Environment, Climate Change and Land Reform Committee

Environmental impacts of salmon farming

Written submission from the National Trust for Scotland

The National Trust for Scotland fully supports aquaculture and the contribution that it can make to both human nutrition and the rural economy provided it can be achieved without damage to the natural environment or impacting the tourist industry. We therefore welcome the scrutiny given by the Scottish Parliament to the environmental effects of fish farming and believe that the SAMS report makes a valuable contribution to this process. The subject areas cover most of the important issues but the review is based on information that is out of date and incomplete. We are concerned that this could put further pressure on the marine environment unless the procedures for managing fish farms are significantly strengthened. The main areas of concern are summarised in the following sections.

Summary

Sea Lice: There is a growing body of evidence that sea lice are having a seriously detrimental impact on wild salmon and seatrout. The review highlights some of this but fails to adequately address the differing impacts on seatrout and the growing consensus from other nearby salmon farming countries (Norway and Ireland) that more effective action is needed. In particular, it fails to highlight the inadequacy of current control measures and the need to take a precautionary approach to the conservation of these wild salmonids, both of which are Priority Marine Features.

Accumulation of Organic Waste: The review points out the huge quantity of organic waste released by fish farms and attempts to evaluate its impact. However, it does not highlight the shortcomings acknowledged by SEPA of the deposition models that have been used to date in estimating the impact on benthic organisms and the resulting inaccuracies in its predictions. It fails to adequately assess the impacts on different benthic communities, especially those that include Priority Marine Features, and consequently does little to improve the protection of Marine Protected Areas.

Use of Medicines and Chemicals: The review fails to assess some of the more recent evidence on the widespread impact of therapeutic chemicals, notably Emamectin Benzoate, and of the resultant revision to EQS. The impacts of other widely used chemicals, notably hydrogen peroxide and azamethiphos, are not adequately addressed. The impacts of these chemicals on features of conservation importance, notably Priority Marine Features and Marine Protected Areas, are barely mentioned and this is the one area where the report is most conspicuously lacking recent data

Sea lice

The review of the impacts of sea lice on wild salmonids repeatedly confuses "salmon" with "salmonids". For instance, section 2.1.1 is titled "Lice and Salmon" but refers to "salmonids" in the subsequent text. This is important because the impacts of lice on sea trout are quite different from the impacts on salmon. Sea trout while at sea spend most of their time in coastal waters where they are often in close proximity to fish farms in contrast to salmon smolts, which usually migrate fairly rapidly from the river mouth to the open sea. Sea trout are therefore much more susceptible to the impacts of sea lice infection and studies in Norway and Ireland[1] have clearly demonstrated this impact. The report makes no reference to the population level effects of this review or, more generally, to the impacts of salmon farming on sea trout populations in the west of Scotland. Importantly, the specific study on the collapse of the sea trout fishery in Loch Maree[2] has not been mentioned. This is remarkable, given that sea trout have been more seriously impacted in the west of Scotland than salmon and they are also a Priority Marine Feature.

One of the biggest shortcomings in the regulation of sea lice on salmon farms is the failure to effectively control the emission of sea lice into the water column. All of the control measures that are in place (either the CoGP levels of 0.5 or 1 lice per fish or the more recent levels of 3 and 8 lice per fish) are apparently based on the impact on the health of farmed fish (=the parasite load borne by individual farmed salmon). The impact on wild fish will be a function of the number of lice larvae emitted into the water column and therefore of the total number of ovigerous lice, not the number of lice per fish. A farm with 1 million fish will emit twice the number of lice larvae as one of 500,000 fish, given equivalent lice loads. There is no discussion in the "Mitigation" section of control measures that would address this fundamental regulatory failure. Marine Scotland have concluded that "adherence to the suggested criteria for treatment of sea lice stipulated in the industry CoGP may not necessarily prevent release of substantial numbers of lice from aquaculture installations". To be effective, a limit on the number of lice per fish must be coupled with a limit on the total number of fish on a farm; one without the other is meaningless. This is particularly important in view of the recent consultation by SEPA of new DZR control measures that would allow licensing even larger salmon farms.

The report correctly points out that there is no scientific justification for the either the CoGP lice levels (0.5 and 1 lice per fish) or the trigger levels established by the Scottish Government in 2016 (3 and 8 lice per fish). It is clearly the opinion of Marine Scotland that neither is effective in controlling transmission of lice to wild fish (see above). More importantly, although the review points out that information on the lice levels at individual farms has recently been released, it does not assess what this shows. In fact, the newly available information reveals that several farms have exceeded 8 lice per fish but only one enforcement action has been taken. We are

[1] Thorstad et al, 2015 Effects of salmon lice Lepeophtheirus salmonis on wild sea trout Salmo trutta—a literature review. Aquacult Environ Interact.

[2] Walker, A. Collapse of Loch Maree Sea Trout. How culpable Is salmon farming?

left with the unsatisfactory situation where the controls are inadequate to protect wild fish and, in any case, they are not being enforced.

Discharge of waste

The review correctly points out that salmon farming discharges huge amounts of organic waste (mainly faeces) into the sea, helpfully giving the equivalent in terms faeces produced by Scotland's population of humans or sheep. However it fails to mention that neither is truly equivalent as neither may be released directly into the water environment without being treated, whereas the salmon faeces are discharged raw into the sea. Of more concern is the fact that the report's authors felt it necessary to excuse the industry by giving the equivalent amount of animal protein produced by sheep. This is irrelevant to the subject of the review.

The report discusses the various models (collectively known as DEPOMOD) used by SEPA to predict the impact of particulate material (mostly faeces) deposited by fish farms. It mentions the new, improved deposition model that SEPA plans to introduce in the future but it fails to assess the accuracy of the older models that have been used to gauge the impact of all existing fish farms and is still being used to evaluate CAR applications submitted today. SEPA (*in litt*. 24 November 2017) have confirmed that the existing model is unsatisfactory in several respects and that it "was seen to over-estimate the accumulation of material below the farm cages and underestimate the quantities accumulating further out". This means that the environmental footprint of all affected farms is considerably wider than was foreseen when SEPA granted licences to operate. Moreover, because the model overestimates the quantity of material deposited directly below the farm (in the AZE) and then fails to regulate the impact within the AZE, it has the effect of concealing the true effects of the damage.

The discussion of the long-term environmental impacts of a fish farm contains no assessment of the previous sea-bed community but this is vital in predicting the recovery time. The review discusses recovery times of 2-6 years, but this is on the basis of the reappearance of relatively short-lived organisms. Several sea bed habitats in Scotland's inshore waters are characterised by extremely long-lived species, such as the Ocean Quahog *Arctica islandica* (a contender for the title of longest lived animal at over 500 years) and Fan Mussel *Atrina fragilis* which does not reach a mature size until about 50-100 years of age. Many faunal turf communities contain complex communities of invertebrates that would take many years to regenerate. It is impossible to conclude that any habitats previously harbouring such species would recover in periods of less than 10 years. Hall-Spencer et al. (2006) reviewed the impact of salmon farms on maerl beds and concluded "The fallowing system whereby cage positions are rotated to allow the deposit-feeders of muddy fjord habitats time to process organic waste is not suited to maerl habitats because of the likely longevity of the damage caused". The conclusion of this review that "there is no doubt that, so long as the cage footprint is small compared with the total area of the loch floor, the sediment fauna will recover eventually" must therefore be questioned. If "eventually" means after a period of 50 years, is this acceptable?

The section on Recirculating Aquaculture Systems (Section 3.4.2) is interesting, given the urgent need to contain a number of the deleterious outputs of aquaculture (disease organisms, chemicals, organic waste) but it is presented in this description as a problem rather than a solution. For instance, it highlights that the production of 1000t of salmon would result in the accumulation of 400t of organic waste that needs to be "dealt with" rather than presenting this as an opportunity to remove this quantity from causing damage to the marine environment.

Use of medicines and Chemicals

The review points out that there is no information on the use of hydrogen peroxide. Given the toxicity of this substance, the lack of agreed EQS and the rapidly increasing usage, this is of grave concern and suggests that further comment is needed.

It is extraordinary that the section of the report dealing with "Effects of anti-lice compounds on ecosystems" (Section 4.6.1) makes no mention of the PAMP2[3] study (except in passing in section 4.10) which prompted the recent review of SEPA's EQS. Failure to consider the PAMP2 study has led to the dangerous conclusion in Section 4.9.1 that "In-feed treatments reach the sea bed together with the organic wastes, and the depositional footprint around the cages will be similar…Siting of fish farms in close proximity to Special Areas of Conservation, Biodiversity Action Plan habitats or PMF is therefore more likely to cause concern from an enrichment/smothering perspective than from chemical use.." In fact there is now evidence that the impact of in-feed chemicals is far more widespread and may affect whole sealochs.

The diagnosis (Section 4.11) by and large reviews out of date information (e.g. the finding of Crane, 2006 that the EQS for EMB was "protective for SACs"). There is no discussion of the recent recommendation by SEPA of the need to reduce the EQS for EMB by a factor of around 100 and the subsequent arguments to curtail its implementation.

Section 4.9 helpfully points out that "there is significant coincidence between natural heritage values and site suitability for fish farming. This is because the requirements for a good farm site (high water quality; good water exchange; shelter; moderate depth) tend also to favour high levels of biodiversity." However, the subsequent discussion is hopelessly out of date. Reference to SARF 046 (the proximity of fish farms to protected features) predates the establishment of MPAs and there is virtually no consideration of this important impact. There is ample published information on both the location of fish farms and MPAs to be able to update this. In fact, of the 227 active salmon farms in the sea, 22% are within MPAs, 18% are in SACs and 2% are in SPAs. In total, 32% are within some form of protected area. The mention of SEPA having "addressed Priority Marine Features (PMFs) and Marine Protected Areas (MPAs) with respect to fish farming in its interim EMB policy statement" is simplistic as it only addresses one aspect of the this impact and,

[3] SARF098: Towards Understanding of the Environmental Impact of a Sea Lice Medicine – the PAMP Suite

moreover, there is evidence the implementation of this guidance by SEPA has been inconsistent.

The review has made no mention of the work by SNH and Marine Scotland in assessing the potential impact of aquaculture on PMFs (through the FEAST tool). This is an extraordinary omission, particularly in view of the urgent need to review this guidance.

The discussion of regulatory effectiveness (Section 4.10) starts off with three provisos:

> a) The exposure modelling is accurate;
>
> b) The EQS represent safe levels for both periodic and chronic exposure for all important organisms characteristic of the feature;
>
> c) Effects of chemicals on key ecosystem functions (e.g. primary production, food web transfers, sediment aeration by burrowers) are well understood."

In fact, none of these conditions has been fulfilled:

a) All of the consents that have been granted to date depend on an outdated model of deposition (AUTODEPOMOD) that does not deal effectively with deposition in areas with irregular topography or high currents.
b) The EQS for EMB has recently had to be radically reduced following a rapid review. This throws doubt on the statement that "The EQS may be regarded as highly precautionary". Reviews of the other therapeutant chemicals need to be urgently reassessed. There is currently no guidance on the use of Hydrogen Peroxide
c) There is virtually no information on this area

Impacts of escapes on wild populations of salmon

The conclusion in Section 5.7 that "What is known from studies in Norway and Ireland is that there is a prima facie case to be made that some adverse effects are occurring in at least a proportion of rivers in areas with salmon farming operations" is a gross-understatement. The most recent review in Norway concluded that escapes from farms posed the greatest threat to wild salmon in Norway.