Dear Grimsby Town Council Members and Planning Committee,

I understand that you are contemplating the approval of a Recirculatory Inland Aquaculture (RAS) farm in Grimsby. This would be the UK's largest RAS facility, which is an experimental form of factory farm which is shown to have significant risks for both the environment, and animal welfare. I am a Doctoral Fellow studying the ethics of salmon farming, and I am writing to highlight some of the significant risks, and guaranteed disastrous side effects, of conducting this factory farming experiment in your district.

I'm sure you're aware of the many pros and cons of this type of facility, but I'm writing to highlight the particular environmental and welfare concerns that my expertise grants me a strong understanding of.

Tanks in an inland system. Photo: asc-aqua.org

What is RAS, really?

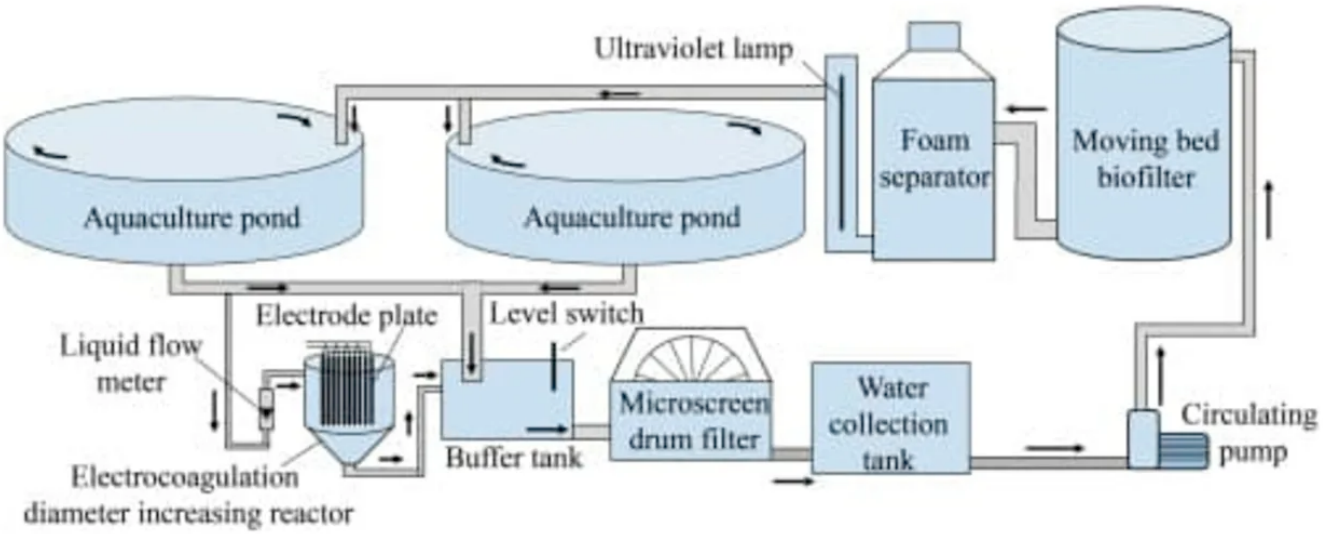
RAS systems are a new kind of factory farm. For the past fifty years, salmon have been grown inland in tanks, and then outwatered for the second half of their lives at sea. RAS systems aim to do the whole process inland, by recreating seawater conditions in tanks.

These facilities require extremely high stocking densities to make the operations profitable. Adult salmon are solitary predators, who range widely and have a strong migration drive. It's currently unknown how they will cope with the highly cramped conditions of a RAS farm.

Citizens have spent so much energy over the past hundred years trying to un-make extant factory farms. It seems wholly contrary to common sense to be licensing new types of factory farms in 2023.

Additionally, maintaining the specific salinity, temperature, chemical balance, and through-flow the salmon require to live is a significant challenge. Large amounts of energy, chemicals, and freshwater are required to maintain the ocean-like conditions of these tanks.

The extremely complex systems used in RAS facilities introduce new potentials for failure and human error, both of which can be catastrophic to the life of the animals within. They are even riskier than sea cages, which for their many flaws, at least are guaranteed to have fresh water flowing through them.



An illustration of the many points of failure in a RAS system. Source: TheFishSite

There are also a large number of other risks in removing salmon from the ocean. Fish quickly foul the water they're in, stripping it of oxygen, and acidifying it with carbon dioxide and ammonia. In order to recirculate the water, these farms require an extremely complicated system of filters, pumps, valves, and generators, each of which has the capacity for failure.

Raising fish in this artificial environment is like placing them on a spaceship, where even the smallest human error or equipment failure can kill every animal onboard.

Case study: Applecross Salmon Hatchery

The Fish Health Inspectorate (FHI) collects mortality data from aquaculture facilities, and here are some UK case studies from extant inland farms. The Applecross salmon hatchery lost 1.5 million fish in August 2022 due to a "dead section in the system" causing hydrogen sulphide to accumulate, quickly killing the fish in acidic water. The same thing happened twice in January of the same year. Two more water quality issues on-site caused a similar stock loss in May 2023. The precise number of animals killed in 2023 isn't known due to spotty record keeping, but it appears to be a total stock loss.

Applecross also has an endemic problem with fungus, which they are not able to effectively clean out of their system. The FHI reports seven mass mortality events due to fungus on this facility in the past 14 months, killing tens of thousands of fish.

Equipment failure and deadly fungus have an ongoing and comorbid relationship at Applecross. The FHI reported that in July this year:

> "The site had a malfunction with a chiller unit which lead to improper function of the units biofilters, this along with an issue with the units ozmoregulation lead to a decrease in the site water quality. Poor water quality onsite is then thought to have increased the level of fungus infections within the stocks leading to a significant mortality event."

230,000 fish died due to this malfunction.

Disease

The Applecross case should highlight that these facilities are highly experimental, and mass mortality is the norm. By giving total control over every aspect of the environment to farm operators, RAS systems exponentially increase the catastrophic potential for human error.

I strongly recommend looking through the FHI's mortality data, which contains thousands of instances of mass mortality in closed farming systems.

https://www.gov.scot/publications/fish-health-inspectorate-mortality-information/

Industry claims that high-control environments cause disease are patently false. High-control environments lack the resilience of open-air environments. Applecross's fungus issue is a good example of how new factory farming system always include unforeseen health issues. In traditional sea pens - highly problematic in other ways - fungus is less of an issue, because there is near-endless fresh water to clean it out of the system. In RAS systems, with a tiny fraction of the volume of water, as well as lots of nooks and crannies and filters and tubes for the fungus to cultivate in, the fungus which is a tiny issue at sea, becomes a relatively huge issue. Every new farming system comes with unforeseen disease risks. While moving salmon farming inland may solve the sea lice issue, we can guarantee that new diseases will emerge, and be just as disastrous as sea-lice in time.

The reason salmon farms want to move inland is because it will prevent their salmon being exposed to pesticide-resistant sea lice, which is currently the industry-limiting disease.

The industry's hope is that by doing the whole operation under factory conditions, they can control disease. However, as has been abundantly established in other farming environments, there is no truly biosecure factory farm, and other diseases will emerge.

Case study: Shrimp farming

Shrimp farming takes place on-land as well. Despite this, six new diseases have emerged since the farming practice developed, each of which have become industry-limiting diseases, like sea

lice in salmon. Yellowhead virus first emerged in a shrimp farm in the inner gulf of Thailand in 1990 and proved capable of causing 100% mortality in a population within 3-5 days of the first animal showing symptoms. The Thai shrimp farming industry collapsed within the year, with 90% of all farms in the gulf closing as they could not control the virus. Mid Mortality Crop Syndrome is a viral infection which emerged in 1993, and regularly causes 80% stock death in prawn farms. The White Spot Syndrome virus emerged in 1992 and is now endemic in shrimp populations on every continent.

Inland shrimp ponds in Mexico.

Industry has been shown again and again to be incapable of removing disease from high-control environments, and to maintain a biosecure broodstock. If RAS systems were capable of delivering disease-free salmon, there would be no disease on any factory farm on Earth. Instead, disease is rife in these environments. And it will be rife in Grimsby.

An additional challenge for salmon is that they are carnivores, and cannibals. This means that the proliferation of prion-based diseases through their feed is basically guaranteed over a long enough time period (e.g. Mad Cow Disease), and this risk only increases with density. In order to make an inland farm profitable, it will have to be extremely densely packed with animals.

Effluent

Another concern is runoff. The runoff from fish farms is so toxic that a single leak could cause extinction of local wild species, and a severe risk to human health.

One study shows that for every ton of fish farmed creates as much effluent as 80 humans. This means that the 3000 ton farm proposed will quadruple the current effluent of the town of Grimsby. [https://ncbi.nlm.nih.gov/pmc/articles/PMC3353277/]

Aquacultured promises a comprehensive filtration system will be installed in its facility, provided by Aquamoaf. However, the Aquamoaf filters they propose are largely untested, only being used in three small commercial facilities, which appear to be in Russia and Slovakia. There is no public log of their performance, failures, or near-misses. Even a single lapse in filtration will dump disease-ridden effluent, rich in nitrogen and phosphates, which will severely disrupt the delicate ecosystem of the Humber Estuary, which is a RAMSAR protected wetland, and designated SAC and SPA environmental protections. There is a well-established link in the literature between salmon farm runoff and erosion of the capacity of coastal ecosystems to support wild populations of wild fish. Even a single lapse of these filters, or an emergency dump of untreated water, would be catastrophic for the delicate local ecosystem. It is an extremely high-risk enterprise to position on an SSSI.

Case study: UK sewage dumping

I'm sure you're aware that the UK is currently undergoing a crisis of unfiltered effluent being dumped into watercourses. Ultimately, these filters are only as good as their enforcement, and local authorities have found themselves completely unequipped to enforce wastewater dumping. Sewage companies are only allowed to dump effluent into waterways in emergency circumstances, but due to infrastructure not being fit for purpose, they have found themselves in emergency situations more than three hundred thousand times last year. We have no reason to believe that this untested, experimental, and demonstrably fragile filtration system is reliable enough to entrust the Humber's biosecurity to.

Summary

My concern is that RAS aquaculture is not capable of delivering on its promises of good food, healthy animals, or an unspoiled environment.

I want to make sure that you’re sufficiently informed that any new factory farm, and this counts as a factory farm, generates novel diseases by definition. This site will be rife with disease, and if you allow it you can reasonably expect mass mortality on an unprecedented scale to be taking place both in the facility, and in the wetland environments downriver from it.

Best wishes,
Mark Borthwick
OOCDTP Doctoral Fellow, Salmon Farming