Appendix A

Harmonia^{+PL} – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland

QUESTIONNAIRE

A0 | Context

Questions from this module identify the assessor and the biological, geographical & social context of the assessment.

a01. Name(s) of the assessor(s):

first name and family name

1. Andrzej Zalewski
2. Magdalena Bartoszewicz
3. Henryk Okarma

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Mammal Research Institute Polish Academy of Sciences, Bialowieża	16-01-2018
(2)	dr		20-01-2018
(3)	prof. dr hab	Institute of Nature Conservation of the Polish Academy of Sciences in Cracow	22-01-2018

a02. Name(s) of the ***Species*** under assessment:

Polish name: Norka amerykańska

Latin name: ***Neovison vison*** (Schreber, 1777)

English name: American mink

Współfinansowano w ramach projektu nr POIS.02.04.00-00-0100/16 pn. *Opracowanie zasad kontroli i zwalczania inwazyjnych gatunków obcych wraz z przeprowadzeniem pilotażowych działań i edukacją społeczną* ze środków Unii Europejskiej w ramach Programu Infrastruktura i Środowisko 2014-2020

acomm02.	Comments:

Polish name (synonym I) –	Polish name (synonym II) –
Latin name (synonym I) *Mustela vison*	Latin name (synonym II) –
English name (synonym I) Mink	English name (synonym II) Wild mink

a03. **Area** under assessment:

Poland

acomm03.	Comments: –

a04. **Status** of the *Species* in Poland. The *Species* is:

	native to Poland
	alien, absent from Poland
	alien, present in Poland only in cultivation or captivity
	alien, present in Poland in the environment, not established
X	alien, present in Poland in the environment, established

aconf01.	Answer provided with a	low	medium	high **X**	level of confidence

acomm04.	Comments: The first farms of American mink were established in Poland in 1928, yet they were small amateur farms. Production farms, on the other hand, began to emerge after the Second World War in 1953 (Lisiecki, Sławoń 1980 - P). The first observations of the species in the wild state from Poland area date back to the end of the 1950s, they were probably observations of subjects running away from the farms. Until 1970, observations of this species occurred sporadically. The expansion of the American mink in Poland began in the 1980s, when the frequency of observations in north-western Poland increased, it is presumed that due to the large distance from the Belarusian and Lithuanian populations, these were not subjects from the east. Most probably, the wild population of mink in western Poland originates from subjects escaping from farms (Brzeziński and March 2003 - P), while in eastern Poland - from escaped animals and/or ones introduced in the Soviet Union. This is confirmed by the results of wild-type and farm mink DNA research carried out in Poland. They demonstrate that wild minks in the eastern part of the country originate from subjects which came from Belarus, while the majority of mink settling in western Poland was colonized by escaping subjects and their offspring (Zalewski et al. 2010 - P). After the emergence of the species in the west of Poland, its expansion began also to the north and south (including: Ruprecht et al. 1983, Romanowski et al. 1984, Ruprecht 1996, Brzeziński and Marzec 2003 - P). In 2001, American mink was entered into the list of game animals. Since then, acquisition from hunting increased from around 2,100 in the 2002/2003 season to 4,200 in the 2014/2015 and 2015/2016 season, and then declined. The species is obtained by hunters in all voivodeships (a list of hunting report data for the PZŁ Czempiń Research Station). The current distribution of the species already covers nearly entire Poland with the exception of its southern areas (Internet source 1: Atlas Ssaków Polski - B).

a05. The impact of the *Species* on major domains. The *Species* may have an impact on:

X	environmental domain
	cultivated plants domain
X	domesticated animals domain
X	human domain

	other domains

acomm05.	Comments: The American mink can negatively affect the natural environment, both by competing for resources with native species (mainly with polecats, ermines and European mink), as well as predation. The influence of the American mink on various native species of birds and mammals has been documented the best (Banks et al. 2008, Bartoszewicz and Zalewski 2003, Ferreras et al. 1999, Brzeziński et al. 2012, 2018 - P). The drastic reduction in the numbers of some species of birds and mammals causes changes in the composition of the group not only of mink prey, but also other predators, which in turn causes the reconstruction of the entire mammalian group in river valleys (Sidorovich and Macdonald 2001 - P). Negative impact on amphibians and fish, which are one of the main components of its diet (Jędrzejewska et al. 2001, Bartoszewicz and Zalewski 2003 - P) is not documented. The lack of research on this subject, however, does not preclude the negative impact of the mink on these species groups. A large number of species of parasites transmitted by American mink may cause an increase in the level of infection in native mammalian species, but no research has been carried out that could confirm this hypothesis. Transfer of tapeworms of the genera *Toxocara* and *Echinococcus*, as well as trichinosis through the mink (Hurnikova et al. 2016 - P) may increase these parasite infections among household animals and humans. Mink has little impact on humans, both directly - not posing a threat, and indirectly - it does not cause major damage to crops or livestock, but can carry rabies. It may affect mink breeding on farms, due to the transfer of Aleutian disease to farms. Minks are sometimes found in anthropogenic habitats (on fishponds, in hen houses), but no impact has been noted on the infrastructure. However, it can affect animal breeding through predation.

A1 | Introduction

Questions from this module assess the risk for the Species to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation. This leads to Introduction, defined as the entry of The Organism within the limits of The Area and subsequently into the wild.

a06. The probability for the *Species* to expand into Poland's natural environments, **as a result of self-propelled expansion** after its earlier introduction outside of the Polish territory is:

	low
	medium
X	high

aconf02.	Answer provided with a	low	medium	high **X**	level of confidence

acomm06.	Comments: The species is already settled in Poland. Until the 1970s, observations were sporadic, from the 1980s - regular, and then the expansion of the species began. Genetic research indicates that part of Poland was colonized by the mink from the east (Belarus), while western Poland - by offspring of escaping subjects from farms established in Poland or from farms in Germany (Zalewski et al. 2009, 2010 - P). This species is still expanding the area of occurrence in Poland and colonizing the southern areas of the country (Brzeziński et al. - in printing - I). The rate of mink expansion in Poland varies from 100 to 2870 km^2/year – an average of 1327 km^2/year (Brzeziński et al., in printing - I).

a07. The probability for the *Species* to be introduced into Poland's natural environments by **unintentional human actions** is:

	low
	medium

X	high

aconf03.	Answer provided with a	low	medium	high X	level of confidence

acomm07. Comments:

The species is already settled in Poland.

a08. The probability for the *Species* to be introduced into Poland's natural environments by **intentional human actions** is:

	low
	medium
X	high

aconf04.	Answer provided with a	low	medium	high X	level of confidence

acomm08. Comments:

In Poland, the first mink farms were created in 1928. Until the end of the 1990s, about 100-200 thousand minks were bred in Poland (Zalewski and Brzeziński 2014 - P). Since the beginning of 2000, there has been a rapid increase in the number of farms and bred minks - over the years 2015-2016, about 8 million minks were bred (Zalewski and Brzeziński 2014 - P). American mink breeding is a branch of animal production. This species is currently the most popular species of animal bred for fur production in the world. Mink is bred primarily to use the pelts, but its by-products include fat used in leather goods care and hair used, among others, in the production of artificial eyelashes. Mink meat is used to produce feed for pet predatory animals. Poland is currently a potentate in the production of mink pelts, taking third place in world production after China and Denmark. About 4 million American mink pelts were produced in Poland in 2010. Production increases year after year, and in 2012 it reached 5.4 million, while in 2015 – 8.5 million pelts (Internet source: http://fureurope.eu/wp-content/uploads/2015/02/FE-Annual-report-2015-Single-Pages.pdf). Over 85% of all Polish farms are located in the north-western part of the country, in the following voivodeships: West Pomeranian, Lubusz, Greater Poland and (Zalewski and Brzeziński 2014 - P) based on the data of the General Veterinary Inspectorate, as of July 2014). At the same time, over 90% of the basic stock is maintained in these voivodships (Zalewski et al. 2010 - P). Studies conducted in Poland proved that wild minks in the eastern part of the originate from subjects who came from Belarus, while the majority of mink settling in western Poland was colonized by escaping subjects and their offspring (Zalewski et al. 2010 - P). One cannot ignore the fact that many minks have escaped and are still recovering as a result of animal rights activists. As a result of mass releases, thousands of American mink are released every year into the European ecosystems. In recent years, mink have been extensively released from cages in many European countries (Germany, the Czech Republic, Denmark, Ireland, Sweden, Greece), and in 2014 perhaps also in Poland (Internet source: http://wyborcza.pl/1,134642 , 16517321, Sadowa_awantura_o_norki.html - I). Many authors indicate that in the wild population, the percentage of subjects escaped from captivity is directly proportional to the number of mink farmed in the area (e.g. Kidd et al. 2009; Bifolchi et al. 2010 - P). In Poland, the percentage of subjects escaping from farms in the wild living population in each voivodeship is dependent on the number of minks kept there (Zalewski et al. 2010). In the north-eastern and central part of the country, where the farm number is relatively small, the escaping subjects from the farms constitute 12-16% of the population of wild minks. In north-eastern Poland (Romincka Forest, Biebrza Valley), escaping subjects constitute 3% of the population, in the Vistula valley (Warsaw - Puławy) - 9%, in the Narew Valley - 15%, and in the west (the Warta, Gwda, Słupia and Welu Valley) - as much as 41% (Zalewski et al. 2010 - P). Wild living escaping subjects most often belong to the standard color variant - the most phenotypically similar to American mink living in North America. A few percent of the population belongs to a pastel variety or the like (Michalska-Parda et al. 2009 - P). This corresponds to the proportion of color varieties grown on Polish farms (Jeżewska-Witkowska et al. 2014 - P). The introduction of mink into

the environment as a result of human activities is demonstrated on the basis of genetic tests (Zalewski et al. 2010, 2011 - P) and on the basis of observations of different color varieties in wild-type populations (Zalewski's own observations). The increase in the number of farms, especially in areas not yet occupied by minks, was probably the reason for the increase in the pace of expansion in 2004-2008 (Brzeziński et al. - in print - I). The inflow of subjects escaping from farms to the natural environment increases genetic variability in wild populations, and this may increase the adaptation of subjects in these populations (Zalewski et al. 2011 - P). In Poland, there has been a regulation of the Minister of Agriculture and Rural Development regarding the minimum conditions foir keeping livestock species, in which the protection of minks and polecats' farms against escapes of animals introduced. However, no security measures are completely effective.

A2 | Establishment

Questions from this module assess the likelihood for the Species to overcome survival and reproduction barriers. This leads to Establishment, defined as the growth of a population to sufficient levels such that natural extinction within The Area becomes highly unlikely.

a09. Poland provides **climate** that is:

	non-optimal
	sub-optimal
X	optimal for establishment of the *Species*

aconf05. Answer provided with a

low	medium	high
		X

level of confidence

acomm09. Comments:

The American mink comes from North America, the southern border of its area of presence runs through the states of California, Nevada, Utah, New Mexico and Texas (Dunstone 1993 - P). The climatic conditions in Poland are very similar to the conditions in the natural range of this species and do not constitute a barrier to its establishment and spread.

a10. Poland provides **habitat** that is

	non-optimal
	sub-optimal
X	optimal for establishment of the *Species*

aconf06. Answer provided with a

low	medium	high
		X

level of confidence

acomm10. Comments:

American mink inhabits various environments in the vicinity of waters: lakes shores, various types and sizes of streams (rivers, streams, drainage channels), ponds, flood plains, sea coasts (Dunstone 1993, Kauhala 1996, Bartoszewicz and Zalewski 2003, Yamaguchi and others. 2003, Melero et al. 2008 - P). The rate of colonization of a given area is dependent on the density of watercourses and surface waters per unit area. As a result, particularly areas characterized by a dense network of rivers, ditches and drainage channels as well as lakes and ponds are exposed to colonization. The activity of mink in these environments is limited to a narrow strip (up to 400 m) of the margins of these reservoirs (Harrington, Macdonald 2008 - P). Due to their high plasticity and wide habitat niche, they occupy all available habitats, yet avoid the banks of river and lake sections strongly transformed by humans (Brzeziński et al. 2012, 2018 - P).

A3 | Spread

Questions from this module assess the risk of the Species to overcome dispersal barriers and (new) environmental barriers within Poland. This leads to spread, in which vacant patches of suitable habitat become increasingly occupied from (an) already-established population(s) within Poland.

Note that spread is considered different from range expansions that stem from new introductions (covered by the Introduction module).

a11. The capacity of the *Species* to disperse within Poland by natural means, **with no human assistance**, is:

	very low
	low
	medium
	high
X	very high

aconf07.	Answer provided with a	low	medium	high **X**	level of confidence

acomm11. Comments:

Population expansion (Data type: B)
American mink is a regular element of Polish fauna since the early 1980s (Ruprecht et al. 1983, Brzeziński and March 2003 - P). Research indicates that in the wild population there is a percentage of escaping subjects from captivity (varying depending on the region of the country - Zalewski et al. 2010 - P), nevertheless, following mass introductions in the Soviet Union and escapes from breeding farms, the species created a wild population that spontaneously expands its range. The range of occurrence covers almost the entire territory of Poland, excluding the southernmost areas. Minks also colonize these areas and the expansion continues. The mathematic model of mink expansion in Poland suggests that by the end of 2025 the entire area of the country will be colonized by this species (Brzeziński et al in print - I). The pace of expansion may be lower in mountain areas, as minks avoid these areas (Zalewski et al. 2009 - P).

a12. The frequency of the dispersal of the *Species* within Poland by **human actions** is:

	low
X	medium
	high

aconf08.	Answer provided with a	low	medium **X**	high	level of confidence

acomm12. Comments:

Mink spreading with human participation (e.g., as a result of trapping from the wild population and transfer to new areas) is unlikely. Minks are caught relatively often, for example, on fishponds, in order to reduce the losses caused by these predators. Since some of the owners of ponds do not want to kill these animals, there are cases of transporting and releasing them near other water reservoirs, far away from the place of catching (A. Zalewski – own observations).

A4a | Impact on environmental domain

Questions from this module qualify the consequences of the *Species* on wild animals and plants, habitats and ecosystems.

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened. See, for example, Red Lists, protected species lists, or Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the

habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

Native species population declines are considered on the local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as a (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

a13. The effect of the *Species* on native species, through **predation, parasitism or herbivory is**:

	inapplicable
	low
	medium
X	high

aconf09.	Answer provided with a	low	medium	high **X**	level of confidence

acomm13. Comments:

American minks have significant impact on both the species that constitute their prey and competitors. This species is a generalist and a food opportunist (Gerell 1967 - P), hunting for prey living in both aquatic and terrestrial environments, and four groups of prey (fish, amphibians, birds and mammals) constitute the main component of its food (Sidorovich 1992, Zalewski and Brzeziński 2014 - P). The composition of the diet is also diverse due to the season, sex and environmental factors, the diet is also very dependent on the location (e.g. Gerell 1968, Erlinge 1969, 1972, Gilbert and Nancekivell 1982, Birks and Dunstone 1985, Sidorovich 1992, Bartoszewicz and Zalewski 2003, Fischer et al. 2009 - P). In Poland, the amount of information about the mink's food preferences is constantly expanding. Studies on the composition of American mink food has been carried out so far in Masuria and the Brodnica Lake District (Brzeziński and Żurowski 1992, - P, Brzeziński 1998 - N), Bialowieza Forest (Jędrzejewska et al. 2001 - P), in the Ujście Warty National Park (Bartoszewicz 2004 - N), Słowiński National Park (Jędrzejewski 1995 - N), in the Barycz Valley (Krawczyk et al. 2013 - P), in the Biebrza Valley (Skierczyński et al. 2008 - P). Based on these studies, it is possible to determine the adaptation of mink to various types of environments and the use of the most easily accessible food resources. In the vicinity of large lakes, the majority of food includes small mammals (voles *Microtus arvalis*, muskrat *Ondatra zibethicus*, water vole *Arvicola amphibius*), the minority of the diet comprises fish or amphibians. In Masuria, crustaceans (crayfish) are quite a significant part of its food. Wintering amphibians are an important source of mink feed in the Białowieża Primeval Forest (51% - most often the *Rana temporaria* moor frog or *Rana arvalis* marshland frog), and in some years – also in the Biebrza Marshes. In Ujście Warty - a bird refuge of European rank, where large concentrations of birds occur almost throughout the year – during the breeding season (Spring) and molting (in Summer), birds constitute over 60% of the mink feed. In other seasons of the year, when birds become harder to hunt, mink feed mainly includes fish and mammals. There were also traces of insects and snails as well as plant food found in the mink diet. In floodplains and lakes, birds form the basis of their food, especially in Spring. Research conducted in Scotland, Sweden and Finland showed that the mink has a huge negative impact on birds (gulls, terns, plovers or auks) inhabiting the sea islands (Craik 1997, Nordstrom et al. 2004, Banks et al. 2008 - P). The presence of minks reduces the breeding success of birds, not only due to the destruction of breeding areas but also by scaring off the adult subjects. The impact of American mink on inland water birds was studied to a lesser extent. In England, it was estimated that mink removed more than 30% of the Eurasian coot *Fulica atra* population and 16% of the common moorhen Gallinula chloropus over the Thames (Ferreras and Macdonald 1999 - P). The nesting success of 3 species of birds over Biebrza (northern lapwing *Vanellus vanellus*, black-tailed godwit *Limosa limosa* and common redshank *Tringa totanus*) was only 10%, and after removal of a significant part of the mink population, it increased to 70% (Niemczynowicz et al. 2017 - P). In Masuria, the number of coots and great crested grebe *Podiceps cristatus* decreased several times after mink presence started in this area (Brzezinski et al. 2012 - P). In the

Ujście Warty National Park, however, this predator had much lower effect. Minks removed only 8% from the population of coots, 11% of ducks and only about 2% of grebes. In case of species nesting in breeding boxes, as many as 47% of clutches had success, and this success was similar to the period prior to occurrence of the mink (Bartoszewicz and Zalewski 2003 - P). Significantly lower nest success was found in graylag goose *Anser anser*, only 14% of nests had young specimens hatching (Bartoszewicz and Zalewski 2003 - P). A few years earlier (between 1994-1996), the success of nested geese on all types of nests in this area was on average 30%, and on artificial nests it oscillated even around 55%. In the United Kingdom and Belarus, it was demonstrated that the mink had a significant influence on the number of water voles (Macdonald and Strachan 1999, Macdonald et al. 2002 - P). With the presence of the American mink over the River Thames in England, the number of water voles has been limited to just a few sites (Macdonald, Strachan 1999). Throughout the area of England, as a result of the colonization of this area by the mink, a drop in the water vole population was noted in 96% of monitored sites. Minks also limited the number of a introduced species – muskrat in Poland (Brzeziński et al. 2010 - P). In some environments, amphibians are an important component of the mink diet, but there are no studies analyzing the effect of mink predation on amphibians. The only results showing the negative impact of the mink on the grass frog *Rana temporaria* population come from Baltic Sea islands (Banks et al. 2008 - P). These studies were conducted in isolated and poor environments, therefore their results are difficult to refer to populations from other areas. Similarly, there are no convincing studies confirming the negative impact of mink on fish populations. Only Norway showed an increase in the mortality rate of two species of salmonids, after the appearance of mink, which could have had an impact on the population size of these species (Heggenes and Borgstrom 1998 - P).

a14. The effect of the *Species* on native species, through **competition** is:

	low
	medium
X	high

aconf10.	Answer provided with a	low	medium	high **X**	level of confidence

acomm14. Comments:

Mink, as an ground and water predator, can compete with species with a similar nutritional niche and have similar habitat preferences. However, this species is characterized by a much wider ecological niche than polecat *Mustela putorius*, otter *Lutra lutra* or the European mink *Mustela lutreola* - predators using similar food and habitat resources (Sidorovich 1992, Lodé 1993, Hammershoj et al. 2004 - P). The diet of this predator includes more species of mammals, birds and fish than in case of any other mustelids. The possibility of using food resources available in the aquatic environment increases the chances of this species to survive harsh Winters, which are a factor increasing mortality of ground predators, such as martens *Martes* spp. or polecats (Niemimaa and Pokki 1990 - P). The variety of potential prey, inhabiting both terrestrial and aquatic environments, makes it a more effective predator than native European species. Many authors indicate the competition - which is dangerous for European predators - between minks and polecats (Schröpfer 1999, Hammershoj 2004 - P), as well as mink and otter (Jędrzejewska et al. 2001, Bonesi and Macdonald 2004, Bonesi et al. 2004, Brzeziński et al. 2008, Brzeziński et al. 2010 - P). Nevertheless, opinions about the extent and significance of competition vary. The reduction in the number of some mink prey causes a decrease in the number of other species of predators feeding on these prey, e.g. ermine (Sidorovich et al. 2008 - P). American mink was one of the likely causes of a sharp decline in the numbers of the European mink - threatened by the complete extinction of the mammal species (Maran and Henttonen 1995, Maran 2007 - P). In Belarus and Spain, along with the invasion of the American mink, the number of the European mink was falling (Sidorovich and Macdonald 2001, Santulli et al. 2014 - P). Potential reintroduction of the European mink in Poland in areas of American mink is pointless.

a15. The effect of the *Species* on native species, through **interbreeding** is:

X	no / very low
	low
	medium
	high
	very high

aconf11.	Answer provided with a	low	medium	high **X**	level of confidence

acomm15. Comments:

There is no risk of hybridization, because the American mink is not closely related to native species of predatory mammals inhabiting Europe. It was found that female mink females were fertilized by male American mink, which resulted in a decrease in the number of receptive females in the environment (Maran and Henttonen 1995 - P). However, because the genetic differences between these species are very large, the female European mink did not give birth to the young ones, which only reduced the increase in the numbers of the European mink (Maran and Henttonen 1995 - P). Several cases of mustelid hybridization in natural conditions have been described, but none of them concerned American mink (Hammershoj 2004 - P).

a16. The effect of the *Species* on native species by **hosting pathogens or parasites** that are harmful to them is:

	very low
	low
	medium
	high
X	very high

aconf12.	Answer provided with a	low	medium **X**	high	level of confidence

acomm16. Comments:

The American mink is a carrier of many external and internal parasites (Najberek, in preparation - N). 5 species of ticks, 36 species of trematodes, 6 species of tapeworms, 6 species of acanthocephalans, 2 species of protozoa, and 31 species of nematodes were found in minks (Zalewski and Brzeziński 2014 - P). The level of infection with internal parasites (nematodes and trematodes) increases with the time that elapsed from the introduction of the introduced mink population (Kołodziej-Sobocińska et al. 2018 - P). Mink is also an intermediate host of *Trichinella* spp. (Hurnikova et al. 2016 - P). Due to the high density of mink in some environments, they can significantly affect the increase in the number of parasites in the environment and cause an increase in the level of infection in native species, but there are no studies confirming this assumption. The mink is also a carrier of viral Aleutian disease (Nituch et al. 2011, Fournier-Cambrillon et al. 2004 - P). Antibodies of the Aleutian disease were found in domestic mammal species in Europe, including polecats, house martin *Martes foina* and forest martin *Martes martes*, European mink *Mustela lutreola* and genet *Genett genetta* (Zalewski and Brzeziński 2014 - P). In Spain, AMDV antibodies have been detected not only in wild American mink, but also in European mink and Eurasian otter *Lutra lutra* (Maňas et al. 2001 - P). There are no studies documenting the impact of this disease on subjects of native species. In American mink, depending on the strain, this disease manifests itself in the form of progressive infection, often leading to the death of the subject (Bloom et al. 1994 - P). The transmission of rabies (disease from the OIE list), a disease subject to obligatory reporting, is a significant threat. Mink, as an additional vector (next to other mammals), may cause more frequent occurrence of this disease. The American mink is also a carrier of canine distemper.

a17. The effect of the *Species* on ecosystem integrity, by **affecting its abiotic properties** is:

X	low

	medium
	high

aconf13.	Answer provided with a	low	medium	high **X**	level of confidence

acomm17. Comments:

The species does not affect abiotic factors.

a18. The effect of the *Species* on ecosystem integrity, by **affecting its biotic properties** is:

	low
	medium
X	high

aconf14.	Answer provided with a	low	medium **X**	high	level of confidence

acomm18. Comments:

American mink can occur at high densities. In this case, it can interfere with biotic factors through predatory pressure (Roemer et al. 2009 - P). For example, on the islands of the Baltic Sea under the pressure of mink presence, the breeding sites preferred by the birds changed due to the increased risk of clutch loss. The greatest diversity of bird species was found in the islands most isolated and inaccessible to this predator. Removal of mink from the islands caused their repopulation by birds (Nordström and Korpimäki 2004 - P). Mink can locally limit the density of breeding pairs of smaller species of waterbirds (some ducks, plover birds, gulls), while in the conducted studies it did not affect the density of larger species (mute Swan Cygnus olor, greylag goose *Anser anser*, common merganser *Mergus merganser* – Nordström et al. 2002, Nordström et al. 2003 - P). Changes in the behavior and abundance of birds (common coot *Fulica atra* and great crested grebe *Podiceps cristatus*) resulting from mink pressure were also observed in Poland, in the Masurian Lake District. Influenced by the presence of mink in the environment, birds began to nest more often in colonies, and also started preferring habitats less exposed to predation (Brzeziński et al. 2012 - P). Similar behaviors were observed in other regions of Poland, for example in Pomerania on lobelia lakes (A. Zalewski - own observation). Mink feces can be a source of parasitic infections or diseases of other predatory mammal species. For example, the Aleutian disease is transmitted, *inter alia*, by the secretions and excretions of animals, and the virus of this disease is extremely resistant and can survive in the soil for over two years (Bloom et al. 1994 - P). Fallen specimens, those eaten by foxes or raccoon dogs and dogs can infected with trichinosis or tapeworms of the *Toxocara* or *Echinococcus* genus. However, there are no publications showing an increase in the infection of other species of predators with parasites or diseases in areas with high mink density.

A4b | Impact on cultivated plants domain

Questions from this module qualify the consequences of the species on cultivated plants (e.g. crops, pastures, horticultural stock).

For the questions from this module, consequence is considered 'low' when presence of the species in (or on) a population of target plants is sporadic and/or causes little damage. Harm is considered 'medium' when The Organism's development causes local yield (or plant) losses below 20%, and 'high' when losses range >20%.

a19. The effect of the *Species* on cultivated plants targets through **herbivory or parasitism** is:

	inapplicable
X	very low
	low
	medium

	high
	very high

aconf15.	Answer provided with a	low	medium	high **X**	level of confidence

acomm19.	Comments: The American mink consumes small amounts of plant food (e.g. Bartoszewicz and Zalewski 2003 - P), so it does not affect plant cultivation.

a20. The effect of the *Species* on cultivated plants targets through **competition** is:

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf16.	Answer provided with a	low	medium	high	level of confidence

acomm20.	Comments: These animals do not compete with plants.

a21. The effect of the *Species* on cultivated plants targets through **interbreeding** with related species, including the plants themselves is:

X	inapplicable
	no / very low
	low
	medium
	high
	very high

aconf17.	Answer provided with a	low	medium	high	level of confidence

acomm21.	Comments: The species is an animal and it is impossible to cross it with plants.

a22. The effect of the *Species* on cultivated plants targets by **affecting the cultivation system's integrity** is:

X	very low
	low
	medium
	high
	very high

aconf18.	Answer provided with a	low	medium	high **X**	level of confidence

acomm22.	Comments: American minks have no impact on the cultivation of plants, therefore they do not affect the integrity disturbance.

a23. The effect of the *Species* on cultivated plants targets by hosting **pathogens or parasites** that are harmful to them is:

X	very low
	low

	medium
	high
	very high

aconf19.	Answer provided with a	low	medium	high **X**	level of confidence

acomm23. Comments:

So far, there is no information on the impact of American mink on crops associated with the fact that it is a host or vector of pathogens and parasites harmful to these plants.

A4c | Impact on domesticated animals domain

Questions from this module qualify the consequences of The Organism on domesticated animals (e.g. production animals, companion animals). It deals with both the well-being of individual animals and the productivity of animal populations.

a24. The effect of the *Species* on individual animal health or animal production, through **predation or parasitism** is:

	inapplicable
	very low
	low
	medium
X	high
	very high

aconf20.	Answer provided with a	low	medium **X**	high	level of confidence

acomm24. Comments:

Mink can cause losses in poultry farms (Harrison and Symes 1989 - P). In Poland, this happens sporadically, however, it is primarily the residents of the villages near where the mink farms are located who complain about the losses in near-house chickencoops (Internet source: http://www.gazetalubuska.pl/apps/pbcs.dll/article?AID =/20080911/POWIAT11/202249549 - access on 20.01.2018 - I). Birds killed by minks sometimes also occur in ornamental bird breeding. Such a case is known from Łeba, where in 2010 minks killed birds in the ornithological garden several times (Internet source: http://www.gazetakaszubska.pl/2468/zaglada-w-lebie, http://www.gp24.pl/apps/pbcs.dll/article?AID=/20101208/POWIATLEBORSKI/702438927 - I). A case of a mink (equipped with a radio transmitter) entering a birdcage and killing one specimen was also found in the vicinity of the Ujście Warty National Park (Bartoszewicz 2004 - N). In addition, American mink predation is also treated as a threat to the economic performance of fish farms. Due to the relatively high fish share in American mink diet in some environments, they can affect fish farming. Particularly in winter, when the rivers freeze, minks feed intensively over the ponds on which people maintain water-aerating ice-holes (Zalewski - unpublished data). Minks feed only on fish in these ponds. According to oral tradition and information published by fish breeders, they often suffer losses caused by minks. However, the results of this study do not confirm this. In 2004-2007, surveys were carried out on the surface of about 50% of the national pond area (the number of analyzed fishing farms was 82-147 depending on the year). On this basis, it can be concluded that although losses caused by wild animals living on ponds pose a very serious problem for carp breeders (95-86.6% of respondents declared that wild animals constitute a significant problem on the farm), the most burdensome include: otter *Lutra lutra*, heron *Ardea* spp., great cormorant *Phalacrocorax carbo* and beaver *Castor fiber* (Lirski and Myszakowski 2007 - P).

a25. The effect of the *Species* on individual animal health or animal production, by having properties that are hazardous upon **contact**, is:

	very low
X	low
	medium
	high
	very high

aconf21.	Answer provided with a	low	medium	high X	level of confidence

acomm25. Comments:

The probability of mink influence on animals and their production as a result of direct contact is low. It can be assumed that they may have a small impact on the production of poultry on farms located near watercourses, where the density of the mink is high. American mink can be aggressive in an emergency situation, so it can lead to bites. No documented cases of mink bites were found in European publications.

a26. The effect of the *Species* on individual animal health or animal production, by hosting **pathogens or parasites** that are harmful to them, is:

	inapplicable
	very low
	low
	medium
	high
X	very high

aconf22.	Answer provided with a	low	medium X	high	level of confidence

acomm26. Comments:

American mink can transfer diseases to mink farms. For example, there were subjects in wild populations infected with Aleutian disease (Fournier-Chambrillon et al. 2004 - P), which can be transferred to farms. The level of infection in various populations in Europe varies from 3 to 67%, and reaches 94% in natural conditions (Zalewski and Brzeziński 2014 - P). This disease causes large losses in mink farms (Farid et al. 2012 - P). Nevertheless, studies demonstrate that it is mink farms that are the source of this pathogen in wild animals (Nituch et al. 2011 - P). The American mink is also a carrier of rabies, which is subject to obligatory reporting pursuant to veterinary regulations (OIE list). In addition, minks are a vector of at least several dozen pathogens and parasites (Najberek, currently prepared - N). For example, instances of dogs eating minks infected with trichinosis may result in transmitting this parasite to household animals.

A4d | Impact on human domain

Questions from this module qualify the consequences of The Organism on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

a27. The effect of the *Species* on human health through **parasitism** is:

X	inapplicable
	very low
	low
	medium
	high
	vert high

aconf23.	Answer provided with a	low	medium	high	level of confidence

acomm27. Comments:

The species is not a parasite.

a28. The effect of the *Species* on human health, by having properties that are hazardous upon **contact**, is:

X	very low
	low
	medium
	high
	very high

aconf24.	Answer provided with a	low	medium	high **X**	level of confidence

acomm28. Comments:

American mink may affect human health to a very low extent and they do not pose a threat to human during direct contact. Cases of man being bitten by minks are probably very rare and take place only when catching those animals. In the event of danger or surprise, minks can be aggressive and there may be bites. They are not very skittish animals, but they do not attack humans spontaneously.

a29. The effect of the *Species* on human health, by hosting **pathogens or parasites** that are harmful to humans, is:

	inapplicable
	very low
	low
	medium
	high
X	very high

aconf25.	Answer provided with a	low	medium **X**	high	level of confidence

acomm29. Comments:

The Aleutian disease, transmitted by American mink, can also infect people and it can result in chronic disease. The only human cases of the disease were found among mink farm employees, at risk of contacting numerous carriers of this disease (Jepsen et al. 2009). A small number of reports may be due to the fact that the course of this disease in humans does manifest with characteristic symptoms, and it may be confused with other ailments. The probability of transmitting parasites posing a threat to humans is low. Although the mink is the host for trichinosis, *Toxocara* and *Echinococcus* (Hurnikova et al. 2016 - P, Kołodziej-Sobocińska et al. in print), the possibility of direct human infection with these parasites is low due to the fact that the mink is an intermediate host for these parasites. However, their presence in minks can increase the number of infections among domestic animals, especially among dogs, and indirectly among humans. Minks are also a vector of rabies, a deadly disease for humans, subject to obligatory reporting (OIE list).

A4e | Impact on other domains

Questions from this module qualify the consequences of the *Species* on targets not considered in modules A4a-d.

a30. The effect of the *Species* on causing damage to **infrastructure** is:

X	very low
	low

	medium
	high
	very high

aconf26.	Answer provided with a	low	medium	high **X**	level of confidence

acomm30. Comments:

Minks have little impact on infrastructure. They can pollute bridges over lakes with feces and prey remains.

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of The Organism on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of the species.

a31. The effect of the *Species* on **provisioning services** is:

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

aconf27.	Answer provided with a	low	medium **X**	high	level of confidence

acomm31. Comments:

In case of increased predation of American mink on fishponds, negative effects on fish production may occur, directly through predation. Mink can also carry parasites, with fish acting as intermediate hosts, and thus affect production. However, there are no studies confirming these assumptions. Similarly, in case of increased predation of American mink on poultry farms, negative impact on farm animals may occur directly through predation. As a game species, minks are hunted for their fur, yet to a low extent.

a32. The effect of the *Species* on **regulation and maintenance services** is:

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

aconf28.	Answer provided with a	low	medium **X**	high	level of confidence

acomm32. Comments:

The presence of American mink in ecosystems may result in higher prevalence of zoonotic diseases, Aleutian disease and parasites in particular.

a33. The effect of the *Species* on **cultural services** is:

	significantly negative
	moderately negative
X	neutral

	moderately positive
	significantly positive

aconf29.	Answer provided with a	low	medium	high **X**	level of confidence

acomm33. Comments:

The fact that minks avoid humans (including urbanized, recreational areas, built up even to a small extent at the banks of lakes or rivers) means that it has no impact on cultural services. Because of that no impact of American mink on cultural services has been recorded. As a game animal, it can have a positive effect on "recreation and leisure", but most hunters rarely hunt minks. Instead, it is currently rather hunting club duty to reduce the number of this predator.

A5b | Effect of climate change on the risk assessment of the negative impact of the Species

Below, each of the Harmonia^{+} modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest to take into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes of atmospherical variables listed in its 2013 report on the physical science basis may be used for this purpose. The global temperature is expected to rise by 1 to 2°C by 2046-2065.

Note that the answers to these questions are not used in the calculation of the overall risk score, but can be but can be considered when decisions are made about management of the *Species*.

a34. INTRODUCTION – Due to climate change, the probability for the *Species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf30.	Answer provided with a	low	medium	high **X**	level of confidence

acomm34. Comments:

The species is already introduced in a major area of Poland. Climate change will not affect its introduction.

a35. ESTABLISHMENT – Due to climate change, the probability for the *Species* to overcome barriers that prevented its survival and reproduction in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf31.	Answer provided with a	low	medium	high **X**	level of confidence

acomm35. Comments:

The species is already established in a major area of Poland. Climate change will not affect its habitat presence.

a36. SPREAD – Due to climate change, the probability for the *Species* to overcome barriers that prevented its spread in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf32.	Answer provided with a	low	medium	high **X**	level of confidence

acomm36. Comments:

Climate change will not affect the spread of the American mink. At the moment, it inhabits areas from Spain to Norway adapting to very variable climatic conditions, and having considered the extremely wide climate niche of the species, climate changes will not affect its spread. The American mink is now found almost all over Poland, excluding the southernmost mountain areas. Areas above 1 200 m above sea level are inadequate for mink, because above this height deciduous forests disappear, giving way to conifers. Coniferous forests, on the other hand, are less productive, and as a result the number and species diversity of small mammals - in many places beings the basic source of mink food - is lower than in deciduous forests (Niedziałkowska et al. 2010 - P). Climate warming can only slightly result in its presence in higher mountain ranges.

a37. IMPACT ON ENVIRONMENTAL DOMAIN – Due to climate change, the consequences of the *Species* on wild animals and plants, habitats and ecosystems in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

aconf33.	Answer provided with a	low	medium **X**	high	level of confidence

acomm37. Comments:

Global warming (especially mild winters) may cause an increase in the number of minks, which will increase the negative impact on the natural environment.

a38. IMPACT ON CULTIVATED PLANTS DOMAIN – Due to climate change, the consequences of the *Species* on cultivated plants and plant domain in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf34.	Answer provided with a	low	medium	high **X**	level of confidence

acomm38. Comments:

The impact of mink on crop cultivation and plant production in Poland is small and it will not increase with global warming.

a39. IMPACT ON DOMESTICATED ANIMALS DOMAIN – Due to climate change, the consequences of the *Species* on domesticated animals and animal production in Poland will:

	decrease significantly

	decrease moderately
	not change
X	increase moderately
	increase significantly

aconf35.	Answer provided with a	low	medium	high X	level of confidence

acomm39. Comments:

The impact of American mink on animal husbandry is not dependent on climate change. Milder winters can reduce predation of mink related to fish bred in ponds, but the significance of losses caused by mink is rather small. Increased density, together with global warming, may result in a slight increase in impact on animal breeding.

a40. IMPACT ON HUMAN DOMAIN – Due to climate change, the consequences of the *Species* on human in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

aconf36.	Answer provided with a	low	medium X	high	level of confidence

acomm40. Comments:

The impact of the American mink on humans is not dependent on climate change.

a41. IMPACT ON OTHER DOMAINS – Due to climate change, the consequences of the *Species* on other domains in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

aconf37.	Answer provided with a	low	medium	high X	level of confidence

acomm41. Comments:

The impact of American mink on other objects is not dependent on climate change.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	0.75
Environmental impact (questions: a13-a18)	0.67	0.83
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.67	0.67

Human impact (questions: a27-a29)	0.50	0.75
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	1.00	0.92
Impact (questions: a13-a30)	0.67	0.85
Overall risk score	0.61	
Category of invasiveness	moderately invasive alien species	

A6 | Comments

This assessment is based on information available at the time of its completing. It has to be taken into account. however. that biological invasions are. by definition. very dynamic and unpredictable. This includes introductions of new alien species and detection of their negative impact. As a result. the assessment of the species may change in time. For this reason it is recommended that it regularly repeated.

acomm42. Comments:

The American mink is one of the predators introduced on many continents. The main manifestation of the negative impact of the American mink on the natural environment is the reduction in the number of native species constituting its prey, and competition with native predator species, which locally leads to the total extinction of its prey and competitors. One should also expect a cascade effect on the environment, which so far has not been studied.

Despite this, after the risk assessment for Poland, the species was classified as an intermediate invasive category. In the module of impact on the natural environment (questions a13-a18), in three points concerning predation (a13), competition (a14) and the transfer of pathogens and parasites (a16), the species has reached its maximum value (1.0) with high certainty (1.0). However, the overall assessment has been lowered due to the smaller impact on the other two points in this module.

The low overall score is also due to the small direct impact of mink on humans (a28), and the lack of impact on crops (resulting from the ecology of this species) (a19-a23). However, an increase in the overall assessment should be considered, due to the very significant level of changes caused by minks in the ecosystem. This impact has been described in great detail above and it must be remembered that a large number of changes is probably unexplored (e.g. the cascade effect). All these conditions should be taken into account in the decision-making process regarding the manner of dealing with the species and their prioritization.

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