Handbook of Alien Species in Europe

DAISIE

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Chapter 8
Alien Birds, Amphibians and Reptiles of Europe

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8.1 Introduction

DAISIE aims to integrate information on current invasions across Europe through an online freely available database of alien species (www.europe-aliens.org, Shirley and Kark 2006). Overall, the DAISIE database includes 55 islands or countries in Europe (including European Russia), Israel and the Macaronesian islands (hereby referred to as Europe). Patterns of alien introductions, their impacts and management tools differ for birds vs. reptiles and amphibians in various ways. Birds are one of the best recorded groups and much better data exists on their introductions. Reptiles and amphibians have smaller numbers of recorded alien species, and information is less detailed in many cases. However, some of the issues concerning aliens of these groups in Europe are similar. For example, prevention seems to be the best strategy to reduce the long-term impacts and costs of dealing with most species. Also, both groups show increase in the number of introduction events during the 20th century, which could be related to rise in human immigration into Europe (Jeschke and Strayer 2006) and in the international trade, both legal and illegal during this period, leading to the deliberate and non-deliberate release of alien birds in the wild (Jenkins 1999). Here we provide information and discussion on each of the two groups and comparisons where relevant. Finally, we provide joint discussion on management options and on future trends.

8.2 Alien Birds

We built a database of bird introductions to Europe. Our main sources were Long (1981) and references therein, Lever (1987) and Hagemeijer and Blair (1997), and these were supplemented with grey literature, country-based reports, publications and information from local experts. Countries that include both mainland and island areas were separated into two regions.

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Overall, we recorded 193 bird species belonging to 37 families introduced in or to Europe since 1850, corresponding to 1883 introduction events. Of these, 140 alien bird species occur in 2007 in at least one of the 55 European regions. Out of these 140, only 77 species have established breeding populations and are termed established species.

8.2.1 *Temporal Trends Since 1900*

Although bird introductions by humans began thousands of years ago (Long 1981), 85% of the known events of bird introductions in Europe occurred after 1850. When considering temporal trends of introductions, two main factors should be taken into account. The first is the number of species introduced and the second is the number of introduction events (a species can be introduced multiple times to similar or different locations). The latter are known to positively affect the potential of a species to establish successfully (Duncan et al. 2003; Cassey et al. 2004; Jeschke and Stayer 2006). The number of alien bird species introduced into Europe has increased between 1900 and 2000 (Fig. 8.1). This includes both successful and failed introductions, in which the alien species failed to establish populations. While the rate of new introduction events was relatively stable in the first decades of the 20th century, the major increase in the number of introduction events in Europe occurred during its last decades. Introductions occurring after 2000 are not included in this paper. This is because we do not yet know the fate of these introductions, which makes it hard to compare them with older introductions (Kark and Sol 2005).

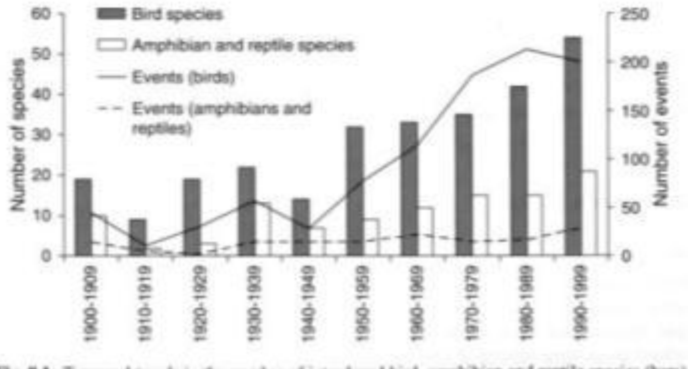

Fig. 8.1 Temporal trends in the number of introduced bird, amphibian and reptile species (bars) and the number of introduction events (lines) in Europe in the 20th century per decade

8.2.2 *Biogeographic Patterns*

Patterns of spatial spread of the 140 alien birds present in Europe shows that 60% of the species are relatively localised at a continental scale with range limits in two countries at most. Although countries differ in size, we included country in some analyses to enable comparison and enhance political action. Thirteen species (9% of the 140) are omnipresent and have invaded very large areas (more than 16 countries each). The three most widespread species in Europe in terms of their spatial range are mute swan *Cygnus olor*, ring-necked pheasant *Phasianus colchicus* and Canada goose *Branta canadensis*.

As shown in Fig. 8.2, the numbers of established alien birds vary largely between different areas in Europe (Table 8.1). Globally, when analyzing patterns at

Fig. 8.2 Richness of alien bird species in the study area: European countries and their islands (and Israel). We show here established alien species that are breeding (n = 77). The richness on the mainland and the islands of a single country (e.g., Italy and its islands) are shown separately

Table 8.1 Number of introduction attempts and success of introductions of birds, amphibians and reptiles in different areas in Europe (alphabetic order of areas). Data for areas with less than five introduction events is pooled in the given row

	Birds	
	Species	Introduction events
Area	All (successful)	All (successful)
Austria	27 (8)	44 (19)
Azores	9 (5)	14 (7)
Balearic Islands	27 (4)	32 (8)
Belgium	24 (16)	64 (49)
Canary Islands	32 (9)	51 (26)
Cyprus	8 (5)	17 (2)
Czech Republic	20 (6)	25 (8)
Denmark	13 (9)	15 (10)
Russia	9 (6)	16 (10)
Finland	13 (9)	25 (17)
France	43 (20)	115 (75)
Germany	60 (15)	120 (49)
Gibraltar	13 (2)	14 (6)
Greece	6 (6)	13 (13)
Ireland	10 (7)	56 (29)
Israel	29 (13)	43 (25)
Italy	72 (19)	120 (75)
Latvia	12 (6)	13 (6)
Norway	12 (8)	29 (19)
Poland	9 (6)	11 (7)
Portugal	27 (6)	56 (17)
Sardinia	9 (5)	11 (5)
Sicily	15 (5)	18 (6)
Spain	52 (18)	94 (47)
Sweden	18 (13)	29 (22)
Switzerland	13 (7)	20 (11)
The Netherlands	25 (13)	89 (60)
Ukraine	15 (6)	19 (12)
United Kingdom	67 (23)	600 (423)
Other islands	27 (17)	46 (24)
Other countries	69 (52)	75 (57)

	Amphibians and reptiles	
	Species	Introduction events
Area	All (successful)	All (successful)
Austria	13 (2)	16 (4)
Azores	4 (2)	5 (2)
Balearic Islands	15 (13)	18 (15)
Belgium	8 (3)	9 (3)
Canary Islands	10 (5)	15 (10)
Croatia	2 (1)	6 (5)
France	13 (11)	29 (16)
Germany	4 (2)	9 (4)
Gibraltar	7 (1)	11 (3)
Israel	3 (2)	11 (9)

Continued

Table 8.1 (continued)

	Amphibians and reptiles	
	Species	Introduction events
Area	All (successful)	All (successfull)
Italy	16 (10)	37 (26)
Malta	6 (2)	6 (2)
Portugal	3 (2)	7 (2)
Spain	26 (17)	49 (20)
Switzerland	7 (2)	9 (2)
The Netherlands	7 (5)	8 (6)
United Kingdom	20 (14)	88 (23)
Other countries and islands	14 (7)	22 (7)

the same spatial resolution (i.e., 50 × 50 km grid squares), richness of alien birds significantly decreases with longitude (Fig. 8.2). Such patterns in alien bird richness can arise as a result of various factors, including variations in human population density (GHFD 2001), which is often associated with introduction effort, increased habitat modification and high disturbance. In addition, the mean number of alien species on island grids (3.4 ± 0.9) is higher than on mainland (2.2 ± 0.04) grid squares (t-value = 11.9, $p < 0.001$) but this is mainly due to the effect of the UK having very high numbers of alien birds. Efforts of alien introductions to UK explains this difference (no more difference when UK is taken out).

8.2.3 *Main Pathways to Europe*

Not all stages of the invasion process have been equally studied and knowledge on main pathways of introduction is often sparse (Jenkins 1999). The most important vector for the arrival of alien birds into Europe is deliberate importation (88 species until 2007). Subsequently, the majority of aliens were deliberately released into the wild (74 species). In cases of non-deliberate introductions, 77 species escaped accidentally from captivity (a species can be introduced multiple times by similar or different pathways). This is probably underestimated because the latter cases are less often recorded than deliberate releases (Kark and Sol 2005).

For the 88 bird species deliberately imported, the main purposes were hunting and what was once termed "fauna improvement", aimed at changing the native fauna, which was in the 19th and early 20th centuries considered as environmental "improvement". Most species non-deliberately introduced originated from zoos or bird parks and were held as pets (Table 8.2). The majority of alien species established in Europe are still localised to the country to which they were introduced (83%) and 17% have naturally spread from the original country of introduction to neighbouring countries.

Table 8.2 Primary modes and sources of introduction of alien birds, amphibians and reptiles in Europe. Values are the number of species introduced. A single species may be represented by more than one category. In parentheses are the number of additional species for which it is unknown whether released and/or escaped is the mode of introduction

Mode of introduction	Source or reason of introduction	Number of bird species	Number of amphibians and reptiles
Released	Hunting/Harvesting	24	8
	Fauna "improvement"	11	28
	Biological control	1	2
	Agriculture	0	1
	Others	17	2
	Unknown	29	19
Escaped	From zoos	27 (12)	1
	As pets	15 (4)	9
	For food	0	10
	Others	10 (3)	12
	Unknown	26 (6)	2
Arrived by dispersal from other alien range	Natural spread	14	3

8.2.4 Most Invaded Habitats

Habitat type is an important factor influencing the establishment of alien birds (Duncan et al. 2003). To determine which European habitats host the highest number of alien birds, species were assigned to habitats using the available literature. Habitats were classified according to the European Nature Information System, level 1 (EUNIS according to Davies and Moss 2003). The number of established alien birds per each EUNIS habitat in 51 (of the 55) regions was calculated, giving a total of 165 species-habitat records. On average, established species occurred in two different EUNIS habitats. The largest proportion of the 165 bird introduction records are into arable land, gardens and parks (Table 8.3). These findings suggest that many introduced birds prefer human-modified habitats in their alien range. This is not surprising since alien birds are often generalist species that can occupy multiple habitats, including human-related habitats also in their native ranges. For example, the monk parakeet *Myiopsitta monachus*, rock dove *Columbia livia* and Canada goose ***Branta canadensis*** that established in Europe are present in their alien distribution range in five or more different habitat types.

8.2.5 Ecological and Economic Impacts

Actual data for impacts of alien birds is often scarce, particularly at regional scales, and part of the information on impacts comes from their native ranges. Most of the

Table 8.3 Total number of established alien birds, amphibians and reptiles found in habitats of 55 European countries with successful introductions (a species may have been introduced in multiple habitats). Habitats are classified according to the EUNIS classification of Davies and Moss (2003), level 1

EUNIS habitats	Number of bird species	Number of amphibian and reptile species
I: Arable land, gardens and parks	38	34
C: Inland surface water habitats	27	32
G: Woodland and forest	25	34
D: Mires, bogs and fens	15	17
E: Grasslands	15	18
B: Coastal habitats	15	9
J: Constructed and industrial	14	18
F: Heathland, hedgerows and scrub	11	17
H: Inland unvegetated or sparsely vegetated areas	5	18
Unknown	28	0

alien bird species with impacts have their native ranges in the Afrotropical, Oriental, and Palearctic biogeographic regions. Over 60% of established alien species originating from Australian, Nearctic and Oriental regions have known negative impacts. It is as yet unclear whether species impacts known from other locations will also be detrimental in Europe. However, it would be useful, for effective control, to consider information from other regions as indication of potential impact rather than wait until a species has spread enough when the evidence of impacts becomes obvious but too costly to deal with. Birds have often been considered less problematic than other aliens (e.g., mammals). Therefore, limited work has been done on their impacts. However, both scientists and policy-makers are becoming increasingly aware that introductions of alien birds can impose serious impacts on native species biodiversity, economic resources and human health (Williamson 1999; Pimentel et al. 2000). Of the 140 alien bird species now breeding in Europe and Israel, 66 species from 18 different bird families have been shown to have negative impacts, with many others unknown. Economic impacts, mainly feeding damage to grain and fruit crops, are the most common. Sixty bird species widely distributed taxonomically across 14 families have known economic impacts. Biodiversity impacts on native bird communities, including competition for resources, predation, and hybridisation with native species are described for 28 species. Biodiversity impacts are more commonly found among species in the Anatidae (ducks and geese), Corvidae (crows), and Psittacidae (parrot) families. Impacts on human health and well-being are known only in a few families, but this area requires much more research.

There are several alien bird species of special concern in Europe. For example, the ruddy duck ***Oxyura jamaicensis*** and the sacred ibis ***Threskiornis aethiopicus***, although still restricted in their distributions, can have impacts on native bird populations (Hughes et al. 2006; Clergeau and Yesou 2006). The ruddy duck, now being actively controlled in several areas, can hybridise with the native white-headed duck *Oxyura leucocephala* and consequently can pose a serious threat to the persistence of this endangered native duck (Hughes et al. 2006). Two other species, the rose-ringed parakeet ***Psittacula krameri*** and the Canada goose ***Branta canadensis***, are known to have negative economic and biodiversity impacts. These species are distributed widely across Europe and are spreading to other areas. Both species are known to inflict heavy damage on agricultural crops and to compete with native species for resources (Blair et al. 2000; Strubbe and Matthysen 2007). The common myna *Acridotheres tristis*, although only recently arrived in Europe and in Israel, is on the IUCN list of the 100 of the World's Worst Species and has the potential to cause large impacts on native biodiversity (Pell and Tidemann 1997; Holzapfel et al. 2006).

8.3 Alien Amphibians and Reptiles

Data on introductions of alien amphibians and reptiles into Europe was gathered mainly from books by Gasc et al. (1997), Lever (2003) and Cox et al. (2006). This was supplemented by a variety of other sources. The compiled dataset included information on 172 introduction events of 29 amphibian species belonging to eight families, and 183 introduction events of 48 reptile species belonging to 14 families. These two datasets were combined and analysed together. The amount of available information differed significantly among different species. The highest number of introduction events for a single species was 38 and the top 10% of species held nearly half of all introduction events. However, about half of all species were represented only once in our database. Although this result partly depends on variation in data availability, it also reflects differences in introduction effort between species. The total numbers of species and introduction events are strongly underestimated, as many remain undocumented. This refers not only to old but also to very recent introductions.

More data was available on successful introduction attempts that led to established populations (159 introductions of 55 species) than on failed ones (54 introductions of 15 species). This bias is a consequence of successful introductions being easier to detect (and document) than unsuccessful ones. The output of 46 events (accounting for 23 species) was unclear, and in as many as 96 cases (44 species) no information on the fate of the introduction was available.

Among 11 species that had five or more introduction events with known outcomes, introductions of five species (*Hyla meridionalis*, *Podarcis muralis*, *Podarcis sicula*, *Testudo graeca*, *Chamaeleo chamaeleon*) were in all cases successful. This can be largely attributed to the fact that the attempts to introduce these species were often undertaken near their native distribution range. For the remaining six species introduction success of the attempts with known result ranged from 8% to 93%. It is more difficult to draw any conclusions on the species that have never been successfully introduced to Europe, as the data is scarcer.

8.3.1 *Temporal Trends Since 1900*

Based on the available data, similar to the pattern seen for birds, both the number of introduction events and the number of species introduced throughout the 20th century have increased towards later years (Fig. 8.1). The trend is more evident when the century is divided into two halves, with the years 1950–2000 accounting for 66% of all introduction events and 67% of all species introduced. The apparent decline in introduction effort after the first decade of the 20th century can be partly attributed to data reporting issues. However, it is possible that the World Wars I and II led to a decline in introduction effort.

8.3.2 *Biogeographic Patterns*

Nearly half (46%) of the amphibians and reptiles successfully introduced to Europe have at least part of their native range in other parts of Europe. Asia and Africa account for one fourth of the reptiles and amphibians introduced to Europe (many of these species also have native ranges in Europe). North America holds only 4% of amphibians and reptiles successfully introduced to Europe. Similar analysis done for the locations from which the individuals were actually imported (referred to as donor areas) shows that for most introduction events the animals were not brought to the non-native areas in Europe directly from their native range but rather from other European areas to which they were introduced in the past, this being a secondary introduction.

There was considerable variation in both the numbers of introduction attempts and their success. In general, south European countries received more attempts to introduce a wider variety of alien amphibians and reptiles than areas further north (Table 8.1). This pattern can probably be attributed to climatic conditions, more adverse for these two groups at higher latitudes. There are, however, exceptions in some northern areas, such as the UK, where introduction effort was high, and in some more southern areas, such as Greece, that had few known introduction attempts.

8.3.3 *Main Pathways to Europe*

Information on pathways of introductions of amphibians and reptiles to Europe is limited (Hulme et al. 2008). Available data indicate, however, that a minimum of 45 species were at least once intentionally transported into new areas as commodities, such as pets, sources of food or biological control agents. Subsequently, 39 species were intentionally released into the wild and nine species escaped from captivity. Six arrived as contaminants of commodities, such as eggs brought with soil, or tadpoles brought with fish for stocking. Another six species arrived as unwanted stowaways of transport vectors such as ships. Some were introduced by more than one of the above pathways. When intentionally introduced, the majority of species was released for what was termed "improvement" of the local fauna (Table 8.2). These species were often originally brought as pets and then set free by their owners. Species that escaped from captivity were originally brought as food for humans or pets.

8.3.4 Most Invaded Habitats

Analysis of the ecosystems most prone to amphibian and reptile invasion was done in the same manner as for birds. The largest proportion of records are in arable land, gardens and parks (EUNIS category I, Table 8.3). This category is closely followed by woodland, forests, inland surface waters and riparian habitats. One should remember, however, that these results are based on data on occurrence of established species and their habitat requirements. They do not take into account the actual impact of species in each habitat. Thus the actual threat from alien amphibians and reptiles to some habitats may be underestimated. This refers particularly to the small areas (e.g., coastal habitats).

8.3.5 Ecological and Economic Impacts

Of the 55 species successfully introduced to Europe, 12 (seven amphibians and five reptiles) were reported to have some adverse impact on native biodiversity. Altogether, there are 35 records of these species having impacts in different parts of Europe. Among the determined mechanisms of impact, predation is the prevailing mechanism, followed by competition with native species. There is one report of an alien amphibian hybridising with its native relative in Spain, and another, the American bullfrog, ***Lithobates catesbeianus***, transmitting pathogens. Interestingly, amphibians had almost twice as many reports for impacts (22 cases) than reptiles (13 cases). Amphibians with impacts belong to three of the seven families successfully established in Europe: Pipidae (the one established species is known to have impacts), Ranidae and Salamandridae (71% and 14% of the established species, respectively, are known to have impacts). Pipidae is probably the most harmful amphibian family also at a global scale, even though it is represented by only two established alien species. Ranidae is the third highest impact family worldwide, with 55% of the established species having adverse effects in different parts of the world.

Undoubtedly, one of the most well known invasive amphibians around the world is the American bullfrog ***Lithobates catesbeianus***. Adults severely predate on native anurans and other aquatic herpetofauna, such as snakes and turtles, and larvae can have significant impacts on benthic algae, thus perturbing aquatic community structure (Crayon 2005; Detaint and Coïc 2006). In France and the UK this frog is also

the vector of the fungus *Batrachochytrium dendrobatidis* (Garner et al. 2005, 2006). This fungus is an agent of chytridiomycosis, a disease severely affecting native amphibians worldwide (Daszak et al. 2004; Hanselmann et al. 2004). There is an urgent need to carry out systematic research on the ecological impact of this species in Europe because available reports are scarce and limited work has been done.

Of nine reptile families successfully established in Europe, Emydidae, Lacertidae and Colubridae, hold 33%, 30% and 14% of the established species, respectively. These were reported as having negative impacts. In contrast to amphibians, the global pattern is quite different than in Europe. Globally, Emydidae and Lacertidae hold the 12th and 13th position among the most invasive families among reptiles, and Colubridae are ninth. Globally, reptile families with highest proportion of species that have negative impacts include Boidae, Alligatoridae, Scincidae, Polychrotidae and Agamidae. These families do not have established representatives in Europe, but the global pattern should serve as an early warning against attempts to introduce them into Europe.

8.4 Management Options and Their Feasibility

Management of alien vertebrates is not a trivial task due to cultural, social, practical and other aspects. The control or eradication of alien populations of vertebrates, and especially of birds is often controversial due to their appreciation by the public and the incomplete knowledge on their impacts (Clergeau and Yesou 2006). For effective management, actions need to be coordinated across countries. In Europe, coordinated alien bird management involves the ruddy duck, aimed at preventing its spread from the UK to western Europe (Hughes et al. 2006; Smith et al. 2005). This bird is controlled annually in the UK, France, Spain and Portugal. The sacred ibis has recently escaped from numerous zoos and bird parks throughout the world, generating concern, and actions are beginning to be organised in Europe (Clergeau and Yesou 2006). Attention to the need to control alien birds has also emerged locally in some cases, for example in the rose-ringed parakeet in Italy, the mute swan in France, and the common myna in Israel.

Prevention is widely considered to be the most cost-effective way to combat invasions (CBD 2002) and needs to be promptly organised at the national, continental and international scales (Clergeau et al. 2004; Simberloff 2005). Intentional introductions should not be allowed before a risk assessment has been carried out at a species-by-species basis. For birds, amphibian and reptiles, the precautionary principle of the "white list" should be fully applied. For highly dangerous species, ban on import, trade and possession should be considered (Miller et al. 2006). For unauthorised and unintentional introductions, it is probably more effective to undertake more comprehensive control of whole pathways that are responsible for introductions of a wide range of different taxa (pathway-based mechanism, Ruiz and Carlton 2003). Over the past few decades one of the major pathways for the introduction of alien amphibians and reptiles to Europe was via the pet trade, which resulted in many unauthorised deliberate releases and unintentional escapes. Keeping alien amphibians and reptiles is becoming more and more popular and the role of this pathway is likely to increase in future. It is vital therefore to restrict pet trade and to build awareness among amateur children and adults, as well as professional amphibian and reptile keepers about the environmental and legal consequences of unauthorised introductions of their pets into the wild, both intentional and resulting from negligence.

If prevention efforts fail, it is vital to early detect the aliens and if feasible, eradicate invasive aliens (CBD 2002). Among very few examples from Europe, there are successful eradications of the American bullfrog (one in the UK and two in Germany, Ficetola et al. 2007a). Success of these actions can be attributed to the fact that they were initiated early, when the populations were still small and limited in terms of numbers and their alien range.

Undoubtedly, the easiest and cheapest way to avoid damages in the long run is to prevent the spread of alien birds by controlling trade and by acting while populations are still local and small. The action has to be coordinated very quickly after the first evidence of reproduction. Therefore, monitoring and reporting systems need to be established. However, for them to be successful, actions must involve clear and direct communication with the public, and should be combined with longer-term educational programs.

8.5 Future Expected Trends

With the rapid increase in globalisation and the resulting homogenisation of biotas (Lockwood and McKinney 2002), quite a few alien species are establishing in large areas around the world. The current trend of increase in Europe in both the number of alien birds and introduction events is likely to continue. While most of the successful introductions up until now were limited to specific countries and to human-modified habitats, we suspect that with the opening of the borders in Europe, the increase in trade and the expansion of urban landscapes, alien species may become even more abundant and successful in Europe. The increase in trade and free movement of goods and people within most of Europe is likely to be followed by the increase in introduction effort of alien amphibians and reptiles, both in terms of the number of species and the number of introduction attempts. The pet trade is likely to remain the main source of intentional and unintentional introductions. Climate change may lead to the decline of some native amphibians and reptiles in Europe (Araújo et al. 2006) and at the same time may cause an expansion of areas suitable for establishment of alien species (Ficetola et al. 2007b). More research into the effects of global changes on aliens should be conducted, combined with applied actions to reduce their negative impacts and establishment.

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Chapter 9
Alien Mammals of Europe

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9.1 Introduction

Mammals are large, charismatic animals that have a mineralised skeleton that may form long lasting fossils. For these reasons, the level of knowledge on this class, together with other vertebrates, is much higher than for any other animal group. Therefore, the available information on introduction patterns, trends of invasions, and detrimental impacts caused to the environment and to human well-being are more detailed than for other groups covered in the DAISIE project.

History of mammal invasions is very long, as anthropogenic introductions of mammals started at least since the beginning of the Neolithic period. Ancient introductions involved wild species commensal of humans (i.e., black rat *Rattus rattus* and house mouse *Mus musculus*), anthropophilous (i.e., lesser white-toothed shrew *Crocidura suaveolens* and wood mouse *Apodemus sylvaticus*) and domestic species (i.e. species domesticated in the Middle East and gone feral, like the Corsican mouflon *Ovis aries*). Data on alien mammals have been collected from available global reviews (Long 2003; Mitchell-Jones et al. 1999; Lever 1985), national inventories (Austria: Englisch 2002; Denmark: Baagøe and Jensen 2007; France: Pascal et al. 2006; Germany: Geiter et al. 2002; Ireland: Stokes et al. 2006; Italy: Andreotti et al. 2001; Scalera 2001; Liechtenstein: Broggi 2006; Scandinavian countries: Weidema 2000; Spain: Nogales et al. 2006; Palomo and Gisbert 2002; Switzerland: Wittenberg 2006; the UK: Battersby and Tracking Mammals Partnership 2005; Weijden et al. 2005). Databases available on the internet were also used as a source of information (i.e. for Belgium, the Nordic countries, etc.). Other data have been collected through inputs of the experts of the DAISIE consortium, but also with the valuable support of many experts of the IUCN Invasive Species Specialist Group and of the Group of Experts on Invasive Alien Species of the Council of Europe. Independent experts have verified each record, which included information on taxonomy, native range, vector and pathway of introduction, date of introduction, status of the species, basic information on population size, distribution and impacts.

Based on the DAISIE database, in the present chapter we present an overview of the main patterns of mammal invasions in Europe, and analyse the main environmental, social and economic correlates to the arrival and successful establishment.