

18th December 2018

The Friends of the Sound of Jura is a community organisation, concerned about threats to sustainable jobs in our community that rely on a clean sea. We are not against finfish farming but believe there is no reason why it should be permitted to harm the environment.

SEPA's Finfish Aquaculture Sector Review only once mentions the industry's impacts on the '*activities of other uses of the environment*', but shellfish fishermen are aware of the evidence for large-scale cumulative impacts of fish farm pollution on commercial species of crustaceans. Our community also cares about harm being done to PMFs and protected areas.

It is clear that open nets are used because they allow fish farm pollution to be dumped, without the sector having to pay to clean it up, and that other users of the sea are bearing the cost. We call for the socioeconomic costs of this practice to be assessed and added to the other costs of farming using open nets that are borne by the environment. The Scottish Government and SEPA have committed to the 'polluter pays' principle, as well as to tackling pollution at source and applying the precautionary principle. These legally-binding principles are part of the UN Convention on Biodiversity and the UN/OSPAR Convention on marine biodiversity, both signed by the UK. Aquaculture companies should pay to clean up their waste, including compensating other sea users for any harm they cause. If they did so, the more expensive new technologies needed to capture waste and exclude sea lice would be more financially attractive. We are concerned that the SEPA sector review has no concrete plans to encourage or direct the industry to innovate in this way. Instead these proposals are aimed at encouraging the use of more exposed, but still inshore sites, where larger farms will be permitted to release more pollution from open nets, and where there is a significant risk that sea lice will harm wild salmonids. Developers should respect the views of the local communities that believe these sites are unsuitable for fish farms. This is rarely the case, and as a result the industry is forfeiting its social licence to operate.

Norway already has operational closed-containment systems in fjords, and really large farms are being developed far offshore. We need to make the same switch in Scotland, with SEPA providing leadership and clarity on the timescale and by making it clear that this change is not voluntary. Encouraging the siting of larger farms in more exposed locations is a dangerous distraction that does not address the fundamental problems of open nets.

We welcome the review's clear statements that '*Fish farm operators will have to manage their sites so that there is no significant adverse impact on the biodiversity of sea life beyond the edge of the mixing zone*', and that the reformed regulations '*will ensure that farm developments are matched to the capacity of the sea to disperse and assimilate their waste discharges.*'

This is clearly necessary; SEPA's internal emamectin options paper (131.pdf, FOI) states that *'Fish farming is unique in that it is a sector which is allowed to discharge substantial quantities of biocides'*, and the current sector review and press release also state that *'Medicines and other chemical treatments for farmed fish can be extremely toxic to sea life at very low concentrations'* and that *'Scottish salmon farm medicine (is) significantly impacting local marine environments ... which increases the now substantial weight of scientific evidence that the existing approaches do not adequately protect marine life.'* In addition, Anne Anderson, then Head of Compliance, confirmed that *'there is no other single sector making discharges to the water environment which has the same total cumulative extent of impacts as fish farms...'* (02/08/2018 letter to Friends of the Sound of Jura)

We understood from David Harley at the Lochgilphead consultation event, that finfish aquaculture is still likely to be the most polluting industry of Scotland's sea, even after the proposed regulatory changes. This is not acceptable. Fish farms are not infrastructure projects of national importance, such as power stations, that warrant making such a sacrifice to a precious shared resource. This in an industry run for profit by largely foreign-owned companies. It has impacts on other sectors that use the sea, on local sustainable jobs and on the wider marine environment that are almost entirely avoidable by using different methods.

### **Communities**

We are glad to read that *'the Scottish finfish aquaculture sector recognises that protecting the environment is fundamental to its success...'* which is true, and that SEPA wants *'communities (to) have a high level of trust towards regulators and businesses'*, which is necessary, but this trust has been much eroded by a culture of secrecy in the industry and its regulators, particularly Marine Scotland. It has not been our experience to date that the industry has *'a strong and positive relationship with neighbouring users of the environment and the communities in which it operates'*.

We welcome SEPA's willingness to listen to communities. The drop-in consultation events were conducted in a spirit of openness and honesty, which is helping to restore some trust that SEPA is not too close to the industry it regulates. The proof of this will be in SEPA's subsequent actions, in implementing this sector review and as part of the SG's Wild Fish Interactions Working Group, for instance.

### **The overall, cumulative impact on the environment**

It seems obvious to us that it is necessary to understand the carrying capacity of the sea before relying on it to assimilate the effluent resulting from a doubling of finfish production using open nets. However, when asked by the REC Committee whether SNH knew the carrying capacity of the west coast for fish farms, Cathy Tilbrook, Sustainable Coasts & Seas Activity Manager for SNH, said: *'We are quite far from that'*.

At present, SEPA and the Local Planning Authorities only consider aquaculture's impacts on a farm by farm basis, taking no account of large-scale cumulative impacts, yet the sector review acknowledges that: *'Wastes can be carried by currents over considerable*

*distances from the mixing zone ... in some circumstances, there is a potential for wastes to combine with other wastes and accumulate in parts of the sea to levels that could harm sea life.'*

*'...at the most dispersive sites, little waste is deposited for long in mixing zones and avoiding any cumulative risks to the wider marine environment will become the primary factor governing the farm sizes that can be accommodated.'*

These larger-scale cumulative impacts are of fundamental importance, so we welcome the assurance, given at the drop-in event, that assessing these impacts is the next priority for SEPA, especially as there has never been an EIA of the whole sector's cumulative environmental impact.

We also welcome the recognition, at that event, that society has a role in deciding whether these environmental impacts are acceptable. It is the feeling that this is not the case that has brought many people and communities to Parliament's and SEPA's doors.

At the Lochgilphead meeting we were also assured that from now on, all new farms will have to assess the cumulative impacts from other sources, as well as their own impacts.

- We would like SEPA to explain, having never done a whole sector cumulative EIA for finfish aquaculture, how it knows that the sea can absorb twice as much pollution as it does now, given that the industry wants to double its capacity (now restated as 'value') by 2030?

We urge SEPA to take a precautionary approach before consenting this doubling, by first making sure it understands all the impacts on commercial shellfish, Priority Marine Feature species and habitats (including wild salmon & sea trout) and including those outside the immediate area of the farms, that could be affected by the cumulative impacts of multiple farms. Sea lice can be carried 30km from their source for instance, and SEPA's survey work in Shetland shows that emamectin benzoate is more pernicious and more widely dispersed than previously believed.

We welcome SEPA's commitment to *'continue to build integrated models for all relevant marine areas of the cumulative effect over time of fish farm discharges and other pressures on the health of marine ecosystems, including the ability of those ecosystems to support protected species and habitats,'* and we are glad that SEPA intends to extend its *'programme of investigative survey work to assess the individual and cumulative environmental performance of fish farms, coordinating with ... other regulators where possible.'*

We would like to know how the cumulative impacts will be assessed at scales larger than single waterbodies, in particular because SNH accepts that it does not know the location of all Priority Marine Features in Scottish waters.

We hope that SEPA will improve the communication of its findings to other agencies. For instance Cathy Tilbrook (SNH Sustainable Coasts & Seas Activity Manager) told us at a

recent meeting with Marine Scotland (1 November 2018) that: *'SEPA is not highlighting massive issue as to benthic impacts'*, that *'the general trend is not causing big alarm bells to ring'*, and that *'we are not in the position of saying there is a major problem.'* This is at odds with SEPA's latest research on emamectin residues in Shetland. Please share all your findings on cumulative impacts with SNH. It needs the bigger picture provided by SEPA in order to advise LPAs on planning permission for fish farms.

- Is SEPA certain that there is not a major cumulative problem developing?
- Will it do a whole sector analysis to look for this?

### **Site choice**

We agree that *'a risk assessment mapping tool to guide appropriate development'* is essential and urgently needed, to ensure that the marine environment is protected. Marine Scotland has promised this for years but there is no sign of it yet. The wild salmonid sensitivity heat maps promised in the National Marine Plan are now at least four years late. The Rivers and Fisheries Trusts Scotland (RAFTS) produced a Government-funded, science-based wild salmonid sensitivity heat-map in 2013.

- In the absence of adequate guidance from Marine Scotland, why does SEPA not use the RAFTS heat map now, to assess the impact of different farm site choices on wild salmonids?

### ***Pollution by waste and pesticides***

We welcome the tightening of standards on suspended organic waste pollution and chemical pollution. However, we believe that these do not go far enough and we urge SEPA to consider these new standards as the first step in a progressive tightening of standards that will result in no release of pollution by fish farms.

We would like to see a deadline set for this to be achieved and suggest the industry's growth target date of 2030. Failing that, to allow no net increase in pollution as the industry expands would provide an incentive for innovation and would apply the precautionary principle in the face of so much uncertainty about adverse impacts.

It is worth noting that we were unclear how the proposals in this review relate to the previous DZR proposals, which are not mentioned in the sector review. We understand from the drop-in event that the review replaces DZR, including its proposed 10% increase in biomass per production cycle and the increase in the maximum size of Allowable Zones of Effect to 0.5 km sq. Some more clarity on this would be welcome.

### **Regulating Mixing Zones for pollution**

We understand that the mixing zone approach, to be applied only to waste and in-feed pesticides initially, means that *'the limit will be equivalent to the 100 metre-based limit (SEPA) applies to all other discharges to the marine environment, including industrial discharges and discharges of effluent via long-sea outfalls.'*

It is good that *'the (new regulatory) framework will ensure that farm developments are matched to the capacity of the sea to disperse and assimilate their waste discharges'*, and that *'fish farm operators will have to manage their sites so that there is no significant adverse impact on the biodiversity of sea life beyond the edge of the mixing zone.'*



We understand from the drop-in event that in future, the Allowable Zone of Effect (AZE) will be the same size as the mixing zone. This is not clear from the sector review.

- Will SEPA please confirm that the AZE will be mapped directly onto the seabed below the modelled mixing zone output from NewDepomod?

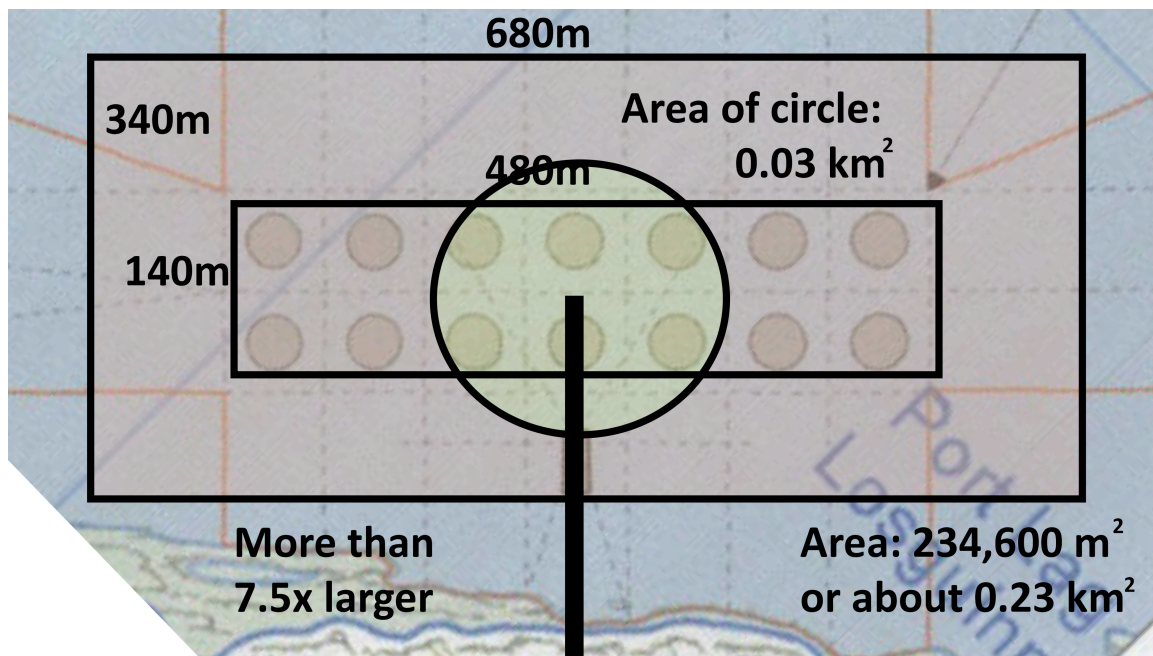
It is appropriate that the mixing zone standard will now be applied in a uniform way to all of Scotland's industries that pollute the sea, including aquaculture, but we are concerned that even after the proposed regulatory changes, finfish aquaculture is still likely to be the most polluting industry of Scotland's sea (David Harley).

In particular we are concerned that the mixing zone rules seem to be applied more favourably to this industry than to others that discharge via outfall pipes.

The outcome does not seem markedly different from SEPA's existing approach, which Anne Anderson described as accepting '*...that the zone where impacts may occur from fish farm discharges is generally very much larger than from discharges made from other industrial sectors.*' (02/08/2018 letter to Friends of the Sound of Jura)

The diagram below shows the proposed 14 cage, 2500t fish farm at Corpach Bay, Jura. The pink rectangle is the cage area plus 100m all round (in fact it would have curved corners). The yellow circle is a 100m radius circle around a notional outfall pipe, centred on the farm.

At the drop-in event we asked how the mixing zone for a large farm like this would be calculated. SEPA explained that the centre of each cage will be treated as if it was the point of discharge of a separate pipe, with a 100m margin added to the merged shape of the 14 circles.



- Why is the c.0.23 km<sup>2</sup> mixing zone for the proposed 2500t farm at Corpach Bay, Jura (pink) about 7.5x larger in area than the 0.03 km<sup>2</sup> mixing zone allowed for a single outfall pipe (yellow)?
- If the mixing zones of the 14 cages are allowed to overlap and merge to make a much larger polluted zone, what is to stop two such farms being sited beside each other (as they are, for instance, at Carradale N and S, with a total biomass of 5000t, now seeking expansion to 7000t overall), further increasing the cumulative mixing zone/AZE area? Or four such farms? Or more?

The mixing zone concept is meaningless if it has no upper size limit.

- Will the mixing zone of each farm vary in shape and orientation, according to modelling of the net current flows, but with the same area as all the cages + a 100m margin, or will it be a simple, evenly-spaced shape, centred on the farm, as shown above?
- Presumably it is still permissible for pollution to kill all but two species of polychaete worm inside this AZE of about 0.23 km<sup>2</sup>?

This impact on seabed biodiversity is an unnecessary consequence of fish farming that could and should be avoided by adopting waste capture technology.

Regarding suspended organic waste, it is good that the new mixing zone rules will apply immediately to new and expanding farms.

- If most existing farms will comply already, why not apply the new rules to existing farms now?

It is also good that those farms that do not comply may have to *'reduce biomass;...; or install systems to capture a proportion of the wastes they currently discharge'* but we do not believe that SEPA's third option, of moving to *'more dispersive locations'*, is the right solution for the disposal of this waste.

The new rules will not apply to existing farms that do not comply until 2022, and some will not need to comply until 2024.

- Why can the new rules not be applied to polluting farms sooner than six year's time?

At the drop-in meeting we discussed the disposal of power station effluent (only warm water presumably) from multiple mixing heads. In highly dispersive sites, the 'boil' at the surface may be displaced sideways, away from the discharge point. In this case, and presumably in comparable situations with fish farm, the mixing zone could be drawn 100m around this 'boil'.

- This would be extremely complex for a fish farm because the mixing zone 'boil' at the surface will move with the changing tide, but the impact of deposited organic effluent/in-feed chemicals will be measured in an AZE mapped on the seabed below the mixing zone, which must have a fixed area and known edges for sampling. This area could not track the moving mixing zone above without becoming much larger.

Please clarify how this would work

### **Chemical pollution: emamectin benzoate**

John Campbell, a toxicologist from Arran, comments on SEPA's 2018 Fish Farm Survey: *'The present approach totally underestimates the impact ... in the near field, 17% of results exceeded the current standard, and 7% exceeded the standard beyond 100 metres ... 12 samples taken beyond 380 m contain emamectin benzoate at concentrations significantly greater than the new proposed far field limit ... and two beyond a kilometre still exceed this limit. All samples taken at the near field stations exceeded the (new interim) standard, as did 75% of the far field stations.'*

In the face of this evidence, and the PAMP2 and PAMP2 refreshment studies that showed an average 60% reduction in crustacean abundance correlated with emamectin benzoate (EMB) use, it is right that UKTAG and SEPA should revise the EQS for EMB, and that SEPA should apply *'the same 100 metre-based mixing zone limit that we will use for organic waste discharges.'*

We are not surprised to see that *'In most cases, discharges of the quantities needed for effective treatment of fish will not be able to comply with the interim environmental standard'*.

It is right that the interim standards should apply immediately to new and expanding farms, such that *'very few farms wishing to use the medicine for the first time, or to increase their existing use of it, will be able to do so.'* It is hard therefore to understand why *'there are no immediate implications... for existing farms'* especially as SEPA is *'advising operators to plan for the strong likelihood that they will need to significantly reduce or cease discharges within a reasonable period of time following'*.

- Why is SEPA working *'with operators to seek ... a voluntary reduction (of) 60%'*? Either EMB harms the marine environment or it does not. If it does, why is its ongoing use acceptable on existing farms?

We understood from the drop-in meeting that UKTAG will report on the new standards for emamectin in early to mid 2019, and that there will be a further consultation exercise on the new EQS. This seems unnecessary, given that the EQS is based on science rather than opinion. We hope the UKTAG recommendation will be accepted, but reiterate that it would be unnecessary to use chemicals at all if fish farm nets were not open to the sea.

### **Chemical pollution: Bath treatments** (excluding Hydrogen peroxide)

Bath chemicals are an important component of fish farm pollution and we are concerned that they are doing serious harm. Several recent papers conclude that the bath chemicals that are licensed for use in Scotland adversely impact commercially-fished crustaceans.<sup>1 2 3 4</sup>

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<sup>1</sup> Urbina M.A., Cumillaf J.P., Paschke K., Gebauer P. (2018) Effects of pharmaceuticals used to treat salmon lice on non-target species: Evidence from a systematic review.

Azamethiphos plumes can be detected 7km down current (SAMS report for ECCLRC Parliamentary inquiry). It is clear that SEPA lacks the tools to monitor most dissolved chemicals but is doing what it can to fill this gap. The review suggests that there will be no change to their use by new or expanding farms, and by some existing farms, before the end of 2021, and for other existing farms that nothing will change until the end of 2024. In the face of this evidence of likely harm to commercial fishing interests and other species, we believe their use should be limited immediately, in accordance with the precautionary principle.

We are also concerned that *'the application of the mixing zone requirements to discharges of medicine residues from bath treatments will mean that the permitted maximum discharge quantities will be greatest in the more dispersive farm locations.'* It is our strong opinion that dispersive locations are not necessarily more suitable sites for fish farms than sheltered, inshore sites. The implication is that all dispersive sites are far offshore, but this is not the case. Many recent proposals for new farms in such sites are less than 100m offshore, in unsuitable locations that will impact local communities and natural heritage assets.

Again, many treatments with bath chemicals would be unnecessary if the nets were not open. The cost to the industry of using them is enormous, and so is the potential cost to the crustacean fishery. At the drop-in meeting, SEPA mentioned that many fishermen had said that their catches are falling around fish farms that use bath chemicals and emamectin. This is consistent with the accounts of shrimp fishermen in Norway.

- How will SEPA be certain that fish farm operators' bath chemicals are having '*no significant adverse impact on the biodiversity of sea life beyond the edge of the mixing zone*'?
- How will the dispersion of bath pesticides be monitored and by whom?
- Will their concentration be monitored in the downstream plumes, or will these chemicals just be diluted to an agreed standard before use?
- How can it be feasible for the farms to dilute chemicals below the level that has the biocidal effect they are looking to achieve?

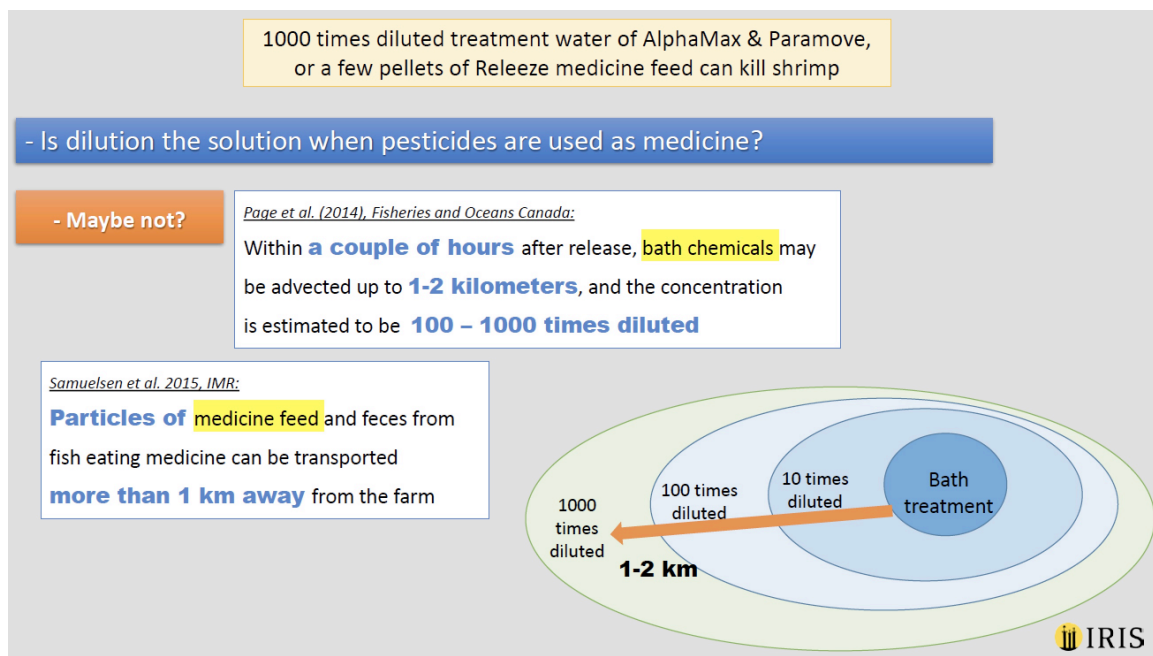
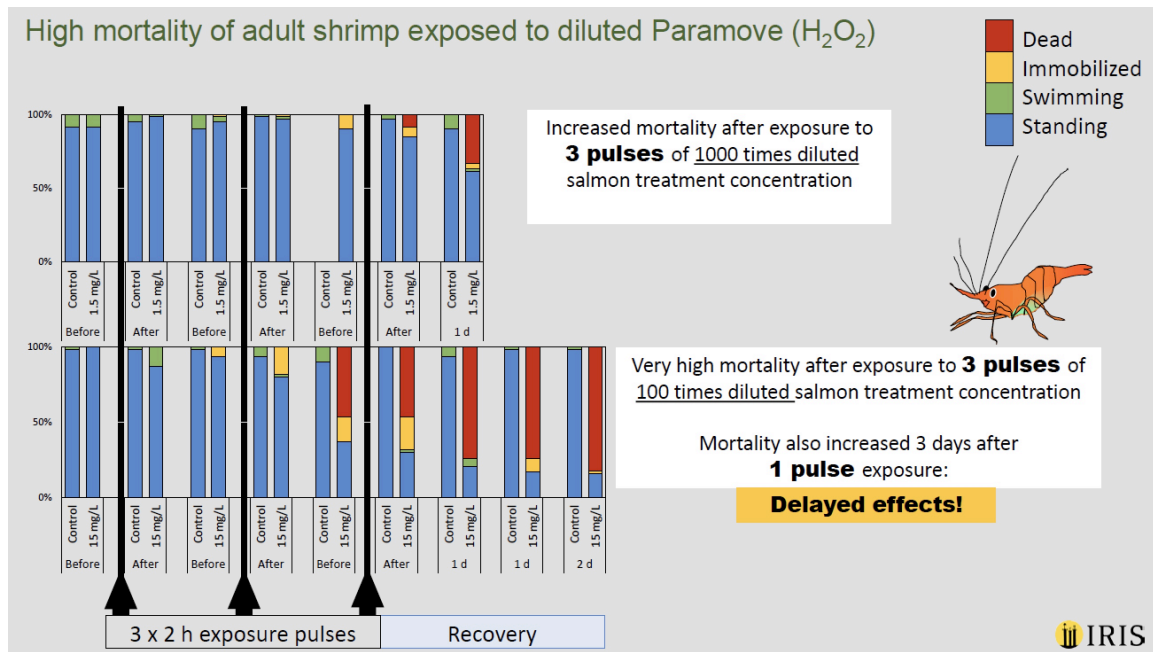
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<sup>2</sup> Gebauer P., Paschke K., Vera C., Toro J.E., Pardo M., Urbina M. (2017) Lethal and sub-lethal effects of commonly used anti-sea lice formulations on non-target crab *Metacarcinus edwardsii* larvae. Chemosphere 185, 1019

<sup>3</sup> Milewski I. et al. (2018) Sea-cage aquaculture impacts market and berried lobster (*H. americanus*) catches. Marine Ecology Progress Series 598:85-97

<sup>4</sup> BurrIDGE L.E., Lyons M.C., Wong D.K.H., MacKeigan K., VanGeest J.L. (2014) The acute lethality of three anti-sea lice formulations: AlphaMax®, Salmosan®, and Interlox®Paramove™50 to lobster and shrimp. Aquaculture 420–421 180–186

**Hydrogen peroxide** isn't mentioned in the sector review, yet 19.6m litres were used in Scotland's fish farms in 2015. The ongoing PestPuls study in Norway by Bechmann *et al*<sup>5</sup> shows that short pulses of H<sub>2</sub>O<sub>2</sub> kill commercially-fished crustaceans at 1/1000 the dose used in fish farms, up to 3 days later. These levels are expected approximately 1-2km away from the cages. (Source: RK Bechmann. PestPuls presentation, Reykjavik. 2018)



<sup>5</sup> <https://www.forskningsradet.no/prosjektbanken/#/project/NFR/267746/Sprak=en>

Lyons et al (2014)<sup>6</sup> show the H<sub>2</sub>O<sub>2</sub> can have a half-life in unfiltered seawater of up to 28 days, rather than breaking down rapidly to oxygen and water, as it does in air, and as it is assumed to do by SEPA, in the sea. At the drop-in event we heard that this is a hard chemical to monitor in the environment because its concentration changes after sampling. However it is clearly causing environmental harm in the quantities used. It also kills the polychaete worms that are needed to turn over the AZE, preventing it from becoming anoxic (Fang et al, 2018)<sup>7</sup>.

- When will SEPA regulate hydrogen peroxide?
- How will its use be monitored and by whom?

As with suspended organic waste/in-feed chemicals, we agree that the mixing zone concept has the potential to improve the present situation, but only if these zones have a reasonable upper size limit. Such zones will do little to limit pollution if they are allowed to expand to fit farms with any number of cages, plus a 100m margin.

**Well-boats** are only mentioned in passing in the review. They are not routinely monitored or risk-assessed for harmful chemicals, and are licensed by Marine Scotland rather than SEPA. We understand that slow progress is being made in transferring their regulation to SEPA, which may be an improvement, depending on the introduction of effective monitoring.

We understand that although they have their own allocation for discharging chemicals away from fish farms, well-boat operators are not allowed to add this allocation to a farm's allocation under CAR, when the well-boat is alongside a farm.

At the drop-in event we voiced our concerns that these vessels may be discharging chemicals where they should not, and that increasing reliance on well-boats rather than in-cage tarpaulin baths is going to make this more likely in future, especially as tarpaulins are harder to deploy in more exposed sites.

We discussed the limitations that SEPA already faces, in monitoring so many fish farms. It is clear that well-boat operations are even harder to scrutinise, and there is a high risk that malpractice could be missed. They should be monitored closely.

In high value fisheries, for instance in the Falklands and Alaska, vessels must carry independent observers, paid for by the industry. A 2500t farm can make a profit of £2.5m every 22 months; this industry can afford to pay for full-time independent observers at all its sites. This would do a great deal to restore public trust.

- When toxic chemicals have already been captured after use, why are well-boats allowed to dump them at sea, rather than disposing of them safely?
- How can SEPA be certain that fisheries and PMFs are not being harmed where well-boats dump their pesticides?

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<sup>6</sup> Lyons M.C., Wong D.K.H., Page F.H. (2014) Degradation of hydrogen peroxide in seawater using the anti-sea louse formulation Interlox® Paramove™50. Science Fisheries Canada

<sup>7</sup> Fang J., Samuelsen O.B., Strand Ø., Jansen H. Acute toxic effects of hydrogen peroxide, used for salmon lice treatment, on the survival of polychaetes *Capitella* spp. and *Ophryotrocha* spp. Aquacult Environ Interact 10: 363–368, 2018

- Will SEPA consider raising a levy on the industry to pay for independent observers on fish farms, well-boats and the treatment vessels fitted with thermolicers etc?

### Dissolved nutrients

Dissolved nutrients are not mentioned in the review but they comprise the largest part of the waste discharged by open net fish farms (SAMS report for ECCLRC Parliamentary Inquiry). Ammonia in particular can promote harmful bacteria and algal blooms. These blooms can cause closures of mollusk farms, and Marine Harvest (table below) gives algal blooms as the main non-infectious killer of farmed fish by number, and the second most important killer by biomass. Warmer seas promote such blooms. In August, Wester Ross Fisheries lost more than 50% of its fish in two farms, to plankton blooms.<sup>8</sup>

Marine Harvest Scottish 2016 annual report:

MAIN CAUSES OF REDUCED SURVIVAL				
	INFECTIOUS		NON-INFECTIOUS	
	FISH NUMBERS	BIOMASS	FISH NUMBERS	BIOMASS
1	HSMI	Gill infections	Algal blooms	Treatments
2	Gill infections	CMS	Treatments	Algal blooms
3	CMS	HSMI	Poor performers	Poor performers
4	PD	PD	Handling	Handling

(HSMI, Heart and Skeletal Muscle Inflammation; CMS, Cardiomyopathy Syndrome; PD, Pancreas Disease)

- Please refer us to the evidence on which SEPA relies for its apparent certainty that harmful algal blooms are not caused, or made worse, by the discharge of dissolved nutrients from fish farms.

We understand from the drop-in meeting that the EQS for dissolved nutrients will also be applied at the edge of the mixing zone, measured by ecological response determined by the EC, in terms of algal species growth.

- Please provide more details of how this important monitoring will happen.
- Will it include toxic bacterial as well as algal monitoring?
- Please explain the work SEPA is doing to ensure that these most widely dispersed of all fish farm pollutants are not having an overall cumulative environmental and socioeconomic impact on the west coast.

### Copper and other metals

Emissions of copper are included on the list on page 13 of the key issues driving non-compliance.

- What is SEPA doing to reduce the quantity of metals entering the sea from antifouling compounds and from feed?

<sup>8</sup> <https://www.bbc.co.uk/news/uk-scotland-highlands-islands-46577748>

## Cocktail effect

The ongoing PestPuls study in Norway shows the adverse and cumulative impact of using more than one chemical at a time.

This extra toxicity is also referred to by Overton *et al* (2018)<sup>9</sup>

- Will SEPA investigate the 'cocktail effect' of using multiple chemicals at the same time?

## Impact on commercial fisheries

*'The results of the analysis have increased the now substantial weight of scientific evidence that the existing standards do not adequately protect marine life.'*

SEPA, on its 2018 Fish Farm Survey Report

*'...the waters in which salmon farming is practiced are usually the same waters in which Scotland's valuable crustacean fisheries are located ... it is not tenable for SEPA to adopt a position where commercial shellfish species are impacted by the day-to-day activities of fish farms, activities which SEPA will have knowingly authorized...'*

SEPA emamectin internal options paper (131.pdf. FOI)

Despite this, Anne Anderson wrote: *'SEPA does not collect or produce data on crustacean fisheries or on the stocks that are pursued by fishermen.'*

(02/08/2018 letter to Friends of the Sound of Jura)

- What will SEPA do to ensure that the discharge of fish farm pesticides, that can kill crabs, lobsters & prawns, does not threaten jobs in our communities?

Grab sampling on rocky substrates does not sample large, commercial crustaceans:

*'It is very rare for large commercial species to be found in seabed samples. This is for a variety of reasons, not least because they are by their very nature not particularly abundant anywhere in the environment and the sampling techniques used will be unlikely to lead to them being caught in a grab ... this does not in itself mean that data on the smaller crustacean species which are sampled cannot be used to determine the health of crustacean species in general, including the health of populations of commercial animals.'*

Anne Anderson (02/08/2018 letter to Friends of the Sound of Jura)

Creel fishermen sample larger, commercial species all the time, and record their catches in detail.

- Why then doesn't SEPA analyse creel fishing catch records around fish farms, looking for declines in landings where new farms have been established, or existing farms expanded, and allowing for changes in fishing effort?

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<sup>9</sup> Salmon lice treatments and salmon mortality in Norwegian aquaculture: a review  
Overton K., Dempster T., Oppedal F., Kristiansen T.S., Gismervik K., Stien L.H. (2018). Reviews in Aquaculture, 1–20



When this has been done in Canada (Milewski *et al*, 2018 *ibid*) it revealed a fall in lobster catches, where chemicals were being used on farms.

### **Predicting the impacts of pollution**

*'...in some cases the location and extent of pollution from the operation of a farm is found to vary enough, from the modelled conditions, to be non-compliant with those conditions'*

This admission in the sector review is a failure of regulatory consenting, based on pollution modelling. AutoDepomod has a large number of flaws (see the list in Annex A) that make it incapable of accurately modelling pollution dispersion in situations other than sheltered, flat-bottomed sea lochs, and for farms above 2500t in all situations.

- Has SEPA now stopped using the Autodepomod pollution modelling software?
- If so, why are proposals for farms such as Corpach Bay, Jura, still being submitted to the Local Planning Authorities for screening, using AutoDepomod modelling?
- Will SEPA please inform Local Planning Authorities that AutoDepomod modelling is no longer acceptable and that applicants for planning permission must stop using it?
- Given AutoDepomod's inaccurate modelling of waste and emamectin deposition, will all existing farms previously consenting using it now be reviewed?

### **An action was agreed at the drop-in meeting that SEPA would check how many existing CAR applications have been made using AutoDepomod.**

Please can we be told the answer? We are concerned that no more CAR applications should not be considered using AutoDepomod, as its flaws are so well known.

NewDepomod is supposed to be able to allow farms to be larger, by accurately predicting the dispersion of their pollution, in real world, complex conditions, but, like AutoDepomod, it makes no allowance for tides bringing waste back into the modelled area, or for storms that re-suspend material. For any kind of accuracy, a minimum of 90 days flow data is required, with additional ground-truthing measurements made at sites away from the site of the farm. NewDepomod's predictions cease 1 km from the farm, at the edge of the modelled domain. In high dispersion sites almost all the pollution will travel at least this far. This is why larger-scale, hydrodynamic modelling is needed for all sites, in particular near other farms, whose waste might accumulate in the same areas.

- How often will hydrodynamic modelling be used? The sector review is unclear.

The Sector Review says there must be no adverse impact on the diversity of seabed life beyond the mixing zone around a farm, but SEPA's hydrodynamic modelling around Shuna and Fetlar has shown that an additional approximate 1% of the seabed, far from the farms, is adversely impacted by the deposition of organic material (also containing emamectin).

- How can these facts be reconciled?
- What action will SEPA take to reduce these impacts to zero, when multiple farms are contributing to the accumulation outside their mixing zones?

## Protected Areas and PMFs

We agree that it is very important that SEPA should work with '*...Marine Scotland and Scottish Natural Heritage to ensure sites are suitably located*' and that '*where developments could affect a marine protected area or priority marine feature (...within, or very close to, the mixing zone), (it will) carry out bespoke assessments to decide if there is a risk to the area or feature and, if so, what controls, including refusing authorisation, are needed to protect the area or feature.*'

However, this has not stopped companies applying for CAR licences for farms inside or on the edges of MPAs. For instance the proposed farm at West Strome/Lochcarron (8/04819/FUL) is almost on top of a flame shell PMF that would be harmed by its effluent. SSF proposes a large new farm at Horse Island, inside the Wester Ross MPA and close to a maerl bed.

Why are these applicants wasting everyone's time, or do they believe they have a chance of getting new farms consented before all the new regulations can take effect? To prevent these abuses, please apply the new regulations and the precautionary principle to all proposals that have already been submitted, as well as to new proposals.

*'To assess whether the status of seabed biological communities at, and beyond, the boundary of the mixing zone is good, we will apply environmental standards that have been developed on behalf of the UK's government administrations by the UK Technical Advisory Group (UKTAG). These standards are aligned to a definition of good status agreed across Europe.'*

We understand that 'good' in the context of the EU Water Framework Directive, specifically means a seabed community IQI of at least 0.64. This is below 'high' quality. The IQI will be measured at the edge of the AZE (an area of seabed equal in size to the mixing zone in the water column).

Since '*environmental standards have not yet been developed for all seabed habitats. For such habitats, which include rocky seabed, we will use the best available science ...*'

- How is it possible to ensure that farms are not compromising PMFs, when SEPA and SNH do not always know the location of the PMFs outside the mixing zones and beyond NewDepomod's modelling range, and given that pollution from multiple farms can accumulate far from all those farms?
- Isn't this uncertainty a good reason to apply the precautionary principle and pause fish farm expansion, until UKTAG's standards and SEPA's and SNH's knowledge has caught up with current industry practice and aspirations?

## Exposed locations

Exposed coasts are among the most biodiverse places in Scotland's seas, and are often protected areas for this reason. They almost always have crustacean fisheries that would be impacted by fish farm pesticides and organic pollution, yet SEPA proposes to offer licences for farms larger than the previous maximum of 2500t, because the strong flow at these sites will disperse pollution more widely. Hydrodynamic modelling and surveys show that in the real world, pollution is not simply diluted to oblivion. Nor are all exposed sites far from the shore or from coastal settlements.

- How will SEPA ensure that the larger amount of pollution from larger farms in these places will not affect the coastal communities that live and work there?
- How will SEPA make safe, unannounced inspections of farms in such exposed places as the west side of Jura?

### Visual impacts

The impact of fish farms on tourism, via changes to the landscape/seascape, are not classed as pollution and are mainly considered by LPAs, advised by SNH, but these impacts can be exacerbated by siting larger farms in inshore, exposed sites, many of which have national-level landscape designations, such as Wild Lands or National Scenic Areas, for instance at Corpach Bay, Jura. This is a further reason to be certain that the best spatial planning tools are applied to the industry as it expands.

The SARF045 study by Nimmo and Cappell (2009)<sup>10</sup> and its follow up, SARF079 (Nimmo. 2012)<sup>11</sup>, are often cited as showing that fish farms have no impact on tourism, but in the first study, 48% of respondents said the expansion of fish farming would negatively impact the scenery, 46% said it would negatively impact the natural environment, a quarter did not want to see an increase in the number of fish farms.

**Over a third did not want to see fish farm get any bigger and 10% said they would be less likely to visit these locations.**

In the 2012 study: *'The effect of a fish farm on the respondents' perception of the area was found to be more negative in 2011 compared to 2008.'* Fish farms had the highest level of negative responses for *'impact of human activities on respondents' experience of Scotland's coastline'*, compared to all other coastal activities. Younger people minded more than those over 65. Six out of eight sailors questioned were 'very negative', as were 50% of scuba divers interviewed. *'The largest negative response was related to the impact on the natural environment and the scenery, as respectively 28% and 20% of respondents scored these negatively.'* *'...a quarter believe that they do have an effect on the beauty or appearance', '23% strongly agree or agree that fish farms spoil the appearance of the coast.'* *'10% strongly agree or agree that they would be less likely to visit those places in Scotland where fish farms are sited.'*

Specifically on expansion: *'34% of respondents (believe that) expansion of fish farming would negatively impact the natural environment and 37% believed it would negatively impact the scenery.'* ***'Approximately one third of respondents did not want to see an increase in the number of fish farms along the Scottish coastline and 41% did not want to see existing fish farms get any bigger.'*** *'...further expansion of fish farming would make 14% more respondents unwilling to revisit and a further 12% felt their activities would be affected compared to current levels of fish farming.'*

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<sup>10</sup> Nimmo F., Cappell R. (2009) Assessment of evidence that fish farming impacts on tourism. SARF045

<sup>11</sup> Nimmo F. (2012) Assessment of Tourists' Impressions of Fish Farming and the Scottish Coastline. SARF079. ISBN: 978-1-907266-48-5

### **Farms larger than 2500 tonnes**

It is not responsible regulation to allow farms to become larger, as an incentive for growth to be concentrated in more exposed sites. BDNC Loch Shuna in Argyll is one example. It is close to the coast, in an area widely used for creel fishing and close to two wild salmonid breeding rivers. Sea trout use those waters all year. It sits directly above the burrowed mud PMFs and close to the Firth of Lorn SAC for rocky reefs.

- Why did SEPA withdraw its objection to planning permission for the expansion of BDNC Loch Shuna to 3500 tonnes of fish, despite its latest seabed impact survey results being borderline at 2500t?
- Why were the Local Authority planners not informed that these results were borderline, instead just being told that there had been an improvement over previous survey results?
- How is this consistent with the need for the *'transformational changes (that) are needed to tackle today's problems'*, called for in the sector review?
- Is it correct that no 3500t farms will be licensed until the sector review is complete?
- Now that the DZR proposal to allow farms to increase by 10% per cycle have been dropped, is there an upper limit on the biomass of these larger, exposed-location farms?

### **Impacts on wild fish**

We welcome the sector review's recognition that *'there is increasing evidence internationally indicating that sea lice abundance in coastal waters can be greatly elevated where open net salmon farming takes place; and that high abundances of sea lice can contribute to some of the losses of wild salmon and sea trout at sea.'*

Wild salmonids are impacted by disease, sea lice and the escape of farmed fish, all of which are directly proportional to the biomass of fish consented by SEPA, so we welcome SEPA's statement that it wants to *'help reduce the contribution of marine cage fish farms to sea lice numbers in coastal waters.'*

It is not clear how it can do this, other than by avoiding siting farms in areas of importance to wild salmonids, and by limiting biomass.

- Does SEPA now take responsibility for reducing the impact of sea lice, disease and escapes on wild fish, and the impact of their loss to the freshwater ecosystem of west coast rivers and lochs, as well as the sea, consistent with its Biodiversity Duty?
- Will it do this by limiting the biomass on farms in areas used by wild salmonids?

It is good that SEPA is part of the Scottish Government's Wild Fish Interactions working group and we look forward to seeing the group's recommendations.

Marine Scotland is the lead agency on wild fish interactions. It suffers from a conflict of interest due to its dual role as a regulator of the aquaculture industry, and its advocate

in Government. When assessing the impact of fish farms on wild salmonids, SEPA must give equal weight to the judgments of Fisheries Management Scotland and the Fisheries Boards and Trusts - the latter are statutory consultees to LPAs on this topic, in addition to Marine Scotland Science.

Before licensing further expansion of the industry, and in the absence of site-specific risk assessment mapping tools for wild salmonid interactions, SEPA should adopt the precautionary principle until such tools are developed.

Pesticides, thermolicers, cleaner fish (wild caught and captive bred) are far from perfect solutions to the problem of sea lice. Physical treatments need to be made frequently, as lice quickly resetttle, and all these treatments bring their own welfare and disease issues. MSS confirms that even when farms operate within industry CoGC sea lice levels, they still release large numbers of sea lice larvae.

Sea lice evolve rapidly. They have becoming resistant to chemicals and now are becoming transparent, making cleaner fish less effective. There are enormous costs to fixing these and the other problem of open nets, including buying and administering pesticides. This expenditure would be saved if the nets were not open.

The review suggests that open net cage farms should be consolidated away from river mouths. This is better than not doing so, but it is not enough. It is based on the assumption, as Terry A'Hearn wrote to the ECCLRC inquiry, that: *'large farms would be limited to more exposed locations **where the risk of infection with sea lice and other diseases can be less***

Dispersive sites away from rivers on some parts of the Sound of Jura's shores, for example, are on wild salmon migratory routes and are used year-round by sea trout. Siting 3500+ tonne farms there would be a disaster because larger farms offer more hosts for sea lice. Sea trout are even more vulnerable to sea lice than salmon because these non-migratory fish live around our coast all year.

- How does SEPA justify the claim that farms in exposed but coastal sites are less prone to risk of infection by sea lice and disease?
- If this benefit is only possible when these farms are stocked with larger 'super smolts', will that be a condition of their CAR licence and planning permission?

A citizen science drogue experiment in 2017 demonstrated that tidal flows in the Sound of Jura transport surface waters around 4km in 3 hours. The latest hydrodynamic modelling by Adams *et al* (SAMS 2016)<sup>12</sup>, shows that these currents can carry viable sea lice larvae from the mainland to the Outer Hebrides, and others back again.

Siting farms in areas with stronger flow increases the scope for cumulative impacts on wild salmonids over greater distances.

- Does SEPA accept that larger farms can release more sea lice, and that the sea lice from farms in exposed sites will spread further on the stronger currents?

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<sup>12</sup> Adams T.P., Aleynik D., Black K.D. (2016) Temporal variability in sea lice population connectivity and implications for regional management protocols. *Aquacult Environ Interact* Vol. 8: 585–596

An effective way to achieve growth in the value of the finish aquaculture sector would be to reduce the mortality of fish in the pens from its current level of around 20%, which is almost universally regarded as unjustifiable. As well as lice infestations, a significant part of this mortality is due to sea lice treatments of fish already weakened by disease (Overton *et al ibid*).

Farmed fish should be separated from sea lice, by adopting closed containment.

**Storms.** The review acknowledges that: *'Climate change and in particular increasing sea surface temperatures, ocean acidification and extreme weather are likely to become more significant to the development of aquaculture.'*

Cage manufacturer, Gael Force, encouraged the REC Committee *'...not to consider that moving offshore to bigger sites is a panacea. ... although nowadays we have much more robust equipment, the process must be one of feeling and moving our way slowly forward ...it is a difficult and challenging environment not just for people but for the fish and their containment and the environmental challenges that can come with that.'*

No farm in an exposed site, such as the west coast of Jura, can be guaranteed to survive the (globally-warmed) 1 in 50 year storm it is supposed to resist, without any loss of fish. Nor is it possible to guarantee that mechanical or mooring failures will not happen under such circumstances, as manufacturers are asked to do by Marine Scotland. SEPA should join other agencies in explaining to the industry that not all exposed locations are equally suitable for fish farming, and that farms should not be sited near to exposed shores where they would face significantly higher risk of damage.

**Escapes.** In exposed sites, farmed fish are more likely to escape during storms, and larger farms mean that more fish are likely to escape. During a severe storm there is no way a boat could pass through the Corryvreckan whirlpool, to recapture fish escaping from a farm at Corpach Bay, Jura, as required by the operator's contingency plan. These plans are doubly worthless because the method used to capture escaped fish (usually gill nets) would also catch most of the local population of wild sea trout and salmon, as well as other fish, and perhaps otters, birds etc.

- Does SEPA accept responsibility for the higher risk of fish escaping from larger farms in more exposed sites?

In Norway, research has shown that competition and interbreeding with escaped fish are even greater threats to wild fish than sea lice. Farmed fish genes have been found in 25% of Scottish west coast wild salmon (RAFTS, 2013).

- Will SEPA accept its responsibility to reduce the biomass of farmed fish in exposed locations, to protect wild fish from the higher risk of escapes?

Closed containment is the only real solution to the sea lice problem. SEPA must push harder for this. Please look closely at the fjord-based Akvafuture<sup>13</sup> system that has been

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<sup>13</sup> <https://www.akvafuture.com/>

operating in Norway for six years. In 2016 it harvested 2000t of salmon, without any sea lice, while capturing and using most of its waste to produce biogas.

### **EIAs and alternative technologies**

Argyll and Bute Local Planning Authority says that it only consents fish farm infrastructure, not its operations. The impact of sea lice is the only exception. Neither the LPA nor SEPA require EIAs for successive biomass expansions at existing farms. EIAs are supposed to consider alternative technologies, in addition to alternative sites.

- Will SEPA please engage with the LPAs to urge them to request EIAs for all farm expansions, as well as for new farms, and that these should include the consideration of alternative technologies to open nets?

### **Compliance with the law**

*'Compliance with environmental law is non-negotiable.'* This is as it should be.

We also welcome the review's recognition that chronic non-compliance damages the environment, in addition to larger, less frequent breaches.

The sector review shows that failing seabed surveys were a contributing factor for 70% of the 19% of finfish farms that were non-compliant in 2017; that's 13% of all farms failing their seabed monitoring, when the standards allowed in the seabed AZE require just two species of polychaete worm to survive.

The sector plans says that SEPA may reduce biomass as a result of seabed quality breaches, which we welcome. It also mentions that fines may now be issued for non-compliance, which is also good. We appreciate that biomass reductions may be more financially punishing and can achieve environmental improvements more quickly than fines. We suggest that SEPA publicises its actions in this respect and explains the rationale. However, for the most serious offences, Anne Anderson confirmed that, *'no marine cage fish farm licences have been revoked by SEPA for persistent breach of licence terms and there have not been any successful prosecutions of marine cage fish farm operators for non-compliance with licence conditions in the recent past.'*

(02/08/2018 letter to Friends of the Sound of Jura)

We understand the recent past to be about ten years. This is unacceptable, and it goes a long way to explain this sector's uniquely high level of non-compliance.

SEPA says, *'we will help responsible compliant businesses to operate by making it significantly harder and more expensive for those who persistently fail to comply with environmental regulation to operate.'* *'We will achieve this by increasing scrutiny, prescription, fees and the use of enforcement and monetary penalties for those who fail to comply.'*

On 21 May 2018, the Cab. Sec. for the Environment confirmed to Michael Russell MSP that *'information collected by an operator cannot be used as evidence to prosecute that operator.'*

- Is the failure to successfully prosecute offenders because self-reported data cannot be used as evidence in court?
- Will SEPA end the self-monitoring and self-reporting of environmental harm?

SEPA acknowledges that it is very hard to assess fish biomass in the cages. Deliberate overstocking seems to occur regularly, with inevitable consequences for seabed health. The change to monitoring feed rather than biomass makes sense, but only if autonomous, tamper-proof feed rate monitors can be relied upon. Until then SEPA will continue to rely on auditing feed purchase records, which seems to have resulted in no recent prosecutions.

- When will these tamper-proof feed monitors be introduced?

**Fraud.** Occasional inspections and audits of paperwork cannot be expected to expose fraud. We have mentioned to Mr A'Hearn, to Anne Anderson and to the SEPA team at the drop-in event, allegation that at least one company keeps two sets of books, showing 'official' stocking and feed rates to SEPA, while keeping the true figures secret. Corin Smith has also been given evidence of alleged deliberate overstocking.<sup>14</sup>

- Does SEPA investigate these and other allegations of deliberate overstocking?
- Why have there been no prosecutions?

Fraud in self-monitored environmental sampling is equally hard to expose. Making sure that seabed samples are analysed by independently accredited labs will be an improvement on the current situation...

- ...but how will SEPA ensure that self-monitored seabed and water samples have been collected where they are supposed to be? This is surely another reason to consider putting independent observers on farms, or for SEPA to collect its own monitoring data.
- When will the quality assured analysis scheme be ready?

### **Monitoring**

We agree that it is an improvement to change from checking seabed compliance against a modelled impact footprint, to using seabed IQI standards, set by SEPA, at the edge of a 100m radius from the point source of effluent emissions. We understand however that the results of doing so will not be available until 2021, in order to check the compliance of existing farms.

The proposal for farms to achieve compliance with those standards by choosing their own monitoring regime, in agreement with SEPA, is puzzling. We cannot see why SEPA does not wish to instruct each farm how its impact should be monitored.

As mentioned above, we are extremely uneasy about self-monitoring. SEPA needs more staff to do its own monitoring, and with more experience of the weak points in the monitoring regime that might be taken advantage of by unscrupulous firms or individuals. A levy on the industry could pay for this.

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<https://www.facebook.com/InsideScottishSalmonFeedlots/photos/pcb.605164646566612/605134859902924/?type=3&theater>



## Transparency

We agree with the need for full transparency, as recommended by the REC inquiry, and that all environmental monitoring data, whether collected by the industry, SEPA or other agencies, must be published in one place, in close to real time. Norway's aquaculture website<sup>15</sup> is an example of best practice.

The existing culture of secrecy is toxic for trust.

## Whole sector approach

We welcome this and suggest that SEPA should also work with feed suppliers, accreditation bodies and seafood buyers to achieve true sustainability in this sector.

## Microplastic pollution

PWC Norway's '*Sustainable growth towards 2050 - Seafood Barometer 2017*'<sup>16</sup> notes the risk that microplastics might find their way up the food chain, into farmed fish.

- SEPA should also consider the impact of marine microplastic pollution accumulating in farmed fish.

## One Planet Prosperity and transformational change

We agree entirely that *'full compliance with environmental regulations will not, by itself, deliver the transformational change required to secure ... One Planet Prosperity'* *'To do this, mere compliance and small scale incremental change will not be enough.'* *'...transformational changes (are) needed to tackle today's problems'.*

There is now a rare opportunity for change, because aquaculture companies are about to invest millions in new open net farm cages, in order to achieve their 2030 targets, but many of the proposals in the sector review will not make any difference until 2024.

This review is not the significant change to the status quo that has been recommended by the ECCLR and REC Committees, and echoed in the Ministerial joint statement. Nor will it directly cause *'...the transition to ... capturing and making beneficial use of waste (that) is essential'*. Until this is done it will not be true that the environment is a *'platform on which economic and social success can be built'*, and One Planet Prosperity will remain beyond our reach.

More Scottish jobs would be created through taking a responsible course, requiring all expansion to be done using new technologies for waste capture and containment. Existing sustainable jobs would be saved from harm by pollution and sea lice impacts on wild fish. **We think these changes need to start now:**

- Why not set a 2030 deadline for the sector to reduce pollution to zero, by capturing it all, and for there to be no more sea lice released by then too, so the industry can plan its investments in new equipment and research?

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<sup>15</sup> <https://www.barentswatch.no/en/fishhealth/>

<sup>16</sup> <https://www.pwc.no/no/publikasjoner/pwc-seafood-barometer-2017.pdf>

- As part of the integrated authorisation framework review, SEPA should argue for the insertion of a Best Available Technology clause in the Controlled Activity Regulations, as is already included in some air pollution control regulations.
- Instead of encouraging larger open net farms in exposed places, why not encourage the uptake of new technology, by limiting all new farms and farm expansion to closed containment methods?

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## Annex A - the limitations of AutoDepomod

(Page numbers below refer to 'NewDepomod Final Report' SAMS).

*'Mayor et al. (2010) published a statistical analysis of SEPA's fish farm monitoring benthic data and concluded that "...in isolation, current speed, water depth, and farm size are not necessarily good predictors of benthic impact.'*" (p 11)

This was published eight years ago yet these continued to be the measured data used by AutoDepomod to make the predictions that form the basis of all biomass consenting.

Specifically, AutoDepomod cannot:

- Model large scale dispersion (Anne Anderson's letter to FoSoJ, 29 Jan 2018)
- Identify specific transport pathways and sensitive receptors (AA's letter)
- Deal with cumulative impact of several farms (or other interacting discharges) (AA's letter)
- Model how material will move once on the seabed or whether it will damage sensitive areas. (Andrew Berkeley, SEPA. p. comm)

This is because:

- It uses current measurements taken only at the fish farm site. (AB p. comm)
- Current measurements are taken for only 14 days, then repeated until they add up to a year. *'In Scotland, at present, these' (15-day hydrodynamical inputs) ... constitute a major source of error in model predictions.'* NewDepomod Final Report p 45.
- The 1x1km grid is too small and skews the dispersion results because particles are not readmitted once they leave the modelled domain. (AB p. comm)
- *'Isolated experiments with domain size showed that the use of a 1 km domain caused, in some cases, an export bias.... The use of larger domains...'* (ie by the improved model) *'...caused not only the overall mass balance to be larger, but also the EQS footprint to be larger.'* (p 37)

When using a larger grid: *'At all sites an impact was observed, even in those cases with sufficiently fast flow (e.g. Ardgour, Noster (2015)) that no impact would have been produced in the original version of the model.'* (p 37)

(ie AutoDepomod's predictions allow too much organic waste to 'vanish' from the domain, never to return. At Dounie, 99% of particles were predicted to leave this area in this way, after which they vanish to 'fate unknown'.)

- Particles are locked down once they've rested on the seabed for 4 days, never re-suspended. (AB p. comm)
- There is no allowance for storms or other infrequent events that can re-suspend

particles. (AB p. comm)

- There is no allowance for burrowing animals to bury, expose or re-suspend the sediment, which happens all the time, in all soft seabeds.
- The seabed is treated as flat, yet:  
*'Bathymetry plays an important role in determining the extent and locations of impacts. In the improved model footprints (are) not elliptical – as they typically, approximately were in the original version...'* (p 28 NewDepomod Final Report)  
Depositing material on steep gradients in NewDepomod now,  
*'... causes the footprints to become extended in one or more directions, and considerably larger than in the original model.'*
- *'... it was concluded that 30 day run times are prohibitively short* (p 43)
- *'The original DEPOMOD work was calibrated at only 2 sites (Cromey et al., 2002a) which may not be representative of the large variety of sites that are currently in use or proposed in Scotland.'* (p 10)  
Even so, *'These dispersion data were used to parameterise the resuspension component of the model...'* (p 9)
- *'...the theoretical decay rate of EMB indicates that discharged quantities reduce to <1% of their original mass during a period of 4.5 years....'* (p 26)
- Yet, **With AutoDepomod the longest possible run was 233 days.** (p 27)
- *'...multiple (EMB) treatments cannot be simulated in the original model...'*, even though multiple EMB treatments are the norm. (p 27)  
Also unrealistically, *'... the original model could only accept a single, constant feed rate...'* and *'... The original model could also only accept 1 hour flow data resolution'* (p 27)
- AutoDepomod is not good at predicting impact dispersive sites:  
*'An analysis of the relationship between modelled organic solid loading and predicted benthic response (using ITI) has shown that **there is in general a tendency for DEPOMOD to over predict impact at quiescent sites and under predict impact at more dispersive sites.***' (p 10)  
*'In addition **there is a considerable degree of variation between predicted and actual values of ITI over a range of sites.***' (p 10)
- *'... **Other anecdotal evidence suggests that in some cases – typically with very fast flow - footprints are observed despite none being predicted by the original AutoDEPOMOD...this implies that the original model can, in some (or perhaps most) cases, be too depositional, but in other cases too dispersive.***' (p 28)
- *'The general pattern indicated by the residue samples are for **concentrations to be much lower at cage edge locations in comparison with model predictions ... but generally higher than predicted by the model further out ... especially at the farthest, "EQS", locations where the model under-estimates actual concentrations in many cases, including some which exceed the EQS.***' (p 27)  
*'The occurrence of cage edge concentrations which fall considerably short of modeled predictions (often by an order of magnitude) is consistent with routine (but patchy) monitoring data seen by SEPA.'* (p 28) ***'This suggests that there is an inherent tendency in the original model to accumulate mass beneath the cages that does not correspond with reality.'***