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. Wanda Olech – external expert
2. Kajetan Perzanowski – external expert
3. Wojciech Solarz

acomm01. Comments:

	degree	affiliation	assessment date
(1)	prof. dr hab.	Department of Genetics and Animal Breeding, Faculty of Animals Sciences, Warsaw University of Life Sciences	28-01-2018
(2)	prof. dr hab.	Museum and Institute of Zoology of the Polish Academy of Sciences; Catholic University of Lublin	15-01-2018
(3)	dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	29-01-2018

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

Polish name: Bizon

Latin name: ***Bison bison*** L.

English name: American bison

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) Bizon amerykański	Polish name (synonym II) –
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
	alien, absent from Poland
X	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: *Bison bison* is a North-American species brought to Poland only for breeding and exhibiting purposes. So far, the species has been present in closed-type breeding (Solarz 2016 – I, ZIMS 2018 – B). In Poland, there are two big farms of bison, in Kurozwęki (Świętokrzyskie Province) and Kwitajny near Elbląg (Warmia-Masuria Province), small groups in four zoos (Warszawa, Łódź, Poznań, Katowice) and in an amusement parks "Indiański Świat" in Koszalin, "Western Ranch" near Karpacz, "Rancho Montana" near Kudowa Zdrój and in Świercze near Pułtusk. Hybrids of bison are also bred at Kadzidłowo (Dziennik Elbląski 2013, Rudziński 2013 – I, Topola 2014 – P, Lis 2015 – I, ZIMS 2018 – B).

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 direct impact – it is the grassland species living in large herds. The species can modify the occupied habitat through feeding or trampling (changes in plant cover or top layer of the soil). It may also affect the natural environment by hybridisation with wisent or transmitting pathogens. American bison at large can damage arable crops and may be a vector for infectious diseases for cattle. Aggressive individuals at large can be dangerous for humans and cause material damage – e.g. damaged fences, road accidents (Tessaro 1989, Pucek et al. 2004 – P, Solarz 2016, Clapway 2017 – I, Krasińska and Krasiński 2017 – P).

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:

At present, the species only occurs in stockyards on farms. There are no wild American bison in neighbourhood countries. Self-propelled expansion of the species in Poland could be difficult due to the anthropogenic barriers. Moreover, this species can be relatively eliminated (like European bison *Bison bonasus*), Woda and Kik 2001 – I, Solarz 2016 – I, DAISIE 2018 – I).

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:

The likelihood of accidental introduction of American bison to the natural environment of Poland is almost close to zero because of its size. There are no possibilities of its accidental transport (Perzanowski 2018 – A).

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

	low
X	medium
	high

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

acomm08. Comments:

On the basis of current knowledge and awareness, there is very little likelihood of such actions even though there used to be unsuccesful attempts to introduce intentionally the hybrids of bison to the natural environment (e.g. Knyszyńska Primveval Forest in 1939, Krawczyk 2010 – I), or succesful (e.g. Caucasus, Nemtsev et al. 2003 – P). In case of negligence or undue diligence in breeding, the individuals kept in captivity may overcome the fence. The problem of escaping from the farm is probable due to the size of individuals and ability to overcome mechanical barriers (such as e.g. the fence) which has happened repeatedly in case of calves at Kurozwęki (Lis 2015 – I). Until recently, a breeding herd was kept without any permission in Zielnów near Darłowo. The latter case demonstrates that the species can be introduced to Poland without being registered, thus beyond any control, which would definitely increase the probability of individuals' escape to the natural environment (Turczyn 2005 – I).

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:

Within the native range of American bison (North America), the climate is very similar to that in Europe. The native range includes the region form South Canada to the central part of the USA. Because these values are within the range of 94-100% as optimal values – the climatic requirements of the species in Poland are fully met (Meagher 1980, Koons et al. 2012 – P, Solarz 2016 – I).

a10. Poland provides **habitat** that is

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

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

acomm10. Comments:

The species *Bison bison* is divided into two subspecies: *B. b. bison* (plains bison) and *B. b. athabascae* (wood bison). The typical habitats of plains bison are short-grass prairies, a type of steppe habitat that does not occur in Poland. Their equivalents could be farmlands and permanent grasslands. The second subspecies tends to occur in the mosaic of field and wood habitats, the conditions that are also preferred by the wisent (Plumb et al. 2014 – P). If such habitats are occupied by bison and without human intervention, the species can easily survive in the wild environment because it is herbivorous and easily adaptable. Thus, the unrestricted access to arable crops and grasslands would satisfy its nutritional requirements. Due to the species size and gregarious nature, the native predators would not be able to control its population numbers (Olech 2018 – A).

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
X	very high

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

acomm11. Comments:

Assessment (Type of data: C)
There is a possible dispersion of individuals escaping from the farms, which can independently survive in case of favourable habitat conditions. This species belongs to the largest mammals of the northern hemisphere. Practically, it has no natural enemies. Its herds may migrate over large distances (Aune et al. 2010 – P). Assuming that the American bison could establish itself in Poland, its capability of spreading in Poland without human involvement would be very high (over 50 km per year) (Perzanowski 2018 – A).

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:

Due to some restrictions concerning the permission for keeping American bison, their import for breeding, and transport to various places in Poland is limited. Similar restrictions would relate to relocation of wild individuals if such populations occur. Despite prohibitions to transport American bison in Poland and from other countries resulting from the act on environmental protection, there are no relevant restrictions on animal transport according to veterinary or breeding regulations. In Poland, bison is a registered species, like cattle, and thus it may be believed that the species could be bred (Olech 2018 – A).

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
- [**X**] medium
- [ ] high

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

acomm13. Comments:

American bison is a herbivore, a ruminant belonging to so called grazers, so it is not dangerous for other fauna species. Like wisent, it feeds on grasses, sedges, herbaceous

plants supplemented with browse. Its potential effect upon native flora is similar to that of wisent. Thus, it does not present any hazard to ecosystems listed in Annex 1, Directive 92/43/EEC (Meagher 1980, Plumb et al. 2014 – P). However, due its field-type feeding in grasslands, the species can cause soil erosion (Olech 2018 – A). If the species would become widespread, it could locally affect the composition of native flora, including the species of special concern (Perzanowski 2018 – A).

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:

If the species occurs near areas occupied by wisents, it would become a serious competitor for our native species due to very similar food niche (Meletti and Burton 2014, Krasińska and Krasiński 2017 – P). Herds of that species could compete with native large herbivores for space. It particularly refers the area of feeding grounds, the access to which, American bison being a large animal, could successfully restrict for the representatives of other, smaller species (Olech 2018 – A).

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

	no / very low
	low
	medium
	high
X	very high

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

acomm15. Comments:

American bison and wisent (European bison) may easily interbreed and produce the fertile offspring. There is no behavioural barrier between these species (Krasińska 1988, Gołębiewska 2009 – P). American bison farms situated near wild populations of wisents can create a hazard to the purity of the native species. Even single individuals escaping from captivity may create such a risk (Krasińska and Krasiński 2017 – P). Breeding of American bison in Europe has been identified as one of the threats to the wisent (Pucek et al. 2004 – P, Solarz 2016 – I).

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:

In wild populations of American bison three main infectious diseases caused by bacteria occur: brucellosis (*Brucella abortus*), tuberculosis (*Mycobacterium bovis*) and anthrax (*Bacillus anthracis*) (Aune et al. 2010 – P). They are all strongly infectious for all hoofed mammals of Polish fauna, including the species of special concern. For example, tuberculosis in the

population of wisents in Bieszczady has led to the elimination of the whole herd. Similar or even worse consequence would occur in case of the epidemic of anthrax. Nevertheless, none of these three diseases has been officially confirmed in Poland. Bison can also suffer from MCF (malignant catarrhal fever) – the disease caused by herpes viruses (Meletti and Burton 2014 – P). American bison can also transmit many external and internal parasites, typical for the wisent and deer family (Meagher 1980 – P). The list of parasites for the Bovidae family is long and contains common species, but there are some taxa typical for the American bison, not reported in wisents or cattle. They are stomach and intestinal nematodes from the Trichostrongylidae family – *Orloffia bisonis* and *Marshallagia* sp. Other species is the American nematode from the Metastrongyloidea superfamily *Parelaphostrongylus tenuis*. Another hazardous parasite found in many ungulates is giant liver fluke *Fascioloides magna* (Demiaszkiewicz et al. 2014, Kornaś et al. 2014 – P).

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

	low
X	medium
	high

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

acomm17. Comments:

In the literature, there is lack of data on the significant impact of American bison on abiotic components of the ecosystems. If the species becomes widespread, places where numerous herds are feeding could suffer from the effects related to soil erosion due to uncovering and damaging of upper soil through trampling and rolling. Such a threat could also consider the habitats of special concern, e.g. xerothermic grasslands however such changes would be easily reversible (Perzanowski 2018 – A).

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:

Due to very similar food niches of American bison and wisents, occurrence of the species in the ecosystems of Poland could produce effects similar to those encountered in case of reintroduction of wisents. Such a large herbivore with considerable nutritional requirements, and living in large aggregations has a strong effect on local flora through reducing biomass, selective foraging upon preferred plant species, damaging woody species e.g. through debarking. Large herds of wild American bison could have an adverse effect on the population of the wisent and its habitat. If the alien species becomes widespread, its effect on the native, umbrella species, being very important for the functioning of natural ecosystem, should be considered as high (Olech 2018, Perzanowski 2018 – A).

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
	medium
X	high
	very high

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

acomm19. Comments:

If wild American bison occur in Poland, this species having a gregarious nature will cause significant damage to arable crops. Due to strong similarity in foraging and nutritional requirements between American bison and wisents, we can extrapolate data related to damage to agriculture caused by wisents (Meletti and Burton 2014 – P). Thus, like in case of wisents, due to the presence of American bison damages to crops through trampling, browsing or eating up could occur. Since the species prefers open habitats, it tends to forage outside the woodlands. If the species becomes widespread, its effect on crops is likely to be high (Meagher 1980, Plumb et al. 2014 – P, Perzanowski 2018 – A). This would include from 1/3 to 2/3 of invaded plant crops. In the worst scenario, plants' condition or a yield of an individual crop could be reduced by even 20%.

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:

The assessed species is not a plant.

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:

The assessed species is not a plant.

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

	very low
	low
X	medium

	high
	very high

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

acomm22. Comments:

There are no literature data on the effect of American bison on condition or productivity of cultivated plants through changing the properties of the agricultural ecosystem, including the cycle of elements, hydrology, physical properties, food webs etc. (Perzanowski 2018 – A). But there are many papers on its closest relative – the wisent. Possible local damage to crops caused by American bison would be reversible if the species did not become too widespread and the herds were not too large. In such a situation the effect on crops would be comparable to well-known and observed effects caused by the numerous presence of wisents in the regions where serious damage to field crops were recorded (Olech 2018 – A).

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:

There are no literature data on pathogens common for American bison and cultivated plants. It is also unlikely to identify such cases during the progress of research (Olech 2018, Perzanowski 2018 – A).

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:

The assessed 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
X	medium
	high
	very high

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

acomm25. Comments:

There may occur cases of injuring or even killing other animals by aggressive individuals (e.g. bulls during mating season or cows with calves) similarly like in the case of the wisent (Krasińska and Krasiński 2017 – P, Padilla 2017 – I). However, such cases are occasional, and such threat may happen only during the face-to-face confrontation. If American bison becomes a widespread species in Poland, the likelihood of such cases would significantly increase (medium probability, medium consequences) (Olech 2018, Perzanowski 2018 – 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
X	very high

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

acomm26. Comments:

American bison may be a vector for many infectious diseases, fatal for the majority of farm animals and wild species of cavicorn ungulates and deer family (tuberculosis, brucellosis, anthrax, bluetongue disease). Those diseases can be transmitted through direct contact and by using the same pastures. This species is also a host to many internal and external parasites (nematodes, flukes, ticks) (Tessaro 1989, Haigh 2002 – P). Thus, American bison is a host or a vector for at least one pathogen/parasite that is obligatory to be reported. Additionally a disease caused by that pathogen/parasite is not curable and can be even fatal.

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:

The assessed 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
	low
X	medium
	high
	very high

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

acomm28. Comments:

When in danger, American bison may attack. Aggressive individuals can be dangerous for people during a direct contact (bulls during mating season, cows taking care of their calves). Wild American bison can also cause road accidents (BioExpedition 2012, ABC News 2015, Clapway 2015, Vervaecke 2015, Padilla 2017 – I). Assuming that the species becomes widespread in Poland, its effect on human health could be considered as medium (medium probability, medium consequences) (Perzanowski 2018 – A).

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

	inapplicable
	very low
	low
	medium
	high
X	very high

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

acomm29. Comments:

American bison can be a vector for infectious animal diseases that are fatal to humans, hardly curable or incurable diseases e.g. tuberculosis, anthrax, brucellosis (Haigh et al. 2002 – P). Although they are transmitted through the direct contact between humans and American bison which affect the likelihood of this hazard, the effect should be considered as high in accordance with the accepted Risk Assessment Methodology.

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
X	low
	medium
	high
	very high

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

acomm30.	Comments: Wild American bison (like wisents) are expected to damage fencing, hay stacks, feed warehouses etc. (ABC News 2015, Ryan 2015 – I, Krasińska and Krasiński 2017 – P). Generally they cause damage relatively seldom. In places where American bison routes intersect with public roads, traffic accidents can be expected, like in case of wisents (Perzanowski 2018 – A).

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:

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments: Wild American bison, like wisents, can cause damage to plant crops and forestry (browsing, debarking, trampling) (Plumb et al. 2014 – P). If the population is large, the caused damage can be significant (Perzanowski 2018 – A).

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32.	Comments: American bison can be an additional vector for some infectious diseases and parasites (Tessaro 1989, Haigh et al. 2002 – P). If the species becomes widespread, the likelihood of quick spread of infectious diseases among gregarious species would be high (Perzanowski 2018 – A).

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm33.	Comments:

American bison, like other exotic species, can be an extra attraction in zoos and show enclosures. American bison in the natural environment would be an alien element creating a visual and cultural dissonance (Woda and Kik 2001, Dziennik Elbląski 2013, Solarz 2016 – I).

The presence of American bison could produce a risk to genetic purity and nutritional competitiveness that would have an adverse effect on the population of the wisent. Thus, its population size would be at risk. And consequently, local tourism connected with the native species would suffer from lower quality and more difficult access to service (Olech 2018 – A).

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:

In its natural environment, American bison occurs in a relatively wide range of climate. Hence changes in temperature by ca. 1°C will not probably change its adaptive capabilities (Koons et al. 2012, Plumb et al. 2014 – P). Thus, the likelihood of introduction also should not be altered (Perzanowski 2018 – A).

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 its natural environment, American bison occurs in a relatively wide range of climate. Therefore changes in temperature by ca. 1°C will not probably change their adaptive capabilities (Koons et al. 2012, Plumb et al. 2014 – P).

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 its natural environment, American bison occurs in a relatively wide range of climate. Hence changes in temperature by ca. 1°C will not probably change their abilities to spread (Koons et al. 2012, Plumb et al. 2014 – P).

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	high **X**	level of confidence

acomm37. Comments:

In its natural environment, American bison occurs in a relatively wide range of climate. Therefore changes in temperature by ca. 1°C will not probably change their adaptive capabilities, and thus the scale of impact on the natural environment (Koons et al. 2012, Plumb et al. 2014 – P).

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	high **X**	level of confidence

acomm38. Comments:

In its natural environment, American bison occurs in a relatively wide range of climate. Hence changes in temperature by ca. 1°C will not probably change their adaptive capabilities, and thus the scale of impact on cultivated plants (Koons et al. 2012, Plumb et al. 2014 – P). Additionally, for that scenario it is difficult to predict the direction of changes in agriculture of 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	high **X**	level of confidence

acomm39. Comments:

In its natural environment, American bison occurs in a relatively wide range of climate. Hence changes in temperature by ca. 1°C will not probably change their adaptive capabilities, and thus the scale of impact on the animal production (Koons et al. 2012, Plumb et al. 2014 – P). There are no premises to determine changes in the type of animal breeding in Poland due to climatic changes.

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	high **X**	level of confidence

acomm40. Comments:

In its natural environment, American bison occurs in a relatively wide range of climate. Therefore changes in temperature by ca. 1°C will not probably change their adaptive capabilities, and thus the scale of impact on human domain (Koons et al. 2012, Plumb et al. 2014 – P).

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

In its natural environment, American bison occurs in a relatively wide range of climate. Hence changes in temperature by ca. 1°C will not probably change their adaptive skills, and thus the scale of impact on other domains (Koons et al. 2012, Plumb et al. 2014 – P). It is impossible to predict changes in the infrastructure in Poland due to climatic changes.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.17	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.50	1.00

Environmental impact (questions: a13-a18)	0.83	0.83
Cultivated plants impact (questions: a19-a23)	0.42	0.83
Domesticated animals impact (questions: a24-a26)	0.75	0.75
Human impact (questions: a27-a29)	0.75	0.75
Other impact (questions: a30)	0.25	0.50
Invasion (questions: a06-a12)	0.58	1.00
Impact (questions: a13-a30)	0.83	0.73
Overall risk score	0.46	
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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Data sources

1. Published results of scientific research (P)

Aune K, Gates CC, Elkin BT, Hugh-Jones M, Joly DO, Nishi J. 2010. Reportable i notificable diseases in American Bison. Status Survey and Conservation Guidelines. pp. 27-37 IUCN Gland

Demiaszkiewicz AW, Pyziel AM, Kuligowska I, Lachowicz J. 2014. *Fascioloides magna* pasożytem jeleni w Borach Dolnośląskich. Medycyna Weterynaryjna 72(2): 110-112

Gołębiewska E, Olech W. 2009. Żubronie. Przegląd Hodowlany 77: 13-15

Haigh JC, Mackintosh C, Griffin F. 2002. Viral, parasitic and prion diseases of farmed deer and bison. Rev. Sci. Tech. 21(2): 219-248

Koons DN, Terletzky P, Adler PB, Wolfe ML, Ranglack D, Howe FP, Hersey K, Paskett W, du Toit JT. 2012. Climate and density-dependent drivers of recruitment in plains bison. Journal of Mammalogy 93(2): 475-481

Kornaś S, Hędrzak M, Basiaga M, Kowal J, Nosal P. 2014. Ocena parazytologiczna stada bizonów z hodowli prywatnej. Medycyna Weterynaryjna 70: 302-307

Krasińska M, Krasiński Z. 2017. Żubr. Monografia przyrodnicza. 448 pp. Wyd. Chyra.p

Krasińska M. 1988. Hybrydy żubra i bydła domowego. 188 pp. Ossolineum

Meagher MM. 1980. Bison. In: Schmidt JL, Gilbert DL. (eds.). Big game of North America, ecology and management. 494 pp. Stackpole Books, Harrisburg

Meletti M, Burton J. (eds.). 2014. Ecology, evolution and behaviour of wild cattle: implications for conservation. Cambridge University Press

Nemtsev AS, Rautian GS, Puzachenko AY, Sipko TP, Kalabushkin BA, Mironenko IV. 2003. Wisent in Caucasia. 292 pp. Moscow – Maikop

Plumb GE et al. 2014. American bison *Bison bison* L, 1758 In: Meletti M, Burton J. (eds.). Ecology, evolution and behaviour of wild cattle: implications for conservation. Cambridge University Press

Pucek Z, Belousova IP, Krasińska M, Krasiński ZA, Olech W. 2004. European Bison. Status Survey and Conservation Action Plan IUCN/SSC Bison Specialist Group

Tessaro SV. 1989. Review of the diseases, parasites and miscellaneous pathological conditions of North American bison. Can Vet Journal 30(5): 416-422

Topola R. 2014. Informator polskich ogrodów zoologicznych i akwariów. Miejski Ogród Zoologiczny Warszawa

Vervaecke H. 2015. An alternative view on the controversy of keeping American bison (*Bison bison*) in countries where European bison (*Bison bonasus*) live freely. Division Animal and Human Health Engineering Studiegebied Biotechniek Odisee

2. Databases (B)

ZIMS 2018. The Zoological Information Management System by ISIS (http://www2.isis.org/pages/zims.org.aspx) Date of access: 2018-01-12

3. Unpublished data (N)

–

4. Other (I)

ABC News 2015. American bison slams parked suv (http://abcnews.go.com/US/american - Bison-slams - Parked-suv-yellowstone-national - Park/story?id=29389103) Date of access: 2018-01-19

BioExpedition 2012. American - Bison (http://www.bioexpedition.com/american - Bison/) Date of access: 2018-01-17

Clapway 2015. Aggressive - Bison - At-yellowstone-national - Park (http://clapway.com/2015/05/17/aggressive - Bison - At-yellowstone-national - Park-123/) Date of access: 2018-01-17

DAISIE 2018. (http://www.europe - Aliens.org/) Date of access: 2018-03-10

Dziennik Elbląski 2013. Trzysta - Bizonow-w-Kwitajnach (http://dziennikelblaski.pl/151485,Trzysta - Bizonow-w-Kwitajnach.html#axzz54RMhen1y) Date of access: 2018-01-17

Krawczyk J. 2010. Lasy drugiej Rzeczpospolitej w zapisach prasowych (https://books.google.pl/books?id=pJ-ylfJb-wUC&pg=PA370&lpg=PA370&dq=puszcza+knyszy%C5%84ska+bizony+1939&source=bl&ots=C4PUUHEtvU&sig=HPWyugMWuaZoiBUp4fKWoofAWys&hl=pl&sa=X&ved=0ahUKEwiG9IW89-HZAhWDiSwKHSAIDt0Q6AEILjAA#v=onepage&q=puszcza%20knyszy%C5%84ska%20bizony%201939&f=false) Date of access: 2018-03-10

Lis T. 2015. Kurozwęcki bizon kontra polski żubr (http://sandomierz.gosc.pl/doc/2550222.Bizon-kontra-zubr) Date of access: 2018-01-16

Padilla A. 2017. Bison mom protects newborn calf (http://kdvr.com/2017/05/31/bison-mom - Protects-newborn-calf-from-coyote - Attack - In-yellowstone/) Date of access: 2018-01-19

Rudziński C. 2013. Kadzidłowo Park dzikich zwierząt (http://www.krajoznawcy.info.pl/park-dzikich-zwierzat-25678) Date of access: 2018-03-10

Ryan PJ. 2015. Where do the buffalo roam (https://montanapioneer.com/where-do-the - Buffalo-roam/) Date of access: 2018-01-19

Solarz W. 2016. Risk assessment of the American bison *Bison bison* (https://circabc.europa.eu/d/a/workspace/SpacesStore/c56cd0e7-e23d-474e-9add - A1fdb72f0688/Bison%20bison%20RA.docx) Date of access: 2018-01-20

Turczyn T. 2005. Bizony Leppera bez zezwolenia (https://wiadomosci.wp.pl/bizony-leppera - Bez-zezwolenia-6037790547288705a) Date of access: 2018-02-06

Woda K, Kik M. 2001. Dlaczego bizon (http://www.faunaflora.com.pl/arch/2001/sierpien/bizon.php) Date of access: 2018-01-17

5. Author's own data (A)

Olech W. 2018. Own database for the *Bison* genus

Perzanowski K. 2018. Own database for the *Bison* genus