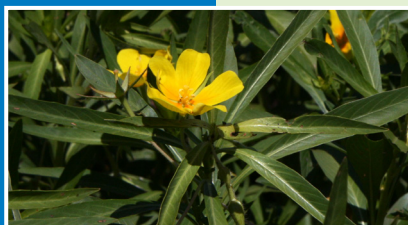
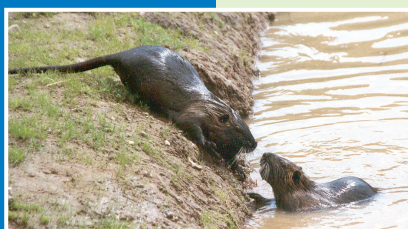


# Alien species on the Dutch Wadden Sea Islands

Occurrence and ecological risks



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**Bureau Waardenburg**  
Ecologie & landschap

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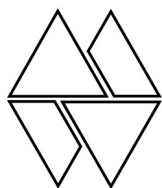
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## Preface

Invasive alien species can have a negative impact on native species and ecosystems, but also can have adverse effects on public health, safety and economy. On islands ecologic risks can be more substantial compared to the mainland due to general smaller population sizes of native species and adaptations to the lack of ground predators

Due to national and trilateral initiatives the Wadden Sea countries (The Netherlands, Germany and Denmark) there is good information available on the distribution and abundance of marine alien species in de Wadden Sea itself. For the Wadden Sea islands this knowledge is more limited and not readily available. Therefore, the Office on Risk Assessment and Research (BuRO) of the Dutch Food and Product Safety Authority has commissioned a project to get insight in distribution and abundance of alien species on the Wadden Sea islands and the ecological risks of those species for native species and ecosystems, especially those protected under the European Bird and Habitat Directives. Bureau Waardenburg has carried out this project.

The Bureau Waardenburg project team included:

|                    |  |
|--------------------|--|
| Tom van der Have   | Wadden Sea, legislation, mammals, birds, insects |
| Rob van der Haterd | habitats, vegetation                             |
| Hans Inberg        | habitats, vegetation                             |
| Bart Achterkamp    | macrofauna                                       |
| Menno Soes         | <i>crustaceae, Fallopia</i>                      |
| Rob Lensink        | birds, mammals, report, project management       |

Just ahead of this project a project was carried out commissioned by the Common Wadden Sea Secretariat on the policies and management of alien species in the Dutch part of the Wadden Sea area. Some information, especially about the management of nature reserves by the NGO's, was used for this project as well. We thank Vereniging Natuurmonumenten, Staatsbosbeheer and it Fryske Gae for their information

Wiebe Lammers (NVWA) provided comments on previous versions of this manuscript. Marc Collier (Bureau Waardenburg) checked our use of the English language. The authors thank everyone who has contributed to this report.



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## Summary

Invasive alien species can have a negative impact on native species and ecosystems, but also can have adverse effects on public health, safety and economy. On islands ecologic risks can be more substantial compared to the mainland due to general smaller population sizes of native species and adaptations to the lack of ground predators.

Due to national and trilateral initiatives of the Wadden Sea countries (The Netherlands, Germany and Denmark) there is good information available on the distribution and abundance of marine alien species in de Wadden Sea itself, but this information is not readily available for the islands. Therefore, the Office on Risk Assessment and Research (BuRO) the Dutch Food and Product Safety Authority (NVWA) has commissioned a project to get insight in distribution and abundance of alien species on the Wadden Sea islands and the ecological risks of those species for native species and ecosystems, especially those protected under the European Bird and Habitat Directives. Bureau Waardenburg has carried out this project,.

This study has three major objectives:

- to give an overview of all alien species on the Dutch Wadden Sea islands in terrestrial ecosystems (above the high tide water mark);
- to identify all alien species, actually threatening native nature (ecosystems or species), or might become a threat in the near future;
- to apply the ISIEA protocol for species with a high (potential) risk profile and to make a short risk analysis for species on the ISIEA back list and pinpointing towards Nature 2000 on the Wadden.

In this study an alien species is defined as a non-native species that is actively or passively introduced in The Netherlands by human activity or by secondary dispersal. Species only occurring in the marine environment are excluded from this study with the exception of species living in the salt marsh. Alien species that are only of importance in relation to agriculture, safety or human and animal health are excluded.

The lists on [nederlandsesoorten.nl](http://nederlandsesoorten.nl) en [werkgroepexoten.nl](http://werkgroepexoten.nl) have been used to get an idea of all alien species that might be relevant. For all these 1490 species their distribution in The Netherlands and the different Wadden Islands have been checked.

Among the 1.490 alien species under consideration approximately 300 of them were found on one or more Wadden Islands in the period 2005 - 2014. The most numerous group are plants, followed by *Crustacea*. Of the five major islands most alien species are found on the largest island of Texel and fewest on the smallest island of Schiermonnikoog. The number of alien species on the uninhabited (and much smaller) islands and sandbanks is far less.

In this study 47 alien species, according to the ISEIA-protocol, belong to the black list (score 11-12, 16 species) or the watch list (score 9-10, 31 species). Among those, 23 species are an actual risk for nature on the Wadden Islands, mainly because they do occur on one or more islands. For 24 species it is a potential risk, mainly because those species are lacking on the islands at this very moment.

The following species are actually a major threat for Natura 2000 goals:

- *Campylopus introflexus*;
- *Prunus serotina*;
- *Vaccinium macrocarpon*;
- *Acer pseudoplatanus*;
- *Cotula coronopifolia*;
- *Rosa rugosa*.

Introduction of:

- *Nyctereutes procyonoides*;
- *Procyon lotor*;
- or another predator (native or non-native),

could be disastrous for the many ground breeding species on the islands (waders, gulls, terns). The appearance of the red fox, which does not occur naturally on the islands but is native on the mainland of The Netherlands, could have a negative impact on ground dwelling species. *Spartina anglica* is a major threat as well, but in the meantime is the major species in a Natura 2000 habitat type, which is contradictory.

## Nederlandse samenvatting

Invasieve exoten kunnen een negatieve impact hebben op inheemse soorten en ecosystemen, maar ook op economie, veiligheid en dier- en volksgezondheid. Het is bekend dat schade aan ecosystemen door invasieve exoten op eilanden groter kan zijn dan op het vaste land. Door acties in het kader van het Trilateraal Waddenzeebeleid (Nederland, Duitsland, Denemarken) bestaat inmiddels een behoorlijk goed overzicht van het voorkomen van mariene exoten in de Waddenzee zelf. De kennis over het voorkomen op de Waddeneilanden is veel minder goed. Daarom wil het Bureau Risicobeoordeling en Onderzoeksprogrammering (BuRO) van de Nederlandse Voedsel- en Warenautoriteit (NVWA) inzicht krijgen welke exoten aanwezig zijn op de Waddeneilanden en welke daarvan schadelijk zijn voor natuur of kunnen worden.

Deze studie heeft drie belangrijke doelen:

- het geven van een overzicht van het voorkomen van exoten op de Waddeneilanden in land-ecosystemen (boven gemiddeld hoogwater);
- het geven van een overzicht van exoten die nu (of in de toekomst) een bedreiging vormen voor de natuur op de Waddeneilanden, in het bijzonder de doelen Natura 2000;
- toepassen van het ISIEA-protocol op soorten met een (potentieel) groot risico voor natuur en natuurdoelen en opstellen van een korte risicoanalyse die is toegesneden op de situatie op de Wadden.

Voor dit rapport zijn exoten gedefinieerd als uitheemse soorten die Nederland niet op eigen kracht kunnen bereiken, maar door menselijk handelen actief of passief terecht zijn gekomen in de Nederlandse natuur. Soorten uit het zoute milieu zijn niet meegenomen in deze studie, behalve soorten die op of in de kwelder voorkomen. Soorten die alleen van belang zijn in relatie tot de teelt van landbouwproducten, openbare veiligheid dan wel het welzijn van mens of dier zijn evenmin meegenomen.

De lijst met exoten die van belang kunnen zijn is afgeleid van de soorten die vermeld zijn in het Nederlandse Soortenregister en de lijst met exoten van de Werkgroep Exoten van de NECOV. Voor 1490 soorten is het voorkomen in Nederland als geheel en op de afzonderlijke Waddeneilanden nagegaan.

in 2005-2014 zijn ongeveer 300 exoten op een of meer eiland vastgesteld. Onder de exoten zijn planten het best vertegenwoordigd, gevolgd door kreeftachtigen. Op de grote eilanden zijn de meeste exoten vastgesteld op het grootste eiland (Texel) en het minste aantal op het kleinste eiland (Schiermonnikoog). Op kleine eiland als Rottum en Griend en de grote zandplaten als de Razende Bol ligt et aantal exoten fors lager in vergelijking tot de vijf grote eilanden.

Voor 47 soorten resulteert toepassing van het ISIEA-protocol in een score van 9-10 (watch list, 31 soorten) en 11-12 (black list, 16 soorten). Van deze 47 soorten komen 23 soorten thans op de eilanden voor en vormen in meer of mindere mate een bedreiging voor Natura 2000. Voor 24 soorten is sprake van een potentiële bedreiging omdat zij thans niet voorkomen op de eilanden.

Op dit moment vormen

- grijs kronkelsteeltje
- Amerikaanse Vogelkers,
- cranberry
- gewone esdoorn
- rimpelroos

de grootste sta in de weg voor realisatie van Natura 2000-doelen. In potentie kan het verschijnen van soorten als:

- wasbeer;
- wasbeerhond;
- of een andere predator (inheems of uitheems);

desastreus uitpakken voor de vele grondbroeders (steltlopers, meeuwen, sterns) op de eilanden. De komst van een soort als de vos, die van nature niet voorkomt op de eilanden maar elders in Nederland inheems is, kan even funest zijn, met name voor grondbroedende soorten. *Spartina anglica* is, als exoot, een bedreiging voor een aantal Natura 2000-waarden. Daarnaast is het de dominante soort in een gelijknamig habitattype dat kenmerkend is voor de overgang tussen wad en kwelder. Hier is sprake van een contradictie.

# 1 Introduction

## 1.1 Background

Invasive alien species can have a negative impact on native species and ecosystems, but also can have adverse effects on public health, safety and economy. On islands ecologic risks can be more substantial compared to the mainland due to general smaller population sizes of native species and adaptations to the lack of ground predators

Due to national and trilateral initiatives of the Wadden Sea countries (The Netherlands, Germany and Denmark) there is good information available on the distribution and abundance of marine alien species in de Wadden Sea itself. For the Wadden Sea islands this knowledge is more limited and not readily available. Therefore, the Office on Risk Assessment and Research (BuRO) the Dutch Food and Product Safety Authority (NVWA) has commissioned a project to get insight in distribution and abundance of alien species on the Wadden Sea islands and the ecological risks of those species for native species and ecosystems, especially those protected under the European Bird and Habitat Directives. Bureau Waardenburg has carried out this project.

In the Netherlands, the Wadden Sea area is about 600 km<sup>2</sup> large. From west to east the barrier islands Texel, Vlieland, Terschelling, Ameland, Schiermonnikoog, Rottumeroog and Rottumerplaat are situated between the Wadden Sea and the North Sea. The first five islands are inhabited, the latter two are uninhabited. Between the islands some sand banks with primordial dune formations are included in this study.

*Tabel 1.1 Islands and sandbanks in the Wadden Sea area, the surface area (ha), number of inhabitants (wikipedia) and the area protected under Natura 2000 (only dune habitats), Salt marshes are part of the of the Wadden Sea (in total 272.449 ha. Rottumerplaat and Griend are guarded during summer both by two wardens.*

| island          | surface<br>in ha | inhabitants | surface protected<br>Natura 2000 |
|-----------------|------------------|-------------|----------------------------------|
| Texel           | 161.120          | 13.641      | 4.615                            |
| Vlieland        | 36.130           | 1.113       | 1.535                            |
| Terschelling    | 86.160           | 4.721       | 5.017                            |
| Ameland         | 58.830           | 3.591       | 2.012                            |
| Schiermonnikoog | 43.990           | 942         | 1.024                            |
| Rottumeroog     | 2.500            | 0           |                                  |
| Rottumerplaat   | 7.820            | (2)         |                                  |
| Griend          | 1.000            | (2)         |                                  |
| Razende Bol     | 4.000            | 0           |                                  |
| Richel          | 1.000            | 0           |                                  |
| Engelsmanplaat  | 900              | 0           |                                  |
| 't Rif          | 700              | 0           |                                  |
| Simonszand      | 600              | 0           |                                  |
| (Wadden Sea)    |                  |             | 272.449                          |

The five major islands all have the same geomorphological structure. Along or behind the beach dune formations are located; all managed by private or governmental nature management organisation (NGO's). The southern side of the islands consists of areas surrounded by dikes and used for mostly agricultural purposes (polders at or slightly above sea level). The eastern parts of the islands (and sometimes the western parts as well) consist of well-vegetated salt marshes, which gradually slope into higher dunes; these salt marshes are also mainly managed by NGO's as well.

Most of the Wadden Sea and its island are protected under the Dutch 'Nature Conservation Law' (Natuurbeschermingswet 1998). In this law the European Bird and Habitat Directives are implemented.

## **1.2 Objectives of this study**

This study has two major goals:

- To give an overview of all alien species on the Dutch Wadden Sea islands in terrestrial ecosystems (above the high tide water mark);
- To identify all alien species, actually threatening native nature (ecosystems or species), or might become a threat in the near future.

In this study an alien species is defined as a non-native species that is actively or passively introduced in The Netherlands by human activity or by secondary dispersal.

Species only occurring in the marine environment are excluded from this study with the exception of species living in the salt marsh. In case of doubt on the exclusive appearance in marine or brackish environments, the species are included in the list.

Alien species that are only of importance in relation to agriculture, safety or human and animal health are excluded from this study.

## 2 Materials and methods

In this study data on distribution and abundance of alien species on the Dutch Wadden Sea islands are presented. These data are available in databases and published sources. No fieldwork was conducted in this study.

### 2.1 Data sampling

#### *Species reviewed*

In the Netherlands there are two lists with aim to include all alien species found in the Netherlands: a list by the Working Group on Alien Species of the NECOV and WEW (Werkgroep Exoten, <http://www.werkgroepexoten.nl/>). The second organisation, which provides a list is Naturalis ('[www.nederlandsesoorten.nl/node/19](http://www.nederlandsesoorten.nl/node/19)'). These two lists have been combined into one list in this report. In the database for each species the original list(s) are still visible and traceable. It should be noted that both lists are currently incomplete. The Naturalis list is being updated in 2015 to capture all alien species that are established in The Netherlands.

The list provided by Naturalis also gives information on the taxonomic order or family. This information is added to species only mentioned on the Working Group Alien Species list.

Both lists give names in Latin and Dutch. The English names of species are found in different databases on the Internet, with the scientific names as a reference.

#### *What is an island?*

For this study a Wadden Sea island is defined as an area surrounded by sea and situated above the level of average high water ('[www.rws.nl](http://www.rws.nl), figure 2.1)).

#### **Sources the distribution of species**

The last decade is characterised by a rapid development of online applications to store field data on distribution and abundance of organisms ([verspreidingsatlassen.nl](http://verspreidingsatlassen.nl), [telmee.nl](http://telmee.nl), [waarneming.nl](http://waarneming.nl)). Most of these data can be viewed and accessed online. For this review of existing knowledge on distribution and abundance of alien species on the Dutch Wadden Sea islands, these databases have been consulted.

In the Netherlands, much biodiversity data are sampled on the basis of 1x1 km squares (following the grid of the Amersfoort-coördinates) or 5x5 km squares. Therefore, it was decided to present data from the 5x5 km grid.

#### *Vegetations*

Floron records the distribution of plant species. They manage the website "[verspreidingsatlas.nl](http://verspreidingsatlas.nl)". Here, on the basis of 5x5 km squares, for each species, the occurrence in different time periods can be viewed. For this study the most recent



period was used: >1990. The website also has data on the distribution of mosses, fungi, and lichens.

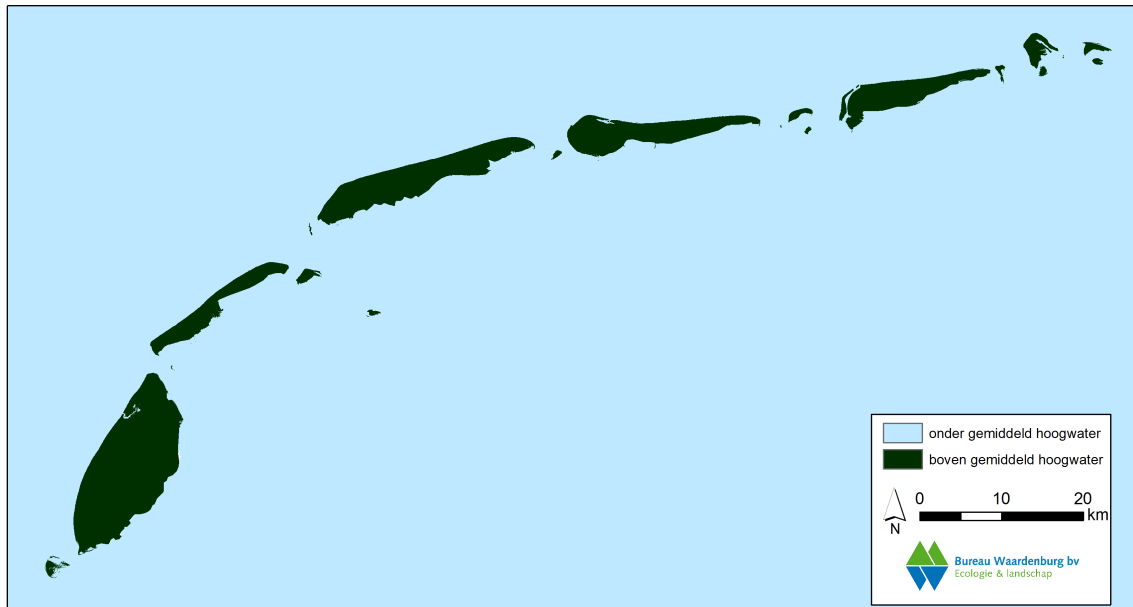


Figure 2.1 The Dutch Wadden Island; in black the land above mean high tide.

Each year a part of the salt marshes on the Wadden Sea islands has been mapped under the supervision of Rijkswaterstaat (the VEGWAD program, e.g. Bergwerff & Buiks 2012). In these surveys no attention was paid to alien species, with one exception. Common cord grass *Spartina angelica* is mapped as (part of) a vegetation type of the lowest parts of the salt marsh. These data were used to illustrate some aspects of the occurrence of this alien species on the Wadden.

#### *Mammals*

Data on the distribution of mammals are gathered by the Zoogdierverseniging (VZZ). More historical data can be found in Broekhuizen *et al.* (1988) and more recent data on the website 'www.telmeel.nl'. Data from the period 2005-2014 were used in this study.

#### *Birds*

The most recent and complete overview of the distribution of birds on Wadden Sea islands can be found in Sovon (2002). These data were combined with more recent information by Lensink *et al.* (2013) and 'www.waarneming.nl' and www.telmeel.nl in the period 2005-2014 with a selection of data indicating breeding.

#### *Insects*

Data on the distribution of insect species were found on waarneming.nl. Data from the period 2005-2014 were used.

#### *Other species groups*

Data on the distribution of insects were found on [waarneming.nl](http://waarneming.nl). Data from the 2005-2014 period were included in this study.

Based on the European Water Directive the regional water boards are running a monitoring program. In this program different aquatic species groups, living in various types of water bodies, are surveyed on a yearly basis. Data from this program ([www.limnodata.nl](http://www.limnodata.nl)) are used for information about aquatic alien species in water bodies on the islands, especially outside the protected areas.

#### **Building a database**

For this project a database was built. In this database all alien terrestrial species in the Netherlands are included. Marine species and species exclusively for agriculture are excluded. For each species the occurrence and abundance on Wadden Island is given, among other characteristics of those species.

#### *Species*

For each species the name is given in Dutch, English and Latin (scientific name), as well as the species group and the history of its occurrence in the Netherlands since the first observation according to the criteria of Naturalis (Netherlands Soortenregister).

#### 2 Alien (not defined)

Introduced by human activities, status unknown.

#### 2a Alien; at least 100 years with reproduction

Introduced by human activities and after introduction at least a 100 years reproduction and forming a self-sustaining population.

#### 2b Alien; between 10 and 100 years with reproduction

Introduced by human activities and after introduction 10-100 years reproduction and forming a self-sustaining population.

#### 2c Alien; less than 10 years with reproduction

Introduced by human activities and after introduction less than 10 years reproduction and forming a self-sustaining population.

#### 2d Alien; incidental import

Introduced by human activities so far no reproduction noticed.

#### *Distribution*

For each Wadden Sea island the number of squares (5x5 km) with registered observations in recent years is given. To put these figures into perspective the number of squares with observations in recent years for the Netherlands as a whole is given as well.

Larger islands usually have more inhabitants, more tourists and more habitats. It is, therefore, expected that more alien species will be introduced on larger islands and will have a higher risk of establishment, as the presence of suitable habitat is also

more likely. To analyse this potential correlation, the number of alien species on each island is compared with surface area (total and Natura 2000 habitat, separately, in ha), number of inhabitants, number of overnight-stays and number of habitats. Any deviation from this expected positive relationship might be caused by absence of presence of certain pathways.

### ISEIA

In Belgium the ISEIA risk assessment protocol for alien species impact was developed (appendix 1) (table 2.1).

*Table 2.1 Summary of the ISEIA protocol (appendix 1).*

| aspect                           | score               | explanation              |
|----------------------------------|---------------------|--------------------------|
| dispersion potential             | 1, 2 or 3           | low, medium or high risk |
| colonisation of natural habitats | 1, 2 or 3           | low, medium or high risk |
| impact on native species         | 1, 2 or 3           | low, medium or high risk |
| impact on ecosystems             | 1, 2 or 3           | low, medium or high risk |
| sum                              | 4-12                |                          |
| black list:                      | ISEIA index = 11-12 |                          |
| watch list:                      | ISEIA index = 9-10  |                          |
| no list                          | ISEIA index = 4-8   |                          |

This protocol is applied to the species with a presumed (potential) high risk for native species and/or native ecosystems. These species all have been subject to a risk analysis before, or have been mentioned in the horizon scan (Leuven *et al.* 2014) or have been included in Annex I or II of the agreement on water plants (2010) or have been on the management list of Bosschap. Also some alien species, which are abundant on the islands, but not mentioned in any list, were assessed with the protocol. The protocol judges four aspects and ends up with the sum of the scores on these four elements. In total the ISEIA-protocol was applied on 100 species. For these species the main vector(s) for the Wadden Sea islands were given as well.

### Natura 2000

In the Netherlands, the European Bird and Habitat Directives are implemented in the Dutch law under the Natuurbeschermingswet 1998, covering the protection of areas. Currently, there are 164 Natura 2000-areas in The Netherlands. For each area a list of habitats and species is available and included in the N2000 Nature Conservation goals. For each island In the Wadden Sea (five main islands) an assignment with habitats and species has been made. The smaller islands (e.g. Rottumeroog, Rottummerplaat) and major sandbanks are part of the Wadden Sea assignment. The beaches of the islands are part of the assignment for the Noordzeekustzone (North Sea Coastal Zone). Details are given in the tables 2.2, 2.3, 2.4, 2.5 and 2.6.

For the alien species the occurrence on the Wadden Islands is linked to one or more habitat type. Most of the habitat types for aliens are located in the Natura 2000 areas. So, most of the occurrence of aliens in the Natura 2000 areas could be linked to one or more habitat types; this has been sorted out. Only a few aliens are linked to habitat

types that mainly occur outside Natura 2000 areas such as eutrophic and hypertrophic waters, highly disturbed grounds.

*Table 2.2 Overview Natura 2000 assignments in the study area, surface area protected and management organisations of the protected area.*

| <i>assignment</i>        | <i>surface (ha)</i> | <i>management</i>                  |
|--------------------------|---------------------|------------------------------------|
| Noordzeekustzone         | 123.134             | RWS, NM, SBB, IFG                  |
| Duinen & Lage Land Texel | 4.615               | SBB, NM, RWS, MinDef, PP           |
| Duinen Vlieland          | 1.535               | SBB, RWS, MinDef, PP               |
| Duinen Terschelling      | 5.017               | SBB, RWS, PP                       |
| Duinen Ameland           | 2.012               | SBB, RWS, MinFin, IFG, PP          |
| Duinen Schiermonnikoog   | 1.024               | NM, RWS, PP                        |
| Waddenzee                | 272.449             | SBB, NM, RWS, MinDef, LNH, IFG, GL |
|                          | GL                  | Groninger Landschap                |
|                          | IFG                 | It Fryske Gae                      |
|                          | LNH                 | Landschap Noord-Holland            |
|                          | MinDef              | Ministerie van Defensie            |
|                          | MinFin              | Ministerie van Financiën           |
|                          | NM                  | Natuurmonumenten                   |
|                          | SBB                 | Staatsbosbeheer                    |
|                          | PP                  | Private property                   |

### *Protected Species*

Parts of the European Bird and Habitat Directives are implemented in the Dutch law under the Flora- and fauna Law covering the protection of species. Plants are a major group in these lists. Since most protected species are rare and mostly confined to highly protected areas or specific environmental condition, the majority occurs in Natura 2000 areas. For these reasons, no special attention was paid to protected species in relation to the abundance of invasive aliens.

Table 2.3a Overview of habitat types in the assignments of the Wadden Sea islands (in Dutch).

|        |   | Noordzeekustzone | Duinen & Lage Land Texel | Duinen Vlieland | Duinen Terschelling | Duinen Ameland | Duinen Schiermonnikoog | Waddenzee | aantal aanwijzingen |
|--------|---|------------------|--------------------------|-----------------|---------------------|----------------|------------------------|-----------|---------------------|
| H1110A | Permanent overstroomde zandbanken (getijdengebied)    |                  |                          |                 |                     |                |                        | 1         | 1                   |
| H1110B | Permanent overstroomde zandbanken (Noordzee-kustzone) | 1                |                          |                 |                     |                |                        |           | 1                   |
| H1140A | Slik- en zandplaten (getijdengebied)                  |                  |                          |                 |                     |                |                        | 1         | 1                   |
| H1140B | Slik- en zandplaten (Noordzee-kustzone)               | 1                |                          |                 |                     |                |                        |           | 1                   |
| H1310A | Zilte pionierbegroeiingen (zeekraal)                  | 1                | 1                        | 1               | 1                   |                |                        | 1         | 5                   |
| H1310B | Zilte pionierbegroeiingen (zeevetmuur)                | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                   |
| H1320  | Slijkgrasvelden                                       |                  |                          |                 |                     |                |                        | 1         | 1                   |
| H1330A | Schorren en zilte graslanden (buitendijks)            | 1                | 1                        | 1               | 1                   |                |                        | 1         | 5                   |
| H1330B | Schorren en zilte graslanden (binnendijks)            |                  | 1                        |                 |                     |                |                        | 1         | 2                   |
| H2110  | Embryonale duinen                                     | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                   |
| H2120  | Witte duinen  |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                   |
| H2130A | *Grijze duinen (kalkrijk)                             |                  | 1                        |                 |                     | 1              | 1                      |           | 3                   |
| H2130B | *Grijze duinen (kalkarm)                              |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                   |
| H2130C | *Grijze duinen (heischraal)                           |                  | 1                        |                 | 1                   | 1              | 1                      |           | 4                   |
| H2140A | *Duinheiden met kraaihei (vochtig)                    |                  | 1                        | 1               | 1                   | 1              |                        |           | 4                   |
| H2140B | *Duinheiden met kraaihei (droog)                      |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   |
| H2150  | *Duinheiden met struikhei                             |                  | 1                        | 1               | 1                   | 1              |                        |           | 4                   |
| H2160  | Duindoornstruwelen                                    |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                   |
| H2170  | Kruipwilgstruwelen                                    |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   |
| H2180A | Duinbossen (droog)                                    |                  | 1                        | 1               | 1                   |                | 1                      |           | 4                   |
| H2180B | Duinbossen (vochtig)                                  |                  |                          | 1               | 1                   |                | 1                      |           | 3                   |
| H2180C | Duinbossen (binnenduinrand)                           |                  |                          |                 |                     |                | 1                      |           | 1                   |
| H2190A | Vochtige duinvalleien (open water)                    |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   |
| H2190B | Vochtige duinvalleien (kalkrijk)                      | 1                | 1                        | 1               | 1                   | 1              | 1                      | 1         | 7                   |
| H2190C | Vochtige duinvalleien (ontkalkt)                      |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   |
| H2190D | Vochtige duinvalleien (hoge moerasplanten)            |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   |
| H6230  | *Heischrale graslanden                                |                  |                          |                 | 1                   | 1              |                        |           | 2                   |
| H6410  | Blauwgraslanden                                       |                  |                          |                 |                     |                | 1                      |           | 1                   |
| H7210  | *Galigaanmoerassen                                    |                  | 1                        |                 |                     |                |                        |           | 1                   |
| totaal |   | 7                | 20                       | 15              | 19                  | 14             | 15                     | 12        |                     |

### Species-area-relations

According to the Theory of island biogeography there is a linear relation between area of an islands (in ha) and the number of species that occur on an island (MacArthur & Wilson 1967). We investigated this relation for the number of alien species on the Wadden Islands. One might expect that with a larger surface the diversity in habitat types increases and therefor the number of species that could exists. In the meantime with a larger surface, an island might 'catch' more aliens. Furthermore, in the Netherlands a larger surface means more inhabitants, more tourists, more traffic by boats, etc and therefor a higher introduction risk of new alien species

Table 2.3b Overview of habitat types in the assignments of the Wadden Sea islands (in English).

|        |  | Noordzeekustzone | Duinen & Lage Land Texel | Duinen Vlieland | Duinen Terschelling | Duinen Ameland | Duinen Schiermonnikoog | Waddenzee | number of assignments |
|--------|--|------------------|--------------------------|-----------------|---------------------|----------------|------------------------|-----------|-----------------------|
| H1110A | Sandbanks which are slightly covered by sea water all the time (tidal zone)                          |                  |                          |                 |                     |                |                        | 1         | 1                     |
| H1110B | Sandbanks which are slightly covered by sea water all the time (North Sea)                           | 1                |                          |                 |                     |                |                        |           | 1                     |
| H1140A | Mudflats and sandflats not covered by seawater at low tide (tidal zone)                              |                  |                          |                 |                     |                |                        | 1         | 1                     |
| H1140B | Mudflats and sandflats not covered by seawater at low tide (North Sea)                               | 1                |                          |                 |                     |                |                        |           | 1                     |
| H1310A | Salicornia and other annuals colonizing mud and sand ( <i>Salicornia</i> )                           | 1                | 1                        | 1               | 1                   |                |                        | 1         | 5                     |
| H1310B | Salicornia and other annuals colonizing mud and sand ( <i>Sagina maritima</i> )                      | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                     |
| H1320  | Spartina swards ( <i>Spartinion maritimae</i> )  |                  |                          |                 |                     |                |                        | 1         | 1                     |
| H1330A | Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (tidal zone)                               | 1                | 1                        | 1               | 1                   |                |                        |           | 5                     |
| H1330B | Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (inland)                                   |                  | 1                        |                 |                     |                |                        | 1         | 2                     |
| H2110  | Embryonic shifting dunes   | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                     |
| H2120  | Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ('white dunes')                    |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                     |
| H2130A | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (calcerous)                            |                  | 1                        |                 |                     | 1              | 1                      |           | 3                     |
| H2130B | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (decalcified)                          |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                     |
| H2130C | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (heather)                              |                  | 1                        |                 | 1                   | 1              | 1                      |           | 4                     |
| H2140A | Decalcified fixed dunes with <i>Empetrum nigrum</i> (humid)  |                  | 1                        | 1               | 1                   | 1              |                        |           | 4                     |
| H2140B | Decalcified fixed dunes with <i>Empetrum nigrum</i> (dry)  |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                     |
| H2150  | Atlantic decalcified fixed dunes ( <i>Calluno-Ulicetea</i> )   |                  | 1                        | 1               | 1                   | 1              |                        |           | 4                     |
| H2160  | Dunes with <i>Hippophaë rhamnoides</i>   |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                     |
| H2170  | Dunes with <i>Salix repens ssp. argentea</i> ( <i>Salicion arenariae</i> )                           |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                     |
| H2180A | Wooded dunes of the Atlantic, Continental and Boreal region (dry)                                    |                  | 1                        | 1               | 1                   |                | 1                      |           | 4                     |
| H2180B | Wooded dunes of the Atlantic, Continental and Boreal region (humid)                                  |                  |                          |                 | 1                   | 1              | 1                      |           | 3                     |
| H2180C | Wooded dunes of the Atlantic, Continental and Boreal region (inside)                                 |                  |                          |                 |                     |                | 1                      |           | 1                     |
| H2190A | Humid dune slacks (open water)   |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                     |
| H2190B | Humid dune slacks (calcerous)  | 1                | 1                        | 1               | 1                   | 1              | 1                      | 1         | 7                     |
| H2190C | Humid dune slacks (decalcified)  |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                     |
| H2190D | Humid dune slacks (high marsh plants)  |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                     |
| H6230  | Species-rich <i>Nardus</i> grasslands,   |                  |                          |                 |                     | 1              | 1                      |           | 2                     |
| H6410  | <i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils ( <i>Molinion caeruleae</i> ) |                  |                          |                 |                     |                | 1                      |           | 1                     |
| H7210  | Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>          |                  | 1                        |                 |                     |                |                        |           | 1                     |
| total  |  | 7                | 20                       | 15              | 19                  | 14             | 15                     | 12        |                       |

Table 2.4 Overview of habitat species Appendix II in the assignments of the Wadden Sea islands.

|       |                            | Noordzeekustzone | Duinen & Lage Land Texel | Duinen Vlieland | Duinen Terschelling | Duinen Ameland | Duinen Schiermonnikoog | Waddenzee | aantal aanwijzingen |
|-------|----------------------------|------------------|--------------------------|-----------------|---------------------|----------------|------------------------|-----------|---------------------|
| H1014 | Narrow-mouthed whorl snail |                  |                          |                 |                     |                |                        | 1         | 1                   |
| H1095 | Sea Lamprey                | 1                |                          |                 |                     |                |                        | 1         | 2                   |
| H1099 | River Lamprey              | 1                |                          |                 |                     |                |                        | 1         | 2                   |
| H1103 | Fint                       | 1                |                          |                 |                     |                |                        | 1         | 2                   |
| H1340 | Tundra Vole                |                  | 1                        |                 |                     |                |                        |           | 1                   |
| H1351 | Porpoise                   | 1                |                          |                 |                     |                |                        |           | 1                   |
| H1364 | Grey Seal                  | 1                |                          |                 |                     |                |                        | 1         | 2                   |
| H1365 | Harbour Seal               | 1                |                          |                 |                     |                |                        | 1         | 2                   |
| H1831 | Floating Water-Plantain    |                  |                          |                 | 1                   |                |                        |           | 1                   |

Table 2.5 Overview of breeding bird species in the assignments of the Wadden Sea islands and their breeding habitats.

|      |                          |                    | Noordzeekustzone | Duinen & Lage Land Texel | Duinen Vlieland | Duinen Terschelling | Duinen Ameland | Duinen Schiermonnikoog | Waddenzee | aantal aanwijzingen | breeding site |
|------|--------------------------|--------------------|------------------|--------------------------|-----------------|---------------------|----------------|------------------------|-----------|---------------------|---------------|
| A004 | Little grebe             | Dodaars            |                  |                          |                 | 1                   |                |                        |           | 1                   | marsh         |
| A017 | Cormorant                | Aalscholver        |                  |                          | 1               |                     |                |                        |           | 1                   | ground, trees |
| A021 | Bittern                  | Roerdomp           |                  | 1                        |                 |                     | 1              | 1                      |           | 3                   | marsh         |
| A034 | Spoonbill                | Lepelaar           |                  | 1                        | 1               |                     |                |                        | 1         | 3                   | ground, shrub |
| A063 | Eider                    | Eider              |                  | 1                        | 1               |                     | 1              | 1                      | 1         | 5                   | ground        |
| A081 | Marsh Harrier            | Bruine Kiekendief  |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                   | ground        |
| A082 | Blue Harrier             | Blauwe Kiekendief  |                  | 1                        | 1               | 1                   | 1              | 1                      | 1         | 6                   | ground        |
| A119 | Crake                    | Porseleinhoen      |                  |                          | 1               |                     | 1              |                        |           | 2                   | marsh         |
| A132 | Oocet                    | Kluut              |                  | 1                        |                 |                     |                |                        | 1         | 2                   | ground        |
| A137 | Ringed Plover            | Bontbekplevier     | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                   | ground        |
| A138 | Sandplover               | Strandplevier      | 1                |                          |                 | 1                   |                |                        | 1         | 3                   | ground        |
| A183 | Lesser Black-backed Gull | Kleine Mantelmeeuw |                  | 1                        | 1               |                     |                |                        | 1         | 3                   | ground        |
| A191 | Sandwich Tern            | Grote stern        |                  |                          |                 |                     |                |                        | 1         | 1                   | ground        |
| A193 | Common tern              | Visdief            |                  |                          |                 |                     |                |                        | 1         | 1                   | ground        |
| A194 | Arctic Tern              | Noordse Stern      |                  |                          |                 |                     |                |                        | 1         | 1                   | ground        |
| A195 | Little Tern              | Dwergstern         | 1                | 1                        |                 | 1                   |                |                        | 1         | 4                   | ground        |
| A222 | Short-eared Owl          | Velduil            |                  | 1                        |                 | 1                   | 1              |                        | 1         | 5                   | ground        |
| A275 | Winchat                  | Paapje             |                  |                          |                 | 1                   |                | 1                      |           | 2                   | shrub         |
| A276 | Stonechat                | Roodborsttapuit    |                  | 1                        |                 |                     |                |                        |           | 1                   | shrub         |
| A277 | Wheatear                 | Tapuit             |                  | 1                        | 1               | 1                   | 1              | 1                      |           | 5                   | ground        |
| A295 | Sedge warbler            | Rietzanger         |                  |                          |                 | 1                   | 1              |                        |           | 2                   | marsh         |
| A338 | Red-backer Shrike        | Grauwe Klauwier    |                  |                          |                 |                     | 1              |                        |           | 1                   | shrub         |
|      |                          |                    | 3                | 12                       | 8               | 10                  | 9              | 7                      | 13        |                     |               |

Table 2.6 Overview of non-breeding bird species in the assignments of the Wadden Sea islands and their use of high tide roosts.

| EU-nr         | English                | Dutch               | Noordzeekustzone | Duinen & Lage Land Texel | Duinen Vlieland | Duinen Terschelling | Duinen Ameland | Duinen Schiermonnikoog | Waddenzee | aantal aanwijzingen | use of high tide roost |
|---------------|------------------------|---------------------|------------------|--------------------------|-----------------|---------------------|----------------|------------------------|-----------|---------------------|------------------------|
| A001          | Red-throated Loon      | Roodkeelduiker      | 1                |                          |                 |                     |                |                        |           | 1                   |                        |
| A002          | Black-throated Loon    | Parelduiker         | 1                |                          |                 |                     |                |                        |           | 1                   |                        |
| A005          | Crested Grebe          | Fuut                |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A017          | Cormorant              | Aalscholver         | 1                |                          | 1               |                     |                |                        | 1         | 3                   |                        |
| A034          | Spoonbill              | Lepelaar            |                  |                          | 1               |                     |                |                        | 1         | 2                   |                        |
| A037          | Bewick's Swan          | Kleine Zwaan        |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A039b         | Bean Goose             | Toendrarietgans     |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A043          | Greylag Goose          | Grauwe Gans         |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A045          | Barnacle Goose         | Brandgans           |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A046          | Brent Goose            | Rotgans             |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A048          | Shelduck               | Bergeend            | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A050          | Wigeon                 | Smient              |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A051          | Gadwall                | Krakeend            |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A052          | Teal                   | Wintertaling        |                  |                          |                 |                     |                |                        | 1         | 1                   | 1                      |
| A053          | Mallard                | Wilde eend          |                  |                          |                 |                     |                |                        | 1         | 1                   | 1                      |
| A054          | Pintail                | Pijlstaart          |                  |                          | 1               |                     |                |                        | 1         | 2                   | 1                      |
| A056          | Shoveler               | Slobeend            |                  |                          | 1               |                     |                |                        | 1         | 2                   |                        |
| A062          | Scaup                  | Toppereend          | 1                |                          |                 |                     |                |                        | 1         | 2                   |                        |
| A063          | Eider                  | Eider               | 1                |                          |                 |                     |                |                        | 1         | 2                   |                        |
| A065          | Scoter                 | Zwarte zee-eend     | 1                |                          |                 |                     |                |                        |           | 1                   |                        |
| A067          | Goldeneye              | Brilduiker          |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A069          | Red-Breasted Merganser | Middelste Zaagbek   |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A070          | Goosander              | Grote Zaagbek       |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A103          | Peregrine              | Slechtvalk          |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A130          | Oystercatcher          | Scholekster         | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A132          | Avocet                 | Kluut               | 1                |                          | 1               |                     |                |                        | 1         | 3                   | 1                      |
| A137          | Ringed Plover          | Bontbekplevier      | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A140          | Golden Plover          | Goudplevier         |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A141          | Grey Plover            | Zilverplevier       | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A142          | Lapwing                | Kievit              |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A143          | Knot                   | Kanoet              | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A144          | Sanderling             | Drieteenstrandloper | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A147          | Curlew Sadpiper        | Krombekstrandloper  |                  |                          |                 |                     |                |                        | 1         | 1                   | 1                      |
| A149          | Dunlin                 | Bonte strandloper   | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A156          | Godwit                 | Grutto              |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| A157          | Bar-tailed Godwit      | Rosse grutto        | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A160          | Curlew                 | Wulp                | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A161          | Spotted Redshank       | Zwarte ruiter       |                  |                          |                 |                     |                |                        | 1         | 1                   | 1                      |
| A162          | Redshank               | Tureluur            |                  |                          | 1               |                     |                |                        | 1         | 2                   | 1                      |
| A164          | Greenshank             | Groenpootruiter     |                  |                          |                 |                     |                |                        | 1         | 1                   | 1                      |
| A169          | Turnstone              | Steenloper          | 1                |                          |                 |                     |                |                        | 1         | 2                   | 1                      |
| A177          | Little Gull            | Dwergmeeuw          | 1                |                          |                 |                     |                |                        |           | 1                   |                        |
| A197          | Black Tern             | Zwarte Stern        |                  |                          |                 |                     |                |                        | 1         | 1                   |                        |
| total species |                        |                     | 18               | 0                        | 6               | 0                   | 0              | 0                      | 39        |                     | 18                     |





## 3 Results

### 3.1 The list of species

For in total 1.490 alien species we checked if they were notices on one or more Wadden Islands. This list contains species recorded in terrestrial habitats in the Netherlands in the period 2005-2014 one or more times and in one or more years. Of this list, 1.407 species are listed in the Netherlands Soortenregister and 704 species are included in the list of the Werkgroep Exoten. The list of Werkgroep Exoten is strong in aquatic species, but weak in terrestrial species like plants, insect and birds. The Werkgroep Exoten just mentions 83 terrestrial alien species.

### 3.2 Number of species

Among the 1.490 alien species under consideration approximately 300 of them were found on one or more Wadden Islands in the period 2005 - 2014. The largest group consist the plants, followed by *Crustacea*.

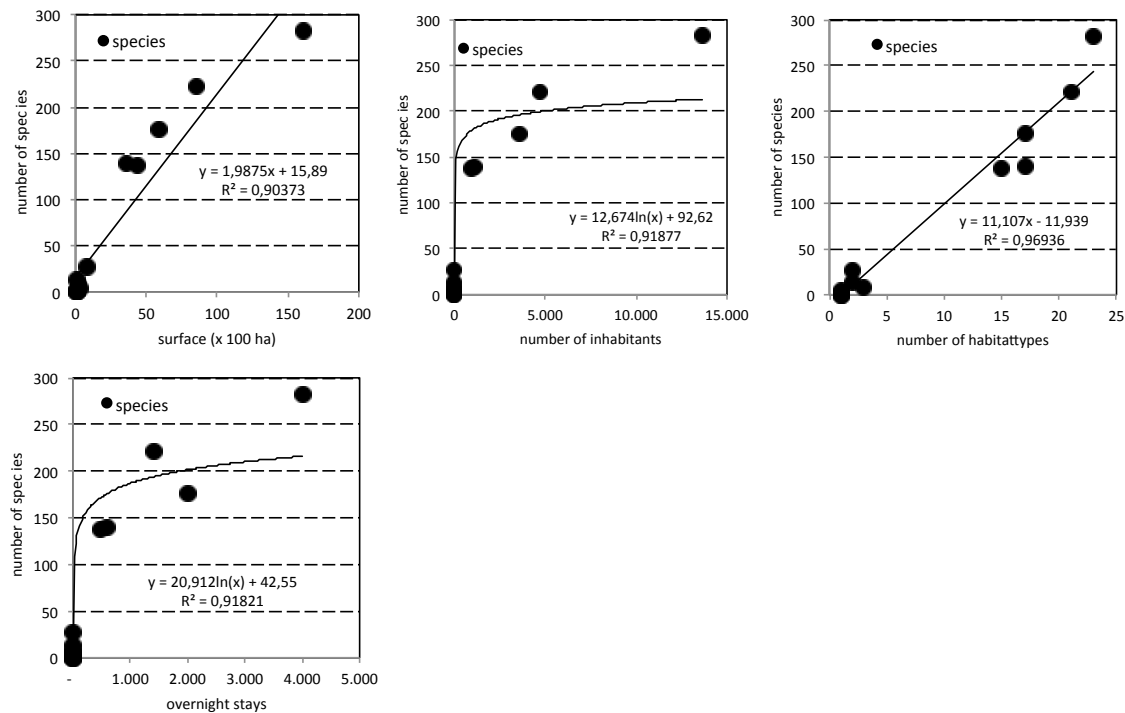
Of the five major islands most alien species are found on the largest island of Texel and fewest on the smallest island of Schiermonnikoog. The number of species on the uninhabited islands and sandbanks is far less.

The number of alien species shows a clear relation with the surface area (ha) of an island, the number of inhabitants and the number of habitat types in the Natura 2000 assignment of the dune area of an island (figure 3.1). Those three elements are highly correlated with each other. Further analyses will be made elsewhere.

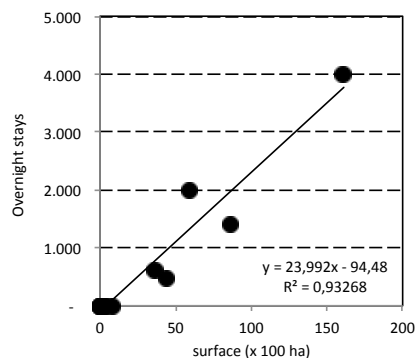
By the Netherlands Soortenregister four categories are in use for alien species:

- >100 years of settlement;
- 10-100 years of settlement;
- <10 years settlement;
- accidental observations, no reproduction (i.c. no settlement).

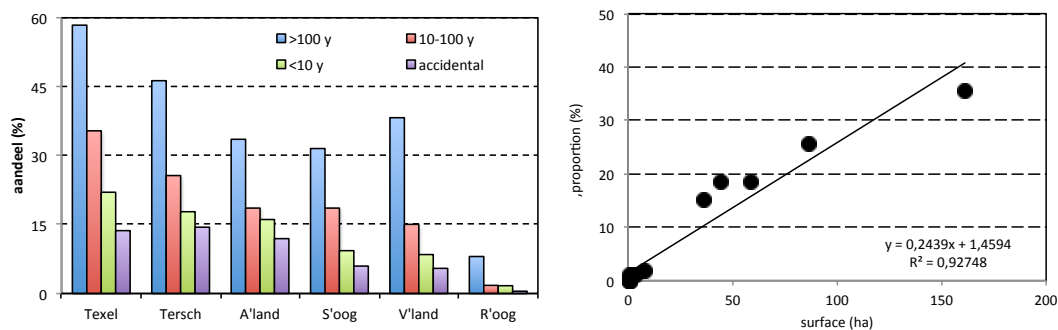
The total number of species in the Netherlands in each category is taken as a reference. In the first category a higher proportion of species is also found on the Wadden Sea islands. The longer alien species are settled in the Netherlands, the larger the proportion of the Dutch list that is also found on the Wadden Sea islands. Furthermore, the smaller the island, the lower the proportion of species on an island in each of the four categories. The latter maybe due to less variation in habitat types or less inhabitants and tourists (figure 3.1).



**Figuur 3.1** Relation between some characteristics of the islands and the number of alien species found on the Wadden Sea islands in the period 2005-2014.



**Figuur 3.2** Relation between the surface of the islands and the number of overnight stays on the Wadden Sea islands in the period 2005-2014.



**Figuur 3.3** Number of alien species (proportion of national total) in each of the four categories (see text) on the six largest Wadden Sea islands (left) and relationship between the number of alien species in category 2b (proportion of national total) and the surface of islands.

### 3.3 Species of risk

Table 3.2 Alien species found on Dutch Wadden Sea islands in the period 2005-2014 with an ISEIA-score of 9, 10, 11 or 12 points.

|  |                           | spread | natural habitats | species | change in habitats | total score | confidence |
|--|---------------------------|--------|------------------|---------|--------------------|-------------|------------|
| <i>Aronia prunifolia</i>               | Appelbes                  | 3      | 2                | 2       | 2                  | 9           | 2          |
| <i>Impatiens glandulifera</i>          | Reuzenbalsemien           | 3      | 2                | 2       | 2                  | 9           | 3          |
| <i>Landoltia punctata</i>              | Smal kroos                | 3      | 2                | 2       | 2                  | 9           | 3          |
| <i>Ludwigia grandiflora</i>            | Grote waterteunisbloem    | 2      | 2                | 2       | 3                  | 9           | 2          |
| <i>Ludwigia peploides</i>              | Kleine waterteunisbloem   | 2      | 1                | 3       | 3                  | 9           | 2          |
| <i>Mephitis mephitis</i>               | Gestreept stinkdier       | 2      | 2                | 3       | 2                  | 9           | 1          |
| <i>Myriophyllum aquaticum</i>          | Parelvederkruid           | 2      | 2                | 2       | 3                  | 9           | 2          |
| <i>Myriophyllum heterophyllum</i>      | Ongelijkbladig vederkruid | 2      | 2                | 2       | 3                  | 9           | 2          |
| <i>Populus x canescens</i>             | Grauwe abeel              | 3      | 2                | 2       | 2                  | 9           | 3          |
| <i>Quercus rubra</i>                   | Amerikaanse eik           | 3      | 2                | 2       | 2                  | 9           | 3          |
| <i>Solidago gigantea</i>               | Late guldenroede          | 3      | 2                | 2       | 2                  | 9           | 2          |
| <i>Alopochen aegyptiaca</i>            | Nijlgans                  | 3      | 3                | 2       | 2                  | 10          | 3          |
| <i>Branta canadensis</i>               | Grote Canadese gans       | 3      | 3                | 2       | 2                  | 10          | 3          |
| <i>Branta hutchinsii</i>               | Kleine Canadese gans      | 3      | 3                | 2       | 2                  | 10          | 3          |
| <i>Cabomba caroliniana</i>             | Waterwaaier               | 2      | 2                | 3       | 3                  | 10          | 2          |
| <i>Corvus splendens</i>                | Huiskraai                 | 3      | 3                | 2       | 2                  | 10          | 3          |
| <i>Elodea nuttallii</i>                | Smalle waterpest          | 2      | 2                | 3       | 3                  | 10          | 3          |
| <i>Fallopia japonica</i>               | Japanse duizendknoop      | 2      | 2                | 3       | 3                  | 10          | 3          |
| <i>Fallopia sachalinensis</i>          | Sachalinse duizendknoop   | 2      | 2                | 3       | 3                  | 10          | 3          |
| <i>Fallopia x bohemica</i>             | Bastaardduizendknoop      | 2      | 2                | 3       | 3                  | 10          | 3          |
| <i>Felis catus</i>                     | Huiskat                   | 3      | 2                | 3       | 2                  | 10          | 3          |
| <i>Hydrocotyle ranunculoides</i>       | Grote waternavel          | 2      | 2                | 3       | 3                  | 10          | 2          |
| <i>Leiothrix lutea</i>                 | Japanse nachtegaal        | 3      | 3                | 2       | 2                  | 10          | 2          |
| <i>Neovison vison</i>                  | Amerikaanse nerts         | 3      | 2                | 3       | 2                  | 10          | 2          |
| <i>Oenothera parviflora</i>            | Kleine teunisbloem        | 3      | 3                | 2       | 2                  | 10          | 2          |
| <i>Oxyura jamaicensis</i>              | Rosse stekelstaart        | 3      | 3                | 2       | 2                  | 10          | 3          |
| <i>Populus _canescens</i>              | Grauwe abeel              | 3      | 2                | 3       | 2                  | 10          | 3          |
| <i>Populus alba</i>                    | Witte abeel               | 3      | 2                | 3       | 2                  | 10          | 3          |
| <i>Procyon lotor</i>                   | Wasbeer                   | 2      | 2                | 3       | 3                  | 10          | 2          |
| <i>Threskiornis aethiopicus</i>        | Heilige ibis              | 3      | 3                | 3       | 1                  | 10          | 3          |
| <i>Vaccinium corymbosum</i>            | Trosbosbes                | 2      | 2                | 3       | 3                  | 10          | 2          |
| <i>Dreissena polymorpha</i>            | (Gewone) Driehoeksmossel  | 3      | 3                | 3       | 2                  | 11          | 3          |
| <i>Dreissena rostriformis bugensis</i> | Quaggamossel              | 3      | 3                | 3       | 2                  | 11          | 3          |
| <i>Lepomis gibbosus</i>                | Zonnebaars                | 3      | 3                | 3       | 2                  | 11          | 2          |
| <i>Nyctereutes procyonoides</i>        | Wasbeerhond               | 3      | 2                | 3       | 3                  | 11          | 2          |
| <i>Rana catesbeiana</i>                | Amerikaanse brulkikker    | 3      | 3                | 3       | 2                  | 11          | 3          |
| <i>Rosa rugosa</i>                     | Rimpelroos                | 3      | 2                | 3       | 3                  | 11          | 3          |
| <i>Acer pseudoplatanus</i>             | Gewone esdoorn            | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Azolla filiculoides</i>             | Grote kroosvaren          | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Baccharis halimifolia</i>           | Struikaster               | 3      | 3                | 3       | 3                  | 12          | 1          |
| <i>Campylopus introflexus</i>          | Grijs kronkelsteeltje     | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Cotula coronopifolia</i>            | Goudknopje                | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Crassula helmsii</i>                | Watercrassula             | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Cyprinus carpio</i>                 | Karper                    | 3      | 3                | 3       | 3                  | 12          | 2          |
| <i>Prunus serotina</i>                 | Amerikaanse vogelkers     | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Spartina anglica</i>                | Engels slijkgras          | 3      | 3                | 3       | 3                  | 12          | 3          |
| <i>Vaccinium macrocarpon</i>           | Cranberry                 | 3      | 3                | 3       | 3                  | 12          | 3          |

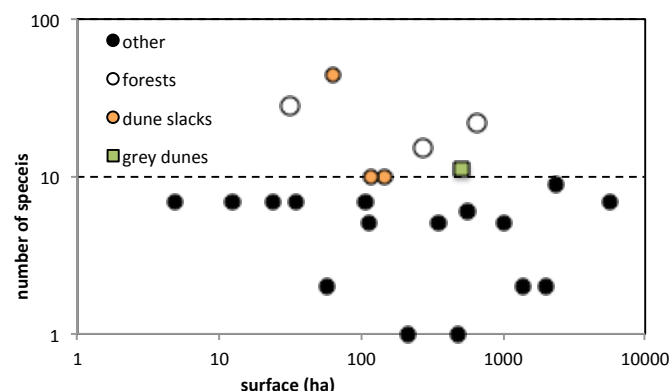
About a 110 species are considered for the ISEIA protocol. Using this simple, but strong protocol results in 47 species with a score of 9 - 12 points (table 3.2). Among them 16 species are on the 'black list' (11-12 points) and 31 species on the 'watch list' (9-10 points). Most of them belong to the group of the higher or vascular plants.

### 3.4 Habitats at risk

The grey dunes, the wooded dunes and the dune slacks have a high number of alien species and this number is relative high as well compared to the total surface (table 3.3. figure 3.4).

**Table 3.3** *Habitat types and the number of alien species (with an ISEIA-score) in each habitat on Dutch Wadden Sea islands in 2005-2014 as well as the surface of the habitat types.*

| code   | type   | animals<br>n | plants<br>n | total<br>n | surface<br>ha |
|--------|--|--------------|-------------|------------|---------------|
| H1110A | Sandbanks which are slightly covered by sea water all the time (tidal zone)                          | 0            | 0           | 0          | ?             |
| H1110B | Sandbanks which are slightly covered by sea water all the time (North Sea)                           |              |             |            | ?             |
| H1140A | Mudflats and sandflats not covered by seawater at low tide (tidal zone)                              | 0            | 1           | 1          | ?             |
| H1140B | Mudflats and sandflats not covered by seawater at low tide (North Sea)                               |              |             |            | ?             |
| H1310A | Salicornia and other annuals colonizing mud and sand ( <i>Salicornia</i> )                           | 0            | 2           | 2          | 2.008         |
| H1310B | Salicornia and other annuals colonizing mud and sand ( <i>Sagina maritima</i> )                      | 0            | 2           | 2          | 57            |
| H1320  | Spartina swards ( <i>Spartinion maritimae</i> )  | 0            | 1           | 1          | 476           |
| H1330A | Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (tidal zone)                               | 6            | 1           | 7          | 5.573         |
| H1330B | Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (inland)                                   | 6            | 1           | 7          | 24            |
| H2110  | Embryonic shifting dunes   | 0            | 1           | 1          | 212           |
| H2120  | Shifting dunes along the shoreline with Ammophila arenaria ('white dunes')                           | 0            | 2           | 2          | 1.396         |
| H2130A | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (calcerous)                            | 2            | 9           | 11         | 507           |
| H2130B | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (decalcified)                          | 2            | 7           | 9          | 2.376         |
| H2130C | Fixed coastal dunes with herbaceous vegetation ("grey dunes") (heather)                              | 2            | 5           | 7          | 35            |
| H2140A | Decalcified fixed dunes with Empetrum nigrum (humid)   | 2            | 5           | 7          | 106           |
| H2140B | Decalcified fixed dunes with Empetrum nigrum (dry)   | 2            | 3           | 5          | 1.003         |
| H2150  | Atlantic decalcified fixed dunes ( <i>Calluno-Ulicetea</i> )   | 2            | 3           | 5          | 113           |
| H2160  | Dunes with <i>Hippophaë rhamnoides</i>   | 0            | 6           | 6          | 550           |
| H2170  | Dunes with <i>Salix repens ssp. argentea</i> ( <i>Salicion arenariae</i> )                           | 2            | 3           | 5          | 354           |
| H2180A | Wooded dunes of the Atlantic, Continental and Boreal region (dry)                                    | 6            | 16          | 22         | 643           |
| H2180B | Wooded dunes of the Atlantic, Continental and Boreal region (humid)                                  | 7            | 8           | 15         | 272           |
| H2180C | Wooded dunes of the Atlantic, Continental and Boreal region (inside)                                 | 9            | 19          | 28         | 31            |
| H2190A | Humid dune slacks (open water)   | 30           | 14          | 44         | 63            |
| H2190B | Humid dune slacks (calcerous)  | 5            | 5           | 10         | 145           |
| H2190C | Humid dune slacks (decalcified)  | 5            | 5           | 10         | 117           |
| H2190D | Humid dune slacks (high marsh plants)  | 29           | 8           | 37         | 1             |
| H6230  | Species-rich <i>Nardus</i> grasslands,   | 7            | 0           | 7          | 12            |
| H6410  | <i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils ( <i>Molinion caeruleae</i> ) | 7            | 0           | 7          | 5             |
| H7210  | Calcareous fens with <i>Cladium mariscus</i> and species of the <i>Caricion davallianae</i>          | 1            | 0           | 1          | 1             |
|        | ground breeding, birds   | 9            |             | 9          |               |
|        | bush breeding, birds   | 1            |             | 1          |               |
|        | crown breeding, birds  | 3            |             | 3          |               |
|        | cavity breeding, birds   | 3            |             | 3          |               |



Figuur 3.4 Relation between the total surface areas of habitat types on the Wadden Islands and the number of alien species that occur in these types.

### 3.5 To keep in control: management of invasive alien species

In 2010, a code of conduct of alien water plants was signed between the government and companies selling water plants (e.g., garden centres). In this voluntary agreement parties declared to stop selling 6 species of water plants (Annex 1). These species were popular items for a pond or an aquarium, but were also pest plants in Dutch water bodies. The other 7 species on the code of conduct are still sold, but with a warning on the packing (Annex 2). Of the Annex 1 species three are found on the Wadden Islands and of the Annex 2 also three species (table 3.4).

Table 3.4 Species listed in the Agreement on water plants (Convenant Waterplanten Staatscourant 11341, 21 juli 2010). In yellow = species not sold anymore (Annex I species); within short time *Cabomba* will be placed on Annex I instead of Annex II.

| species                           | Dutch                     | Texel | Vlieland | Terschelling | Ameland | Sch'oog |
|-----------------------------------|---------------------------|-------|----------|--------------|---------|---------|
| <i>Azolla filiculoides</i>        | Grote kroosvaren          | 5     | 0        | 2            | 0       | 0       |
| <i>Crassula helmsii</i>           | Watercrassula             | 0     | 0        | 1            | 1       | 0       |
| <i>Hydrocotyle ranunculoides</i>  | Grote waternavel          | 0     | 0        | 0            | 1       | 0       |
| <i>Egeria densa</i>               | Egeria                    | 0     | 0        | 1            | 0       | 0       |
| <i>Ludwigia grandiflora</i>       | Grote waterteunisbloem    | 0     | 0        | 0            | 0       | 0       |
| <i>Myriophyllum aquaticum</i>     | Parelvederkruid           | 1     | 0        | 0            | 0       | 1       |
| <i>Myriophyllum heterophyllum</i> | Ongelijkbladig vederkruid | 0     | 0        | 0            | 0       | 0       |
| <i>Pistia stratiotes</i>          | Watersla                  | 0     | 0        | 1            | 0       | 0       |
| <i>Salvinia molesta</i>           | Grote vlotvaren           | 0     | 0        | 0            | 0       | 0       |
| <i>Hydrilla verticillata</i>      | Hydrilla                  | 0     | 0        | 0            | 0       | 0       |
| <i>Eichhornia crassipes</i>       | Waterhyacinth             | 0     | 0        | 0            | 0       | 0       |
| <i>Ludwigia peploides</i>         | Kleine waterteunisbloem   | 0     | 0        | 0            | 0       | 0       |
| <i>Cabomba caroliniana</i>        | Waterwaaier               | 0     | 0        | 0            | 0       | 0       |

### 3.6 Native aliens among mammals

The mammalian fauna of the Wadden islands differs from the fauna of main land. Many mammals never have reached the islands and are lacking since those islands exists. In last decades some of the native species have been released on the islands; for example red deer on Terschelling in 2008 and red fox on Vlieland in 2009. Both have been eliminated shortly after introduction, mainly because they did not occur on the islands naturally and they had an unknown impact on flora and fauna on the Wadden Islands.

**Table 3.5** *Mammals on the Wadden Islands (after [www.telmee.nl](http://www.telmee.nl)). Some of them do not occur naturally on the islands but do so after introduction. Some of the mammal species are non-native.*

|                           |                          | Texel | Vlie | Ters | Amel | S'oog | Roto | Rotp | Griend | intrduced | alien |
|---------------------------|--------------------------|-------|------|------|------|-------|------|------|--------|-----------|-------|
|                           |                          |       |      |      |      |       |      |      |        |           | risk  |
| egel                      | Erinaceus europaeus      | 10    | 2    | 6    | 4    | 4     | 0    | 0    | 0      |           |       |
| gewone bosspitsmuis       | Sorex araneus            | 0     | 0    | 4    | 0    | 0     | 0    | 0    | 0      |           |       |
| tweekleurige bosspitsmuis | Sorex coronatus)         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| dwergpspitsmuis           | Sorex minutus            | 0     | 0    | 6    | 2    | 0     | 0    | 0    | 0      |           |       |
| waterspitsmuis            | Neomys fodiens           | 8     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| veldspitsmuis             | Crocidura leucodon       | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| huisspitsmuis             | Crocidura russula        | 9     | 0    | 0    | 4    | 3     | 0    | 0    | 0      |           |       |
| mol                       | Talpa europaea           | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| vos                       | Vulpes vulpes            | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| wasbeer                   | Procyon lotor            | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           | x     |
| hermelijn                 | Mustela erminea          | 3     | 0    | 0    | 0    | 0     | 0    | 0    | 0      | x         |       |
| wezel                     | Mustela nivalis          | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| bunzing                   | Mustela putorius         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| Amerikaanse nerts         | Neovison vison           | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           | x     |
| steenmarter               | Martes foina             | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| boommarter                | Martes martes            | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| das                       | Meles meles              | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| otter                     | Lutra lutra              | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| gewone zeehond            | Phoca vitulina           | 3     | 3    | 3    | 3    | 3     | 3    | 3    | 3      |           |       |
| grijze zeehond            | Halichoerus grypus       | 1     | 1    | 1    | 1    | 1     | 1    | 1    | 1      |           |       |
| wild zwijn                | Sus scrofa               | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| damhert                   | Dama dama                | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| edelhert                  | Cervus elaphus           | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| ree                       | Capreolus capreolus      | 0     | 0    | 0    | 8    | 5     | 0    | 0    | 0      |           |       |
| moeflon                   | Ovis ammon               | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           | x     |
| eekhoorn                  | Sciurus vulgaris         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| siberische grondeekhoorn  | Tamias sibiricus         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           | x     |
| bever                     | Castor fiber             | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| hamster                   | Cricetus cricetus        | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| rosse woelmuis            | Myodes glareolus         | 9     | 0    | 6    | 0    | 0     | 0    | 0    | 0      |           |       |
| woelrat                   | Arvicola amphibius       | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| muskusrat                 | Ondatra zibethicus       | 0     | 0    | 3    | 0    | 3     | 0    | 0    | 0      |           | x     |
| ondergrondse woelmuis     | Myodes glareolus         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| aardmuis                  | Microtus agrestis        | 7     | 0    | 0    | 4    | 0     | 0    | 0    | 0      |           |       |
| veldmuis                  | Microtus arvalis         | 1     | 0    | 0    | 5    | 2     | 0    | 0    | 0      | x         |       |
| noordse woelmuis          | Microtus oeconomus       | 12    | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| dwergmuis                 | Micromys minutus         | 12    | 1    | 6    | 0    | 1     | 0    | 0    | 0      |           |       |
| grote bosmuis             | Apodemus flavicollis     | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| bosmuis                   | Apodemus sylvaticus      | 14    | 3    | 9    | 4    | 3     | 0    | 0    | 0      |           |       |
| bruine rat                | Rattus norvegicus        | 8     | 3    | 2    | 3    | 2     | 0    | 0    | 0      | x         |       |
| zwarte rat                | Rattus rattus            | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| huismuis                  | Mus musculus             | 8     | 0    | 5    | 2    | 0     | 0    | 0    | 0      |           |       |
| hazelmuis                 | Muscardinus avellanarius | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| eikelmuis                 | Eliomys quercinus        | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           |       |
| beverrat                  | Myocastor coypus         | 0     | 0    | 0    | 0    | 0     | 0    | 0    | 0      |           | x     |
| haas                      | Lepus europaeus          | 11    | 3    | 10   | 6    | 6     | 0    | 0    | 0      |           |       |
| konijn                    | Oryctolagus cuniculus    | 11    | 4    | 8    | 6    | 6     | 1    | 0    | 0      |           |       |
| species/island            |                          | 16    | 8    | 13   | 13   | 12    | 3    | 2    | 2      |           |       |

Especially predators like fox are a big threat to ground breeding birds. Table 3.5 gives an overview of terrestrial mammals that occur in The Netherlands (native and non-native). Some of those species do not occur naturally on the islands. After settlement they could be a major threat to especially ground breeding birds.





## 4 Risk analyses

In this study 47 alien species fall in the category black list or watch list according to the ISEIA-protocol. Among those, 29 species are a current threat for nature on the Wadden Islands, mainly because they do occur on one or more islands. For 18 species it is a potential threat, mainly because those species are not present on the islands at this very moment.

In the following for each of these 47 species a short risk analysis is presented. This analyses points towards the major (potential) threats. Species occur in alphabetical order. A lot of facts about these species come from Wikipedia; most of the judgement on risks is the expertise of the authors. In the mean-time a lot of species are a risk for native flora and fauna elsewhere on the world, and facts about effects are known mentioned in Wikipedia (with references).

### 4.1 **Acer pseudoplatanus**    *gewone esdoorn*

|         |   |
|---------|---|
| Sources | Wikipedia-NL, Wikipedia-UK,   |
| Origin  | <i>Acer pseudoplatanus</i> , the sycamore or sycamore maple, is a species of maple native to Central Europe and Southwestern Asia, from France eastwards to Ukraine, and south in mountains to northern Spain, northern Turkey and the Caucasus, but cultivated and naturalized elsewhere, e.g. Western Europe.   |
| Habitus | The sycamore maple is a large deciduous tree that reaches 20–35 m tall at maturity, with a broad, domed crown. The monoecious yellow-green flowers are produced in spring on 10–20 cm pendulous racemes, with 20–50 flowers on each stalk. The 5–10 mm diameter seeds are paired in samaras, each seed with a 20–40 mm long wing, which catches the wind and rotates when they fall; this helps them to spread further from the parent tree. The seeds are mature in autumn about 6 months after pollination.   |
| Alien   | It is noted for its tolerance of wind, urban pollution, salt spray, and low summer temperatures, which makes it a popular tree for planting in cities, along roads treated with salt in winter, and in coastal localities. It is cultivated and widely naturalised north of its native range in Northern Europe, notably in the British Isles and Scandinavia north to Tromsø, Norway (seeds can ripen as far north as Vesterålen); Reykjavík, Iceland; and Tórshavn on the Faroe Islands. It now occurs throughout the Netherlands, and elsewhere in Western Europe. |
| Wadden  | Due to its salt tolerance, this tree grows on many sites in de coastal forests on the Wadden Islands.   |

Table 4.1 Number squares (5x5 km) with *Acer pseudoplatanus* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1560 | 11    | 4    | 5    | 4    | 3     | 2       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.2 The ISEIA score for *Acer pseudoplatanus*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|             |   |
|-------------|---|
| Pathway(s)  | Once introduced in an area, it can easily spread by its seed.   |
| Natura 2000 | It can outcompete native species in bushes (H2160) and the drier parts of the dune forests (H2180). The species has some tolerance towards shadow, so it can form a closed understory in the forest.  |
| Risk        | The sycamore is a threat to native dune forests by outcompeting species in the tree layer, in the under store and reducing forest vegetation due to shortage in light (shadow). The species itself is shadow tolerant, so young trees develop under their parents and compete many other species. |
| Management  | Trees can be cut, often regrowth from the remaining trunk.  |
| Conclusion  | Since the species can dominate the scene, it can be a threat to native ecosystems. Note: two other species of <i>Acer</i> also occur ( <i>A. campestre</i> and <i>A. platanoides</i> ) and cause similar problems to a somewhat lesser extend.  |

## 4.2 *Alopochen aegyptiaca nijlgans*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL, Gyimesi & Lensink 2010.   |
| Origin  | The Egyptian goose <i>Alopochen aegyptiacus</i> is a member of the family of the <i>Anatidae</i> (ducks, geese and swans). It is native to Africa south of the Sahara and the Nile Valley. Egyptian geese were considered sacred by the Ancient Egyptians, and appeared in much of their artwork. They have been raised for food and extensively bred in parts of Africa since the ancient Egyptians domesticated them. |
| Habitus | The Egyptian goose is believed to be most closely related to the shelducks (genus <i>Tadorna</i> ) and their relatives, and is placed with them in the subfamily <i>Tadorninae</i> . It is the only extant member of the genus  |

*Alopochen*, which also contains closely related prehistoric and recently extinct species. mtDNA cytochrome b sequence data suggest that the relationships of *Alopochen* to *Tadorna* need further investigation.

This species breeds widely in Africa except in deserts and dense forests, and is locally abundant. While not breeding, it disperses somewhat, sometimes making longer migrations northwards into arid regions of the Sahel. The same behaviour is noted in Europe. The species is breeding in many habitats, but always with water nearby for safety.

This is a largely terrestrial species, which will also perch readily on trees and buildings. Egyptian geese typically eat seeds, leaves, grasses, and plant stems. Occasionally, they will eat locusts, worms, or other small animals. The female builds the nest in old nests and cavities in trees and uses reeds, leaves and grass for construction. Both parents take turns incubating eggs. Egyptian geese usually pair for life. Both the male and female care for the offspring until they are old enough to care for themselves.

**Alien** Because of their popularity chiefly as ornamental bird, escapes are common and feral populations have become established in the UK, Western Europe and southeast USA.

**Wadden** The species is breeding on all five main islands in small numbers. Breeding populations are also present on the adjacent mainland. Outside the breeding season flocks of hundreds of birds are found occasionally.

Table 4.3 Number squares (5x5 km) with *Alopochen aegyptiaca* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1250 | 12    | 3    | 8    | 4    | 2     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

**Pathway(s)** In the Netherlands it is kept in captivity and traded occasionally. It is not popular for collections because of its aggressive behaviour. Release and escape are the main source of introductions in addition to secondary dispersal. Nowadays, the Egyptian goose is abundant from northern France to Denmark.

**Natura 2000** Egyptian goose breeds in the dunes and salt marshes. Feeding occurs more on agricultural grassland than on salt marshes or dune grassland.

**Risk** Both sexes are aggressive and territorial towards their own species when breeding and frequently pursue intruders into the air, attacking them in aerial "dogfights". Neighbouring pairs may even kill another's offspring for their own offspring's survival as well as for more resources. This species will nest in a large variety of situations, especially in holes in mature trees in parkland. It will compete with other species for

nesting sites and is able to chase them from their nests (e.g., birds of prey). In the Netherlands it is part of the herbivore community on grasslands.

Table 4.4 The ISEIA score for *Alopochen aegyptiaca*; see Appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| Sum of scores                              | 10    |
| Certainty                                  | 3     |

**Management** Hunting is the most effective to reduce numbers. There is a short period in which birds cannot fly due to the simultaneous moult of flight feathers. However, they cannot be hoarded during this period as is usually done in geese. Therefore, it is difficult to catch the birds during the moulting period.

**Conclusion** Egyptian goose competes with native species for food (grassland) and nest sites, but large effects have yet not been observed in Western Europe.

#### 4.3 *Aronia prunifolia* *appelbes*

**Sources** Wikipedia-NL, Wikipedia-UK

**Origin** *Aronia prunifolia*, called the purple chokeberry, is a North American species of shrub in the rose family. It is native to eastern Canada and to the eastern and central United States, from Nova Scotia west to Ontario and Wisconsin, south as far as western South Carolina with an isolated population reported in southern Alabama. Apparently originated as a hybrid of the black and red chokeberries but might be more accurately considered a distinct species than a hybrid. This sort of thing is not unusual; many species of plants originated as hybrids.

**Habitus** *Aronia prunifolia* is a branching shrub forming clumps by means of stems forming from the roots. Flowers are white or pink, producing purple fruits. *Aronia prunifolia* is a deciduous Shrub growing to 3 m (9ft) by 2.5 m. It is in flower from July to August, and the seeds ripen from October to December. The flowers are hermaphrodite (have both male and female organs) and are pollinated by Insects.

Grows on light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland) or no shade. It prefers dry or moist soil.

|        |   |
|--------|---|
| Alien  | <p>This species is used as a garden plant. Furthermore hybrids with <i>Sorbus</i> are used for fruit growing, also in the Netherlands and in the Wadden islands.</p> <p>Many people consider the fruits to be foul-tasting. Fruits are dried (like raisins) and used in juice. Fruits has high values in flavonoïden, vitamines C and K. It is used as an natural alternative for the red colour in food by the artificial Ponceau 4R (E124).</p> |
| Wadden | Species recorded on the three most westerly islands. Here also recorded in wet dune slacks.   |

Table 4.5 Number squares (5x5 km) with *Aronia prunifolia* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 240 | 4     | 2    | 3    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | Introduced as a garden species, as well as for fruit growing purposes. Seeds are eaten and transported by birds (thrushes, starling).   |
| Natura 2000 | <i>Aronia</i> is growing on wet places in peatlands (Nieuwkoop, Wieden) and dune slacks (H2190C), dune heather (H2140A) and wet dune forest (H2180B) It can dominate the vegetation by forming dense shrubs. Dense shrubs can be used as a nesting site by a Natura 2000 species Purple Heron (Nieuwkoop), probably spoonbill in the future?. |
| Risk        | When growing in dense shrubs, native species will disappear form the site.  |

Table 4.6 The ISEIA score for *Aronia prunifolia* ; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

|            |   |
|------------|---|
| Management | Removing plants with roots by digging seems to be the only way to eliminate them.               |
| Conclusion | Occurs on specific sites, so the problem can be recognized and solved. A threat to Nature 2000. |

#### 4.4 *Azolla filiculoides* grote kroosvaren

|         |                             |
|---------|-----------------------------|
| Sources | Wikipedia-NL, Wikipedia-UK, |
|---------|-----------------------------|

|         |   |
|---------|---|
| Origin  | Water Fern <i>Azolla filiculoides</i> is a species of <i>Azolla</i> , native to subtropical and tropical regions of the Americas as well as most of the Old World including Europe, Asia and Australia.   |
| Habitus | It is a floating aquatic fern, with very fast growth, capable of spreading over lake surfaces to give complete coverage of the water in only a few months. Each individual plant is 1-2 cm across, green tinged pink, orange or red at the edges, branching freely, and breaking into smaller sections as it grows. It is not tolerant of cold temperatures, and in temperate regions it largely dies back in winter, surviving by means of submerged buds. Like other species of <i>Azolla</i> , it can fix nitrogen from the air. <i>Azolla</i> prefers eutrophic waters. |
| Alien   | The species has been introduced to many regions of the Old World, grown for its nitrogen-fixing ability which can be utilized to enhance the growth rate of crops grown in water like rice, or by removal from lakes for use as green manure. It has become naturalized, sometimes also an invasive species, in several regions, including western Europe.  |
| Wadden  | <i>Azolla</i> occurs on two Wadden islands.   |

Table 4.7 Number squares (5x5 km) with *Azolla filiculoides* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 751 | 5     | 0    | 2    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.8 The ISEIA score for *Azolla filiculoides*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Pathway(s)  | If present in an area, it spreads by natural vectors (birds, fish, mammals), or human vectors (boats). A small fragment is enough to colonize new sites.   |
| Natura 2000 | On Texel and Terschelling <i>Azolla</i> grows in dune waters (H2190A, H2190D).   |
| Risk        | The fairy fern or floating water fern forms thick mats on the water surface and which can double in size in a few days, blocking out light and killing aquatic flora and fish. Fragmentation of the fronds makes control by mechanical means virtually impossible. This is compounded by the annual production of millions of tiny spores, which are released in autumn and grow into new plants the following year. |

Management In the UK recently a project involves researching and testing the use of a 2mm-long North American weevil *Stenopelmus rufinus* as an agent to control the weed naturally. First results are positive.

Conclusion Species is a threat to Nature 2000.

#### 4.5 *Baccharis halimifolia* *struikaster*

Sources Wikipedia-NL, Wikipedia-UK, VLIZ Alien Species Consortium (2011).

Origin *Baccharis halimifolia* is a North American species of shrubs in the daisy family. It is native to Nova Scotia, the eastern and southern United States eastern Mexico, the Bahamas, and Cuba. In most of its range, where no other species of the genus occur, this plant is often simply called *Baccharis*. Distribution northward limited by severe winter frost.

Habitus *Baccharis halimifolia* is a fall-flowering shrub growing to about 4 m high and comparably wide, or occasionally a small tree. Its simple, alternate, thick, egg-shaped to rhombic leaves mostly have coarse teeth, with the uppermost leaves entire. These fall-flowering *Baccharis* plants are dioecious, with male and female flowers on separate individuals. Their flowers are borne in numerous small, compact heads in large leafy terminal inflorescences, with the snowy-white, cotton-like female flower-heads showy and conspicuous at a distance.

*Baccharis halimifolia*, usually found in wetlands, is unusually salt-tolerant, and often found along salty or brackish shores of marshes and estuaries, and the inland shores of coastal barrier islands. In Florida, it is also found along ditches, in old fields, and in other disturbed areas. Other habitats in the northeastern United States include freshwater tidal marshes and open woods and thickets along the seacoast.

Table 4.9 Number squares (5x5 km) with *Baccharis halimifolia* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 2  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.10 The ISEIA score for *Baccharis halimifolia* ; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 1     |



|             |   |
|-------------|---|
| Alien       | In Australia, <i>B. halimifolia</i> is an invasive species along the coast of southern Queensland and New South Wales. As biological control the rust fungus <i>Puccinia evadens</i> is used. The species has also become naturalized in Europe and in New Zealand. <i>Baccharis halimifolia</i> is occasionally cultivated, useful as a hedge or border as well as a specimen plant. |
| Wadden      | Species does not occur on the Wadden Islands. Probably not to be expected due to severe frost in some winters; time will learn.   |
| Pathway(s)  | This species is used in gardens. In France the species is cultivated for its flowers, as wind-screen and along roads. It produces a huge amount of light seed, which is transported by wind or water. Slight tolerant to frost.   |
| Natura 2000 | In the Netherlands the species is found in Zeeland (Kwade Hoek) and Wieringen. Further, invasive, spread from the south is expected; but might be limited in the north due to (sometimes) severe frost in winter. Due to salt and wind tolerance this species is to be expected in the outer dunes ridges (H2110, H2120, H2130).  |
| Risk        | In France already problems when it dominates the coastal scene. Seeds and leaves are poisonous and therefor a threat to live stock.   |
| Management  | While producing huge amounts of seeds, hard to manage.  |
| Conclusion  | A potential threat to Nature 2000.  |

#### 4.6 **Branta canadensis**    *grote Canadese gans*

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL, Lemaire & Wiersma 2011.  |
| Origin  | The Canada goose <i>Branta canadensis</i> is a large goose species with a black head and neck, white patches on the face, and a brown body. It is native to arctic and temperate regions of North America. Some subspecies can be distinguished; where <i>B. c. parvipeps</i> may reach Europe as a vagrant.   |
| Habitus | <p>Canada geese are primarily herbivores, although they sometimes eat small insects and fish. Their diet includes green vegetation and grains. The Canada goose eats a variety of grasses when on land. It feeds by grasping a blade of grass with the bill, then tearing it with a jerk of the head. The Canada goose also eats beans and grains such as wheat, rice, and corn when they are available. In the water, it feeds from silt at the bottom of the body of water. It also feeds on aquatic plants, such as seaweeds. In urban areas, they are also known to pick food out of garbage bins.</p> <p>Most European populations are non-migratory, but those in more northerly parts of Sweden and Finland migrate to the North Sea and Baltic coasts. Relatively tame, feral birds are common in parks, and have become a nuisance species in some areas.</p> |

|        |  |
|--------|--|
| Alien  | Canada goose has been introduced to different sites in Scandinavia for hunting purposes and to the UK and Western Europe for ornamental purposes. From those site the number has increased and the distribution have become wider and wider. Has also been introduced into locations in the southern hemisphere. |
| Wadden | Species is breeding on all five islands, and is increasing.  |

*Table 4.11 Number squares (5x5 km) with Branta canadensis in The Netherlands (NL) and the Wadden Sea islands.*

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 313 | 12    | 0    | 1    | 1    | 1     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |  |
|-------------|--|
| Pathway(s)  | Introductions for ornamental purposes have been the basis of the current occurrence. The increase and spread have started with escapes from collections and releases in parks. The rate of increase is >20% per year for some decennia. The free flying population in Western Europe is subject to hunting, which leads to a lower rate of increase.   |
| Natura 2000 | Pairs are breeding in or near wet dune slacks (H2190), with water for safety and surrounding vegetation for feeding. Pairs with young usually disperse to nearby polders, for a higher food quality on agricultural grassland. Local birds can stay overnight on dune slack waters (H2190B) causing eutrophication by faeces.  |
| Risk        | Extremely successful in human-altered areas, Canada geese have proven able to establish breeding colonies in urban and cultivated areas, which provide food and few natural predators, and are well known as a common park species. Their success has led to them sometimes being considered a nuisance or pest species because of their depredation of crops and issues with their noise, droppings, aggressive territorial behaviour, and habit of begging for food, especially in their introduced range. |

*Table 4.12 The ISEIA score for Branta canadensis; see appendix 1 for a legend.*

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|            |  |
|------------|--|
| Management | Hunting is the most effective to reduce numbers, together with catching moulting birds (no flight feathers) in June. |
|------------|--|

Conclusion High population growth rates can lead to future problems, despite the current management practice, including culling and egg treatments, in the Netherlands. Can be considered a threat to Natura 2000 areas.

#### 4.7 *Branta hutchinsii* *kleine Canadese gans*

Sources Wikipedia-UK, Wikipedia-NL, Lemaire & Wiersma 2011.

Origin The cackling goose *Branta hutchinsii* is a North American bird of the genus *Branta* of black geese, which contains species with largely black plumage, distinguishing them from the grey *Anser* species.

Habitus It breeds in northern Canada and Alaska in a variety of tundra habitats. However, the nest is usually located in an elevated area near water. Like most geese, it is a migratory species and the wintering range includes most of the U.S., and is locally found in western Canada and northern Mexico. Ring recoveries have proved that cackling geese have occasionally reached Western Europe as wild birds. These vagrants most likely belong to the subspecies *hutchinsii* and possibly others. Cackling geese feed mainly on plant material. When feeding in water, they submerge their heads and necks to reach aquatic plants, sometimes tipping forward like a dabbling duck. Flocks of these birds often feed on leftover grains in arable fields, especially during migration or in winter. They also eat insects, molluscs and crustaceans occasionally.

Alien Cackling goose has been introduced to different sites in Western Europe for ornamental purposes. From those sites the number has increased and the distribution have become wider. In The Netherlands there are a few locations with increasing numbers.

Wadden Species is still lacking as a breeding bird on the islands. Most nearby breeding around Purmerend, in larger numbers.

Table 4.13 Number squares (5x5 km) with *Branta hutchinsii* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 5  | 1     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) Cackling goose can be bought in the waterfowl trade. From escapes and releases it can spread and increase in numbers. Like other goose species can reach high rates of population increase.

Natura 2000 Potential risk; see *Branta canadensis*.

Risk Competing with other herbivorous species for food on natural and agricultural habitats. See also *Branta canadensis*.

Table 4.14 The ISEIA score for *Branta hutchinsii*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

Management Hunting is the most effective to reduce numbers together with catching moulting birds (no flight feathers) in June.

Conclusion High growing rates can lead to future problems, despite today's hunting pressure in the Netherlands. A threat to Nature 2000.

#### 4.8 **Cabomba caroliniana** *waterwaaier*

Sources Wikipedia-UK, Wikipedia-NL, Matthews *et al.* 2013.

Origin *Cabomba caroliniana*, commonly known as green cabomba or fanwort, is an aquatic perennial herbaceous plant native to tropical South America in southern Brazil, Paraguay, Uruguay and northeast Argentina as well as southeast USA.

Habitus Fanwort is a submersed, sometimes floating, but often rooted, freshwater perennial plant with short, fragile rhizomes. The erect shoots are upturned extensions of the horizontal rhizomes. The shoots are grass green to olive green or sometimes reddish brown. The leaves are of two types: submersed and floating. The submersed leaves are finely divided and arranged in pairs on the stem. The floating leaves, when present, are linear and inconspicuous, with an alternate arrangement. They are less than 13 mm long and narrow (less than 6.4 mm). The leaf blade attaches to the centre, where there is a slight constriction. The flowers are white and small (less than 13 mm) in diameter, and are on stalks which arise from the tips of the stems.

Grows rooted in the mud of stagnant to slow flowing water, including streams, smaller rivers, lakes, ponds, sloughs, and ditches. In some States in the United States it is now regarded as a weed. Fanwort stems become brittle in late summer, which causes the plant to break apart, facilitating its distribution and invasion of new waterbodies. It produces by seed, but vegetative reproduction seems to be its main vehicle for spreading to new waters.

Alien Large numbers of plants are sent from Florida to the rest of the U.S. for commercial use. Fanwort is also grown commercially in Asia for export to Europe and other parts of the world. Small-scale, local cultivation occurs in some areas. Aquarists are probably responsible for some introductions, as in The Netherlands.

Wadden Species still lacking on the Wadden Islands.

Table 4.15 Number squares (5x5 km) with *Cabomba caroliniana* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 35 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Pathway(s) *C. caroliniana* was available in shops for use in aquaria. From here it was introduced into the wild. It spreads primarily by stem fragments or rhizomes; facilitated by humans, birds or mammals.

Natura 2000 Potential risk for the wet dunes slacks (H2190).

Risk *C. caroliniana* is an extremely persistent and competitive plant. Under suitable environmental conditions it forms dense stands and crowds out previously well-established plants. Once established, this plant can clog drainage canals and freshwater streams interfering with recreational, agricultural, and ecological purposes.

Table 4.16 The ISEIA score for *Cabomba caroliniana*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

Management In a closed water body with a heavy infestation it is recommended to use strict hygiene regulations and mechanical control (involving cutting and removing plants and ensuring fragments are not spread). Ongoing mechanical control is expensive but may be the only option. In the case of isolated plants and in small areas physical control (hand pulling by divers) and the use of herbicides may offer suitable control. Because *cabomba* requires direct sunlight, shading has been used to kill it in small areas; however the cost is prohibitive for large-scale programs.

Conclusion A potential threat to Natura 2000 on the Wadden.

#### 4.9 **Campylopus introflexus** *grijs kronkelsteeltje*

Sources Wikipedia-NL, Wikipedia-UK.

Origin This moss is native in the southern hemisphere: South-America, South-Africa, Australia, New Zealand, Pacific Islands.

Habitus It can be found in a variety of settings, from bogs to dunes to flat roofs, often decalcified habitats. Individual plants measure 0.5–5 centimetres, with lanceolate (lance-shaped) leaves 4–6 mm. The plants are found in dense mats and are yellowish to olive green. This species will

|        |  |
|--------|--|
|        | sometimes reproduce asexually by means of stem tips that break off and are distributed by the wind. Multiple sporophytes are often present in one plant. It produces spores of 12–14 $\mu\text{m}$ in size.                            |
| Alien  | It is a neophyte in Europe and coastal western North America. In some parts of Europe and North America the species has become invasive; for instance in The Netherlands.  |
| Wadden | The species do occur on all major Wadden Islands as well as two smaller ones. As soon as dune formations are developed, with some relative stable parts (grey dunes) circumstances are optimal for colonisation by <i>Campylopus</i> . |

Table 4.17 Number squares (5x5 km) with *Campylopus introflexus* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1259 | 10    | 4    | 9    | 5    | 4     | 1       | 0     | 1      | 0      | 0      | 0     | 0     | 0     |

|            |  |
|------------|--|
| Pathway(s) | Species is first observed in the Netherlands in 1962. Thereafter it has rapidly colonized coastal dunes and inland areas. Its spores are spread by the wind. |
|------------|--|

Table 4.18 The ISEIA score for *Campylopus introflexus*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|             |   |
|-------------|---|
| Natura 2000 | This moss grows in grey dunes (H2130), specially parts with bare, decalcified sand. After colonisation it forms monotone, closed layers of moss (up to 5 cm thick). This layers can stand for several decennia. Thereafter they decompose, resulting in a second development of a thick moss layer, a more varied vegetation with lichens or next stage with a closed grassy vegetation. Additional N-deposition speeds up the development of <i>Campylopus</i> |
| Risk        | The natural succession in grey dunes from bare sand to a varied vegetation with lichens and flowering plants is interrupted and for at least several decades fixed. The valuable early succession stages/stadia have become very rare.  |
| Management  | By chopping or sodding, the vegetation succession in grey dunes can be set back. Lowering N-deposition also helps.  |
| Conclusion  | This species is a major threat to Natura 2000 conservation goals.   |

#### 4.10 *Corvus splendens* huiskraai

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL, Slaterus <i>et al.</i> 2009.  |
| Origin  | The house crow <i>Corvus splendens</i> , also known as the Indian, grey-necked crow, Ceylon crow or Colombo crow, is a common bird of the crow family that is of Asian origin but now found in many parts of the world, where they arrived ship-assisted mainly around the Indian Ocean.  |
| Habitus | Size is between jackdaw and carrion crow (40 cm in length) but is slimmer than both. The forehead, crown, throat and upper breast are a rich glossy black, whilst the neck and breast are a lighter grey-brown in colour. The wings, tail and legs are black. There are regional variations in the thickness of the bill and the depth of colour in areas of the plumage.<br>House crows feed largely on refuse around human habitations, small animals such as insects and other small invertebrates, eggs, nestlings, grain and fruits. |
| Alien   | Recently, it has been introduced in Europe and has been breeding in the Hook of Holland since 1998. An individual has been present in Cork Harbour on the south coast of Ireland since early September 2010. It arrived in Australia ship-assisted but all arrivals have been eliminated.   |
| Wadden  | Species is lacking from the Wadden Islands.   |

Table 4.19 Number squares (5x5 km) with *Corvus splendens* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.20 The ISEIA score for *Corvus splendens*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|             |   |
|-------------|---|
| Pathway(s)  | The house crow is associated with human settlements throughout its range, from small villages to large cities. It easily hops from harbour to harbour by ship. It arrived in Hook of Holland by ship (1997), presumable twice. A small population became established after regular and successful reproduction. |
| Natura 2000 | Potential threat for Natura 2000 goals; especially breeding birds like terns, spoonbills and gulls.   |

|            |  |
|------------|--|
| Risk       | Species is a potential threat to colony breeding species on the Wadden Islands.  |
| Management | The house crow is very difficult to catch, because it highly social and relatively clever. The first established population in Europa (Hoek van Holland) might have become a stepping-stone to colonize Europe. After an increase from 2 to 27 individuals and much discussion, a culling program has started in 2014 and numbers are now reduced. |
| Conclusion | A potential threat which could be difficult to eliminate in urban environments.  |

#### 4.11 *Cotula coronopifolia* goudknopje

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK, ecomare.nl   |
| Origin  | Brass button <i>Cotula coronopifolia</i> is native to southern Africa and has been introduced to other parts of the world, e.g. Europe, North America, South America, etc.).   |
| Habitus | Brass buttons are common plants that occupy a specialized ecological niche. They prefer muddy, anoxic wetlands and brackish water. They are very salt-tolerant. The plant has fat, fleshy leaves that store water during times of saline inundation. The reddish stems and green, blade-shaped leaves are coated with a shiny cuticle to retain moisture.  |
| Alien   | Although brass buttons is known to be invasive, its spread appears to be relatively slow in large parts of the world. The colonisation in the Netherlands was quit fast. Their reproductive biology (seed) and other attributes result in low to high rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic in estuaria. |

Table 4.21 Number squares (5x5 km) with *Cotula coronopifolia* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 200 | 8     | 0    | 0    | 0    | 2     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.22 The ISEIA score for *Cotula coronopifolia*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|        |  |
|--------|--|
| Wadden | Brass button is known from two Wadden Islands. This species was first observed in the Netherlands in the seventies. In the last decade |
|--------|--|



|             |   |
|-------------|---|
|             | distribution and abundance have increased rapidly also in the Wadden Sea area. On Texel it was first found in 2004, on Schiermonnikoog more recent.   |
| Pathway(s)  | It probably came by ship to Europa. The species produces much seed. Today's distribution is linked to the distribution of major sites for waterfowl. Geese and ducks are thought to be a main vector in the spread of the species and the sometimes sudden and dominant occurrence.   |
| Natura 2000 | Brass button grows on Texel in a brackish environment on both sides of the dike: on the Schorren, in the polder in reserves as Waal & Burg and in some dune valleys (H2190). Just above water level it can dominate the vegetation, and outcompete native vegetation (H1310, H1330). On Schiermonnikoog it is recently found. |
| Risk        | Since the species can germinate in early spring, before other species, it has an advantage as competitor.   |
| Management  | no options.   |
| Conclusion  | A serious threat to Natura 2000.  |

#### 4.12 **Crassula helmsii** *watercrassula*

|             |  |
|-------------|--|
| Sources     | Wikipedia-NL, Wikipedia-UK,  |
| Origin      | <i>Crassula helmsii</i> , known as swamp stonecrop or New Zealand pigmyweed is an aquatic or semi-terrestrial species of succulent plant in the family <i>Crassulaceae</i> . Originally found in Australia and New Zealand.  |
| Habitus     | The shoots are rather stiff, carrying narrow parallel-sided leaves in opposite pairs, each leaf being about 4–24 mm. Small white flowers with four petals are produced in summer on long stalks arising from the upper leaf axils. The flowers are always above water. The plant grows on the muddy margins of ponds where it forms carpets with 100% cover, or semi-submerged in deeper water, or totally submerged with elongated stems. It does not die back in winter. |
| Alien       | it has been introduced around the world. In the Netherlands, this plant is one of six introduced aquatic plants which were banned from sale from April 2014; In the UK it is one of the five species with a ban from sale. Since the first records in the eighties abundance and distribution in the Netherlands have increased steadily.  |
| Wadden      | <i>Crassula helmsii</i> is only recently found on two locations on two Wadden Islands.   |
| Natura 2000 | <i>Crassula helmsii</i> is a serious threat to Nature 2000 goals, since it can dominate the scene from the bottom onto the bank, with no other species left (three growth forms!). Especially wet dune slacks (H2190, mainly the valuable <i>Littorelletea</i> -vegetations) with permanent and semi-permanent water are vulnerable.   |

Pathway(s) Species is popular for use in garden ponds and aquaria. Since it grows easy and much, it is found also into the wild. The main vector might be birds and feet of men. In the wild it spreads by seed and by rhizomes.

Table 4.23 Number squares (5x5 km) with *Crassula helmsii* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 203 | 0     | 0    | 1    | 1    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.24 The ISEIA score for *Crassula helmsii*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

Risk The main risk is the disappearance of species rich vegetation type that are quite unique for the Atlantic dune coast.

Management Clean up the water body is in many cases the only solution, but consider the other nature values involved; a total removal of bottom, water and vegetation, including the seed bank. Since 2010 the species is not sold anymore by garden centres (Annex I).

Conclusion This species is a major threat to Natura 2000 conservation goals for wet dune slacks (H2190).

#### 4.13 *Cyprinus carpio* *karper*

Sources Wikipedia-NL, Wikipedia-UK, Schiphouwer *et al.* 2014,

Origin The common carp *Cyprinus carpio* is a widespread freshwater fish of eutrophic waters in lakes and large rivers in Europe and Asia. The wild populations are considered vulnerable to extinction. The species has also been domesticated and introduced into environments worldwide, and is often considered a very destructive invasive species, being included in the List of the world's 100 worst invasive species.

Habitus Domesticated forms can grow to a maximum length of 120 centimetres, a maximum weight of over 40 kilograms and an oldest recorded age of 65 years. Wild common carp are typically slimmer; half in size and growth rate.

Alien The common carp is native to Asia, and has been introduced to every part of the world with the exception of the Middle East and the poles. They are the third most frequently introduced species worldwide, and

their history as a farmed fish dates back to Roman times. Carp are used as food in many areas, but are now also regarded as a pest in some regions due to their ability to out-compete native fish stocks.[8] The original common carp was found in the inland delta of the Danube River about 2000 years ago

Wadden Common carp occur on three of the five main islands. There it lives mainly outside the nature reserves in larger water bodies.

Table 4.25 Number squares (5x5 km) with *Cyprinus carpio* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 701 | 4     | 2    | 0    | 1    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.26 The ISEIA score for *Cyprinus carpio*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

Pathway(s) The species is introduced era's ago. It is grown commercially for sports, and put in many waters to for sport anglers.

Natura 2000 Larger water bodies are scarce in Nature 2000 ion the Wadden Islands.

Risk Common carp have been introduced, sometimes illegally, to most continents and some 59 countries. Due to their fecundity and their feeding habit of grubbing through bottom sediments for food, they are notorious for altering their environments. In feeding, they may destroy, uproot, disturb and eat submerged vegetation, causing serious damage to native duck, such as canvasbacks, and fish populations. Similar to the grass carp, the vegetation they consume is not completely digested, and rots after excretion, raising the nutritional level of the water and causing excessive algae growth. They destroy nests of other fish and eat their eggs, reducing their numbers significantly.

Management The carp itself can sustain a troubled water environment. If all carp could be caught, regrowth of water plants is possible. Then predator fish, living hidden between the plants, can sustain a clear water environment by controlling carp.

Conclusion At this moment the occurrence of carp on the Wadden Islands is locally; mainly outside the Natura 2000 areas. Nevertheless, it is a threat for aquatic elements in Natura 2000.

#### 4.14 Dreissena polymorpha

driehoeksmossel

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK,  |
| Origin  | The zebra mussel <i>Dreissena polymorpha</i> is a small freshwater mussel. This species was originally native to the lakes of southern Russia, being first described in 1769 in the Ural, Volga and Dnieper rivers. These mussels are still found nearby, as Pontic (Black Sea) and Caspian species. However, the zebra mussel has been accidentally introduced to numerous other areas, and has become an invasive species in many different countries worldwide.   |
| Habitus | Zebra mussels and the closely related and ecologically similar quagga mussels are filter-feeding organisms. They remove particles from the water column. Zebra mussels process up to one litre of water per day, per mussel. Since the zebra mussel has become established in turbid water bodies, water clarity has increased. This improved water clarity allows sunlight to penetrate deeper, enabling growth of submerged macrophytes.   |
| Alien   | Zebra mussels have become an invasive species in the USA and Western Europe. They disrupt the ecosystems by monotypic colonization, and damage harbors and waterways, ships and boats, and water treatment and power plants. Water treatment plants are most affected because the water intakes bring the microscopic free-swimming larvae directly into the facilities. The zebra mussels also cling to pipes under the water and clog them. One of the positive contributions of the invasion is that Zebra mussels are an important food resource for diving ducks such as tufted duck and pochard. |
| Wadden  | The zebra mussel is restricted to fresh water systems, and in The Netherlands mainly linked to the riverine areas in the centre of the country.  |

Table 4.27 Number squares (5x5 km) with *Dreissena polymorpha* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 186 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.28 The ISEIA score for *Dreissena polymorpha*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 11    |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Pathway(s)  | Species is widespread in the Netherlands and can reach every potential site. The Rhine-Donau Canal facilitates additional introductions to Western Europe.   |
| Natura 2000 | Zebra mussels have not been found yet on the Wadden islands.   |
| Risk        | So far the filter capacity is positive for water clarity (growth of macrophytes) and it is a major food resource for diving ducks. Nonetheless, native aquatic ecosystems can be substantially changed after settlement of the zebra mussel. |
| Management  | Hardly no options.   |
| Conclusion  | A potential threat for Natura 2000 on the Wadden Sea islands.  |

#### 4.15 **Dreissena rostriformis bugensis** *quagga mussel*

|            |   |
|------------|---|
| Sources    | Wikipedia-NL, Wikipedia-UK,   |
| Origin     | The quagga mussel, scientific name <i>Dreissena bugensis</i> , and also known as <i>Dreissena rostriformis bugensis</i> , is a species (or subspecies) of freshwater mussel, an aquatic bivalve mollusc in the family <i>Dreissenidae</i> . This subspecies is indigenous to the Dnieper River drainage of Ukraine. The species is named after the quagga, an extinct subspecies of African zebra, possibly because, like the quagga, its stripes fade out towards the ventral side. The quagga mussel shell is striped and/or with a zig-zag pattern, as is that of the zebra mussel, but the quagga shell is paler toward the end of the hinge. |
| Habitus    | The quagga mussel is a filter feeder. It uses its cilia to pull water into its shell cavity through an incurrent siphon and it is here that desirable particulate matter is removed. Each adult mussel is capable of filtering one or more litres of water each day, where they remove phytoplankton, zooplankton, algae, and even their own veliger larvae.  |
| Alien      | Zebra mussels have become an invasive species in the USA and Western Europe. They disrupt the aquatic ecosystems by monotypic colonization, and damage harbors and waterways, ships and boats, and water treatment and power plants. Water treatment plants are most affected because the water intakes bring the microscopic free-swimming larvae directly into the facilities. The zebra mussels also cling to pipes under the water and clog them. One of the positive aspects of the invasion is that Zebra mussels are an important food source for diving ducks such as tufted duck and pochard.  |
| Wadden     | The zebra mussel is restricted to fresh water systems, and in The Netherlands mainly linked to the riverine area in the centre of the country.  |
| Pathway(s) | Species is wide spread in the Netherlands and can reach potentially every suitable site. The Rhine-Donau Canal facilitates new introductions to the population in Western Europe.   |

Table 4.29 Number squares (5x5 km) with *Dreissena rostriformis bugensis* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 79 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.30 The ISEIA score for *Dreissena rostriformis bugensis*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 11    |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Natura 2000 | Zebra mussels have not been found yet on the Wadden islands.   |
| Risk        | Filter capacity is positive for water clarity (growth of macrophytes) and it is a major food source for diving ducks. Nonetheless, native systems are substantially and perhaps irreversibly changed after settlement of the zebra mussel. |
| Management  | Hardly no options.   |
| Conclusion  | A potential threat for Natura 2000 on the Wadden Sea islands.  |

#### 4.16 *Elodea nuttallii* *smalle waterpest*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL.   |
| Origin  | <i>Elodea nuttallii</i> is a species of waterweed known by the common name western waterweed or Nuttall's waterweed. This is a perennial aquatic plant, which is native to North America where it grows submersed in lakes, rivers, and other shallow water bodies. It is also found in Eurasia, where it is commonly weedy; it is not known as a weed species in its native range.   |
| Habitus | It grows rapidly in favourable conditions and can choke shallow ponds, canals, and the margins of some slow-flowing rivers. It requires summer water temperatures of 10–25 °C, and moderate to bright light conditions, as well as preferably eutrophic waters. In Europe nearly all individuals are female, only some places with male plants are known. It is closely related to <i>Elodea nuttallii</i> , which generally has narrower leaves under 2 mm broad. It is usually fairly easy to distinguish from its relatives, like the Brazilian <i>Egeria densa</i> and <i>Hydrilla verticillata</i> . These all have leaves in whorls around the stem; however, <i>Elodea</i> usually has three leaves per whorl, whereas <i>Egeria</i> and <i>Hydrilla</i> usually have four or more leaves per whorl. <i>Egeria densa</i> is also a larger, bushier plant with longer leaves. |

|        |   |
|--------|---|
| Alien  | The first European evidence of <i>Elodea nuttallii</i> was probably 1914 in England, though it had been determined wrongly as <i>Hydrilla verticillata</i> . It is an invasive species to Europe and is now covering practically the whole continent. |
| Wadden | Species found on three of the five islands with potential habitat. Before 1990 it has been recorded on Vlieland.  |

Table 4.31 Number squares (5x5 km) with *Elodea nuttallii* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1378 | 7     | 0    | 1    | 1    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | It is sometimes used as an aquarium plant. It was introduced long ago. It mainly spreads vegetative, facilitated by men, mammals or birds.  |
| Natura 2000 | On Texel it is growing in wet dune slacks (H2190A, H2190D).   |
| Risk        | Due to its ability to grow fast, <i>E. nuttallii</i> , it can form a dense vegetation and overgrow all other species in the water column. It can change the physical and ecological conditions of the waterbody and therefore affect animal life. |

Table 4.32 The ISEIA score for *Elodea nuttallii*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|            |  |
|------------|--|
| Management | Clean up the water body; a total removal of bottom, water and vegetation, including the seed bank. Since 2010 species is not sold anymore by garden centres (Annex I). |
| Conclusion | A threat to Nature 2000 conservation goals.  |

#### 4.17 *Fallopia japonica* Japanse duizendknoop

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL, bestrijdingduizendknoop.nl  |
| Origin  | <i>Fallopia japonica</i> , commonly known as Japanese knotweed, is a large, herbaceous perennial plant of the family <i>Polygonaceae</i> , native to East Asia in Japan, China and Korea. In North America and Europe the species is very successful and has been classified as an invasive species in several countries. |

|         |  |
|---------|--|
| Habitus | Japanese knotweed has hollow stems with distinct raised nodes that give it the appearance of bamboo, though it is not closely related. While stems may reach a maximum height of 3–4 m each growing season, it is typical to see much smaller plants in places where they sprout through cracks in the pavement or are repeatedly cut down. The leaves are broad oval with a truncated base, 7–14 cm long and 5–12 cm broad, with an entire margin. The flowers are small, cream or white, produced in erect racemes 6–15 cm long in late summer and early autumn. |
| Alien   | European adventurer Philipp von Siebold transported knotweed from a Japanese volcano to Holland. By 1850 a specimen from this plant was added to the Royal Botanic Gardens, Kew. It was favoured by gardeners because it looked like bamboo and grew everywhere. It is listed as one of the world's worst invasive species.  |
| Wadden  | The species is present on 4 of 5 major islands. On all 4 islands it occurs within the borders of the Natura 2000 area.   |

Table 4.33 Number squares (5x5 km) with *Fallopia japonica* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1237 | 5     | 0    | 3    | 2    | 1     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | Species is nowadays rarely sold as a garden plant. Illegal dump of garden rubbish, a major pathway in the past, is not the main pathway anymore. This species regenerates easily from small fragments of the rhizomes and from the nodes of the stem. Contaminated soil, dispersal by mowing machines and floating stems are probably the main pathways. Seed seems to play a minor role. |
| Natura 2000 | It will grow on ruderal sites as well as in forests and forest edges (H2180A, 2180C).   |

Table 4.34 The ISEIA score for *Fallopia japonica*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|      |   |
|------|---|
| Risk | It is a frequent colonizer of temperate riparian ecosystems, roadsides and waste places. It forms thick, dense colonies that completely crowd out any other herbaceous species and is now considered one of the worst invasive exotics. The success of the species has been partially |
|------|---|



attributed to its tolerance of a very wide range of soil types, pH and salinity. Its rhizomes can survive temperatures of  $-35^{\circ}\text{C}$  and can extend 7 m horizontally and 3 m deep, making removal by excavation extremely difficult.

- Management** Because eradication of this species is difficult and costly it is advisable to start any management with preventing further dispersal. Make e.g. sure that pieces of stems don't fall in fresh water during mowing. Japanese knotweed has a large underground network of roots (rhizomes). To eradicate the plant the roots need to be killed. All above-ground portions of the plant need to be controlled repeatedly for several years in order to weaken and kill the entire patch. Picking the right herbicide is essential, as it must travel through the plant and into the root system below. Injecting stems with glyphosphate is the most promising and probably also most cost effective method. Digging up the rhizomes is a common solution where the land is to be developed, as this is quicker than the use of herbicides, but safe disposal of the plant material without spreading it is difficult. Anecdotal reports of effective control describe the use of goats to eat the plant parts above ground followed by the use of pigs to root out and eat the underground parts of the plant. Mowing is not a effective control method and even stimulates horizontal growth of the rhizomes.
- Conclusion** A major threat to dune forest and shrub.

#### 4.18 **Fallopia sachalinensis** *Sachalinse duizendknoop*

- Sources** Wikipedia-UK, Wikipedia-NL, bestrijdingduizendknoop.nl
- Origin** Giant knotweed or Sakhalin knotweed *Fallopia sachalinensis* is a species of *Fallopia* native to northeastern Asia in northern Japan (Hokkaidō, Honshū) and the far east of Russia (Sakhalin and the southern Kurile Islands).
- Habitus** *Fallopia sachalinensis* is a herbaceous perennial plant growing to 2–4 m tall, with strong, extensively spreading rhizomes forming large clonal colonies. The leaves are some of the largest in the family, up to 15–40 cm long and 10–28 cm broad, nearly heart-shaped, with a somewhat wavy, crenate margin. The flowers are small, produced on short, dense panicles up to 10 cm long in late summer or early autumn; it is gynodioecious, with male and female (male sterile) flowers on separate plants. The species is closely related to the Japanese knotweed, *Fallopia japonica*, and can be distinguished from it by its larger size, and in its leaves having a heart-shaped (not straight) base and a crenate margin. Grows on shady and sunny sites, preferable eutrophic. In broad leaved forest, on road sites, forest edges, ruderal sites, marshes.

|        |  |
|--------|--|
| Alien  | <p>It was introduced to Europe and grown in many botanic gardens. It came prominently into notice about 1893, when a drought in Western Europe caused a decided shortage in forage for cattle. This plant was little affected, and since its tender shoots and leaves were eaten by stock, the plant was widely grown experimentally as a forage crop. It has proved less useful than was predicted, and its deliberate cultivation has been almost entirely abandoned. It has, however, like <i>F. japonica</i>, proved to be an invasive weed in several habitats.</p> <p>It has hybridised with <i>Fallopia japonica</i> in cultivation; the hybrid, <i>Fallopia × bohemica</i> is frequently found in the British Isles and elsewhere (also in The Netherlands).</p> |
| Wadden | Known form 1 location in the dunes from the northern half of Texel.  |

Table 4.35 Number squares (5x5 km) with *Fallopia sachalinensis* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 450 | 1     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|             |  |
|-------------|--|
| Pathway(s)  | Introduced on many sites in western Europe. Nowadays rarely available as a garden plant. A small part of a rhizome (cm) and nodes of the stems can be the start of a new settlement. Pathways same with <i>Fallopia japonica</i> . |
| Natura 2000 | Known form 1 location in the dunes from the northern half of Texel.  |
| Risk        | It forms closed stands and can dominated the site and therefor eliminate native flora.   |

Table 4.36 The ISEIA score for *Fallopia sachalinensis*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|            |  |
|------------|--|
| Management | <p>Because eradication of this species is difficult and costly it is advisable to start any management with preventing further dispersal. Make e.g. sure that pieces of stems don't fall in fresh water during mowing.</p> <p>Giant knotweed has a large underground network of roots (rhizomes). To eradicate the plant the roots need to be killed. All above ground portions of the plant need to be controlled repeatedly for several years in order to weaken and kill the entire patch. Picking the right herbicide is essential, as it must travel through the plant and into the root system</p> |
|------------|--|

below. Injecting stems with glyco-phosphate is the most promising and probably also most cost-effective method.

Digging up the rhizomes is a common solution where the land is to be developed, as this is quicker than the use of herbicides, but safe disposal of the plant material without spreading it is difficult. Anecdotal reports of effective control describe the use of goats to eat the plant parts above ground followed by the use of pigs to root out and eat the underground parts of the plant.

Mowing is not a effective control method and even stimulates horizontal growth of the rhizomes.

Conclusion A potential threat to dune forest and shrub.

#### 4.19 **Fallopia x bohémica** *bastaardduizendknoop*

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL, bestrijdingduizendknoop.nl   |
| Origin  | <i>Fallopia x bohémica</i> is the hybrid between <i>Fallopia japonica</i> and <i>Fallopia sachalinensis</i> and occurs at three different ploidy levels: $2n=44$ ; 66; and 88.   |
| Habitus | Whatever ploidy level is considered, all taxa are capable of producing viable seed giving rise to vigorous plants (usually with aneuploid chromosome numbers), which currently do not become established spontaneously in Europe.<br>It occurs in habitats similar to those occupied by <i>Fallopia japonica</i> ; principally in riparian and ruderal habitats, but also in salt marshes. Of the alien knotweeds the most adapted to shady habitats.  |
| Alien   | The fact that all <i>F. japonica</i> var. <i>japonica</i> were male-sterile, meant that once male-fertile plants of <i>Fallopia sachalinensis</i> reached Europe, hybridization was inevitable. Any seed collected from Japanese knotweed would thus be of hybrid origin. Botanic gardens around the world were distributing this hybrid seed as <i>F. japonica</i> . Evidence from herbarium material shows that this hybrid arose not long after the arrival of <i>F. sachalinensis</i> in the late nineteenth century, whereas the earliest date for a plant established in the wild is currently 1954 for County Durham, UK.<br>Given that both <i>F. japonica</i> and <i>F. sachalinensis</i> were present in Siebold's Garden of Acclimatisation in Leiden, it could have also arisen there and been distributed further. It is first reported by Adolphi (1999). It is quickly becoming more common, especially along road sides and water courses. |
| Wadden  | This hybrid does not occur on the Wadden Islands.  |

Table 4.37 Number squares (5x5 km) with *Fallopia x bohemica* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 120 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |  |
|-------------|--|
| Pathway(s)  | <p>The main method of reproduction is by vegetative propagation so there is a danger of contaminated soil. Also there are some reports of short, sea-borne transfer of viable rhizome fragments of <i>Fallopia japonica</i> from island to island in the west of Scotland and there is nothing to suggest that <i>F. x bohemica</i> is any less adept in this ability so this possibility cannot be excluded.</p> <p>Viable seed is produced in sites where <i>F. japonica</i> var. <i>japonica</i> co-exists with male-fertile <i>F. sachalinensis</i>; however, such sites are rather rare, and germination and establishment are even rarer occurrences. Natural production of F1 seed can in no way account for the current distribution, therefore it must be assumed that it was distributed asexually as a garden plant and subsequently discarded into the wild. Such plants finding themselves on water courses are then able to spread downstream by vegetative means.</p> |
| Natura 2000 | Potentially: it can form closed stands and can dominated the site and therefor eliminate native flora. It is considered the vigorous of the alien knotweeds.   |
| Risk        | It forms closed stands and can dominate the site and therefor eliminate native flora.  |

Table 4.38 The ISEIA score for *Fallopia x bohemica*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|            |   |
|------------|---|
| Management | <p>Much viable seed is produced in Europe, but it very rarely establishes in the wild. Research should be carried out to examine what is stopping it and how germination would be affected by the changes in season predicted by the various Climate Change scenarios. Priority should be given to the eradication of male-fertile clones to prevent production of backcross seed.</p> <p>Because eradication of this species is difficult and costly it is advisable to start any management with preventing further dispersal. Make e.g. sure that pieces of stems don't fall in fresh water during mowing.</p> |
|------------|---|

Giant knotweed has a large underground network of roots (rhizomes). To eradicate the plant the roots need to be killed. All above-ground portions of the plant need to be controlled repeatedly for several years in order to weaken and kill the entire patch. Picking the right herbicide is essential, as it must travel through the plant and into the root system below. Injecting stems with glyphosphate is the most promising and probably also most cost effective method.

Digging up the rhizomes is a common solution where the land is to be developed, as this is quicker than the use of herbicides, but safe disposal of the plant material without spreading it is difficult. Anecdotal reports of effective control describe the use of goats to eat the plant parts above ground followed by the use of pigs to root out and eat the underground parts of the plant.

Mowing is not a effective control method and even stimulates horizontal growth of the rhizomes.

Conclusion A major threat to dune forest and shrub.

#### 4.20 **Felis catus** *verwilderde kat*

This species occurs since a long time in the wild, for more then centuries. Therefor, it is not threatened as an alien. Nevertheless, it does not belong to the native Dutch fauna, and especially not to the native fauna of the Wadden Islands. Since it occurs on the Wadden Islands, it has a negative impact on ground breeding species. In this review it is threatened as an alien.

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL.   |
| Origin  | The domestic cat <i>Felis catus</i> or <i>Felis silvestris catus</i> is a small, domesticated, and carnivorous mammal. They are often called housecats when kept as indoor pets or simply cats when there is no need to distinguish them from other <i>felids</i> and <i>felines</i> . Humans often value cats for companionship and their ability to hunt vermin.  |
| Habitus | Feral cats are domestic cats that were born in or have reverted to a wild state. They are unfamiliar with and wary of humans and roam freely in urban and rural areas. The number of feral cats is not known. Feral cats may live alone, but most are found in large colonies, which occupy a specific territory and are usually associated with a source of food.  |
| Alien   | Feral cats can live in forests, grasslands, tundra, coastal areas, agricultural land, scrublands, urban areas, and wetlands. Their habitats even include small oceanic islands with no human inhabitants. Further, the close relatives of domestic cats, the African wildcat <i>Felis silvestris lybica</i> and the Arabian sand cat <i>Felis margarita</i> both inhabit desert environments and domestic cats still show similar adaptations and behaviours. The ability of feral cats to thrive in almost any terrestrial |

habitat has led to its designation as one of the world's worst invasive species.

Wadden Feral cats live on all five main islands. Although they are managed by shooting, the fauna management units have not succeeded in eliminating the feral populations. This is probably caused by frequent new escapes and introductions that sustain the feral population.

Table 4.39 Number squares (5x5 km) with *Felis catus* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 270 | 12    | 5    | 9    | 6    | 6     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) Cats are common pets in Europe and North America, and their worldwide population exceeds 500 million. In the Netherlands it is a common pet as well. On the Wadden a major source of introductions could be tourists losing control over their cat leading to an escape.

Natura 2000 Ground breeding and ground feeding birds are affected, as well as other ground dwelling animals.

Risk To date, little scientific data is available to assess the impact of cat predation on prey populations. Even well-fed domestic cats may hunt and kill, mainly small mammals, but also birds, amphibians, reptiles, fish, and invertebrates. Hunting by domestic cats may be contributing to the decline in the numbers of birds in urban areas, although the importance of this impact remains controversial. In the wild, the introduction of feral cats in human settlements can threaten native species with extinction. In many cases, controlling or eliminating the populations of non-native cats can produce a rapid recovery in native animals.

The domestic cat is probably a significant predator of birds. UK assessments indicate they may be accountable for an estimated 64.8 million bird deaths each year. Certain species appear more susceptible than others; for example, 30% of house sparrow mortality is linked to the domestic cat. In robins *Erithacus rubecula* and dunnocks *Prunella modularis*, 31% of deaths were the result of cat predation as has been revealed by ring recoveries. The presence of larger carnivores such as coyotes, which prey on cats and other mesopredators reduces the effect of predation by cats and other small predators such as opossums and raccoons on bird numbers and diversity. The proposal that cat populations will increase when the numbers of these top predators decline is called the mesopredator release hypothesis. However, a new study suggests cats are a much greater threat to biodiversity than previously thought.

Table 4.40 The ISEIA score for *Felis catus*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

Management Public attitudes towards feral cats vary widely, ranging from seeing them as free-ranging pets, to regarding them as vermin. For this reason hunting of feral cats is closed in 9 of 12 provinces, only in 3 provinces it is possible with a permit Ffwet ex art 68.?

Conclusion A threat with a negative impact on ground breeding species.

#### 4.21 *Hydrocotyle ranunculoides* grote waternavel

Sources Wikipedia-UK, Wikipedia-NL, www.cabi.org.

Origin *Hydrocotyle ranunculoides*, known commonly as water pennywort, floating pennywort, or floating marsh pennywort, is an aquatic plant in the family *Apiaceae*. It is native to North and South America and parts of Africa. It is a threatened species in parts of its native range in the United States.

Habitus Water pennywort has stems that spread horizontally and can float on water. Leaves grow on petioles up to 35 cm long, and are round to kidney-shaped, with 3–7 lobes and crenate to entire margins. Flowers are small, pale greenish white to pale yellow, and come in umbels of 5–13. Fruits are small achenes that can float, helping the seeds to disperse. *H. ranunculoides* is capable of both sexual and asexual reproduction, even in the temperate climate of western Europe. It has been found to flower and fruit as early as May in the Netherlands. The characteristics that indicate its invasiveness are typical of many aquatic weeds: high growth rates, adaptability to prevailing nutrient conditions, very effective vegetative propagation, plasticity in growth response, overwintering to avoid low temperature stress, resistance to herbivory, resistance to chemical control, and absence of specific pests and diseases in introduced environments.

Alien In The Netherlands and other countries in Western Europe it is an invasive alien species which is currently spreading in waterways. It is one of five aquatic plants which are banned from sale in the UK from April 2014 as well as in The Netherlands. The plant is sold as a tropical aquarium plant in the Netherlands, Belgium and the UK. It has been grown in aquatic nurseries since the mid-1980s and was first noted in the UK in the river Chelmer in 1991 (Payne, 1992). In the Netherlands and Belgium, the first occurrence is

reported in autumn 1995 as an escapee from aquatic nurseries. It has also been recorded more recently from France, Ireland, Italy and Germany.

Wadden It is known from one location on Ameland.

Table 4.41 Number squares (5x5 km) with *Hydrocotyle ranunculoides* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 352 | 0     | 0    | 0    | 1    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) *H. ranunculoides* has been intentionally introduced as an ornamental tropical aquarium plant in the UK, Netherlands and Belgium. The viability of seeds is unknown and it is likely that the majority of sites where the species occurs outside the natural range are the result of deliberate introductions through cultivation or the aquarium trade. *H. ranunculoides* has also been considered for phytoremediation as it accumulates heavy metals and phosphorus.

Natura 2000 It is known from one location on Ameland, outside Natura 2000.

Risk Forms dense rafts and outcompetes native plant species. Reduced light levels below the rafts can cause die off of waterweeds and algae and reduce water oxygenation levels. Deoxygenates water killing fish and other fauna. Blocks water bodies and may lead to an increased risk of flooding. The growth form of floating mats reduces light and restricts growth of submerged macrophytes and has been shown to greatly reduce the number of native plants in an affected area.

Table 4.42 The ISEIA score for *Hydrocotyle ranunculoides*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

Management Although care should be taken to remove all cut plant material from the water body as rapid re-growth can occur from a single node. Hand pulling or spot chemical treatment should follow cutting to reduce re-growth. Should not be released in the wild. Since 2001 the government has implemented a ban on trade and ownership.

Conclusion A potential threat to native flora and fauna in dune slacks and other waters.



#### 4.22 *Impatiens glandulifera* reuzenbalsemien

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL.   |
| Origin  | <i>Impatiens glandulifera</i> is a large annual plant native to the Himalayas. Via human introduction it is now present across much of the Northern Hemisphere and considered an invasive species in some areas.  |
| Habitus | It typically grows to 1 to 2 m high, with a soft green or red-tinged stem, and lanceolate leaves 5 to 23 cm long. The crushed foliage has a strong musty smell. Below the leaf stems the plant has glands that produce sticky, sweet-smelling, and edible nectar. The flowers are pink, with a hooded shape, 3 to 4 cm tall and 2 cm broad; the flower shape has been compared to a policeman's helmet.<br>After flowering between June and October, the plant forms seed pods 2 to 3 cm long and 8 mm broad, which explode when disturbed, scattering the seeds up to 7 metres. The green seedpods, seeds, young leaves and shoots are all edible. |
| Alien   | Himalayan Balsam is now widely established in other parts of the world (such as Europe), in some cases becoming an invasive species weed. The aggressive seed dispersal, coupled with high nectar production, which attracts pollinators, often allows the Himalayan Balsam to outcompete native plants. Himalayan Balsam also promotes river-bank erosion due to the plant dying back over winter, leaving the bank unprotected from flooding. Invasive Himalayan Balsam can also adversely affect indigenous species by attracting pollinators (e.g. insects) at the expense of indigenous species.   |
| Wadden  | This species has reached all five main islands. Is occurs in small eutrophic, and most of the time wet patches. Due to its preference for eutrophic stands, its distribution is mostly outside Natura 2000.   |

Table 4.43 Number squares (5x5 km) with *Impatiens glandulifera* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1128 | 3     | 1    | 4    | 1    | 1     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.44 The ISEIA score for *Impatiens glandulifera*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Pathway(s)  | The main vector are gardens and green garden-centres. It produces lots of seeds, which spread easily. Also transport by birds and mammals.   |
| Natura 2000 | This species can occur in wet dune forest (H2180B), and dune slack with mars vegetation (H2190D).  |
| Risk        | Once settled Himalayan Balsam can dominate the vegetation; and therefor displace native species.   |
| Management  | Patches Himalayan Balsam can be mowed, most effective before seed development.   |
| Conclusion  | On the Wadden Himalayan Balsam is invasive, but up to now mostly outside Natura 2000. It is a potential threat to wet habitats in the dunes. |

#### 4.23 *Landoltia punctata* *smal kroos*

|         |   |
|---------|---|
| Sources | Wikipedia-UK; Jacono, C.C. 2002. <i>Landoltia punctata</i> . U.S. Department of the Interior. U.S. Geological Survey.; <a href="http://www.issg.org/database/species/ecology.asp?si=1018">http://www.issg.org/database/species/ecology.asp?si=1018</a>  |
| Origin  | <i>Landoltia punctata</i> (or <i>Spirodela punctata</i> , common name dotted duckmeat) is a species of duckweed ( <i>Lemnaceae</i> ). The species is morphologically intermediate between <i>Lemna</i> and <i>Spirodela</i> . In 1999 D.H. Les and D.J. Crawford proposed segregating the species to a new genus <i>Landoltia</i> containing just the species <i>L. punctata</i> , on the basis of biochemical and DNA studies.<br><i>S. punctata</i> originally was found in Australia and South Asia. |
| Habitus | <i>L. punctata</i> prefers "small, quiet, nutrient rich waters such as ponds, ditches, swamps and backwaters; also seasonally intermittent waters. <i>Landoltia punctata</i> spreads mainly through vegetative budding from two pouches at base of the frond. New fronds often remain attached to original frond by a short stem. You often see clusters of several fronds linked together. This species may sometimes reproduce sexually, producing seed.  |
| Alien   | Today this species has also been found in the southern and eastern United States.   |
| Wadden  | So far, this species does not occur on the Wadden Sea islands.  |

Table 4.45 Number squares (5x5 km) with *Landoltia punctata* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 0  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|            |   |
|------------|---|
| Pathway(s) | <i>Landoltia punctata</i> is introduced to nutrient filled wastewater ponds as a means to absorb excess nutrients. Also, <i>L. punctata</i> could potentially |
|------------|---|

be utilized as a fertilizer. (Chaiprapat *et al*, 2005). *L. punctata* was introduced via the aquarium trade to the USA (CAIP, 2002).

After escape, *L. punctata* can be vectored by waterfowl, but less likely by raccoons, beavers and wild hogs. However, they die rapidly once removed from the water, drying out within 1/2 to 10 hours.

Natura 2000 A potential threat for wet dune slacks (subtypes H2190A and H2190D, relatively nutrient rich waters and marshes).

Risk *L. punctata*'s impacts are generally unknown, but it has the potential to become a serious nuisance due to its rapid colonization, easy distribution, and quick dispersal rate.

Table 4.46 The ISEIA score for *Landoltia punctata*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 3     |

Management In the USA Diquat is a widely used and effective herbicide because it causes ion leakage in duckweed and other aquatic plants.

Conclusion A potential threat for wet dune slacks.

#### 4.24 *Leiothrix lutea* Japanese nightingale

Sources Wikipedia-UK, Wikipedia-NL.

Origin The red-billed leiothrix *Leiothrix lutea* is a member of the *Leiothrichidae* family, and is native to the Indian subcontinent.

Habitus The *leiothrix* is about six inches in length, generally olivegreen, and has a yellow throat with orange shading on the breast. It also has a dull yellowish ring around the eye that extends to the bill.

This bird eats fruits such as strawberries, ripened papaya, guavas and also various species of *Diptera*, *Mollusca*, *Lepidoptera*, and *Hymenoptera*. Its food is usually gathered from foliage and dead wood and it usually searches for food in lower strata of vegetation.

The *leiothrix* is an open cup nester. Several nests are found between April and June and are placed within ten feet of the ground. Dense vegetation provides the shrub nesting species protection against predators.

Alien It has also been introduced in various parts of the world, with small populations of escapees having existed in Japan since the 1980s. It has become a common cage bird and amongst aviculturists it goes by various names: Pekin robin, Pekin nightingale, Japanese nightingale, and Japanese (hill) robin, the last two being misnomers as it is not

native to Japan. The *leiothrix* was released in Western Australia but it failed to become established. This species was also introduced in Great Britain but permanent establishment was unsuccessful. It was introduced to France, where it is now established in several areas.

Wadden To date, this species has not been found on the Wadden Sea islands.

Table 4.47 Number squares (5x5 km) with *Leiothrix lutea* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) This species is traded as a cage bird. The occurrence in the Netherlands is exclusively the result of escapes. Proven breeding in the wild is lacking. This could be caused by the lack of a climate match in The Netherlands, but with increasing temperatures, settlement of this (sub)-tropical species cannot be excluded.

Natura 2000 Forms a potential threat to the bird community of dune forests (H2180).

Risk No information is available on the ecological risks and impact.

Table 4.48 The ISEIA score for *Leiothrix lutea*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

Management Catch them if they are observed on Wadden Sea islands.

Conclusion A potential threat, with an impact on the forest bird community.

## 4.25 *Lepomis gibbosus* *zonnebaars*

Sources Wikipedia-NL, Wikipedia-UK, Soes *et al.* 2011

Origin The pumpkinseed's natural range in North America is from New Brunswick down the east coast to South Carolina. It then runs inland to the middle of North America, and extends through Iowa and back through Pennsylvania. Pumpkinseed sunfish have however been introduced throughout most of North America. They can now be found from Washington and Oregon on the Pacific Coast to Georgia on the Atlantic Coast. Yet they are primarily found in the North-eastern United States and more rarely in the south-central or South Western region of the continent.

|         |  |
|---------|--|
| Habitus | Pumpkinseeds typically are 10 cm in length, but can grow up to 40 cm. They typically weigh less than 450 g. They are orange, green, yellow or blue in colour, with speckles over their sides and back and a yellow-orange breast and belly. Pumpkinseeds typically live in warm, calm lakes, ponds, and pools of creeks and small rivers with plenty of vegetation. They prefer clear water where they can find shelter to hide. Pumpkinseeds feed on a variety of small food both at the surface of the water and at the bottom. Among their preferred prey are insects, mosquito larvae, small molluscs and other crustaceans, worms, minnow fry, and even other smaller pumpkinseeds. |
| Alien   | In Europe, the pumpkinseed is considered an invasive species. They were introduced to European waters, and outcompete native fish and diminish populations of native amphibians, native dragonflies, etc.  |

Table 4.49 Number squares (5x5 km) with *Lepomis gibbosus* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 122 | 0     | 0    | 1    | 0    | 1     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.50 The ISEIA score for *Lepomis gibbosus*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 11    |
| Certainty                                  | 2     |

|             |  |
|-------------|--|
| Wadden      | <i>Lepomis gibbosus</i> occurs on two islands in a small pond near Midsland (Terschelling) and in the Berkenplas (Schiermonnikoog).  |
| Pathway(s)  | Pumpkinseeds have been introduced to Europe in the nineteenth century. Nowadays the species is popular as a garden pond species and is easy to keep in aquaria. The species reproduces quite easy. Brood has often been put into the wild. |
| Natura 2000 | Species occur in wet dune slacks (H2190) with permanent or nearly permanent water.   |
| Risk        | Pumpkinseeds mainly feed on zooplankton, like the eggs of other fish species, amphibians, dragonflies, etc. Therefore, it is a threat to 'typical species' of the dune slacks (H2190).   |
| Management  | If the species occur in isolated water it is an option to pump away (nearly) all the water and catch all fish.   |
| Conclusion  | A threat to native fauna in wet dunes slacks.  |

#### 4.26 **Ludwigia grandiflora** *grote waterteunisbloem*

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL., www.cabi.org  |
| Origin  | <i>L. grandiflora</i> is a productive emergent perennial native to South and Central America and parts of the USA; ranging from the Rio La Plata in Argentina north to the south/south-eastern USA. In the USA, its range is primarily along the Atlantic coast and through the Gulf Coastal Plain (south-eastern New York through Florida, westward to Texas)   |
| Habitus | <i>L. grandiflora</i> is an emergent, aquatic, herbaceous perennial with two growth forms. During the first growth stage, the plant produces smooth or sparsely pubescent stems that grow horizontally over the soil or water, rooting at nodes and producing white, spongy roots. Leaves are smooth, alternate and have petioles. During the second stage, shoots begin to grow vertically and flower, stems become pubescent and can grow up to 1 m tall.  |
| Alien   | It was introduced to France in 1830 and has become one of the most damaging invasive plants in that country. It was more recently introduced beyond its native range in the USA, where it also causes severe problems. In its non-native range, <i>L. grandiflora</i> can transform ecosystems both physically and chemically. It can sometimes be found growing in impenetrable mats; under these conditions, <i>L. grandiflora</i> can displace native flora and interfere with flood control and drainage systems, clog waterways and impact navigation and recreation. The plant also has allelopathic activity that can lead to dissolved oxygen crashes and the accumulation of sulphide and phosphate in the water. These not insubstantial and year-round effects on water quality can cause 'dystrophic crises' and intoxicated ecosystems. |
| Wadden  | So far, this species is lacking from the Wadden Islands.   |

Table 4.51 Number squares (5x5 km) with *Ludwigia grandiflora* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 103 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|            |  |
|------------|--|
| Pathway(s) | Humans may be the primary vector of transmission. <i>L. grandiflora</i> has been historically valued as an ornamental; ornamental plantings likely explain its introduction to Europe. <i>L. grandiflora</i> disperses primarily through the movement of plant parts in water, although sexual reproduction and transportation of the resulting seeds may also be an important means of dispersal. Water currents can generate very high propagule pressure and water-mediated dispersal of stem fragments or floating mats can contribute both to population growth and invasive spread |
|------------|--|

Natura 2000 Species could potentially occur in wet dune slacks (H2190) with permanent or nearly permanent water.

Risk *L. grandiflora* can cause very severe environmental impacts. It gives off allelopathic elements that impact water quality throughout the year. Nuisance levels of the plant can lead to impoverished flora by decreasing seedling survival of vulnerable native taxa. *L. grandiflora* can manipulate dissolved oxygen concentrations, causing severe hypoxia or even anoxia during summer months. The plant also causes sulphate and nitrate levels to drop in favour of increased sulphide and phosphate concentrations, thus causing 'a dystrophic crisis' and an intoxicated ecosystem.

Due to the species' ability to shade out other submersed vegetation, it is generally considered a threat to biodiversity in its introduced range. Its allelopathic activity is detrimental to vulnerable native flora, as the chemical alterations the plant effects on the habitat contribute to decreasing seedling viability.

Table 4.52 The ISEIA score for *Ludwigia grandiflora*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

Management As stem fragments are easily transportable, it is extremely important to decrease the instances of accidental introduction by addressing humans as a vector. By establishing guidelines on how to properly clean equipment, dispose of aquarium water, and identify target plants, it is likely that instances of accidental transportation and release will decrease. This species is widely available in the horticultural trade and therefore education and legislation should be targeted at addressing the threat of intentional introduction. In The Netherlands this species may not be sold anymore since 2004.

Conclusion A potential threat for flora and fauna in the wet dune slacks.

#### 4.27 *Ludwigia peploides* *kleine waterteunisbloem*

Sources Wikipedia-UK, Wikipedia-NL.

Origin *L. peploides* is native almost all over the United States. It lives predominately along east and south west coast. States between Nevada, Washington, Michigan and all states north of New York do have a native species of *L. peploides* nor are they invasive.

|         |  |
|---------|--|
| Habitus | <p><i>L. peploides</i> is an herbaceous perennial wetland plant usually common along mud or a water surface. <i>L. peploides</i> sprawl flat along the mud or water surface. It is very similar to the <i>Ludwigia hexapetala</i> and very difficult to tell apart. The leaves are arranged in clusters and vary in size.</p> <p>The reason these plants are scattered all over the globe is because <i>Ludwigia</i> can be generated during all seasons just from fragments of stems or rhizomes. They can be broken as easily by wind, water flow or animals. <i>Ludwigia peploides</i> have the ability to double their biomass from their broken particles between 15 to 90 days. This also allows this species to continue to thrive in habitat and regions where sexual reproduction cannot occur.</p> |
| Alien   | <p>It is native to many parts of the Americas, but it can be found on many continents and spreads easily to become naturalized. It is well known as a troublesome aquatic noxious weed that invades water ecosystems and can clog waterways. This is perennial herb, which grows in moist to wet to flooded areas. It is considered the most invasive alien aquatic plants in France. They have spread all across the country at such alarming rates that it has been assigned to the German Black List of invasive species,</p> <p>In the Netherlands the species is rare, probably because of incapability to produce fertile seeds in this climate.</p>   |
| Wadden  | So far, this species is lacking from the Wadden Islands.   |

Table 4.53 Number squares (5x5 km) with *Ludwigia peploides* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlle | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 5  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.54 The ISEIA score for *Ludwigia peploides*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 1     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

|             |   |
|-------------|---|
| Pathway(s)  | The plants were traded originally for ornamental purposes. A ban on trade will hopefully prevent any further spread and ecological impact.        |
| Natura 2000 | Species could potentially occur in wet dune slacks (H2190) with permanent or nearly permanent water.  |
| Risk        | Due to the species' ability to shade out other submersed vegetation, it is generally considered a threat to biodiversity in its introduced range. |



|            |   |
|------------|---|
|            | Its allelopathic activity is detrimental to vulnerable native flora, as the chemical alterations the plant effects on the habitat contribute to decreasing seedling viability.  |
| Management | As stem fragments are easily transported, it is extremely important to decrease the instances of accidental introduction by addressing humans as a vector. This species is widely available in the horticultural trade; therefore, education and legislation should be targeted at addressing the threat of intentional introduction. In The Netherlands this species may not be sold anymore since 2010. |
| Conclusion | A potential threat to native flora and fauna in wet dune slacks.  |

#### 4.28 **Mephitis mephitis** *gestreept stinkdier*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL, Van Belle & Schut 2011.   |
| Origin  | The striped skunk <i>Mephitis mephitis</i> is a skunk of the genus <i>Mephitis</i> , native to southern Canada, the United States and northern Mexico. It is known for of its wide range and ability to adapt to human-modified environments.   |
| Habitus | <p>The striped skunk is a stoutly-build, short-limbed animal with a small, conical head and a long, heavily furred tail. Adult males are 10% larger than females, with both sexes measuring 52-77 cm (total body length) and usually weighing 1.8–4.5 kg, though some may weigh 5.5 kg. The feet are plantigrade with bare soles and are not as broad or flat as those of hog-nosed skunks. The forefeet are armed with five long, curved claws adapted for digging, while the those on the hind feet are shorter and straighter. Like all skunks, the striped skunk possesses two highly developed scent glands on each side of the anus, containing about 15 ml of musk each.</p> <p>The striped skunk inhabits a wide variety of habitats, particularly mixed woodlands, bushy corners and open fields interspersed with wooded ravines and rocky outcrops. Some populations prefer cultivated areas instead of uncultivated ones.</p> <p>The striped skunk is polygamous, and normally breeds once a year, though yearling females who have failed to mate may enter a second oestrous cycle a month after the first. The mating season usually occurs between mid-February to mid-April, though it is delayed at higher latitudes.</p> <p>The gestation period lasts around 59–77 days, with kits being born at about mid-May to early June. Litters generally consist of 2–10 kits. Kits are born blind and sparsely furred, weighing 25–40 grams. The eyes open after around three weeks, and are weaned after 42–56 days. At this point, the kits may accompany their mother outside the den, becoming independent after 2½ months.</p> |

Alien The species is kept for fur, as well as a pet. Dutch animals are presumed escapes or releases, with probably at least one reproducing group (Friesland).

Wadden To date, the species is lacking on the Wadden Sea islands.

Table 4.55 Number squares (5x5 km) with *Mephitis mephitis* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 6  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) The striped skunk is one of North America's most sought after furbearers. The striped skunk is easily tamed, and was often kept in barns to kill rats and mice during the 19th century. Selective breeding has resulted in the emergence of various colour mutations, including black, chocolate-brown or smoky grey and white, apricot, albino, white, lavender, champagne and mahogany.

Natura 2000 Striped skunks are a potentially threat for ground-dwelling species, especially birds and amphibians.

Risk As a ground-dwelling species, it is a risk for ground breeding and ground feeding species, especially colonial breeding birds.

Table 4.56 The ISEIA score for *Mephitis mephitis*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 1     |

Management If deemed necessary, numbers can easily be regulated by catching or culling.

Conclusion A potential threat to Natura 2000 areas.

#### 4.29 *Myriophyllum aquaticum* parelvederkruid

Sources Wikipedia-UK, Wikipedia-NL.

Origin Parrot-feather *Myriophyllum aquaticum* is native to the Amazon River in South America, but it can now be found on every continent except Antarctica.

Habitus Parrot-feather is a perennial plant. The woody emergent stems grow over 5 feet long and will extend to the bank and shore. Almost all plants of this species are female, in fact there are no male plants found

outside of South America. Seeds are not produced in any North American plants. Parrot-feather reproduces asexually. New plants grow from fragments of already rooted plants. The plant has whorls of feathery blue-green to waxy gray-green leaves deeply cut into many narrow lobes.

Parrot-feather typically grows in freshwater streams, ponds, lakes, rivers, and canals that have a high nutrient content.

**Alien** It is thought that this plant was introduced to North America around the late 1800s. It was first discovered in the United States in the 1890s in Washington D.C. During the 20th century it colonized areas in South Africa, Japan, England, New Zealand, and Australia. As it prefers a warmer climate, it is chiefly found in the southern parts of the United States and Europe.

**Wadden** Known from two locations on the Wadden Islands in the dunes of Texel and Schiermonnikoog.

*Table 4.57 Number squares (5x5 km) with Myriophyllum aquaticum in The Netherlands (NL) and the Wadden Sea islands.*

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 231 | 1     | 0    | 0    | 0    | 1     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

**Pathway(s)** Parrot-feather is used for indoor and outdoor aquatic use. It is a popular plant in aquatic gardens. It spreads easily and has become an invasive species and a noxious weed in many areas. The plant can be introduced to new areas when sections of its rhizome are dug up and moved.

**Natura 2000** H2190A+D (wet dune slacks, open water and relatively eutrophic marshland)

*Table 4.58 The ISEIA score for Myriophyllum aquaticum; see appendix 1 for a legend.*

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

**Risk** While parrot-feather may provide cover for some aquatic organisms, it can seriously change the physical and chemical characteristics of lakes and streams. The parrot feather grows abundantly and shades out naturally occurring algae. The parrot-feather grows in bundles and emerges out of the water. In large numbers, the plants make a dense

|            |  |
|------------|--|
|            | mat on the water's surface. Because of this, they shade the water from sunlight and cause native plants to die because of light deficiency. The organisms that feed on the native plants can die off due to starvation.  |
| Management | Species is hard to control. Cutting and chopping can actually promote the plant's spread. Most effective is to dry out the waterbody and remove plants with the underwater bottom.<br>This plant is one of six introduced aquatic plants (Annex I) which are banned from sale since July 2010. |
| Conclusion | A threat to Nature 2000 conservation goals.  |

#### 4.30 **Myriophyllum heterophyllum** *ongelijkbladig vederkruid*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL, www.cabi.org.   |
| Origin  | <i>M. heterophyllum</i> is an aquatic plant native to the southern USA; Virginia to Florida, northward to Ontario and Michigan, and westward to Missouri and Texas. It is considered invasive elsewhere in the USA and as an emerging invader in Europe.  |
| Habitus | <i>M. heterophyllum</i> is an aquatic plant that has submerged vegetation with emergent flowering spikes. Plants hermaphroditic, occasionally monoecious. Stem stout, to 100 cm; internodes crowded. Submerged leaves 4- or 5-whorled or scattered, pectinate, oblong in outline, (1; segments in 5-12 pairs, filiform.<br><i>M. heterophyllum</i> occurs primarily in lakes, ponds, rivers and swamps, but can also grow in a semi-terrestrial form when stranded on mudflats. Asexual vegetative propagation is thought to be the dominant mode of reproduction in introduced populations |
| Alien   | In Europe, it is found in Austria, Belgium, France, Germany, Netherlands and Spain and possible in other countries in Western Europe.   |
| Wadden  | The species is still lacking on the Wadden islands.   |

Table 4.59 Number squares (5x5 km) with *Myriophyllum heterophyllum* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 75 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|            |   |
|------------|---|
| Pathway(s) | <i>M. heterophyllum</i> is a popular plant in the aquarium and water gardening trades and can readily be obtained from any number of aquatic plant vendors under a variety of names. Plants genetically confirmed as <i>M. heterophyllum</i> have been purchased from a variety of vendors under a variety of common names (myrio, foxtail, and parrotfeather) and scientific names of ( <i>M. heterophyllum</i> , <i>M. pinnatum</i> , |
|------------|---|

*M. tuberculum*, *M. aquaticum* and *M. simulans*). Once escaped from an aquarium or cultivated pond, *M. heterophyllum* is capable of spreading through vegetative fragments. As such, it can be moved around by any number of water and animal vectors and may be commonly transported among water bodies on boats and boat trailers. Seeds may also be dispersed by animal vectors.

Natura 2000 Potentially a risk for wet dune slacks (H2190A, 2190D).  
 Risk *M. heterophyllum* is highly competitive and able to outcompete other aquatic plants. It forms dense mats of submergent vegetative material throughout the water column and at the water surface, which can prevent water flow, reduce sunlight and reduce oxygen availability. The resulting low oxygen conditions can harm or kill aquatic organisms

Table 4.60 The ISEIA score for *Myriophyllum heterophyllum*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

Management Species is hard to control. Cutting and chopping can actually promote the plant's spread. Most effective is to dry out the water body and remove plants with the underwater bottom.

This plant is listed on Annex II of the Agreement on water plants; beware of the risk (July 2010).

Conclusion A potential threat for Nature 2000 conservation goals.

#### 4.31 **Neovison vison** Amerikaanse nerts

Sources Wikipedia-UK, Wikipedia-NL, Dekker 2012.

Origin The American mink *Neovison vison* is a semiaquatic species of mustelid native to North America, though human intervention has expanded its range to many parts of Europe and South America.

Habitus American mink territories are held by individual animals with minimal intra-sex overlap, but with extensive overlap between animals of the opposite sex. Most territories are located in undisturbed, rocky, coastal habitats with broad littoral zones and dense cover. They may also occur on estuaries, rivers and canals near urban areas. Home ranges are typically 1–6 kilometres long, with male territories being larger than those of females. The American mink is a carnivore, which feeds on rodents, fish, crustaceans, frogs, and birds. The American mink may nest in burrows dug previously by muskrats, badgers and skunks, and may also dig dens in old ant-hills.

|        |   |
|--------|---|
| Alien  | The American mink was first imported to Great Britain in 1929, though a series of escapes and releases lead to the establishment of a self-sufficient feral population in Devon by the late 1950s, and others by the early 1960s. In Ireland, the American mink was not farmed until the early 1950s, thus feral populations established themselves there much later. The species is now widespread in mainland Great Britain and Ireland, though some places remain not colonised. The total mink population in Great Britain is estimated at 110,000. This population may be declining as European otter numbers increase. There are no estimates for the mink population in Ireland, but it is thought to be low, because of Ireland's strong otter population. In the Netherlands numbers are limited, probably due to the fact that American mink is a by-catch in muskrat traps. New introductions originate exclusively from farms and are restricted to the surroundings of farms. No reproduction has been proven yet. |
| Wadden | Species is lacking from the Wadden Sea islands.   |

Table 4.61 Number squares (5x5 km) with Neovison vison in The Netherlands (NL) and the Wadden Sea islands.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 225 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|            |   |
|------------|---|
| Pathway(s) | It is the most frequently farmed animal for its fur, exceeding the silver fox, sable, marten, and skunk in economic importance.<br>Breeding American minks for their fur began in the late 19th century, as increasing enthusiasm for mink pelts made the harvesting of wild minks insufficient to meet the new demands. American minks are easily kept in captivity, and breed readily. In 2005, the U.S. ranked fourth in production behind Denmark, China and the Netherlands. Minks typically breed in March, and give birth to their litters in May. Farmers vaccinate the young kits for botulism, distemper, enteritis, and, if needed, pneumonia. They are harvested in late November and December. |
|------------|---|

Table 4.62 The ISEIA score for Neovison vison; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

|             |  |
|-------------|--|
| Natura 2000 | Americans minks are a potential threat to ground breeding species. |
|-------------|--|

|            |  |
|------------|--|
| Risk       | In its introduced range in Europe it has been classified as an invasive species linked to declines in European mink, Pyrenean desman, and water vole populations. It is the most frequently farmed animal for its fur, exceeding the silver fox, sable, marten, and skunk in economic importance.  |
| Management | Although difficult to catch, the American mink, prior to being commercially farmed, was among the most frequently trapped furbearers as, unlike other furbearing mammals, it did not hibernate in winter, and could thus be caught on a nightly basis even in the far north. In the Netherlands many escapes are caught quite easily in muskrat traps. |
| Conclusion | It is a potential threat. Since fur farms are lacking on the islands the introduction risk is very limited.  |

#### 4.32 **Nyctereutes procyonoides** *wasbeerhond*

|         |   |
|---------|---|
| Sources | Wikipedia-NL, Wikipedia-UK, Mulder (2011).  |
| Origin  | The raccoon dog <i>Nyctereutes procyonoides</i> is a canid indigenous to East Asia. It is the only extant species in the genus <i>Nyctereutes</i> . It is considered a basal canid species, resembling ancestral forms of the family. The raccoon dog is named for its superficial resemblance to the raccoon <i>Procyon lotor</i> , to which it is not closely related. Native East Asian raccoon dog populations have declined in recent years due to hunting, fur trade, urbanization, an increase of animals associated with human civilization such as pets and abandoned animals, and diseases that may be transmitted between them. Following its introduction into central and western Europe, however, it has been treated as a potentially hazardous invasive species.  |
| Habitus | <p>In reflection of their omnivorous diets, raccoon dogs have small and weak canines and carnassials, flat molars and relatively long intestines. They have long torsos and short legs. Total lengths can range from 45 to 71 cm. The tail, at 12 to 18 cm long, is short, amounting to less than 1/3 of the animal's total length and hangs below the tarsal joints without touching the ground. The ears are short and protrude only slightly from the fur.</p> <p>The mating season begins from early February to late April, depending on location. Raccoon dogs are monogamous animals, with pair formations usually occurring in autumn. The gestation period lasts 61–70 days, with pups being born in April–May. Litter sizes on average consist of 6–7 pups, though 15–16 pups can be born in exceptional cases. Raccoon dogs are the only canids known to hibernate.</p> <p>Raccoon dogs are relatively slow, omnivores that feed on insects, rodents, amphibians, birds, fish, reptiles, molluscs, carrion and</p> |

|        |  |
|--------|--|
|        | insectivores (and their eggs). Plant food is highly variable, and includes bulbs, rhizomes, oats, millets, maize, nuts, fruits, berries, <i>etc.</i>   |
| Alien  | From 1928–1958, 10,000 raccoon dogs of the <i>N. p. ussuriensis</i> subspecies were introduced in 76 districts, territories and republics of the Soviet Union in an attempt to improve their fur quality. In 1948, 35 raccoon dogs were introduced into Latvia. The population increased rapidly. In 1960, Latvia officially reported a total of 4,210 raccoon dog were hunted. The raccoon dog is now abundant throughout Finland, Estonia, Latvia, and Lithuania, and has been reported as far away as Serbia, France, Romania, Italy, Switzerland, Germany, Norway, Denmark, and Sweden. In response, Denmark set a goal of zero breeding raccoon dogs by 2015. Deliberate introductions are known on German islands in the Baltic Sea. |
| Wadden | This species is spreading and increasing in numbers in Germany, despite the fact that substantial numbers are shot annually. In recent years the number of observation in The Netherlands has increased. It is mainly seen in the eastern half of the country. To date, no observations are known on the Wadden Islands.   |

Table 4.63 Number squares (5x5 km) with *Nyctereutes procyonoides* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 81 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.64 The ISEIA score for *Nyctereutes procyonoides*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 11    |
| Certainty                                  | 2     |

|             |  |
|-------------|--|
| Pathway(s)  | Animals in Western Europe have their ancestors in Western Russia and the Baltic states. Since then they expand their range and increase in number by natural reproduction.           |
| Natura 2000 | To date, no raccoon dogs have been observed in Natura 2000 areas on the Wadden Sea islands.  |
| Risk        | If present, due to their feeding habit, the raccoon dog is a threat to ground breeding birds (egg predation), bush breeding (birds), amphibians and fish living near the water edge. |
| Management  | This relatively slow species is easily shot, but is mainly active during the night, which limits management actions. .If numerous, shooting is the only option.                      |



Conclusion To date, the raccoon dog is a potential threat and its possible occurrence on the Wadden Sea islands should be monitored.

#### 4.33 *Oxyura jamaicensis* *rosse stekelstaarteend*

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK, Deuzeman & Slaterus (2014).  |
| Origin  | The ruddy duck <i>Oxyura jamaicensis</i> is a stiff-tailed duck from North America and the Andes Mountains of South America. The nominate subspecies has a large distribution range from Mexico in the south, deep into Canada. Northern populations are migratory. In the Andes three subspecies occur, breeding in mountain lakes.   |
| Habitus | Their breeding habitat is marshy, shallow lakes and ponds. They nest in dense marsh vegetation near water. The female builds the nest out of grass, locating it in tall vegetation to hide it from predators. A typical brood contains 5 to 15 ducklings. Pairs form each year. They winter in coastal bays and unfrozen lakes and ponds. These birds dive and swim underwater. They mainly eat seeds and roots of aquatic plants, aquatic insects and crustaceans.  |
| Alien   | As a result of escapes from wildfowl collections in the late 1950s, they became established in Great Britain, from where they spread into Europe. This duck's aggressive courting behaviour resulted in frequent hybridization with the globally endangered, native white-headed duck ( <i>Oxyura leucocephala</i> ) in Spain, which caused concern amongst Spanish conservationists. Due to this, a ambitious scheme to extirpate the ruddy duck from Great Britain started; there have also been culling attempts in other European countries. By early 2014, the cull had reduced the British population to about 20–100 individuals, down from a peak of about 5500 birds in 2000. |

Table 4.65 Number squares (5x5 km) with breeding *Oxyura jamaicensis* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 10 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.66 The ISEIA score for *Oxyura jamaicensis*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

|             |  |
|-------------|--|
| Wadden      | The ruddy duck is a rare visitor to the Wadden Island and it is not known as a breeding bird on the Islands. On a yearly base, about 10 pairs are found breeding in the Netherlands. Distribution and abundance of this species in The Netherlands is monitored (Sovon) and management actions have been started.  |
| Pathway(s)  | The ruddy duck is kept in waterfowl collections (see Avibase); from there it might escape. They are easy to breed in captivity.  |
| Natura 2000 | At this moment in the Netherlands no habitat types or species are threatened by this stiff-tailed duck (but elsewhere in Europe). The species hybridizes with the globally threatened White-headed duck in Spain.  |
| Risk        | The ruddy duck is dominant over the endangered native white-headed duck and produces fertile hybrids with this species. The native species occur in very small numbers in Spain and small numbers in Southeast-Europe. After shooting all ruddy ducks in Spain no hybrids have been found and the situation in Spain seems to be under control now; nonetheless the white-headed duck is still highly endangered. No one has ever investigated the impact on other (diving) waterfowl in Western Europe. |
| Management  | The eradication of the ruddy duck is the only option to reduce the threat for a native, threatened species. Furthermore trade (and keeping) should be stopped.   |
| Conclusion  | Currently, the ruddy duck is a threat to Natura 2000 goals elsewhere in Europe, not on the Wadden Sea islands themselves.  |

#### 4.34 **Oenothera parviflora** (*O. oakesiana*, *O. deflexa*) duin- en zandteunisbloem

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL.  |
| Origin  | This species is native in eastern North America. Recently split into <i>Oenothera oakesiana</i> (the former var. <i>ammophila</i> , known mainly from the dunes) and <i>deflexa</i> (the former var. <i>parviflora</i> , only known from inland areas) after a taxonomic revision of the genus.                                    |
| Habitus | Small-flowered evening-primrose or northern evening primrose <i>Oenothera parviflora</i> is a biennial or perennial native wildflower that can grow to five feet (150 cm) in height. The stems are variably hairy, and the hairs may have glands at their bases or at their tips. It grows in calcareous sandy soils in the dunes. |
| Alien   | Two of several North-American species introduced to Europe mostly by transports of grain in the 18th century, many of which are now naturalised in European ecosystems   |
| Wadden  | It is growing on all islands. Two other species of <i>Oenothera</i> ( <i>O. biennis</i> and <i>O. glazioviana</i> ) occur on all islands, as well as their hybrid ( <i>O. x fallax</i> )   |

Table 4.67 Number squares (5x5 km) with *Oenothera parviflora* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 84 | 1     | 4    | 4    | 5    | 3     | 2       | 1     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.68 The ISEIA score for *Oenothera parviflora*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 12    |
| Certainty                                  | 2     |

|             |   |
|-------------|---|
| Pathway(s)  | Spreads easily by seeds.  |
| Natura 2000 | Grows in the outer dune ridges (H2120, H2130). <i>O. oakesiana</i> is even a considered a typical species of H2120. |
| Risk        | Hardly competing with native flora, the other two species of <i>Oenothera</i> cause just as many problems.          |
| Management  | Species does not stand mowing and chopping. Should be done for some years because of a seedbank.                    |
| Conclusion  | A threat to Nature 2000 conservation goals.   |

#### 4.35 **Populus alba** *witte abeel*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL.   |
| Origin  | <i>Populus alba</i> is native from Morocco and the Iberian Peninsula through central Europe (north to southern Germany and Poland) to central Asia.   |
| Habitus | It is a medium-sized deciduous tree, growing to heights of up to 16–27 m (rarely more), with a trunk up to 2 m diameter and a broad rounded crown. The bark is smooth and greenish-white to greyish-white with characteristic diamond-shaped dark marks on young trees, becoming blackish and fissured at the base of old trees. The young shoots are covered with whitish-grey down, including the small buds. The leaves are 4–15 cm long, five-lobed, with a thick covering of white scurfy down on both sides but thicker underneath; this layer wears off the upper side but not the lower, which stays white until autumn leaf fall. Larger, deeply lobed leaves are produced on fast-growing young trees, and smaller, less deeply lobed leaves on older, slow-growing trees. The flowers are catkins up to 8 cm long, produced in early spring; they are dioecious, with male and female catkins on separate trees; the male catkins are grey with conspicuous dark red stamens, the female catkins |

are greyish-green. The female catkins lengthen to 8–10 cm after pollination, with several green seed capsules, maturing in late spring to early summer. It also propagates by means of root suckers growing from the lateral roots, often as far as 20–30 m from the trunk, to form extensive clonal colonies.

It requires abundant light and ample moisture, and stands up well to flood water and slightly acidic soils. It is very attractive as an open-grown tree in water meadows, and, because of its extensive root system and tolerance of salt, is also planted to strengthen coastal sand dunes.

**Alien** *P. alba* is considered not to be native in the low countries along the North Sea. It has come to be considered weedy or invasive, and has been banned in parts of the USA.

**Wadden** Species occurs on all islands, including the smaller Rottumerplaat. This shows the capacity of spreading and colonizing by root or seed.

Table 4.69 Number squares (5x5 km) with *Populus alba* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1216 | 10    | 6    | 4    | 4    | 2     | 2       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.70 The ISEIA score for *Populus alba*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

**Pathway(s)** It is planted on many sites in the low countries, especially in the coastal areas due to its salt resistance. From these stands it can spread clonally by roots or by seed.

**Natura 2000** *Populus alba* can colonize parts of the dune forest (H2180).

**Risk** Due to its high growth rate *Populus alba* can outcompete other tree species in the canopy.

**Management** After cutting much root storage can occur.

**Conclusion** A threat to Natura 2000 forest.

#### 4.36 **Populus x canadensis** *Canada populier*

**Sources** Wikipedia-UK, Wikipedia-NL.

|         |  |
|---------|--|
| Origin  | <i>Populus x canadensis</i> is a hybrid between <i>P. deltoides</i> × <i>P. nigra</i> , the first being native in the USA and the second in Europe.                    |
| Habitus | is a medium-sized to large deciduous tree, reaching 20–30 m (rarely 40 m) tall, with a trunk up to 1.5 m diameter, though some old individuals have grown much bigger. |
| Alien   | This hybrid exists since about 1750, originated from France. Popular tree along roads and canals; highly wind resistance.  |
| Wadden  | Used on locations on the windy Wadden Islands.   |

Table 4.71 Number squares (5x5 km) with *Populus x canadensis* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1234 | 7     | 1    | 1    | 1    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.72 The ISEIA score for *Populus x canadensis*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 10    |
| Certainty                                  | 3     |

|             |   |
|-------------|---|
| Pathway(s)  | Can produce viable seed and may interbreed with other <i>Populus</i> species ( <i>P. nigra</i> ) or races.  |
| Natura 2000 | It may occur in the dune forest (H2180), but colonisation is slow.  |
| Risk        | Risk of interbreeding with other <i>Populus</i> species, which could lead to a combination of features, which do well in a salty and windy environment. |
| Management  | Cutting trees is the best option. After cutting, root storage can occur, but not as extensive as in <i>P. alba</i> and <i>P. x canescens</i> .          |
| Conclusion  | A minor threat to Natura 2000 forest.   |

#### 4.37 *Populus x canescens* *grauwe abeel*

|         |   |
|---------|---|
| Sources | Wikipedia-UK, Wikipedia-NL,   |
| Origin  | Its natural range is in the Middle East and South- and Central-Europe. <i>Populus x canescens</i> , the grey poplar, is a hybrid between <i>Populus alba</i> white poplar and <i>Populus tremula</i> common aspen. It is intermediate between its parents, with a thin grey downy coating on the leaves, which are also much less deeply lobed than the leaves of <i>P. albus</i> . |

*Populus alba* is native from Morocco and the Iberian Peninsula through central Europe (north to southern Germany and Poland) to central Asia. *Populus tremula* is a species of poplar native to cool temperate regions of Europe and Asia, from Iceland and the British Isles east to Kamchatka, north into the Arctic Circle in Scandinavia and northern Russia, and south to central Spain and Turkey.

**Habitus** *Populus* × *canescens*, the grey poplar, is a hybrid between *Populus alba* (white poplar) and *Populus tremula* (common aspen). It is intermediate between its parents, with a thin grey downy coating on the leaves, which are also much less deeply lobed than the leaves of *P. alba*.

It can become a very vigorous tree with marked hybrid vigour, reaching 40 m tall and with a trunk diameter over 1.5 m – much larger than either of its parents. Most trees in cultivation are male, but female trees occur naturally and some of these are also propagated. In dune areas it often remains low, even shrublike.

**Alien** From its natural range this hybrid is exported all over the western world, for use as a road side tree, and in gardens and parks. Therefore it is grown in horticulture. In the Netherlands different races grow. *Populus* × *canescens* grows naturally in the inside range of the dunes along the Dutch coast. Since this interbreed arose south in Central Europe, in a more milder climate 250 years ago, one might argue that nowadays it could have reached The Netherlands on its own. And therefore *P. x canescens* is native.

**Wadden** On Texel this hybrid is widely spread along the inside dunes. In other islands it has been recorded as well.

Table 4.73 Number squares (5x5 km) with *Populus x canescens* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vle | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|-----|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1070 | 10    | 4   | 6    | 3    | 2     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.74 The ISEIA score for *Populus x canescens* ; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 3     |

**Pathway(s)** From existing stands it spreads easily by roots or seed.

**Natura 2000** This species often occur in the dune forest (H2180).

**Risk** Due to its relative high growth speed, this species is very competitive.

Management Cutting trees is the best option. After cutting, root storage can occur.  
Conclusion A minor threat to Natura 2000 forest.

#### 4.38 *Procyon lotor* wasbeer

Sources Wikipedia-UK, Wikipedia-NL, Lammertsma *et al.* 2008.  
Origin The raccoon *Procyon lotor*, sometimes spelled racoon is a medium-sized mammal native to North America.  
Habitus The raccoon is the largest of the procyonid family, having a body length of 40 to 70 cm and a body weight of 3.5 to 9 kg. The diet of the omnivorous raccoon, which is usually nocturnal, consists of about 40% invertebrates, 33% plant foods, and 27% vertebrates.  
The original habitats of the raccoon are deciduous and mixed forests, but due to their adaptability they have extended their range to mountainous areas, coastal marshes, and urban areas, where some homeowners consider them to be a nuisance species.  
Home range sizes vary anywhere from 3 ha for females in cities to 50 km<sup>2</sup> for males in prairies.  
Alien As a result of escapes and deliberate introductions in the mid-20th century, raccoons are now also distributed across mainland Europe, Caucasia, and Japan. Sightings have occurred in all the countries bordering Germany, which hosts the largest population outside of North America. Another stable population exists in northern France, where members of the U.S. Air Force near the Laon-Couvron Air Base released several raccoons, which were kept as pets, in 1966. About 1,240 animals were released in nine regions of the former Soviet Union between 1936 and 1958 for the purpose of establishing a population to be hunted for their fur. Two of these introductions were successful. By 2012 it was estimated that Germany now had more than a million raccoons.  
Wadden To date, the raccoon does not occur on the Wadden Sea Islands.

Table 4.75 Number squares (5x5 km) with *Procyon lotor* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 28 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Pathway(s) Raccoons are sometimes kept as a pet and were kept for its fur. Wild populations in Germany will be the major source for spread into the Netherlands, which is inevitable in relation to the German population size.

|             |   |
|-------------|---|
| Natura 2000 | Ground breeding species (eggs of terns, gulls) might be a major food for raccoons if they would occur on the Wadden Sea islands.  |
| Risk        | Raccoons can carry rabies, a lethal disease caused by the neurotropic rabies virus carried in the saliva and transmitted by bites, and raccoon round worm, a potentially fatal disease for humans and dogs. |

Table 4.76 The ISEIA score for *Procyon lotor*; see appendix 1 for a legend.

|   | score |
|---|-------|
| <i>Dispersal potential or invasiveness</i>        | 2     |
| <i>Colonisation of high conservation habitats</i> | 2     |
| <i>Adverse impacts on native species</i>          | 3     |
| <i>Alteration of ecosystem functions</i>          | 3     |
| <i>sum of scores</i>                              | 10    |
| <i>Certainty</i>                                  | 2     |

|            |   |
|------------|---|
| Management | The raccoon was a protected species in Germany, but has been declared a game species in 14 states since 1954. Hunters and environmentalists argue the raccoon spreads uncontrollably, threatens protected bird species and competes with native carnivores. Since raccoons in high mortality areas have a higher rate of reproduction, extensive hunting may not solve problems with raccoon populations. Older males also claim larger home ranges than younger ones, resulting in a lower population density. |
| Conclusion | A potential threat for ground living and ground breeding species (birds in colonies) on the Wadden Sea islands.   |

#### 4.39 *Prunus serotina* Amerikaanse vogelkers

|         |   |
|---------|---|
| Sources | Wikipedia-NL, Wikipedia-UK,   |
| Origin  | North America, mid west - east coast  |
| Habitus | Woody species from the understory of the forest. Flowering in May, producing large amounts of seeds in autumn. Seeds transported by birds and mammals. Species grows mainly in pioneer-situations. It is in fact a tree species, whereas in the Netherlands we mainly know it as a shrub as it rarely is enabled to grow for long periods.  |
| Alien   | Introduced nearly a century ago, mainly to improve the soil in forests on poor sandy soils. Leaves decompose easily and it is used soil improver on a large scale in the eastern half of the Netherlands and in dune forests. On many places dominant in the understory of forests. In the sixties and seventies, when the perspective on the use of forests changed, it became clear <i>Prunus serotina</i> had become a pest. Nowadays on the management list of Boschap, a forest management organisation. |



Wadden *Prunus serotina* is present and widespread on all five main Wadden Sea islands, as well as in nearly all squares with suitable habitat on those islands.

Table 4.77 Number squares (5x5 km) with *Prunus serotina* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1254 | 9     | 4    | 6    | 4    | 5     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

Table 4.78 The ISEIA score for *Prunus serotina*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

Pathway(s) Because of its widespread occurrence on all five main islands it forms a large and local source of seed. Birds and mammals easily spread the seeds.

Natura 2000 *Prunus serotina* grows in the dune forests, sometimes forming dense stands in the understory. Furthermore, the species colonizes quite rapidly grey dunes (especially decalcified).

Risk Where it grows, native species are declining. It speeds up the succession from grey dunes to dune forests.

Management Much effort has been made, to eradicate of this species, especially in forests in the seventies and eighties of the 20th century. Nowadays these efforts have been slowed down in certain areas, but in other areas (such as the Amsterdam dunes) it has recently been intensified after an enormous increase in the last two decades. If circumstances evolve towards a more mature forest system, this pioneer species most likely disappears as part of the natural succession. In dune areas it is also managed, for example, by goats, which include it in their diet in contrast with many other grazers.

Conclusion To date, this species is a major threat Natura 2000 conservation goals.

#### 4.40 **Quercus rubra** *Amerikaanse eik*

Sources Wikipedia-UK, Wikipedia-NL,

Origin *Quercus rubra*, commonly called northern red oak or champion oak, (synonym *Quercus borealis*), is an oak in the red oak group (*Quercus* section *Lobatae*). It is a native of North America, in the eastern and

|         |   |
|---------|---|
|         | central United States and southeast and south-central Canada. It prefers good soil that is slightly acidic. Often simply called "red oak", northern red oak is formally so named to distinguish it from southern red oak ( <i>Q. falcata</i> ), also known as the Spanish oak.  |
| Habitus | In many forests in its native range, this deciduous tree grows straight and tall, to 28 m, exceptionally to 43 m tall, with a trunk of up to 50–100 cm diameter. Open-grown trees do not get as tall, but can develop a stouter trunk, up to 2 m in diameter. It has stout branches growing at right angles to the stem, forming a narrow round-topped head. It grows rapidly and is tolerant of many soils and varied situations, although it prefers the glacial drift and well-drained borders of streams.[3] It is frequently a part of the canopy in an oak-heath forest, but generally not as important as some other oaks. |
| Alien   | <i>Quercus rubra</i> is introduced to Europe more than two centuries ago, first as an ornamental tree in parks and estates. In the twenties century the use as a forest tree started, They grow well on sandy acid soils in the eastern half of the country and the dunes. In the first decades <i>Q. rubra</i> develop more rapid compared to <i>Q. robur</i> .  |
| Wadden  | This species is growing in the dunes forests on all five main islands.  |

Table 4.79 Number squares (5x5 km) with *Quercus rubra* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1034 | 2     | 3    | 3    | 2    | 1     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |  |
|-------------|--|
| Pathway(s)  | Once introduced, or planted, further spread by natural dispersal of acorns. Acorns are food sources for Jay, Pheasant, Mice, squirrel, which contribute in the spread of this tree species.  |
| Natura 2000 | This species grows in the inner side of the dunes, on sites for relatively dry dune forest H2180A and H2180C.  |
| Risk        | Once present, this species is hard to eliminate; after cutting much root storage can occur. In stands of <i>Quercus rubra</i> the understory is lacking as well ground vegetation. Mainly due competence for light and in the upper soil layers for water. |

Table 4.80 The ISEIA score for *Quercus rubra*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 3     |

Management Species is hard to eliminate. After cutting much regrowth from roots occurs.

Conclusion A threat to dune forest.

#### 4.41 **Rana catesbeiana** *Amerikaanse brulkikker*

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK, Spitzen - van der Sluijs & Zollinger 2010.   |
| Origin  | The American bullfrog <i>Rana catesbeiana</i> , often simply known as the bullfrog in Canada and the United States, is an aquatic frog, a member of the family <i>Ranidae</i> , or “true frogs”. This frog is native to southern and eastern parts of the United States and Canada, but has been widely introduced across other parts of North, Central and South America, Western Europe, and parts of Asia, and in some areas is regarded as an invasive species.  |
| Habitus | Bullfrogs are sexually dimorphic, with males being smaller than females and having yellow throats. Males have tympani larger than their eyes, whereas the tympani in females are about the same size as the eyes. Bullfrogs measure about 9 to 15 cm from snout to vent. They grow fast in the first eight months of life, typically increasing in weight from 5 to 175 g and large mature individuals can weigh up to 500 g. In some cases bullfrogs have been recorded as attaining 800 g and measuring up to 20 cm in length. |
| Alien   | The American bullfrog is introduced to many places on earth; as a pet, for consumption and as pond decoration in gardens. In the Netherlands it was for quite a period traded as pond decoration. Currently, this is forbidden. The species is monitored and has been eradicated in the last remaining sites. Nowadays it does occur anymore in The Netherlands.   |
| Wadden  | The bullfrog has never been observed on the Wadden Sea islands.  |

Table 4.81 Number squares (5x5 km) with *Rana catesbeiana* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 0  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.82 The ISEIA score for *Rana catesbeiana*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 11    |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Pathway(s)  | This species is traded globally, for consumption (frog legs), as a pet and ornamental garden animals.  |
| Natura 2000 | This species has been eradicated recently.   |
| Risk        | Compared to native amphibians the bullfrog is of larger size and there for will eat native species. Furthermore, a part of the population is infected with <i>Batrachochytrium dendrobatidis</i> . For this mould or fungus the bullfrog is a vector, but for many native amphibian species this fungus is a severe threat, because most native species die after infection. |
| Management  | Small populations can be eradicated.   |
| Conclusion  | This species is a potential threat to native fauna in the wet dune slacks.   |

#### 4.42 **Rosa rugosa** *rimpelroos*

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK, Boer (2013).   |
| Origin  | <i>Rosa rugosa</i> (rugosa rose) is a species of rose native to eastern Asia, in northeast China, Japan, Korea and southeast Siberia, where it grows on the coast, often on sand dunes.  |
| Habitus | <i>Rosa rugosa</i> is a suckering shrub, which develops new plants from the roots and forms dense thickets 1–1.50 m tall with stems densely covered in numerous short, straight prickles 3–10 mm long. The leaves are 8–15 cm long, pinnate with 5–9 leaflets, most often 7, each leaflet 3–4 cm long, with a distinctly corrugated (rugose, hence the species' name) surface. The flowers are pleasantly scented, dark pink to white (on <i>R. rugosa</i> f. <i>alba</i> (Ware) Rehder), 6–9 cm across, with somewhat wrinkled petals; flowering occurs in spring. The hips are large, 2–3 cm diameter, and often shorter than their diameter, not elongated; in late summer and early autumn the plants often bear fruit and flowers at the same time. The leaves typically turn bright yellow before falling in autumn.   |
| Alien   | <i>Rosa rugosa</i> is widely used as an ornamental plant. It has been introduced to numerous areas of Europe and North America. It has many common names, several of which refer to the fruit's resemblance to a tomato, including beach tomato or sea tomato. This species hybridises readily with many other roses and is valued by rose breeders for its considerable resistance to the diseases rose rust and rose black spot. It is also extremely tolerant of seaside salt spray and storms, commonly being the first shrub in from the coast. It is widely used in landscaping, being relatively tough and trouble-free. Needing little maintenance, it is suitable for planting in large numbers; its salt-tolerance makes it useful for planting beside roads, which need de-icing with salt regularly. <i>Rosa rugosa</i> is naturalized in many parts of Europe, and it is considered an invasive species in some habitats, particularly in |

seashores of North Europe. It can out-compete native flora, thereby threatening biological diversity

Wadden Due to its characteristics this species occur on all major islands and some of the smaller ones. Every 5x5 square in the dune areas of the islands has its stands with *Rosa rugosa*.

Table 4.83 Number squares (5x5 km) with *Rosa rugosa* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 1012 | 13    | 7    | 8    | 5    | 5     | 2       | 0     | 2      | 1      | 0      | 0     | 0     | 0     |

Table 4.84 The ISEIA score for *Rosa rugosa*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 11    |
| Certainty                                  | 3     |

Pathway(s) This species was once introduced for ornamental purposes in gardens, parks and along roadsides. Once growing on a location, the species spreads by seed and rhizomes. At the end it forms dense stands.

Natura 2000 *Rosa rugosa* is wide spread in all Natura 2000 dune areas on the Wadden Islands; it colonizes grey dunes (H2130), bushes (H2160, H2170) and forests edges (H2180).

Risk *Rosa rugosa* forms extensive impenetrable thickets due to root and stem suckering. It displaces the natural flora of beach and dune vegetation and outcompetes early successional plant species in these habitats. It reduces the number of native species, irrespective of the dune type in which the shrub is established, affecting both common and rare species. The strong reduction of the species diversity is caused by the shading effect due to the high stand density. When local plant life is displaced the animal species that depend on these plants are also threatened (such as butterflies that lay the eggs only on certain seashore plants). A special problem is that *Rosa rugosa* has ecological demands comparable to those of *Rosa pimpinellifolia* and that especially young succession phases in dunes are affected. It has been found to colonize uninhabited, isolated islands affecting the pristine ecosystem. Besides, thickets of *Rosa rugosa* were seen starting dune formation, thereby altering the physical habitat substantially

Management The most efficient method for removing the species is to dig it up. There is a need to ensure that all rhizomes and roots have been removed. Furthermore, the procedure needs to be repeated until one is certain

that all rhizome pieces have been found and removed. The remaining rhizomes can be removed by hand. Mechanical measures or not that effective. Goats are the only animals that seem to be able to graze *Rosa rugosa* enough to control it efficiently

Conclusion *Rosa rugosa* is a big threat to Natura 2000 on the Wadden Islands. Control measures are costly, but could be effective.

#### 4.43 **Solidago gigantea** *late guldenroede*

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL, <a href="http://www.cabi.org/isc/datasheet/50575">www.cabi.org/isc/datasheet/50575</a> .   |
| Origin  | <i>Solidago gigantea</i> is a North American plant species in the sunflower family. Its common names include tall goldenrod and giant goldenrod, in reference to its height of up to 2 m tall, rather large for the genus, smooth goldenrod and late goldenrod. It is a widespread species known from most of non-arctic North America east of the Rocky Mountains. It has been reported from every state and province from Alberta to Nova Scotia to Florida to Texas, and also from the State of Nuevo León in north-eastern Mexico.   |
| Habitus | <i>Solidago gigantea</i> is a herb up to 200 cm tall, sometimes spreading by means of underground rhizomes. They often grow in clumps, with no leaves as the base but numerous leaves on the stem. At the top, each stem produces a sizable array of many small flower heads, sometimes several hundred. Each head is yellow, containing both disc florets and ray florets.<br>The habitat preferences of the North American <i>Solidago</i> species are wide. <i>S. gigantea</i> prefers heavy soil types and wetland edges. It usually colonizes semi-natural habitats and often occurs on riverbanks in central Europe. It establishes well in disturbed sites and becomes dominant due to extensive vegetative spread. In the exotic range in Hungary, <i>S. gigantea</i> proved to be a more successful invader than <i>S. canadensis</i> / <i>S. altissima</i> , whereas these species have a wider natural geographical distribution than <i>S. gigantea</i> in their native North America. |
| Alien   | <i>S. gigantea</i> is introduced to Europe and temperate parts of Asia. The zonal amplitude stretches from the mediteranian to the sub-boreal belt in the eastern part of the European range. It was introduced into Europe as an ornamental plant in the mid 1700s, and the first observations of wild populations date back to the mid 1800s. After its introduction it has shown itself well able to naturalize in temperate regions of the world. Cumulative numbers of localities as well as numbers of occupied grid squares showed a continuous increase since 1850 for this species. A large part of the present range of <i>S. gigantea</i> was already occupied by 1950, but within many grid cells the species still increase.  |
| Wadden  | <i>Solidago gigantea</i> is found on all islands.  |

Table 4.85 Number squares (5x5 km) with *Solidago gigantea* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL   | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|------|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 1360 | 7     | 1    | 1    | 2    | 1     | 0       | 0     | 0      | 0      | 0      | 0    | 0     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | It continues to be available as an ornamental from mail-order catalogues and web-sites of commercial nurseries and botanical gardens. However, most new settlements originate from seeds from populations in natural areas. <i>S. gigantea</i> is less noxious than <i>S. altissima</i> , but it is an undesirable invader on account of its large rhizomes, viable seeds and vigorous growth leading to gross changes in the native vegetation and fauna. However, it invades poorly managed pasture easily. |
| Natura 2000 | From the forest edges this species can colonize the understory of dune forest with an open canopy (H2180).  |
| Risk        | It invades (and dominates) poorly managed pasture; such as road sides, pastures, forest edges.  |

Table 4.86 The ISEIA score for *Solidago gigantea*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 2     |
| Alteration of ecosystem functions          | 2     |
| sum of scores                              | 9     |
| Certainty                                  | 2     |

|            |   |
|------------|---|
| Management | In agriculture crops it can be managed by tilling; on more natural stands it is hard to manage. |
| Conclusion | A threat to forest within the inner dunes ridges.   |

#### 4.44 *Spartina anglica* *Engels slijkgras*

|         |  |
|---------|--|
| Sources | Wikipedia-NL, Wikipedia-UK,  |
| Origin  | Common cord grass <i>Spartina anglica</i> is a (stable) hybrid of <i>S. maritima</i> (native in South-England) and <i>S. alterniflora</i> (native in North America). This hybrid ( <i>S. x townsendii</i> ) has doubled its genome (tetraploid) and is also known as <i>S. anglica</i> . |
| Habitus | It is a herbaceous perennial plant growing 0.4-1.3 m tall, yellowish green in spring and summer, and turning light brown in autumn and   |

|        |  |
|--------|--|
|        | winter. The leaves are 20-60 cm long, and 1.5 cm broad at the base, tapering to a point.   |
| Alien  | <i>Spartina anglica</i> was first regarded as a valuable new species for coastal erosion control, its dense root systems binding coastal mud and the stems increasing silt deposition, thereby assisting in land reclamation from the sea. As a result, it was widely planted at coastal sites. It was introduced in Zeeland (NL) in 1926, German Wadden 1927 and Denmark 1931, it subsequently colonised substantial areas of intertidal mudflats and has become an invasive alien species. |
| Wadden | The species is widespread in the Dutch Wadden Sea region, occurring on every island, with the exception of the bare, sandy islands. The vegetation maps made by RWS, give an idea on the number of locations with <i>common cord grass</i> (table 4.x).  |

Table 4.87 Number squares (5x5 km) with *Spartina anglica* in The Netherlands (NL) and on the Wadden Sea islands in the period 2005-2014.

|         | NL  | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engl | t Rif | Simon |
|---------|-----|-------|------|------|------|-------|---------|-------|--------|--------|--------|------|-------|-------|
| squares | 154 | 5     | 3    | 8    | 6    | 6     | 2       | 1     | 2      | 0      | 0      | 1    | 1     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | The American species <i>S. alterniflora</i> was introduced to Europe by seed in ballast water in ships. The newly formed hybrid <i>S. anglica</i> mainly spreads by (parts) of its rhizomes, although it produces fertile seeds.                                |
| Natura 2000 | The species occurs on many sites in the Wadden Sea. Mainly on locations that otherwise would be bare mudflats (H1130) or <i>Salicornia</i> -vegetations (H1310). <i>Spartina anglica</i> -vegetations are also considered as a habitat type of its own (H1320). |

Table 4.88 The ISEIA score for *Spartina anglica*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|            |  |
|------------|--|
| Risk       | New swards may take some time to become established, but once they do, vegetative spread by rhizomes is rapid, smothering natural ecosystems and preventing birds like waders from feeding on intertidal mudflats. In some areas however, a natural dieback of unknown cause has reversed the spread, and artificial control is no longer necessary where this dieback has occurred. |
| Management | There are hardly no management options for this species.   |



Conclusion This species is a major threat Natura 2000 conservation goals (H1130, H1310). On the other hand *Spartina* stands are a protected habitat type itself. A contradiction?

Table 4.89 Number of locations (n) with *Spartina* and the total surface (ha) of these locations, according to 4 main vegetation types with a different abundance of *Spartina* (after Pranger 2011, 2012, Reitsma et al. 2012, Simons 2014).

| type                       | 14  |      | 18    |       | 19   |       | 26          |       |
|----------------------------|-----|------|-------|-------|------|-------|-------------|-------|
| abundance                  | <5% |      | 5-50% |       | >50% |       | 50% in comb |       |
| code                       | Ss0 | Ss0  | Ss3   | Ss3   | Ss5  | Ss5   | Pps         | Pps   |
|                            | n   | ha   | n     | ha    | n    | ha    | n           | ha    |
| Texel, De Slufter          |     |      | 2     | 0,01  | 12   | 0,12  | 3           | 0,01  |
| Texel De Hors              |     |      | 0     | 0,00  | 0    | 0,00  | 0           | 0,00  |
| Texel, Mok & Mokbaai       |     |      | 2     | 0,01  | 3    | 0,10  | 0           | 0,00  |
| Texel, De Schorren         |     |      | 6     | 0,11  | 17   | 0,31  | 67          | 2,57  |
| Texel, Schor De Cocksdoorp |     |      | 1     | 0,00  | 0    | 0,00  | 1           | 0,01  |
| Vleiland                   | 0   | 0    | 7     | 0,32  | 14   | 0,60  |             |       |
| Terschelling Boschplaat    | 4   | 0,5  | 46    | 4,90  | 45   | 6,00  | 4           | 0,40  |
| Ameland                    | 17  | 6,9  | 1     | 0,20  | 41   | 1,00  |             |       |
| Schiermonnikoog            | 1   | 0,17 | 40    | 4,10  | 59   | 8,10  | 46          | 12,10 |
| Rottumeroog, Rottumerplaat | 2   | 0,2  | 31    | 2,60  | 44   | 4,80  | 4           | 1,00  |
| Griend                     |     |      | 7     | 0,04  | 3    | 0,01  | 2           | 0,02  |
| total                      | 24  | 7,77 | 143   | 12,29 | 238  | 21,04 | 127         | 16,11 |

#### 4.45 Threskiornis aethiopicus heilige ibis

Sources Wikipedia-UK, Wikipedia-NL, Smits *et al.* 2010.

Origin A wading bird of the ibis family, Threskiornithidae, the sacred ibis breeds in Sub-Saharan Africa, southeastern Iraq, and formerly in Egypt, where it was venerated and often mummified as a symbol of the god Thoth.

Habitus An adult individual is 68 cm long with all-white body plumage apart from dark plumes on the rump. The bald head and neck, thick curved bill and legs are black. The white wings show a black rear border in flight. Sexes are similar, but juveniles have dirty white plumage, a smaller bill and some feathering on the neck.

The African sacred ibis occurs in marshy wetlands and mud flats, both inland and on the coast. It will also visit cultivation areas and rubbish dumps.

The bird nests in tree colonies, often with other large wading birds such as herons. It builds a stick nest, often in a baobab tree and lays two or three eggs.

It is an opportunistic scavenger and feeds on various fish, frogs, small mammals, reptiles and smaller birds as well as insects. It may also probe into the soil with its long bill for invertebrates such as earthworms.

|        |   |
|--------|---|
| Alien  | The African sacred ibis has been introduced into France, Italy, Spain, Taiwan, and the United States (south Florida). Numbers in southern Europe have increased after introduction. |
| Wadden | No breeding records on the Wadden Sea islands, only a few incidental records of non-breeding birds.   |

Table 4.90 Number squares (5x5 km) with *Threskiornis aethiopicus* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 0  | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |   |
|-------------|---|
| Pathway(s)  | This species is traded and often held captivity in zoos and other public places. From here birds might escape, as has occurred in Zuid-Holland. Free-flying birds from a zoo were the origin several breeding pairs in a Natura 2000 area in the Netherlands. These have all been caught. Recent observations are most likely from the introduced population in France. New settlements, therefore, cannot be excluded.   |
| Natura 2000 | To date, there are just a few observations in the Wadden Sea of this species; outside the breeding season, with no indication for any breeding.   |
| Risk        | The introduced and growing populations in southern Europe are considered as a problem and a large eradication programme has been started, since these predators can devastate breeding colonies of terns. They also compete successfully for nest sites with cattle and little egrets. The adaptable ibises supplement their diet by feeding at rubbish tips, which helps them to survive the winter in these temperate regions. On the Wadden the sacred ibis might be a threat to spoonbills, terns and egrets. |

Table 4.91 The ISEIA score for *Threskiornis aethiopicus*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 1     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

|            |  |
|------------|--|
| Management | Around (former) bird parks birds are relative easy to catch.   |
| Conclusion | As long as this species does not breed on the Wadden Sea islands or nearby mainland, this species is a potential threat to (ground) breeding birds on the islands. |

#### 4.46 *Vaccinium corymbosum* *troscobosbes*

|         |  |
|---------|--|
| Sources | Wikipedia-UK, Wikipedia-NL.  |
| Origin  | <i>Vaccinium corymbosum</i> , the northern highbush blueberry, is a North American species of blueberry, which has become a food crop of significant economic importance. It is native to eastern Canada and the eastern and southern United States, from Ontario east to Nova Scotia and south as far as Florida and eastern Texas.   |
| Habitus | <i>Vaccinium corymbosum</i> is a deciduous shrub growing to 1.8–3.7 m tall and wide. It is often found in dense thickets. The dark glossy green leaves are elliptical and up to 5 cm long. In autumn, the leaves turn to a brilliant red, orange, yellow, and/or purple. The flowers are long bell- or urn-shaped white to very light pink, 8.4 mm long. The fruit is a 6.4–12.7 mm diameter blue-black berry. This plant is found in wooded or open areas with moist acidic soils (pH 4.5-5.5). |
| Alien   | <i>Vaccinium corymbosum</i> is naturalized in other places in the world: Europe, Japan, New Zealand, the Pacific Northwest of North America, etc. It is the most common commercially grown blueberry in present day North America and Europe.  |
| Wadden  | This species in the Netherlands is restricted to the (former) peatlands in the east of the country; but found on one location on Vlieland.   |

Table 4.92 Number squares (5x5 km) with *Vaccinium corymbosum* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 40 | 0     | 0    | 0    | 0    | 0     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

|             |  |
|-------------|--|
| Pathway(s)  | It is sold for gardens and landscaping, as well as for fruit growing. Fruits are eaten by birds and from there transported into natural sites. |
| Natura 2000 | The species has a preference for wet, acid, humid sites; and could colonize the older wet dune slacks and relatively open, wet dune forest.    |
| Risk        | It can form dense vegetation in (former) peatlands and in other wet acid stands.   |

Table 4.93 The ISEIA score for *Vaccinium corymbosum*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 2     |
| Colonisation of high conservation habitats | 2     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 10    |
| Certainty                                  | 2     |

|            |  |
|------------|--|
| Management | Elimination is only possible by whole plant (including roots) removal. |
|------------|--|

Conclusion A (potential) threat to Natura 2000 areas in the dunes.

#### 4.47 *Vaccinium macrocarpon* cranberry

|         |   |
|---------|---|
| Sources | Wikipedia-NL, Wikipedia-UK,   |
| Origin  | <i>Vaccinium macrocarpon</i> is native to central and eastern Canada and the northeastern and north-central United States. It is also naturalized in parts of Europe and in scattered locations along the Pacific Coast of North America (from California to British Columbia).<br>The species is grown commercially for its edible berries. Many of these are grown in artificial ponds called cranberry bogs. There is some evidence suggesting that the berries or their juice is useful in treating certain urinary tract infections. |
| Habitus | <i>Vaccinium macrocarpon</i> is a shrub, often ascending (trailing along the surface of the ground for some distance but then curving upwards). It produces white or pink flowers followed by sour-tasting red or pink berries 9–14 mm across. It grows well on slightly decalcified wet and sandy soils.   |
| Alien   | This species came to Terschelling in 1845 (ship wreck). Around 1900 people started to grow the Cranberry in low lying dune valleys with the groundwater table just underneath the surface. Ever since, growing cranberries is, with some ups and downs, of major commercial interest for this Wadden Island. Cranberry fields are for hire by the owner of the nature-reserves.   |
| Wadden  | Terschelling is the major stronghold for this species. On Vlieland also some large areas are colonized. On Texel the species is increasing.   |

Table 4.94 Number squares (5x5 km) with *Vaccinium macrocarpon* in The Netherlands (NL) and the Wadden Sea islands.

|         | NL | Texel | Vlie | Ters | Amel | S'oog | R'plaat | R'oog | Griend | R' Bol | Richel | Engpl | t Rif | Simon |
|---------|----|-------|------|------|------|-------|---------|-------|--------|--------|--------|-------|-------|-------|
| squares | 57 | 3     | 4    | 6    | 2    | 1     | 0       | 0     | 0      | 0      | 0      | 0     | 0     | 0     |

Table 4.95 The ISEIA score for *Vaccinium macrocarpon*; see appendix 1 for a legend.

|  | score |
|--|-------|
| Dispersal potential or invasiveness        | 3     |
| Colonisation of high conservation habitats | 3     |
| Adverse impacts on native species          | 3     |
| Alteration of ecosystem functions          | 3     |
| sum of scores                              | 12    |
| Certainty                                  | 3     |

|             |  |
|-------------|--|
| Pathway(s)  | The species spreads by seed. Commercial fields are established by planting. Soon thereafter it forms dense stands with hardly no other species.  |
| Natura 2000 | Cranberry fields grow at best in humid dune slacks (decalcified). These dune slacks are known for their species rich vegetation.   |
| Risk        | Due to its dominance in humid dune slacks, the species rich vegetation is disappearing.  |
| Management  | After some decades the vitality of cranberry plants is lowering. By sodding the dune slacks the original vegetation can be restored. At the same moment circumstances are mostly good for a next generation of cranberry, starting from seeds. |
| Conclusion  | This species is a major threat Natura 2000 conservation goals for dune slacks (H2190).   |

## 5 Conclusions and recommendations

### 5.1 Conclusion

This study had three major objectives:

- To give an overview of all alien species on the Dutch Wadden Sea islands in terrestrial ecosystems (above the high tide water mark);
- To identify all alien species, actually threatening native nature (ecosystems or species), or might become a threat in the near future;
- To apply the ISIEA protocol for species with a high (potential) risk profile and to make a short risk analysis for species on the ISIEA back list and pinpointing towards Nature 2000 on the Wadden.

The lists on [nederlandsesoorten.nl](http://nederlandsesoorten.nl) en [werkgroepexoten.nl](http://werkgroepexoten.nl) have been used to get an idea of all alien species that might be relevant. For all these 1490 species their distribution in The Netherlands and the different Wadden Sea islands have been checked.

Among the 1.490 alien species under consideration approximately 300 of them were found on one or more Wadden Islands in the period 2005 - 2014. The most numerous group are plants, followed by *Crustacea*. Of the five major islands most alien species are found on the largest island of Texel and fewest on the smallest island of Schiermonnikoog. The number of species on the uninhabited (and much smaller) islands and sandbanks is far less.

In this study 47 alien species do fall in the category black list or watch list according to the ISIEA-protocol. Among those, 29 species are an actual risk for nature on the Wadden Islands, mainly because they do occur on one or more islands. For 18 species it is a potential risk, mainly because those species are lacking on the islands at this very moment.

The following species are a major threat for Natura 2000 goals:

- *Campylopus introflexus*;
- *Prunus serotina*;
- *Vaccinium macrocarpon*;
- *Acer pseudoplatanus*;
- *Cotula coronopifolia*;
- *Rosa rugosa*.

Introduction of:

- *Nyctereutes procyonoides*;
- *Procyon lotor*;
- another predator (native or non-native);

could be disastrous for the many ground breeding species on the islands (waders, gulls, terns). The appearance of the native red fox, which does not occur naturally on the islands, could have a negative impact on ground dwelling species. *Spartina*

*anglica* is a major threat as well, but in the mean time is the major species in a Natura 2000 habitat type, which seems to be a contradiction.

## **5.2 Recommendations**

More attention to detailed mapping of alien flora and fauna species during vegetation surveys and fauna monitoring programs; (e.g. by SBB, RWS, NM, iFG); especially the species of high risk. It is an argument for better monitoring, but also provides better information for management.

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