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:	***Mephitis mephitis* (striped skunk)**
	Objectives:	Assess the risks associated with this species in GB
	Version:	Original Draft 28/06/11
	Author:	C. Wilson (Natural England)
	Suggested citation:	Wilson, C. (2011). GB Non-native Orgaism Risk Assessment for *Mephitis mephitis*. www.nonnativespecies.org

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the Risk Assessment?		Request made by GB Programme Board
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 and no risk assessment is known of for elsewhere in Europe.
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		N/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)	*Mephitis mephitis* (striped skunk). Of about thirteen species of skunk, two *Mephitis* spp, seven *Conepatus* spp and four *Spilogale* spp, that occur in N or S America (Voigt, 1985), *M mephitis* is the only one believed to be sold as a pet in the UK.
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 southern Canada, USA and Mexico (Long, 2003; Voigt, 1985). It has been introduced to and successfully established on Prince Edward Island and may have colonised Nova Scotia (Long, 2003). They have been found on Vancouver Island, probably resulting from deliberate releases, and have also been expaning their range in mainland Canada (Long, 2003). Attempts to introduce them in the Russian Federation, adjacent independent republics and the Ukraine during the 1930s, with individual releases of up to 29 animals, were not very successful (Lever, 1985; Long, 2003) but introductions in the northern Caucasus since 1930 may have established (Long, 2003). Skunks of uncertain species (probably *Conepatus)* were released on islets off West Falkland, but are thought no longer present (Strange, 1972, cited in Lever, 1985). The species is omnivorous, feeding on small mammals, amphibians, birds' eggs, insects, grubs, berries and carrion (Azevedo et al, 2006; Burt & Grossenheider, 1976). In its native range it can be a significant predator of ground nesting birds' nests (e.g. Rollins & Carroll, 2001; Vickery et al, 1992) and may exhibit mass predation on occasions (e.g. predation on amphibians in USA; Groves, 1980).
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 has one litter per year (Ewer, 1973; Lariviere & Messier, 1997), first breeds at 1yr and litter may be up to 10 young, though usually in range 4-7 (Burt & grossenheider, 1976; Ewer, 1973; Greenwood & Sargeant, 1994; Walker & Paradiso, 1975). Dispersal distances of 10km to 119km recorded for skunks in North Dakota (Sargeant et al, 1982).
9	Does the organism occur outside effective containment in the Risk Assessment area?	NO (Go to 11)	*M mephitis* is occasionally sold and kept as an exotic pet in Britain. It has been estimated that 100-200 may be kept as pets in Britain (Parrot et al, 2009) but this is based on very limited information (Parrot et al, 2008). In England, during 2001-2003, the RSPCA responded to 25 incidents involving escaped or abandoned animals (Parrot et al, 2008, 2009). From January 2004 to November 2009, they responded to 19 incidents involving free ranging skunks, in 14 of which the ID was confirmed (RSPCA unpublished data). These included, in July 2009 a striped skunk, said to have been a young female (<1yr old), found in the Forest of Dean, Gloucestershire. The animal was taken into captivity at a 'wildlife sanctuary' (BBC, 2009a). One month later another skunk was reported (and photographed) visiting a garden in Coleford, Forest of Dean. It was reported that two were regularly seen in the area and also that one had been killed on a road in the Forest (BBC, 2009b). The origin and current status of any remaining animals is not known. Parrot et al (2009) report the species' status in England as 'absent from wild', 'present in enclosed environments - zoos, collections and domestic pets'. It is not recorded in the wild in Britain by Lever (1977, 1985 & 2009), Baker (1990), Long (2003) or Baker & Hills (2008).
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)	The species is omnivorous and, in its natural range, occurs in a wide range of habitats. It has been suggested that it is such a generalist with respect to habitat that it is easier to characterize unsuitable areas rather than preferred habitat (Verts, 1967 cited in Bixler & Gittleman, 2000). There, therefore, appears to be no reason why it should not be capable of establishing and surviving 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)	In its natural range the species occurs in a range of climatic zones, from warm temperate to cool temperate, and in a range of habitats, fully encompassing the Nearctic equivalents of conditions found in the RA area.
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)	Attempts to introduce them in the Russian Federation, adjacent independent republics and the Ukraine during the 1930s, with individual releases of up to 29 animals, were not very successful (Lever, 1985; Long, 2003) but introductions in the northern Caucasus since 1930 may have established (Long, 2003). They have been reported outside captivity in France (Moutou, 2003) but no established feral populations are recorded in Western Europe (Mitchell-Jones et al, 1999).
17	Can the organism spread rapidly by natural means or by human assistance?	YES (Go to 18)	Animals are believed to be only kept in small numbers, but keeping as pets, and therefore occurrence of escapes or abandonment, could occur anywhere within RA area. Once in the wild, the species has moderate dispersal ability, with dispersal distances in excess of 100km recorded (Sargeant et al, 1982), though more typical dispersal distances <~20km (Bjorge et al, 1981; Rosatte & Gunson, 1984).
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)	Uncertain risk; as an additional mesopredator the species could have an impact on some vulnerable groups, such as ground nesting birds, and could cause nuisance/economic damage by predating small stock, such as poultry. It has the potential to cause nuisance damage because of its use of urban habitats and man-made structures as denning sites, which has been reported in the USA and Canada (Lariviere et al, 1999; Weissinger et al, 2009). Could potentially compete with native omnivores - e.g. badgers (*Meles meles*) (cf. Azevedo et al, 2006). The striped skunk is also the principal vector of rabies in North America (Charlton et al, 1988; Sargeant, 1982) and may act as a reservoir or vector for a number of other diseases, such as leptospirosis (Ferguson & Heidt, 1981; Scholwater et al, 1981), tularemia (Berrada et al, 2006), trichinella (Murrell et al, 1987; Schad et al, 1984) Lyme disease (Fish & Daniels, 1990) and Cryptosporidium (Perz & Le Blancq, 2001) or of transmitting ectoparasites to other species (Durden & Richardson, 2003). They are also susceptible to a number of other diseases (e.g. toxoplasmosis, Ferguson & Heidt, 1981; Streptococcus, Hwang et al, 2002; Aleutian disease, Pennick et al, 2007; Hodgkin's disease, Smith & Barker, 1983). Risk of transfer of disease, parasites or zoonoses to domestic pets or humans might be heightened by the species' use of urban habitats (Weissinger et al, 2009).
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?	very few - 0	LOW - 0	*M mephitis* is present in the risk assessment area, in low numbers, kept in captivity as pets. It is also widely kept in zoos and wildlife parks, where its keeping is subject to the provisions of the Zoo Licensing Act 1981. 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.			The primary pathway of entry is through the pet trade and subsequent escape or deliberate release/abandonment of pet animals. This is also a pathway where the risk of escape is considered to be increasing in the UK (Parrott et al, 2009). Animals kept in zoos or wildlife parks are subject to the Zoo Licensing Act which requires that standards of accomodation, staffing and management are adequate for the proper care and wellbeing of the animals and the proper conduct of a zoo. The risk of escape from these regulated premises is therefore considered to be significantly less than that associated with the pet trade, due to the lack of regulation and control over keeping conditions in the latter. Information from the internet suggests that striped skunks for the pet trade are commonly bred in the UK. It is not known if any are directly imported for the pet trade. Some of the questions assessing the pathways for entry into the RA area are not directly applicable to this case. The primary pathway for their entry involves their escape (or deliberate release/ abandonment) from captivity in the situations referred to above. 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?	moderately likely - 2	LOW - 0	For *M mephitis* 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 scored as 'moderately likely' because of the low numbers of animals involved in the trade.
1.4	Is the concentration of the organism on the pathway at origin likely to be high?	unlikely - 1	LOW - 0	Relatively small numbers are kept in captivity (probably fewer than 200 in kept as pets in England: Parrott et al, 2008 & 2009) and it is considered unlikely that a species of this type would be kept in large numbers by any single owner.
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	LOW - 0	In its natural range the species occurs in a range of climatic zones, from warm temperate to cool temperate, and in a range of habitats, fully encompassing the Nearctic equivalents of conditions found in the RA area. Because of its generalist omnivore feeding behaviour and habitat selection it is thought unlikely that there would be land management practices that would prevent its survival. Vulnerability to road accident mortality (Gehrt, 2005) may limit survival in highly fragmented landscapes, with heavy traffic volumes, as occur in some parts of the RA area.
1.6	How likely is the organism to survive or remain undetected by existing measures?	unlikely - 1	MEDIUM -1	The species is primarily nocturnal (Lariviere & Messier, 1997), but is likely to be recognisable to many non-specialists (e.g. from prortrayal in films and on television). Initial releases or escapes are most likely to occur in urban/suburban or parkland areas and any escaped individuals seen 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?	unlikely - 1	MEDIUM -1	The species is likely to be kept only in small numbers, if not singly, and is, in any case, not especially prolific.
1.9	What is the volume of movement along the pathway?	minor - 1	MEDIUM -1	Movement along pathway, in the sense of escapes/releases from captivity into the wild, probably occurs infrequently and in low numbers, but little firm data available. Over the 3 year period 2001-2003 the RSPCA responded to 25 incidents involving escaped or abandoned individuals (Parrott et al, 2008 & 2009) and from Jan 2004 to November 2009 they responded to 19 incidents (RSPCA unpublished data). This suggests about 3-8 incidents per year. However, the level of uncertainty over the exact figure is high as it is unknown how often animals may escape and go unreported. In addition, skunks may be particularly prone to being abandoned because of their pungent defensive scent glands, as de-scenting, which is commonly practiced on pet skunks in the USA, is banned in Britain (Parrott et al, 2008).
1.10	How frequent is movement along the pathway?	occasionally - 2	MEDIUM -1	Given the relatively small numbers believed to be kept in captivity, escapes/releases would be expected to be only occasional. RSPCA figures suggest about 3-8 incidents per year (Parrott et al, 2008 & 2009; RSPCA unpublished data) which may represent up to 8% of captive popultation (i.e. if true captive population is 100 and 8 escapes occur). If the number of animals kept in captivity were to increase significantly, escapes would also be expected to increase.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	LOW - 0	Locations of captive animals not known, but could be very widely distributed.
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 *M mephitis* ' escape from captivity, except that levels of activity may be lower during cold periods of winter or escape of already pregnant females (e.g. in spring) may accelerate establishment.
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 is likely, in many cases, to place it in proximity to suburban gardens, parkland, cemeteries etc, which could provide suitable habitat. In addition, skunks may be particularly prone to being abandoned by pet owners because of their pungent defensive scent glands, as de-scenting, which is commonly practiced on pet skunks in the USA, is banned in Britain (Parrott et al, 2008).

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 *M mephitis* are unlikely to have to travel far from their point of escape to find suitable habitat. In addition, with potential dispersal distances in excess of 100km recorded (Sargeant et al, 1982), and even with more typical dispersal distances <~20km (Bjorge et al, 1981; Rosatte & Gunson, 1984), there are few parts of the RA area where they could not access suitable habitat quite readily.

	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	In its natural range the species occurs in a range of climatic zones, from warm temperate to cool temperate, and in a range of habitats, fully encompassing the Nearctic equivalents of conditions found in the RA area.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	similar - 3	LOW - 0	Abiotic factors likely to affect the establishment of *M mephitis* are likely to be similar in the RA area and temperate parts of its natural range.
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	LOW - 0	The species is omnivorous and adaptable, with a varied diet. In its natural range, it occurs in a wide range of habitats and it has been suggested that it is such a generalist with respect to habitat that it is easier to characterize unsuitable areas rather than preferred habitat (Verts, 1967 cited in Bixler & Gittleman, 2000). It, therefore, appears likely that many habitats in the RA area will be suitable for its establishment.
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 farmland, woodland, parkland, cemeteries, gardens etc and is widespread throughout the UK. Upland moorland and montane habitats may not be suitable.
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?	likely - 3	LOW - 0	The species may face competition from native and established introduced mesopredators, such as the fox *Vulpes vulpes* , badger, otter *Lutra lutra,* polecat *Mustela putorius* and American mink *Mustela/Neovison vison* . However, in its native distribution it co-exists with a greater range of sympatric carnivores and, despite significant dietary overlap (Azevedo et al, 2006), continues to thrive. It seems unlikely that competition would prevent its establishment in the RA area.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	likely - 3	LOW - 0	Potential predators of young skunks exist in the UK, these include raptors, red fox, feral and domestic cats, and badgers. Possible predation by American badgers *Taxidea taxus* is reported in their native range (e.g. Sargeant et al, 1982), but the American badger is largely carnivorous and considered a more active hunter than the Eurasian badger (Neal & Cheeseman, 1996). It seems unlikely that predation or other 'natural enemies' would prevent establishment.
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 some parts of the species' natural range.
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	moderately likely - 2	MEDIUM -1	There are no regulatory controls on the conditions or security in which captive individuals must be kept. There are also no established control measures for animals in the wild, but if early reporting of escapes/releases occurs, it is likely that currently available control techniques could be effective in preventing establishment.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	occasional - 2	MEDIUM -1	*M mephitis* is kept as a pet at various (unknown) locations throughout the UK but only in small numbers. Estimated captive population 100-200 (Parrot et al, 2008 & 2009).
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	moderately likely - 2	MEDIUM -1	Reproductive strategy and life cycle similar to other small carnivores. The species has one litter per year (Ewer, 1973; Lariviere & Messier, 1997), first breeds at 1yr and litter may be up to 10 young, though usually in range 4-7 (Burt & Grossenheider, 1976; Ewer, 1973; Greenwood & Sargeant, 1994; Walker & Paradiso, 1975). The species is recorded as living up to 10 years in captivity (Walker & Paradiso, 1975).
1.26	How likely is it that the organism's capacity to spread will aid establishment?	moderately likely - 2	MEDIUM -1	Dispersal distances of 10km to 119km recorded for skunks in North Dakota (Sargeant et al, 1982) though more typical dispersal distances <~20km (Bjorge et al, 1981; Rosatte & Gunson, 1984). Escape/release at most locations within the RA area would therefore place animals within potential dispersal distance of suitable habitat.
1.27	How adaptable is the organism?	adaptable - 3	MEDIUM -1	The species is omnivorous and, in its natural range, occurs in a wide range of habitats. It has been suggested that it is such a generalist with respect to habitat that it is easier to characterize unsuitable areas rather than preferred habitat (Verts, 1967 cited in Bixler & Gittleman, 2000). The species can occupy rural and urban habitats (Weissinger et al, 2009) and use man-made structures as denning sites (Lariviere et al, 1999).
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	likely - 3	HIGH -2	Experience with other species establishment suggests this is unlikely but no data known of for this species.
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	very few - 0	LOW - 0	Attempts to introduce the species in the Russian Federation, adjacent independent republics and the Ukraine during the 1930s, with individual releases of up to 29 animals, were not very successful (Lever, 1985; Long, 2003) but introductions in the northern Caucasus since 1930 may have established (Long, 2003). Unfortunately no information is given for the low success rate of these attempts at establishment. It has been introduced to and successfully established on Prince Edward Island and has been found on Vancouver Island, probably resulting from deliberate releases (Long, 2003).They have been reported outside captivity in France (Moutou, 2003) and the Netherlands (www.stichtinghetstinkdier.nl/indexenglish.htm) but no established feral populations are recorded in Western Europe (Mitchell-Jones et al, 1999).

1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	unlikely - 1	MEDIUM -1	The species is sufficiently novel and identifiable that early reporting is a reasonable expectation, though it may remain dormant for long periods during the winter months. Although it is nocturnal the escapes that have occurred to date appear to have been readily detected. It occurs at relatively low density; population densities of 2-6/km2 have been reported in its native range (Gehrt, 2005). It is likely that effective control could be undertaken using conventional methods.
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)?	unlikely - 1	MEDIUM -1	It is possible that escapees could exist in small numbers in a wild state for a period of time before detection/effective action is taken to remove them. Given the relatively small numbers in captivity it is likely that such escapes/releases would be of individuals/small numbers, widely dispersed in space and/or time, and unlikely to result in establishment of breeding populations.

	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	The species has moderate dispersal ability, with dispersal distances in excess of 100km recorded (Sargeant et al, 1982), though more typical dispersal distances <~20km (Bjorge et al, 1981; Rosatte & Gunson, 1984). However, low numbers are likely to mean slow rate of establishment, and therefore slow rate of spread of any such 'population'.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	slow - 1	HIGH -2	The species is kept as a domestic pet at, possibly, widespread locations throughout the RA area. Simoultaneous or successive escapes/releases could therefore facilitate spread. However, numbers believed to be low (see above). Once escaped and if they became established in an area, human assisted spread is unlikely, but this is difficult to predict.
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 the species could be 'contained', partly because of low numbers likely to be involved and naturally low population density, 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 farmland, woodland, parks, gardens etc. provide potentially suitable habitat 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?	minor - 1	MEDIUM -1	Direct economic loss appears to be minor and mainly confined to nuisance damage. Main impact is as the principal vector of rabies in North America (Charlton et al, 1988; Sargeant, 1982).
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	MEDIUM -1	Could cause nuisance/economic damage by predating small stock, such as poultry, damaging gardens, golf courses etc (Knight, 1994) or trivial loss to maize/corn crops or fruit orchards (Borchert et al, 2008; Knight, 1994). May also cause damage to beehives, which can be significant in individual cases (Knight, 1994; Obrien & Marsh, 1990). The striped skunk is also the principal vector of rabies in North America (Charlton et al, 1988; Sargeant, 1982) and may act as a reservoir or vector for a number of other diseases, such as leptospirosis (Ferguson & Heidt, 1981; Scholwater et al, 1981), tularemia (Berrada et al, 2006), trichinella (Murrell et al, 1987; Schad et al, 1984) Lyme disease (Fish & Daniels, 1990) and Cryptosporidium (Perz & Le Blancq, 2001) or of transmitting ectoparasites to other species (Durden & Richardson, 2003). They are also susceptible to a number of other diseases (e.g. toxoplasmosis, Ferguson & Heidt, 1981; Streptococcus, Hwang et al, 2002; Aleutian disease, Pennick et al, 2007; Hodgkin's disease, Smith & Barker, 1983). Risk of transfer of disease, parasites or zoonoses to domestic pets or humans might be heightened by the species' use of urban habitats (Weissinger et al, 2009)
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	MEDIUM -1	Unlikely to have any more than minor and localised impact on production costs etc.
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 for any products as a result of the presence of the organism.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	MEDIUM -1	There are no legal or other restrictions known that would have an impact on exports as a result of the presence of *M mephitis.* Only scenario where this might arise likely to be involvement of the species in spread of livestock disease. In this respect it is likely to have a minor effect, relative to other widespread native, or already established, species.
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	MEDIUM -1	It is recognised as an important predator of ground nesting grassland birds, gamebirds and waterfowl in parts of its native range in the USA and Canada (Vickery et al, 1992; Rollins & Carroll, 2001; Lariviere et al, 2006).
2.12	How important is environmental harm likely to be in the Risk Assessment area?	minor - 1	MEDIUM -1	As an additional mesopredator the species could have an impact on some vulnerable groups, such as ground nesting birds. Given low numbers of escapes/releases, and low probability of widespread establishment, any such impact is likely to be highly localised and probably minor by comparison with native predators and already established non-natives, such as mink (*Mustela/Neovison vison*). May potentially compete with native omnivores - e.g. badgers (*Meles meles*) or polecats (*Mustela putorius*) though it coexists with a greater variety of mesopredators in its native range, than is present in the RA area (cf. Azevedo et al, 2006) and it seem unlikely that this would have a significant effect.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minor - 1	MEDIUM -1	Little evidence of social harm in native range reported in literature. However, some social harm probably caused by minor damage/nuisance behaviour. It was the third most frequently recorded species in a survey of urban nuisance wildlife complaints in New York (after racoon Procyon lotor and squirrels; Curtis et al, 1995).
2.14	How important is the social harm likely to be in the Risk Assessment area?	minor - 1	MEDIUM -1	Could cause nuisance/minor economic damage by predating small stock, such as poultry, which could cause social harm. It has the potential to cause nuisance damage because of its use of urban habitats and man-made structures as denning sites (Knight, 1994; Lariviere et al, 1999; Weissinger et al, 2009).
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?	likely - 3	MEDIUM -1	A range of potential predators of young skunks exist in the UK, these include some raptors, red fox (*Vulpes vulpes*) and badgers, but adults likely to be more or less immune to predation. American badger (*Taxidea taxus*) reported to predate the species in native range (e.g. Sargeant et al, 1982) but *T taxus* reported to be more predatory than Eurasian badger (Neal & Cheeseman, 1996).
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 species such as red fox, mink (*Mustela/Neovison vison*). Unlikely to establish at high densities (Gehrt, 2005). Poisoning is not an option within the UK under current legislation. Most significant difficulty in control likely to 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?	very unlikely - 0	LOW - 0	No reason apparent why this should be the case.

2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	moderately likely - 2	MEDIUM -1	The striped skunk is the principal vector of rabies in North America (Charlton et al, 1988; Sargeant, 1982) and may act as a reservoir or vector for a number of other diseases, such as leptospirosis (Ferguson & Heidt, 1981; Scholwater et al, 1981), tularemia (Berrada et al, 2006), trichinella (Murrell et al, 1987; Schad et al, 1984) Lyme disease (Fish & Daniels, 1990) and Cryptosporidium (Perz & Le Blancq, 2001) or of transmitting ectoparasites to other species (Durden & Richardson, 2003). They are also susceptible to a number of other diseases (e.g. toxoplasmosis, Ferguson & Heidt, 1981; Streptococcus, Hwang et al, 2002; Aleutian disease, Pennick et al, 2007; Hodgkin's disease, Smith & Barker, 1983). Risk of transfer of disease, parasites or zoonoses to domestic pets or humans might be heightened by the species' use of urban habitats (Weissinger et al, 2009).
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 most likely to be affected include those in close proximity to human habitation, where escapes from captivity are most likely to occur. These may result in establishment 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. Deliberate abandonment of animals may also result in potential establishment in more remote areas perceived as providing suitable habitat; e.g. woodland or forestry plantations.

Summarise Entry	moderately likely - 2	LOW - 0	*M mephitis* is present in captivity, in unknown locations, potentially widespread across the risk assessment area, but understood to be in low numbers and probably kept singly or in very small numbers by individual owners. The principal pathway for entry is escape from captivity either accidentally or by deliberate release/abandonment. Abandonment may have become an increased possibility in recent years because of prohibition of de-scenting by the Animal Welfare Act 2006, but RSPCA figures for before and after 2006, do not show any pattern consistent with this surmise.
Summarise Establishment	unlikely - 1	MEDIUM -1	Deliberate attempts to introduce the species in the Russian Federation, adjacent independent republics and the Ukraine during the 1930s, with individual releases of up to 29 animals, were not very successful (Lever, 1985; Long, 2003) but introductions in the northern Caucasus since 1930 may have established (Long, 2003). No established feral populations are recorded in Western Europe and, as a relatively easily recognisable (from portrayal in film & television) and novel species, it is considered likely that early reporting would occur - especially of first generation escapes/releases which are most likely to be relatively tame and approachable.
Summarise Spread	slow - 1	MEDIUM -1	The species has moderate dispersal ability, with dispersal distances in excess of 100km recorded (Sargeant et al, 1982), though more typical dispersal distances <~20km (Bjorge et al, 1981; Rosatte & Gunson, 1984). However, low numbers are likely to mean slow rate of establishment, and therefore slow rate of spread of any such 'population'. 'Dispersal' more likely to occur as a result of multiple escapes/releases.
Summarise Impacts	minor - 1	MEDIUM -1	Potential limited local impact on ground nesting birds. May cause nuisance damage because of its use of urban habitats and man-made structures as denning sites (Lariviere et al, 1999; Weissinger et al, 2009). Potential to act as a reservoir/vector of important diseases, but unless it became widely established, unlikely to be as significant as other already present/native species. Risk of transfer of disease, parasites or zoonoses to domestic pets or humans might be heightened by the species' use of urban habitats (Weissinger et al, 2009).
Conclusion of the risk assessment	LOW - 0	MEDIUM -1	*M mephitis* is present in the risk assesment area in captivity in relatively small numbers (though information sparse). The primary pathway for entry into the environment is escape or deliberate release from captivity. The chances of small numbers of individuals escaping, or being released, therefore remains. Following escape/release the likelihood of establishment will depend on early detection and control/containmment action. Animals believed to be kept normally singly or in very small numbers, so low propagule pressure for establishment. Species is relatively recognisable to non-specialists, and novel in appearance, so early detection/reporting considered likely. Chance of establishment therefore considered low. If established, considered feasible to eradicate by early action and subject to standard control methods. Main risk is potential public opposition. If established, with exception of disease risk (which would almost certainly involve other species as well), impacts likely to be minor and localised.
Conclusions on Uncertainty		MEDIUM -1	Almost all published information relates to the species in its native range, as few established feral populations exist, so little information available on actual experience of introduction/establishment. Inferences have therefore had to be drawn from data from native range for potential impacts etc in RA area. Because of this, lack of certainty about actual numbers and distribution (in captivity) in the RA area, and the effectively 'random' nature of the risk of escape/release from captivity, the overall level of uncertainty for the Risk Assesment is placed at medium.

References

Baker, S J (1990) Escaped exotic mammals in Britain. Mammal Review, 20(2/3); 75-96.

Baker, S J & Hills, D (2008) Escapes and Introductions. In: Harris, S & Yalden, D W (eds.) The Mammals of the British Isles; Handbook, 4th Edition. The Mammal Society, Southampton; pp. 780-794.

BBC (2009a) Whiff of mystery as skunk appears. BBC News 27 July 2009; http://news.bbc.co.uk/go/pr/fr/-/1/hi/england/gloucestershire/8171148.stm

BBC (2009b) Locals scent strangers in garden. BBC News 23 August 2009; http://news.bbc.co.uk/go/pr/fr/-/1/hi/england/gloucestershire/8216856.stm

Berrada, Z L, Goethert, H K & Telford, S R (2006) Racoons and skunks as sentinels for enzoonotic Tularemia. Emerging Infectious Diseases, 12(6); 1019-1021.

Bixler, A & Gittleman, J L (2000) Variation in home range and use of habitat in the striped skunk. J Zool Lond, 251; 525-533.

Bjorge, R R, Gunson, J R & Samuel, W M (1981) Population characteristics and movements of striped skunks in central Alberta. Canadian Field Naturalist, 95(2); 149-155.

Borchert, M, Davis, F W & Kreitler, J (2008) Carnivore use of an Avocado orchard in southern California. California Fish and Game, 94(2); 61-74.

Burt, W H & Grossenheider, R P (1976) A Field Guide to the Mammals; North America north of Mexico, 3rd Edition. Peterson Field Guides, Houghton Mifflin, Boston.

Charlton, K M, Webster, W A, Casey, G A & Ruprecht, C E (1988) Skunk rabies. Clinical Infectious Disease, 10; suppl. 4.

Curtis, P D, Richmond, M E, Wellner, P A & Tullar, B (1995) Characteristics of the private nuisance wildlife control industry in New York. Proceedings of the Sixth Eastern Willdlife Damage Control Conference 1993, University of Nebraska, Lincoln; 49-57.

Durden, L A & Richardson, D J (2003) Ectoparasites of the striped skunk in Connecticut, USA. Comp Parasitol, 70(1); 42-45.

Ewer, R F (1973) The Carnivores. Weidenfeld and Nicholson, London.

Ferguson, D V & Heidt, G A (1981) Survey for rabies, leptospirosis, toxoplasmosis and tularemia in striped skunks from three public use areas in northwestern Arkansas. Journal of Wildlife Diseases, 17(4); 515-519.

Fish, D & Daniels, T J (1990) The role of medium-sized mammals as reservoirs of Borrelia burgdorferi in southern New York. Journal of Wildlife Diseases, 26(3); 339-345.

Gehrt, S D (2005) Seasonal survival and cause-specific mortality of urban and rural striped skunks in the absence of rabies. Journal of Mammalogy, 86(6); 1164-1170.

Greenwood, R J & Sargeant, A B (1994) Age-related reproduction in striped skunks in the upper Midwest. Journal of Mammalogy, 75(3); 657-662.

Groves, J D (1980) Mass predation on a population of the American toad. The American Midland Naturalist. 103(1); 103-104.

Hwang, Y T, Wobester, G, Lariviere, S & Messier, F (2002) Streptococcus equisimilis infection in striped skunks in Saskatchewan. Journal of Wildlife Diseases, 35(3); 641-643.

Knight, J E (1994) Skunks. Wildlife Damage Management; The Handbook: Prevention and Control of Wildlife Damage. University of Nebraska, Lincoln; 113-118.

Lariviere, S & Messier, F (1997) Seasonal and daily activity patterns of striped skunks in the Canadian prairies. J Zool Lond, 243; 255-262.

Lariviere, S, Walton, L R & Messier, F (1999) Selection by striped skunks of farmsteads and buildings as denning sites. American Midland Naturalist, 142; 96-101.

Lariviere, S, Walton, L R & messier, F (2006) Summer movements and impact of individual striped skunks on duck nests in Saskatchewan. Canadian Field Naturalist, 120(3); 342-346.

Lever, C (1977) The Naturalized Animals of the British Isles. Hutchinson, London.

Lever, C (1985) Naturalized Mammals of the World. Longman, Harlow, Essex.

Lever, C (2009) The Naturalized Animals of Britain and Ireland. New Holland, London.

Long, J L (2003) Introduced Mammals of the World; their History, Distribution and Influence. CABI Publishing, Oxford.

Mitchell-Jones, A J, Amori, G, Bogdanowicz, W, Krystufek, B, Reijnders, P J H, Spitzenberger, F, Stubbe, M, Thissen, J B M, Vohralik, V & Zima, J (1999) The Atlas of European Mammals. T & A D Poyser, London.

Moutou, F (2003) Observation of a striped skunk in Yonne department, France. Small Carnivore Conservation, 29; pp.14.

Murrell, K D, Stringfellow, F, Dame, J B, Leiby, D A, Duffy, C & Schad, G A (1987) Trichinella spiralis in an agricultural ecosystem. II Evidence for natural transmission of Trichinella spiralis spiralis from domestic swine to wildlife. J Parasit, 73(1); 103-109.

Neal, E & Cheeseman, C (1996) Badgers. Poyser Natural History, Poyser, London.

Obrien, J M & Marsh, R E (1990) Vertebrate pests of beekeeping. Proceedings of the Fourteenth Vertebrate Pest Conference 1990. Univertsity of California, Davis; 228-232.

Parrott, D, Roy, S & Fletcher, M (2008) The Status of Scarce Non-native Birds and Mammals in England. CSL Final Report to Defra.

Parrott, D et al (2009) NECR009 Horizon Scanning for New Non-native Animal Species in England. Natural England Commissioned Report, Natural England, Sheffield.

Pennick, K E, Latimer, K S, Brown, C A, Hayes, J R & Sarver, C F (2007) Aleutian disease in two domestic striped skunks. Veterinary Pathology, 44(5); 687-690.

Perz, J F & Le Blancq, S M (2001) Cryptosporidium parvum infection involving novel genotypes in wildlife from lower New York State. Applied and Environmental Microbiology, 67(3); 1154-1162.

Rollins, D & Carroll, J P (2001) Impacts of predation on northern bobwhite and scaled quail. Wildlife Society Bulletin. 29(1); 39-51.

Rosatte, R C & Gunson, J R (1984) Dispersal and home range of striped skunks in an area of population reduction in southern Alberta. Canadian Field Naturalist, 98(3); 315-319.

Sargeant, A B, Greenwood, R J, Piehl, J L & Bicknell, W B (1982) Recurrence, mortality and dispersal of prairie striped skunks, and implications to rabies epizootiology. Canadian Field Naturalist, 96(3); 312-316.

Schad, G A, Leiby, D A & Murrell, K D (1984) Distribution, prevalence and intensity of Trichinella spiralis infection in furbearing mammals of Pennsylvania. J Parasit, 70(3); 372-377.

Smith, D A & Barker, I K (1983) Four cases of Hodgkin's disease in striped skunks. Veterinary Pathology, 20; 223-229.

Vickery, P D, Hunter, M L & Wells, J V (1992) Evidence of incidental nest predation and its effects on nests of threatened grassland birds. Oikos. 63; 281-288.

Voigt, D R (1985) Skunks. In: Macdonald D (ed.) The Encyclopaedia of Mammals. Vol. 1, Guild, London; pp. 122-123.

Walker, E P & Paradiso, J L (1975) Striped and Hooded Skunks. In: Mammals of the World, Vol II, 3rd Edition. John Hopkins Univeristy Press, Baltomore & London; pp. 1212.

Weissinger, M D, Theimer, T C, Bergman, D L & Deliberto, T J (2009) Nightly and seasonal movements, seasonal home range, and focal location photo-monitoring of urban striped skunks: implications for rabies transmission. Journal of Wildlife Diseases, 45(2); 388-397.