Introduction

With seaweed farm applicants across the South West and contracted marine engineers, other contractors, the Marine Management Organisation and their primary advisors all relying on desktop surveys and research, a report from experienced seaweed cultivators and producers makes essential reading.
In this document, we highlight aspects of the Horizon Seaweed report most relevant to the Port Quin Bay applications, but they also have a bearing on the licensed site in Port Isaac Bay, and the application for the site off Combe Martin. We urge the MMO to read this document in full, and suggest also reading the report linked below.

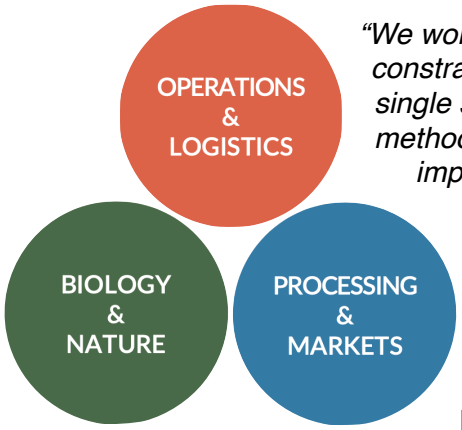
In February 2024, after 8 years producing seaweed through wild harvesting and cultivation, Peter Elbourne and Iskander Bond of New Wave Foods Ltd (now trading as Horizon Seaweed link), published a report of their discoveries.

They are quick to point out that their report is in no way a handbook, or blueprint for how to construct a successful seaweed farm operation, nor is it a research paper, it is more of a knowledge-sharing document, direct from the front line of seaweed production - a review of the seaweed aquaculture trials carried out between 2016 and 2023 by New Wave Foods Ltd "*aimed at those with some working knowledge of seaweed and/or experience in aquaculture or related marine activities. To a degree, the report is framed around the vision our trials were geared towards: overcoming bottlenecks to ultimately unlock farming at scale*".

Throughout the report there are warnings from lessons learned, advice on mitigation, and assessments of accepted knowledge and knowledge gaps, all from real world experience of seaweed cultivation in open water.

In this document we highlight some of the key insights from the report which have a bearing on the applications and licences in the South West. The full report can be accessed here, but is also attached. All italicised sections are taken form this report.

Constraints



"We worked hard to identify simple solutions to these complex, interacting constraints. Ultimately, it is unlikely that there is any single solution that will enable scale and viability. Our approach was to trial methods and systems to reveal their shortcomings and potential for improvement"

Cultivation at scale is impacted by all these constraints, particularly with regard to costs, as any mitigation will invariably result in increased outlay: The use of tidal harbours has time and cost implications, and affects deployment, maintenance and emergency call-outs; placement of land-based infrastructure and onward processing away from the farm site increases biomass loss and quality, and therefore market price; limited markets for seaweed products not certified as organic has implications for project viability; bioremediation of heavy metals, disease, biofouling, and mitigation of impacts on marine animals, all have increased cost implications for farmers.
The specifics of this are discussed below.

Scale

"The Marine Directorate (then Marine Scotland) published the Seaweed Cultivation Policy Statement in 2017, which defines two scales of farm sites based on expected environmental impacts. Small – Medium sites containing 0 – 50 x 200m longlines are seen as unlikely to have significant impacts, whilst Large contain >50 x 200m longlines and are seen as more likely to have significant impacts"

The authors of the report do not consider prospective companies deploying at scale in the first instance, and only explore the implications of "f*arms crossing from Small – Medium into Large scale production*", using lessons learned to boost viability.

It is interesting to note that it is expected that applications for large scale farms (>50 x 200m longlines) in Scotland require an EIA. Whilst this might add around £50,000 to up front costs, it would seem prudent when considering deployment of vast amounts of infrastructure in the nearshore marine environment.

"*The most recent studies on the subject are focused on determining the tools that should be used to measure the environmental impacts. They are also based on Micro to Small scale sites for a limited number of cycles. Whilst strategic partnerships between farmers and regulatory bodies can help alleviate some of this challenge, there are still significant costs involved that will deter early investment. The guesswork that has been used to determine where these lines should be drawn should be reviewed in the context of more recent studies, what can feasibly be achieved by early scaling farmers, and how the effects of seaweed farming compare to the concessions that have been given to other industries*"

Consistently, the authors refer to the "*most recent studies*". There are many more cautious published papers dated in the last few years which should be understood to supersede earlier research. It is worth noting that Biome Algae, and therefore Aqua Botanika, quote extensively from papers published as far back as 2007. This is not just on the subject of environmental impact, but also on entanglement, biodiversity and bioremediation.

"*As of writing this report (February 2024), only three farm sites within the UK have deployed more than 10km of seeded line (50 x 200m). All these sites will most likely have only done so for at most two production cycles*"

These numbers are dwarfed by the Port Quin site, and the timescale of "*two production cycles"* cannot compare with a licence to undertake an anticipated 50 production cycles.

Scale has an exponential affect on environmental impact, disturbance and displacement of marine mammals and seabirds, plastic pollution, project costs and the logistics of the landing and stability of wet biomass.

"*A prospective farmer should also be aware of the research that has been conducted exploring the possible effects of seaweed farming on the environment. This is to ensure that the plan and reasonings for their operations are both grounded and realistic. A good place for any farmer to start is the work published by Campbell et al. 2019*"

Campbell et al. is misquoted throughout Biome Algae's FIR document, and we have addressed this in the SPQBG Submission. It is clear that the wider understanding of Campbell's work is that it is precautionary.

The report strikes a similarly precautionary tone:

"*Set work schedules to avoid dates and times wildlife are active.*
- *Minimum standoff distances from shore for infrastructure and / or vessels to avoid interaction with land-based wildlife.*
- *Low footprint anchors reduce the possible impact on benthic communities.*
- *A policy of limiting the amount of noise during operations to only what is necessary.*
- *Staff training on how to notice signs of disturbance and how to avoid wildlife in the area*"

"*Operations at all scales must consider the local wildlife and embed within their plans methods of minimising the chances of any disturbance occurring.* ***The only viable mitigation method for more sensitive wildlife will be to avoid their habitats entirely***"

Red Listed Atlantic puffin, harbour porpoise, humpback and minke whales and native grey seals are considered to be "sensitive wildlife".

"*Fresh seaweed has a low stability once harvested and removed from the water. It will rapidly degrade if it is not processed into a more stable state (e.g. dry, ensiled, frozen, chilled). This degradation can make the seaweed unusable for food within 48 hours. Beyond this time frame it is likely to degrade to the point where it is challenging to handle and transform it into a sellable product for any application*"

The report goes into some detail about the handling of seaweed post harvest, including whilst still at sea, transferring to transport, packing, unpacking and drying. The MMO have made it very clear that licence determination does not include the consideration of the onward journey of the product, or the applicants' ability to land, transport and process the harvest. This is a naive stance, as without functioning processing ability, a licensed farm is redundant. One of the applicants for Port Quin was discovered earlier this year asking questions on an Irish 'Polytunnel Appreciation Group' on Facebook. Follow-up photographs on the applicant's own page appear to show kelp fronds drying in a polytunnel. The applicant then used Facebook Marketplace to sell small bags of dried seaweed.

The report states that: "*We never considered drying seaweed in external surfaces or within polytunnels. This is partly because of the difficulty of maintaining food quality and safety standards in such environments. However, the critical factor is inconsistent drying conditions with uncontrolled temperature and humidity. This will result in unreliable drying cycles and would have been particularly challenging for scaling processing operations in Scotland. Overall, it is unlikely that such methods will be useful at any significant scale*".

To process the amounts of seaweed Biome Algae claim to be able to harvest when farming at capacity (~1500 tonnes in total) within the 48 hour window described in the report, particularly in the uncontrolled environment of polytunnels, is completely unfeasible.

It appears that in the eight years' experience of the authors of the report that farming at scales of >100 hectares presents too many obstacles to success for such farms to be viable, currently.

Site Selection and Design

"…greater exposure increases risks of mechanical damage of both the crop and infrastructure"

Wave height and current strength have largely not been examined in the report, but we have addressed exposure factors in the SPQBG Submission.
"Certain types of mud and sand will more firmly contain anchors than others. Screw anchors cannot be used with harder or looser sediments. Existing charts might not

always appropriately depict these variations, making site surveys a prudent step before making assumptions about what anchors can be utilised"

"…a prospective farmer should still expect to have to validate whether a site is suitable for seaweed growth. This will come in the form of surveying the surrounding areas for wild populations of the species to be grown and performing trial deployments. The act of surveying the surrounding areas for wild populations will also be necessary for determining whether and where seed stock for the site can be obtained from"

All of Biome Algae's surveys have been desktop, there have been no site specific surveys at all. The Visual Impact Assessment is of such low quality that we cannot consider this to be a survey.

The expectation of the authors of the report, as responsible operators, is that prospective farmers would carry out detailed, site specific research. This should be considered as step one of the process.

Site selection has logistical implications during deployment and harvest, particularly when working from tidal harbours and in dynamic environments.

"*Continuous accessibility from sea is preferable. Due to the timeframe constraints discussed later in this report, it is vital that all possible complications to these time frames are minimised. Ideally, a landing site will always be accessible from the sea, regardless of the vessel, tide, wind and other users. Having a landing site that can only be accessed during certain conditions or by certain vessels will create strain on the farming operations that will only become more pronounced with scale. Accessibility from land is just as important for the same reasons*"

Another aspect of site selection which should be considered by applicants and the MMO is the practicalities of preparation for deployment on land, and the practicalities of landing hundreds of tonnes of wet seaweed. The harbour in play for Port Quin is Padstow. Padstow is incredibly squeezed for space, with around 20 fisheries landing there, two sand companies receiving large quantities of estuary sand regularly, and multiple boat tour companies, ferries and tourist boats. During holiday periods there are also over 500,000 extra day visitors each year. Approach to Padstow harbour is tidal, with the harbour itself drying out. Access is restricted either side of high tide.
Padstow harbour would struggle to accommodate further large scale businesses. Padstow Harbour Commissioners have submitted a representation regarding the proposed Port Quin Bay farm which highlights the difficulties that would be

experienced during deployment and harvest. We are certain that some practicalities have not been considered at all, including:

“An area will be required for assembly and maintenance work to be carried out. With space for lengths of grow lines to be laid out and measured for marking where buoys or spacer bars should be attached. Appropriate storage facilities can extend the lifespan of materials. Plastic items such as ropes and buoys will deteriorate if left in the sun and metal components will rust if left in high moisture conditions. Organic material left on components can rot in damp conditions, creating unpleasant odour. Undercover areas that remain dry year-round are ideal for storage”

There are no such storage facilities available in Padstow, and no space to lay out thousands of kilometres of rope.

Other aspects of design have also not been considered by Biome Algae:

“…there will be potential for lines to sag to depths suboptimal for growth, necessitating more frequent placement of buoys along the line, which in turn increases costs and reduces deployment and harvesting efficiency. With higher tensioning, lower spacing can be used and, with wider spacing, lower tensioning is required. Higher tension is more challenging to work with as it requires more forces to achieve, in most cases necessitating mechanical aid. High tensions also impart a greater strain on components, which necessitates a higher specification (i.e. cost) to achieve the same service life. Achieving higher tension can also be further complicated by the interaction between grow lines. During deployment, the tensioning of subsequent lines can reduce the tension on lines already connected to the grid. The reverse is true for harvesting, where more tension will be put onto lines still in the water as lines are removed, making it harder to access subsequent lines”

High tension is championed in Biome Algae’s FIR document, but the negative implications were not explored.

"A further operational challenge with these designs is the wild seeded communities that will grow on the components that are in the water year-round. Creating a rig that can hold a climax wild seeded community will invariably require higher specifications for the components. At the sites we have farmed, mussels and barnacles will establish themselves within two years on components that have remained in the water for the duration. The density of these species is far beyond that of seaweed and would have required a substantial increase in buoyancy to hold. Alternatively, spat settlement would need to be cleared at least once a year to avoid exceeding the specification of the design during harvest season”

Biofouling does not feature in Biome Algae's FIR document, but has been of concern to us for some time. It is far from reassuring to see it spelled out so starkly in the report.

"The first rig deployed to our farm was a grid design, consisting of a 50 x 50m square and single screw anchors at each corner. The square itself was flanked on the north and south sides by a catenary system that is intended to distribute forces evenly across each line. Original plans were to utilise a 2m spacing between each 50m grow line, however it was found that even with mechanically aided tensioning, entanglement still occurred"

Entanglement of lines is not mentioned in the FIR document, but there is a clear attempt to mitigate this outcome in the Arc Marine design. However, spacer bars in the proposed Port Quin infrastructure are placed in the system to keep the header lines **1m apart,** the spacers at the bottom of the seed catenaries are also at **1m, spaced every metre** along the header lines. From the experience of the authors of the report this arrangement would certainly result in entanglement of lines. Also:

"Further testing using various spacer bars between lines proved impractical due to:
- Inconsistent prevention of entanglement
- Optimum solution would be high cost
- Spacer bars ultimately would reduce operational efficiency during deployment and harvesting"

And:

"*Additional buoyancy and / or spacer bars attached along the grow line slows harvest rates. As previously discussed, there can be challenges in accessing multiple longlines attached to each other with spacer bars. As each component is attached to the grow line with either a knot or clip, those must be accessed and removed during the harvest. This adds to the need to reduce the number of buoys and spacer bars in infrastructure designs*"

The authors of the report could not be imagining anything so vast as a 576 x 160 metre longline set-up when they wrote:
"Overall, we concluded that a higher number of lines increases the challenge of working with this [longline] design"

Consultation / Social License

"At any scale, improper plans for farming operations have the potential to negatively impact other marine users and the wider public. The current licensing process for farm sites requires the prospective licensee to account for all stakeholders needs before they are granted a license. It is the responsibility of both the licensee and relevant regulatory body to ensure that the requirements of all stakeholders are upheld in the details of the license and implementation of the farm site. Farmers should always engage with the relevant stakeholders at the very earliest stages of development, as there is not always a viable way to pre-emptively determine each stakeholders' requirements. As has been seen with multiple developments, if stakeholders are not consulted early enough it can result in negative responses to plans because they have been formed without their input. A community hearing about a project in a format that appears to show a fixed site selection and infrastructure has already proven to be a source of contention. If such a project were to have included communities from the start, some negative responses could have been avoided. This engagement should ideally occur before wider public consultation events"

It is conceivable that the 'community' mentioned here refers to the community of Port Quin. It certainly describes our situation.

"Seaweed farming operations at large scales will require more area of the sea than any other aquaculture industry currently being practiced in the west. Finfish and bivalve farming require less area than seaweed farming per unit of production. To avoid the difficulties surrounding other marine users and social licensing that using such areas could create, many see the future of seaweed farming as sites that are further offshore"

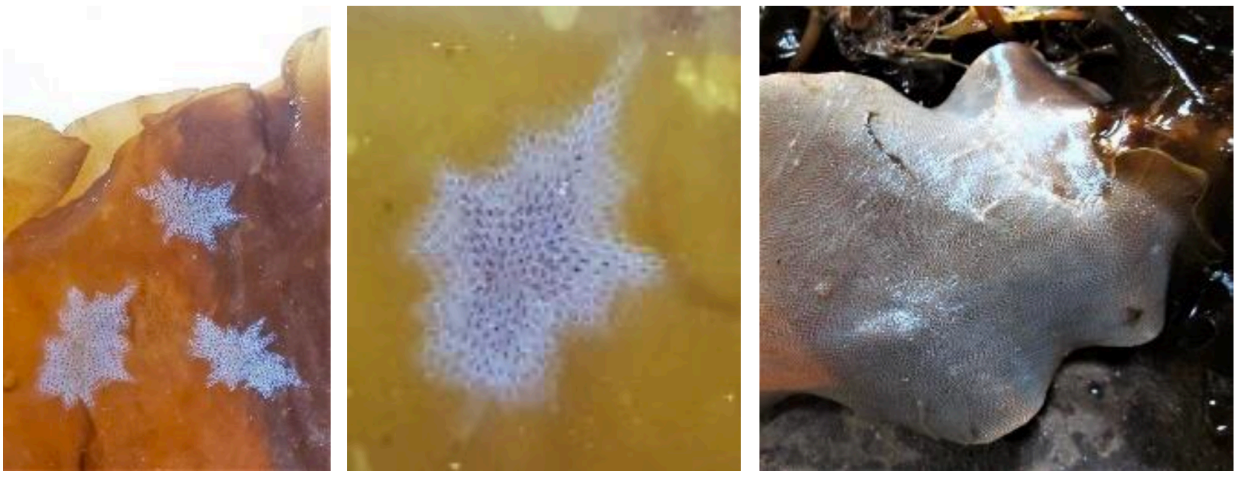
There are obvious cost implications to farming further offshore, co-locating with wind farm operations, for instance. But even siting a large seaweed farm over the horizon would be much more likely to be positively received. Crucially, communities and stakeholders need to be consulted, engaged and collaborated with as part of the pre-application process, especially with emerging industries such as seaweed cultivation.

Fouling / Markets

”Seaweed has a propensity to absorb contaminates (e.g. heavy metals, chemical pollutants) and harbour microorganisms. Farmers intending to sell their crop for uses that are sensitive to these factors (e.g. food, feed, cosmetics, nutraceuticals etc.) should consider the inputs of these that could impact their selected sites. Risk assessments for such should consider the land use in the vicinity of the farm, any water inputs, other marine industries, and local vessel traffic. Testing of local wild populations is a prudent step to take to help validate any assumptions.”

This aspect of bioremediation has not been assessed by the applicants in the South West, despite the prolific mining history in Devon and Cornwall, particularly of arsenic, antimony and lead. The SPQBG Submission addresses this in the Geological Report.

“The first visible fouling would usually be hydroids (e.g. Obelia geniculate, Dynamena pumila),which would likely settle out on both Atlantic wakame and sugar kelp simultaneously”



"*Bryozoans (e.g. Electra pilosa, Membranipora membranacea) will usually start to appear in May and are a more significant issue because they form a calcium carbonate mat. This is both visible on end product and a textural problem, so presence of bryozoans would likely mean the seaweed could not be used in food applications*"

"Seaweed will likely dry out in warm, windy conditions. Similarly, harvesting during rainfall can leave seaweed sitting in freshwater. In contrast to the relatively short duration of wild harvest, farmed seaweed may be sat on the deck of a boat for 8 hours before reaching land. Both dessication and freshwater exposure can damage condition of the seaweed"

The above points are a concern when operating out of Padstow, where there will be multiple occasions when conditions and tides will make visits to the site impossible, allowing biofouling to occur unchecked. This will also impact deployment, maintenance and harvest.

"Since operations commenced in 2016, around 5% of our sales by volume have been Atlantic wakame or sugar kelp. Where we have had interest for pallet quantities of these two cultivated species, organic certification was important and so these orders were fulfilled with wild harvested seaweed. It is possible that organic accreditation will unlock opportunities for farmed seaweed, but in our experience the critical factor has been the limited interest in Atlantic wakame and sugar kelp"

Atlantic wakame and sugar kelp both appear on Biome Algae's list of species to be cultivated at Port Quin.

"*Many of the markets for farmed seaweed are nascent, which means that product specifications are not necessarily fixed. This makes building sales more challenging. Holding dried seaweed stock provides more options in terms of continuity of supply, flexible particle size and secondary processing. However, drying carries significant additional costs and constrains cashflow*"

"*Ultimately, it is important to make conservative assumptions about dry yields when modelling. We would expect a yield of 10% when processing batches, usually seeing Atlantic wakame come out slightly higher and sugar kelp slightly lower. This is a significant multiplier of cost to produce the fresh seaweed*"

Carbon Capture / Nutrient removal

"From our perspective, these limits have often been understated in the information put forward in the past few years. Recently, a more realistic outlook is being presented, recognising that the majority of carbon fixed by seaweed is stored on a short-term basis. Only a small proportion of the carbon within seaweed is likely to be sequestered"

"Seaweed derived products can be used to replace products made from fossil fuels. Both plastics and biofuels are the most cited. There is a substantial economic challenge for these products to replace fossil fuel based ones at sufficient volume to significantly impact climate change. There is a further challenge in competing with other similarly low carbon – or even negative carbon - products. There are already niche markets for seaweed derived products that perform significantly better than fossil fuel based ones, thus justifying their higher price point. The prospecting of many seaweed species for such products is progressing in laboratories across the world. Scientific understanding is developing and it is fair to say that approach has yet to reach its full potential"

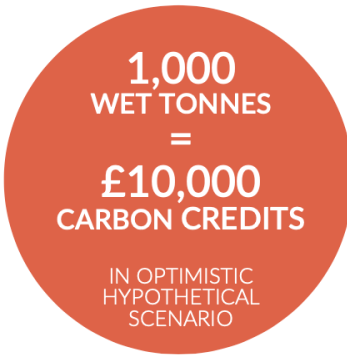
"Unfortunately, seaweed farming does carry a carbon footprint, principally due to:
i) Use of fossil fuels by marine vessels (potential for hydrogen or electric powered boats, but this may be decades into the future).
ii) Use of materials for farm infrastructure (concrete, steel, plastic are all challenging to replace)
This is excluding energy use associated with the stabilisation of raw material, which will be essential to retain carbon within the seaweed"

"The concept of seaweed shedding carbon that is then sequestered into sediment or the deep sea has been presented several times. Some amount of particle organic carbon (POC) is lost as seaweed grows out, but the majority of POC is shed as it dies back towards the end of its season. Kelp left on lines through the summer will degrade significantly. Both POC loss during growth and dieback represent a loss of yield for a farmer. Dissolved organic carbon (DOC) can also be lost during growth. The form this idea has been presented in is for either farmers to gain credits based on the shedding during the grow out, or non-farmers who have built artificial reefs to gain credits based on all the shedding. The methods of proving and then quantifying the carbon sequestration of these processes have yet to be developed. There are serious ecological questions over whether increasing the load of seaweed fragments in the deep sea should be undertaken. This will only be

feasible to achieve in certain areas where transport to suitable areas of the deep sea reliably occurs"

"The price of one tonne of CO_2 in January 2024 was £50-£70 in the EU Emissions Trading System, down from a peak of around £90 per tonne in February 2023. The candidate kelp species for farming at scale in northern Europe are approximately 3% carbon by wet weight (sugar kelp, Atlantic wakame). Therefore, 1 wet tonne of seaweed contains 30kg of carbon at point of harvest. This carbon content converts to 110kg of carbon dioxide (x3.67). Even assuming the optimistic scenario of:

i) a zero carbon farming operation (i.e. 0kg CO_2e per tonne of fresh weight harvested)
ii) 100% of the carbon content of the farmed seaweed qualifying for the credit and
iii) the record high carbon price of £90 per tonne, the carbon credit value of one tonne of fresh seaweed is just £10.



Scaling up to a large operation of 1,000 wet tonnes annually would yield the farmer around £10,000 of carbon credits. This is not a significant enough revenue stream to influence commercial strategies: it is inconceivable that a farmer could run an operation based on the sales price of carbon in seaweed alone. There is also the question of who gains the credit for that carbon sequestration in the value chain. In the case of replacement, should it be the farmer growing the seaweed, the company that creates the product from the seaweed or the end user of the product? Ultimately the value to the farmer is likely to lie in the increased price achieved for an environmentally sustainable, low impact product than any carbon credit in the seaweed itself"

There are caveats around carbon sequestration in the FIR document, citing "further research" being needed. It is our opinion that this research has been carried out, and that the results show that carbon sequestration is not a measurable benefit of large scale seaweed cultivation. This again highlights the need to consult the most recent published research.

Bioremediation "*Whilst these higher value uses can temporarily remove nutrients from the ecosystem, many conceivable uses will result in them eventually finding their way back into the ecosystem on a timescale that makes its removal irrelevant for sequestration"*

Habitat "*Wild benthic substrates are typically spread across two dimensions with a higher variation of substrate types. These differences will select for different adaptations and so impact the end communities that can grow on each. Species without a pelagic stage in their lifecycle are only likely to interact with the anchors of a seaweed farm. They will therefore most likely be excluded from most wild settlement communities created by seaweed farms. Species that require flat areas and / or the varied benthic environments created by rocks and boulders will similarly be excluded"*

N**utrient Removal** *"It is impossible to state the bioremediation capacity of seaweed without also recognising that this same propensity for nutrient removal can negatively impact the environment. Even within an area of high anthropogenic nutrient inputs, it is unlikely that the entire set of nutrients required by the seaweed are being provided by anthropogenic sources. Therefore, to varying degrees depending on the exact type and amount of anthropogenic nutrient sources, seaweed growth at farm sites must always rely on naturally occurring nutrients. This can place farmed seaweed in direct competition with wild populations of algae in the vicinity of the farm that also use those nutrients"*

Shading "*The canopies created by seaweed farming prevent some light from reaching lower depths. These shaded areas could impact phototrophic species living below. The degree to which this effect can be negative will depend on the density of farm infrastructure, water depth and the habitats they are placed over. Most of this shading effect is from the seaweed crop itself. Therefore, it is limited to the end of the growth period, whereupon it is removed during the harvest. Whilst this limits the duration that shading occurs, this is also a critical time for most phototrophic species. Well-mixed nutrients and lengthening days create the same conditions for rapid growth in wild populations as it does for farmed seaweed. Limiting light during this period can prevent wild populations from making the best use of this optimum growth period.*

Phytoplankton have also been cited as possibly being negatively affected by shading. The degree of this impact would depend on how long the phytoplankton will remain under the canopy of the seaweed farm. Higher water exchange and infrastructure spacing will reduce the time phytoplankton are impacted"

Bioremediation, habitat creation and nutrient removal are understood to be benefits of seaweed cultivation, however the report again has concerns.
Shading is not addressed in the FIR document.

Plastics

"…most components of seaweed farms will be made of plastic for the foreseeable. It is therefore inevitable that some form of plastic pollution will come from seaweed farming from:
i) direct loss of plastic items at sea
ii) degradation to microplastic
iii) the inefficiencies in disposal when recycled or not.

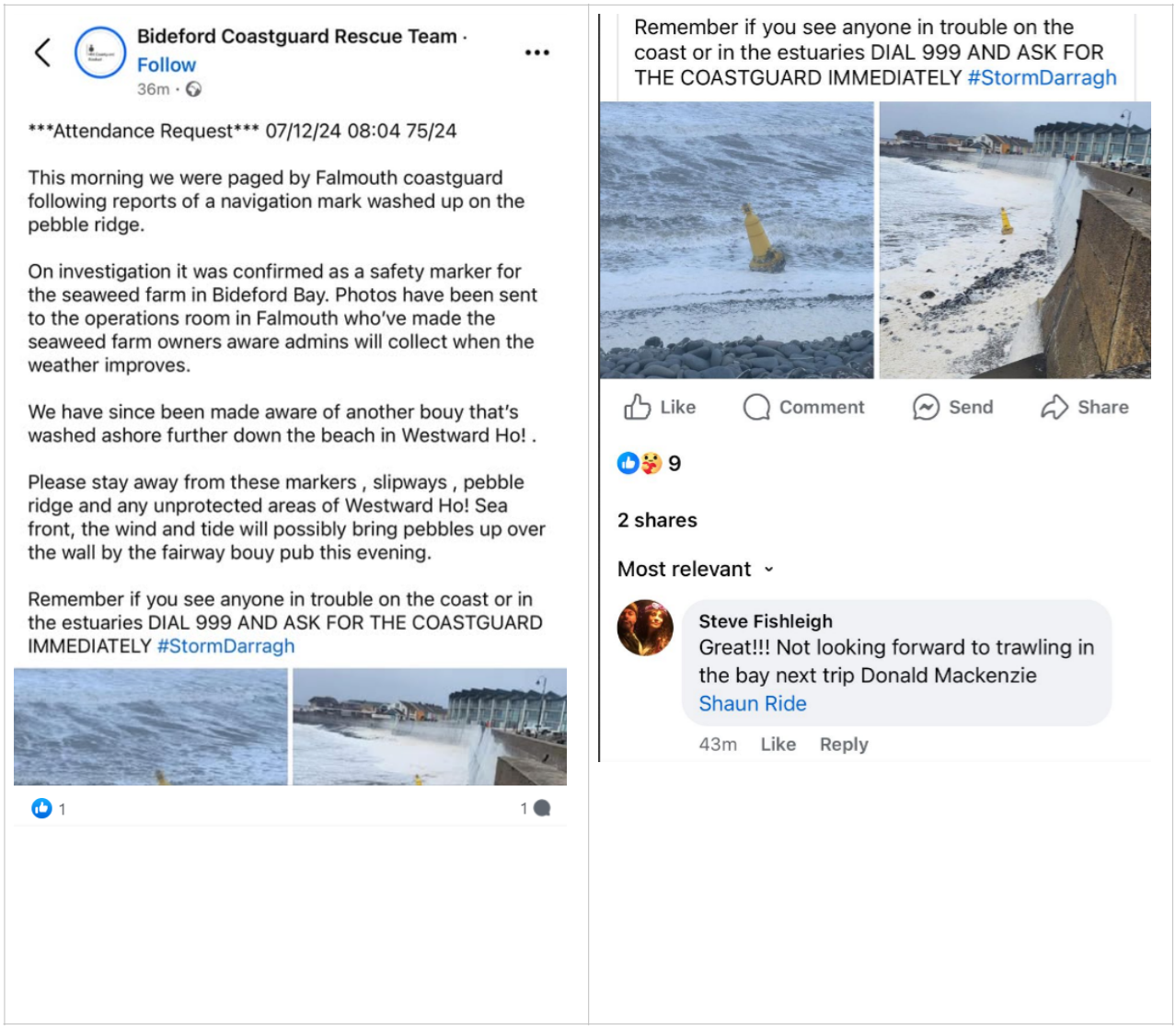
The exact extent to which seaweed farming will contribute to plastic pollution is yet to be determined and will be subject to high variability between different approaches"

"The estimated weight of various plastic components on our multiple long line rig is as follows:
~150kg ropes (including grow lines), ~80kg spacer bars, ~70kg buoys.
Each of these components are expected to last five to ten years before requiring replacement. The yield of this rig is expected to average 6 wet tonnes per annum, i.e. 30 to 60 wet tonnes over the course of these components' lifespan.

This translates to an average of 7.5g of plastic waste per wet kg of seaweed produced from the rig components, or at least ***7.5 tonnes of plastic waste*** *produced by a large-scale operation producing 1,000 tonnes of wet seaweed per annum.*

However, this calculation does not account for losses of components at sea. Large storms and sustained poor conditions can disrupt maintenance regimes and exacerbate wear points. Both of which can lead to broken infrastructure and components becoming detached and either sinking or floating from the site. Whilst inbuilt redundancies reduce the likelihood of this occurring, there will likely always be some losses due to human error and the difficult task of predicting natural movements at sea"

On 7th December 2024, as storm Darragh made landfall, Algapelago seaweed farm in Bideford Bay suffered a significant infrastructure failure, the consequences of which are not yet known. See screengrabs below from the Coastguard confirming this incident:



Port Quin Bay is in a similarly, if not more exposed position.

Despite Biome Algae's assertions of infrastructure resilience, we have evidence of multiple gear loss incidents across the country, in all sea conditions. These incidents predominantly involve buoys breaking free, but there has also been loss of larger sections of infrastructure, such as ropes.
Not all gear will wash up on shore, instead remaining at sea causing significant navigational and entanglement risk and plastic pollution.

We have also been made aware of the substantial loss of microfibres from the marine rope used in seaweed farm operations. This loss is consistent through the year, increasing with rope age, but is particularly marked when ropes are hauled at harvest. This can not be mitigated.

Employment

Much has been made by the applicants for the Port Quin Bay farm of the opportunities for employment related to staffing the seaweed farm operation. We have always contested this. We are aware that applicant Camel Fish Ltd already use low paid seasonal workers in their fishing operations, and there would be no reason for them to change this model when diversifying.

Also, Biome Algae have been keen to point out their connections with universities. If BA were to secure student researchers, it is likely that these students would replace even the seasonal workers. This would be at no cost to the applicants, as students would be funded by their university or by outside bodies.

"…there is a variation in the number of staff required to carry out each stage:
- The fewest staff are required during cycle planning and crop monitoring.
- Moderate levels of staff are required during preparation stages, with more needed leading up to deployment than harvesting.
- *The most staff are required during deployments and harvesting, with more required. during harvests due to the quantities of material being handled.*

The high seasonality means it is clear employing a fixed team year-round will be inefficient. However, staff retention between growing cycles is essential for continuous improvement"

"With larger scale operations typically needing more highly qualified staff to operate larger vessels, more complex equipment and under a greater range of conditions. Larger scales will also require more staff members with similar experience and qualifications. The type of work these full time staff will be expected to perform will change with the stages of the production calendar. Whilst the site is fallow, most work will involve onshore processes of resetting equipment for the next season. The best approach will be to have a small core team with a variety of skillsets and then recruit seasonal employees or contractors on an ad-hoc basis.
At all scales, farmers will need to be able to increase their staffing during busier times of year. This mirrors challenges we experience with wild harvesting in Caithness, because there are months where more harvesters are required. However,

the difference with farming is that there are prolonged periods with less activity. This makes it difficult to train staff and build on that knowledge year-on-year"

We don't believe that this message has reached the fishers and hauliers in Padstow. They still believe that there will be increased employment should licence be approved.

Conclusion

This practical and easy to read Horizon Seaweed report strikes a very cautionary tone overall. The authors themselves shifted from wild harvesting to trialling multiple cultivation models in varying locations. They then returned to wild harvesting to consider their findings, and to take advantage of the significantly more robust market for certified organic, wild harvested product.

The authors confirm our concern that the high costs of seaweed cultivation cannot be matched by the current market for the end product. They also agree that more recent research has cast doubt on carbon sequestration and habitat creation for which seaweed farming has been previously known.

The report highlights issues with high-tensioned rope systems, gear entanglement and loss, farm access, scale, seeding, harvesting, processing, plastic pollution and the market for the end product. These issues have also been addressed by the Save Port Quin Bay Group.

The authors strongly suggest using recent studies to assess the efficacy of proposals, of which there are many, rather than relying on outdated data. May we suggest Zhang et al. (2022a), Zhang et al. (2022b), Corrigan et al. (2024), Walker C et al. (2023). It is always worth referring to Campbell et al. (2019), as she recognised the issues ahead of most, and Clark et al. (2021), similarly.

The overall conclusion, regarding the Port Quin applications specifically, is that Biome Algae and Camel Fish should not be granted a licence to operate a seaweed farm at any scale. The inadequacy of the applications and FIR document, the lack of commitment to early and transparent consultation, the false and misleading statements, the disregard for marine wildlife and habitats, the lack of land based infrastructure, the lack of a market for any end product, the blatant attempts to 'play the system' and Biome Algae's history of irresponsible management, should rule out any further consideration of their applications.