

Loch Fyne Marine Biosecurity Plan

**Developed in Partnership with the
Stakeholders in Loch Fyne**

C2W Consulting



Maritime and Environmental
Facilitation and Engagement

www.c2w.org.uk

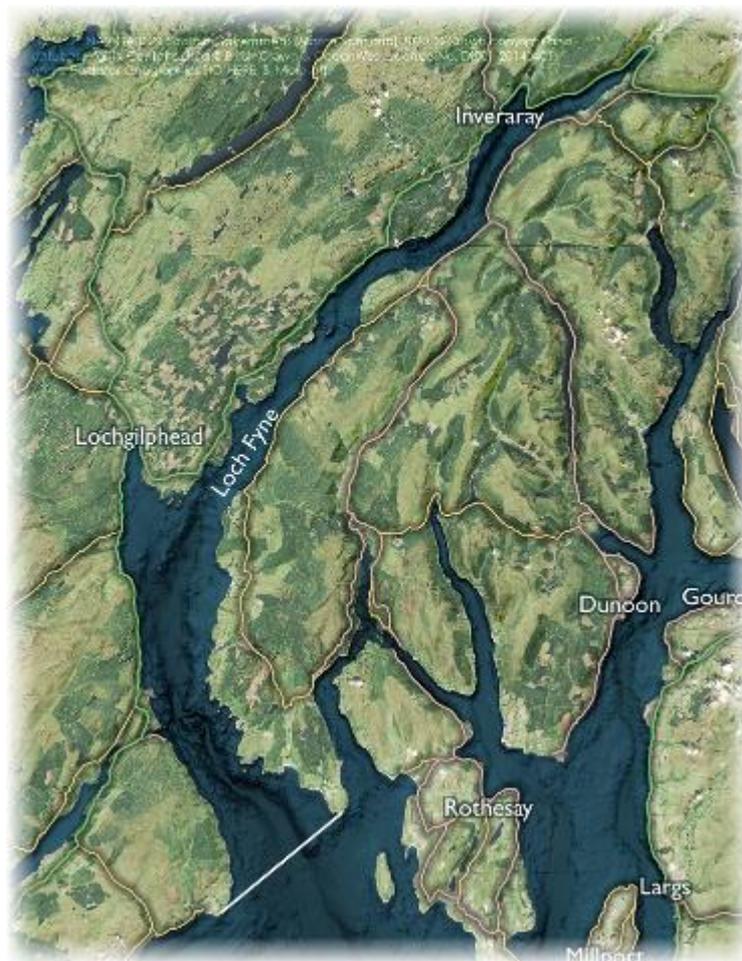


Figure 1 Loch Fyne, Argyll and Bute, Scotland, UK

marinescotland



This plan was funded by Marine Scotland and has been developed by the users and community of Loch Fyne, Argyll, Scotland with the support of C2W Consulting.

This plan is non-statutory, and all actions listed are undertaken on a voluntary basis.

This biosecurity plan was developed in partnership with local stakeholders between November 2019 and April 2020.

The Loch Fyne Biosecurity Plan covers the areas from the head of the loch near Cairndow, out to a seaward boundary loosely defined by a line from Ardlamont point in the east to Skipness point in the west.

Principle Contractor

Marine Scotland appointed Sarah Brown of [C2W Consulting](#) to deliver the community and stakeholder led biosecurity plan.

REPORTING

What to do if you think you've seen *Didemnum vexillum*, the carpet sea-squirt

1. Don't IGNORE IT!
2. Note the location, preferably using GPS, and take photographs of the colony if possible and safe to do so. Take photos both zoomed in and of the entire colony.
3. Contact Marine Scotland or **CALL** Scotland's Environmental and Rural Services (SEARS) Helpline on 0845 230 2050. They will pass your report and photos onto Marine Scotland who will be able to respond quickly.
4. Adopt the precautionary approach and assume that it is *D. vexillum* until confirmed otherwise and follow best practice by not moving any material, stock or boats etc. from the site.

HAVE YOU SEEN THIS?



CARPET SEA-SQUIRT, *Didemnum vexillum*, is an invasive non-native marine animal. Now known to be in the UK. It can compete with native species for space and can smother immobile species. Fouling of man-made hard structures such as vessel hulls, aquaculture equipment, docks, moorings is common. It can prove costly to marine industries and users.

WHAT DOES IT LOOK LIKE?
Carpet Sea Squirt can reproduce quickly and overwinter in a reduced form. It may look like some native species, but can be identified by the following features:

- It can grow as thin flexible sheets or hang down in long rope like growths
- It has a uniform pale orange, cream or off-white colour
- The surface is leathery (not slimy) and has a veined or marbled appearance
- Has numerous pores on the surface but these close up out of water to produce white spots

WHAT SHOULD I DO IF I FIND IT?

1. **Note the location** to the nearest 100m or provide GPS coordinates
2. **Take a photograph** or detailed description
3. **CALL** Scotland's Environmental and Rural Services (SEARS)
☎ **Helpline on 0845 230 2050**
✉ **MarineNonNativeS@gov.scot**
4. **Assume that it is *D. vexillum*** and do not move any material, stock or boats from the site.

    **Scottish Government**
Riaghaltas na h-Alba
gov.scot

Executive Summary

Didemnum vexillum, the invasive, non-native carpet sea squirt, has been found in three locations in Scotland, most recent of these is Loch Fyne in Argyll and Bute. Thought to originate from Japan it has the potential to grow rapidly, smother immobile species and potentially impact not only the native wildlife but also important economic sectors such as fish and shellfish growing.

Biosecurity planning is recognised as the best way to assist stakeholders to identify threats and mitigating actions which will lower their risk from invasive non-native species. Undertaking this planning activity at a regional scale helps to boost effectiveness by linking efforts with adjacent businesses and communities.

Marine Scotland commissioned C2W Consulting between December 2019 and March 2020 to work with local stakeholders to create this plan. Actions listed in the plan effect the full range of users of the Loch including sea fishing, aquaculture, both fin and shellfish, leisure boating, diving, commercial shipping, transport and defence.

Actions have been through a risk assessment process and centre around the informed assumptions that:

- *D. vexillum* is most often found on manmade structures.
- It can spread by larval dispersal but also by fragmentation of colonies which can dislodge and settle elsewhere. Local conditions such as wave action, UV exposure and freshwater events such as surface water can all influence where it flourishes.
- Adhering to best practice, the biosecurity plan assumes that the *D. vexillum* risk is the same across the whole of Loch Fyne.
- *D. vexillum* is killed without the use of chemicals through desiccation (drying out) and prolonged exposure to freshwater. Any other treatments may require permits and advice should be sought before taking action.
- Maintaining antifouling coatings and reducing biofouling on vessels is a useful step towards lowering risk.

Please note

- As a business or an individual it is your responsibility to look out for, report and not to move a non-native species.
- You could be committing an offence unless you can show you took all reasonable steps to avoid moving or causing the spread of an invasive non-native species, such as *D. vexillum*.
- If you think that you have found *Didemnum vexillum* you should report it straight away by emailing MarineNonNativeS@gov.scot or via the SEARS helpline on 0845 230 2050.



D. vexillum growing over boulders on the seabed. © Ian Davidson, Smithsonian Environmental Research Centre, Maryland, USA

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Background

Marine invasive non-native species can pose threats to both marine industries and the natural environment. At a national level Marine Scotland is responding to the invasive species known as Carpet Sea Squirt – *Didemnum vexillum* – which is now present in Scottish waters. Carpet Sea Squirt can grow rapidly to cause heavy biofouling with impacts for boats and infrastructure and it can smother immobile species including farmed shellfish as well as natural features.

Carpet Sea Squirt is present in Loch Fyne and information has circulated to raise awareness of the issue. To complement the awareness raising work Marine Scotland commissioned this biosecurity plan to support marine users to contain the spread of the Carpet Sea Squirt and to minimise its potential impacts. Whilst this plan is focused on the Carpet Sea Squirt, *D. vexillum*, the actions listed are useful and practical against many marine invasive species.

Non-Native and Invasive Non-Native Species

Non-native species are introduced plants and animals from other parts of the world. When a non-native species thrives aggressively it becomes a problem to the local ecology and economy and it is then termed 'invasive'.

Some non-native species have been moved from their native range accidentally for example on boat hulls, in ballast water or via the transport of goods and materials. Some species have been intentionally released for food or sport (rabbits) or for horticulture such as garden plants like rhododendron (*R. ponticum*). Species may have been introduced many times before they have become established.

Problems Associated with Invasive Non-Native Species

Invasive non-native species (INNS) often have advantages over native species, they can be more adaptable and have left behind their native predators and diseases. This means they can often grow at great speeds, overtaking native species in terms of food, space and light. They can smother native species and habitats such as fish breeding grounds and therefore disrupt whole ecosystems. They also clog and potentially damage important infrastructure such as roads and buildings on land or water intakes, fish cages, propellers and lock gates in the marine environment. INNS are thought to be one of the greatest threats to biodiversity and [Defra](#)¹ have estimated that they cost the UK economy at least £2 billion per year, with more than £244 million of that spent in Scotland.

Biosecurity

Scottish law regarding INNS is amongst the most advanced in the UK. The [Wildlife and Natural Environment \(Scotland\) Act, 2011](#)² includes a [Code of Practice on Non-Native Species](#)³ which helps to explain the impact of the legislation. The Act refers to plants and animals, making no distinction about invasive or non-native species and makes it a strict liability offence to:

¹ The Economic Cost of Invasive Non-Native Species on Great Britain F. Williams, R. Eschen, A. Harris, D. Djeddour, C. Pratt, R.S. Shaw, S. Varia, J. Lamontagne-Godwin, S.E. Thomas, S.T. Murphy CAB/001/09 November 2010

² Wildlife and Countryside Act 1981 (Amended)

³ Code of Practice on Non-Native Species Made by the Scottish Ministers under section 14C of the Wildlife and Countryside Act 1981

- release an animal to a location outside its native range,
- allow an animal to escape from captivity to a location outside its native range,
- otherwise cause an animal not in the control of any person to be at a location outside its native range,
- plant, or otherwise cause to grow, a plant in the wild at a location outside its native range.

‘Native range’ is defined in the 1981 Act as: “the locality to which the animal or plant of that type is indigenous, and does not refer to any locality to which that type of animal or plant has been imported (whether intentionally or otherwise) by any person.” And to ‘Release’ is defined as when an animal or plant is no longer under human control.

The Code of Practice also defines ‘in the wild’ as being just about everywhere except for:

- arable and horticultural land
- improved pasture
- settlements
- private and public gardens

The Act allows for voluntary Species Control Agreements (SCA) and compulsory Species Control Orders (SCO) to be issued to help with management of non-native species. There is no time limit to SCAs or SCOs which can be issued by Scottish Ministers, including Marine Scotland as well as Scottish Natural Heritage, Scottish Environment Protection Agency (SEPA) and Forestry Commission.

The Code of Practice says that everyone has a responsibility to act in a precautionary way with regard to non-native species, that people should carry out risk assessments, exercise due diligence and follow good practice. The process of biosecurity planning ensures that this is done in a structured way and recorded to enhance communication and awareness raising.

The Scottish Government has a three-tier policy regarding non-native species:

- Prevention – most effective and least environmentally damaging,
- Rapid Response – early detection and potential eradication,
- Control & Containment – where the INNS is widespread and eradication is not feasible, control of the population and mitigation of negative impacts.

Given the boundary free nature of the marine environment eradication of INNS has proved to be unsuccessful in all but a tiny number of cases globally and so biosecurity in this context often focuses on control and containment.

The Carpet Sea Squirt, *Didemnum vexillum*

The carpet Sea Squirt, *Didemnum vexillum*, as described by Kott in 2002, is an invasive colonial ascidian. It has been risk assessed by experts, using information from other countries which have similar environmental conditions, who conclude that it could have the potential to blanket some areas of seabed and potentially affect fisheries and shellfisheries.⁴ It is difficult to identify with certainty in the wild and often microscopic analysis or DNA techniques are needed for an accurate identification.

Arrival

Although *D. vexillum* was possibly transported to the UK from Japan on oyster shells in the 1960/70's it was not recorded in the UK until much later meaning it is possible that this was not the vector. The most likely mode of arrival to the UK, where it was first found on the South coast of England, was in ballast water or on ships hulls. Since then it is believed to have moved around the UK via hull transfer and with aquaculture stock movements.

In 2009 it was recorded in Scotland for the first time. It was found in the Firth of Clyde, by researchers at the Scottish Association for Marine Science and since then it has been found only in Loch Creran, north of Oban, and subsequently in Loch Fyne.



***D. vexillum* on a scallop.**

© Woods Hole Coastal and Marine Science Centre

There seem to be 4 major genetic variations (haplotypes) in the UK meaning multiple introductions are likely. Many sites show multiple haplotypes meaning there could have been one multiple haplotype infection or several infections of one or more haplotypes.⁵

Growth and Biology

D. vexillum will grow on hard structures, living or non-living and in the right conditions it can grow quickly smothering even mobile species such as crabs, in the dense mat created by the colony. Its impacts tend to be most notable on stationary species such as mussels, oysters and seaweeds where it can smother the growing plants and animals. It also creates problematic fouling on man-made structures such as oyster bags, keep nets, fish farm infrastructure, marina infrastructure, boats etc.

Where the current is stronger the colonies tend to remain in mats but where it is weaker longer pendulous growths form which are easier to fragment and will break off and form new colonies elsewhere.

⁴ GB Non-Native Organism Risk Assessment Scheme, *D. vexillum*, <https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=1743> accessed 16.03.2020

⁵ Molecular identification of *Didemnum vexillum* Kott, 1982 from sites around the UK coastline, Graham et al 2015

The Carpet Sea Squirt reproduces asexually by budding or fragmentation and the fragments can survive for several weeks as they drift to a new site. The colony will also reproduce sexually generating larvae, which only live for a few hours in the water column.⁶

Natural Control and Treatments

Some sea urchins, whelks and other echinoderms have been shown to feed on *D. vexillum* but not in sufficient quantities to make for an effective biological control in the UK.⁷

UV exposure does not appear to be a totally effective treatment for carpet sea squirt (ascidian) removal from water or on hard substrates, and other treatments such as acetic acid sprays, lime solutions, chlorine or bleach dips should be used under direction and may require to be licensed.⁸

Immersion in freshwater for specific periods or desiccation (fully drying out) by air drying can be effective control methods.

Attempts to eradicate *D. vexillum* from the environment have been made in other parts of the UK and elsewhere in the world, unfortunately, despite extensive efforts, these have not been successful.



Pendulous growth form of *D. vexillum* from west coast of Scotland

© Dr D Minchin, Marine Organism Investigations

Stakeholder Analysis

Marine Scotland requested that the development of a biosecurity plan for Loch Fyne was community led. The process was therefore designed around the needs of the relevant stakeholders and community groups. C2W Consulting undertook a desk study of all identifiable stakeholders in the Loch Fyne area. These were defined as any individual or business whose details were in the public domain and linked to Loch Fyne for work, living/dwelling or recreation. The search included the following sectors:

- Aquaculture – shellfish
- Aquaculture – fin fish
- Aquaculture – seaweed

⁶ Lambert G. (2009). Adventures of a sea squirt sleuth: unravelling the identity of *Didemnum vexillum*, a global ascidian invader.

⁷ Carman, M.R., Allen, H.M. & Tyrrell, M.C. (2009) Limited value of the common periwinkle snail *Littorina littorea* as a biological control for the invasive tunicate *Didemnum vexillum*. *Aquatic Invasions*, 4(1): 291-294

⁸ Good practice management guidance for carpet sea squirt - RAPID LIFE (2018)

- Marine tourism – boating (yachts and small craft)
- Marine tourism – diving
- Marine tourism – cruise ships
- Marine tourism – caravan parks
- Marine recreation – boating (yachts and small craft)
- Marine recreation – slipways and informal access points
- Marine recreation – diving
- Marine recreation – swimming
- Fishing – commercial creel
- Fishing – commercial trawl
- Fishing – other
- Fish and shellfish processing
- Ministry of Defence
- Canals
- Ferries
- Port Authority
- Statutory agencies

Developing the stakeholder list of more than 120 contacts gained from publicly available data sources, was followed by establishing contact with those individuals and organisations. A series of approximately 50 face to face meetings or phone calls were then held during which the stakeholder's activities were discussed in confidence before practical biosecurity actions were identified. These actions were noted and outlined in a follow up email. The actions were then applied to a risk assessment protocol to gauge effectiveness as biosecurity measures against *D. vexillum* in terms of reducing the risk of the vector being associated with *D. vexillum*, reducing the risk of the vector moving *D. vexillum*, or reducing the risk of effective establishment of *D. vexillum*.

The biosecurity plan was finalised and published by Marine Scotland in March 2020.

Scope of the Plan

Whilst many of the actions outlined in the Plan may be effective against other invasive non-native species, the Loch Fyne Marine Biosecurity Plan focuses on the Carpet Sea Squirt *Didemnum vexillum* only.

The plan covers the whole of Loch Fyne in Argyll and Bute, Scotland, UK (see Fig 2 over the page). The Plan covers all maritime activities in the Loch including movement of vessels, stock, plant, processing and in water equipment.

During plan development the consultants also worked with major stakeholders in close proximity to the Loch, e.g. operations within Kilbrannan Sound and Clyde-wide stakeholders such as the Clyde Marine Planning Partnership.

The plan covers all activities which have a risk of introducing or spreading *D. vexillum*. No areas were excluded from the marine area; however, the plan does not cover any activities which occur completely above mean high water springs (MHWS) unless using water from Loch Fyne e.g. deputation activities.

In discussions with stakeholders it was made clear that good biosecurity can only be undertaken when everyone takes part. This means that the plan relates not only to businesses in the area but their contractors and customers as well. **It is the responsibility of all stakeholders to take whatever actions they deem necessary to communicate with customers and contractors and to ensure that they play their part in delivering good biosecurity.**

Due to the difficulties of eradication of any species in the marine environment the focus of this biosecurity plan is control and containment of *D. vexillum* within Loch Fyne.

Responsibility

The plan belongs to the stakeholders involved in its development as outlined on page 9. The actions outlined have been amalgamated to allow for useful biosecurity measures to be shared across sectors and to avoid limiting any one organisation in the actions they wish to take to reduce their risk from *D. vexillum*.

It is recommended that every organisation keen to ensure biosecurity should appoint someone in the role of 'biosecurity officer'.

Reporting

If you find or suspect carpet sea squirt, please report it immediately by email to Marine Scotland (MarineNonNativeS@gov.scot) or using the Scottish Environment and Rural Services (SEARS) telephone number 08452 30 20 50.

If you would like to discuss the plan or wider biosecurity issues please contact Bernadette Moloughney, Marine Scotland, Bernadette.moloughney@gov.scot or call 0131 244 8102.

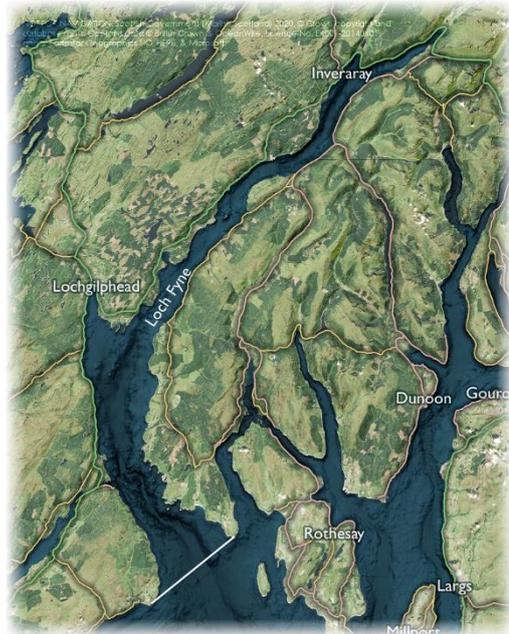


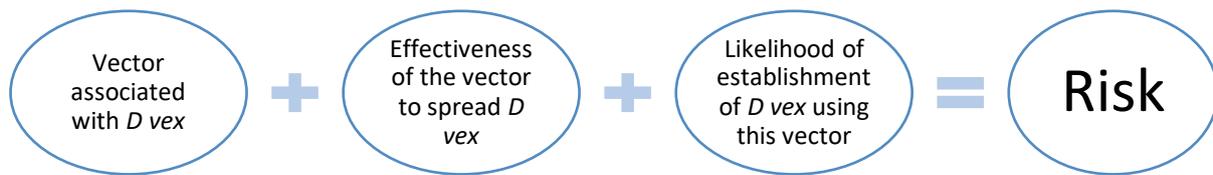
Figure 2 A map showing the approximate extent of the plan area.

Risk Assessment Process

The biosecurity planning process begins by gathering information about the activities happening in an area. This information is then paired up with data about the receiving environment such as salinity, temperature, tidal movements etc. Assessing this against known attributes of the organism concerned, in this case the Carpet Sea Squirt, *Didemnum vexillum*, gives an assessment of the effectiveness of the vector and the risk of establishment being successful should a transfer take place.

This biosecurity plan took a pathways/vectors approach to risk and assessed each activity separately. This means that subtle differences in how an activity is undertaken, or available biosecurity measures, can mean that the risk assessment gives a slightly different score, for example two identical boats which are both used frequently, hauled out annually, cleaned and antifouled may have different scores because one of them gets beached regularly and so may damage the

antifouling coating and potentially disturb colonies in the intertidal zone, while the other boat does not. For this reason the detailed risk assessments are not published in this document.



The risk assessment was undertaken using a scoring system from zero to a maximum of 3 points for each aspect:

- 0 - known negative – published evidence demonstrates a negative correlation
- 1 - suspected negative – evidence is available to support a suspected negative correlation
- 2 - suspected positive – evidence is available to support a suspected positive correlation
- 3 - known positive- published evidence demonstrates a positive correlation

Risk Rating

The scores were then added together to give the total risk for the activity before and after biosecurity actions had been put in place:

- 0-2 Low risk
- 2-4 Low/Medium risk
- 5-6 Medium risk
- 6-7 Medium/High risk
- 7-9 High risk

The risk was then reassessed using the same approach in light of biosecurity actions agreed with stakeholders.

Agreeing Biosecurity Actions

Biosecurity actions were discussed and agreed on the basis of critical control points and the multiple barriers method. Critical control points are identifiable times, activities or structures which offer an opportunity to significantly lower the biosecurity risk. For example, these may be monitoring opportunities such as when a boat is hauled out of the water at the end of the season, or treatment opportunities such as when shellfish stock is going off site. The fluid nature of the marine environment means that the multiple barriers method is used to put in as many layers of these controls to reduce the risk as much as possible.

‘Stop Events’ where activities should be halted and advice sought from Marine Scotland, were also discussed with stakeholders. The likely stop events will be as a result of finding *D. vexillum* in a new area or in significantly larger colonies than previously experienced. The actions resulting from a ‘Stop Event’ are outlined in the contingency plan see Annex B.

Pathways and Vectors

The way that invasive species move about are known as pathways and vectors. The pathway is generally considered to be the wider activity e.g. marine tourism or forestry operations. The vector

is the specific aspect of the pathway which has a biosecurity risk so for example in marine tourism it could be seal watching boats, or in forestry it could be timber barge movements.

Priority pathways and vectors associated with *D. vexillum*⁹

Pathway	Vectors	Risk of Introducing or Spreading <i>D. vexillum</i> within GB	Risk of Introducing or Spreading <i>D. vexillum</i> within Loch Fyne
Recreational boating	Larva or colony movement on boat hulls	High	High
	Sediment transfer via anchoring or dinghy movements	Medium	Medium
Fisheries/Aquaculture	Larva or colony movement on boat hulls or feed barges	High	High
	Dispersal of fragments due to net washing	High	High
	Movement of larva or fragments in well boats	High	High
	Movement of larva or fragments on stock	High	High
Ship Recycling	Larva or colony movement on boat hulls	High	Low (no activity in Loch Fyne)
Marine industries (oil, gas, renewable and dredging)	Larva or colony movement on boat hulls	High	Low (no activity in Loch Fyne)
	Dispersal of colonies through disturbance of substrate or movement of sediments.	High	Low (no activity in Loch Fyne)
Shipping	Movement of larva or colonies in ballast water	Low	Low (Ballast Water Convention)
	Larva or colony movement on boat hulls	Low	Low (no activity in Loch Fyne)

Site Description

For the purposes of this project the northern boundary extends to Mean High Water Springs (MHWS) at the head of the Loch near Cairndow, and the approximate southern boundary is considered to be from Skipness Point to Ardlamont Point.

Loch Fyne is Scotland’s longest and deepest sea loch. It runs in a general south west/north east direction for some 70 km and reaches a maximum charted depth of 189 m. The Loch runs north east from the Firth of Clyde and is no more than 6 km wide at the widest point in Lower Loch Fyne and

⁹ Extrapolated from Recommendations for Reducing the Rate of Spread and Potential Re-Invasion of *Didemnum vexillum*, GB *Didemnum vexillum* Working Group, 2011

less than 3 km wide in the upper Loch north of Otter Narrows. The surrounding terrain is hilly on both sides of the Loch with heights reaching more than 500 m at the north east part of the Loch.

Loch Fyne covers an area of 183.7 km² at high water and has a volume at low water of 9,747 million cubic meters. Annual rainfall is 1750 mm per year giving runoff of approximately 1,340 million cubic meters per year.

Tidal range in the Loch is 3.1 m and at Otter Narrows the predicted tidal flow rates reach a maximum of 1.1 knots. Otherwise tidal currents are weak. Wind driven water movement may significantly increase surface water flows with return movement along the loch bed and sides. Tidal flushing time is 13 days.

Bottom water tends to become isolated in the summer and renewed in the winter. The renewals occur by density currents flowing in from the sills and these produce a characterising grading of the bottom sediments from coarse to fine away from the sills.

Upper Loch Fyne starts at a sill at Otter Narrows and the upper loch is separated by a second sill at Minard. Mean depths at the sills are 20 m and 16 m. The lower region is continuous with the Inchmarnock Water. Mean Depth at low water is 55.5 m.

The sheltered nature of Loch Fyne, in common with other fjordic lochs, allows the formation of soft muddy sediments particularly in the upper reaches. The basins between sills create stable conditions similar to deeper waters in more exposed locations and species found in waters over 50 m in other places can be found in as little as 15 m in Loch Fyne.

Uses of Loch Fyne

Loch Fyne is a busy area and during the stakeholder mapping more than 20 sectors were identified as using the Loch for some purpose, with almost 120 contacts approached to be part of the Plan development. There are 10 fin fish aquaculture sites, 3 hatcheries, at least 3 oyster and mussel growing areas across Loch Fyne, and a thriving shellfish processing sector in Tarbert. Commercial fisheries for prawns, crab, lobster and other species also work out of the Loch, predominantly from Tarbert Harbour.

There are many private moorings for yachts and small craft in Loch Fyne, some under Mooring Associations regulated by Crown Estate Scotland. Groups of moorings can be seen in areas such as Strachur where there is also a small service pontoon, or in the outer harbour at Tarbert. Portavadie and Tarbert provide the majority of the marine services although the waiting pontoon at Ardrishaig also supports the thriving leisure sector.

The Crinan Canal attracts more than 1600 vessels annually, and potentially provides a bio secure passage north and south along the west coast as marine invasive species are known not to tolerate prolonged exposure to freshwater.

Tourism is an important part of the local economy and a number of caravan sites are located locally; many visitors will bring small boats, kayaks or other craft with them to launch into Loch Fyne. Leisure fishing, wild swimming and diving are other significant uses of the Loch and all carry some level of risk from a biosecurity perspective.

Calmac ferries run regular transportation services from Loch Fyne from Tarbert across to Portavadie and down to Arran. Northern Lighthouse Board have a number of local aids to navigation and Peelports Group are the Harbour Authority with rights to grant works licences. The Ministry of Defence also makes use of the Loch as does Forestry Land Scotland for harvesting timber.

Risks which are largely outside the practical control of users of the Loch include movement of invasive species attached to marine litter or via natural movement due to water currents, tides or associated with wildlife.

Designations

Upper Loch Fyne was designated as a Marine Protected Area (MPA) in 2014. The designation was to conserve four key habitats and one key species: burrowed mud, flame shell beds, horse mussel beds, sublittoral mud and specific mixed sediment communities and ocean quahog aggregations. Some of these protected features could potentially be negatively impacted by *D. vexillum*, however biogenic reefs such as those created by flame shells and horse mussels are thought to be particularly vulnerable.

There are four Sites of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) bordering Loch Fyne featuring geological formations and upland oak woods. They are designated for features ashore and do not include the Loch. They are:

- Strone Point SSSI: Geological: Structural and metamorphic geology: Dalradian
- Tarbert to Skipness Coast SSSI: Oak Woodlands and Bryophytes
- Artilligan and Abhainn Srathain Burns SSSI: Oak Woodlands
- Ardchlyne Woods SSSI: Oak Woodlands
- Tarbert Woods SAC

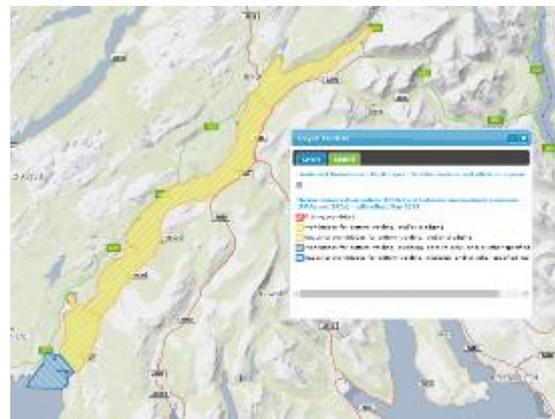


Figure 3 A map showing the marine protected areas in upper Loch Fyne

There are no large centres of population around Loch Fyne. The main settlements and their population at the 2011 census are as follows:

- Inveraray 600
- Tarbert 1180
- Ardrishaig 1350
- Lochgilphead 2390

Fishing has declined significantly as a main activity on the loch in recent years. Aquaculture and leisure marine users now dominate as users of the Loch. The main hubs for marine activities are as follows:

- Tarbert: Local fishing fleet, aquaculture service vessels, ferries and marina for visiting and resident boats. Boat storage ashore.
- Portavadie: Marina and visitor destination. Boat storage ashore.
- Ardrishaig: Eastern end of the Crinan Canal providing transit route west and resident boats on moorings. Local boat storage ashore.
- Argyll Caravan Park. Access by slipway.

Monitoring and review of the plan on a site and regional level

Monitoring for *D. vexillum* has been agreed by all stakeholders during ongoing routine work including:

- Vessel haul out
- Infrastructure surveys
- Mooring maintenance
- When it is safe to do so at Mean Low Water Springs around structures such as piers and slipways and along the seashore
- During shellfish husbandry work
- During fin fish net cleaning and before movement of feed barges

Working Assumptions about *D. vexillum*

Evidence about how *D. vexillum* behaves, including in Scottish waters, is still being gathered however the following statements underpin the risk assessment and the biosecurity actions, and are based on published evidence, expert advice, experience of biosecurity and stakeholder interviews.

- *D. vexillum* prefers to grow on manmade structures.
- *D. vexillum* can spread by larval dispersal but also by fragmentation of colonies which can dislodge and settle elsewhere.
- Local conditions such as wave action, UV exposure and freshwater events such as surface water can all influence where it flourishes.
- Adhering to best practice, the biosecurity plan assumes that the *D. vexillum* risk is the same across the whole of Loch Fyne.
- *D. vexillum* is killed by natural methods such as desiccation (drying out) and prolonged exposure to freshwater. Any other treatments may require a licence and advice should be sought before taking action.
- Maintaining antifouling coatings and reducing biofouling on vessels is a useful step towards lowering risk.

Sector Specific Risk Assessment and Biosecurity Actions

The risk levels have been set according to the process outlined on page 13. Higher risk levels of 8 or 9 are highlighted in red. When a range of risk is quoted (e.g. moorings, after biosecurity actions are rated 5-7) this reflects the multiple uses and abilities to control risk across different sites and activities.

Recreation – Marina Services

Best Practice for Marine Leisure Sector including marina operators and commercial mooring owners.

- Read and circulate Check/Clean/Dry advice www.nonnativespecies.org/checkcleandry/
- Give staff basic identification training and guides.
- Encourage an open culture of reporting unusual sightings, including photographing and recording latitude/longitude.
- Identify high risk locations in your marina/site and monitor them for unusual growth e.g. near the lifting and wash-down area, on breakwaters or pontoons and on any vessels which do not regularly get used and have heavy fouling.
- Seek opportunities to work in partnership with research organisations or conservation groups to improve monitoring, training and reporting.

Activity	Risk description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk level before biosecurity actions	Risk level after biosecurity actions
Piers, conventional floating walkway pontoons (see Mooring Association section for flexible HDPE style pontoons)	Pontoons and piers, including their anchoring systems, are known to be a suitable habitat for <i>D. vexillum</i> .	Place signage raising awareness of invasive species and <i>D. vexillum</i> in prominent places. Discontinue pontoon scraping in the summer months. Scrape pontoon fouling in the winter if required and there have been no previous signs of <i>D. vexillum</i> .	A natural level of biofouling may provide some defence against <i>D. vexillum</i> settling. Scraping pontoons may alter this and provide open habitat suitable for <i>D. vexillum</i> settlement, especially during the main growing season (summer). Scraping during summer months (the main growing season) may risk fragmenting colonies of <i>D. vexillum</i> .	9	7

		Ask contractors doing maintenance surveys to look out for <i>D. vexillum</i> . Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Pontoons can provide a habitat for a range of INNS and so a cleaning regime in winter may reduce risk of establishment.		
Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Moorings	Moorings strops and chains have been shown to be a suitable habitat for <i>D. vexillum</i> .	Survey moorings annually. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot . Drop the moorings to the seabed in winter, if the seabed locally is muddy. If it is stony or sandy do not.	Smothering <i>D. vexillum</i> , and other biofouling, in mud should clean the chain. It will also reduce the available growing medium and reduce wear and tear. However, a stony or sandy seabed may increase the risk of spread so check before taking action.	6-8	5-7
Contractors	Contractors may move <i>D. vexillum</i> between sites through fragmentation or larval transport.	Write into terms and conditions that equipment must be clean on arrival and departure (Check/Clean/Dry). Circulate <i>D. vexillum</i> information and place signage on site as a reminder. Request that divers and contractors look out for, and report, any <i>D. vexillum</i> type colonies and report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Contractors are often the only people with regular sight of underwater structures and are therefore best placed to raise any alerts.	6	4

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Recreational vessels – T & Cs	All marine vessels are likely to carry INNS if they are present in the water column, even with fresh antifouling paint. Infrequent use decreases the effectiveness of the antifouling coating and increases the risk of colonisation.	<p>Encourage boaters to use their vessels regularly and haul out at least annually for scrub and reapplication of antifouling coating.</p> <p>Include in Terms and Conditions a clause to allow for heavily fouled vessels to be lifted out at the owners cost (see hull fouling ranking table in Annex D). Identify heavily fouled vessels and insist on haul out and clean.</p> <p>Encourage awareness of INNS and associated threats.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot</p>	<p>Frequent use of vessels makes ablative antifouling coatings work more effectively.</p> <p>Use of T & C clearly states the expectation of the site manager and allows for costs to be recouped.</p> <p>Cleaning heavily fouled vessels reduces the risk of colonies getting established.</p>	9	6
Wash down facilities	<p>Washing of boat hulls risks can fragmentation of any colonies increasing the potential to spread.</p> <p>Scrubbing off biofouling from vessels close to the sea e.g. on a slipway, will increase the risk of</p>	<p>Only scrape down boat hulls well away from MHWS, preferably into a collection area or onto a permeable surface.</p> <p>Wash down scrapings and run off should be trapped by an interceptor and disposed of to landfill or incinerator.</p>	<p><i>D. vexillum</i>, is killed by desiccation or prolonged exposure to freshwater.</p> <p>Ensuring material does not return to the water, and activities do not encourage fragmentation lowers risk.</p>	9	5-6

	<p>spreading viable material into receptive waters.</p> <p>In water cleaning of biofouling e.g. a boat in the water, may require a licence. In water cleaning of <i>D. vexillum</i> can cause viable material to fragment and disperse into receptive waters.</p>	<p>Halt boat wash down if <i>D. vexillum</i> is suspected. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot</p>			
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Recreation – Mooring Associations

Best Practice for marine leisure including yachts, RIBs, motorboats etc.

- Read and circulate Check/Clean/Dry advice www.nonnativespecies.org/checkcleandry/
- Use the correct antifoul for your boat and type of use. Apply and use the antifoul as directed by the manufacturers.
- Use your boat frequently to minimize the build-up of fouling and ensure the antifouling paint works effectively.
- When hauling out for wash down, do so as far away from the water's edge as possible, well above the extreme high-water line, and make sure none of the scrubbed off material gets back into the sea.
- If you are unable to use your boat regularly or have to leave it for a long period, consider having your boat hauled out and dry stored.
- If your mooring is on a muddy seabed, drop your mooring in winter to smother any fouling which has accumulated through the season. NB this will not work, and should not therefore be recommended for biosecurity, if there is a sandy or rocky seabed.

Activity	Risk assessment before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk level before biosecurity actions	Risk assessment after biosecurity actions
Recreational vessels	<p>All marine vessels are likely to carry INNS if they are present in the water column, even with fresh antifouling paint.</p> <p>Infrequent use decreases the effectiveness of the antifouling coating and increases the risk of colonisation.</p>	<p>Encourage boaters to use their vessels regularly and haul out at least annually for scrub and reapplication of antifouling coating.</p> <p>Include in Mooring Association rules a clause to encourage all vessels to be lifted and cleaned.</p> <p>Encourage awareness of INNS and associated threats.</p>	<p>Frequent use of vessels makes ablative antifouling coatings work more effectively.</p> <p>Use of Mooring Association rules states the expectations for biosecurity and potentially allows for costs to be recouped from the owners of the vessels.</p> <p>Cleaning heavily fouled vessels reduces well away from the waters edge reduces the risk of colonies getting established and of spreading <i>D. vexillum</i>. (see hull fouling ranking in Annex D).</p>	9	6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Moorings - Recreational Vessel (private, mooring association, visitor etc)	Moorings strops and chains have been shown to be a suitable habitat for <i>D. vexillum</i> .	<p>Survey moorings annually. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p> <p>Drop the moorings to the seabed in winter, if the seabed locally is muddy. If it is stony or sandy do not.</p> <p>If moorings are not well used consider permanent removal.</p>	Smothering <i>D. vexillum</i> , and other biofouling, in mud should clean the chain. It will also reduce the available growing medium and reduce wear and tear. However, a stony or sandy seabed may increase the risk of spread so check before taking action.	6-8	5-7
Light use high density polyurethane (HDPE) flexible pontoons used by recreational boaters for short stays and landing only	Pontoons, including their anchoring systems, are known to be a suitable habitat for <i>D. vexillum</i> .	<p>Discontinue pontoon scraping/cleaning in the summer months.</p> <p>Scrape pontoon fouling in the winter if required and there have been no previous signs of <i>D. vexillum</i>.</p> <p>Request that anyone inspecting the pontoons looks out for <i>D. vexillum</i>.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p>	<p>A natural level of biofouling may provide some defence against <i>D. vexillum</i> settling. Scraping pontoons may alter this and provide open habitat suitable for <i>D. vexillum</i> settlement, especially during the main growing season (summer).</p> <p>Scraping during summer months (the main growing season) may risk fragmenting colonies of <i>D. vexillum</i>.</p> <p>Pontoons can provide a habitat for a range of INNS and so a cleaning regime in winter may reduce risk of establishment.</p> <p>Monitoring and haul out of pontoons during the winter also lowers risk.</p>	6	5

Aquaculture – Fin Fish

Best practice for aquaculture – NB many actions will already be in place under measures designed to maintain stock health and pathogen control, the following will further lower risks associated with NNS.

- Identify any high risk issues not already covered by pathogen controls and decide on relevant actions e.g. survey before movement of feed barges.
- Give staff basic identification training and ID guides.
- Encourage an open culture of reporting unusual sightings including photographing and recording latitude/longitude.
- Refer to Marine Scotland and relevant Producer Organisations for best practice advice.

Activity	Risk assessment before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk level before biosecurity actions	Risk assessment after biosecurity actions
Nets/cages - in situ	Whilst the large number of cages presents a significant amount of growing surface nets are usually dipped in an antifouling solution before deployment and/or cleaned by rotary disc on a circa 10-14 day cycle which ensures that biofouling does not accumulate.	Net washing team are provided with identification information and asked to look for <i>D. vexillum</i> . If found, they will take pictures and report to biosecurity manager. Net washing will be stopped at that area, but the team will continue to clean the rest of the net. SSC will report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	The constant cleaning of the cages means <i>D. vexillum</i> colonies are unlikely to get established.	6	4

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Nets/cages - movements	<i>D. vexillum</i> present on the nets may be put under stress and/or disturbed by movement, potentially causing larvae release and/or fragmentation of colonies. A quantity of water will be retained by the nets which are then transferred to the shore base and onwards to other terrestrial sites for storage etc.	Check nets before movement Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot and do not move the nets until advice has been received from Marine Scotland.	Once the fish have been removed net cleaning may stop for a period of time and <i>D. vexillum</i> may get a further opportunity to colonise.	5	4
Fin fish cages flotation rings/ buoyancy collar/Froya rings	Whilst the rings present a large growing surface they are also checked and cleaned every two years. Froya rings, used to weight the net bases, may accumulate significant biofouling during the production cycle.	Provide identification information to the washing team. Any sightings result in wash down being halted and a report sent to biosecurity manager and on to Marine Scotland via MarineNonNativeS@gov.scot . No further action until advice has been received from Marine Scotland. Survey any Froya rings or net weight systems for <i>D. vexillum</i> colonies when periodic infrastructure checks are done. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Vigilance is key to assessing the risk of <i>D. vexillum</i> colonising these structures.	6-7	4-5

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Feed barges	The man-made surface of a feed barge is a highly suitable growing medium for <i>D. vexillum</i> .	Feed barges are to be checked for <i>D. vexillum</i> prior to cleaning every 2 years (usually during June to Sept), if suspected areas are identified stop cleaning and report to biosecurity manager who will report to Marine Scotland by email to MarineNonNativeS@gov.scot .	The cleaning and maintenance of feed barges is a critical control point. Identifying suitable materials to wrap a colonised barge would be helpful as a contingency plan.	8	5
Cage and barge mooring lines and anchors	Moorings and chains are known to be suitable habitat for <i>D. vexillum</i> .	Moorings and chains are to be surveyed every cycle (approx. 2 years) and divers asked to check for <i>D. vexillum</i> like growths. If suspect colonies are found pictures to be taken and submitted to biosecurity manager who will report to Marine Scotland by email to MarineNonNativeS@gov.scot .	As it is not possible to drop the moorings or remove them, the annual surveys provide an opportunity for early warning of any issues.	7	6
RIBs/ workboats	The boats are in constant use and therefore have a low fouling burden. They are hauled out and washed every 200hrs of use (approx. every 2 months). All surfaces above the water are disinfected between site movements.	Provide <i>D. vexillum</i> identification materials and use the monthly wash down as an opportunity to check for <i>D. vexillum</i> . Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot . Wash down well away from the water's edge (e.g. MHWS plus 150 m) and onto a permeable surface, if possible.	Lack of hull fouling lowers risk, however the monthly haul out can damage antifouling coating and should be checked and maintained before relaunch.	4	3

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Landing craft	The boats are in constant use (low fouling burden) and hauled out and antifouled every 2 years. All surfaces above the water are disinfected between site movements. However due to the slower hull speeds, movement out of Loch Fyne for maintenance and lack of regular under water survey they are a higher risk than the RIBs.	<p>If hull fouling begins to build up e.g. if the vessel is not used for a period of time, a dive survey should be carried out before movement out of Loch Fyne.</p> <p>If <i>D. vexillum</i> is suspected report Marine Scotland by email to MarineNonNativeS@gov.scot and do not move the boat until advice has been received.</p>	<p>Vessels should only be washed down out of the water and well away from the waters edge.</p> <p>Landing craft, and other vessels which are too large to be hauled out within Loch Fyne risk spread of <i>D. vexillum</i> to other areas should they become colonised.</p>	7	6 -5
Well boats	Well boats which service sites across the west coast harvesting and treating fish throughout the production cycle.	<p>Check the discharge protocol and cleaning regime to ensure that it is effective against <i>D. vexillum</i>.</p> <p>Antifoul regime must be maintained, and any damaged areas repaired quickly.</p> <p>Alert skippers to the biosecurity risk in Loch Fyne.</p> <p>Check moorings and pier head for any signs of <i>D. vexillum</i> and report any suspected sightings Marine Scotland by email to MarineNonNativeS@gov.scot.</p>	<p>UV filters, ionisation and ozonation are not known to be effective against <i>D. vexillum</i>. See Annex A for details about larvae sizes.</p> <p>The wells, decks and structures are regularly cleaned and disinfected.</p> <p>The wells are closed between pick up in Loch Fyne and discharge at Strone in Loch Striven.</p>	5-6	5-4

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Water intake and treatment infrastructure	Saltwater for shore based fish rearing facilities is pumped into 3 layers of filtration (drum, sand and UV) which removes almost 100% of biological material.	Provide <i>D. vexillum</i> identification materials and regularly check the filters for any suspect material. If any suspicious material is found collect a sample, freeze or preserve in alcohol or similar before reporting to Marine Scotland by email to MarineNonNativeS@gov.scot .	UV filters, ionisation and ozonation are not known to be effective against <i>D. vexillum</i> and other ascidians. It is possible that some physical filters, which can filter out the larvae, will reduce the risk, check with your supplier for details. See Annex A for larvae sizes.	2	2
Rearing Tanks	All rearing tanks using saltwater use filtered water from Loch Fyne. It is possible that the physical filters will filter out the <i>D. vexillum</i> larvae, and therefore reduce the risk, however it is advisable to check with your supplier for details. See Annex A for larvae sizes.	Continue to monitor for signs of <i>D. vexillum</i> within the filtration system and in the tanks. Ensure the filtration system is working effectively at all times.	Despite the filtration system, the ideal growing conditions at a hatchery may provide an opportunity for <i>D. vexillum</i> to proliferate so vigilance is encouraged.	3	3
Fish movement	All fish are moved only with filtered water from Loch Fyne. It is possible that the physical filters will filter out the <i>D. vexillum</i> larvae, and therefore reduce the risk, however it is advisable to check with your supplier for details. See Annex A for larvae sizes.	Continue to monitor for signs of <i>D. vexillum</i> within the filtration system and in the tanks. Ensure the filtration system is working effectively at all times. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Despite the filtration system the ideal growing conditions may provide an opportunity for <i>D. vexillum</i> to proliferate.	3	3

Aquaculture – Shellfish, including static gear fishing (creel)

Best practice for aquaculture including shellfish farming and creel fishing

- Give staff basic identification training and ID guides, place posters in prominent positions.
- Encourage an open culture of reporting unusual sightings including photographing and recording latitude/longitude.
- Refer to Marine Scotland and relevant producer organisations for best practice advice.

Activity	Risk assessment description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk level before biosecurity actions	Risk assessment after biosecurity actions
Oysters and mussels-selling stock on for consumption	All products go for consumption, not for growing on.	If 'sale for consumption only' model changes, it may significantly alter the risk associated with this activity. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Depuration and cleaning of product may still lead to spread of <i>D. vexillum</i> .	5	5

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Oysters and mussels - buying stock in for growing on prior to selling for consumption	It is possible that shellfish coming on site may carry <i>D. vexillum</i> .	<p>Monitor shellfish coming on site for any signs of <i>D. vexillum</i>.</p> <p>Ask all suppliers to check their stock for any signs of <i>D. vexillum</i> like material.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p>	<p>Spat bought in is currently only routinely tested for shellfish diseases, they are not tested for invasive species.</p> <p>It may not be a requirement to report the sighting of an INNS in the stock source area, as it is in Scotland (See Scottish Code of Practice in Invasive Non Native Species) so it is important to ask the supplier for assurances.</p>	5-9	5
Workboats	Businesses use a range of small vessels to service their sites.	Continue maintenance regime with boats including annual haul out and antifouling regime.	The boats are in regular use and are well maintained with regular haul out and antifouling regime.	6	4
Landing craft	Landing craft are used to move heavy cargo mostly within Loch Fyne. (Unlike landing craft used in fin-fish production they are not disinfected between sites.)	<p>Haul out annually and antifoul to reduce biofouling.</p> <p>Wash down the deck and avoid moving material including sediments and seaweed between sites.</p> <p>Repair any damage to antifouling coating from groundings.</p>	Landing craft cannot be hauled out within Loch Fyne and so risk spread of <i>D. vexillum</i> should they become colonised.	8	6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Moorings - workboats	Moorings strops and chains have been shown to be a suitable habitat for <i>D. vexillum</i> .	<p>Survey moorings annually. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p> <p>Drop the moorings to the seabed in winter, if the seabed locally is muddy. If it is stony or sandy do not.</p>	Smothering <i>D. vexillum</i> , and other biofouling, in mud should clean the chain. It will also reduce the available growing medium and reduce wear and tear. However, a stony or sandy seabed may increase the risk of spread so check before taking action.	6-8	5-7
Locally grown oysters	Movement of live stock from environmentally similar areas, including spat importation, has potential to be high risk.	<p>Regularly check stock for any signs of <i>D. vexillum</i>. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p> <p>Circulate information about <i>D. vexillum</i> to all relevant staff and make posters available on site.</p> <p>Ask suppliers if they have <i>D. vexillum</i>, and/or how they check for signs of infection.</p>	It may not be a requirement to report the sighting of an INNS in the stock source area, as it is in Scotland (See Scottish Code of Practice in Invasive Non Native Species) so it is important to ask the supplier for assurances.	9	6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Oyster and mussel processing	Oysters and mussels are received from across the UK and depurated in tanks using Loch Fyne saltwater. There is no filter on water in or out pipes. All shellfish go for consumption.	<p>Consider using an appropriate filter (see Annex A for further information about larvae size) to filter the water being used for depuration to lower risk.</p> <p>Send <i>D. vexillum</i> poster to all suppliers.</p> <p>Ask all suppliers to check their stock for any signs of <i>D. vexillum</i> like material and report any suspected sightings to Marine Scotland by email to MarineNonNativeS@gov.scot.</p>	<p><i>D. vexillum</i> can be fragmented and spread during the collection, depuration and cleaning processes. This is a useful visual inspection point.</p> <p>It may not be a requirement to report the sighting of an INNS in the stock source area, as it is in Scotland (See Scottish Code of Practice in Invasive Non Native Species) so it is important to ask the supplier for assurances.</p>	6	4
Oysters and mussels - husbandry	Oysters and mussels, and associated infrastructure such as trestles and ropes, provide a suitable habitat for <i>D. vexillum</i> to grow on. Importing spat is a high-risk activity as sites which are registered as disease free are not necessarily tested for invasive species.	<p>Monitor shellfish for any signs of <i>D. vexillum</i>. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p> <p>Ask suppliers of spat what biosecurity actions they take, particularly with regard to <i>D. vexillum</i>. Consider isolating the transported spat for monitoring and/or treatment.</p>	<p>It may not be a requirement to report the sighting of an INNS in the stock source area, as it is in Scotland (See Scottish Code of Practice in Invasive Non Native Species) so it is important to ask the supplier for assurances.</p>	9	5

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Creel boats and creels/keeps	It is known that creels and keeps are a suitable habitat for <i>D. vexillum</i> .	<p>Monitor creels and keeps for <i>D. vexillum</i> settlement. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p> <p>Keeps and creels to be cleaned at the designated space made available by Tarbert Harbour Authority as per their recent notice and air dried as often as possible.</p>	<p>Air drying and cleaning of creels and keeps is an important biosecurity action.</p> <p>Restricting cleaning to a designated area allows for washdown material to be collected and disposed to landfill.</p>	7	5

Port Authority, ferry operators and shipping

Best practice for shipping including ferries, extractive industries, bulk goods transport and short sea shipping – NB actions may already be in place under measures such as Ballast Water Convention or IMO guidelines on hull fouling.

- Identify high risk areas for additional monitoring e.g. areas where high risk (long distance or Short Sea Routes from high risk ports with significant additional INNS) vessels dock. Monitor these areas for unusual growth patterns at least quarterly at mean low water springs (MLWS).
- For Short Sea Routes (SSR), have a policy to encourage mid water transfer or complete cycling of ballast water between ports.
- Include survey for *D. vexillum* in routine structural surveys.
- Give staff basic training and identification guides.
- Encourage an open culture of reporting sightings including photographing and recording latitude/longitude.
- Refer to credible organisations such as International Maritime Organisation (IMO) for best practice advice.
- Seek opportunities to work in partnership with research organisations or conservation groups to improve monitoring, training and reporting.

Activity	Risk assessment description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk assessment before biosecurity actions	Risk assessment after biosecurity actions
Management of the harbour	The broad range of activities and habitats that the Port is responsible for puts them at high risk from INNS.	A Biosecurity Manager has been appointed. Biosecurity plans are requested for high risk works licence applications.	Although the Harbour Authority, Peelports, does not operate any shipping in the area or have moorings in Loch Fyne, the Harbour Authority needs to be aware of biosecurity and to integrate it into its management of the area.	8	7

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Awareness of INNS	Port Authority stakeholders need to be aware of the issues and be empowered to report sightings.	Biosecurity awareness raising workshops have been held. A poster has been circulated in 2018 to recreation and marina contacts within the Clyde about <i>D. vexillum</i> .	Encouraging relevant stakeholders to take action is an important part of reducing the biosecurity risk.	8	7
Biosecurity planning	The Harbour Authority has run a series of 3 UK wide biosecurity meetings with stakeholders looking at pathways, users and awareness with the ambition to write biosecurity plans for all their ports. The biosecurity plans have not yet been finalised.	Consider completion of the biosecurity plan for the Loch Fyne area as a priority.	The complexity of Port Authority operations and ability to ensure compliance will limit the ability to reduce risk.	8	6
Works licences	Works licences are a critical control point where actions to reduce risk can be taken by those undertaking the activity, offering considerable control for the Port Authority.	When assessing works licences Peelports now request that a biosecurity risk assessment is included in higher risk submissions.	It is not stipulated how this should be carried out and the results are not audited.	8	6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Bulk goods transportation e.g. forestry shipments	A temporary barge forms a pontoon and allows access to vessels removing timber.	<p>Check the barge for signs of <i>D. vexillum</i> when infrastructure and safety inspections are carried out.</p> <p>Contact Marine Scotland before moving the barge at the end of the cycle (circa 10+ years).</p> <p>Circulate <i>D. vexillum</i> poster and information to all relevant staff and contractors and encourage Check/Clean/Dry approach.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p>	<p>The ships are in Loch Fyne and alongside the barge for 1-2 days while they are stocked.</p> <p>They take short sea routes across to processing sites in Ayrshire and in the Republic of Ireland.</p> <p>The ships do not take on ballast water in Loch Fyne.</p> <p>The barge/pontoon presents a suitable growing surface to <i>D. vexillum</i>.</p>	7-8	5-6
Ferry operations	Calmac ferries run regular transportation services in Loch Fyne from Tarbert across to Portavadie and down to Arran.	<p>Check ferries, piers and pontoons for signs of <i>D. vexillum</i> when infrastructure and safety inspections are carried out.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p>	<p>The constant use of the ferries will keep biofouling to a minimum however the repetitive nature of the journeys make transportation of viable material more likely.</p> <p>Calmac are drafting a biosecurity plan for their activities and have placed <i>D. vexillum</i> information at prominent sites in Loch Fyne.</p>	6	5

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Dredging contracts	Dredging is seen as a high-risk activity with disturbance, fragmentation and movement of material all concerns.	<p>Dredging contracts include a request for contractors to follow the 'Check Clean Dry' approach, taking care to remove any sediments outside of the hold before leaving the area.</p> <p>Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot.</p>	It is not clear how Check/Clean/Dry should be carried out and the outcomes are not audited.	8	7

Tourism – Marine Based

Best practice for Small Scale Marine Leisure including dinghy sailors, trailer sailors, kayakers, divers etc.

- Rinse everything with fresh water after use.
- Dry out anything you can between uses.
- Do not move sediment, water or other material such as weed from one site to another e.g. on wet/dry suits, tanks, dinghies, outboards etc.
- Read and circulate Check/Clean/Dry advice www.nonnativespecies.org/checkcleandry/

Activity	Risk assessment description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk assessment before biosecurity actions	Risk assessment after biosecurity actions
Paddle steamer	The Waverley uses Loch Fyne on a weekly basis in the summer. She also overnights in Largs each week. However, she is well maintained and antifouled annually in April at Greenock. She also has a permanent berth at the Science Museum in Glasgow which has a significant freshwater influence, creating a natural biosecurity measure.	<p>Circulate the poster to relevant people. Make copies available at relevant sites.</p> <p>Encourage vigilance and reporting by all staff.</p> <p>When undertaking routine dive surveys request that divers look out for, and report, signs of <i>D. vexillum</i>.</p> <p>Should Waverley's home berth change biosecurity should be considered when a new berth is identified.</p>	Her potential exposure to <i>D. vexillum</i> puts her at a relatively high risk of picking up some <i>D. vexillum</i> .	7	5

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Piers, conventional pontoons and flexible high-density polyurethane (HDPE) pontoons	Piers and pontoons, including their anchoring systems, are known to be a suitable habitat for <i>D. vexillum</i> .	<p>Place signage raising awareness of invasive species and <i>D. vexillum</i> in prominent places.</p> <p>Discontinue pontoon scraping/cleaning in the summer months. Scrape pontoon fouling in the winter if required and there have been no previous signs of <i>D. vexillum</i>.</p> <p>Ask contractors doing maintenance surveys to look out for <i>D. vexillum</i>.</p> <p>Take opportunity at MLWS, if safe to do so, to monitor exposed surfaces for signs of <i>D. vexillum</i>.</p>	<p>A natural level of biofouling may provide some defence against <i>D. vexillum</i> settling. Scraping pontoons may alter this and provide open habitat suitable for <i>D. vexillum</i> settlement, especially during the main growing season (summer).</p> <p>Scraping during summer months (the main growing season) may risk fragmenting colonies of <i>D. vexillum</i>.</p> <p>Pontoons can provide a habitat for a range of INNS and so a cleaning regime in winter may reduce risk of establishment.</p>	9	7
Boats (leisure)	Leisure vessels ranging from dinghies to larger sailing yachts and powered craft are all used on Loch Fyne for a range of tourism purposes.	<p>Posters to be placed at slipways, access points and caravan parks and onto social media to raise awareness.</p> <p>Antifouling coating to be maintained. Boats hauled out at least annually to clean and reapply antifouling coating.</p> <p>Wash down the deck and anchors, empty voids such as bait wells and bilges to avoid moving material including water, sediments and seaweed between sites.</p>	Risk cannot be eliminated due to the wide range of potential activities and methods of communication/compliance by individuals.	6-8	3-6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Moorings	Mooring strops and chains have been shown to be a suitable habitat for <i>D. vexillum</i> .	Survey moorings annually. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot . Drop the moorings to the seabed in winter, if the seabed locally is muddy. If it is stony or sandy do not.	Smothering <i>D. vexillum</i> , and other biofouling, in mud should clean the chain. It will also reduce wear and tear. However, a stony or sandy seabed may increase the risk of spread so check before taking action.	6-8	5-7
Divers	Visiting recreational divers do mostly shore dives around the loch. The minority use boats. No drying room available.	No organised club has been identified within Loch Fyne. Information circulated via BSAC, Sea Search and locally. Report any suspected sightings to Marine Scotland MarineNonNativeS@gov.scot .	Divers generally wash down and dry kit during regular maintenance.	5	3
Tenders	Tenders for commercial tourist boats have antifouling coating.	Ensure that antifouling coating is maintained, and that damage caused during landings is touched up regularly.	These boats are used regularly but do remain in the water all season, tethered behind the mother ship.	4	3
Accommodation	Land based accommodation.	Include biosecurity information in welcome pack.	Useful place to raise awareness of the issues.	0	0

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Crinan canal	The Canal may act as an inoculation for boats moving from salt to freshwater. Also, a valuable opportunity to give out information about <i>D. vexillum</i>	Poster to be handed out with the licences. Staff to encourage vigilance and reporting.	<i>D. vexillum</i> cannot tolerate lengthy immersion in freshwater and so may not survive transit through the Canal on the hull of an infected vessel.	4	3

Mooring Contractors

Best practice for commercial Marine Operations including diving, maintenance and construction companies.

- Train your staff to be alert to unusual growth in the marine environment.
- All wash down should be done away from the water's edge and no runoff should return to the Loch.
- Give staff basic training and identification guides.
- Encourage an open culture of reporting sightings including photographing and recording latitude/longitude.
- Refer to Marine Scotland for best practice advice.

Activity	Risk assessment description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk assessment before biosecurity actions	Risk assessment after biosecurity actions
Divers	Due to their work activities commercial divers may be in regular contact with <i>D. vexillum</i> material in Loch Fyne.	<p>All teams asked to look for <i>D. vexillum</i>. Particularly if working in Loch Fyne. If found, report to SEARS/Marine Scotland.</p> <p>Employ check/clean/dry before leaving any site. Create paper trail to prove due diligence.</p> <p>Consider creating a biosecurity plan for wider operations.</p> <p>Copy of <i>D. vexillum</i> poster at shore site and copies on vessels.</p>	Divers wash down and dry kit during regular maintenance.	8	6

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Boats (workboats)	As workboats are in close contact with potentially infected materials there is a high risk of fragmentation of colonies and/or moving material.	Inspect hull/subsea equipment before leaving any work site. Check decks, anchors etc. are cleaned of any sediments or material before leaving an area.	Boats are in regular use and hull fouling should therefore be minimal.	8	6
Mooring maintenance or other infrastructure work	As contractors are in close contact with potentially infected materials there is a higher risk of fragmenting or moving material.	If any <i>D. vexillum</i> is suspected stop operations in that area and report any suspected sightings to Marine Scotland by email to MarineNonNativeS@gov.scot .	Pendulous growths of <i>D. vexillum</i> is easily fragmented and should be treated with care.	8	6

Fishing - Mobile gear (trawling)

Best practice for trawl fishing boats.

- Give staff basic training and identification guides.
- Do not move sediment or other material such as weed out of the area, washdown before moving the vessel.
- Encourage an open culture of reporting sightings including photographing and recording latitude/longitude.
- Refer to Marine Scotland for best practice advice.

Activity	Risk assessment description before biosecurity actions	Range of biosecurity actions agreed	Justification	Risk assessment before biosecurity actions	Risk assessment after biosecurity actions
Moorings	Moorings strops and chains have been shown to be a suitable habitat for <i>D. vexillum</i> .	Survey moorings annually. If any <i>D. vexillum</i> is suspected notify Marine Scotland/SEARS. Drop the moorings to the seabed in winter, if the seabed is muddy. If it is stony or sandy do not.	Smothering <i>D. vexillum</i> , and other biofouling, in mud should clean the chain. It will also reduce the available growing medium and reduce wear and tear. However, a stony or sandy seabed may increase the risk of spread so check before taking action.	6-8	5-7

Activity	Risk description	Range of biosecurity actions agreed	Justification	Risk before	Risk after
Fishing boats and gear	Most boats are in regular use (low fouling burden) and hauled out and antifouled approximately every 2 years. However due to the slower hull speeds, movement out of Loch Fyne and constant seabed interactions (depending on gear type) they are a higher risk than some other boat types.	<p>If hull fouling begins to build up e.g. if the vessel is not used for a period of time, a dive survey should be carried out before movement out of Loch Fyne.</p> <p>If <i>D. vexillum</i> is suspected report to Marine Scotland by email to MarineNonNativeS@gov.scot and do not move the boat or gear until advice has been received from Marine Scotland.</p> <p>Avoid moving any sediment or other material in or out of Loch Fyne.</p>	<p>Vessels should only be washed down out of the water and well away from the waters edge.</p> <p>Fishing boats, and other vessels which are too large to be hauled out within Loch Fyne risk spread of <i>D. vexillum</i> to other areas should they become colonised.</p>	8	5-7

Annex A: *D. Vexillum* – Further biological information

The larvae are around 400µm in diameter (0.4 mm) and generally are released when the water reaches the ideal growing temperature of around 14 to 20° C or if the colony is stressed e.g. by disturbance, and stops in the range of 9 to 11° C. The colonies have been shown to survive a range of temperatures from -2 to +24° C. There is some research to support the idea that fluctuating temperatures seem to slow down *D. vexillum* reproduction, meaning areas where there are steady temperatures may be more susceptible to colonisation.¹⁰

D. vexillum has been observed to grow in Scotland in the intertidal zone and internationally has been seen to grow down to depths in excess of 60 m. It generally prefers areas where it is protected from wave action and where faecal matter will be washed away.

The Carpet Sea Squirt is tolerant of a range of salinities, however it has been shown that it prefers higher salinities with the range of 26–30 psu¹¹ optimal for growth compared to medium and low salinities i.e. 15–28 psu, 10–26 psu, and the colonies tend to die off below 20 psu¹²

¹⁰ Valentine, Page & Carman, Mary & Dijkstra, Jennifer & Blackwood, Dann. (2009). Larval recruitment of the invasive colonial ascidian *Didemnum vexillum*, seasonal water temperatures in New England coastal and offshore waters, and implications for spread of the species. *Aquatic Invasions*. 4. 153-168. 10.3391/ai.2009.4.1.16.

¹¹ psu – Practical Salinity Unit – oceanic seawater is considered 35 psu

¹² In situ growth of the colonial ascidian *Didemnum vexillum* under different environmental conditions. Bullard and Whitelatch, 2009

Annex B: Contingency Planning, Stop Events and Development

Biosecurity planning cannot anticipate all events and, particularly in the marine environment, new invasions can occur, and invasive species can still proliferate.

Timing can be critical when responding to a new threat such as *D. vexillum* being found in a new area or in larger colonies than previous experience, and a rapid response is important. Government agencies may be responsible for many of the resulting actions, but the community have a clear role especially in raising the alert.

Upon receiving a report of a non-native species, for example when an operator calls a stop event, Marine Scotland in partnership with other expert bodies, will assess risk and determine an appropriate response. The following table provides an indication of the steps undertaken.

What	What	When	Who
Raise the alert	SEARS Hotline (0845 230 2050 or email MarineNonNativeS@gov.scot) Provide details of date, location, take photographs and send to Marine Scotland.	Immediately	Anyone can raise an alert!
Rapid Response team	Marine Scotland will liaise with relevant experts to assess risk and determine action	Immediately	Marine Scotland
Confirm identification	Marine Scotland will facilitate collection of samples and confirm identification	ASAP	Marine Scotland
Survey	Survey may be necessary to define size of new colony/expansion	ASAP but seasonal considerations of growth stages, dive suitability etc. will need to be taken into account.	Marine Scotland, or another expert partner
Identify pathway/vector of spread	Carry out pathway analysis and risk assessment.	ASAP	Marine Scotland, or another expert partner using local information.
Consider management options	Consider eradication, control, and containment. Can this be controlled or contained?	ASAP	Marine Scotland, together with local businesses site operator, vessel owner, local enterprise as appropriate.

Strengthen containment options	Risk of spread to new locations. Options considered appropriate and proportionate to the situation – e.g. removal/cleaning of vessel, treatments, equipment de-fouling.	ASAP	Local stakeholders, vessel owners, Marine Scotland, SNH, SEPA, national associations such as Scottish Salmon Producers Organisation, Association of Scottish Shellfish Growers or national sporting authorities.
Communications response	Inform loch users and wider public	Once survey and mitigation response are complete or in the interim if helpful to local community	Marine Scotland and partners, local community, national bodies and trade organisations.

Other biosecurity alerts

Biosecurity threats leading to a stop event could include the arrival of certain types of vessels or towed structures which may be heavily fouled (see Annex D, hull fouling ranking), significant marine debris, new activities and pathways or the establishment of *D. vexillum* in new areas.

Early investigation and information gathering are important e.g. vessel details, movement, arrival, state of fouling etc. and can be done by a range of stakeholders including the public, the Mooring Association and agencies such as SNH, Marine Scotland or SEPA. If an activity is observed which causes concern regarding biosecurity, details should be taken and reported via the SEARS helpline or via email to MarineNonNativeS@gov.scot so advice can be given by Marine Scotland.

Annex C: Response to Future Developments

Guidance on responding to possible future developments/changes in Loch Fyne

It is likely that new developments, projects, activities and enterprises will be proposed for Loch Fyne. As with existing activities they could pose some level of biosecurity risk. The following types of activity could include:

Proposal/Activity	Biosecurity Risk Factors
New shellfish and finfish farms	Risk of introducing INNS and offer submerged surfaces suitable for growing INNS including <i>D. vexillum</i> .
New swinging moorings	Activity of laying the mooring may disturb and spread NNS, creation of artificial substrate could offer suitable growing substrate, increase numbers of visiting vessels which could increase risk of INNS spread.
Construction of new slipways, jetties and major repairs to existing structures	Biosecurity risk increased during the construction phase especially the use of construction barges. Creation of artificial substrates increase the growing medium, risk of new and repeated introduction of INNS could be increased by the use of facilities.
New recreation enterprises e.g. sea kayaking centre	New pathways

This biosecurity plan would apply to future activities. Actions to minimise the risk associated with activity could also be addressed in the future by discussing biosecurity in pre-planning interactions and making appropriate biosecurity planning and actions a condition of consent for Town and Country Planning (Argyll and Bute Council), Wildlife Legislation (SNH) and Marine Licensing (MS-LOT and Crown Estate Scotland).

This approach is becoming the standard for developments in the marine environment. Depending on the type of activity and the risk associated with it, consent conditions could include a requirement for a particular biosecurity action, e.g. dropping a mooring to smother fouling (if the seabed is suitable) or require that a biosecurity plan is developed. Consent conditions will have to be realistic, achievable and proportionate, but the following indicates a range of conditions which could be considered:

- The contractor/applicant must submit a Biosecurity Plan/Risk Assessment to the licence authority for written approval at least 6 weeks prior to commencement of the works. No works may be undertaken prior to written agreement from the licencing authority.
- The contractor/applicant must submit an updated Biosecurity Risk Assessment for written approval by the licencing authority by a specified time.

- The Licence Holder must ensure that any actions outlined in the documents detailed in conditions above are implemented as approved in writing by the licencing authority. Any proposed changes to the actions outlined in the Biosecurity Risk Assessment must be submitted to, and agreed in writing by the licencing authority prior to any changes being enacted.
- The contractor/applicant/licence holder must ensure that all equipment, materials, machinery and Personal Protective equipment (PPE) used are in a clean condition prior to their arrival on site to minimise risk of introducing non-native species into the marine environment.

Annex D: Hull Fouling Ranking

To assist in identifying high risk vessels an internationally accepted ranking of hull fouling is described below.

Rank	Description	Visual estimate of biofouling cover
0	No visible fouling. Hull entirely clean, no biofilm on visible submerged parts of the hull.	Nil
1	Slime fouling only. Submerged hull areas partially or entirely covered in biofilm, but absence of any plants or animals.	Nil
2	Light fouling. Hull covered in biofilm and 1–2 very small patches of one type of plant or animal.	1–5 % of visible submerged surfaces
3	Considerable fouling. 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. 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. Many different types of plant and/ or animal covering most of visible hull surfaces.	41–100 % of visible submerged surfaces