Response to SEPA's 2nd consultation
on the proposed new regulatory framework
for managing interactions between sea lice from finfish farms and wild salmonids

The Coastal Communities Network (CCN) is a community-led network comprising 25 local groups committed to the preservation and safeguarding of Scotland's coastal and marine environments. CCN's mission is to connect and strengthen community-led efforts to protect, restore, and sustainably use coastal and marine resources for the benefit of nature, people, and climate. Our vision is for Scotland's seas to be clean, healthy and abundant in biodiversity, contributing positively to local livelihoods, as well as the health and wellbeing of all the people of Scotland.

CCN has committed a great deal of effort to participating in this consultation.
We are doing so in good faith because we hope SEPA will design, implement and enforce these new regulations sufficiently well to reverse the proportion of the decline of wild salmon and sea trout that is due to sea lice from fish farms.
This does not mean that we entirely agree with the proposals. Their success will depend on how they are applied, so CCN is reserving judgement on whether the proposed new regulations are fit for purpose, until they can be tested in action.

It has not been possible to break down our response according to your 21 questions. Sorry.

Why this matters
"…there is sadly now unequivocal evidence that populations of Atlantic salmon are at crisis point."
Mairi Gougeon MSP, Cabinet Secretary for Rural Affairs and Islands.
Foreword to the Scottish Wild Salmon Strategy

The decline of wild salmon and sea trout undoubtedly has many causes. We need to take action on them all. One cause is sea lice from fish farms.

SEPA cites clear evidence that infections of around 0.08 sea lice per gram of salmon post-smolt (i.e., more than 1 louse on an average 20-gram post-smolt) cause serious physiological effects, with potential to result in indirect mortality. The probability of mortality, including mortality resulting directly from the infestation, increases with the lice burden. At around 0.1 sea lice per gram (2 lice on an average 20-gram post-smolt), the probability of mortality is likely to be up to 20 %. At around 0.24 sea lice per gram of post-smolt, the probability of mortality is estimated to be 50 %. We believe this to be true.

We also agree with SEPA that sea lice from fish farms in Scotland can negatively impact populations of wild salmon and sea trout, and that the number of sea lice on farmed fish in an area partly determines the risk to wild fish. Other relevant factors include how sea lice from fish farms are dispersed by local currents; how long wild salmonids spend in the sea area concerned and the resilience of each river's salmonid population.

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SEPA acknowledges that one of the core objectives of the Government's Scottish Wild Salmon Strategy is for our rivers to have healthy, self-sustaining populations of wild Atlantic salmon that achieve good conservation status[1]. Restoring wild fish populations in Scotland's rivers to good status is also one of the main objectives of SEPA's river basin management planning[2,3].

The Scottish Government's Response to the Salmon Interactions Working Group (SIWG) said, "we welcome these jointly agreed recommendations which ask for a step change in how the risk of sea lice transfer from farmed to wild fish is managed. We agree that the regulatory regime for the protection of wild salmonids should be robust, transparent, enforceable and enforced."

CCN agrees that a step change in regulation is essential to attempt to reverse the catastrophic decline in these iconic Scottish fish.

The intended purpose of the new framework

The purposes of the regulatory controls available to SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 are, "to enable SEPA to prevent deterioration of the water environment and to contribute to restoring waters to good ecological status".

SEPA acknowledges that this includes protecting and, where necessary, restoring the status of their wild salmonid populations". It says, "the framework will aim to protect wild salmon and sea trout populations from sea lice (*Lepeophtheirus salmonis – the salmon louse*) from fish farms", and, "where pressure on the water environment from regulated activities is leading to adverse impacts, we use our regulatory powers to help improve the condition of the water environment".

SEPA also says that its "regulations must be transparent, accountable, consistent, and proportionate, targeting action to where it is needed, based on environmental risk", and that the new regulations will deliver benefits for some outcomes in the National Performance Framework. These include that, "we live in communities that are inclusive, empowered, resilient and safe".

For this reason, SEPA says it is proposing a risk assessment process that will enable communities to understand the potential risks to their local environment and that the outcome should be an increased level of trust in the regulatory system.

Having spent a significant amount of time engaging with SEPA about the proposals, CCN finds them a really complex set of regulations that are being phased in very slowly with regard to existing farms - five years have already passed since the 2018 Parliamentary Inquiry concluded, regarding fish farm regulations, that "the status quo is not an option".

[1] https://www.gov.scot/publications/scottish-wild-salmon-strategy/pages/3/
[2] https://www.sepa.org.uk/environment/water/river-basin-management-planning/
[3] https://www.gov.scot/policies/water/water-environment/

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The current system for protecting wild fish is certainly flawed but its replacement seems unlikely to increase trust in the industry or its regulators very much, until the regulations can be seen to have made a tangible difference to lice numbers on farms and in the sea, helping to increase wild salmonid numbers by reducing lice infestations on wild fish.

The precautionary principle

SEPA says, "before we take action, we must ensure the action is evidence-based, proportionate, reasonable and necessary", but SEPA also says that in its use of screening models at least, where doubts exist it will give nature the benefit of the doubt[4].
The latter is an expression of the precautionary principle.

The 2018 Scottish Parliament's Environment, Climate Change and Land Reform (ECCLR) Committee and Rural Economy and Connectivity (REC) Committee inquiries recommended that the precautionary principle should be applied more often in Scottish aquaculture regulation and consenting decisions.

The Scottish Government's Vision for Sustainable Aquaculture explicitly states that the duty on Ministers to have due regard to the five guiding principles on the environment will apply to future development of policies under the Vision for Sustainable Aquaculture, for managing aquaculture in a way that protects the environment and promotes sustainable development[5].
The five guiding principles on the environment are the:

- Principle that protecting the environment should be integrated into the making of policies;
- Precautionary principle as it relates to the environment;
- Principle that preventative action should be taken to avert environmental damage;
- Principle that environmental damage should as a priority be rectified at source; and
- Principle that the polluter should pay.

The duty to apply the precautionary principle to protecting wild salmonids already applies to Scottish Ministers and SEPA, due to the OSPAR convention[6], as follows:

"Preventive measures are to be taken when there are reasonable grounds for concern that human activities may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship. A lack of full scientific evidence must not postpone action to protect the marine environment. The principle

[4] "The screening models we use are designed to make robust assessments of risk but to not underestimate risk (i.e., the benefit of doubt is given to the environment)"
[5] https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2023/07/vision-sustainable-aquaculture/documents/scotlands-vision-sustainable-aquaculture/scotlands-vision-sustainable-aquaculture/govscot%3Adocument/scotlands-vision-sustainable-aquaculture.pdf
[6] https://www.ospar.org/about/principles/precautionary-principle

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anticipates that delaying action would in the longer term prove more costly to society and nature and would compromise the needs of future generations."

SEPA does not need to have perfect information about a clear and acknowledged environmental risk, such as the impact of sea lice on wild fish, before it takes precautionary measures. Under these circumstances, SEPA must apply precautionary measures while it gathers better data on those impacts, to inform future management.

Adaptive management instead of the precautionary principle
SEPA says, "the SIWG recognised that, whilst some gaps in understanding remained, a framework for managing sea lice interactions could be introduced, based on best available evidence"; "It recommended that conditions to safeguard wild salmonids should be contained within a licence rather than through planning consent and that the licencing system should be based on an adaptive management approach".
SEPA also says that the new system will be "adaptive from the start, evolving and improving in response to experience of its operation and new scientific understanding".

It does make sense to adapt the regulation of fish farming in the light of new information but adaptive management cannot be used as an alternative to applying the precautionary principle when there is a clear threat and when information about it is lacking.
The precautionary principle necessarily comes before adaptive management.

SEPA plans to apply lice limits for existing farms that are placed high in its risk matrix, but only after detailed sea lice modelling has been calibrated and validated by sentinel cage experiments and other means, saying that, "where we are confident that the sea lice exposure threshold in a WSPZ is exceeded and salmon populations are not in a good state or are declining, we will work with the operators of those farms making the greatest contribution to exposure to require action to reduce pressure from sea lice on the wild salmon population".

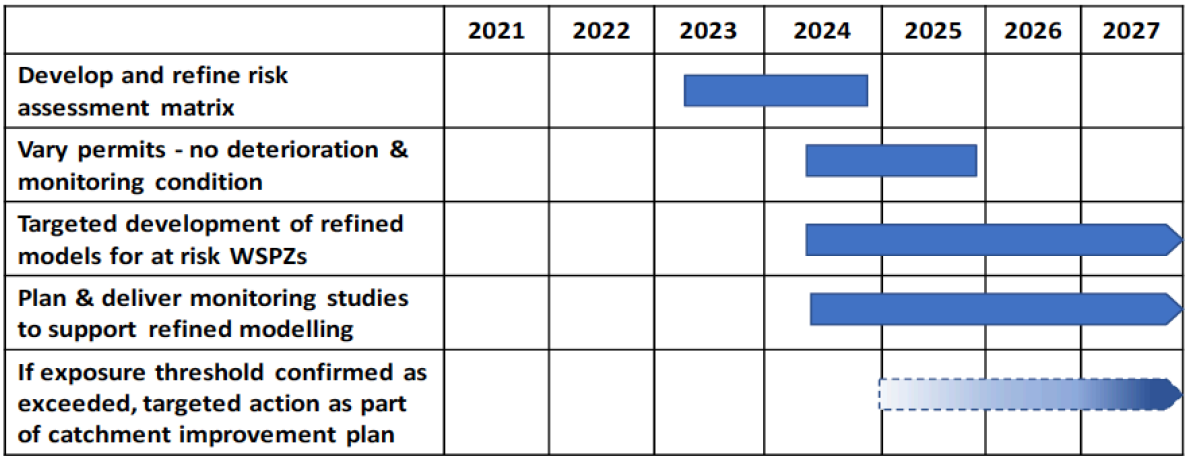

Figure 12: Projected timetable for introducing measures at existing farms.

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SEPA acknowledges that this will take many years: "We expect it will take several production cycles before we have generated sufficiently robust evidence from refined models and monitoring to determine if and where action is required to reduce pressures on wild salmon populations from sea lice".
Figure 12 above, from the consultation document, shows that this will probably not start to make any significant difference until 2027, at least nine years after the Parliamentary Inquiry called for urgent and meaningful action to address regulatory deficiencies.
In the meantime, the industry has added more than 50,000 tonnes of new farm biomass; working towards doubling salmon production by 2030.

Precautionary measures for existing farms
SEPA says, "the framework will help guide development to the least environmentally sensitive locations", but this only seems to apply to new farms.

Any harm done to wild salmonids by fish farm sea lice that is happening now is due to the operation of existing farms. There is an urgent need to act to reverse this harm
SEPA says, "when considering the regulation of an existing site, our objectives include:

- Preventing deterioration of the environment.
- Reducing the impact on the environment of existing activities where they are resulting in impacts on the status of the water environment."

However, while SEPA undertakes the slow process of validating its modelling and gathering more information, it proposes only to cap lice numbers on existing farms at their historical values[7], some of which have been high enough to harm wild fish, saying that, "these 'no-deterioration' conditions enable the activity to continue without affecting its normal performance".

It is unreasonable that SEPA's interim measures should not necessarily affect a harmful farm's normal performance.
In practice this means that maximum lice levels on the most damaging existing farms will be frozen until SEPA can thoroughly model their impacts, allowing the worst performing farms to carry on releasing high numbers of lice for several more years, even in the areas where wild salmonids are most vulnerable. This is a perverse reward for the operators of the worst farms for sea lice.

SEPA says that, "for farms categorised as medium risk, considerable risk or high risk, [it will set] conditions limiting the maximum number of adult female sea lice on the farm to the typical maximum for that farm", with that maximum being derived from the previous three spring's counts"[8].

[7] "adding sea lice control conditions to the permits of those existing fish farms that contribute significantly to the concentrations of sea lice to which wild salmonids are exposed in WSPZs …starting with farms that pose the greatest risk to wild salmon post-smolts if sea lice numbers on the farms were to increase. The conditions will be designed to ensure that, during the smolt migration window, **current sea lice management performance is maintained and any increase in the typical numbers of sea lice on the farms is avoided**".
[8] Consultation section "*Regulation of existing farms - preventing deterioration*"

SEPA has since said that it may be possible to use six years of lice data, but given that many farms have a two-year production cycle, and that lice counts are usually lower in the first of these, even using six years of data would still not be precautionary. This makes no sense when SEPA's goal is to stop further deterioration in salmon numbers.

When the final conditions are applied to individual farms' CAR licences, SEPA says that farms will have tight lice limits if they make substantial contributions to the lice density in areas where there is little or no "remaining available capacity". SEPA estimates that there are 21 farms in this category (see Fig. 10 below).

Farms that make moderate contributions to lice, in areas where there is little or no capacity, and those that make substantial contributions in areas with intermediate capacity will have to limit AF lice to 0.2 per fish. SEPA estimates that there are 20 such farms.

SEPA's analysis suggests that another 39 farms either contribute significantly to the infective-stage sea lice exposure in waterbodies with large remaining available capacity, or contribute moderately to infective-stage sea lice exposure in intermediate capacity areas, or make small contributions in areas where there is little or no remaining capacity.
SEPA proposes a limit of 2 adult female lice per fish for these farms, saying that this is "designed to achieve the permitting objectives of guarding against the risk of deterioration (exceedance of the sea lice threshold) and avoiding unnecessarily limiting scope for future development".

The remaining 82 farms will have no lice limits.

SEPA says it will start to phase in these measures from 2024, starting with farms identified as posing a high risk, or a considerable risk of causing the sea lice exposure threshold to be exceeded, or further exceeded, if the numbers of adult female sea lice on the farm increase, and that, "the conditions will not require changes in the normal management of sea lice on the farms".

SEPA's intention is that, in some years' time, "by re-running and improving screening assessments, we will be able to review the risk categorisation of individual farms, taking account of changes over time, including improved understand of local patterns of sea lice dispersion and wild salmonid post-smolt movements. The outcomes of updated assessments of risk would be used to identify and target any further action necessary to prevent deterioration, such as adding, or revising, sea lice control conditions in farm permits; advise farmers on the outcomes of their management of sea lice and our latest assessments of environmental capacity and help identify if, and where, action to reduce infestation pressure on wild salmon may be required".

This very gradual process is not fit for its stated purpose of preventing further deterioration, or of matching the urgency required to protect two species that the Scottish Government accepts are in crisis, especially given that SEPA's 0.75 copepodid lice/m^2 24-hour threshold

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of harm is not intended to protect below-average sized salmonid post-smolts, even in waterbodies with no remaining capacity.

SEPA's proposal to set a ceiling of 2 AF lice per fish in 24% of existing farms[9], represents a significant relaxation of the current industry Code of Good Practice, which has a voluntary ceiling of 0.5 AF lice per fish for all farms during the Spring salmon post-smolt migration. In 2021 and 2022, roughly 40% of Scotland's fish farms exceed a weekly average of 0.2 AF lice per fish, according to SEPA.[10]

A single strict lice ceiling is far simpler and easy to enforce. Two adult female lice per fish is ten times higher than the Springtime ceiling strictly enforced in all of Norway's salmon farms. SEPA's consultation document refers to the Norwegian approach[11], as being achievable and able to ensure that developments "use environmental capacity efficiently without unnecessarily limiting scope for future development".

As an interim measure, SEPA should apply a 0.2 AF lice/fish ceiling to all farms in the eight WSPZs in which it believes wild salmon post-smolts are currently at risk of harm, and to all other farms that it currently considers to be at medium risk, considerable risk or high risk of harming wild salmonids.
This should apply until individual farms can be proven to be doing no harm.

Figure 10 in the consultation (*matrix illustrating the no deterioration conditions that will apply to existing farms*) (below) would suggest that this might apply to 80 farms (21+15+5+28+4+7). We appreciate that this number may change when SEPA's virtual smolt model has been applied to the analysis.

If SEPA lacks a mechanism for doing this, it should seek one.

[9] 39 out of a total of 162 farms
[10] "in 2021 and 2022, close to 60% of reported weekly averages were less than or equal to 0.2 adult female lice per fish"
[11] "In Norway, large numbers of farms report compliance with the mandatory average of 0.2 adult female lice per fish in sensitive areas during the main migration period. Performance of farms in Norway against this limit is published on the Barents Watch website. Basing controls on this standard of good practice (i.e., an average of 0.2 adult female sea lice per fish or fewer) that has been demonstrated as achievable will ensure that developments use environmental capacity efficiently and so do not unnecessarily limit scope for future development."

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Use of capacity by farm	Remaining available capacity in WSPZ		
	Large (108)	Intermediate (5)	Little or none (8)
Negligible	50	5	4
Small	8	6	7
Moderate	9	4	5
Substantial	28	15	21

Key: Permit conditions controlling on farm sea lice levels (existing sites)

No numeric lice limits. Permit will authorise keeping in open-net pens of the maximum number of fish with which the farm is typically stocked on the farm

Limits on the total number of adult female lice set to reflect farm's performance over the last three Spring periods

Key: Permit conditions on monitoring and reporting (existing sites)

Weekly fish numbers and average numbers of adult female sea lice per fish.

Weekly fish numbers and average numbers of adult female sea lice per fish. Enhanced sea lice counts likely to be required.

Figure 10 in the consultation. Matrix illustrating the no deterioration conditions that will apply to existing farms

Capacity

SEPA defines the capacity of an environmental system as, "the extent to which it can sustainably accommodate additional pressure before there is a risk of significant adverse impacts".

It is surely not the case, as the consultation document says, that, "environmental systems with limited available capacity require tight control of developments to *avoid…opportunities for future development being unnecessarily compromised*."

This is a contradiction in terms.

More broadly, we disagree profoundly with the concept that all the available "capacity" of waterbodies that do not yet approach the level of harm that SEPA has set, can safely be filled up.

The sea is a complex, non-linear system which we understand poorly. It is hubristic to imagine that we can accurately predict the unused sea lice "capacity" available within WSPZs, especially when SEPA has set a threshold of harm that defines "significant adverse impacts" as well above zero.

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Align the regulations with Scottish Government policies for salmon and sea trout recovery
SEPA should provide for the recovery of salmon and sea trout in rivers where they bred until recently, in order to be consistent with the Scottish Government's Wild Salmon Strategy and Implementation Plan and the impending Biodiversity Strategy.
This may require extensions to, or the creation of, new WSPZs, as well as lice number restrictions on some farms outside the high-risk areas that SEPA has so far identified.

Risk Assessment

Do the proposed regulations completely protect wild salmonids?
100% protection of all wild salmon and sea trout post-smolts is not achievable, but SEPA should more publicly acknowledge that it has chosen to accept some level of mortality due to sea lice (described below).
Choosing to allow some harm to continue makes it harder to stop the deterioration in wild salmon and sea trout numbers due to sea lice, or to achieve the Wild Salmon Strategy's and Biodiversity Strategy's aim of reversing their losses. SEPA should analyse the impact of this choice.
SEPA has chosen to apply thresholds of harm that do not aim to protect all salmon post-smolts, in the following ways:

- SEPA says it has set a sea lice exposure threshold of harm (24-hours exposure to 0.75 cop/m^2), "which defines the level of exposure beyond which the likelihood of salmon post-smolts being infected with harmful numbers of sea lice is significant". This is, "the maximum cumulative concentration of infective-stage sea lice integrated over the upper 2 metres of sea to which salmon post-smolts can be exposed *without a likely significant impact*".
This threshold is intended to prevent an average weight (20g) salmon post-smolt from acquiring more than 2 sea lice before it leaves Scottish waters.
The consultation document also states that "at around 0.1 sea lice per gram [2 lice on a 20g fish] the probability of mortality is likely to be up to 20 %".
SEPA appears to have decided that the residual chance of mortality below 0.1 sea lice per gram is not a *likely significant impact*, but it hard to see why not. Limiting lice exposure to SEPA's threshold will not prevent all 20g post-smolts from dying.
- SEPA's approach only gives this degree of partial protection to average-sized fish.
Fewer lice can kill smaller fish, which also swim more slowly, so they will be exposed to lice for longer. Moriarty et al (2023)[12] modelled this effect: "We found that salmon lice impact depends on initial size of host, smaller smolts will be more susceptible, while larger smolts are less impacted by a given number of lice encounters and migrate more rapidly".
- Based on this degree of partial protection, SEPA has modelled the "lice density field", using an assumption that is less conservative than is standard in industry modelling. This assumes that each farmed fish is host to 0.4 adult female lice, rather than the more usual figure of 0.5. There is no clear reason for using 0.4, which reduces the modelled lice density by 20%, relative to most other modelling.
0.5 adult AF lice per fish is the industry's voluntary Code of Good Practice level in Spring.
The industry's annual average lice count for all farms, 2018-2020, was 0.63 AF lice per fish[12].

[12] doi.org/10.1016/j.prevetmed.2023.105888

- SEPA assesses the cumulative impact of exposing wild fish to the modelled lice field, by tracking "virtual smolts" as they swim through it. It then reduces the apparent risk to wild fish by disregarding the top 5% of the resulting lice exposure figures[13]. Before adopting this approach, SEPA should test the assumption that the top 5% of exposure is due to modelling artefacts, as it states, rather than to the patchy distribution of sea lice in the open sea (more on this below).
- The same fish face exposure to sea lice outside SEPA's WSPZs, further increasing their risk of harm (more on this below).
- Wild fish face addition exposure to sea lice if they swim through more than one non-contiguous WSPZ (more on this below).
- SEPA says that permit conditions on sea lice numbers on farms, "will apply from 16th March to 30th May to control infective-stage sea lice concentrations in WSPZs during the period of wild salmon post-smolt migration", but not all salmon post-smolts migrate before the end of May and sea trout are in coastal waters all year, where they will only be protected by SEPA from 16th March until the end of June.

The industry's voluntary Code of Good Practice allows only 0.5 AF lice per farmed fish between 1st February to 30th June inclusive. SEPA should adopt those dates for the new regulations for salmon, to protect more salmon post-smolts.

We acknowledge that SEPA's screening approach is more precautionary in some other ways, which may counteract some of the risks above. SEPA should analyse and explain to what extent this is the case. For instance:

- SEPA's screening modelling uses a proxy for farmed fish numbers that is higher than the maximum annual fish biomass a farm would contain at one time. This overestimates the fish numbers on which lice production calculations are based. However, SEPA has also assumed that all fish weigh 5kg. This is the weight at which many fish are harvested but it is very unrealistic for the first Spring of production, greatly underestimating fish numbers in the farms. This assumption may result in underestimates of fish numbers in the second Spring as well, given that many farms do not harvest out fully-grown fish until later in the year. SEPA should assess and explain the extent to which this assumption will cancel out its precautionary modelling assumption about biomass.
- SEPA's virtual fish tracking method grades waterbodies according to the greatest minimum swim distance for fish entering that waterbody from their breeding rivers. Fish from rivers closer to the end of the WSPZ will swim less far, putting them at lower risk.
- The SEPA screening model does not include sea lice vertical movements. The industry believes that the lack of vertical lice movements in SEPA's modelling is causing 3-4x overestimates of lice densities. CCN's modelling includes these vertical movement. Its results indicate a smaller difference in total density but with significant changes in the distribution of sea lice, lowering their density in some areas and raising it in others.

SEPA must establish what difference this makes and in which areas. In some areas the effect may be precautionary, but not in others.

It is important to include sea lice at all depths where lice might reasonably occur, before comparing their density to the threshold of harm, not just the top two metres as at present.

[13] "The use of a 95th percentile statistic means that the highest 5 % of modelled exposures are excluded"

Special Areas of Conservation
We accept that SEPA has limited resources and must prioritise some areas over others. The assessment of the risk from existing and new farms, where their lice might affect the salmon that breed in Special Areas of Conservation, should be a high priority, and likewise with SACs for freshwater pearl mussels. This assessment should be done urgently, regardless of whether new farms have been proposed in these areas.

Risk assessment framework for sea trout
We appreciate that SEPA is still working out how best to protect sea trout and has prioritised salmon in the interim. However, sea trout are also in dire straits and are more vulnerable to sea lice than salmon, as they are present in coastal waters all year.
The proposed regulations do very little for them at present, although more is promised.

SEPA acknowledges that for sea trout, "movements of up to 20 km within sea loch systems are common", so it proposes to make WSPZs for sea trout that, "within sea loch systems, will extend up to 20 km from the relevant river mouths", however, "for rivers flowing out into open sea areas, they will extend outward from the river mouth for 5 km".
The argument for a 5km radius zone around river mouths on open coasts was geared towards salmon, which SEPA argued might swim quickly away from the coast.
By contrast, it is well-established that sea trout stay near the shore, so they need narrower protected zones that are longer than 5km. Rivers opening into open sea areas should have 20km-long coastal protection zones on either side, to reflect sea trout behaviour.

SEPA says, "we are planning to base the framework on the spatial extent of high infective-stage sea lice concentrations in WSPZs during the period from 1st April to 30th June".
This is insufficient. Sea trout do not migrate so they need protection until at least September.
In order to give sea trout some protection beyond the dates when the protection for salmon would also benefit them, SEPA says that proposed developments, "predicted to make a substantial contribution to infective-stage sea lice concentrations within a WSPZ, will be subject to permit limits on the maximum number of sea lice allowed on the farm from 1st June until 28th June", but even in these most vulnerable locations, SEPA only plans the lice limit on farms during this time to be set at 0.5 AF lice per fish x the maximum number of fish on the farm. By comparison, the lice limit proposed to protect wild salmon in the most vulnerable areas is 0.2 AF lice per fish x the maximum number of fish in each farm.
How has SEPA reached this conclusion? Sea trout are not less worthy of protection than salmon. Both are Scottish Government Priority Marine Species.

Additionally, applying the lice limit on farms as a 28-day rolling average will smooth out peaks in sea lice numbers, concealing the risk to wild fish, as it does with salmon.

SEPA has not so far proposed any WSPZs in the Northern Isles, to protect sea trout, saying, "we will phase-in consideration of risks to sea trout populations in our application process for farm developments in the Northern Isles once we have established an operational risk framework, including a network of WSPZs and screening models."
It should move this work on with urgency.

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Applying an interim limit to the level of lice on farms in the Northern Isles, to protect sea trout, would be reasonable and proportionate.

How many existing farms pose a risk to wild salmonids?
For this consultation, SEPA has used screening models to calculate the contribution that individual farms make to infective-stage sea lice concentrations within WSPZs, concluding that, "the outputs indicate that a relatively small number of farms make large contributions to exposure risk".
We appreciate that this is an assessment of relative risk, intended only to help prioritise where further assessment should be targeted and that it does not imply impact, but surely this conclusion is premature? At this stage it is not helpful for SEPA to suggest that only a few farms will need to reduce lice levels, or keep them low, or for SEPA's expectation to be "that most development proposals will not require refined modelling".

The consultation's Figure 4 (*Proposed risk assessment matrix for categorising the relative potential risk posed by individual farms*) shows that 64 of the 162 farms with CAR licences[14] are likely to make a substantial contribution to infective-stage sea lice concentrations, and another 18 farms are in waterbodies that SEPA says have little or no available sea lice capacity, where any increase in lice above the counts reported in the last few Springs will push the limits.
This suggests that about 50% of all CAR licensed farms may be making large contributions to exposure risk, or are fairly easily capable of doing so.

Lice numbers vary considerably from year to year; for instance, farms may have high lice counts because their fish cannot be treated for lice when their gills have been compromised by disease or micro-jellyfish. This is not uncommon but it does not happen to the same farms every year. So far, SEPA has only had access to reported lice counts at farm level covering three Springs (2021-2023).

We do not agree that SEPA's proposed risk assessment methodology is fit for the purpose of halting deterioration. As stated above, we believe that until SEPA has its final system for assessing the impact of existing farms ready, a reasonable interim approach would be to apply Norway's 0.2 lice per fish ceiling to all farms.

Measures should also apply to farms outside WSPZs
SEPA is correct to say that CAR permit conditions to protect wild salmonids should also apply to fish farm developments outside of WSPZs, because infective-stage lice can be carried into WSPZs from developments outside.

[14] 162 is the sum of all the figures in the matrix

Are the proposed WSPZs in the right places?
SEPA says, "to target protection where potential risk is greatest, we have identified a network of WSPZs along the West Coast and around the Western Isles (Figure 3).
The network includes:

- All sea lochs into which salmon rivers drain.
- Sounds through which salmon populations are likely to migrate.
- Sea areas within 5 km radius of all salmon river mouths, irrespective of whether the river drains into a sea loch or sound.
- All areas of sea within 5 km of rivers designated for the protection of freshwater pearl mussels. This includes salmon rivers and non-salmon rivers. In the latter, trout act as the sole hosts in the lifecycle of the mussels."

The WSPZs proposed so far do not include all the high-risk areas through which wild salmonids are likely to migrate. SEPA's and CCN's modelling shows clear risks of lice accumulations in areas outside the designated WSPZs.

Please note that while the hydrodynamic model underlying the sea lice dispersion modelling commissioned by CCN has been calibrated and validated against field measurements, the particle tracking component has not yet been calibrated/validated against sentinel cage data, in common with all current sea lice models used in Scotland.

In its response to the first sea lice consultation, CCN urged SEPA to extend WSPZs into additional areas where modelling shows that high lice densities can occur.
SEPA has responded that, "the potential paths that salmon post-smolts could take on their migration start to multiply considerably. Infective-stage lice concentrations are also generally low away from WSPZs and patchy in time and space".

In several cases, migrating fish have only two possible paths, for instance when they leave Loch Linnhe, and the sea lochs East of Skye. It would not be hard to test the consequences for wild fish of using both options in these and other similar cases.
The concentrations of infective-stage lice are not necessarily low in a number of areas away from WSPZs.
Also, the distribution of planktonic animals is always patchy. Norway's sea lice modellers acknowledge this[15]. Patchiness does not render the risk from sea lice insignificant, either inside or outside of WSPZs.

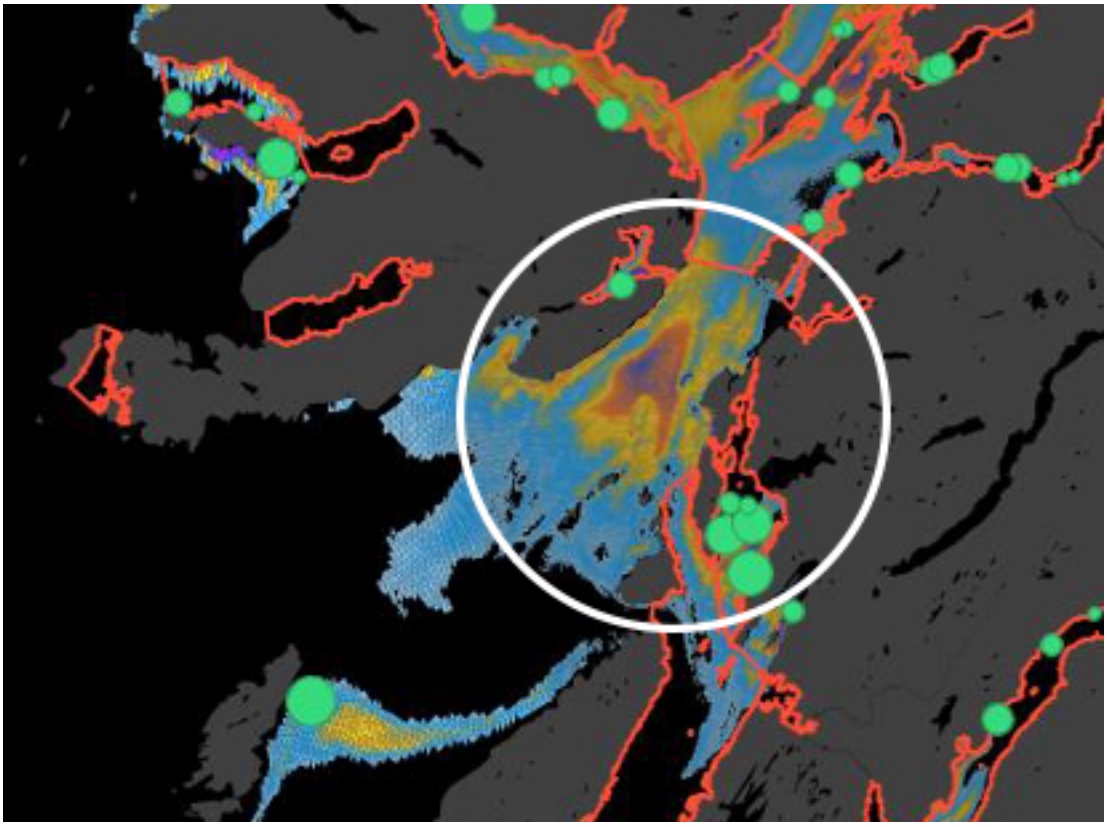
The WSPZs should be extended where modelling indicates that significant lice accumulations can occur outside the proposed WSPZ boundaries.

We believe that WSPZs should be extended in the following areas, based on SEPA's risk screening modelling and the modelling commissioned by CCN:

[15] A number of studies has shown that "particles" transported in the ocean rarely constitute smooth continuous fields but rather establish patchy patterns with strong gradients"
Sandvik, A. D., Johnsen, I. A., Myksvoll, M. S., Sævik, P. N., and Skogen, M. D. Prediction of the salmon lice infestation pressure in a Norwegian fjord. – ICES Journal of Marine Science, 77: 746–756

The Firth of Lorn

The circled area falls outside SEPA's proposed Loch Linne WSPZs and the Sound of Jura/Sound of Shuna WSPZs, but SEPA's modelling show that wild fish in that area may experience very high lice densities.



Enlargement of part of SEPA's sea lice consultation Figure B:
SEPA's modelling of average lice/m^2 concentration > 0.04 over April and May shown against sites and WSPZ. Geographical Area 2. Orange lines enclose the proposed WSPZs. **Circle added to highlight high sea lice density areas outside all WSPZs**

Some fish leaving the WSPZs to the South and fish from the Loch Linnhe WSPZ almost certainly swim through this area, as they only have a choice between using the Firth of Lorn or the Sound of Mull.
SEPA should designate this area as a WSPZ in its own right, joining the WSPZs to the South and North.

CCN's modelling also suggests a significant risk that sea lice can accumulate and could contribute to harming wild fish in that area.

The outputs from this modelling (below) are not quantified sea lice density maps. They are indicative of areas where particles that behave like sea lice are relatively likely to accumulate, based on sea lice sources at the locations of existing farms. These sources are scaled to match the reported biomass for each farm in May 2020 and in 2021, with 0.5 AF lice per fish in all farms. The assumed weight of fish is 4.5kg.
The modelling commissioned by CCN includes sea lice vertical swimming behaviour.

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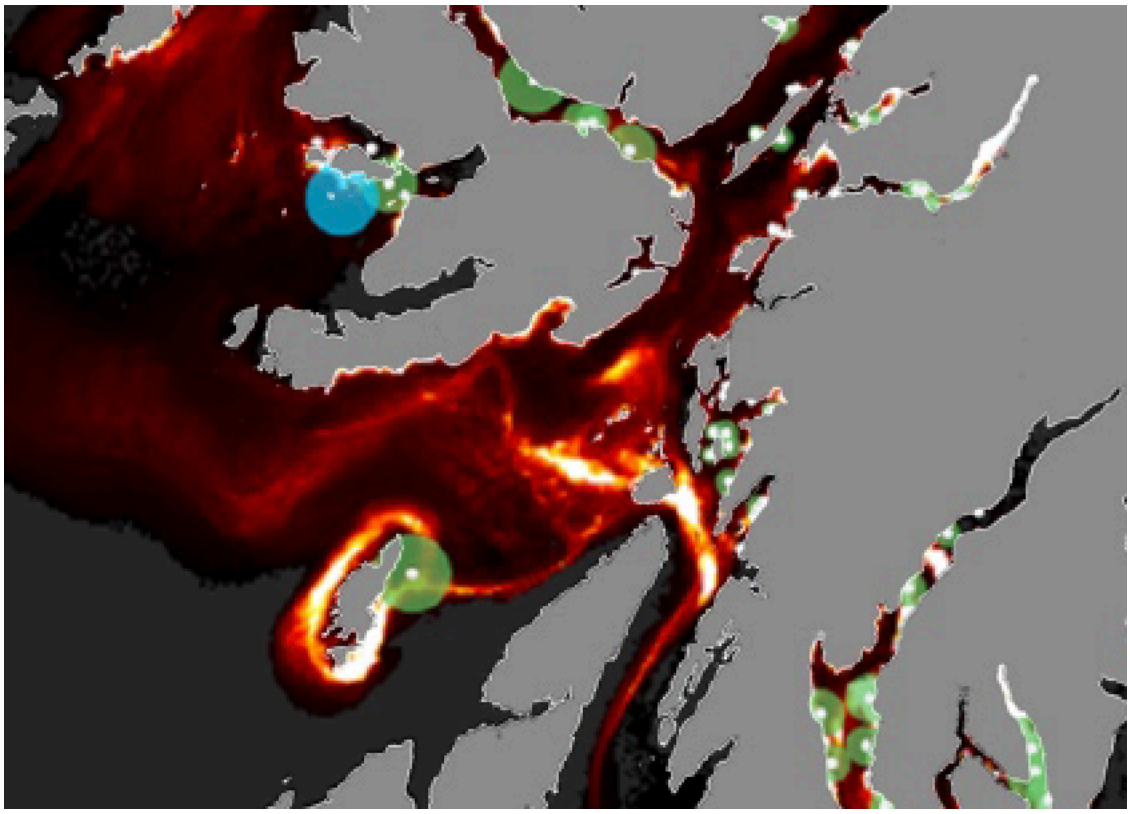
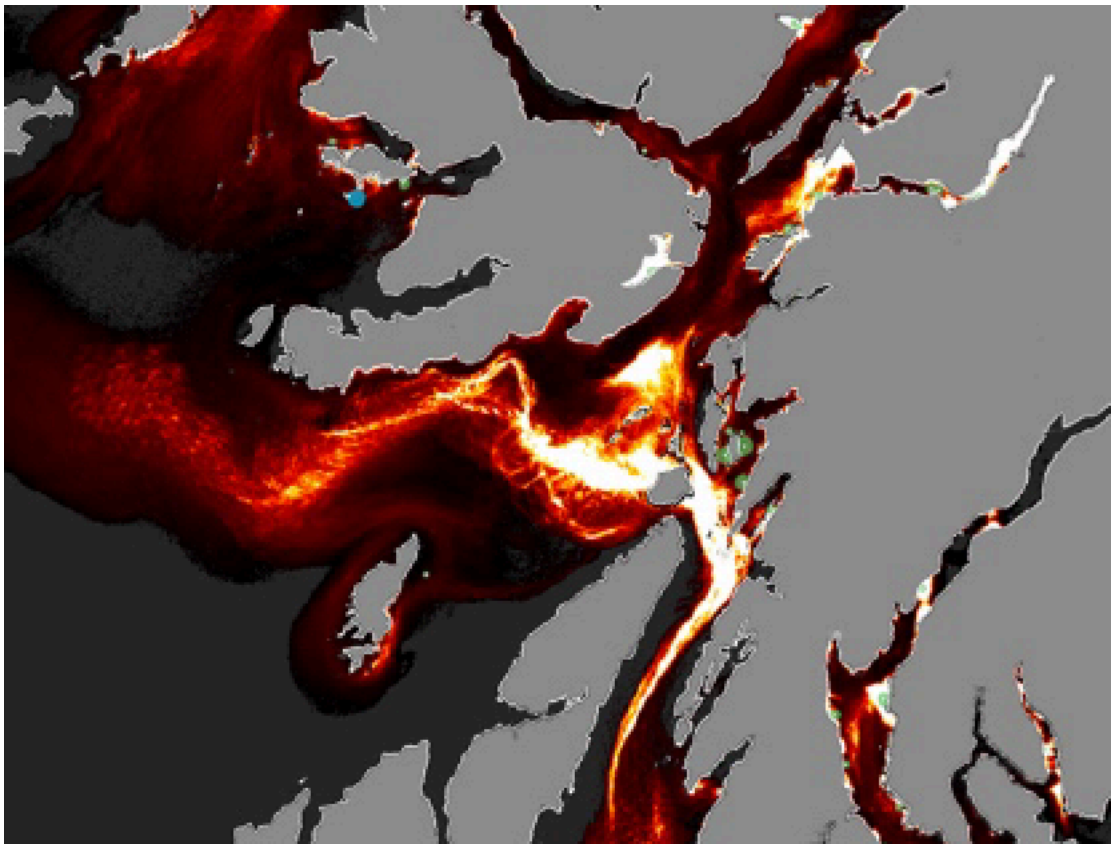


Reported May **2020** biomass on all farms



Reported May **2021** biomass on all farms

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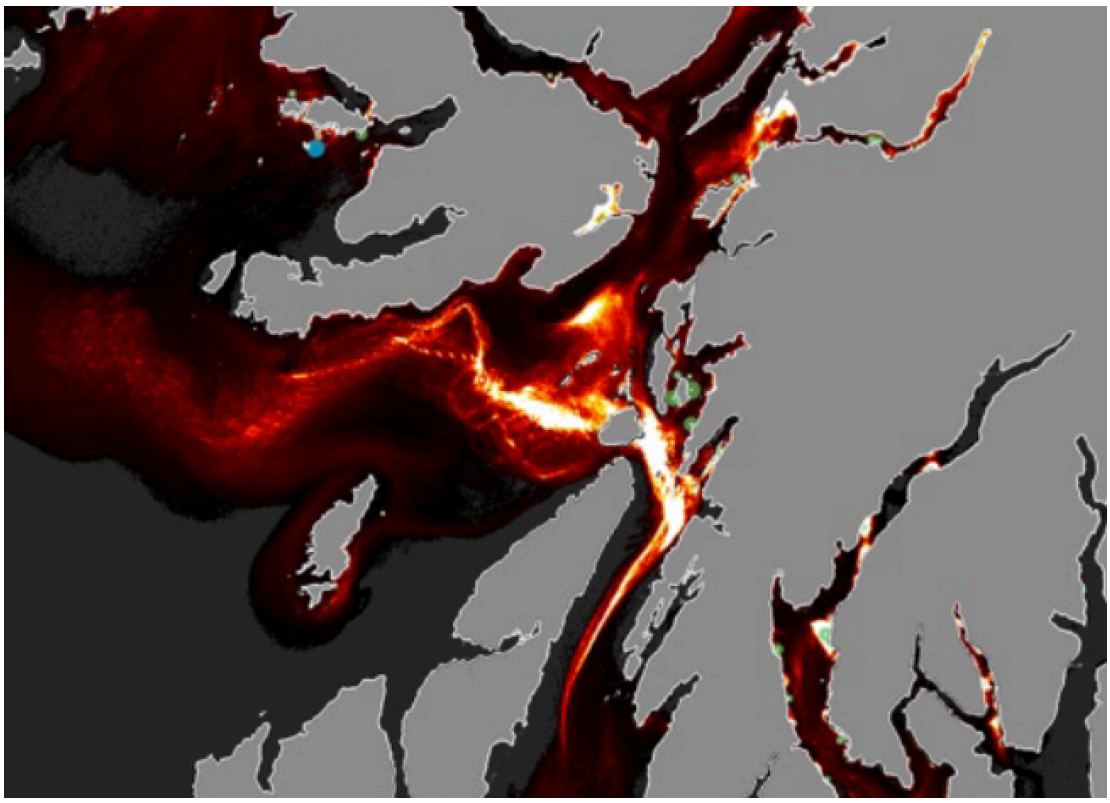
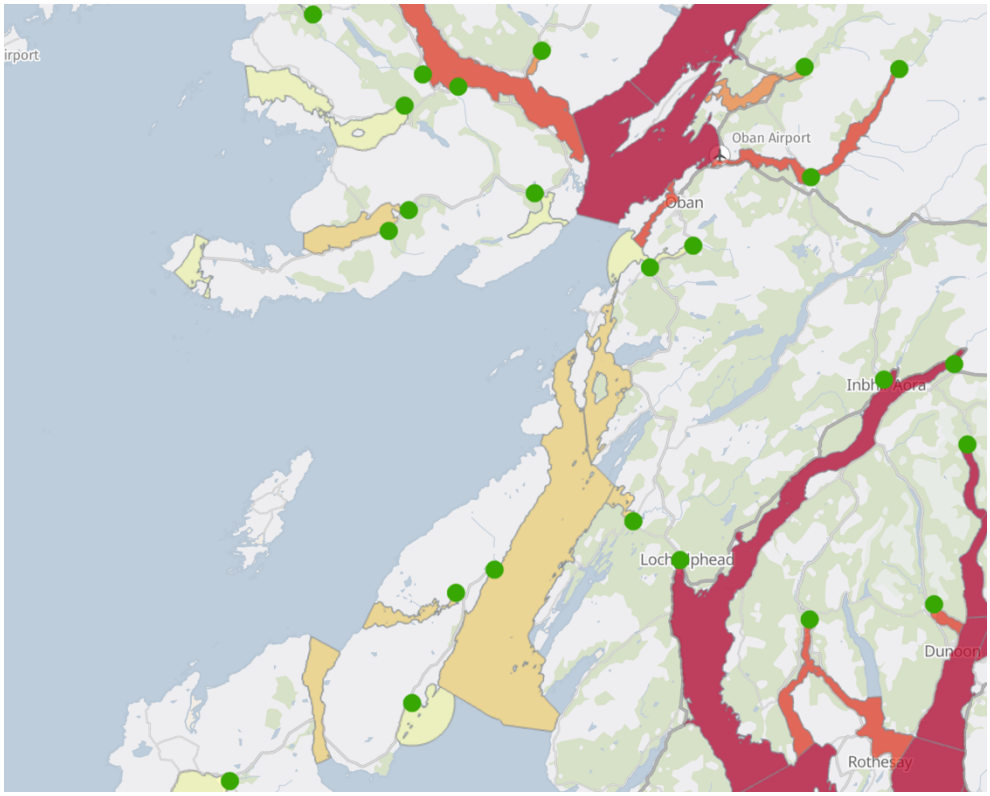
When the reported sea lice figures for 2021 are used instead of the blanket 0.5 AF lice per fish assumption, the modelled accumulation areas are similar (below).



Reported May **2021** biomass for all farms, with the WSPZ map for comparison.



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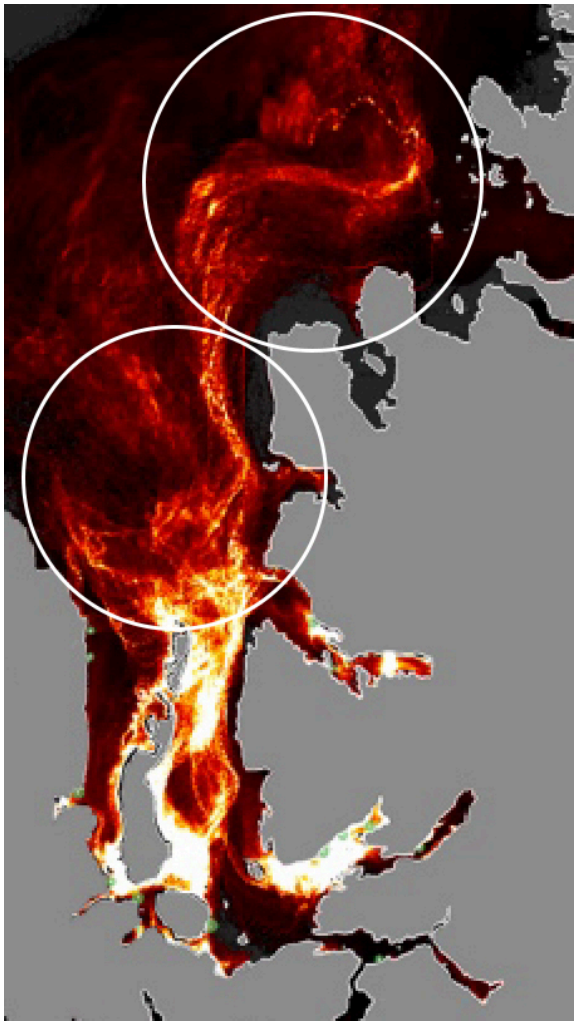
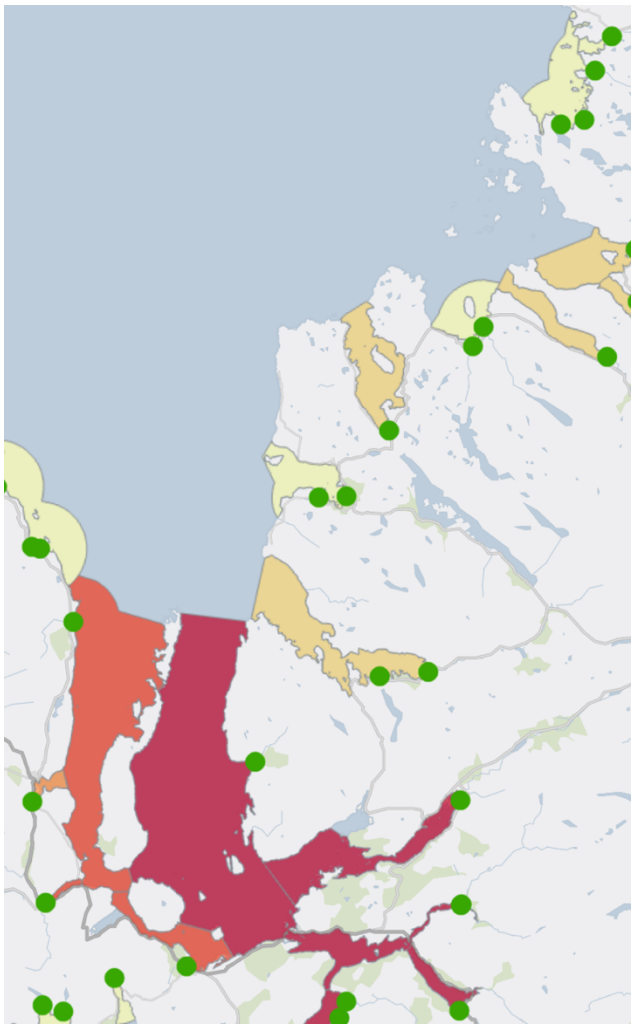
Modelling the reported lice figures and biomasses for May 2021 also flags other areas where sea lice are likely to accumulate outside the proposed WSPZs:

East and North of Skye

CCN's modelling indicates a large area of lice accumulation outside the proposed WSPZs in this area. This could pose an additional risk to wild fish which migrate North and West from their breeding rivers to the East of Skye. Some are likely to encounter lice in these areas.

The WSPZ should be expanded in the geographically constrained southern circled area, and serious consideration should be given to whether wild salmonids are sufficiently protected inside the more northern circle.





Reported May **2021** sea lice and biomass

Sound of Harris

The map below indicates where lice accumulations are likely to occur, based on reported sea lice figures and biomass for all farms in May 2021. Also below is a map of the proposed WSPZs. There are two hot spot areas outside the WSPZs. Wild fish migrating away from West-facing rivers, or through the Sound of Harris, would be hard put to avoid them.

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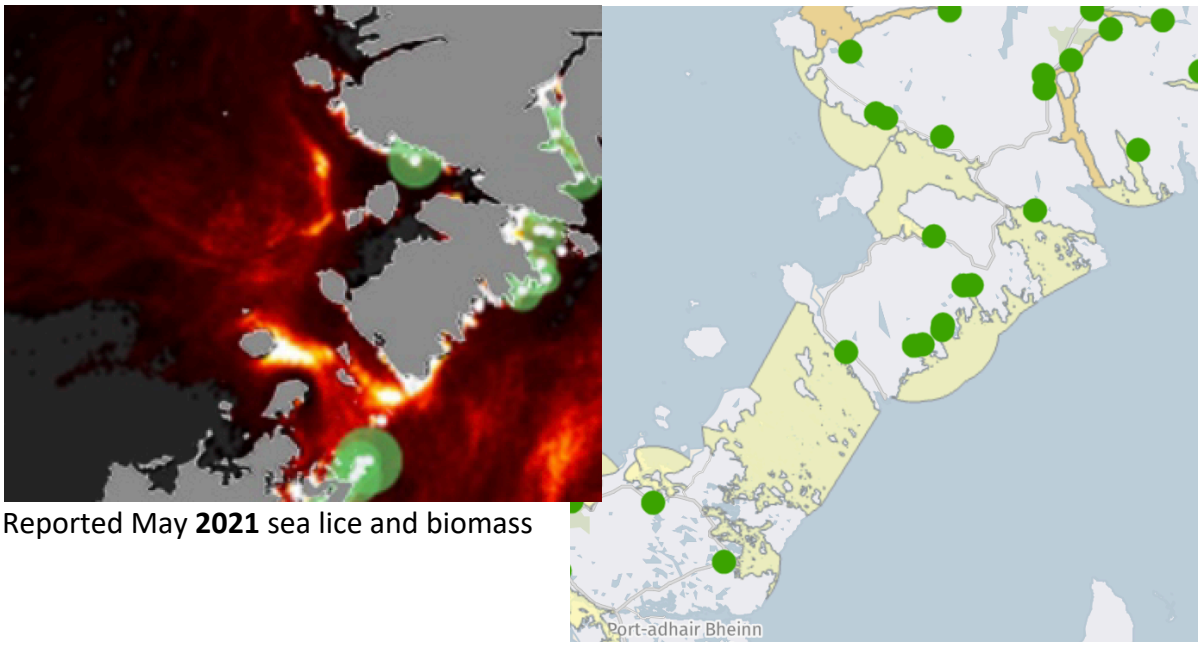
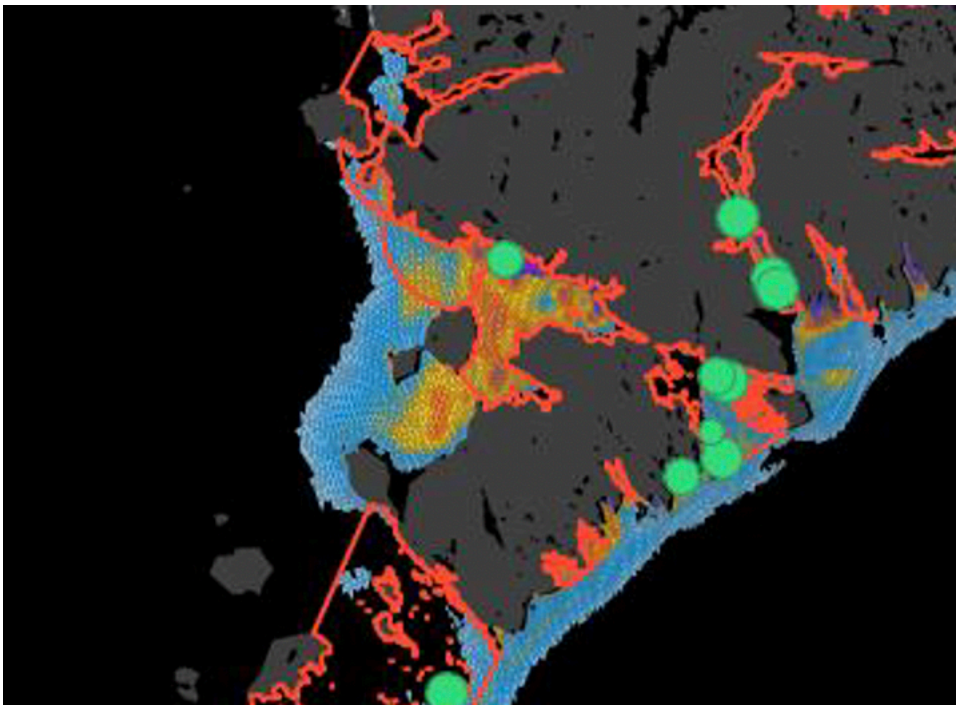


Reported May **2021** sea lice and biomass

SEPA's screening modelling (below) predicts high lice densities in some areas West of the Sound of Harris. The proposed WSPZs should be expanded in this area.
Differences in lice distribution may be partly due to the lack of sea lice vertical movement in SEPA's modelling.



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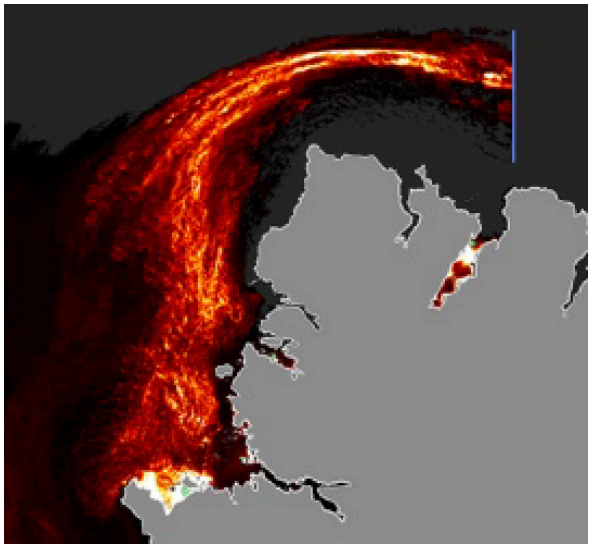
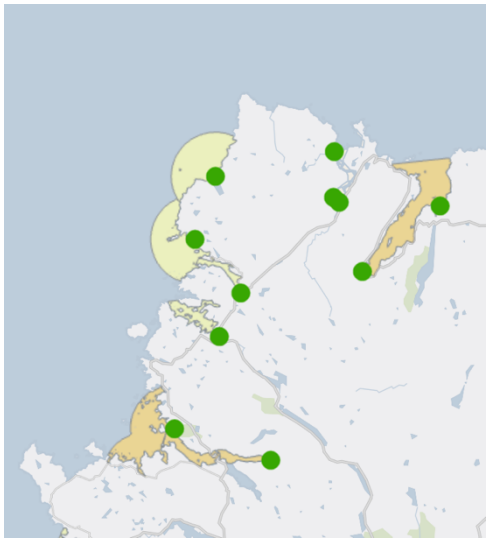
North-west mainland coast

The map below is based on the reported lice figures and farm biomasses for May 2021. The predicted plume of lice is entirely due to the farms in North-west Sutherland. The plume extends quite far along the North coast until it reaches the boundary of the modelled domain (blue line). This raises the possibility that lice from farms on the North-west mainland coast could affect wild fish around Orkney.

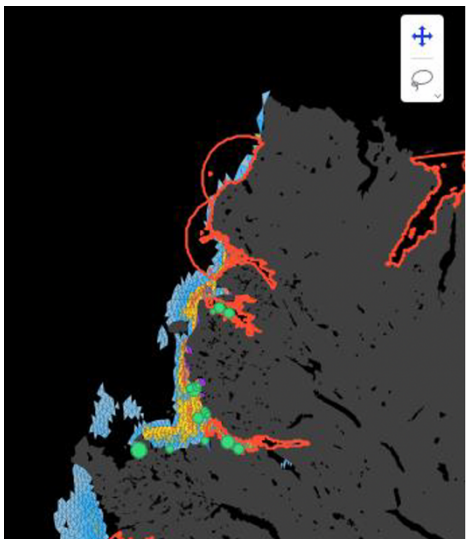
Under the proposed new regulatory framework, wild salmonids in the North-west are only protected for 5km from the mouths of their breeding rivers. This is clearly inadequate, not least for sea trout, which are very likely to spend time in the area of highest lice exposure risk outside the WSPZs, to the west of Oldany Island (bottom left on the maps).

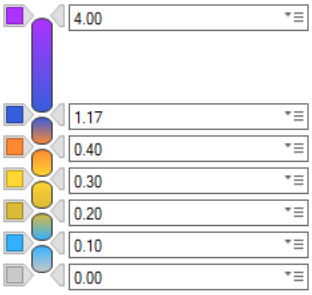




Reported May **2021** sea lice and biomass

SEPA's modelling also predicts that areas outside the proposed WSPZs, around Oldany and more widely to the North, will have high lice densities. Wild salmonids in these areas will not be adequately protected by the proposed zones. These WSPZs should be expanded.





Key to SEPA's sea lice mapping.
Values in lice/m^2

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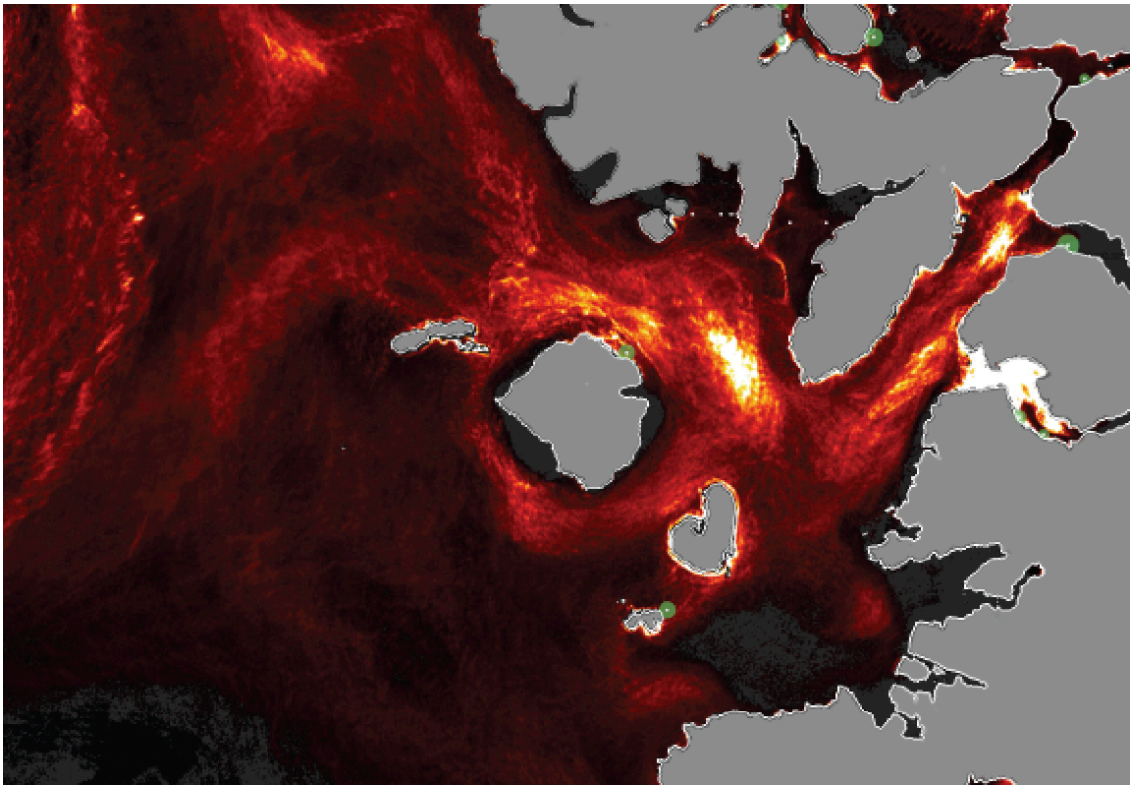
Between Rum, Skye and in the Sound of Sleat

SEPA's risk screening modelling uses three Scottish Shelf sub-area models. These do not yet join up very effectively, leaving a poorly-represented gap in the modelling grid between the Inner and Outer Hebrides. CCN's modelling indicates that sea lice are likely to accumulate between Rum, Skye and the mainland. The hot spot between Rum and the South of Skye is visible in other years as well but it is absent in SEPA's modelling results.

SEPA should devote some modelling effort to this area before confirming the WSPZs.



Reported May **2021** sea lice and biomass

SEPA has so far dismissed the possibility of classing this area as a WSPZ because these zones are supposed to be bottlenecks that wild fish cannot avoid, as they migrate away from their breeding rivers. This narrow definition fails to allow for some areas that do not include salmonid breeding rivers but through which many wild fish must pass.

That is true here. Particles tracked in the Sound of Sleat and its adjacent sea lochs (Nevis and Hourn) tend to be flushed from North to South, then West along the South Coast of Skye. It seems that they can accumulate in the areas shown, where they will add to the cumulative lice exposure risk for wild fish.

The gap between the islands is no wider than the southern gap in the WSPZ between Jura and the mainland, and not much larger than the width of several other bottleneck areas that SEPA has proposed. Like them, it is also a bottleneck for wild fish.

SEPA's screening model does not have very high resolution in this and several other important inshore areas. As a precaution, SEPA should designate this area as a WSPZ, while it does its own detailed modelling to check these results.

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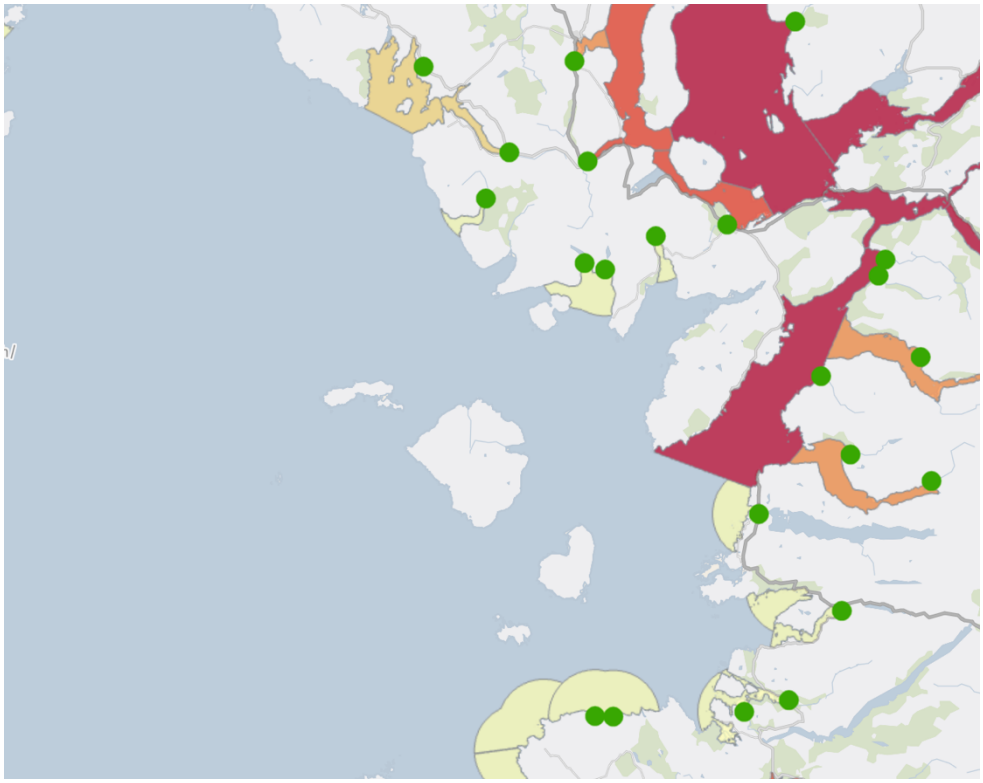
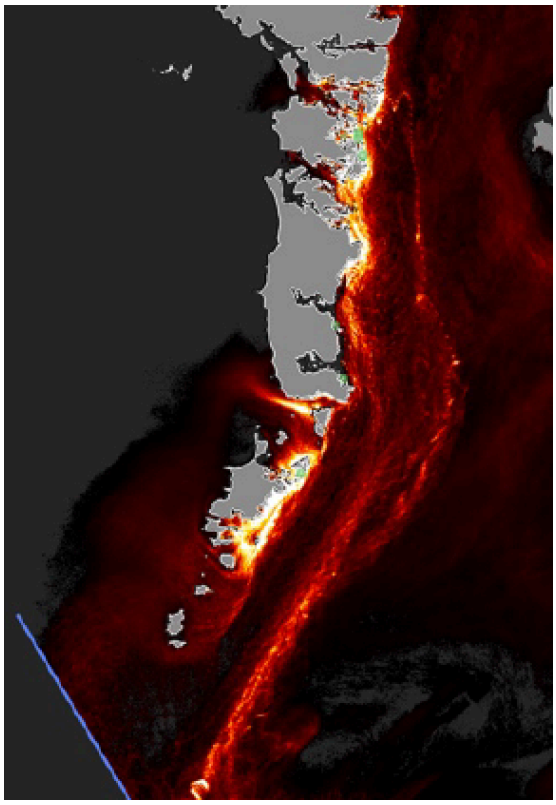
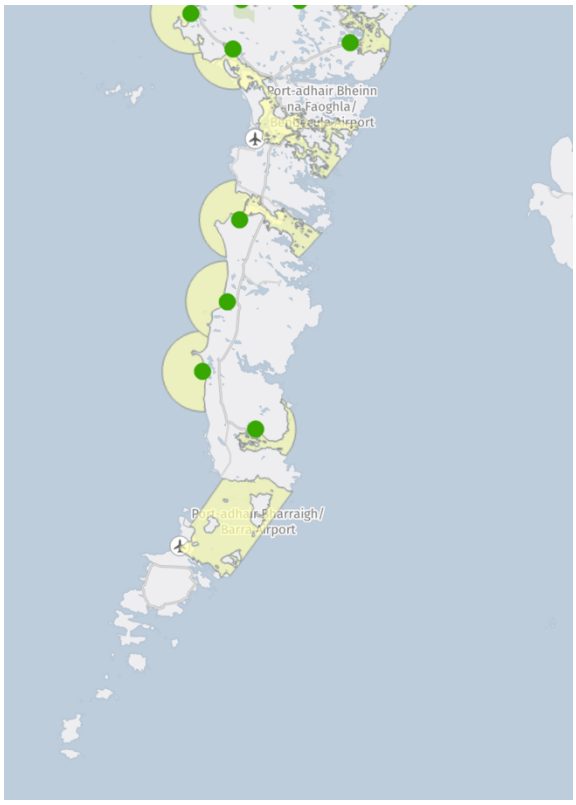


SEPA's WSPZs map of the area including Rum and South Skye, for comparison

East of the southern Outer Hebrides.





Reported May **2021** sea lice and biomass. The blue line shows the edge of the model grid.

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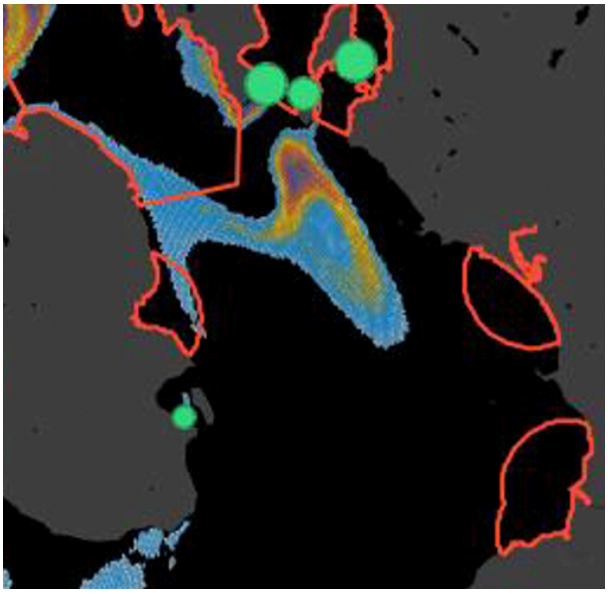
The area of higher lice exposure to the East of the Outer Hebrides is not a modelling artefact – water in the Minch flows southwards to the East of the islands, at high enough speeds to displace migrating salmon post-smolts. A salmon post-smolt that was tagged in the River Orchy has been detected by an array near Barra, having also been detected in the Sound of Mull. That fish could well have crossed the Minch via a curved northern route, passing through the areas where sea lice are likely to accumulate outside the WSPZs, both offshore and along the islands' East coasts.

Other areas with high lice density outside SEPA's proposed WSPZs

SEPA's screening modelling (extracts below from maps in the second sea lice consultation document) also highlights that sea lice concentrations are likely to be elevated in some other areas outside the currently proposed WSPZs.

New WSPZs should be created, or existing ones expanded, to reflect the risk that these areas represent to migrating fish.

SEPA's Spotfire system and CCN's modelling can identify which farms are largely responsible for the lice that aggregate in these areas.



South of Bute and the Cumbraes

SEPA has issued CAR licences for four proposed new farms in the Firth of Clyde, at South Bute, Cumbrae, Little Cumbrae and Ardentinny. These farms do not yet have planning permission.

SEPA's modelling shows the area of high lice density that would result from these farms. This is clearly on one of only two possible migration routes for wild fish, but the hot spot is outside the proposed WSPZs, so lice from those farms would not count towards the cumulative total exposure calculated by SEPA's virtual fish analysis.

The WSPZs should be expanded in this area.

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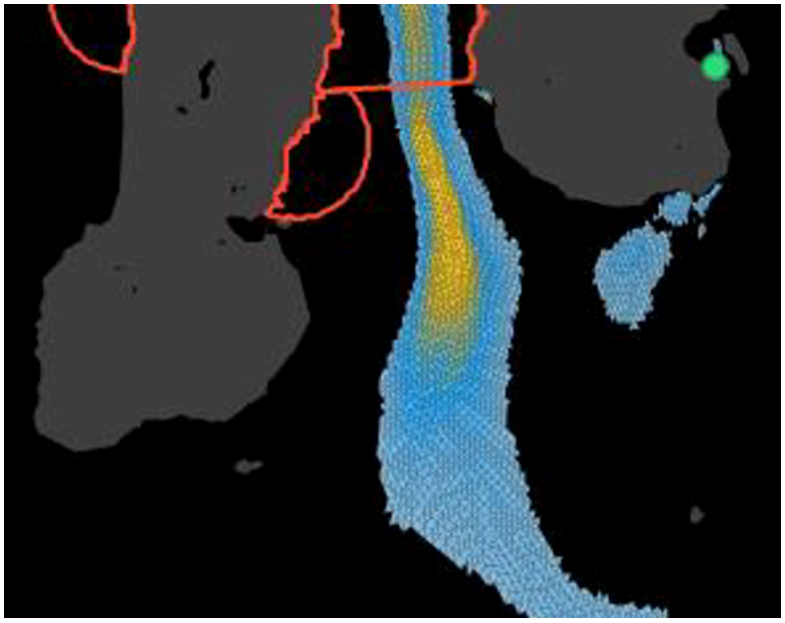
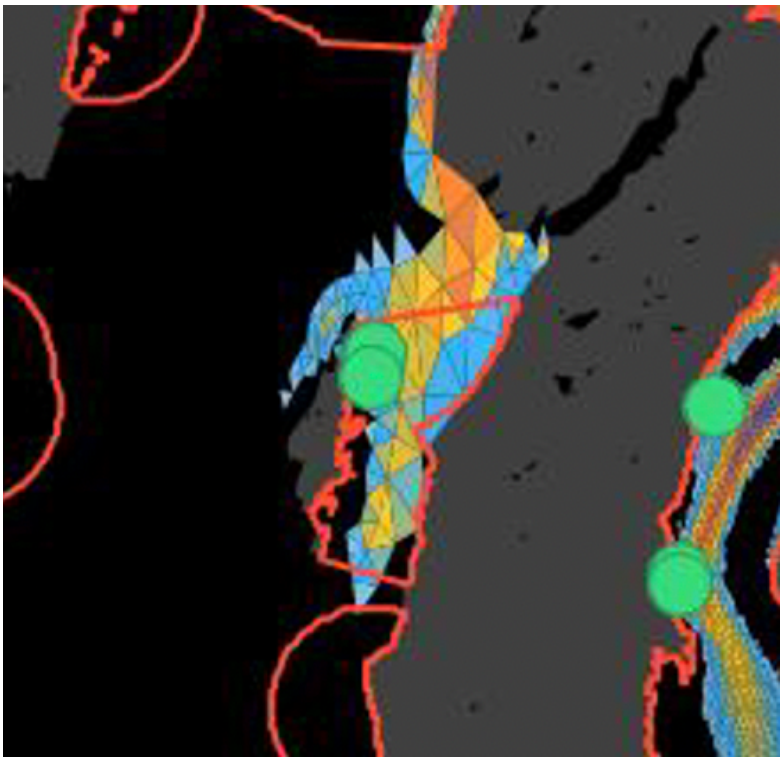


South of Kilbrannan Sound
There is a similar concentration of sea lice on the only other migration route for wild fish leaving the Firth of Clyde.
This area is outside the proposed WSPZs.

It should also be included in a WSPZ.



North of Gigha
SEPA's modelling also predicts an area of high lice density north of Gigha. Gigha is of concern because a very large new farm has been proposed just West of the island. This will add lice to those discharged by the existing farm.
Fish leaving the Greater Clyde may well swim past Gigha, then on through the Sound of Jura and beyond, passing through multiple WSPZs.

The WSPZ should be expanded North of Gigha, in anticipation of the proposed development.

A lice accumulation south of Ulva in Loch na Keal, Mull, also warrants a larger WSPZ.

The Northern Isles
SEPA seems to have concluded that sea lice from the west coast cannot interact with fish from the Northern Isles, and vice versa, so the west coast sea lice model can safely be considered in isolation from a future Northern Isles model.
While this may be true of Shetland, it is may not be true of Orkney.

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CCN's modelling predicts a plume of sea lice extending far around Cape Wrath from farms on the North-west coast**.**
Rabe and Gallego (2020)[16] found that "Orkney is reasonably self-contained, although there is some potential connectivity (import) from the northernmost mainland FMAs".
This interconnection has scope to affect sea trout from Orkney.
In addition, west coast salmon post-smolts certainly pass through the Pentland Firth, where they may be affected by sea lice from Orkney's fish farms.
SEPA should assess this possibility by further modelling.

Include the impact of fish passing through multiple WSPZs
SEPA does not include the risk that salmonid posts-smolts will swim through multiple, non-contiguous WSPZs, increasing their cumulative exposure to sea lice.
The reason given is that fish migration routes are largely unknown. However, when migrating fish are faced with only two choices, which is quite common, SEPA should at least factor in some proportion of the additional possible risk, as a precaution. The risk to any fish making long distance coastal migrations through multiple WSPZs should also be assessed.

Reliable sea lice and farmed fish counts are essential for reliable modelling
To a large extent, the proposed regulations will rely on accurately modelling the sources, distribution and impact of sea lice. This modelling will be severely compromised if the lice figures reported by farms are not accurate, or are not statistically valid (especially when sampling too few fish, in too few cages, on large farms).
Many farms go for long periods without reporting lice counts (citing 'harvesting', 'treatments' and other reasons. The *Scottish salmon farming - Harvesting, sea lice and disease* report[17], shows that some farms have not reported sea lice counts for up to 14 weeks. The s*ea lice data counts* section of the *Breaching the Limits* report[18] shows that in 2022, Scottish salmonid farms reported "no count" on 1391 occasions, accounting for 18.6% of the total lice counts provided. No data does not mean there were no lice.
This data must be improved urgently. All the data must be published in a timely fashion.

Modelling

Exposure risk assessment must include high intensity, low frequency events
SEPA's virtual fish tracking method counts up the cumulative exposure of fish on various routes through the predicted lice densities in a WSPZ, as they vary in time. This will capture the fishes' exposure to peak sea lice densities.
Then SEPA excludes the top 5% of these exposure figures, "because predicted high exposure values may include artefacts of modelling and, if not excluded, could lead to substantial overestimates of risk".

[16] Interpretation of sea lice connectivity patterns among Scottish Farm Management Areas. Scottish Marine and Freshwater Science Vol 11 No 4
[17] https://wildfish.org/wp-content/uploads/2022/10/Scottish-salmon-farming_Harvesting-sea-lice-and-disease.pdf
[18] https://wildfish.org/wp-content/uploads/2023/03/Sea-Lice-Report-March-23.pdf

It is widely understood by fish biologists and modellers (for example Sandvik, in Norway) that wild fish are put at significant risk by brief exposure to infrequent, high lice densities.

Before excluding the highest 5% of cumulative lice exposure figures from its analysis, SEPA should demonstrate that the highest exposure figures are solely due to modelling artefacts, and it should test the effect of excluding them, in terms of how many virtual fish tracks no longer reach the 0.75 cop/m^2 day threshold of harm.

The highest risk to wild fish often occurs when farms are in their second year of production. Since multiple farms in a waterbody are usually managed in synchronisation, lice numbers in the waterbody will often be higher in either odd- or even-numbered years.

As a trial, SEPA assessed the risk to wild fish in the Greater Clyde system during 2021 and 2022, using its screening model and virtual fish tracking method.
All but one of the 16 farms in the Greater Clyde are supposed to be managed in synchronisation, so the biomass of fish in those farms is very different in odd and even-numbered years, and the risk from sea lice will vary accordingly.
SEPA's analysis reflected the large variations in sea lice numbers reported by farms between years, with the 95th percentile of exposures varying from 1.04 lice per m^2 days to 0.1 lice per m^2 days. In May 2021 for instance, the Carradale farm had average counts of around 1.5 AF lice per fish, with a peak of 2.5 (data below, published online by SEPA).

29/03/2021	05/04/2021	12/04/2021	19/04/2021	26/04/2021	03/05/2021	10/05/2021	17/05/2021	24/05/2021
2.15	1.43	1.88	1.21	1.17	1.13	1.74	2.49	1.03

The impact of mortality on wild fish populations is affected by their highest exposure to sea lice so it is vital to regulate according to the highest risk years, rather than to the average risk, which will be spread across at least the two, very different years of a production cycle.

SEPA's modelling and analysis, based on very few years of sea lice counts in farms in the Firth of Clyde and Loch Linnhe, has persuaded it that few farms are responsible for contributing most lice to these areas. This may be true in some years, but in different years the largest number of lice may well come from different farms.
The Carradale farm above, for example, had much lower sea lice counts two years later, during the same phase of production. When gill disease and injury next prevent its fish from being treated for sea lice, that farm is likely to have high lice counts again, as could any other farm.

Until SEPA can analyse more years of farm-specific lice counts, it cannot safely conclude which farms in these waterbodies are posing the greatest risk to wild fish, therefore, in the WSPZs where its screening modelling shows there is a cumulative risk of harm, it should act in a precautionary way to reduce that risk by imposing an interim lice ceiling on all farms, until better information is available.
Outside the eight WSPZs at the highest risk, SEPA should also impose a precautionary lice ceiling on individual farms that have large biomasses and high lice levels.

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SEPA points out that when it modelled the effects of imposing Norway's on-farm lice ceiling of 0.2 AF lice per fish on all farms in Loch Linnhe, "the 95th percentiles of virtual salmon post-smolt exposures would have been 0.44 lice per m^2 days in 2021 and 0.39 lice per m^2 days in 2022, well below the sea lice exposure threshold".

Gold standard modelling by SEPA

In its consultation document, SEPA says it intends only to do **screening** modelling to identify areas where sea lice may impact wild fish. It does so by moving virtual sea lice particles through a hydrodynamic field, generated by a model that lacks biological sea lice behaviour. It is aiming only "to identify where more detailed assessment using refined models is required to decide if a development can proceed".

SEPA says this is similar to its screening modelling for pesticides and particulate pollution from fish farms, but fish farm pollution is different to sea lice – it does not spread so far or do much of its harm by concentrating in small high intensity areas, where sensitive receptors also gather. Unlike sea lice, particulate pollution and emamectin benzoate can also be fairly easily sampled, and resampled again later, to check the accuracy of modelling and self-reported surveys.

Before passing any responsibility for predicting wild fish impacts to the industry, SEPA must do more than screening modelling. It must provide the industry and all interested parties with a gold standard model for companies to use when submitting proposals for new farms. This must include appropriate grid resolution (c. 100m horizontally) in areas crucial to wild fish, and a lice behaviour model in its particle tracking. The Norwegians' robust criteria can be used to model lice behaviour. Good vertical resolution is also important in the HD model.

This approach has an exact counterpart in SEPA's existing regulatory system for particulate and in-feed pesticide pollution. When applying for a CAR licence, companies must submit NewDepomod modelling (a hydrodynamic model with particle tracking), using standard default setting. They may also submit their own refined modelling at higher resolution, if they choose, using methods approved by SEPA's modelling team.

When companies submit their own more detailed sea lice modelling, they should be obliged to build on the same standardised underlying HD model and to use SEPA's sea lice behavioural model criteria. Otherwise, companies will reach very different conclusions through using different criteria and modelling assumptions. This will be especially important in shared waterbodies, where companies will have to model each other's farms.

The gold standard model must at least cover the whole west coast in a single grid (and probably ought to also include Orkney – see above).

Working collaboratively to refine a pre-existing model, such as SAMS' WestCom, may be the best way to achieve this gold standard modelling.
The resulting model must be available and easily accessible to all interested parties.
CCN would like to contribute to this collaborative modelling effort.

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SEPA must then use this model to analyse the cumulative impact of lice from all existing fish farms, in all waterbodies. This is essential to determine the risk from existing farms, otherwise detailed modelling will be limited to areas where new farms are proposed.

First-pass, risk screening modelling is insufficient for this, so SEPA must allocate resources for this to be done to gold standard modelling standards, including lice behaviour. Companies are unlikely to have an interest in doing large-scale modelling in areas where they do not have farms.

Model validation and calibration

No models have yet been satisfactorily validated or calibrated against sentinel cage data. When the SPILLS project attempted to do this, only one model out of three had even moderate predictive competence, and only in one quarter of the modelled scenarios.
It is now of great importance to develop a gold standard model that can be validated and calibrated, as has been done in Norway. This will take time.
Until a gold standard model exists, SEPA should take a precautionary approach to protecting wild fish from lice from existing farms.
All the sentinel cage data and hydrodynamic field measurements needed to calibrate and validate the gold standard model must be free of commercial confidentiality clauses and must be published, so they are available to all interested parties.

Farm-to-farm infestation and fallow periods

When modelling the impact of new farms, SEPA should not assume that the length of gap between fallow periods is largely responsible for the timing of sea lice reinfestation. Farm-to-farm infestation between Farm Management Areas may make reinfestation of restocked farms more likely. Many FMAs are too small and too close together to prevent this. Rabe et al (2020)[19] applied connectivity modelling at local to regional scale. There was strong interconnectivity between some FMAs.

Virtual smolt tracking method

SEPA's virtual smolt tracking method seems a reasonable basis for assessing exposure to sea lice, but only if the tracks are not limited by excluding areas outside WSPZs, where lice can gather in high densities, and only when peak lice exposure values are included in the cumulative exposure total.
It is not precautionary to assume that fish swim constantly and by the most direct routes to the open sea. For example, Lilly et al (2022)[20] show that reverse movements associated with tides extend the time that salmon post-smolts spend in estuaries.

[19] Rabe et al The potential for sea lice transmission between Scottish finfish aquaculture management areas. Estuarine, Coastal and Shelf Science 238 (2020) 106716 doi.org/10.1016/j.ecss.2020.106716
[20] Lilly et al Investigating the behaviour of Atlantic salmon (*Salmo salar L.*) post-smolts during their early marine migration through the Clyde Marine Region**.** Journal of Fish Biology 101(5) (2022) doi:10.1111/jfb.15200

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Compliance and enforcement

Counting sea lice and fish in farms

Compliance checking is only as good as the data on which it is based.
SEPA must ensure that statistically valid, independent, weekly sea lice counting happens on all farms, without significant gaps. When sea lice were counted independently on farms in Canada, the resulting figures were significantly higher. SEPA must address this risk and the current loopholes that allows long gaps in reporting due to harvesting and other reasons.

SEPA does acknowledge that some farms will need to have "enhanced" sea lice monitoring, saying that "sufficient fish must be sampled to provide confidence in the estimated average number of lice per fish…More fish need to be sampled to provide a confident estimate when compliance with the limit condition requires very low numbers of adult female lice per fish", but it plans to limit this better monitoring to high-risk sites.
SEPA will also "review whether additional monitoring may be required for farms in the considerable risk category to ensure accurate estimates of the average number of adult female sea lice per fish".

The method it chooses must be able to improve public confidence that the farm's performance is based on counts that are reliable and objective.
Communities must be able to understand the potential risks to their local environment, in order to trust the regulatory system, so the method used must satisfy SEPA's criteria that its regulations are transparent, accountable, consistent, and proportionate, targeting action to where it is needed, based on environmental risk.

SEPA says it intends to rely on farm operators to do most of the lice counting and will work with FHI in developing the protocol, but this amounts to self-assessment of licence term breaches, on which sanctions might depend. This cannot rely mostly on self-reporting.

SEPA says that "monitoring should be automated as soon as practical using interpretation of suitable imagery by artificial intelligence", but only on high-risk farms, and not for three years. The industry says these methods are not accurate enough but we believe that SEPA should persist – the methods will improve and having any data is better than long gaps.
The counter results should be compared to self-reported and independent human counts, to calibrate the automated counter data. These counters should be required at all farms.

SEPA says it will "analyse reported data to check for patterns through time or across farms (within a company or across the sector) and will undertake reviews of records held at farms and shore bases", providing it with intelligence to help target farm inspections or company/sector-wide investigations. This is essential, but even so, it is hard to see how SEPA can largely rely on self-reported lice counts to check compliance.
Focusing independent counting or observing teams on farms where lice numbers are trending upwards will help.

A levy on the industry would provide the funding needed for the counts to be independently verified.

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SEPA says that weekly estimated fish numbers and weekly sea lice counts will only be required between 16th March and 30th May. This period should extend at least until the end of June, to allow for the interim protection period for sea trout as well, but why not require full weekly reporting of fish numbers and sea lice numbers all year, for future modelling of the impact on sea trout?
This would not represent extra work, as the farms are collecting and reporting weekly lice numbers anyway and the companies say they know the number of fish in the pens.

In Norway all farms have to submit weekly lice and fish counts, and sea temperature and (probably) salinity figures. The authorities use this data to model lice densities on a weekly basis but also to do an annual modelling analysis of sea lice density in the sea.
SEPA should commit to doing annual analyses of sea lice across the whole industry as well.

Assessing compliance with numeric lice limits
SEPA says that numeric sea lice limits will comprise:

- A limit applied on the number of adult female lice as a rolling 28-day average, with 16th March being the first day of the first 28-day period in the control period; and 30th May being the last day of the control period, and;
- A limit applied as a maximum number of adult female lice on any day of the control period. This proposed limit is four times above the rolling 28-day average.

SEPA has concluded that wild post-smolt salmon will pass through the longest of its WSPZs in around eight days. What matters to these fish is their cumulative exposure to lice during that time, which mounts most quickly in areas of high lice density.

Using such a long period for a rolling average will smooth out these peaks, concealing the risk to wild fish. For the fish that pass through a waterbody during a week when lice numbers are high on farms, it is irrelevant if the lice counts are lower for the next three weeks, reducing the rolling average after they have left the area.

For instance, in the extreme case that the successive lice counts on a farm were 7.9, 0, 0, 0 AF lice per fish, the four-week rolling average would be 1.975. This is less than SEPA's proposed 2 lice per fish condition for farms in the majority of categories in the Figure 8 schema (below). SEPA say it is unlikely that spikes will arise so quickly. However, they can fall that quickly after lice treatment.

Permitting lice peaks of up to 4x the rolling average is too generous. SEPA has provided no justification for this figure. On what basis is it assumed to be safe?
An analysis of reported lice figures is needed before adopting it, to show the size and frequency of peaks that would be permitted.

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SEPA asserts that its "screening modelling shows that it is the average lice management performance of the farms contributing to infective-stage sea lice concentrations in a WSPZ that is most important in managing exposure risk. Occasional small peaks do not drive the exposure risk. This is because exposure risk is dependent on the accumulation of infective-stage sea lice from multiple farms."

This assumption makes a significant difference to the likely effectiveness of the new regulations but SEPA has not provided details of its analysis to back this up.
It must be proven to be true.
In the example above, a count of 7.9 lice per fish would be allowed for a week, within the licence conditions of farms in the majority of categories in the Figure 8 schema.
A jump from 2 to around 8 lice per fish is probably quite unusual, but allowing spikes of 4 or 6 lice per fish in each farm could still substantially raise the risk for wild fish.
These spikes could not reasonably be described as "occasional small peaks", which would not drive exposure risk.

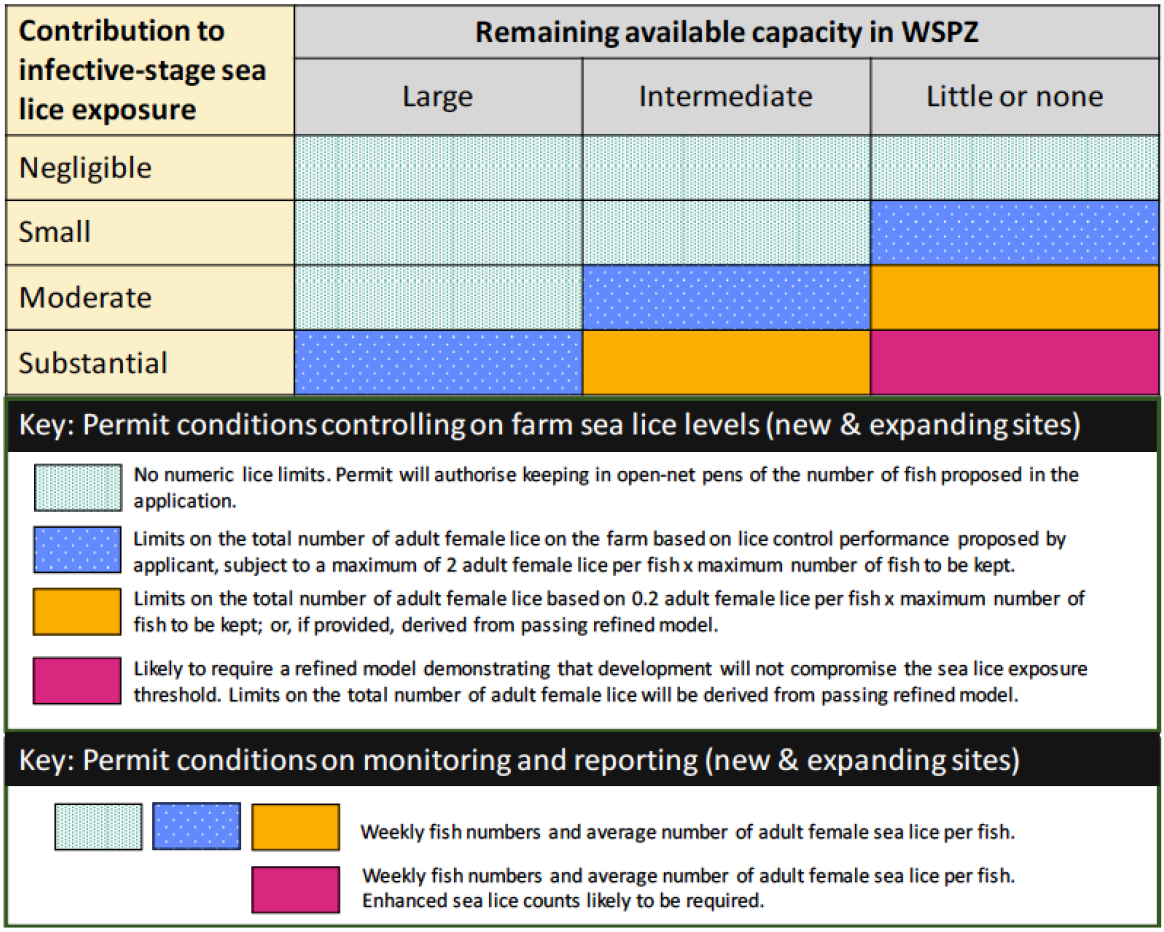

Figure 8 schema, from SEPA's sea lice consultation

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Farmers should certainly focus on maintaining low average numbers of lice on their farms during the wild salmon post-smolt migration period, as SEPA says, but short duration, high intensity exposure is also very dangerous to wild salmonid post-smolts, which can pick up enough lice to kill them in just a few hours at high lice densities. This must be avoided as well.

Also, many waterbodies contain multiple farms and it is likely that lice numbers on different farms will peak in different weeks, so there could be several such peaks in succession, raising the risk for wild fish without this counting as non-compliance by any farm, or resulting in any action to lower the overall lice density in the waterbody.

The one-week lice peak criterion must be set closer to the average and the average should not be smoothed over four weeks. Allowing averaging over two weeks would still be generous to the farm operators.

Sanctions for breaching licence conditions
Sanctions for non-compliance with the new sea lice terms of CAR licences must include fines, the reduction of biomass and ultimately the suspension and revocation of licences if required, as with any other CAR licence breaches.

Closing or moving farms
To significantly reduce the number of lice that a farm releases, its operators may have no option but to close or move the farm.
The SIWG recommended that farms should be relocated, “where best scientific evidence indicates that an existing site presents an adverse impact on wild salmonids”, and if tighter regulatory standards have been applied but have not been effective.
Relocating harmful farms was also recommended by the 2018 REC Committee inquiry into salmon farming.
SEPA’s response to the SIWG makes no mention of relocating farms to protect wild fish. This should be an option, if that is the best way to prevent deterioration of the environment.

Lowering sea lice numbers by relaxing rules on pesticides
The consultation says that, “operators must take all reasonable steps to minimise discharges of medicines. One way to minimise discharges is to deploy a range of non-medicinal sea lice control measures to reduce reliance on anti-sea lice medicines”.

In workshops on the sea lice regulations, the industry proposed that SEPA could relax its pesticide discharge rules in the Spring, in order to protect wild fish.

SEPA should resist this. Improving one aspect of the environment by allowing another to be degraded would be inconsistent SEPA’s remit to “prevent deterioration of the water environment and to contribute to restoring waters to good ecological status”.

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Likewise, the industry may argue that having a 0.2 lice/fish ceiling in more farms in Spring would result in more pesticide treatments. SEPA should remind farm operators that they must take all reasonable steps to minimise discharges of medicines, which may mean that some farms should contain fewer fish, rather than resorting to using more pesticides.

The COP15 Kunming-Montreal Global Biodiversity Framework resolution requires nations, including Scotland, to "reduce pollution risks and the negative impact of pollution from all sources, by 2030, to levels that are not harmful to biodiversity and ecosystem functions and services, considering cumulative effects", including, "reducing the overall risk from pesticides and highly hazardous chemicals by at least half including through integrated pest management, taking into account food security and livelihoods".[21]
The EU's Farm to Fork programme has a similar target to half pesticide discharges by 2030.

SEPA has said previously that it will review its current regulations on bath pesticide discharges. At present these limit the concentration of chemicals discharged, but not the annual frequency of discharges. This review is long overdue.
Pesticide discharges are more frequent than when the present regulations were put in place, increasing the risk of cumulative impacts on non-target species.

If SEPA believes there is a risk that increasing the frequency of bath chemical discharges will be detrimental for the environment, it should change the pesticide regulations rather than relaxing the rules to help companies comply with its sea lice regulations.

Compliance assessment information
SEPA says it recognises the importance of publicly accessible information on site compliance. We agree that this is vital. SEPA's present system for assessing and presenting information on compliance is woefully inadequate. The most recent information is four years old.
Farm operational data is reported weekly or monthly but is published on Scotland's Aquaculture Website up to six months in arrears. This is also inadequate.
Some seabed assessments are years behind as well.
Will SEPA assess sea lice data this slowly? If so, how will it intervene to quickly reduce high farm sea lice counts during the Spring post-smolt run?

Rapid action in Spring, if there is a problem
SEPA says, "we will focus our work to support and advise farmers in advance of, and during the early part of, the Spring salmon post-smolt migration period. This timing allows us to check that operators of farms that could pose a considerable or high risk are focused on controlling lice from the start of the regulatory control period on 16th March".

If lice numbers are above the safe level set for a given farm and control measures are not working, what provisions does SEPA have to intervene quickly, to drive lice numbers down

[21] https://www.cbd.int/article/cop15-cbd-press-release-final-19dec2022

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ahead of or during a spring smolt run? Or does SEPA only propose to "monitor compliance over the whole of the season and review performance at the end of the season", before "discussing with farmers any implications for next year's season"?

CCN understands that in Norway the authorities intervene to reduce farm biomass during the Spring, if lice numbers exceed the strict ceiling. This should happen in Scotland.

Apportioning responsibility for action to reduce sea lice numbers
It is relatively straightforward to apportion responsibility for the share of an area's modelled lice burden to a proposed new or expanded farm, but SEPA has not detailed how it plans to share out the responsibility among existing farms and companies, when it comes to them acting jointly to reduce sea lice exposure for wild fish.
It says only that "this will involve targeting action to reduce the contribution to infective stage sea lice concentrations of farms:

- categorised using our risk matrix as high risk because of the scale of their contributions; and,
- if necessary, to address the exceedance of the sea lice exposure threshold, those categorised as representing a considerable risk."

Disputes are inevitable. More detail is needed on how they will be resolved.

New farms

Which proposed new farms these regulations will apply to
SEPA says it will "undertake sea lice screening assessments of all pre-applications and applications received after the publication of this consultation".
This is insufficient. SEPA should acknowledge the urgency of the need to act on the risk to wild salmonids by doing sea lice screening for all undecided applications for planning permission, where farms already have CAR licences, and for all applications for CAR licences that have not yet been decided.

When proposed farms will be turned down
SEPA is correct to say that applications for farm developments likely to result in the sea lice exposure threshold being exceeded, or further exceeded, are unlikely to be granted authorisation.

Threshold for the impact of new farms at considerable risk of causing harm
"For developments screened as posing a considerable risk if sea lice are not tightly controlled, the limit conditions will be calculated based on:

- 0.2 adult female sea lice per fish at maximum fish numbers; or
- The on-farm lice numbers derived from a refined model demonstrating that the development can be accommodated without the sea lice exposure threshold being exceeded, or further exceeded, as applicable."

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The threshold of 0.2 adult female sea lice per fish is appropriate in these circumstances, but industry should not be solely responsible for modelling whether this can be exceeded, as detailed above.

Measuring success

A significant part of how success is judged will be the comparison of calibrated and validated sea lice dispersion modelling to field measurements of sea lice in sentinel cages and on wild fish.

Who will monitor sea lice and wild fish for these comparisons?

This must be done independently of the industry. The results must not be classed as commercially confidential and must be published.

Transparency and trust

SEPA says it will, "regularly provide advice to farmers to help them effectively target their efforts to maintain and improve their environmental performance. This will include highlighting our latest assessments of sea lice exposure risks; discussing farm environmental performance; and encouraging innovation in how compliance is secured and demonstrated. We will provide advice at farm, company or sector level as appropriate".

This is good. All these assessments should be put in the public domain, to build transparency and trust, including an annual review/hindcast of sea lice densities, based on reported data, as Norway does.

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