MARINE MAMMAL ENTAGLEMENT PROTOCOL

FOR THE PROPOSED CÂR-Y-MÔR

ST JUSTINIAN'S THREE HECTARE SEAWEED AND SHELLFISH FARM

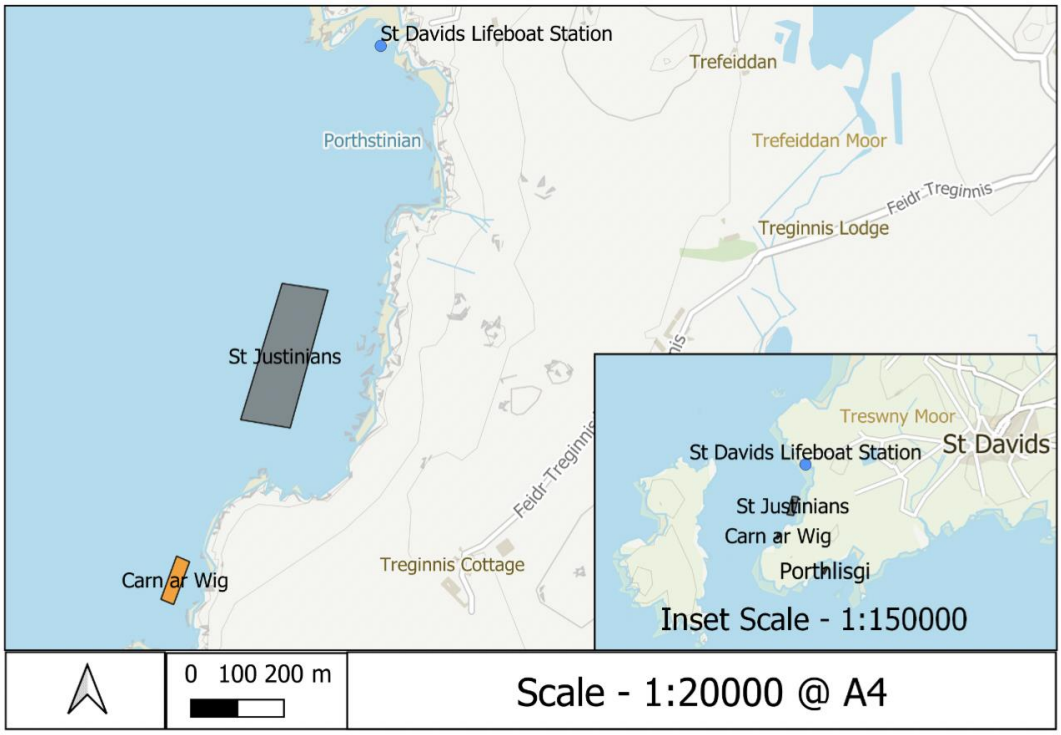

Figure 1. Proposed location of new three hectare integrated multi-trophic ocean farm, (St Justinian's site), black outline, grey infilled box. Existing trial site, (Carn ar Wig), Black outline, orange infill.

Table 1. Longitude and latitude for the area occupied by the proposed St Justinian's ocean farm installation.

Longitude	Latitude
-5.312440965606686	51.87332853640763
-5.3137350082397505	51.87070162364426
-5.3121900558471715	51.87054263792684
-5.311006965606687	51.87319753571296

This document sets out a marine mammal entanglement protocol for CÂR-Y-MÔR's 3-hectare Seaweed and Shellfish integrated multi-trophic aquaculture site.

- Section 1. Gives an overview of the sea-farm development and the relevant species at the sea-farm
- Section 2. Gives a protocol for marine mammal entanglement monitoring at the site, monitoring training of employees and rescue protocol of entangled mammal
- Section 3. Gives an outline of an adaptive management plan. This will include the protocol to follow if a mammal is found entangled in the farm and a process for implementing new practices as a result.

1. INTRODUCTION

1.1 The farm

Câr-y-Môr has started a pioneering regenerative ocean farming system off of the St Davids Peninsula in Pembrokeshire. There are two trial sites by St Justinians and Porthlysgi. These trial sites have grown-on from indigenous seed stock, all collected from within the area of the farms siting. The crops grown are Sugar Kelp (*Saccharina latissima*), Oarweed (*Laminaria digitata*), Laver (*Porphyra sp.*) and Dulse (*Palmaria palmata*), and three local species of shellfish - Scallop (*Pectin maximus*), Oyster (*Ostrea edulis*) and Mussels (*Mytilus edulis*). This farming method uses no fertiliser, pesticides, agricultural land or freshwater. It is a sustainable, low impact, low to negative carbon system. It creates a source of food, soil conditioning, medicines, neutraceuticals and many more Natural Products.
Câr-Y-Môr's long term goal is to continue ocean farming with the addition of a commercial kitchen for food, medicines, cosmetics and related products. The development of a research lab and education centre - ultimately to learn, inspire and teach others to replicate this ocean farming method across Wales, and the World. Regenerative ocean farms across Wales will enhance local marine biodiversity, improve 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 In-water infrastructure design

The design of the farm is to be installed in two phases. The Phase 1 and Phase 2 are represented by 125 m marine grade aquaculture long-lines in 8 (4 seaweed lines and 4 shellfish lines intercalated) rows to make a 125 m x 100 m area site. 11 fifteen inch A floats for the seaweed lines and 5 250L pencil floats for the shellfish lines, respectively. A total of 88 fifteen-inch A floats and 40 pencil floats.
The seaweed farm is oriented long line running north to south.

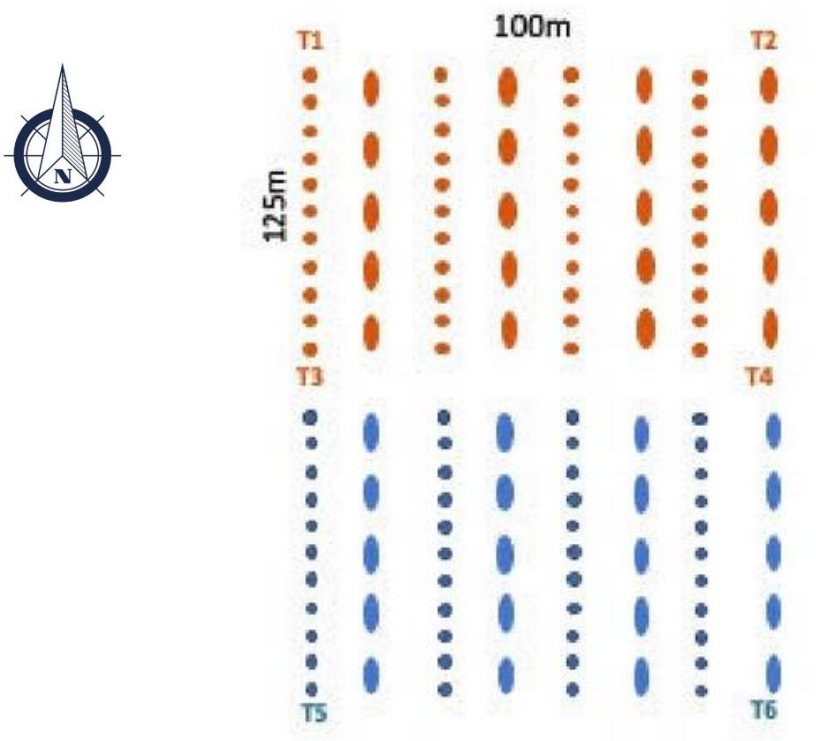

Figure 2. PROPOSED FARM : Plan view of sea surface.
Phase 1 four trinity house yellow special mark buoys are represented by T1-T4. 44 orange circles represent 4 seaweed lines each with 11 fifteen-inch yellow A floats. 20 orange shapes represent 4 shellfish lines each with 5 pencil floats (250 litre)
Phase 2 two trinity house special marks buoys are represented by T5-T6.
44 blue circles represent 4 seaweed lines each with 11 fifteen-inch A floats .
20 blue shapes represent 4 shellfish lines each with 5 pencil floats (250 litre).

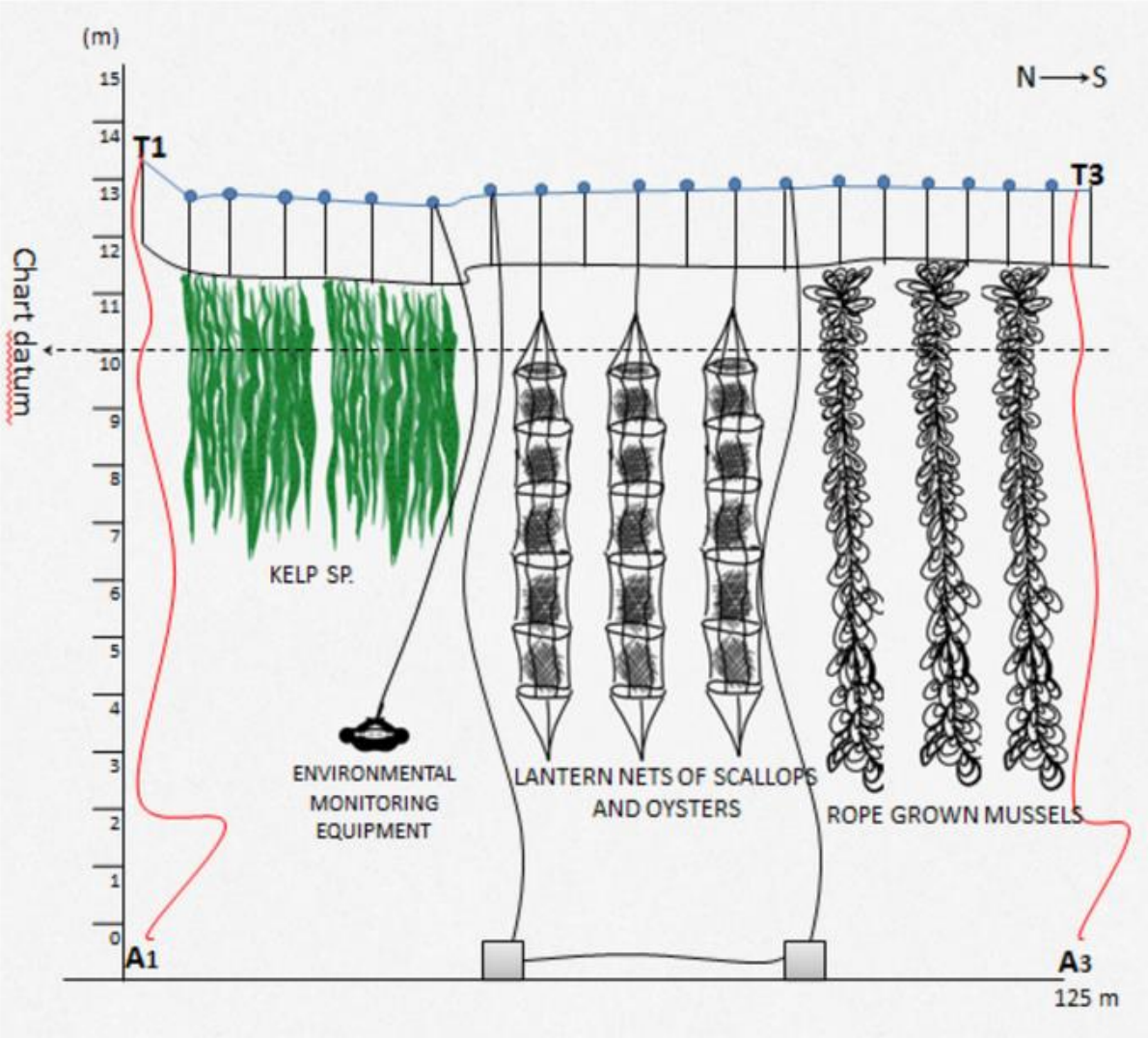

Figure 3. PROPOSED FARM: Underwater view of side elevation showing all different structures planned to be used on the lines
The vertical red lines represent the riser chain (16mm). Examples of Seaweed and bivalves that will l suspended and grown off the header lines (2 metres below the surface.)

1.3 Relevant mammal species in the area

Marine mammals present in the area include the grey seal (*Halichoerus grypus*), common dolphin (*Delphinus delphis*), bottlenose dolphin (*Tursiops truncatus*), harbour porpoises (*Phocoena phocoena*), Risso's dolphin (*Grampus griseus*), Short-beaked common dolphin (*Delphinus delphinus*) and even some visiting whales such as the Northern minke whale (*Balaenoptera acutorostrata*). Grey seal haul-out sites are present in the Ramsey Sound. Grey seals are one of the key species that the Pembrokeshire Marine SAC is designated for, with a breeding population of around 5,000 individuals, and making up 4% of the UK grey

seal population. Pupping season is in the autumn, from August at the earliest, to December at the latest. The Ramsey Sound population is mostly on the southeast coast of the island. There is a porpoise sensitive area within the Sound, identified under the Pembrokeshire Marine Code, with ‘cautionary’ areas to the north of the Sound, and ‘extreme caution’ areas to the south.

1.4 Risk to the species

The potential impact on these marine mammals by the proposed St Justinian site:

- No impact on the Porpoises as they stay in the fast-moving tidal areas through the centre of the sound feeding.
- From time to time, seals visit the trial farms as the farms have created a new marine ecosystem and the seals visit to feed on the fish. There will be no fishing nets and all ropes will be kept taught and moored so there are no opportunities for entrapment. When divers are checking the trial farms, seals often come to investigate as they are very inquisitive creatures, so it is probable that some seals will visit the proposed farm motivated by curiosity or in order to feed.
- All other mammals mentioned do not visit the proposed site, as it is relatively shallow and close to the coast and out of the main current they all travel through for feeding.
- The fact that the trial farms have created a new marine ecosystem implies that a three-hectare farm will probably create a haven for more juvenile marine life. This in turn will attract predators, including marine mammals. Unlike intensive fish farming, there are no predator nets or large net cages etc. - however there is still a minor risk of entrapment. No entrapment has been seen at the trial sites. A number of rope grown mussel farms in Scotland have been assessed for this risk, and no marine mammals have been found to become entangled. Instead, they have been found to feed in the area due to increased fish density.

● All volunteers and the local community are informed of the monitoring protocol of always checking from the coast path, by boat and underwater. These include regular checking of the anchoring lines to keep the lines taut at all times, checking of the farm after extreme weather and at regular intervals, and frequent maintenance. Furthermore, remote underwater cameras will be regularly used on the farms at different depths. If any entanglement risk to mammals are identified, the Society will be notified so actions can be taken immediately to reduce the risk.

● The potential impact of disturbing any mammals will be mitigated by reducing boat speed and any activity that frightens them, as a key objective of these farms is to improve marine ecosystems.

● 'Ghost' fishing gear, such as nets and hooked lines are a perennial problem in the worlds oceans. Car-Y-Mor will remove any ghost gear immediately. The work boat has a crane that can lift larger nets out and carries sharp implements like knives and scissors.

1.5 Additional justification of risk level based on existing literature:

- Seaweed farms and suspended shellfish farms use similar mooring arrangements
- Limited data is currently available on macroalgae farm entanglement due to the relatively new nature of this form of aquaculture. No evidence of entanglement in wild Kelp forests.
- Studies of entanglement in shellfish farms show that, globally, there is low risk (Kemper et al., 2003; Price et al., 2017).
- It has been shown that species that can use echolocation will likely avoid such sites altogether as documented in UK, US and NZ (Price et al., 2017).
- The risk posed to species that do not use echolocation remains low as the seaweeds grown on the farm are not a natural food source for these species (Opportunistic use of aquaculture sites for food is believed to be a main driver for entanglement in aquaculture site (Price et al., 2017))

- Seaweed aquaculture has the potential to increase biodiversity in areas around the sea-farm (Campbell et al., 2019; Grebe et al., 2019; Hasselström et al., 2018; Kelly, 2005). Therefore, the risk of entanglement cannot be ruled out, but the likelihood is low.
- In their review of interactions between marine mammals and aquaculture, Würsig & Gailey (2002) pointed out that, contrary to fish farms, mussel farms do not commonly act as attracting points to cetaceans because of the great number of lines and buoys that make it difficult or even impossible for them to capture prey efficiently.

A monitoring plan and adaptive management plan will be essential to understanding and reducing the risk of any marine mammal entanglements that may occur due to the presence of the sea-farm. Monitoring and managing entanglement risks will be essential to ensure that the potential environmental benefits of the seaweed farm are realized.

2. Monitoring Plan

Based on the risk assessment in section 1.4 we conclude that an entanglement monitoring plan will be suitable in the initial stages of farm set up and operation. This purpose of this monitoring plan is as follows;

1. To inform on the relevant training for staff on how to observe, mitigate and resolve cases of marine mammal entanglement
2. To inform how to conduct surface inspections to mitigate entanglement
3. To inform how to conduct subsurface inspections to mitigate entanglement
4. Cameras fitted above and below water line. Underwater microphones fitted. Live streaming to Car-Y-Mor office when signal good, data stored on memory card for physical downloading.

Data collected in this monitoring plan (e.g., entanglement incidents, marine debris found around the site, and any marine mammals spotted in the area) will be shared with Natural Resources Wales and relevant stakeholders.

Should marine animal entanglement become a regular issue, the adaptive entanglement plan as outlined in Section 3 will be implemented.

2.1 Marine Entanglement Monitoring Training

Marine mammal entanglement monitoring training is designed to gain a better understanding of;

- how marine mammals interact with the sea-farm
- the proper procedures to follow should an animal be found entangled

The following training courses should be completed by at least one member of the crew operating the farm at any time.

- Marine Mammal Medic Training Course offered by the British Divers Marine Life Rescue (https://bdmlr.org.uk/marine-life-medic-mmm-training-course). This course is a comprehensive introduction to the procedures to follow when an entangled mammal is found.
- Marine Mammal Observer Training Course (https://jncc.gov.uk/our-work/marine-mammal-observer-training/). This course is designed to give the farm operators a better understanding of how marine mammals may or may not be interacting with the farm.

2.2 Surface Inspections

- Site visited weekly sometimes more often during harvesting, close to shore so any entanglement will be visible to anyone walking the coastpath, visible from RNLI lifeboat station.
- Description of pontoon style vessel employed by the farm.
  - Aluminium hull construction.
  - 10m x 4m Flat Bottom barge / pontoon with a 1m hull depth and cargo hold 2,5 x 1 x 0,9m.
  - One Hydraulic Deck crane lifting 500 kg at 2,7m outreach in lightship condition (worst case) results in 1,8-degree heel, 1/2t Hydraulic Pot / Line Hauler Mounted on the Port Bow corner.

- The draft @ full load (8200 kg) Should be no more than 0,25 m and be capable of being coded to MCA COP 4 and 20 nm.
- Small Open Back Cuddy type wheelhouse at stern.
- Maximum power of 2 x 115HP outboards with Hydraulic steering and in full load condition should be capable of a minimum top speed of 12 kn.
- To include a fully compliant Electronics and safety Equipment
- Railings to 1m along both sides, stern, removable working section on port side, heavy duty Dive ladder on transom.

- Vessel moves slowly <3knots north to south along lines. Onboard crane used to lift out lines. Vessel moves through the sea-farm, east to west alongside long-lines.
- Two Livestream ready IP67 digital cameras mounted on large marker buoys, one above surface one below. Underwater acoustic device below water surface. Memory cards downloaded weekly, lenses cleaned and battery state checked and charged. Livestream to Car-Y-Mor office when local reception improved.

Table 2; Manual sea-farm surface inspection protocol

Manual sea-farm surface inspection protocol		
Manual inspections carried out	**Immediate actions taken**	**Future sea-farm design/operational changes**
Checking of rope tension of long-lines. Entanglement of shellfish gear Buoyancy of buoys. Wear on ropes. Damage of trinity house buoys. Flotsam, jetsam and 'ghost' fishing gear entangled in sea-farm.	Slack mooring lines are adjusted to correct tension, worn components fixed or replaced. Any holes patched. (Marine grade glue to be used). Replace buoy if damage too extensive. Replace buoy if damage too bad. Litter, ghost nets etc. removed. Inspect for damage to installation, movement of anchors if large debris removed.	Any faults logged. Continual assessment of design. Modifications made as necessary.

2.3 Sub-surface inspections

Remote Inspections		
Remote Inspections carried out	**Immediate actions taken**	**Future sea-farm remote monitoring changes**
Checking of remote surface camera for long-line alignment, buoyancy of buoys, damage of trinity house buoys, debris/ghost fishing nets entangled in sea-farm. Hydrophone installed.	If a fault is observed. Vessel is taken out to farm to observe and address fault/entanglement. In case of threat to shipping, local harbour master is informed.	IP67 digital cameras to be Livestream ready, signal is poor in the area atm but should improve as systems get upgraded. Underwater hydrophone installed. Starlink global broadband to be used once switched on.

Table 3: Remote sea-farm surface inspection protocol

Underwater camera e.g., GoPro, can be lowered into water on an extender pole, ROV can deployed for more detailed and deeper observations. Scuba and or snorkel equipment can be used. Water clarity can be very clear in the area, observers can see into water column from the boat. Underwater camera connected to marker buoy. Underwater acoustic measurement device (Hydrophone) fitted to marker buoy.

Table 4. Manual sea farm sub surface inspection protocol.

Manual Inspections		
Manual inspections carried out	**Immediate actions taken**	**Future sea-farm design/operational changes**
Deploy ROV or Drop Camera to check integrity of gear on seabed, entanglement of shellfish gear, debris/ghost fishing nets entangled in sea-farm. Look through surface when visibility good.	Sea-bed equipment is winched onto deck and re-deployed in a more appropriate position/orientation.	Different design of equipment is used to prevent movement if recurring problem.

Table 5: Remote sea-farm sub-surface inspection protocol.

Remote Inspections		
Remote Inspections carried out	**Immediate actions taken**	**Future sea-farm remote monitoring changes**
Remote sub-surface camera observing crucial aspects of infrastructure, remote passive-acoustic monitor recording marine mammal occurrences	Vessel is taken out to farm to remedy observed faults. In case of emergency and threat to shipping e.g., long-line has come loose, local harbour master is informed.	Position sub-surface monitoring camera near to vulnerable equipment. Link camera equipment to Livestreaming server.

3. Adaptive Entanglement Management Plan

3.1 Occurrence of Entanglement (Immediate Response)

[To be updated once training courses have been completed]

3.1.1 Identification of relevant protection organizations

Several relevant conservation and rescue bodies with an interest in marine animal entanglement have been identified. They are as follows:

- Natural Resources Wales (NRW) Tel: 0300 065 3000, email: icc@naturalresourceswales.gov.uk
- Cetacean Stranding Investigation Programme (CSIP), tel: 0800 6520333
- British Divers Marine Life Rescue (BDMLR), tel: 01825 765546
- Welsh Marine Life Rescue (WMLR), tel: 01646 692943
- Royal Society for the Prevention of Cruelty to Animals (RSPCA), tel: 0300 1234 999

3.1.2 Reporting Trapped or Deceased Species

If a marine animal is found trapped and alive in the site infrastructure, BDMLR, RSPCA, and/or WMLR will be contacted immediately. This incident will then be reported to NRW and CSIP.

If a marine mammal is found deceased, NRW and CSIP will immediately be contacted and work on the site will cease until the animal has been removed. There may also be a need to test samples of the macroalgae to ensure no diseases are present.

In cases where an entrapped animal is found (living or deceased) a follow up investigation will take place as to how the animal became entangled in the first place. We will also attempt to understand what may have drawn the animal to the site.

3.2 Occurrence of Regular Entanglements (Long Term Plan)

Should regular entanglements occur on the farm site, sea-farm design and operational protocol changes will be implemented according to Table 6 below. If the methods mentioned below do not drastically reduce/ eliminate entanglements, all farm infrastructure will be removed from the water. We would then begin consultation with Natural Resources Wales about how to move forward to prevent future entanglements and ensure safe operation of the farm.

Table 6: Adaptive entanglement mitigation strategies

Species at risk	**Primary mitigation strategy**	**Comments**
Cetaceans	Use of acoustic deterrent on sea-farm such as dolphin pingers (https://www.futureoceans.com/dolphin-pinger-10khz/)	n/a
Sea Turtles	Currently no technological deterrents are available. Ensure the sea-farm is fully operational and conduct inspections as outlined in section 2.	Main food source is jellyfish (Stringell, 2016). Therefore, occurrence is in summer where the farm is not operational (*Leatherback Turtle*, 2020).
Seals	Use of acoustic deterrent on sea-farm	Underwater cameras may be placed in strategic points throughout the farm to understand what is attracting the seals and how they are becoming entangled.

4. Conclusion

- The likelihood of marine mammal entanglement in the macroalgae farm is Low.
- To mitigate these risks and to better understand the potential entanglement risks our plan has outlined relevant staff training, surface inspections, and subsurface inspections
- Staff training includes the Marine Mammal Medic course and a Marine Mammal Observation course.
- A minimum of one staff member trained in these courses must be present when visiting the site.
- Visual surface inspections will take place from shore with binoculars.
- Ghost nets and lost hooked lines are a global problem. Car-Y-Mor are in a good position, (crane mounted on workboat), to remove any ghost gear seen on the farm or surrounding waters.
- Remote surface inspections will take place at a minimum weekly, moving to constantly once Livestreaming comes online.
- Visual sub-surface inspections will take place at a minimum weekly, weather depending.
- Remote sub-surface inspections will take place at a minimum weekly using underwater camera on an extender pole.
- Information collected during these inspections will be logged in onboard logbook and digitally backed up.
- At the end of the grow-out period, a report summarising the occurrence of marine mammals observed close to the farm, relevant entanglement risks observed, entanglement incidents and according actions taken, will be made available
- An adaptive entanglement management plan outlining further protocols used should regular entanglement occur at the sea-farm

5. References

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