EU NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

Name of organism: *Neovison vison*

Authors (alphabetical order):
George Bouros, Jasja Dekker, Asun Gómez, Lauren A. Harrington, Zsolt Hegyeli, Calin Hodor, Kaarina Kauhala, Andreas Kranz, Erkki Korpimäki, Maurice La Haye, Xavier Lambin, David Macdonald, Sisco Mañas, Tiit Maran, Johan R. Michaux, Laura Moreno, Santiago Palazón, Madis Põdra, Pälvi Salo, Attila D. Sandor, Margarida Santos-Reis, Arnd Schreiber, Dan Traian Ionescu, Jiska van Dijk, Andrzej Zalewski, Iñigo Zuberogoitia

Risk Assessment Area: European Union (28 Countries)

Draft: 8/06/2016

EU CHAPEAU	
QUESTION	**RESPONSE**
1. In how many EU member states has this species been recorded? List them.	24 countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom. There is no American mink in Malta and information is not available from Bulgaria, Croatia and Cyprus (Macdonald & Harrington 2003, Bonesi & Palazón 2007, Dekker & Hofmeester 2014, Hegyeli & Kecskés 2014). In addition it is recorded in the non-member state Norway (The Norwegian Directorate for Nature Management 2011). American mink is kept also in fur farms almost all over Europe, in such countries as Germany, Denmark, Finland, Spain, Poland etc. (Kauhala 1996, Ruiz-Olmo et al 1997, Hammershoj et al 2005), though no longer in the United Kingdom. It is believed that keeping American mink as a pet is gaining popularity in some countries as well, for example in France (P. Fournier, pers. comm.).
2. In how many EU member states has this species currently established populations? List them.	Populations known to exist in 19 countries: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom (Macdonald & Harrington 2003, Bonesi & Palazón 2007, Roy et al 2009, Zalewski et al 2010, Hegyeli & Kecskés 2015). Also in the non-member state Norway there are established populations (The Norwegian Directorate for Nature Management 2011).
3. In how many EU member states has this species shown signs of invasiveness? List them.	The species has shown signs of invasiveness in all countries in which it has become established. 19 countries: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom (Macdonald & Harrington 2003, Bonesi & Palazón 2007, Roy et al 2009, Zalewski et al 2010, Hegyeli & Kecskés 2014, Fraser et al 2015). In the non-member state Norway it has shown to be extremely invasive (The Norwegian Directorate for Nature Management 2011).

4. In which EU Biogeographic areas could this species establish?	Alpine, Baltic, Boreal, Continental, Atlantic, Mediterranean, Steppic, Pannonian, Black sea.
5. In how many EU Member States could this species establish in the future [given current climate] (including those where it is already established)? List them.	All EU member states under 'already established': (19 countries, as in response 2.), and 'additional states not yet established': all other member states (8 countries, as in response 6). The species could establish in most of countries where some areas still have remained free, or where it has been eradicated (14 countries): Austria, Czech Republic, Estonia (islands), France, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania, Slovakia, Spain and United Kingdom. Other countries (6 countries: Denmark, Finland, Ireland, Latvia, Lithuania and Sweden) are considered as fully colonized (Macdonald & Harrington 2003, Bonesi & Palazón 2007).
6. In how many EU member states could this species become invasive in the future [given current climate] (where it is not already established)?	The species has shown signs of invasiveness in all countries in which it has become established. Therefore, it could become invasive in 9 countries where it is not known to exist (as an established population): Belgium, Bulgaria, Croatia, Cyprus, Hungary, Malta, Netherlands, Luxembourg, and Slovenia. Further, a number of countries (e.g., Portugal – Rodrigues et al. 2015) have still locations free of American mink, and it is likely to invade to these areas as well.

SECTION A – Organism Information and Screening		
Stage 1. Organism Information	**RESPONSE** **[chose one entry, delete all others]**	**COMMENT**
1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	Neovison vison (Schreber, 1777) EN: American mink	It is a single taxonomic entity. European mink (*Musteola lutreola*) and polecat (*Mustela putorius*) are morphologically similar, and similar in size, but American mink can be adequately distinguished from those species. American mink belongs in its own distinct genus – Neovison – within the Mustelidae family.
2. If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)		
3. Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	In the Netherlands a risk assessment has been published by the Dutch Mammal Society in 2012, commissioned by the Netherlands Food and Consumer Product Safety Authority (Ministry of Economic Affairs), Team Invasive Exotics (Dekker, 2012).	There exists also a risk assessment in Norway (see The Norwegian Directorate for Nature Management 2011).
4. If there is an earlier risk assessment is it still entirely valid, or only partly valid?	No	For the Netherlands and Norway it is still entirely valid.
5. Where is the organism native?		North America.
6. What is the global distribution of the organism (excluding Europe)?		The species is native to the North America: its natural range extends from Alaska and Canada through most of United States, except a few southern regions as California, Nevada, Arizona, Utah, New-Mexico and West-Texas (Dunstone, 1993, Larivière 1999). Outside the native range,

		and besides Europe, the American mink has also been introduced to South America (and is currently present in Chile and Argentina, ranging as far south as Tierra del Fuego and Navarino Island) and Asia (Russia, Mongolia, Japan) (Heptner et al 1967, Previtali 1998, Bobrov et al 2008, Shimatani et al 2008, Ibarra et al. 2009, Fasola et al. 2011, Schüttler, et al. 2010, Oleinikov A. Yu. 2013, Saveljev, et al. 2015).
7. What is the distribution of the organism in Europe?		The distribution of the species consist of the following countries in EU: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Spain, Sweden, United Kingdom (Bonesi & Palazón 2007, Reid & Helgen 2008). The species is also present in the European part of Russia, Belarus, and the Ukraine, and within Europe in Iceland and Norway (Bevanger & Henriksen 1995, Bonesi & Palazón 2007, Reid & Helgen 2008). It is important to note that since the most important sources of invasion have been mink farms with an uneven distribution in Europe, the distribution of American mink is not continuous in all countries, but contain an often unknown number of uninvaded areas.
8. Is the organism known to be invasive (i.e. to threaten organisms, habitats or ecosystems) anywhere in the world?	Yes	American mink is an invasive mammal species with the highest impact on native fauna in Europe, affecting negatively at least 47 native species (Genovesi et al. 2012). Through ecological competition it affects negatively several native carnivores, namely European mink, polecat and stoat (*Mustela erminea*) (Maran et al. 1998,

		Sidorovich & Macdonald 2001, Sidorovich & Solovej 2007, Sidorovich et al 2010, Zuberogoitia et al. 2013). The impact of American mink predation on waterfowl, seabirds, small mammals, amphibians and fish has also been documented in various studies in Europe (Woodroffe et al. 1990; Barreto et al. 1998, Macdonald et al. 2002a, Nordström et al. 2003, Ahola et al. 2006, Banks et al. 2008, Ficher et al. 2009, Melero et al. 2012, Brzezinski et al. 2012, Aars et al. 2001) and in South America (Fasola et al. 2011, Valenzuela 2013). American mink is one of the main factors involved in the near extinction of the water vole in the UK (summarised in Woodroffe et al. 1990) is responsible for the loss of important colonies of ground-nesting sea birds on the coast of Scotland (Craik et al. 1997, Clode and Macdonald 2002) and drastic decreasing of coots and grebes density (Brzeziński 2012). In the archipelago of SW Finland, especially the numbers of seabirds nesting in colonies (razorbills and black guillemots) declined dramatically after the invasion of American mink in the 1970s; since 1992 the experimental removal of mink has increased the breeding densities of several bird species in the area (Nordström et al. 2002, 2003). In Argentina, American mink have spread to remote plateau lakes where they predate endangered hooded grebes (*Podiceps gallardoi*, Roesler et al. 2012). In several countries, American mink is the main reason for the disappearance of the endangered European mink (Maran et al. 2011), and its presence is inimical to recovery attempts for the European mink (Põdra et al. 2013; Zuberogoitia et al. 2013; Santulli et al. 2014).

		American mink can also transmit diseases (Maran & Henttonen 1995, Mañas et al. 2001, Mañas et al. 2016). The American mink eradication experiments in the Baltic Sea resulted, first of all, in return of extinct bird species, or in the increase of number of rare species in the area (Nordström et al. 2002). These results indicate that the invasion of American mink is detrimental first of all to the species already rare and/or endangered.
9. Describe any known socio-economic benefits of the organism in the risk assessment area.	Yes	Hunting/trapping may provide minimal benefit in some countries in east and north Europe. Yearly hunting bag in Finland is ca 40 000-60 000 individuals (Finnish Game and Fisheries Research Institute 2014), but the economic value of the catch is small. Nowadays, mink are trapped mostly because they are considered vermin, not because of their fur. However, an association was recently established to increase the appreciation and value of wild fur; they promote a "Wild Finnish Fur" trademark. Mink farming is common in several EU countries, most notably in Denmark, Netherlands, Poland, Finland and Sweden. In Europe a total of 31.3 million skins were produced in 2011 (EFBA Annual report 2011). According to the Danish Veterinary and Food Administration (DVFA - Ministry of Food, Agriculture and Veterinary, 2014): "- Denmark is the world's largest producer of mink skins with an annual production of around 15 million skins accounting for approximately 40%

		of all mink fur farming globally. - There are about 1500 mink farms in Denmark with approximately 3 million breeding females. - Fur farming in Denmark is the third largest type of animal farming. - The Danish fur farmers own the cooperative company Kopenhagen Fur. - Kopenhagen Fur is the world's largest fur auction house. - It is estimated that approximately 6000 people are employed in the fur industry, of which approximately 3500 are fur farmers. - In the financial year 2011/12 Kopenhagen Fur had a turnover of 10,5 billion Danish kroner (1,4 billion €). - In 2012 the production reached 15,6 million mink skins (compared to 12,2 million in 2012). - Fur is Denmark's largest export to China/Hong Kong." Still according to DFAV, in Denmark about 75000 American minks were hunted from the 1999/2000 to the 2012/2013 hunting season and several EU countries are known to be producers of mink skins (DK, FI, SE, NL, PL, ES, DE, FR, BE, IT, EI, GR, LT, LV, EE), with production levels for the year 2013 ranging from 100 000 (EE) to 17 200 000 (DK). One mink farm is known to exist in PT despite not being legal under the Portuguese IAS regulation (Rodrigues et al. 2015). Two mink farms in northern Spain/Basque Country are within the Spanish European mink range (Regional Government of Gipuzkoa province) and some are situated nearby (MAGRAMA 2014). Two mink farms are known to exist in Romania,

		made by a Dutch investor from Mink Farm Invest, with a production capacity of 80 000 mink furs/year, none of them has environmental permits.
10. Has this risk assessment been requested by the Programme Board? (If uncertain check with the Non-native Species Secretariat)	NA	
11. What is the reason for performing the risk assessment?	Identification of invasive alien species of EU concern	American mink is an invasive mammal with serious negative impacts on native species in all countries where it is established, or where it may arrive in the future. The fur-farm management needs European-wide regulation; for instance prohibition of mink farms in one country is likely to result in establishment of new mink farms in other MSs with impact to local fauna.
12. Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?	Yes	American mink is a highly resilient opportunistic predator, which can easily adapt to a variety of aquatic habitats – rivers, streams, channels, lakes, wetlands and coastal areas and archipelagos (Kauhala et al. 1996, Sidorovich 2000) and spread across mountain ranges that are only semi permeable barriers to dispersal Fraser et al 2014). The diet of American mink varies largely in different types of habitat and in different seasons of the year (Dunstone 1993, Sidorovich et al. 1998, Sidorovich 2000). Demographic studies carried out in Belarus suggest that reproduction rate of the species may change significantly in different invasion phases: it is significantly higher in expanding populations than in stable populations allowing very fast occupation of invaded areas (Sidorovich 1997, Melero et al. 2015). The capability to adapt to different habitats, opportunistic feeding behaviour, flexible

		reproduction strategy and high reproduction rate are the intrinsic attributes that make American mink a highly invasive species. On one hand, due to its opportunistic feeding behaviour its effect on any single species may not be so strong, especially on mainland areas where many potential prey species are available. On the other hand, being an opportunistic predator means that mink does not rely on a single prey species and therefore the reduction of one prey species density (e.g. already rare or endangered species) will not result in a decline in mink numbers (as would be typical according to classic predator-prey cycle model). Indeed, some experiments have shown that especially rare or locally extinct species benefit the most from mink removal, which implies that mink predation has been limiting their population densities (Nordström et al. 2002, 2003).
13. Does the organism occur outside effective containment in Europe?	Yes	It is, however, possible to eradicate minks from some islands.
14. Is the organism widely distributed in Europe?	Yes	Present in more than 20 countries in Europe. There are also increasing/expanding populations in several countries that have not yet been entirely colonised (Macdonald & Harrington 2003, Bonesi & Palazon 2007, Rodrigues et al. 2015).
15. 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 Europe, in the open, in protected conditions or both?	Yes	The species occupies all kind of freshwater habitats and also coastal areas (Dunstone, 1993) in most of Europe (both in protected and unprotected areas). Therefore, many suitable habitat types for the survival, development and increase/spread of American mink occur naturally (in the open) in

		Europe. The American mink is also sufficiently adaptable and opportunistic in its diet that it is able to find suitable prey species almost everywhere.
16. 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	
17. Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in Europe or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.	NA	
18. Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of EU or sufficiently similar for the organism to survive and thrive?	Yes	Ecoclimatic zones within the original range in North America, and areas occupied in Europe, South America and Asia, are sufficiently similar with those of EU area that is not yet occupied. The climate conditions in all of EU countries can be regarded as appropriate for the American mink.
19. Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in Europe?	Yes	American mink is kept in farms in many countries across Europe (from Finland to Portugal). The species adapts easily to conditions in captivity (fur farms) and also breeds successfully there.
20. 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	Establishment of feral populations of American mink outside its native range has occurred as a combined effect of both direct and indirect man's activity. The species was brought to Europe in the 1920s for fur farming (Gerell 1967). Since then mink escaped from the farms, but also was deliberately released (Animal Rights movements)

		in several places in many countries. American mink were also deliberately released for hunting purposes in many localities in the former Soviet Union (Heptner et al. 1967, Maran et al. 1998).
21. Can the organism spread rapidly by natural means or by human assistance?	Yes	Although the initial feral populations were established by escapees from fur farms, the following rapid spread in many countries in Europe occurred via natural dispersal and high reproductive potential. Average observed dispersal distances of juvenile mink in the UK were ca 19 km, but some individuals dispersed over 130 km from their natal territories (Lambin et al. 2011). The longest dispersal recorded in Sweden was 45 km (Gerell 1970). Mink can also cross open bodies of water up to 5 km (Bevanger & Henriksen 1995). The continued escapes from farms keep the mink population close to carrying capacity in local habitats and this is believed to contribute to even faster invasion rate. Fast expansion of American mink has been documented in Finland between the 1950s and 1970s (Kauhala 1996): in some areas the annual frequency of occurrence, based on game inquiries, increased from 20% to 80% in just a few years. As a reflection of this, the annual mink catch also increased ca 7-fold between the 1970s and 1990s. In Spain, a drastic range expansion has occurred as well: the known distribution area has increased nearly 17-fold in less than 30 years, from 75 UTM squares (10x10 km) in 1985 (Ruiz-Olmo et al. 1997) to 1277 UTM squares in 2012 (MAGRAMA 2014), covering now most of central and northern

		Spain. Fast increasing trend is also observed in Norway and in Ireland (Bevanger & Henriksen 1995, Roy et al. 2009, The Norwegian Directorate for Nature Management 2011). In Portugal, after a first phase of slow expansion (55 km in 20 years), American mink seems to have expanded its range quite rapidly in only 2 years (45 km). The initial delay could be due to local thriving otter populations, whereas the recent establishment of alien red swamp crayfish (*Procambarus clarkii*) in the area could be a plausible explanation for the acceleration in the mink's expansion. Being a key food resource, crayfish may be playing an important role as an expansion facilitator (Rodrigues et al. 2015). Expansion rates have been calculated also in northern Scotland as follows: The rate of expansion by area ranged from 101 – 2 866 km2 year-1, with a mean of 1 327 km2 year-1. Radial expansion rates ranged from 1 – 23 km year-1 (mean 10 km year-1) and linear expansion rates ranged from 8 – 27 km year-1 (mean 14 km year-1) (Fraser et al. 2015). Spread of up to 22.5 km per year has also been recorded in Portugal (Rodrigues et al. 2015). That mink are also appearing at isolated plateau lakes in Argentina that are not connected even by seasonal streams, shows that mink are capable even of travelling long distances over largely unsuitable habitat (Roesler et al. 2012). Natural spread has shown to be even greater in

		some places because different specimens escaped simultaneously from multiple sites, i.e. mink colonised an area from many focal points. Spread and colonisation rates may be even further enhanced by continued escapes over time (Zalewski et al. 2012, Fraser et al. 2015). Therefore, as long as fur industry impact is not adequately regulated in the European zone, human assistance will continue to play an important role in the expansion of the species.
22. Could the organism as such, or acting as a vector, cause economic, environmental or social harm in Europe?	Yes	The American mink is an ecologically damaging species in all areas where it has been introduced. It is a mammal species with the highest impact on native fauna in Europe, affecting negatively at least 47 native species (Genovesi et al 2012). American mink predation may result in local extinctions (e.g. of the water vole in the UK (Aars et al 2001)). Some experiments have shown that especially rare or locally extinct species benefit the most from mink removal, which implies that mink predation has been limiting their population densities (Nordström et al. 2002, 2003). Besides predation effects, competition by American mink through intraguild aggression is an important factor (the most important factor in several countries) in the current rapid decline of the endangered European mink. The much reduced and fragmented range of the European mink means that it is in serious danger of imminent extinction, which has been estimated to occur in no more than 10 years (Maran et al. 2011, Zuberogoitia et al. 2013). American mink may also launch small-scale

		trophic cascades, e.g. affecting plant biodiversity through its predation effects on voles (Fey et al. 2009). The species is likely to cause some economic damage in farms, attacking small animals such as rabbits or chickens, and in fish farms. Social harm may come into consideration among fishermen and also naturalists: as an effective predator, American mink may affect fish/crayfish fauna in rivers or bird fauna in wetlands, for example. Being an opportunistic predator mink, like stoat and martens, preys also upon vermin rodents and in this way may somewhat reduce the number of these around farms.

SECTION B – Detailed assessment

PROBABILITY OF ENTRY

Important instructions:

- Entry is the introduction of an organism into Europe. Not to be confused with spread, the movement of an organism within Europe.
- For organisms which are already present in Europe, only complete the entry section for current active pathways of entry or if relevant potential future pathways. The entry section need not be completed for organisms which have entered in the past and have no current pathways of entry.

QUESTION	RESPONSE [chose one entry, delete all others]	CONFIDENCE [chose one entry, delete all others]	COMMENT
1.1. How many active pathways are relevant to the potential entry of this organism? (If there are no active pathways or potential future pathways respond N/A and move to the Establishment section)	few	high	The species is already present in most of Europe and is still spreading. Five pathways for new introductions can be considered in the areas currently free of American mink.
1.2. List relevant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 1.3 to 1.10 (copy and paste additional rows at the end of this section as necessary).	Many	Very high	At least five potential pathways are relevant: 1. Escapes from fur farms. 2. Deliberate releases from fur farms (radical animal rights activist's attacks). 3. Escapes during transport (possible accidents). 4. Escapes from private owners other than fur farms. 5. Deliberate releases by these private owners, other than fur farms. Escapes and deliberate releases from fur farms have been the main pathways for the establishment of feral populations. Various studies confirm that the

			populations in the wild are the result of direct releases (Heptner et al. 1967) or escapes from fur farms (Dunstone 1993, Kauhala 1996, Ruiz-Olmo et al. 1997, Hammershoj 2005, Zuberogoitia et al. 2013). Escapes during transport as well as escapes and releases from private owners can be considered as potential pathways too.
Pathway name:	**[Escapes from fur farms]**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	accidental	very high	Escapes from fur farms have both intentional and accidental character: mink have been brought to farms intentionally, but regular escapes during normal farming routines are accidental and stochastic events.
1.4. 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? Sub note: In your comment discuss how likely the organism is to get onto the pathway in the first place.	very likely	high	Continual escapes from mink farms have been the origin of American mink populations in several countries, such as Finland, Denmark, Estonia, Spain (Kauhala 1996, Ruiz-Olmo et al. 1997, Hammershoj et al. 2005, Maran 1991) and also in Portugal where the first mink reports were from minks that supposedly escaped from a mink farm located in the Spanish margin of the bordering Minho river (Vidal-Figueroa 1987). In central Romania, there have been several escapes in 2015 from a recently established farm (Zs. Hegyeli, unpublished). The number of escaping mink at any one time/at any given time/at any given occasion is usually sufficiently large to establish a population in the wild. The number of escaping mink depends on the total number of mink in the farm, the construction quality, farm management practices and the human factor. The following examples may be considered as insufficient protection measures and potential causes of

			escapes: absence of a double fence around the farm, irregular or no set up live-traps along the outer fence of the farms, deterioration of mink cages over time and lack of maintenance of cages, insufficient number of mink-keepers and faulty management/handling of mink, lack of plans and preparation to address small or large-scale escapes.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	very likely	high	The survival rate of escaped American mink individuals is unknown, but probably the survival rate in the wild is rather low due to domestication in captivity. However, there are no known threats during the passage along the pathway (other than 'normal' threats that might be encountered by any wild predator). Continuous escapes provide a sufficiently high number of founder specimens to make the establishment of feral population highly probable. The fact that populations establish by individuals escaped from fur farms is evidenced by the number of countries currently occupied by feral American mink and the current extent of the invaded range of the American mink. The genetic analyses of feral and ranch mink have also confirmed presence of escapees from farm in wild populations (Zalewski et al. 2010, 2011, Zuberogoitia et al. 2013). Pregnant females escaping could give birth to young animals in the wild, or males and females escaping during the mating season (March) could mate in the wild, producing an independent wild-born generation within 3-4 months.
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	moderately likely	high	As the American mink is small, elusive and fast (as are most other mustelids), mink farming always carries a risk of escapes (from cages and farms during routine management) and accidental event (e.g. destruction of farm by storm or flood). The probability of mink avoiding (i.e. surviving) recapture once it has escaped

			the cage/farm would depend on how quickly they were detected, and the trapping effort put into place. Naive escapees from farms are relatively easy to trap, whereas feral mink starting with first wild-born generation tend to be trap-shy and difficult to trap (Zuberogoitia et al. 2006).
1.7. How likely is the organism to enter Europe undetected?	likely	high	American mink are already present in Europe, both in the wild and in captivity (in fur farms). Specific field methods are needed to detect the presence of escaped mink. Direct observations are not likely when only a few specimens escape, and American mink signs (footprints, faeces) can easily be confused with those of other small mustelids (polecat, martens etc.). Moreover, the species´ high capability of dispersion means that the time period when escaped animals can be detected near fur farms is short. In most countries with feral American mink, they remained undetected until they had reached high densities and established breeding populations. For example, American mink were first introduced to the UK in 1929 and were recorded in the wild almost immediately, but breeding in the wild was not documented until 1956 (Usher, 1987).
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	very likely	high	The probability of escape is at its highest when there are a maximum number of mink in the farm (i.e., end of summer to autumn); this is also the period for juvenile dispersion in the wild. Potential prey species are abundant during this period, which increases the probability of the escapees to survive, disperse and occupy the habitat available. However, American mink can potentially establish in any month of the year.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	likely	high	The likelihood is higher when the mink farm lies close to suitable habitat (river, stream, lake etc.), and lower where there is no suitable habitats nearby. However,

			mink are able to travel over long distances in unsuitable habitat (Roesler et al. 2012). For example, although they will usually avoid swimming in strong currents, they can cross open bodies of water up to 5 km wide (Bevanger & Henriksen 1995).
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	very likely	high	Available experience confirms that escapes from fur farms are rather common and escaped mink are able to adapt in the wild (Kauhala 1996, Ruiz-Olmo et al. 1997, Hammershoj et al. 2005, Zuberogoitia et al. 2013, Dekker & Hofmeester 2014). Therefore, escapes from fur farms can be considered as one of the main causes of establishment of the American mink in new areas within Europe. The lack of regulations demanding farms to take precautionary measures to avoid escapes in several European countries makes the likelihood of escapes very high. The prohibition of mink farming in one country is likely to increase mink farming in other countries, thus increasing also environmental problems in the latter.
Pathway name:	[**Deliberate releases from fur farms**]		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	intentional	low	
1.4. 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? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	very likely	very high	Radical animal rights activists have been responsible for massive releases in many countries. Intentional releases are not frequent, but when they happen, the number of liberated mink is usually large or very large (hundreds or thousands of mink), and the likelihood that a feral population will be established is extremely high.

			No farm is fully protected from such an attack and there is always a possibility that mink travel along this pathway to the wild.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	very likely	very high	The likelihood is higher when the farm lies near to suitable habitat (river, stream, lake etc.) and lower where there are no suitable habitats nearby. Taking into account the high capability of dispersal of the mink (up to 130 km – Lambin et al. 2011), the likelihood in general is very high. It is also higher when (a) the farm has not taken precautionary measures to prevent escapes, and when (b) the re-trapping of released mink is not undertaken in a timely manner.
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	likely	high	Deliberate releases have been documented as the main cause of establishment in Spain: 4 out of 6 populations were formed due to massive escapes (Ruiz-Olmo et al. 1997). It is obvious that many American mink populations in Europe originate from deliberate releases (Bonesi & Palazón 2007), although it is not always possible to distinguish between escapes, deliberate releases and expansion of already-established populations. Also, the effect of regular escapes and deliberate releases are mutually supportive processes in the establishment of feral populations.
Pathway name:	**[Escapes during the transport (possible accidents)]**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	accidental	very high	
1.4. How likely is it that large numbers of the organism	moderately likely	medium	Escapes during transport are a rather theoretical

will travel along this pathway from the point(s) of origin over the course of one year? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.			pathway but still it should be evaluated. When they happen, the number of escaped mink can be large or very large (hundreds or thousands of minks) and the likelihood that a feral population becomes established around the site of the accident is relatively high.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	moderately likely	medium	Mink survival from an accident during transport may vary largely. However, once mink have escaped from a transport vehicle, their chances of survival will be the same as for escapes or deliberate releases from farms.
1.6. How likely is the organism to survive existing management practices during passage along the pathway?	moderately likely	medium	Mink survival from an accident during transport may vary largely. Once the accident happens, management practices do not have much effect.
1.7. How likely is the organism to enter Europe undetected?	unlikely	high	The species is already present in Europe but it still may enter in new areas in different countries. As the number of escaped mink during transport can be large or very large, it is likely that the animals would be detected later.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	moderately likely	medium	The need for transport (and risk of accidental massive escapes) could be highest when maximum numbers of mink are present in farms (end of summer to autumn). This is also the period for juvenile dispersion in the wild. Potential prey species are abundant during this period, which increases the probability of the escapees to survive, disperse and occupy the habitat available.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	moderately likely	medium	The likelihood is higher when the site of the accident lies near to suitable habitat (river, stream, lake etc.) and lower where there are no suitable habitats nearby.

1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	moderately likely	medium	Escapes during transport are a rather theoretical pathway but still it should be evaluated. When they do happen, the number of escaped mink can be large or very large (hundreds or thousands of minks) and the likelihood that a feral population becomes established is relatively high. Escapes during transport can be considered as potential but not highly likely pathways of American mink establishment into new areas within Europe.
Pathway name:	**[Escapes from private owners]**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	accidental	medium	
1.4. 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? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	moderately likely	medium	The number of escaped minks from private owners is probably notably lower than the number of escapes from farms. At the same time, there are no mechanisms that could be applied to even minimize the number of escapes, as most of pet mink locations remain unknown. In case the American mink becomes more popular as a pet in the future, the number of escaped individuals is likely to increase.
1.5. How likely is the organism to survive during passage along the pathway (excluding management practices that would kill the organism)? Subnote: In your comment consider whether the organism could multiply along the pathway.	moderately likely	medium	The survival rate of escaped American mink from private owners is unknown, but probably the survival rate in the wild is rather low due to domestication in captivity (Hammershoj 2004). Survival depends also from locality of the private owner (the probability of survival is higher for escapees in the countryside than in cities) and keeping conditions (level of domestication).

1.6. How likely is the organism to survive existing management practices during passage along the pathway?	moderately likely	medium	Survival may vary widely depending on the owner's management practices.
1.7. How likely is the organism to enter Europe undetected?	likely	high	The species is already present in Europe but it still may enter into new areas in different countries. Specific field methods are needed to detect the escaped mink in the wild. Direct observations as well as finding of signs of the escaped animal are not likely. Moreover, the species' high capability of dispersion means that the time period when escaped animals can be detected near the location of private owner is short.
1.8. How likely is the organism to arrive during the months of the year most appropriate for establishment?	very likely	high	The probability of escape from private owners is highest when the juveniles reach independence and they need to be dispersed (i.e. end of summer to autumn, which is also the period for juvenile dispersion in the wild). Potential prey species are abundant (many juveniles) in this period, which increases the probability of the escapees to survive, disperse and occupy the habitat available.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	moderately likely	medium	The likelihood depends on the location of the mink owner and may be relatively high when escapes occur near suitable habitat (river, stream, lake, etc.).
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	moderately likely	medium	Escapes from private owners can be considered as a rather theoretical pathway, especially since their frequency is unknown; however, they should still be evaluated. It is possible that the number of escaped minks is not high, but same time this pathway is uncontrollable. Therefore, there is a possibility that escaped pet minks can establish populations in new areas within Europe.

			"My Pet Mink" community created in Facebook is one sign of the growing interest of people in having mink as a pet (https://www.facebook.com/mypetmink/info). Some people even train the minks to hunt. http://modernfarmer.com/2014/05/farm-confessional-minks-escape-farms-train-hunt/
Pathway name:	**[Deliberate releases from private owners]**		
1.3. Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (the organism is a contaminant of imported goods)? (If intentional, only answer questions 1.4, 1.9, 1.10, 1.11)	intentional	medium	
1.4. 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? Subnote: In your comment discuss how likely the organism is to get onto the pathway in the first place.	moderately likely	medium	The number of mink released by private owners is unknown but probably quite low. However, at the same time there are no mechanisms that could be applied to even minimize the number of such releases, especially as most of pet mink locations remain unknown. In case American mink become more popular as pets in the future, the increased number of released (and escaped) individuals increases the probability of establishment of new feral populations.
1.9. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	moderately likely	medium	The likelihood depends on the location of the mink owner. When the suitable habitat (river, stream, lake etc.) is near, the likelihood may be relatively high.
1.10. Estimate the overall likelihood of entry into Europe based on this pathway?	moderately likely	medium	The number of American mink released by private owners is unknown and this pathway can be considered as a rather theoretical one; however, it should still be evaluated. The number of mink released into the wild is probably not high, but at same time this pathway is

			uncontrollable. Therefore, new populations may become established as result of deliberate releases. An important parallel demonstrating the potential feasibility of this pathway is the case of feral ferrets in the UK, which have in some places established feral populations in the wild. Some reasons for their release are the expenses or time involved in keeping them (as is the case for many unwanted pets). "My Pet Mink" community created in Facebook is one of the signs of people growing interest to have mink as a pet (https://www.facebook.com/mypetmink/info).
End of pathway assessment, repeat as necessary.			
1.11. Estimate the overall likelihood of entry into Europe based on all pathways (comment on the key issues that lead to this conclusion).	very likely	high	The overall likelihood of entry into new areas in Europe as result of direct or indirect human actions is very high. Present wild populations of American mink originate mostly from fur farms in Europe. Farms create opportunities for escapes and deliberate releases and they are also the principal source of new populations in the future. Possible accidents during transport as well as escapes or releases of pet minks may contribute to the establishment of more individuals in the wild, and may augment entry from farms.

PROBABILITY OF ESTABLISHMENT

Important instructions:

- For organisms which are already well established in Europe, only complete questions 1.15 and 1.21 then move onto the spread section. If uncertain, check with the Non-native Species Secretariat.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
1.15. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Europe?	widespread	very high	American mink lives in a variety of habitats including rivers, streams, canals, wetlands, lakes, coastal areas and archipelago. It is characterized by opportunistic feeding behaviour and thus a varying diet that includes small mammals, amphibians, fish, crayfish and birds in different proportions (Dunstone 1993, Sidorovich et al 1998). Suitable habitats with enough food resources are present and widely distributed throughout Europe, guaranteeing its survival, establishment and successful reproduction.
1.21. How likely is it that biological properties of the organism would allow it to survive eradication campaigns in Europe?	moderately likely	high	In general, the eradication of invasive mustelids is a difficult task. The most common reasons for imperfect removal are probably the lack of opportunity (if individuals take longer to find a trap than the trap remains available), active avoidance (if individuals find but refuse to enter a trap), or both, in unknown proportions (Zuberogoitia et al. 2006, King et al. 2009). The removal may also fail due to lack of eradication experience and insufficient financial support (Zabala et al. 2010). Besides, American mink present high reproductive plasticity: reproduction rate (and proportion of females) can increase

			markedly when density is affected by intensive trapping (Sidorovich 1997, Melero et al. 2015) and its pregnancy duration may vary from 30 – 75 days depending upon environmental conditions (Lariviere 1999). Such a response decreases the probability of success of the eradication campaigns, especially when trapping effort is insufficient or methods used are inadequate. Mink is also exceptionally mobile hence potentially able to recolonise cleared areas (Bryce et al 2011), though this mobility and a tendency to re-occupy the best sites can be exploited in control efforts (Oliver et al 2016). That being said, in some cases local or regional eradication has been achieved. For example, in Norway effective local control and local eradication programmes have been carried out and have been successful after the Norwegian action plan against the American Mink was implemented after 2011 (Pers com J. van Dijk). Continuous removal of American mink in the outer archipelago of SW Finland has resulted in an essentially mink-free area of over 800 km^2 (with land area less than 10% of this; P. Salo pers comm.). The Hebridean Mink Project ran from 2001-2006 at a cost of £1.6 million and successfully eradicated invasive mink from 1100 km^2 of the southern islands of the Hebridean Archipelago in Scotland (Roy 2011). Dogs have also been used in the Finnish archipelago to locate minks from their dens. An air-blasting device is then used to flush out the mink from its refuge (Nordström 2003).

			In the Netherlands no population has been established so far, presumably because of the control program to eradicate muskrats. American mink is a by-catch within this program, with yearly ca. 70-120 individuals trapped as a by-catch (as noted in the annual reports of the Union of Waterboards). New trapping methods, developed in the UK (mink rafts; Reynolds et al. 2004, 2013), have demonstrated that effective control or even local eradication is possible with reasonable effort. The method is currently used in several areas in Europe and gives significantly better results compared to traditional trapping with baited cage-traps (Harrington et al. 2009; Bryce et al. 2011, Tragsatec 2015). However, the method should be viewed as a possible solution for reducing/removing already established American mink, given sufficient resources and motivation – it would not be suitable for capturing dispersing mink as they escape.

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of a pest within an area.

QUESTION	RESPONSE	CONFIDENCE	COMMENT
2.1. How important is the expected spread of this organism in Europe by natural means? (Please list and comment on the mechanisms for natural spread.)	major	high	The species is spreading rapidly in Europe. It is likely that the expansion occurs both by natural means (from already established feral populations) and by human assistance (escapes and releases from fur farms). American mink can be considered as an effective invader: it is an opportunistic predator with a high reproduction rate, it is capable to adapt to a number of habitat types, and juveniles can disperse long distances from their natal territories. Thus American mink can rapidly spread and colonise large areas. Demography studies carried out in Belarus show that the reproduction rate of American mink increases markedly in the expansion phase of the population: the number of embryos per female mink was 7.1-7.6 during the expansion, and only 3.3-4.3 in a stable population. Moreover, predominance of females was observed during the expansion (Sidorovich 1997). Similar tendency was recently observed in Scotland (Melero et al. 2015). Fast expansion of American mink has been documented in several countries in Europe. In Finland American mink colonized the whole country between the 1950s and 1970s (Kauhala 1996). Similarly, the species managed to settle in a greater part of Norway

			(about 80-85%) during 35 years (Bevanger & Henriksen 1995, The Norwegian Directorate for Nature Management 2011). It took 25 years from first observation of the American mink in the wild to full occupation of mainland Estonia (Maran 1991). In Spain, a drastic range expansion has occurred as well: the known distribution area has increased nearly 17 fold in less than 30 years, from 75 UTM squares (10x10 km) in 1985 (Ruiz-Olmo et al. 1997) to 1277 UTM squares in 2012 (MAGRAMA 2014, Põdra & Gómez in prep.), covering now a majority of the central and northern Spain. Fast expansion has also been observed in Ireland (Roy et al. 2009). The common feature of the species' spread in all of these countries is the establishment of small isolated populations close to fur farms, followed by their rapid expansion into other areas without farms, due to efficient dispersal. Observed average dispersal distances of juvenile mink in the UK were ca 19 km, but some individuals dispersed over 130 km from their natal territories (Lambin et al. 2011). Mink can also cross open bodies of water up to 5 km wide (Bevanger & Henriksen 1995). Landscape features such as mountains may slow down but not stop the rate of colonisation (Zalewski et al 2009, Fraser et al 2013). Successful colonisation observed in very different climatic and landscape conditions suggests that the species may invade most of Europe in the nearest future unless appropriate measures are not implemented.
2.2. How important is the expected spread of this	major	high	Human assistance may still play an important role in

organism in Europe by human assistance? (Please list and comment on the mechanisms for human-assisted spread.)			the expansion of the American mink. Escapes or deliberate releases from fur farms (radical animal rights activists attacks on farms) may help the species to spread faster and may increase local abundance close to habitat carrying capacity (presumably both). Escaped mink from farm increase genetic diversity of feral population which may have accelerate adaptation and expansion (Zalewski et al 2010). Also, possible escapes during the transport or keeping mink as pet may increase the importance of human-assisted spread. Over 80% of feral mink captured in Denmark were escaped mink from farms (Hammershoj 2005), over 40% in western Poland. Farms have been considered as a source of established population in several countries such as Estonia, Finland, Norway, Spain and recently Romania (Kauhala 1996, Maran, 1991, Ruiz-Olmo et al. 1997, Hegyeli & Kecskés 2014). Several escaped minks have also been detected in Netherlands, but a truly wild mink population is probably not yet established (Dekker & Hofmeester 2014).
2.3. Within Europe, how difficult would it be to contain the organism?	difficult	high	Preventing American mink from moving into new areas after it has established is a difficult task. In mountainous areas, or in areas with artificial barriers (roads, industrial areas, etc.), the invasion of American mink may be limited to some extent and it may be a little easier to control its expansion, although the extent of the task should still not be underestimated. The use of effective methods for detection and control (mink rafts; Reynolds et al 2004, 2013) would assist in maintaining specific areas free of the alien mink

			(Bryce et al 2011). Mink rafts are also the most effective method for eradicating American mink at a large scale, but only with considerable input of resources and manpower, and continued effort. However, the method should be viewed as a possible solution for reducing/removing already established American mink, given sufficient resources and motivation – it would not be suitable for capturing dispersing mink as they escape. Mink have been reduced to very low density over 29,000 km2 in Scotland through community-led trapping effort combined with adaptive management (Bryce et al. 2011; Lambin X., pers. comm.), demonstrating control can be achieved. The establishment of mink farms in areas still free of American mink results in further invasions. Union-level regulation of mink farming both in terms of prevention of escapes as well as legally required thorough Environmental Impact Assessment works towards prevention of further invasions.
2.4. Based on the answers to questions on the potential for establishment and spread in Europe, define the area endangered by the organism.	[Most of Europe]	high	See answers to the questions 3-6 EU CHAPPEAU.
2.5. What proportion (%) of the area/habitat suitable for establishment (i.e. those parts of Europe were the species could establish), if any, has already been colonised by the organism?	67-90	high	
2.6. What proportion (%) of the area/habitat suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	67-90%	medium	The spread of the species may vary a lot in different parts of Europe. It depends on the presence of the different pathways, natural or artificial barriers, control measures etc. Fast expansions documented in

			Finland, Norway, Ireland and Spain suggest that large areas can be invaded in just a few years. Feral mink may disperse over 130 km from their natal territories (Lambin et al. 2011), they are able to travel over long distances in unsuitable habitat (Roesler et al. 2012), and they can cross open water bodies up to 5 km wide (Bevanger & Henriksen 1995). In addition, the establishment of new mink farms (possibly following the prohibition of mink farms in other countries) in the countries without mink farming will create a new vector of American mink invasion to areas still free of American mink.
2.7. What other timeframe (in years) would be appropriate to estimate any significant further spread of the organism in Europe? (Please comment on why this timeframe is chosen.)	10	high	Due to its fast expansion in most of Europe and its high impact on native species, there is a critical need to estimate the spread of American mink in Europe as soon as possible. Fast-detection methodology for detection of mink needs to be developed.
2.8. In this timeframe what proportion (%) of the endangered area/habitat (including any currently occupied areas/habitats) is likely to have been invaded by this organism?	90-100%	high	A large part of the available habitat is likely to be invaded within the next 10 years. The rate of expansion may depend on the presence of barriers, the frequency of escapes/releases from fur farms, and possible control measures.
2.9. Estimate the overall potential for future spread for this organism in Europe (using the comment box to indicate any key issues).	rapidly	high	American mink has invaded a large part of Europe (present in more than 20 countries) during a few decades and many of populations show an increasing trend (Bonesi & Palazon 2007). Therefore, it is likely that the species will colonize those areas that still remain vacant unless prevention measures are not undertaken. The presence of barriers may slow down the dispersal rate but not stop the invasion. Well-planned eradication and control activities may prevent

			the colonization at a local level (e.g. specific river basins).

PROBABILITY OF IMPACT

Important instructions:

- When assessing potential future impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Where one type of impact may affect another (e.g. disease may also cause economic impact) the assessor should try to separate the effects (e.g. in this case note the economic impact of disease in the response and comments of the disease question, but do not include them in the economic section).
- Note questions 2.10-2.14 relate to economic impact and 2.15-2.21 to environmental impact. Each set of questions starts with the impact elsewhere in the world, then considers impacts in Europe separating known impacts to date (i.e. past and current impacts) from potential future impacts. Key words are in bold for emphasis.

QUESTION	RESPONSE	CONFIDENCE	COMMENTS
2.10. How great is the economic loss caused by the organism within its existing geographic range, including the cost of any current management?	major	high	Concrete data are not available for direct damage. In farms American mink may cause damages to small livestock, preying on chickens, rabbits and other small domestic animals. Also, its presence in fish farms or fish ponds may cause economic damages (for example, some damages have been reported from Norwegian salmon farms and UK fresh water trout farms). Mink may also affect hunting reserves as a predator of rabbits and partridges. Economic losses related to conservation/control activities may be very high. Eradication and control of the species is generally costly, especially if the activity (eradication) covers a large area (Zabala et al 2010).
2.11. How great is the economic cost of the organism currently in Europe excluding management costs (include any past costs in your response)?	minor	medium	Direct damages are related mostly to killing of small animals in farms. Also, mink presence in fish farms or fish ponds may cause some damages. The impact of the American mink to ecological services is difficult to measure. However, considering the number of species under its direct impact, it can be assumed that ecological services are negatively affected

			by mink presence.
2.12. How great is the economic cost of the organism likely to be in the future in Europe excluding management costs?	minor	medium	Direct damages are related mostly to killing of small animals in farms, fish farms or fish ponds and hunting reserves. Concrete data are not available, so there is moderate uncertainty in these predictions. The impact of the American mink to ecological services is difficult to measure. However, considering the number of species under its direct impact, it can be assumed that ecological services are negatively affected by mink presence.
2.13. How great are the economic costs associated with managing this organism currently in Europe (include any past costs in your response)?	minor	high	The costs associated with conservation/control activity may locally seem quite high but as only a few projects have been carried out in the past, the total costs at the European level remain low. Some examples of control projects are described below: The Hebridean Mink Project ran from 2001-2006 at a cost of £1.6 million and successfully eradicated invasive mink from 1100 km^2 of the southern islands of the Hebridean Archipelago, in Scotland (Roy 2011). In Ireland, an estimated cost of the expenditure required to achieve 75% annual control over a catchment of 800 km^2 for a 5-year period was 1.062.425 euros (Roy et al. 2009). The yearly estimated costs for mink trapping effort in the Archipelago National Park, SW Finland were roughly around 10.000 € in 2009 (J. Högmander, Metsähallitus, pers. comm.). This includes ca 6.700 € rewards and travel expenses for voluntary trappers, 1.000 € for equipment and 2.300 € for salaries of Metsähallitus staff (Metsähallitus is the instance

			managing national parks in Finland). Methods include both trapping and locating mink using scent dogs; in the latter case mink are then flushed out of their refuges using an air-blasting device, and killed with a shotgun. Removal was begun in 1992 in one area and has since expanded to cover over 800 km^2 of the outer archipelago (of which less than 10 % are land; Banks et al. 2008, P.Salo pers. comm.). This area can be considered mink-free, but if mink removal would cease for a year or two, mink would rapidly invade the area again. Most islands are not isolated enough to prevent mink from entering. The Finnish archipelago project has been running for over 20 years. Other, short-term projects in Finland before year 2009 have had costs < 30.000 €. It should be noted that most mink control activities in Finland are performed by voluntary hunters (either during "normal" trapping practices or some campaigns), but the efficiency and spatial scale of these trapping schemes is unknown (P. Salo, pers. comm.). The cost of control activities (trapping, monitoring) can be reduced using more effective methods. The studies carried out in UK and initial results of an ongoing project in Spain demonstrate that the detection and capture of American mink is significantly more economic using the mink rafts method (Reynolds et al. 2004, Harrington et al. 2009, Tragsatec 2015). Rafts can save manpower primarily by pre-defining where and when to direct trapping effort. Rafts can be operated by citizen conservationists who call upon a trained person only when a mink is caught, making it possible to have control over very large spatial scales (Bryce et al 2011).
2.14. How great are the economic costs associated with managing this organism likely to be in the future in	moderate	high	Eradication/control in priority areas (the remaining European mink areas in Spain, France and Romania,

Europe?			Important Bird Areas across Europe etc.) requires continuous management to avoid serious ecological damages. The costs are likely to be minor in comparison to current costs for maintenance of semi-natural habitats in Europe. Currently, eradication programs are on-going in several countries. For example, three Life-projects, which include eradication activities of American mink populations, are under way in Spain (LUTREOLA, INVASEP, DESMANIA) and in Poland (Polish Important Birds Areas). Trapping campaigns (using mink rafts) have only recently begun in some areas and the costs of a truly effective mink control campaign, using the latest developments in the whole country have not been estimated. However, the Spanish Strategy for mink eradication and control (MAGRAMA, 2014) estimates yearly costs of mink control at 1.886.640 € at the minimum, although the most recent methods of trapping (using mink rafts) are not considered. This means that the costs of a truly effective mink control campaign through the whole country have not been estimated, and the Spanish Strategy needs to be updated. To ensure effectiveness at a large enough scale to reduce ecological damage, it is important that sufficient resources are provided to cover the costs. It is difficult to estimate precise costs, and whilst some estimates exist in the literature, they do not always use the most cost-effective methods. What is certain is that the costs will only increase if mink are allowed to continue to proliferate and spread in Europe.
2.15. How important is environmental harm caused by the	moderate	medium	Environmental harm has been recorded everywhere

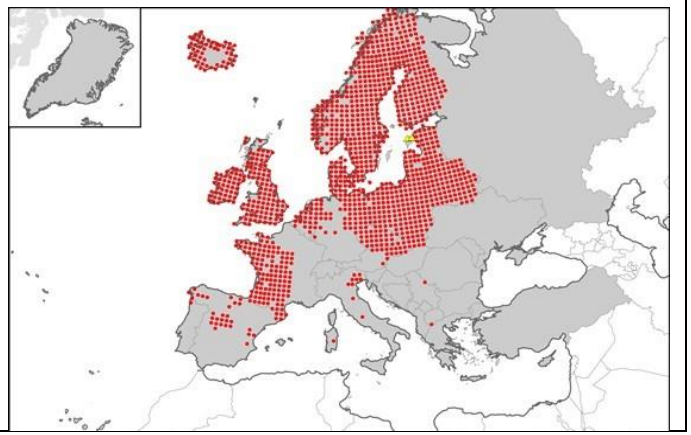
organism within its existing geographic range excluding Europe?			American mink has invaded. In South America, invasive mink can cause serious damages to mammals and birds: not only ground-nesting birds in coastal areas but even woodpeckers (Jaksic et al. 2002, Jimenez et al. 2013). The potential impact of American mink on the endangered Hooded Grebe in Argentina has been described as catastrophic (Roesler et al. 2012). Also, in Russia the American mink is negatively effecting a critically endanger species: European mink is rapidly becoming less abundant in comparison with American mink. For instance, in Vologda and Kostroma regions the proportion of European mink skins in the hunting bag of the two mink species decreased from 50-70% to 1-10% in the last 5-7 years (until 2006). For the whole of Russia recent records refer only to the capture of single individuals or to local populations consisting of some tens of individuals (Skumatov and Saveljev 2006). American mink is present from the far East to the West of Russia, and it is also spreading towards the south, recently recorded also in the in the territory of the Uvs Nuur Hollownorth of Mongolia (Oleinikov. 2013, Saveljev et al. 2015).
2.16. How important is the impact of the organism on biodiversity (e.g. decline in native species, changes in native species communities, hybridisation) currently in Europe (include any past impact in your response)?	major	very high	American mink is an invasive mammal with the highest impact on native species in Europe, affecting negatively at least 47 native species. Several of these species are considered as threatened (Genovesi et al. 2012). Through ecological competition American mink affects negatively several native carnivores: for example, American mink is a direct cause of the extinction of the few last remaining populations of the European mink (Maran et al. 1998, Sidorovich & Macdonald 2001). It

			may also affect other small mustelids such as polecat (Barrientos 2015) and stoat (Sidorovich & Solovej 2007). Alien mink predation seriously damages waterfowl, small mammals, amphibians and fish across Europe (Barreto et al. 1998, Macdonald et al. 2002, Nordström et al. 2002, 2003, Ahola et al. 2006, Fischer et al. 2009, Melero et al. 2012), and it may even launch small-scale trophic cascades, e.g. affecting plant biodiversity through its predation on voles (Fey et al. 2009). American mink is one of the main factors involved in the near extinction of the water vole in the UK (summarised in Woodroffe et al. 1990) and is responsible for the loss of important colonies of ground-nesting sea birds on the coast of Scotland (Craik et al. 1997; Clode and Macdonald 2002). In some countries, American mink is the main reason for the disappearance of the endangered European mink (Maran et al. 2011), and its presence is inimical to recovery attempts for the European mink (Põdra et al. 2013). American mink can also transmit diseases (Maran & Henttonen 1995, Mañas et al. 2001, Mañas et al. 2016), and frequent escapes from farms may increase the level of diseases in the wild population. Therefore there is a possible indirect impact of the American mink as a disease reservoir, which could have a deeper impact on the survival of European small carnivores (like mustelids) through the transport of pathogens. The American mink eradication experiments in the Baltic Sea resulted, first all, in return of extinct bird species, or in the increase of number of rare species in the area (Nordström et al. 2002). These results indicate that invasion of American mink is detrimental first of all to the species already rare and/or endangered.
2.17. How important is the impact of the organism on	major	high	American mink colonisation into new areas may affect

biodiversity likely to be in the future in Europe?			negatively a number of native species present, including some threatened ones. For example, the endangered Iberian desman (*Galemys pyrenaicus*) can be affected by American mink in Spain and in France in the future. There is a very real risk of the European mink going extinct in the near future as a result of competition/intra-guild aggression from American mink (Maran et al. 2011). The invasion of American mink into Romania, France and Spain endangers one of the last surviving European mink populations with extinction.
2.18. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism currently in Europe (include any past impact in your response)?	moderate	medium	The impact of the American mink to ecological services is difficult to measure. However, considering the number of species under its direct impact, it can be assumed that ecological services are negatively affected by mink presence. For instance, the local extinctions of different species (European mink in many regions of Europe, water vole in some areas of the UK etc.) because of American mink predation clearly demonstrate damages to trophic interactions in riparian habitats. Mink may also launch small-scale trophic cascades, e.g. affecting plant biodiversity through its predation on voles (Fey et al. 2009).
2.19. How important is alteration of ecosystem function (e.g. habitat change, nutrient cycling, trophic interactions), including losses to ecosystem services, caused by the organism likely to be in Europe in the future?	moderate	medium	Taking into account its influence on fauna associated with aquatic habitats, alterations in ecosystem functions and trophic interactions are likely to occur at least in some areas. Mink may even launch small-scale trophic cascades, e.g. affecting plant biodiversity through its predation on voles, which are the main grazers on the small islands in the archipelago of SW Finland (Fey et al. 2009).

2.20. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism currently in Europe?	moderate	medium	American mink predation directly causes changes in the conservation status of various threatened species, provoking their decline or extinction (as e.g. European mink). The conservation value of protected areas has declined accordingly in many areas (islands, wetlands etc.).
2.21. How important is decline in conservation status (e.g. sites of nature conservation value, WFD classification) caused by the organism likely to be in the future in Europe?	moderate	medium	Decline of the conservation value of protected areas, due to biodiversity loss in riparian and aquatic habitats, is likely to occur.
2.22. How important is it that genetic traits of the organism could be carried to other species, modifying their genetic nature and making their economic, environmental or social effects more serious?	minimal	low	Unknown.
2.23. How important is social, human health or other harm (not directly included in economic and environmental categories) caused by the organism within its existing geographic range?	minor	medium	Not known in the wild. In mink farms with frequent contacts between minks and humans, Aleutian mink disease parvovirus may play a role in human health: 2 mink farmers in Denmark have been infected (Jespen et al. 2009).
2.24. How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	minor	medium	See the answer to the question 2.23.
2.25. How important might other impacts not already covered by previous questions be resulting from introduction of the organism? (specify in the comment box)	minimal	low	Not known.
2.26. 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	major	high	Expected negative impact towards biodiversity is high everywhere in Europe. There is no evidence that predators, competitors, parasites or pathogens present in

be present in Europe?			Europe have limited the expansion of American mink. Still, few studies have reported a correlation between otter (*Lutra lutra*) population recovery and mink population decline e.g. in UK and Finland (McDonald et al. 2007, Urho et al. 2014). There is no evidence of casual link between these two processes and a majority of experts regard this correlation in mentioned few studies of coincidental character. In Spain, the limiting effect of otter has not been observed: the expansion of American mink has occurred in parallel with the recovery of otter (Põdra & Gómez, in prep.). Predation risk by sea eagles may limit individual mink movements between islands in the archipelago of SW Finland, but the possible negative implications of this on the mink population can only be speculated (Salo et al. 2008). Continuous expansion of American mink in several countries gives reason to believe that the impact on native species has an increasing trend.
2.27. Indicate any parts of Europe where economic, environmental and social impacts are particularly likely to occur (provide as much detail as possible).	[insert text + attach map if possible]	high	Negative environmental impact is likely to occur (or increase) in all countries where American mink may establish or become more widespread: Belgium, Bulgaria, Croatia, Cyprus, Malta, Netherlands, Luxembourg, Slovenia, but also in part of Austria, Czech Republic, Estonia (islands), France, Germany, Greece, Hungary, Ireland, Italy, Poland, Portugal, Romania, Slovakia, Spain, United Kingdom. Economical cost related to the control/eradication will probably have major importance in those countries where conservation activities are already under way, or about to start (to protect threatened species because of mink invasion). Such countries include Spain, UK, Ireland, Finland and Estonia, but also Romania,

			Belgium, Netherlands, Portugal etc. The most accurate distribution area of American mink in Europe in 2009 (Genovesi et al. 2009) is presented below. By now, the area has increased in several countries, for example Spain (MAGRAMA 2014), Portugal (Rodrigues et al 2015) and Romania (Hegyeli & Kecskés 2014). 

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Entry	very likely	high	The overall likelihood of entry into new areas in Europe as result of natural spread or human activity is very high. Present wild populations of American mink originate mostly from fur farms in Europe. Farms are also the principal cause for the formation of new populations in the future, as they leave opportunities for escapes or deliberate releases. Possible accidents during transport as well as escapes or releases of pet minks may contribute to spreading the species into the wild. Entering into new areas by natural means is very likely to occur, taking into account the fast expansion of mink populations in several countries. The establishment of mink farms in areas with no or only very few mink in the wild will start new invasion processes. Lack of escape prevention measures in existing farms will support feral mink populations with additional escapee mink and in this way strengthen the effect of feral mink population to native fauna.
Summarise Establishment	very likely	very high	The species is already established in major part of Europe, from North (Finland, Sweden, and Norway) to South (Portugal, Spain). Climate conditions can be considered as suitable in the area still free of American mink: Netherlands, Belgium, parts of Germany and France etc. The species can be successfully kept and bred in captivity (fur farms) and it may establish in a variety of habitats in the wild: rivers, streams, canals, wetlands, lakes and coastal areas. There is no evidence

			that the existence of competitors, predators or diseases will prevent the establishment of new populations. Moreover, the species is difficult to detect and eradicate due to its elusive nature and high capability to disperse and reproduce. The large and viable feral population in Europe, combined with existing fur farms, produce a high number of founders which can easily establish in new areas.
Summarise Spread	rapidly	high	American mink has invaded a large part of Europe (present in more than 20 countries) during a few decades and many of the populations show an increasing trend. Therefore, it is very likely that the species will keep spreading and rapidly colonizing areas that have still remained vacant. Landscape features (presence of barriers) may slow the speed of invasion. However, feral mink may have dispersal distances of over 100 km and they are able to travel long distances also in unsuitable habitat, including open bodies of water. The establishment of mink farms in areas with no or only very few mink in the wild will start new invasion processes. Lack of escape prevention measures in existing farms will support feral mink populations with additional escapee mink and in this way strengthen the effect of feral mink population to native fauna. Well-planned conservation activities may prevent the colonization at a local level.

Summarise Impact	major	high	American mink is an invasive mammal with the highest impact on native species in Europe, affecting negatively at least 47 native species. Through ecological competition and predation it provokes the decline of several threatened species (European mink, water vole etc.) and drives them even to extinction (local extinctions have already occurred). The continuous expansion of mink populations in several countries suggests that the impacts on native species are still increasing. Expected negative impact towards biodiversity will be high in many places in Europe in the future. Predators, competitors, parasites or pathogens present in Europe do not seem to limit the American mink. The economic cost of control activities is high and thus complete eradication of the species at the European level is not currently practical. Same time, removal of the species has been successful at local level: several projects have completely eradicated mink on islands and also in a few continental areas.
Conclusion of the risk assessment	high	high	A large number of scientific publications demonstrate the invasiveness of the American mink and its very high ecological impact (the species is the main cause of decline or extinction of several threatened species). The main risk for establishment comes from mink farms.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
3.1. What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?	[climate directly]	low	Global warming may affect freshwater habitat quality in dry (Mediterranean) areas in the future, affecting also invasive mink populations. At the same time, climate change may favour the species in northern Europe, the area with harsh climate conditions.
3.2. What is the likely timeframe for such changes?	50	low	Difficult to predict.
3.3. What aspects of the risk assessment are most likely to change as a result of climate change?	[increase of suitable habitat in north and decrease in south Europe]	medium	
ADDITIONAL QUESTIONS – RESEARCH			
4.1. If there is any research that would significantly strengthen confidence in the risk assessment please summarise this here.	[the species invasiveness has demonstrated in many studies]	high	Confidence in the risk assessment is very high. A large number of scientific publications demonstrate the invasiveness of the American mink, the mechanism by which it causes extinction or decline of native species and the difficulties in eradicating it. There is also a substantial scientific literature on the ecology of the American mink, its habitat associations and diet. The species is widespread in large part of Europe (more than 20 countries; Bonesi & Palazon 2007). Recent studies in different countries show that expansion of existing populations is on-going (Roy 2011, MAGRAMA 2014, Rodrigues et al. 2015). Also, the establishment of a new population has been observed recently in Romania (Hegyeli & Kecskés 2014) and the risk of establishment is estimated to be high in Belgium (Branquart 2013) and the Netherlands (Dekker & Hofmeester 2014).

			Control/eradication methods have been tried and tested in a number of different projects. Future mitigation work should be monitored and an adaptive management approach should be adopted (to refine methods in future). However, no further research that would significantly strengthen confidence in the risk assessment is required. There is a need to elaborate means and methods to prevent mink escapes from farms. The escapes from farms can be regarded as environmental pollution. The lack of methods to identify the origin of mink found in the wild prevents implementing the "polluter pays" principle. There is a need for research to make it possible to identify the origin of escaped minks from the farms. There is also a need to identify the ecologically sensitive regions in Europe, where mink farming should be prohibited or restricted.

REFERENCES:

Ahola, M., Nordström, M., Banks, P.B., Laanetu, N. & Korpimäki, E. (2006) Alien mink predation induces prolonged declines in archipelago amphibians. Proc. R. Soc. B 273: 1261–1265.

Aars J., Lambin X, Denny R, Griffin A. (2001) Water vole in the Scottish uplands: distribution patterns of disturbed and pristine populations ahead and behind the American mink invasion front Animal Conservation 4: 187-194

Banks, P. B., Norrdahl, K., Nordström, M. & Korpimäki, E. (2004) Dynamic impacts of feral mink predation on vole metapopulations in the outer archipelago of the Baltic Sea. - Oikos 105: 79-88.

Banks, P.B, Nordström, M., Ahola, M., Salo, P., Fey, K. & Korpimäki, E. (2008) Impacts of alien mink predation on island vertebrate communities of the Baltic sea archipelago: review of a long- term experimental study. Boreal Environment Research 13: 3-16.

Barreto, G. R., Rushton, S. P., Strachan, R. and Macdonald, D. W. (1998) The role of habitat and mink predation in determining the status and distribution of declining populations of water voles in England. Anim. Conserv. 1: 129–137.

Barrientos, R. (2015) Adult sex-ratio distortion in the native European polecat is related to the expansion of the invasive American mink. Biological Conservation. 186: 28-34. DOI: 10.1016/j.biocon.2015.02.030

Bevanger, K. & Henriksen, G. (1995) The distributional history and present status of the American mink (Mustela vison Schreber, 1777) in Norway. Ann. Zool. Fenn. 32: 11–14.

Bobrov V. V., Varshavsky A. A., Khlyap L. A. (2008) Alien mammals in the ecosystem of Russia. Moscow: KMK Scientific Press Ltd; 54–62 (in Russian).

Bonesi, L., Chanin, P. & Macdonald, D.W. (2004) Competition between Eurasian otter Lutra lutra and American mink Mustela vison probed by niche shift. Oikos 106: 19–26.

Bonesi, L. & Palazon, S. (2007) The American mink in Europe: status, impacts and control. Biological Conservation 134: 470-483.

Branquart, E. (2013) Risk analysis of the American mink, Neovison vison, Risk analysis report of non-native organisms in Belgium. Cellule interdépartementale sur les Espèces invasives (CiEi), DGO3, SPW / Editions, 30 pages.

Brzezinski, M, Natorff, M:, Zalewski, A. & Zmihorski (2012) Numerical and behavioral responses of waterfowl to the invasive American mink: A conservation paradox. Biological Conservation 147: 68–78.

Bryce, R., Oliver, M.K., Davies, L., Gray, H., Urquhart, J. & Lambin, X. (2011) Turning back the tide of American mink invasion at an unprecedented scale through community participation and adaptive management. Biological Conservation 144(1): 575–583.

Clode, D. & MacDonald, D.W. (2002) Invasive predators and the conservation of island birds: the case of American Mink Mustela vison and terns Sterna spp. in the Western Isles, Scotland. Bird Study 49: 118–123.

Craik, J. C. A. (1997) Long-term effects of North American Mink on seabirds in western Scotland. Bird Study 44: 303-309.

Cuzic, M., Marinov, M. & Cuzic, V. (2002) American Mink (Mustela vison) – a new mammal species of the DDBR territory. Scientific Annals of the Danube Delta Institute for Research and Development, Tulcea-Romania 9: 52–54.

Dekker, J.J.A. 2012. De Amerikaanse nerts in Nederland. Rapport 2012.16. Zoogdiervereniging, Nijmegen. (in Dutch).

Dekker, J.J.A & Hofmeester, T.R. (2014) The status of the American mink (Neovison vison) in the Netherlands. Lutra, 57 (1): 5-15.

Direktoratet for naturforvaltning (2011) Handlingsplan mot mink.In Norwegian with English abstract.

Dunstone, N. (1993) The mink. T & AD Pyser Natural History, London.

EFBA (European Fur Breeders' Association) Annual report 2011. 23 p.

Fasola, L., Muzio, J., Chehébar, C., Casini, M. & McDonald, D.W. (2011) Range expansion and prey use of American mink in Argentinean Patagonia: dilemmas for conservation. European Journal of Wildlife Research 57: 283-294.

Fey, K., Banks, P.B, Oksanen, L. & Korpimäki, E. (2009) Does removal of an alien predator from small islands in the Baltic Sea induce a trophic cascade? Ecography 32: 546-552.

Finnish Game and Fisheries Research Institute (2014) Hunting 2013. Riista- and kalatalous – Tilastoja 6/2014. Official Statistics of Finland – Agriculture, Forestry and Fishery. 36 p.

Fischer, D. et al. (2009) Predation of the alien American mink, Mustela vison on native crayfish in middle-sized streams in central and western Bohemia. – Folia Zool. 58: 45 – 56.

Fraser, E.J., Macdonald, D.W., Oliver, M.K., Piertney, S. & Lambin, X. (2013) Using population genetic structure of an invasive mammal to target control efforts – an example of the American mink in Scotland. Biological Conservation, 167: 35–42.

Fraser, EJ; Macdonald, DW; Oliver, MK; Piertney, SB and X Lambin (2014) Using population genetic structure of an invasive mammal to target control efforts – an example of the American mink in Scotland. Biological conservation 167:35-42 http://dx.doi.org/10.1016/j.biocon.2013.07.011

Fraser E.J, X Lambin, J. M. J. Travis, L.A. Harrington, S. C. F. Palmer, G Bocedi and D. W. Macdonald (2015) Range expansion of an invasive species through a heterogeneous landscape – the case of American mink in Scotland. Diversity and Distributions 21, 8: 888–900. DOI: 10.1111/ddi.12303

Gerell, R. (1967) Dispersal and acclimatization of the mink (Mustela vison Schreb) in Sweden. Viltrevy 5: 1-38.

Gerell, R. (1970) Home ranges and movements of the mink Mustela vison Scheber in southern Sweden. Oikos 21: 160-173.

Genovesi, P., Bacher, S., Kobelt, M., Pascal, M., Scalera, R. (2009) Alien mammals of Europe. In: DAISIE, ed. Handbook of Alien Species in Europe. Invading Nature: Springer Series in Invasion Ecology. Springer, Dordrecht, Netherlands: 119–29.

Genovesi, P., Carnevali, L., Alonzi, A. and Scalera, R. (2012) Alien mammals in Europe: updated numbers and trends, and assessment of the effects on biodiversity. Integrative Zoology, 7: 247–253.

Hammershøj, M. (2004) Population ecology of free-ranging American mink Mustela vison in Denmark. PhD thesis, National Environmental Research Institute, Kalø, Denmark. 30 pp. http://afhandlinger.dmu.dk

Hammershøj, M., Pertoldi, C., Asferga, T., Møller, T.B. & Kristensen, N.B. (2005) Danish free-ranging mink populations consist mainly of farm animals: Evidence from microsatellite and stable isotope analyses. Journal for Nature Conservation 13: 267—274.

Harrington L.A., Harrington, A.L., Moorhouse, T., Gelling, M., Bonesi, L. & MacDonald, D.W. (2009) American mink control on inland rivers in southern England: an experimental test of a model strategy. Biological Conservation 142: 839-849.

Hegyeli, Z. & Kecskes, A. (2014) The occurrence of wild-living American Mink Neovison vison in Transylvania, Romania. Small Carnivore Conservation, 51: 23–28.

Heptner, V.G., Naumov, N.P., Yurgenson P.B., Sludskiy, A.A., Chirkova, A.F. & Bannikov, A.G. (1967) Mlekopitayushchie Sovetskogo Soyuza [Mammals of Soviet Union], Vol.2 (1) Sea cows and carnivora. 1004 p. Moscow. (In Russian).

Ibarra, J.T., Fasola, L., Macdonal, D.W., Rozzi, R., Bonacic, C. (2009) Invasive American mink Mustela vison in wetlands of the Cape Horn Biosphere Reserve, Southern Chile. What are they eating? Fauna & Flora International, Oryx 43 (1), 87-90.

Jaksic, F.M., Iriarte, J.A., Jiménez, J.E., Martínez, D.R. (2002) Invaders without frontiers: cross-border invasions of exotic mammals. Biol Invasions 4: 157–173.

Jepsen, JR, d'Amore, F, Baandrup, U, Clausen, MR, Gottschalck, E & Aasted, B (2009) Aleutian mink disease virus and humans. Emerging Infectious Diseases (Print Edition), 15, 12:2040-2042.

Jiménez, J.E., Crego, R.D., Soto, G.E., Román, I., Rozzi, R., Vergara, P.M. (2013) Potential impact of the alien American Mink (Neovison vison) on Magellanic woodpeckers (Campephilus magellanicus) in Navarino Island, Southern Chile. Biological Invasions. doi:10. 1007/s10530-013-0549-1.

Kauhala, K., (1996) Distributional history of the American mink (Mustela vison) in Finland with special reference to the trends in otter (Lutra lutra) populations. Annales Zoologici Fennici 33, 283– 291.

King, C.M., McDonald, R.M., Martin, R.D., Dennis, T. (2009) Why is eradication of invasive mustelids so difficult? Biological Conservation. 142: 806–816.

Kranz, A., Toman, A., Polednikova, K., Polednik, L. and Kiss, J. B. (2004). Distribution, status and conservation priorities of the European Mink in the Romanian Danube Delta. Scientific Annals of the Danube Delta Institute for Research and Development, Tulcea-Romania 10: 38–44.

Lambin, X., Atkinson, S., Bryce, R., Davies, L., Gray, H., Oliver, M.K, Urquhart, J. (2011) Turning back the tide of American mink invasion at unprecedented scales in partnership with communities. 8th European Vertebrate Pest Management Conference, Book of abstracts. Julius-Kühn-Archiv 432: 24-25. DOI: 10.5073/jka.2011.432.008

Larivière, S. (1999) Mustela vison. Mammalian Species 608: 1-9.

Lodé, T. (2006) Can low densities of carnivores result in genetic depletion? An investigation within French polecat populations. Journal of Animal Breeding and Genetics, 123: 152–158.

Macdonald, D. W., Sidorovich, V. E., Anisomova, E. I., Sidorovich, N. V. and Johnson, P. J. (2002a) The impact of American mink Mustela vison and European mink Mustela lutreola on water voles Arvicola terrestris in Belarus. Ecography, 25: 295–302.

Macdonald, D.W., Sidorovich, V.E., Maran, T., Kruuk, H., (2002b). The Darwin Initiative. European Mink, Mustela Lutreola: Analyses for Conservation. Wildlife Conservation Research Unit, University of Oxford, Oxford.

Macdonald, D.W. & Harrington, L.A. (2003) The American mink: the triumph and tragedy of adaptation out of context. New Zealand Journal of Zoology 30: 421-441.

MAGRAMA (2014) Estrategia de gestión, control y erradicación del visón americano (Neovison vison) en España. 38 p.

Mañas. S, Ceña, J.C., Ruiz-Olmo, J., Palazón, S., Domingo, M., et al. (2001) Aleutian mink disease parvovirus in wild riparian carnivores in Spain. Journal of Wildlife Diseases 37: 138–144.

Maran, T. & Henttonen, H. (1995) Why is the European mink (Mustela lutreola) disappearing? A review of the process and hypotheses. Ann. Zool. Fennici 32: 47-54.

Maran, T., Macdonald, D.W., Kruuk. H., Sidorovich. V., Rozhnov, V.V. (1998) The continuing decline of the European mink, Mustela lutreola: evidence for the intraguild aggression hypothesis. In: Dustone N, Gorman ML (eds) Behaviour and ecology of riparian mammals. Symposia of the Zoological Society of London, Cambridge University Press: 297–324.

Maran, T., Skumatov, D., Palazón, S., Gomez, A., Põdra, M., Saveljev, A., Kranz, A., Libois, R. & Aulagnier, S. (2011) Mustela lutreola. The IUCN Red List of Threatened Species 2011: e.T14018A4382176.

Maran, T. (1991) Distribution of the European mink, Mustela lutreola, in Estonia: an historical review. Folia Theriological Estonica 1: 1- 17.

Marinov, M. E., Kiss, J. B., Toman, A., Poledník, L., Alexe, V., Doroftei, M., Doroșencu, A. & Kranz, A. (2012) Monitoring of European Mink (Mustela lutreola) in the Danube Delta Biosphere Reserve – Romania, 2003–2011. Current status and setting of goals for the European Mink conservation. Scientific Annals of the Danube Delta Institute 18: 69–74.

McDonald, R. A., O'Hara, K. & Morrish, D. J. (2007) Decline of invasive alien mink (Mustela vison) is concurrent with recovery of native otters (Lutra lutra). Diversity and Distributions 13: 92–98.

Melero, Y. , Plaza, M., Santulli, G., Saavedra, D., Gosàlbez, J., Ruiz-Olmo, J. & Palazón, S. (2012) Evaluating the effect of American mink, an alien invasive species, on the abundance of a native community: is coexistence possible? Biodiversity and Conservation 21: 1795–1809.

Melero, Y., Robinson, E., Lambin, X. (2015) Density and age - dependent reproduction partially compensates culling efforts of invasive non - native American mink. Biological invasions DOI 10.1007/s10530-015-0902-7

Moore, N.P., Roy, S.S. & Helyar, A. (2003) Mink (Mustela vison) eradication to protect ground-nesting birds in the Western Isles, Scotland, United Kingdom. New Zealand Journal of Zoology 30 (4): 443-452.

Nordström, M., Högmander, J., Nummelin, J., Laine, J., Laanetu, N. & Korpimäki, E. (2002) Variable responses of waterfowl breeding populations to long-term removal of introduced American mink. Ecography 25: 385– 394.

Nordström, M. (2003) Introduced predator in Baltic Sea archipelagos: variable effects of feral mink on bird and small mammal populations. PhD thesis, Annales Universitatis Turkuensis, SER. AII, TOM. 158.

Nordström, M., Högmander, J., Laine, J., Nummelin, J., Laanetu, N. & Korpimäki, E. (2003) Effects of feral mink removal on seabirds, waders and passerines on small islands in the Baltic Sea. Biological Conservation 109: 359– 368.

Nordström, M. & Korpimäki, E. (2004): Effects of island isolation and feral mink removal on bird communities on small islands in the Baltic Sea. - Journal of Animal Ecology 73: 424-433.

Nordström, M., Laine, J., Ahola, M. & Korpimäki, E. (2004): Reduced nest defence intensity and improved breeding success in terns as responses to removal of non-native American mink. – Behavioral Ecology and Sociobiology 55:454-460.

Oleinikov A. Yu. (2013) Distribution of native and introduced semiaquatic mammals in Sikhote-Alin. Russian Journal of Biological Invasions 4 (3):180-189.

Oliver MK;, SB Piertney; A Zalewski; Y Melero; X Lambin (2016) The compensatory potential of increased immigration following intensive American mink population control is diluted by male-biased dispersal. Biological Invasions in press

Põdra, M., Gómez, A., Palazón, S., (2013) Do American mink kill European mink? Cautionary message for future recovery efforts. Eur. J. Wildl. Res. 59, 431–440.

Previtali, A., Cassini, M. H. and Macdonald, D. W. (1998) Habitat use and diet of the American mink (Mustela vison) in Argentinian Patagonia. Journal of Zoology, 246: 482–486.

Reid, F. & Helgen, K. (2008) *Neovison vison*. The IUCN Red List of Threatened Species. Version 2014.3. <www.iucnredlist.org>.

Reynolds, J.C., Short, M.J. & Leigh, R.J. (2004) Development of population control strategies for mink Mustela vison, using floating rafts as monitors and trap sites. Biological Conservation 120 (4): 533–543.

Reynolds, J. C., Richardson, S. M., Rodgers, B. J. E. and Rodgers, O. R. K. (2013) Effective control of non-native American mink by strategic trapping in a river catchment in mainland Britain. The Journal of Wildlife Management, 77: 545–554.

Rodríguez, R., Ramírez, O., Valdiosera, C. E., García, N., Alda, F., Madurell-Malapeira, J., Marmi, J., Doadrio, I., WillersIev, E., Götherström, A., Arsuaga, J. L., Thomas, M. G., Lalueza-Fox, C. and Dalen, L. (2011) 50,000 years of genetic uniformity in the critically endangered Iberian lynx. Molecular Ecology, 20: 3785–3795.

Rodrigues, D.C., Simões, L., Mullins, J., Lamoa, S., Fernandes, C., Rebelo, R., Santos-Reis, M. (2015) Tracking the expansion of the American mink (Neovison vison**)** range in NW Portugal. Biological Invasions, 17 (1): 13-22.

Roesler, I., Imberti, S., Casañas, H., Volpe, N., (2012) A new threat for the globally Endangered Hooded Grebe Podiceps gallardoi: The American mink Neovison vison, Bird Conservation International 0:1-6.

Roy, S., Reid, N., McDonald, R.A. (2009) A review of mink predation and control in Ireland. Iris Wildlife Manuals, No. 40. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

Roy, S. (2011) Strategies to improve landscape scale management of mink populations in the west coast of Scotland: lessons learned from the Uists 2001-2006. In: Veitch, C. R.; Clout, M. N. and Towns, D. R. (eds.). 2011. Island invasives: eradication and management. IUCN, Gland, Switzerland. Pages 114-117.

Ruiz-Olmo J., Palazón S., Bueno F., Bravo C., Munilla I. and Romero R. (1997) Distribution, status and colonization of the American mink Mustela vison in Spain. J. Wildl. Res., 2(1): 30-36.

Santulli G, Palazón S, Melero Y, Gosálbez J and X Lambin (2014) Multi-seasons occupancy analysis reveals large scale competitive exclusion of the critically endangered European mink by the invasive non-native American mink in Spain. Biological Conservation 176, 21–29 http://dx.doi.org/10.1016/j.biocon.2014.05.002

Salo, P., Nordström, M., Thomson, R. L. and Korpimäki, E. (2008) Risk induced by a native top predator reduces alien mink movements. Journal of Animal Ecology, 77: 1092–1098.

Salo, P., Ahola, M. P. & Korpimäki, E. (2010) Habitat-mediated impact of alien mink predation on common frog densities in the outer archipelago of the Baltic Sea. – Oecologia 163: 405-413.

Saveljev, A.P., Shar, S., Scopin A.E., Otgonbaatar, M., Soloviev, V.A., Putincev, N.I. Lhamsuren, N. (2015) Introduced semiaquatic mammals in the Uvs Nuur Hollow (Current distribution and Ecological Vectors of Naturalization). Russian Journal of Biological Invasions, 2015, Vol. 6, No. 1, pp. 37–50.

Shimatani, Y., T. Takeshita, S. Tatsuzawa, T. Ikeda and R. Masuda. (2008) Genetic identification of mammalian carnivore species in the Kushiro Wetland, eastern Hokkaido, Japan, by analysis of faecal DNA. Zoological Science 25:714-720.

Schüttler, E., J.T. Ibarra, B. Gruber, R. Rozzi & K. Jax. (2010) Abundance and habitat preferences of the southernmost population of Mink: Implications for managing a recent island invasion. Biodiversity and Conservation 19: 725-743

Sidorovich, V.E. (1997) Mustelids in Belarus. Evolutionary ecology, demography and interspecific relationships. Zolotoy Uley, Minsk, p 289.

Sidorovich, V.E. (2000) The ongoing decline of riparian mustelids (European mink, Mustela lutreola, polecat, Mustela putorius and stoat, Mustela erminea) in eastern europe: a review of the results to date and na hypothesis. In: Griffiths, H.I. (Ed.), The Mustelids in a Modern World. Management and Conservation Aspects of Small Carnivore: Human Interactions. Bachuys, Leiden, pp. 295–317.

Sidorovich, V.E., Polozov, A.G., Zalewski, A. (2010) Food niche variation of European and American mink during the American mink invasion in north-eastern Belarus. Biological invasions, 12, 7: 2207-2217.

Sidorovich, V.E. (2011) Analyses of Vertebrate-Prey Community. Minsk, Tesey, 736 p.

Sidorovich, V.E., Kruuk, H., Macdonald, D.W., Maran, T. (1998) Diets of semiaquatic carnivores in northern Belarus, with implications for population changes. In: Dustone N, Gorman ML (eds) Behaviour and ecology of riparian mammals. Symposia of the Zoological Society of London, Cambridge University Press, Cambridge, pp 177–190.

Sidorovich, V. E. (2000). Seasonal variation in the feeding habits of riparian mustelids in river valleys of NE Belarus. *Acta Theriologica*, *45*(2), 233-242.

Sidorovich, V. & MacDonald, D.W. (2001). Density dynamics and changes in habitat use by the European mink and other native mustelids in connection with the American mink expansion in Belarus. Netherlands Journal of Zoology 51(1): 107-126.

Sidorovich, V. & Solovej, I. (2007) The stoat Mustela erminea population decline in northern Belarus and its consequences for weasels Mustela nivalis. New Zealand Journal of Zoology 34:9-23.

Steil, J. & Heger, T. (2008) Der Mink (Mustela vison SCHREBER 1777) in Deutschland – eine Bedrohung für heimische Arten? Natur und Landschaft 83: 365–369.

The Norwegian Directorate for Nature Management (2011) Scientific basis for action plan against American Mink in Norway Invasive American Mink (Neovison vison): Status, ecology and control strategies. DN-utredning 6-2011.

Tragsatec (2015) Report of the project LIFE 13 NAT/ES/001171 LIFE LUTREOLA "Nuevos enfoques en la conservación del visón europeo en España" Acción A1: Comprobación de la efectividad de las metodologías de detección y de captura del visón europeo y del visón americano.

Urho, L., Holmala, K., Pennanen, J. T., Pursiainen, M., Rintala, J. & Veneranta, L. (2014) Haitallisten vieraiden kala-, rapu- ja nisäkäslajien leviäminen, tietoisuuden lisääminen ja hallinta. RKTL:n työraportteja 10/2014. 76 p. [in Finnish]

Valenzuela, A.E.J., Raya Rey, A., Fasola, L., Saenz Samaniego, R.A. & A Schiavini, A. (2013) Trophic ecology of a top predator colonizing the southern extreme of South America: bof invasive American mink (Neovison vison) in Tierra del Fuego. Mammal. Biol., 78:104-110.

Vidal-Figueroa, T., Delibes, M. (1987).Primeros datos sobre el visón americano (Mustela vison) en el suroeste de Galicia y noroeste de Portugal. Ecología 1:145-152.

Woodroffe, G.L, Lawton, J.H. & Davidson, W.L. (1990) The impact of feral mink Mustela vison on water voles Arvicola terrestris in the North Yorkshire Moors National Park, Biological Conservation, 51, 1:49-62

Zschille, J., Stier, N., Roth, M., Mayer, R. (2014) Feeding habits of invasive American mink (Neovison vison) in northern Germany- potential implications for fishery and waterfowl. Acta Theriologica 59, 1: 25-34

Zalewski, A., Michalska Parda, A., Bartoszewicz, M., Kozakiewicz, M., Brzezinski, M. (2010) Multiple introductions determine the genetic structure of an invasive species population: American mink Neovison vison in Poland. Biological Conservation, 143, 6:1355–1363

Zalewski, A., Michalska Parda, A., Ratkiewicz,M. Bartoszewicz, M., Kozakiewicz, M., Brzezinski, M. (2011) High mitochondrial DNA diversity of an introduced alien carnivore: comparison of feral and ranch American minkNeovison vison in Poland. Diversity and distributions. 17, 4: 757:768

Zabala, J., Zuberogoitia, I. & González-Oreja, J.A. (2010) Estimating costs and outcomes of invasive American mink (Neovison vison) management in continental areas: a framework for evidence based control and eradication. Biol. Invasions. 12: 2999-3012.

Zuberogoitia, I., González-Oreja, JA., Zabala, J. & Rodríguez-Refojos, C. (2010) Assesing the control/eradication of an invasive species, the American mink, based on field data; how much would it cost? Biodiversity and Conservation, 19: 1455-1469

Zuberogoitia, I., Zabala, J. & Martínez, J.A. (2006) Evaluation of sign surveys and trappability of American mink. Consequences for management. Folia Zoologica, 55 (3): 257-263.

Zuberogoitia, I., Zalewski, H., Zabala, J., Zalewski, A. (2013) The impact of river fragmentation on the population persistence of native and alien mink: an ecological trap for the endangered European mink. Biodiversity Conservation 22:169-186.

Zuberogoitia, I., Pérez de Ana, J.M., (2014) Population trends and evolution of the knowledge of European Mustela lutreola (Linnaeus, 1761) and American mink Neovison vison (Schreber, 1777) in Bizkaia. Munibe Monographs. Nature Series 3: 119-131