3. INVASIVE ALIEN SPECIES

Slipper limpet *Crepidula fornicata* on a king scallop *Pecten maximus*

Key Messages

- Invasive alien species are one of the greatest threats to our native biodiversity. They are now widely recognised as being second, only to habitat destruction, in the threat they pose to biodiversity.
- The 'Invasive species in Ireland Report[(1)]', which outlined a series of 10 key recommendations, was prepared for NIEA and the National Parks and Wildlife Service, Dublin, in 2006.
- The Convention on Biological Diversity 1993, to which the UK and Irish Governments are signatories, sets out a series of guiding principles in relation to invasive alien species.
- The Convention on Biological Diversity also outlines a series of guiding principles to deal with invasive alien species. The most effective measures should aim to prevent the introduction of an invasive species in the first place; or where they do occur to control the invasive alien species through early detection and direct control actions before they become fully established in specific locations.
- At the time of writing several invasive alien species have been identified in our coastal waters. These include invasive alien species of plant (Japanese wireweed and common cord grass) and invasive alien animal species (leathery sea squirt, slipper limpet, Pacific oyster, *Didemnum vexillum*, bamboo worm and Japanese skeleton shrimp).
- Monitoring and port surveys are required to ensure information is kept up-to-date.
- Non-commercial boating and commercial shipping traffic pose a significant risk for introducing and spreading invasive alien species through a range of pathways. These pathways include "hitch-hikers" in cargo, ballast water discharge and species attached to the hulls or engines of watercraft.
- Historically, human activities such as aquaculture and boating, have been associated with the introduction and further spread of non-native invasive species in Northern Ireland's coastal waters.

What is an alien species?

Alien species are animals and plants that have been introduced, either intentionally or unintentionally, outside their natural range. Many of these alien species live in harmony with the native species in our environment causing no adverse impacts.

A few species however, become what are known as 'invasive alien species' as they thrive in our habitats and out-compete our native plants and animals. These invasive aliens are now widely recognised as one of the greatest threats to our native biodiversity, second only to that of habitat destruction.

What effects can alien species have?

Invasive alien species are documented as having negative effects on the environment (both direct and indirect) and adversely affecting recreational activities such as boating, fishing and swimming. Other impacts include the subsequent knock-on effects on the economy through lost revenue and the costs associated with direct control or mitigation measures.

Japanese wireweed, *Sargassum muticum*

Invasive alien species can affect our native species in a variety of ways. The recognised impacts include direct competition for food or habitat space, predation, or through the introduction of diseases or parasites. Some invasive aliens are known as "ecosystem engineers" because they make such large changes to the habitat they invade that it begins to function in a different way.

Indirect impacts to the wider environment may also occur. For example, excessive growth of invasive aliens can shade out native species, as has been documented for Japanese wireweed. They may also foul hard structures, clog marinas impeding vessel movement, foul or even completely smother aquaculture beds and may require restrictions to be placed on aquaculture to prevent further spread.

What do we know about invasive alien species in Ireland?

In light of the range of invasive aliens found on the whole island of Ireland, NIEA, in partnership with the National Parks and Wildlife Service (NPWS) Dublin, commissioned the 'Invasive Species in Ireland' report in 2006 [(1)]. The aim of the report was firstly to review the impact of existing and potential future alien species on native biodiversity. Secondly the report was to provide recommendations to Government in both jurisdictions that would address the requirements of the guiding principles on invasive species set out in the Convention on Biological Diversity 1993. The report recommended 10 key actions to reduce the risk of invasions, help control and manage new and established invasive populations, monitor impacts, raise public awareness, improve legislation and address international obligations.

Further information can be found at: http://www.invasivespeciesireland.com/downloads/general_information.asp

The most effective measures are prevention, early detection and direct action. Codes of practice have been developed for particular sectors. Efforts are being made to improve education and raise awareness on how to prevent the introduction and spread of alien species.

What is being done about them?

In response to 10 key recommendations in the 'Invasive Species in Ireland' report, NIEA and NPWS jointly funded a 3 year contract in May 2006 to begin implementing the recommendations of the report. The work included a risk assessment of all known established and potential invasive species to enable identification of those species that posed the biggest threat to the island of Ireland. The results of the risk assessment were then used to develop management and contingency plans for the established and potential species posing the greatest threat. The website http://www.invasivespeciesireland.com has been created to support this work and promote greater understanding of the issues involved. In December 2009, a further 3 year contract was funded by NIEA and NPWS to

build upon and continue the implementation of the report's recommendations.

Which invasive species occur at present?

Currently a small number of invasive aliens are known to occur in the marine and coastal environment of Northern Ireland. There are, however, many other invasive aliens that could potentially arrive here in future. Species such as the "killer shrimp" *Dikerogammarus villosus* which has recently been detected in Great Britain could arrive in our coastal waters and have a significant impact. Other species, which could not previously survive in our environment, may in future find suitable conditions as a result of climate change. There are, at present, 8 known invasive species in our seas.

(i) Leathery sea squirt *Styela clava*

The first record of this species in Europe was at Plymouth on the southwest coast of England in 1953[2], with the first record in Ireland in 1971 in Cork Harbour[3]. In Northern Ireland it was first confirmed in Larne Lough in 2008.

The Leathery sea squirt grows in very high densities that may affect native biodiversity. Economic impacts include smothering blue mussels *Mytilus edulis*, scallops *Pecten maximus*, oysters *Ostrea edulis* and fouling hard structures such as buoys, marina supports, boat hulls and aquaculture cages.

(ii) Slipper limpet *Crepidula fornicata*

The slipper limpet was first recorded in Northern Ireland at Belfast Lough in 2009 [4]. It is native to the western Atlantic, specifically the eastern coast of North America. From there it has been introduced to other parts of the world and has become problematic. Slipper limpets are typically found attached to stones on soft substrates around the low water mark or attached to the shells of mussels and oysters. They may also form curved chains of up to 12 animals sometimes forming dense carpets which can smother bivalves and alter the seabed, making the habitat unsuitable for larval settlement. This may impose significant economic costs to the aquaculture industry.

(iii) Pacific Oyster *Crassostrea gigas*

Pacific oysters were first brought to Northern Ireland as part of aquaculture development. They have now been grown in Northern Ireland since the early 1970s when initial growth and survival trials were carried out in Strangford Lough. The first site was licensed around 1977. There are now several licensed sites in Northern Ireland which include 3 in Larne, 1 in Killough Bay, 1 in Dundrum Bay, 2 in Strangford Lough and 3 in Carlingford Lough. Pacific oysters are also grown at a number of sites in Lough Foyle. All the sites are in intertidal areas. Production has ranged between 200 and 400 tonnes annually. Recent work in Strangford Lough suggests that, although outside their previous natural breeding range, feral populations of Pacific oysters are now breeding successfully which may bring about a fundamental change to the ecosystem of the area. Pacific oysters are also known to have spawned in Lough Foyle.

(iv) Common Cord-grass *Spartina anglica*

Cord-grass *Spartina* species colonise a wide range of substrates from soft muds to shingle in sheltered areas. There are currently 4 species present in the UK but only the small cord-grass *Spartina maritima* is native. During the late 1800s the smooth cord-grass *Spartina alterniflora* was introduced from the east coast of North America. It hybridised with the native small cord-grass, resulting in a sterile hybrid *Spartina x townsendii*. Subsequently, a fertile hybrid arose called the common cord-grass *Spartina anglica*. This is a robust grass with shoots that can reach 1.3m in height, with an ability to spread both vegetatively and by seed.

Common cord-grass was historically extensively planted throughout Britain to stabilise sediments along intertidal mudflats. Its success is largely attributed to the ability of the seed to lie dormant for many years before they germinate and then spread rapidly. The first intentional planting of common cord-grass in Northern Ireland was in Belfast Lough in 1929. It did not establish successfully and is now extinct in that area but in the 1940s, before its negative environmental impacts were known, it was introduced into Strangford Lough to increase sediment accretion in coastal

Common chord grass, *Spartina anglica* in a bed of intertidal seagrass (Lough Foyle)

protection schemes [5]. It is now abundant in Strangford Lough and in Carlingford Lough, Lough Foyle, Dundrum Inner Bay and the Roe Valley estuary.

Common cord-grass colonises sheltered coastal mudflats at a tidal level below the normal coastal salt marsh vegetation, producing dense swards. These swards can slow the movement of water and increase the rate of sediment deposition. This in turn raises the general level of the marsh blocking out other species and reducing the biodiversity of the marsh and mudflat. On intertidal mudflats it reduces the food available for wildfowl and wading birds, notably eel grass beds and invertebrates.

(v) *Didemnum vexillum* - a colonial sea squirt

Didemnum vexillum has no common name. It is a colonial sea creature that grows either in long colonies like candle wax that hangs from any hard surface such as docks or ship hulls or it may form undulating mats that cover rocks and shellfish beds. In Northern Ireland it occurs in Carlingford Lough[6]. Although it can spread by larvae and by fragmentation, it is mainly transported on boat hulls, fishing equipment, aquaculture trestles and ballast water. Colonisation threatens the aquaculture and fishing industries by interfering with fish spawning grounds, smothering shellfish, seaweeds and other seabed species.

(vi) Japanese skeleton shrimp *Caprella mutica*

The Japanese skeleton shrimp was first described from northern areas of South East Asia in 1935 and the first European record was from the Netherlands in 1994. It is one of the most rapidly invading species in Europe and has spread throughout the North Sea, Celtic Sea and the English Channel. It is now widespread in Scottish coastal waters and was recorded in Northern Ireland in Bangor marina in 2009. The Japanese skeleton shrimp is frequently associated with man-made structures and is found in abundance on boat hulls, buoys, floating pontoons and aquaculture infrastructure. In some Scottish marine Special Areas of Conservation it has been seen to form dense aggregations on reefs made of the shells and tubes, horse mussels *Modiolus modiolus*, blue mussels and the tubeworms *Serpula vermicularis* and *Sabellaria alveolata*.
The impact in these areas is unknown. It is highly likely that its dispersal is associated with vessel movements.

(vii) Japanese wireweed *Sargassum muticum*

Japanese wireweed occurs naturally in Chinese and Japanese coastal waters. It is associated with an unintentional introduction to France in oysters from British Columbia or Japan. From France it spread to the UK. It was first recorded in Northern Ireland in Strangford Lough in 1995[7]. It is now present at several locations around the coast of Ireland on hard rock and eel grass beds in the intertidal zone and deeper water. It can grow 10 centimetres a day forming dense floating mats that can reach up to 16 metres in length. Its ability to reproduce both sexually and through floating fragments, aids its spread.

Dense stands of wireweed can reduce the available light for other species, restrict water flow, allow sediment to accumulate and take up nutrients to the detriment of native species[8]. Its prolific growth has become a great nuisance; drifting and fouling marinas, clogging the intake pipes of boats and drifting ashore to cover eel grass meadows which are an internationally important bird feeding habitat.

(viii) Bamboo worm *Clymenella torquata*

The 'Bamboo' worm gets its name from bamboo-like segmentation. It was positively identified for the first time in Ireland, from Carlingford Lough in 2006. Retrospective checks of archive material confirmed that it had been present in the Lough since at least 1990, the date of the earliest archive material available, but had been misidentified as a native species, *Clymenella cincta*. It is probable that this American species arrived directly with imports of half-grown North American oyster *Crassostrea virginica* for ongrowing during the late 1800s or early 1900s or from such material from the south coast of England where it had also become established[9]. The impact of what is potentially one of our earliest introductions is difficult to assess as no baseline data is available.

How are alien species spread?

There are 2 main pathways for the introduction of invasive aliens to the marine environment; by ships and by shellfish cultivation or aquaculture. The UK and Ireland are net importers with many ships arriving full of cargo which reduces the amount of ballast water being brought into the region. The volume of shipping traffic, however, into Northern Ireland (Chapter 15) must mean there is a risk of introductions through ballast water. In addition many fouling organisms can attach to the hulls of vessels and be introduced in this manner.

Northern Ireland has over 30 licensed marine shellfish sites which produce over 10,000 tonnes of shellfish annually, most of which is exported to other EU member states for market or ongrowing (fattening). Aquaculture may act as vector through the introduction of broodstock contaminated with potential alien species or through the relaying of stock between water bodies for ongrowing.

How can the spread be controlled?

There are currently 2 main mechanisms for the control of these pathways.

Firstly, DARD license all aquaculture activities in the region and it is planned that in Foyle and Carlingford the Loughs Agency will become the responsible authority with the introduction of new legislation covering the 2 cross-border sea loughs. This licensing is strongly linked to the implementation of the EC Regulation on the use of alien and locally absent species in aquaculture and the Aquatic Animal Health Regulations. These regulations control the movement of shellfish into and within Northern Ireland and are subject to inspection by DARD Fisheries Inspectors.

In recent years shipments of mussels containing Slipper limpet have been impounded and returned to source. Licence conditions may also be used to impose management measures, such as the use of triploid or sterile Pacific oysters to reduce the risk of spawning.

Secondly, the International Convention for the Control and Management of Ships Ballast Water and Sediments, which seeks to control the spread of alien species through controlling the discharge of ballast waters.

Legislation	
Marine Strategy Framework Directive Descriptor 2 'Biological diversity is maintained. The quality and occurrence of habitats and the distribution of species are in line with prevailing physiographic, geographic and climatic conditions'	
Other relevant EC Directives & Regulations (full references and corresponding regulations – Appendix II)	
Habitats Directive	To promote biodiversity by requiring measures to maintain or restore natural habitats and species of European importance, in favourable conservation status
Birds Directive	A framework for the conservation and management of wild birds
EC Regulation on the use of alien and locally absent species in aquaculture.	A framework for the prevention and limiting of further spread of marine invasive species
Water Framework Directive (WFD)	A framework which aims to achieve 'Good Ecological Status' for waterbodies
International Agreements	
OSPAR (Oslo Paris) Convention for the protection of the marine environment of the North-East Atlantic	Biodiversity and ecosystems strategy
Convention on Biological Diversity	An international treaty to sustain the rich diversity of life on earth (biodiversity)
The International Convention for the Control and Management of Ships Ballast Water and Sediments.	To prevent, minimise and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments
Local legislation	
Wildlife (Northern Ireland) Order 1985	Affording national protection measures to certain species
Environment (Northern Ireland) Order 2002	The principal measure for ASSI site protection in Northern Ireland
Fisheries Act (Northern Ireland) 1966	The principle measure for the protection of fish in Northern Ireland
The Water Environment (WFD) Regulations (NI) 2003	The principle measure for the implementation of the EC Water Framework Directive
Aquatic Animal Health Regulations (Northern Ireland) 2009	This requires that anyone conducting aquaculture must be registered with DARD. DARD may inspect and place conditions on the aquaculture producer to maintain disease free status

References

(1) Stokes, K., K. O'Neill & R.A. McDonald 2006 Invasive species in Ireland. Report to Environment & Heritage Service and National Parks & Wildlife Service by Quercus, Queens University. Environment & Heritage Service, Belfast and National Parks & Wildlife Service, Dublin.

(2) Carlisle, D.B. 1954 Notes on the *Didemnidae*. III. A comparison of *Didemnum maculosum*, *Didemnum candidum*, *Didemnum helgolandicum*, and *Tridemnum alleni*. Journal of the Marine Biological Association, UK 33: 313-324.

(3) Guiry, G.M. & M.D. Guiry 1973 Spread of an introduced ascidian to Ireland. Marine Pollution Bulletin 4: 127.

(4) McNeill, G., J. Nunn & D. Minchin 2010 The slipper limpet *Crepidula fornicata* Linnaeus, 1758 becomes established in Ireland Aquatic Invasions 5, Supplement 1: S21-S25.

(5) Robb, G.N., T. McDermott, & N. Reid 2009 Current distribution of *Spartina anglica* in Northern Ireland. Report prepared by the Natural Heritage Research Partnership, Quercus for the Northern Ireland Environment Agency, Northern Ireland, UK.

(6) Minchin D. & E. Sides 2006 Appearance of a cryptogenic tunicate, a *Didemnum* sp. fouling marina pontoons and leisure craft in Ireland. Aquatic Invasions 1: 143-147.

(7) Davison, D.M. 1996 *Sargassum muticum* in Strangford Lough, 1995 – 1998; A review of the introduction and colonisation of Strangford Lough MNR and cSAC by the invasive brown algae *Sargassum muticum*. Report to the Environment & Heritage Service, D.o.E. (N.I.).

(8) Strong, J.A. 2003 The environmental impact of *Sargassum muticum* around the coastline of Northern Ireland. PhD Thesis, Queens University of Belfast.

(9) Minchin, D. 2007 A checklist of alien and cryptogenic aquatic species in Ireland, Aquatic Invasions, Volume 2, Issue 4: 341-366.

References/Information sources:

http://www.invasivespeciesireland.com

http://globallast.imo.org/index.asp

http://www.imo.org/ marine environment, ballast water management

http://www.scotland.gov.uk/Publications/2008/04/03093608/17

http://www.ni-environment.gov.uk/biodiversity/invasive_alien_species.htm

http://www.dardni.gov.uk/index/fisheries-farming-and-food/fisheries/aquaculture/fisheries-newpage-3.htm

http://www.ni-environment.gov.uk/10intros.pdf

http://www.marlin.ac.uk/marine_aliens/species.asp?SpID=20

http://www.belfast-harbour.co.uk

http://www.aquaticinvasions.net/2010/Supplement/AI_2010_5_S1_McNeill_etal.pdf