient for managing the risks associated with fish pathogens. This has been discussed in detail with the Scottish Government which is content with its current position and interpretation.

In terms of managing fish farm morts, all seven operational ABP registered AD facilities in Scotland were contacted, suggesting that there is existing capacity to take the annual 10,000 tonnes of morts. One large AD facility stated that it could accept the entire annual tonnage of morts, whilst others stated that they could each accept a proportion. The Western Isles dry AD facility is currently unable to process morts, but this may change in the future. The Northern Isles face more of a challenge, and although AD options are actively being considered, these will take some time to come to fruition. On Shetland, the Energy from Waste (EfW) facility is reducing the quantity of fish farm waste that it takes, and this means that in the short-term morts from both Shetland and Orkney will need to be hauled to the mainland for disposal.

For IVC facilities, it is not clear whether there is capacity to take the annual tonnage of morts. Although five facilities indicated they had capacity to take additional waste, two were not able to quantify this spare capacity, whilst three facilities collectively could absorb 4,460 tonnes within their existing capacity.

3.2 Incineration / Rendering and capacity

Suitable incineration infrastructure in Scotland is extremely limited, with only one small-scale incinerator in Livingston able to take morts at the current time. This facility has not historically accepted fish mortalities, however has the necessary licences and capacity required to treat routine mortalities at what is understood to be very low levels. The potential associated with the energy from waste facility on Shetland is increasingly diminishing.

In addition, there are a number of smaller-scale, local options currently going through the planning process and recently (2015) permission has been granted for an incinerator on Benbecula capable of processing up to 10 tonnes / day, set up specifically to deal with the problem of processing fish mortalities close to source.

Cross-industry feedback suggests that significant quantities of fish farm morts are sent to Widnes for incineration, even where there are potentially lower cost options in Scotland (see Table 1 below). In the case of one haulier, the inability of two AD facilities in Scotland to confirm that they could accept Category 2 ABP (specifically, morts) led to Widnes being identified as the compliant option for processing this waste. The vast majority of fish mortalities currently being incinerated are transported to the SecAnim facility in Widnes, and this facility's operators have stated that it can process all of the fish farm morts produced in Scotland.

One rendering plant in Scotland has just begun to process Category 2 fish, and if the current trial is successful the rendering volumes will expand.

3.3 Haulage and capacity

As noted above it is the duty of the fish farm to produce commercial documents that comply with the ABP legislation ensuring the haulier receives a copy and the original is supplied to the destination premises, the haulier should ensure that the documentation is in place.

Transporting fish morts did not appear to pose a problem, although significant mass mortality events clearly put companies under pressure. However, several hauliers could offer a service for mass and routine mort transport in the future, including a number of road hauliers that already haul routine morts.

Johnson Marine already provide a range of services to fish farms in Scotland, and are interested in developing services involving bulk haulage of fish farm mortalities by boat. Calmac may also be interested in diversifying their business model, to incorporate the haulage of fish farm mortalities.

Hordafor are able to offer a complete haulage service by boat, although they do not currently operate in Scotland, and infrastructure would need to be set up in order to offer a viable solution. Scanbio are in a similar position, but already have appropriately licensed storage infrastructure in Inverness. There could be potential for both Scanbio and / or Hordafor to pick up by boat from individual fish farms, with the boat making multiple stops.

Table 1. Summary of **current practices for disposal of fish farm mortalities (Atlantic salmon), with estimated costs. Estimated costs include haulage and gate fees (as well as landfill tax, where appropriate)**

Region	£/Tonne - Landfill	£/Tonne for Incineration e.g. Widnes			£/Tonne for AD – Aberdeenshire
		Whole Fish - Mass Morts		Ensiled - Routine	Ensiled - Routine
		10 tonnes/load	25 tonnes/load	25 tonnes/load	25 tonnes/load
W. Isles	£327	£360	£189	£169	-
NW Mainland (Highland)	-	£285	£159	£139	-
Shetland	£174	-	-	-	-
Orkney	-	£600	£240	-	£154
South West (Argyll)	£357	£215	£159	£111	-

Table 2. Summary of **potential future options, for disposal of fish farm mortalities (Atlantic salmon), with estimated costs. Estimated costs include haulage and gate fees (as well as landfill tax, where appropriate)**

Region	£/Tonne for Alternative Practices/Options				
	IVC - Mainland	AD - Mainland	AD – Island ¹	Incineration - Mainland ²	Incineration - Island ³
	25 tonnes/load	25 tonnes/load	25 tonnes/load	25 tonnes/load	3 tonnes/load
W. Isles	£174	-	£144	-	190
NW Mainland (Highland)	£144	£124	-	£866	-
Shetland	£184	£174	-	£876	-
Orkney	£174	£164	-	£876	-
South West (Argyll)	£106	£106	-	£837	-

1. A local AD for Shetland is still very much at the early stages in terms of planning. An application for upgraded processing infrastructure at the Lewis AD facility is being taken forward (Oct 2015)

2. An alternative to Widnes is Novus although the latter is significantly higher cost.

3. This incinerator, on Benbecula, is due to be operational in 2016 (planning consent given), with loads of 3 tonnes being brought to the site

4 Impacts of change to the previous derogation

4.1 The costs to fish farmers associated with the loss of landfill as a disposal option

Data provided by stakeholders from across the haulage and treatment sectors indicates that where companies have previously disposed of fish farm waste at licensed landfill sites, they should already be able to secure lower cost contracts with more sustainable processes (see Table 1 above).

Shetland is an exception, where a lower cost option is dependent on the mainland AD and IVC infrastructure being able to take Shetland's fish farm waste. For the fish farms in all of the regions identified, lower cost options than hauling to Widnes for incineration are available, where Scottish infrastructure has capacity to process it.

4.2 The impacts on Rural Landfill Operators

Ten remote landfill site operators were contacted (using the most recent, SEPA, 2013 database) to quantify the economic impacts that will result from a future change to regulations which prohibits the landfilling of fish farm waste. The tonnages identified amount to approximately 23% of the estimated arisings of fish mortalities in the country, with the loss of income for Scottish landfill sites as a whole, shown to be £228,149.

5 Future options

In addition to the potentially available disposal options there has been identified 2 further options which could also be employed successfully in Scotland to utilise fish farm mortalities in the future. A variation of the Norwegian system as outlined in 5.1 below and biodiesel production as outlined in 5.2 below.

5.1 The Norwegian System

In the future, there may be the potential to implement the Norwegian System as an alternative approach to haulage, or variations on this e.g. at a smaller scale to enable bulk pick-ups and possibly storage (ensiled) infrastructure for mass events. This system takes both Category 2 and 3 fish waste and incorporates the following:

- Collection of dead fish on a daily basis
- Ground / chopped and mixed with formic acid pH \leq 4
- Storage pH \leq 4 at least 24 hours
- Particle size of less than 10 mm (after filtration or maceration)
- Heat treatment: at least 85° Celsius for at least 25 minutes

A variation on the Norwegian system could involve the continuation of sea haulage and road transport, but with the latter involving the movement of fish farm mortalities to a central treatment facility (rather than using a bulk carrying, sea-going vessel). The use of bulking and ensiling stations located at either Ullapool or Oban may present a more economically feasible means of hauling ensiled fish mortalities down to facilities in the central belt of Scotland, and dependent upon ensiling capacity, may offer an interim solution for mass events.

5.2 Innovative Business Development Opportunities

A number of innovative technologies have been identified as having potential for future development:

- Biodiesel production – the maximum amount of oil that could be produced from fish farm mortalities, from Scotland as a whole, would be 1,500 tonnes per annum (based on 10,000 tonnes of waste generated per annum)
- Alkaline hydrolysis – reduces biological material into a sterile aqueous solution
- Dehydration – not currently used for morts, but a technology is under development
- Flymeals – Stirling University lead work in Scotland on incorporating fly larvae into animal feed. They are currently piloting insect based approaches to deal with morts. Their trials utilise flies to break down whole fish arising from routine mortalities, thereby removing the need to ensile fish and / or transport off-site
- Small-scale niche markets: fish-skin leather, synthetic hydroxyapatite, vermiculture, mass seaweed culture.

6 Recommendations

1) A number of potential opportunities for the movement of fish farm waste more cost effectively (than is currently the case) have been identified. These could involve establishing consolidation centres at different locations across the country. Cost benefit analyses, business planning and pilot / demonstration projects could all be carried out to describe in detail the extent of the opportunities, issues and risks associated with such developments. There may be value in considering whether financial support to assist in taking forward such projects is a possibility.

2) There may be value in work being carried out to collate data currently being collected on smolt mortalities. Although the tonnages are considered to be significantly lower than the fish farm mortalities given in this report, they may also represent significant tonnages at a very local level, which could make a contribution to otherwise small-scale, resource efficiency projects.

3) Confirmation from the European Commission regarding the current treatment of fish farm mortalities in Scotland.



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