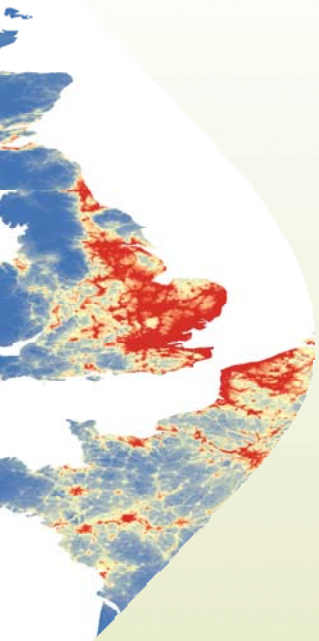

RINSE

Targeting and Prioritisation

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)

Azolla filiculoides

ACKNOWLEDGEMENTS

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.

This report was commissioned by the RINSE project under Work Package 1: Targeting and Prioritisation. For more information on the other outputs of the RINSE Project visit our website **here**.

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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INTRODUCTION

Invasive Species

An invasive non-native species (INS) is a species that has been moved outside of its natural range with the aid of humans, and is causing environmental or economic damage in its introduced range.

At a global level, INS are believed to be one of the most significant 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

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 region of southern England, northern France, Belgium and the Netherlands, an area with broadly similar geography and pathways of spread for INS. The 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. It is made up of both researchers and practitioners, with NGOs, research institutes, local authorities and national-level government agencies all being represented within the project.

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 effect of the whole project being far greater than the sum of its parts.

Horizon Scanning and Prioritisation

It is widely accepted that by far the cheapest and most efficient way to tackle the threats posed by INS is to prevent them from becoming established in the first place. The more knowledge we have about species moving towards our area that are likely to become invasive in the future, and the pathways by which those species spread, the better placed we are to prevent them from establishing and spreading.

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

To help us develop an accurate, impartial and evidence-based list of INS that are of greatest concern in the RINSE area we called upon the skills of Dr Belinda Gallardo and Dr Alexandra Zieritz, who are part of Dr David Aldridge's research team at the University of Cambridge. It was hoped that 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 Report presents the key findings of their Horizon scanning and Prioritisation exercise. The full Report, including supporting appendices and a more detailed analysis of the results, can be found on the RINSE website (www.rinse-europe.eu).

WHAT DID WE DO?

Area of study

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

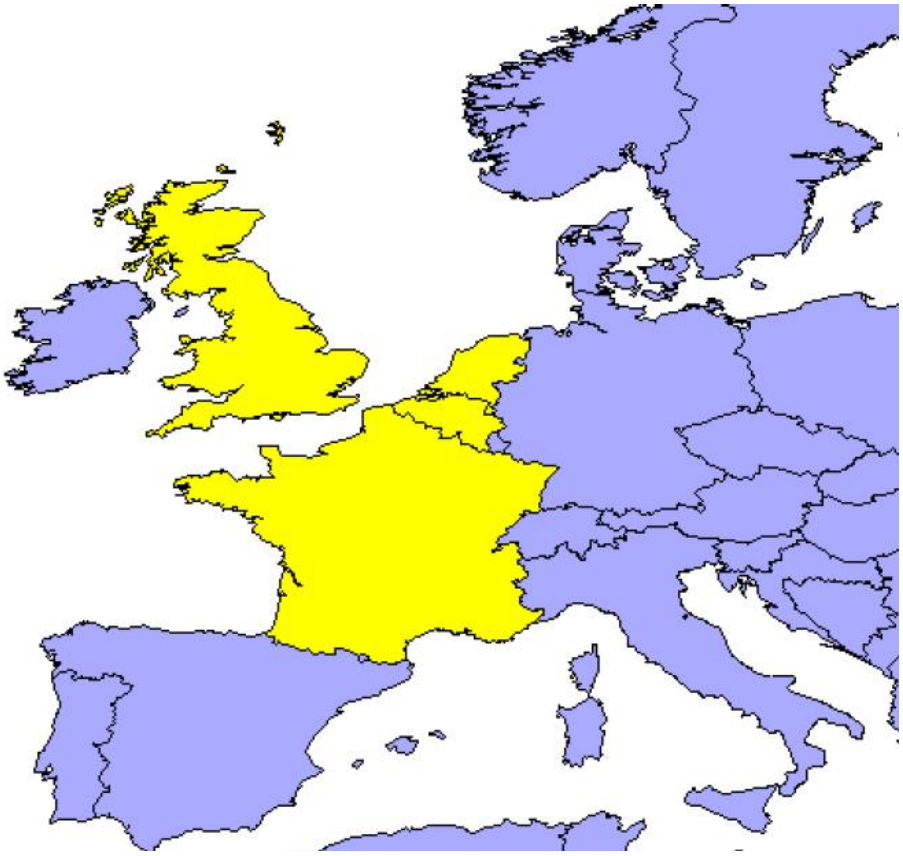

Figure 1 The four RINSE countries considered in this study: Great Britain, France, Belgium and the Netherlands.

General Registry

Data on presence of non-native species (NNS) in RINSE countries (including those areas outside of the Two Seas area) was obtained through a systematic review of 59 online databases and scientific papers. Some of these were global in scope, while others were more locally focussed (for a full list of sources please refer to the full Report). NNS that were found to be present in some, or all, of the RINSE countries were noted, along with other information such as their favoured habitat.

Five groups were investigated in more detail to analyse patterns of introduction and invasion histories of NNS within the RINSE countries: Angiosperma that featured in the RINSE Black list (details on the Black list below), Mollusca, Osteichthyes (bony fish), Anseriformes (geese, ducks, swans and relatives) and Mammalia. For each of the species on these focus lists, additional data was 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 most negative impacts on biodiversity. Using 16 of such 'worst invader' lists, a metalist of 340 invasive non-native species (INS) was created and 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 on the 21st November 2012. The Workshop was attended by 22 invited experts drawn from 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 4 risk categories: ecological impact, invasive potential, management difficulty and economic impact. The species were then ranked by their overall average score with the top 3 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 that they regarded as the 'most concerning' in terms of their current and potential environmental impacts in 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 environmental and socio-economic factors that influence the presence or absence of the species of interest. The list of 72 species that were modelled comprised as many of the species on the Alert list as possible (for some sufficient distribution data was unavailable 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 Europe	(BioCase, www.biocase.org)
Ocean Biogeography Information System B. Gallardo, A. Zieritz and D. C. Aldridge (2013)	(IOBIS, iobis.org/mapper)
The Netherlands Biodiversity Information Facility	(NLBIF, www.nlbif.nl)
Waarnemingen network	(waarnemingen.be/ waarnemingen.nl)
National Biodiversity Network	(NBN, Gateway data.nbn.org.uk)
Discover Life	(www.discoverlife.org)

Data on environmental conditions for inclusion in the SDMs was obtained from the World Climate Database (www.worldclim.org): 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, details of which can be found in the full Report.

Ten sets of data for the marine environment were obtained from Bio-Oracle: maximum and minimum surface temp; maximum photosynthetic active radiation; salinity, pH, phosphate, dissolved oxygen, calcite, silica, minimum and maximum chlorophyll. Socio-economic data on the human impacts on marine ecosystem was 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' that illustrates the risk of invasion across the four RINSE countries for terrestrial, freshwater and marine species. 'Hot spots' for invasion are easily identifiable using this map, which can be found later in this Report.

WHAT HAVE WE LEARNT?

General Registry

A total of 3454 non-native species (NNS) were found to be present in at least one of the four RINSE countries. The origin of these NNS was highly varied; however Europe, Asia and North America all contributed a significant number each being the source of over a quarter of the NNS present in the 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 for recreation (leisure fishing) and the aquaculture industry was responsible for almost all introductions of molluscs in to RINSE countries. This dependence of INS on humans for their introduction and spread further highlights the role biosecurity can play in the effective and efficient control of such INS.

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

Once established, invasive non-native fish have expanded their range the quickest, taking only an average of 47 years to spread from their first RINSE country to their last. In contrast, mammals took almost 4 times longer; an average of 175 years to spread across all four RINSE countries.

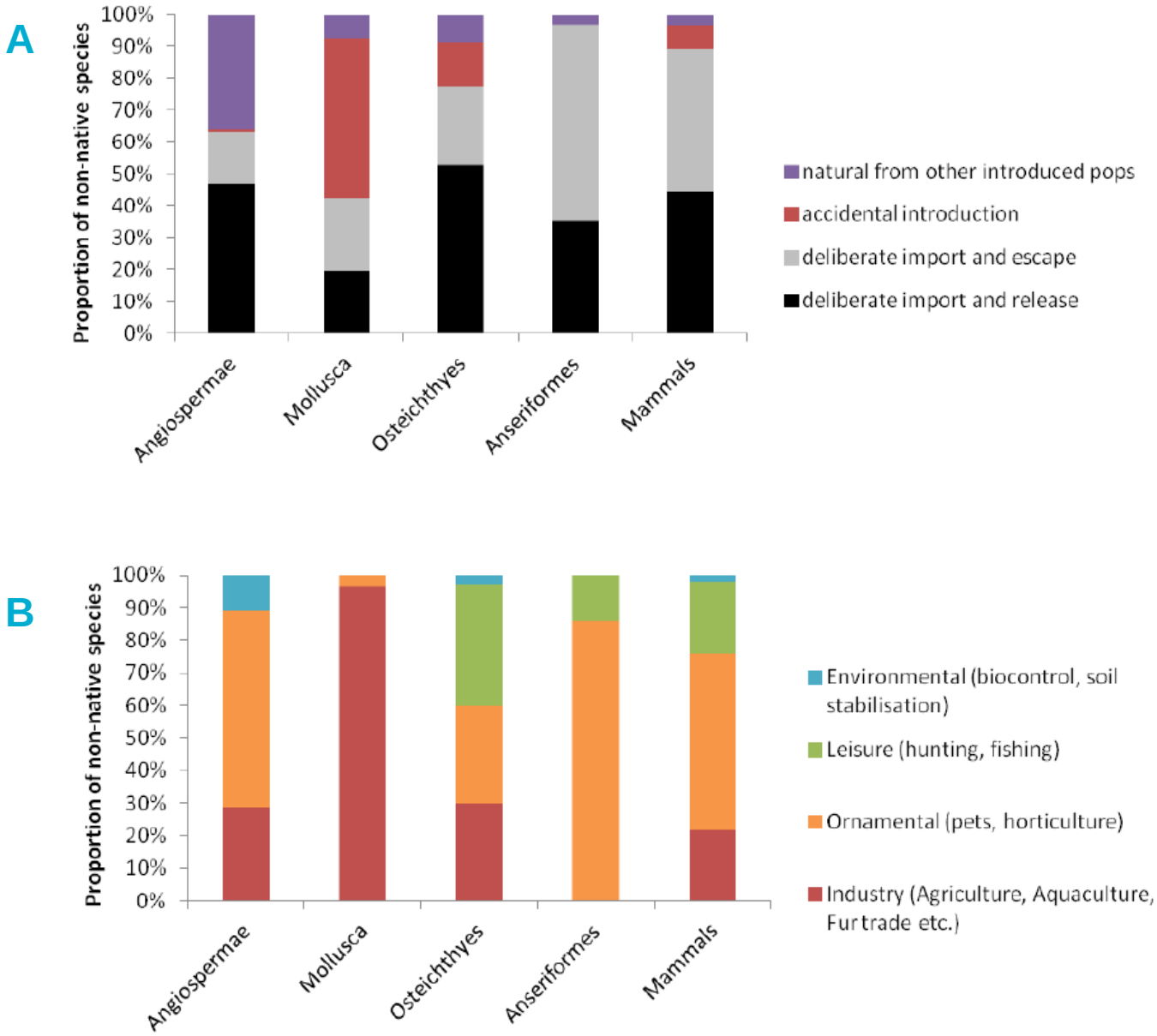

Figure 2 Vectors of introduction for NNS: **[A]** Pathways of introduction of non-native Angiospermae, Mollusca, Osteichthyes, Anseriformes and Mammalia species to RINSE countries; **[B]** Reasons for deliberate introductions of non-native Angiospermae, Mollusca, Osteichthyes, Anseriformes and Mammalia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

Horizon Scanning

The prioritised Black list (a list of 265 INS that are 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	New Zealand pigmyweed
Dikerogammarus villosus	Killer shrimp
Hydrocotyle ranunculoides	Floating pennywort
Caulerpa taxifolia	Killer 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 vector of introduction for all top 12 Alert List species (Table 3) was associated with 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 Europe, four 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*).

There is more information about these top 12 species available from our website.

Species Distribution Modelling

A total of 72 SDMs were produced including 30 Black list species and 42 Alert list species. The complete set of SDMs is available download here for the **Black List** and **Alert List**.

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). Urban areas, particularly Greater London (UK), Manchester (UK) and Paris (France), are also at a high risk of invasion with 25 species predicted to establish is these metropolitan areas. The highlands in Scotland are shown to be at a lower risk of invasion, with between 0 and 5 species predicted to establish in the 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*).

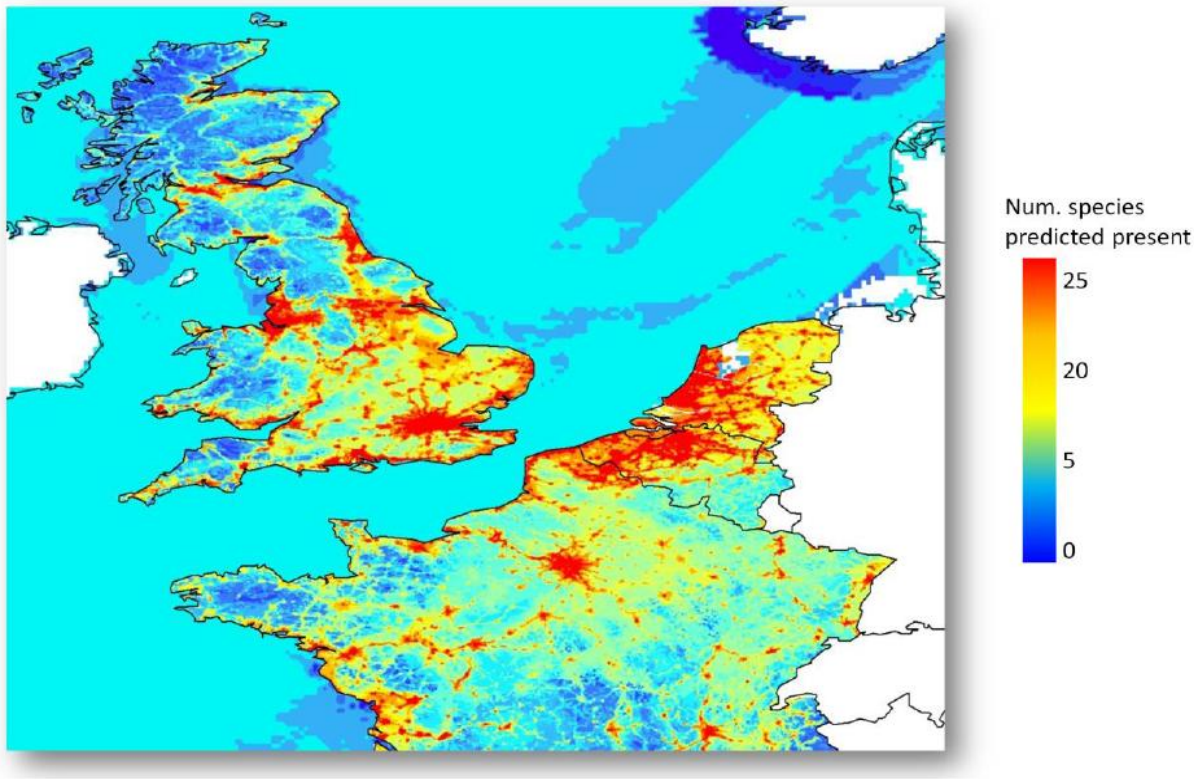

Figure 3 Combined heat map showing cumulative probability of presence of 42 invasive species included in the Alert List of species.

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.

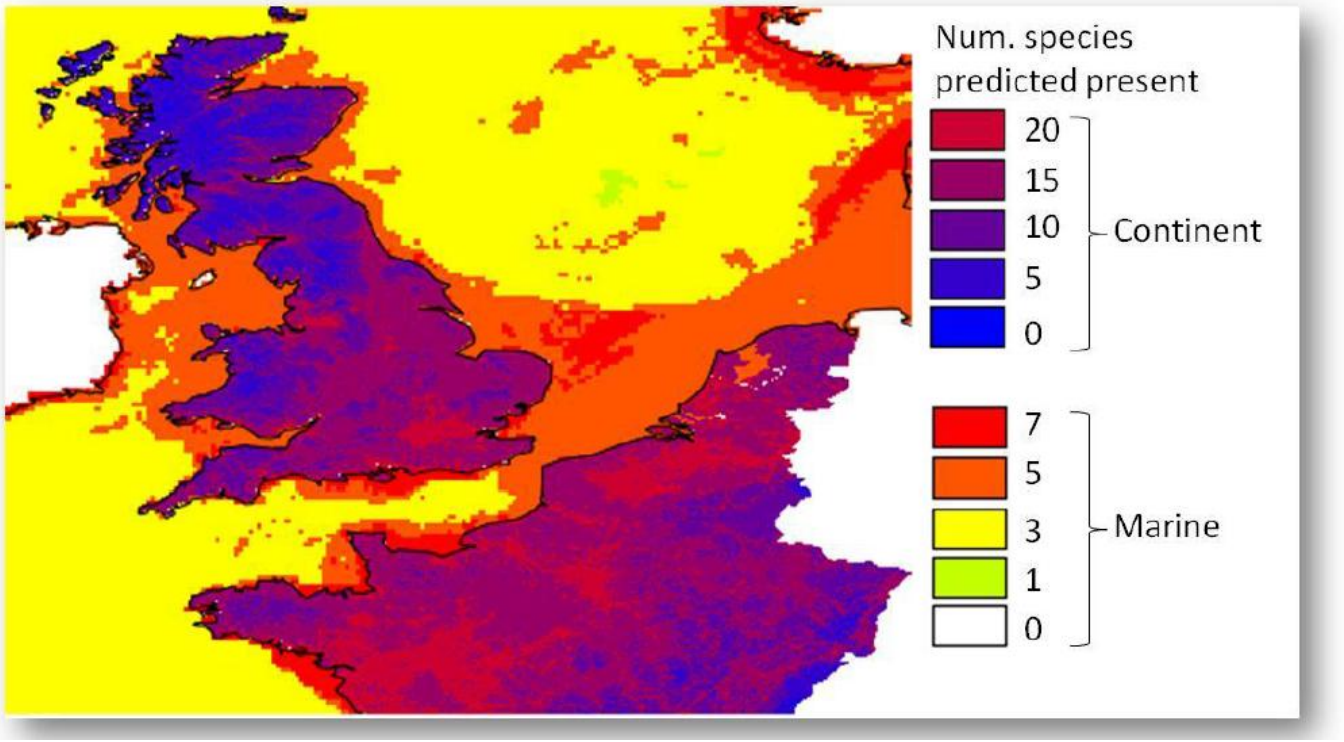

Figure 4 Heat map showing cumulative probability of presence of 31 invasive species included in the Black List of species.

WHAT WILL THIS INFORMATION BE USED FOR?

As you will see, the results of the research carried out by the University of Cambridge could 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 (77% of the worst invasive species in Europe, as described by DAISIE, are found in the Two Seas region despite it representing only 9.7% of Europe's total area). This is likely to be due to the high population density and intensity of trade and travel in this region of Europe, leading to a 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 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 SE 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 one of the first of its kind. Working across national boundaries with our nearest European neighbours, who also share a broadly 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 also 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 a fantastic 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, and there is much potential to use this Registry for further academic research in the future. The Black and Alert list should also help highlight those species that we should be most wary of in the coming years.

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 **here.**

To see the individual invasion heat maps click below:

ALERT List

Black List

To learn more about the top 12 Alert and Black List species click below:

ALERT List

Black List

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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