LOCH MOIDART SEAWEED FARM

APPENDIX B - MARINE BIOSECURITY PLAN

Site Name or Description of Operation: Loch Moidart Seaweed Farm

Site/Operation Location(s): North Channel, Loch Moidart

Plan period: June 2022 - ongoing

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[redacted]

Farm overview

Description of operation

Moidart Capital plan to farm two species of seaweed that are native to Loch Moidart and the surrounding area: *Alaria esculenta* (winged kelp) and *Saccharina latissima* (sugar kelp). The proposed seaweed farm covers an area of less than 1000m2, consisting of four 50m longlines suspended between an anchor at either end, with end spacer bars and a central bar at 25m.

Moidart Capital intend to deploy and seed the farm in June 2022. The farm unit is estimated to produce around 2 tonnes yield (wet weight), and harvesting will be carried out rapidly over the course of up to two days, depending on weather conditions.

Harvested kelp will be brought to shore at the private slipway at Kinlochmoidart. All seaweed will be processed in a facility close to the site at Kinlochmoidart. All farming and processing activity will take place within a 5-mile radius.

Other interactions with the seaweed farm will consist of monthly checks of the structure in addition to checks preceding and following storm events.

Site description

Location

The seaweed farm will be situated in the North Channel of Loch Moidart, between the northern shore of Eilean Shona and the Mainland (Figure 1). The loch is split into two channels by the islands of Eilean Shona and Shona Beag, roughly 8km in length. The farm site is situated just outside the Loch Moidart and Loch Shiel Woods SAC. Qualifying marine interests for which the area is designated an SAC include intertidal mudflats and sandflats for the Annex II species otter *Lutra lutra*.

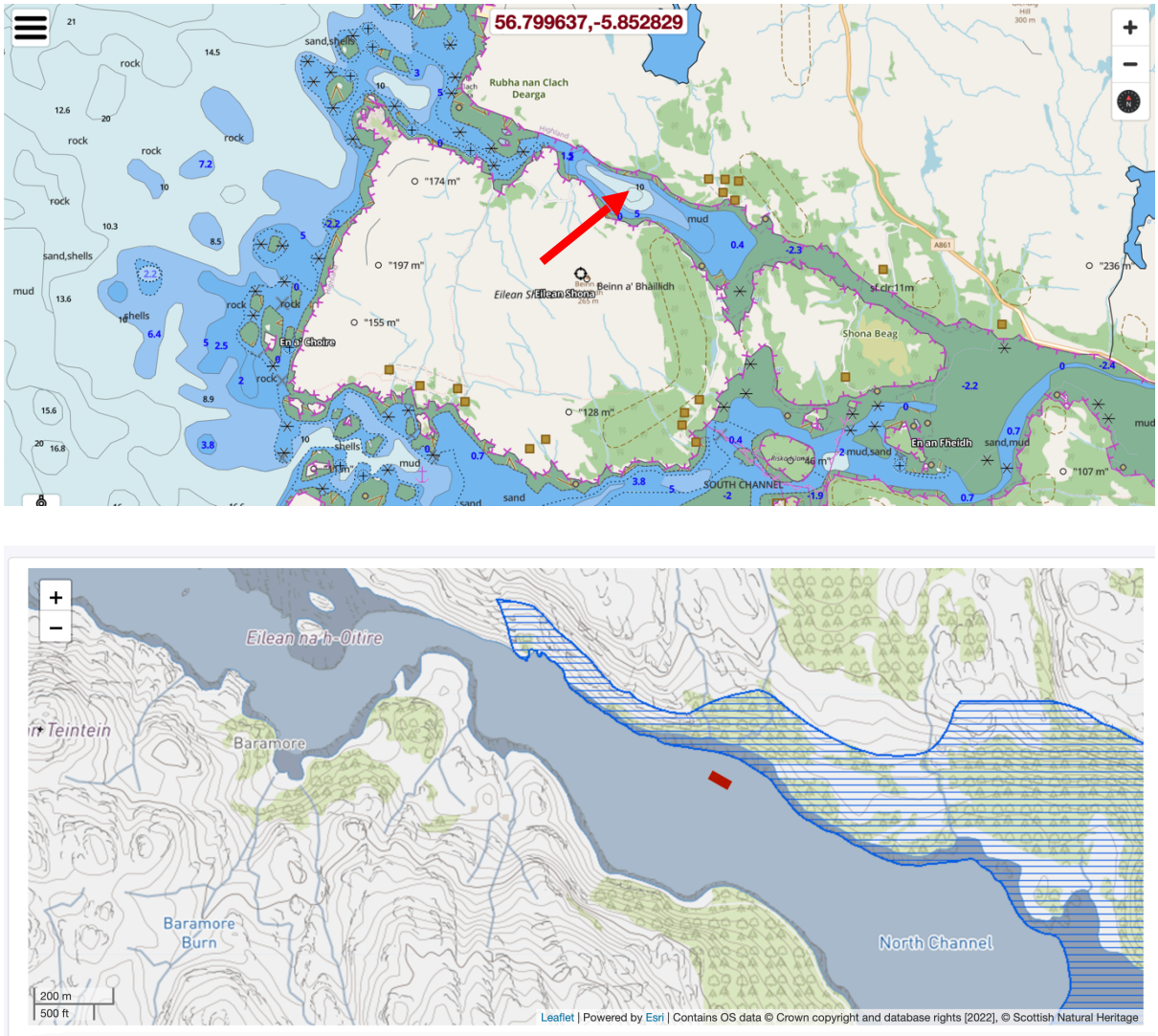

Figure 1. Plan view of the Loch Moidart seaweed farm

Floating structures

The main structure of the farm will comprise a floating four-line grid suspended from floating mooring buoys fixed to the seabed at two mooring points (Figure 2). The total area of the grid structure will be 50x3m, consisting of 4x50m longlines at 1m distance attached by two spacer bars at either end, with a third located centrally at 25m. Each longline will be supported and kept afloat by 5 buoys spaced at 12.5m distance. The structure will require two 150KG anchors, both of which will be marked with a buoy. An unlit yellow Special Mark buoy will be placed at the centre of the most southerly rope to the seaward side.

The farm structure will have the following floating elements:

- Floating mooring buoys
- Longline buoys
- Unlit yellow Special Mark buoy

- Seeding lines
- Grid spacers
- Mooring lines

Subsurface structures

2x150KG concrete anchors will be used to moor the structure. Following the installation of the grid structure, the longlines will be seeded directly and deployed onto the site.

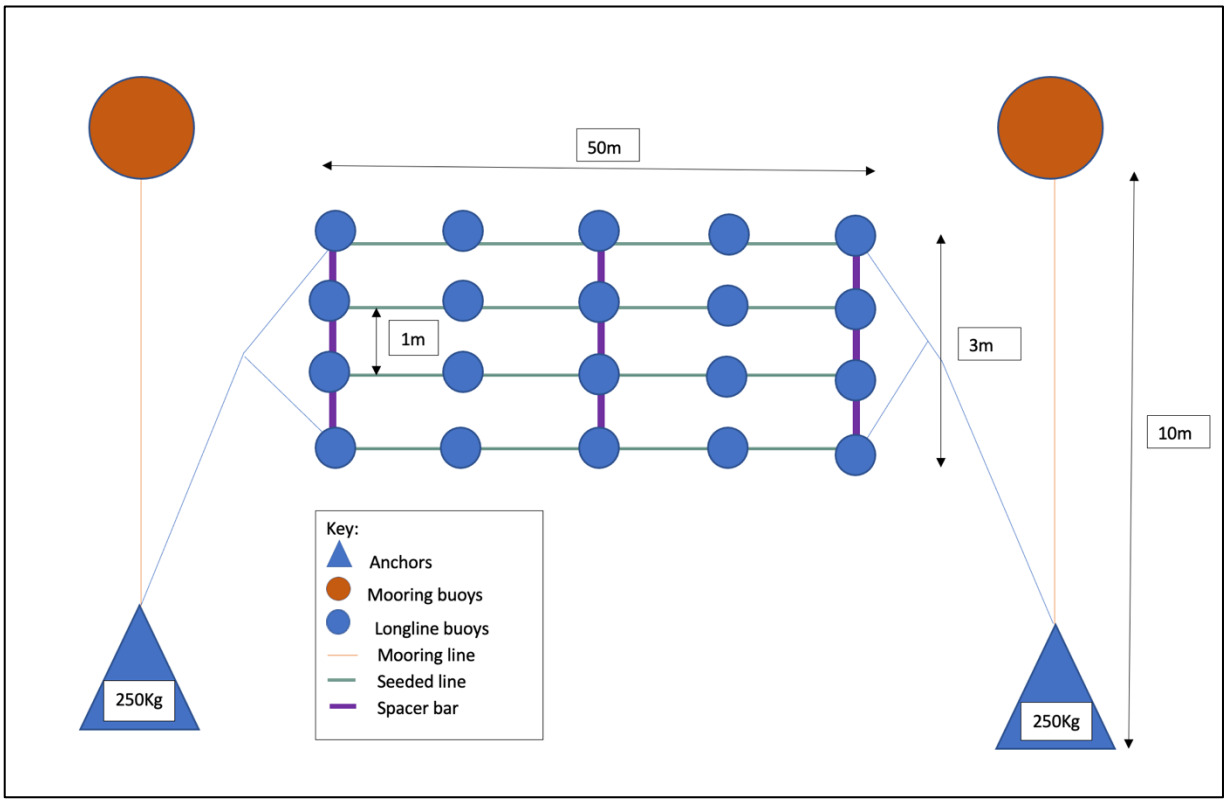

Figure 2. Illustrative design of farm structure

Non-Native Species (NNS) on the West Coast of Scotland

Species	Description	Habitat and Ecology
Key NNS recorded on west coast of Scotland		
Sargassum muticum	Wireweed is native to Japan and is considered invasive by SNH.	Grows on hard substrata in shallow waters and can also tolerate estuarine conditions. It can out-compete local species because it is fast-growing, can reproduce within the first year of life and being monoecious can fertilise itself (Pizzolla 2008).
Didemnum Vexillum	The carpet sea squirt is native to Japan and is considered invasive by SNH.	The species forms large leathery patches colonising artificial structures, rocks, boulders and even tide pools. It is usually found in low energy environments where water motion is limited. It is capable of covering extensive areas of the substratum (Gibson-Hall & Bilewitch 2018).
Caprella mutica	The Japanese skeleton shrimp is considered invasive by SNH.	Often found on biogenic reefs and in areas of human activity on natural and artificial substrate such as hydroids, mooring ropes and buoys. Fully benthic lifecycle with limited dispersal potential although can disperse along coasts on drifting algae.
Schizoporella japonica	This encrusting bryozoan was originally described from Japan, but is now well established in the Pacific coast of North America and European waters.	In the invaded range, the species has been found just below the waterline on floating structures, such as plastic fenders, mooring buoys, or the vertical walls of pontoons and is a typical fouling species (CABI 2019a).
Bugula neritina	The native locale of this bryozoan is unknown and was widespread when surveys of the species first started.	*B. neritina* colonies are typically found in harbours and embayments, intertidal to 5 m, attached to any available hard substrate (CABI 2019b).
Styela clava	This solitary sea squirt is native to the north-west Pacific and considered invasive by SNH.	*Styela clava* is found in shallow water on hard surfaces and occurs abundantly in sheltered warm water docks and harbour installations (Neish 2007).
Other well-established NNS across Scotland		

Species	Description	Habitat and Ecology
Codium fragile subsp. *Tomentosoides*	Known as green sea-fingers, this spongy green seaweed can displace native seaweeds and is considered invasive by SNH.	Occurs on rock and coralline algae in pools and on open rock, often found on man-made structures. Reproduction likely occurs towards the end of the summer / beginning of autumn.
Austrominius modestus	This barnacle is native to Australasia but introduced into Britain in the 1940s.	*A. modestus* inhabits a wide range of habitats including estuaries and harbours, occurring at a range of shore heights, tidal ranges and salinity regimes (CABI 2019c).
Undaria pinnatifida	*Undaria pinnatifida* is native to northeast Asia and one of only two seaweeds included in the Invasive Species Specialist Group list of the 100 most invasive species of the world.	The species inhabits rocky substrates from the low intertidal to 18 m depth, and is widespread at depths of 1–3 m (Epstein & Smale 2017).

Site features affecting biosecurity

Salinity, temperature and freshwater input

Loch Moidart is designated as a Shellfish Growing Water. Freshwater inputs directly to the designated area are limited to minor streams, none of which are monitored by SEPA but are considered to be of at least good quality. Much of the freshwater flowing through the North and South channels comes from the River Shiel and the River Moidart. Both these rivers are classified by SEPA as being of good quality. The Scottish Sea Lochs Catalogue gives a salinity reduction of 0.1ppt for the North Channel (CEFAS, 2012). Due to these freshwater inputs within 1km of the intended farm site, this lowers the risk of the introduction of Non-Native Species (NNS).

Temperatures range between 12–13.5°C during the summer months. During winter months, the range is likely to be 6.5–8.4°C although temperatures can reach as low as 4°C. Due to this complete marine environment, favourable temperatures, and tidal conditions in the area around Loch Moidart, the algae farm could be considered at risk from the colonisation of NNS when assessed under the NatureScot Biosecurity Planning guidelines (Payne *et al*. 2014).

Anchors

Standard concrete anchors offer a large surface area for colonisation due to their size. However, concrete anchors often lack structural complexity and take time to become bio fouled because of chemical leaching. Once a community has become established, concrete anchors are quite indistinguishable from surrounding substrate. Concrete anchors are typically coupled with a chain riser, which can also become heavily bio fouled.

Grid structures

The spacer bars will be made from metal and are suspended approximately 2m below the surface of the water. This could provide a suitable structure for settlement of NNS.

Buoys

Floating buoys which mark each anchor (four per grid) and longline (25 per longline), will be partially submerged and provide a manmade substrate for NNS settlement and will be in close proximity to the harvesting vessel. However, buoys may be easily cleaned during site visits to prevent the build-up of biofouling organisms.

Site activities affecting biosecurity

Maintenance of farm site

Even small structures will require maintenance throughout the growing season. This may include the disposal of biofouling which has colonised equipment.

Seeding lines

Seeding lines could present a risk of introducing NNS into Loch Sunart as seaweed cultures are generally grown offsite and transported to the farm. Seeding lines will likely be constructed from polypropylene and will become heavily fouled with a range of species. It should be noted that any submerged material that has not been antifouled, would be suitable for NNS settlement. Furthermore, any material with limited cleaning or eradication potential possesses an increasing risk as time passes and more biofouling organisms are established.

Work vessel

The hull of the work vessel has the potential to accumulate biofouling and increase the risk of NNS. However, antifouling, cleaning and eradication measures are available that reduce this risk. Additionally, the vessel used will be a small, newly refurbished barge based in Loch Moidart that will not have travelled from other countries, regions or water bodies, thereby reducing the risk of NNS introduction.

Biosecurity Control Measures - Instructions for site users

Activity type	Recommended biosecurity measures
Arrival of vessel with moorings, lines, anchors	• Carry out regular biofouling inspections, antifouling treatments, and inspection • If the level of biofouling is ranked at level 3 or higher (see Biofouling Visual Assessment table – Appendix A) the materials/structure should not be introduced until biofouling is removed. Removal must be in a controlled manner with all removed material contained and not released to the marine environment • Removal of biofouling must be in a controlled manner with all removed material contained and not released to the marine environment
Introduction of new construction materials/structures to the marine environment	• Visual inspection prior to introduction and clean if required
Introduction of seed stock to farm	• Stringent visual inspection of seed prior to deployment. • Use a reputable seed supplier with no historic INNS issues • Source a local supplier if possible • Harvest fertile material for seedstock from within 5 miles of farm site • If any INNS are found seed should not be used
Movement of site workers	• Apply Check, Clean, Dry procedure for all clothing and equipment: https://thegreenblue.org.uk/check-clean-dry/
Harvesting	• Harvest should be checked for epiphytes and especially NNS • Harvested kelp you should be stored correctly for onward transport to processing facility
Departure/removal of barges/ vessels/ lines or moorings	• Use the Biofouling Visual Assessment table (Appendix A) prior to vessel departure or removing subsea equipment. • Removal must be in a controlled manner with all removed material contained and not released to the marine environment
Training	• Training will be given to key staff in the identification of NNS and using the Biofouling Visual Assessment Table (Appendix A). These references should be printed off and placed in a biosecurity plan folder along with this Biosecurity Plan.

Contingency Plan

Issue	Action	Responsibility	Equipment
Fragmentation or dispersal of NNS into the water column.	Remove debris from the water column and dispose to landfill. Use the same procedures in place for routine cleaning.	Seaweed farm staff	Hand nets or boat hook.
Workboat is ranked at class 3 or above in the visual inspection (see Table 5).	The vessel is not allowed entry to worksite. It should be removed from water at home port, cleaned and antifouled. Inspect surrounding berths.	Seaweed farm staff	Laminated copy of Biofouling Visual Assessment table (Appendix A) to be available on site.
Rafted material with NNS dislodged	Remove from water and allow to air dry or dispose to landfill.	Seaweed farm staff	Hand nets or boat hook.
New non-native species found.	Inform Marine Scotland and SNH. Follow Marine Scotland and SNH instructions. The GB Non-native Species Secretariat should also be informed so they can update species distribution and abundance databases for NNS. Relevant details are located on their website: http://www.nonnativespecies.org	Seaweed farm staff	Copy of Marine Scotland contact available onsite.

Appendix A

Biofouling visual assessment table (from Payne *et al.* 2014)

Rank	Description	Visual estimate of biofouling cover
0	No visible fouling. Hull/structure entirely clean, no biofilm on visible submerged parts of the hull.	Nil
1	Slime fouling only. Submerged hull/structure areas partially or entirely covered in biofilm, but the absence of any plants or animals.	Nil
2	Light fouling. Hull/structure covered in biofilm and one to two very small patches of one type of plant or animal.	1–5 % of visible submerged surfaces
3	Considerable fouling of hull/structure. Presence of biofilm, and fouling still patchy, but clearly visible and comprised of either one or more types of plant and/or animal.	6–15 % of visible submerged surfaces
4	Extensive fouling of hull/structure. Presence of biofilm and abundant fouling assemblages consisting of more than one type of plant or animal.	16–40 % of visible submerged surfaces
5	Very heavy fouling of hull/structure. Many different types of plant and / or animal covering most of visible hull surfaces.	41–100 % of visible submerged surfaces