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. Andrzej Purcel – external expert
2. Teresa Nowak
3. Władysław Danielewicz

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr inż.	Department of Green Areas Management, Institute of Food Sciences and Agrotechnics, The branch of the University of Zielona Góra in Sulechów	25-02-2018
(2)	dr	Faculty of Biology and Environmental Protection, University of Silesia in Katowice	04-05-2018
(3)	dr hab.	Department of Forest Botany, Faculty of Forestry, Poznań University of Life Sciences	13-04-2018

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

Polish name: Dławisz okrągłolistny

Latin name: ***Celastrus orbiculatus*** Thunb.

English name: Asiatic bittersweet

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 according to The Plant List (2013 – B) – a database of taxonomic nomenclature; common Polish name according to the publication on nomenclature for Poland (Mirek et al. 2002 – P). In addition to the names given below, the following English names of the species are used: Japanese bittersweet, Oriental bittersweet (CABI 2018 – B). Cultivars: "Hercules" (with male flowers), "Diana" (with female flowers), and "Hermaphroditus" (with hermaphroditic flowers).

Polish name (synonym I) –	Polish name (synonym II) –
Latin name (synonym I) *Celastrus articulatus*	Latin name (synonym II) *Celastrus orbiculata*
English name (synonym I) Oriental bittersweet	English name (synonym II) Chinese bittersweet

a03. **Area** under assessment:

Poland

acomm03.	Comments: –

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

	native to Poland
	alien, absent from Poland
	alien, present in Poland only in cultivation or captivity
	alien, present in Poland in the environment, not established
X	alien, present in Poland in the environment, established

aconf01.	Answer provided with a	low	medium	high **X**	level of confidence

acomm04.	Comments: Beginnings of the cultivation of Asiatic bittersweet in Poland and in the world are falling to the second-half the 19th century (Rehder 1949, Dolatowski 1997 – P). A species was grown in gardens as a decorative climber from which it spread into the natural environment in certain areas of Poland (Dubiel i in. 1975, Białobok 1993, Danielewicz i Maliński 1995, Purcel 2009 – P, Dławisz w Beskidzie Niskim 2016 – I, Wróbel 2017 – P). Tokarska-Guzik et al. (2012 – P) assigned to this species the "locally established" and recommend excluding it from cultivation in forests. In forest ecosystems surrounding the fortifications of the Międzyrzecz Fortified Area, the Japanese bittersweet is a permanently established species (Purcel 2010, 2011 – P). Moreover, it is grown and cultivated, also in botanical gardens. It is an alien established, and invasive species in the USA (CABI 2018 – B). Secondary range also includes Europe.

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: In the natural environment, the Asiatic bittersweet threatens the local biodiversity, especially in forest and scrub phytocenoses. The Asiatic bittersweet, may cause difficulty in the growth, and even death, of coexisting plants by creating shade and liming availability of

nutrients (Dreyer et al. 1987, Fike and Niering 1999 – P). It is emphasized that it is a particular threat to young trees. The climber has fairly large, up to 10 cm long, wide, inverse egg-shaped leaves (Seneta and Dolatowski 2008 – P), which effectively cut-off light from the plants growing below them. The climber can increase by 1-4 m a year (Asiatic bittersweet "Diana" 2018, Asiatic bittersweet "Hercules" 2018 – I) and "climb" on all possible vertical elements, including trees and shrubs. The presence of the Asiatic bittersweet changes both the abiotic and the biotic conditions of the natural environment (Beringen et al. 2017 – P). The species makes restoration of forests very difficult. Overgrowth of forest cultures by the Asiatic bittersweet may contribute to losses in forest management. It deforms trees, contributes to smaller growth, and causes trees to be less resistant to mechanical damage (Dreyer et al. 1987, Ichihashi and Tateno 2011 – P). *Celastrus orbiculatus* can be the host of the *Xylella fastigiosa* bacterium (EPPO Global Database 2018 – B) which causes a disease of grapevines and many other wild plants (e.g. goosefoot *Chenopodium album* and cultivated plants, such as e.g. olive *Olea europea*, ansu apricot *Prunus armeniaca*). The bacterium is included in the EPPO A2 list (EPPO Global Database 2018 – B). Uncontrolled growth of the Asiatic bittersweet within building structures, transport infrastructure, and overhead lines (e.g. power lines) can cause their damage and involve the need to fight the plant, which leads to significant costs.

A1 | Introduction

Questions from this module assess the risk for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation. This leads to *introduction*, defined as the entry of *the organism* to within the limits of *the area* and subsequently into the wild.

a06. The probability for ***the species*** to expand into Poland's natural environments, **as a result of self-propelled expansion** after its earlier introduction outside of the Polish territory is:

	low
	medium
X	high

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

acomm06. Comments:

Celastrus orbiculatus spreads vegetatively and grows 1 m to 4 m per year. Moreover, generative diasporas also play a role in the introduction of the species. Seeds can be carried by birds (Dreyer 1987 – P) and small mammals. The species is present and is locally established in Poland. In such a case, the criteria adopted in the Procedure for risk assessment of negative impact of invasive and potentially invasive alien species in Poland – *Harmonia*$^{+PL}$ indicate that the following answer should be selected: high likelihood, with high level of confidence. However, due to its presence also in the neighboring countries, e.g. Czech Republic and Germany, it is likely to be "dragged in", e.g. via animals (among others birds).

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

	low
	medium
X	high

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

acomm07.	Comments: The likelihood of introduction as a result of unintentional actions of people has been determined to be high. Parts of roots and seeds may be carried with the soil, e.g. in connection with construction projects. Diasporas may be spread by means of transport during forestry works, such as e.g. logging.

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

	low
	medium
X	high

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

acomm08.	Comments: The species and its varieties in the entire Poland are often offered in plant nurseries. It is a climber used in arranged green areas from which it may escape into new sites (Purcel 2014 – P). The Asiatic bittersweet is kept in collections and botanic gardens in Poland. It has been in 22 from 42 surveyed sites; five of them reported spontaneous spread of the species (Employees of botanical garden... 2018 – N). It is offered both at gardening supply stores and by online stores (Związek Szkółkarzy Polskich 2018 – I). The species may spread spontaneously ("escape") from the sites where it is cultivated.

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: The species is present in the moderate climate zone. It is frost-resistant (Związek Szkółkarzy Polskich 2018 – I). In Poland, in a majority of its territory, with the exception of mountainous areas, the conditions are suitable for its growth. According to the map of climate similarity to the rest of the world, the values of climate similarity are in the range of 94-100% (D'Hondt et al. 2014 – P). However, this does not apply to the entire natural range of the Asiatic bittersweet.

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 Asiatic bittersweet prefers fertile, moist soils with neutral pH and diverse structure (CABI 2018 – B). On the other hand, it poorly tolerates wetland soils or soils that are periodically inundated (Sinclair et al. 1987 – P). It occupies habitats of diverse fertility, moisture, and lighting levels (Purcel 2010, 2011 – P). In the forest classification, the following habitats are most optimum for the species: Lśw (fresh forest) and LMś (fresh mixed forest) (based on a valuation description of tree stands in the Świebodzin and Międzyrzecz Forest District in which it is established (Biuro Urządzania Lasu i Geodezji Leśnej 2018 – B). The species has a fairly wide habitat spectrum in its secondary range. It can be present in forests, scrubs, in farmland areas, along roads, and in scrubs along water courses. It tolerates various levels of lighting (e.g. Purcel 2010, Steward et al. 2003 – P). Conditions in Poland are optimal for the species.

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
X	medium
	high
	very high

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

acomm11.	Comments:

Approximation (type C data).
On account of relatively small number of localities in the natural environment of Poland, a substantial amount of information about probable source/places exists, where from the species is spreading, than about the pace of the proliferation of the species. It is known that if the species spreads without human involvement, one can consider the value of the growth and the distance by which the seeds spread. Of note is the role of birds in their dispersion. In the Międzyrzecz Fortified Area, the most remote sites of the Asiatic bittersweet are now located 5 km away from the original cultivation sites, i.e. the fortifications, which were built in the years 1934 – 1938. The years when the bunkers were built are most likely the period in which the Asiatic bittersweet was planted as a plant that would mask the fortified shelters (Purcel 2011 – P). However, the speed of the spread depends, among other things, on the simultaneous presence of male and female individuals at specific sites. Therefore, the ability of the species to spread without the involvement of humans must be estimated as medium.

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 **X**	high	level of confidence

acomm12.	Comments: The species and its varieties in the entire Poland are often offered in gardening supply centers and decorative plant nurseries, including online (e.g. Związek Szkółkarzy Polskich 2018 – I). The Asiatic bittersweet is a climber used in arranged green areas from which it can escape to new sites (Purcel 2014 – P), and is also kept in collections of botanic gardens and arboretums (cf. commentary to question a08). Seeds and parts of shoots and roots can be spread during forestry works (e.g. logging and transport). The data obtained from botanical gardens indicates that the Asiatic bittersweet is currently cultivated in at least 22 collections of botanical gardens and arboretums, with a total of approx. 130 specimens. The oldest plants in the aforementioned collections were grown in 1949 (Botanical Garden of the A. Mickiewicz University in Poznań). Spontaneous occurrence of seedlings was observed, to a greater or lesser extent, in the Botanical Garden of the Wrocław University, the Botanic Garden at the Forest Experimental Institute in Rogów, the Botanical Garden of the Polish Academy of Sciences – Center for Preservation of Biodiversity, at the Forest Arboretum in Zielonka, and the Botanic Garden of the Maria Skłodowska-Curie University in Lublin. In four of the above-mentioned collections, preventive actions have been taken to limit the spread of the species, which consisted mainly in elimination of seedlings (Index Plantarum 2013 – B, Index Plantarum UMCS 2010 – B, Employees of botanical gardens... 2018 – N). If a species is present in ruderal (disturbed) habitats, such as roadsides, parts of roots or seeds can be carried to other locations with the soil (Nowak 2015 – A). However, there is no data available on the distance over which the species spreads from its original site.

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.	Comments: A non-parasitic plant species.

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

	low
	medium
X	high

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

acomm14. Comments:

Assuming that the species still will be spread in Poland, one should point to the very great threat to many species of the special concern growing in broadleaved forest habitats (widely spread in our country). The potential threat and significant decreases of the number can concern such species of the special concern like e.g.: Wild Service-tree (*Sorbus torminalis*), Martagon Lily (*Lilium martagon*), sedge (*Carex umbrosa*), Broad-leaved Helleborine (*Epipactis helleborine*), Mezereon (*Daphne mezereum*), Alpine Squill (*Scilla bifolia*).

The Asiatic bittersweet, may cause difficulty in the growth, and even death, of coexisting plants by creating shade and limiting availability of nutrients (Dreyer et al. 1987, Fike and Niering 1999 – P). It is emphasized that it is a particular threat to young trees. The climber can increase by 1-4 m a year (Asiatic bittersweet "Diana" 2018, Asiatic bittersweet "Hercules" 2018 – I) and "climb" on all possible vertical elements, including trees and shrubs.

In forest undergrowth, if often forms a thick cover and blocks natural restoration of plants. Due to the fast growth of its biomass, its clear domination in phytocenoses is guaranteed and it prevent spontaneous regeneration of forest phytocenoses. The climber has fairly large, up to 10 cm long, wide, inverse egg-shaped leaves (Seneta and Dolatowski 2008 – P), which effectively cut-off light from the plants growing below them. Also, by entwining tree tops it restricts photosynthesis and causes gradual death of such plants. The trees and shrubs on which it climbs often become deformed and are more susceptible to damage (Purcel 2010, 2011, 2014 – P). However, no research has been performed in Poland that would indicate examples of a reduction of the population of specific native species, especially special care species.

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. Comments:

The species does not interbreed with native species. Our flora does not contain other representatives of the *Celastrus* genus and the native species from the Celastraceae family do not form inter-genus hybrids. No data on this subject was identified (likelihood = low, consequence = low).

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

	very low
	low
X	medium
	high
	very high

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

acomm16. Comments:

The Asiatic bittersweet is sometimes the host of the *Xylella fastigiosa* bacterium (Fryer 2011, EPPO Global Database 2018 – B) which causes a disease of grapevines and many other wild plants (e.g. goosefoot *Chenopodium album*) and cultivated plants (e.g. olive *Olea*

europea and ansu apricot *Prunus armeniaca*). The bacterium is included in the EPPO A2 list (EPPO Global Database 2018 – B). Intensive international exchange of plant material and the warming of the climate produces the risk of transfer of infected plants or pathogen vectors to Poland. Consequently, the aforementioned pathogen can potentially cause diseases of plants from such genuses as hackberry *Padus*, berry *Vaccinium*, maple *Acer*, oak *Quercus*, and elm *Ulmus* (Kołodziejska 2017). Currently, this bacterium was identified in some countries of the European Union; consequently, the European Commission has implemented appropriate phytosanitary measures to prevent its introduction and further spread. The Commission Implementing Decision (EU) 2015/789 of 18 May 2015 as regards measures to prevent the introduction into and the spread within the Union of *Xylella fastidiosa* (Wells et al.), amended by the Decision 2015/2417 of 17 December 2015, provides for the duty to issue plant passports to host plants. *Celastrus orbiculatus* is included in the list of plants (Annex 1 to the aforementioned Implementing Decision) that are considered to be susceptible to European and extra-European isolates of a specific organism (European Commission 2015 – I).

In its natural range, a fungus species typical for the climber – *Marssonia celastri* – was identified, whose presence is manifested by spots on leaves (Shin and Lee 1999 – P).

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

	low
	medium
X	high

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

acomm17. Comments:

The species can completely rebuild the ecosystem and causes changes that are hard to reverse and concern, most of all, the processes taking place in oak-hornbeam habitats. It causes destruction of plants in all layers of the tree stand, which may result in, among other things, changes in the soil profile. Invasion of the Asiatic bittersweet contributes to shading of the habitat, changes in availability and circulation of nutrients, and level of decomposition of dead biomass (Beringen et al 2017 – P). The species probably increases mineralization of nitrogen and decomposition of the forest litter. It causes eutrophication of the soil and an increase of the pH and the index of mineralization of nitrogen (Leicht-Young et al 2015 – P). There is also data concerning the probability of alleopathic impact (harmful or beneficial impact of the chemical substances excreted by the plant to the ground) on coexisting elements of the flora (Pisula and Meiners 2010 – P). However, they require further studies in natural environment conditions. If the Asiatic bittersweet lives in a mycorrhiza or has a sufficient quantity of phosphorus available, its aboveground parts grow intensively and strengthen the competitive impact of the species with regard to the access of light. The possibility of effective invasion of the Asiatic bittersweet can be associated with mycorrhizal fungi that help the plant acquire phosphorus (Lett et al. 2011).

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 **X**	high	level of confidence

acomm18. Comments:

In the case of massive presence, the Asiatic bittersweet causes extreme reduction of biodiversity in forest ecosystems and changes that are hard to reverse in the processes taking place in oak-hornbeam habitats. The species forces out other species from attacked phytocoenosis (including special care species), thus contributing to a modification of the

ecosystem (Purcel 2010 – P). Significant restructuring of the vegetation results in changes in zoocoenosis, e.g. due to unavailability of the food base or changes in ability of animals to find shelter. When the shoots are dense, one can expect that the species present in lower parts of the phytocoenosis will be eliminated, especially photophilic species. It also contributes to hindered growth of trees – they are smaller and less thick (Ichihashi and Tateno 2011 – P). The seeds of the Asiatic bittersweet germinate regardless of the light conditions, the stability of the ground, and the thickness of the forest litter in forests (Ellswort et al. 2004, 2004a – P). This indicates great danger, especially to rare species and to natural and semi-natural habitats.

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. Comments:

The species is a plant and does not have parasitic properties.

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

	inapplicable
	very low
	low
	medium
	high
X	very high

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

acomm20. Comments:

The Asiatic bittersweet has the biggest impact on forest cultures. Probability of competition in forest plantations – it is expected that in extreme cases the impact will concern more than 2/3rds of plantations of the plants that are the object of the invasion (Purcel 2017 – A) (likelihood = high). Invasion of the Asiatic bittersweet can cause a particular threat to young trees. Given its likely growth rate of 1 to 4 m per year (e.g. Związek Szkółkarzy Polskich 2018 – I), the forest species lose the competition (consequence = high).

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. Comments:

Creation of hybrids may be of little importance in the case of decorative plants. The species can form hybrids with a related species – the American bittersweet *Celastrus scandens*, introduced also in Poland for decorative purposes, although very rarely (Seneta and Dolatowski 2008 – P). This capacity to form hybrids is demonstrated in particular in North America (Leicht and Silander 2006, Zaya at al. 2015 – P) from which *C. scandens* originates and where *C. orbiculatus* has its secondary range. The possibility of occurrence of such hybrids is also reported by Seneta (1994 – P) (likelihood = low, consequence = low).

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

	very low
	low
	medium
	high
X	very high

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

acomm22. Comments:

In the case of invasive presence of the Asiatic bittersweet, forest plantations may survive only thanks to consistent plant care procedures; consequently, the impact on this type of plantation is very big (the impact affects over 2/3rds of the plantations that are subject to invasion) (likelihood = high). The Asiatic bittersweet is a species that quickly colonizes habitats in forests, which puts a stop to regeneration and ecological succession as a result of domination of that species and the impossibility to reconstruct the forest (Dreyer 1994, Greenberg et al 2001, Ellsworth et al 2004, Leicht-Young et al 2007 – P, Fryer 2011 – B, Purcel 2011 – P) (consequences = high).

An invasion of the *Celastrus orbiculatus* can cause a disturbance to forest plantations and renovation of forests. Even though the soil seed bank of the species is characterized by short duration, most often one year, seeds can germinate regardless of the light conditions (Ellsworth et al 2004, 2004a – P). After 3 years, the germination capacity of seeds is very low (Van Clef and Stiles 2001 – P).).

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 **X**	high	level of confidence

acomm23. Comments:

The Asian bittersweet can become the host of the *Xylella fastigiosa* bacterium, which is responsible for the Pierce disease in grapevines (*Vitis*) and many other wild and cultivated (including decorative) plants, e.g. goosefoot (*Chenopodium album*), olive (*Olea europea*),

wallnut (Juglans), magnolia (*Magnolia*), peach (*Prunus persica*), cherry laurel (*Prunus laurocerasus*), ansu apricot (*Prunus armeniaca*), cherry (*Prunus cerasus*), plum (*Prunus domestica*), almond (*Prunus dulcis*), heath (*Vaccinium*), maple (*Acer*), oak (*Quercus*), elm (*Ulmus*), mulberry (*Morus*), and oleander (*Nerium oleander*) (Fryer 2011, EPPO Global Database 2018 – B, Kołodziejska 2017 – P). The bacterium is included in the EPPO A2 list, but it has not been identified in Poland (EPPO Global Database 2018 – B). Intensive international exchange of plant material and warming of the climate lead to the hazard of transfer of infected plants or pathogen vectors to Poland, which may have a great impact on the fast growing Polish wine making industry (especially in the Lubuskie Province). So far, the bacterium was found in some European Union countries; consequently, the European Commission has implemented phytosanitary measures aimed to prevent its introduction and spread. The Commission Implementing Decision 2015/2417 of 18 May 2015 as regards measures to prevent the introduction into and the spread within the Union of *Xylella fastidiosa* (Wells et al.), amended by the Decision 2015/2417 of 17 December 2015, provides for the duty to issue plant passports to host plants. *Celastrus orbiculatus* is included in the list of plants (Annex 1 to the aforementioned Implementing Decision) that are considered to be susceptible to European and extra-European isolates of a specific organism (European Commission 2015 – I). In its natural range, a fungus species typical for the climber – *Marssonia celastri* – was identified, whose presence is manifested by spots on leaves (Shin and Lee 1999 – 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. Comments:

The plant species does not influence trees as a result of predation or parasitism.

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

X	very low
	low
	medium
	high
	very high

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

acomm25. Comments:

No proof of impact of the species on animals during direct contact has been found so far. The leaves may turn out to be poisonous, among others to horses (Seneta 1994 – 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. Comments:

A plant species; it is not a host and does not harbor pathogen or parasites that are harmful to animals.

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 species is not a parasite.

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 **X**	high	level of confidence

acomm28. Comments:

The species does not constitute a hazard to people during direct contact. However, it is reported that the plant is poisonous to people (Seneta and Dolatowski 2008 – P). However, there is no information available about the consequences of eating the fruits.

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. Comments:

No information about the species harboring of pathogens and parasites that are harmful to people.

A4e | Impact on other domains

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

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

	very low
	low
X	medium
	high
	very high

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

acomm30. Comments:

Uncontrolled growth within building structures, transport infrastructure, and overhead lines (e.g. power lines) can result in the need to fight the Asiatic bittersweet, which leads to significant costs. In the Międzyrzecz Fortified Area, a number of impassable forest roads were observed, which were due to fallen trees overgrown by the Asiatic bittersweet. The shoots of the Asiatic bittersweet that entwine a tree or several trees all the way to their tops hinder the works performed as a part of forest management and cause a great threat to the safety of people and property using for cutting and transport of trees (Purcel 2017 – A). In 2017, over ten such events were observed (Purcel 2017 – N) (probability = medium, effect = medium).

A5a | Impact on ecosystem services

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

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

X	significantly negative
	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments: The very negative impact on supply services is due mostly to the increasing losses caused by the Asiatic bittersweet in production forests. This is manifested in big limitations to harvesting of wood and increased costs of plant care procedures in tree stands (see items a20 and a22). It is also more difficult to establish new forest stands (due to higher costs of removal of the Asiatic bittersweet). The economic suitability of wood is decreased due to the fact that the Asiatic bittersweet deforms trees, contributes to smaller growth, and causes trees to be less resistant to mechanical damage (Dreyer et al. 1987, Ichihashi and Tateno 2011 – P). The species is a host of the bacterium *Xylella fastidiosa* which is responsible, among other things, for the Pierce disease of grapevines, fruit trees, and other food-producing species (Kołodziejska 2017 – P, see item a23). At the same time, the Asiatic bittersweet has a positive impact on the analyzed type of ecosystem services. The species is known as a medicinal plant. Studies are conducted, especially on the anti-cancer properties of the species (Li et al. 2014, Wang et al. 2012, Zhu et al. 2015 – P). It is also used in the case of poisoning and infectious diseases, and even snake bites. In the Międzyrzecz Fortified Area, which is the largest site of the Asiatic bittersweet in Poland and where it is present on a massive scale and is not desirable, the impact of this species on supply services is clearly very negative, especially that this plant is not acquired for medicinal purposes. No detailed data is available about the impact of the species on the provision of food. However, given the habitats where the species is present, one can expect negative impact on obtaining food from wild plants, such as blackberry.

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm32.	Comments: Positive impact – may concern use of this species in managed green areas as e.g. a species grown in degraded areas (e.g. in cities) or one that has a positive impact on the quality of air (Bugała 2000, Purcel 2014, Czekalski 2016 – P). However, there are broad possibilities of use of other "substitute" plant species. Negative impact – among others impact on forest ecosystems (cf. comment in question a31). In North America it was once planted to prevent erosion of river banks, which reduced the risk of floods (Dreyer et al. 1987, Steward et al. 2003 – P).

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33.	Comments: The Asiatic bittersweet is a decorative climber among others due to its fruits and the color of its leaves in the autumn (Bugała 2000, Purcel 2014, Czekalski 2016 – P). It is recommended to be used in hedges (effective separation and attenuation of noise), to plant on ugly structures, fences, etc., both planted by amateurs and in managed urban green

areas. Its fruits may also be used in dry compositions (Dławisz (Celastrus) 2018, Związek Szkółkarzy Polskich 2018 – I). From this point of view, the species affects the aesthetic experiences of people). However, the appearance of the plant in the winter is no longer so attractive. There are fairly broad possibilities of use of other "substitute" plant species.

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 **X**	high	level of confidence

acomm34. Comments:

The species is already present outside of cultivated areas in Poland's natural environment. The size of the secondary range and the invasive nature of the species observed at other geographic latitudes (among others in North America, Panama, and New Zealand) may indicate significant abilities to overcome successive barriers related to cultivation (Invasive Species Specialist Group (ISSG) 2018 – B).

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 **X**	high	level of confidence

acomm35. Comments:

The species is already established in Poland's natural environment, both in the lowland parts (e.g. Purcel 2010 – P) and in lower mountain and foothill locations (Nobis 2007 – P, Dławisz w Beskidzie Niskim 2016 – I, Wróbel 2017 – P). The size of the original and secondary range and the invasive nature of the species may indicate significant abilities to overcome successive barriers related to establishment in ecosystem of various degrees of natural character (Invasive Species Specialist Group (ISSG) 2018 – B).

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 **X**	medium	high	level of confidence

acomm36. Comments:

Studies based on models that use different parameters do not clearly determine how the behavior of alien and invasive plants can change in a specific area. The process of spreading of a species of a certain biology depends on many factors, not just an increase of temperature. On the other hand, it is hard to foresee the scenario caused by an increase of temperature: What other factors will change and in what direction. Consequently, any forecasts should be approached with caution and further observations should be conducted (Dukes et al. 2009, Beringen et al. 2017 – P, Merow et al. 2017 – I). In the case of this evaluation, a more pessimistic scenario was assumed: the temperature increase can slightly facilitate the spread of the species. This can be particularly visible in mountainous areas where the lower temperatures that have prevailed so far prevented spread of the climber, which is also emphasized in the analyses that have been performed (Grace et al. 2002 – 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
	not change
X	increase moderately
	increase significantly

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

acomm37. Comments:

If we assume that there will be more sites of the Asiatic bittersweet in the natural environment, then the general impact on the natural environment will be greater. Numerous publications and reports about the invasive nature of the Asiatic bittersweet in other parts of the world (as mentioned in previous sections) with different climates may indicate a certain likelihood of an increase in its impact on wild plants and animals and on habitats and ecosystems in Poland. However, the consequences of such phenomena as e.g. warming of the climate in specific regions of Poland are hard to predict.

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.	Comments:

The species is a host of the bacterium *Xylella fastidiosa* which is responsible, among other things, for the Pierce disease of grapevines, fruit trees, and other food-producing species. This bacterium is currently spreading in warmer climates (Kołodziejska 2017 – P, see sec. a23).

Consequently, in sec. a36 and a37 it was assumed that if the number of sites increases, more forest stands will be threatened. It is possible that the habitat spectrum will become enlarged to include unused grassland, which the Asiatic bittersweet readily colonizes in the USA (Fike and Niering 1999 – P).

a39. IMPACT ON THE DOMESTICATED ANIMALS DOMAIN – Due to climate change, the consequences of *the species* on domesticated animals and animal production in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm39.	Comments:

So far, the impact of the Asiatic bittersweet on animal breeding has not been demonstrated (cf. sec. a24 – a26); consequently, the climate change will not be of any significance in this case.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm40.	Comments:

No impact of the species on people during direct contact (cf. sec. a27 – a29).

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41.	Comments:

There is no accurate data in this regard (cf. sec. a30). One must suspect that the impact on "other objects" will not change.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.75	0.50
Environmental impact (questions: a13-a18)	0.60	0.50
Cultivated plants impact (questions: a19-a23)	0.50	0.70
Domesticated animals impact (questions: a24-a26)	0.00	0.50
Human impact (questions: a27-a29)	0.00	0.50
Other impact (questions: a30)	0.50	0.50
Invasion (questions: a06-a12)	0.92	0.83
Impact (questions: a13-a30)	0.60	0.54
Overall risk score	0.55	
Category of invasiveness	moderately 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 regularly repeated.

acomm42. Comments:

The result makes it possible to classify the species in the group of “moderately invasive alien species” (the negative impact has reached the value of 0.60). The highest grade, equal to 1, was achieved by the Asiatic bittersweet in the following modules: “Introduction” (questions a06-a08) and “Establishment” (questions a09-a10). A medium value was achieved in the module “Impact on the natural environment” (questions a13-a18) and was equal to 0.6. On the other hand, in the “Spread” module (questions a11-a12), the species achieved a relatively high grade of 0.75. At the same time, no impact was observed (the grade was zero) in the modules “Impact on animal breeding” (questions a24-a26) and “Impact on people” (questions a27-a29). A fairly high impact was demonstrated in the modules “Impact on plant growing” (questions a19-a23) (grade 0.50) and “Impact on other objects.” The “total grade” is 0.55. A majority of the grades were given with a medium and high level of certainty. An analysis of the collected materials indicates that the spread of the Asiatic bittersweet in Poland is becoming more intensive. There are several dispersion points that have been documented; the fact that raises concern is that they are located in various parts of the country (Nobis 2007, Purcel 2011 – P, Dławisz w Beskidzie Niskim 2016 – I, Wróbel 2017 – P). The characteristics of the species that are associated with its biology lead to the suspicion that the effectiveness of its spread is very high. Also, it has developed physiological mechanisms that enable it to effectively compete in phytocenoses. Moreover, the scale of influx of new plants from the gardening sector, as a result of intentional introduction by people, remains high. It appears that measures aimed to suppress the species may still be successful. What is particularly important is consistent fight with the Asian bittersweet in protected areas. A very difficult situation and a big challenge in the reduction of quantity of this species is present at its largest site in Poland – the surroundings of the fortifications of the

Międzyrzecz Fortified Area (Lubuskie Province) where forest management in the areas where the species is present is difficult. In order to address the advertised usefulness of the climber in various types of utility plantings (insulation, sound attenuation, etc.), planting of only the male variety may be recommended, instead of total elimination of the plant from gardening supply stores.

Data sources

1. Published results of scientific research (P)

Beringen R, van Duinen GA, de Hoop L, de Hullu PC, Matthews J, Odé B, van Valkenburg JLCH. van der Velde G, Leuven RSEW. 2017. Risk assessment of the alien Staff-vine (*Celastrus orbiculatus*). Reports Environmental Science 523. Department of Environmental Science. The Netherlands Faculty of Science, Institute for Water and Wetland Research, Radboud University

Białobok S. 1993. Dławisz na starych cmentarzach w okolicy Gorlic. Rocz. Dendrol. 41: 141-142

Bugała W. 2000. Drzewa i krzewy. PWRiL, Warszawa.

Czekalski M. 2016. Liściaste krzewy ozdobne. 2: 1-200. PWRiL, Warszawa.

D'hondt B, Vanderhoeven S, Roelandt S, Mayer F, Versteirt V, Ducheyne E, San Martin G, Grégoire JC, Stiers I, Quoilin S, Branquart E. 2014. Harmonia^{+} and Pandora^{+}: risk screening tools for potentially invasive organisms. Belgian Biodiversity Platform. 1-63 (file:///C:/Users/pc1/Downloads/harmoniaplusform.pdf) Date of access: 2018-03-06

Danielewicz W, Maliński T. 1995, Materiały do znajomości dendroflory Wielkopolskiego Parku Narodowego. Morena 3: 7-27

Dolatowski J. 1997, Kolekcje dendrologiczne Augusta Denizota. Rocz. Dendrol. 45: 97-111

Dreyer GD. 1994, *Celastrus orbiculatus* Asiatic Bittersweet: Element stewardship abstract. In: iMap Invasives Project. The Nature Conservancy (https://www.invasive.org/weedcd/pdfs/tncweeds/celaorb.pdf) Date of access: 2018-02-25

Dreyer GD, Baird LM, Fickler C. 1987. *Celastrus scandens* and *Celastrus orbiculatus*: comparisons of reproductive potential between a native and an introduced woody vine. Bulletin of the Torrey Botanical Club 114: 260-264.

Dubiel E, Loster S, Zając EU, Zając A. 1975. Notatki florystyczne z Beskidu Niskiego i Dołów Jasielsko-Sanockich. Fragm. Flor. Geobot. 21: 459-461

Dukes JS, Pontius J, Orwig D, Garnas JR, Rodgers VL, Brazee N, Cooke B, Theoharides KA. 2009. Responses of insect pests, pathogens, and invasive plant species to climate change in the forests of northeastern North America: What can we predict? Canadian Journal of Forest Research 39(2): 231-248 (https://doi.org/10.1139/X08-171) Date of access: 2018-05-04

Ellsworth JW, Harrington RA, Fownes JH. 2004. Survival, growth and gas exchange of *Celastrus orbiculatus* seedlings in sun and shade. The American Midland Naturalist 151: 233-240

Ellsworth JW, Harrington RA, Fownes JH. 2004a Seedling emergence, growth, and allocation of Oriental bittersweet: effects of seed input, seed bank, and forest floor litter. Forest Ecology and Management 190: 255-264

Fike J, Niering WA. 1999. Four decades of old field vegetation development and the role of *Celastrus orbiculatus* in the northeastern United States. Journal of Vegetation Science 10: 483-492

Grace J, Berninger F, Nagy L. 2002. Impacts of climate change on the tree line. Annals of Botany 90(4): 537-544

Greenberg C. H., Smith L. M., Levey D. J. 2001. Fruit fate, seed germination and growth of an invasive vine – an experimental test of 'sit and wait' strategy. Biological Invasions 3: 363-372

Ichihashi R, Tateno M. 2011. Strategies to balance between light acquisition and the risk of falls of four temperate liana species: to overtop host canopies or not? Journal of Ecology 99(4): 1071-1080

Kołodziejska A. 2017. *Xylella fastidiosa* nowe zagrożenie dla Europy. Informator Sadowniczy. 30 Plantpress Sp. z o.o. (http://sadinfo.pl/download/informator_sadowniczy_2017/IS-04-2017.pdf) Date of access: 2018-03-06

Krüssmann G. 1976. Handbuch der Laubgehölze. 1. Verlag Paul Parey.

Leicht S. A., Silander J. A. 2006. Differential responses of invasive *Celastrus orbiculatus* (Celastraceae) and native *C. scandens* to changes in light quality. American Journal of Botany 93: 972-977

Leicht-Young SA, Silander JA, Latimer AM. 2007. Comparative performance of invasive and native *Celastrus* species across environmental gradients. Oecologia 154: 273-282

Leicht-Young SA, Bois ST, Silander JA. 2015. Impacts of *Celastrus*-primed soil on common native and invasive woodland species. Plant Ecology 216(4): 503-516

Lett CN, DeWald LE, Horton J. 2011. Mycorrhizae and soil phosphorus affect growth of *Celastrus orbiculatus*. Biological Invasions 13:2339. (https://link.springer.com/article/10.1007/s10530-011-0046-3) Date of access: 2018-05-04

Li G, Liu D, Guo S, Sunagawa M, Hisamitsu T, Liu Y. 2014. Anti-invasive effects of *Celastrus Orbiculatus* extract on interleukin-1 beta and tumour necrosis factor-alpha combination-stimulated fibroblast-like synoviocytes. BMC Complementary and Alternative Medicine. 14:62. (http://www.biomedcentral.com/1472-6882/14/62) Date of access: 2018-05-04

Mirek Z., Piękoś-Mirkowa H., Zając A., Zając M. 2002. Flowering plants and pteridophytes of Poland. A checklist. Biodiversity of Poland. 1: 1-442 Inst. of Botany PAN

Nobis M. 2007. Rośliny naczyniowe zachodniej części Przedgórza Iłżeckiego (Wyżyna Małopolska). Prace Botaniczne 1-458

Pisula NL, Meiners SJ. 2010. Relative allelopathic potential of invasive plant species in a young disturbed woodland Journal of the Torrey Botanical Society 137(1): 81-87

Purcel A. 2009 Obce gatunki drzew i krzewów w Wielkopolskim Parku Narodowego – ich występowanie i rola w biocenozach Parku. Morena 14: 35-191

Purcel A. 2010. Ekspansja dławisza okrągłolistnego (*Celastrus orbiculatus* Thunb.) na centralnym odcinku Międzyrzeckiego Rejonu Umocnionego. Przegląd Przyrodniczy. 21(3): 3-14

Purcel A. 2011 Możliwości rozprzestrzeniania się dławisza okrągłolistnego (*Celastrus orbiculatus* Thunb.) z centralnego odcinka Międzyrzeckiego Rejonu Umocnionego. Przegląd Przyrodniczy 22(1): 10-16

Purcel A. 2014. Dławisz okrągłolistny (*Celastrus orbiculatus* Thunb.) – cenny gatunek w terenach zieleni miejskiej, czy raczej uciążliwy chwast? Zeszyty Naukowe Instytutu Zarządzania i Inżynierii Rolnej PWSZ w Sulechowie 1(1): 53-62 Wyd. PWSZ w Sulechowie.

Rehder A. 1949. Manual of cultivated trees and shrubs. MacMillian.

Seneta W. 1994. Drzewa i krzewy liściaste 2. PWN, Warszawa.

Seneta W, Dolatowski J. 2008. Dendrologia. Wydawnictwo Naukowe PWN., Warszawa.

Shin HD, Lee HT. 1999. A new species of *Marssonina* on *Celastrus orbiculatus*. Mycotaxon 72: 199-203

Sinclair W, Lyon H, Johnson W. 1987. Diseases of Trees and Shrubs. Ithaca, NY, USA: Cornell University Press.

Steward A. M., Clemants S. E., Moore G. 2003. The concurrent decline of the native *Celastrus scandens* and spread of the non-native *Celastrus orbiculatus* in the New York City metropolitan area. Journal of the Torrey Botanical Society. 130(2): 143-146

Tokarska-Guzik B, Dajdok Z, Zając M, Zając A, Urbisz A, Danielewicz W, Hołdyński C. 2012 Rośliny obcego pochodzenia w Polsce ze szczególnym uwzględnieniem gatunków inwazyjnych. GDOŚ, Warszawa.

Van Clef M, Stiles EW. 2001. Seed longevity in three pairs of native and non-native congeners: assessing invasive potential. Northeastern Naturalist 8(3): 301-310

Wang M, Zhang X, Xiong X, Yang Z, Sun Y, Yang Z, Hoffman RM, Liu Y. 2012 Efficacy of the Chinese Traditional Medicinal Herb *Celastrus orbiculatus* Thunb on Human Hepatocellular Carcinoma in an Orthothopic Fluorescent Nude Mouse Model. Anticancer Research 1213-1220
(https://pdfs.semanticscholar.org/e9ca/a08a549d1dd801bf1a4788be07590bbf8b63.pdf) Date of access: 2018-03-24

Wróbel D. 2017. Występowanie roślin inwazyjnych w obrębie budowli i powierzchni utwardzonych w dolinach rzecznych Karpat i Kotliny sandomierskiej. Czasopismo Inżynierii Lądowej, Środowiska i Architektury 34(64): 197-208 (DOI:10.7862/rb.2017.20)

Zaya DN, Leicht-Young SA, Pavlovic NB, Feldheim KA, Ashley MV. 2015. Genetic characterization of hybridization between native and invasive bittersweet vines (*Celastrus* spp.). Biological Invasions 17(10): 2975-2988

Zhu Y, Liu Y, Qian Y, Dai X, Yang L, Chen J, Guo S, Hisamitsu T. 2015. Antimetastatic Effects of *Celastrus orbiculatus* on Human Gastric Adenocarcinoma by Inhibiting Epithelial-Mesenchymal Transition and NF-?B/Snail Signaling Pathway Yaodong. Integrative Cancer Therapies 14(3): 271-281 (DOI: 10.1177/1534735415572880) Date of access: 2018-05-04

2. Databases (B)

Biuro Urządzania Lasu i Geodezji Leśnej. 2018. Bank Danych o Lasach (https://www.bdl.lasy.gov.pl/portal) Date of access: 2018-03-18

CABI. 2018. *Celastrus orbiculatus* (Asiatic bittersweet). (https://www.cabi.org/isc/datasheet/12009) Date of access: 2018-05-04

EPPO Global Database 2018. *Xylella fastidiosa* (https://gd.eppo.int/taxon/XYLEFA) Date of access: 2018-05-05

Fryer Janet L. 2011. *Celastrus orbiculatus*. In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). (https://www.fs.fed.us /database/feis/plants/vine/celorb/all.html) Date of access: 2018-03-18

Index Plantarum UMCS. 2010. Index Plantarum Ogrodu Botanicznego Uniwersytetu Marii Skłodowskiej-Curie (https://umcs.lublin.pl/images/media/Ogrod.Botaniczny) Date of access: 2010-01-01

Index Plantarum. 2013. INDEX PLANTARUM ARBORETUM W WOJSŁAWICACH (http://arboretumwojslawice.pl/index-plantarum/index-plantarum-drzewa-lisciaste/) Date of access: 2018-02-25

International Union for Conservation of Nature (IUCN), Invasive Species Specialist Group (ISSG). 2018. Global Invasive Species Database. (http://www.iucngisd.org/gisd/speciesname/Celastrus+orbiculatus#) Date of access: 2018-03-24

Invasive Species Specialist Group (ISSG). 2018. International Union for Conservation of Nature (IUCN), Global Invasive Species Database. (http://www.iucngisd.org/gisd/speciesname/Celastrus+orbiculatus#) Data dostępu: 2018-03-24

The Plant List. 2013 Version 1.1. (http://www.theplantlist.org/) Data dostępu: 2018-05-02**3.**

3. Unpublished data (N)

Employees of botanical garden and arboretum in Poland 2018. Survey on the maintenance of invasive plant species of alien origin in cultivation

4. Other (I)

Dławisz (*Celastrus*) 2018. Clematis. Źródło Dobrych Pnączy. (http://www.clematis.com.pl/pl/informacje-o-roslinach/wiecej-informacji/artykuly-o-pnaczach/) Date of access: 2018-05-04

Dławisz okrągłolistny 'Diana' 2018. Szkółki Konieczko – Drzewa Krzewy Owocowe Ozdobne oraz Leśne. (https://www.drzewa.com.pl/3908-dlawisz-okraglolistny-diana-celastrus-orbiculatus-diana-.html) Date of access: 2018-05-04

Dławisz okrągłolistny 'Hercules' 2018. CLEMATIS Źródło Dobrych Pnączy. (http://www.clematis.com.pl/pl/encyklopedia?view=plant&plantid=114) Date of access: 2018-05-04

Dławisz w Beskidzie Niskim 2016. Zielnik Karpacki Agnieszki Michalik. Rośliny naczyniowe. (http://www.zielnik-karpacki.pl/gallery/show/id/351) Date of access: 2018-05-04

European Commission 2015 DECISIONS COMMISSION IMPLEMENTING DECISION (EU) 2015/789 of 18 May 2015 as regards measures to prevent the introduction into and the spread within the Union of Xylella fastidiosa (Wells et al.) (notified under document C(2015) 3415) (http://piorin.gov.pl/zdrowie-roslin/organizmy-szkodliwe/xylella-fastidiosa,2.html) Date of access: 2018-03-06

Merow C, Treanor Bois S, Allend JM, Xiee Y, Silander JA. 2017. Climate change both facilitates and inhibits invasive plant ranges in New England. Proceedings of the National Academy of Sciences of the United States of America. (www.pnas.org/cgi/doi/10.1073/pnas.1609633114) Date of access: 2018-05-04

Związek Szkółkarzy Polskich 2018 E-katalog. *Celastrus orbiculatus*. (https://www.e-katalogroslin.pl/plants/1272,dlawisz-okraglolistny_celastrus-orbiculatus) Date of access: 2018-05-04

5. Author's own data (A)

Nowak T. 2015 Own observations

Purcel A. 2017 Own observations