RINSE

# Activity 1
# Targeting and Prioritisation
# Condensed Report

2 Mers Seas Zeeën
INTERREG IV A
FRANCE - ENGLAND - VLAANDEREN - NEDERLAND

"Investing in your future"
Crossborder cooperation programme
2007-2013 Part-financed by the European Union
**(European Regional Development Fund)**

**Report by Norfolk County Council, Activity leader**

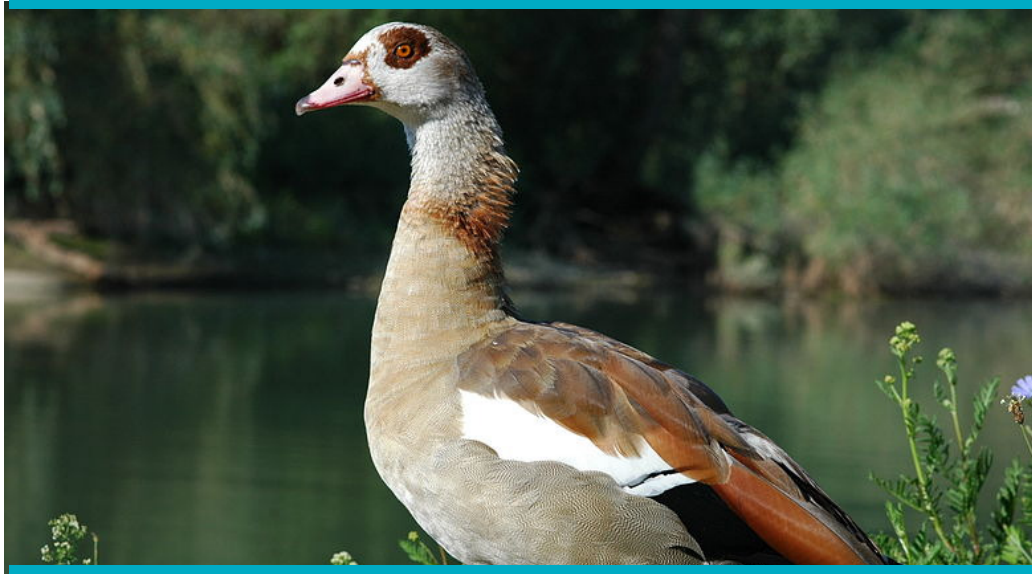
RINSE

Himalayan balsam *Impatiens glandulifera*

(GB NNSS)

Japanese knotweed *Fallopia japonica*

(Polly Bryant)



Egyptian goose *Alopochen aegyptiaca*

*(*Vera Buhl)

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## Condensed Report by Activity Leader

## Norfolk County Council (UK),

## On behalf of the project consortium

# Overview

Invasive non-native species (INS) are species which have moved outside of their natural range usually with accidental or intentional assistance from humans, and which cause environmental or economic damage in their introduced range. At a global level, INS are believed to be one of the principal causes of biodiversity loss – second only to habitat destruction. Their economic impact is also significant. A recent study by the European Environment Agency (EEA) estimated that the cost of INS across Europe is at least 12 billion Euros a year. Despite the severe damage that these species are causing there is still a lack of a coordinated effort to reduce their impacts and spread across Europe. The RINSE project aims to help address the problem.

RINSE (Reducing the Impacts of Non-native Species in Europe), a project funded through the Interreg Two Seas programme, aims to increase cooperation and share best practice between key organisations involved in the management of INS in the Two Seas area. This area encompasses the coastal regions of southern England, northern France, Belgium and the Netherlands, areas which share broadly similar geography and pathways of spread for INS. The Two Seas area also contains several of the largest commercial ports in Europe, including Southampton, Rotterdam and Antwerp, which increases the likelihood of introductions of novel species to the area.

The project brings together a partnership of nine diverse organisations, representing both researchers and practitioners, by including non-governmental organisations (NGOs), research institutes, local authorities and national-level government agencies. The objectives of the RINSE project are to:

1. Develop cross-border tools to improve prioritisation and targeting of IAS, so that scarce resources can be directed towards the species and sites of greatest concern;
2. Enhance awareness and capacity to address INS within a range of key cross-border target audiences;
3. Develop new approaches and promote best practice for the management of INS, by delivering field trials and demonstration projects.

These objectives are interlinked and mutually supportive, with the overall output of the whole project designed to be far greater than the sum of its parts.

## Horizon scanning and prioritisation

It is widely accepted that the most cost effective and efficient way of tackling the threats posed by INS is to prevent them from becoming established in the first place. The more knowledge we have about the potentially invasive species moving towards us and the pathways by which those species spread, the better placed we are to prevent them from establishing and spreading.

Unfortunately many INS are already established across all, or some, of the Two Seas area. With limited resources available to manage these species, it is important to focus our efforts on those that are, or have the potential to become, the most damaging.

A specialised research team based at the University of Cambridge were commissioned to assist in the development of an accurate, impartial and evidence-based list of INS of greatest concern within the RINSE area. The development of such a list would help the RINSE project, and other organisations within the RINSE area, to target their resources more appropriately.

This Condensed Report presents the key findings of this exercise in INS horizon scanning and prioritisation. The full Activity Report, including supporting appendices and a more detailed analysis of the results, can be found on the RINSE website (www.rinse-europe.eu).

The RINSE Project area compromises of four countries located across the British Channel and southern part of the North Sea – England, France, Belgium and the Netherlands.

**Figure 1.** The four RINSE countries considered in this study are England, France, Belgium and the Netherlands. The eligible areas of each country are indicated in grey.

Data on presence of non-native species (NNS) in within these countries (including species outside of the eligible area) were obtained through a systematic review of 59 online databases and scientific papers. These sources ranged in scope from global to more locally focussed information. A full list of sources is available within the full Activity Report. NNS found to be present in some, or all, of the RINSE countries were recorded, along with other relevant information such as their preferred habitat and climate.

Five different groups of organisms were investigated in more detail in order to analyse patterns of NNS introduction and invasion histories within the RINSE countries. These were Angiosperma (flowering plants) Mollusca (includes snails, slugs and squids), Osteichthyes (bony fish), Anseriformes (geese, ducks, swans and relatives) and Mammalia.

For species within these groups, additional data were obtained on the following:

- Year of first observation in wild
- Functional type
- Continent of origin
- Invasion pathway
- Habitat types
- Presence/absence of asexual reproduction or self fertilisation
- Presence/absence of resistant stages
- Presence/absence of predators in invaded range

### Horizon Scanning

Several national and international institutions have produced lists of invasive non-native species (INS) that are perceived to be having, or have the potential to have, the greatest negative impacts on biodiversity. Using 16 of such 'worst invader' lists, a metalist of 340 INS was created, then divided into two main groups:

- **ALERT list** of INS for the RINSE region. This comprises of species not yet present in any of the four RINSE countries, a total of 79 species.
- **BLACK list** of INS already present in at least one of the four RINSE countries, a total of 261 organisms.

These lists were verified at a RINSE Experts Workshop held in November 2012. The Workshop was attended by 22 invited experts representing all four RINSE countries.

### Prioritisation of the Alert and Black Lists

The Alert list was ranked using a risk scoring system modified from Molnar et al. (2008) which considered four risk categories: ecological impact, invasive potential, management difficulty and economic impact. The species were then ranked by their overall average score with the top three plants, terrestrial animals, aquatic inland animals and marine organisms extracted to generate a top 12 of Alert INS.

The Black list was prioritised using an online survey. Experts were asked to select 10 INS which they regarded as 'most concerning' in terms of their current and potential environmental impacts within the RINSE region. The results of this survey were used to produce a list of the top 12 Black list species. This method, although not as rigorous as the risk scoring system, proved to be an efficient way of ranking such a large number of species.

### Species Distribution Modelling

The potential distribution of 72 NNS across the four RINSE countries was predicted using a series of Species Distribution Models (SDMs). These sophisticated models take into account both the environmental and socio-economic factors which influence the presence or absence of the species of interest. The 72 species comprised as many of the species on the Alert list as possible (for some species insufficient distribution data were available to calibrate the SDM), and selected species from the Black list.

Data on the current distribution of the 72 species to be modelled was obtained from seven online data gateways (Table 1).

**Table 1:** Data Gateways

| | |
|---|---|
| Global Biodiversity Information Facility | (GBIF, data.gbif.org) |
| Biological Collection Access Service for | (BioCase, www.biocase.org) |
| Ocean Biogeography Information | (IOBIS, iobis.org/mapper) |
| B. Gallardo, A. Zieritz and D. C. | |
| The Netherlands Biodiversity | (NLBIF, www.nlbif.nl) |
| Waarnemingen network | (waarnemingen.be/ |
| National Biodiversity Network | (NBN, Gateway data.nbn.org.uk) |
| Discover Life | (www.discoverlife.org) |

Data on environmental conditions for inclusion in the SDMs were obtained from the World Climate Database (www.worldclim.org). These included annual mean temperature, temperature seasonality, maximum temperature of warmest month, minimum temperature of coldest month, annual precipitation, precipitation of driest month, altitude and precipitation seasonality. A total of five socio-economic layers were also included in the SDMs: global human influence index, land use, density of human population, distance from closest commercial port and distance from closest road. This data was gathered from a range of sources, further details of which can be found in the full Report.

Ten marine environment datasets were obtained from Bio-Oracle (www.oracle.ugent.be). These included maximum and minimum surface temperature; maximum photosynthetic active radiation; salinity, pH, phosphate, dissolved oxygen, calcite, silica and minimum and maximum chlorophyll. Socio-economic data on the human impacts on marine ecosystems were also included in the SDMs. This socio-economic data was taken from National Centre for Ecological Analysis and Synthesis.

Finally, the maps generated for each of the 72 modelled species were combined to produce a single 'heat map' illustrating the risk of invasion across the four RINSE countries for terrestrial, freshwater and marine species.

# Results

A total of 3454 non-native species (NNS) were found to be present in at least one of the four RINSE countries. The origins of these NNS were highly varied; however Europe, Asia and North America were significant contributors, accounting for more than 25% of the NNS present within RINSE countries.

The majority of NNS found within the Two Seas area were from the phylum Arthropoda (invertebrates), with three times as many as the Chordata (vertebrates); the next largest group. In terms of habitat, 75% of NNS inhabit terrestrial ecosystems, with only 6% and 11% occupying freshwater and marine habitats respectively.

Once established, invasive non-native fish expanded their most rapidly, taking on average 47 years to spread from their first RINSE country to their last. In contrast, mammals took almost 4 times as long (on average 175) to spread across all four RINSE countries.

Vectors of spread for INS varied greatly between taxa (Fig 2). The ornamental trade was the most significant pathway of entry for plants, geese and mammals. In contrast, 40% of fish were introduced via recreation (leisure fishing). The aquaculture industry was responsible for almost all mollusc introductions to RINSE countries. The dependence of INS on humans for their introduction and spread further highlights the role of biosecurity in their effective and efficient control.

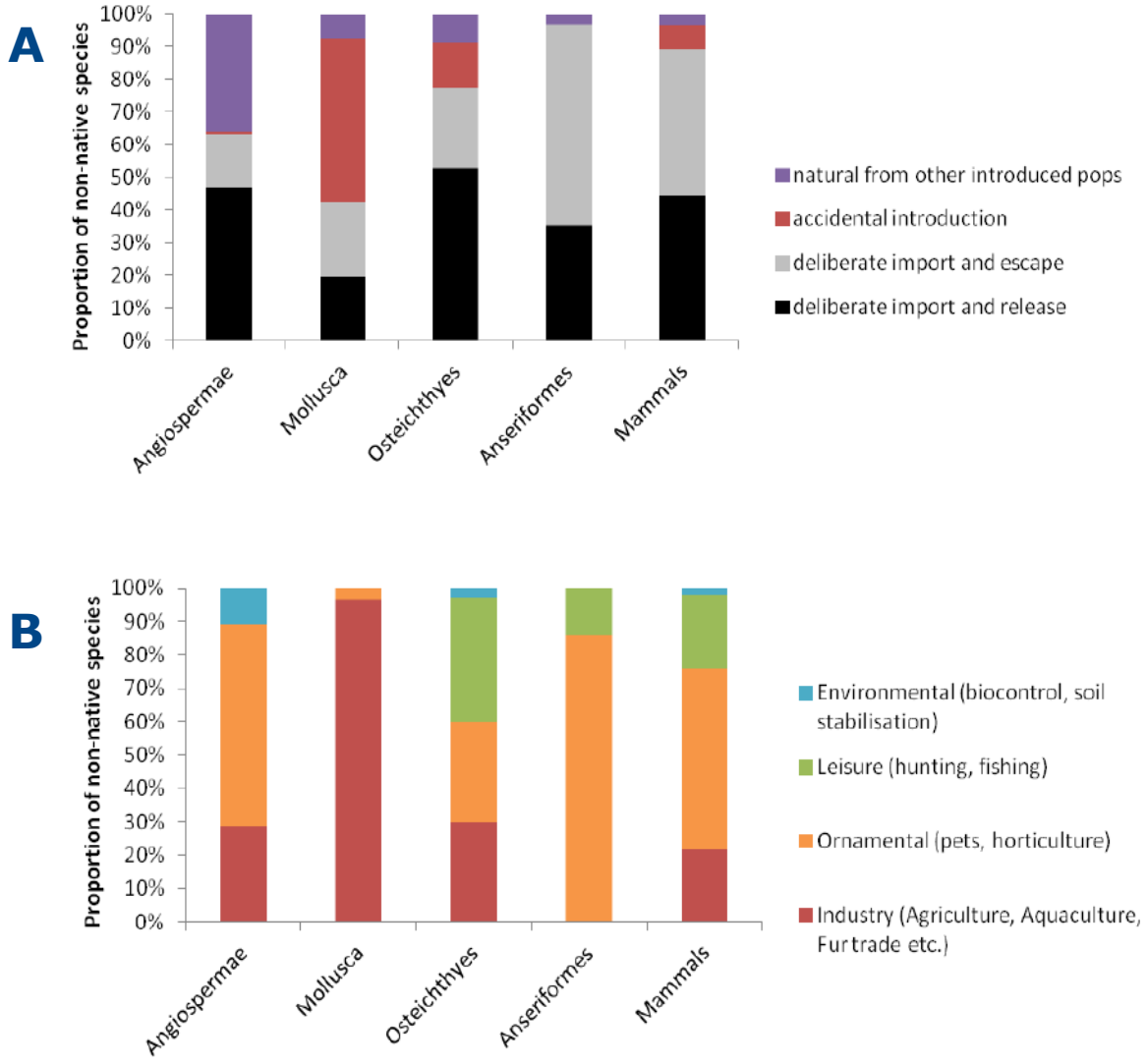


**Figure 2** Vectors of introduction for NNS: **[A]** Pathways of introduction of non-native Angiospermae, Mollusca, Osteichthyes, Anseriformes and Mammalia species to RINSE countries; **[B]** Reasons for deliberate introductions of non-native Angiospermae, Mollusca, Osteichthyes, Anseriformes and Mammalia species to RINSE countries. Data corresponds to deliberate imports represented in **[A]**.

## Horizon Scanning

The prioritised Black list (a list of 265 INS already present in at least one of the four RINSE countries) should help guide our future priorities for INS control and eradication programmes (Table 2). The results of the University of Cambridge's research indicate a high-degree of biological interchange between the four countries represented in the RINSE partnership, highlighting that it is both important and difficult to effectively reduce the spread of these species in this inter-connected region of Europe.

**Table 2**: Top 12 Black List Species

| | |
|---|---|
| *Crassula helmsii* | Australian stone |
| *Dikerogammarus villosus* | Killer shrimp |
| *Hydrocotyle ranunculoides* | Floating pennywort |
| *Caulerpa taxifolia* | Toxic algae |
| *Codium fragile* | Green sea fingers |
| *Branta canadensis* | Canada goose |
| *Harmonia axyridis* | Harlequin ladybird |
| *Mustela vison* | American mink |
| *Sciurus carolinensis* | Grey squirrel |
| *Fallopia japonica* | Japanese knotweed |
| *Heracleum mantegazzianum* | Giant hogweed |
| *Impatiens glandulifera* | Himalayan balsam |

**Table 3:** Top 12 Alert List Species

| | |
|---|---|
| *Neogobius gymnotrachelus* | Racer goby |
| *Percottus glenii* | Amur sleeper |
| *Pomacea canaliculata* | Apple snail |
| *Asterias amurensi* | Japanese sea star |
| *Potamocorbula amurensis* | Asian clam |
| *Rhopilema nomadica* | Nomad jellyfish |
| *Agrilus planipennis* | Emerald ash-borer |
| *Castor canadensis* | Canadian beaver |
| *Solenopsis invicta* | Red fire ant |
| *Imperata cylindrica* | Blady grass |
| *Melaleuca quinquenervia* | Melaleuca |
| *Pueraria lobata montana* | Kudzu |

The primary introduction vector for all top 12 Alert List species (Table 3) was human activity such as agriculture, ornamental trade and aquaculture. This highlights the role that improved biosecurity and stricter trade regulations could play in the future. Although the majority of the top 12 Alert species are yet to be found in the Two Seas area, four species are currently present in countries as close as Poland and Germany: the racer goby (*N. gymnotrachelus*), Amur sleeper (*P. glenii*), Canadian beaver (*C. canadensis*) and blady grass (*I. cylindrica*). More information on these top 12 species is available from www.rinse-europe.eu.

### Species Distribution Modelling

A total of 72 SDMs were produced including 30 Black list species and 42 Alert list species. The coastal areas of Belgium and the Netherlands were found to be at a high risk of invasion from the 42 Alert list species (Figure 3).

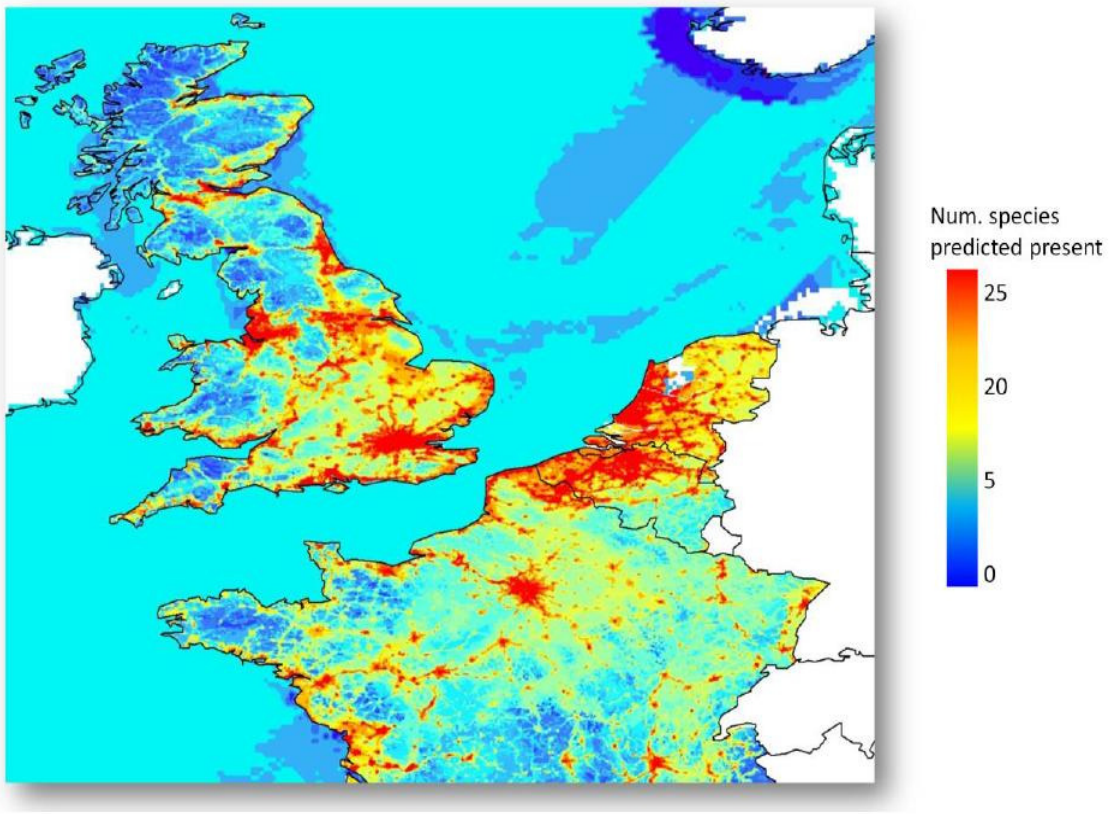


**Figure 3** Combined heat map showing cumulative probability of presence of 42 invasive species included in the Alert List of species.

Urban areas, particularly Greater London (England), Manchester (England) and Paris (France), are also at a high risk of invasion with 25 species predicted to establish in these metropolitan areas. The Scottish highlands are shown to be at a lower risk of invasion, with between 0-5 species predicted to establish in this area. Despite this, individual heat maps reveal the area remains under threat from specific species such as bush currant (*Miconia calvescens*), American rope (*Mikania micrantha*) and the racer goby (*Neogobius gymnotrachelus*).

Cumulative risk scores were higher for Black INS in comparison to Alert INS, an expected outcome given the RINSE region has already proved to be suitable for Black INS (Figure 4). A large proportion of Belgium and the Netherlands was found to be suitable for a number of species compared to Great Britain and France where this area affect was diluted. Similar to the Alert list species, urban and coastal areas were found to be particularly prone to invasion.

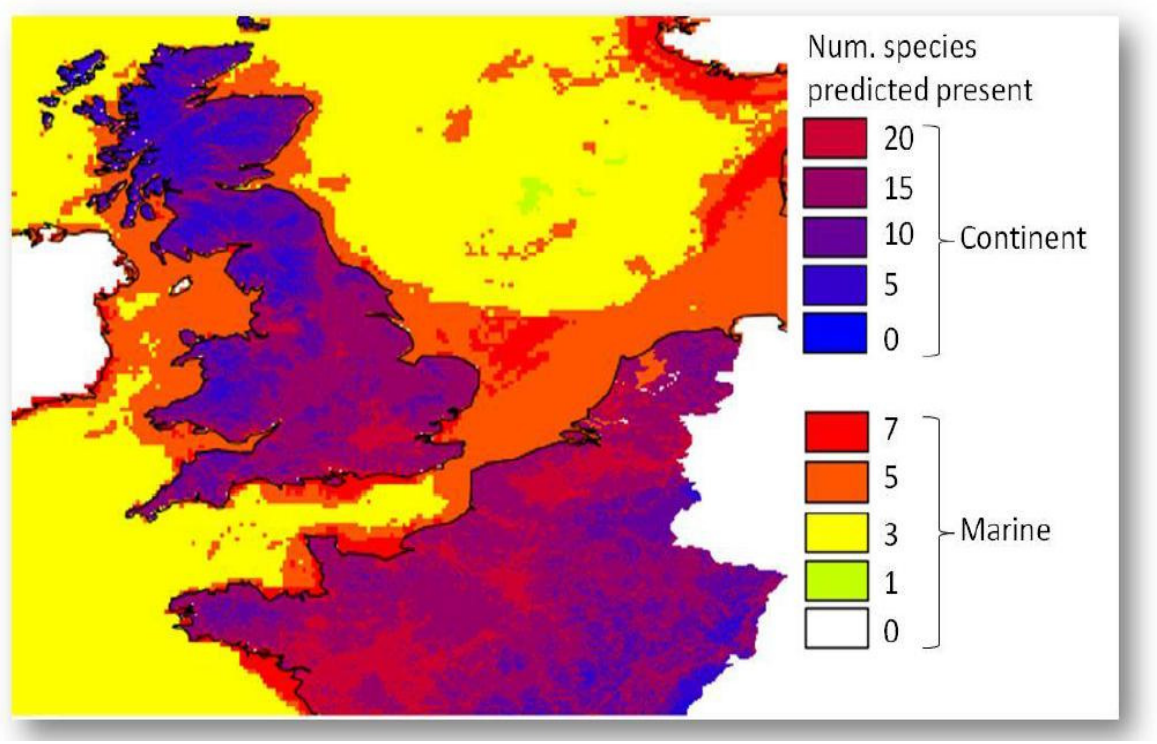


**Figure 4** Heat map showing cumulative probability of presence of 31 invasive species included in the Black List of species.

## What will this information be used for?

The results this research will be invaluable in facilitating a more targeted approach to the management of INS across this region, which we can now state with confidence is a true 'hot spot' for INS in Europe. Despite representing only 9.7% of the total area of Europe, 77% of the worst INS (described by DAISIE) are found in the Two Seas region. This is likely to be due to high population density and the intensity of trade and travel within this region of Europe, leading to higher than average 'propagule pressure' and a correspondingly increased number of NNS becoming established. The total number of introduced species found in the RINSE area is seven times higher than in Argentina (652 species), three times higher than Mexico (ca. 1,000 species) and twice that of Australia (2,241 species). Within the Two Seas region, the south east of England, Belgium and the Netherlands were shown to have a very high suitability for a varied range of potential invaders including plants, terrestrial and aquatic animals.

The cross-border approach to horizon-scanning and prioritisation for INS facilitated by RINSE is cutting edge and one of the first of its kind. Working across national boundaries with our nearest European neighbours, who share a similar suite of habitats and climate, could be the first step in facilitating a more co-ordinated and effective approach to the management of INS in the RINSE area.

We hope that the results of this research will be useful to other stakeholders and researchers across the RINSE area. At a basic level, the heat maps produced as a result of the Species Distribution Modelling are an effective visual aid in describing the potential distribution of our regions most concerning INS if their spread is not prevented. Others may find the full Species Registry useful, with much potential to use this for future academic research. The Black and Alert lists will also assist in highlighting species of concern to be cautious of in the near future.

We encourage you to read the full Targeting and Prioritisation Report, which contains far more detailed information and analyses than we have been able to present in this brief summary. The full Report can be downloaded **at www.rinse-europe.eu.** Further information is also available from the following reference**:**

**B. Gallardo, A. Zieritz and D. C. Aldridge (2013)**. 'Targeting and Prioritisation for INS in the RINSE Project Area' The RINSE Project and Cambridge Environmental Consulting Ltd.

The RINSE Partnership is happy to share the data associated with this study. If you should require this data please contact the RINSE Lead Partner, Norfolk County Council on + 44(0)1603 228977 or email nnnsi@norfolk.gov.uk

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This report was commissioned by the RINSE project under Work Package 1: Targeting and Prioritisation.

For more information on this study and to read the full report visit the RINSE website here:

**http://www.rinse-europe.eu/resources**

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