



Appendix A

Harmonia^{+PL} – procedure for 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. Karolina Mazurska
2. Wojciech Solarz
3. Henryk Okarma

acomment01.	Comments:	degree	affiliation	assessment date
		(1) mgr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	02-02-2018
		(2) dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	02-02-2018
		(3) prof. dr hab.	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	29-05-2018

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

Polish name: Królik

Latin name: ***Oryctolagus cuniculus*** Linnaeus, 1758

English name: Rabbit

acomm02.

Comments:

Feral rabbit and Feral European rabbit are also frequently used English names.

Polish name (synonym I)

Dziki królik

Polish name (synonym II)

Królik europejski

Latin name (synonym I)

Lepus cuniculus

Latin name (synonym II)

Ammotragus cuniculus

English name (synonym I)

European wild rabbit

English name (synonym II)

Wild rabbit

a03. Area under assessment:

Poland

acomm03.

Comments:

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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

aconf01.

Answer provided with a

low

medium

high

level of confidence

X

acomm04.

Comments:

The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P). The first introductions of rabbits to wildlife within the current borders of Poland took place around 1860 in Silesia. Before 1885, rabbits were also introduced in the surroundings of Poznań, Pomerania and then East Prussia (Pax 1925 – P). As a result of numerous intentional introductions and the local spread of some populations, at the end of the 19th century or in the first quarter of the 20th century the range of the species was already continuous and its eastern border, apart from a few exceptions, ran along the Vistula river (Nowak 1968 – P). Although the severe winter of 1928 –1929 resulted in a short-term drop in the number of rabbits and after 1930 intentional introductions were less frequent, until the outbreak of World War II the species was very numerous and in some areas it even occurred on a massive scale. The exceptionally cold winter of 1939/1940 marked the beginning of a period of constant population decrease (Nowak 1968 – P). At the beginning of the 1960s, the population of rabbits in most areas was already small or very small. Since the early 1980s, the reduction of rabbit population has intensified. Since the beginning of the 21st century, the population of rabbits in the leased areas (constituting about 90% of all hunting areas in Poland) increased gradually, which was a result of the introduction of animals from captive breeding. Between 2003 and 2009, a total of around 20 000 individuals were introduced (on average around 2 900 individuals per year). However, due to the varying fate of these introductions and the capture of rabbits in the same period, the total population of this species in hunting areas was estimated to be around 13 900 individuals on average. Currently, rabbits occur mainly in the central and western part of Poland. The Vistula river is the border of the compact range, and the sites to the east are less numerous (Solarz 2011 – P). Its presence was confirmed in 214 areas of the Atlas of Mammals in Poland (Solarz 2018 – B).

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

- the environmental domain
- the cultivated plants domain

<input checked="" type="checkbox"/>	the domesticated animals domain
<input checked="" type="checkbox"/>	the human domain
<input checked="" type="checkbox"/>	the other domains

acomm05.	<p>Comments:</p> <p>Rabbit has a negative influence on all assessed domains. The effect on the environmental domain is manifested mainly by herbivory (Defra 2011 – I, Marchant 2012 – P), by disturbance of biotic and abiotic factors (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P) and by transmission of a large number of pathogens and parasites (CABI 2018 – B, Najberek 2018 – N) including notifiable diseases listed by the World Organisation for Animal Health (OIE). The effect on the domesticated animals domain and on the human domain is also associated with the transmission of numerous pathogens and parasites by the species. The effect on the cultivated plants domain is related to the herbivory of this species and the disturbance of crop integrity (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P). Burrowing can lead to subsidence of the ground along with the infrastructure on the surface (Taras 2007 – P) and is a demonstration of the negative impact of the species on other domains.</p>
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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* to 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:

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf02.	Answer provided with a	low	medium	high X	level of confidence
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acomm06.	<p>Comments:</p> <p>The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P), which according to the Harmonia^{+PL} assessment methodology indicates the following response: high probability with a high degree of certainty. Wild rabbit was first introduced in Poland around 1860. Since then, it has become a permanent element of the natural environment of the country. Presently, this species occurs mainly in the central and western Poland. The Vistula river is the border of the compact range, and the sites to the east of it are less numerous (Solarz 2011 – P).</p>
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a07. The probability for *the species* to be introduced into Poland’s natural environments by **unintentional human actions** is:

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf03.	Answer provided with a	low	medium	high X	level of confidence
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acomm07.	<p>Comments:</p> <p>The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P), which according to the Harmonia^{+PL} assessment methodology indicates the following response: high probability with a high degree of certainty. At the same time, due to the size of the rabbit, the probability of introducing this species into the natural</p>
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environment of Poland as a result of unintentional human activities (e.g. as a result of contamination of imported goods or as a "stowaway" passenger in means of transport or in travellers' luggage) in practice equals zero.

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

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

acomm08. Comments:
 The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P), which according to the Harmonia^{+PL} assessment methodology indicates the following response: high probability with a high degree of certainty. The first intentional introductions of rabbits to the natural environment of Poland took place around 1860 in Silesia. Currently, rabbit is a game species, therefore it is subject to hunting management – animals of this species are regularly introduced into the natural environment of Poland. Between 2003 and 2009, an average around 2 900 individuals per year were introduced (Solarz 2011 – P). Currently, about 1 500 rabbits are introduced to the natural environment annually (Krajewski and Sadowski 2013 – P).

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:

<input type="checkbox"/>	non-optimal
<input type="checkbox"/>	sub-optimal
<input checked="" type="checkbox"/>	optimal for establishment of <i>the species</i>

aconf05.	Answer provided with a	low	medium	high	level of confidence
				X	

acomm09. Comments:
 The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P), which according to the Harmonia^{+PL} assessment methodology indicates the following response: optimal climatic conditions, with a high degree of certainty (despite the opinion that climatic conditions may be one of the reasons for the failure of rabbit introductions in north-eastern Poland, Solarz 2011 – P). Wild rabbit prefers the steppic, Mediterranean and oceanic climates (according to the Köppen classification of climatic conditions) (CABI 2018 – B), which are typical of its native range, i.e. the Iberian Peninsula and the north-western part of Africa. The species has been introduced and is established on almost all continents (except Antarctica) (DAISIE 2008, CABI 2018 – B), and occurs, e.g. in the humid continental, subarctic and desert climate areas, thus it should be considered an extremely plastic species, with great tolerance for very different climatic conditions.

a10. Poland provides **habitat** that is

<input type="checkbox"/>	non-optimal
<input type="checkbox"/>	sub-optimal
<input checked="" type="checkbox"/>	optimal for establishment of <i>the species</i>

aconf06.	Answer provided with a	low	medium	high X	level of confidence
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acomm10. Comments:
The species is established in Poland (DAISIE 2008, CABI 2018, Alien species in Poland 2018 – B, Solarz 2011 – P), which according to the Harmonia^{+PL} assessment methodology indicates the following response: optimal habitat conditions, with a high degree of certainty. Wild rabbit prefers different types of dry lowland areas. It occurs most often on forest edges, in young coniferous and mixed forests, on the ravine slopes, in buffer strips within fields, on grasslands, clearings, wastelands and in other man-made environments (cemeteries, parks, abandoned buildings, orchards, etc.) (Solarz 2011 – P, Alien Species in Poland 2018 – B).

A3 | Spread

Questions from this module assess the risk of *the species* to overcoming dispersal barriers and (new) environmental barriers within Poland. This would lead 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 to be 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

aconf07.	Answer provided with a	low	medium	high X	level of confidence
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acomm11. Comments:
Estimation (Data type: C)
Results of research on the speed of expansion of the rabbit indicate that in some conditions it may be high. In Argentina, for example, the maximum rate of expansion was 9 kilometres per year (Never and Soriguer 2009 – P). In Poland, no detailed research was conducted in this respect, however, it can be concluded with high confidence certainty that in Poland, wild rabbit is not a species which has high migration capacity. This is reflected in the distribution of the species in Poland, which is closely linked to the sites in which it is introduced. Current distribution of the wild rabbit does not differ from its distribution throughout the whole period of the presence of this species in our country, which lasts for about 160 years. Wild rabbit occurs mainly in the central and western part of Poland. The Vistula river is the border of the compact range, and the sites to the east of it are less numerous (Solarz 2011 – P). It can, therefore, be estimated that, in the long run, the speed of the population expansion does not exceed 100 m per year.

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

- low
- medium
- high

aconf08.	Answer provided with a	low	medium	high X	level of confidence
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acomm12. Comments:
Wild rabbit is a game species, therefore it is subject to hunting management – individuals of this species are regularly introduced into the natural environment of Poland. Between 2003

and 2009, an average around 2 900 individuals per year were introduced (Solarz 2011 – P). Currently, about 1 500 rabbits are introduced into the natural environment annually (Krajewski and Sadowski 2013 – P). Because of such management of the species, wild rabbit is spreading and will continue to spread to new areas. The decrease in populations of some small game species is the reason why many hunting associations are interested in introducing rabbits it into their hunting areas. Some hunters even consider it an alternative species in the case of a decrease of population of hare *Lepus europaeus* (Kamieniarz and Kamieniarz 1992 – P). If the rabbit population growth in a given hunting area is too quick, rabbits are caught and resettled. A colony of individuals of this species located in the municipal cemetery in Toruń can serve as an example – the area is included in the programme for the recovery of small animals, therefore excessive wild rabbit individuals are caught and resettled (Krajewski and Sadowski 2013 – P). According to the scale adopted in the Harmonia^{+PL} procedure, it should be estimated that there are more than 10 such cases per decade (frequency is high).

A4a | Impact on the 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 species. 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 at a local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as (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:

<input type="checkbox"/>	inapplicable
<input type="checkbox"/>	low
<input checked="" type="checkbox"/>	medium
<input type="checkbox"/>	high

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

acomment13. Comments:
 Wild rabbit is a herbivorous species. Its dietary preferences depend on the local availability of plant food. These are both cultivated and wild plants, including trees (Defra 2011 – I, Marchant 2012 – P). Rabbits can damage or eliminate young trees of many species. Rabbits can also remove the bark of large trees, causing serious damage to them. In extreme cases rabbits may be the cause of complete inhibition of natural forest regeneration (Defra 2011 – I). Assuming that the species was widespread throughout the country, it is concluded that rabbits, due to their herbivorous nature, could cause severe declines in the population of native species of particular concern. Such an effect has been recorded in Great Britain (Crawley and Michael 1990 – P). The influence of rabbits was therefore assessed as medium.

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

<input checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

aconf10.	Answer provided with a	low X	medium	high	level of confidence
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acomm14. Comments:
 Negative effects of wild rabbit due to competition with other species were reported (e.g. in Australia, a total of about 156 species of plants and animals threatened by the presence of the rabbit or by the competition with it were identified, DEWHA 2008 – P), however, those species do not occur in Poland. According to some opinions (Sumiński 1963 – P), in Poland wild rabbit may outcompete hare and roe deer *Capreolus capreolus* (not classified as species of particular concern) through competition for food and shelter, but this has not been documented by scientific research (Solarz 2011 – P). Research by Katony et al. (2004 – P), conducted in Hungary, showed that despite overlapping feeding grounds, the population size of hares has not been significantly reduced by the co-occurring rabbits. The rabbit's influence resulting from competition was small or expressed in a decrease of other features of the hare population, which were not subject to this study. Assuming that the rabbit was widely spread in Poland, it can only be expected that the presence of this species would, at most, result in small declines in the populations of the native species mentioned above. Due to the lack of research on the subject, the degree of certainty of the response is low.

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
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acomm15. Comments:
 Wild rabbit does not hybridise with any native species found in the natural environment in Poland; it is the only representative of the *Oryctolagus* genus in Poland.

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	high X	level of confidence
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acomm16. Comments:
 Wild rabbit is a vector of at least 45 pathogens and parasites: viruses, bacteria, fungi, protozoa, nematodes, tapeworms, including Myxomatosis virus, Rabbit hemorrhagic disease virus (RHDV), rabies virus (RABV), West Nile virus (WNV), Venezuelan Equine Encephalomyelitis (VEE), goatpox virus (GPV), Bovine Virus Diarrhoea and Mucosal Disease (BVD/MD), Rinderpest virus (RPV), Q fever bacteria, *Trypanosoma evansi*, *Echinococcus granulosus* (CABI 2018 – B, Najberek 2018 – N). All the above pathogens and parasites are the cause of diseases which are included in the list of the World Organisation for Animal Health (OIE) and are therefore compulsorily notifiable. These pathogens and parasites can be very dangerous or deadly for other wild animal species that coexist with the rabbit in the natural environment, i.a. hares, ruminants and predatory mammals. Wild rabbit is also a host for at least 26 species of ticks and mosquitoes, i.a. *Haemaphysalis longicornis*, *Dermacentor marginatus*, *Ixodes bivari*, *Ixodes granulatus*, *Ixodes holocyclus*, *Psorophora columbiae*, *Aedes cinereus*, *Aedes cantans*, *Anopheles freeborni*, *Culex tarsalis* (Najberek 2018 – N),

which in addition are vectors of some of the above pathogens. In accordance with the adopted methodology, the impact of rabbits on native species by transmission of pathogens or parasites was considered to be very significant.

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf13.	Answer provided with a	low	medium	high	level of confidence
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

acommm17. Comments:
 Wild rabbits are considered to be ‘ecosystem engineers’ (Bravo et al. 2009 – P), they dig extensive and deep burrows with several entrances leading to single- or multi-family nesting chambers. Through digging burrows rabbits can contribute to exposure to and drying of plant roots and soil (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P). Depending on the extent of the damage, this impact may be easily or hardly reversible and, assuming that the species was widespread, it could affect both habitats considered not to be of particular concern and those of particular concern, including habitat 6510 (lowland hay meadows of *Alopecurus pratensis*, *Sanguisorba officinalis*). However, due to the lack of research on this matter in Poland, the degree of certainty of this response was considered to be low.

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf14.	Answer provided with a	low	medium	high	level of confidence
		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

acommm18. Comments:
 Wild rabbit’s influence on the ecosystem’s integrity through disturbance of its biotic factors may be manifested by mass feeding, crushing and trampling of vegetation (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P), which locally may cause hardly reversible disturbances in trophic networks, which include a significant decrease of the availability of food for other herbivores. If the species became widespread, this could affect both habitats considered not to be of particular concern and those of particular concern, including habitat 6510 (lowland hay meadows of *Alopecurus pratensis*, *Sanguisorba officinalis*). In extreme cases rabbits may be the cause of complete inhibition of natural forest regeneration (Defra 2011 – I). In addition, rabbits can be an important source of food for predators. So in their native range, they play an important role for endangered species, such as Iberian lynx *Lynx pardinus* and Spanish imperial eagle *Aquila aldabertii* (Lees and Bell 2008 – P) However, in the areas where the rabbit has been introduced, such a change in the trophic net may have a number of negative effects, including an increase of populations of alien predator species, such as racoon *Procyon lotor*, raccoon dog *Nyctereutes procyonoides* and American mink *Mustela vison*.

A4b | Impact on the cultivated plants domain

Questions from this module qualify the consequences of *the species* for 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 plant targets through **herbivory or parasitism** is:

<input type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input checked="" type="checkbox"/>	very high

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

acomment19. Comments:

Large populations of rabbits can cause serious damage to agriculture and forestry. These damages are caused by feeding, crushing and trampling of vegetation and digging burrows (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P). In Great Britain, damage to agriculture caused by rabbits is observed since the 13th century. There, wild rabbit is the largest vertebrate pest, causing damage to crops estimated to be over £250 million per year. The biggest losses are caused to grassland, crops of grains, brassicas and roots, plantations of young trees and plants grown in gardens and orchards (Marchant 2012 – P). Winter wheat, barley and oat are the most vulnerable crops. The impact of rabbits feeding on winter cereals is most evident in winter, when the growth of plants is slow and decreases during the faster growth of plants in spring (Defra 2011 – I). The feeding of this species on freshly sown fields can lead to their complete destruction. Continuous feeding of rabbits on grassland reduces the vitality of valuable fodder species such as *Festuca pratensis*. Feeding, scratching and digging may also cause changes in the composition of meadow and grassland plants – it may stimulate infestation of weeds, such as nettles and thistle, leading to the degradation of grassland (Defra 2011 – I). Rabbits can damage or eliminate young trees of many species. This species can also debark large trees, causing serious damage and loss to forestry. In extreme cases rabbits may cause an inhibition of natural forest regeneration (Defra 2011 – I). In Australia, the damage to agriculture caused by this species is estimated to be \$206 million per year. Rabbits feeding in the fields can cause harvest losses of up to 100%. The losses are also caused by competition for food with farm animals. As a result of this influence, the body weight of farm animals is reduced, wool production is lower, the number of litters decreases and their mortality during drought periods is higher (Gong et al. 2009 – P). In the case of the spread of the species throughout Poland, its impact on crops should be considered as very high. Such an assessment is a result of the high probability of the impact (it is expected that the impact could affect more than 2/3 of the crops that are the subject of the invasion), with a significant effect (in the worst case scenario, the condition of the plants or the yield of a single crop would be reduced by more than 20%).

a20. The effect of *the species* on cultivated plant targets through **competition** is:

<input checked="" type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

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

acomment20. Comments:

Wild rabbit is an animal and therefore does not compete with plants.

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

- inapplicable
- no / very low
- low
- medium
- high
- very high

aconf17. Answer provided with a

low	medium	high
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 level of confidence

acomm21. Comments:
Wild rabbit is an animal, so it does not hybridise with plants.

a22. The effect of *the species* on cultivated plant targets by **affecting the cultivation system’s integrity** is:

- very low
- low
- medium
- high
- very high

aconf18. Answer provided with a

low	medium X	high
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 level of confidence

acomm22. Comments:
Rabbits have a negative effect on plant cultivation mainly through foraging (see question a19). The negative impact of this species also includes crushing and trampling the vegetation, as well as digging burrows, which leads to the exposure and drying out of plant roots – including trees – and soil drying (Sumiński 1963, Nowak 1968, Caboń-Raczyńska 1984 – P). In extreme cases rabbits may cause an inhibition of natural forest regeneration (Defra 2011 – I).
This type of impact can lead to changes in the properties of the agro-ecosystem, including disturbance of the elements cycle, hydrology and altering physical properties of the soil. Assuming that this species is widespread in Poland, it is estimated that the probability of occurrence of such disturbances would be medium. Such an impact would affect from 1/3 to 2/3 of crops, and its effect would be medium – in the worst case scenario the condition of plants or yield of a single crop would be reduced approximately from 5% to 20%. Under these assumptions, the impact should be assessed as medium.

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

- very low
- low
- medium
- high
- very high

aconf19. Answer provided with a

low	medium	high X
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 level of confidence

acomm23. Comments:
Until now, no pathogen or parasite species harmful to crops have been identified in wild rabbit. There is also no reason to believe that they could be discovered as research progresses.

A4c | Impact on the 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:

<input checked="" type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf20.	Answer provided with a	low	medium	high	level of confidence
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acomm24. Comments:
Wild rabbit is a herbivorous species.

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

<input checked="" type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf21.	Answer provided with a	low	medium	high	level of confidence
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acomm25. Comments:
Biting is the only potential harmful interaction influencing health of an individual animal during direct contact. The lack of data indicates that rabbits avoid direct confrontation with farmed or domesticated animals and that such interactions are therefore unlikely (less than one direct contact per 100 000 farmed or domesticated animals per year). The effect of such events is undoubtedly small (the animal will heal fully). Therefore, the impact of wild rabbit on the health of an individual animal or on animal production due to properties that pose a risk during direct contact should be assessed to be very low.

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

<input type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input checked="" type="checkbox"/>	very high

aconf22.	Answer provided with a	low	medium	high	level of confidence
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acomm26. Comments:
Rabbit is a vector of at least 45 pathogens and parasites: viruses, bacteria, fungi, protozoa, nematodes, tapeworms, including Myxomatosis virus, Rabbit hemorrhagic disease virus (RHDV), rabies virus (RABV), West Nile virus (WNV), Venezuelan Equine Encephalomyelitis (VEE), goatpox virus (GPV), Bovine Virus Diarrhoea and Mucosal Disease (BVD/MD),

Rinderpest virus (RPV), Q fever bacteria, *Trypanosoma evansi*, *Echinococcus granulosus* (CABI 2018 – B, Najberek 2018 – N). All the above pathogens and parasites are the cause of diseases which are included in the list of the World Organisation for Animal Health (OIE) and are therefore compulsorily notifiable. Myxomatosis and Rabbit hemorrhagic disease are typical for rabbits kept for breeding or as pets and are fatal to animals. Other diseases affect cattle (Bovine Virus Diarrhoea and Mucosal Disease, Rinderpest, Q fever), horses (West Nile fever, Venezuelan Equine Encephalomyelitis, *Trypanosoma evansi*), sheep (Q fever), goats (goatpox), cats (rabies, West Nile fever, *Trypanosoma evansi*, *Echinococcus granulosus*) dogs (rabies, West Nile fever, *Trypanosoma evansi*, *Echinococcus granulosus*). Infection with these diseases by livestock (as cattle, horses, sheep, goats), is very likely if rabbits use pastures as feeding areas. Wild rabbit is also a host for at least 26 species of ticks and mosquitoes, i.a. *Haemaphysalis longicornis*, *Dermacentor marginatus*, *Ixodes bivari*, *Ixodes granulatus*, *Ixodes holocyclus*, *Psorophora columbiae*, *Aedes cinereus*, *Aedes cantans*, *Anopheles freeborni*, *Culex tarsalis* (Najberek 2018 – N), which are also vectors of some of the above pathogens. In accordance with the adopted methodology, the impact of rabbits on individual animal health or animal production through the transmission of pathogens and parasites harmful to these animals should be assessed as very high.

A4d | Impact on the 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
- very low
- low
- medium
- high
- vert high

aconf23. Answer provided with a

low	medium	high
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 level of confidence

acomm27. Comments:
Wild rabbit is 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
- high
- very high

aconf24. Answer provided with a

low	medium	high
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 level of confidence

acomm28. Comments:
The species can only affect human health during direct contact by biting. The lack of data on this matter indicates that rabbits avoid direct confrontation with humans. However, biting may happen when humans try to feed less skittish individuals or when they attempt to capture wild rabbits. The likelihood of such events is considered medium (1 –100 cases per 100 000 people per year) and the effect is considered low (medical consultations are rare, the disease does not cause inability to work, there are no permanent impairments, low

stress levels). Therefore, the impact of rabbit on human health due to all its hazardous potential during direct contact should be assessed as low.

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

<input type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input checked="" type="checkbox"/>	very high

aconf25.	Answer provided with a	low	medium	high X	level of confidence
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acomment29. Comments:

Rabbit is a vector of over 45 pathogens and parasites: viruses, bacteria, fungi, protozoa, nematodes, tapeworms (see questions a16 and a26), including those dangerous for humans, such as rabies virus (RABV), West Nile virus (WNV), Venezuelan equine encephalitis (VEE), Q fever bacteria, *Echinococcus granulosus* (CABI 2018 – B, Najberek 2018 – N). All the above pathogens and parasites are the cause of diseases which are included in the list of the World Organisation for Animal Health (OIE) and are therefore compulsorily notifiable. Rabies is an incurable disease, the main cause of death is respiratory failure. According to the WHO (World Health Organisation), approximately 60 000 people die of rabies every year (WHO 2014 – I). West Nile Fever is a disease that belongs to the group of haemorrhagic fevers, which may cause i.a. nausea, vomiting, difficulty swallowing, wry neck, muscle weakness, gait abnormality, coordination disorders, parkinsonism and impairment of consciousness. Venezuelan equine encephalitis is characterised by neurological issues, headaches, weakness, convulsions, nausea and vomiting. Headaches gradually increase and are followed by impaired consciousness (drowsiness, lethargy or coma). The Venezuelan form of equine encephalitis has a mortality rate of less than 0.5%. Q fever is considered to be one of the most contagious diseases in the world as just one bacterium may cause infection in susceptible individuals. The disease manifests itself like flu, with sudden fever, general malaise, severe headache, muscle pain, loss of appetite, dry cough, pleural pain, chills. There are also symptoms from the gastrointestinal tract: vomiting, diarrhea, nausea. Endocarditis and pneumonia may occur. Echinococcosis caused by echinococcus sp. tapeworms is an extremely dangerous and deadly disease, its main symptom is a cyst, usually located in the liver, less frequently in the lungs, spleen, bones or brain. Wild rabbit is also a host for at least 26 species of ticks and mosquitoes, i.a. *Haemaphysalis longicornis*, *Dermacentor marginatus*, *Ixodes bivari*, *Ixodes granulatus*, *Ixodes holocyclus*, *Psorophora columbiae*, *Aedes cinereus*, *Aedes cantans*, *Anopheles freeborni*, *Culex tarsalis* (Najberek 2018 – N), which are also vectors of some of the above pathogens.

In accordance with the adopted methodology, the impact of rabbit on human health as a result of the transmission of pathogens and parasites harmful to humans is very high.

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:

<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input checked="" type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf26.	Answer provided with a	low	medium X	high	level of confidence
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acomment30. Comments:
Rabbits dig large and deep burrows with several entrances to single or multifamily nesting chambers. Digging the burrow may lead to subsidence of the soil and the infrastructure on its surface (Taras 2007 – P). This can have a negative impact in particular on the various types of flood protection measures (Gilvear and Black 2009, Marchant 2012 – P). Depending on the type of damage, the effect of such events should be considered as partially reversible (medium), and the probability of their occurrence should be over 1, but not more than 100 events per 100 000 objects per year (medium).

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
- neutral
- moderately positive
- significantly positive

aconf27.	Answer provided with a	low	medium	high X	level of confidence
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acomment31. Comments:
The effect of rabbit on supply services was identified as very negative as it negatively affects crops and grassland by consuming and trampling it as well as digging burrows (see question a19 and a22). The species also has a negative influence on farmed animals, it can transmit more than 45 pathogens and parasites, including diseases included on the World Organisation for Animal Health (OIE) list: myxomatosis, viral haemorrhagic rabbit disease, rabies, West Nile fever, Venezuelan equine encephalitis, goatpox, bovine viral diarrhoea and mucosal disease, rinderpest, Q fever, surra, echinococcosis (see question a26). In addition, rabbits compete with farmed animals for food (see question a19). Rabbit is also a game species which is appreciated for its meat, but that does not balance the above mentioned negative effects.

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf28.	Answer provided with a	low	medium	high X	level of confidence
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acomment32. Comments:
The effect of wild rabbit on regulatory services has been identified as very negative as it has an adverse influence on biological regulation – regulation of zoonoses, through the transmission of more than 45 pathogens and parasites, including diseases listed by the

World Organisation for Animal Health (OIE): Myxomatosis, rabbit viral haemorrhagic disease, rabies, West Nile fever, Venezuelan equine encephalitis, goatpox, bovine viral diarrhoea and mucosal disease, rinderpest, Q fever, surra, echinococcosis (see questions a16 and a26). Moreover, through digging burrows rabbits can contribute to exposure to and drying of plant roots and soil (see questions a17 and a30) and disturb trophic networks by mass consuming, crushing and trampling the plants (see question a18).

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

<input type="checkbox"/>	significantly negative
<input checked="" type="checkbox"/>	moderately negative
<input type="checkbox"/>	neutral
<input type="checkbox"/>	moderately positive
<input type="checkbox"/>	significantly positive

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

acommm33. Comments:
 The effect that rabbit has on cultural services is assessed as moderately negative as it damages various crops, including plants grown in house gardens, orchards and garden plots, by consumption, trampling and digging burrows. Moreover, digging burrows in archaeological sites causes damage to culturally valuable objects and can result in their complete destruction. It also leads to destabilization of monuments, e.g. statues (Defra 2011 – I). Rabbits are often bred in-house and are also a game species and can therefore be seen as a desirable part of the ecosystem by some members of the society. However, these qualities do not counterbalance the negative impacts mentioned above.

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

Below, each of the Harmonia^{PL} modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest taking into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes in atmospheric 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:

<input type="checkbox"/>	decrease significantly
<input type="checkbox"/>	decrease moderately
<input checked="" type="checkbox"/>	not change
<input type="checkbox"/>	increase moderately
<input type="checkbox"/>	increase significantly

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

acommm34. Comments:
 Wild rabbit prefers a steppic, Mediterranean and oceanic climate (CABI 2018 – B). Its spread and establishment on most continents (CABI 2018 – B) proves its ease of adaptation to very different climatic conditions, also to the prevailing humid continental climate in Poland. The species has already overcome geographical barriers and is established in natural

environment of Poland. Therefore, the predicted climate change will not affect the species' ability to overcome further barriers connected with introduction.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf31. Answer provided with a

low	medium	high X
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 level of confidence

acomm35. Comments:
Wild rabbit has already overcome the barriers preventing its establishment in Poland, so climate change will not affect this parameter.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf32. Answer provided with a

low	medium X	high
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 level of confidence

acomm36. Comments:
Wild rabbit prefers a steppic, Mediterranean and oceanic climate (CABI 2018 – B). Under favourable conditions, with constant access to adequate food, rabbits can reproduce during all year (Smith and Boyer 2008, Australian Government 2011 – P). Therefore, in case of climate warming, an increase in the reproduction rate of the species and, consequently, a moderate increase in the spread rate in Poland cannot be excluded. On the other hand, the population of this species in Poland was the largest in the period before World War II (Solarz 2011 – P), when climatic conditions were more severe than at present. It seems, therefore, that the climate is not the only factor significantly affecting the dynamics of rabbit population.

a37. IMPACT ON THE 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
- increase significantly

aconf33. Answer provided with a

low	medium X	high
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 level of confidence

acomm37. Comments:
Wild rabbit has a negative impact on the natural environment due to transmission of pathogens and parasites, herbivory and disturbance of abiotic and biotic factors in ecosystems (see questions a13, a16 – a18). If the predicted climate change results in an increase in the area occupied by the rabbit population in Poland and increase of the population itself, the species' negative impact on the natural environment is also likely to increase.

a38. IMPACT ON THE 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
- increase significantly

aconf34. Answer provided with a

low	medium X	high
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 level of confidence

acomm38. Comments:
This species has a negative impact on plant cultivation as it is herbivorous and it also disturbs integrity of the crops (see questions a19 and a22). If the predicted climate change results in an increase in the area occupied by the rabbit population in Poland, and increase of the population itself, the species' negative impact on plant crops is also likely to increase.

a39. IMPACT ON THE 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
- increase moderately
- increase significantly

aconf35. Answer provided with a

low	medium X	high
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 level of confidence

acomm39. Comments:
Wild rabbits adversely affect animal husbandry by transmitting pathogens and parasites (see question a26). If the predicted climate change results in an increase in the area occupied by the rabbit population in Poland and increase of the population itself, the species' negative impact on animal husbandry is also likely to increase.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf36. Answer provided with a

low	medium X	high
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 level of confidence

acomm40. Comments:
The species has a negative impact on humans by transmitting pathogens and parasites and, to a lesser extent, by posing a risk during direct contact (see questions a28 and a29). If the predicted climate change results in an increase in the area occupied by the rabbit population in Poland and increase of the population itself, the species' negative impact on humans is also likely to increase.

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
- increase moderately
- increase significantly

aconf37. Answer provided with a

low	medium X	high
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 level of confidence

acomm41. Comments:
Wild rabbit has a negative effect on other objects, mainly due to digging burrows, which may lead to subsidence of the ground along with the infrastructure located on its surface (see question a30). If the predicted climate change results in an increase in the area occupied by the rabbit population in Poland and increase of the population itself, the species' negative impact on the natural other sites is also likely to increase.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.63	1.00
Environmental impact (questions: a13-a18)	0.58	0.58
Cultivated plants impact (questions: a19-a23)	0.50	0.67
Domesticated animals impact (questions: a24-a26)	0.50	1.00
Human impact (questions: a27-a29)	0.63	0.75
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.88	1.00
Impact (questions: a13-a30)	0.63	0.70
Overall risk score	0.55	
Category of invasiveness	moderately invasive alien speciesp	

A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account. However, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting 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:
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