MONITORING PLAN

For the Câr-Y-Môr St Justinian IMTA Site

Abstract

Monitoring plan designed to set an environmental baseline and continued monitoring at the St Justinian seaweed and shellfish farm operated by Câr-Y-Môr

Justin Davis and Jon Moore

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1. Introduction

1.1. Câr-Y-Môr

For the Love of the Sea Ltd is a Community Benefit Society trading as Câr-Y-Môr. The society was registered in Aug 2019. This society now has over three hundred committed members. The Society is managed by fifteen individuals, with combined experience in aquaculture and fisheries, marine conservation, community engagement, business development and management skills. Câr-Y-Môr also purchased Solva Seafoods in 2020 to create local jobs and develop a trading record. In 2023 the businesses were fully merged and it has acted as a route to sell seaweed and shellfish grown on the farms.

Câr-y-Môr has started Wales's first regenerative ocean farm. Câr-y-Môr is located in the St Davids Peninsula, with two trial sites at Carn ar Wig and Porthlysgi, growing kelp, mussels, native oysters, and scallops. This farming method uses no fertiliser, pesticides or freshwater, and provides a sustainable nutritious food source. Câr-y-Môr also operates a 3ha ocean farm near St Justinian. Câr-Y-Môr's long term goal is to continue ocean farming alongside the development of an education program and seaweed/ seafood processing facility. Ultimately, Câr-y-Môr hopes to inspire others to replicate this ocean farming method across Wales. Regenerative ocean farms across Wales will enhance local marine biodiversity and the well-being of local communities, stimulate sustainable ocean jobs creation and give young people a route into an integrated Welsh seafood sector.

1.2. St Justinian's IMTA

The three hectare site (labelled St Justinians) is 500 meters north east of the Carn ar wig trial site. The marine environment in this location is highly suitable ocean farming. This conclusion is based on the successful tests at the trial farms (PEBL, 2022), and accessibility to the site. The site is located in Ramsey Sound in a shallow open bay on the east side of the Sound (*Figure 1)*. The minimum depth is 10m at chart datum. The surrounding sea is (32 - 35) ppt salinity, with high tidal currents, delivering massive quantities of nutrient rich water to the farmed species . The water quality is classed as 'A Grade' (CEFAS, 2024) with no local significant freshwater input.

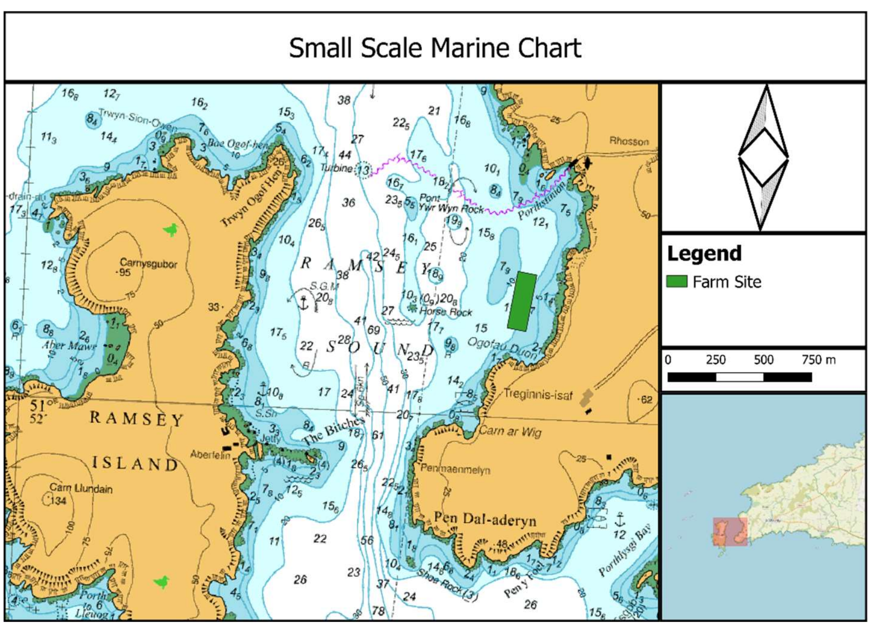

Figure 1: Location of the St. Justinian IMTA site

Infrastructure on the seabed is 6 x 600kg anchors, 3 x 100m lengths of 38mm ground chain, and assorted oyster cages. Other infrastructure includes lines seeded with seaweed and assorted buoys for supporting the farm structure. Anchors and ground chain were installed in June 2022. *Figure 2* gives an overview of infrastructure in the water. The farm management team visits the farm approximately three times per week. During the harvest period (May-June and August-September) farm visits are more frequent.

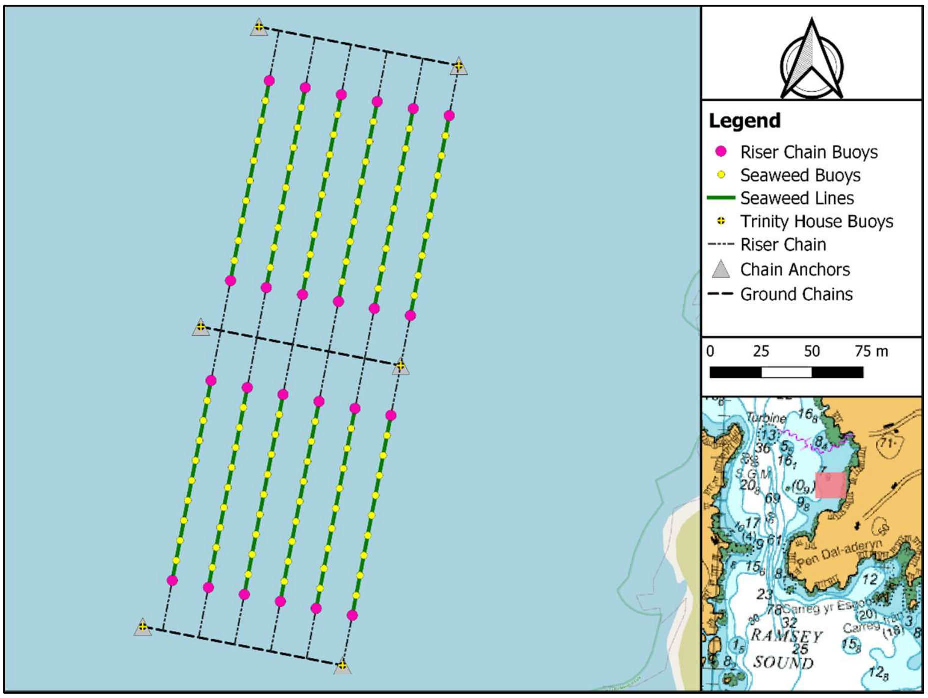

Figure 2: Layout of the St. Justinian IMTA site.

1.3. Pembrokeshire Marine SAC

Ramsey Sound lies within the Pembrokeshire Marine Special Area of Conservation, which is protected under the Conservation of Habitats and Species Regulations 2017 (as amended). The site has been designated for a number of habitats and species, but the focus of this monitoring plan is primarily on just one of those features: *Reef* habitat (NRW).

NRW (2018) summarises the conservation objectives for reef habitat in the SAC. They are that: i) the distribution and extent of reef within the site is stable; ii) the physical, biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded; and iii) the presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded (NRW).

1.4. NRW licence

1.4.1. Decision – CAS-02246-C1H3Q3

Planning Inspector Decision

1. The appeal is allowed and the decision to issue the licence is quashed in part. The Licensing Authority is hereby directed to grant a licence for a 20-year period, to add Condition 3.17 in respect of monitoring, and to replace condition 3.21 regarding decommissioning with Condition 3.18 set out in the attached

Schedule. Conditions 3.5 to 3.20 of the existing licence should be imposed on the new licence and numbered accordingly. Existing conditions 3.1 to 3.4 should not be imposed.

New and amended conditions

50. The practicality of imposing a monitoring condition on a licence was mentioned at the hearing with NRW expressing the view that, as the operation was already in place, this would present problems. The position would be the same, however, if the appellant applied for a new licence prior to the expiration of the current one as NRW suggests. I am therefore directing in the new monitoring condition that the Monitoring Programme should be submitted within 6 months of the determination date of the licence. If it is not, NRW has the authority to compel the sea farm to cease operation and, if the matter is not resolved, for it to be removed.

50. In the light of the 20 year licence period the decommissioning condition must be altered to reflect that. As the sea farm is already in place and operating there is no need for the four conditions requiring the notification of various bodies. The remaining conditions should therefore be renumbered.

DEML2151v1 Cover Letter

Accordingly, please find attached for your review and retention a copy of Marine Licence DEML2151v1 and its conditions.

The Marine Licence has been varied as follows;

- *extending the expiry date of the licence from 22 March 2027 to 22 March 2042*
- *the addition of condition 3.17 requiring production and adherence to a Monitoring Programme*
- *amendment to condition 3.18.1 relating to decommissioning to reflect the extended duration of the licence.*

1.4.2. DEML2151v1

3.17 Monitoring

3.17.1 *The Licence Holder must submit a detailed Monitoring Programme to the Licensing Authority for written approval within 6 months of the determination date of this licence* [13/11/2024]. *The Monitoring Programme must set out full details of the location and specification of the infrastructure of the IMTA including the monitoring infrastructure; the methodology; other monitoring equipment, the timetable and other details for assessing, recording and reporting to the Licensing Authority the effect of the licensed IMTA on the designated features of the Pembrokeshire Marine SAC.*

3.17.2 *The Licence Holder must ensure that all the requirements of the Monitoring Programme outlined in Condition 3.17.1 are implemented as approved in writing by the Licensing Authority. The Licence Holder must submit its first report to the Licensing Authority within one year of the determination date of this licence. Thereafter subsequent reports shall be submitted to the Licensing Authority every twelve months. Any proposed changes to the Monitoring Programme must be submitted to, and agreed in writing by NRW acting on behalf of the Licensing Authority, prior to any changes being enacted.*

3.18 Decommissioning

3.18.1 *The Licence Holder must ensure that all infrastructure and associated equipment are decommissioned prior to 22 March 2042, or within 2 months from the cessation of operations, whichever is the sooner.*

2. Reef

Reef, in the context of SACs and the Habitats Directive, is defined by the European Commission (European Commission, 2013) as:

> *"either biogenic concretions or of geogenic origin. They are hard compact substrata on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions."*

Irving (2009) provides additional useful guidance on the patchiness of 'stony reef':

> *The minimum size of a reef has been agreed as being >25m^2 and it must consist of >10% cobbles (or larger particles, ie [boulders & bedrock]). The critical part appears to be the amount/extent of sediment forming the matrix within which the cobbles (clast material) are found. The greater the sediment component then the more patchy the stony reef feature is likely to be and consequently of lower 'reefiness'.* (Irving, 2009)

This is relevant to the reef at St. Justinians, which is very patchy and composed of bedrock, boulders and cobbles with finer sediments between. The extent and distribution of reef at St. Justinians has not yet been mapped, but study of the existing seabed video footage from the area under and surrounding the St Justinians farm (from April 2021 and May 2023) (*Figure 4)* shows that bedrock reef extends out from the shore but becomes gradually more broken, patchy and less rugged with distance; gradually grading into the mobile gravel plains that dominate the main channel. Using the definitions above, reef extends some distance under the northern and eastern sides of the farm but likely beneath less than 30% of the farm area. GIS data retrieved from the Wales Environmental Information Portal indicates the areas where reef is assumed to be present.

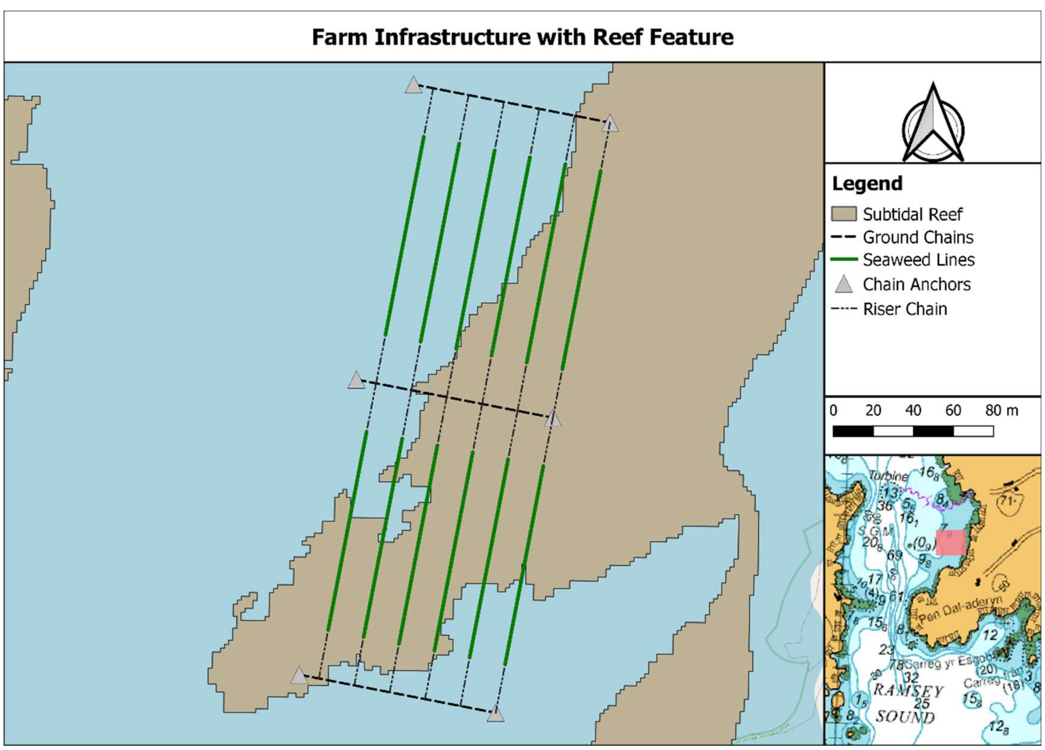

Figure 3: Rendering of the farm site with an approximation of reef features. Based on UKHO Multibeam survey (data ID HI_1365)

Study of the existing seabed video footage of reef in the area under and surrounding the St Justinian farm (from April 2021 and May 2023) (*Figure 4*) shows that the reef habitat is extremely heterogeneous at many scales, comprising a patchy mosaic of rugged bedrock outcrops and ridges, angular boulders (small to large) and cobbles; with mixed sediments of sand, gravel and pebbles in gulleys, hollows and some more extensive patches between reef. Reef features include upward facing surfaces, steep and vertical facing surfaces, facing in all directions. The reef is mostly low lying but with some vertical or very steep surfaces more than half a metre high. Fissures, crevices and interstices between boulders are fairly common, though many are filled with finer sediments. The video stills in *Figure 4* illustrate some of the range of reef habitats present and the farm mooring chains and anchors that lie upon it.

Figure 4: Video stills (captured from diver operated video footage collected in May 2023) to illustrate some of the range of reef habitats and the farm mooring infrastructure.

The site is exposed to strong tidal streams, although the embayment provides some shelter from the tide as one moves closer to the shore. Water depths in the area covered by the farm range from 10 to 12 metres below chart datum; so with the typically moderate water clarity in the area most of the reef habitat is classified as 'circalittoral' (i.e. animal dominated). Infralittoral (plant dominated) reef habitat is restricted to the shallower inshore areas and is only found on the tops of the more elevated bedrock outcrops and ridges under the eastern edge of the farm.

Further study of the 2021 and 2023 seabed video footage suggests that the majority of the low-lying reef habitat under the St. Justinians farm is subject to frequent scour and/or smothering by the abundant time-swept sediments. These habitats are therefore characterised by low diversity assemblages of opportunistic and scour tolerant species. However, a small proportion of the reef is characterised by more sensitive communities and species, including small numbers of long-lived slow growing species, e.g. erect sponges, ross corals and solitary cup corals, and small areas of well developed species rich communities of faunal and/or algal turfs. Those communities and species are only present where the environmental conditions of the reef are suitable for them to develop and survive, which is primarily those rock surfaces that are stable and sufficiently raised above the surrounding seabed, or otherwise protected by topography, to remain unscoured by mobile sediments.

2.1. Risks to subtidal reef habitat from IMTA farms

Integrated multi-trophic aquaculture is a new industry and there has been very little study of its specific effects on the marine environment. However, the component features of an IMTA farms infrastructure and activities are not new and there is considerable literature (particularly regarding ocean going vessels) and experience to inform an assessment (Broad, Rees, & Davis , 2020). However, data is significantly lacking on the impacts of static mooring systems on subtidal reefs. It is our hope that the data collected from this monitoring plan will begin to fill knowledge gaps around static macroalgae aquaculture mooring systems and their impacts on temperate rocky reefs in Wales.

The potential known effects can be summarised as follows:

1) Direct effect of the farm infrastructure:
   a) Loss of habitat (permanent or temporary) from the footprint of the farm mooring infrastructure (i.e. anchors & chains);
   b) Physical damage from anchors, chains and other infrastructure (e.g. seabed cages) during installation or post-installation movement (e.g. from storm damage);
2) Indirect effects of the farm presence & operation
   a) Smothering by materials that may drop to seabed and accumulate during operation of the farm (e.g. seaweed detritus and shellfish shells). This impact is unlikely at this specific site due to the high energy environment of Ramsey Sound and the relatively small scale aquaculture operation (Visch, Kononets, Hall, Nylund, & Pavia, 2020) (Campbell, et al., 2019) (Chamberlain, Fernandes, Read, Nickell, & Davies, 2001) (Weitzman, Steeves, Bradford, & Filgueira, 2019) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017);
   b) Shading seabed from sunlight. This is relatively insignificant based on local site monitoring and data from studies of other sites (Campbell, et al., 2019) (Weitzman, Steeves, Bradford, & Filgueira, 2019) (PEBL, 2022) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017).
   c) Changes in hydrodynamic regime (tidal currents and wave exposure). However, date from monitoring on the site shows that in this particular location this is not an issue. This is likely due to the high energy environment of Ramsey Sound and the relatively small scale nature

of the seaweed/ shellfish farm (Weitzman, Steeves, Bradford, & Filgueira, 2019) (Wood , Capuzzo, Kirby, Mooney-McAuly, & Kerrison, 2017) (PEBL, 2022).

Relating those effects to the conservation objectives listed in Section 1.3:

i) reduced distribution and extent of reef could result from 1a) and 1b) if they cause permanent loss of habitat;
ii) degradation of the reef's structure and function could result from 1) and/or 2) if they cause ecologically significant changes for a substantial period of time;
iii) degradation of the reef's typical species could result from 1) and/or 2) if they cause significant changes to those species for a substantial period of time.

Monitoring objectives have not been defined so the overall aim of the survey and monitoring programme is to provide data that informs assessment against the conservation objectives. However, it is inevitable that assessment of ii) and iii) will be to some extent subjective, based on the collected data followed by expert judgement of their significance. The significance of any effect will embody the magnitude of change, the area affected (relative to the total reef area) and the period of the effect. As the Marine Licence has been extended from 5 to 20 years, the magnitude of change and area affected will have greater significance.

3. Rationale of survey and monitoring design

Baseline data on the reef at St. Justinians is very limited, so in the absence of any other existing data a standard visual survey approach using remote cameras and survey divers to describe and then monitor selected attributes of reef character, species and communities is considered appropriate.

Of the potential effects listed in the section above, it is understood that NRW's primary concerns relevant to the St. Justinians farm (Ben Wray pers. comm.) are from the first two on the list: 1a) loss of habitat and 1b) physical damage. Loss of, or damage to, poor quality sediment scoured reef habitat will be of less concern than loss of, or damage to, the more valuable habitats. Smothering is considered of limited risk in this area because of the relatively strong tidal currents; and a limited amount of light reaches the seabed anyway, due to depth and turbidity. Reduced light may have some effects on the abundance of some red algal populations, but this is not expected to have a significant effect on attributes related to the reefs function or its typical species. Previous monitoring of multiple sites has shown there is no significant difference light regimes in Ramsey Sound when a seaweed farm is in the water (PEBL, 2022). Changes to the hydrodynamic regime are considered unlikely at the scale of the St. Justinians farm as the site is relatively small scale compared to the high energy environment of Ramsey Sound (Green Wave, 2024). Nevertheless, it will be advantageous if the design can assess notable changes due to all five potential effects.

The footprint of the chain and anchor has already had an inevitable, but temporary, small impact on the extent of the reef. An estimate of this footprint may be calculated if a remote camera survey of the reef is carried out. When the chain and anchor are removed then the underlying reef habitat will recover naturally. Recovery time will d end on the pre-impact quality of the habitat; likely ranging from <1 year to >5 years. Permanent loss of reef habitat is not likely because the rock is relatively hard and will not be significantly abraded by the anchor and chain (as can happen in softer rock areas in other parts of UK). A few bedrock ridges appear friable, so it is theoretically possible that the weight and movement of the anchor and chain could break it into smaller pieces. The risk of that impact is considered insignificant and there are no plans to monitor it or assess it further.

Conclusion 1: The first priority is to survey the extent and distribution of the reef under, and immediately surrounding, the St. Justinian farm. This may be achieved with a remote camera system (preferably ROV).

1a) loss of habitat and 1b) physical damage from the anchors and chains will have also resulted in <u>some</u> degradation of the reef's structure and function and of its populations of typical species. Relevant examples of the reef's function that may be degraded include biological productivity, biodiversity, reproductive capacity and other biological interactions. While the majority of the reef habitat is relatively poor quality due to sediment scour, the areas characterised by more sensitive communities and species deserve particular attention because any damage to them will result in greater and longer-term degradation of reef function and populations of some typical species. The significance of effect will therefore be judged largely on the quality of the reef that is lost or damaged (for up to 20 years).

Identifying locations where higher quality habitats are concentrated, particularly in the vicinity of the anchors and ground chains, will therefore provide valuable information for the assessment. It will also be important for the detailed design of the monitoring. It is expected that a remote camera survey can provide an indicative distribution map of reef quality features.

Any movement of the anchors or chains across reef habitat would cause damage to the reef communities through abrasion. Study of the existing seabed video footage from infrastructure inspection (from May 2023) does show areas that appear to have been abraded by movement of the chain (e.g. Figure 4 g). A full and more detailed survey of the reef along the ground chains is needed to assess the extent of such damage to date.

Improved knowledge of the distribution of the reef and its quality, in relation to the existing infrastructure, could potentially also offer options for mitigation by moving the anchors and chains small distances (‘micro-siting’) from areas of higher quality reef to areas that are already naturally scoured.

Conclusion 2: The remote camera survey should be designed to provide as much detail, as reasonably achievable, on the distribution of selected indicators of reef quality (list of indicators to be defined) and indicators of chain movement (e.g. areas of apparent abrasion). This mapping should be focussed mainly along the ground chain corridor (at least 1 metre on both sides) but provide at least some information on the quality of the reef under the farm. The potential for mitigation by ‘micro-siting’ should then be assessed.

In the absence of pre-installation data the assessment strategy should compare reef quality immediately adjacent to the ground chains with reference areas nearby; then repeat, at appropriate intervals, to monitor and assess any longer term changes that may be caused by the farm.

While imagery from a remote camera system may provide considerable information on the distribution and quality of reef habitats and some conspicuous reef species, more detailed characterisation of reef habitats and communities in relation to the farm and its mooring infrastructure will provide greater confidence in any assessment of its effects. A survey by experienced survey divers, to ground-truth the remote imagery and establish a more detailed baseline of data for impact assessment and on-going monitoring, is considered appropriate.

Conclusion 3: Using the indicative mapping results from the remote camera survey, a team of experienced survey divers could locate areas of high quality reef within a distance of four metres from the ground chain, provide a fairly detailed characterisation of the habitats and associated communities (using standard MNCR Phase 2 style methodology) (Hiscock 1996) and compare those adjacent to the ground chain with those further away (beneath the farm and outside the farm). Photographs could be taken to illustrate notable differences in presence / absence or abundance of conspicuous species or signs of abrasion by the ground chain.

As the main concern is related to the ground chain (and anchors), and as they are intended to remain in place for the duration of the life of the current farm, then the chain can also provide the basic infrastructure for locating survey sites.

Conclusion 4: Coloured cable ties would be attached, by the divers, at the nearest point on the ground chain to each survey site. The distance from the cable tie to the survey site would be measured. As best possible, the cable ties would be attached where the chain lies next to distinctive bedrock rock features and photographed - that imagery could then also be used to monitor any movement of the chain over time.

With a detailed baseline characterisation of the reef habitats, any conspicuous indicators of effects may be used as the basis of on-going monitoring. Imagery from remote camera surveys will be adequate for routine monitoring of those known conspicuous indicators.

Conclusion 5: Repeat surveys (routine monitoring) of the defined survey sites would be carried out using a remote camera system to capture high resolution imagery. Post-survey analysis of the video would be carried out, for comparison with the habitat and community descriptions collected during the baseline survey. A requirement for repeat surveys by a dive team could be triggered if results from the remote camera are considered inadequate.

NRW have suggested (Ben Wray pers. comm.) that the monitoring programme should provide at least some quantitative data that can be used to assess any impacts of the farm mooring infrastructure on the reef.

A list of appropriate indicators and relevant quantification measures can be developed after the remote video survey and further informed by the initial diver surveys; they would likely include percentage cover or counts per unit area of selected species and a measure of reef abrasion.

A survey unit of 0.1 m^2 (quadrat, 31.6 cm x 31.6 cm) would be appropriate, because it is large enough to contain multiple individuals of most of the likely indicator species and is small enough to be surveyed and photographed in one view by remote video camera or diver in potentially moderate to poor visibility.

The heterogeneity of the reef habitat is much too high for a fully randomised placement of quadrats (or any other sampling units). It would require an unfeasibly high number of quadrats to achieve sufficient statistical power for detection of any notable effects. However, a fixed quadrat approach (in small patches of higher quality reef) and/or a stratified random approach (in any larger areas of higher quality reef) would provide an adequate basis for the assessment strategy.

Analysis (enumeration) of selected indicator species could be done *in-situ* or from photographs and each has its own advantages and disadvantages. Analysis from photographs is preferred in this situation because the likely indicators species are expected to be sufficiently conspicuous to be enumerated with reasonable accuracy and it will take less dive time to collect a larger number of photos. The communities of interest are also primarily within the circalittoral zone so unlikely to be obscured by a canopy of algae.

Conclusion 6: The dive team would carry out photo-quadrat surveys in the defined survey areas, using 0.1 m^2 quadrats / framers. Protocols would be developed to minimise any bias (to over or under-estimate effects of the farm) in the placement of the quadrats. A minimum of 10 quadrats would be surveyed from each of the treatments (ground chain, reference (outside) and reference (inside)). Enumeration of the photos would be carried out post-survey.

Remote cameras are not ideal for quadrat style surveys, even if they have a laser pointer system (or other mechanism) for maintaining or measuring frame size. It is unlikely they could be used to accurately locate and photograph fixed quadrat areas. However, when controlled by an experienced handler in reasonable conditions they could provide good quality imagery, and subsequent stratified random data, from a larger area of reef (i.e. a relocated area of high-quality reef).

Conclusion 7: The remote camera repeat survey would be designed to capture sufficient high resolution video of the defined survey areas to allow post-survey quantification of the selected indicator species. Comparisons would be made with quantitative baseline data from the diver-held camera imagery. Trials, to test the use of this methodology and the quality of the resulting imagery, would be carried out following (or during) the baseline survey. If the remote camera data are considered inadequate for direct comparison and if the assessment requires more quantitative data then a repeat survey by a dive team will be triggered.

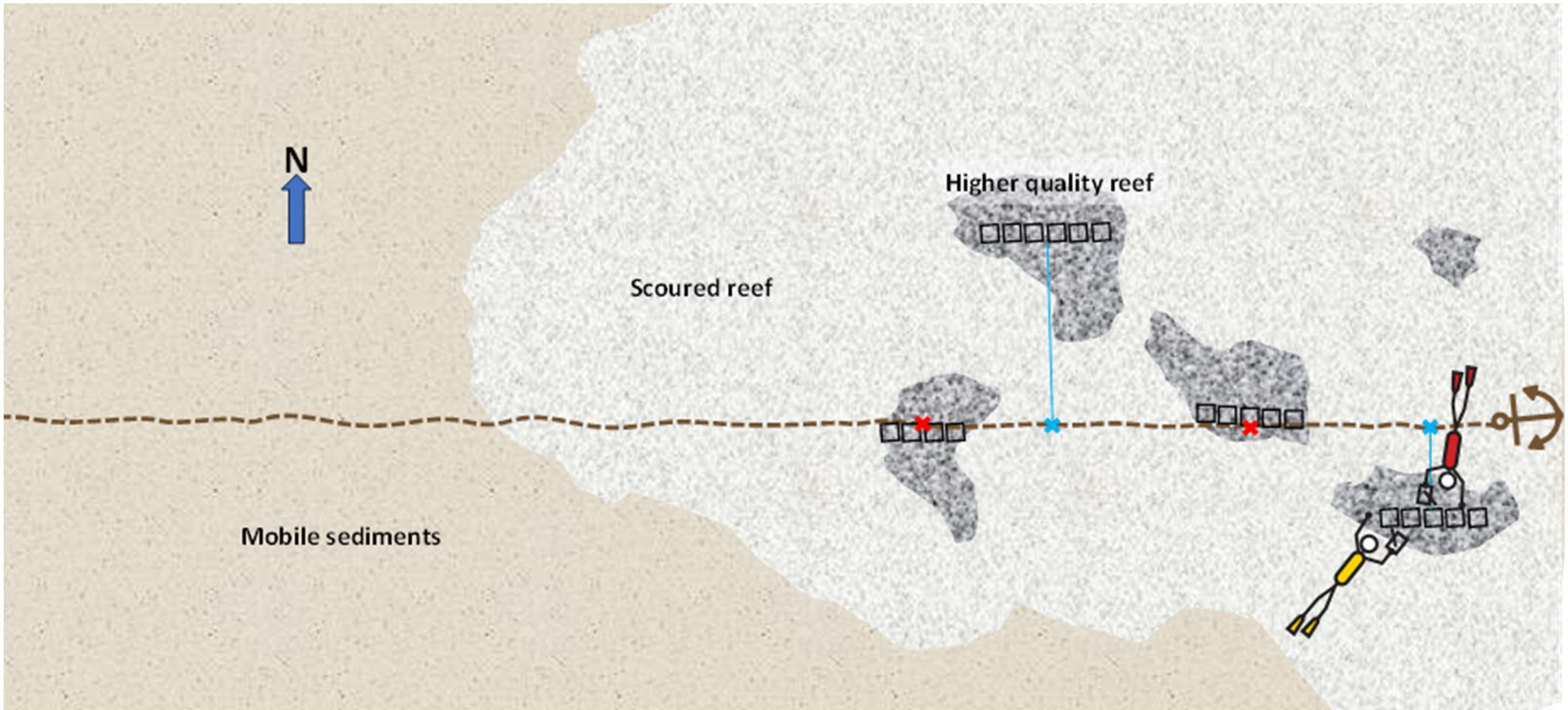

Figure 5: Schematic illustration of baseline survey plan – divers surveying quadrats placed in areas of higher quality reef (dark grey), surrounded by lower quality scoured reef (light grey). Mobile sediment habitat (buff) dominating to west. Ground chain (dashed brown line) marked with cable ties (red & blue crosses). Tape measure / guide line (blue) laid by divers to measure distance from ground chain.

4. Baseline survey

A baseline survey will be carried out in the spring of 2024, in three stages:

1. The first stage will be a remote imagery survey to map the extent and distribution of the reef under, and immediately surrounding, the St. Justinian farm. It will also provide some detail on the distribution of selected indicators of reef quality.
2. The second stage will be a survey, using a team of experienced marine biological survey divers, to provide a fairly detailed characterisation of the habitats and associated communities along and adjacent to the ground chain. A standard MNCR Phase 2 style methodology (Hiscock, 1996) would be used and photographs could be taken to illustrate notable differences in presence / absence or abundance of conspicuous species or signs of abrasion by the ground chain.
3. The third stage, planned to take place immediately following or interspersed within stage two, will be a photo-quadrat survey, by the dive team, in defined survey areas, to provide quantitative data on selected indicators of reef quality. Quadrats would be surveyed from areas along the ground chain, in reference areas (outside the farm) and reference areas (inside the farm). Enumeration of the photos would be carried out post-survey

All diving operations will be conducted under the HSE Approved Code of Practice (ACOP) for scientific and archaeological diving projects (HSE, 2014) which sits within the wider requirements of the Diving at Work Regulations 1997. For convenience, the survey diving will be planned in accordance with rules and guidance for scientific diving in the country agencies (Holt, 2015), which is familiar to the dive team. Car-y-Mor will be the client and will appoint a diving contractor who may also be a representative of Car-y-Mor. A detailed project plan and risk assessment will be prepared in advance and will be available for review by any relevant person or organisation.

The results of the baseline survey, including an assessment of the impacts of the farm infrastructure on the condition of the reef feature, will be written into a report and submitted to NRW within 4 months of the completion of the survey.

5. Monitoring programme

- The subsequent inspections will be led by PEBL CIC
- A UAV fitted with high-resolution camera (Chasing Gladius Mini S) tethered to a surface video feed will be used to allows for precise control and navigation along the predetermined paths
- Inspections will focus on the areas along the chain and anchors where markers were previously placed during the baseline exercise (areas having species or habitats of note)
- Video footage will provide a visual record of the reef's condition over time (2x per year). Comparing these subsequent inspection videos with the baseline data will help in understanding the impact of the seaweed farm's infrastructure on the reef ecosystem.
- Each inspection generates a detailed report that includes video analysis, findings, and any notable changes, and impacts observed. These reports will also make recommendations based on the results of monitoring considering if any mitigation is required to avoid impacts on sensitive/ high value areas of reef. Reports will be submitted to NRW for review once a year in July. Reports will give a description of the current habitat status and a comparison of the baseline vs newly collected data.

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