



Marine Invasive Non-Native Species in the Solway Firth

PREPARED BY SOLWAY FIRTH PARTNERSHIP FEB 2021

REVISED FOR 2021 – 2024

Solway Firth

Partnership

Definitions

Invasive Non-Native Species

Invasive non-native species (INNS) are species which have been transported outside of their natural range, and can damage our environment, environmental services, the economy, our health and the way we live.¹ Impacts of INNS are so significant, they are considered to be one of the greatest threats to biodiversity worldwide. They threaten the survival of rare native species and damage sensitive ecosystems and habitats.

Biosecurity

Biosecurity means taking steps to make sure that good practices are in place to reduce and minimise the risk of spreading invasive non-native species. A good biosecurity routine is always essential, even if invasive non-native species are not always apparent.

¹(Convention on Biological Diversity, 2015a) *What are Alien Invasive Species?*

Abbreviations / Glossary

AAG	Area Advisory Group (for River Basin Management Planning)
ABT	Associated British Ports
AT	Angling Trust
BMFS	British Marine Federation Scotland
CMPP	Clyde Marine Planning Partnership
CBD	Convention on Biological Biodiversity
CBDC	Cumbria Biodiversity Data Centre
CFINNS	Cumbria Freshwater Invasive Non-Native Species Initiative
CWT	Cumbria Wildlife Trust
DAISIE	Delivering Alien Invasive Species Inventories for Europe
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EMS	European Marine Site
GB	NNSS Great Britain Non-Native Species Secretariat
IAS	Invasive Alien Species
INNS	Invasive Non-Native Species
ISSG	Invasive Species Specialist Group
MMO	Marine Management Organisation
MarLIN	Marine Life Information Network
MCS	Marine Conservation Society
MPA	Marine Protected Area
MSS	Marine Scotland Science
NNS	Non-native species
NT	National Trust
NTS	National Trust for Scotland
NE	Natural England
NatureScot	Nature Scot
NWIFCA	North Western Inshore Fisheries and Conservation Authority
RAFTS	Rivers and Fisheries Trusts of Scotland
RAT	River Annan Trust
RBMP	River Basin Management Plan
RYAS	Royal Yacht Association Scotland
SAC	Special Area of Conservation
SAMS	Scottish Association for Marine Science
SWT	Scottish Wildlife Trust
SEPA	Scottish Environment Protection Agency
SCAONB	Solway Coast Area of Outstanding Natural Beauty
SG	Scottish Government
SFP	Solway Firth Partnership
SWSEIC	South West Scotland Environment Information Centre
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TGB	The Green Blue
WANE	Wildlife and Natural Environment
WCRIFG	West Coast Regional Inshore Fisheries Group
WOW	World Oceans Week
WWT	Wildfowl and Wetlands Trust

Contents

Definitions	2
Invasive Non-Native Species	2
Biosecurity	2
Abbreviations / Glossary	3
Executive Summary	5
COVID-19.....	6
Table 1: Action Plan 2021-2024.....	7
1 Scope and Purpose	8
2 Background.....	10
3 Context	11
3.1 Biosecurity – the nature of the problem.....	11
3.2 Policy and Legislation	14
3.3 Existing Planning Framework.....	17
4 Biosecurity Issues in the Solway	18
4.1 Description of the Solway.....	18
4.2 Use of the Area.....	18
4.3 Biosecurity: Current and potential threats	20
4.3.1 Current Threats.....	20
4.3.2 Potential Threats.....	24
4.5 Stakeholders.....	27
5 Biosecurity Management and Strategy.....	28
5.1 Objectives and Outputs.....	28
5.2 Review of Action Plan 2018 - 2021	32
5.3 Actions and Timeframes	34
Table 8: Action Plan 2021-2024.....	34
References	36
Additional References	41
Appendices	42
Appendix 1 Invasive Non-Native Species recording schemes and further information sources.....	42
Appendix 2 GB NNSS ‘Check, Clean, Dry’ Campaign	43
Appendix 3 SFP Marine INNS ID Guide	44

Executive Summary

This plan describes the biosecurity issues of the Solway and presents actions that have been agreed with stakeholders for the prevention, early detection, control and mitigation of the introduction and spread of Marine Invasive Non-Native Species (INNS) and those INNS of freshwater and brackish water that impact on the marine and coastal environment. The vision of this plan is:

‘To establish a sustainable framework for preventing, detecting, and controlling marine invasive non-native species within the Solway Firth Partnership (SFP) area through appropriate management, data collection, liaison and education.’

The key objectives and outputs of the plan are to:

Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas.

Output 1.1: Continue to ensure that key stakeholders are aware of the threat of marine INNS through an awareness raising programme which will include promoting the Check, Clean, Dry Initiative, updating web pages on the SFP website, producing articles for Tidelines, taking part in activities during Invasive Species Week in collaboration with SG etc.

Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS which pose significant threats to biodiversity and economic interests.

Output 2.1: Facilitate a programme to aid early surveillance and data collection of marine INNS including setting up submerged settlement panels at selected harbours / marinas in the Solway, and reporting results to the NBN Gateway.

Output 2.2: Promote the reporting of INNS and facilitate the Government’s rapid response mechanism for those INNS which pose significant threats to local marine and coastal biodiversity and economic interests.

Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country.

Output 3.1: Facilitate effective control or eradication programmes in line with national policy and work with stakeholders to implement them.

The successful implementation of the actions in this plan is expected to bring about environmental and economic benefits for the Solway including:

- The conservation of internationally and nationally designated sites such as the Solway Firth European Marine Site, Luce Bay and Sands SAC etc;
- Maintenance and enhancement of biodiversity;
- Maintenance and, where necessary, improvement of the water environment so that the inshore waters meet the Water Framework Directive standards, and the European marine sites are maintained at favourable status;
- Protection of the high-quality landscape of the area, including the National Scenic Areas in Dumfries and Galloway and the Solway Coast Area of Outstanding Natural Beauty in Cumbria;
- Helping to ensure the outcomes of INNS management in the Solway area are more cost effective, strategic, and sustainable.

COVID-19

During 2020/21 COVID-19 has had an impact on the work of SFP. Staff have been working from home in line with Government guidance and rules and have therefore been unable to carry out public facing work such as guided walks, talks and outdoor events. COVID-19 restrictions have also limited any travel between the Scottish and English side of the Solway unless essential. Staff were therefore unable to deploy the settlement panels for monitoring INNS during summer 2020. The situation is constantly evolving and at the start of this plan a national vaccination programme is being rolled out. Staff will continue to work safely, following government guidelines and it is hoped that the settlement panels will be installed for the summer 2021 monitoring season.

Table 1: Action Plan 2021-2024

Action	Lead	Partners ²	Timeframe		
			2021 - 22	2022 - 23	2023 - 24
Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas					
Continue to update web pages on the SFP website	SFP	SFP	✓	✓	✓
Promote Check, Clean, Dry Campaign	SFP	SFP/ SEPA/ EA/ River Trusts/ NWIFCA/ TGB/ RYAS/ BMFS	✓	✓	✓
Actively engage with commercial and recreational users at the main Solway harbours and marinas to raise awareness of marine INNS	SFP	Industry, recreational vessel users	✓	✓	✓
Include articles in Tidelines magazine as appropriate	SFP	Partner input welcome	✓		✓
Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS, which pose significant threats to biodiversity and economic interests.					
Set up a series submerged settlement panels at selected harbours / marinas	SFP	AONB/ NE/ NTS/ DGC Rangers/ NSA Vols/ WWT/ SWT /NWIFCA/ SAMS	✓	✓	✓
Promote an effective single point of contact reporting and response system	SFP / GBNNS	NatureScot, Marine Scotland / NE / SWSEIC / CBDC	✓	✓	✓
Continue surveillance of Pacific oyster distribution around the Solway, resources allowing	SFP / EA/ NatureScot / NE	SFP/ SEPA/ NWIFCA	✓	✓	✓
Survey for marine INNS during routine work	SFP / SEPA/ EA / NatureScot / NE	SFP/ NWIFCA	✓	✓	✓
Promote national campaigns such as the American lobster campaign etc.	SFP	SFP / SG / NatureScot	✓	✓	✓
Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country					
Remove Pacific oyster where possible from identified locations in Galloway	SFP	SFP	✓	✓	✓
Look at funding opportunities to enable INNS work	SFP	SFP	✓	✓	✓

² Partners - These are organisations who have been identified as likely partners, but further discussion is required.

✓ indicates the need for action in marked years (COVID-19 allowing).

1 Scope and Purpose

This plan describes the biosecurity issues of the Solway and presents actions that have been agreed with stakeholders for the prevention, early detection, control, and mitigation of the introduction and spread of Marine Invasive Non-Native Species. The vision of this plan is:

‘To establish a sustainable framework which will prevent, detect, control and eradicate marine invasive non-native species within the Solway Firth Partnership area through appropriate management, data collection, liaison and education.’

The key objectives for meeting the vision of the plan are:

Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas.

Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS which pose significant threats to biodiversity and economic interests.

Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country.

The objectives are in accordance with the 3-stage approach asset out by the Convention for Biological Diversity (CBD)³ and recommended within the GB Invasive Non-Native Species Strategy.⁴:

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

Of these, the first two stages are the most cost effective. The ultimate key to the effectiveness of this approach is the building of local awareness, capacity, and partnerships to ensure the success and long-term sustainability of the presented actions.⁴The resulting environmental and economic benefits for the Solway include:

- The conservation of internationally and nationally designated sites such as the Solway Firth European Marine Site, Luce Bay and Sands SAC etc.;
- Maintenance and enhancement of biodiversity;
- Protection of natural fish and shellfish stocks;
- Maintenance and, where necessary, improvement of the water environment so that the inshore waters meet the Water Framework Directive (2000) standards⁵, and the European conservation site is maintained at favourable status;
- Protection of the high-quality landscape of the area including the National Scenic Areas in Dumfries and Galloway and the Solway Coast Area of Outstanding Natural Beauty (AONB) in Cumbria.

³ (United Nations, 1992) Convention on Biological Diversity

⁴ (DEFRA, The Scottish Government, Welsh Government, 2015)The Great Britain Invasive Non-Native Species Strategy

⁵ (Water Framework Directive, 2000)

The area covered by this plan is consistent with that of the Solway Firth Partnership (Fig 1).



Figure 1 Geographical Extent of the Solway Biosecurity Plan⁶

This Plan covers marine and coastal species only, including those that spend a part of their lifecycle in fresh waters. Galloway Fisheries Trust, the River Nith District Salmon Fishery Board and the River Annan Trust in Dumfries and Galloway, the Association of Rivers Trusts and Rivers and Fisheries Trust of Scotland (RAFTS) collaborated with the Cumbria Forum and the Cumbria Freshwater Invasive Non-Native Species (CFINNS) Initiative to develop the Cumbria Freshwater Biosecurity Plan which covers both fresh water and brackish water species.⁷ They reported on the success of that plan along with suggested actions for the future.⁸ In addition, the North West Inshore Fisheries and Conservation Association (NWIFCA) produced a biosecurity plan in 2014 for inshore fisheries.⁹ It is important that this plan overlaps the marine and freshwater plans to ensure all potential INNS at every stage of their life cycle are covered.

⁶ ©SFP

⁷ (Cumbria Freshwater Invasive Non-Native Species Initiative, 2011) *Cumbria Freshwater Biosecurity Plan 2011 – 2015*

⁸ (Cumbria Freshwater Invasive Non-Native Species Initiative, 2015) *The Cumbria Freshwater INNS Initiative Biosecurity Plan Implementation 2010-2015*

⁹ (Temple S. , 2014) *NWIFCA Biosecurity Plan 2014-2019, Incorporating Marine Invasive Non-Native Species and Shellfish Diseases*

2 Background

Solway Firth Partnership (SFP) is an independent charity that works with people to support the sustainable development of the Solway Firth whilst protecting the special qualities of the local marine and coastal area.

This Plan was originally based on a biosecurity plan template developed by RAFTS, a leading independent freshwater conservation charity which represented Scotland's national network of rivers and fisheries Trusts and Foundations. It linked in with Biosecurity Plans prepared by the River Nith Trust¹⁰, the River Annan Trust¹¹ and the Galloway Fisheries Trust. These formed a set of 25 plans produced throughout Scotland as part of a national programme of action implemented through RAFTS with backing and support from the Scottish Government, SNH (now NatureScot), SEPA and the Esmée Fairbairn Foundation. RAFTS no longer appears to be active. On the English side, the CFINNS Initiative¹² and the NWIFCA¹³ have produced biosecurity plans although these haven't been updated in recent years. The Cumbria Freshwater Biosecurity Plan (2011)¹⁴ was the first countywide plan in England and was funded by Natural England, the Environment Agency, the Angling Trust (AT) and RAFTS. There are links between those documents and this plan.

SFP held a Marine INNS Seminar in September 2012 in Carlisle to bring together stakeholders from both sides of the Solway to discuss the potential threat of marine INNS and explore the options for dealing with them. A wide range of experts from Scotland and England presented at the seminar and, along with workshops and feedback sessions, informed the agreed outcomes from the partners present (Section 4.5 Stakeholders). The actions from the seminar for SFP to take forward were:

- Produce a biosecurity plan for the Solway;
- Provide training to existing coastal volunteer groups to help identify marine INNS;
- Raise awareness of marine INNS across the Solway to encourage prompt reporting.

The aims, outputs and actions of this Biosecurity Plan were produced from consultation with the stakeholders present at the Marine INNS Seminar. The Plan provided a platform for local action to address the issue of INNS over its four-year lifespan and future editions of the plan. This revised version of the Plan, 2021-24 continues to review outcomes and impacts of actions, since the original publication in 2013. SFP will continue to monitor, review, and incorporate the presented information into future plans. This Plan is not a legal instrument but draws on existing legal and regulatory instruments to support the implementation of its actions and to help achieve its objectives. The successful implementation of this Plan will rely on strong local partnerships founded on solid legal and policy principles by a range of interested parties.

¹⁰ (Nith Catchment Fishery Trust, 2011)

¹¹ (The River Annan Trust & District Salmon Fishery Board, 2018)

¹² (Cumbria Freshwater Invasive Non-Native Species Initiative, 2011)

¹³ (Temple S., 2014) NWIFCA Biosecurity Plan 2014-2019

¹⁴ (Cumbria Freshwater Invasive Non-Native Species Initiative, 2011)

3 Context

3.1 Biosecurity – the nature of the problem

Non-native species (NNS) have been introduced deliberately, for cultural and economic benefit, and accidentally to the UK over many hundreds of years¹⁵. The increase in global shipping, aquaculture and recreational tourism has increased the threat of introducing NNS to the marine environment. This can be exacerbated by climate change depending on the tolerance and adaptability of individual species. Not all NNS are invasive from the start of their establishment as some take time to establish and develop the rapid growth required for invasive behaviour. Climate change is expected to have a significant impact on biodiversity by making conditions more favourable for NNS allowing a northward range expansion for various species and where NNS are already present, they may become invasive.¹⁶

Non-native species become 'invasive' (INNS) when they thrive aggressively and threaten native species, ecosystems, natural features (such as mussel banks), or interfere with manmade structures and business interests such as aquaculture or fisheries. INNS are one of the greatest threats to biodiversity, being capable of rapidly colonising a wide range of habitats and excluding the native flora and fauna. This can be through competition for resources such as space, light and food or, in some cases, local species can become prey to INNS. The presence of INNS can also impact on the water environment and the condition of European protected areas, increasing the risk that these sites do not meet their favourable conservation target or the requirements of the EC Directive on the community action in the field of water policy (Water Framework Directive)¹⁷ and the EC Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)¹⁸.

The Solway is an estuary with limited shipping along the north Solway Coast but with important national and international commercial shipping routes on the south Solway to ports such as Workington, Whitehaven and Silloth. Stranraer is a major ferry and shipping port with links to Ireland, England, Wales and further north in Scotland. Fishing is an important industry on both sides of the Solway with Kirkcudbright being the main base for scallop fishers in south Scotland although smaller ports such as Isle of Whithorn are also used. Scallop boats also work out of the Cumbrian ports on the Solway and although the Isle of Man is not within the area of this biosecurity plan boats from the island fish within the Solway area and land at local ports.

Recreational boat users also use and visit the Solway area with activities such as sea angling, scuba diving, sea kayaking, jet skiing, wind and kite surfing popular in the area. These factors mean that there is an increasing probability that certain INNS are likely to arrive in the Solway.

There are no major aquaculture installations in the Solway but there is a native oyster farm in Loch Ryan (The Loch Ryan Oyster Farm Fishery Co Ltd). There have been various aquaculture trials on the South Solway coast for oyster and mussel cultivation, but the companies appear to have closed or become dormant at the time of this plan. Whilst

¹⁵ (Bax, Williamson, Aguero, Gonzalez, & Geeves, 2003) Marine invasive alien species: a threat to global biodiversity. (GB Non-Native Species Secretariat, 2015a) Definition of terms

¹⁶ (Cook, et al., 2013) Impacts of climate change on non-native species. *Marine Climate Change Impacts* (GB Non-Native Species Secretariat, 2015a) Definition of terms

¹⁷ (Water Framework Directive, 2000)

¹⁸ (Marine Strategy Framework Directive, 2008)

aquaculture companies have stringent measures to prevent the introduction of disease and must abide by the current Aquaculture & Fisheries (Scotland) Act 2013¹⁹ and the Aquatic Animal Health (England and Wales) Regulations 2009²⁰, the impact of INNS introduced accidentally by the industry itself or from another source could be devastating.

There is some information available on the cost of impacts of marine INNS,²¹ partly relating to individual species, but no specific costing studies have been done to date for the Solway Firth. An economic report estimates that INNS cost the UK economy an approximate total of £1.7 billion per year, £244,736,000 of which is spent in Scotland and £1,291,461,000 in England.²² The ecological, social and economic impacts and the costs for mitigation, control and eradication of these species may have been eased with the introduction of: the government's Wildlife and Natural Environment (Scotland) Act 2011, restricting the introduction of INNS²³; the International Maritime Organization's International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which requires all ships to implement a Ballast Water and Sediments Management Plan²⁴; and the GBNNSS's Check, Clean, Dry Campaign encouraging water users to take measures to prevent the spread of INNS from one water body to another²⁵.

In contrast to terrestrial INNS, marine INNS are still greatly understudied, and so far, only a fraction of the invaders and their impacts have been recorded. In addition, knowledge of successful control methods in the marine environment is in the early stages of development.

The Solway is now known to have ten marine INNS (Table 2). This is the nine included in the previous plan and one species, Tube worm (*Ficopomatus enigmaticus*), which was accidentally missed out of the 2015 revision of the plan but was recorded in Whitehaven 2014²⁶. The ten species are Japanese wireweed (*Sargassum muticum*)²⁷, Pacific oyster (*Magallana gigas* previously *Crassostrea gigas*)²⁸, orange-tipped sea squirt (*Corella eumyota*)²⁹, leathery sea squirt (*Styela clava*)³⁰, green sea fingers³¹ (*Codium fragile*), acorn or Darwin barnacle³² (*Elminius modestus* or *Austrominius modestus*) [referred to as acorn barnacle from here on] and common cord grass³³ (*Spartina anglica*), American lobster³⁴ (*Homarus americanus*), Tube worm³⁵ (*Ficopomatus enigmaticus*) and Japanese skeleton shrimp³⁶ (*Caprella mutica*). Further to this, the arrival of other species already present in England, Wales and Ireland is to be expected (see Section 4). Whilst this number may be considered small relative to those recorded in other parts of the world, it is in the interests of all users of the Solway to keep the number of INNS to a minimum.

¹⁹ (Aquaculture & Fisheries (Scotland) Act, 2013)

²⁰ (The Aquatic Animal Health (England and Wales) Regulations, 2009)

²¹ (Williams, et al., 2010) *The Economic Cost of Invasive Non-Native Species on Great Britain*

(Nimmo, Cook, Moxey, Hambrey, & Black, 2010) *Cost benefit analysis of management options for Didemnum vexillum (carpet sea squirt) in Scotland*

²² (Williams, et al., 2010) *The Economic Cost of Invasive Non-Native Species on Great Britain*

²³ (Wildlife and Natural Environment (Scotland) Act, 2011)

²⁴ (International Maritime Organization, 2004)

²⁵ (GB non-native species secretariat, 2015b) *Check, Clean, Dry*

²⁶ (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

²⁷ (Solway Firth Partnership, 2015) *Records of Japanese wireweed*

²⁸ (Solway Firth Partnership, 2012) *Records of Pacific oyster*

²⁹ (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

³⁰ (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

³¹ (Solway Firth Partnership, 2016) *Records of Green Sea Fingers*

³² (National Biodiversity Network Trust, 1989) *Records of Acorn Barnacle*

³³ (National Biodiversity Network Trust, 2002) *Records of Common Cord Grass*

³⁴ (Marine Scotland, 2015) *Record of American Lobster*

³⁵ (C.A. Wood, 2015) *Records of Tubeworm*

³⁶ (Solway Firth Partnership, 2014) *Record of Japanese skeleton shrimp*

Table 2: Marine INNS currently present in the Solway

Water Body Name	Species of Concern
Loch Ryan, points along North Solway ³⁷	Japanese wireweed (<i>Sargassum muticum</i>)
North Solway – various points ³⁸	Pacific oyster (<i>Magallana gigas</i> previously <i>Crassostrea gigas</i>)
North Inner Solway and South Inner Solway – various points & Head of Luce Bay ³⁹	Common cord grass (<i>Spartina anglica</i>)
North Solway including Loch Ryan ⁴⁰	Orange tipped sea squirt (<i>Corella eumyota</i>)
North Inner Solway and South Inner Solway – various points ⁴¹	Acorn barnacle (<i>Elminius modestus</i>)
Loch Ryan ⁴²	Leathery sea squirt (<i>Styela clava</i>)
Loch Ryan, North Solway ⁴³	Green sea fingers (<i>Codium fragile</i>)
Loch Ryan, marina ⁴⁴	Japanese skeleton shrimp (<i>Caprella mutica</i>)
Solway, landed at Workington ⁴⁵	American Lobster (<i>Homarus americanus</i>)
Solway, Whitehaven Marina ⁴⁶	Tube worm (<i>Ficopomatus enigmaticus</i>)

INNS can be released and spread through many different pathways in the marine environment.⁴⁷ Experience from around the world would suggest that these include the following, in no particular order:

- Hull fouling of both commercial and private vessels;
- Fouling of commercial fishing vessels and equipment;
- Fouling of buoys, way markers and navigational lights;
- Fouling of other recreational equipment, e.g., diving gear, fishing lines, sea kayaks, mooring ropes, dinghies, canoes, clothing;
- Ballast water exchange;
- Distribution through water transfer of planktonic stages;
- Escape or release of plants and animals from aquaria;
- Live bait or its live packaging released or escaped;
- Importation or movement of new species (historically), shellfish or stock for aquaculture;
- Organisms attached to structures and equipment subsequently relocated, e.g. pontoons, aquaculture cages, dredges;
- Natural occurrences, e.g. debris from the 2011 Japanese tsunami has reached the USA coast with INNS attached.

Given the high costs for the mitigation, control and eradication of marine INNS once they are established, this Plan emphasises the need for prevention of arrival and, failing that, rapid response to the introduction of INNS before they become established. The Plan therefore identifies pathways and develops actions to limit the likelihood of INNS entering the Solway in the first place.

Management of INNS at a local scale in inshore waters is a new approach and there is much to learn regarding successful prevention and control of organisms in open systems. Even identification of marine INNS can be difficult, often requiring microscopic or genetic

³⁷ (National Biodiversity Network Trust, 2004) *Records of Japanese wireweed*

³⁸ (Solway Firth Partnership, 2012) *Records of Pacific Oyster*

³⁹ (National Biodiversity Network Trust, 2002) *Records of Common Cord Grass*

⁴⁰ (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

⁴¹ (National Biodiversity Network Trust, 1989) *Records of Acorn Barnacle*

⁴² (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

⁴³ (Solway Firth Partnership, 2016) *Record of Green sea fingers*

⁴⁴ (Solway Firth Partnership, 2014) *Records of Japanese skeleton shrimp*

⁴⁵ (Marine Scotland, 2015) *Personal communication*

⁴⁶ (C.A. Wood, 2015) *Records of Tubeworm*

⁴⁷ (Bax, Williamson, Aguero, Gonzalez, & Geeves, 2003) *Marine invasive alien species: a threat to global biodiversity*

examination of a sample to distinguish it from native species. It is therefore important to develop a rigorous reporting, identification and recording system as part of any Biosecurity Plan. In terms of control of existing INNS, mechanical methods are favoured as chemical methods would usually also involve the destruction of native flora and fauna and biological methods such as the introduction of a predator which can alter the ecosystem in other unforeseen ways.⁴⁸

3.2 Policy and Legislation

The UK has international obligations to address INNS issues, principally through the Water Framework Directive⁴⁹ and the European Habitats⁵⁰ and Birds Directives⁵¹, the United Nation's Convention of Biological Diversity which includes the International Plant Protection Convention⁵², the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention')⁵³ and the Bern Convention on Conservation of European Wildlife and Habitats⁵⁴.

The actions presented in this plan conform to, and are supported by UK Government legislation associated with the prevention, management and treatment of INNS:

European Commission Directive on the community action in the field of water policy (2000/60/EC) (The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017)

The aims within the Directive are that water bodies reach good ecological status and (subject to paragraph (3)) good surface water chemical status, if not already achieved, by 22nd December 2021; and that no deterioration in ecological status is permitted. This applies to the impact of INNS in the marine environment, as well as inland, and this plan can help achieve these objectives.

Under WFD, depending on the invasive species and their extent, water bodies are not able to reach high ecological status; the maximum level obtainable is good ecological status. To achieve this, the Directive requires that INNS 'have not damaged the native aquatic plant and animal communities. Again, depending on the species and extent, some INNS can also reduce the ecological status further e.g., to moderate. The Solway Firth is currently assessed as being at risk from deteriorating in water quality status due to the presence of the INNS.

European Commission Directive establishing a framework for community action in the field of marine environmental policy (2008/56/EC) (Marine Strategy Framework)⁵⁵

This Directive requires each member state to work towards "Good Environmental Status" of their marine waters by 2020.

The first stage of this process in Scotland, under the auspices of the Marine (Scotland) Act 2010, is the adoption of Scotland's National Marine Plan in 2015 and its subsequent review in 2018. Within this Plan: General Policy 10 Invasive non-native species: Opportunities to reduce

⁴⁸ (Payne, Cook, & Macleod, 2014) *Marine Biosecurity Planning*

⁴⁹ (Water Framework Directive, 2000)

⁵⁰ (Habitat Directive, 1992)

⁵¹ (Bird Directive, 2009)

⁵² (United Nations, 1992) *Convention on Biological Diversity*

⁵³ (OSPAR, 1972) *Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention')*

⁵⁴ (Council of Europe, 1979) *Convention on the Conservation of European Wildlife and Natural Habitats*

⁵⁵ (Marine Strategy Framework Directive, 2008)

the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made.⁵⁶

In England and Wales, the legislation is comprehensive and sectoral, in response to problems. The legislation with the greatest bearing upon INNS is The Wildlife and Countryside Act 1981 which significantly controls the release of new species. A detailed outline of all legislation and regulations can be accessed via GBNNSS⁵⁷. When new invasions occur, rapid response is led by the Great Britain Programme Board (made up of senior representatives from across Britain's administrations) who work with partners to eradicate species, where practicable.

The Wildlife and Natural Environment (Scotland) Act 2011⁵⁸

This legislation amended the Wildlife and Countryside Act 1981 relating to INNS. The 2011 changes introduced a new regime of Species Control Agreements and Species Control Orders. These enable relevant bodies (Scottish Ministers, NatureScot, Marine Scotland, SEPA and Forestry and Land Scotland) to set out measures that must be taken to control or eradicate INNS - plant or animal - when control is considered to be both viable and of sufficient priority.

The Scottish Government has published a Code of Practice⁵⁹ to accompany the 2011 Act, which fits in under section 14c of the Wildlife and Countryside Act 1981 to help people understand their legal responsibilities with regard to non-native plants and animals. Further, this Act is a means to translate the Bern Convention⁶⁰ into Scottish national law.

The Great Britain Non-Native Species Framework Strategy (2015)⁶¹

Aims to address the key weaknesses in our capacity to respond to the threats posed by NNS. The Strategy provides a framework for a more co-ordinated and structured approach to dealing with NNS and any potential invasive threat in or to GB. It includes better co-ordinated and strategic prevention measures aimed at reducing the introduction of damaging non-native species into GB.

Convention on Biological Diversity (CBD), Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets⁴²

The CBD is the only international instrument across all groups and vectors which is legally binding⁶² and calls out to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species."⁶³ Under the Strategic Plan for Biodiversity 2011-2020, an overarching framework, all participating parties are encouraged to produce national strategies and action plans similar to this one for the Solway Firth. Aichi Biodiversity Target 9 sets out that "by 2020, invasive alien species and pathways are identified and prioritised, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment"⁶⁴

⁵⁶ (The Scottish Government, 2015) *Scotland's National Marine Plan*

⁵⁷ (GB Non-Native Species Secretariat, 2015a) *Definition of terms*

⁵⁸ (Wildlife and Natural Environment (Scotland) Act, 2011)

⁵⁹ (The Scottish Government, 2012) *Code of Practice on Non-Native and Invasive Non-Native Species*

⁶⁰ (Council of Europe, 1979) *Convention on the Conservation of European Wildlife and Natural Habitats*

⁶¹ (DEFRA, The Scottish Government, Welsh Government, 2015) *The Great Britain Invasive Non-Native Species Strategy*

⁶² (Fasham & Trumper, 2001) *Review of Non-Native Species Legislation and Guidance*

⁶³ (United Nations, 1992) *Convention on Biological Diversity. Article 8(h)*

⁶⁴ (Convention on Biological Diversity, 2015b) *Aichi Biodiversity Targets*

The UK Marine Strategy⁶⁵

The UK Marine Strategy provides the framework for delivering marine policy at the UK level and sets out how we will achieve the vision of clean, healthy, safe, productive and biologically diverse oceans and seas. The strategy contributes to progress for Good Environmental Status (GES) for non-indigenous species which are 1 of the 11 elements (descriptors).

The 25 Year Environment Plan (2018)⁶⁶

This looks to the future of the environment and broadly describes what environmental aims are being sought over the next 25 years. Some of this document is applicable to the whole UK, however those sections covering INNS are applicable only to England as matters relating to the environment are devolved. This government-led plan is a policy document which features non-natives, understanding the threat they pose to the health of native biodiversity. The plan seeks to take actions such as strengthening biosecurity, maintain alert systems for high-risk species, reducing the risk from high-risk pathways, and continuing a focus on pre-emptive action and effective intervention across England.

European Regulation on Invasive Alien Species (2015)⁶⁷:

This provides for a set of measures to be taken across Member States in relation to Invasive Alien Species (IAS) that are included on a 'list of Invasive Alien Species of Union Concern.' Three core strategies are detailed, prevention, early detection and rapid eradication and management. Supporting the Commission in IAS regulation are the

- **Committee on IAS** – Supports the implementation of the IAS regulation, consisting of representatives from all Member States;
- **Scientific Forum on IAS** – Provides advice on scientific questions related to the implementation of IAS regulation;
- **Working Group for IAS** – Assists the Commission and facilitates coordination, consisting of interested stakeholders.



Figure 2: Checking a settlement panel in Stranraer Marina, Sept 2019

⁶⁵ (UKMMAS, 2019) The UK Marine Strategy

⁶⁶ (DEFRA, 2018) 25 Year Environment Plan

⁶⁷ (EU, p. Regulation 1143/2014 on Invasive Alien Species)

3.3 Existing Planning Framework

This Biosecurity Plan links Government-led policy, legislation and strategic action with local actions while it reflects, implements and/or supports the provisions and requirements of the following existing Plans:

- Solway Firth Partnership Business Plan 2021 – 2024⁶⁸
- The River Basin Management Plan for the Solway Tweed River Basin District 2015⁶⁹
- Solway Firth European Marine Site Management Plan⁷⁰
- Solway Coast Area of Outstanding Natural Beauty Management Plan⁷¹
- NSA Management Strategies for Nith Estuary, Fleet Valley and East Stewartry Coast⁷²
- Cumbria Local Biodiversity Action Plan⁷³
- Dumfries and Galloway Local Biodiversity Action Plan⁷⁴
- The Cumbria Freshwater Biosecurity Plan⁷⁵
- River Annan Trust Biosecurity Plan 2010 – 2016⁷⁶
- River Nith Trust Biosecurity Plan 2011 - 2016⁷⁷
- Galloway Fisheries Trust⁷⁸
- North Western Inshore Fisheries and Conservation Authority Biosecurity Plan 2014 - 2019⁷⁹
- Identifying best practice in management of activities on Marine Protected Areas (NECR108)⁸⁰

This Plan also helps to support the protection of Marine Protected Areas (MPAs) and European Marine Sites (EMS) within the Solway area.

⁶⁸ *(Solway Firth Partnership, 2021) Business Plan*

⁶⁹ *(Environment Agency; Natural Scotland) The river basin management plan for the Solway Tweed river basin district*

⁷⁰ *(Natural England; Scottish Natural Heritage, 2000) Solway Firth European Marine*

⁷¹ *(Solway Coast Area of Outstanding Natural Beauty, 2020) Managing For The Future*

⁷² *(Dumfries & Galloway Council, 2019) National Scenic Areas (NSAs)*

⁷³ *(Cumbria County Council, 2001) Cumbria Biodiversity Action Plan*

⁷⁴ *(Norman, 2009) Dumfries & Galloway Local Biodiversity Action Plan*

⁷⁵ *(Cumbria Freshwater Invasive Non-Native Species Initiative, 2011) Cumbria Freshwater Biosecurity Plan*

⁷⁶ *(The River Annan Trust & District Salmon Fishery Board, 2018) Biosecurity*

⁷⁷ *(Nith Catchment Fishery Trust) River Nith Catchment Bio-Security Plan 2011 - 2016*

⁷⁸ *(Galloway Fisheries Trust, n.d.) No longer available*

⁷⁹ *(Temple S., 2014) Biosecurity Pan 2014 - 19*

⁸⁰ *(Natural England, 2012) Identifying best practice in management of activities on Marine Protected Areas (NECR108)*

4 Biosecurity Issues in the Solway

4.1 Description of the Solway

The Solway Firth covers a surface area of 3,923 km² with a maximum water depth of 265m and an average water depth of 55m (Figure 2). The two shores of the Solway differ broadly in character reflecting their differing geology, with older harder rocks on the Scottish side creating a more rugged coastline than the softer sandstone and coal measures of the southern shore. The north shore consists of a series of peninsulas divided by estuaries, with hard sedimentary rocks creating a rugged coast. In the south, softer sediments have been eroded to form a wide coastal plain, backed by the more resistant rocks of the Lake District Fells.

The Solway is influenced by the Atlantic Ocean through the North Channel and through St George's Channel much further to the south. This effect generates rapid tidal streams in the Solway. One of the main reasons for the lack of major commercial development at the head of the Solway Firth is the difficulty in navigating the shallow uncharted waters, which restricts access to all but the smallest vessels.

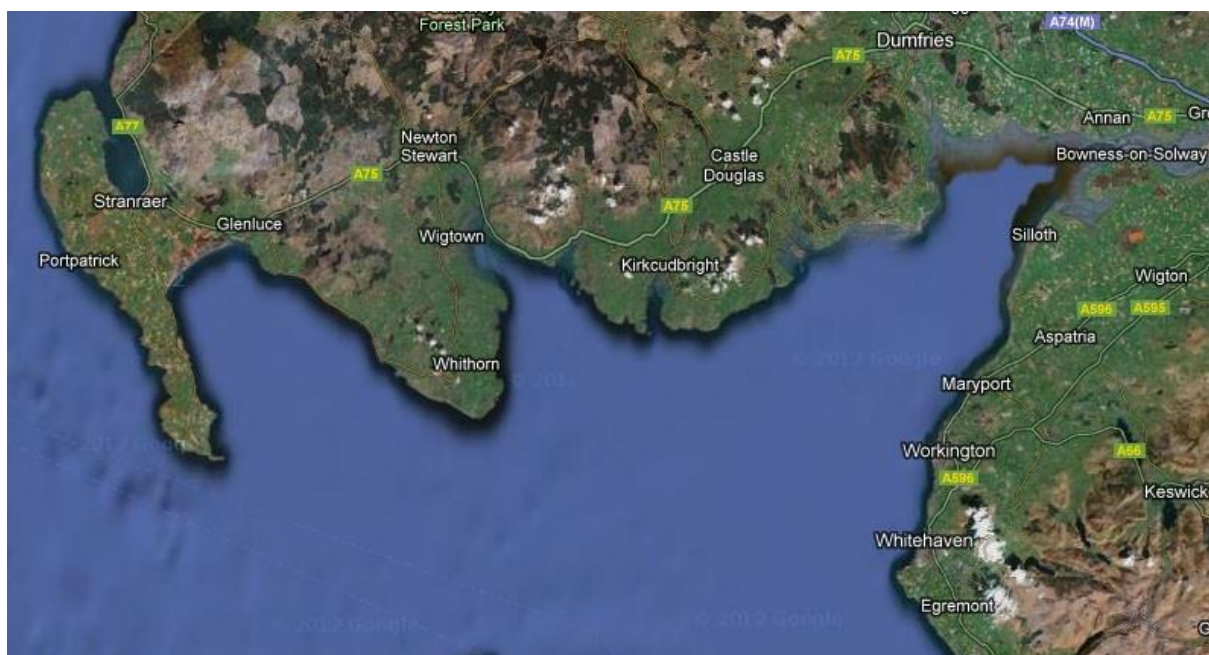


Figure 3: Map of the Solway⁸¹

4.2 Use of the Area

The Solway accommodates many small and medium sized harbours with the larger ports situated along the Cumbrian shore. The commercial activity of Workington and Silloth contrasts markedly with the relative tranquillity of the small harbours on the Galloway coast. The area's main fishing ports and harbours are Whitehaven and Stranraer, Maryport, Silloth, Annan, Kirkcudbright, and the Isle of Whithorn. Most of the area's fishing fleet is involved in shellfish fishing with the key species being scallops, queen scallops, nephrops, brown shrimp, cockles, crab, lobster, whelk mussels and periwinkles.

⁸¹ Google Maps: Imagery©2021 TerraMetrics, Map data ©2021

Demersal fish (cod, whiting, plaice, sole, dogfish) are also landed by the local fleet. From the Cumbrian shores fishing for Dover sole, bull huss and turbot is important along with plaice, cod, codling and skate.

There are several locally based sailing clubs in the Solway with good marina facilities at Whitehaven, Maryport and Stranraer and pontoons at Kippford and Kirkcudbright. Most sailing activity is restricted to within 5 km of the coast and the most popular trans-Solway route is between Maryport and Kippford. Boating is highly seasonal, with most activity taking place between May and September, although there is some sailing year-round.



Figure 4: Sea angling at Silloth, Cumbria

Other recreational activities such as windsurfing, scuba diving, jet skiing and land sailing also take place at various locations around the Solway. Sea angling including angling from the shore (Figure 4), inshore fishing and deep-sea fishing, is popular with frequently caught fish including lesser spotted dogfish, mackerel, pollack and ballan wrasse during May to October, with cod caught during the winter. Flounder and dab are mainly caught in the inner reaches of the estuaries. Bass can be caught from beaches while tope fishing from boats is popular off the Galloway coast.

Renewable energy is widely regarded as a cleaner source of energy than finite fossil fuels. Securing sustainable clean energy from the marine environment contributes to a diverse energy mix, improves energy security, and helps meet domestic and international renewable obligations. Robin Rigg in the Solway Firth was Scotland's first offshore wind development and has a capacity of 180MW from 60 turbines.⁸²

As of 2011 there were a reported 20.5 km of submarine electricity cables and over 90 km of oil and gas pipeline in the Solway Firth and North Channel⁸³. There are also seabed telecommunication cables and power cables, which run across the Firth to Ireland and Northern Ireland.

⁸² Now 58 turbines. (EON, 2015) Robin Rigg

⁸³ (Scotland's Marine Atlas, 2011)

4.3 Biosecurity: Current and potential threats

At the time of writing there are ten known species of marine INNS already present in the Solway, see Table 3, with an additional five species being in proximity or a potential threat, see Table 4. These are species that if introduced would have severe consequences for local biodiversity and the economy, see more information under individual species descriptions.

There is also a growing recognition of the impacts of trans-located species. Trans-located species are native species that have been transported outside of their natural range, which can have severe ecological impacts.

4.3.1 Current Threats

Several INNS have been recorded and are known to be present in the waters Solway Firth, presenting a risk to the biodiversity of the natural ecosystem (Table 3).

Table 3: Current threats of INNS in the Solway

Common Name Scientific Name	Environmental Impact	Socioeconomic Impact
Common Cord Grass, <i>Spartina anglica</i>	Medium	Low
Pacific oyster, <i>Magallana gigas</i> previously <i>Crassostrea gigas</i>)	Medium	Low
Wireweed, <i>Sargassum muticum</i>	Medium	Low
Orange tipped sea squirt, <i>Corella eumyota</i>	Low	Medium
Acorn barnacle, <i>Elminius modestus</i>	Low	Low
Leathery sea squirt, <i>Styela clava</i>	Low	Medium
Green sea fingers <i>Codium fragile</i>	Low	Low
Japanese skeleton shrimp, <i>Caprella mutica</i>	High	Medium
American Lobster <i>Homarus americanus</i> (NB only one record has been submitted to date)	High	Medium
Tube worm <i>Ficopomatus enigmaticus</i>	Low	Medium

The impacts shown above are based on information in the GBNNSS risk assessments for species, where completed, (available at <http://www.nonnativespecies.org>) and on the experience of the impact of these species in other parts of the UK and in the Solway to date. These will be updated following publication of a NatureScot report in mid 2021.



Common cord-grass (*Spartina anglica*) is a well-established and vigorously invasive grass of estuarine salt marshes in England, Wales, Ireland and from southern Scotland to Argyll, the west coast of Scotland. It is a hybrid of a North American and a British native species, which arose some time before 1892. It colonises the lower zones of estuarine salt marshes and intertidal mudflats, excluding native flora and fauna and can lead to a loss of habitat for feeding and roosting, seriously affecting populations of migratory wildfowl and waders. It may compete

with areas used for commercial oyster and mussel farming and have an impact on the recreational use of the coast by land locking sandy beaches. *S. anglica* is an aggressive invasive ranked among the "100 world's worst alien invaders" by the International Union for Conservation of Nature (IUCN).⁸⁴ Removal by digging at an early stage of invasion can be successful, but manually intensive. Smothering in plastic sheeting has been locally successful. Alternatively, herbicides have been used but can need frequent reapplication.



Pacific oysters (*Magallana gigas* previously *Crassostrea gigas*) were deliberately introduced to Great Britain from Canada during the 1960s for commercial purposes with the first record from the wild being in 1965⁸⁵. Farmed populations occur throughout England, Scotland, Wales and Ireland, and are widespread in Europe. It was initially presumed that temperatures in British waters would not be suitable for Pacific oysters to successfully spread, settle and spawn locally, but escapees have established feral populations in

south-east and south-west England and Wales⁸⁶. There are extensive beds of naturally recruited Pacific oysters in some southern estuaries of England and sparse settlements are known from the north coast of Wales near Conwy. Mature individuals were first recorded on the Galloway coast at Ravenshall in October 2012, Ross Bay in December 2012 and Balcary Bay in January 2013. A survey published in 2015 confirmed the Solway Firth to be an ideal habitat for *C. gigas* although densities are low at present.⁸⁷ These are small colonies but will be removed to prevent any spread.



Wireweed (*Sargassum muticum*) is a highly distinctive large olive-brown seaweed, often over 1m long. Its lateral branches hang like washing from a line when held out of the water. Wireweed competes with native seaweeds and sea grasses through rapid growth, shading and abrasion. It is a nuisance in harbours and shallow waters where it is a hazard to boating due to entanglement of propellers. It can dominate in rock pools, altering the habitat. It is distributed widely along the coasts

of south and west England, Wales and West Scotland⁸⁸. It was first recorded in Scotland in Loch Ryan in 2004 and has since populated various areas further north up the west coast. Whilst physical removal may be possible, care must be taken to prevent further spread of the species and recolonisation from surrounding populations following clearance is likely. See Appendix 2 for contact details of species-specific recording scheme.

⁸⁴ (Lowe, Browne, Boudjelas, & De Poorter, 2000) *100 of the World's Worst Invasive Alien Species – A selection from the Global Invasive Species Database*

⁸⁵ (GB non-native species secretariat, 2012) *Factsheet on Pacific oyster*

⁸⁶ (GB non-native species secretariat, 2012) *Factsheet on Pacific oyster*

⁸⁷ (Cook, Beveridge, Lamont, O'Higgins, & Wilding, 2014). *Survey of Wild Pacific Oyster Crassostrea gigas in Scotland*

⁸⁸ (GB non-native species secretariat, 1971) *Wireweed factsheet*



Orange tipped sea squirt (*Corella eumyota*) has been found along the south coast of England at Brighton, Portsmouth and Weymouth and in harbours on the south west, south and east coasts of Ireland⁸⁹. Records have also been noted on the Galloway Coast and within Stranraer marina. This is a solitary sea squirt, 2-4 cm long, which often attaches to hard substrates such as cobbles, boulders, ship hulls and shells of mussels and oysters. Note the distinctive curved or U-shaped gut, the identifying feature. Other similar squirts have an S shaped gut. It may threaten oyster and mussel farms through fouled gear and by smothering and outcompeting cultures.



Acorn (Darwin) barnacle (*Elminius modestus*) is a small sessile barnacle, 5-10 mm in diameter, which is native to Australasia and is now widely distributed around most coasts of England and Wales and present in areas of Scotland including various sites around the Solway⁹⁰. It attaches to a variety of surfaces including rocks, stones, hard-shelled animals and artificial structures including ships, and tolerates a wider range of salinity and turbidity than native species. This is a fast-growing species that is quick to reach maturity, which, combined with its high reproductive output in water

temperatures above 6°C, gives it a competitive advantage over native species. This barnacle can dominate hard surfaces and displace native species; it has largely displaced native barnacles in estuaries in southwest England, although impacts are less significant on exposed rocky shores. In favourable conditions it can be a nuisance as a fouling organism. Spread of this species may be limited by the appropriate treatment of ships' ballast water and removal of hull fouling communities but is unlikely to be prevented due to the species' ability to disperse naturally during the pelagic larval phase.



Leathery sea squirt (*Styela clava*) is a brown solitary sea squirt up to 20 cm tall, attached by a small flat holdfast at the base of a narrow stalk. It attaches to solid surfaces in shallow water, especially in harbours and marinas but also on wrecks and natural rock bottoms. It is a large organism that can achieve high densities and did prove to be a severe nuisance to long-line mussel farming in eastern Canada until replaced by other invasive species, however, this species has not been noted as a problem to aquaculture in the UK to

date. It is distributed from the Clyde around the south coast of England and to the Humber

⁸⁹ (GB non-native species secretariat, 2004) *Factsheet on Orange-tipped sea squirt*

⁹⁰ (The Marine Life Information Centre, 1972) *Factsheet on Acorn barnacle*

and has been recorded in Loch Ryan⁹¹. Mechanical clearance by individual ‘picking’ appears possible; however, small unstalked individuals would be very inconspicuous, suggesting that total clearance of surfaces would be necessary to achieve eradication.



© GB NNSS

Green sea fingers (*Codium fragile*) is a spongy green seaweed with numerous Y-shaped, branching, cylindrical fronds with a felt-like texture. It usually grows to around 25 cm in Britain. It has the potential to compete with native species for space, forming dense clumps and potentially altering community structure. It can be a nuisance to fisheries and aquaculture, particularly on NW Atlantic shores; it fouls nets and may attach to, uplift and move commercially produced shellfish and seaweed. Green sea fingers are present around

Great Britain including the Scilly Isles, Channel Islands, South Wales, the south coast of England, the west coast of Scotland to Argyll and has been recorded within Stranraer marina⁹². It is well established, so prevention of further dispersal is unlikely. Mechanical removal would be unlikely to succeed as the species can reproduce asexually from fragments; however, a population of green sea fingers in Oban was decimated through predation by sea slugs, suggesting a possible biological control strategy.



© T. Nickell

Japanese skeleton shrimp (*Caprella mutica*) is an aggressive skeleton shrimp originally from NE Asia, which is rapidly invading and has established populations in the North Sea, West coast of Scotland and Irish Sea. It was first recorded in the UK near Oban in 2000, is found at several sites in the Clyde and was found within Stranraer marina in 2015⁹³ and then in 2018 and 2019 during monitoring surveys⁹⁴. It grows up to 49 mm in length, has fine hairs on 3rd to 7th body

segment, males have large spines on 3rd and 7th body segment and females have orange spots on their brood pouch. *Caprella mutica* can be found in harbours and marinas amongst fouling growth on boat hulls, ropes and nets where it can clog equipment and nets as well as outcompete native species.

⁹¹ (The Marine Life Information Network, 2004) *Factsheet on Leathery sea squirt*

⁹² (Solway Firth Partnership, 2016) *Record of Green sea fingers*

⁹³ (Solway Firth Partnership, 2015) *Record of Japanese skeleton shrimp*

⁹⁴ (Solway Firth Partnership, 2018) *Reports of Japanese skeleton shrimp during Marine INNS Monitoring*



American Lobster (*Homarus americanus*) is easily confused with the native European Lobster although the American lobster tends to be larger and olive green/ brown in colour. American Lobsters could be a serious risk in GB and Europe as it could have significant detrimental impacts on our native lobster through competition, interbreeding and by spreading disease. This species is currently very uncommon in GB waters although a specimen was landed in Workington in 2015⁹⁵ (in the past decades there have been 24 confirmed reports in UK waters). This species' most characteristic feature is the red tipped spines on the rostrum. American Lobsters prefer rocky ocean bottoms over sandy and muddy areas.



Tube worm (*Ficopomatus enigmaticus*) is a reef building tubeworm, believed to be native to Australia and regions of the Indian Ocean. It is an aggressive species that dominates habitats, significantly altering water conditions and physical environments resulting in changes to native communities. Thousands of individuals can form extensive reefs causing fouling to boat hulls, equipment and blockages to pipes. This species was noted in Whitehaven Marina in 2014 and then found to be covering over 16% of settlement panels in a 2016 study in the same marina⁹⁶.

4.3.2 Potential Threats

Looking further afield provides an idea of the species that are likely to become a problem in the Solway through various pathways. The following species (Table 4) are considered most likely to appear in the Solway area in the near future due to their proximity. Should you encounter any of the listed species please refer to [Appendix 2](#) for contact details of species-specific recording schemes.

Table 4: Potential threats of INNS in the Solway

Common Name Scientific Name	Risk of Introduction	Local Impact
Chinese mitten crab (<i>Eriocheir sinensis</i>)	High Risk	High
Carpet sea squirt (<i>Didemnum vexillum</i>)	High Risk	High
Slipper limpet (<i>Crepidula fornicata</i>)	Low Risk	Medium
Killer shrimp (<i>Dikerogammarus villosus</i>)	High Risk	High
Zebra mussel (<i>Dreissena polymorpha</i>)	Medium Risk	High

⁹⁵ (Marine Scotland, 2015) *Report of American lobster*

⁹⁶ (C.A. Wood, 2015) *Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*

Chinese mitten crab (*Eriocheir sinensis*) was first introduced to the Thames Estuary in 1935 and is now established in several sites throughout England and Wales⁹⁷. Juveniles occur in lower estuaries and marine habitats. As they develop, young crabs migrate upstream, into freshwater and brackish systems. Adults usually live in burrows in muddy riverbanks, although aquatic vegetation and marshes may provide an alternative habitat. Adults migrate into deep, open, saltwater locations to reproduce. This species can impact marine and freshwater ecosystems and is a voracious predator that will consume a range of invertebrate species and the eggs of fish leading to competition with native species and impacting invertebrate and fish populations. It burrows into riverbanks, increasing erosion and river turbidity, and causing bank collapse. Burrowing also leads to the siltation of gravel beds, including those used for fish spawning. Chinese mitten crab is known to have been present in the Duddon estuary (South West Lakes), where two females were recorded and captured. Remains of a Chinese mitten crab were found in the River Clyde in June 2014, the first evidence of a mitten crab in the wild in Scotland.⁹⁸ More recently there have been anecdotal reports of Chinese mitten crab in the Lune Estuary, south of the Solway. It is also the intermediate host for the mammalian lung fluke (*Paragonimus westermani*), which is known to infect humans.



Carpet sea squirt (*Didemnum vexillum*) was first recorded in 2008 in the Plymouth and Holyhead estuaries, carpet sea squirt has now been recorded in a number of other locations in Great Britain including several locations on the Clyde and in Argyle and is a species of particular concern in Scotland. It forms pale orange, cream or off-white colonies of extensive thin (2-5 mm) sheets and can form long pendulous outgrowths. Colonies can overgrow other fauna and occupy a substantial proportion of available space. On offshore banks in the USA, it has shown very extensive coverage of the seabed, potentially smothering species living in gravel and affecting aquaculture. There have been decreases in brittle stars and sea urchins noted in The Netherlands. It is suggested that carpet sea squirt degrades in cold weather and that this influences its ability to regenerate and reproduce sexually. Wrapping affected surfaces in polythene sheets secured with cable ties has been effective in New Zealand and North Wales (UK), whilst a costly exercise, causes the encased sea squirt to suffocate and decay within weeks, and can be enhanced by adding a biocide such as bleach within the plastic wrapping. Repopulation from untreated sites has occurred in North Wales. Much work has been done on this species in Scotland. Community Biosecurity Plans have been produced for Loch Fyne⁹⁹ & Loch Creran¹⁰⁰, addressing issues there with Carpet sea squirt. See Appendix 2 for contact details of species-specific recording scheme.



⁹⁷ (GB non-native species secretariat, 2012) *Factsheet on Chinese mitten crab*

⁹⁸ (Clyde River Foundation, 2014) *Chinese Mitten Crab update*

⁹⁹ (Scottish Government, 2020) *Loch Fyne Community Biosecurity Action Plan*

¹⁰⁰ (Scottish Government, 2017) *Loch Creran Community Biosecurity Action Plan*

Slipper limpet (*Crepidula fornicata*) was discovered in Liverpool Bay in 1872, but this population has since died out. It was subsequently introduced to Essex between 1887 and 1890 with American Oysters *Crassostrea virginica* from northeast USA¹⁰¹; it may also have been transported on ships' hulls and in ballast water when it is in the open-water larval phase. Since 1934, it has been found in silt brought into the UK with Dutch oysters and is now abundant in the whole of the North Sea on oyster and mussel banks. It is thought to have been introduced into the Solent in the 1930s and by the 1970s, was thought to be the most dominant seabed creature in the area. Its numbers are continuing to increase. Slipper limpet competes with, and can displace, other filter-feeding invertebrates. The species can be a serious pest of oyster and mussel beds.



Killer shrimp (*Dikerogammarus villosus*) is highly invasive with only a few known populations in Britain¹⁰². A key feature is the presence of cone shaped protrusions on the tail. It is often larger than native freshwater shrimp species and sometimes has a striped appearance. It is a voracious predator; killing invertebrates and small fish and will quickly dominate the habitats it invades and can significantly alter their ecology. It is tolerant of poor water quality and brackish water and can survive in damp conditions for up to five days. It could, therefore, be spread through ballast water and by equipment used in the water, including angling gear, boats, kayaks and trailers.



Zebra mussel (*Dreissena polymorpha*) is a freshwater mussel species with a distinctive striped colouration and shape. They are found commonly across England and Wales and in limited locations in Scotland and Ireland¹⁰³. It inhabits a range of clean and well-oxygenated freshwaters but can tolerate weakly brackish waters. It attaches, usually in groups, by sticky byssal threads to anything solid underwater such as masonry, stones, wooden posts, tree roots or shells. This attachment can block pipework, affect lock gates and other hard structures in the water. They can also significantly alter ecosystems by smothering native species and rapidly filtering out nutrients from the water. The growth of these colonies is like that of marine mussels.



¹⁰¹ (GB non-native species secretariat, 2019) *Factsheet on Slipper limpet*

¹⁰² (GB non-native species secretariat, 2010) *Factsheet on Killer shrimp*

¹⁰³ (GB non-native species secretariat, 2016) *Factsheet on Zebra mussel*

4.5 Stakeholders

The engagement of key stakeholders is imperative for the success of this plan (Table 5), including those involved in the development of the plan through attendance at the INNS Seminar in Carlisle.

A wider group of stakeholders including industry will have the opportunity to be involved in the development and revision of this plan. It is also hoped that these organisations will be keen to be involved in raising awareness of INNS and ensuring that Biosecurity measures are in place in their area of interest to prevent the spread of INNS.

Table 5: Key stakeholders in the Solway

Stakeholder Group	Stakeholder
Government and Agency	Environment Agency GB NNS Secretariat Marine Scotland MMO Natural England NWIFCA SEPA NatureScot
Local Authority	Allerdale Borough Council Cumbria County Council Carlisle City Council Copeland Borough Council Dumfries and Galloway Council Solway Coast Area of Outstanding Natural Beauty
Fisheries	River Annan District Salmon Fishery Board River Nith District Salmon Fishery Board Galloway Fisheries Trust
Non-Government Organisation	Cumbria Biodiversity Data Centre Cumbria Wildlife Trust Eden Rivers Trust West Cumbria Rivers Trust Galloway Fisheries Trust Lake District Coast Aquarium National Trust for Scotland Nith Catchment Fishery Trust River Annan Trust RSPB South Cumbria Rivers Trust (the CFINNS Initiative) South West Scotland Environmental Information Centre West Coast RIFG
Recreational Sport	Scottish Sea Angling Conservation Network
Industry	Kirkcudbright Training Range Robin Rigg Wind Farm, RWE Solway Shore Stories
Marine and Coastal Fora	Clyde Marine Planning Partnership North Solway Area Advisory Group Solway Area Advisory Group Solway Firth Partnership

5 Biosecurity Management and Strategy

5.1 Objectives and Outputs

The objectives of this plan will be achieved through a partnership approach focused on the three strategic elements described previously, and namely:

- **Prevention** – this is the most effective and least environmentally damaging option;
- **Rapid Response** – includes early detection and surveillance, potential eradication;
- **Control and Containment** – where INNS are widespread and eradication is not feasible, control of the population and mitigation against negative impacts is required.

This section of the biosecurity plan was developed in part through a workshop with various stakeholders at Tullie House Museum in Carlisle on 21 September 2012. Actions for prevention are based on identifying and disrupting pathways for the introduction and spread of INNS and include a mixture of awareness raising and practical measures. Actions for rapid response focus on the establishment of a reporting and response system by species but are also dependent on a raised level of awareness amongst users of the marine environment. Control and containment measures will be coordinated with national initiatives and advice.

Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas.

Output 1.1: Continue to ensure that key stakeholders are aware of the threat of marine INNS through an awareness raising programme which will include promoting the Check, Clean, Dry Initiative, updating web pages on the SFP website, producing articles for Tidelines, taking part in activities during Invasive Species Week in collaboration with SG etc.

Awareness activities will be focused on addressing local priorities as well as supporting the GBNNSS Media and Communications Strategic Plan and its key messages to the general public:

- INNS damage our environment, the economy, our health and the way we live;
- We require the support of stakeholders to increase awareness, reporting and better understanding of INNS issues and impacts;
- INNS
 - threaten our native plants, animals and habitats;
 - are estimated to cost the British economy between £2 and £6 billion pounds each year;
 - can threaten our health.

The local priorities for increasing awareness will aim to disrupt the pathways for the introduction and spread of INNS in the Solway area (Table 6).

Table 6: Pathways, preventative action, and relevant stakeholders

Mechanism for Spreading	Preventative Action	Stakeholder
Ballast water	Follow Ballast Water Convention and do not pump non-treated water out in harbours or into the Solway Firth	Port Authorities, Harbour Masters, vessel operators and owners
Hull fouling	Annual haul-out of vessel and treatment with antifouling. Hull design to prevent fouling and encourage easy cleaning	All vessel manufacturers, operators and owners
Port infrastructure as a receptor	Good housekeeping. Design to discourage fouling.	Port Authorities, Local Authorities
Fouling of recreational equipment	'Check, Clean, Dry' all marine equipment and clothing between use and before moving from one water body to another (see Appendix 3)	All marine groups, associations and users using water-based equipment
Relocation of structures and equipment	'Check, Clean, Dry' all structures and equipment before moving from one water body to another (see Appendix 3)	Port Authorities, marinas, fisheries, offshore industries
Attached to marine debris / litter	Minimise marine litter / debris, National Marine Litter Strategy, Fishing for Litter campaign, beach cleaning activities	Local Authorities, Fisheries, SFP, NTS, Solway Coast AONB, MCS, general public
Escape or release of plants and animals from aquaria	Do not release animals and plants from aquaria. Use native species whenever possible.	Stockists, general public
Aquaculture	Ensure no contamination of imported aquaculture stock Ensure imported aquaculture stock does not include marine INNS Maintain good practice during biofouling	Stockists, aquaculture industry
Natural dispersal	Understand tidal currents and spread risk for each invasive species.	NatureScot, GB NNSS, SEPA, Environment Agency

Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS which pose significant threats to biodiversity and economic interests.

Output 2.1: Facilitate a programme to aid early surveillance and data collection of marine INNS including setting up submerged settlement panels at selected harbours / marinas in the Solway, and reporting results to the NBN Gateway .

Marine species can often be extremely difficult to identify with the naked eye and can look very similar to other marine species from the same family. Often laboratory identification with the use of a microscope or even genetic level analysis is required to be certain of the species. It is therefore essential that any material circulated to help identify INNS contains enough information to allow the user to be fairly certain it is indeed the relevant INNS that has been

sighted and that, where appropriate, these sightings are checked by an appropriate organisation such as Marine Scotland. If appropriate, training courses can be set up for existing volunteer groups to help them identify INNS and to follow the appropriate reporting systems.

A reporting system exists for marine INNS through the NatureScot and Marine Scotland websites and for the Chinese Mitten Crab through GB NNSS. All records can also be submitted either directly to SFP for passing on or to the South West Scotland Environmental Information Centre or the Cumbria Biodiversity Data Centre, depending on location¹⁰⁴.

Output 2.2: Promote the reporting of INNS and facilitate the Government's rapid response mechanism for those INNS which pose significant threats to local marine and coastal biodiversity and economic interests.

The type of rapid response - a GB or Scottish high priority response that will be led by national governmental institutions OR a local priority response - will depend on the species detected and be proportionate to the threat posed. The response will also be in line with national guidelines for the relevant species.

In the Solway, species not currently present, that would require a GB or Scottish high priority response are:

- Carpet Sea Squirt, *Didemnum vexillum*
- American lobster, *Homarus americanus*
- Chinese Mitten Crab, *Eriocheir sinensis*
- Slipper limpet, *Crepidula fornicata*
- Killer shrimp, *Dikerogammarus villosus*
- Zebra mussel, *Dreissena polymorpha*

The response to reports of these species would be to follow the procedure:

1. Report to SFP who will pass the information onto GBNNSS, NatureScot, Marine Scotland, SWSEIC or CBC);
2. Determine the extent of infestation;
3. Isolate area where practicable;
4. Follow relevant Codes of Practice to prevent further spread.

Species requiring a local priority response at present are:

- Common cord grass, *Spartina anglica*
- Pacific oyster, *Crassostrea gigas*
- Japanese wireweed, *Sargassum muticum*
- Orange tipped sea squirt, *Corella eumyota*
- Green sea fingers, *Codium fragile*
- Acorn barnacle, *Elminius modestus*
- Tube worm, *Ficopomatus enigmaticus*
- Japanese skeleton shrimp, *Caprella mutica*
- Leathery sea squirt, *Styela clava*

¹⁰⁴ See Appendix 1

The response to reports of these species in new locations would follow the procedure:

1. Report to SFP who will send onto appropriate local record centre;
2. Determine the extent of the infestation;
3. Surveys in course of normal work to establish and map distribution;
4. Identify source and close pathways if possible;
5. Include new areas in eradication / control programmes;
6. Monitor the invaded area;
7. Follow relevant Codes of Practice to prevent further spread.

It should be noted that the list of priority species may change as our understanding about INNS in the Solway Firth increases.

Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country.

Output 3.1: Facilitate effective control or eradication programmes in line with national policy and work with stakeholders to implement them

Control and eradication programmes, if deemed necessary would only be undertaken in line with national policy and using a combination of specialist contractors and agency staff due to the specialist nature of such operations in the marine environment. Surveys can identify INNS distribution; however, these can be costly in the marine environment and would normally only be carried out for GB/Scottish Response species. Additional funding sources would need to be identified for any survey, control and eradication works.

By raising awareness of the necessity to incorporate biosecurity planning within industry and by implementing biosecurity procedures such as 'Check, Clean, Dry' (see Appendix 3) or the annual haul-out and anti-fouling of a marine vessel, stakeholders in the Solway will help to prevent further spread of INNS from the Solway to other parts of Scotland.

5.2 Review of Action Plan 2018 - 2021

Since the first publication of the Action Plan in 2013, SFP has successfully facilitated - in accordance with the objectives outlined, several actions. Actions completed from the third iteration of the Plan are highlighted below:

Table 7: Action Plan 2018-2021

Action	Lead	Partners*	Timeframe		
			2018 - 19	2019 - 20	2020 - 21
Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas					
Continue to update web pages on the SFP website	SFP	SFP	✓	✓	✓
Promote Check, Clean, Dry Campaign	SFP	SFP/ SEPA/ EA/ River Trusts/ NWIFCA/ TGB/ RYAS/ BMFS	✓		
Actively engage with commercial and recreational users at the main Solway harbours and marinas to raise awareness of marine INNS	SFP	Industry, recreational vessel users	✓	✓	
Include articles in Tidelines magazine as appropriate	SFP	Partner input welcome			
Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS, which pose significant threats to biodiversity and economic interests.					
Set up a series submerged settlement panels at selected harbours / marinas	SFP	AONB/ NE/ NTS/ DGC Rangers/ NSA Vols/ WWT/ SWT /NWIFCA/ SAMS	✓	✓	
Promote an effective single point of contact reporting and response system	SFP / GBNNS	NatureScot, Marine Scotland / NE / DGERC / CBDC	✓	✓	
Continue surveillance of Pacific oyster distribution around the Solway, resources allowing	SFP / EA/ NatureScot/ NE	SFP/ SEPA/ NWIFCA	✓	✓	
Survey for marine INNS during routine work	SFP / SEPA/ EA / SNH/ NE	SFP/ NWIFCA	✓	✓	
Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country					
Remove Pacific oyster where possible from identified locations in Galloway	SFP	SFP	✓	✓	
Look at funding opportunities to enable INNS work	SFP	SFP			

*Partners - These are organisations who have been identified as likely partners, but further discussion is required. ** ✓ indicates the need for action in marked years (COVID-19 allowing).

Some examples of recent successfully completed actions include:

Studies 2016, 2017, 2018 and 2019 - Early detection of marine INNS using submerged settlement panels' – Conducted in the growing seasons (May-September) these monitoring studies used submerged settlement panels to identify INNS growing at Stranraer marina and Portpatrick harbour. In addition, monitoring was also carried out in Maryport Marina in 2018 and 2019; and in Kirkcudbright Marina in 2019. It was not possible to carry out monitoring at any sites in 2020 due to COVID-19.

Surveillance for the carpet sea squirt, *Didemnum vexillum* was carried out in 2018 in Stranraer Marina and Portpatrick Harbour by Marine Scotland. Samples from the sites were tested for eDNA of the marine INNS but were negative.

Survey of Pacific Oyster in Scotland – SFP provided local knowledge for this survey which was commissioned by Scottish Aquaculture Research Centre (SARF) and carried out by SAMS. The Solway was a selected survey site.¹⁰⁵

Promotion of local and national marine INNS Projects – this has been achieved through displaying information, including the 'Check, Clean, Dry' Campaign, on the SFP website, in SFP e-newsletters and bi-annual Tidelines magazine.

Recording and Removal work was carried out by volunteers and students of the University of Glasgow, Dumfries Campus (Figure 4).



Figure 5: *Spartina anglica* removal by volunteers at Rockcliffe on the North Solway

¹⁰⁵ (Cook, Beveridge, Lamont, O'Higgins, & Wilding, 2014)) Survey of Wild Pacific Oyster *Crassostrea gigas* in Scotland

5.3 Actions and Timeframes

This section presents further actions required to realise the objectives and outputs along with the lead agency, key partners and timeframe required for their implementation. Funding will be sought to complete those action plan areas with funding sources needing to be identified for all survey, control and eradication works.

Table 8: Action Plan 2021-2024

Action	Lead	Partners ¹⁰⁶	Timeframe		
			2021 - 22	22 - 23	23 - 24
Objective 1: Continue to reduce the risk of introduction and spread of marine INNS within the Solway area and to other areas					
Continue to update web pages on the SFP website	SFP	SFP	✓	✓	✓
Promote Check, Clean, Dry Campaign	SFP	SFP/ SEPA/ EA/ River Trusts/ NWIFCA/ TGB/ RYAS/ BMFS	✓	✓	✓
Actively engage with commercial and recreational users at the main Solway harbours and marinas to raise awareness of marine INNS	SFP	Industry, recreational vessel users	✓	✓	✓
Include articles in Tidelines magazine as appropriate	SFP	Partner input welcome	✓		✓
Objective 2: Promote optimum surveillance, detection, monitoring and rapid response systems for the identified Marine INNS, which pose significant threats to biodiversity and economic interests.					
Set up a series submerged settlement panels at selected harbours / marinas	SFP	AONB/ NE/ NTS/ DGC Rangers/ NSA Vols/ WWT/ SWT /NWIFCA/ SAMS	✓	✓	✓
Promote an effective single point of contact reporting and response system	SFP / GBNNS	NatureScot, Marine Scotland / NE / SWSEIC / CBDC	✓	✓	✓
Continue surveillance of Pacific oyster distribution around the Solway, resources allowing	SFP / EA/ NatureScot / NE	SFP/ SEPA/ NWIFCA	✓	✓	✓
Survey for marine INNS during routine work	SFP / SEPA/ EA / NatureScot / NE	SFP/ NWIFCA	✓	✓	✓
Promote national campaigns such as the American lobster campaign etc.	SFP	SFP / SG / NatureScot	✓	✓	✓
Objective 3: Develop effective control programmes for existing marine INNS which are operational and sustainable, including preventing further spread of INNS from the Solway to other parts of the country					
Remove Pacific oyster where possible from identified locations in Galloway	SFP	SFP	✓	✓	✓
Look at funding opportunities to enable INNS work	SFP	SFP	✓	✓	✓

¹⁰⁶ Partners - These are organisations who have been identified as likely partners, but further discussion is required.

✓ indicates the need for action in marked years (COVID-19 allowing).

The Solway Firth Partnership has initiated biosecurity planning within the Solway area. Progress in delivering the objectives of this Biosecurity Plan will be determined by the level of engagement, support and commitment of the stakeholders and partners to deliver action against shared priorities. That is the challenge for all parties as we seek to implement the actions and deliver the objectives of the plan. To ensure the effective implementation of this plan, it is vital that the outcomes and impacts of the actions are monitored and reviewed to ensure that the objectives are being met. A monitoring programme should include:

- Assessment of efficiency of surveillance and rapid response systems;
- Occurrence and distribution of INNS within the Solway area;
- Effectiveness of any established control and eradication programmes;
- Assessment of the ability to close or restrict established pathways of transmission;
- Monitoring the effectiveness of all legislation and codes of practice especially those that are aimed at closing /restricting pathway. This will be facilitated by a Local Coastal Partnership Officer (SFP where possible) sitting on the Scottish Government marine INNS working group.

In addition, it is essential to carry out regular risk assessments and update the environmental, socioeconomic risk scores for those species present as well as the introduction risk scores for those species likely to arrive in the near future.

All monitoring within the time period of this plan is dependent on government guidelines regarding COVID-19. SFP staff will continue to follow government guidelines and only take part in monitoring when safe to do so.

Solway Firth Partnership will undertake to review the biosecurity plan regularly and will include new records of INNS as appropriate to ensure the plan continues be as up to date as possible.

Contact Details

Solway Firth Partnership
Campbell House
The Crichton
Bankend Road
Dumfries
DG1 4UQ
Tel: 01387 702161
Email: info@solwayfirthpartnership.co.uk

References

- Aquaculture & Fisheries (Scotland) Act . (2013). asp7. Edinburgh: HMSO.
- Bax, N., Williamson, A., Agüero, M., Gonzalez, E., & Geeves, W. (2003). *Marine invasive alien species: a threat to global biodiversity*. Marine Policy, 27.
- Bird Directive. (2009). *Council Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds (Bird Directive)*.
- C.A. Wood, J. B. (2015). *Report to The Bromley Trust, RAS 2015, Non-Native Species Rapid Assessment Surveys in English Marinas (E Anglia & W coast)*. The Marine Biological Association.
- Clyde River Foundation. (2014, 9 25). *Chinese Mitten Crab:update*. Retrieved Feb 9, 2021, from <http://www.clyderiverfoundation.org/chinese-mitten-crab-update/>
- Convention on Biological Diversity. (2015b). *Aichi Biodiversity Targets*. Retrieved Feb 9, 2021, from <https://www.cbd.int/sp/targets/>
- Convention on Biological Diversity. (2015a). *What are Invasive Alien Species?* Retrieved Feb 1, 2021, from <https://www.cbd.int/invasive/WhatareIAS.shtml>
- Cook, E., Beveridge, C., Lamont, P., O'Higgins, T., & Wilding, T. (2014). *Survey of Wild Pacific Oyster Crassostrea gigas in Scotland*. Scottish Aquaculture Research Forum Report SARF099.
- Cook, E., Jenkins, S., Maggs, C., Minchin, D., Mineur, F., Nall, C., & Sewell, J. (2013). Impacts of climate change on non-native species. *Marine Climate Change Impacts Partnership Science Review 2013*, 155-166.
- Council of Europe. (1979, September 19). Convention on the Conservation of European Wildlife and Natural Habitats. Bern, Switzerland. Retrieved Feb 2021, 9, from <http://conventions.coe.int/Treaty/EN/Treaties/Html/104.htm>
- Cumbria County Council. (2001). *Cumbria Biodiversity Action Plan*. Retrieved Feb 9, 2021, from https://www.cumbria.gov.uk/planning-environment/conservation/biodiversity/bio_BAP.asp
- Cumbria Freshwater Invasive Non-Native Species Initiative. (2011, 12 20). *Cumbria Freshwater Biosecurity Plan*. Retrieved Feb 9, 2021, from <https://www.nw-ifca.gov.uk/app/uploads/Cumbria-freshwater-biosecurity-plan.pdf>
- Cumbria Freshwater Invasive Non-Native Species Initiative. (2011). *Cumbria Freshwater Biosecurity Plan 2011-2015*. Retrieved Feb 1, 2021, from http://cfinns.scrt.co.uk/wp-content/uploads/2014/06/CFBPlan_final.pdf
- Cumbria Freshwater Invasive Non-Native Species Initiative. (2015). *The Cumbria Freshwater Invasive Non-Native Species Initiative Biosecurity Plan Implementation 2010-2015*. Retrieved Feb 1, 2021, from <http://cfinns.scrt.co.uk/wp-content/uploads/2016/01/CFINNS-Initiative-CFBP-report.pdf>
- DEFRA. (2018). *A Green Future: Our 25 year plan to improve the environment*. Retrieved Feb 9, 2021, from <https://www.gov.uk/government/publications/25-year-environment-plan>

- DEFRA, The Scottish Government, Welsh Government. (2015). *The Great Britain Invasive Non-Native Species Strategy*. Retrieved Feb 1, 2021, from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/455526/gb-non-native-species-strategy
- Dumfries & Galloway Council. (2019). *National Scenic Areas (NSAs)*. Retrieved Feb 9, 2021, from <https://www.dumgal.gov.uk/article/15974/National-Scenic-Areas-NSAs->
- Environment Agency; Natural Scotland. (2015). *The river basin management plan for the Solway Tweed river basin district*. Retrieved Feb 8, 2021, from The river basin management plan for the Solway Tweed river basin district
- EON. (2015). *Robin Rigg*. Retrieved Feb 9, 2021, from <https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/wind/offshore/robin-rigg>
- EU . (n.d.). Regulation 1143/2014 on Invasive Alien Species.
- Fasham, M., & Trumper, K. (2001). *Review of Non-Native Species Legislation and Guidance*. St Ives: Ecoscope Applied Ecologists.
- Galloway Fisheries Trust. (n.d.). Retrieved from Galloway Fisheries Trust: <https://gallowayfisheriestrust.org/>
- GB non-native species secretariat. (1971). *Wireweed, Sargassum muticum*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=3141>
- GB non-native species secretariat. (2004). *Orange-tipped sea squirt, Corella eumyota*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=902>
- GB non-native species secretariat. (2010). *Factsheet on Killer shrimp*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1219>
- GB non-native species secretariat. (2012). *Factsheet on Pacific oyster*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1013>
- GB non-native species secretariat. (2012). *Factsheet on Chinese mitten crab*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1379>
- GB Non-Native Species Secretariat. (2015a). *Definition of terms*. Retrieved Feb 1, 2021, from <http://www.nonnativespecies.org/index.cfm?pageid=64>
- GB non-native species secretariat. (2015b). *Check, Clean, Dry*. Retrieved Feb 2021, 9, from <http://www.nonnativespecies.org/checkcleandry/>
- GB non-native species secretariat. (2016). *Factsheet on Zebra mussel*. Retrieved from GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1250>

- GB non-native species secretariat. (2019). *Factsheet on slipper limpet*. Retrieved from GB non-native species secretariat:
<http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1028>
- Habitat Directive. (1992). *Council Directive 92/43/EEC of May 1992 on the conservation of natural habitats and of wild fauna and flora*.
- International Maritime Organization. (2004, 2 13). *International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)*. Retrieved Feb 9, 2021, from [https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-\(BWM\).aspx](https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships'-Ballast-Water-and-Sediments-(BWM).aspx)
- Lowe, S., Browne, M., Boudjelas, S., & De Poorter, M. (2000). *100 of the World's Worst Invasive Alien Species – A selection from the Global Invasive Species Database*. Auckland: ISSG.
- Marine Scotland. (2015). Email communication.
- Marine Strategy Framework Directive. (2008). *Council Directive 2008/56/EC of 17 June 2008 establishing a framework of community action in the field of marine environmental policy (Marine Strategy Framework Directive)*.
- National Biodiversity Network Trust . (2004). *Sargassum muticum*. Retrieved from NBN Atlas: <https://species.nbnatlas.org/species/NHMSYS0021058667>
- National Biodiversity Network Trust. (1989). *Records of Darwin Barnacle*. Retrieved from NBN Atlas: <https://species.nbnatlas.org/species/NHMSYS0021006592>
- National Biodiversity Network Trust. (2002). *Records of Common Cord Grass*. Retrieved from NBN Atlas:
https://species.nbnatlas.org/species/NHMSYS0000463855#tab_mapView
- Natural England. (2012, 12 5). *Identifying best practice in management of activities on Marine Protected Areas (NECR108)*. Retrieved Feb 9, 2021, from <http://publications.naturalengland.org.uk/publication/3800278>
- Natural England; Scottish Natural Heritage. (2000). *Solway Firth European Marine*. Retrieved Feb 9, 2021, from <http://publications.naturalengland.org.uk/search?q=Solway+Firth+European+Marine+Site+Management+Plan&num=100>
- Nimmo, F., Cook, E. J., Moxey, A. P., Hambrey, J., & Black, K. (2010). *Cost benefit analysis of management options for Didemnum vexillum (carpet sea squirt) in Scotland*. Retrieved from <https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/resouce/0038/00388277.pdf>
- Nith Catchment Fishery Trust. (2011). *River Nith Catchment Bio-Security Plan 2011 - 2016*. Retrieved Feb 8, 2021, from <http://www.river-nith.com/wp-content/uploads/2014/01/Nith-Catchment-Biosecurity-Plan.pdf>

- NNSS GB non-native species secretariat. (n.d.). *Factsheet on orange-tipped sea squirt, *Corella eumyota**. Retrieved from NNSS GB non-native species secretariat: <http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=902>
- Norman, P. (2009, April). *Dumfries & Galloway Local Biodiversity Action Plan*. Retrieved Feb 9, 2021, from https://www.dumgal.gov.uk/media/19945/Local-Biodiversity-Action-Plan/pdf/Local_Biodiversity_Action_Plan.pdf
- OSPAR. (1972). Retrieved from The Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention'): <https://www.ospar.org/convention>
- Payne, R. D., Cook, E. J., & Macleod, A. (2014). *Marine Biosecurity Planning – Guidance for producing site and operation-based plans for preventing the introduction of non-native species*. Report by SRS Ltd. in conjunction with Robin Payne to the Firth of Clyde Forum and Scottish Natural Heritage.
- Scotland's Marine Atlas. (2011). In J. M. Baxter, I. L. Boyd, M. Cox, A. E. Donald, S. J. Malcom, H. Miles, . . . C. F. Moffat (Eds.).
- Scottish Government. (2017). *Loch Creran Community Biosecurity Action Plan*. Retrieved from Scottish Government: <https://www.gov.scot/publications/loch-creran-community-biosecurity-action-plan/>
- Scottish Government. (2020). *Loch Fyne Community Biosecurity Action Plan*. Retrieved from Scottish Government: <https://www.gov.scot/publications/loch-fyne-community-biosecurity-action-plan/>
- SEPA. (n.d.). *North Solway area management plan 2010-2015*. Retrieved from https://www.sepa.org.uk/media/37401/north-solway_area-management-plan.pdf
- SEPA. (n.d.). *South Solway Area Management plan 2010 - 2015*. Retrieved from https://www.sepa.org.uk/media/76350/doc-5-south_solway_amp_overview.pdf
- Solway Coast Area of Outstanding Natural Beauty. (2020). *Managing For The Future*. Retrieved Feb 9, 2021, from <https://www.solwaycoastaonb.org.uk/2019/our-work/management-plan/>
- Solway Firth Partnership. (2012). Record of Pacific Oyster.
- Solway Firth Partnership. (2014). Record of Japanese skeleton shrimp from member of public.
- Solway Firth Partnership. (2015). Record of Japanese wireweed.
- Solway Firth Partnership. (2016). *Rapid Assessment Survey of Stranraer Marina*.
- Solway Firth Partnership. (2018). *Invasive non-native species*. Retrieved from Solway Firth Partnership: <https://www.solwayfirthpartnership.co.uk/environment/invasive-non-native-species/>
- Solway Firth Partnership. (2021, Feb). *Business Plan*. Retrieved Febh 2021, 9, from <https://www.solwayfirthpartnership.co.uk/about-us/what-we-do/business-plan-accounts-archive/>

- Temple, S. (2014). *Biosecurity Plan 2014 - 19*. NWIFCA. Retrieved Feb 9, 2021, from <https://www.nw-ifca.gov.uk/app/uploads/NWIFCA-Biosecurity-Plan.pdf>
- Temple, S. (2014). *NWIFCA Biosecurity Plan 2014-2019, Incorporating Marine Invasive Non-Native Species and Shellfish Diseases*. Retrieved Feb 1, 2021, from <https://www.nw-ifca.gov.uk/biosecurity/>
- The Aquatic Animal Health (England and Wales) Regulations. (2009). *SI 2009/ 463*. London: HMSO.
- The Marine Life Information Centre. (1972). *An acorn barnacle (Austrominius modestus)*. Retrieved from MarLIN: <https://www.marlin.ac.uk/species/detail/1771>
- The Marine Life Information Network. (2004). *Factsheet on sea squirt, Styela clava*. Retrieved from MarLIN: <https://www.marlin.ac.uk/species/detail/1883>
- The River Annan Trust & District Salmon Fishery Board. (2018). *Biosecurity*. Retrieved Feb 9, 2021, from <https://www.riverannan.org/biosecurity>
- The Scottish Government. (2012). *Code of Practice on Non-Native and Invasive Non-Native Species*. Edinburgh: HMSO.
- The Scottish Government. (2015). *Scotland's National Marine Plan – A Single Framework for Managing Our Seas*. Edinburgh: HMSO.
- United Nations. (1992). Retrieved Feb 1, 2021, from <https://www.cbd.int/doc/legal/cbd-en.pdf>
- United Nations. (1992). *Convention on Biological Diversity. Article 8(h)*.
- Water Framework Directive. (2000). *Council Directive 2000/60/EC of 23 October 2000 on the community action in the field of water policy (Water Framework Directive)*.
- Wildlife and Natural Environment (Scotland) Act. (2011). (*asp 6*). Edinburgh: HMSO.
- Williams, F., Eschen, R., Harris, A., Djeddour, D., Pratt, C., Shaw, R., . . . Murphey, & S. (2010). *The Economic Cost of Invasive Non-Native Species on Great Britain*. Retrieved Feb 1, 2021, from <https://www.cabi.org/uploads/projectsdb/documents/6534/Economic%20Costs%20of%20INNS%20to%20the%20British%20Economy%20-%20Final%20Report%20v3.pdf>

Additional References

Used in preparation of this report:

Marine Life Information Network (2021). MarLIN - The Marine Life Information Network - Home. Retrieved 1 Feb, 2021 from: <http://www.marlin.ac.uk>

Solway Firth Partnership (1996 & 2021). Solway Firth Review. Dumfries: SFP Retrieved 1 Feb, 2021 from. <https://www.solwayfirthpartnership.co.uk/solway-review/>

Scottish Natural Heritage (2008). Alien species and the Water Framework Directive: using alien species forums to address problems in Scottish catchments, Commissioned Report No.299. Edinburgh: SNH.

Council Directive 2014/89/EU of 23 July 2014 establishing a framework for maritime spatial planning.

Commission Decision 2010/477/EC of 1 September 2010 on the criteria and methodological standards on good environmental status of marine waters.

Appendices

Appendix 1

Invasive Non-Native Species recording schemes and further information sources.

Recording schemes:

- Marine Invasive Non-Native Species
<https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/marine-non-native-species> or
Email: enquiries@nature.scot tel:01463 725000
- Carpet Sea Squirt
UK Centre for Ecology and Hydrology
https://www.brc.ac.uk/risc/alert.php?species=carpet_seasquirt
- Chinese Mitten Crab
<http://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?pageid=254>
- For all other marine INNS
Email GB NNSS: alert_nonnative@ceh.ac.uk
Contact MarLIN: http://www.marlin.ac.uk/marine_alien/marine_alien.htm
- For any records in **Dumfries and Galloway** contact South West Scotland Environmental Information Centre <https://swseic.org.uk/> or call 01387 760274.
- For any records in **Cumbria** contact Cumbria Biodiversity Data Centre <http://www.cbdc.org.uk/> or call 01288 618732 618770.

For Further information on Marine INNS

- NatureScot
<https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/marine-non-native-species>
- Marine Scotland
<https://www.nature.scot/professional-advice/protected-areas-and-species/protected-species/invasive-non-native-species/identify-and-report-invasive-non-native-species>
- GB Non-Native Species Secretariat
<https://secure.fera.defra.gov.uk/nonnativespecies/home/index.cfm>
- RAFTS Invasive Species and Bio-security Programme
http://www.invasivespeciesscotland.org.uk/biosecurity_programme/biosecurity_plans.asp
- International Maritime Organisation Ballast water
<http://www.imo.org/OurWork/Environment/BallastWaterManagement/Pages/default.aspx>

For Advice on Best Practice for leisure boaters on preventing the spread of INNS

- The Green Blue
http://www.thegreenblue.org.uk/boat_users/antifoul_and_invasive_species.aspx

Appendix 2

GB NNSS 'Check, Clean, Dry' Campaign



STOP THE SPREAD

STOP THE SPREAD
INVASIVE AQUATIC SPECIES
CHECK-CLEAN-DRY

Are you unknowingly spreading invasive species on your water sports equipment and clothing?

Invasive species can affect fish and other wildlife, restrict navigation, clog up propellers and be costly to manage. You can help protect the water sports you love by following three simple steps when you leave the water.

CHECK Check your equipment and clothing for live organisms - particularly in areas that are damp or hard to inspect.

CLEAN Clean and wash all equipment, footwear and clothing thoroughly.
If you do come across any organisms, leave them at the water body where you found them.

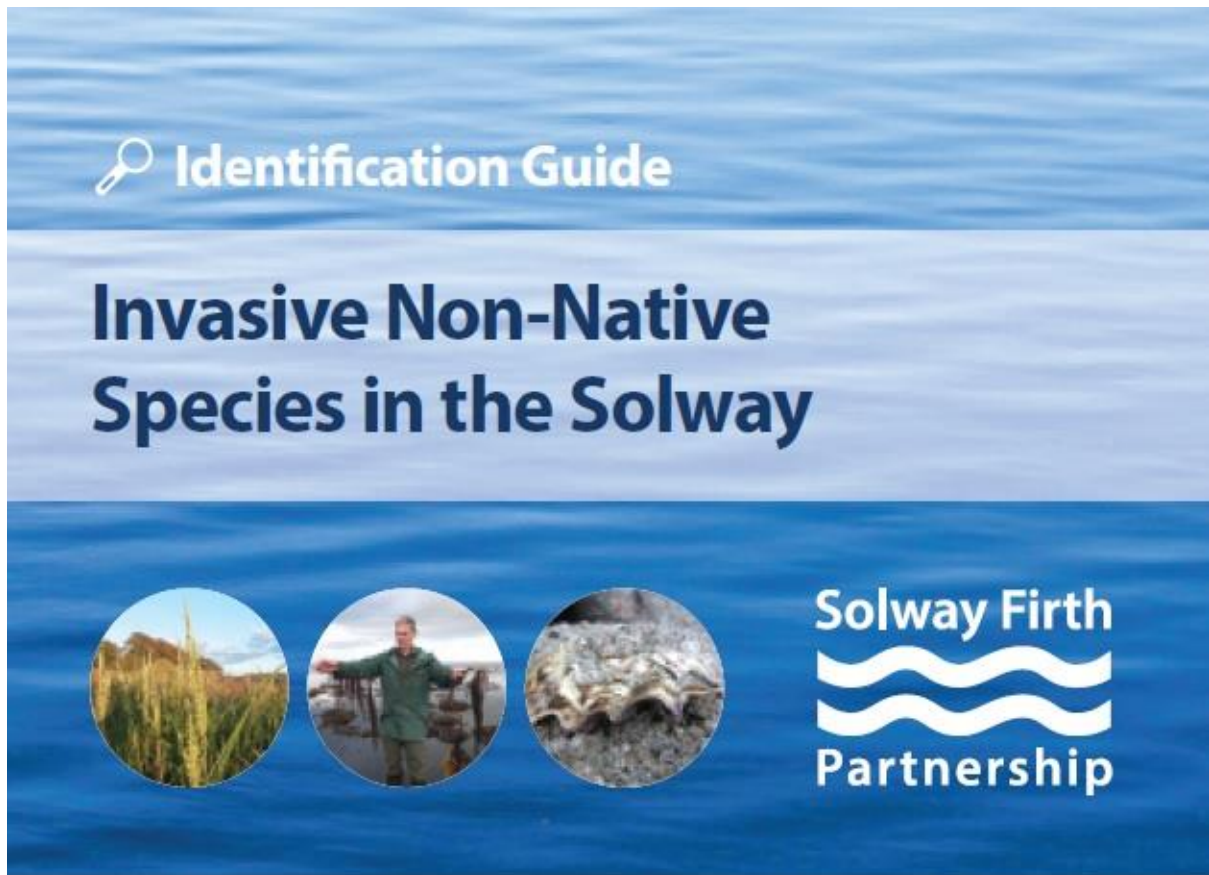
DRY Dry all equipment and clothing - some species can live for many days in moist conditions.
Make sure you don't transfer water elsewhere.

For more information go to www.direct.gov.uk and search for Check Clean Dry

Logos: Angling Trust, Canoe and Kayak Association, British Rowing, RYA, defra, Environment Agency, NATURAL ENGLAND, NNSS

Appendix 3

SFP Marine INNS ID Guide



Should you wish to receive any further, more detailed information on specific projects, actions or set goals please contact info@solwayfirthpartnership.co.uk