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

Magdalena Bartoszewicz
first name and family name

Andrzej Zalewski
first name and family name

Henryk Okarma

acomm01. Comments:

degree	affiliation	assessment date
Dr.	Kompan Manufacturing Poland Sp. z o.o.	12.12.2017
degree	affiliation	assessment date
Dr.	Mammal Research Institute Polish Academy of Sciences, Bialowieża	21.12.2017
degree	affiliation	assessment date
Prof.	Institute of Nature Conservation Polish Academy of Sciences, Kraków	22.12.2017

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

Polish name

Szop pracz
Latin name

Procyon lotor Linnaeus, 1758
English name

Raccoon

acomm02.	Comments:	
	Polish name (synonym I)	Polish name (synonym II)
	Szop	…….
	Latin name (synonym I)	Latin name (synonym II)
	…….	…….
	English name (synonym I)	English name (synonym II)
	Northern raccoon	…….

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	
alien, present in Poland in the environment, established	**X**

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

acomm04.	Comments: in „Comments" (questions acomm04-41) experts should provide **explanations for their answers and list sources of information**. In particular, Comments should explain the decision in cases when data is lacking, incomplete or uncertain, or if the available information is contradictory. Source of the information should also be provided here, with author and year of publication; data sources should be divided into P – published results of scientific research; B - databases; N – unpublished data; I - other; A – author's own data. Detailed information (including full bibliographic record) should be provided at the end of the questionnaire "Data sources". Guidance on data sources citation is available at the end of the *Harmonia*$^{+PL}$ – procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland. The reports on the occurrence of the Raccoon in Poland were occasional until the 1990s. (Bogdanowicz, Ruprecht 1987, Bartoszewicz et al. 2008b - P). After 1995, the number of observations increased, especially in western Poland. Since 2000, a distinct expansion of this species has been observed, progressing from the west to the east (Bartoszewicz et al. 2008a, 2008b, Gabryś et al. 2014 - P). In 2004 the species was included into the list of game species. Since then, annual hunting bag has increased from about 20 individuals in the hunting season 2004/2005, up to 990 individuals in the 2016/2017 (data of hunting reports of the Czempiń Research Station of the Polish Hunting Association - P). The results of the Raccoon invasion study in Poland show that the dispersion is not as intense as in the initial stage of colonization of new areas, and that the population of the species has the characteristics of a resident population (Okarma et al. 2012 - P). Stable populations occur primarily in the western part of Poland; however, the current distribution of the species already reaches the northern, southern and eastern borders of the country (Atlas of Mammals of Poland 2017 – B).

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

environmental domain	**X**
cultivated plants domain	**X**
domesticated animals domain	**X**
human domain	**X**
other domains	**X**

acomm05.	Comments: The Raccoon can affect the natural environment by competition for resources with other species (native and other alien species), as well as by predation, because by extending the list of predatory mammals in Poland, it raises the level of predation in ecosystems (Głowaciński 2011 - P). As a vector of parasites and pathogenic microorganisms, it deteriorates the sanitary condition of the environment (Lutz W. 1996, Bartoszewicz et al. 2008a, 2008b, Popiołek et al. 2011, Karamon et al. 2014, Leśniańska et al. 2016 - P). The impact of the Raccoon on cultivated plant is insignificant, however, the Raccoon seasonally feeds in orchards and gardens, eating mainly fruits (Hohmann 2001 - P, Bartoszewicz 2017 - A). If in high densities, the species can cause conflicts with humans. Potentially, it can cause damage to maize and potato crops (Ikeda et al. 2004 - P). raccoons may present a risk for human health as carriers of pathogenic organisms, including parasites (Lutz W. 1996, Bartoszewicz et al. 2008a, 2008b, Popiołek et al. 2011, Karamon et al. 2014, Leśniańska et al. 2016 - P). The species also occurs in anthropogenic habitats (in human settlements, gardens), so it can sporadically cause damage to the infrastructure. It was noted especially in Japan, but it is also possible in Poland, especially where raccoons live and reproduce in places settled or used by people.

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	
high	**X**

aconf02. Answer provided with a

low	medium	high	level of confidence
		X	

acomm06. Comments:
The species is already established in Poland. The Raccoon has been recorded in Poland regularly since the end of the 1990s. Genetic research indicates that Poland has been colonised by raccoons from two directions: from the west (Germany) and south (Czech) (Biedrzycka et al. 2014 - P) and this species is still colonizing new areas. The colonisation of Poland continues at the rate of 80-100 km / 5 years (Głowaciński 2011 - P).

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

low	
medium	
high	**X**

aconf03. Answer provided with a

low	medium	high	level of confidence
		X	

acomm07. Comments:
The species is already established in Poland.

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

low	
medium	
high	**X**

aconf04. Answer provided with a

low	medium	high	level of confidence
		X	

acomm08. Comments:
There is no official public data available to assess if the Raccoon is still bred in Poland as a fur animal (Fur Europe 2017 – B). However, it is maintained as a pet. One can also easily buy it online. However, its breeding proves difficult due to its agility and aggression; thereby there is a risk of escapes or intentional release of animals.

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	
optimal for establishment of the *Species*	**X**

aconf05. Answer provided with a

low	medium	high
		X

level of confidence

acomm09. Comments:

The Raccoon is native to North America, where its natural range was limited to the east coast, but in the 20th century its range has significantly expanded and now covers most of North and Central America (Zeveloff 2002 - P). The climatic conditions in Poland are very favorable for this species and are not a barrier to its establishment and expansion.

a10. Poland provides **habitat** that is:

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

aconf06. Answer provided with a

low	medium	high
		X

level of confidence

acomm10. Comments:

The Raccoon occurs in many different types of habitats: all kinds of wetlands and in the vicinity of watercourses and reservoirs, deciduous, mixed and coniferous forests, urbanized areas (rural, suburban and urban), agricultural areas. Due to its wide ecological niche, it easily adapts almost to any available habitat (Bartoszewicz et al. 2008, Zeveloff 2002 - 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	
very high	**X**

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

acomm11. Comments:

The Raccoon occurs permanently in Poland since about 1990s (Bogdanowicz, Ruprecht 1987 - P). Stable populations occur particularly in the western part of the country (Lubuskie, Zachodniopomorskie and Dolnośląskie Voivodships). In the north-eastern Poland, the existence of The Raccoon was also found, which may indicate that this species has already colonized almost the entire territory of Poland (Zalewski A. - A).

Estimation of population spread (Type C)
The expansion into other parts of Poland continues relatively slowly but lack of monitoring of the spread of this species makes it impossible to precisely assess the pace of expansion. According to rough estimations the rate of colonisation of Poland continues at the rate of 80-100 km / 5 years (Głowaciński 2011 - P).

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

low	
medium	**X**
high	

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

acomm12. Comments:

Between 1960s and 1980s, there were 12 documented cases of Raccoon escapes from fur farms (Bogdanowicz, Ruprecht 1987 - P). However, in 1962 about 200 raccoons were kept in Poland, while in 1992 only about 50 (Skoczyński 1992 - N). The raccoons are also kept in several zoological gardens (Topola 2016 – P). The raccoons are also offered for sale in pet stores as well as online. Breeding or keeping raccoons as a pet increases the risk of escapes or intentional releases when the pet animal becomes troublesome or aggressive.

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	

high	**X**

aconf09. Answer provided with a

low	medium	high
	X	

level of confidence

acomm13. Comments:

The proportion of birds in the Raccoon diet does not exceed several percent of biomass even in areas where birds are an easily accessible source of food (Bartoszewicz et al. 2008a - P). The current results of research in Poland do not confirm the expected significant negative impact of the Raccoon on native species (Jędrzejewska et al. 2014 - P). Also in Germany, where the density of the raccoons is the highest in Europe, to date no negative impact of Raccoon on native ecosystems has been recorded (Hohmann 2001). In five Polish national parks protecting wetlands and waterfowl, the number of some water birds (coots, gulls, meadow ducks, waders) has decreased (Komar, Zalewski 2014 - P). However, it is not clear whether this is a result of a European trend caused by changes in habitats of these birds, or the direct predation of invasive alien predatory mammals (including the Raccoon). This can also be the cumulative impact of predators, the number of which increased in Poland after introduction of the Raccoon, Raccoon dog *Nyctereutes procyonoides* and American mink *Neovison vison*. The assessment of the impact of the Raccoon on breeding success of birds (especially those nesting in tree hollows – the Goosander *Mergus merganser*, Goldeneye *Bucephala clangula*) is very difficult and no studies have been carried out to analyse it. It is also difficult to estimate the impact of this predator on birds as the density of the Raccoon population increases in some areas. In recent years, the Raccoon predation on the European pond turtle *Emys orbicularis* has been observed in one of its last refuges in western Poland (Najbar - I). In this case, due to the risk of extinction of this native species, the impact of the Raccoon on the tortoise can be very destructive in the near future.

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:

Regarding the dietary breadth of raccoons and its overlap with other species, no analyses were made in Poland. Results of the North American research indicate that the percentage of dietary overlap of the Fox *Vulpes vulpes* with the Raccoon is 45%, while of the Badger *Taxidea taxus* with the Raccoon is about 52% (Azevedo et al. 2005 - P). The Fox, Badger and Raccoon sometimes inhabit the same habitats in Poland, and their food niches overlap, therefore it can be assumed that there is competition for food between these species. The Raccoon occurs in various habitats and feeds on a variety of food resources, both plant and animal food, so it can compete with mammals and birds that use the same food sources and prefer similar den sites.

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

no / very low	**X**
low	
medium	

high	
very high	

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

acomm15.	Comments: There is no risk of hybridisation, because the Raccoon is not closely related to native species of predatory mammals inhabiting Europe. The natural range of the *Procyonidae* family is limited to North, Central and South America (Ewer 1998 - 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	
very high	**X**

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

acomm16.	Comments: The Raccoon is a carrier of pathogens that cause many diseases, including rabies, distemper virus, sarcoptic mange, encephalitis, toxoplasmosis, histoplasmosis, leptospirosis (e.g. Beineke et al. 2015, Beltran-Beck et al. 2012, Tinline et al. 2002, Rees et al. 2009, Zeveloff 2002 - P). It is also a carrier of many parasites, including the roundworm *Baylisascaris procyonis.* This parasite is the most severe parasitological threat associated with the presence of the Raccoon in Poland. It is highly non-specific with regard to hosts and about as many as 130 vertebrate species (wild and domesticated) have been identified to be affected by this parasite that can cause serious illnesses. Larval infections have been recognized in a range of species, primarily rodents, birds including galliformes, columbiformes, passeriformes and psittaciformes (Kazacos 2001, Sorvillo et al. 2002, Page 2013 - P). The invasion of this parasite contributed to a very strong decline of the Allegheny woodrat *Neotoma magister* - a rodent inhabiting the eastern United States (Logiudice 2001, Page 2013 - P). This roundworm can spread very easily, because one Raccoon specimen can shed daily over 1.000.000 eggs (Kazakos 2016 -P). Raccoons, as generalists predators, also feed on plant food and excrete undigested seeds. Raccoons usually defect in selected places, and their latrines are common throughout habitats occupied by the species, thereby the exposure of other species to infection is high. In forested habitats latrines have been reported in densities ranging from 3 to 44 latrines/ha, in urban and suburban areas from 8.7 to 21.7 latrines/ha (Page 2013) or 1.9 latrines per backyard (Page et al. 2009 - P). Rodents, passerines and lagomorphs are especially vulnerable to infection because these species use latrines as a source of food (Logiudice 2001, Weinstein et al. 2017 - in print -P). However, prevalence of the parasite in Poland is 1.9-3.7% (Bartoszewicz et al. 2008a, Popiołek et al. 2011, Karamon et al. 2014 - P) and is much lower than in Germany (39-71% - Winter et al. 2005 - P). In the longer term, we can expect that the number and population density of raccoons in Poland will increase to levels similar to those in Germany, and the prevalence of *B.procyonis* in the Polish population may also rise to several dozen percent. Transmission of rabies (OIE listed disease) also poses a high risk. The Raccoon, as an additional carrier of rabies (in addition to foxes and raccoon dogs), can significantly increase the occurrence of this disease, despite the action of oral vaccination of foxes. This is particularly important in the eastern part of Poland, where rabies appears relatively often, carried by predators migrating from the east. In 1990-2010, 142 cases of rabies have been registered in Europe (Beltran-Beck et al. 2012 - P). In North America, raccoons are one of the main rabies vectors (Rees et al. 2009 - P) *Sarcoptes scabiei* (sarcoptic mange) infections were found in raccoons in Europe. Detailed studies have shown infection in raccoons is likely to have originated from infected foxes (Renteria-Solis et al. 2014 - P). In Germany and Luxembourg, the occurrence of *Toxoplasma gondii*, causing toxoplasmosis, was found in raccoons (Heddergott et al. 2017 - P). Research in Poland has revealed that raccoons are infected by the following endoparasites: *Trichinella spiralis, Ancylostoma* spp., *Baylisascaris procyonis, Capillariidae, Placoconus lotoris, Spirocerca lupi, Strongyloides procyonis, Echinostoma* sp., *Acanthocephala*, *Mesocestoides, Coccidia, Trematoda* (Popiołek et al. 2011, Karamon et al. 2014, Osten-Sacken, Stolarczyk 2016, Cybulska et al. 2016 - P). In addition, micro-parasites *Cryptosporidium* spp. and *Enterocytozoon bieneus* (Leśniańska et al. 2016 - P*)* were found in raccoons. In Poland 6 species of ectoparasites were found on raccoons: *Ctenocephalides felis, Trichodectes* (*Stachiella*) *octomaculatus, Hypoaspis* (*Alloparasitus*) *oblonga, Echinonyssus isabellinus, Ixodes hexagonus,* Psocoptera (Haitlinger, Łupicki 2009 - P).

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

low	**X**
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:
In optimal conditions, the Raccoon can occur in high densities. In such circumstances, dense latrine sites can be a source of parasitic infections, especially to rodents and small bird species, contributing to their higher mortality (Logiudice 2001, Page 2013, Weinstein 2017 - in print - P). On the other hand, rodents and passerines constitute food resource for many species of birds of prey and carnivores.

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	
very low	
low	
medium	**X**
high	
very high	

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

acomm19.	Comments: Raccoon is an omnivorous species whose diet seasonally changes. In autumn it includes fruits in orchards and gardens: plums, apples, pears, become an important source of food for individuals inhabiting human settlements (Hohmann et al. 2001 - P, Bartoszewicz - A). This is probably not of significant economic concern but it can lead to conflicts. In Japan, introduced raccoons cause losses of maize, melons, watermelons, strawberries, potatoes, and the total amount of agricultural damage amounts to 30.000.000 yen every year (Ikeda et al. 2004 - P). In the United States, crop losses caused by raccoons, especially in maize, have significantly increased in the last 20 years and constitute about 25% of the total losses caused by wild animals (total crop losses caused by animals are estimated at about USD 22 billion a year) (Conver 1998 , Beasley, Rhides 2008 - P).

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

inapplicable	**X**
very low	
low	
medium	
high	
very high	

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

acomm20.	Comments: The species is an animal.

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

inapplicable	**X**
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.

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

very low	**X**
low	
medium	

high	
very high	

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

acomm22. Comments:
No information has been available so far on the impact of the Raccoon on the cultivation system's integrity.

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

very low	**X**
low	
medium	
high	
very high	

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

acomm23. Comments:
No information has been available so far on the impact of the Raccoon on the cultivated plants 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:
No predation by raccoons on farms of livestock has been reported from Poland but this cannot be ruled out. In the United States, the Raccoon is considered one of the most onerous predators on poultry farms (Wilfred 1953 - P). Prehensile forepaws allow raccoons to kill and take prey through the wire mesh, while native predators do not have such ability.

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

very low	
low	**X**
medium	
high	
very high	

aconf21. Answer provided with a

low	medium	high
		X

level of confidence

acomm25. Comments:
When severely distressed, Raccoons can be aggressive towards dogs, so they can bite them. In Europe, no published lethal cases of pet animals were found as a result of the Raccoon bite. However, there are a few oral reports from hunters about dog death, shortly after biting by the Raccoon.
American literature, however, has long been reporting a disease called *coonhound paralysis* or *acute canine idiopathic polyradiculoneuritis (ACIP*) (e.g., Cummings, Haas 1967 - P). This is acute idiopathic peripherals nerves paralysis and it can occur in any dog breed, usually after a contact with the Raccoon's saliva. The treatment must be long-term, but it is treatable. In Europe, no mention was found in this respect. The disease is probably viral or bacterial.

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	
very high	**X**

aconf22. Answer provided with a

low	medium	high
		X

level of confidence

acomm26.	Comments: Raccoon is a rabies carrier (OIE listed disease). Taking into consideration the widely spread action of oral rabies vaccination in Poland, the probability of raccoons' infection is rather low. In eastern Poland, where rabies appears much more often than in other regions of the country, raccoons can be an additional rabies host. Another disease transmitted by raccoons is sarcoptic mange, which is very often found in the eastern regions of Poland. raccoons are carriers of many pathogens and parasites, but the most dangerous is *Baylisascaris procyonis*. Among domesticated species: poultry, pheasants, rabbits and dogs can be infected. However, sheep, goats and pigs are resistant to this parasite (Piñero et al. 2012, Bowman 2005 - P). Infections have also been recognized in bob-white quail, emus, guinea pigs, porcupines, chinchillas, prairie dogs, woodchucks and primates (Sorvillo et al. 2002 - P). This parasite is also a threat to animals kept in Polish zoological gardens, rehabilitation wildlife centers and other exhibits. For now, the prevalence of *B. procyonis* is low (1.9-3.7%), however, taking into account the growing Raccoon population, their increasing prevalence in areas inhabited by humans and on animal farms, and the occurrence of the highest population density in urban areas - the risk of contact with the Raccoon feces, and thus the risk of infection, will increase.

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:

inapplicable	**X**
very low	
low	
medium	
high	
very high	

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

acomm27.	Comments: The species in not a parasite.

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

very low	
low	
medium	**X**
high	
very high	

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

acomm28. Comments:
If the Raccoon is strongly distressed, it may become aggressive and it can bite. With the expected increase of Raccoon population in human settlements, there is an increasing probability of accidental meetings causing disturbance and therefore raccoons may be aggressive.

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	
very high	**X**

aconf25. Answer provided with a

low	medium	high
		X

level of confidence

acomm29. Comments:
Raccoon is a carrier of the parasite *Baylisascaris procyonis*, which in the case of infection may cause illness, sometimes leading to death. If swallowed, after 2-4 weeks eggs develop into migrating larvae that can move through the nervous system (neural larva migrans), settle in the eyes (ocular larva migrans) or internal organs (visceral larva migrans). The disease is incurable and can result in death. Infants and children under the age of 4 years have a highest probability of infection, because the probability of exposure to earth or fruits contaminated with the Raccoon feces is the highest. Reported human cases of infection are extremely rare. In 1975-2010, only about 30 cases the world have been recorded worldwide, including six fatal outcomes. One case occurred in Germany and the remaining ones – in North America (Sorvillo et al. 2002, (Sorvillo et al. 2002, Piñero et al. 2012 - P).
In Poland, the prevalence of B. procyonis is from 1.7 to 3.7%, thus it is low and the main risk for human is contact with the Raccoon excrements. It should be expected that as the Raccoon population and density increases in urban and suburban areas, the risk of infection will increase as well. However, based on the available information, it can be expected that even in areas of massive occurrence of raccoons in their natural range (North America) and in areas where the species is alien (Germany), the likelihood of this disease is very low. Moreover, raccoons are rabies vector (see points a16 and a26), the OIE notifiable, lethal disease in humans.

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:

very low	
low	
medium	**X**
high	
very high	

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

acomm30. Comments:
Raccoons inhabiting buildings or foraging from nearby human settlements may cause damage to roofing, wooden structures, spread of rubbish, destruction of crops in home gardens or greenhouses (Vantassel et al. 2007, Craven, Drake 2012 - P).

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 increasing of Raccoon predation on poultry farms, negative impact on domesticated animals may occur directly by predation or by the spread of parasites. Moreover, in case of an increase in Raccoon population density in woodlands, the risk of being infected with parasites may increase due to harvesting of wild products (forest fruits, mushrooms).

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

significantly negative	
moderately negative	**X**
neutral	
moderately positive	
significantly positive	

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

acomm32. Comments:
The presence of the Raccoon in ecosystems may result in higher prevalence of zoonoses, especially parasitic diseases, but also canine distemper virus infection and rabies, of which it is the vector.

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:
While searching for food in urban areas, raccoons penetrate garbage containers, so they can spread waste. They also can cause a damage of buildings and landscape architecture objects (Ikeda et al. 2004, Vantassel et al. 2007, Craven, Drake 2012 - P). Wooden constructions are particularly vulnerable, because raccoons leave deep scratches from theirs claws.

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	
not change	**X**
increase moderately	
increase significantly	

aconf30. Answer provided with a

low	medium	high
		X

level of confidence

acomm34. Comments:
The natural range of the Raccoon extends from southern Canada all the way to Panama, thus it covers several climate zones - from temperate to tropical. Therefore, climate change will not affect the expansion of range.

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	
not change	
increase moderately	**X**
increase significantly	

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

acomm35. Comments:
The species is already established in a large part of Poland.

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	
not change	**X**
increase moderately	
increase significantly	

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

acomm36. Comments:
Considering the very wide climate niche of the species, climate change will not affect its spread.

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	
increase moderately	**X**
increase significantly	

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

acomm37. Comments:
The impact on environmental domain will probably increase with the increase of the Raccoon population; however, it will be slightly dependent on climate change.

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	
not change	
increase moderately	**X**
increase significantly	

aconf34. Answer provided with a

low	medium	high
	X	

level of confidence

acomm38. Comments:
If the climate change results in a change in cultivated plants domain towards species preferred by raccoons (e.g. maize), and the number of raccoons will grow, the impact of these predators on crops may increase.

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 the Raccoon on animal husbandry is not dependent on climate change.

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	high
	X	

level of confidence

acomm40. Comments:
The impact of the Raccoon on humans does not depend 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	
not change	**X**
increase moderately	
increase significantly	

aconf37. Answer provided with a

low	medium	high
		X

level of confidence

acomm41. Comments:
The impact of the Raccoon on other domains does not depend on climate change.

Summary

Module	**Score**	**Confidence**
Introduction (questions: a06-a08)	1.0	1.0
Establishment (questions: a09-a10)	1.0	1.0
Spread (questions: a11-a12)	0.75	1.0
Environmental impact (questions: a13-a18)	0.46	0.75
Cultivated plants impact (questions: a19-a23)	0.17	0.9
Domesticated animals impact (questions: a24-a26)	0.58	0.83
Human impact (questions: a27-a29)	0.75	1.0
Other impact (questions: a30)	0.5	1.0
Invasion (questions: a06-a12)	0.92	1.0
Impact (questions: a13-a30)	0.75	0.9
Overall risk score	0.69	
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.

Below you can include your own comments on the assessment.

acomm42.	Comments: The main aspect of the negative Raccoon impact on the natural environment is the transmission of the rabies virus and endoparasites, as well as predation. In this risk assessment for Poland, the species the Raccoon was classified as moderately invasive alien species. The maximum negative impact of this species (0.75) has been reached for the 'Human impact' module (questions: a27-a29). The total impact on the natural environment was assessed at 0.5, reaching the maximum value (1.0) in points concerning predation (a13) and the transfer of pathogens and parasites (a16). It must kept in mind that categories of invasiveness in this assessment were determined *a priori*, without knowledge of actual distribution of this parameter. Moreover, the maximum value scored by the Raccoon (0.75) is minimally lower (0.01) from the value allowing to categorise the species as 'very invasive'. All these aspects should be taken into consideration in the decision process on how to deal with alien species and how to prioritise them.

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