

## RURAL ECONOMY AND CONNECTIVITY COMMITTEE

### SALMON FARMING IN SCOTLAND

#### SUBMISSION FROM DR JAMES MERRYWEATHER

I write as an independent ecologist, a board member of the Skye & Lochalsh Environment Forum<sup>1</sup> and the Scottish Salmon Think-Tank,<sup>2</sup> which is affiliated to the Salmon Aquaculture Reform Network, Scotland,<sup>3</sup> a Scotland-wide coalition of coastal community organisations with the common opinion that salmon aquaculture should be properly regulated.

Salmon aquaculture, as currently conducted using nets, is responsible for numerous detrimental impacts, both environmental and socio-economic. I have dealt with environmental impacts in my submission to the ECCLR committee's recent consultation *Environmental impacts of salmon farming*. Those considerations should also be of vital importance to the REC committee, in addition to impacts – both advantageous and (in my opinion of greater significance) detrimental – of net-cage salmon farming on a diversity of rural community economies.

The environmental impacts have been satisfactorily summarised in the letter accompanying the ECCLR committee's report from Graham Dey MSP to the convener of the REC committee Edward Mountain MSP.<sup>4</sup> However, I wish to iterate briefly the main environmental problems, validated by references to reliable source literature:

**1. Solid organic waste** released into the sea from a single modern salmon farm is approximately 1,000 tonnes *per annum*.<sup>5</sup> The total from approximately 250 active farms (variable according to production cycle) is, therefore, approximately 250,000 tonnes *per annum*. It does not require scientific expertise to conclude that that amounts to a substantial pollution problem. Put another way: as Richard Luxmoore told the REC committee (March 14 2018) "A single fish farm, which currently has a maximum size of 2,500 tonnes [fish production], produces the sewage equivalent of a town twice the size of Oban." In this context, members of the public frequently and justifiably complain that if they may be prosecuted for accidentally allowing a septic tank to overflow into a water course, why is an entire high profit industry permitted to dispose of all its waste, untreated, into the sea, intentionally?

Common sense and a general understanding of the current degraded condition of the world's oceans would suggest that the pollution caused by Scotland's 250 salmon farms should actually be deemed intolerable and mitigation measures instigated. N.B. the above figures are annual measurements, therefore cumulative impacts, already several decades-worth thereof, should not be overlooked. **When will the Precautionary Principle, Principle 15 of the UN Biodiversity Convention, Rio 1992, to which Britain is a signatory and which is routinely recommended by the statutory authorities (e.g. SNH, JNCC<sup>6</sup>), ever be implemented?**<sup>7</sup>

**2. Dissolved Nitrogen and Phosphorus compounds.** In 2000, concentrations of dissolved nitrogen (N) as ammonia and urea, and phosphorus (P) as phosphates liberated from Scotland's fish farms were estimated to be equivalent to the entire human sewage of Scotland (were it to be released into the sea untreated).<sup>8</sup> Both are acknowledged causes of eutrophication,<sup>9</sup> on land and in water. By 2015, farmed salmon production had increased significantly (to >130%) as will have its impacts.<sup>10</sup>

Research published 6 February 2018 confirms that N eutrophication is a cause of "... seagrass [a declining and economically important UK Priority Habitat<sup>11</sup>] degradation across the British Isles".<sup>12</sup> Sources of N cited are agricultural fertilisers and human sewage. Is there any reason not to conclude that salmon farm generated N is also a significant cause of seagrass degradation, not yet accounted for? It does not take much N to cause severe ecological problems: "... chronic exposure to nitrate enriched waters is directly lethal to *Zostera marina* even at low enrichment levels, and likely represents an important causative agent in the disappearance of eelgrass meadows from many quiet embayments and coastal lagoons throughout the world."<sup>13</sup>

**3. Excess pesticides and chemotherapeutants** Contamination of the sea and seabed by chemical therapeutants used, in the main, to control sea lice has long been a cause for public concern, though confirmatory data have not been readily available for public scrutiny. However, SEPA recently released figures revealing that 45 Scottish sea lochs had been found to be contaminated thus, principally with emamectin benzoate (SLICE<sup>®</sup>) and teflubenzuron, both of which are deadly to crustaceans in particular<sup>14</sup> (non-target crabs, lobsters, prawns etc. as well as target sea lice) plus a wide range of other organisms, not least humans. This raises socio-economic questions about the livelihoods of inshore fishermen, the safety of the public and the health of the environment in general. SEPA describes emamectin thus, reflecting warnings printed on labelling of its agricultural formulations: "Emamectin benzoate is toxic to birds, mammals, fish and other aquatic organisms (particularly those living on the sea bed)." The manufacturers warn that this pesticide is not suitable for application in or near water!

We might also note that SLICE<sup>®</sup> is applied in salmon feed, migrating from the gut to the skin where the sea lice feed, presumably suffusing the entire fish. Under most circumstances (not specifically in fish muscle) this chemical's half-life is at least 175 days whereas application in feed is stopped at about 60 days before harvest. Can we be confident that there is no residue of this toxin remaining in the fish at point of sale and consumption? If it were not necessary – see mitigation – there would be no such risk.

**4. MITIGATION OF SALMON FARM IMPACTS** Fish farms that maintain their salmon in nets cause many more impacts than pollution alone. Of them, only one – the wild fish constituent of salmon feed, as fish meal and oil – cannot be mitigated by conversion to closed containment, otherwise known as Recirculating Aquaculture Systems (RAS), in which the fishes are maintained in tanks.

Therefore, ALL environmental disadvantages associated with current salmon farming in are eliminated if tanks replace the nets that allow free passage between farm and sea of waste, excess pesticides, pests, diseases and alien genes (via escapes).

Aquaculture industry spokespersons routinely deny the efficacy and cost effectiveness of closed containment. That seems not to be the opinion of the companies that are currently operating closed containment fish farms, many of which raise salmon, even Atlantic salmon. Norway, home country of the polluting net-cage salmon farmers, is leading the way to conversion, at home and around the world.

Mentioning just a few RAS projects: Numerous RAS installations are being built in Norway and Norwegian companies have begun building full scale RAS salmon farms in China and at Belfast, Maine, USA. Somebody is erecting a gigantic land-based salmon farm near Miami FL, which is projected to produce 90,000 tonnes of salmon per cycle. That sort of investment has to be backed up by a significant degree of

confidence in the method, which the salmon aquaculture companies working in Britain ought to find persuasive, particularly if strictly encouraged by the Scottish Government. I request that the Scottish Government should follow Norway, obliging salmon farmers to convert, by stages as will be necessary, but progressively and urgently.

**5. SOCIO-ECONOMIC IMPACTS OF SALMON FARMING IN NETS** Much is routinely claimed by the salmon farming industry about its creation of employment in areas where jobs are hard to find. Figures quoted in planning proposals tend to exceed actuality and those who are employed are frequently not from local communities. Actual figures are variable, often anecdotal and exaggerated, so that I find an alternative argument becomes more relevant than simplistically, if justifiably, criticising the industry for not fulfilling promises made to encourage public support.

Many members of the public, ignorant of the wider picture, consider that the jobs argument trumps all other objections to salmon farming (as currently conducted using nets). They have not learnt that, arguably, salmon farms pollute the sea, have an indirect but significant deleterious impact on wild salmonid populations and actually do not always (if ever, on balance) provide benefits to rural communities. Additionally, few consider detrimental impacts on existing economic activities in which they are not involved, such as inshore fishing and tourism. Creel fishermen are aware.<sup>15</sup>

Economy *versus* Environment is not a case of opposite arguments. Both impacts are important in very different ways. Job creation does not justify pollution. Environmental impacts may be measured, characterised and regulated (currently inadequately). The various economic impacts can be mutually contradictory and must be weighed against one another.

Therefore, consideration must be given, not to the number of jobs *promised*, but to precise numbers *created* by a fish farm, at its installation and also when established (the need for staff inevitably decreases). The large multi-national aquaculture companies inevitably offer cash or community improvements as they prepare their planning applications. Are these incentives truly beneficial to local people or do they represent cynical bribes, offered to deflect objections?

Additionally, a new fish farm creates problems in the economies of other sectors in adjacent communities?

**Creel fishing** The coincidence of salmon farms in Scottish sea lochs and the UK Priority Habitat 'Seapens and burrowing megafauna in circalittoral fine mud' (SS.SMu.CFiMu.SpMmeg) is very striking.<sup>16,17</sup> The burrowed mud habitat is where creel fishermen have their fishing grounds, so new fish farms locating in those calm waters take up the fishermen's traditional sea areas and the toxic impacts of fish farm therapeutic chemicals on the crustaceans upon which they rely for their livelihood become a significant impediment to economic prosperity.

**Tourism** is undoubtedly one of Scotland's main sources of income. So, we are told, is salmon farming, though by how much seems to be dependent upon the boldness of a published boast (£600m-£2bn). Many people consider salmon farms to be unsightly, so their desirability in the Scottish landscape is highly questionable. For my part, a fish farm in the landscape is certainly a visual impediment to enjoyment, not just because of its visual impacts, but because of the ecological harm of which I am aware. Many people, however, complain, without reference to those ecological impacts, that a fish farm is simply an unacceptable blot on the landscape.

My landscape is that of the Isle of Skye, one of Scotland's most popular tourist magnets. When the community of Sleat (south Skye) opposed four planning applications to site fish farms in Lochs Slapin and Eishort, visual impact was undoubtedly a major concern. That landscape was relieved.

Now north Skye (in the Trotternish region) is being targeted for four industrial scale salmon farms, the first two in full view, both north and south, from the iconic Invertote viewpoint, which has become so popular that major improvements are being carried out now, in preparation for the 2018 season. Cars, motor cycles, camper vans and tour buses crowd the inadequate parking area all summer (as notoriously, because of similar limited facilities, they do by the Fairy Pools and the Storr). Numerous objections delivered to the Highland Council's planning department have argued, with justification, that adding fish farms to the view will be detrimental to tourism. Visitors interviewed at the viewpoint have said they will not return if fish farms are installed.

If tourists eschew Invertote because the view has been adulterated, there will be knock-on detriments for a wide array of tourism-dependent Skye businesses, which are so obvious I need not list them. The same applies throughout western Scotland.

**MITIGATION** The mitigation measure already recommended and acknowledged by the ECCLR committee (though not the intransigent salmon aquaculture industry) – RAS – would provide not only environmental benefits (or rather non-detriments). It would also create at least as many on-farm jobs as the existing net-cage fish farms, *plus* employment for those involved in their construction and installation.

It may be argued that fish farm employment would be taken out of the Highlands. That is probably true, but arguably the advantages far outweigh that disadvantage. All environmental disadvantages of net-cages would be totally eliminated (though the wild fish constituent of salmon feed would still need to be replaced in the recipe to reinstate diminished wild fish stocks and community fisheries in regions where local people have lost access to them, replaced by abject poverty, in e.g. Chimbote, Peru, site of a processing plant belonging to Skretting, suppliers to the Scottish salmon industry). Salmon farms could be installed on brownfield and derelict sites, preferably within a reasonable distance of centres of consumption or efficient transport systems.

Then, perhaps, all we would have to be concerned about is the well-being of battery farmed fishes, as yet given little thought other than by Compassion in World Farming.<sup>18</sup>

Dr James Merryweather  
March 2018

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<sup>1</sup> <http://www.slef.org.uk>

<sup>2</sup> <http://www.scottishsalmonthinktank.net>

<sup>3</sup> <https://salmonaquaculturescotland.wordpress.com/>

<sup>4</sup> [http://www.parliament.scot/S5\\_Environment/Inquiries/20180305\\_GD\\_to\\_Rec\\_salmon\\_farming.pdf](http://www.parliament.scot/S5_Environment/Inquiries/20180305_GD_to_Rec_salmon_farming.pdf)

<sup>5</sup> Data from: e.g. Marine Harvest/SEPA modelling data in ES DOC 6 APP 7.5.1a AUTODEP MODELLING REPORT (page 7)

<http://wam.highland.gov.uk/wam/applicationDetails.do?activeTab=documents&keyVal=ORYFDYIHOFN00>

<sup>6</sup> <http://incc.defra.gov.uk/default.aspx?page=2519>

<sup>7</sup> N.B. Highland Council Planning Officer Mark Harvey informed the ECCLR committee that he finds the Precautionary Principle inconvenient. I contend that not to implement the Precautionary Principle for that reason is a unilateral choice he may not make.

<sup>8</sup> MacGarvin M. (2000). *Scotland's Secret? Aquaculture, nutrient pollution, eutrophication and toxic blooms*. WWF Scotland. <http://www.wwf.org.uk/filelibrary/pdf/secret.pdf>

<sup>9</sup> Excessive richness of nutrients in a lake or other body of water, frequently due to run-off from the land.

<sup>10</sup> Total salmon production (**Scotland, 2000**) = **128,830 tonnes**. Data: Stagg, R.M & Allan, C.E.T. (2001). Scottish Fish Farms Annual Production Survey 2001. Marine Scotland Science. <http://www.gov.scot/Uploads/Documents/survey2001.pdf>.

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Total salmon production (**Scotland, 2015**) = **171,722 tonnes**. Data: Munro, L.A., & Wallace, I.S. (2016). Scottish Fish Farm Production Survey 2015. Marine Scotland Science. <http://www.gov.scot/Resource/0050/00505162.pdf>

<sup>11</sup> [http://jncc.defra.gov.uk/pdf/UKBAP\\_BAPHabitats-49-SeagrassBeds.pdf](http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-49-SeagrassBeds.pdf)

<sup>12</sup> Jones, B.L., Cullen-Unsworth, L.C. & Unsworth R.K.F. (2018). Tracking Nitrogen Source Using  $\delta^{15}\text{N}$  Reveals Human and agricultural Drivers of Seagrass Degradation across the British Isles. *Frontiers in Plant Science*. 9:133, 1-10. <https://doi.org/10.3389/fpls.2018.00133>

<sup>13</sup> Burkholder JoAnn M., Katherine M. Mason, Howard B. Glasgow, Jr. (1992). Water-column nitrate enrichment promotes decline of eelgrass *Zostera marina*: evidence from seasonal mesocosm experiments. *Marine Ecology Progress Series*, 81: 163-178.

<sup>14</sup> Gebauer, P. *et al.* (2017). Lethal and sub-lethal effects of commonly used anti-sea lice formulations on non-target crab *Metacarcinus edwardsii* larvae. *Chemosphere*, 185, 1019-1029.

<sup>15</sup> [http://www.parliament.scot/S5\\_Environment/General%20Documents/089\\_Scottish\\_Creel\\_Fishermens\\_Federation.pdf](http://www.parliament.scot/S5_Environment/General%20Documents/089_Scottish_Creel_Fishermens_Federation.pdf)

<sup>16</sup> <http://jncc.defra.gov.uk/marine/biotopes/biotope.aspx?biotope=JNCCMNCR00001218>

<sup>17</sup> [http://aquaculture.scotland.gov.uk/map/map.aspx?postcode=&layers=AQUA\\_1,AQUA\\_6](http://aquaculture.scotland.gov.uk/map/map.aspx?postcode=&layers=AQUA_1,AQUA_6)

<sup>18</sup> <https://www.ciwf.org.uk/philip-lymbery/blog/2016/11/scottish-intensive-salmon-farming-plumbs-new-depths>