Risk Assessment of *Tamias sibiricus*

Name of Organism:	*Tamias sibiricus*, Laxmann 1769 – Siberian Chipmunk
Objective:	Assess the risks associated with this species in Ireland
Version:	Final 15/09/2014
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Expert reviewer	Colin Lawton

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About the risk assessment

This risk assessment is based on the **N**on-native species **AP**plication based **R**isk **A**nalysis (NAPRA) tool (version 2.66). NAPRA is a computer based tool for undertaking risk assessment of any non-native species. It was developed by the European and Mediterranean Plant Protection Organisation (EPPO) and adapted for Ireland and Northern Ireland by Invasive Species Ireland. It is based on the Computer Aided Pest Risk Analysis (CAPRA) software package which is a similar tool used by EPPO for risk assessment.

Notes: Confidence is rated as low, medium, high or very high.
Likelihood is rated as very unlikely, unlikely, moderately likely, likely or very likely.
The percentage categories are 0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%.
N/A = not applicable.

This is a joint project by Inland Fisheries Ireland and the National Biodiversity Data Centre to inform risk assessments of non-native species for the European Communities (Birds and Natural Habitats) Regulations 2011. It is supported by the National Parks and Wildlife Service.

DOCUMENT CONTROL SHEET

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Stage 1 - Organism Information
The aim of this section is to gather basic information about the organism.

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the risk assessment?		A risk assessment is required as this species is listed as a "Non-native species subject to restrictions under Regulations 49 and 50" in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011, SI 477/2011.
2	Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES	*Tamias sibiricus*, Laxmann 1769 – Siberian chipmunk Taxonomy: Kingdom: Animalia Phylum: Chordata Class: Mammalia Order: Rodentia Family: Sciuridae Subfamily: Xerinae Tribe: Marmotini Genus: Tamias Species sibiricus Synonyms: *Eutamias sibiricus,* Laxmann 1769 Common names: Asian chipmunk, Siberian chipmunk Some authors include *Eutamias* as a subgenus in genus *Tamias* Illiger, 1811 (Thorington and Hoffmann 2005) while others treat it as a separate genus (Obolenskaya *et al.*, 2009). Different authors recognise a number of subspecies of *T. sibiricus* mainly on the basis of peculiarities of pelage coloration (Thorington and Hoffmann 2005). Thorington and Hoffmann (2005) listed 9 subspecies: *T. sibiricus sibiricus, T. sibiricus asiaticus, T. sibiricus lineatus, T. sibiricus okadae, T. sibiricus ordinalis, T. sibiricus orientalis, T. sibiricus pallasi, T. sibiricus senescens* and *T. sibiricus umbrosus*. Obolenskaya *et al.* (2009) and Koh *et al.* (2009) showed that there are three major groups within *T. sibiricus*, recognised as separate subspecies: *T. sibiricus sibiricus* (including *orientalis, jacutensis, altaicus, lineatus, okadae, pallasi, asiaticus* and *uthensis*) in the northern part of the range - Russia, extreme northeast of the Korean peninsula, Mongolia, Japan and northeast China; *T. sibiricus barberi* – Korean Peninsula except the extreme northeast region; and *T. sibiricus senescens* (including *intercessor, ordinalis* and *umbrosus*) - central China, south of Liaoning

Stage 1 - Organism Information

The aim of this section is to gather basic information about the organism.

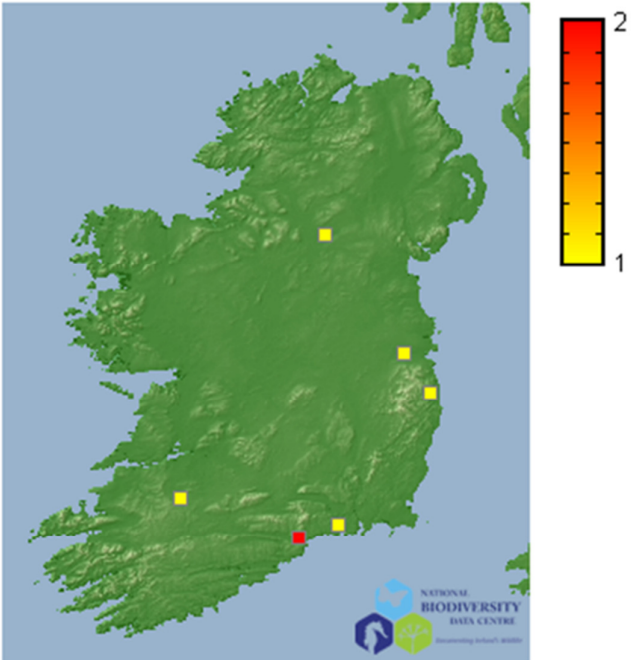| N	QUESTION	RESPONSE	COMMENT
			Province.
			There are 25 species of chipmunk (Wilson & Reeder, 2005), and some expertise is required in distinguishing one from another. It is likely that any chipmunk recorded in Ireland could be identified by the general public as a Siberian chipmunk. It is unlikely that any other chipmunks will be introduced to Ireland, as the Siberian chipmunk is the one sold by pet shops, however the records should continue to be verified by individuals familiar with the various species.
3	If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)	N/A	
4	Describe the organism.	-	A small, diurnal and omnivorous terrestrial squirrel living primarily in forested habitat (Chapuis, 2006, 2009). It has a body length of 12-17cm, less than 25cm including tail and is ~100g in weight (CABI, 2014; NNSS, 2011). It has a general sandy-rufous pelage colouration and a long bushy brown-grey tail, which is shorter than body length (CABI, 2014). It is distinguished from other chipmunk species by having five dark longitudinal stripes separated by lighter zones of the same width down its back from head to rump (one central and two lateral dark stripes at either side) (Chapuis, 2006,2009). It has small, slightly round erect ears and a pointed snout (NNSS, 2011). It sits with front paws held off the ground. It does not show sexual dimorphism and young and adults are not distinguishable except by their size and proportions (CABI, 2014). It inhabits and reproduces in a burrow where it hibernates from October-November to March-April (Chapuis, 2006, 2009).
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment for Ireland)	YES	In Ireland, a preliminary risk assessment was previously carried out. This was a prioritisation risk assessment as part of the Risk Analysis and Prioritisation for Invasive and Non-native Species in Ireland and Northern Ireland (ISI, 2012). It designated *Tamias sibiricus* as a "high risk" invasive species.
6	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?	PARTIAL	Only a preliminary risk assessment was previously conducted in Ireland (refer to Question 5)
7	Where is the organism native?		The organism is native to China, Japan, Kazakhstan, South Korea, North Korea, Mongolia and Russia (Tsytsulina *et al.*, 2008; Figure 1).

Stage 1 - Organism Information

The aim of this section is to gather basic information about the organism.

N	QUESTION	RESPONSE	COMMENT
			 Figure 1. Native range of Siberian chipmunk (Modified from Tsytsulina *et al.*, 2008).
8	What is the current global distribution of the organism (excluding Ireland)?		In addition to the countries within its native range, established populations exist in the wild of Austria, Belgium, France, Germany, Italy, Netherlands and Switzerland (Bertolino *et al.*, 2000; Long, 2003; Mitchell-Jones *et al.*, 1999; Riegel *et al.*, 2000).
9	What is the current distribution of the organism in Ireland?	-	At present 7 records are verified for this species in Ireland (Figure 2; National Biodiversity Data Centre, 2014). These originate from counties Waterford (2 locations), Wicklow, Dublin, Limerick and Fermanagh.

Stage 1 - Organism Information
The aim of this section is to gather basic information about the organism.

N	QUESTION	RESPONSE	COMMENT
			  Figure 2. Map showing the verified records for *Tamias sibiricus* – Siberian chipmunk per $10km^2$ in Ireland. Colour scale bar slows density of records per 10km (National Biodiversity Data Centre, 2014).
10	Is the organism known to be invasive anywhere in the world?	YES	The Siberian chipmunk is listed as one of 100 most invasive species in Europe (DAISIE, 2009).There are few studies that investigate the invasiveness of this species within its introduced range. In Belgium, Riegel *et al.* (2000) reported no effect on breeding bird abundance which contrasts with studies from within the Siberian chipmunk's native range (Russia) that show a correlation between high chipmunk density and reduced breeding success of warblers (Forstmeier and Weiss, 2002, 2004). In France, competition between the Siberian chipmunk and the red squirrel (*Sciurus vulgaris*) has been suggested as a reason for low densities of the latter (CABI, 2014). However, this study was limited by the

Stage 1 - Organism Information			
The aim of this section is to gather basic information about the organism.			
N	**QUESTION**	**RESPONSE**	**COMMENT**
			naturally occurring low densities of the red squirrel in the study forest. Also in France, the Siberian chipmunk is an additional vector of Lyme's disease (*Borrelia spp*) and has higher occurrence of the bacteria responsible for Lyme's disease than native rodents (Marsot *et al.*, 2011) and a higher incidence of ticks than native rodents (Pisanu *et al.*, 2010).

Stage 2 - Detailed assessment: Section A - Entry
This section evaluates the probability of entry of an organism into Ireland. For organisms which are already present, only complete the entry section for currently active pathways of entry and potential future pathways. The entry section need not be completed for pathways which have allowed an organism to enter in the past but are no longer active.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.01	How many active/future pathways are relevant to the potential entry of this organism (n/a, very few, few, moderate number, many or very many)?	VERY FEW	MEDIUM	This animal is traded as a pet species and introductions within European countries have been linked to escapes or deliberate releases in the wild (Baker, 2008; Bertolino and Genovesi, 2005). Therefore, the likely routes or introduction are escapes from pet shops or private homes and deliberate releases from pet shops or private homes. Deliberate releases have been recorded in the United Kingdom as a result of vandalism, occurring in Berkshire in 2005 in Sussex in 2009 (NNSS, 2011).
1.02	List significant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways.	1. Pet trade	MEDIUM	The pet trade is the most significant pathway for this species to enter Ireland. Pathways into the wild will likely result from escapes or deliberate releases as is documented in United Kingdom (Baker, 2008) and Europe (Bertolino and Genovesi, 2005). At present we do not have a list of pet shops in Ireland that stock this species. We are also unaware of the particular points of entry for this species into Ireland e.g. which sea ports or airports imported species are imported through. Molecular analysis of four established populations of Siberian chipmunk in France indicate that they originated from South Korea (CABI, 2014). Imports from South Korea to Europe numbered 200,000 animals a year from the 1960s to 1980s (CABI, 2014). Based on this information it is likely that any introduced animals are likely to originate from South Korea.

Pathway 1 – Pet trade				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	INTENTIONAL	HIGH	This species is sold across the world as a domestic pet. Any introduction to Ireland is likely to originate from an animal sold from a pet shop.
1.04	How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year?	MODERATELY LIKELY	LOW	At present, we are not aware of the numbers of Siberian chipmunk that are imported to Ireland for the pet trade. Movement of Siberian chipmunk along this pathway would be dependent on the demand for the species by enthusiasts. Up to 200,000 animals were imported to Europe from South Korea yearly between the 1960s and 1980s (CABI, 2014). Therefore, we

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
Pathway 1 – Pet trade				
				can only assume that any animals brought into Ireland now originate from the same source e.g. South Korea.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	LIKELY	MEDIUM	With no current legislation on the importation of the Siberian chipmunk, it is likely that the species could enter Ireland undetected and without the knowledge of the relevant authority.
1.06	How likely is the organism to survive during passage along the pathway?	LIKELY	MEDIUM	Likely for the species nutrimental and housing requirements to be catered for by the pet trader and subsequent pet shop and/or pet owner.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	MODERATELY LIKELY	MEDIUM	In temperate regions, such as Ireland, hibernation ranges from 4-5 months, with breeding taking place soon after hibernation in March-April (CABI, 2014). The first cohort is produced in April-May and the second in July-August (CABI, 2014). Females are mature from 8 to 14 months of age and breeding success is a function of available food resources (Marmet, 2008). Establishment success would, therefore, be initially dependent on the release or escape of one sexually mature chipmunk of each sex, between April and August, to a suitable breeding ground (i.e. forested habitat) with a plentiful food supply or the escape or release of a pregnant female. It is moderately likely for the species to arrive during this period.
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	MEDIUM	The optimal habitat for the Siberian chipmunk is rural forest, however populations have become established in several parts of Europe in sub-optimal areas such as urban parks and suburban woods. This species does not have a large home range (0.7 - 1.8 ha) and does not move large distances (Marmet *et al.*, 2009) and so rarely spreads from points in which it has become established.
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	LIKELY	MEDIUM	As evident in Figure 2, introductions or escapes have already taken place and the species has been recorded within the wild in Ireland.The Siberian chipmunk does not make an ideal pet; making releases more likely (NNSS, 2011). Additionally, there are no regulations preventing pet traders from importing the animal.
1.10	Do other pathways need to be considered?	NO	MEDIUM	

Overall likelihood				
N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.11	Estimate the overall likelihood of entry into Ireland based on all pathways (comment on the key issues that lead to this conclusion).	LIKELY	HIGH	Entry of the species is likely, based on the fact that the species is traded as a pet within Ireland and that records from the wild exist for this species (National Biodiversity Data Centre, 2014).

Stage 2 - Detailed assessment: Section B - Establishment
This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	UNSURE	MEDIUM	At present 7 records for this species exist for Ireland with 3 of these from the same county (National Biodiversity Data Centre, 2014). No studies that we are aware of have been undertaken to determine whether these records represent established and breeding populations.
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local climatic conditions and the organism's current global distribution?	LIKELY	MEDIUM	Temperatures within the native range of the Siberian chipmunks range from -65°C to > 30°C (CABI, 2014). During periods of extreme cold the species can hibernate while during periods of hot weather it can slow down its activity (Chapuis, 2005). Ireland has a temperate oceanic climate, which is mild, moist and changeable, with abundant rainfall and lack of temperature extremes (Keane and Collins, 2004). Therefore, there is no reason to believe that the species would not establish in Ireland because of its climatic conditions.
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local abiotic conditions and the organism's current global distribution?	LIKELY	MEDIUM	*Tamias sibiricus* lives in a wide range of environmental conditions. Its natural range is between 29°N and 69°N, rising together with forest vegetation from sea level to the subalpine zone of high mountain ranges (about 3000 metres in the Altai Mountains). Temperatures experienced range from -65°C to > 30°C. (CABI, 2014). *T. sibiricus* escapes the rigours of winter by hibernating and in summer, when temperatures are high, it can also slow down its activity and remain in its burrow (Chapuis, 2005). The main limiting factor for populations is food availability, and especially the availability of fruits or seeds that can be stored. Reasons for failure to establish are unknown. Populations have established in the wild of Austria, Belgium, France, Germany, Italy, Netherlands and Switzerland (Bertolino *et al.*, 2000; Long, 2003; Mitchell-Jones *et al.*, 1999; Riegel *et al.*, 2000) and although the species has failed to establish, thus far, in United Kingdom (Baker, 2008) it is reasonable to believe that the abiotic conditions of Ireland are suitable for the establishment of this species.
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?	LIKELY	MEDIUM	Habitats that the species occupies within its native and introduced ranges occur in Ireland e.g. urban parks, suburban forests, broad leaved woodland and conifer forests (CORINE, 2006; Fossitt, 2000). Siberian chipmunks will encounter urban parks and suburban forests as a result of escapes or deliberate releases. In contrast, occupation of rural woodlands by this species is only likely to occur as a result of deliberate introductions.

Stage 2 - Detailed assessment: Section B - Establishment
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N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?	LIKELY	MEDIUM	Little research has examined whether competition occurs with other species in native environments. One study from France (reported in CABI, 2014) suggests the species may compete with the red squirrel (*Sciurus vulgaris*). However, competition is suggested as being more detrimental for the red squirrel than the Siberian chipmunk. We are not aware of any other species resident in Ireland that will directly compete with this species.
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	LIKELY	MEDIUM	Several authors have suggested that introductions have failed in a number of European countries due to predation by the domestic cat (CABI, 2014; Baker, 2008). Therefore, it is possible that introductions of small numbers of animals may be stopped by domestic cats in Ireland. The species is also known as a prey item of diurnal raptors e.g. common buzzard (*Buteo buteo*) and mammalian carnivores e.g. red fox (*Vulpes vulpes*) (CABI, 2014). Both domestic and wild predators (such as the pine marten) may halt some introductions but it is obvious from the number of established populations in Europe that predation pressure does not always stop establishment.
2.07	How likely is it that establishment will occur despite existing management practices?	LIKELY	MEDIUM	At present we are not aware of any existing management strategies that will limit or prevent the establishment of this species in Ireland.
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	-	LOW	Two potential management practices that could benefit Siberian chipmunks are the ban on hedgerow cutting from March to August, which could facilitate dispersal and the 30% target broadleaved afforestation by state forestry bodies. The actual effects these practices have is not currently known.
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	UNLIKELY	MEDIUM	The species has established in continental Europe within urban and suburban parks that contain broadleaved woodland, which can be found in Ireland. Additionally the species occupies small home ranges (Marmet *et al.*, 2009), does not disperse large distances i.e. < 1km and does not cross roads or open spaces easily (Marmet *et al.*, 2011). Therefore, targeted eradication campaigns are likely to be effective.

Stage 2 - Detailed assessment: Section B - Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	LIKELY	MEDIUM	The following are biological traits of the Siberian chipmunk which may facilitate establishment: The species can breed twice a year (Vinokurov and Solomonova, 2002) and have 4 -5 animals per litter (Chapius, 2005). Females are mature from 8 to 14 months of age (Marmet, 2008) and fecundity increases with age (Kawamichi and Kawamichi, 1993). This species inhabits locations that have widely varying temperature highs and lows. In extreme low temperatures it can hibernate and in extreme highs it can lower its activity (Chapuis, 2005). Therefore, it is likely to be able to cope with Ireland's climate.
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	UNLIKELY	MEDIUM	Spread is likely to be slow as the species occupies small home ranges (0.7 -1.5ha) (Marmet *et al.*, 2009) and does not disperse far from the natal home range (259 - 933m) (Marmet *et al.*, 2011). The distribution of the species in Europe is primarily a result of releases/escapes and not natural colonisation.
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	LIKELY	MEDIUM	The species inhabits a wide range of environmental conditions (detailed earlier in the risk assessment). Therefore, the species has a degree of adaptability to climatic and abiotic conditions that will facilitate its establishment in Ireland.
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	LIKELY	LOW	The genetic diversity of established European populations of the Siberian chipmunk is not known at present. Therefore we cannot make an accurate assessment at this time. However, other squirrel species have shown themselves capable of establishing despite a very restricted founder gene pool (e.g. grey squirrels in Ireland).
2.14	Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Ireland? If possible, specify the instances of invasion elsewhere in the justification box	LIKELY	MEDIUM	In addition to the countries within its native range, established populations exist in the wild of Austria, Belgium, France, Germany, Italy, Netherlands and Switzerland (Bertolino *et al.*, 2000; Long, 2003; Mitchell-Jones *et al.*, 1999; Riegel *et al.*, 2000).

The species has established following introductions/escapes in European countries (Austria, Belgium, France, Germany, Italy, Netherlands and Switzerland). However, additional introductions to France have failed as have introductions to the United Kingdom (Baker, 2008; Bertolino *et al.*, 2000). Based on this information, there is a possibility of introductions to Ireland succeeding and failing. However, establishing the specific |

Stage 2 - Detailed assessment: Section B - Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				likelihood is difficult to do due to varying sizes of the number of individuals introduced and other local factors. A total of 14 (100%) introductions have been recorded in United Kingdom and all have failed (Baker, 2008) while 3 out of 14 (21%) introductions in France have failed (Bertolino, 2009).
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?	LIKELY	HIGH	Transient individuals or populations are likely. Unless trade of this species as a pet is regulated or controlled, it is likely the risk of deliberate releases or escapes occurring will continue.
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box	LIKELY	MEDIUM	There is a likelihood of the species establishing in Ireland due to records of this species in the wild at present and studies from continental Europe that indicate that releases/escapes of Siberian chipmunk can lead to the establishment of populations. However, the failure of the species to establish in United Kingdom and other European countries introduces an element of doubt into our confidence of this species establishment in the wild of Ireland.

Stage 2 - Detailed assessment: Section C - Spread
This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.01	What area (given in % or 10km squares) in Ireland could the organism establish (0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%)?	0-10%	MEDIUM	Only ~4% of Ireland is covered with the species favoured terrestrial habitat of coniferous (3.23%), deciduous (0.41%) and mixed woodland (0.42%) (with an additional 5.89% of transitional woodland) (CORINE, 2006), habitats that the species is found within its native range and introduced range (CABI, 2014). Therefore, we can assume that urban parks and woodland/forest will be the habitats this species will occupy in Ireland.
3.02	How important is the expected spread of this organism in Ireland by natural means (minimal, minor, moderate, major or massive)?	MINIMAL	MEDIUM	The species has a low natal dispersal rate (< 1km), with small home ranges (< 2ha) but can occur in high densities in habitats it occupies (Marmet *et al.*, 2009; 2011). Additionally, there is little evidence of the establishment of new populations from natural spread in continental Europe. Most established populations are separate and unconnected from one another due to their establishment from different releases/escapes. These factors combined with the suggestion that they encounter difficulty in crossing roads and open habitats (CABI, 2014) suggest the spread my natural means is likely to be minimal.
3.03	How important is the expected spread of this organism in Ireland by human assistance (minimal, minor, moderate, major or massive)?	MODERATE	MEDIUM	This is likely to be the main method of dispersal in Ireland of this species. Studies from Europe indicate that established populations occur as a result of deliberate human releases as well as escapes. The verified records of the species in Ireland are also isolated from one another which indicate more than one release.
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MINOR	MEDIUM	The species occupies small home ranges (Marmet *et al.*, 2009), does not disperse large distances i.e. < 1km and does not cross roads or open spaces easily (Marmet *et al.*, 2011). Therefore, targeted eradication campaigns are likely to be effective.
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	0-10%	HIGH	Introductions and the establishment of this species primarily originate from woodland and parkland (CABI, 2014). Less than 10% of the island of Ireland is forested (refer to Question 3.01), therefore we can assume that this is the area at greatest risk of colonisation. However, no work has been done to date, in Ireland, to determine whether records represent established populations.

Stage 2 - Detailed assessment: Section C - Spread

This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.06	What proportion of the area in Ireland suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	0-10%	HIGH	At present we do not know whether any of the records from Ireland represent established populations. However, given the low dispersal rates of this species, they are highly unlikely to spread to more than 10% of the available woodland in Ireland in the next five years even if established at one or more of the recorded locations.
3.07	What other timeframe would be appropriate to estimate any significant further spread of the organism (10, 20, 40, 80 or 160 years)? Please comment on why this timeframe is chosen.	10	MEDIUM	At present, the number of records are small from Ireland for this species and it is not known if they represent established populations. It is therefore recommended that a survey be undertaken in the locations records are known from, to establish whether populations exist. Determining this factor will then allow an assessment of the further spread of this species.
3.08	In this timeframe, what proportion of the area (including any currently occupied areas) is likely to have been invaded by this organism?	0-10%	LOW	At present we do not know how often this species is released into the wild in Ireland. We also do not know whether populations are established. Therefore, we do not currently know what proportion of endangered area that is likely to be invaded by this species.
3.09	Based on the answers to questions on the potential for establishment and spread in Ireland, define the area endangered by the organism. Be as specific as possible. If available, provide a map showing the area most likely to be endangered.	-	MEDIUM	The areas at greatest risk from invasion by this species are likely to be urban and suburban parks and forests (CABI, 2014), as recorded elsewhere in Europe. Broadleaved and coniferous woodland, their preferred habitat is also at risk, but less likely to be reached by the introduced animal.
3.10	Estimate the overall potential for future spread for this organism in (very slowly, slowly, moderately, rapidly or very rapidly). Use the justification box to indicate any key issues.	VERY SLOWLY	MEDIUM	The natural spread of this species in Ireland is likely to be low due to the low natural dispersal rate of this species in its introduced range. The factor likely to be the greatest influence on the future spread of this species will be human mediated dispersal resulting from deliberate introductions or escapes.

Stage 2 - Detailed assessment: Section D - Impact
This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.01	How great is the economic loss caused by the organism within its global distribution (excluding Ireland), including the cost of any current management?	MINIMAL	MEDIUM	None of the studies, to date, on this species within its introduced range have indicated any economic loss associated with its presence. Reports of damage to crops originate from Russia in the middle of the 20th century but these were considered negligible (CABI, 2014). It is a known vector for the bacteria associated with Lyme's disease (Marsot *et al.*, 2011), so there could be associated health costs. No evidence of management is recorded within continental Europe at present. Introductions in United Kingdom have been controlled but the cost not known presently (NNSS, 2011).
4.02	How great has the economic cost of the organism been in Ireland from the time of introduction to the present? Exclude any costs associated with managing the organism from your answer.	N/A	N/A	To-date there are no known economic costs incurred.
4.03	How great is the economic cost of the organism likely to be in the future in Ireland? Exclude any costs associated with managing the organism from your answer.	MINOR	LOW	The future economic costs in Ireland are likely to be low as none have been reported in Europe where populations have been present since the 1960s. As it is a known vector of Lyme's disease its presence in the future may have implications for the spread of this disease.
4.04	How great have the economic costs of managing this organism been in Ireland from the time of introduction to the present?	N/A	N/A	To-date there are no known economic costs incurred.
4.05	How great is the economic cost of managing this organism likely to be in the future in Ireland?	MINOR	MEDIUM	Any costs associated with managing this species i.e. control or eradication, are likely to be minor. This assumption is based on the small number of records known and the ecology of the species which lends itself to control i.e. low dispersal rates, small home ranges.
4.06	How important is environmental harm caused by the organism within its global distribution?	MINIMAL	LOW	At present there is little research to indicate that the species causes environmental harm within its global distribution. Research that exists which indicates a negative effect of this species is speculative and often contradicted by other research. Red squirrel (*Sciurus vulgaris*) abundance is reported to be lower in the presence of Siberian chipmunks in France in a site with naturally low squirrel abundance (CABI, 2014; Dozieres, 2008). This is contradicted by Bertolino *et al.* (2000) that suggests that both species can co-exist without apparent competition. Similarly, Riegel *et al.* (2000) reported no effect on abundance of breeding birds in Belgian forests by the presence of Siberian chipmunks.

Stage 2 - Detailed assessment: Section D - Impact
This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				This contrasts with findings by Forstmeier and Weiss (2002 and 2004) that indicate Siberian chipmunk abundance has a negative effect on the breeding success of a species of warbler.
4.07	How important has the impact of the organism on biodiversity* been in Ireland from the time of introduction to the present? *e.g. decline in native species, changes in community structure, hybridisation	MINIMAL	MEDIUM	It is likely that the impact, if any, has been minimal to date due to the low number of records to Ireland. Additionally, the lack of recorded negative effects associated with established populations within its introduced range further substantiates this claim.
4.08	How important is the impact of the organism on biodiversity likely to be in the future in Ireland?	MINIMAL	LOW	The impact of the Siberian chipmunk on Ireland's biodiversity is likely to be minimal based on the findings of current research. However, further research is required to determine whether the introduction of the Siberian chipmunk combined with the presence of the grey squirrel (*Sciurus carolinensis*) has an impact on Irish red squirrel populations.
4.09	How important has alteration of ecosystem function* caused by the organism been in Ireland from the time of introduction to the present? *e.g. habitat change, nutrient cycling, trophic interactions	MINIMAL	MEDIUM	To date, no effect has been documented in Ireland but no research has been conducted examining any effect. However, no impact is recorded in Europe where introduced populations exist.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the future?	MINIMAL	MEDIUM	At present there is no evidence to suggest this species will have a future impact on ecosystem function in Ireland. It could be expected that, as some populations in Europe have been present since the 1960s, an impact on ecosystem functioning would be evident by now.
4.11	How important has decline in conservation status* caused by the organism been in Ireland from the time of introduction to the present? *e.g. sites of nature conservation value, WFD classification, etc.	MINIMAL	MEDIUM	No evidence of decline in the conservation status of any other organism has been recorded from the establishment of populations within Europe. Therefore, as records from Ireland are low in number at present and impacts are not known from established populations in Europe it is unlikely that the species will have any significant impact in the future.
4.12	How important is decline in conservation status caused by the organism likely to be in the future in Ireland?	MINIMAL	MEDIUM	Based on what information is available from established populations in continental Europe this is likely to be low. However, research into the impact, if any, on the red squirrel population will be required if populations are found to have established in Ireland. This species is already under threat from the introduced grey squirrel.

Stage 2 - Detailed assessment: Section D - Impact
This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.13	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within its global distribution?	MINOR	MEDIUM	This species is a known vector for the bacteria responsible for Lyme's disease (Marsot *et al.*, 2011) and is a known host to ticks (Pisanu *et al.*, 2010). Therefore, its introduction will increase the number of species already in Ireland that are known vectors for this disease. However, there is no evidence, at present, which suggests the occurrence of Lyme's disease in the human population increases as a result of the presence of Siberian chipmunk populations.
4.14	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland?	MINIMAL	MEDIUM	Based on the small number of records in Ireland, it is unlikely that established populations currently exist. Therefore, we can speculate that the social or human health harm caused is minimal at present.
4.15	How important is it that genetic traits of the organism could be carried to other organisms / species, modifying their genetic nature and making their economic, environmental or social effects more serious?	MINIMAL	HIGH	This species will not breed with any other species presently found in Ireland.
4.16	How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	MODERATE	MEDIUM	Studies from France indicate the Siberian chipmunk is a vector of Lyme's disease (Marsot *et al.*, 2011) and can carry ticks which can facilitate the spread of this disease (Pisanu *et al.*, 2010).
4.17	How important might other impacts not already covered by previous questions be resulting from introduction of the organism? Specify in the justification box.	N/A	MEDIUM	We are not aware of other impacts not already covered by the previous questions.
4.18	How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Ireland?	MINIMAL	MEDIUM	The expected impacts are likely to be minimal. Introduction may have failed in a number of European countries due to predation by the domestic cat (CABI, 2014; Baker, 2008). It is known to be an occasional food item of American mink (*Neovision vision*) but it is a secondary prey item (CABI, 2014).
4.19	Indicate any parts of where economic, environmental and social impacts are particularly likely to occur. Provide as much detail as possible, where possible include a map showing vulnerable areas.	-	MEDIUM	As the Siberian chipmunk is known primarily from introductions to urban parks and suburban forests in Europe it is likely that areas similar to these in Ireland will be at greatest risk from any impacts of its introduction. Similarly, broadleaved woodlands and coniferous forests in rural locations will be other locations where impacts may occur.

Stage 2 - Detailed assessment: Section D - Impact
This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MINIMAL	MEDIUM	Based on current research the impact of the Siberian chipmunk is likely to be minimal in Ireland. At present it is not recorded as having a negative impact within its introduced range on species within the habitats it has been introduced. However, few studies have investigated impacts so further research is required. Any research should focus on woodland birds, of which an impact has been recorded in its native range, and red squirrels where potential competition could occur.

Stage 2 - Detailed assessment: Section E - Conclusion

This section requires the assessor to provide a score for the overall risk posed by an organism, taking into account previous answers to entry, establishment, spread and impact questions.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
5.01	Estimate the overall risk of this organism in Ireland. Noting answers given in 1.11, 2.16, 3.10 & 4.20	MINIMAL	MEDIUM	Entry of the species is likely, based on the fact that the species is traded as a pet within Ireland and that records from the wild exist for this species (National Biodiversity Data Centre, 2014). There is a likelihood of the species establishing in Ireland due to records of this species in the wild at present and studies from continental Europe that indicate that releases/escapes of Siberian chipmunk can lead to the establishment of populations. However, the failure of the species to establish in United Kingdom and other European countries introduces an element of doubt into our confidence of this species establishment in the wild of Ireland. The natural spread of this species in Ireland is likely to be low due to the low natural dispersal rate of this species in its introduced range. The factor likely to be the greatest influence on the future spread of this species will be human mediated dispersal resulting from deliberate introductions or escapes. Based on current research it is likely that the overall risk of this organism in Ireland will be minimal. The species is a known vector of Lyme's disease, which will increase the risk of this disease spreading, but no major economic impact or significant effect on biodiversity is recorded elsewhere within its introduced range in Europe. Few studies have investigated impacts and further research is required. Any research should focus on woodland birds, of which an impact has been recorded in its native range, and red squirrels where potential competition could occur.

Stage 2 - Detailed assessment: Section F – Additional questions

This section is used to gather information about the potential effects of climate change on the risk posed by an organism. It is also an opportunity for the risk assessor to highlight high priority research that could help improve the risk assessment.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
6.01	What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	-	MEDIUM	We are not aware of any direct aspects of climate change that will affect the risk assessment of this species. Climate change may have an indirect impact on the risk associated with Lyme's disease which the Siberian chipmunk is a known vector. Studies of tick borne encephalitis in Sweden have related an increased occurrence of the disease in humans with milder winters (Lindgren and Gustafson, 2000). Similarly, milder winters and warmer nights in spring and autumn have been linked to increased tick abundance (Lindgren *et al.*, 2000). However, the complexity of the epidemiology and ecology of Lyme's disease limits the ability of researchers to implicate climate change in the increased occurrence of this disease (Gray *et al.*, 2009).
6.02	What is the likely timeframe for such changes (5, 10, 15, 20, 50 or 100 years)?	20	LOW	We are not sure of the likely time changes associated with an increased risk of exposure to Lyme's disease as a consequence of higher tick abundance and winter survival. These effects have already been observed in relation to climate change in Sweden and tick borne encephalitis (Lindgren and Gustafson, 2000; Lindgren *et al.*, 2000). However, we are not aware of similar changes in Ireland.
6.03	What aspects of the risk assessment are most likely to change as a result of climate change	-	MEDIUM	It is possible that the risk associated with Lyme's disease may change as the result of further research on the role climate change has on ticks and tick borne disease.
6.04	If there is any research that would significantly strengthen confidence in the risk assessment, please note this here. If more than one research area is provided, please list in order of priority.	-	MEDIUM	At a national level research is needed to examine whether or not the known recordings of the species has resulted in the establishment and/or spread of populations. Modelling of the species potential rate of spread and likely distribution in Ireland would significantly strengthen the confidence in this risk assessment. Both nationally and internationally research is needed to examine the potential economic, environmental and social impacts of the species in its native and introduced range, particularly any potential impact on the red squirrel population. In order to determine the likelihood of future releases or escapes, a record should be made of the number of pet shops supplying the animals, number of animals sold per annum, number of current owners of Siberian chipmunks and the estimated % of pets that escape or are released.

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