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. Czesław Hołdyński
2. Anna Bomanowska – external expert
3. Maria Zając

acomm01. Comments:

	degree	affiliation	assessment date
(1)	prof. dr hab	Department of Botany and Nature Protection, Faculty of Biology and Biotechnology, University of Warmia and Mazury in Olsztyn	23-01-2018
(2)	dr	Department of Geobotany and Plant Ecology, Institute of Ecology and Environmental Protection, Faculty of Biology and Environmental Protection, University of Lodz	28-01-2018
(3)	prof. dr hab	Institute of Botany, Jagiellonian University, Kraków	28-01-2018

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

Polish name: Opornik łatkowaty

Latin name: ***Pueraria montana*** (Lour.) Merr

English name: Kudzu

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:

Latin name: *Pueraria montana* (Lour.) Merr. (acc. The Plant List 2013 – B)

synonym: *Pueraria montana* var. *lobata* (Willd.) Sanjappa & Pradeep (The Plant List 2013 – B) – according to new taxonomic approaches a variety of the species *Pueraria montana*, formerly considered a separate species of *Pueraria lobata* (Willd.)

Polish name: Opornik łatkowaty, ołownik łatkowaty; the plant is also known as kudzu (Szweykowska and Szweykowski 2003 – P).

English name: Japanese arrowroot, kudzu vine, porch-vine, telephone vine, foot-a-night vine (CABI 2007, Global Invasive Species Database 2018 – B). Its common name, often used in numerous languages is kudzu (CABI 2007, Global Invasive Species Database 2018 – B).

Polish name (synonym I) Ołownik łatkowaty	Polish name (synonym II) Kudzu
Latin name (synonym I) *Dolichos hirsutus*	Latin name (synonym II) *Dolichos japonicus*
English name (synonym I) kudzu vine	English name (synonym II) Japanese arrowroot

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	level of confidence
		X	

acomm04. Comments:

The literature research does not indicate the occurrence of *Pueraria montana* in Poland in both natural and anthropogenic ecosystems. However, this species can occur in garden cultivations (Kochanowska 2010 – P). No information about the escape of this plant outside the gardens has been found. The existing information obtained from the staff of Polish botanical gardens and arboreta (curators of the collections) also do not indicate the occurrence of kudzu (Employees of botanical gardens... 2018 – N). The species is on the list of plants banned in the European Union, which should be a sufficient reason for the lack of its introduction into the natural environment. The analysis of sales offers made for the purpose of completion of the card of the discussed species demonstrated that until recently one of the most famous auction websites offered the sale of Japanese arrowroot (kudzu) seeds. Although this auction is no longer valid, but its results indicate interest in the species (Allegro auction website 2018 – I).

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
	the domesticated animals domain
	the human domain
X	the other domains

acomm05. Comments:

Kudzu (Japanese arrowroot) (*Pueraria montana*) occurs naturally in Southeast Asia and on the islands of Oceania and Japan. In some countries, e.g. China, Japan, Korea, Malaysia, Pakistan, Taiwan, it is a valuable useful, or medicinal, edible, fibrous and forage plant (Hill 1985 – P, Heuzé and Tran 2015 – B, Glass and Al-Hamdani 2016 – P). It was introduced to North and Central America (in 1876, on the occasion of the Philadelphia Exhibition it was imported to the USA as an ornamental plant), South Africa, Central Asia, the Caucasus region and to Ukraine. In the area of its secondary range, mainly in the USA, the species poses very serious economical threats and causes serious economic losses (Munger 2002, CABI 2018, Csurhes 2016, VRO 2017, Global Invasive Species Database 2018 – B). *Pueraria montana* is included in the list of the most dangerous invasive species in the world (Lowe et al. 2000 – I, Nentwig et al. 2017 – P). In places, where it was brought thanks to its unusual adaptive abilities, it displaces native species (Mitich 2000 – P, CABI 2018 – B). Due to its rapid growth (20-30 m per year; Forseth and Innis 2004 – P) it effectively competes with native species, forming dense, single-species monocultures, limiting access to light and oxygen to other species (Blaustein 2001, Forseth and Innis 2004, Follak 2011, Lindgren et al. 2013 – P). Entwining trees and shrubs, which it climbs, it weakens their growth, strangling and even crushing tree trunks (Blaustein 2001 – P). In Europe *Pueraria montana* grows in several places, including warm regions of Switzerland and Italy near Lake Maggiore and Lake Lugano, the vicinity of Mostar in Bosnia and Herzegovina and in Ukraine (Crimea). Typical habitats occupied by kudzu are open areas or scrub adjacent to deciduous or mixed forests, but it easily attacks anthropogenic habitats such as road and railway embankments, abandoned pastures and banks of inland water reservoirs (EPPO 2007 – P). It colonizes many natural and semi-natural habitats (EPPO 2007 – P), for example forest edges or disturbed areas (van der Maesen 1985, Halim 1992, Heider et al. 2007 – P). Kudzu is believed to drastically reduce biodiversity, because of its ability to suppress other vegetation and the development of monocultures on a large scale (Alderman 1998, Forseth and Innis 2004, Sun et al. 2006 – P). A dense "canopy" formed by leaves can lead to the destruction of both juvenile plants (seedlings in the case of forest plantations) and mature trees (Berisford et al. 2006 – P). Pron (2006 – P) reports that the species contributes to the reduction in the number of taxa in occupied places from 20-25 per 4 m^2 of a meadow or forest to 6-9 species in plots colonized by kudzu. Forest problems related to aggressive kudzu also include edge tree mortality, exclusion of native species and a possibility of increasing a fire risk in winter (Putz 1991, Harrington et al. 2003 – P). Kudzu, because of its strong expansion in some localities in the USA , limits the development of urban, suburban and rural areas, occupying areas primarily intended for cultivation or building (Blaustein 2001 – P). It weakens the condition of the trees and causes their die down in young forest plantations. The species poses a threat to crops as a vector of fungal pathogens causing diseases of leguminous and ornamental plants. Encroachment of kudzu at the margins of arable fields cause yield losses due to shading and competition, as well as making mechanical harvesting difficult (Slaminko i in. 2008 – P, Orwa i in. 2009 – B, Lindgren i in. 2013 – P).

It is assumed that kudzu does not occur in Poland. The occurrence of the species in the area of our country would significantly influence a decrease in biodiversity. This is because kudzu can affect native plants and completely modify the structure of ecosystems, in which it is present (Clabassi et al. 2003, EPPO 2007 – P). Kudzu's ability to cover and shade forest layers, atmospheric nitrogen fixation and emit isoprene suggests that it can have a significant effect on native biodiversity of forests, nitrogen cycles in forests, nitrogen saturation, freshwater eutrophication and local air quality. The growth rate of kudzu increases rapidly in response to an increase in CO_2, and growth without "wood tissue" limitation may increase the competitive advantage of kudzu. This fact combined with the sensitivity to low temperatures means that kudzu can increase its range in future, warmer environments with high CO_2 emissions. Rapid growth, vegetative reproduction, high leaf area index and photosynthesis rate make kudzu an aggressive competitor (Forseth and Innis 2004 – 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:

Kudzu does not occur in the natural environment in Poland. In Europe, the sites of this species are reported only in several isolates sites in the south and east of the continent: in Italy (Celesti-Grapov et al. 2009 – P), Switzerland (Gigon et al. 2014 – P), Bosnia and Herzegovina (Maslo 2016 – P) and Ukraine (CABI 2018 – B), mostly under cultivation and it does not demonstrate strong tendencies to become wild (EPPO 2007 – I). An application for intentional introduction of the species with a purpose of scientific research has already been submitted by Germany (EPPO 2007 – P). In addition, signals of uncontrolled sale of kudzu seeds have already been registered in Europe (EPPO 2007 – P). A probability of self-propelled expansion of kudzu from abroad to the area of Poland is very low. As a matter of fact, this species occurs in Ukraine – a country neighbouring Poland, but populations formed there are found in areas situated far from Poland (Crimea, CABI 2018 – B; M. Shevera – personal information). Therefore, despite that fact that the condition of "medium probability" is met, a real probability of a self-propelled, independent expansion of diaspores of the discussed species was assessed on the basis of expert knowledge as "low", and practically impossible at long distances.

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. Comment:

The probability of a spontaneous occurrence of kudzu in the natural environment as a result of unintentional human actions in our climate conditions is unlikely. At most it can be brought with seed material, soil, construction or gardening equipment. A pieces of plants can be also accidentally taken on clothing, in a luggage, road or rail transport. Due to very limited occurrence of species in Europe, and currently, also the ban on its cultivation in EU (EPPO 2007 – P), a probability of such an event is low – it can happen more rarely that once per a decade.

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. Comment:

The main potential route for the colonization of new areas by the discussed species are horticultural and collection cultivations for medicinal and decorative purposes, as well as for fodder in agriculture (EPPO 2007 – P). According to the EPPO report (2007 – P), wherever it occurs outside its natural range, it has been intentionally introduced (e.g. in Italy and Switzerland, Great Britain). *Pueraria montana* has already been naturalized in Italy, and the probability of its spread in other regions of EPPO is high, it grows well under a wide range of conditions and on most types of soil. The southern parts of the EPPO regions are more at risk. Recently, it has been advised to apply phytosanitary measures in the case of this species in Europe (EPPO 2007 – P), as small invasions and "escapes from gardens" were observed in Switzerland. In addition, there are concerns about a possible future invasion in the countries, to which it was introduced, but has not yet been naturalized. The main habitats, which it can colonize are forest edges or forests with open canopy, banks of rivers, as well as road and railway networks. In Polish society, there is still a small awareness of the hazard to native flora caused by the invasion of alien species. Therefore, as previously mentioned, kudzu seeds were offered for sale on one of the Internet websites (Hołdyński 2018, own data – A). However, these are sporadic cases – most sellers (breeders) treat seriously a ban on trade of potentially invasive species. The risk of the occurrence in cultivation exists, because kudzu is an attractive garden plant and is useful for humans (including its medicinal properties: Hill 1985, Li et al. 2011 – P), and possible climate change or cultivation will facilitate the establishment of the species in the north of Europe (Follak 2011, Gigon et al. 2014 – P).

A2 | Establishment

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

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

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

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

acomm09. Comment:

Pueraria montana has a wide climatic amplitude, in its original range it can grow in areas where the temperature in winter drops to -30˚C (China, Korea; Lindgren et al. 2013 – P), and in its introduced range it can survive cold winters with several grades of frost (Illinois; McCain et al. 2006 – P). In Europe, in Switzerland, it tolerates temperature drops down to -18°C (Gigon et al. 2014 – P). However, in general, low temperatures effectively limit the spread of the species to the north. The leaves are affected as early as at the first frosts, and their development in spring in considerably delayed compared to most forest trees (Miller and Edwards 1983, Mitich 2000 – P). Recent studies have also demonstrated that physiological processes in leaves cells of kudzu seedlings are disturbed after only four hours of exposure to -28˚C (Ziska 2009 – P). Kudzu in its native distribution, i.e. in Southeast Asia and on the islands of Oceania and Japan, prefers warm to temperate zones or occurs at higher altitudes (van der Maesen 1985, Halim 1992, Heider et al. 2007 – P). It develops in full sun; growth rate and survival are reduced in the case of shady sites (Abramovitz 1983, Forseth and Teramura 1987, Carter and Teramura 1988, Forseth and Innis 2004 – P). This species has optimal conditions for growth and development in the warm and temperate zones, with mild winters (5-15˚C) and hot summers with temperatures above 25-27˚C and

precipitation of at least 1000-1500 mm per year (Mitich 2000, Lindgren et al. 2013 – P). In its introduced range, it grows best in areas having high day and night temperatures with periodic summer rains (CABI 2018, ODA 2013 – B) and prefers lowland areas up to 1000 m a.s.l. In the navtive range kudzu also grows in mountainous areas (Global Invasive Species Database 2018 – B). The species can survive in dry areas, because it accumulates water in its large fleshy tuberous roots (Global Invasive Species Database 2018 – B). In Europe, favourable climatic conditions for this species occur in the southern part of the continent up to Hungary and Slovakia (Follak 2011 – P). The similarity between the climate of Poland and the climate of native range of kudzu is at the level of 45-94%, similarly in areas, where the species was introduced (secondary range), which means, theoretically, that its requirements are partially met in Poland, although the real climate niche occupied in its invasive range can significantly differ from the climate niche occupied in its native range. Kudzu is able to survive unfavourable climatic conditions, but it acquires the features of invasiveness under conditions of high summer temperature and high humidity only (EPPO 2007 – P, CABI 2018 – B). Invasiveness is most likely in the case of mild winters with hot and wet summer and abundant insolation. *Pueraria montana* can survive very frosty winters, but it is accompanied by a decrease in plant's growth and expansion rate (in this case it reproduces vegetatively only).

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. Comment:

The plant in its original range occurs in deciduous and mixed forests, as well as in anthropogenic habitats such as: pastures, conifer plantations, railway and road embankments, banks of water reservoirs (Forseth and Innis 2004 – P, EPPO 2007 – I). In its secondary range, it colonizes mainly open anthropogenic and unsettled habitats: roadsides, embankments, railway areas, wastelands, boundary strips, fallows, forest edges, overexposed wood stands and young tree plantations (CABI 2018, Csures 2016, Global Invasive Species Database 2018 – B). The species grows best in full sun, tolerates shade, but its growth in the shade is very limited (Forseth and Innis 2004 – P, ODA 2013 – B). It prefers fertile, well-drained clay soil, but is able to grow on soils poor in nutrients, because, like most legumes, it has the ability to symbiotic atmospheric nitrogen fixation (Miller and Edwards 1983, Lindgren et al. 2013 – P, Csurhes 2016 – B). It prefers moist soils, but does not tolerate excessive moisture content and flooding (Mitich 2000 – P). It much better tolerates dry soils with periodic water shortage (Global Invasive Species Database 2018 – B). This species is relatively insusceptible to soil pH, it can grow on soils characterized by pH from 3 to 8 (Mitich 2000 – P, EPPO 2007 – I, Gigon et al. 2014 – P). Despite the availability of anthropogenic habitats listed above in Poland, their colonization by the species and its establishment are unlikely due to sub-optimal climatic conditions.

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	high **X**	level of confidence

acomm11. Comment:

Assessment (data of type C)
In the natural range of the species, generative diaspores (seeds) are spread by mammals and birds (Weber 2003 – P). In the literature there is little information about factors related to the distribution of kudzu seeds, and zoochory (dispersal by animals) seems to be ineffective. The seeds can be transported by wind at short distances, apart from this there is no information about other mechanisms facilitating further transport of diaspores (source int. – I). In its secondary range, kudzu blooms rarely in some North American populations, in other areas it sometimes produces many flowers, but they develop few pods or pods contain few seeds. In addition, the seeds are often destroyed by native species of insects (bugs, Hemiptera), less frequently by a naturalized species *Borowiecius ademptus* (Thornton 2001 – P). Low seed production results from the fact, that in the areas of secondary establishment of the species, there are no suitable pollinators (Orwa et al. 2009 – B), which are: a bee originating from East Asia *Megachile sculpturalis* (Pappert et al. 2000, Forseth and Innis 2004 – P); in the US this species is pollinated by hymenopterans ("membrane-winged")Hymenoptera (Thornton 2001 – P), in Japan and China by the above-mentioned bee (Batra 1998 – P), which is also a species naturalized in the USA (Mangum and Brooks 1997 – P). In the secondary range, the method of dispersion using seeds is not very effective (Hipps 1994 – P). As a matter of fact, sometimes a small amount of produced seeds is able to germinate under various climatic and edaphic (i.e. chemical, physical and biological characteristics of the soil which determined specific habitat) conditions (Susko et al. 2009 – P), however their viability is low and it is estimated that they have less that 10% chance of germinating. Additionally, most of the seeds is infected with fungal diseases and as much as 80% of seeds are eaten by insects (Forseth and Innis 2004 – P).

The species in its secondary range spreads mainly in a vegetative way. It is characterized by a very fast growth rate reaching even 30 cm per day and from 10 to 30 m during the growing season (Mitich 2000 – P). New shoots may grow from the parent plant in every possible direction. In the case of contact with the soil, the plant may develop roots and give birth to a new individual in each node of a vegetative shoot . Assuming that a shoot extents by 10-30 m in the growing season, and nodes occur on average every 30 cm, theoretically during one year one shoot may give birth to 50 new shoots (Mitich 2000 – P).

Expansion of population (data of type B)
In the US, the migration rate to the north is estimated at 50000 ha per year (Pappert et al. 2000, Ziska 2009 – P).

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

	low
	medium
X	high

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

acomm12. Comment:

The main potential route to intentionally introduce the species to a new area is the sale of plants for the horticulture and agriculture (Blaustein 2001, Forseth and Innis 2004, McCain et al. 2006 – P, EPPO 2007 – I, Geerts et al. 2016 – P). This species is spread unintentionally as a result of bringing diaspores with plant material, soil, as well as construction and

gardening equipment (McCain et al. 2006 – P). It was assessed that if the species occurs in Poland, the frequency of its dispersal by human actions will be high, because of its decorative and medicinal properties. Kudzu, apart from being a visually attractive vine, is also used as a traditional medicine. Its root (usually powdered) has been used in medicine since ancient times for the therapy of: migraine, coronary insufficiency, arterial hypertension, allergy, diarrhoea, alcoholism, as well as against common cold, flu, fever. The plant is rich in isoflavonoids (including puerarin, daidzein, daidzin). The effect in the treatment of alcoholism is attributed to daidzin and daidzein. Kudzu is also used as a source of textile and rigging fibre (CABI 2018 – B). Moreover, the species can spread by accidentally introduction of root fragments able to regenerate, from which new plants will grow, e.g. on the occasion of earthworks conducted during various types of investments (roads, railways) (CABI 2018 – B).

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**:

X	inapplicable
	low
	medium
	high

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

acomm13. Comment:

This species does not affect native species through predation, parasitism or herbivory.

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. Comment:

This species is highly competitive in relation to other plant species. The key features which contribute to its competitive success are rapid vegetative growth, rooting of shoots at the nodes during a minimum contact with soil, large leaf area, which ensures effective photosynthesis and the ability to atmospheric nitrogen fixation (Forseth and Innis 2004 – P, Global Invasive Species Database 2018 – B). This species causes significant decreases in coverage and the number of species in the areas it occupies. Gigon et al. (2014 – P) report that in the area of 4 m^2 of a kudzu-free community 20-25 species were present, while in the

same area, but infected by kudzu, only 6-9 species grew. Kudzu is believed to drastically reduce biodiversity, because of its ability to form monocultures on a large scale (Alderman 1998, Forseth and Innis 2004, Sun et al. 2006 – P). The literature reports that in the US this species currently covers an area from 1,2 to 2,8 million ha, and it is estimated that this area grows at a rate of 50000 ha per year. Forecasts indicate that over time kudzu may cover larger and larger areas of potentially productive forests and arable lands, causing losses estimated at 100 to 500 million dollar per year (Mitich 2000 – P). In extreme cases, kudzu removes all other species from the occupied area, forming monocultural communities of a structure totally different that the original one (Lindgren et al. 2013 – P, ODA 2013 – B). In the ecosystems occupied by the species, a decrease in the number of taxa of invertebrates, e.g. beetles, ants and arthropods, was observed (EPPO 2007 – B). It is difficult to predict which species would be affected in Poland. The assessment is related to a strong competitiveness towards whole plant communities, in the case of species of special concern, it it difficult to list their examples, because in the literature only species native for the US (*Trillium reliquum*, Heckel 2004 – I) and Switzerland (*Cistus salviifolius*, *Celtis australis*, *Ornithogalum pyrenaicum*, Gigon et al. 2014 – P).

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

X	no / very low
	low
	medium
	high
	very high

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

acomm15. Comment:

In Poland, there are no native species of the genus *Pueraria*, so there is no possibility of interbreeding in natural conditions.

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

X	very low
	low
	medium
	high
	very high

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

acomm16. Comment:

There are no known examples of the effect of kudzu by hosting pathogens on native species growing wild or occurring in Poland.

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

	low
X	medium
	high

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

acomm17. Comment:

Assuming that the species would spread throughout Poland, it could significantly affect nitrogen management in the soil. Kudzu lives in symbiosis with bacteria of the genus *Rhizobium* fixing atmospheric nitrogen, in the case of large areas occupied by this species,

	biogeochemical cycles may change, and thus the abiotic properties of the ecosystem may change (Forseth and Innis 2004 – P). It was found that the species can increase the nitrogen content in the top soil layer (1-6 cm) even twice (Pron 2006, EPPO 2007, Hickman et al. 2010, Gigon et al. 2014 – P). Excess of nitrogen compounds in the catchment area infected by kudzu may cause eutrophication of water and increase the content of nitrates 2-5 times. In addition, it creates every year a thick layer of leaf necromass with a high nitrogen content, contributing to a strong eutrophication of the habitat (Forseth and Innis 2004 – P). A dense canopy formed by wide kudzu leaves reduces availability of sunlight for the other plant species. This described effect does not rather relate to habitats of special concern, mainly Natura 2000. Assuming that the species would spread in Poland primarily in anthropogenic habitats, these changes would be relatively durable.

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.	Comment: Assuming that this species would spread throughout Poland, it could create large populations and disturb the proper state of preservation of habitats of special concern, including habitats of Natura 2000, mainly: oak-hornbeam forests (code 9160), hydrophilous tall herb fringe communities (code 6430) and other habitats difficult to predict because of the lack of examples in Europe. Therefore, it will probably reduce floristic biodiversity (CABI 2018, Global Invasive Species Database 2018 – B).

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
X	very low
	low
	medium
	high
	very high

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

acomm19.	Comment: The species is a plant, it is not a parasitic organism, therefore it does not affect the cultivation of plants by the above-mentioned characteristics.

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

	inapplicable
	very low

	low
	medium
X	high
	very high

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

acomm20. Comment:

Kudzu is characterized by rapid vegetative growth, thanks to which it can tightly cover and thus destroy (block) almost all fruit cultivations, ecological orchards, plantations of energy trees (willows, poplars), formerly arable forests etc. Few plants are able to survive under a dense canopy formed by leaves of the species. Kudzu growth in the margins of arable fields may cause a significant yield loss, because of their shading and difficult mechanical harvesting (Lindgren et al. 2013 – P). The species weakens the condition and causes dying out of trees in orchard plantations and young forest plantations, climbing them, shading, densely and tightly entwining them with its shoots, and consequently "constricting" them (Blaustein 2001 – P, Munger 2002 – B, Forseth and Innis 2004 – P, Orwa et al. 2009 – B). The literature reports that losses in forest cultivations (plantations) resulting from kudzu expansion were estimated at a level of 100 to 500 million dollars per year (Blaustein 2001, Quimby et al. 2003, Forseth and Innis 2004, EPPO 2007 – P). Probably, the species has allelopathic effect on other plants (Rashid et al. 2010 – P).

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

	inapplicable
X	no / very low
	low
	medium
	high
	very high

aconf17.	Answer provided with a	low	medium	high **X**	level of confidence

acomm21. Comment:

The species does not have a possibility of interbreeding with related species including useful (cultivated) plants occurring in Poland.

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

	very low
	low
	medium
X	high
	very high

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

acomm22. Comment:

Assuming that the species would spread throughout Poland, it could lead to a change in the properties of agroecosystems, including the nitrogen cycle, which in the case of large areas occupied by this species can cause changes in biogeochemical cycles, and thus the properties of the ecosystem may change (Forseth and Innis 2004 – P). It has been found that this species can increase the nitrogen content in the top soil layer (1-6 cm) even twice (Hickman et al. 2010, Gigon et al. 2014 – P). The literature reports that after removal of the species, the content of nitrogen in the soil is higher than in the areas not occupied by this

	plant, which makes it an effective green manure for other crops (Forseth and Innis 2004 – P). Limitations in the area of arable land are possible (in the United States, the species occupies areas, where forest cultivations were present or planned, which results in huge economic losses).

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

	very low
	low
X	medium
	high
	very high

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

acomm23.	Comment: In the leaves and roots of the species, a fungus *Phakopsora pachyrhizi* causing soybean rust may spend the winter. This is a disease of soybean leaves, which is currently considered the greatest hazard to the cultivations of this plant (Slaminko et al. 2008, Jordan et al. 2010, Sikora 2014 – P). This fungus can also infect other species of legumes (Fabiszewski et al. 2010 – P). An invasive insect *Megacopta cribraria* (F.) originating from Asia, whose host is kudzu, can also feed on legumes (Gardner et al. 2013, Ruberson et al. 2013 – P). In addition, this species is a vector for microscopic fungi of the genus *Phytophtora* (EPPO 2007 – B, Hatcher et al. 2012 – P), causing dangerous diseases of cultivated and ornamental plants. The European and Mediterranean Plant Protection Organization (EPPO) included *Phytophtora* species into the A2 list (EPPO 2017 – B). Kudzu is also a host for parasitic nematodes, including 5 species of the genus *Meloidogyne* and the species *Rotylenchulus reniformis* (Li et al. 2011 – P), which attacks, among others, plantations of citrus plants (Stoyanov 1971 – P).

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.	Comment: The species is a plant, it is not a parasitic organism.

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	high **X**	level of confidence

acomm25.	Comment: The species does not have biological, physical and/or chemical characteristics, which are hazardous upon contact with production and companion animals or to animal production. Leaves of kudzu are applied in the US as fodder for livestock, because of high content of microelements or as an additive to fodder for beef and dairy cattle during periods of drought or in late summer and early autumn, when the quality of seasonal grasses diminishes (Hill 1985, Li et al. 2011 – P, Heuzé and Tran 2015 – B, Glass and Al-Hamdani 2016 – P).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm26.	Comment: The species is a plant and is not a host or vector of animal pathogens/parasites.

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.	Comment: The species does not have an effect on human health through parasitism.

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

X	very low
	low
	medium

	high
	very high

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

acomm28. Comment:

The species is not hazardous for humans and does not have properties, which would be hazardous for human health upon a direct contact with any part of the plant. The literature reports that kudzu has medicinal properties and has been used for thousands of years in China and Japan to treat numerous common diseases (Shurtleff and Aoyagi 1977 – P, Hill 1985, Li et al. 2011 – P, PFAF 2018 – B). Different parts of the plants, including its dried and powdered root, are used in products applied for the therapy of: migraine, coronary insufficiency, arterial hypertension, allergy, diarrhoea, alcoholism, as well as against common cold, flu, fever etc. The plant is rich in isoflavonoids (including puerarin, daidzein, daidzin). The effect in the treatment of alcoholism is attributed to daidzin and daidzein. In traditional Chinese medicine kudzu (chin.: 葛藤 – ge-gen) is one of 50 basic, fundamental herbs used in medicine (Li et al.2011, Ożarowski et al. 2013, Koirala et al. 2017, Xiao et al. 2017 – P). Leaves, shoots and flowers of the species can be eaten as a vegetable raw, steamed or marinated (van der Maesen 1985 – P). In Japan, kudzu starch is a valued foodstuff, used among others, for the production of bread, noodles, ice-cream, beverages, jellies (Li et al. 2011 – P).

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm29. Comment:

There is no information that this species is a potential vector of pathogens and parasites harmful to humans.

A4e | Impact on other domains

Questions from this module qualify the consequences of *the species* on targets not considered in modules A4a-d.

a30. The effect of *the species* on causing damage to **infrastructure** is:

	very low
	low
	medium
X	high
	very high

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

acomm30. Comment:

If the species spread throughout Poland, it could generate large losses in infrastructure. Frequent cases in the countries, where the species occurs are breaking of power transmission lines, because of the weight of shoots, which entwine electric poles treating

	them as a support, damages of road surfaces and railway embankments because of heavy roots and shoots – cracking and bursting of hard surfaces (even asphalt) and damages of elevations and roofs to residential, commercial buildings and mechanical damages of fences, which the species "climbs" (Miller 2000 – P).

A5a | Impact on ecosystem services

Questions from this module qualify the consequences of *the organism* on ecosystem services. Ecosystem services are classified according to the Common International Classification of Ecosystem Services, which also includes many examples (CICES Version 4.3). Note that the answers to these questions are not used in the calculation of the overall risk score (which deals with ecosystems in a different way), but can be considered when decisions are made about management of *the species*.

a31. The effect of *the species* on **provisioning services** is:

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm31. Comment:

Nowadays, the greatest potential of the species can be a powdered extract originating from the roots of the plant, used as kitchen starch and as an ingredient of medicinal formulations. In traditional Chinese medicine, kudzu is considered one of the most important medicinal plants and is an ingredient of many pharmaceutical products (Li et al. 2011 – P). Root and shoot of kudzu are rich in flavoinoids, isoflavonoids and isoflavones, which are effective in the treatment of various diseases, e.g. cardiovascular disorders, ischemic stroke, digestive system diseases, cancers, alcoholism, Alzheimer's disease (Li et al. 2011, Ożarowski et al. 2013, Koirala et al. 2017, Xiao et al. 2017 – P). In addition, leaves, shoots and flowers of the species can be eaten as a vegetable raw, steamed or marinated (van der Maesen 1985 – P). In Japan, young shoots are collected and used as flexible waterproof fibres for weaving durable wicker baskets. Cellulose (ligneous) fibres and roots are used as the basic raw material for the production of thin traditional paper, the fibre is also applied to fill pillows, beds and chairs and after burning, it acts as a mosquito repellent (Shurtleff and Aoyagi 1977, Mitich 2000 – P). Kudzu flowers are used by bees to produce extremely aromatic honey (Shurtleff and Aoyagi 1977 – P). It is also used in the experimental production of methane and gasohol (Hipps 1994, Mitich 2000 – P). On the other hand, this species, overgrowing large forest areas, orchards and other plantations decreases their potential productivity and causes large economic losses (Orwa et al. 2009 – B). It also constitutes a hazard to legumes cultivations, being a vector of fungal pathogens (Slaminko et al. 2008, Hatcher et al. 2012 – P, EPPO 2017 – B). Positive utility characteristics are neutralized by "defects" of the expansive species in the environment and negative effects on cultivated plants.

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	high **X**	level of confidence

acomm32.	Comment: The species in the area of its occurrence regulates soil processes – it lives in symbiosis with bacteria of the genus *Rhizobium* fixing atmospheric nitrogen, which affects nitrogen management in the soil (Forseth and Innis 2004 – P). Studies conducted in the US demonstrated that after removal of the species, the content of nitrogen in the soil was higher than in the areas not occupied by this plant, which indicates its characteristics as a green fertilizer (Forseth and Innis 2004 – P). On the other hand, excessive concentration of nitrogen in the soil in areas occupied by the species leads to increased emission of nitrogen oxides NOx and nitrogen oxide N_2O (nitrous oxide), which indirectly affects an increase in the ozone concentration in the air (Hickman et al. 2010 – P). Kudzu is also a strong emitter of isoprene (C5H8), a photochemically reactive hydrocarbon, which is a precursor of tropospheric ozone (Hickman et al. 2010 – P, Heuzé and Tran 2015 – B). Therefore, this species is attributed with a negative impact on air quality by periodical increase in the concentration of tropospheric ozone (Lindgren et al. 2013 – P). Sharkey and Loreto (1993 – P) investigated the emission of isoprene by kudzu, because the large area occupied by this species made it a source comparable to tree species. Isoprene contributes to the formation of blue mists in some forests (Went 1960 – P). The species also has a negative effect on the occurrence and course of extreme phenomena in forest ecosystems. The vine entwines tree crowns and growing inside forms a "canopy", connecting trunks with each other, which in the case of violent storms and hurricanes causes a domino effect and large destruction of the wood stand (Forseth and Innis 2004 – P). Because of its growing manner, kudzu also increases a risk and rapidity of fires in forest plantations, creating a "fire ladder" facilitating the spread of fires in tree crowns (Harrington et al. 2003, Forseth and Innis 2004 – P).

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	high **X**	level of confidence

acomm33.	Comment: Opinions about the effect of this species on this kind of ecosystem services, are divided. According to some authors (e.g. Alderman and Alderman 2001 – P), this effect is neutral or positive, however according to others (e.g. Blaustein 2001, Forseth and Innis 2004, Lindgren et al. 2013 – P) kudzu changes the native landscape through the formation of tight monocultures, which decreases aesthetic and recreational values of areas valuable for the nature and culture. Considering the fact that this second opinion is much more frequently expressed and discussed, it has been assumed that the effect of the species on this kind of services is moderately negative.

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
X	increase moderately
	increase significantly

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

acomm34. Comment:

Assuming that in the future, the temperature will increase by 1-2°C and at the same time the air humidity will increase, the probability of introduction of the species to the area of Poland may moderately increase. Jarnevich and Stohlgren (2009 – P) investigated the effect of climate change on the spread of kudzu in the United States. The forecasts related to global warming included an increase in temperature of 3°C to 5°C (IPCC 2001, Forseth and Innis 2004 – P), which, according to the authors, will favour the occupation of new areas by the species; in addition this process will be favoured by forecast warmer winters and higher concentrations of CO_2. Tendencies observed over the past few decades such as: a decrease in the number of frosty days, an earlier date of the last spring frost and a later date of first frosts in autumn may facilitate overcoming geographical barriers by the species and its occurring 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
	not change
X	increase moderately
	increase significantly

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

acomm35. Comment:

Forecasts related to global warming and assuming global temperature increase by a few degrees Celsius, assume the shift of the range of the species further to the north (Forseth and Innis 2004, Jarnevich and Stohlgren 2009 – P). It is indicated by species migration models created based on forecast climate changes, including an increase in air temperature and CO_2 level in the atmosphere (Ziska 2009, Bradley et al. 2010 – P). Forecasts related to global warming included an increase in temperature of 3°C to 5°C (IPCC 2001, Forseth and Innis 2004 – P), which, according to the authors, will favour establishment of this species further and further in the north, this process will be additionally favoured by forecast warmer winters and higher CO_2 concentrations. This species, even under current conditions, establishes in the north of the US, despite severe temperatures and periodic water shortages (McClain et al. 2006, Follak 2011, Lindgren et al. 2013 – P). Tendencies observed over the past few decades in Poland and other regions of Europe such as: a decrease in the number of frosty days, an earlier date of the last spring frost and a later date of first frosts in autumn may facilitate the establishment of the species further to the north of the continent (Follak 2011 – P). Although these are only forecasts of climate change, and the establishment and spread of the species in a new area are also affected by other factors, it cannot be excluded that such climate change will cause that the probability of the species to overcome barriers, which up to now made its survival and reproduction in Poland impossible, will moderately increase.

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
X	increase moderately
	increase significantly

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

acomm36. Comment:

Forecasts related to global warming and assuming global temperature increase by a few degrees Celsius, assume the shift of the range of the species further to the north (Forseth and Innis 2004, Jarnevich and Stohlgren 2009 – P). It is indicated by species migration models created based on forecast climate changes, including an increase in air temperature and CO_2 level in the atmosphere (Ziska 2009, Bradley et al. 2010 – P). Forecasts related to global warming included an increase in temperature of 3°C to 5°C (IPCC 2001, Forseth and Innis 2004 – P), which, according to the authors, will favour a spread of this species further to the north, this process will be additionally favoured by forecast warmer winters and higher CO_2 concentrations. Tendencies observed over the past few decades such as: a decrease in the number of frosty days, an earlier date of the last spring frost and a later date of first frosts in autumn may facilitate the spread of the species in our area, although it should be considered that these are only forecasts, and the establishment and spread of the species in a new area is also affected by other factors.

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
X	increase moderately
	increase significantly

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

acomm37. Comment:

Assuming that in the future the temperature will increase by 1-2°C and at the same time the humidity of the air will grow, the probability for kudzu to be introduced, establish and spread may also moderately increase. Conditions for its development will improve, which may have effect on its faster growth rate. Therefore, assuming theoretically that in such conditions the species could appear in Poland and could survive the winter, there is a possibility of its spread in the natural environment, and then it can negatively (competition) influence wild plants and animals, as well as 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
	not change
X	increase moderately
	increase significantly

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

acomm38.	Comment:

The most important predictors of climatic conditions suitable for the species are precipitation and temperature (Bradley et al. 2010 – P). If the assumed temperature increase in the years 2046-2065 is from 1 to 2 °C, and at the same time the level of precipitation grows, the conditions of development of the species will improve, which can result in its faster growth and coverage of e.g. cultivated areas (assuming that the species will be present in Poland). A potential introduction of pathogens of the genus *Phytophthora* with the species, is also possible.

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.	Comment:

The species does not have an effect on animal husbandry and the forecast climate warming will not result in a change in this area.

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.	Comment:

The species does not have an effect on humans and the forecast climate warming will not result in a change in this area.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm41.	Comment:

The most important predictors of climatic conditions suitable for the species are precipitation and temperature (Bradley et al. 2010 – P). If the assumed temperature increase in the years 2046-2065 is from 1 to 2 °C, and at the same time the level of precipitation grows, the conditions of development of the species will improve, which can

result in its faster growth and overgrowth of infrastructure facilities, similarly as it is in the south of the United States (assuming that the species will be present in Poland).

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	0.17	1.00
Establishment (questions: a09-a10)	0.50	1.00
Spread (questions: a11-a12)	0.63	1.00
Environmental impact (questions: a13-a18)	0.50	1.00
Cultivated plants impact (questions: a19-a23)	0.40	0.90
Domesticated animals impact (questions: a24-a26)	0.00	1.00
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.75	1.00
Invasion (questions: a06-a12)	0.43	1.00
Impact (questions: a13-a30)	0.75	0.98
Overall risk score	0.32	
Category of invasiveness	moderately invasive alien speciesp	

A6 | Comments

This assessment is based on information available at the time of its completion. It has to be taken into account. However, that biological invasions are, by definition, very dynamic and unpredictable. This unpredictability includes assessing the consequences of introductions of new alien species and detecting their negative impact. As a result, the assessment of the species may change in time. For this reason it is recommended that it regularly repeated.

acomm42. Comment:

Japanese arrowroot *Pueraria montana* (kudzu) is a fast growing vine originating from Southeast Asia, where it is an appreciated medicinal, edible, fodder, fibre and ground cover plant. In the areas where it was introduced (mainly in the US), it is a strongly invasive plant causing profound changes in the species composition and structure of ecosystems and being the cause of large economic losses. In Europe kudzu occurs in several isolated small sites in the south of the continent (Italy, Switzerland, Bosnia and Herzegovina, Ukraine - Crimea), usually under cultivation, rarely becoming wild (EPPO 2007 – I). Currently, the import and trade of kudzu seeds in the area of the European Union is under restrictive limitations, and the species was included into the A2 list of organisms subjected to quarantine (EPPO 2007, 2017 – B). In Poland, kudzu currently occurs only under cultivation and has a status of a non-invasive alien species. In the future, a risk of the spread of the species in Poland is possible, though rather low. Its ability to a self-propelled spread is small, and inadequate climatic conditions (mainly too low temperatures in winter) prevailing in the area of our country, are a big limitation for the survival of individuals. The highest risk of the spread of kudzu in Poland is related to the desire of gardeners-collectors to possess it in their garden as an attractive, decorative ornamental plant and an appreciated medicinal plant. In such a situation, there may be a hazard of kudzu to escape from the cultivation and occur in unsettled habitats, which in case of its establishment

would cause negative and irreversible effects in the natural environment. The public awareness of the risk created by this plant should be increased, which combined with a ban on its import, trade, storage and cultivation will limit a possibility of its invasion.

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