

Review of the Grey Squirrel *Sciurus carolinensis*

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Review of the Grey Squirrel *Sciurus carolinensis* (MAMMALIA: SCIURIDAE)

1) Introduction

Invasive Alien Species (IAS) are species or lower taxa whose introduction or spread outside their natural range threatens biological diversity. They are considered one of the most important threats to biodiversity, as well as impacting the economy and human health (Bruemmer *et al.*, 2000; Genovesi and Shine, 2003; Bertolino, 2008; CBD Secretariat, 2009; Kettunen *et al.*, 2009). Furthermore, the spread of IAS is likely to increase, as demand for trade, travel and transport expands both within the EU and beyond (Shine *et al.*, 2008; Shine *et al.*, 2009b).

The EU Wildlife Trade Regulations contain provisions to list in Annex B, “species in relation to which it has been established that the introduction of live specimens into the natural habitat of the Community would constitute an ecological threat to wild species of fauna and flora indigenous to the Community” (Article 3.2(d) of EC Regulation 338/97). The Commission may also establish restrictions on introduction into the Community “of live specimens of species for which it has been established that their introduction into the natural environment of the Community presents an ecological threat to wild species of fauna and flora indigenous to the Community” (Article 4.6(d) of EC Regulation 338/97). Four IAS have already been listed in Annex B, with their import into the EU currently prohibited: the Red-eared slider *Trachychemys scripta elegans*, American bullfrog *Rana catesbeiana*, Painted turtle *Chrysemys picta* and Ruddy duck *Oxyura jamaicensis*. There are also provisions under the Regulations to restrict “the holding or movement of live specimens of species in relation to which restrictions on introduction into the Community have been established in accordance with Article 4(6)”, although it is not clear whether these have been utilised for these or any other species.

The North American Grey squirrel *Sciurus carolinensis* is native to eastern North America (Bertolino, 2008). It has been introduced to several countries in Europe, and it has replaced native Eurasian red squirrels *Sciurus vulgaris* in much of Britain and parts of northern Italy (Wauters *et al.*, 2001; Bertolino and Genovesi, 2003; Gurnell *et al.*, 2004a; Bertolino, 2008). *S. carolinensis* is widely considered to be an IAS, which is predicted to spread further into mainland Europe, becoming a forest pest species and likely to replace *Sciurus vulgaris* in large parts of its range (Bruemmer *et al.*, 2000; Lurz *et al.*, 2001; Bertolino, 2008). Lurz *et al.* (2001) and Bertolino and Genovesi (2005) recommended that the species should be considered as a priority for trade restrictions.

A review of Grey squirrel has been conducted at the request of the European Commission, to assess the threat posed by trade in live animals and the possible subsequent intentional/accidental release into the wild, to determine whether the species might merit listing in Annex B of Council Regulation 338/97, Article 3.2(d). This report is not intended to be exhaustive but instead aims to provide an introductory overview on to the topic to facilitate further discussion. Member States are invited to submit information on national legislation relating to the Grey Squirrel in order to update and complete the information in Table 1.

2) Assessment of trade in *Sciurus carolinensis*

In the absence of any trade statistics, an internet survey was conducted 4th-7th May 2010, in order to investigate whether live *Sciurus carolinensis* appear to be traded within the EU, and whether there appears to be demand for this species as a pet. Firstly, a list of pet retailers or classifieds websites offering small animals for sale within a variety of EU countries was compiled (Annex 1), and each website was checked for advertisements relating to *S. carolinensis*. Secondly, Google searches were conducted in a number of EU languages (English, French, Spanish, Portuguese, Italian, German, and Finnish), using the Google search engines of those countries and search terms such as 'for sale', 'buy', 'pets', 'price' and 'wanted', as well as the species' scientific and common names.

In each case, price and source (e.g. wild or captive-bred) were noted when available, in addition to whether the advertisement used the species' scientific or common name. There may be some uncertainty regarding advertisements using a species' common name, as often the same common name may be used for several different species. However, initial searches revealed that for small mammal pets (such as hamsters, rabbits, chinchillas and chipmunks), common names are generally used, hence searching by scientific name only would have restricted our findings. Nevertheless, if photographs indicated that the species advertised was not *S. carolinensis*, this information was noted.

Any other indications that the species is kept as a pet, or that there is demand for this species as a pet were also noted, as well as any other trade in the species or its parts and derivatives (such as skins or meat).

Pet trade – offers for sale

- Advertised for sale as 'Amerikansk grægern (*Sciurus carolinensis*)' on the Danish website www.dyreudstyr.dk (price 1500DKK each, from a private breeders).
- A pair of 'Scoiattoli canadesi' were advertised on the Italian website www.subito.it, with no information on price or source.
- Advertised on the Italian website www.supernatura.it for 150€ each as 'Scoiattoli canadesi', source unspecified.
- Pairs of 'Scoiattoli canadesi' were advertised on the Italian website www.italypet.com, one advert was for captive born specimens (no information on price), the other was for 300€ per pair (no information on source).
- There was a recent sale of 'Scoiattoli canadesi' on the Italian website <http://annunci.ebay.it>, but the advertisement details no longer displayed.
- Advertised on the Spanish website www.almacenanimal.com for 200€ each as 'Ardilla gigante de Carolina', with no information on source.
- There was one advertisement for an 'Ardilla gris' (125€ each, source unspecified) and several advertisements for 'ardillas [squirrels]' (200€ each) on the Spanish website www.adoos.es, although none of the photographs looked like *S. carolinensis*.
- There was one advertisement for an 'Ardilla gris' (200€ including the cage) on the Spanish website <http://ardillascoreanas.mforos.com>, although the photograph did not look like *S. carolinensis*.
- There was an advertisement for 'Grey squirrels' on the UK website www.pets-classifieds.co.uk (£150 each, source unspecified), with the same trader advertising on the website <http://mcmammals.webs.com/stocklist.htm> (captive-bred grey squirrels, £150 each, currently sold out).
- There was an advertisement for an 'ecureuil [squirrel]' for 40€ on the French website <http://forum.magicmaman.com>, but it did not specify which species.
- There was an advertisement offering 'Grauhörnchen' on the Austrian website www.tieranzeigen.at, with no information on price or source.

Pet trade - indication of interest/demand

- There were several advertisements for people wanting 'squirrels' on the French website www.toutypasse.com, but they did not specify which species.
- Someone on the Spanish website <http://ardillascoreanas.mforos.com> wanted to buy a pair of 'Ardilla gris (*Sciurus carolinensis*)'.
- Two people on the UK websites www.wildaboutbritain.co.uk/forums and www.birdtrader.co.uk requested information on how to obtain 'Grey squirrels'.

Other

- Someone in the UK claimed to have seen skinned grey squirrels for sale in Salisbury market for £2.25 each www.singletrackworld.com/forum/topic/grey-squirrels-for-sale.
- Several news stories in the UK indicated that wild grey squirrels were being caught, sold at various butchers and markets, and appearing on the menu in pubs and restaurants: <http://news.bbc.co.uk/1/hi/uk/7347828.stm>; <http://www.heraldscotland.com/news/home-news/chef-hopes-city-diners-will-go-nuts-for-squirrel-1.1023369>; [http://www.yorkpress.co.uk/news/5046521.The Black Swan pub adds squirrel pie to their menu/](http://www.yorkpress.co.uk/news/5046521.The_Black_Swan_pub_adds_squirrel_pie_to_their_menu/); <http://www.guardian.co.uk/lifeandstyle/2008/may/11/recipes.foodanddrink>.
- Several fly-fishing websites in Finland, Sweden and the UK sold squirrel skins or tails for use as dubbing or fly-tying material: <http://mistpool.com>; <http://www.karhunjalshop.fi>; www.nordisktflugfiske.se; www.flytek.co.uk; www.fastmailtackle.co.uk; www.fishingmegastore.com; www.theessentialfly.com.
- Two retailers of make-up brushes in Sweden advertised brushes made from grey squirrel hair: www.kohlindo.se; www.makeupshowbrush.se.

Genovesi and Bertolino (2006) reported that *S. carolinensis* was had been introduced as a pet in many countries, then accidentally escaped into the wild or was intentionally released for ornamental purposes. They noted that the species was "Still traded in Europe as a pet."

3) Conservation status of *Sciurus carolinensis* in range states

COMMON NAMES:

Veverka popelavá (Czech), Grå eger (Danish), Grijze eekhoorn (Dutch), Cat squirrel (English), Eastern gray squirrel (English), Eastern Grey Squirrel (English), Grey Squirrel (English), Migratroy squirrel (English), Hallorav (Estonian), Harmaaorava (Finnish), Écureuil gris (French), Grauhörnchen (German), Szürke mókus (Hungarian), Gráikorni (Icelandic), Scoiattolo grigio (Italian), Grækorn (Norwegian), Wiewiórka szara (Polish), Esquilo-cinzeno (Portuguese), Ardilla gris (Spanish), Grå ekorre (Swedish)

RANGE STATES:

Australia (ex, int), Canada, Republic of Ireland (int), Italy (int), South Africa (int), United Kingdom of Great Britain and Northern Ireland (int), United States of America

S. carolinensis is native to Canada and the United States, where it is found in large blocks of hardwood or mixed forests, as well as in urban areas (Linzey *et al.*, 2008). It was classified as Least Concern in the IUCN Red List "because of its wide distribution, large population, occurrence in a number of protected

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areas, no major threats, and it is tolerant to habitat disturbance and its population is increasing” (Linzey *et al.*, 2008).

4) Status in the EU

S. carolinensis was introduced to the United Kingdom and Ireland (in the 19th century and early 20th century) and to Italy (mid 20th century), where it has expanded its range from these initial introduction sites and replaced the native Eurasian red squirrels *Sciurus vulgaris* throughout much of the British Isles and parts of northern Italy (Wauters *et al.*, 2001; Bertolino and Genovesi, 2003; Gurnell *et al.*, 2004b; Bertolino, 2008). Italy currently contains the only population of *S. carolinensis* in continental Europe, but the species is predicted to spread further into the mainland (reaching France and Switzerland in the next few decades), replacing *S. vulgaris* across large parts of its range and having a significant impact on forests (Bruemmer *et al.*, 2000; Lurz *et al.*, 2001; Bertolino and Genovesi, 2003; Genovesi and Bertolino, 2006; Bertolino, 2008).

Italy: Bertolino and Genovesi (2003) provided the following information on the introduction and spread of *S. carolinensis* in northern Italy:

“In Italy, the American grey squirrel was first introduced into Piedmont (north-western Italy) in 1948, when two pairs were imported from Washington, DC (USA) and released at Stupinigi (province of Turin; Bertolino *et al.*, 2000). In 1966, five animals imported from Norfolk (Virginia, USA) were released into the park of Villa Groppallo at Genoa Nervi. A third introduction occurred in 1994 at Trecate (province of Novara), when the municipality funded the release of three pairs of grey squirrels in an urban park; however, in response to pressure to eradicate this nucleus, the animals were recaptured two years later (Bertolino *et al.*, 2000).

The population at Genoa Nervi seems still to be confined to a 2-3 km² area close to the site of introduction in a residential district with several private gardens and parks (Spanò *et al.*, 1999). [...]

The Piedmont population has shown a rapid increase of its range in recent decades. From its introduction until 1970, the grey squirrel was only recorded close to the release site, occupying an area of about 25 km² (Wauters *et al.*, 1997b). Subsequently, the species started to spread into the surrounding area: in 1990, the species’ range was 243 km² and in 1997 380 km². [...] After 1997, the range increased dramatically, and in the winter of 1999 the grey squirrel was present in an area of 880 km².”

Based on several localized population estimates, Wauters *et al.* (1997a; in: Bertolino and Genovesi, 2003) estimated the population of *S. carolinensis* in Italy to number around 2500 individuals, whereas Bertolino and Genovesi (2003) revised this estimate to take account of the varying squirrel abundance in different woodland habitats, and estimated there to be up to 6400 individuals.

Lurz *et al.* (2001) modelled the potential spread of *S. carolinensis* beyond their 1996 distribution in the Piedmont region and predicted that they would become established throughout central and northwest Piedmont and to border with France by 2048, or by 2039 if their fecundity and reproductive success increased as they gained access to higher quality habitats. They noted that the species would become impossible to control effectively once it reached the pre-alpine forests in the north of Piedmont, where continuous woodland cover connects Italy with France (Lurz *et al.*, 2001).

Republic of Ireland: O’Teangana *et al.* (2001) provided the following information on the species’ introduction into Ireland:

“it was introduced into Ireland from England in 1911 at Castle Forbes, Co. Longford (grid reference: N 1080) (Watt, 1923), when six pairs were released. Interestingly, Lever (1977) gives the date as 1913 for this release, whilst also referring to another Grey Squirrel release at Ballymahon, Co. Longford, in 1928. The reliability, origin and success of this latter Grey Squirrel introduction remains unknown.

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The report of another release in the Dublin area in 1928 (Deane, 1964) was, if accurate, seemingly unsuccessful as Grey Squirrels were not recorded in Dublin until the 1970s. Wherever it has been introduced, the Grey Squirrel has been regarded as an actual or potential forestry pest and/or competitor of the native squirrel species."

The species' range has increased greatly since the initial introductions (O'Teangana *et al.*, 2001). *S. carolinensis* was reported to be currently widespread in central and eastern Republic of Ireland (EHS/NPWS, 2007; Ross, 2008), present in 16 of the 26 counties (EHS/NPWS, 2007). Expansion rates were reported to have varied between regions from 0 to 13.4 km/yr, with a modal rate of 0.56 km/yr and a mean of 1.941 km/yr (O'Teangana *et al.*, 2001).

O'Teangana *et al.* (2001) reported that "The animal is ubiquitous in the midland counties and has extended its range to southern Tipperary and, most recently, Wexford. Expansion eastward to the coast is almost complete; Grey Squirrels have become a common feature quite recently in most urban parks around Dublin. East Wicklow remains free of Grey Squirrels, although they are common in the west of this county. Expansion of the Grey Squirrel into the west of Ireland is apparently hindered by the River Shannon, with Grey Squirrels present along its east bank but as yet unrecorded on the western side. However, it has out-flanked the river north of its source, and is now colonizing westward through Leitrim."

United Kingdom of Great Britain and Northern Ireland: Gurnell (1987) provided the following information on the introduction and spread of *S. carolinensis* in the UK:

"Grey squirrels were first introduced into England and Wales from the eastern USA in 1876 and introductions continued to 1915 or later. It is believed that they were originally introduced as exotic animals in country-house parks and gardens [...] They were also introduced into Scotland from Canada between 1892 and 1920 [...] (Tittensor, 1977; Lloyd, 1983). Between 1906 and 1937 grey squirrels were translocated to different places within Britain. [...] At first the grey squirrel did not spread very far from its major points of introduction but between 1930 and 1945 it dramatically extended its range. Since then, the range of the grey squirrel has continued to spread but in a more patchy fashion. Now it is found almost everywhere in central and southern England, Wales, the central lowlands of Scotland."

Bertolino (2008) reported that "At present, the range of the grey squirrel covers most of England and Wales, the southern part of Scotland and part of Ireland (Gurnell, 1987; O'Teangana *et al.*, 2001; O'Neill and Montgomery, 2003)."

Harris *et al.* (1995) estimated the total pre-breeding population to be about 2,520,000 individuals, with 2 million in England, 0.2 million in Scotland and 0.32 million in Wales.

Impact on native EU flora and fauna

In Northern Ireland, *S. carolinensis* was reported to have become more widespread than the red (O'Teangana *et al.*, 2001; Huxley, 2003; in: EHS/NPWS, 2007), replacing them in woods in all six counties (EHS/NPWS, 2007). The EHS/NPWS (2007) reported that "Since 1995-6, grey squirrels appear to have overcome the natural barriers of Lough Erne, Lough Neagh and the River Bann, and have penetrated the whole of west Co. Antrim and north through Co. Londonderry (O'Neill and Montgomery, 2003)."

5) Impact on native EU flora and fauna

a) The Eurasian red squirrel *Sciurus vulgaris*: *S. carolinensis* has replaced the native red squirrel *S. vulgaris* through much of England and Wales and parts of Scotland, Wales and northern Italy (Gurnell and Pepper, 1993; Wauters *et al.*, 2001; Bertolino and Genovesi, 2003; Gurnell *et al.*, 2004a; Bertolino, 2008). It has been considered to be among the '100 of the World's Worst Invasive Alien Species' (Lowe *et al.*, 2000; Genovesi, 2005).

Bruemmer *et al.* (2000) reported that "Red squirrels are now extinct in southern England, except for some offshore islands such as the Isle of Wight. A few isolated populations can still be found in central England and parts of Wales. The remaining strongholds of the red squirrel are in northern England and Scotland. However, their range is declining even in those areas and careful management of selected conservation areas is required to retain them in northern England in the future (Gurnell and Lurz, 1997; Lurz *et al.*, 1998)." In Ireland, *S. vulgaris* was reported to remain "widespread and locally abundant" and present in all but two counties (Meath and Westmeath), although species replacement was reported to be occurring in those counties with the longest association with *S. carolinensis* (O'Teangana *et al.*, 2001).

The precise mechanisms behind the ecological replacement of *S. vulgaris* by *S. carolinensis* are not fully understood, but are generally considered to be a combination of competitive exclusion (over food resources or habitat) and resistance to disease (grey squirrels are thought to act as a reservoir host of parapoxvirus, which is fatal to red squirrels) (Kenward and Holm, 1993; Rushton *et al.*, 2000; Bruemmer *et al.*, 2000; O'Teangana *et al.*, 2001; Bryce *et al.*, 2001; Tompkins *et al.*, 2002; Wauters *et al.*, 2002; Gurnell *et al.*, 2004b; EHS/NPWS, 2007; Bertolino, 2008).

S. vulgaris is currently classified as Least Concern on the IUCN Red List (Shar *et al.*, 2008) because of its large population size and wide range across the Palaearctic, although the documented population declines in the United Kingdom, Ireland and Italy were noted (Gurnell and Pepper, 1993; Wauters *et al.*, 1997b; O'Teangana *et al.*, 2001; in: Shar *et al.*, 2008) and competition with *S. carolinensis* and the likely spread of *S. carolinensis* throughout Europe was noted as a threat (Shar *et al.*, 2008).

b) Woodland birds: *S. carolinensis* is known to prey on birds' eggs and chicks (Moller, 1983; Hewson and Fuller, 2003), and could also potentially compete with woodland birds for nest sites and food (Hewson and Fuller 2003). It has been postulated that the decline in UK woodland birds over recent decades may be related to the increase in squirrel abundance (Hewson and Fuller, 2003). However, Newson *et al.* (2010) recently analysed extensive national bird and grey squirrel monitoring data in England (the BTO/JNCC/RSPB Breeding Bird Survey, 1995-2005), and found little evidence that increases in *S. carolinensis* in recent years had driven population declines of the 36 woodland bird species investigated in their analysis. Newson *et al.* (2010) also noted that their results concurred with a study by Amar *et al.* (2006).

c) Bark stripping and damage to timber trees: *S. carolinensis* was widely reported to cause damage to woodland and timber plantations through bark-stripping (Kenward and Holm, 1993; Bruemmer *et al.*, 2000; Lurz *et al.*, 2001; Bertolino and Genovesi, 2003; Bertolino, 2008). Bruemmer *et al.* (2000) reported that "Gray squirrels cause economic damage to forests by removing bark from trees, particularly broadleaved types such as oak and beech, and have the potential to suppress natural forest regeneration." The authors also noted that bark stripping of poplars cultivated for pulp and timber was a particular problem in northern Italy (Bruemmer *et al.* 2000). Bertolino (2008) noted that "In woodlands in the UK, the grey

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squirrel was estimated to reduce the value of tree crops by around 25% or 10 million GBP, while estimated current annual control cost for timber protection is 3 million GBP (DEFRA, 2003)."

S. carolinensis was also reported to be a garden pest by digging up bulbs and eating the bark of ornamental plants (Genovesi, 2005).

6) Management

Management options to control existing populations of *S. carolinensis* include nest destruction, shooting, live trapping and poisoning (warfarin poisoning is used widely in Great Britain but is not permitted in Italy); the development of an oral immunocontraceptive is also being investigated (Bruemmer *et al.*, 2000; Genovesi and Bertolino, 2006; Bertolino, 2008).

With regards to the management of *S. carolinensis* and other IAS within the EU, Bertolino (2008) advised that:

"For the future, considering the difficulty in removing established populations, it is important to adopt a preventive strategy. The invasion process can be divided into arrival, establishment and spread. In Europe, squirrels released into the wild established new populations with ease. Thus, it is important to reduce the arrival rate of new animals and species. This could be done by working toward a trade restriction between countries where the squirrels are already established, and also by evaluating the threats that new species could pose to European biodiversity."

Genovesi and Bertolino (2006) advocated prevention by an import suspension through inclusion of *S. carolinensis* in the EU Wildlife trade Regulations, regulation of pet trade and information campaign to traders and owners.

Italy: In late 1996, the National Wildlife Institute, in co-operation with the University of Turin, produced an action plan to eradicate *S. carolinensis* from Italy (Bertolino and Genovesi 2003). A trial eradication programme started in May 1997 in Racconigi (Turin), but was suspended for three years because NWI was taken to court by animal rights campaigners. Preliminary results indicated that eradication was feasible, but after the 3-year break in activities, the range of *S. carolinensis* had expanded to the point that eradication was no longer considered practical (Bertolino and Genovesi 2003).

Bertolino (2008) reported that in 2006, an action plan for the eradication of the *S. carolinensis* population along the Ticino river was proposed, to eliminate the risk for Switzerland, but this was still under consideration.

Bertolino (2008) also reported that "Political concern about the lack of action in Italy has been expressed by the Permanent Commission of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats), which has produced two recommendations (n. 78 of 1999 and n. 114 of 2005) underlining the necessity to eradicate grey squirrels in Italy in order to stop their further expansion into Europe, and save the native red squirrel from wide-scale extinction."

Republic of Ireland: A draft All-Ireland Species Action Plan for *S. vulgaris* has been prepared by Environment and Heritage Service and National Parks & Wildlife Service (EHS/NPWS, 2007; Colhoun, 2007). Current actions include targeted culling of *S. carolinensis*.

United Kingdom of Great Britain and Northern Ireland: Bertolino (2008) gave the following information on management in the UK:

“Introduction of new grey squirrels into Great Britain was banned in 1937 with the ‘Grey squirrel prohibition of importation and keeping order’ (Sheail, 1999). A bounty scheme to control the species, operated by the British government in the 1950s, made no significant impact on grey squirrel populations and was considered ineffective (Sheail, 1999). Grey squirrels are now controlled in the country mainly to reduce damage to trees by cage or kill trapping, shooting or warfarin poisoning³⁵. Small numbers of grey squirrels are also trapped to protect designated red squirrel areas (Mayle *et al.*, 2004).”

The Forestry Commission has a framework for *S. carolinensis* policy and action in England, which includes encouraging “effective and humane control of grey squirrels, focusing resources on locations where they are causing the greatest threat to the sustainable management of woodland, and the associated public benefits”, as well as funding research into control and silvicultural techniques, monitoring damage caused by *S. carolinensis* and raising awareness for targeted squirrel control (Forestry Commission 2006).

7) Legal and policy instruments

Invasive Alien Species are a global problem, requiring international cooperation to prevent their introduction and spread (Genovesi and Shine, 2003; Shine *et al.*, 2008). Numerous global, regional and subregional conventions contain provisions for IAS prevention, eradication or control (reviewed in: Genovesi and Shine, 2003; Miller *et al.*, 2006; Shine *et al.*, 2008). The European Commission has recognised IAS as an emerging issue, the Convention on Biological Diversity has identified it as a major cross-cutting theme and the Convention on the Conservation of European Wildlife and Natural Resources 1979 (Bern Convention) recognises the need for a regional approach (Genovesi and Shine, 2003). The IUCN/SSC Invasive Species Specialist Group and the Global Invasive Species Programme (GISP) have produced numerous guidelines and publications on the issue (e.g. Lowe *et al.*, 2000; IUCN, 2000; Shine, 2008). The DAISIE (Delivering Alien Species Inventories for Europe) project, funded by the European Commission under the Sixth Framework Programme, aims to provide European inventories of IAS and establish the basis for an early warning system (Miller *et al.*, 2006; DAISIE, 2010).

A European Strategy on Invasive Alien Species was established to provide guidance to Bern Convention Parties in their efforts to:

- rapidly increase awareness and information on IAS issues and ways to tackle them;
 - strengthen national and regional capacity and cooperation to deal with IAS issues
 - prevent the introduction of new invasive alien species into and within Europe and support rapid response to detected incursions;
 - reduce the adverse impact of existing invasive alien species;
 - recover species and restore natural habitats and ecosystems that have been adversely affected by biological invasions, where feasible and desirable; and
 - identify and prioritise key actions to be implemented at the national and regional level.”
- (Genovesi and Shine, 2003)

The European Commission is currently considering options for the best strategy on IAS, which includes the possibility of developing a comprehensive, dedicated EU legal instrument (Miller *et al.*, 2006; Shine *et al.*, 2008; Shine *et al.*, 2009a; 2009b). It is recognised that prevention of unwanted introductions is the most desirable approach, followed by eradication where possible or longterm containment/control (Shine *et al.*, 2008). Shine *et al.* (2009b) advised that “a comprehensive EU legal instrument, is the only policy package that could deliver the necessary visibility, coverage, coordination, resourcing and horizon-scanning for all types of IAS risks and impacts.”

Legal and policy instruments

Most Member States of the EU also have some national legislation in relation to IAS (reviewed in: Miller *et al.*, 2006; Shine *et al.*, 2008), but they were found to vary widely in terms of scope and purpose. Twenty Member States had some provisions in place in relation to import/export of IAS (Table 1), sixteen in relation to possession/trade of IAS, twenty-six controlled introduction to the wild of some IAS within their borders and nineteen has some provisions for statutory control and/or eradication if IAS (Shine *et al.*, 2008). Most import/export restrictions in place in Member States were limited to specific groups of organisms, such as wild birds or aquatic species.

Miller *et al.* (2006) noted that “Even in the case of species that are known to be invasive in one MS, there are no European-level restrictions on further sale or distribution within the Community.”

S. carolinensis is mentioned specifically in a number of EU and national provisions.

- There are species-specific recommendations for *S. carolinensis* in the Convention on the Conservation of European Wildlife and Natural Resources 1979 (Bern Convention). For example, Recommendation No. 114 (2005) of the Standing Committee included a request that Contracting Parties “apply measures preventing the introduction of alien squirrel species addressing relevant pathways such as trade and tourism” and Recommendation No. 123 (2007) of the Standing Committee recommended that Italy “1. urge the Lombardia Region and the other competent local authorities to start without further delay the eradication program of the Grey squirrel in the Ticino Valley, so as to significantly delay invasion of Southern Alps” and that Contracting Parties “2. ban trade and possession of the Grey squirrel; 3. eradicate new possible introduced populations of Grey squirrels.”
- In the UK, Section 14 of the Wildlife and Countryside Act 1981¹ is the principal legislation dealing with the release of non-native species in Great Britain; it has been amended by the Nature Conservation (Scotland) Act 2004 in Scotland, and the Natural Environment and Rural Communities Act (2006) in England and Wales (GB Non-Native Species Secretariat, 2009). Under this Act, it is an offence to release or allow to escape into the wild any non-native animal or animal included in Part I of Schedule 9 (which includes *S. carolinensis*). It is also forbidden to sell, offer or expose for sale, or have in possession or transport for the purposes of sale, any of these species.
- Likewise, under Section 15 of the Wildlife (Northern Ireland) Order 1985¹, it is an offence to release or allow to escape into the wild any non-native animal or animal included in Part I of Schedule 9 (which includes *S. carolinensis*).
- The Destructive Imported Animals Act 1932¹ restricts the import and keeping of certain mammals in Great Britain, including *S. carolinensis*, although the appropriate authority (Natural England in England, WAG in Wales and SEERAD in Scotland) may licence imports for research or exhibition purposes (GB Non-Native Species Secretariat, 2009).
- *S. carolinensis* is listed in Annex III (non-native species of known ecological risk) of Decree-Law No. 565/99² regulating the introduction of exotic flora and fauna species 1999, Portugal, for which it is forbidden to purchase, sell, offer for sale, transport or possess, as a way to prevent introduction into the wild or restocking from escapees.
- *S. carolinensis* is mentioned in Article 3 of the Federal Variety Protection Ordinance 2005³, Germany, for which possession and trade are forbidden.
- In neighbouring Switzerland, Article 8 of the Ordonnance sur la chasse et la protection des mammifères et oiseaux sauvages 2008⁴, prohibits the release of non-native animals, particularly those listed specifically in the legislation, including *S. carolinensis*.

¹ The UK Statute Law Database www.statutelaw.gov.uk

² http://www.igf.min-financas.pt/inflegal/bd_igf/bd_legis_geral/Leg_geral_docs/DL_565_99.htm

³ <http://faolex.fao.org/docs/pdf/ger76195.pdf>

⁴ <http://faolex.fao.org/docs/pdf/swi3649.pdf>

Table 1. Overview of existing Member State legal and policy frameworks regarding Invasive Alien Species (as of December 2008). Sources: Miller *et al.*, 2006; Shine *et al.*, 2008.

Country	Import/ export	Provisions in relation to import/export	Possession/ trade	Introduction	Control/ eradication	IAS Strategy
Austria	Not found		Not found	Yes	Not found	Action Plan
Belgium	Yes	Restrictions are in place in relation to import, export and transit of nonindigenous wild bird species.	Not found	Yes	Yes	In Biodiversity Strategy
Bulgaria	Yes	Import of alien plant and animal species for the purpose of breeding and raising shall not be permitted if this is detrimental to habitats and species.	Not found	Yes	Yes	Under development
Cyprus	Being developed (fauna)	Import of aquatic species is prohibited without a written permit.	Yes	Yes	Not found	Not found
Czech Republic	Yes	Game species have special controls on import, and the phytosanitary list includes some agricultural weed species that are prohibited imports.	Not found	Yes	Yes	In Biodiversity Strategy
Denmark	Not found		Not found	Yes	Yes	Yes (pending approval, Sept 2008)
Estonia	Yes	19 animal species and two plant species are listed as prohibited imports. This is an open list that is regularly updated, and new species are added according to new data.	Not found	Yes	Yes	Not found
Finland	Yes	Import of wild birds or mammals is prohibited without permission from the Minister of Agriculture and Forestry.	Not found	Yes	Yes	Under development
France	Yes	Import of game birds is prohibited without permit, with six species excepted.	Yes	Yes	Yes	In Biodiversity Strategy (most Overseas Territories plans address IAS)
Germany	Not found		Yes	Yes	Yes	In Biodiversity Strategy
Greece	Yes	Import of all alien species to be farmed/used as baits is prohibited.	Yes	Not found	Yes	Not found
Hungary	Not found ⁱ		Being developed (pets)	Yes	Yes	Under development
Ireland	Yes	The importation of wild animals and birds is subject to licence.	Yes	Yes	Yes	Actively developed (Invasive Species in Ireland, legal review)
Italy	Yes	Specific phytosanitary conditions are in place for the import of certain plant species from	Yes	Yes	Not found	Not found

Country	Import/ export	Provisions in relation to import/export	Possession/ trade	Introduction	Control/ eradication	IAS Strategy
		Japan.				
Latvia	Yes	The plant protection law states regulations for the import/export of plants (likely to be only for commercial pests of plants, but not clear).	Not found	Yes	Yes	In Biodiversity Strategy
Lithuania	Yes	Imported species should be put under quarantine to make sure there are no accidental invasives among them. Potential IAS that are known to cause harm elsewhere should be treated as dangerous (import prohibited, etc). A permit is required for the import of live alien animals into the country.	Yes	Yes	Yes	Action Plan
Luxembourg	Not found		Yes	Yes	Being developed	In National Nature Conservation Plan
Malta	Yes	The Competent Authority can prohibit the importation of any species of flora and fauna that may endanger native biodiversity (applies only to imports from non-EU countries). Certain listed plant species are prohibited for import.	Yes	Yes	Yes	Under development + covered by Sustainable Development Strategy
The Netherlands	Yes	The import of two species into the Netherlands is prohibited (<i>Muntingia reevesi</i> and <i>Hydrocotyle ranunculoides</i>).	Yes	Yes	Yes	Yes (pending approval)
Poland	Yes	Obtaining consent from the Minister for the Environment is necessary for importing alien species whose introduction into the environment could pose a threat to native biodiversity. However, the criteria for recognizing alien species as a threat have not yet been specified.	Being developed	Yes	Yes	In Biodiversity Strategy
Portugal	Yes ⁱⁱ	Imports and dissemination of new exotic fauna into Madeira are controlled.	Yes	Yes	Yes	In Biodiversity Strategy
Romania	Yes	Import of alien animal and plant species can be done only with the approval of the Romanian government and the Romanian Academy of Sciences.	Not found	Yes	Yes	Not found
Slovakia	Yes	Import of seven listed invasive plants is prohibited.	Yes	Yes	Yes	In Biodiversity Strategy
Slovenia	Not found ⁱ		Yes	Yes	Not found	Under development
Spain	Yes	Import of game (hunting and fishing) species requires authorisation. In addition, some specific phytosanitary requirements apply to	Yes	Yes	Yes	Yes

Country	Import/ export	Provisions in relation to import/export	Possession/ trade	Introduction	Control/ eradication	IAS Strategy
		imports into the Canary Islands.				
Sweden	Yes	Import of animals requires authorisation to prevent the introduction of diseases and the introduction of alien animal species that may harm indigenous fauna. Import and spread of plants and plant material is regulated in order to prevent the spread of plant pests and diseases.	Yes	Yes	Yes	Yes (end 2008)
UK	Not found		Yes	Yes	Yes	Yes (May 2008)

ⁱ Were in place prior to EU membership.

ⁱⁱ Specific restrictions in relation to Madeira, under development for the Azores.

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Annex

Websites used to investigate the trade in *Sciurus carolinensis* within the European Union.

Website	Country/Region	Type of site
www.eurofauna.com	Europe	pets classifieds
http://www.tieranzeigen.at/kleintiere/	Austria	pets classifieds
http://animaux.vivastreet.be/	Belgium	pets classifieds
http://be.tootannonces.com	Belgium	pets classifieds
http://www.kugli.com/Pets_Animals/country/Czech_Republic-CZ	Czech Republic	pets classifieds
http://www.dba.dk/dyr/stue-og-kaeledyr/gnavere	Denmark	pets classifieds
www.lemmikkipalstat.net	Finland	pets classifieds
www.puutorinakvaario.fi	Finland	pet retailer
www.verkkopirkko.fi	Finland	pets classifieds
www.4pets.fi	Finland	pet retailer
www.vente-animaux.com	France	pets classifieds
www.petite-annonce-gratuite.com	France	pets classifieds
www.evannonce.com/animaux	France	pets classifieds
www.marche.fr/animaux	France	pets classifieds
www.toutypasse.com/autres	France	pets classifieds
http://www.local24.de/tiere/nagetiere/	Germany	pets classifieds
http://www.markt.de/Tiere/	Germany	pets classifieds
http://annunci.ebay.it	Italy	pets classifieds
www.aquazoo.it	Italy	pet retailer
www.italypet.com	Italy	pets classifieds
www.aziendanaturaviva.com	Italy	pet retailer
http://www.supernatura.it/	Italy	pet retailer
http://dyrenett.no/no/	Norway	pets classifieds
www.adoos.es	Spain	pets classifieds
www.olx.es	Spain	pets classifieds
www.almacenanimal.com	Spain	pet retailer
www.mundoanuncio.com	Spain	pets classifieds
http://espana.anunciosdiarios.com	Spain	pets classifieds
www.ebay.es	Spain	pets classifieds
www.anuncios-gratuitos.com/clasificados/animales/	Spain	pets classifieds
www.abc-annons.se	Sweden	pets classifieds
www.uppslaget.se/annonser	Sweden	pets classifieds
www.petsathome.com/shop/small-pet	United Kingdom	pet retailer
www.animalanticsonline.com	United Kingdom	pet retailer
www.petforums.co.uk/small-animal-classifieds	United Kingdom	pets classifieds
www.pets-classifieds.co.uk	United Kingdom	pets classifieds
http://pets.oodle.co.uk	United Kingdom	pets classifieds