



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. Henryk Okarma
2. Izabela Wierzbowska – external expert
3. Karolina Mazurska

acomment01.	Comments:	degree	affiliation	assessment date
	(1)	prof. dr hab.	Institute of Nature Conservation of the Polish Academy of Sciences in Cracow	28-01-2018
	(2)	dr	Institute of Environmental Sciences, Jagiellonian University, Cracow	06-02-2018
	(3)	mgr	Institute of Nature Conservation of the Polish Academy of Sciences in Cracow	08-02-2018

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

Polish name: Maral (jeleń mandżurski)
Latin name: ***Cervus elaphus sibiricus***
English name: Altai wapiti

acomm02.

Comments:

Taxonomy of *Cervus* class is very complex and the experts cannot agree on its classification into species and subspecies. In recent years a view has been adopted, based on phylogenetic molecular studies, that maral belongs to the subspecies of wapiti *Cervus canadensis*, which has been lately recognized as the separate species (Lorenzini and Garofalo 2015 – P). According to the current state of knowledge, maral is the subspecies of (*Cervus canadensis*) and it should be called *Cervus canadensis sibiricus* in Latin, and not *Cervus elaphus sibiricus*. Significant changes in red deer (*Cervus elaphus*) and wapiti (*Cervus canadensis*) size and build were the base for defining them as two separate species (Brook et al. 2016 – P, Long 2003 – P, Wilson and Mittermeier 2011 – P). Manchurian wapiti also is not a synonym for maral because it belongs to another subspecies of wapiti and occupies other areas than maral. The Latin name for Manchurian wapiti is (*Cervus canadensis xanthopygus*) (Brook et al. 2016 – P, Wilson Mittermeier 2011 – P). Marals (*C. c. sibiricus*) occupy north-western part of Kazakhstan, a part of Mongolia, whereas Manchurian wapiti (*C. c. xanthopygus*) live in south-western part of Siberia, Far-Eastern Russia, Ussuria and Manchuria (Brook et al. 2016 - P). It is thus suggested that the name of maral subspecies is changed into the current name *Cervus canadensis sibiricus*.

Polish name (synonym I)
Jeleń mandżurski

Polish name (synonym II)

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Latin name (synonym I)
Cervus canadensis sibiricus

Latin name (synonym II)

–

English name (synonym I)
Altai maral

English name (synonym II)

–

a03. Area under assessment:

Poland

acomm03.

Comments:

–

a04. Status of the species in Poland. The species is:

- | | |
|-------------------------------------|--|
| <input type="checkbox"/> | native to Poland |
| <input type="checkbox"/> | alien, absent from Poland |
| <input checked="" type="checkbox"/> | alien, present in Poland only in cultivation or captivity |
| <input type="checkbox"/> | alien, present in Poland in the environment, not established |
| <input type="checkbox"/> | alien, present in Poland in the environment, established |

aconf01.

Answer provided with a

low

medium

high

X

level of confidence

acomm04.

Comments:

According to the register of the Polish Chief Veterinary Officer (2017 – B), information from district veterinary officers (Hędrzak and Wierzbowska 2018a – A) and from the Polish Deer Farmers Association (Hędrzak and Wierzbowska 2018b – A), it should be noted that in Poland marals are not kept for production purposes. They are not maintained in Polish zoos (Topola 2016 – P). The only herd is kept on an agritourism farm in Zatyki near Gołdapia (Warmia-Masuria Province). According to information obtained from the farm owner, the herd consisted of 10 individuals on 6.02.2018 (Hędrzak 2018 – A).

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

- | | |
|-------------------------------------|---------------------------------|
| <input checked="" type="checkbox"/> | the environmental domain |
| <input checked="" type="checkbox"/> | the cultivated plants domain |
| <input checked="" type="checkbox"/> | the domesticated animals domain |

- the human domain
- the other domains

acomm05. Comments:
 Taking into account maral similarity to wapiti *Cervus canadensis*, this species can affect all areas and damage the natural environment, especially forests (Gill 1992) because marals are herbivorous and can intercross with red deer *Cervus elaphus* (Moore and Littlejohn 1989), also they can spread diseases and parasites among wild and farm animals (Drożdż et al. 1998, Kowal et al. 2016, Najberek 2018). And the above issues can pose indirect threat to human health. Marals, which belong to large cervids, are often involved in road accidents resulting in property damage and a threat to human health. There are no studies that marals cause damage to crops. However, due to their feeding habits similar to those of red deer which affects crops (Wilson et al. 2009), marals can be assumed to cause damage to crops and meadows near forests.

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:

- low
- medium
- high

aconf02. Answer provided with a

low	medium	high X
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 level of confidence

acomm06. Comments:
 Marals occupy north-western part of Kazakhstan, a part of Xinjiang from north to southern part of Siberia, and the northern part of Mongolia (Brook et al. 2016 - P). Wild marals do not occur in Poland neighbourhood countries. Single herds are kept in zoos, e.g. in the Czech Republic. Although wild marals are not observed in Poland and neighbourhood countries, their genetic material can be present in the gene pool of red deer in Europe. The reason for this is that many local autochthonous populations were hybridized with red deer brought from other areas, e.g. the areas located near the occurrence site of marals (Hartl et al. 2003 - P). On the turn of 19. and 20. Century, there were large-scale translocations of deer in different parts of Europe, in areas where they were expatriated by hunters. Taking into account the fact that red deer and maral can interbreed, a part of gene variation of red deer in Europe is likely to include the genetic material of maral.

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

- low
- medium
- high

aconf03. Answer provided with a

low	medium X	high
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 level of confidence

acomm07. Comments:
 Maral is a large cervid and there are no reports on unintentional introductions of animals of that size. Therefore the probability of unintentional introduction into natural environment is very low.

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

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

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

acomm08. Comments:
 The Polish legislation prohibits the introduction of alien species into the natural environment. In Poland, there is only one herd of 10 marals kept as a tourist attraction in Warmia-Masuria Province. They live in a closed area (Hędrzak 2018 – A). Although the risk of escape can never be ruled out completely, taking into account low number of animals kept and measures taken to prevent their escape, the probability of intentional introduction of these individuals into natural environment is low.

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

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

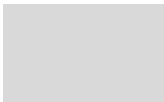
acomm09. Comments:
 This species naturally live in more severe climate than in Poland, in areas of cool, continental type of temperate climate (Brook et al. 2016 - P). The climatic similarity between its natural habitat and Poland is low, not greater than 45% (in accordance with Harmony⁺ methodology). The species introduction into less severe climate conditions increases their survival rate contrary to the reverse situation. Thus, the climate in Poland has been assessed as moderately positive.

a10. Poland provides **habitat** that is

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

aconf06.	Answer provided with a	low	medium	high	level of confidence
				X	

acomm10. Comments:
 The natural range of marals includes open grassland, steppes (Wilson and Mittermeier 2011 – P), and areas of secondary succession and the upper woods, from where they enter open areas above the upper borderline of the forest (Sokolow 1989 – P). They occupy fir forests, spruce forests and pine forests (Nuridinowitsch 2013 – P). Food requirements of marals are similar to other cervids of the same size. They feed on a wide range of plants, from grass, herbs, leaves, sprouts to bark of branches and trunks of young trees. Marals are associated to occupy forest areas. There are no literature data whether they feed on arable crops (Heptner et al. 1961 – P, Baskin and Danell 2003 – P). Mountainous areas and possibly large



forest areas in western and north-eastern part of Poland are optimal conditions for establishment of this species. Like wapiti, marals can also occupy habitats with park plants (Strong et al. 2013 - P).

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:

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

aconf07.	Answer provided with a	low	medium X	high	level of confidence
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acomm11.	Comments: Assessment (Data type: C) There is no published research data on spreading or population growth rate of the species (a single-point dispersion/expansion of the population). Due to certain similarities between marals and red deer (size, life history, fertility, behaviour), the spreading rate of released marals has been assessed as high (from 1 km to 10 km per year).
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a12. The frequency of the dispersal of *the species* within Poland by **human actions** is:

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

aconf08.	Answer provided with a	low	medium X	high	level of confidence
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acomm12.	Comments: There is no verified data from the published test results. In Poland, there is only one small herd of marals kept on the agritourism farm. There have been no reports on farmers interest in this species, which could potentially escape from new farms. Moreover, the intentional movement of this species in the environment is not permitted according to the Polish legislation. Because of little interest from the public, we can assume that the species translocation within a distance greater than 50 km will not be frequent (less than one case per decade).
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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 checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

aconf09.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

acomment13. Comments:
 Marals belong to cervid that feed on a wide range of products, and their food requirements are similar to those of other similar-size cervids. In summer, marals mainly eat grass, and sometimes leaves and shoots of trees and bushes. They eat more shoots from October to November. At the end of February and March, when first thaws take place, the animals begin to feed on herb fringes from last year. They are their primary type of food until the end of April. In winter, marals mainly eat hay if they have access to this forage. In other cases, they feed on shoots of trees and bushes (Nuridinowitsch 2013 – P). Shoots contribute then ca. 40% of their food (Anatoliewitsch 2014 – P). There are no literature data that describe the species effects on flora, forest ecosystem and fields. Marals, like other cervids of comparable size, are likely to have some impact on herbaceous plants, forests, cultivated plants and agriculture areas (Gill 1992 – P, Dolman and Wäber 2008 – P, Wilson et al. 2009 – P), but it is difficult to assess the scope of this effect.

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

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

aconf10.	Answer provided with a	low	medium	high	level of confidence
			<input checked="" type="checkbox"/>		

acomment14. Comments:
 There is no published information on competition between marals and other species of cervids. The examples of other cervids species introduced beyond their natural habitats show that at high density, they can displace other native species and compete with them for food. In Poland, none of cervids species is of special concern. But, taking into account that the optimal areas for marals (such as large forest complexes) are occupied by *Bison bonasus*, the restriction of carrying capacity for the bison. This assumption can be supported by studies performed in North America, concerning the interaction between wapiti and *Bison bison*. These studies have demonstrated that habitat niches of these animals overlapped in more than 80% even though they occupied that area in a different way and tried to avoid each other, whereas their food niches overlapped in more than 90% in spring and summer seasons (Telfer and Cairns 1979 – P). According to other studies, wapiti often feed on hay bales prepared for cattle or wild ungulates (Gooding and Brook 2014 – P). The same can refer to marals.

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

<input type="checkbox"/>	no / very low
<input type="checkbox"/>	low
<input checked="" type="checkbox"/>	medium

<input type="checkbox"/>	high
<input type="checkbox"/>	very high

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

acommm15. Comments:

In farming conditions red deer (*Cervus elaphus*) and wapiti (*Cervus canadensis*) can intercross between themselves (Moore and Littlejohn 1989 – P, Randi et al. 2001 – P). Because maral (*Cervus canadensis sibiricus*) is the subspecies of wapiti, it should be assumed that also in the natural environment, mating between maral stags and red deer hinds, and between red deer stags and maral hinds is possible (Wierzbowska et al. 2010).. In the past, there were deliberate attempts to crossbreed wapiti with red deer in natural environment. They were made in many places in Europe, e.g. Scotland (Pérez-Espona et al. 2011 – P) or in forest in Kobiór, near Pszczyna (Wierzbowska et al. 2010 - P). There are known hybrids as effect of such crossbreeding.

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

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

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

acommm16. Comments:

Marals host many ectoparasites, such as *Lipoptena* spp., *Hypoderma diana* and *Booponus borealis*, *Dermacentor marginatus*, parasitic bowl fly *Booponus borealis*, and others (Kowal et al. 2016, Abdybekova et al. 2017 – P, Najberek 2018 – N,). This species also carries a dangerous blood-sucking nematode *Ashworthius sidemi* (synonym: *A. gagarini* Kostyaev, 1969) (Drożdż 1973 – P, Drożdż et al. 1998 – P), which can pose a threat to hoofed mammals in Poland, including the endangered species – European bison. The parasite is transmitted with food in areas used for foraging by infested animals. The parasite may contribute to death of young bisons and affects the condition of adult individuals. Moreover, the studies on 508 marals kept under farming conditions in Kazakhstan demonstrated that they carried: 6 species of nematodes – *Bunostomum phlebotomum*, *Capillaria bovis*, *Haemonchus contortus*, *Nematodirus spathiger*, *Oesophagostomum venulosum*, *Trichuris skrjabini*; 2 species of cestode: *Moniezia benedeni* and *Moniezia expansa* and 3 species of coccidia: *Eimeria cervi*, *E. gallivalerioi* and *E. robustus* (Abdybekova et al. 2017 - P). These parasites may affect the condition of infested animals.

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

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

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

acommm17. Comments:

There are no scientific data that the species disturbs abiotic factors of the ecosystem.

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

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

aconf14.	Answer provided with a	low	medium X	high	level of confidence
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acomment18. Comments:
 This species will produce similar effects like other species of cervids of comparable size, particularly wapiti whose feeding on grassland reduces turf covering (Packer 1963 – P). Like wapiti, marals can significantly modify the species composition of forest environment and restricts biodiversity in forests (Roberts et al. 2014 - P). The processes in some habitats with high density of individuals can affect biotic factors of the ecosystem. Thus, the species impact was defined as moderate. In the worst case scenario, the changes in processes taking place in habitats other than those of particular concern, are difficult to reverse or the changes in processes related to habitats of particular concern are easily reversible.

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

aconf15.	Answer provided with a	low	medium X	high	level of confidence
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acomment19. Comments:
 There is no literature data on the effect of their natural occurrence on cultivation of crops. Like other species of cervids, marals probably cause damage to crops (Wilson et al. 2009 - P). Due to their foraging preferences, e.g. grazing, marals can cause damage to meadows near forests and rising crops. Shoots contribute to ca. 40% of maral diet in the winter period (Anatoliewitsch 2014 – P) which means that this species probably causes local damages to forest plantations. Because marals prefer forest habitats (Heptner et al. 1961 – P), their expected impact on plant crops should be low, that is, less than 1/3 of invaded plants. In the worst case scenario the plant form or the yield of a single crop will drop by ca. 5% - 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
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 level of confidence

acomm20. Comments:
This species is an animal.

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:
This species is an animal.

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:
There are no published results from studies on the species impact on cultivated plants state or yields due to modified properties of agro-ecosystem, including changed cycle of elements, hydrology, physical properties, and trophic networks. Marals are likely to feed on cultivated plants. However, due to their feeding preferences within the ecosystems, their impact is assessed to be low.

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:
No literature data is available on the species as the host or vector for pathogens or parasites harmful to cultivated plants.

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:

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

aconf20. Answer provided with a

low	medium	high
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 level of confidence

acomm24. Comments:
This species is neither a predator nor a parasite.

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
- medium
- high
- very high

aconf21. Answer provided with a

low	medium	high
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 level of confidence

acomm25. Comments:
No information is available on the biological, physical and/or chemical properties of the species that are harmful during the contact with farm or domestic animals or harmful to livestock production (e.g. toxins or allergens). There is no information on interactions between marals and farm animals, such as fallow deer *Dama dama* and sika deer *Cervus nippon*. We can suppose that direct contacts in the form of kicking or hitting with antlers are probable on meadows near forests, especially during a year-long grazing. The probability of direct contact is low: less than one case a year per 100 000 farm or domestic animals; m a

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

aconf22. Answer provided with a

low	medium	high
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 level of confidence

acomm26. Comments:
This species carries a blood-sucking nematode *Ashworthius sidemi* (synonym: *A. gagarini* Kostyaev, 1969) (Drożdż 1973 – P, Drożdż et al. 1998 – P), and some species of nematodes, cestodes, coccidia and a variety of ectoparasites (Abdybekova et al. 2017 – P, Najberek

2018 – N). *Ashworthius sidemi* can be fatal to farmed ruminants (Moskwa et al. 2015 – P), which can reduce the capacity of livestock production, especially in the areas of a year-long grazing. Transmission of the parasite is with food, in areas where infested wild animals share pastures with farmed ones. It should be assumed that if the species is spread throughout Poland, there will be between 1 and 100 cases of infestation with the parasite for 100 000 of farmed animals per year. The effects of the infestation may include permanent health problems and is not completely curable. There are no reported species that the species carries diseases which are not classified as notifiable diseases.

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:

<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"/>	vert high

aconf23. Answer provided with a

low	medium	high
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 level of confidence

acomm27. Comments:
This species is not a parasite.

a28. The effect of *the species* on human health, 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

aconf24. Answer provided with a

low	medium	high X
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 level of confidence

acomm28. Comments:
There is no published information on the biological, physical and/or chemical properties of the species that are harmful during the direct contact with humans. Due to their quite large size, hitting with legs or antlers is possible if an animal is to be caught improperly or is under stress. The probability of direct contact is low, that is, less than one case a year per 100 000 farm or domestic animals.

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

aconf25.	Answer provided with a	low	medium	high X	level of confidence
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acomm29. Comments:
Marals host ectoparasite *Lipoptema cervi* (Kowal et al. 2016 – P) which can also attack human. The parasite bite for humans is not hazardous, but can cause secondary allergic reaction. Parasite carries bacteria *Bartonella* that cause bartonellosis in humans (Samuel et al. 2012 - P). The effect was assessed as medium, as the disease incurred by these pathogens is curable.

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
- high
- very high

aconf26.	Answer provided with a	low	medium X	high	level of confidence
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acomm30. Comments:
There is no data on maral impact on infrastructure. We can only suppose that marals, like other species of cervids, are involved in road accidents on a local scale, and thus cause damage to property and present a threat to human health. The likelihood was assessed as medium (more than 1 but less than 100 incidents per 100 000 objects annually) and the effect – as medium too (partly reversible).

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 X	high	level of confidence
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acomm31. Comments:
This species, especially occurring at high density, can have a potential effect on plant crops (forests and meadows near forests, cereal crops). Transmission of hazardous parasites can reduce the capacity of livestock production. Therefore, effects of marals on catering services has been assessed as moderately negative

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 X	high
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 level of confidence

acomm32. Comments:
This species, like other species of cervids of comparable size, can affect to a certain extent functioning of plant ecosystems, such as forests, open ecosystems, and crops. The possible negative effect on forest can have a negative impact on ecosystem which plays a crucial regulatory role. Moreover, this species transmits pathogens/parasites, and consequently can affect the control over animal diseases.

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

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

aconf29. Answer provided with a

low	medium X	high
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 level of confidence

acomm33. Comments:
There are not any known studies confirming the species impact on aesthetic aspects, recreation, cultural and artistic aspects, religiousness and spiritual realm, education and science. If the species spread throughout Poland, it could replace the native red deer, which would negatively affect the culture of the country. At the same time it can be expected that maral would become game species. There were some attempts to maintain wapiti in Poland, but they did not arouse much interest (Darmowe Archiwum Alle 2012 – I, Biogospodarstwo 2009 – I, Wierzbowska et al. 2010 - P).

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:

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

aconf30. Answer provided with a

low X	medium	high
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 level of confidence

acomm34. Comments:
This species does not occur in Poland neighbourhood countries, and its natural habitats have a climate of low similarity to the Polish one: cool, continental type of temperate climate (Brook et al. 2016 - P). The predicted global warming will not reduce climate differences, and can even slightly increase dissimilarities between sites of successful introduction and Poland. Thus, the change in the probability of the species introduction in Poland is unlikely.

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 X	high
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 level of confidence

acomm35. Comments:
Attempts to introduce the species in areas not far from the native range in Russia, that is at a distance of ca 1300 km from the Altai Mountains. Although the local climate is milder than the climate in Poland, the species did not succeed in establishment (Kassal 2015 – P). The natural range of the species occurrence has a climate with low probability to that in Poland: cool, continental type of temperate climate (Brook et al. 2016 - P). The predicted global warming will not reduce climate differences, and can even slightly increase dissimilarities between sites of successful introduction and Poland. Thus, the change in the probability of the species establishment in Poland is unlikely.

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 X	medium	high
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 level of confidence

acomm36. Comments:
The natural range of the species occurrence has a climate with low probability to that in Poland: cool, continental type of temperate climate (Brook et al. 2016 - P). The predicted global warming will not reduce climate differences, and can even slightly increase dissimilarities between Poland and places of its occurrence. It cannot therefore be expected that the likelihood of spread of the species in Poland (in case it establishes) will increase.

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 X	medium	high
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 level of confidence

acomm37. Comments:
As the predicted changes in climate probably will not change on introduction, establishment and spread of the species, the impact rating of the species on wild plants and animals, habitats and ecosystems in Poland will not change either.

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 X	medium	high
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 level of confidence

acomm38. Comments:
As the predicted changes in climate probably will not change on introduction, establishment and spread of the species, the impact rating of species on cultivated plants or plant production in Poland will not change either.

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 X	medium	high
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 level of confidence

acomm39. Comments:
As the predicted changes in climate probably will not change on introduction, establishment and spread of the species, the impact rating of species on farm animals and animal production in Poland will not change either.

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 X	medium	high
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 level of confidence

acomm40. Comments:
As the predicted changes in climate probably will not change on introduction, establishment and spread of the species, the impact rating of species on human domain in Poland will not change either.

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:
As the predicted changes in climate probably will not change on introduction, establishment and spread of the species, the impact rating of species on other domains in Poland will not change either.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.00	0.67
Establishment (questions: a09-a10)	0.50	0.75
Spread (questions: a11-a12)	0.38	0.50
Environmental impact (questions: a13-a18)	0.42	0.75
Cultivated plants impact (questions: a19-a23)	0.08	0.67
Domesticated animals impact (questions: a24-a26)	0.38	0.75
Human impact (questions: a27-a29)	0.25	1.00
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.29	0.64
Impact (questions: a13-a30)	0.50	0.73
Overall risk score	0.15	
Category of invasiveness	potentially invasive alien species	

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 is regularly repeated.

acomm42. Comments:
The taxonomic status of maral is unclear and its biology and ecology is very poorly studied, resulting in very restricted availability of information on the species. Moreover, it has no invasion history, as it has never been introduced outside of its natural range. For these reasons, the assessment of the risk from this species is very difficult. It is noteworthy that although according to the applied procedure the species was classified as potentially

invasive, its impact index (0.50) is just 0.01 below the threshold allowing classification of the species as moderately invasive.

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