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

acomm01. Comments:

	degree	affiliation	assessment date
(1)	prof. dr hab.	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	01-02-2018
(2)	dr	Institute of Environmental Sciences, Jagiellonian University	26-01-2018
(3)	mgr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	07-02-2018

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

Polish name: Wapiti

Latin name: ***Cervus canadensis*** Erxleben, 1777

English name: American elk

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

acomm02. Comments:

Polish name (synonym I)	Polish name (synonym II)
jeleń kanadyjski	– wapiti kanadyjski
Latin name (synonym I)	**Latin name (synonym II)**
–	–
English name (synonym I)	**English name (synonym II)**
–	–

a03. **Area** under assessment:

Poland

acomm03. Comments:
–

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

	native to Poland
X	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
		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 a board member of Polish Deer Farmers Association (Hędrzak and Wierzbowska 2018b – A) and taking into account the fact that elks do not occur in any zoo in Poland (Topola 2016 – P), it can be quite definitely concluded that there are no elks in Poland. In Poland, there used to be attempts to maintain wapitis in private farms. One of the first documented attempt took place in 1861. Fourteen individuals were imported to Pszczyna Forest. It was however not possible to breed the animals in the farm conditions and they went extinct (Wierzbowska et al. 2010 - P). Based on information found on the Internet on the offer of agritourism farms, we came upon 5 individuals (1 stag and 4 hinds) who were kept in Czelin (West Pomeranian Province) in 2009 and which produced offsprings (Biogospodarstwo 2009 – I). In 2012, the owner tried to sell a two-year stag and a hind from two mothers, but we do not know whether they were finally sold (Free Alle Archive 2012 – I). According to the information obtained directly from the farm owner (17.01.2018), he does not currently have any individuals from this species.

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

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

acomm05. Comments:

The species representatives, like other bigger and average-size cervids, affect the natural environment, cause damage to forest ecosystem and crops. They are intercrossed with red deer *Cervus elaphus*, producing fertile offspring. There were some cases of carrying bovine tuberculosis, which is a threat to protected and farm animals, and wild game. It is also a threat to human health. Wapiti are often involved in road accidents resulting in property damage and a threat to human health.

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:

X	low
	medium
	high

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

acomm06. Comments:

Wapiti (or its subspecies) do not occur in Poland neighbourhood countries, they were only introduced into Italy, few individuals were introduced in 19th century but there is no information about fate of the animals whether they increase in numbers or broaden geographic distribution (Brook et al. 2016 – P, Masseti 2016). They occur naturally in North America and Asia. In Poland, they are neither kept in zoos (Topola 2016 – P), nor in private farms (Hędrzak and Wierzbowska 2018a,b – A, Główny Inspektorat Weterynarii *[Polish Chief Veterinary Officer]* 2017 – B, Topola 2016 – P).

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

X	low
	medium
	high

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

acomm07. Comments:

Wapiti are unlikely to be introduced into Poland environment as a result of human unitentional activities. It is a timid species and avoids contact with humans (Wilson and Mittermeier 2011 – P). The chance that it will be unintentionally introduced is equal to zero.

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

X	low
	medium
	high

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

acomm08. Comments:

There is still some interest, at least among some groups, in introducing different types of cervids, including wapiti, into the natural environment. Due to a legal ban on introducing alien species into the natural environment in Poland (The Act of 16 April 2004 on Nature Conservation – I), there is a low probability of the intentional introduction of this species. As there are no wapitis on farms,in zoos and free ranging in Poland and neighbourhood countries, their intentional or accidental transport to Poland is impossible. The species can only appear in Poland in case of the escape of a calf transported by mistake with red deer calves to animal holding. Hoever possible, such a situation has not been reported so far.

A2 | Establishment

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

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

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

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

acomm09. Comments:

Wapiti naturally occurs in the temperate climate zone (Brook et al. 2016 – P) and the climate zone more severe than in Poland (Grubb 2005 – P). Snow cover larger than 70-75 cm is a limiting factor of wapiti occurrence (Wilson and Mittermeier 2011 – P). The lack of harsh winters in Poland and high adaptative features of wapiti will not probably be an obstacle for the species settlement in the country (Wilson i Mittermeier 2011 – P)

a10. Poland provides **habitat** that is

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

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

acomm10. Comments:

They naturally occupy deciduous and coniferous forests in the mountains or uplands (Skovlin 1982 – P). In the mountains, they live in peat bogs, open ground above the forest boundary, meadows and grassland (Brook et al. 2016 – P, Wilson and Mittermeier 2011 – P). During heavy winter and large snow cover, wapiti come down from higher mountain region to valleys. - an important element of their habitats will be places providing good shelter (Gingery et al. 2017 – P, Roberts et al. 2013 – P, Skovlin 1982 – P, Strong et al. 2013 - P). Mountainous areas and possibly large forest areas in western and north-eastern part of Poland are optimal conditions for establishment of this species. Sometimes habitats with park plants are used for their introduction into North America, (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:

	very low
X	low
	medium
	high
	very high

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

acomm11. Comments:

Assessment (Data type: C)
There is no published research data on broading the distribution range or population growth rate of the species (a single-point dispersion/expansion of the population) in sites into which it has been introduced. According to observations made for various populations in North America, not all elks migrate. Usually the individuals living in the mountains tend to migrate. They are seasonal migrations, which distance depends on availability and abundance of winter forage, extent of human impact on the environment, including hunting pressure. Studies of wapiti herds introduced in different parts of North America show that even if they expand their range it is not a very dynamic change . If they migrate over large distance in the winter period, they come back to left areas in spring (Adams 1982 – P). Considering the areas, which form favourable habitats for wapiti occurrence in Poland, and the presence of large predators restraining the number of wapiti (De Vivo et al. 2011 – P), the expected rate of population expansion will be low: from 10 m to 100 m per year.

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

X	low
	medium
	high

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

acomm12. Comments:

Hunters show some interest in wapiti, but the intentional movement of this species in the environment is not permitted according to the Polish legislation. If wapiti were kept on farms, they could escape or be intentionally released e.g. by members of animal protection organizations which would probably refer to large herds maintained in holdings. Maintaining wapiti on such a large scale is unlikely in Poland. On the basis of the above facts, we can assume that the translocation within a distance greater than 50 km will not be frequent (less than one case per decade).

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**:

	inapplicable
	low
	medium
X	high

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

acomm13. Comments:

Wapiti, like other large cervids, feed on a wide range of plant products: moss, grass, herbs, branches and tree bark. Their diet includes 159 species of herbs, 59 species of grass and 95 woody plant species (Kufeld 1973 – P). According to studies on wapiti natural occurrence, their foraging can significantly modify the species composition of forest environment and restrict biodiversity (Robert et al. 2014 - P). It also refers to protected areas. Wapiti are predominantly grassconsumers. They eagerly graze herbs, and browse shoots mainly in winter (Strong et al. 2013 - P). They also feed on peat bogs (Brook et al. 2016 – P, Wilson and Mittermeier 2011 – P). It can be assumed that the favourable areas for wapiti in Poland are located in its southern part. There are many protected areas with endangered habitats and species (e.g. Orchidaceae from the orchid family). However, their feeding preferences can be estimated on the basis of studies on other deer species, e.g. in the USA it was shown that white tailed deer diet comprises 98 species of mono- and dicotyledonous plants which are considered to be threatened. They are 39.8% and 56.1%, respectively. Among them 38.7% plants belong to Liliaceae and Orchidaceae (Miller et al. 1992 – P). Thus, it might be suggested that wapiti may have a strong negative effect.

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

	low
	medium
X	high

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

acomm14. Comments:

The studies performed in North America in areas occupied by wapiti and *Bison bison* have shown that even though the animals occupied that area in a different way and tried to avoid each other, their habitat niches overlapped in more than 80% and their food niches overlapped in more than 90% in spring and summer (Telfer and Cairns 1979 – P). The authors suggested that elimination of wapiti would increase the habitat capacity for bison. Wapiti often feed on hay bales prepared for cattle or wild ungulates (Gooding and Brook 2014 – P). In Poland, the favourable areas for wapiti overlap with the occurrence range of *Bison bonasus*. Regarding the wapiti preference for forest-meadow ecotones, they are likely to reduce the carring capacity for bison. Therefore, their competition was aasessed as intense. However, it cannot be unequivocally defined whether food niches of these species would overlap because there are no studies on interactions between wapiti and European bison. By browsing willow trees, this species can contribute to exclusion of the European beaver *Castor fiber* from small streams. Such a case was observed in the northern part of Yellowstone National Park (Bilyeu et al. 2008 - P).

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

	no / very low
	low
	medium
X	high
	very high

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

acomm15. Comments:

According to historical data from the 19th century, there were some attempts to interbreed wapiti and red deer (Wierzbowska et al. 2010 - P). Although they were

successful, the animals did not show interest in other species without the human intervention. However, wapiti and red deer can produce fertile offspring. According to studies performed by Smith et al. (2014 – P) wapiti genotype introgression is 0.53% in the gene pool of contemporary species of the Scottish red deer even though the foundation herd introduced in Ireland in the 19th century did not survive. A small contribution of wapiti genotypes to the gene pool of red deer in Scotland was also found (Pérez-Espona et al. 2011 - P).

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

	very low
	low
	medium
	high
X	very high

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

acomm16. Comments:

Wapiti can carry *Bovine tuberculosis* and brucellosis (*Brucella abortus* type) - they are classified as notifiable diseases (OIE list), that can be passed to native species of domesticated and wild ungulates, including the European bison. Thus, wapiti can pose a threat to bison - a protected species (Gooding and Brook 2014 – P, Rogala et al. 2014 – P, Najberek 2018 – N).

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

	low
X	medium
	high

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

acomm17. Comments:

Physical properties of soil, including bulk density, are deteriorated by deer feeding on grassland (Packer 1963 – P). In Yellowstone National Park, wapiti due to browsing willow trees led to beaver displacement from some streams (willow is their primary food). Lower level of groundwater and erosion of fine deposit were the intermediate effects (Bilyeu et al. 2008 - P). Such cases are probable in places of wapiti occurrence in Poland. 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.

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

	low
	medium
X	high

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

acomm18. Comments:

Turf covering is reduced by deer grazing on grassland (Packer 1963 – P). This species also modifies 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. The example of Rocky Mountain National Park (USA) shows that wapiti have a negative effect on beaver population because of the lower

number of shrub vegetation along the water course banks (Baker et al. 2012 - P). To sum it up, in the worst case scenario this species can cause difficult-to-reverse changes in processes in habitats of particular concern e.g. raised bogs (7110) and riparian woods (91E0).

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:

	inapplicable
	very low
	low
X	medium
	high
	very high

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

acomm19. Comments:

In North America, wapiti cause crop raiding, which is serious in some areas (Brook 2002 – P). The damage is observed in cereals, meadows and forage stored for domestic animals, e.g. hay stacks (Gooding and Brook 2014 – P, Hegel et al. 2009 - P). The damage range largely depends on the spatial structure of such elements as forests, bush, arable land and roads (Hegel et al. 2009 - P). In woods in southern Poland, small farms located near wood are prone to damage to the extent similar by damage caused by red deer. In winter, in the mountains they can browse shoots of young trees standing out from the snow cover which is likely to cause losses in forest economy (Strong et al. 2013 - P). Damage to forest stands is particularly intensive in places of greater extent of human impact on the environment and during the hunting season. Wapiti then look for shelter to hide, e.g. greenwood (Hayden-Wing 1979 – P, Morgantini and Hudson 1979 – P).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm20. Comments:

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:

X	inapplicable
	no / very low

	low
	medium
	high
	very high

aconf17.	Answer provided with a	low	medium	high	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:

X	very low
	low
	medium
	high
	very high

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

acomm22.	Comments: There are no published results from studies on the species impact on cultivated plants form or yields due to modified properties of agro-ecosystem, including changed cycle of elements, hydrology, physical properties, and trophic networks. Wapiti can feed on cultivated plants and cause local damage (Brook 2002 – P). High density of wapiti is assumed to damage large meadows near forests due to erosion processes and reduced turf covering (Packer 1963 – P). Such areas are prone to wash out during rainfalls that are quite abundant in the mountains. The expected impact should be low: it will regard less than 1/3 of invaded plants (probability low). In the worst case scenario the plant form or the yield of a single crop will be slightly reduced in small scale (less than ca. 5%).

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

X	very low
	low
	medium
	high
	very high

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

acomm23.	Comments: 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:

X	inapplicable
	very low
	low
	medium
	high
	very high

aconf20.	Answer provided with a	low	medium	high	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:

X	very low
	low
	medium
	high
	very high

aconf21.	Answer provided with a	low	medium **X**	high	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). Wapiti use grazing land and feeding sites. They appear in the company of cattle (Goodlin and Brook 2014 – P, Hosten et al. 2007 – P, zu Dohna et al. 2014 - P). Fences do not pose a barier to wapiti deer . They are large animals and the cases of physical contact with animals, that is, kicking or hitting with antlers are possible. The probability of direct contact is low: less than one case a year per 100 000 farm or domestic animals.

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

	inapplicable
	very low
	low
	medium
	high
X	very high

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

acomm26. Comments:

Wapiti can use forage for cattle and they feed on unfenced grazing land and do not avoid the immediate neighbourhood of cattle (Goodlin and Brook 2014 – P). They can easily overtake fences around the pastures. Wapiti is the potential carrier of brucellosis and bovine tuberculosis. Such diseases can be passed to farm animals (zu Dohna et al. 2014 - P). In Poland, both cattle and sheep are at risk and the potential impact is considered big because tuberculosis and brucellosis are notifiable diseases that can lead to animal death.

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:

X	inapplicable
	very low
	low
	medium
	high
	vert high

aconf23.	Answer provided with a	low	medium	high	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:

	very low
X	low
	medium
	high
	very high

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

acomm28. Comments:

In the literature, there are no recoded cases of wapiti aggression against human. The species is quite timid and escape to avoid contact with human. The spatial distribution of wapiti population is mainly affected by human activity (Hayden-Wing 1979 – P, Morgantini and Hudson 1979 – P, Rogala et al. 2011 – P). But deer avoid contact with human. However, in the hazardous situation (attacked or injured animal) wapiti can maul people while escaping. Male wapiti use antlers to fight against predators. So, they are likely to hurt human.

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

	inapplicable
	very low
	low
	medium
	high
X	very high

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

acomm29. Comments:

Wapiti are carriers of *Bovine tuberculosis* bacteria causing bovine tuberculosis (Goodlin and Brook 2014 – P, zu Dohna et al. 2014 – P) and *Brucella abortus* bacteria causing brucellosis (Goodlin and Brook 2014 – P, Najberek 2018 – N). Both of them are notifiable diseases. Tuberculosis is fatal, and brucellosis can cause permanent damage to cardiac muscle and even cured people need afterwards regular visits in specialised medical centres.

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
X	medium
	high
	very high

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

acomm30. Comments:

Collisions between wapiti and motor vehicles are inevitable in the places of their occurrence. However, however the number of collisions depend on the density of individuals and types of roads. For USA and Canada, the cost of one collision with wapiti that includes repair costs of a vehicle, compensation, casualty treatment, police procedure, loss of hunting benefits and removing a dead animal was estimated at ca. 17 500 USD in 2007 (Huijser et al. 2009 - P). It should be emphasized that wapiti are large animals and effects of collision are similar to those with moose *Alces alces*. Turf covering is reduced by deer feeding on grassland (Packer 1963 – P). Such effects can be probably observed on private garden plots near forestry land.

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
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

Tuberculosis and brucellosis infections among farm animals can causes losses in livestock production. Moreover, wapiti can eat forage intended for farm animals, which can increase costs of livestock production. Additionally, forest plantations and arable lands can sustain possible damage. The damage is rather local and occurs in small farms. Wapiti can be the purpose of hunting as their meat is acknowledged venison. However, the total impact of the species on catering services has been assessed as moderately negative.

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

	significantly negative
X	moderately negative
	neutral

	moderately positive
	significantly positive

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

acomm32. Comments:

On a local scale, wapiti can enhance soil erosion (due to trampling and damaging turf) , damage of riparian vegetaion (due to herbirory) and indirectly negatively affect beaver population. In the end these can lead to loweringr groundwater level near small water courses. Wapiti can carry bovine tuberculosis and brucellosis, so they affect the control over animal diseases.

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

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). Individuals kept in some farms could be attractive as a part of the agritourism offer. But the increased population would require its control. Like in case of red deer, hunting for this timid species would draw interest in some areas. However, there are not any known studies confirming the species impact on aesthetic aspects, recreation, cultural and artistic resources, religiousness and spiritual realm, education and science.

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
X	not change
	increase moderately
	increase significantly

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

acomm34. Comments:

Wapiti naturally occurs in the temperate climate zone (Brook et al. 2016 – P) and in the climate zone more severe than in Poland (Grubb 2005 – P). In Europe, wapiti are observed

	only in Italy. Thus, the climate is no longer a barrier against the species occurrence in Poland. The predicted global warming will not change the likelihood for overcoming geographical barriers related to the species occurrence in Poland.

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
X	not change
	increase moderately
	increase significantly

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

acomm35.	Comments: In the present range of expansions wapiti occupy areas in the temperate and subtropical climate zones (mountainous regions of North America) . Wapiti originate from areas with lower temperatures. In case of the species occurrence in Poland, global warming should not affect an opportunity for its establishment adaptation.

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
X	not change
	increase moderately
	increase significantly

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

acomm36.	Comments: In the present range of expansions wapiti occupy areas in the temperate and subtropical climate zones. Wapiti originate from areas with lower temperatures. In case of the species occurrence in Poland, global warming should not affect its opportunity for spreading.

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
X	not change
	increase moderately
	increase significantly

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

acomm37.	Comments: The predicted changes in climate will not change the impact rating of the species on wild plants and animals, habitats and ecosystems in Poland.

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

X	not change
	increase moderately
	increase significantly

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

acomm38. Comments:

The predicted changes in climate will not change the impact rating of species on cultivated plants or plant production in Poland.

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
X	not change
	increase moderately
	increase significantly

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

acomm39. Comments:

The predicted changes in climate will not change the impact rating of species on farm animals and animal production in Poland.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm40. Comments:

The predicted changes in climate will not change the impact rating of species on human domain in Poland.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

The predicted changes in climate will not change the impact rating of species on other domains in Poland.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.00	1.00
Establishment (questions: a09-a10)	0.75	1.00
Spread (questions: a11-a12)	0.13	0.75
Environmental impact (questions: a13-a18)	0.88	0.92
Cultivated plants impact (questions: a19-a23)	0.17	0.83
Domesticated animals impact (questions: a24-a26)	0.50	0.75
Human impact (questions: a27-a29)	0.63	0.75
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.29	0.92
Impact (questions: a13-a30)	0.88	0.75
Overall risk score	0.26	
Category of invasiveness	very 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:

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