

Exotic mammals in trade and captivity in the Netherlands

Risk of establishment as a precursor to
invasiveness



Datum: 14-7-2014
Rapport: 2014.032
In opdracht van: Bureau van de Zoogdierverseniging

Exotic mammals in trade and captivity in the Netherlands

Risk of establishment as a precursor to invasiveness

01-09-2014

Auteur:

Sanne Westbroek

In opdracht van:

Bureau van de Zoogdiervereniging, Utrecht University

Productie:

Zoogdiervereniging

Postbus 6531

6503 GA NIJMEGEN

e-mail: info@zoogdiervereniging.nl

website: www.zoogdiervereniging.nl

Zoogdiervereniging Rapport 2014.032



Rapport nr.: 2014.032
Datum uitgave: September 2014
Titel: Exotic mammals in trade and captivity in the Netherlands
Subtitel: Risks of establishment as a precursor to invasiveness
Auteur: Sanne Westbroek
Aantal pagina's: 52
Begeleider: Ir, Hans Hollander

Universiteit: Utrecht University
Opleiding: Environmental Biology master programme,
Track Ecology & Natural Resource Management
Begeleider: Dr, Pita Verweij, Copernicus Institute of Sustainable Development
Postbus 80125
3508 TC, Utrecht

Dit rapport kan geciteerd worden als:

Westbroek, S. 2014 Exotic mammals in trade and captivity in the Netherlands: Risks of establishment as a precursor to invasiveness. Zoogdiervereniging-rapport <rapportnummer>. Zoogdiervereniging, Nijmegen.

De Steunstichting VZZ, onderdeel van de Zoogdiervereniging, is niet aansprakelijk voor gevolgschade, alsmede voor schade welke voortvloeit uit toepassingen van de resultaten van werkzaamheden of andere gegevens verkregen van de Zoogdiervereniging. Opdrachtgever vrijwaart de Stichting VZZ voor aanspraken van derden in verband met deze toepassing.

© Zoogdiervereniging

Niets uit dit rapport mag worden verveelvoudigd en/of openbaar gemaakt worden d.m.v. druk, fotokopie, microfilm of op welke andere wijze dan ook, zonder voorafgaande schriftelijke toestemming van Zoogdiervereniging, noch mag het zonder een dergelijke toestemming worden gebruikt voor enig ander werk dan waarvoor het is vervaardigd.

Preface

This study was performed in the framework of an internship at the Zoogdiervereniging, as part of a minor research project (33 ec) of the master programme Environmental Biology (track Ecology and Natural Resource Management) of Utrecht University.

Within the Dutch Expertise Centre Exotics (NEC-E), the Zoogdiervereniging (The Dutch Mammal Society) works to build up knowledge about exotic mammals. One of their goals is early detection of these mammals by means of a horizon scan. The focus of this report is on exotic mammal species that are not yet present in the wild in the Netherlands. In this study it was attempted to detect potentially invasive exotic mammal species before they are present in the wild.

Eventually, more insight is obtained as to which of the mammal species currently present in trade and captivity in the Netherlands are likely to be able to establish here. If risk assessments would be conducted on these species, measures can be taken against the species posing high risks to Dutch ecology, economy and health before they become established in the wild.

Acknowledgements

I would like to express my gratitude to my supervisors Hans Hollander of the Dutch mammal society and Pita Verweij of Utrecht University for their guidance, support and expertise during the various phases of this research project. I would also like to thank the other interns at the Dutch mammal society for their support and company. Last but not least, I would like to thank NEC-E (het Nederlands Expertise Centrum Exoten) for letting me join their meetings.

Content

Summary	7
1 Introduction	8
1.1 Literature background.....	8
1.2 Problem	11
1.3 Main- and sub questions	12
1.4 Approach	12
2 Methods	13
2.1 Obtainment of species lists.....	13
2.2 Synthesis of mammal lists.....	14
3 Results	18
3.1 Digital market places	18
3.2 Climate match	20
3.3 "Classification scheme Habitat" match	20
3.4 Habitat & diet match.....	21
3.5 Evaluation of mammal species list.....	22
3.6 Different species groups.....	23
4 Discussion	24
4.1 Exotic mammal species on digital market places	24
4.2 Evaluation of used data sources	25
4.3 Habitat and diet plasticity.....	26
4.4 Observed and assessed species.....	27
4.5 Species groups	29
5 Conclusions	30
6 Recommendations	31
References	32
Appendix 1: Risk of establishment.....	36
Appendix 2: Species observed in the wild at least once in the Netherlands, and species on which Dutch risk assessments were conducted.....	44
Appendix 3: Risk of establishment per species group	45

Summary

Exotic mammals are defined as mammals that establish outside their native range due to human activities like transport and infrastructure. Exotic species are referred to as *invasive* exotic species when they start to reproduce explosively and pose risks to ecology, economy and health. Since invasive exotic species can pose risks, it is important to take measures against them. In order to do this, it is important to identify them as quickly as possible. Therefore, the goal of this report was to identify potentially invasive exotic mammal species before they become established in the wild in the Netherlands. It was determined which exotic mammal species from trade and captivity in the Netherlands will be able to establish in the wild, as a precursor to possible invasiveness.

Several lists were obtained to determine which species are present in trade and captivity in the Netherlands. These lists consisted of exotic mammal species offered on digital market places, species rescued or found by the AAP foundation, imported and exported CITES species, mammal species in zoos, and mammal species kept by private owners. Based on habitat, climate and diet it was determined whether or not these species will be able to establish themselves in the Netherlands.

The analysis of species offered on digital market places showed that species that might be able to establish themselves in the Netherlands (and therefore possibly become invasive) made up a relative high amount of the advertisements. Because of this, measures have to be taken to prevent spread of these species (e.g. creating awareness and/or prohibitions).

Results from analysis of habitat, climate and diet of all found species indicated that the large majority of the species will not be able to establish in the Netherlands. Only a small number will be able to establish here, and an even smaller number are likely to become invasive. However, these potentially invasive exotic species can have drastic impacts on local health, ecology and economy. Because of these potential risks, it is highly recommended to perform full risk assessments on all species with a high risk of becoming established in the Netherlands. However, there is an even greater need for risk assessments on species with high establishment potential that were already observed in the wild in the Netherlands and on which no risk assessments were conducted yet. Therefore risk assessments are recommended on the North American porcupine (*Erethizon dorsatum*), nutria (*Myocastor coypus*), the Bennet's wallaby (*Macropus rufogriseus*), the capybara (*Hydrochoerus hydrochaeris*), and the Patagonian cavy (*Dolichotis patagonum*).

Due to the number of species kept in the Netherlands, their small sizes, high reproductive rate, rodents were identified as the species group with the highest risk of establishment in the Netherlands. Therefore, risk assessments on rodent species with high establishment potential are also recommended.

From this study, it can be concluded that a significant number of exotic mammals is present in trade and captivity in the Netherlands. Some of these species are able to establish here and can potentially damage ecology, economy and health. In order to take measures against possible invasive species at the earliest possible stage, it is highly important to always keep track on which species are present in trade and captivity in the Netherlands. By means of research, education and monitoring the number of species introductions can hopefully be decreased. If adequate measures are taken it is possible to mitigate the rate at which invasive exotic species are altering and homogenizing distinctive ecosystems.

1 Introduction

In order to take measures against invasive exotic species, it is important to identify them as quickly as possible. To become an invasive exotic species, the species first has to establish outside its native range. In this study, it is attempted to identify potential invasive mammal species before they become established in the Netherlands. It is determined which mammal species currently present in trade and captivity in the Netherlands are likely to be able to establish in the wild, as a precursor to possible invasiveness. This chapter starts with an overview of literature information about invasive exotic mammals (Section 1.1). Thereafter, the problem, research questions and approach are described (Section 1.2, 1.3 & 1.4 respectively).

1.1 Literature background

Definitions

According to the Dutch government, exotic mammals are defined as mammals that cannot reach the Netherlands on their own. They enter areas by human activities like infrastructure and transport. Species occurring naturally in surrounding areas that reach the Netherlands independent of human activities are not included in this definition, it can be expected that these species will cause less damage (e.g. predators often travel along with their prey animals, which regulates the numbers). Furthermore, it is impracticable to stop mammal species from naturally entering new areas (Rijksoverheid, 2007). When exotic species establish and reproduce explosively, they can threaten safety and biodiversity. In that case they are called invasive exotic species (Keller *et al.*, 2011).

Globalisation

Even though invasive exotic species seem to be a problem of the last decades, the world has a long history of exotic species introductions. Since introductions of these species are by definition linked to human activities, it will be no surprise that trends in exotic species introductions are often associated with trends in human migration and trade activities. Since 1500 AD, humans have introduced exotic species all over the world. Around 1500, many events that strongly influenced dispersal of exotic species took place (e.g. rediscovery of America, global exploration, end of the middle ages, changes in industry) (Hulme, 2009).

Data about exotic species in Europe show that there was another progressive increase of exotic invertebrates, mammals and plant species around 1800 AD. This corresponds to the start of the industrial revolution. During the industrial revolution, canals and railways were constructed and steamships were introduced. This increased the international trade all over the world (Hulme, 2009 and references therein).

During the last few decades, the pace of introductions of exotic species drastically increased again due to modernised technology, travel and trade (Meyerson & Mooney, 2009 and references therein), something referred to as "the era of globalisation" (Hulme, 2009). This increase of globalisation results in a higher number of exotic species introductions in new ecosystems. (Keller *et al.*, 2011 and references therein; Perrings *et al.*, 2005 and references therein). Since the Netherlands are known as a trading nation, this country plays an important role in the distribution and receiving of exotic species (Rijksoverheid, 2007). Due to globalisation, the number of exotic

species introduced in the Netherlands increases annually (Biological globalisation, 2007 via Rijksoverheid, 2007).

Stages of invasiveness

Because introduced species can eventually become invasive, the increased amount of species introductions, can threaten local ecology, economy and health. However, the majority of the imported exotic species will not become invasive in their new range. Most exotic species are unable to survive in their new environment. Or they are able to survive, but cause no damage. Only a small amount of species are able to reproduce explosively in their new habitat and thereby form a severe threat for local economy, human health and ecology (Beleidsnota, Rijksoverheid).

Species become invasive via a number of stages. These are importation, introduction, establishment and invasion. First of all, the species has to be *imported* via a specific pathway and it has to survive the passage. In the case of exotic species, the pathway has to be mediated by humans. Second, when a species survived the transit and escapes, it is referred to as *introduced* (found outside captivity or control). If it reproduces without intervention by humans, the species is *established*. Finally, when the species starts spreading strongly and has significant impacts on ecology, economy or human health it is defined as *invasive* (Keller *et al.*, 2011; Williamson & Fitter, 1996). For several groups of British animals and plants, it was estimated that about 1 in a 1000 imported species eventually become invasive. This is often referred to as the “tens” rule. 1 in 10 imported species end up in the wild (introduced). 1 out of 10 introduced species become established, and 1 out of 10 established species become invasive (Williamson & Fitter, 1996; Williamson 1993). Whether the “tens” rule is also applicable to invasive exotic mammal species in the Netherlands still has to be determined.

Pathways of importation

As was stated in the previous paragraph, in order to become invasive outside their native range, species first have to be transported to their new range via a specific pathway. According to Hulme *et al.* (2008), exotic species can enter a new region by three different mechanisms. These are; *importation as/with a commodity*, *arrival with a transport vector* and *natural dispersal*. These three mechanisms can be divided in six different pathways; “release, escape, contaminant, stowaway, corridor and unaided” (Hulme *et al.*, 2008). An overview of the transport mechanisms and pathways is shown in Table 1.1.

Table 1.1 Three mechanisms and six pathways for dispersal of non-native species (Hulme *et al.*, 2008)

Mechanisms for dispersal of exotic species according to Hulme <i>et al.</i>, 2008					
Importation as/with a commodity			Arrival with a transport vector	Natural dispersal	
Release	Escape	Contaminant	Stowaway	Corridor	Unaided

Species transported via the first mechanism, are deliberately transported beyond their native range as a commodity. This happens when the species have desirable traits or qualities humans can benefit from. These species can be intentionally released (e.g. for hunting purposes, American minks released from fur industry by activists), or they can escape from captivity (escaped pets).

Species from other areas can also arrive *with* a commodity, this happens when the traded organisms are contaminated with the exotic species (e.g. parasites and diseases). These contaminants can escape and become invasive (Keller *et al.*, 2011).

Foreign species might also arrive unintentionally as a stowaway with a transport vector. In this case they travel on, or in human transport vehicles (e.g. in cargo of airplanes, bats arriving in between pellets on ships) (Keller *et al.*, 2011).

In the last mechanism, the species disperse naturally using infrastructure corridors created by humans, like railways, roads, canals or other human created linear habitats. Or they might arrive using the unaided pathway. This happens when species were exotic in the donor region/country and arrive in a new area by natural spread (Hulme *et al.*, 2008).

In Europe, the majority of the exotic terrestrial vertebrates were originally imported as commodities. They were used as pets, live food and for their fur. Some of these pathways have been restricted and adjusted in order to reduce invasion risks. However, many pathways are still frequently used (e.g. pet trade is still an important pathway for introduction of exotic animals). There is much less information about unintentional introductions, since these often only come to light when the species is already established (Keller *et al.*, 2011).

Risks to ecology, economy and health

Even though only a small amount of the introduced species will survive and become invasive in their new range, the ones that do become invasive can severely threaten local biodiversity and safety. The ways in which invasive mammals can threaten safety and biodiversity can be divided in ecological-, economical- and human health impacts. Ecological impacts of invasive mammals include, transmission of infectious diseases to native fauna, outcompeting native species, genetic mixing with native species (resulting in losses of native characteristics), and herbivory/predation. Economic impacts are; danger to human infrastructure (traffic collisions), livestock (predation or transmission of infectious diseases), forestry (herbivory, damaging tree barks) and agriculture (herbivory). Human health impacts are; Transmission of infectious diseases, danger to human safety (traffic collisions, aggressive species) (Perrings *et al.*, 2011; Keller *et al.*, 2011).

Measures against invasive exotic mammals

Since invasive exotic mammals can have many negative effects, often measures have to be taken to prevent this. Species are generally introduced in a new area via a number of stages. In each stage, the possibilities to intervene in the spread of the species are different. It is attempted to control invasive species at the earliest possible stage. In the Netherlands, invasive species are controlled by means of prevention, elimination, or isolation and management of the population (Rijksoverheid, 2007).

Since it is very difficult to get a species away once it is already established, the focus will be on taking preventive measures. Many of the invasive exotic species in the Netherlands were introduced on purpose and sometimes released deliberately. These intentional introductions of exotic species often have to do with a lack of awareness. Therefore, providing adequate information about the risks of exotic species, might prevent deliberate introductions in the future. Besides awareness, an important measure is to develop laws and regulations regarding possession and importation of exotic species (Rijksoverheid, 2007).

Despite the preventive measures, some (potentially) invasive species might still invade into the wild. In that case, it is important to identify these species as quickly as possible by an effective signalling network. Risk analysis should be made to determine if intervention is needed. When the settlement process is still at an early stage and the numbers of species are clear, elimination is usually a feasible solution (Rijksoverheid, 2007). In the case of mammals this can be done by structurally removing them from the invaded area, hunting, or catching them alive (Hollander, 2013).

When an exotic species already established in the Netherlands, it is often difficult to eliminate all individuals of the population. In that case isolation and management of the population is usually the best solution to control the population (Rijksoverheid, 2007). In the case of vertebrates, eliminating established species has never been successful (Bomford, 2003 via Lammertsma *et al.*, 2012). So, once populations of an exotic mammal species are established in the Netherlands they have to be maintained at low population densities in colonized areas (e.g. by contraception, hunting or trapping), and further spread has to be prevented. They have to be excluded (e.g. by fences) from vulnerable areas (Lammertsma *et al.*, 2012).

Predictors of establishment and invasiveness

Whether species eventually become invasive depends on complex interactions between the species and characteristics of its new environment (Hayes & Barry, 2008). These interactions are made even more complex by possible plastic responses of the species. Species are for example able to respond plastic to changing habitats and diets. They might be able to survive in a broader range of habitats than where they are currently found. Species are, for example, able to consume other food resources when their favourable source is not available. For more specialized species it is often more difficult to expand their diet than for generalists. Specialised species are dependent on (some) specific resources, and are often unable to consume other prey items. Generalists are more capable to change their foraging strategies. Therefore it is easier for those species to adapt to changing food sources (and changing environments). The more specialised a species is, the lower the probability that a species will survive in its new range (Ross *et al.*, 2010).

Despite these complex interactions determining whether or not a species will be able to survive outside its native range, some characteristics have been found that most invasive vertebrates have in common. For example, most of these species have short generation times, are present in high abundances in their native range, can function in a broad range of physical conditions, females are able to colonize new areas on their own, consume a wide range of diets, are large in size, and have a substantial link with humans (Ehrlich, 1989 via Sakai *et al.*, 2001).

1.2 Problem

As was stated in the introduction, the earlier an exotic species is detected, the easier it is to intervene in the spread of the species. However, the best way of managing these species, is by preventing them from establishing in the wild. In order to do this, the species that currently present a risk of becoming invasive (but are not yet present in the wild) have to be documented. If these species are known, preventive measures can be taken.

1.3 Main- and sub questions

The main question that will be answered during this study is:

Which exotic mammal species have the potential to establish themselves in the Netherlands in the future?

The sub questions that will be answered during this study are:

1. Which exotic mammal species are offered on digital market places? And does this change over time?
2. Which additional mammal species are kept in the Netherlands (both in captivity and in trade)?
3. Which of these species have the potential to establish themselves in the Netherlands (based on climate/diet/habitat matches)?
4. For which species is a risk assessment most urgently needed?
5. Which species groups (e.g. deer, rodents, marsupials, carnivores) pose the highest risks of establishing themselves in the Netherlands?

1.4 Approach

Since most invasive mammal species have established outside their native range because they were originally imported as a commodity (e.g. to be used as pets). An overview will be made of mammal species in trade and captivity in the Netherlands. According to Hayes & Barry (2008), climate- and habitat matches are the most important predictors of establishment success in new environments.

Furthermore, mammal species that are able to consume broader diets and are able to live in a broad range of habitats are often more invasive than species with more specialised diets and habitats (Keller *et al.*, 2011; Jeschke & Strayer, 2006). Therefore, it will be determined which of the species in trade and captivity in the Netherlands are able to establish here based on climate, habitat and diet matches.

The methods used are described in Chapter 2. Thereafter, the results are presented in Chapter 3, and they are discussed in Chapter 4. Chapter 5 presents the conclusions of this study and Chapter 6 the recommendations for future research and measures that can lead to a decrease of the problems caused by invasive exotic mammals.

2 Methods

In order to determine which species are kept in the Netherlands, several lists had to be obtained (Section 2.1). First of all, a rough survey of species in trade in the Netherlands was performed by analysing mammal species offered on digital market places. Then a list of species rescued by the AAP foundation was made. It was determined which CITES species were imported and exported over the years 2000-2009, which mammal species are kept in zoos, and a list of mammal species kept by private owners was obtained. These lists were combined, and it was determined whether or not, species will be able to survive in the wild in the Netherlands based on climate, habitat and diet (Section 2.2). In this chapter it is described how the various lists were obtained and analysed. A schematic overview of the analysis of the obtained list is shown in Figure 2.3.

2.1 Obtainment of species lists

Exotic mammals on digital market places

During this study, exotic mammals on digital market places were assessed two times. The first time was at February 3 & 4 (2014), and the second time at June 16 & 17 (2014). A policy measure that is likely to influence the offer of exotic mammals on digital market places is the positive list. The positive list is a policy measure that will be launched at the 1st of January (2015). After launching of this list, private owners will be allowed to keep some species without any special conditions, some other species are only allowed under special conditions. There will also be a list of species which will be prohibited for private owners (For more information about this list, see Westbroek, 2014 report 2014.033). Chances are that the number of exotic mammals on digital market places will increase just before- and/or just after start of the positive list, because people might want to get rid of their exotic mammals. Analysed digital market places are shown in Table 2.1. The current measurements of offered species on digital market places can be used as a baseline for comparison with offered animals after start of the positive list.

Table 2.1 Analysed digital market places.

Analysed digital market places	
Organisation	Website
Exotictrade	www.exotictrade.com
Marktplaats	www.marktplaats.nl
Vereniging van Parkdierenliefhebbers	www.parkdierenvereniging.nl

On Marktplaats, exotic mammal species from the categories “other animals” (overige dieren) and “rodents” (knaagdieren) were listed.

Only the undomesticated and less domesticated animals were listed. Whether or not species are domesticated was determined using Wikipedia (Wikipedia, July 2014). The Syrian and Russian dwarf hamsters were not listed, these species were offered so much that listing them was too time-consuming. Furthermore, ferrets, alpacas, lamas and camels were not listed.

Mammal species at Foundation AAP

Foundation AAP is a rescue centre for exotic animals in the Netherlands. An overview of the exotic mammals saved by Foundation AAP was made by using information on the website of the AAP Foundation (Foundation AAP, July 2014). Since this foundation sometimes offers shelter to exotic animals from other countries, only the exotic mammals rescued/found in the Netherlands were included in the analysis.

Imported and exported CITES mammals

The lists of imported and exported CITES mammals was created using the CITES website (CITES Trade Database, July 2014). Figure 2.1 shows the terms that were searched to obtain the list of imported species. For the list of exported species, the searched terms were almost the same, except that "Netherlands" was filled in at "Exporting countries" and "All countries" was filled in at "Importing countries". The result was a list of all imported and exported living CITES species from the years 2000 to 2009. The non-mammal species were removed manually.

Mammal species in zoos

In order to determine which species are kept in zoos in the Netherlands, a list from the website www.Studio-evenaar.nl (July 2014) was used. This website contains information about the animal species kept in zoos in the Netherlands. Since this list not only consists of mammal species, all non-mammal species were removed manually. Furthermore this list does not show all mammal species kept in all zoos in the Netherlands. Some species were added based on websites from zoos.

Mammal species kept by private owners

During one of the interviews for the other part of this study (See Westbroek, 2014 report 2014.033), a list of mammal species kept by private owners in the Netherlands was obtained. This list, comprising 359 mammal species was made by the Livestock Research group of the Wageningen University & Research centre (WUR) (Ipema, 2011).

2.2 Synthesis of mammal lists

Of the various obtained lists, only undomesticated mammal species were analysed. Whether or not species are domesticated was determined using a list on Wikipedia (Wikipedia, July 2014). Furthermore, certain species groups were not analysed because establishment in the wild is not likely, for they are recaptured fast due to their size (e.g. elephants and giraffes), or because they pose high risks for people (e.g. large cats, or other large predators). These species are unwanted, therefore they will be detected and removed from the wild quickly; making establishment very unlikely. Other species groups were excluded for time management reasons. Excluded species and species groups are shown in Table 2.2. The species of the various obtained lists were placed into a

Year selection:	From: 2000 to 2009
Exporting countries:	All Countries
Importing countries:	Netherlands
Source:	C- Captive-bred animals, F- Born in captivity (F1 and subsequent), I- Confiscations/seizures, O- Pre-Convention, R- Ranched, W- Wild, D- Captive-bred/artificially propagated (Appendix I)
Purpose:	B- Breeding in captivity or artificial propagation, E- Educational, L- Law enforcement/judicial/forensic, M- Medical (including biomedical research), N- Reintroduction or introduction into the wild, P- Personal, Q- Circus and travelling exhibitions, S- Scientific, T- Commercial, Z- Zoo
Trade Terms:	live
Species:	

Fig 2.1. Searched terms to obtain CITES list of imported species over the years 2000-2009 (Figure from CITES Trade Database, July 2014)

single file. The double listed species were removed. Further information about these species was obtained using the protocol below.

Table 2.2. Table showing excluded species and species groups. Whether species were not analysed because they are large, dangerous, or for time-management reasons is indicated with X.

Unanalysed Species and species groups	Size	Dangerous	Time-management
Moose (<i>Alces alces</i>)	X		
Alpacas (Vicugna)	X		
Barbary sheep			X
Camels and llamas	X		
Capricorns/Ibexes (Capra)/ Springboks (Toer)/ markhor			X
Equines	X		
Giraffes	X		
Heavy cattle (buffalos, gnus, oxen)	X		
Hippos	X		
Okapis	X		
Oryx species			X
Pigs, swine's, peccary's			X
Porcupines (except the American porcupine)			X
Primates			X
Rhinos	X	X	
Sea mammals			X
Sheep (Ovis)			X
Sloths			X
Some large cats (panthers, lions, tigers, cougars, leopards)		X	
Tapirs (Tapirus)	X		
Waterbucks (Kobus)	X		

Information on climate, habitat and diet

After creating the total list, the common names and range of the mammal species were determined using the website from the International Union for the Conservation of Nature (IUCN) Red list (IUCN Red List of Threatened Species, July 2014).

Using the information about the range of the species and the World Map of Köppen-Geiger climate classification (Figure 2.2) (Kottek *et al.*, 2006), it was determined whether there was a climate match between the range of the species and the Netherlands. It was assumed that areas with a "warm temperate, fully hybrid, warm summer (Cfb) climate" and areas with a "warm temperate, fully hybrid, hot summer (Cfa) climate" have a climate match with the Netherlands. It was classified whether or not species have a climate match with the Netherlands. Furthermore, the website of the IUCN Red List has "Classification schemes" which show different habitat types where the species occurs. Matches with these habitat types were also classified. Used classifications were Yes (++), probably (+), Maybe (+-), Probably not (-), and No (--).

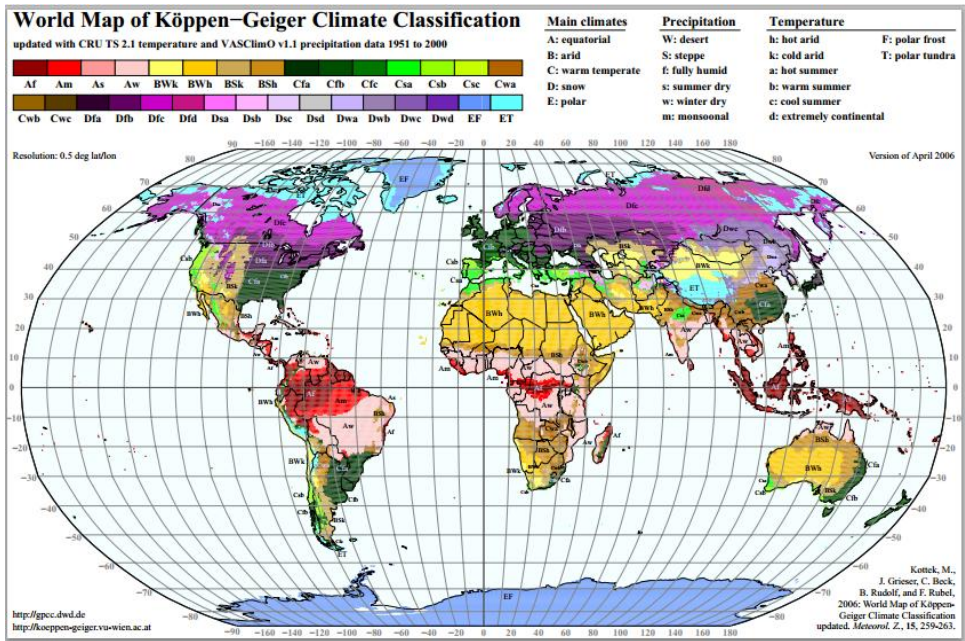


Fig 2.2 World Map of Köppen-Geiger Climate Classification. Figure from Kottuk *et al.*, 2006

Of the species with both a "Climate match" and a "Classification scheme match", more detailed habitat information and diets were analysed. This information was also obtained from the website of the IUCN Red List. If this information was not specific enough, more information was obtained via a mammal encyclopaedia (Walker, 1975). Habitat matches were judged both by me, and by an expert (Hollander, H. Dutch Mammals Society).

Species with a climate match, Classification scheme match, a habitat match and a diet match were indicated as "High Risk Species". These species will probably be able to survive and reproduce in the wild in the Netherlands. Species without a Climate match, and species with a Climate match, but no Classification scheme match (which probably also indicates that they survive in other climates) were classified as "Low risk species". These species will not be able to survive and reproduce in the Netherlands. Species with a climate match and a Classification scheme match, but no habitat and diet match were indicated as "Medium risk species". These species might be able to survive and reproduce in the Netherlands, but it is not certain (Fig 2.3).

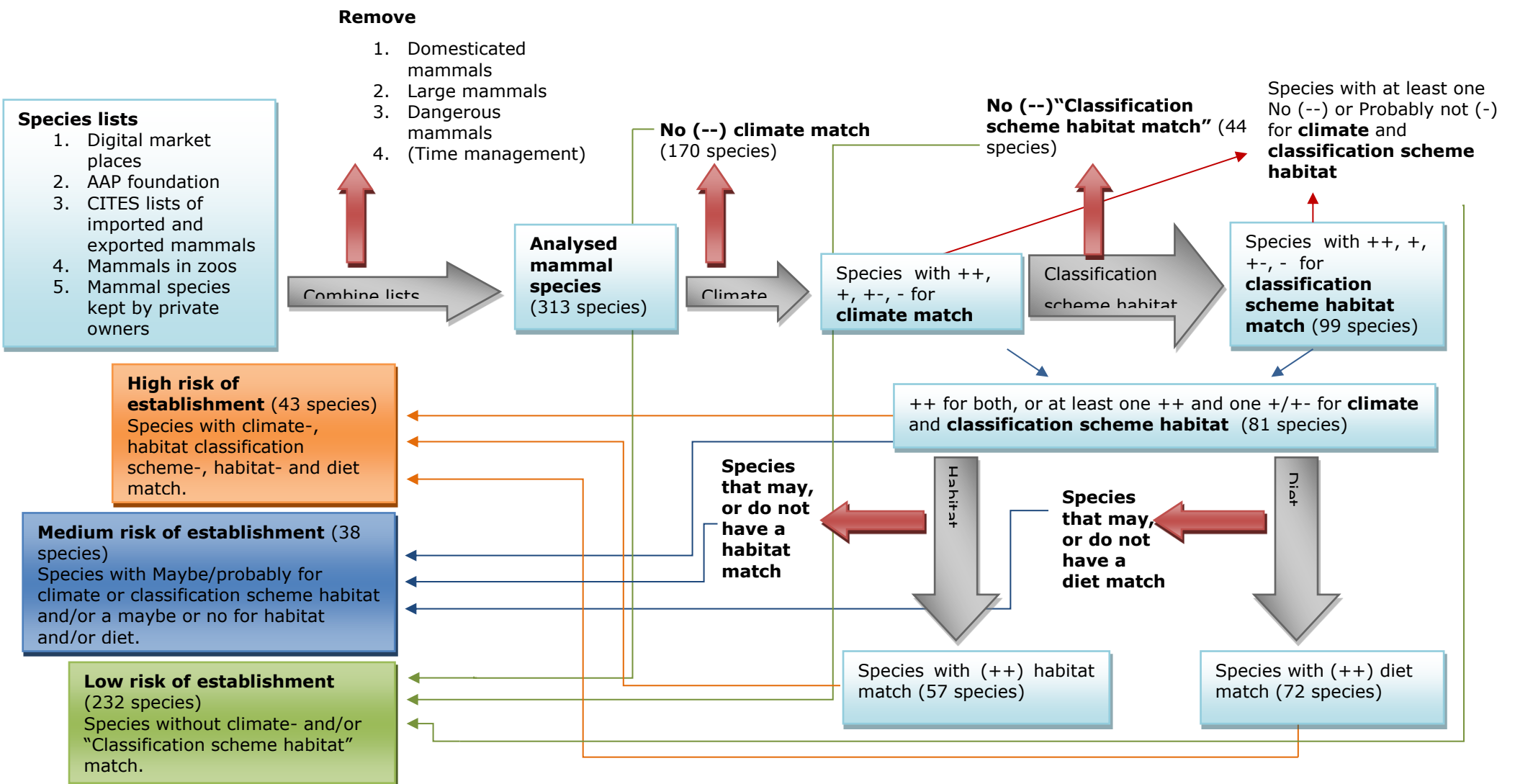


Fig 2.3 Schematic overview of the used protocol for analysis of species. First, the found lists were combined and certain mammal groups were removed. A list of 313 species was left, first it was determined which of these species had a climate match with the Netherlands. Species were classified with Yes (++), probably (+), Maybe (+-), Probably not (-), and No (--). Of the species with ++, +, +/-, and - for climate match with the Netherlands, it was determined whether or not they had a "Classification scheme habitat" match with the Netherlands. The species with a ++ for both, or at least one ++ and one +/-/- for climate and classification scheme habitat were further analysed for their more specific habitats and diets. Species with ++ for climate-, habitat classification scheme-, habitat- and diet were considered high risk species. Species with +/-/- for climate or classification scheme habitat and/or a +- or -- for habitat and/or diet were considered medium risk species. Species with -- for climate- and/or "Classification scheme habitat" match were considered low risk species. For simplification reasons, the species with a +/-/- for both Climate and Classification scheme habitat were left out of this figure. These species were further analysed for habitat and diet. If these species did not have a habitat and/or diet match, they were considered Low risk species. If these species did have a Diet and Habitat match, they were considered medium risk species.

3 Results

In this section, the found results are shown. It starts with the results from the analysis of digital market places. The different species and species groups that were found are displayed in varying graphs (Section 3.1). Subsequently, the results from conducted climate matches are shown (Section 3.2), followed by matches of the habitat types from the classification schemes (Section 3.3). Thereafter, matches with diet and habitats are displayed in a graph (Section 3.4). These results were combined to determine which proportion of species will probably be able to survive in the Netherlands. This is shown in a graph in section 3.5. Furthermore, this section shows which proportion of these species have been observed at least once in the Netherlands, and on which proportion a Dutch risk assessment has been conducted. Finally, in section 3.6 it is shown which proportion of different species groups will be able to survive in the Netherlands.

3.1 Digital market places

At the first time of analysing digital market places (February 3 & 4, 2014), 59 species of undomesticated animals were found in 373 advertisements on the three different digital market places. The second time (June 16 & 17, 2014), 58 different species were found in 421 advertisements. Three indigenous species which are prohibited as pets according to the Flora and Fauna Act (STOWA, July 2014) (the harvest mouse; *Micromys minutus*, the garden Dormouse; *Eliomys quercinus*, and the bank vole; *Myodes glareolus*) were found.

In Figure 3.1 the species are divided in 12 different species groups. It shows the number of advertisements for these species groups. The majority of advertisements are for chinchilla's, squirrels and gerbils. The rodent species and other mammal species that did not fit in any of the groups, were grouped in the groups "Other rodents" and "Other species" respectively.

Figure 3.2 shows the distribution of species within a number of the species groups.

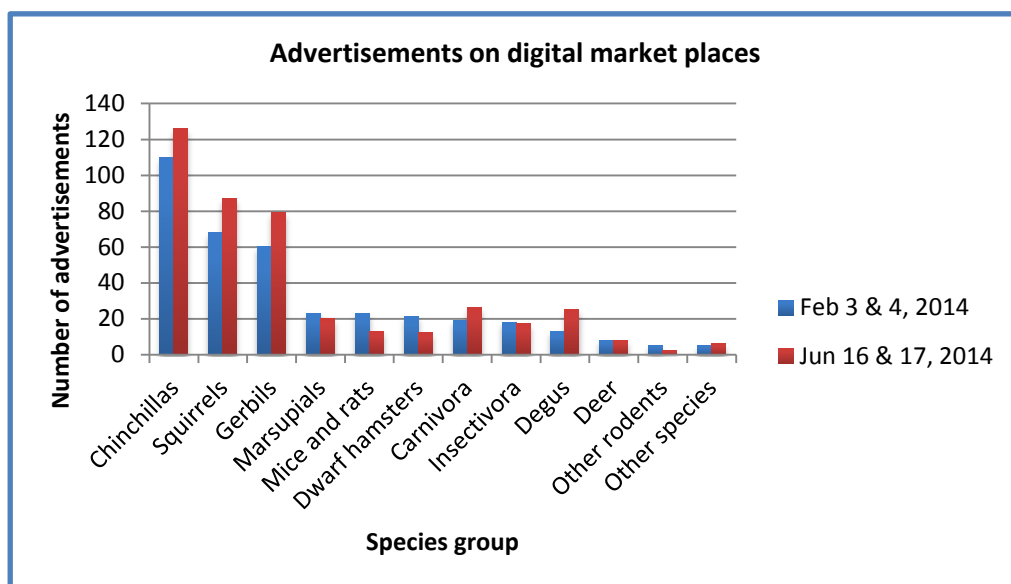
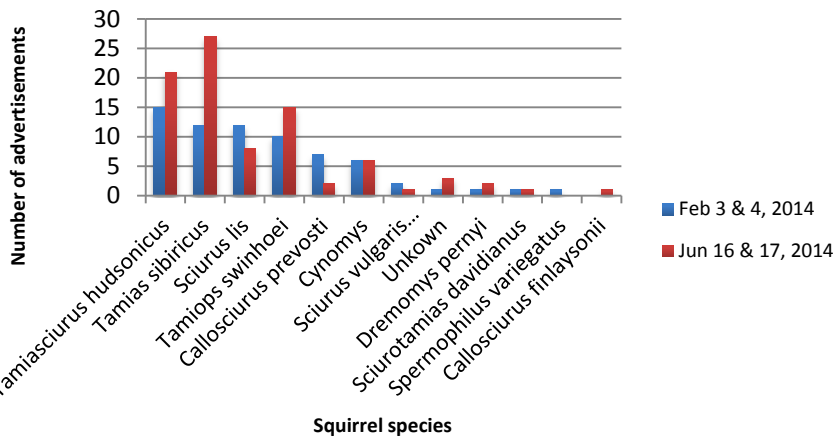
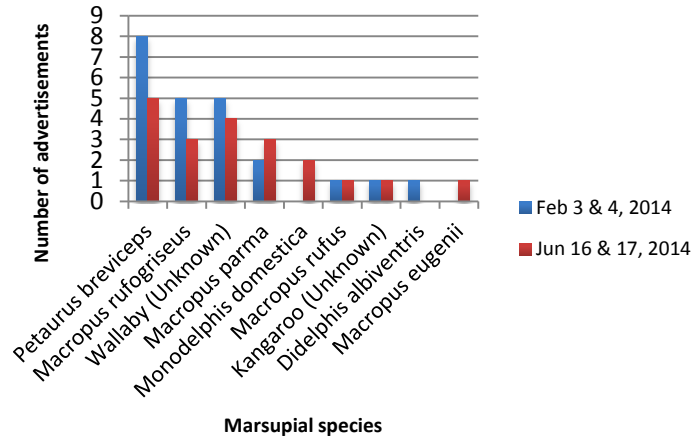


Fig 3.1 Number of advertisements for different species groups found on digital market places.

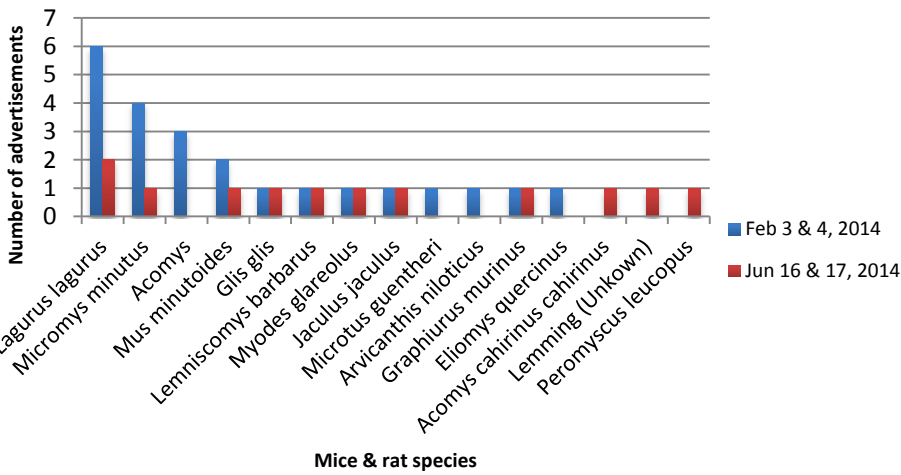
Squirrel advertisements



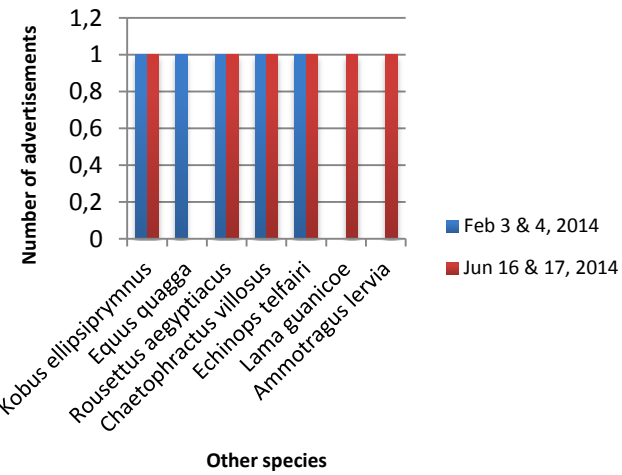
Marsupial advertisements



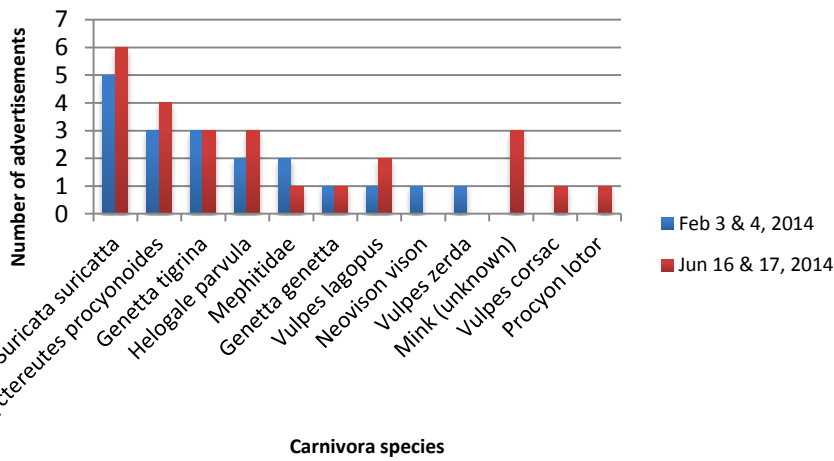
Mice & rat advertisements



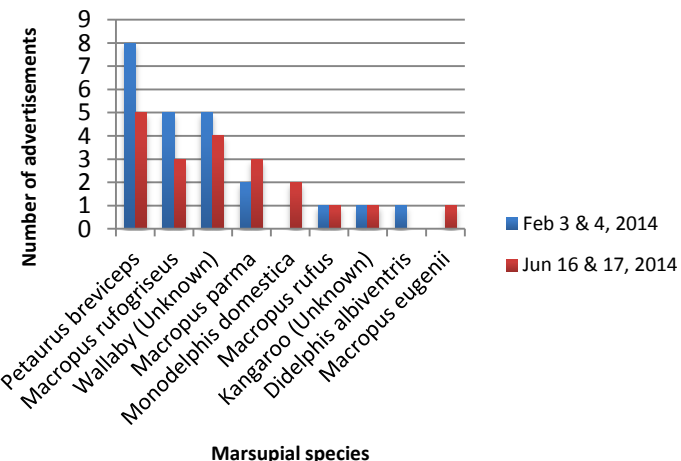
Other species advertisements



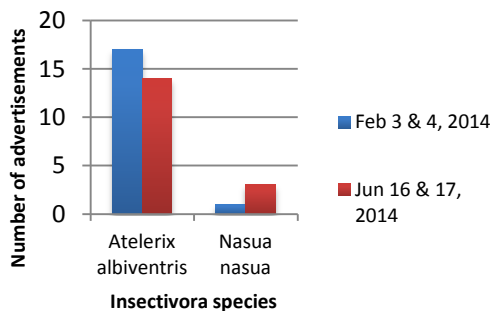
Carnivora advertisements



Marsupial advertisements



Insectivora advertisements



Other rodent advertisements

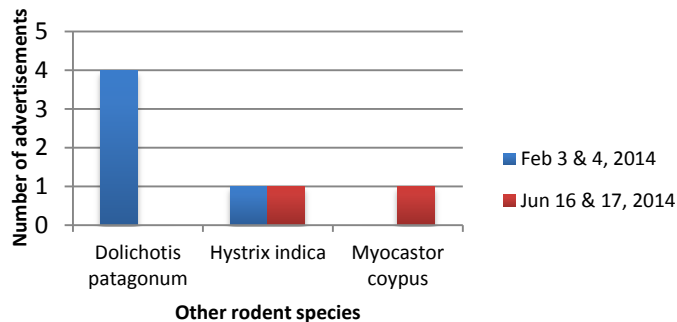


Fig 3.2 Figures showing number of advertisements for species within the different species groups.

3.2 Climate match

Figure 3.3 shows that most of the 313 analysed species (54%) did not have a climate match with the Netherlands. 28% of the species did have a climate match. These species were mainly from the East of North America, the East of China, East Australia north-east Argentina, Uruguay, south Paraguay and south-east Brasil. For some species it was not sure whether they have a climate match, these species often occupied ranges of which only a small part had the same climate as in the Netherlands.

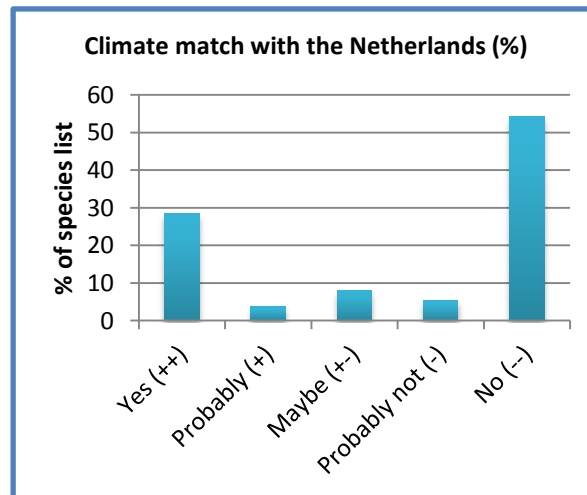


Fig 3.3 Table shows the percentage of species list that do (++) , probably have (+) , maybe have (+-) , probably do not have (-) , and do not have (-) a climate match with the Netherlands.

3.3 “Classification scheme Habitat” match

For the 143 species of which the climate match was indicated with ++, +, +- and -, an analysis of the habitat types in the classification schemes on the IUCN website was done. Figure 3.4 shows that most of these species (51%) did have a match with the habitat types of these classification schemes. For 31% of the species there was no match between the Dutch habitats and the “Classification scheme” habitats. For some species there was no habitat classification scheme on the IUCN website, these were indicated with “Unknown”.

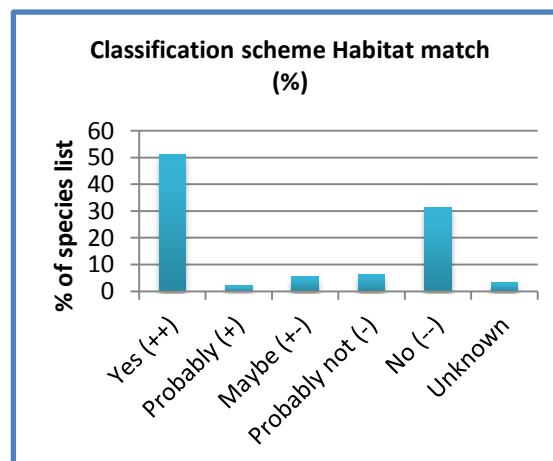


Fig 3.4 Table shows the percentage of the 143 species with a ++, +, +- , - for climate match that do (++) , probably have (+) , maybe have (+-) , probably do not have (-) and, do not have (-) a “Classification scheme Habitat” match with the Netherlands.

3.4 Habitat & diet match

For the 81 species with ++ for both the Climate and Classification scheme match, or at least one ++ and one +/-/-, the more detailed habitat information and diets were analysed. Figure 3.5 shows that 87% of these species had a Diet match with the Netherlands and 69% had a Habitat match with the Netherlands. 4% of the species did not have a Diet match, and 20% did not have a Habitat match.

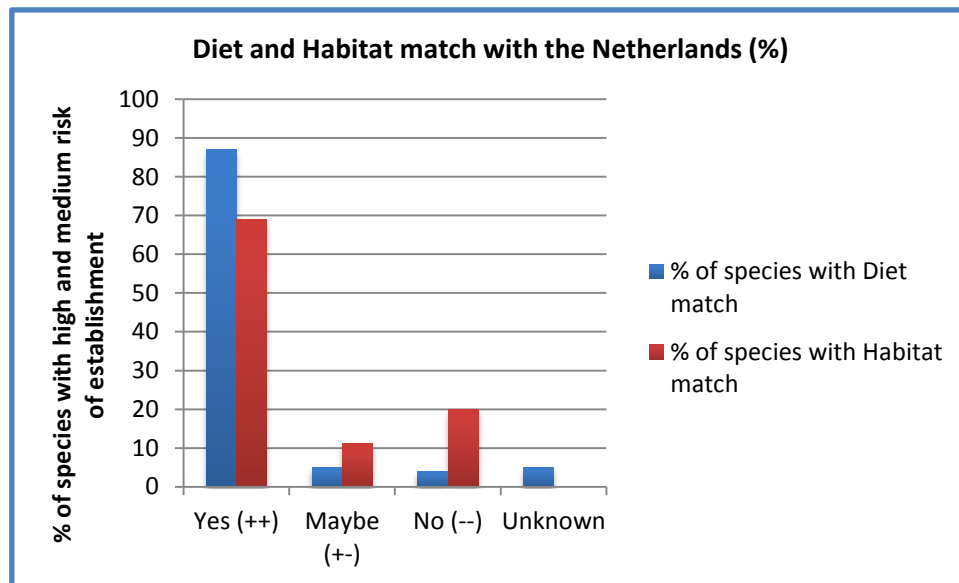


Fig 3.5 Percentage of species that do (++) , maybe have (+-), or do not have (--) a Diet and Climate match with the Netherlands.

3.5 Evaluation of mammal species list

The 78 species with ++ for both the Climate and Classification scheme match, or at least one ++ and one +/-, were considered at least “Medium risk species”. After analysis of the more specific habitats and diets, the species that had a match (++) for all four of these categories were considered “High Risk species”. Figure 3.6 shows that 43 of the species have a “High risk of establishment”, indicating that if these species end up in the wild in the Netherlands, there is a high probability they will survive. 38 species have a “Medium risk of establishment” (Figure 3.6), meaning that they might survive if they end up in the wild, but it is not certain. 232 of the analysed species have a “Low risk of establishment” (Figure 3.6), these species will probably not survive if they end up in the wild.

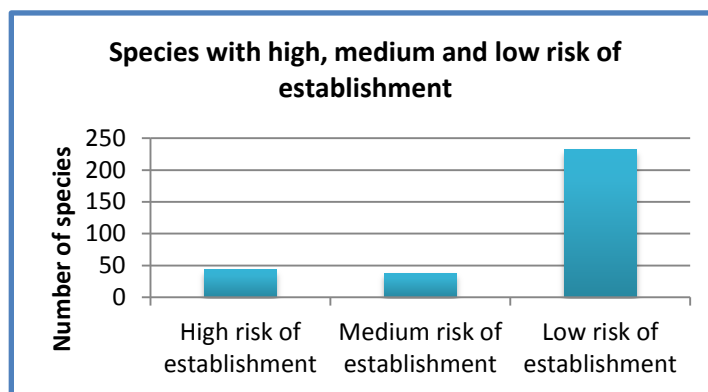


Fig 3.6 Number of species from 313 analysed species with high, medium and low risks of establishment.

Figure 3.7 shows which percentage of the species with a low, medium and high risk of establishment were observed in the wild in the Netherlands at least once and on which percentage of species a risk assessment has been performed. The specific species are shown in Appendix 2. Species indicated as high risk species have the highest percentage of species that were observed at least once in the Netherlands and risk assessments have been carried out on these species on the highest percentage of these species. These percentages were lower for the medium risk (of establishment) species, and lowest for the low risk (of establishment) species.

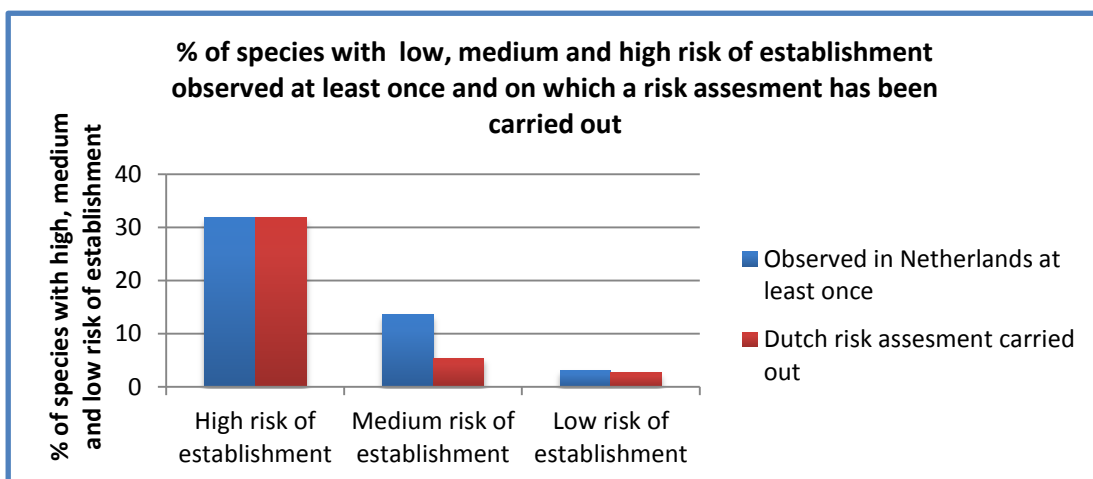


Fig 3.7 Percentage of species with high, medium and low risk of establishment that were observed at least once in the Netherlands, and on which a Dutch risk assessment has been carried out. 22

3.6 Different species groups

Special attention was given to some species groups of the mammal species list. These groups were marsupials, rodents, cervidae, carnivora and insectivora. It was determined which part of these groups consists species with low, medium and high risk of establishment. The species with high, medium and low risk of establishment from the different species groups are shown in Appendix 3. Figure 3.8 shows that rodents are by far the largest species group, consisting of 131 species. However, the majority of these species (108 species) will probably not survive in the wild in the Netherlands. Even though rodents make up the largest species group, the amount of species with high and medium risk of establishment are equally high in the carnivora group (13 and 10 respectively). The carnivora group is the second largest group, consisting of 66 different species. After this come the cervidae (deer) (48 species; 8 high risk species, 5 medium risk). The insectivora contain 4 high risk species and the marsupials contain 3 high risk species, they both contain 9 low risk species. The marsupials also contain 7 medium risk species.

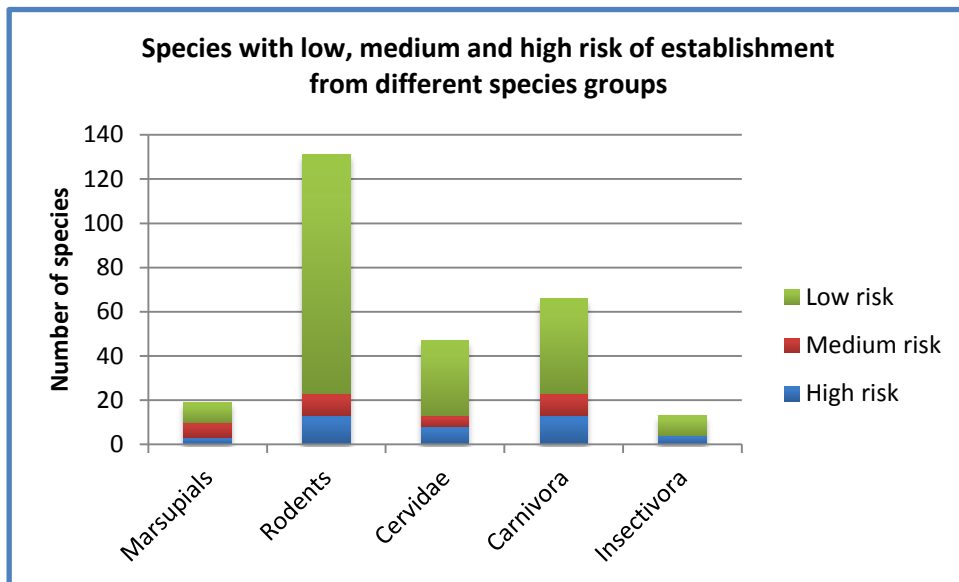


Fig 3.8 Number of species with low, medium and high risk of establishment in different species groups.

4 Discussion

From the results, it can be concluded that there are many different exotic mammal species in trade and captivity in the Netherlands. Only a small percentage of these species will be able to establish here, and an even smaller proportion will become invasive. Even though the number of potential invasive species is low, they can have drastic impacts on health, ecology and economy. Therefore it is important to investigate which species are present in the Netherlands, and assess the risks they pose. If potential invasive species are detected as early as possible, measures taken against them will be more effective. Studies like the one conducted here will contribute to the early detection of potential invasive exotic species before they have established.

In this section the found results are discussed. First, the found species on digital market places are evaluated, then the reliability of the different used species lists will be discussed. Subsequently, the influence of habitat- and diet plasticity on the outcome of this study are assessed. This is followed by an evaluation of the species that were observed in the Netherlands and on which no risk assessments have been conducted yet. Finally, it is determined which species *group* has the highest chance to establish in the Netherlands.

4.1 Exotic mammal species on digital market places

In order to get a rough idea of which mammal species are present in trade in the Netherlands, digital market places were analysed. It is the first time such a comprehensive analysis of so many species on digital market places was performed and reported in the Netherlands. This analysis gives insights in the amounts and numbers of exotic species offered on digital market places. It can be used to determine whether and which species posing risks to Dutch ecology, economy and health are offered and actively traded in the Netherlands.

Furthermore, the obtained results can be used as a baseline for comparison with the analysis exotic species offered on digital market places during the upcoming years. In this way, the long-term influence of the positive list on the trends in trade of exotic mammals can be observed.

The results show that there were more advertisements for exotic mammal species in June than in February. This is probably because more young are born during spring. These are offered on digital market places during summer. Furthermore, the results show that even though the number of offered species was approximately the same in February and June (59 and 58 respectively), the species compositions were slightly different. However, because this is the first time such an analysis of digital market places is done, it is not yet possible to draw any conclusions about differences in number of species and species composition. In order to find patterns, exotic species offered on digital market places should be analysed more often and over a longer period of time. Though it is not possible to draw any conclusions about patterns, there were some interesting findings regarding the species that were offered.

Several species that will probably be able to establish in the Netherlands (Appendix 1) were offered on digital market places. They even made up a relative high amount of the advertisements, making it relatively easy for private owners to obtain these species. After chinchilla's, most advertisements were for various squirrel species. It was remarkable that all medium and high risk species offered

more than 5 times on digital market places were squirrel species like the American red squirrel (*Tamiasciurus hudsonicus*), the Siberian chipmunk (*Tamias sibericus*), the Japanese squirrel (*Sciurus lis*) and the Swinhoe's striped squirrel (*Tamiops swinhoei*). Establishment of exotic squirrel species in the Netherlands can pose several risks to Dutch ecology. These include competition with the native red squirrel and danger to forestry (due to removal of bark) (Dijkstra & Dekker, 2008). All high- and medium risk species that do not belong to the squirrel group were offered less than 5 times on digital market places. These included the sika deer (*Cervus nippon*), reeve's muntjac (*Muntiacus reevesi micurus*), the genet (*Genetta genetta*), the raccoon dog (*Nyctereutes procyonoides*), the American mink (*Neovison vison*), the parma wallaby (*Macropus parma*) and the Patagonian hare (*Dolichotis patagonum*). Risk assessments of the raccoon dog, the American mink and sika deer are available online (Mulder, 2011; Dekker, 2012; Lammertsma *et al.*, 2012 respectively). Since quite a lot of exotic mammal species on digital market places will be able to establish in the Netherlands, and possibly pose risks to Dutch ecology, economy and health, measures have to be taken to prevent spread of these species. It has to be decided whether it will be sufficient to make traders and owners more aware of the risks, or whether trade and possession of some species should be prohibited. Of course, the latter will only work when there is enough enforcement.

It was remarkable that native species like the harvest mouse (*Micromys minutes*), the bank vole (*Myodes glareoles*) and the garden Dormouse (*Eliomys quercinus*) were also offered on digital market places. Possession of- and trade in these species is prohibited under the Flora and Fauna Act (ARCADIS, 2006). This indicates that the enforcement of this legislation is not sufficient, and should be improved. Possession of and trade in reeve's muntjac is also prohibited according to the Flora and Fauna Act, but it is still uncertain whether this also applies to subspecies (Overheid.nl, Wet- en regelgeving).

4.2 Evaluation of used data sources

Altogether, the list of exotic mammal species found on digital market places together with the CITES lists of imported and exported mammals, list of mammal species kept by private owners, list of mammals rescued by foundation AAP, list of mammals kept in zoos give are a reasonable representation of the mammal species present in trade and captivity in the Netherlands. It can be assumed that the species on these list are present in the Netherlands. This was the first time all these different lists of species were combined to get an overall overview of which mammal species are present in trade and captivity in the Netherlands. This is important, because in order to take measures against potential invasive exotic mammal species, it first has to be determined which species are already present.

However, since most of the lists were not developed for the same purpose they are used for here, the majority of the used lists were incomplete. In the following paragraphs, the used lists will be evaluated.

List of mammal species kept by private owners

There was a lot of resistance against the positive list (see S.Westbroek, 2014 report 2014.033), and the positive list was the reason for the identification of which mammals kept by private owners. Many owners, especially of small mammals like rodents, probably did not cooperate, since it is impossible to properly monitor small mammals that are kept within houses. Furthermore, the used list of mammals kept by private owners was an older version consisting of 359 species (Koene *et al.*, 2013). The latest version consists of 550 species (Hopster, 2014), however for time management reasons it was not possible to use that list.

List of mammal species in zoos

The list of mammals kept in zoos is also incomplete. An implementation expert (of CITES, zoo decrees and possession exemptions) from the Rijksdienst Voor Ondernemend Nederland (RVO) was asked for an overall list of all mammal species kept in zoos in the Netherlands, unfortunately this was not possible. Time wise it was not possible to contact all zoos personally. Therefore, a list from the website of Studio-Evenaar was used. However, this list does not contain all mammal species from all zoos in the Netherlands. Therefore, websites of the zoos themselves were used to look for species not mentioned on the Studio-Evenaar list. Most zoos also do not have an overview of all mammals kept in their zoos on their website. Again, especially small rodent species are often not mentioned.

Foundation AAP list and CITES list

Foundation AAP does not mention all rescued species on their website for privacy reasons of the previous owners of the species. Finally, the CITES lists of imported and exported mammals only contain CITES species. No record was available of import and export of non-CITES species. There were also no proper records of numbers and amounts of species in illegal trade, so the magnitude of this factor is largely unknown.

During this investigation it became clear that there are many opportunities to improve registration of exotic mammals in the Netherlands. Although it is practically impossible, it would be good to properly register which species are entering/exiting the Netherlands, and which species are present in the Netherlands in trade and in captivity.

4.3 Habitat and diet plasticity

After analysis of climate and habitat types, 83 species were left of which more specific habitats and diets were analysed. The majority of these species had a habitat and/or diet match with the Netherlands. In fact, this number might be even higher. During this study, only currently observed habitats and diets (as reported on the website of IUCN Red list, July 2014) of the species were analysed. However, species are often able to respond plastic to changing environments, they might

therefore be able to survive on a broader range of habitats/diets than is found in their native range.

Whether species forage on certain resources often depends on their availability. If there are enough resources, species generally specialize on resources with maximal energy return. If the amount of favourable resources declines, species are able to expand their diet and consume less favourable prey items. The more specialised a species is, the lower the probability that a species will survive in its new range (Ross *et al.*, 2010).

Habitat and diet plasticity might explain why some species, like the Siberian chipmunk and Bennet's wallaby, that were listed here as "medium risk" species are able to survive here. The Siberian chipmunk already has established populations around Tilburg (Dijkstra & Dekker, 2008), and there seems to be a small population of established Bennet's wallabies near Makkinga – Oosterwolde (Friesland) (Hollander, 2014).

It can be concluded that based on current diets and habitats, the high risk species have the highest probability to establish in the Netherlands. However, as is indicated by the Bennet's wallaby and the Siberian chipmunk, probability of establishment by medium risk species is also relatively high.

4.4 Observed and assessed species

Since both medium- and high risk species might establish in the Netherlands, it is recommended to assess risks posed by all species listed under medium and high risk species that have not been assessed already. However, in the next two paragraphs the focus will be on species that were already observed in the wild in the Netherlands at least once, and on which no risk assessments were conducted yet. There is a greater need for risk assessments on these species, since individuals of them were already observed in the wild.

High risk of establishment

Of the "high risk" species, 14 species were observed at least once in the Netherlands. Risk assessments were also conducted on 14 of the "High risk" species. However, the species that were observed in the Netherlands were not necessarily the same species on which risk assessments were carried out.

The North American porcupine (*Erethizon dorsatum*) and the nutria (*Myocastor coypus*) have been observed in the wild in the Netherlands, but no risk assessments were conducted on these species. There is no information about the North American porcupine as an exotic mammal. However, in its native range this species is often considered a pest species. In North America porcupines damage properties, outbuildings, trucks and cars by gnawing. Furthermore, porcupines feed on tree bark during winter, resulting in conflict with the timber industry (Roze, 2009).

The nutria already has established populations in many European countries, including the Netherlands. This species can damage wetlands by feeding on aquatic vegetation. It might also prey on eggs and destroy nests of (endangered) aquatic birds. Furthermore the species can cause economical damage by feeding on crops (maize and sugar beets), and disrupting river banks and dikes by burrowing activity (DAISIE, June 2006). In North America and France, nutrias are faught

with baits containing toxicants. Furthermore, in North America, zinc phosphide is sprayed on sweet potatoes and carrots to prevent crop damage (DAISIE, June 2006). Whether these measures are safe for ecology and health, and if they would be allowed in the Netherlands has to be investigated. In the Netherlands, nutria's are actively caught and shot, and the population is currently under control (UUV). However, actual damage caused by nutria's in the Netherlands has never been investigated. It could be useful to investigate this to determine whether taking measures against these species is really necessary.

Because the nutria and North American porcupine were already observed in the Netherlands, and measures were already taken against the nutria, it is highly recommended to analyse the risks posed by these species. If necessary, preventive measures against the North American Porcupine can still be taken. For the nutria it can be determined whether the taken measures are really necessary.

Medium risk of establishment

Of the medium risk species, more species were observed in the Netherlands than risk assessments were conducted. Of the species observed in the Netherlands, risk assessments were not conducted on the Bennett's wallaby (*Macropus rufogriseus*), the capybara (*Hydrochoerus hydrochaeris*), and the Patagonian cavy (*Dolichotis patagonum*).

The Bennett's wallaby already has some established populations in England and France (DAISIE, July 2014), and as was stated before, there also seems to be a small population of established wallabies in the Netherlands (Hollander, 2014). Bennett's wallabies can have several negative ecological and economical effects. Ecological effects include removal of understory vegetation in forests, preventing native bush regeneration, and possibly decrease water quality. Economic effects are pasture damage, sometimes even completely removing cover. They might also graze on green feed crops (Environment Canterbury Regional Council, June 2014). The Ross River virus is a zoonosis carried by wallabys (Knapen *et al.*, 2010). This zoonosis is only carried by wallabys on Australia, and export of live wallabys from Australia for commercial purposes is not allowed under the Australian law (Australian government, Department of Foreign Affairs and Trade). Therefore, the probability that wallabys in the Netherlands will be contaminated with this virus is very small. Since this species already seems to have a small established population in the Netherlands, a risk assessment on this species is recommended to determine whether measures should be taken.

No information was found about the capybara as an introduced species, but in its native range, this species is known to cause crop damage in corn fields (Barros Ferraz *et al.*, 2003). Since this species is a large rodent and herbivore, it can be expected that it will inhibit bush regeneration and damage forest understory.

Aside from occasional escapes (Paras, 2009), there is also not much information about the Patagonian cavy as an exotic species. However, since this species is also a large rodent, just like the capybara, ecological impacts are expected to be similar. Furthermore, the species might compete with the European hare, as their diets overlap (Campos *et al.*, 2001).

Even though these species were listed as “medium risk”, risk assessments on these species are also strongly recommended. Due to habitat and diet plasticity, these species might also be able to survive in the Netherlands, and it should be investigated whether- and which risks they pose for Dutch ecology and economy. If necessary, preventive measures (like prohibition of the species and/or education about the (possible) risks these species pose) should be taken.

4.5 Species groups

It was found that rodents make up the largest group of species in trade and captivity in the Netherlands. Since many rodent species were probably not reported, it is likely that the number is even higher. The second largest group of species in trade and captivity in the Netherlands were the carnivores. The number of high- and medium risk species were also highest in rodents and carnivores.

Besides the capybara and the Patagonian cavy, the high- and medium risk rodents are generally small species that are often kept in high numbers. Their small size makes it harder to recapture these species once they escape. Furthermore, rodents generally have a high reproduction rate. These factors increase chances of establishment of rodent populations in the Netherlands. However, only a relatively small number of escaped rodent species will survive in the Netherlands (Table 4.1).

A relatively high amount of the carnivore species is able to survive in the Netherlands. However, less species of this group are kept in the Netherlands, and they are often kept in lower numbers than rodents. Furthermore, their reproduction rate is generally lower, and carnivore species are generally larger, therefore they will be recaptured faster after escape (Table 4.1).

For these reasons, the risk of establishment in the Netherlands is highest for rodent populations.

Table 4.1 Factors influencing chances of established populations of rodents and carnivores.

Rodents	Carnivora
Higher total number of species	Lower total number of species
Smaller	Larger
Kept in higher numbers	Kept in lower numbers
Fast reproductive cycle	Slower reproductive cycle
Larger chance of escape in higher amounts	Smaller chance of escape in high amounts
Majority will not survive	Larger proportion will survive

5 Conclusions

It can be concluded that a significant number of exotic mammal species is present in trade and captivity in the Netherlands. The majority of these species will probably not be able to establish in the Netherlands due to differences in climate, food sources and habitat. However, as this report shows, some species are able to establish and can potentially damage ecology, economy and health. From the analysis of digital market places it can be concluded that quite a lot of exotic mammals that will be able to establish in the Netherlands are offered on digital market places, making it easy for private owners to obtain these species. Since some of these species could become invasive if they end up in the wild, measures like creating awareness among sellers/buyers and/or prohibitions have to be taken to prevent this.

Risk assessments are most highly recommended on species with high establishment potential that were already observed in the wild in the Netherlands and on which no risk assessments were conducted yet (the North American porcupine; *Erethizon dorsatum*, the nutria; *Myocastor coypus*, the Bennet's wallaby; *Macropus rufogriseus*, the capybara; *Hydrochoerus hydrochaeris*, and the Patagonian cavy; *Dolichotis patagonum*). It has to be determined if- and which risks these species pose to Dutch ecology, economy and health. If necessary, appropriate measures have to be taken against these species. Additionally, rodents were identified as the species *group* with the highest risk of establishment in the Netherlands. Therefore, risk assessments on rodent species with high establishment potential are also recommended.

6 Recommendations

This study identified a number of opportunities to improve the situation regarding exotic mammals in the Netherlands. If these opportunities are seized, ecological, economical and health damage caused by exotic species can be mitigated. Even though many recommendations were already given in the discussion and conclusion chapters, these are summarised in this paragraph.

- Measures should be taken against advertising of exotic mammal species that might become invasive in the Netherlands are offered on digital market places. These measures could include creating awareness of the risks posed by possible invasive species among sellers and buyers, or prohibition from public sale of certain species.
- The enforcement of the Flora and Fauna Act on digital market places should be improved. Currently this is not sufficient, since some prohibited indigenous species are offered.
- It should be investigated whether subspecies of Reeve's muntjac are also prohibited under the Flora and Fauna Act, and whether it is necessary to also prohibit subspecies. This might even be a juridical problem that not only applies to the Reeve's muntjac, but to all subspecies of prohibited species. Something that should be further investigated.
- It is recommended to analyse the risks for ecology posed by the North American porcupine, the nutria, the Bennet's wallaby, the Patagonian cavy and the capybara. If necessary, appropriate measures against these species have to be taken.
- Rodents were identified as the species group with the highest risk of establishment in the Netherlands. Therefore, full risk assessments on rodent species with high establishment potential are also recommended.

In the upcoming years, the pace of exotic species introductions will only increase due to increased globalisation, making studies like the one conducted here even more important. By means of research, like the one conducted here, potential invasive species can be identified before they are present in the wild. Owners and traders of these species can be educated about the risks their species pose to ecology, economy and health if they end up in the wild, and policy measures like prohibitions can be taken. If, despite these measures, invasive non-native species do end up in the wild, an adequate monitoring network is needed to identify and remove them as quickly as possible.

Hopefully, if these measures are taken, homogenization and alteration of distinctive ecosystems by exotic mammal species can be prevented, or at least mitigated.

References

- ARCADIS, Gedragscode flora – en faunawet voor de bouw- en ontwikkelingssector (2006), Obtained; July 11, via <https://mijn.rvo.nl/documents/13225/111559/Gedragscode+flora+en+faunawet+voor+de+bouw+en+ontwikkelingssector/a33e5b33-66af-4a49-808d-0757b131b7ea?version=1.44>.
- Australian Government, Department of Foreign Affairs and Trade. Kangaroos. Obtained; July 12, 2014 via <http://www.dfat.gov.au/facts/kangaroos.html>.
- Barros Ferras, K.M.P.M., Lechevalier, M.A., Zarate do Couto, H.T., & Martins Verdade, L., Damage caused by capybaras in a corn field. *Scientia Agricola* 60 (2003), pp. 191-194.
- Campos, C.M., Tognelli, M.F., & Ojeda, R.A., Mammalian species; *Dolichotis patagonum*. *The American society of Mammalogists* 652 (2001), pp. 1-5.
- CITES; Convention of International Trade in Endangered Species of Wild Fauna and Flora, CITES Trade Database. Obtained; July 10, 2014 via .
- D.R. Lammertsma, G.W.T.A. Groot Bruinderink and A.J. Griffioen, Risk assessment of Sika Deer *Cervus nippon* in the Netherlands. Report 2295. Alterra, Wageningen, NL, (2012).
- Dekker, J.J.A., De Amerikaanse nerts in Nederland. Report 2012.16. Zoogdierverseniging, Nijmegen, NL, (2012).
- Delivering Alien Invasive Species Inventories for Europe (DAISIE). Species fact sheet; *Myocastor coypu*. (2006) Obtained; June 25, 2014 via <http://www.europe-aliens.org/speciesFactsheet.do?speciesId=52881#>.
- Delivering Alien Invasive Species Inventories for Europe (DAISIE). Species fact sheet; *Macropus rufogriseus*. Obtained; July 29, 2014 via <http://www.europe-aliens.org/speciesFactsheet.do?speciesId=52866#>.
- Dijkstra, V. & J. Dekker. Risico-assessment uitheems eekhoorns. VZZ rapport 2008.10. Zoogdierverseniging, Arnhem (2008).
- Dijkstra, V., Amerikaanse rode eekhoorn. *Kijk op exoten* 7 (2014), pp. 14-15.
- Environment Canterbury Regional Council (Ecan.govt.nz). Wallabies; Information and advice about managing wallabies (*Macropus rufogriseus rufogriseus*). Obtained; June 25, 2014 via

<http://ecan.govt.nz/ADVICE/YOUR-LAND/PLANT-ANIMAL-PESTS/MANAGING-ANIMAL-PESTS/Pages/wallabies.aspx>.

Foundation AAP; Opvang voor uitheemse dieren. Tot nu toe gered. Obtained; July 10, 2014 via <http://www.aap.nl/wat-aap-doet/tot-nu-toe-gered/Page-6.html>.

Hayes, K.R. & Barry, S.C., Are there any consistent predictors of invasion success? *Biological Invasions* 10 (2008), pp. 483-506.

Hollander, H., Risico-analyse muntjak (*Muntiacus reevesi*). Report 2013.09. Zoogdierverseniging, Nijmegen, NL (2013).

Hollander, H., Wallabies – zoogdierexoten from down under. *Kijk op exoten* 8 (2014), pp. 12-13.

Hopster, H., Resultaten van de (her)inventarisatie van in Nederland gehouden zoogdiersoorten. Letter to stakeholders (2014).

Hulme, P.E. Trade, transport and trouble: managing invasive species pathways in an area of globalisation. *Journal of applied ecology* 46 (2009), pp. 10-18.

Hulme, P.E., Bacher, S., Kenis, M., Klotz, S., Kühn, I., Minchin, D., Nentwig, W., Olenin, S., Panov, V., Pergl, J., Pyšek, P., Rogues, A., Sol, D., Solarz, W., Vilà, M., Grasping at the routes of biological invasions: a framework for integrating pathways into policy. *Journal of applied ecology* 45 (2008), pp. 403-414.

Ipema, B., Interviews met organisaties van belanghebbenden over de methodiek voor een positieflijst voor zoogdieren. Report 416, Wageningen UR Livestock Research (2011).

IUCN; The IUCN Red List of Threatened species. Obtained; July 29, 2014 via <http://www.iucnredlist.org/>.

Jeschke, J.M., & Strayer, D.L., Determinants of vertebrate invasion success in Europe and North America. *Global Change Biology* 12 (2006), pp. 1608-1619.

Keller, R.P., Geist, J., Jeschke, J.M. & Kühn, I. Invasive species in Europe: ecology, status, and policy. *Environmental sciences Europe* 23 (2011).

Koene, P., Ipema, B., & De Mol, R.M., Zoogdiersoorten die geschikt zijn als gezelschapsdier. Report 701, Wageningen UR Livestock Research (2013).

Kottek, M., Grieser, J., Beck, C., Rudolf, B. & Rubel, F., World map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift* 15 (2006), pp. 259-263.

Lammertsma, D.R. Groot Bruinderink, G.W.T.A. and Griffioen, A.J.. Risk assessment of Sika Deer, *Cervus nippon* in the Netherlands. Report 2295. Alterra, Wageningen, NL, (2012).

Meyerson, L.A. & Mooney, H.A. Invasive alien species in an era of globalisation. *Frontiers in ecology and the environment* 5 (2007), pp. 199-208.

Mulder, J.L., The raccoon dog in the Netherlands – a risk assessment. Bureau Mulder-natuurlijk, De Bilt, NL, (2011).

Novillo, A. & Ojeda, R.A. The exotic mammals of Argentina. *Biological invasions* 10 (2008), pp. 1333-1344.

Overheid.nl, Wet- en regelgeving. Besluit aanwijzing dier- en plantensoorten Flora- en faunawet. Obtained; June 5, 2014 via http://wetten.overheid.nl/BWBR0011851/geldigheidsdatum_05-06-2014.

Paras, A., Cavies hop into neighbourhood. *The Post and Courier* (2009). Obtained on June 25, 2014 via <http://www.postandcourier.com/article/20090409/PC1602/304099880>.

Perrings, C., Dehnen-Schmutz, K., Touza, J. & Williamson, M. How to manage biological invasions under globalization. *Trends in ecology and evolution* 20 (2005), pp. 213-215.

Perrings, C., Williamson, M., Barbier, E.B., Delfino, D., Dalmazzone, S., Shogren, J., Simmons, P. & Watkinson, A., Biological invasion risks and the public good: an economic perspective. *Conservation ecology* 6 (2002).

Rijksoverheid (2007), Beleidsnota invasieve exoten. Obtained; January 7, 2014 via <http://www.rijksoverheid.nl/documenten-en-publicaties/notas/2007/10/15/beleidsnota-invasieve-exoten.html>.

Ross, S., Munkhtsog, B., & Harris, S., Dietary composition, plasticity, and prey selection of Pallas's cats. *Journal of Mammalogy* 91 (2010), pp. 811-817.

Roze, U., *The North American porcupine* (second edition). Cornell University, United States of America, (2009).

Sakai, A.K., Allendorf, F.W., Holt, J.S., Lodge, D.M., Molofsky, J., With, K.A., Baughman, S., Cabin, R.J., Cohen, J.E., Ellstrand, N.C., McCauley, D.E., O'Neil, P., Parker, I.M., Thompson, J.N. & Weller, S.G., The population Biology of invasive species. Annual review of ecology and systematics 32 (2001), pp. 305-332.

STOWA, Overzicht beschermingsregimes AMvB Flora- en faunawet, Obtained; July 10, 2014 via [http://florafaunawet.stowa.nl/Upload/Overzicht%20beschermingsregimes%20\(2\).pdf](http://florafaunawet.stowa.nl/Upload/Overzicht%20beschermingsregimes%20(2).pdf).

Unie Van Waterschappen (UVW), Muskus- en beverratten steeds beter onder controle. Obtained; July 12, 2014 via http://www.uvw.nl/zoekpagina-zoekresultaat-nieuws.html?newsdetail=20130225-1398_muskus-en-beverratten-steeds-beter-onder-controle&highlight=beverrat

Walker, E.P. Mammals of the World; Third Edition. The Johns Hopkins University Press, Baltimore and London (1975).

Westbroek, S. The positive list and other policy measures that affect trade in- and possession of exotic mammals in the Netherlands: Stakeholder perceptions and recommendations. Report 2014.033, Bureau van de Zoogdierverseniging, Nijmegen (2014)

Wikipedia, List of domesticated animals. Obtained; July 10, 2014 via http://en.wikipedia.org/wiki/List_of_domesticated_animals.

Williamson, M. & Fitter, A., The varying success of invaders. Ecology 7 (1996), pp. 1661-1666.

Appendix 1: Risk of establishment

High risk of establishment	
Scientific name	Common name
<i>Blarina brevicauda</i>	Northern Short-tailed Shrew
<i>Blastocerus dichotomus</i>	Marsh Deer
<i>Callosciurus erythraeus</i>	Pallas's Squirrel
<i>Canis lupus</i>	Gray Wolf
<i>Capreolus pygargus</i>	Siberian roe deer
<i>Castor canadensis</i>	American Beaver
<i>Cervus nippon</i>	Sika
<i>Chaetophractus vellerosus</i>	Screaming Hairy Armadillo
<i>Chaetophractus villosus</i>	Big Hairy Armadillo
<i>Cricetulus migratorius</i>	Gray Dwarf Hamster
<i>Cryptotis parva</i>	Least Shrew
<i>Cuon alpinus</i>	Dhole, Red Dog
<i>Erethizon dorsatum</i>	North American Porcupine
<i>Erinaceus amurensis</i>	Amur Hedgehog
<i>Genetta genetta</i>	Common Genet
<i>Glaucomys volans</i>	Mexican Flying Squirrel
<i>Hydropotes inermis</i>	Chinese Water Deer
<i>Lynx rufus</i>	Bobcat, Bay Lynx
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Martes flavigula</i>	Yellow-throated Marten
<i>Mephitis mephitis</i>	Striped Skunk
<i>Mustela lutreola</i>	European Mink
<i>Muntiacus reevesi</i>	Reeves' Muntjac
<i>Myocastor coypus</i>	Coypu
<i>Neovison/Mustela vison</i>	American Mink
<i>Nyctereutes procyonoides</i>	Raccoon dog
<i>Odocoileus virginianus</i>	White-tailed Deer
<i>Paguma larvata</i>	Masked Palm Civet
<i>Prionailurus bengalensis</i>	Leopard Cat
<i>Procyon lotor</i>	Northern Raccoon
<i>Pudu pudu</i>	Southern Pudu, Chilean Pudu
<i>Rusa unicolor</i>	Sambar, Sambar Deer
<i>Sciurus carolinensis</i>	Eastern Gray Squirrel
<i>Sciurus lis</i>	Japanese Squirrel
<i>Sciurus niger</i>	Bryant's Fox Squirrel
<i>Sorex palustris</i>	American Water Shrew, Water Shrew
<i>Speothos venaticus</i>	Bush Dog, Vinegar Dog, Savannah Dog
<i>Spermophilus citellus</i>	European Ground Squirrel
<i>Tamias striatus</i>	Eastern Chipmunk
<i>Tamiasciurus hudsonicus</i>	Red Squirrel

<i>Tamiops swinhoei</i>	Swinhoe's Striped Squirrel
<i>Trichosurus vulpecula</i>	Common Brushtail Possum
<i>Wallabia bicolor</i>	Swamp Wallaby

Medium risk of establishment	
Scientific name	Common name
<i>Bettongia gaimardi</i>	Tasmanian Bettong,
<i>Canis aureus</i>	Golden Jackal
<i>Caracal caracal/Lynx caracal</i>	Caracal
<i>Cerdocyon thous</i>	Crab-eating Fox
<i>Chrysocyon brachyurus</i>	Maned Wolf
<i>Cricetulus barabensis</i>	Striped Dwarf Hamster
<i>Dasyprocta azarae</i>	Azara's Agouti
<i>Dolichotis patagonum</i>	Patagonian Cavy
<i>Dremomys pernyi</i>	Perny's Long-nosed Squirrel
<i>Elaphodus cephalophus</i>	Tufted Deer
<i>Elaphurus davidianus</i>	Père David's Deer, Pere David's Deer
<i>Felis chaus</i>	Jungle Cat
<i>Funambulus pennantii</i>	Five-striped Palm Squirrel
<i>Hippocamelus bisulcus</i>	Patagonian Huemul
<i>Hydrochoerus hydrochaeris</i>	Capybara
<i>Lagostomus maximus</i>	Argentine Plains Viscacha
<i>Lepus timidus</i>	Mountain Hare
<i>Lycalopex gymnocercus</i>	Pampas Fox
<i>Lynx pardinus</i>	Iberian Lynx
<i>Macropus parma</i>	Parma wallaby
<i>Macropus robustus</i>	Common Wallaroo
<i>Macropus rufogriseus</i>	Red-necked Wallaby, Bennett's Wallaby
<i>Marmota marmota</i>	Alpine Marmot
<i>Mazama gouazoubira</i>	South American Brown Brocket
<i>Muntiacus crinifrons</i>	Black Muntjac, Hairy-fronted Muntjac
<i>Octodon bridgesi</i>	Bridges's Degu
<i>Petaurus breviceps</i>	Sugar Glider
<i>Potorous tridactylus</i>	Long-nosed Potoroo
<i>Procavia capensis</i>	Rock Hyrax, Rock Dassie
<i>Procyon cancrivorus</i>	Crab-eating Raccoon
<i>Tamias (Eutamias) sibiricus</i>	Siberian Chipmunk
<i>Tamiops maritimus</i>	Maritime Striped Squirrel
<i>Thylogale thetis</i>	Red-necked Pademelon
<i>Tragelaphus oryx</i>	Common Eland, Eland

<i>Vormela peregusna</i>	European Marbled Polecat
<i>Atilax paludinosus</i>	Marsh Mongoose
<i>Graphiurus murinus</i>	Woodland Dormouse
<i>Tenrec ecaudatus</i>	Tailless Tenrec, Common Tenrec

Low risk of establishment	
Scientific name	Common name
<i>Amblonyx cinerea/Aonyx cinerea</i>	Oriental Small-clawed Otter
<i>Antidorcas marsupialis</i>	Springbok
<i>Aonyx capensis</i>	African Clawless Otter
<i>Cynictis penicillata</i>	Yellow Mongoose
<i>Hemicentetes nigriceps</i>	Highland Streaked Tenrec
<i>Hippocamelus antisensis</i>	Taruca, Peruvian Guemal,
<i>Lemniscomys rosalia</i>	Single-Striped Lemniscomys
<i>Lemniscomys striatus</i>	Typical Lemniscomys
<i>Lemniscomys zebra</i>	Heuglin's Lemniscomys
<i>Leptailurus serval</i>	Serval
<i>Macroselides proboscideus</i>	Round-eared Sengi
<i>Muntiacus rooseveltorum</i>	Roosevelts' Muntjac
<i>Muntiacus truongsoneensis</i>	Annamite Muntjac
<i>Mus (Nannomys) minutooides</i>	Southern African Pygmy Mouse
<i>Oreotragus oreotragus</i>	Klipspringer
<i>Otocyon megalotis</i>	Bat-eared Fox
<i>Pedetes capensis</i>	Spring Hare
<i>Sciurus granatensis</i>	Red-tailed Squirrel
<i>Suricata suricatta</i>	Meerkat
<i>Tragelaphus strepsiceros</i>	Greater Kudu
<i>Civettictis civetta</i>	African Civet
<i>Acomys cahirinus</i>	Cairo Spiny Mouse
<i>Acomys dimidiatus</i>	Eastern Spiny Mouse
<i>Acomys minous</i>	Crete Spiny Mouse
<i>Acomys russatus</i>	Golden Spiny Mouse
<i>Addax nasomaculatus</i>	Addax
<i>Aepyceros melampus</i>	Impala
<i>Alces alces americana</i>	Moose, Siberian Elk
<i>Alopex lagopus</i>	Arctic Fox
<i>Alticola roylei</i>	Royle's Mountain Vole
<i>Ammotragus lervia</i>	Barbary Sheep
<i>Antilope cervicapra</i>	Blackbuck
<i>Atelerix albiventris</i>	Four-toed Hedgehog
<i>Axis axis</i>	Chital
<i>Axis calamianensis</i>	Calamian Deer

<i>Axis kuhlii</i>	Bawean Deer, Kuhl's Hog Deer, Bawean Hog Deer
<i>Axis porcinus</i>	Hog Deer
<i>Bettongia penicillata</i>	Woylie
<i>Blarinella quadratacauda</i>	Asiatic Short-tailed Shrew
<i>Boselaphus tragocamelus</i>	Nilgai
<i>Callosciurus adamsi</i>	Ear-spot Squirrel
<i>Callosciurus albescens</i>	Kloss's Squirrel, Kloss Squirrel
<i>Callosciurus baluensis</i>	Kinabalu Squirrel, Inabalu Squirrel
<i>Callosciurus caniceps</i>	Gray-bellied Squirrel
<i>Callosciurus finlaysonii</i>	Finlayson's Squirrel
<i>Callosciurus inornatus</i>	Inornate Squirrel
<i>Callosciurus melanogaster</i>	Mentawai Squirrel
<i>Callosciurus nigrovittatus</i>	Black-striped Squirrel
<i>Callosciurus notatus</i>	Plantain Squirrel
<i>Callosciurus orestes</i>	Borneo Black-banded Squirrel
<i>Callosciurus phayrei</i>	Phayre's Squirrel
<i>Callosciurus prevostii</i>	Prevost's Squirrel
<i>Callosciurus pygerythrus</i>	Irrawaddy Squirrel
<i>Callosciurus quinquestratus</i>	Anderson's Squirrel
<i>Callosciurus finlaysonii</i>	Finlayson's Squirrel, Finlayson's Squirrel
<i>Calomyscus bailwardi</i>	Zagros Mountains Calomyscus
<i>Capromys pilorides</i>	Desmarest's Hutia
<i>Cephalophus natalensis</i>	Red Duiker
<i>Cervus alfredi</i>	Visayan Spotted Deer
<i>Chinchilla lanigera</i>	Long-tailed Chinchilla
<i>Crossarchus obscurus</i>	Common Kusimanse
<i>Cryptoprocta ferox</i>	Fossa
<i>Ctenodactylus gundi</i>	Gundi, North African Gundi
<i>Cynomys ludovicianus</i>	Arizona Black-tailed Prairie Dog
<i>Cynomys mexicanus</i>	Mexican Prairie Dog, Mexican Prairie Marmot
<i>Cynomys parvidens</i>	Utah Prairie Dog
<i>Dasyprocta leporina</i>	Red-rumped Agouti, Brazilian Agouti
<i>Dasyprocta punctata</i>	Central American Agouti
<i>Dolichotis salinicola</i>	Dwarf Patagonian Cavy
<i>Echinops telfairi</i>	Lesser Hedgehog Tenrec
<i>Echinosorex gymnura</i>	Moonrat
<i>Otocolobus manul</i>	Pallas's Cat, Manul
<i>Funambulus layardi</i>	Layard's Palm Squirrel
<i>Funambulus palmarum</i>	Common Palm Squirrel
<i>Funambulus sublineatus</i>	Dusky-striped Squirrel, Dusky Palm Squirrel
<i>Funambulus tristriatus</i>	Western Ghats Striped Squirrel
<i>Galictis vittata</i>	Greater Grison

<i>Galidia elegans</i>	Malagasy Ring-tailed Mongoose
<i>Genetta thierryi</i>	Hausa Genet, Haussa Genet
<i>Gerbillurus setzeri</i>	Namib Brush-tailed Gerbil
<i>Gulo gulo</i>	Wolverine
<i>Heliosciurus gambianus</i>	Gambian Sun Squirrel
<i>Heliosciurus mutabilis</i>	Mutable Sun Squirrel
<i>Heliosciurus punctatus</i>	Small Sun Squirrel
<i>Heliosciurus rufobrachium</i>	Red-legged Sun Squirrel
<i>Heliosciurus ruwenzorii</i>	Ruwenzori Sun Squirrel
<i>Heliosciurus undulatus</i>	Zanj Sun Squirrel
<i>Helogale parvula</i>	Common Dwarf Mongoose
<i>Hemicentetes semispinosus</i>	Lowland Streaked Tenrec
<i>Hippotragus niger niger</i>	Sable Antelope
<i>Hyaena hyaena</i>	Striped Hyena
<i>Hylomys suillus</i>	Short-tailed Gymnure
<i>Hypogeomys antimena</i>	Votsovoetsa
<i>Ictonyx libyca</i>	Saharan Striped Polecat
<i>Jaculus jaculus</i>	Lesser Egyptian Jerboa
<i>Jaculus orientalis</i>	Greater Egyptian Jerboa
<i>Kerodon rupestris</i>	Rock Cavy
<i>Lagidium viscacia</i>	Southern Mountain Viscacha
<i>Lasiopodomys brandtii</i>	Brandt's Vole
<i>Lemniscomys barbarus</i>	Barbary Striped Grass Mouse
<i>Lemniscomys bellieri</i>	Bellier's Lemniscomys
<i>Lemniscomys griselda</i>	Griselda's Lemniscomys
<i>Lemniscomys hoogstraali</i>	Hoogstraal's Lemniscomys
<i>Lemniscomys linulus</i>	Senegal One-striped Grass Mouse
<i>Lemniscomys macculus</i>	Buffoon Striped Grass Mouse
<i>Lemniscomys mittendorfi</i>	Mittendorf's Lemniscomys
<i>Lemniscomys roseveari</i>	Rosevear's Lemniscomys
<i>Lycaon pictus</i>	African wild dog
<i>Lynx canadensis</i>	Canadian Lynx
<i>Macropus eugenii</i>	Tammar Wallaby, Tamar Wallaby
<i>Macropus rufus</i>	Red Kangaroo
<i>Macropus fuliginosus</i>	Western Gray Kangaroo
<i>Madoqua kirkii</i>	Kirk's Dikdik
<i>Manis tetradactyla</i>	Black-bellied Pangolin, Long-tailed Pangolin
<i>Manis tricuspis</i>	White-bellied Pangolin,
<i>Mazama americana</i>	South American Red Brocket/Red Brocket
<i>Mazama bricenii</i>	Mérida Brocket, Rufous Brocket, Meroia Brocket
<i>Mazama pandora</i>	Yucatan Brown Brocket
<i>Mazama temama</i>	Central American Red Brocket

<i>Meriones (Parameriones) persicus</i>	Persian Jird
<i>Meriones crassus</i>	Sundevall's Jird
<i>Meriones unguiculatus</i>	Mongolian Gerbil, Mongolian Jird
<i>Mesocricetus auratus</i>	Golden Hamster
<i>Microtus guentheri</i>	Günther's Vole
<i>Monodelphis domestica</i>	Grey Short-tailed Opossum
<i>Mungos gambianus</i>	Gambian Mongoose
<i>Mungos mungo</i>	Banded Mongoose
<i>Mungotictis decemlineata</i>	Malagasy Narrow-striped Mongoose
<i>Muntiacus atherodes</i>	Bornean Yellow Muntjac
<i>Muntiacus feae</i>	Fea's Muntjac
<i>Muntiacus gongshanensis</i>	Gongshan Muntjac
<i>Muntiacus muntjak</i>	Southern Red Muntjac
<i>Muntiacus puhoatensis</i>	Puhoat Muntjac
<i>Muntiacus putaoensis</i>	Leaf Muntjac, Leaf Deer
<i>Muntiacus vuquangensis</i>	Large-antlered Muntjac, Giant Muntjac
<i>Nasua narica</i>	White-nosed Coati, Coatimundi
<i>Octodon degus</i>	Degu
<i>Octodon lunatus</i>	Moon-toothed Degu
<i>Octodon pacificus</i>	Pacific Degu
<i>Pachyuromys duprasi</i>	Fat-tailed Jird/Fat-tailed Gerbil
<i>Phalanger orientalis</i>	Northern Common Cuscus
<i>Philander opossum</i>	Gray Four-eyed Opossum, Guaiki
<i>Phodopus campbelli</i>	Campbell's Desert Hamster/Campbell's Hamster
<i>Phodopus roborovskii</i>	Desert Hamster, Roborowski's Hamster
<i>Phodopus sungorus</i>	Dzhungarian Hamster
<i>Prionailurus viverrinus</i>	Fishing Cat
<i>Przewalskium albirostris</i>	White-lipped Deer, Thorold's Deer
<i>Psammomys obesus</i>	Fat Sand Rat
<i>Pteromys volans</i>	Russian Flying Squirrel, Siberian Flying Squirrel
<i>Pteropus lylei</i>	Lyle's Flying Fox
<i>Pteropus rodricensis</i>	Rodrigues Flying Fox
<i>Pteropus vampyrus</i>	Large Flying-fox, Large Flying Fox
<i>Rangifer tarandus</i>	Reindeer, Caribou, Peary Caribou
<i>Rhombomys opimus</i>	Great Gerbil
<i>Rhynchocyon petersi</i>	Black and Rufous Sengi
<i>Rousettus aegyptiacus</i>	Egyptian Fruit Bat
<i>Rucervus duvaucelii</i>	Barasingha, Swamp Deer
<i>Rucervus eldii</i>	Eld's Deer, Thamin, Brow-antlered Deer
<i>Rucervus schomburgki</i>	Schomburgk's Deer
<i>Rusa alfredi</i>	Phillipine Spotted Deer, Visayan Spotted Deer
<i>Rusa marianna</i>	Phillipine Deer, Phillipine Brown Deer

<i>Rusa timorensis</i>	Javan Rusa, Rusa, Javan Deer
<i>Sciurotamias forresti</i>	Forrest's Rock Squirrel
<i>Sciurus igniventris</i>	Northern Amazon Red Squirrel
<i>Sciurus variegatoides</i>	Variegated Squirrel
<i>Sekeetamys calurus</i>	Bushy-tailed Jird
<i>Sorex arcticus</i>	Arctic Shrew
<i>Sorex mirabilis</i>	Ussuri Shrew
<i>Spalacopus cyanus</i>	Coruro
<i>Spermophilus variegatus</i>	Rock Squirrel
<i>Spermophilus richardsonii</i>	Richardson's Ground Squirrel
<i>Suncus megalura</i>	Climbing Shrew
<i>Tamiops macclellandii</i>	Himalayan Striped Squirrel
<i>Tamiops rodolphii</i>	Cambodian Striped Squirrel
<i>Tragelaphus angasii</i>	Nyala
<i>Tragelaphus eurycerus</i>	Bongo
<i>Tragelaphus spekii</i>	Sitatunga, Marshbuck
<i>Tragulus javanicus</i>	Javan Chevrotain
<i>Tragulus kanchil</i>	Lesser Oriental Chevrotain
<i>Tragulus napu</i>	Greater Oriental Chevrotain
<i>Tragulus nigricans</i>	Balabac Mouse Deer
<i>Tragulus versicolor</i>	Silver-backed Chevrotain, Vietnamese Mousedeer
<i>Tragulus williamsoni</i>	Williamson's Chevrotain, Williamson's Mousedeer
<i>Tupaia belangeri</i>	Northern Treeshrew, Northern Tree Shrew
<i>Tupaia glis</i>	Common Treeshrew, Common Tree Shrew
<i>Viverra zangalunga</i>	Malay Civet, Malayan Civet, Oriental Civet
<i>Vulpes corsac</i>	Corsac Fox, Corsac
<i>Vulpes lagopus</i>	Arctic Fox, Polar Fox
<i>Arctictis binturong</i>	Binturong
<i>Arvicanthis niloticus</i>	African Arvicanthis
<i>Cricetomys gambianus</i>	Northern Giant Pouched Rat
<i>Crocuta crocuta</i>	Spotted Hyena
<i>Cynomys gunnisoni</i>	Gunnison's Prairie Dog
<i>Cynomys leucurus</i>	White-tailed Prairie Dog
<i>Gazella subgutturosa</i>	Goitered Gazelle
<i>Macropus (Notamacropus) agilis</i>	Agile Wallaby
<i>Marmota bobak</i>	Bobak Marmot
<i>Odocoileus hemionus</i>	Mule Deer,
<i>Paradoxurus hermaphroditus</i>	Common Palm Civet, Mentawai Palm Civet
<i>Phyllostomus discolor</i>	Pale Spear-nosed Bat
<i>Potos flavus</i>	Kinkajou
<i>Spermophilus tridecemlineatus</i>	Thirteen-lined Ground Squirrel
<i>Tragelaphus imberbis</i>	Lesser Kudu

<i>Vulpes velox velox</i>	Swift Fox
<i>Bassariscus astutus</i>	Ringtail
<i>Cavia aperea</i>	Brazilian Guinea Pig
<i>Cavia magna</i>	Greater Guinea Pig
<i>Eira barbara</i>	Tayra, Greyheaded Tayra
<i>Genetta Tigrina</i>	Cape Genet
<i>Herpailurus yaguarondi</i>	Jaguarundi, Eyra Cat
<i>Leopardus geoffroyi</i>	Geoffroy's Cat
<i>Leopardus pardalis</i>	Ocelot
<i>Leopardus wiedii</i>	Margay/Tree Ocelot
<i>Mazama bororo</i>	São Paulo Bororó/Small Red Brocket
<i>Mazama chunyi</i>	Peruvian Dwarf Brocket, Chunyi, Dwarf Brocket
<i>Mazama nana</i>	Southern Bororó/Brazilian Dwarf Brocket
<i>Myrmecophaga tridactyla</i>	Giant Anteater
<i>Nasua nasua</i>	South American Coati
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby,
<i>Pudu mephistophiles</i>	Northern Pudu
<i>Puma yagouarondi</i>	Jaguarundi, Eyra Cat
<i>Rattus tunneyi</i>	Australian Pale Field Rat/Pale Field Rat
<i>Sciurotamias davidianus</i>	Père David's Rock Squirrel
<i>Setifer setosus</i>	Greater Hedgehog Tenrec
<i>Elephantulus rupestris</i>	Western Rock Elephant Shrew
<i>Galea musteloides</i>	Common Yellow-toothed Cavy
<i>Mazama rufina</i>	Dwarf Red Brocket, Little Red Brocket Deer
<i>Vulpes zerda</i>	Fennec Fox
<i>Xerus (Geosciurus) inauris</i>	South African Ground Squirrel
<i>Xerus erythropus</i>	Striped Ground Squirrel
<i>Canis mesomelas</i>	Black-backed Jackal
<i>Lagurus lagurus</i>	Steppe Vole

Appendix 2: Species observed in the wild at least once in the Netherlands, and species on which Dutch risk assessments were conducted

High establishment risk species			Medium establishment risk species			Low establishment risk species		
Species	Observed	Assessed	Species	Observed	Assessed	Species	Observed	Assessed
Pallas's Squirrel	X	X	Patagonian Cavy	X		Red-tailed Squirrel	X	X
Sika	X	X	Perny's Long-nosed Squirrel	X	X	Prevost's Squirrel	X	
North American Porcupin	X		Capybara	X		Black-tailed Prairie Dog	X	
Striped Skunk	X	X	Bennett's Wallaby	X		Grey Short-tailed Opossum		X
Reeves' Muntjac	X	X	Siberian Chipmunk	X	X	White-nosed Coati	X	
Nutria	X					Gray Four-eyed Opossum		X
American Mink	X	X				Northern Amazon Red Squirrel		X
Raccoon dog	X	X				Variagated Squirrel	X	X
Northern Raccoon	X	X				Pale Spear-nosed Bat	X	
Eastern Gray Squirrel	X	X				Kinkajou	X	
Japanese Squirrel	X	X				South American Coati	X	
Bryant's Fox Squirrel	X	X				Père David's Rock Squirrel		X
Eastern Chipmunk		X						
Red Squirrel	X	X						
Swinhoe's Striped Squirrel	X	X						
Common Brushtail Possum		X						

Appendix 3: Risk of establishment per species group

<i>Rodents</i>	
High risk species	
<i>Callosciurus erythraeus</i>	Pallas's Squirrel
<i>Castor canadensis</i>	American Beaver
<i>Cricetulus migratorius</i>	Gray Dwarf Hamster, Grey Hamster
<i>Erethizon dorsatum</i>	North American Porcupine
<i>Glaucomys volans</i>	Mexican Flying Squirrel, Southern Flying Squirrel
<i>Myocastor coypus</i>	Coypu, Nutria
<i>Sciurus carolinensis</i>	Eastern Gray Squirrel, Gray Squirrel, Grey Squirrel
<i>Sciurus lis</i>	Japanese Squirrel
<i>Sciurus niger</i>	Bryant's Fox Squirrel
<i>Spermophilus citellus</i>	European Ground Squirrel, European Squirrel, European Souslik
<i>Tamias striatus</i>	Eastern Chipmunk
<i>Tamiasciurus hudsonicus</i>	Red Squirrel, Mount Graham Red Squirrel, Mountain Weasel
<i>Tamiodopsis swinhoei</i>	Swinhoe's Striped Squirrel
Medium risk species	
<i>Dasyprocta azarae</i>	Azara's Agouti
<i>Dolichotis patagonum</i>	Patagonian Cavy, Patagonian Hare, Patagonian Mara
<i>Dremomys pernyi</i>	Perny's Long-nosed Squirrel, Servaline Genet
<i>Hydrochoerus hydrochaeris</i>	Capybara
<i>Lagostomus maximus</i>	Argentine Plains Viscacha
<i>Lepus timidus</i>	Mountain Hare, Arctic Hare
<i>Marmota marmota</i>	Alpine Marmot
<i>Tamias (Eutamias) sibiricus</i>	Siberian Chipmunk
<i>Tamiodopsis maritimus</i>	Maritime Striped Squirrel
<i>Graphiurus murinus</i>	Woodland Dormouse
Low risk species	
<i>Lemniscomys striatus</i>	Typical Lemniscomys
<i>Lemniscomys zebra</i>	Heuglin's Lemniscomys
<i>Pedetes capensis</i>	Spring Hare, Springhare, Springhaas
<i>Sciurus granatensis</i>	Red-tailed Squirrel
<i>Acomys cahirinus</i>	Cairo Spiny Mouse, Greater Wilfred's Mouse, Northeast African Spiny Mouse
<i>Acomys dimidiatus</i>	Eastern Spiny Mouse
<i>Acomys minous</i>	Crete Spiny Mouse
<i>Acomys russatus</i>	Golden Spiny Mouse

<i>Callosciurus adamsi</i>	Ear-spot Squirrel
<i>Callosciurus albescens</i>	Kloss's Squirrel, Kloss Squirrel
<i>Callosciurus baluensis</i>	Kinabalu Squirrel, Inabalu Squirrel
<i>Callosciurus caniceps</i>	Gray-bellied Squirrel
<i>Callosciurus finlaysonii</i>	Finlayson's Squirrel
<i>Callosciurus inornatus</i>	Inornate Squirrel
<i>Callosciurus melanogaster</i>	Mentawai Squirrel
<i>Callosciurus nigrovittatus</i>	Black-striped Squirrel
<i>Callosciurus notatus</i>	Plantain Squirrel
<i>Callosciurus orestes</i>	Borneo Black-banded Squirrel
<i>Callosciurus phayrei</i>	Phayre's Squirrel
<i>Callosciurus prevostii</i>	Prevost's Squirrel
<i>Callosciurus pygerythrus</i>	Irrawaddy Squirrel
<i>Callosciurus quinquestriatus</i>	Anderson's Squirrel
<i>Callosciurus finlaysonii</i>	Finlayson's Squirrel, Finlayson's Squirrel
<i>Calomyscus bailwardi</i>	Zagros Mountains Calomyscus
<i>Capromys pilorides</i>	Desmarest's Hutia
<i>Chinchilla lanigera</i>	Long-tailed Chinchilla
<i>Ctenodactylus gundi</i>	Gundi, North African Gundi
<i>Cynomys ludovicianus</i>	Arizona Black-tailed Prairie Dog, Black-tailed Prairie Dog
<i>Cynomys mexicanus</i>	Mexican Prairie Dog, Mexican Prairie Marmot
<i>Cynomys parvidens</i>	Utah Prairie Dog
<i>Dasyprocta leporina</i>	Red-rumped Agouti, Brazilian Agouti
<i>Dasyprocta punctata</i>	Central American Agouti
<i>Dolichotis salinicola</i>	Dwarf Patagonian Cavy
<i>Funambulus layardi</i>	Layard's Palm Squirrel
<i>Funambulus palmarum</i>	Common Palm Squirrel, Indian Palm Squirrel
<i>Funambulus sublineatus</i>	Dusky-striped Squirrel, Dusky Palm Squirrel
<i>Funambulus tristriatus</i>	Western Ghats Striped Squirrel
<i>Gerbillurus setzeri</i>	Namib Brush-tailed Gerbil, Setzer's Hairy-footed Gerbil
<i>Heliosciurus gambianus</i>	Gambian Sun Squirrel
<i>Heliosciurus mutabilis</i>	Mutable Sun Squirrel
<i>Hypogeomys antimena</i>	Votsovotsa
<i>Heliosciurus punctatus</i>	Small Sun Squirrel
<i>Heliosciurus rufobrachium</i>	Red-legged Sun Squirrel
<i>Heliosciurus ruwenzorii</i>	Ruwenzori Sun Squirrel
<i>Heliosciurus undulatus</i>	Zanj Sun Squirrel
<i>Jaculus jaculus</i>	Lesser Egyptian Jerboa
<i>Jaculus orientalis</i>	Greater Egyptian Jerboa
<i>Kerodon rupestris</i>	Rock Cavy

<i>Lagidium viscacia</i>	Southern Mountain Viscacha
<i>Lasiopodomys brandtii</i>	Brandt's Vole
<i>Lemniscomys barbarus</i>	Barbary Striped Grass Mouse
<i>Lemniscomys bellieri</i>	Bellier's Lemniscomys
<i>Lemniscomys griselda</i>	Griselda's Lemniscomys
<i>Lemniscomys hoogstraali</i>	Hoogstraal's Lemniscomys
<i>Lemniscomys linulus</i>	Senegal One-striped Grass Mouse
<i>Lemniscomys macculus</i>	Buffoon Striped Grass Mouse
<i>Lemniscomys mittendorfi</i>	Mittendorf's Lemniscomys/Mittendorf's Striped Grass Mouse
<i>Lemniscomys roseveari</i>	Rosevear's Lemniscomys/Rosevear's Striped Grass Mouse
<i>Meriones persicus</i>	Persian Jird
<i>Meriones crassus</i>	Sundevall's Jird
<i>Meriones unguiculatus</i>	Mongolian Gerbil, Mongolian Jird
<i>Mesocricetus auratus</i>	Golden Hamster
<i>Microtus guentheri</i>	Günther's Vole
<i>Octodon degus</i>	Degu
<i>Octodon lunatus</i>	Moon-toothed Degu
<i>Octodon pacificus</i>	Pacific Degu
<i>Octodon degus</i>	Degu
<i>Octodon lunatus</i>	Moon-toothed Degu
<i>Octodon pacificus</i>	Pacific Degu
<i>Phodopus campbelli</i>	Campbell's Desert Hamster/Campbell's Hamster
<i>Phodopus roborovskii</i>	Desert Hamster, Roborowski's Hamster
<i>Phodopus sungorus</i>	Dzhungarian Hamster
<i>Psammomys obesus</i>	Fat Sand Rat
<i>Pteromys volans</i>	Russian Flying Squirrel, Siberian Flying Squirrel
<i>Rhombomys opimus</i>	Great Gerbil
<i>Rhynchocyon petersi</i>	Black and Rufous Sengi or Elephant-shrew
<i>Sciurotamias forresti</i>	Forrest's Rock Squirrel
<i>Sciurus igniventris</i>	Northern Amazon Red Squirrel
<i>Sciurus variegatoides</i>	Variegated Squirrel
<i>Sekeetamys calurus</i>	Bushy-tailed Jird
<i>Sorex arcticus</i>	Arctic Shrew
<i>Sorex mirabilis</i>	Ussuri Shrew
<i>Sciurotamias forresti</i>	Forrest's Rock Squirrel
<i>Sciurus igniventris</i>	Northern Amazon Red Squirrel
<i>Sciurus variegatoides</i>	Variegated Squirrel
<i>Sekeetamys calurus</i>	Bushy-tailed Jird
<i>Sorex arcticus</i>	Arctic Shrew
<i>Sorex mirabilis</i>	Ussuri Shrew

<i>Spalacopus cyanus</i>	Coruro
<i>Spermophilus</i> (<i>Otospermophilus</i>) <i>variegatus</i>	Rock Squirrel
<i>Spermophilus richardsonii</i>	Richardson's Ground Squirrel
<i>Suncus megalura</i>	Climbing Shrew
<i>Tamiops macclellandii</i>	Himalayan Striped Squirrel
<i>Tamiops rodolphii</i>	Cambodian Striped Squirrel
<i>Arvicanthis niloticus</i>	African Arvicanthis
<i>Cricetomys gambianus</i>	Northern Giant Pouched Rat
<i>Cynomys gunnisoni</i>	Gunnison's Prairie Dog
<i>Cynomys leucurus</i>	White-tailed Prairie Dog
<i>Marmota bobak</i>	Bobak Marmot
<i>Spermophilus tridecemlineatus</i>	Thirteen-lined Ground Squirrel,
<i>Cavia aperea</i>	Brazilian Guinea Pig
<i>Cavia magna</i>	Greater Guinea Pig
<i>Rattus tunneyi</i>	Australian Pale Field Rat/Pale Field Rat
<i>Sciurotamias davidianus</i>	Père David's Rock Squirrel
<i>Galea musteloides</i>	Common Yellow-toothed Cavy
<i>Xerus (Geosciurus) inauris</i>	South African Ground Squirrel
<i>Xerus erythropus</i>	Striped Ground Squirrel, Geoffroy's Ground Squirrel
<i>Lagurus lagurus</i>	Steppe Vole

Marsupials	
High risk species	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Trichosurus vulpecula</i>	Common Brushtail Possum
<i>Wallabia bicolor</i>	Swamp Wallaby
Medium risk species	
<i>Bettongia gaimardi</i>	Tasmanian Bettong
<i>Macropus parma</i>	Parma wallaby
<i>Macropus robustus</i>	Common Wallaroo
<i>Macropus rufogriseus</i>	Red-necked Wallaby, Bennett's Wallaby
<i>Potorous tridactylus</i>	Long-nosed Potoroo
<i>Thylogale thetis</i>	Red-necked Pademelon
<i>Petaurus breviceps</i>	Sugar Glider
Low risk species	
<i>Bettongia penicillata</i>	Woylie
<i>Macropus eugenii</i>	Tammar Wallaby, Tamar Wallaby
<i>Macropus rufus</i>	Red Kangaroo
<i>Macropus fuliginosus</i>	Western Gray Kangaroo

<i>Monodelphis domestica</i>	Grey Short-tailed Opossum
<i>Phalanger orientalis</i>	Northern Common Cuscus
<i>Philander opossum</i>	Gray Four-eyed Opossum
<i>Macropus agilis</i>	Agile Wallaby
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby

Cervidae	
High risk species	
<i>Blastocerus dichotomus</i>	Marsh Deer
<i>Capreolus pygargus</i>	Siberian Roe Deer
<i>Cervus nippon</i>	Sika
<i>Hydropotes inermis</i>	Chinese Water Deer
<i>Muntiacus reevesi</i>	Reeves' Muntjac
<i>Odocoileus virginianus</i>	White-tailed Deer
<i>Pudu pudu</i>	Southern Pudu, Chilean Pudu
<i>Rusa unicolor</i>	Sambar, Sambar Deer
Medium risk species	
<i>Elaphodus cephalophus</i>	Tufted Deer
<i>Elaphurus davidianus</i>	Père David's Deer, Pere David's Deer
<i>Hippocamelus bisulcus</i>	Patagonian Huemul
<i>Mazama gouazoubira</i>	South American Brown Brocket
<i>Muntiacus crinifrons</i>	Black Muntjac
Low risk species	
<i>Hippocamelus antisensis</i>	Taruca, Peruvian Guemal
<i>Muntiacus rooseveltorum</i>	Roosevelts' Muntjac
<i>Muntiacus truongsongensis</i>	Annamite Muntjac
<i>Alces americanus</i>	Moose, Siberian Elk
<i>Axis axis</i>	Chital
<i>Axis calamianensis</i>	Calamian Deer
<i>Axis kuhlii</i>	Bawean Deer, Kuhl's Hog Deer
<i>Axis porcinus</i>	Hog Deer
<i>Cervus alfredi</i>	Visayan Spotted Deer
<i>Mazama americana</i>	South American Red Brocket
<i>Mazama bricenii</i>	Mérida Brocket, Rufous Brocket
<i>Mazama pandora</i>	Yucatan Brown Brocket
<i>Mazama temama</i>	Central American Red Brocket
<i>Muntiacus atherodes</i>	Bornean Yellow Muntjac
<i>Muntiacus feae</i>	Fea's Muntjac
<i>Muntiacus gongshanensis</i>	Gongshan Muntjac
<i>Muntiacus muntjak</i>	Southern Red Muntjac

<i>Muntiacus puhoatensis</i>	Puhoat Muntjac
<i>Muntiacus putaoensis</i>	Leaf Muntjac, Leaf Deer
<i>Muntiacus vuquangensis</i>	Large-antlered Muntjac, Giant Muntjac
<i>Przewalskium albirostris</i>	White-lipped Deer, Thorold's Deer
<i>Rangifer tarandus</i>	Reindeer, Caribou, Peary Caribou
<i>Rucervus duvaucelii</i>	Barasingha, Swamp Deer
<i>Rucervus eldii</i>	Eld's Deer, Thamin, Brow-antlered Deer
<i>Rucervus schomburgki</i>	Schomburgk's Deer
<i>Rusa alfredi</i>	Phillipine Spotted Deer
<i>Rusa marianna</i>	Philippine Deer, Philippine Brown Deer
<i>Rusa timorensis</i>	Javan Rusa, Rusa, Javan Deer
<i>Odocoileus hemionus</i>	Mule Deer, Black-tailed Deer
<i>Mazama bororo</i>	São Paulo Bororó/Small Red Brocket
<i>Mazama chunyi</i>	Peruvian Dwarf Brocket
<i>Mazama nana</i>	Southern Bororó
<i>Pudu mephistophiles</i>	Northern Pudu
<i>Mazama rufina</i>	Dwarf Red Brocket

Carnivores	
High risk species	
<i>Canis lupus</i>	Gray Wolf,
<i>Cuon alpinus</i>	Dhole, Red Dog
<i>Genetta genetta</i>	Common Genet
<i>Lynx rufus</i>	Bobcat, Bay Lynx
<i>Martes flavigula</i>	Yellow-throated Marten
<i>Mephitis mephitis</i>	Striped Skunk
<i>Mustela lutreola</i>	European Mink
<i>Neovison vison</i>	American Mink
<i>Nyctereutes procyonoides</i>	Raccoon dog
<i>Paguma larvata</i>	Masked Palm Civet
<i>Prionailurus bengalensis</i>	Leopard Cat
<i>Procyon lotor</i>	Northern Raccoon
<i>Speothos venaticus</i>	Bush Dog, Vinegar Dog
Medium risk species	
<i>Canis aureus</i>	Golden Jackal
<i>Caracal caracal/Lynx caracal</i>	Caracal
<i>Cerdocyon thous</i>	Crab-eating Fox
<i>Chrysocyon brachyurus</i>	Maned Wolf
<i>Felis chaus</i>	Jungle Cat, Reed Cat
<i>Lycalopex gymnocercus</i>	Pampas Fox

<i>Lynx pardinus</i>	Iberian Lynx
<i>Procyon cancrivorus</i>	Crab-eating Raccoon
<i>Vormela peregusna</i>	European Marbled Polecat
<i>Atilax paludinosus</i>	Marsh Mongoose, Water Mongoose
Low risk species	
<i>Amblonyx cinerea</i>	Oriental Small-clawed Otter
<i>Aonyx capensis</i>	African Clawless Otter
<i>Cynictis penicillata</i>	Yellow Mongoose
<i>Leptailurus serval</i>	Serval
<i>Otocyon megalotis</i>	Bat-eared Fox
<i>Civettictis civetta</i>	African Civet
<i>Alopex lagopus</i>	Arctic Fox
<i>Crossarchus obscurus</i>	Common Kusimanse
<i>Cryptoprocta ferox</i>	Fossa
<i>Otocolobus manul</i>	Pallas's Cat, Manul
<i>Galictis vittata</i>	Greater Grison
<i>Galidia elegans</i>	Malagasy Ring-tailed Mongoose
<i>Genetta thierryi</i>	Hausa Genet, Haussa Genet
<i>Gulo gulo</i>	Wolverine
<i>Helogale parvula</i>	Common Dwarf Mongoose
<i>Hyaena hyaena</i>	Striped Hyena
<i>Ictonyx libyca</i>	Saharan Striped Polecat
<i>Lycaon pictus</i>	African wild dog
<i>Lynx canadensis</i>	Canadian Lynx
<i>Mungos gambianus</i>	Gambian Mongoose
<i>Mungos mungo</i>	Banded Mongoose
<i>Mungotictis decemlineata</i>	Malagasy Narrow-striped Mongoose
<i>Nasua narica</i>	White-nosed Coati, Coatimundi
<i>Prionailurus viverrinus</i>	Fishing Cat
<i>Viverra zangueana</i>	Malay Civet, Malayan Civet, Oriental Civet
<i>Vulpes corsac</i>	Corsac Fox, Corsac
<i>Vulpes lagopus</i>	Arctic Fox, Polar Fox
<i>Arctictis binturong</i>	Binturong
<i>Crocuta crocuta</i>	Spotted Hyena
<i>Paradoxurus hermaphroditus</i>	Common Palm Civet
<i>Potos flavus</i>	Kinkajou
<i>Vulpes velox velox</i>	Swift Fox
<i>Bassariscus astutus</i>	Ringtail
<i>Eira barbara</i>	Tayra, Greyheaded Tayra
<i>Genetta tigrina</i>	Cape Genet
<i>Herpailurus yagouaroundi</i>	Jaguarundi, Eyra Cat
<i>Leopardus geoffroyi</i>	Geoffroy's Cat

<i>Leopardus pardalis</i>	Ocelot
<i>Leopardus wiedii</i>	Margay/Tree Ocelot
<i>Nasua nasua</i>	South American Coati
<i>Puma yagouaroundi</i>	Jaguarundi, Eyra Cat
<i>Vulpes zerda</i>	Fennec Fox
<i>Canis mesomelas</i>	Black-backed Jackal

Insectivores	
High risk species	
<i>Blarina brevicauda</i>	Northern Short-tailed Shrew
<i>Cryptotis parva</i>	Least Shrew,
<i>Erinaceus amurensis</i>	Amur Hedgehog
<i>Sorex palustris</i>	American Water Shrew, Water Shrew
Low risk species	
<i>Macroscelides proboscideus</i>	Round-eared Sengi
<i>Atelerix albiventris</i>	Four-toed Hedgehog
<i>Blarinella quadrata</i>	Asiatic Short-tailed Shrew
<i>Echinosorex gymnura</i>	Moonrat, Gymnure
<i>Hylomys suillus</i>	Short-tailed Gymnure
<i>Rhynchocyon petersi</i>	Elephant-shrew
<i>Tupaia belangeri</i>	Northern Treeshrew
<i>Tupaia glis</i>	Common Treeshrew
<i>Elephantulus rupestris</i>	Western Rock Elephant Shrew