Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism:	***Tamias sibiricus*** **- Siberian chipmunk Laxmann (1769)**	
	Objectives:	Assess the risks associated with this species in GB	
	Version:	FINAL 04/04/11	
N	**QUESTION**	**RESPONSE**	**COMMENT**
1	What is the reason for performing the Risk Assessment?		*T. sibiricus* is not native to the UK but is sold and kept as a domestic pet. It has become established in several other western European countries and escapes from captivity have been reported in the UK.
2	What is the Risk Assessment area?	GB	
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	No risk assessment has been carried out for the UK. *T. sibiricus* is mentioned in "An inventory of alien species and their threat to biodiversity and economy in Switzerland" (Wittenberg, 2005). In this report they were considered of 'low invasion potential' although the risk of importing disease with non-native pets was emphasised.
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		No valid risk assessment for the UK. NB: Wittenberg (2005) based conclusions on limited data from a Belgian study (Riegel, 2001 cited in Wittenberg, 2005) and data from the Hanbuch der Saugetiere Europas (Krapp, 1978a & b, cited in Wittenberg, 2005). Additional available data for *T. sibiricus* or related species is considered here.
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Tamias sibiricus* (Siberian or Asian chipmunk). The genus *Tamias,* some species of which formerly classified as *Eutamias,* comprises more than 20 species of which *T. sibiricus* is that most commonly kept as a pet (Meredith, 2002) and therefore considered to have potential for establishment in a feral state within the assessment area. Where published data is not available for *T. sibiricus* reference is made to congeneric species, if this is considered relevant.
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	NO or Uncertain (Go to 8)	Natural range is throughout the Siberian taiga zone from the Russian far east, Sakhalin and Hokkaido, west to the White Sea and south to the Altai Mountains and into western China (Long, 2003). It has extended its range westwards during the 20th century into Russian Karelia (Amori, 1999) and has been reported in Finland (Grzimek, 1975, cited in Long, 2003). It has been introduced in Western Europe and feral populations have established in Belgium, Germany, The Netherlands, Switzerland, Italy, France and Austria (Amori, 1999; Long, 2003). Little information is available on status of the feral populations. Most information is available for Italy where populations are found in Verona, Belluno and Rome (Bertolino *et al.* , 2000); population near Verona estimated at ~100 animals in 1999 and that in Belluno at ~1000 (Amori, 1999). In Belgium, where they have been imported as pets since the 1960s, there are four feral populations, one in Zonienwold, Brussels, estimated at 18,000 animals in 2000, one in Westerlo, one in Zwijnaarde and one in Calmeynbos (Verbeyen, 2001). In Calmeynbos 17 animals were released about 1980 and in 1998 the population was estimated at 380. However, since then it appears to have declined (est. 160 in 1999 and 70 in 2000) (Verbeyen, 2001). In Switzerland, the population originating from releases in about 1970 is described as "small, but stable" (Long, 2003). In France there are ten different populations, mainly in suburban forests and urban parks, and some populations appear to spread at a rate of 200-250m per year following introduction (Chapuis, 2005). In the Zonienwold in Belgium it is suggested there may be a negative impact on ground nesting birds (Verbeyen, 2001) and there is evidence from their native range that Siberian chipmunks can significantly affect breeding success of dusky warblers *Phylloscopus fuscatus* (Forstmeier & Weiss, 2002 & 2004). However, in Italy they appear to co-exist with native *Sciurus vulgaris* without any adverse impact on the latter (Bertolino et al, 2000). Other *Tamias* spp are implicated in negative effects of predation; e.g. chipmunks in the Sierra Nevada, California predate yellow warbler *Dendroica petechia* nests (Cain *et al.* , 2006) and increases in eastern chipmunks *T. striatus* in Pennsylvania have resulted in increased predation in bird nests (Yahner, 2003). Also *T. striatus* may consume the bulbs of rare perennial wildflowers (Fletcher *et al.* , 2001).

8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?	YES or UNCERTAIN (Go to 9)	The species is capable of having more than one litter per year in favourable conditions and mean litters of 3 to 7, and annual production of 3.1-8.5 young/female/year, have been recorded in captive colonies (Blake & Gillett, 1984). At least one feral population in Europe has grown to several thousands but one other smaller population appears to have gone into decline (Verbeyen, 2001). In its native range it is reported to have a significant impact on forest nut production and on cereal grain crops (Long, 2003). The species and some of its congenerics have been recorded as significant predators of bird eggs/young (Cain *et al.* , 2006; Forstmeir & Weiss, 2002 & 2004; Yahner, 2003). May threaten other native rodents (e.g. *Sciurus vulgaris* and *Clethrionomys glareolus)* and maybe some birds through competition for food, although there is no published evidence for this. Some indication that coexistence with *S. vulgaris* does not have an adverse effect in Italy (Bertolino *et al.* , 2000). Work in Canada suggests that the congeneric *T. striatus* and the N American red squirrel *Tamiasciurus hudsonicus* may co-exist through spatio-temporal trade-off in foraging efficiency (Guerra & Vickery, 1998).
9	Does the organism occur outside effective containment in the Risk Assessment area?	NO (Go to 11)	*T. sibiricus* is commonly kept as a pet in the UK. Five reports of escapes from captivity have been recorded by the Wildlife Management & Licensing Service in England in the 5 year period 2002-2006 (WMLS data). These have occurred in Yorkshire (May 04), Berkshire (May 05 & Jan 06, possibly related), Cheshire (Jun 06) and Wiltshire (Aug 06). Two escapes, due to vandalism, concerned significant numbers of animals (Berks, May 05, ~70 animals; Wilts, Aug 06, 19 animals). All animals are believed to have been recaptured or killed. Other reports concerned individuals or small numbers, most or all are believed to have been accounted for, and no feral populations are known to exist at present.
10	Is the organism widely distributed in the Risk Assessment area?		
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?	YES (Go to 12)	*T. sibiricus* is primarily a forest species, feeding on seeds, nuts and fruit, supplemented with some animal matter. However, it has established in several areas in Europe in managed forests, parkland and mixed landscapes (Bertolino *et al.* , 2000; Chapuis, 2005; Verbeyen, 2001). It is very likely that it could find suitable habitat in the Risk Assessment area.
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?	NO (Go to 14)	
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.		
14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?	YES (Go to 16)	Populations of *T. sibiricus* have become established in comparable temperate parts of central, southern and northern Europe including Austria, Belgium, France, Germany, Italy, The Netherlands and Switzerland (Amori, 1999; Long, 2003).
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?		
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?	YES (Go to 17)	Populations of *T. sibiricus* have become established from escapes and deliberate releases in comparable parts of Europe including Austria, Belgium, France, Germany, Italy, The Netherlands and Switzerland (Amori, 1999; Long, 2003).
17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	Animals are kept in significant numbers at some locations (cf. release of ~70 recorded in one incident by WMLS). Data from France indicates that they can spread at a rate of 200-250m per year, at least during the first decades following introduction (Chapuis, 2005).
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?	YES OR UNCERTAIN (Go to 19)	In Russia *T. sibiricus* is known to destroy up to half the forest nut production, and cause great damage to grain crops and potentially in gardens and orchards (Long, 2003). Also potential impact on breeding birds (see Q.7 above).
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B	
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.		

B	SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences			
	Probability of Entry	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	few - 1	MEDIUM -1	*T. sibiricus* is already present in the risk assessment area kept in captivity as pets. The primary pathway for introduction is escape or deliberate release from captivity.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.			Some of the questions assessing the pathways for entry into the risk assessment area are not directly applicable to this case. Chipmunks are kept in captivity both as pets and in exotic collections. The primary pathway for their entry involves their escape (or deliberate release) from captivity. The questions are answered in so far as is possible, given this pathway.
1.3	How likely is the organism to be associated with the pathway at origin?	likely - 3	LOW - 0	For the case of *T. sibiricus* the principal pathway for entry is escape or release from captivity. The origin of the pathway is considered to be the keeping of the animals in captivity. Likelihood of association is considered to remain high as long as the species continues to be kept in captivity.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	likely - 3	LOW - 0	Husbandry recommendations are that animals in captivity should be kept in outdoor aviary style enclosures (Meredith, 2000). Although the individual populations are rarely very large, the "concentration" of individuals is likely to be high. Evidence from recent incidents indicates that numbers kept in collections may be several 10s of animals whilst even pets may be kept in numbers of 10+. These could be sufficient to establish a founder population. The population in Calmeynbos, Belgium is believed to have originated from 17 animals released in ~1980 (Verbeyen, 2001).
1.5	How likely is the organism to survive existing cultivation or commercial practices?	likely - 3	LOW - 0	*T. sibiricus* has escaped captivity and become established in parts of Europe with comparable cultivation and commercial practices.
1.6	How likely is the organism to survive or remain undetected by existing measures?	unlikely - 1	MEDIUM -1	*T. sibiricus* is diurnal, easily recognisable and identifiable. Initial releases or escapes are most likely to occur in urban/suburban or parkland areas and any escaped individuals are likely to be promptly reported by members of the public.
1.7	How likely is the organism to survive during transport /storage?	N/A		Not relevant to pathway considered.
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	moderately likely - 2	MEDIUM -1	The species breeds readily in captivity but is susceptible to stress which may reduce breeding success and can lead to abandonment of the young (Blake & Gillett, 1984; Meredith, 2002).
1.9	What is the volume of movement along the pathway?	minor - 1	HIGH -2	Movement along pathway, in the sense of escapes/releases from captivity into the wild, probably only occurs infrequently and in low numbers, but no firm data available other than WMLS records.
1.10	How frequent is movement along the pathway?	occasionally - 2	HIGH -2	Escapes/releases only recorded occasionally (1 per year recorded by WMLS in 2002-2006). It is probably likely that additional escapes of pet animals occur, and go
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	LOW - 0	*T. Sibiricus* is already widely distributed in the risk assessment area in captivity.
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	moderately likely - 2	MEDIUM -1	Time of year is probably not an important factor in determining the success of *T. sibiricus'* escape from captivity, except that levels of activity are likely to be lower during cold periods of winter when the animals would normally enter a torpid state.
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	moderately likely - 2	MEDIUM -1	Use of the species as a pet or in small zoos/exhibits is likely, in many cases, to place it in proximity to suburban gardens, parkland, cemeteries etc, which could provide suitable habitat.
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	likely - 3	LOW - 0	Escaped individuals of *T. sibiricus* are unlikely to travel far from their point of escape. However, the congeneric *T. striatus* may use hedgerows to move between habitat patches and appears to be able to traverse distances of 200-400m to reach such habitat corridors (Silva *et al.* , 2005). It seems likely that *T. sibiricus* could do the same. They are also flexible in their choice of habitat; native habitat consists of woodland with a bushy understorey but they have been reported to thrive in parkland and cemeteries (Wittenberg, 2005).

	Probability of Establishment	RESPONSE	UNCERTAINTY	COMMENT
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	similar - 3	LOW - 0	Current native distribution stretches across a large part of northern Asia, and reaches as far west as Finland. Stable populations originating from escapees exist across Europe in areas with similar climatic conditions to the UK.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	very similar - 4	LOW - 0	Abiotic factors likely to affect the establishment of *T. Sibiricus* are likely to be similar across those European countries where feral populations have established.
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	many - 3	MEDIUM -1	The species usually lives in woodland habitats with a bushy understorey feeding on nuts, seeds, tree buds, mushrooms, berries and cereals. Species is also regularly found in parks and towns. Therefore no single species is "vital" for its survival, development and multiplication. However, suitable habitat is present and widely distributed in the Risk Assessment Area.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	Suitable habitat is likely to include woodland, parkland, cemeteries, gardens etc. and is widespread throughout the UK.
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	N/A		
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	MEDIUM -1	Potential competitors exist within the Sciuridae, namely the red squirrel (*Sciurus vulgaris*) and the already invasive grey squirrel (*Sciurus carolinensis*). However, the red squirrel is already absent from most of the Risk Assessment area. Other small woodland mammals may also compete for similar food sources such as bank vole (*Clethrionomys glareolus*) and dormouse (*Muscardinus avellanarius*), but there is no published evidence to support this. Most of the species likely to come into competition with *T sibiricus* are also present in parts of north western Europe where the species has become established. There is also some evidence to suggest that it (or congeneric species) can co-exist with other Sciuridae (Bertolino *et al.*, 2000; Guerra & Vickery, 1998).
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	likely - 3	MEDIUM -1	A range of potential predators exist in the UK, these include raptors, red fox (*Vulpes vulpes*), feral and domestic cats, and potentially owls. This suite of predators has not prevented the establishment of the already invasive grey squirrel (*S. carolinensis*) in the UK. However, on a localised scale, particularly in the likely high-risk habitats, it is possible that feral/domestic cats may have a significant impact, as appears to have been the case in one of the incidents reported to the WMLS, where 9 out of 19 escapees are believed to have been killed by cats.
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	N/A		Man's management of the environment/habitat in the Risk Assessment area is similar to that in other parts of Europe where *T. Sibiricus* has already become established.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	likely - 3	MEDIUM -1	Similar husbandry practices across Europe where escapee populations have become established. Escapes from captivity in UK are known to have occurred in the past and control measures have prevented populations establishing (WMLS data) - however this cannot be guaranteed in the future.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	widespread - 4	LOW - 0	*T. sibiricus* is kept as a pet throughout the UK (no estimates of captive population available).
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	likely - 3	MEDIUM -1	Reproductive strategy and life cycle similar to that of existing squirrels.
1.26	How likely is it that the organism's capacity to spread will aid establishment?	moderately likely - 2	HIGH -2	In areas of Europe where escaped individuals have previously become established most populations do not appear to have increased and spread significantly (Wittenberg 2005). However, Chapuis (2005) reports a rate of spread of 200-250m/year and evidence from congenerics suggests they may use hedges and other linear features as dispersal corridors (Silva *et al.*, 2005).
1.27	How adaptable is the organism?	moderately adaptable - 2	MEDIUM -1	The original range of this organism spans Northern Europe and Asia (including Japan) It has also established stable populations in several parts of western Europe.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	very likely - 4	LOW - 0	Several of the feral populations in Europe are reported to have originated from small numbers of animals (e.g. 17 animals at Calmeynbos, Belgium: Verbeyen, 2001).
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	many - 3	LOW - 0	Escaped and illegally released individuals of *T. sibiricus* have formed established permanent populations across Europe. Middle and western European populations originate entirely from escapees.
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	moderately likely - 2	MEDIUM -1	After the largest reported escape of chipmunks in the UK all individuals were successfully captured or exterminated (WMLS data), however escapee populations in Europe have still managed to become established.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	moderately likely - 2	MEDIUM -1	It is possible that escapees could exist in a wild state for a period of time before effective detection/action is taken to remove them. In most cases, it is considered likely that these would be very short-term and unlikely to breed in the wild.

	Spread	RESPONSE	UNCERTAINTY	COMMENT
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	slow - 1	MEDIUM -1	In most cases in Europe where escaped individuals have previously become established populations have not increased and spread significantly (Wittenberg 2005) (but see additional comments above at Q. 1.26).
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	slow - 1	HIGH -2	*T. sibiricus* has already been widely transported as a domestic pet. Once escaped and established in an area, human assisted spread is unlikely, but this is difficult to predict. If a population of an attractive mammal is seen to have established in one area, individuals may be tempted to release or transport other animals elsewhere.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	with some difficulty - 2	MEDIUM -1	Likelihood is that it could be 'contained', partly because of apparent relatively slow rate of spread, and partly because of easy recognition of the species in new areas and ease with which it could be trapped. However, practical difficulties likely to arise because of diverse landownership patterns likely to be encountered in typical release/escape areas and because of potential public opposition to control.
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.	Suitable habitat throughout RA area	LOW - 0	Areas of woodland, parks, gardens, orchards etc. where chipmunks may escape from captivity across whole of risk assessment area.

	Impacts	RESPONSE	UNCERTAINTY	COMMENT
2.5	How important is economic loss caused by the organism within its existing geographic range?	major - 3	HIGH -2	In Russia *T. sibiricus* is reported to destroy half the average forest nut production, cause great damage to grain crops and can also damage gardens and orchards (Long, 2003).
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minor - 1	HIGH -2	There appear to be no published quantitative estimates of the economic impact of *T. sibiricus.* The congeneric *T. striatus* is said to benefit from the presence of agricultural areas within 100-1000m of forest patches and can reach high levels of abundance in forest patches embedded in an agricultural matrix (Silva *et al.*, 2005). To some extent, this parallels the situation in much of the rural parts of the RA area, where woodland, forest or orchards form relatively isolated patches within an agricultural landscape, and it may be reasonable to infer that *T. sibiricus* would show a similar response. Population density is likely to be highest in July-September, following breeding (*cf* data for *T/Eutamias townsendii* in Sullivan *et al.*, 1983). Working with another congeneric *T/E townsendii,* Sullivan *et al.* (1983) recorded post-breeding densities up to ~240/km2, where supplementary feed was provided, suggesting this could be considered a high density population. Meredith (2002) gives food consumption of 25-30g/day for captive Siberian chipmunks. Using these data a crude estimate of the potential consumption of a chipmunk population may be made as follows: if it is assumed that 30g/day is typical for wild-living animals and that 50% of the diet is obtained from agricultural crops, potential consumption of crops = 240x30x0.5 = 3,600g/day for every square km of occupied habitat. If it is assumed that ripening cereals are consumed at this rate over a 30 day ripening period this is equivalent to 108kg over that period. The UK has about 28,000km^2 of woodland (Defra data), although much of this is unlikely to be suitable habitat for chipmunks. If it is assumed that 50% is occupied at the density indicated above, and that about 26% of this is accessible to crop land (25.6% of UK agricultural land was in crops or fallow in 2005; Defra data), then the total population impacting crop land would be 873,600. Rounding this to 1 million, and using the same assumptions as above, this indicates a potential loss of cereals of 450 tonnes over a 30 day ripening period. Whilst it is acknowledged that this is a very crude estimate, the figures suggest that the loss is likely to be an insignificant proportion of the total production of over 20 million tonnes of cereals per annum ('minor' on the guidance scale provided in the 'User Manual').
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minor - 1	HIGH -2	The admittedly crude estimate given above suggests that overall loss is likely to be minor. However, it is possible that individual producers could suffer economic loss if vulnerable crops are subject to pressure from a high density population.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	MEDIUM -1	There does not appear to be any basis for expecting a reduction in consumer demand. In some circumstances, if control measures are undertaken, it is possible that the cost of control might be reflected in an increase in commodity costs.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	unlikely - 1	MEDIUM -1	There are no legal or other restrictions known that would have an impact on exports as a result of the presence of *T. sibiricus.* The species is already present in a number of other EU member states.
2.10	How important would other economic costs resulting from introduction be? (specify)	minor - 1	MEDIUM -1	It is likely that control would be carried out on an ad-hoc basis by farmers/landowners and others acting on their behalf. Costs are likely to be met, at least to a significant degree, informally, by time input rather than cash cost.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	moderate - 2	HIGH -2	No data could be found to accurately estimate the environmental harm of *T. sibiricus* within its native range, however *T. sibiricus* is reported to destroy half the average forest nut production in parts of Russia (Long, 2003) and may be a threat to some bird species (Forstmeir & Weiss, 2002 & 2004). In the naturalised populations in Italy Bertolino *et al.* (2000) reported no interaction of *T. sibiricus* with other species and an apparent lack of interspecific competition with *Sciurus vulgaris.* An assessment of the environmental impacts of other species within the genus rarely attributes significant environmental harm to members of the genus except when present at high densities (Myers *et al.* 2006). However, predation impact on nesting birds is reported for some other congeneric species (Cain *et al.*, 2003 & 2006; Yahner, 2003).
2.12	How important is environmental harm likely to be in the Risk Assessment area?	moderate - 2	HIGH -2	*T. sibiricus* has been reported to cause some environmental damage in parts of its native range. Comparison with other chipmunk species usually attributes large scale damage to high densities but suggests there may be an impact on some nesting birds. The spread of most naturalised communities of *T. sibiricus* has been small since their establishment. In the light of this limited spread *T. sibiricus* is unlikely to reach high densities or become widespread (at least in the years immediately following establishment). However, if the species were to establish and become widespread across the RA area they may have the potential to cause significant environmental harm.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minor - 1	MEDIUM -1	No direct information is available for the amount of social harm done by *T sibiricus.* Social harm may arise as a result of damage to gardens in semi- urban environments which is referred to by some reports (Long, 2003).
2.14	How important is the social harm likely to be in the Risk Assessment area?	minor - 1	MEDIUM -1	Unless escaped populations of *T. sibiricus* reach high densities the chances of the social impacts being major are likely to be small. However the types of environment where social harm is most likely to occur is in urban/semi-urban environments, and it is in these areas that the chances of an escaped population becoming established is greatest.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	No mechanism is identified whereby this could occur.
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	moderately likely - 2	MEDIUM -1	A range of potential predators exist in the UK, these include raptors, red fox (*Vulpes vulpes*), feral and domestic cats, and potentially owls. However the impact of these predators on *T. sibiricus* is hard to predict. In the immediate period following escape in urban/semi-urban areas domestic cats may have a significant impact (WMLS data).

2.17	How easily can the organism be controlled?	easily - 1	MEDIUM -1	Transferable methods of control (trapping and shooting etc.) are already established for other invasive species such as *Sciurus carolinensis.* Poisoning is not an option within the UK unless an appropriate product/method is approved under the Control of Pesticides Regulations 1986. A significant difficulty in control may occur where a population is in an urban/semi-urban area, with complex patterns of land ownership and potential for public opposition.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	unlikely - 1	LOW - 0	Methods would be little different from some existing methods for killing *Sciurus carolinensis* .
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	likely - 3	MEDIUM -1	*T. sibiricus* is known to be asymptomatic hosts for various infectious diseases and parasites, including *Borrelia burgdorferi* (Lyme disease), rabies, *Cryptosporidium parvum* , ticks (*Ixodes spp* .) and fleas. Wild chipmunk fleas have been associated with *Yersinia pestis* (plague) (Meredith 2002).
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		MEDIUM -1	The parts of the risk assessment area that are most likely to be affected are those in close proximity to human habitation, where escapes from captivity are most likely to occur. Establishment is most likely to occur where such areas provide access to suitable habitat, such as parkland and amenity woodland. Environmental and social impacts are most likely to occur in gardens, parklands and immediate surrounding countryside of these areas, although areas of cereal production may also be threatened.

Summarise Entry	likely - 3	MEDIUM -1	*T. sibiricus* is already present across the risk assessment area in captivity. The principal pathway for entry is escape from captivity either accidentally or by deliberate release. This pathway is both realistic and likely as exemplified by recent escapes of chipmunk in the UK and across Europe.
Summarise Establishment	moderately likely - 2	MEDIUM -1	Escaped individuals of *T. sibiricus* have failed to become established in the UK to date, however the entire European population descends from naturalised escapees. *T. sibiricus* clearly has the ability to establish in an analogous environment to that in the risk assessment area.
Summarise Spread	slow - 1	MEDIUM -1	There are several established populations founded by escaped individuals across Europe, however once established released populations have not increased and spread significantly (Wittenberg 2005). A rate of spread of 200-250m per year has been reported in France (Chapuis, 2005). The rate of spread in the risk assessment area is likely to be similarly.
Summarise Impacts	moderate - 2	MEDIUM -1	The Environmental and Economic impacts of *T. sibiricus* are not widely published, however various authors refer to impacts on forest nut production, predation on breeding birds and damage to grain crops, gardens and orchards. *T. sibiricus* appears to co-exist with *Sciurus vulgaris* without evidence of interspecific competition, but its impact on other small mammals through competition has not been established.
Conclusion of the risk assessment	MEDIUM -1	MEDIUM -1	*T. sibiricus* is already present in the risk assessment area in captivity. The primary pathway for entry into the environment is escape or human release. The chances of individuals escaping, or being released, in the future seems high, based on the history of escapes across Europe. Following escape/release the likelihood of establishment will depend on early detection and control/containment action. One recent substantial escape appears to have been successfully controlled as a result of early reporting and prompt action. If established, subsequent spread is likely to be slow. The highest risk is in urban/semi-urban environments, where density of captive animals is likely to be highest and suitable habitat is available, and where difficulty or opposition to control may occur.
Conclusions on Uncertainty		MEDIUM -1	There is relatively little relevant information published on this species. The Risk Assessment has had to be based on a small number of reports and drawing parallels with studies on other *Tamias* species. Because of this, and the effectively 'random' nature of the risk of escape/release from captivity, the overall level of uncertainty for the Risk Assessment is placed at medium.

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