

LOCH CRERAN

COMMUNITY LED MARINE BIOSECURITY PLAN TO SUPPORT AN 'ACTIVE LOCH'



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THIS PLAN WAS FUNDED BY MARINE SCOTLAND AND HAS BEEN DEVELOPED BY THE USERS AND COMMUNITY OF LOCH CRERAN, ARGYLL, SCOTLAND WITH THE SUPPORT OF SARAH BROWN OF C2W, DR ELIZABETH COTTIER-COOK AND EUAN PATERSON OF SAMS AND ROBIN PAYNE.

All actions within the plan are undertaken on a voluntary basis.

Contents

Glossary.....	3
REPORTING	4
About Non Native and Invasive Species	5
What Does the Law Say?.....	5
About <i>Didemnum vexillum</i> (<i>D vex</i>)	6
Biosecurity Planning.....	8
Control and Containment of <i>D vex</i>	9
About Loch Creran	11
Pathway / Vector Analysis, Risk Assessment and Biosecurity Actions.....	13
Monitoring and Observation	32
Further Research and Useful Projects	34
Best Practice Advice by Sector	35
Ownership of the Plan	39
Annex A: Legal Context in Scotland	40
Annex B: Contingency Planning	42
Annex C: Response to Future Developments	45
Annex D: FAQ's.....	47
Annex E: Risk Assessment.....	50
Annex F: Case Studies	51
Annex G: Sources of Further Information.....	52
Annex H: Hull Fouling Ranking.....	54

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GLOSSARY

AAG – Area Advisory Group

AFC - Antifoul Coatings

AIS - automatic identification system is an automatic tracking system used for collision avoidance on ships and by vessel traffic services (VTS)

Alert Species – A list of species of particular concern by [GB Non-Native Species Secretariat](#)

ASSG - Association of Scottish Shellfish Growers

BWC – Ballast Water Convention

D vex - *Didemnum vexillum*, commonly known as the ‘carpet sea squirt’

Horizon Scanning – Assessing what species are likely to arrive next

INNS – Invasive Non-Native Species

IMO – International Maritime Organisation

MLWS – Mean Low Water Springs

MPA – Marine Protected Area

MS – Marine Scotland – Directorate of the Scottish Government and is responsible for the integrated management of Scotland's seas

MS-LOT – Marine Scotland Licensing Operations Team

MSS – Marine Scotland Science - the scientific Division of Marine Scotland

Native range - the locality to which the animal or plant of that type is indigenous.

NNS – Non-Native Species

PPE – Personal Protective Equipment

Rapid Response – Taking rapid action after discovery of a NNS

Release (of a non-native animal) - when an animal is released so that it is no longer under human control.

ROV – Remotely Operated Vehicle

SAC – Special Area of Conservation

SAMS – Scottish Association for Marine Science

SEARS – Scotland’s Environmental and Rural Services

SEPA – Scottish Environmental Protection Agency

SNH – Scottish Natural Heritage

SSR – Short Sea Route

Stakeholder – interested individuals and organisations

The wild - Arable and horticultural land, improved pasture, settlements, private and public gardens are not generally considered to be 'in the wild' - just about everywhere else is.

Vessel – any waterborne item including boats, kayaks, ships, fish farm infrastructures etc

UHI – University of the Highlands and Islands

REPORTING

WHAT TO DO IF YOU THINK YOU'VE SEEN DIDEMNUM VEXILLUM, THE CARPET SEA-SQUIRT (*D VEX*)

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. **CALL** Scotland's Environmental and Rural Services (SEARS) Helpline on 0845 230 2050. They will pass your report and photos onto the relevant authority who will be able to respond quickly. Alternative contacts given on page 52.
4. Adopt the precautionary approach and assume that it is *D vex* until confirmed otherwise and follow best practice by not moving any material, stock or boats etc. from the site.



Close up of pendulous growth form of *D vex* from west coast of Scotland
© Dr D Minchin, Marine Organism Investigations



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



Pendulous growth form of *D vex* in Wales © NRW

ABOUT NON NATIVE AND INVASIVE SPECIES

What are Non Native and Invasive Non Native Species?

Non Native Species (NNS) are those species found outside their normal or native range due to human activity. Some of these have been moved around the world accidentally for example on boat hulls or in ballast water or via the transport of goods and materials. Some species have been intentionally released for food or sport, for example pheasants or for horticulture e.g. garden plants such as rhododendron and azalea. Some species may have been introduced many times before they have become established in the UK.

When a non-native species is established and then becomes a problem to the local ecology and economy it is labelled 'invasive' (INNS). NNS can also be call non-indigenous or alien species.

Why should we worry about them?

INNS can often grow at tremendous rates, out competing native species for food, space and light. They can smother native species and lead to a monoculture which can damage and adversely affect entire ecosystems. They can also clog or damage important infrastructure such as roads and buildings on land or water intakes, fish cages, propellers and lock gates in the marine environment.

WHAT DOES THE LAW SAY?

Scottish law leads the way in the battle against non-native species. The Wildlife and Countryside (Scotland) Act was amended (Wildlife and Natural Environment (Scotland) Act) in July 2012. A Code of Practice on Non-Native Species gives detailed guidance about the new regulations. SNH has also produced a useful guide which spells out the changes to the law.¹

The new legislation is about prevention of introduction of NNS (biosecurity) rather than cure. It makes the following an offence:

- Releasing an animal to a place outwith its native range.
- Allowing an animal to escape from captivity to a place outwith its native range.
- Otherwise causing an animal outwith the control of any person to be at a place outwith its native range.
- Planting a plant in the wild at a place outwith its native range.
- Otherwise causing a plant to grow in the wild at a place outwith its native range.

The core message is - ***if in doubt, don't plant and don't release - seek further advice.***

The Act also provides powers to relevant government agencies to offer voluntary Species Control Agreements (SCA) and, if that fails, serve Statutory Species Control Orders (SCO).

¹ <http://www.snh.gov.uk/docs/B1113471.pdf> accessed 6th March 2017

Emergency Species Control Orders (ESCO) can be made more rapidly in acute situations. SCOs and ESCOs can both operate on the 'polluter pays' principle. If government agency staff or their contractors have to carry out the eradication, control or containment work, then the cost of this work can be recovered from the site operator or owner.²

- As a business or an individual it is your responsibility to look out for, report and not to move a NNS.
- If you think that you have found any NNS, including *Didemnum vexillum* (*D vex*) or something that looks similar, you should report it straight away.
- You could be committing an offence unless you can show you took all reasonable steps to avoid moving or causing the spread of a NNS, such as *D vex*.

The regulations and Code of Practice do encourage sensible steps to be taken which reduce the risk posed by NNS. The Scottish Government therefore recommends creating and adhering to a biosecurity plan such as this one. This shows that you are taking reasonable steps to avoid the further spread of a known NNS and so are following the best practice set out in the Code of Practice.

ABOUT DIDEMNUM VEXILLUM (*D VEX*)

What is *Didemnum vexillum*?

Didemnum vexillum, commonly referred to as 'Carpet Sea-Squirt' or '*D vex*' is a type of colonial ascidian originally thought to be from Japan. It grows in dense carpets or mats across a range of materials, but it prefers hard substrates such as rocks and manmade structures such as piers, nets, pontoons, mooring chains and boat hulls. The mat is a colony of many individual animals which filter feed from the surrounding water. *D vex* is hermaphroditic but can also reproduce through budding.

With enough food and space and the right temperature and salinity it can grow incredibly quickly, rapidly covering large areas, smothering and potentially killing-off whatever it is growing over. This prevents the ecosystem from functioning normally, for example by preventing fish and other marine animals from feeding and successfully breeding or by growing over a commercial stock such as scallops, mussels or oysters.

D vex larva can only survive for around 3-4 hours in the water column but as the colony grows, pieces can be broken off and float away. These pieces reshape becoming globular and can survive for several weeks drifting in the tide before finding suitable areas to settle



D vex on a scallop.
Woods Hole Coastal and Marine Science Center

² Scottish Government, Code of Practice on Non-Native Species - Made by the Scottish Ministers under section 14C of the Wildlife and Countryside Act 1981, 2012, Edinburgh. p. 60. And Wildlife and Natural Environment (Scotland), 2011: Scotland. p. 69

and colonise. Some colonies of *D vex* form pendulous growths that seem to drip down from the main colony but this is not always the case.

D vex, like many invasive species, is successful because it can survive in a wide range of growing environments including a range of temperatures and salinities. *D vex* will tolerate temperatures down to -2°C but generally waters below 4°C will significantly reduce its success and may even kill colonies. It will start to grow and reproduce when the water is around 10°C, but its preferred temperature range is 14-18°C when it will grow most rapidly. It can be found from the shallows down to 80m depth and although it prefers sea-water it can withstand salinity levels down to around 20ppt and up to 45ppt.³ We are still learning about how this adaptable species behaves in Loch Creran.

How do we know it is in Loch Creran?

A systematic and wide-ranging series of surveys have been undertaken in and around the Loch by experts to establish where *D vex* is present. This has included shoreline surveys on foot, surveys of infrastructure using boats and underwater cameras and dive surveys of specific locations. A dive survey of the serpulid reef is planned for 2017. DNA samples have been analysed by Marine Scotland to confirm the identification of *D vex*.

How do I identify it?

D vex can be quite difficult to identify with certainty by eye, in fact suspected samples of *D vex* will often need to be confirmed by DNA analysis before we can be sure of an identification. However there are a number of identifying traits to look out for:

- *D vex* can range in colour from light grey/off white to a bright orange.
- *D vex* will often have quite marked dark veins running through the mat, especially as the colony gets larger.

The clearest identifying feature is the way it grows forming large mat like colonies which can also form long pendulous colonies which 'drip' from the main mat – see pictures on page 4.

Why are we worried about it?

In essence, *D vex* is a significant fouling species which, because of the speed it can grow, can outcompete, smother and kill off other species. The problem is enhanced because it has limited natural predators to keep it in check so it grows over everything, smothering feeding and spawning grounds, fouling nets and keeps, as well as, overgrowing crustaceans and shellfish. There are several examples from around the world of places where *D vex* has caused significant problems, Sitka in Alaska, Whangamata in New Zealand, as well as Georges Bank in New England to name a few. When it was discovered in Holyhead in Wales there was a significant eradication attempt which has so far proved unsuccessful – for more information see Annex E: Case Studies.

D vex can kill or severely restrict the growth of the animals it is growing on and, in the case of commercial shellfish, removing *D vex* is difficult and expensive and can reduce the value of the stock at market. As well as the potential impact on commercial operations, in Loch Creran, there

³ www.cabi.org/isc/datasheet/107996

is concern about it growing on the protected and sensitive biogenic serpulid and horse mussel reefs. These reefs are based on living creatures which could easily be smothered by *D vex*. For more information about the reefs see the section 'About Loch Creran' on page 11.

BIOSECURITY PLANNING

What is Biosecurity Planning?

Once they have been introduced, eradicating or controlling the spread of a NNS species, particularly in the marine environment, can be very difficult. Preventing introduction (biosecurity) is the best option, after that it is often a case of having to manage growth and control the spread – also known as 'control and containment'.

Biosecurity planning is the process by which actions that limit the risk of introducing or spreading species such as *D vex* are identified and prioritised. The process is recommended as best practice in the Code of Practice which accompanies the amendment to the Wildlife and Countryside Act (1981), the Wildlife and Natural Environment (Scotland) Act and by SNH.⁴

The biosecurity actions identified in this Plan have been developed in response to finding *Didemnum vexillum* (*D vex*), the carpet sea-squirt in Loch Creran, however, they are widely applicable to most marine NNS.

Developing a Biosecurity Plan for Loch Creran

Didemnum vexillum (*D vex*), the invasive carpet sea squirt, has been confirmed in Loch Creran. This species has the potential to negatively impact on businesses including aquaculture, recreation and tourism and negatively affect the quality of the environmental features for which Loch Creran has been designated as a SAC and MPA, in particular the serpulid and horse mussel reefs and shellfish beds.

Loch Creran is the furthest north *D vex* has been found in the UK. Marine Scotland, with its partners in Scottish Natural Heritage (SNH) and the Scottish Environmental Protection Agency (SEPA), is working to reduce the risk of it spreading further to protect the natural environment as well as the businesses of the west coast of Scotland and beyond.



Photo by Meuret-Woody

D vex growing on an oyster bag.

The purpose of this Plan is to:

- Identify biosecurity risks and actions to mitigate them,
- Facilitate cooperation and communication between users of Loch Creran and relevant authorities and,

⁴ Payne, R.D., Cook, E.J., Macleod, A. and Brown, S. (2014). *Marine Biosecurity Planning – Guidance for producing site and operation-based plans for preventing the introduction of non-native species*. www.snh.gov.uk/docs/A1294630.pdf

- Highlight individual and collective roles and responsibilities.

To develop this Plan major stakeholders in Loch Creran were identified and then approached for a face to face meeting. All were happy to meet and positive about discussions. Most were moderately concerned about the impact on the health of the Loch and the possibility of their businesses being compromised in some way. All were open to the idea of taking basic steps towards biosecurity at a low or no cost level, but with some support from a central body such as Marine Scotland or SNH.

The approach taken with stakeholders was to emphasise that:

- Everyone has a role to play in successful biosecurity.
- No single business or sector was being targeted.
- We should assume that *D. vex* is in the marine environment in the Loch and could become established at further locations.
- In order to achieve the best possible outcomes this should be seen as a positive 'Active Loch Biosecurity Plan'.

Having discussed the habitat preferences and life stages of *D vex* and its relevance to their marine activities, stakeholders were asked to propose biosecurity actions that they thought would be practical for them. They were also asked about the type and amount of monitoring and additional observations they could do.

CONTROL AND CONTAINMENT OF *D VEX*

How can we limit its movement?

D vex is very robust and able to spread reasonably easily, especially the larval stage or when fragments break off the main colony and are able to float freely in the water column. This means it can travel in any water which moves or on any material, from boat hulls to fish farms and on oyster shells through to diving gear or fishing tackle. The most effective biosecurity action, therefore, is to keep it under control, limit its growth and contain it in the Loch, limiting its ability to spread via hitch hiking on vessels or other objects. In particular this means limiting the amount of suitable habitats so it doesn't get a chance to become widely established and minimising the possibility of it hitch-hiking a ride out of the Loch. *D vex* particularly likes to grow on hard surfaces which include manmade structures such as pontoons, moorings, boats and harbour walls.

Encouraging reporting, heightened awareness of *D vex* and putting a strong monitoring and containment program together will be an important part of keeping the Loch healthy – an 'Active Loch Policy' or Biosecurity Plan. This means looking for *D vex* colonies and reporting them immediately but it also means taking other actions such as keeping boat hulls clean, using suitable antifoul and working together to make sure that anything manmade that is not in use is removed such as moorings, aquaculture equipment, floats and pontoons.

Can we eradicate it? How can we control it?

Marine Scotland and its partners has considered possible eradication methods for *D vex* in the Loch and has concluded that this is not likely because of the possibility of reintroduction coupled with the likely social and environmental costs.

Experience and trials in the UK and elsewhere indicates that there are a number of ways in which colonies of *D vex* can be killed on artificial structures and commercial shellfish sites. These include wrapping, air drying, immersion in freshwater and some chemical treatments such as acetic acid. However the correct use and most appropriate combination of treatments will depend on circumstances and activity. It is therefore important that any *D vex* which is found is reported immediately to allow Marine Scotland to provide case by case advice on the most appropriate treatment.

NB Acetic acid (vinegar) is a weak acid and is a registered hazardous substance in the UK – if you see *D vex* do not use vinegar, it may not be appropriate for your site and is potentially damaging to the natural environment. Always report your sighting and discuss treatment options with Marine Scotland before taking action. For more information about an experimental trial using acetic acid see Annex E: Case Studies.



D vex smothering a keep net in British Columbia.



Decorator crabs covered in *D vex* in New Zealand.



D vex on mussel shells in New Zealand.



D vex encrusting structures in Rhode Island.

Photos courtesy of Woods Hole Coastal and Marine Science Centre and A Pannell and A Coutts

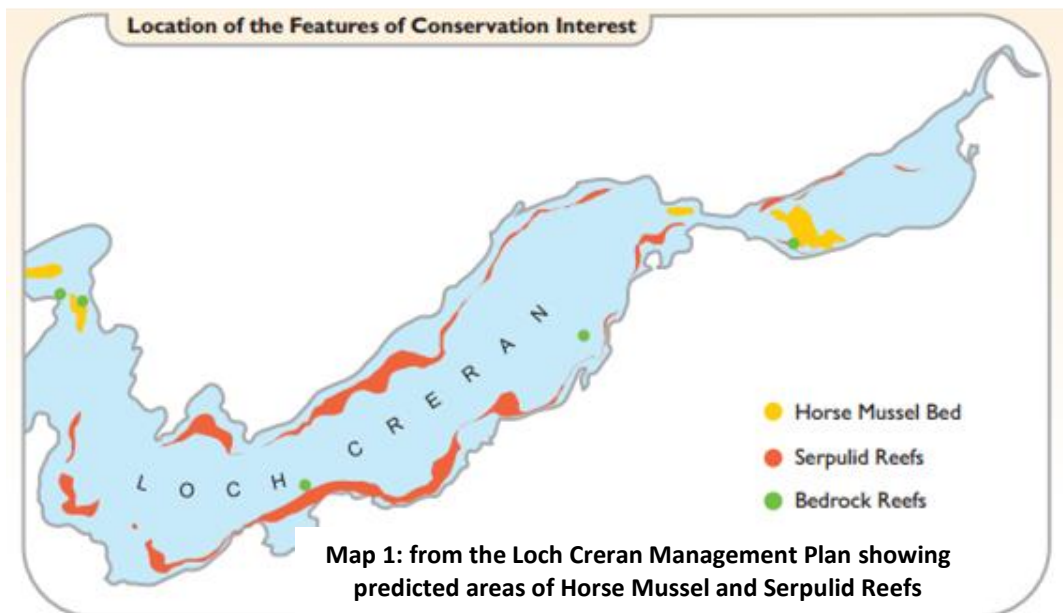
ABOUT LOCH CRERAN

Site Description

Situated at the southern end of the Loch Linnhe, Loch Creran is a typical fjordic sea loch with a constricted opening into the Lynn of Lorn at Eriska. It is approximately 13km long with a surface area at high water of 15km² giving a volume of approximately 177million m³. It has a tidal range of 3.3m. Maximum depth is 49m and a mean depth at low water of 13.4m.

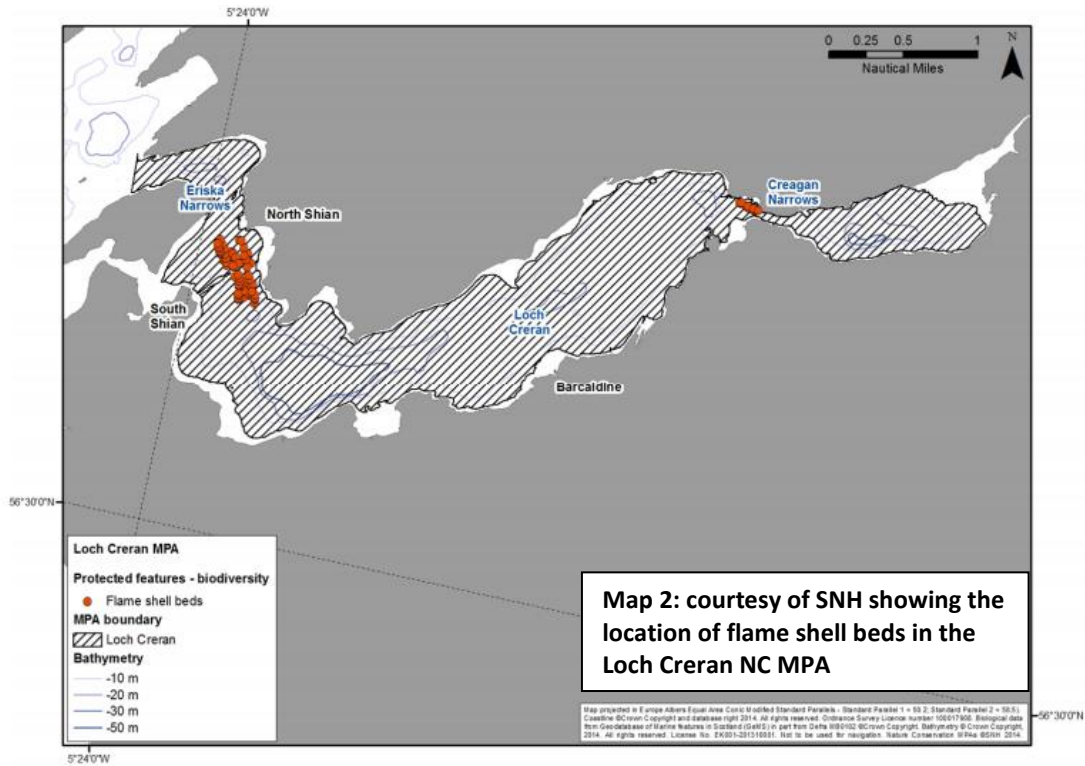
There are 4 sills in the system which influence water circulation. Spring tidal currents in excess of 4 knots occur over a shallow rocky sill at the loch entrance. Loch Creran is divided into a large lower basin and a small upper basin, separated by silled narrows at Creagan. The lower basin is further divided into three basins of 14 m, 27 m and 49 m maximum depths. The loch is a typically well-mixed system although temperature and salinity gradients are common, particularly during periods of high rainfall. Salinities in the lower basin of the loch are generally in the range of 30-33‰ and temperatures range from a low of around 6°C to a high of 13-15°C.

Loch Creran is very sheltered from wave action, which is reflected in the mud and fine sand that characterise the bottom sediments. The Loch Creran Marine SAC⁵ is a site of international conservation importance designated for its biogenic reefs of serpulid tube worm and horse mussels, and the bedrock reefs. It is also a Nature Conservation MPA for flame shell and geodiversity.⁶ The biogenic reefs support a vast array of life with 2,500 individual animals being counted on one reef. The serpulids generally grow from 6-13m depth and the horse mussels will grow from 7-25m depth. The reefs expand and shift, as any living feature does, so mapping them is challenging, the map below is where the reefs are predicted to be.



⁵ www.argyllmarinesac.org/pdfs/lcfulldocument.pdf accessed 6th March 2017

⁶ www.snh.gov.uk/docs/A978505.pdf accessed 6th March 2017



Annual rainfall in the area is 2000mm and there is evidence that there is a strong freshwater influence in the upper Loch, and a two-tier stratification throughout the Loch. Additional information about tidal dynamics and salinity would inform biosecurity planning and is a possible area for useful future study.^{7, 8, 9}

Main activities and users of the Loch

The Loch is well utilised by a range of individuals, businesses and industries. These include:

- Recreational vessels, both power and sail. This includes limited day sailor/trailer launched boats and kayakers.
- Shipping including, staff transport and, until very recently, bulk shipment of timber.
- Aquaculture, including finfish and shellfish farming (limited to oysters at this time).
- Tourism including waterfront hotels and restaurants and attractions including Sealife Centre and marine tours.
- Residential water front properties with private access to the Loch.
- Marine engineering including building and servicing of fish farm infrastructure and boat maintenance including cleaning and storage.

⁷ www.argyllmarinesac.org/pdfs/lcfulldocument.pdf

⁸ Scottish Sea Lochs, A Catalogue. Edwards, A, Sharples, F, 1986

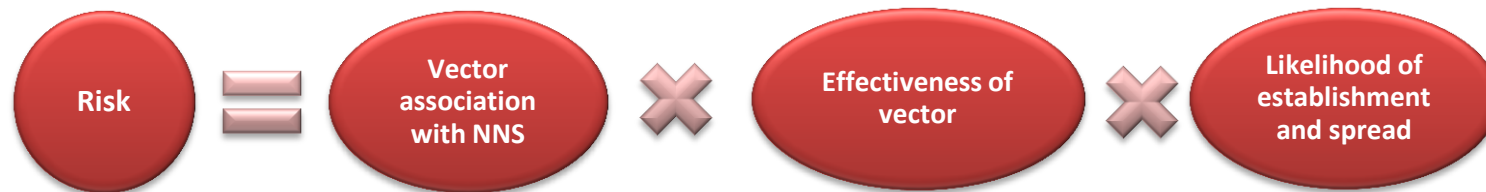
⁹ <http://algalweb.net/archive/smaefiles/teaching/SCM/Tyler3.pdf> and Landless & Edwards, 1976; Gage, 1974; Jones, 1979 and by some current meter work done in 1972, Edwards & Edelman, 1976b

**PATHWAY / VECTOR ANALYSIS, RISK ASSESSMENT
AND BIOSECURITY ACTIONS**

Pathways and vectors are the way NNS are moved from one site to another for example on boat hulls, aquaculture equipment or water transportation. All movements in, around and out of the Loch present some risk of moving *D vex* to a new site. Higher risk activities, such as fin and shellfish farming and boat movements need to be dealt with practically and effectively and much is still being learnt about the best way to do this in Loch Creran.

Marine Scotland and SNH take an evidence based approach. Evidence tells us that *D vex* is unlikely to be present on **EVERY** vessel or piece of equipment **ALL** the time – however we also take the precautionary approach and encourage Loch users to take sensible steps to reduce risk on the basis that it **MIGHT** be on their vessels or equipment. Table 1 below identifies the specific activities and pathways which take place in Loch Creran to assess the risk associated with these. Actions are then proposed to help reduce and minimise the risk of spread.

Risk assessment requires the use of judgement and will include an element of uncertainty. However it is a useful way of looking at pathways objectively and identifying sensible and proportionate control measures to minimise the risk of spreading invasive non-native species. Here, we have assessed risk and mitigating actions to limit the spread by using the following assessment methodology.



Whilst few actions are likely to be 100% effective against *D vex* we are working under the following informed assumptions:¹⁰

- *D vex* will do well on vertical and suspended manmade structures such as mooring chains so removing them where possible or including them in monitoring is important.¹⁰
- Most of the seafloor in Loch Creran is silt and mud which will provide an anoxic environment that will smother *D vex* and not be a suitable growing medium.
- *D vex* can be predated by whelks and star fish particularly when in contact with the seafloor, though this is not thought to be a significant control.¹¹
- *D vex* does not tolerate being exposed to air and dried out.¹²
- *D vex* does not tolerate very low salinity environments.

All stakeholders are asked to identify a person who is responsible for biosecurity in their organisation. This person is encouraged to develop a biosecurity plan for their own organisation or site which fits within this Loch wide Biosecurity Plan. The 'Biosecurity Manager' is responsible for reporting and communication and for reviewing the efficacy of the Biosecurity Plan.

For more information on risk assessment please go to [Annex E: Risk Assessment](#).

¹⁰ Denny 2008, Kleeman 2009, Laing et al. 2010

¹¹ Forrest et al (2013) and Hopkins et al 2011

¹² Carman et al (2010)

Table 1: Pathway and Vector Analysis, Risk Assessment and Biosecurity Actions

Recreational Activities and Related Businesses					
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Vessels and moorings at commercial and private sites throughout the Loch.	<p>Approximately 40 moorings well used by sailing and motor vessels at Creran Marine.</p> <p>Further 15 moorings at S Shian Moorings</p> <p>Approximately 75+ other individually or commercially owned moorings including those at the Barcaldine site which are due to be removed (tbc).</p>	<p>Majority of vessels are well maintained, used regularly and are removed from the Loch in winter. A small minority may not be used during any particular season. A minority remain in the water over the winter.</p> <p>Private vessels are not restricted in their movements and hull fouling/AFC are not monitored.</p> <p>There is evidence that <i>D vex</i> grows better on suspended materials such as mooring chains, than on the seabed where it is vulnerable to predation and other limiting factors.</p> <p>Not all boat owners are</p>	<p>It would be a positive step to remove some manmade structures and putting others in a disadvantageous growing medium. Could be trialled for a period of time to test efficacy.</p> <p>Forming a mooring association (see below) would reduce costs and improve communication with private mooring holders.</p> <p>Will be challenging to enforce notification and wash down but sends a strong message.</p>	<p>To help manage fouling, drop all vacant moorings to the seabed in winter, removing the upper section and buoy and replacing with a 12mm riser to the surface with a marker buoy.</p> <p>Remove buoy and chain to yard and expose to weather. Remove 12mm riser in the spring and remove to yard and expose to weather.</p> <p>Any vessels with fouling levels ranked 3 or above should be brought to the attention of the Biosecurity Manager and notified that they present an increased biosecurity risk and encouraged to haul out</p>	<p>BEFORE mitigating actions - MEDIUM/HIGH</p> <p>AFTER mitigating actions - MEDIUM/LOW</p>

		<p>following best practice in applying paint.</p> <p>Higher risk vessels include those that remain in the water year round and those which are not regularly used.</p> <p>Boat owners/users are generally not aware of or able to identify <i>D vex</i>.</p>		<p>and wash down locally before moving.</p> <p>Hold an antifouling workshop to help disseminate best practice.</p> <p>Work with The Green Blue to develop communication tools.</p> <p>Offer identification training to recreational users to raise awareness and encourage reporting.</p>	
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Occasional and recreational users including winkle and cockle gatherers, trailer launched boats, day sailors, kayakers, divers and short stay/visiting boats.	<p>Boats launched at Creran Marine and informally from the lane near the Rudha Garbh FY site.</p> <p>Divers often use car park in upper Loch.</p> <p>Approximately 20-50 recreational visiting vessels are estimated to use the Loch annually. The Loch is</p>	<p>Potential for transfer of quantities of water and biological material.</p> <p>Risk of moving viable larvae between water bodies on kit and in/on boats.</p> <p>Risk associated with divers taking samples or disturbing colonies causing spread by fragmentation.</p>	<p>Make the signage attractive and emphasise the positive aspects of Loch Creran biodiversity as well as the need to be vigilant with regard to <i>D vex</i>.</p> <p>Include QR code (matrix barcode) and SEARS number for easy reporting.</p> <p>Make the 'Check,</p>	<p>Public Signage at points around the Loch including.</p> <ul style="list-style-type: none"> • Land adjacent to Rudha Garbh site, owned by FY. • Isle of Eriska Hotel • Creagan Inn • Creran Marine • Lay-by in upper Loch 	<p>BEFORE mitigating actions - MEDIUM/HIGH</p> <p>AFTER mitigating actions - MEDIUM</p>

	not used for regattas or similar due to anchoring restrictions.	Risk of larval settlement on boat hulls and transfer to other water bodies.	Clean, Dry' message clear. ¹³ Tie into SAC messages and boards. Messages to cockle/winkle gatherers via Environmental Health.	Creran, Argyll and Bute Council. • South Shian 'big layby'. Raise awareness with local dive groups, kayak clubs and relevant national organisations e.g. BSAC/PADI and BCU. Use social media to access hard to reach groups. Investigate the possibility of developing an app for reporting purposes.	
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Wash Down – of boat hulls, equipment, creels etc.	Creran Marine wash down boats as they come out for winter storage. Yeoman Glensanda, Scottish Sea Farms and local	Potential for <i>D vex</i> to be washed off boats and equipment, fragmented and dispersed back into the Loch.	Use of an interceptor to capture wash down run-off would improve both biosecurity and ground water discharges. Potentially	Minimise the potential for NNS to be returned to the Loch by washing down onto hard standing well away from the water's edge.	BEFORE mitigating actions – MEDIUM

¹³ www.nonnativespecies.org/checkcleandry/

	fishermen all wash down equipment on or near the Loch.	<p>Vessels coming in from other areas to make use of services e.g. wash down, may introduce NNS.</p> <p>Fragments (which can last few weeks) and larvae washed into open water disperse and form new colonies.</p> <p>Risk mitigated by washing down onto hard standing and away from water's edge (at Creran Marine).</p>	high implementation cost.	<p>If possible wash in fresh water and leave to dry before re-entering the Loch or another water body.</p> <p>Undertake staff training, where appropriate to assist in identification and encourage reporting.</p>	AFTER mitigating actions – MEDIUM/LOW
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Tern Raft	A series of pontoons have been in place for several years which provide a safe breeding site for terns.	Raft does not move and would be very difficult/disturbing to Terns to remove for cleaning.	Raft was surveyed in 2016 and not found to have D vex.	<p>Maintain regular surveillance of the rafts. Identify a source of plastic wrapping should it be needed to clean the rafts.</p> <p>Do not move or scrape/clean the rafts before a clear NNS survey.</p>	<p>BEFORE mitigating actions – LOW</p> <p>AFTER mitigating actions - LOW</p>

Shipping					
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Yeoman Glensanda staff transport	6 or more return journeys per day	<p>Fast moving vessels which are well maintained and hauled out regularly for cleaning and AFC.</p> <p>Vessel speed and good maintenance regime risk of moving viable larvae between water bodies is reduced.</p> <p>Repeated boat movements can risk repeated introductions however.</p>	There is an opportunity to raise awareness with signage onboard the crew vessel.	Ensure maintenance regime keeps hull fouling to a minimum with regular monitoring of high risk areas such as trailing edge, trim tabs etc.	<p>BEFORE mitigating actions – LOW</p> <p>AFTER mitigating actions - LOW</p>
<i>Rose of Lorne</i> barge/heavy transport vessel	Regularly used but can sit for up to 4 days and potentially accumulates fouling in this time. Is not annually hauled out for inspection.	<p>Regular repeat travel to destinations (Glensanda quarry) increases risk of successful introductions over time.</p> <p>Risk of hull fouling enabling the transport of adult organism to other water bodies is increased.</p>	Difficult to slip as nearest facility is on Bute.	<p>Investigate in-water cleaning methods.</p> <p>Prior to next haul out investigate longer term hull fouling treatments.</p>	<p>BEFORE mitigating actions – MEDIUM/HIGH</p> <p>AFTER mitigating actions - MEDIUM</p>

Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
ALL Loch users with work boats.	Yeoman Glensanda, Scottish Sea Farms, Fusion Marine, Inverlussa etc	Most work boats are well maintained and have AFC. Due to regular use and local travel risk of moving viable larvae around the Loch is medium.	Organisations should be particularly aware of the need to clean boats which are transported to different sites by road as this can increase the potential for viable larva and fragments to be transferred.	Make staff aware of 'Check, Clean, Dry' biosecurity steps. Ensure the maintenance regime is sufficient to reduce fouling risk. All equipment which has been in contact with the Loch should, if practical, be washed with freshwater and/or dried regularly.	BEFORE mitigating actions – MEDIUM/HIGH AFTER mitigating actions - MEDIUM
Occasional visiting vessels	The Loch has occasional significant visiting vessels, some of which have ballast water.	Yeoman Glensanda has a long standing policy of requiring vessels to fully cycle their ballast water before arrival. Vessels will have to adhere to IMO Ballast Water Convention.	Ballast Water Convention (BWC) comes into force in September 2017 ¹⁴ Risk of moving viable larvae between water bodies is reduced by cycling of ballast water and BWC standards (not yet active).	Make visiting vessels aware of this Biosecurity Plan and encourage them to take steps to avoid the spread of known NNS or introduction of new ones.	BEFORE mitigating actions – MEDIUM/HIGH AFTER mitigating actions - MEDIUM

¹⁴ [www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-\(BWM\).aspx](http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx)

Aquaculture and Fishing

NB: Biosecurity measures related to stock movements are being addressed in detail with Marine Scotland outside of this plan. This Plan will be updated with any relevant new actions or advice as relevant. The actions below are generic best practice advice. These actions are in addition to the already established Disinfection Guide and 'Code of Good Practice – Scottish Finfish Aquaculture'¹⁵

Pathway/Vector	Detail/Activity	Analysis	Comment	Action	Risk Assessment
Finfish farm	One finfish farm currently operates in the Loch. It is owned by Scottish Sea Farms, who also operate the processing factory and are developing a fully enclosed hatchery on the shore at the Barcaldine site. Advanced techniques of husbandry are trialled at the farm.	<p>Cages are cleaned regularly.</p> <p>Risk of viable populations existing on the nets – in-situ pressure washing colonies will disperse larvae and fragments of <i>D vex</i>.</p>	A clear line of reporting to Marine Scotland and trained SSF staff is important to ensure this potentially costly measure is enacted effectively and quickly.	<p>Opportunity for monitoring and reporting.</p> <p>Train dive teams to identify <i>D vex</i>. Check for suspected <i>D vex</i> prior to washing and halt cleaning process and alert Marine Scotland if a colony is found.</p> <p>Ensure that any parties supplying feed, smoults/eggs etc. are aware of biosecurity plan and are alert for <i>D vex</i> in particular.</p>	<p>BEFORE mitigating actions – MEDIUM/HIGH</p> <p>AFTER mitigating actions - MEDIUM</p>

¹⁵ <http://thecodeofgoodpractice.co.uk/wp-content/uploads/2015/02/cogp-annexes-feb-15.pdf> and <http://thecodeofgoodpractice.co.uk/wp-content/uploads/2015/02/cogp-chapter-4-seawater-lochs2.pdf>

Finfish feed barge and fish farm cages	<p>There is one feed barge in the Loch.</p> <p>Barges and other infrastructure can be brought in for maintenance or for demolition.</p>	<p>Feed barges can be in situ for 5 years at a time and accumulate significant fouling. Barges can be relocated for cleaning and maintenance.</p> <p>Significant potential for <i>D vex</i> to become established and act as a source of (re)infection for the fish farm and other structures.</p>	<p>As a well surveyed vertical, free floating manmade structure with multiple suspension lines (one of the preferred habitats for <i>D vex</i>) the barge represents a useful early warning site for the spread of <i>D vex</i>.</p>	<p>Train dive team to identify NNS.</p> <p>Regularly survey the barge for NNS.</p> <p>Do not move the barge unless there has been a full clear biological survey confirming an absence of <i>D vex</i> and other NNS.</p> <p>Alert Marine Scotland to any suspected <i>D vex</i> on the structure as soon as possible for best advice for your site.</p>	<p>BEFORE mitigating actions – HIGH</p> <p>AFTER mitigating actions - MEDIUM</p>
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Finfish farm infrastructure manufacturing	<p>Fusion marine currently manufacture on the beach at Barcaldine before floating completed units out to a holding mooring.</p>	<p>Units are made of new HDPE (a robust low adherence surface), and are usually removed within 4 weeks. The units are watertight.</p>	<p>Due to reported low adherence on HDPE when it is new in the water and the short time items are in the water the risk of moving viable larvae between water bodies is minimal.</p>	<p>Train staff to identify and report suspected <i>D vex</i>.</p> <p>Survey all structures for fouling prior to departure from the Loch. If <i>D vex</i> is suspected do not move the structure, contact SEARS helpline straight away.</p>	<p>BEFORE mitigating actions – LOW</p> <p>AFTER mitigating actions - LOW</p>

Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Finfish well-boats and service boats	Regular well-boat movements are made to the S Shian fish processing factory.	<p>Well-boat water is treated using a variety of techniques and chemicals to ensure pathogen control. It is unclear how effective these treatments are against <i>D vex</i>. Discharge point located off Lady Rock at the S end of the Sound of Mull.</p> <p>Service boats such as those used by Inverlussa are hauled out annually for inspection and cleaning. Disinfection routines (as per Code of Good Practice) are adhered to and documented.</p>	<p>Risk of moving viable larvae between water bodies in well-boat water is potentially mitigated by treatments for pathogen control.</p> <p>Risk of moving colonies of <i>D vex</i> on boat hulls and in well water to sensitive habitats as repeated introductions will improve chances of successful establishment of <i>D vex</i> in a new area.</p>	<p>Assess efficacy of pathogen control measures against <i>D vex</i>.</p> <p>Adhere to biosecurity and pathogen protocols when discharging well water.</p>	<p>BEFORE mitigating actions – MEDIUM/HIGH</p> <p>AFTER mitigating actions – MEDIUM/LOW</p>
Pontoon at South Shian processing plant	215m HDPE pontoon with multiple anchors. Includes pumping system for fish processing.	<p>Water used to move fish is pumped back to the boat after filtration.</p> <p>Risk of pontoon structure becoming heavily fouled and a suitable <i>D vex</i> habitat.</p>	<p>Easy to access manmade structure with multiple suspension lines (one of the preferred habitats for <i>D vex</i>). Represents a useful early warning site for spread of <i>D vex</i>.</p>	<p>Train staff and survey regularly for suspected <i>D vex</i> growth. Alert Marine Scotland if <i>D vex</i> is suspected.</p>	<p>BEFORE mitigating actions – MEDIUM/HIGH</p> <p>AFTER mitigating actions - MEDIUM</p>

Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Oyster and mussel farms	<p>Several acres of foreshore in the Loch are used for growing oysters.</p> <p>Stock movement includes bringing in spat, and juvenile oysters which are then moved/sold to other sites for growing on or sold to market for food.</p>	<p>Sites are active and generally well maintained. Pathogen and fouling control measures lower risk.</p> <p>Some unused trestles have already been identified and removed from the water.</p> <p>Oyster growing bags and stock are monitored and managed to minimize risk.</p>	<p>There is an abandoned mussel farm on the north shore of Loch Creran. The Crown Estate are undertaking an assessment prior to removal by a contractor.</p> <p>Potential for <i>D vex</i> to become established on the permanent structures (trestles) and bags.</p> <p>Structures and stock are difficult to 100% clean creating a reinfection risk.</p> <p>Stock and equipment movement between sites (both inside and outwith the Loch has potential to carry <i>D vex</i> and other INNS.</p>	<p>Management options vary according to the site however take a precautionary approach to check all shellfish stock for evidence of <i>D vex</i> and other NNS before moving. Request evidence from suppliers that they are adhering to biosecurity measures.</p> <p>Removal of any unused equipment from the water. NB removal of unused infrastructure has begun and will take time to complete. Infrastructure not visibly in use may be lying fallow for a short time before being brought back into use so it may not be practical to remove it from the water.</p> <p>Dry equipment as often as possible.</p>	<p>BEFORE mitigating actions – MEDIUM/HIGH</p> <p>AFTER mitigating actions – MEDIUM/LOW</p>

				<p>Flush equipment with fresh water before storage.</p> <p>Maintain a clean and weed free site.</p> <p>Report any sightings to Marine Scotland as soon as possible for best advice for your site.</p>	
Fishing, creel, angling, commercial	There are a small number of active fishing vessels in the Loch. The majority of activity is by one vessel.	Creels are only used and cleaned within the Loch. Boat is hauled out annually and has effective AFC.	Whilst the creels are kept within the Loch they spend static time on the seabed and do accumulate fouling.	<p>Train fishermen to identify <i>D vex</i> and encourage reporting. Report any sighting as soon as possible.</p> <p>When practical wash creels away from the water's edge and dry them regularly.</p>	<p>BEFORE mitigating actions - MEDIUM</p> <p>AFTER mitigating actions - MEDIUM</p>

Tourism and attractions					
Pathway/Vector	Detail/Activity	Analysis	Comment	Action	Risk Assessment
Isle of Eriska Hotel	3 moorings and pontoon	High tidal influence at this site (circa 4-6kts). Primarily day use by visiting yachts and tour boats.	<p>Although the moorings are in a relatively high energy environment there is a significant back eddy which could increase risk of settlement of <i>D vex</i>. Possible site for early warning of <i>D vex</i> range expansion.</p> <p>Moorings are not in constant use and are usually used by charter vessels (subject to substantial use and therefore low fouling risk) and fast moving vessels (low fouling risk).</p>	<p>Drop moorings to the seabed in winter.</p> <p>Place signage on shore where visitors will be able to see it.</p>	<p>BEFORE mitigating actions - LOW</p> <p>AFTER mitigating actions - LOW</p>
Creagan Inn	3 moorings for visitors managed by the Creagan Inn	Not busy moorings – significant fresh water influence.	Investigations into salinity at this site would inform biosecurity planning.	<p>Drop moorings to the seabed in winter.</p> <p>Place signage on shore where visitors will be</p>	BEFORE mitigating actions - LOW

			Low use. There is anecdotal evidence for a significant fresh water influence which <u>may</u> reduce risk level.	able to see it.	AFTER mitigating actions - LOW
Pathway/Vector	Detail/Activity	Analysis	Comments	Actions	Risk Assessment
Seaxplorer	RIB trips around and out of the Loch	Well maintained fast boats in regular use. Visiting potentially sensitive sites e.g. seal haul outs.	The high level of use and speed making the most effective use of AFC, and regular maintenance of the vessels means the risk of moving viable larvae between water bodies is minimal.	Train staff to increase awareness and reporting of <i>D vex</i> . Encourage vigilance when taking tours at MLWS when reefs in and outside the Loch may be visible.	BEFORE mitigating actions - LOW AFTER mitigating actions - LOW
Pier House Hotel (at Appin, just outside Loch Creran)	7 moorings	High tidal influence at this site (circa 4-5 kts). Moorings are not in constant use.		Drop moorings to the seabed in winter. Place signage on shore where visitors will be able to see it.	BEFORE mitigating actions - LOW AFTER mitigating actions - LOW
Sealife Sanctuary	Water extraction for use in the sanctuary. Transfer specimens to other attractions.	Water is circulated on site and returned to the Loch. All animals are quarantined before movement, fish are	Due to existing quarantine procedures risk of moving viable larvae between water bodies is minimal.	Ensure that quarantine procedures are adhered to. Train staff to identify <i>D</i>	BEFORE mitigating actions – MEDIUM/LOW

	Pontoon for Seaxplorer extends from their land.	treated with copper solution. Site can experience regular fresh water inundation when significant stratification is evident.		vex and monitor tanks for any suspected colonies.	AFTER mitigating actions - LOW
Marine maintenance and engineering					
Pathway/Vector	Detail/Activity	Analysis	Comment	Action	Risk Assessment
Creran Marine	Creran Marine is a well-run, tidy yard which acts as a significant hub for servicing a range of vessels used on the West coast including Staffa Tours boats.	Boats are generally hauled out for maintenance work over the winter and will be scrubbed down during the process.	Potential for <i>D vex</i> to be transferred via visiting boats or resident boats. Additional vessel movements into the Loch as boats come in to use the Creran Marine services.	Minimise the amount of time non-resident boats spend in the Loch by booking lift in/outs as close to their arrival/departure as possible. Wash boats well away from the water's edge. Train staff to identify suspected <i>D vex</i> and ensure that boats hauled out are checked for colonies. Alert Marine Scotland to any suspected <i>D vex</i> , if possible/practical halt washing operations until	BEFORE mitigating actions – MEDIUM/HIGH AFTER mitigating actions - MEDIUM

				<p>samples can be taken for analysis. If not possible photograph suspected colony and send photos to Marine Scotland.</p> <p>Drop moorings to the seabed in winter.</p> <p>Place signage where boaters come off the water.</p>	
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A number of a useful communications and training opportunities have arisen from discussions with stakeholders and through the risk assessment process. These are summarised in the table below.

Table 2: Communication, Training and Group Resources			
Action	Justification	Comment	Implications
Establishment of a Loch Creran biosecurity group.	Experience from other areas indicates that bringing together interested parties regularly to share knowledge and discuss successes and challenges significantly improves uptake of a biosecurity plan. Meetings - 2 / 3 per year to review actions and latest research.	Could be hosted by another organisation. As the marine planning process develops interaction with the marine planning partnership for the area will be important.	Needs to be facilitated and some ongoing support – venue, calling meetings, actions, minutes etc.
Establish one Mooring Association (MA) to cover the whole Loch with South Shian as a separate MA.	Facilitate communication with mooring holders and unify actions. Reduced fees offset the cost of dropping moorings in winter.	Needs to be on an appropriate footing to ensure that navigation is not compromised.	Requires someone to set it up and maintain it. S Shian MA needs to remain separate as the MA is set up to manage the moorings accessed via private land.
Biosecurity mailing list	Better communications throughout the Loch and beyond (if relevant)	Data protection needs to be appropriately managed.	Needs to be set up and facilitated to be useful.
Purchase of ROV or underwater camera resource for Active	An ROV or underwater camera would be a useful tool for survey, monitoring and identification of	Also useful for education/engagement and for	Yeoman Glensanda would potentially be willing to host, maintain and to <u>part</u>

Loch Biosecurity Plan Users.	NNS.	checking moorings etc	finance. People would need to be trained to use and maintain it to avoid damage e.g. to biogenic reefs or the camera.
Communications to wider boating community	Pre-season communications are a useful way of ensuring boats enter and leave the Loch with clean hulls.	Useful organisations include Creran Marine, Royal Highland Yacht Club, Clyde Cruising Club, Oban Sailing Club and relevant diving and kayak clubs. Amendment to the leaflet made to raise awareness of the SAC with divers may be possible. See www.argyllmarinesac.org/pdfs/divencode.pdf	Work with The Green Blue to produce relevant literature and messaging.
Biosecurity planning for other areas.	Engaging with other Lochs within the High Surveillance areas to raise awareness and encourage reporting.	Marine Scotland are leading on this level of communication.	Sharing the process of developing the plan and the actions to encourage others to produce their own relevant local plans.

MONITORING AND OBSERVATION

The following monitoring and heightened observance plan has been proposed by stakeholders. Marine Scotland, with SNH, will continue to undertake scientific biological monitoring of the Loch including a planned survey of the serpulid reefs in 2017. Use of an underwater survey using a waterproof camera is encouraged as *D vex* prefers habitats below the immediate splash zone.

Table 2: Monitoring and Observation Routines

Who	Where	When	What
Yeoman Glensanda	Rudha Garbh and Glensanda underwater structures	Annually	During routine structural surveys contractors will be asked to specifically look for <i>D vex</i> . Any relevant underwater video footage will be shared with SNH/Marine Scotland.
Yeoman Glensanda	Rose of Lorne	Weekly	Using the hull fouling scoring chart Yeoman Glensanda will check the hull and take remedial action as required (fouling ranking 3+).
Sealife Sanctuary	Pontoon on site	Quarterly at MLWS	Staff will check the pontoon and surrounding seabed for <i>D vex</i> from the surface at least quarterly.
Fusion Marine	Foreshore at Barcaldine	Quarterly at MLWS	Staff will walk the low water area to check for <i>D vex</i> and check any structures that come to them for re-furbishment.
Oyster Farmers	Foreshore	MLWS	Check trestles, shore and bags for <i>D vex</i> .
Scottish Sea Farms	Pontoon	Monthly/when divers are down.	During routine surveys divers will be tasked with checking for <i>D vex</i> .
Scottish Sea Farms	Cages	Monthly/when divers are down.	During routine surveys divers will be tasked with checking for <i>D vex</i>
Scottish Sea Farms	Feed barge	Quarterly/when divers are down.	As above but also more detailed survey for <i>D vex</i> prior to moving the barge. Share any relevant footage with SNH/Marine Scotland
NW Marine	Private and commercial moorings	During mooring maintenance in winter and spring.	Mooring buoys, strops, pick-ups etc.
Boat Owners	UK wide	On haul out – encourage annual lift	Check boat hulls for <i>D vex</i> and other INNS

		out and clean for all boats	
Creran Marine	Creran Marine	On haul out/during mooring maintenance.	Check boat hulls and moorings for <i>D vex</i> and other INNS
Fishermen	On FV <i>Audrey</i>	Regularly as creels are hauled	Check creels for <i>D vex</i> and other INNS

FURTHER RESEARCH AND USEFUL PROJECTS

During the biosecurity plan writing process a number of interesting and useful topics and suggestions were offered for discussion. These are presented here as ideas to be taken forward if money, time, necessity and/or fresh research indicates that it would be possible and fruitful to do so.

Proposed Action	Comments
Decontamination/risk management Berths	There are a number of freshwater burns which flow into Loch Creran, it is possible that these could be used as decontamination areas. In particular the Burn which flows down Glen Dubh has potential, as do the moorings at the Creagan Inn. It could be possible to move infrequently used vessels onto moorings in freshwater to control hull fouling. The efficacy of this needs to be tested and backed up with evidence.
Develop knowledge of fouling in the Loch	Investigations into fouling communities would inform biosecurity planning. Installation and analysis of settlement panels and further biological survey work would be useful.
Gathering of salinity and hydrological data	Would aid the identification of potential decontamination berth and modelling of <i>D vex</i> risk of spread through the Loch.
Testing HDPE fouling release properties	The self-cleaning/low adherence (HDPE) nature of the pontoons used in the Loch was noted by a number of users. Whilst this material is now in wide use in the marine environment it has not been tested, to the best of our knowledge, for applications relevant to biosecurity.
Antifouling Paint Tests	It is unknown which AFC works best in Loch Creran or against <i>D vex</i> . Insight into this would be useful e.g. long and short term coatings and other innovative coatings such as silicone based paints.
Biological control of <i>D vex</i>	Predation by species has been useful in other INNS outbreaks in other parts of the world, but it is not a widely accepted or used technique due partly to the difficulties of potentially introducing (another) NNS and also accurately recording its effectiveness. In Loch Creran we have anecdotal reports of potentially significant populations of native starfish which could predate on <i>D vex</i> if they were in the right area.

BEST PRACTICE ADVICE BY SECTOR

The following is a guide to the practical, low or no cost steps anyone can take to reduce the risk of spreading any invasive species. These actions are not specific to *D vex*.

All users of the marine environment

If you run a business or manage a site or run a club consider writing your own biosecurity plan.

Keep it simple and useful to you and your team or volunteers. Appoint a person to keep it under review.

Be aware of *D vex* and other marine INNS and know how to **report suspicious looking growth**.

Remember –

- You don't need to be a marine biologist.
- Don't aim to identify every species.
- Look out for unusual growth patterns, areas which have obviously quickly been taken over or which just don't look 'normal'.
- Take photos, lat/long and estimate of quantity/area covered and report to SEARS hotline on 08452 30 20 50 or email info@sears.scotland.gov.uk.
- You can also record your sighting using the iRecord website or the SeaLife Tracker app. www.brc.ac.uk/irecord/ www.brc.ac.uk/sealife_tracker/home

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.
- Don't move sediment, water or other material such as weed from one site to another.
- This includes wet/dry suits, booties, tanks, dinghies, outboards etc.
- Read and circulate The Green Blue advice to relevant contacts see www.thegreenblue.org.uk

Larger Scale Marine Leisure including yachts, RIBs, motor boats etc.

- Use the correct antifoul for your boat and type of use.
- Apply and use the antifoul as directed by the manufacturers. Be aware that antifoul which is designed to last 2 years is generally not designed to be hauled out for the winter and scrubbed down.
- Use your boat frequently to minimize the build-up of fouling and ensure the 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.
- Drop your mooring to the seabed in winter to smother any fouling which has accumulated through the season.
- Read and circulate The Green Blue advice to relevant contacts.

Marine Leisure Sector including marina operators and commercial mooring owners.

- Train your staff to be alert to unusual growth in the marine environment.
- Give staff basic identification training and ID guides.
- Encourage an open culture of reporting unusual sightings, including photographing and recording lat/long.
- Identify high risk locations in your marina/site and monitor them for unusual growth e.g. near the lifting and wash-down area, on breakwater 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.
- Read and circulate The Green Blue advice to relevant contacts.

Commercial Marine Operations including fishing, diving, maintenance and construction companies.

- Train your staff to be alert to unusual growth in the marine environment.
- Do not wash down equipment into the Loch. All wash down should be done away from the water's edge and no run off should return to the Loch.
- Give staff basic identification training and ID guides.
- Encourage an open culture of reporting unusual sightings including photographing and recording lat/long.
- Seek opportunities to work in partnership with research organisations or conservation groups to improve monitoring, training and reporting.
- Refer to Marine Scotland for best practice advice.

Aquaculture including fin and shellfish farming – 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.
- Train your staff to be alert to unusual growth in the marine environment.
- Give staff basic identification training and ID guides.
- Encourage an open culture of reporting unusual sightings including photographing and recording lat/long.
- Refer to Marine Scotland for best practice advice. Association of Scottish Shellfish Growers, Scottish Shellfish Producers Organisation and British Trout Association all also disseminate best practice, training and advice.

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 SSR from high risk ports with significant additional INNS) vessels dock. Monitor these areas for unusual growth patterns at least quarterly at MLWS.
- For SSR, have a policy to encourage mid water transfer or complete cycling of ballast water between ports (Yeoman Glensanda already have this policy in place).
- Take advantage of opportunities to survey sites e.g. when structural surveys are undertaken also look for unusual growth patterns and report as required.
- Train staff to be alert to unusual growth in the marine environment.
- Give staff basic identification training and ID guides.
- Encourage an open culture of reporting unusual sightings including photographing and recording lat/long.
- Refer to credible organisations such as IMO for best practice advice.
- Seek opportunities to work in partnership with research organisations or conservation groups to improve monitoring, training and reporting.

OWNERSHIP OF THE PLAN

This Plan belongs to the stakeholders of Loch Creran. Stakeholders are encouraged to appoint a 'Biosecurity manager' within their organisation who can ensure that the actions identified in the actions and monitoring tables are carried out and reviewed for effectiveness regularly. Individual organisations are also encouraged to create their own version of this plan which outlines their site specific actions and monitoring programme.

Marine Scotland continues to support the actions identified in the Plan and encourages reporting of any NNS including *D vex* like growths.

Regularly, but not frequent, meetings with stakeholders will help to review implementation of the Plan and e-communications will also be ongoing. The Plan will be reviewed at least annually to ensure that best practice has been updated by any new evidence.

The following organisations and individuals were involved in the development of this Plan.

- Achalic Farm
- Appin Community Council
- Argyll and Bute Council
- Bidwells
- C2W, Marine Matters Managed
- Caledonia Oysters
- CB Marine Services
- Creagan Inn
- Creran Marine
- Crown Estate
- Derek Bailey, fisherman
- Fusion Marine
- International Paints
- Isle of Eriska Hotel
- NW Marine
- RYA Scotland
- SAMS
- Scottish Sea Farms
- Seaexplorer Tours
- Sealife Sanctuary
- SEPA
- Shian Fisheries
- SNH
- West Highland Mooring Association
- Yeoman Glensanda Aggregate Industries

ANNEX A: LEGAL CONTEXT IN SCOTLAND

In Scotland, amendments to Section 14 of the Wildlife and Countryside Act as amended (Wildlife and Natural Environment (Scotland) Act) and the Code of Practice on Non-Native Species have significantly strengthened the law in relation to NNS. Two further offences have been added to the existing offence of releasing a non-native animal from captivity in the 1981 Act. The new offences are:

- allowing an animal to escape from captivity outwith its native range, and;
- causing an animal to be in a place outwith its native range.

The 'causing an animal' offence can include the accidental transfer and spread of non-native animals that, for example, result from site operations and development work where biosecurity procedures are absent or inadequate.

For plants, a new offence has been created of planting or causing any plant species to grow in the wild outwith its native range. This offence includes situations where poor biosecurity in relation to site operation and development led to the spread of a non-native plant in the wild. The definition of 'wild' in this context would include fin and shellfish farms.

The Scottish offences in relation to non-native plants and animals are 'strict liability offences' so knowledge, intention, recklessness or negligence do not have to be proved.

A legal defence that all reasonable steps were taken to prevent the offence and that all due diligence was exercised to avoid committing the offence can be made. The Code of Practice on Non-Native Species sets out in broad terms what 'reasonable steps' mean in this context.

REASONABLE STEPS AS SET OUT IN THE CODE OF PRACTICE ON NNS

- Adopting a precautionary approach and not carrying out operations which might lead to the spread of NNS until there is a clear understanding of the situation.
- Carrying out risk assessments to understand the risk of spreading a NNS, setting out how to avoid it happening.
- Seeking advice and following good practice.
- Reporting the presence of NNS.

The amended Scottish legislation also provides powers to relevant government agencies to offer voluntary Species Control Agreements (SCA) and, if that fails, serve Statutory Species Control Orders (SCO). SCOs are intended for situations where an invasive species is present and must specify which operations should be carried out, who is to carry them out and when they must be carried out. SCOs and Emergency Species Control Orders (ESCO), made more rapidly in acute situations, can both operate on the 'polluter pays' principle. If government agency staff or their contractors have to carry out the eradication, control or containment work, then the cost of this work can be recovered from the site operator.

Other significant legal drivers for site operators and developers are:

- The Environmental Liability (Scotland) Regulations (SI 2009/226) [53] - these have established a civil law mechanism based upon the 'polluter pays' principle. Under the Regulations, certain operators who cause a risk of 'significant' damage or cause

- 'significant' damage to land, water or biodiversity will have a duty to avert such damage occurring or, where damage does occur, a duty to reinstate the environment.
- The Biodiversity Duty – All public bodies have a duty under the Nature Conservation (Scotland) Act 2004 to 'further the conservation of biodiversity' as they carry out their work. The revised Scottish Biodiversity Strategy document 2020 Challenge for Scotland's Biodiversity - A Strategy for the conservation and enhancement of biodiversity in Scotland provides a clearer view of the types of activities that should be considered with regard to that duty. In relation to combating the threat of NNS, the 2020 document states "we must work to prevent their establishment and spread, identify their means and routes for invasion, raise awareness of the need for biosecurity, and implement legislation and international agreements".
 - The Aquatic Animal Health (Scotland) Regulations 2009 and the equivalent Regulation for England and Wales implement the Council Directive 2006/88/EC on animal health requirements for aquaculture animals and products. The Regulations require Aquaculture Production Businesses (APBs), including shellfish and finfish farmers, as a condition of their authorisation, to produce and implement a Biosecurity Measures Plan for operation of the site to restrict the spread of disease. Although not intended to cover NNS, the plan preparation process as well as the actions and precautions specified by the plan for diseases could also act to prevent the introduction and spread of NNS.
 - The Marine Strategy Framework Directive and the Water Framework Directive set a wider strategic and operational context for preventing the spread of NNS and their control, which feeds down to the operator and site level.
 - The EU Regulation on Invasive Alien Species has recently been published. The regulation includes a list of Species of Union Concern (SUC). Growing, breeding, selling or intentionally releasing these species is banned across the EU. Member states will also list Invasive Alien species of Member State Concern for similar bans that would apply only within that Member State. Action plans on the pathways of invasive alien species (i.e. INNS) are required by the Regulation. Member States are required to:
 - Analyse pathways of unintentional introduction and spread and:
 - Identify "priority pathways" based on the volume or impact of the species moved by that pathway.

Adapted from Cook, E.J., Payne, R., Macleod, A. and Brown, S. (2014). Marine Biosecurity Planning – Identification of best practice: A Review. Scottish Natural Heritage Commissioned Report 748 http://www.snh.org.uk/pdfs/publications/commissioned_reports/748.pdf

ANNEX B: CONTINGENCY PLANNING

Contingency Plan and Responding to Possible Future Developments

Through the biosecurity planning process a comprehensive set of routine biosecurity actions are put in place. However they cannot anticipate all unexpected events and some biosecurity alerts, which although unpredictable, may have a reasonable probability of occurring during the plan period.

Timing can be critical when responding to a new threat and a **rapid response** stands a much better chance of containing that threat. Knowing what should be done, when and by whom increases the chances of a successful response. Government agencies may be responsible for many of these actions but the community have a clear role as well, especially in raising the alert to new threats or species found. Those people working in the marine environment are best placed to notice when something unusual is observed

Responding to a NNS report

Upon receiving a report of a non-native species, Marine Scotland will immediately liaise with SNH, SEPA and other experts such as the Scottish Association of Marine Science, to assess risk and determine an appropriate initial response. The following table provides an indication of the steps undertaken to develop a response.

What	What	When	Who
Raise the alert	SEARS Hotline (0845 230 2050), Marine Scotland or SNH contacts 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 SNH, SEPA and other experts such as Scottish Association for Marine Science (SAMS) to assess risk and determine initial action	Immediately	Marine Scotland, SNH, SEPA, SAMS, other expertise as required.
Confirm identification	Marine Scotland or partner will take samples and confirm identification	ASAP	Marine Scotland/SNH/SEPA/expert partner
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	Marine Scotland, SNH, SEPA/expert partner

		taken into account.	
Identify pathway/vector of spread	Carry out pathway analysis and risk assessment.	ASAP	Marine Scotland, SNH, SEPA using local information.
Consider management options	Consider eradication, control, and containment. Can this be controlled or contained?	ASAP	Marine Scotland, SNH, SEPA 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	Loch Creran 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 could include the arrival of certain types of vessels or towed structures which may be heavily fouled, significant marine debris, new activities and pathways or the establishment of *D. vex* in new areas.

Early investigation and information gathering is 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 so advice can be given.

Testing contingency approach

Until a contingency plan is tested in real life its effectiveness is uncertain. Rather than wait for a real incident to reveal the strengths and weaknesses of the planned response its best to carry out an exercise to test the response to an imagined but likely scenario. This is routinely undertaken to check other important procedures for example for an oil spill emergency. An 'incursion exercise' should be undertaken to create a simulation of the response, for example, to the discovery of a new NNS in Loch Creran or the unexpected arrival of a heavily fouled salvage barge from a distant port. The benefits of the approach are that it identifies any legal and regulatory barriers, practical difficulties or resource inadequacies as well as building links between participants and engendering an ethos of a shared responsibility. Consider doing these on a regular basis.

ANNEX C: RESPONSE TO FUTURE DEVELOPMENTS

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

It is likely that new developments, projects, activities and enterprises will be proposed for Loch Creran. 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 NNS and offer submerged surfaces suitable for growing NNS including <i>D vex</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 NNS 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 NNS 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 the Crown Estate).

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 or biofouling cleaning, or could require that a biosecurity plan to be 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 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: FAQ'S

Providing informative and correct information can encourage vigilance, reporting and good practice which all contribute to a successful response. This section has been developed to assist stakeholders in their communications with clients, neighbours, visitors or other interested parties. Marine Scotland can be contacted for any additional information which may be helpful to your communications about *D vex* and INNS in general.

What is *Didemnum vexillum* (*D vex*)?

D vex, commonly known as Carpet Sea Squirt, is an invasive non-native marine species. Consisting of cream, orange or off-white colonies, *D vex* will often form thin sheet-like mats (2-5 millimetres thick) or extensive pendulous growth (up to 2 metres in length). It has a leathery, firm texture with dark veins running through the colony. *D vex* is a filter feeder and has numerous tiny pores, which are scattered across the surface and are responsible for siphoning water into the colony. It has been identified as a 'High Risk' species by the GB non-native species secretariat (www.nonnativespecies.org).

What are the potential impacts of *D vex*?

We are not sure how *D vex* will behave in the Loch however in other areas it has been shown to smother native species and reduce the performance of commercial species and cause fouling on man-made structures, including equipment used by the aquaculture industry. The species can grow quickly during summer months and can easily spread if not well managed. *D vex* has few natural predators and is extremely tolerant to fluctuations in water temperature and salinity.

What is the current status in Loch Creran?

D vex has been detected in Loch Creran. Commercial operations on the loch and sea-going craft regularly travelling on the loch have been informed and have been involved in shaping mitigation measures that will attempt to prevent further spread of *D vex* both within and outwith the Loch. Marine Scotland is the competent authority and, with the help of SNH, is leading on monitoring, management and detection.

What are the next steps for dealing with *D vex* in Loch Creran?

Marine Scotland has been in discussion with commercial and leisure users of the loch, who have contributed to a community-led biosecurity plan. The plan includes a series of biosecurity measures, agreed by the community, which minimise the risk of spreading *D vex* by controlling its growth and opportunities to move out of the loch. The approach is that biosecurity is a change in the way we do things, not a halt to activities, unless absolutely necessary.

Where did *D vex* come from?

D vex is likely to have originated from north-east Asia, but is distributed as widely as New Zealand, Canada, the USA, France, Ireland and the Netherlands. More recently *D vex* has been

found at several sites on the south coast of England, in North Wales, in Ireland and N Ireland. *D vex* was first detected in Scotland in 2009 within the Firth of Clyde.

How does it spread?

D vex can spread through a number of vectors, including the hulls of ships and leisure craft, via aquaculture (both fin and shellfish), and through natural dispersal in the tide. It can also 'hitch-hike' on marine litter and general flotsam and jetsam. It is therefore difficult to establish how *D vex* came to Loch Creran. *D vex* spreads through both a free-swimming 'tadpole' larval phase and by fragmentation. In the case of the former, release of larvae gradually occurs usually over the summer months and the larvae are only able to settle successfully for a few hours after release. The larvae are, therefore, likely to settle within a relatively short distance of the initial colony. However, dispersal by the suspension of fragments in the water column can be far more extensive and fragments have been recorded to survive for up to 30 days. Fragments will then typically re-attach within six hours of making contact with a hard surface.

How quickly does it grow?

Optimum growth is during the summer months (July to September), when the seawater temperature in Scotland is between 9 - 16 degrees Celsius. Colonies are capable of reaching 30 cm in diameter within 21 days of settlement and can form extensive mats over the surfaces that it colonises.

Can it be eradicated or removed from the loch?

Experience elsewhere in the UK and around the world suggests eradication of *D vex* is difficult and in most cases, unlikely. In Loch Creran the approach is to control it where it is found and minimise the risk of spreading it to other locations in the marine environment.

What is the extent of *D vex* in the loch?

Although the confirmed sightings of *D vex* are limited within the Loch, there is an expectation that it will spread if no preventative action is taken. All stakeholders and specific habitats could potentially be affected. Marine Scotland and SNH are planning further work in 2017 and this will help inform if *D vex* has spread within the Loch

Will *D vex* affect the protected reef?

The Loch Creran Marine SAC is a site of international conservation importance, designated for its biogenic reefs of serpulid tube worms and horse mussels. These could offer a suitable substrate to *D vex* to grow on. The reef will be surveyed by SNH to determine if it is established there.

What limitations or enforcements will be imposed on loch users now *D vex* is confirmed?

Marine Scotland has worked successfully with local companies to minimise the impact on their businesses. The type of response [to a confirmed case of *D vex*](#) will depend on where it is found and ~~will~~ be considered on a case by case basis. The approach is that biosecurity is a change in the way we do things, not a halt to activities unless absolutely necessary.

What steps can be taken to prevent further spread, both within and outwith the loch?

There are lots of options open to us. Divers and kayakers can follow the 'Check - Clean - Dry' campaign and make sure their kit and boats are clean before they launch and dried well afterwards. Drying out in this way kills almost all marine species. Boat owners can minimise risk by making sure they are properly antifouled once a year and that the paint works well by using their boats more, not less. The shell and finfish sector have protocols in place to manage a wide range of biosecurity issues and are well placed to deal with *D vex*, even if we can't eradicate it. For more information see the section on 'Best Practice Advice' on page 35.

What do I do if I find *D vex*?

Reporting the presence of *D vex* at the earliest opportunity means that the relevant authority can quickly take action to help contain the species and minimise its spread.

1. Note the location, preferably using GPS, and take photographs of the colony (both zoomed in and of the entire colony), if a camera is available.
2. Contact Scotland's Environmental and Rural Services (SEARS) Helpline on 0845 230 2050 and they will pass your report to the relevant authority, who will be able to respond quickly. .
3. Assume that it is *D vex*, until confirmed otherwise and follow best practice by not moving any material, stock or boats etc. from the site.



Two images of *D vex* to aid identification. Notice the different colour of the colonies – this will change with water temperature and salinity. Note also the thicker dark veins or lines which cross the mat, this is an identifying feature of *D vex*.
Photos © E Cook, SAMS

ANNEX E: RISK ASSESSMENT

Risk assessment requires the use of judgement and will include an element of uncertainty. However it is a useful way of looking at pathways objectively and identifying sensible and proportionate control measures to minimise the risk of spreading invasive non-native species. Here, we have assessed risk and mitigating actions to limit the spread by using the following assessment methodology.



Vector/pathway association with NNS	Description
High	INNS have been identified in association with the vector/pathway
Medium	NNS have been identified in association with vector/pathway
Low	It can be determined with sufficient confidence that NNS are not in association with the vector/pathway

Pathway/Vector effectiveness	Description
High	Viable biological material is likely to be transported AND actively dispersed by the vector/pathway in large quantities and/or frequently.
Medium	Viable biological material is likely to be transported by the vector/pathway, but in small volumes/less frequently
Low	Control measure exists to identify and manage situations where viable biological material is being transported

Likelihood of establishment and spread	Description
High	Environmental conditions within the recipient environment are suitable for growth AND reproduction
Medium	Environmental conditions within the recipient environment are suitable for growth, but not reproduction under present climatic conditions
Low	Environmental conditions within the recipient environment are outside those necessary for growth and reproduction

Final Risk Assessment

Pathway/Vector effectiveness	Vector/pathway association with NNS		
	High	Medium	Low
High	High	Medium/High	Low
Medium	Medium/High	Medium	Low
Low	Low	Low	Negligible

ANNEX F: CASE STUDIES

The case studies below provide examples of the impacts of marine INNS and the importance of early detection and reporting.

Mussel farming in New Zealand

Mussel farming in New Zealand has been affected by biofouling by *D vex* and other marine INNS. In the Marlborough Sounds, it has been estimated that mussel farms lose up to 15 % of their seed stock through biofouling. Impacts include direct effects on the growth rate of mussels, the cost of removing biofouling during harvesting and processing, and reduced product value through disfiguration of the mussel shell. Adoption of new industry practices and an apparent decline in the level of invasiveness of *D vex* over recent years has enabled the industry to live with the problem, (Fletcher *et al.* 2013).



D vex on mussel lines in New Zealand. © L Fletcher

This videos show the impact of *D vex* on mussels lines in New Zealand:

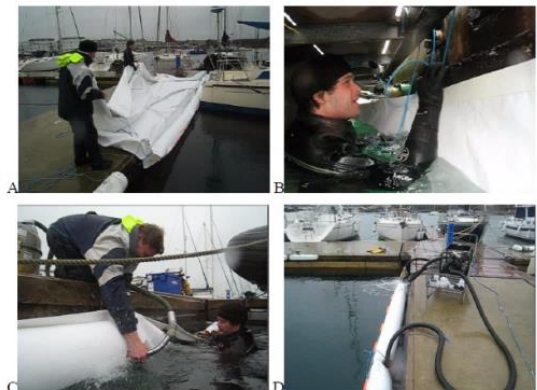
<http://www.biosecurity.govt.nz/pests/didemnum>

Oyster farming in the west of Ireland

An study is being done at an oyster farm in Ireland to establish effective ways to manage *D vex*. Fouled oyster bags were treated using 3 different combination methods including a dilute vinegar spray, bag turning, and both spraying and turning. The methods and results are being investigated and further work will be conducted on the impact of treatments on native species and oysters (Obrien *et al.*, 2015).

Attempted eradication of Didemnum vexillum in Holyhead Harbour.

The only eradication attempt of *Didemnum vexillum* in the UK has been carried out in Holyhead Harbour. The techniques used were a combination of plastic wrappings and accelerant (acetic acid or chlorine). The second attempt at eradication by treating all of the affected surfaces at once was partially successful. Small colonies were detected on the breakwaters and follow-up treatment is planned. In the longer term, containment appears to be most viable option for managing this species (Holt *et al.* 2011; Sambrook *et al.* 2014).



Attempted eradication of D vex, Holyhead, Wales.(c) R Holt, NRW

ANNEX G: SOURCES OF FURTHER INFORMATION

Contacts

Marine Scotland – Lorna King, lorna.king@gov.scot (Policy), Lyndsay Brown, Lyndsay.Brown@gov.scot (Science)

Videos of *D vex*

Herne Bay drift dive over *Didemnum* <https://www.youtube.com/watch?v=eHrwWFaUF4Y>

Didemnum on mussels lines in New Zealand: www.biosecurity.govt.nz/pests/didemnum

Divers bagging a net covered in *Didemnum* <https://vimeo.com/43504437?from=outro-embed>

Didemnum on the sea floor at Sitka <https://vimeo.com/43568351>

Further reading

GB Non-Native Species Secretariat - www.nonnativespecies.org

Scottish Natural Heritage marine NNS pages - <http://www.snh.gov.uk/protecting-scotlands-nature/nonnative-species/law-scotland/>

Marine Scotland Science, October 2016, Best practice guidance for the control of the invasive Carpet Sea Squirt *Didemnum vexillum* on shellfish farms <http://www.gov.scot/Topics/marine>

Code of Practice on Non-Native Species - Made by The Scottish Ministers Under Section 14C of The Wildlife and Countryside Act 1981 Available from : www.gov.scot/Publications/2012/08/7367/downloads

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ANNEX H: 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