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. Zygmunt Dajdok
2. Zbigniew Celka
3. Barbara Sudnik-Wójcikowska

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr	Department of Botany, Institute of Environmental Biology, University of Wrocław	17-02-2018
(2)	dr hab.	Department of Plant Taxonomy, Institute of Environmental Biology, Faculty of Biology, Adam Mickiewicz University in Poznań	11-04-2018
(3)	dr hab.	Department of Plant Ecology and Environmental Conservation, Faculty of Biology, University of Warsaw; Biological and Chemical Research Centre, University of Warsaw	04-05-2018

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

Polish name: Rzepień włoski*

Latin name: ***Xanthium albinum*** (Widder) H. Scholz

English name: Riverside Cocklebur

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:

The Latin and Polish names were given as in 'Flowering plants and pteridophytes of Poland checklist.' (Mirek et al. 2002 – P). Selected synonymous names: *X. italicum* Moretti, *X. orientale* subsp. *italicum* (Moretti) Greuter, *X. riparium* Itzigs. & Hertsch, *X. glanduliferum* Greene, *X. macounii* Britt., *X. pennsylvanicum* Wallr., *X. echinatum* Murray, *X. canadense* A. Gray, *X. occidentale* Bert., *X. orientale* L. subsp. *riparium* (Čelak) Greuter, *X. orientale* L. (Kucharski 1992, Greuter 2003 – P, The Plant List 2013 – B). The list of synonyms is unusually long and includes several dozen names (Vinogradova et al. 2010 – P, Kew 2018 – B). In American sources, in *Xanthium* genus, only two species are most commonly reported: *X. spinosum* and *X. strumarium* (USDA-NRCS 2014, e-Floras 2018 – B). The latter can be found in three varieties: var. *canadense*, var. *glabratum* and var. *strumarium*. The species have a total of several dozen (!) synonymous names, some of them shared with *X. albinum* (USDA-NRCS 2014, e-Floras 2018 – B). In some sources *X. albinum*, together with *X. italicum, X. ripicola* and *X. saccharatum*, is a part of the complex *Xanthium orientale* agg. (Medvecka et al. 2012 – P) or is included in the broadly understood *X. strumarium* L. s.l. (Manual 2012 – B). Taxonomic issues associated with *X. albinum* may result from the fact that the species originates from certain American forms and is perhaps a foreign species that emerged in the European part of its range (Tacik 1971, Dostál and Červenka 1983, Sudnik-Wójcikowska 2011, Zając and Zając 2015 – P). Without detailed research, it is not possible to explain this phenomenon.

*NOTE: The authors suggest using name Riverside cocklebur instead of Italian cocklebur, as the first name is more neutral.

Polish name (synonym I)	Polish name (synonym II)
Rzepień brzegowy	–
Latin name (synonym I)	**Latin name (synonym II)**
Xanthium riparium	–
English name (synonym I)	English name (synonym II)
–	–

a03. **Area** under assessment:

Poland

acomm03. Comments:

–

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

	native to Poland
	alien, absent from Poland
	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	level of confidence
		X	

acomm04. Comments:

In Poland, *Xanthium albinum* belongs to the group of established species of foreign origin, invasive neophytes that complete the entire development cycle (Mirek et al. 2002, Tokarska-Guzik 2005, Kącki and Dajdok 2009, Tokarska-Guzik et al. 2012 – P). It has been present in Poland since the mid-19th century. (Kucharski 1993, Tokarska-Guzik 2005 – P). It grows mainly in the valleys of large rivers – Vistula, Bug, San, Warta, Noteć – and the lower part of the Oder River (Borysiak 1994, Ratyńska 2001, Dajdok and Kącki 2003, Kucharczyk 2003, Kucharczyk and Krawczyk 2004, Tokarska-Guzik et al. 2015, Zając and Zając 2001, 2015 – P). It also grows in the Carpathian Foreland and in the Carpathian Foothills in the valley of Wisłoka river (Zając and Zając 2015 – P). It is also present in ruderal habitats – for

instance, it is popular in Warsaw (Sudnik-Wójcikowska 1987 – P) and in Poznań (Jackowiak 1998 – P). It is considered a rare species in Lower Silesia, Pomerania (Gdańsk Pomerania) and Central Pomerania, it is not present in North-Eastern Poland (Zając and Zając 2001 – P). ATPOL database includes 1 138 sites of the species in Poland and lists it at 474 squares of the 10×10 km cartogram (Zając and Zając 2015 – P). The species invades river valleys and could have been cultivated because of its medicinal and practical properties (Kucharski 1992, Kącki and Dajdok 2009 – P). It prefers riversides but also grows on roadsides, wastelands, waste dumps, railway areas and cultivated fields (Kącki and Dajdok 2009, Rutkowski 2011, Sudnik-Wójcikowska 2011 – P).

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

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

acomm05. Comments:

Xanthium albinum is included in the list of foreign species that may pose a risk to the nature of Poland and the European Union (Tokarska-Guzik et al. 2015 – I). Riverside cocklebur is a species found in anthropogenic, semi-natural and natural habitats. It grows mainly in river valleys on wetlands. Its individuals are most numerous in the areas of periodically exposed riverbed banks, where it can be a part of so-called summer annual plant communities of the *Bidentetea tripartiti* class. The patches, in which it reaches a high share, are included in the *Xanthio riparii-Chenopodietum* group, for which it is a characteristic species (Matuszkiewcz 2001 – P). Moreover, it appears in the *Isoëto-Nanojuncetea* class communities, as well as in rushes – e.g. in the reed patches of *Phalaridetum arundinaceae*, and in the flood plain meadows of the alliance *Agropyro-Rumicion crispi* (Kucharczyk and Krawczyk 2004, Kącki and Dajdok 2009 – P). It mainly affects the structure and species composition of plant communities through competition and allelopatic interaction. *Xanthium albinum* ousts natural communities with rare plant species from these areas by forming compact groups in river valleys. A similar pattern is observed in meadows and pastures. Grasslands which are dominated by *Xanthium albinum* are no longer suitable as pastures for domestic and wild animals (Mikołajczak et al. 2008, Nowakowski et al. 2008, Kącki and Dajdok 2009 – P). The young plants of *X. albinum* (with up to 4 leaves) are poisonous, as are the germinating seeds and seedlings. The plant is poisonous to cows, pigs, sheep, horses and hens. Older plants are not poisonous (Mowszowicz 1982 – P, Wikiwand 2018 – B). The plant can also be found in waste yards, roadsides and railway areas (Kącki and Dajdok 2009 – P). Riverside cocklebur also grows as weed in cultivated fields, river valleys in humid habitats and contributes to the attenuation of cultivated plant species (Warcholińska 1974, Mowszowicz 1986, Kącki and Dajdok 2009, Tóth and Sikora 2016 – P). There are Slovak and Hungarian reports of the species entering the field weed communities growing in sugar beet, maize, sunflower and potato crops (Böszörményi and Bagi 2008, Tóth and Sikora 2016 – P). Negative effects of *X. albinum* on human health have also been identified. The glandular trichomes covering the leaves and stems of riverside cocklebur release substances that can cause contact dermatitis in allergic people (Weaver and Lechowicz 1983, Vinogradova et al. 2010 – P). During flowering, pollen of this species can cause allergy in humans (Weaver and Lechowicz 1983, Jaggi and Gangal 1987 – P). The massive occurrence of *X. albinum* on riverside beaches has the potential of lowering their recreational value (Vinogradova et al. 2010 – 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:

	low
	medium
X	high

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

acomm06. Comments:

In Poland, *Xanthium albinum* belongs to the group of established species of foreign origin, invasive neophytes (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). It has become widely spread in Poland – its sites are present on over 400 (out of 3 646) squares of ATPOL grid with a side of 10 km (Zając and Zając 2001 – P). It was described in Europe by Moretti in 1822 after being spotted in the valley of an Italian river. (Kucharski 1992, Tokarska-Guzik 2005 – P). Lohmeyer and Sukopp (1992 – P) date back the first quotations about the plant in Europe to 1830. The earliest reports about its sites in Poland date back also to 1830, from the Noteć Valley (Brandes and Belde 2004 – P) and to 1853 from the Oder river Valley (Fiek 1881, Tokarska-Guzik 2005 – P). Abromeit et al. (1898–1940 – P) states that it probably arrived to the Gdańsk Pomerania area from the south with the current of Vistula river and was noticed already in 1864. There is no information about migration routes to Poland, it is assumed that the plant has migrated via river valleys, and that floods or animals were the causal factor (Zając and Zając 2015 – P). The fruits of the Riverside cocklebur are easily attached to the fur or feathers of animals that have direct contact with this species (zoochory – the use of animals by plants to spread diasporas) (Kącki and Dajdok 2009 – P).

Among the countries bordering with Poland, the species is widespread in Germany (FloraWeb 2013 – B), Slovakia (Medvecká et al. 2012 – P), the Czech Republic (Pyšek et al. 2012 – P), Ukraine (Protopopova et al. 2006 – P), as well as Russia, or at least its central part (Vinogradova et al. 2010 – P).

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:

In Poland, riverside cocklebur is already an established species of foreign origin (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). Because of unintentional human actions, involucres of female inflorescences with two fruits inside each (for *X. albinum* those are achenes – dry, uncracked, single-seed fruit) covered with hooks can be disseminated during travel or transported across Poland with goods from areas where *X. albinum* grows. Accidental transfer cannot be excluded either, e.g. on anglers' clothes. It is likely that boats, barges and ships may spread the fruits of the species. Spreading of fruits may also occur as a result of using fluvial sand for construction purposes, or during its transport in the course of works carried out in flooded areas (e.g. in connection with strengthening/adjustment of river beds), as well as during the transfer of biomass after mowing of areas dominated by this species (Vinogradova et al. 2010 – P). The above examples are classified as anthropochory, i.e. the spread of plant diasporas caused by man.

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:

At present, *Xanthium albinum* is classified in Poland as an established species of foreign origin, an invasive neophyte (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). In accordance to the procedure of risk assessment for the negative impact of invasive and potentially invasive foreign species in Poland (*Harmonia*$^{+PL}$) for species that are already established in Poland, the probability of their introduction into the natural environment of Poland as a result of intended human actions should be assessed as high with a high degree of certainty.

Currently, there is no information about cultivation of this species, but in the 19th and early 20th century it could have been cultivated (Kucharski 1992, Wolski et al. 2006, Kącki and Dajdok 2009 – P) for medicinal and practical purposes (Broda and Mowszowicz 2000, Sarwa 2001, Chrzanowska 2014 – P). In North America, riverside cocklebur is used by some Indian tribes as food (Łuczaj 2004 – P). Riverside cocklebur is not seen as a plant of ornamental or practical value. Therefore, a deliberate release into the environment seems unlikely. However, considering that the species of the genus *Xanthium* are chemically homogeneous (Amin et al. 2016 – P), it can be assumed that the possible reason for introduction into cultivation could be the medicinal properties of the plant, e.g. antibacterial properties of oil made from *X. strumarium* (Sharifi-Rad et al. 2016 – P), colouring properties or significance in phytotherapy (Wolski et al. 2006, Böszörményi and Bagi 2008 – 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
	sub-optimal
X	optimal for establishment of *the species*

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

acomm09. Comments:

In Poland, *Xanthium albinum* is part of a group of established species of foreign origin, invasive neophytes (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). Its origins are difficult to determine and disputable. The southern part of North America is most often indicated (Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P), but it seems very likely that its established form on the European continent derrived from its American forms (Tacik 1971, Dostál and Červenka 1983, Sudnik-Wójcikowska 2011, Zając and Zając 2015 – P). The probable places of origin of the species or its parental forms (e.g. *Xanthium strumarium*) are climatically similar to Poland. Riverside cocklebur begins to sprout at a temperature of approx. 25°C after water has subsided and the habitat has dried (Brandes and Belde 2004, Kącki and Dajdok 2009 – P). *Xanthium albinum* prefers large river valleys with sandy banks and low water levels in summer and autumn (Brandes and Belde 2004 – P). According to the research by Mikołajczak et al. (2008 – P), in the conditions of a long spring or summer flooding in the Ujście Warty National Park, the percentage of germinated seeds of riverside cocklebur was several times lower than during the so-called normal year. Dry and hot

summers (e.g. in 1994 in Germany in the central Elbe region) cause *X. albinum* to dry out due to a lack of water (Belde 1996 – P). The similarity between the climate of Poland and that of some parts of the natural and secondary range of the species is 94–100%, which means that the climatic conditions in Poland are optimal for the examined species. In addition, the fact that this annual plant blooms and bears fruit every year indicates that the climatic conditions in Poland are optimal for this species.

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:

Xanthium albinum is an established foreign species in Poland, an invasive neophyte (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). Probable parental forms (e.g. *Xanthium strumarium*) inhabit the banks of rivers and lakes in North America, where they grow together with *Cyperus* and *Polygonum* species, which are associated with humid or seasonally moist, often alkaline soils and the peripheries of segetal habitats (Kucharski 1992 – P, e-Floras 2018 – B). Within its secondary range, *X. albinum* colonises similar habitat types. It can be found in alluvial areas in large river valleys with fluctuating water levels. It particularly often grows in river valley sections in which natural material accumulation processes occur during the floods. The species inhabits different parts of the flood plains. It can be found both on sandy silts at a greater distance from riverbeds and in their close vicinity, as well as on the outskirts of hollows and ponds exposed during the summertime when the water levels are lower. It also grows in meadow and pasture communities and occupies anthropogenic habitats, i.e. wastelands, waste yards, railway areas, roadsides and cultivated fields (Kucharski 1992, Kącki and Dajdok 2009 – P). Its optimal habitat conditions are found in large river valleys and ruderal habitats of cities (Tokarska-Guzik 2005, Zając and Zając 2015 – P). Additionally, riverside cocklebur reproduces and spreads effectively in Poland, which proves that the habitat conditions 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
	medium
	high
X	very high

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

acomm11. Comments:

The first information on *Xanthium albinum* sites in the Noteć Valley in Poland dates back to 1830 (Brandes and Belde 2004 – P) and in Nowa Sól in the Oder river Valley – to 1853 (Fiek 1881 – P). Nowadays, further new sites are being colonized in Poland, mainly in semi-

natural and natural habitats (Tokarska-Guzik et al. 2012 – P). It grows in many places in Poland, mainly in large river valleys and in big cities (Zając and Zając 2001, 2015 – P). ATPOL database contains 1 138 *X. albinum* sites in Poland and the species is recorded in 474 out of 3 646 units of cartogram in the scale of 10×10 km (Zając and Zając 2015 – P). The majority of sites is populated by large numbers of individuals (Tokarska-Guzik et al. 2012 – P). For example, in the Słońsk nature reserve (which today is a part of the Ujście Warty National Park), *X. albinum* was present in more than half of the designated sites and the number of the individuals was described as very large (Chmiel et al. 2000 – P). In the Ujście Warty National Park, which was formed in 2001, it is a very common species (234 sites) with a large population (Wojciechowska 2009 – N).

Dispersion form a single source (A type data):
The species spreads mainly through zoochory (see a07) – due to the specific structure of the female inflorescence involucres covered with hooked spikes, inside which there are two fruits, and hydrochory – dry stems can be carried by the water with involucres and fruits and spread in spring during flood surges (Vinogradova et al. 2010 – P). In favourable conditions, a single individual of *X. albinum* produces from 1 000 to 10 800 achenes (to the authors of this study this number seems to be overestimated), and in conditions of high population density the number of produced achenes decreases to 140–1 160 (Vinogradova et al. 2010 – P). They may remain on the parental plant until the following year (Vinogradova et al. 2010 – P). *Xanthium* fruits can float on the water surface for up to 30 days (Böszörményi and Bagi 2008 – P), so it should be assumed that the potential range of fruit dissemination with river currents may exceed 50 km. Therefore, the species is included in the group of plants whose dispersion from a single source (A) is very high. At the same time, floods and pioneering conditions are a factor in the success of *Xanthium albinum* in floodplains, according to Brandes and Belde (2004 – P) in such areas, the achenes of the riverside cocklebur germinate immediately after the water subsides.

Population expansion data (B type data) and estimation of biological mobility of the species (C type data): based on the biological and ecological characteristics of the species, a very high dispersion should be assumed for both data types. In Poland, the number of sites has been rising since the mid-19th century, and reached over 1 100 at the beginning of the 21st century (Brandes and Belde 2004 – P, Fiek 1881 – P, Zając and Zając 2015 – 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. Comments:

Nowadays, *Xanthium albinum* is not cultivated in Poland and therefore it does not escape from cultivation. With human involvement, riverside cocklebur can be spread accidentally, mainly as a result of sticking of its fruit to clothes, and also to equipment used to e.g. mow meadows or pastures in floodplains overgrown by the species. Farm animals (e.g. cattle or sheep) grazing in floodplains dominated by riverside cocklebur can also contribute to the expansion of the species. According to Vinogradowa et al. (2010 – P), the use of riverside sand can also contribute to the spread of fruit of the species. Other forms of activity in areas overgrown by riverside cocklebur, such as river banks reinforcements or floodbanks renovations, may also be of similar importance. It is also probable that people will accidentally transfer its burs on river banks used for recreational purposes, e.g. the banks of the Vistula River in Warsaw in the area of the National Stadium. In urban areas, river banks are often used for dog walking. These animals can also indirectly carry cocklebur burs that attach to their fur.

Assuming that the species is found all over Poland, its ability to spread as a result of intentional and unintended human activities can be estimated, assessing the frequency of movement of diasporas (fruits or multiple fruits) to a distance greater than 50 km. There are

	no particular research results, but it seems that it can be defined as high (more than 10 cases per decade).

A4a | Impact on the environmental domain

Questions from this module qualify the consequences of *the species* on wild animals and plants, habitats and ecosystems.

Impacts are linked to the conservation concern of targets. Native species that are of conservation concern refer to keystone species, protected and/or threatened species. See, for example, Red Lists, protected species lists, or Annex II of the 92/43/EWG Directive. Ecosystems that are of conservation concern refer to natural systems that are the habitat of many threatened species. These include natural forests, dry grasslands, natural rock outcrops, sand dunes, heathlands, peat bogs, marshes, rivers & ponds that have natural banks, and estuaries (Annex I of the 92/43/EWG Directive).

Native species population declines are considered at a local scale: limited decline is considered as a (mere) drop in numbers; severe decline is considered as (near) extinction. Similarly, limited ecosystem change is considered as transient and easily reversible; severe change is considered as persistent and hardly reversible.

a13. The effect of *the species* on native species, through **predation, parasitism or herbivory is**:

X	inapplicable
	low
	medium
	high

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

acomm13. Comments:

The species is a non-parasitic plant and does not affect native species through predation, parasitism or herbivorous behaviour.

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:

In Poland, riverside cocklebur occurs in several types of plant communities. The greatest number of its individuals can be observed in phytocoenoses belonging to the *Bidentetea tripartiti* and *Isoëto-Nanojuncetea* classes, which develop on periodically exposed water banks, as well as in the flood plain meadows of the alliance *Agropyro-Rumicion crispi* (Kącki and Dajdok 2009 – P), where it competes with other species for habitat resources (e.g. nitrogen compounds). When in larger concentrations, it can oust native species, it can also do that through limiting access to light, especially in areas in which it reaches higher density. The impact of *X. albinum* on native taxa leads to reduction of biodiversity of the occupied habitats. The allelopathic effect (mutual chemical interaction of plants, usually through the substances secreted by the roots – the impact may be beneficial or harmful) is also known among the taxa of the genus *Xanthium*. It also turns out that the substances contained in the spikes of the cover and fruits are growth inhibitors, delay the germination of seeds and inhibit the growth of other plants (Wikiwand 2018 – B). However, Brandes and Belde (2004 – P), when comparing the patches of vegetation formed on the banks of the Elbe, both with and without *Xanthium albinum*, found no significant differences in species diversity. In recent years, phytocenoses in the middle part of the Oder River on the banks of the river

bed were observed, where *Xanthium albinum* and another rapidly spreading species, i.e. *Eragrostis albensis* (Dajdok and Wuczyński 2013 – A), played an important role. Therefore, it seems justified to consider the cumulative effect of their presence when assessing the impact of both species. However, this impact in the Polish conditions needs to be precisely determined by observations on the permanent study plots of areas inhabited by the 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:

X. albinum does not affect native species by cross-breeding with them. The plant is a frequent self-pollinator (Böszörményi and Bagi 2008 – P). In Poland there are four species of the genus *Xanthium*: *X. spinosum*, *X. strumarium*, *X. macrocarpum* and *X. albinum*. All of them are foreign species to Polish flora (Mirek et al. 2002 – P). Hybrids of *X. strumarium* and *X. albinum* = *X.* ×*kostalii* are mentioned in the literature (Tokarska-Guzik 2005, Rutkowski 2011, Pyšek et al. 2012 – P).

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

	very low
X	low
	medium
	high
	very high

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

acomm16. Comments:

Another neophyte, *Cuscuta campestris*, was found to parasitize on *Xanthium albinum* individuals (Belde 1996 – P, Brandes and Belde 2004 – I). Böszörményi and Bagi (2008 – P) point to viral diseases that infect riverside cocklebur and are transmitted by aphids, as well as to several parasitic fungi. Their impact is most often analysed in relation to cultivated plants. Transmission of those to wild species cannot be ruled out completely. This aspect, however, requires more research.

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. Comments:

Xanthium albinum is an annual plant, but due to its intensive vegetative growth it reduces access to light for other plants in riverside systems, ruderal habitats and cultivated fields. As it has already been emphasized, the cocklebur can also release chemical substances indifferent to other plants (the phenomenon of allelopathy) to the substrate.

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

	low
	medium
X	high

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

acomm18. Comments:

Xanthium albinum has a negative impact on Natura 2000 habitats: rivers with muddy banks (code 3270) (Tokarska-Guzik et al. 2012 – P). It is found in many Natura 2000 areas designated for protection of habitats in Poland (Nobis 2014 – P). The plant association *Xanthio riparii-Chenopodietum rubri* consisting of riverside cocklebur poses a threat to natural communities of native species by occupying their potential habitats and also by acting through substances secreted by the roots (allelopathy) or contained in the spines of the cover and in the fruits and constituting growth inhibitors, retarding the germination of seeds and inhibiting the growth of other plants (Wikiwand 2018 – B). *Agrostio stoloniferae-Pulicarietum vulgaris*, *Chenopodietum rubri*, *Chenopodio rubri-Polygonetum brittingeri* and *Chenopodio polyspermi-Corrigioletum litoralis* are being ousted (Borysiak 2004 – P). This was confirmed by the results of the monitoring of natural habitats. Among the eleven monitored habitat areas in Poland, in nine *Xanthium albinum* was observed and it was identified together with *Bidens frondosa* as the most threatening to biodiversity of natural habitats (Nobis 2014 – P). The plant communities typical of habitat 3270 are very dynamic. They are destroyed by high water levels in late autumn and re-created the following year (Nobis 2014 – P). Vegetation patches with a high proportion of riverside cocklebur can affect ecosystem integrity by reducing the value of such communities, e.g. for birds feeding in floodplains (geese or Charadriiformes species during their migrations). In Poland, such an impact seems probable, i.e. on the area of the Ujście Warty National Park.

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 has no parasitic properties.

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

	inapplicable
	very low
X	low

	medium
	high
	very high

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

acomm20. Comments:

Riverside cocklebur may spread to neighbouring cultivated areas and grasslands. In this way, it may contribute to the suppression of cultivated plant species (Warcholińska 1974, Mowszowicz 1986, Kącki and Dajdok 2009 – P). The cases of mass colonisation of agricultural fields closest to the borders of Poland have been reported in Slovakia, Hungary and Ukraine. In Hungary, riverside cocklebur is the most harmful as weed in maize, sunflower, sugar beet and potato crops. In the warmer regions of the temperate zone, *Xanthium albinum* is a significant weed in the soy beans and cotton crops (Böszörményi and Bagi 2008 – 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. Comments:

Species of the genus cocklebur *Xanthium* growing in Poland (*X. spinosum*, *X. strumarium*, *X. macrocarpum* and *X. albinum*) are alien species to Polish flora and are not cultivated plants (Mirek et al. 2002 – P). In the literature, the hybrids between *X. strumarium* and *X. albinum* = *X.* ×*kostalii* were reported (Tokarska-Guzik 2005, Rutkowski 2011, Pyšek et al. 2012 – P).

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

	very low
X	low
	medium
	high
	very high

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

acomm22. Comments:

The presence of riverside cocklebur *Xanthium albinum* may disturb the integrity of the crops, prevent and limit the agricultural use of cultivated fields and grasslands as a result of the intensive overgrowing and ousting of crops (Mikołajczak et al. 2008 – P). However, this applies mainly to the areas located in the south and south-east of Poland. Species is considered as a weed in the Czech Republic in sugar beet (Tóth and Sikora 2016 – P), in Hungary in maize, sunflower and potatoes (Böszörményi and Bagi 2008 – P), in Russia in sunflower (Kurdyukova 2014) and in North America in soybean and cotton crops (Böszörményi and Bagi 2008, Vinogradova et al. 2010 – 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
	medium
X	high
	very high

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

acomm23. Comments:

The species of the genus *Xanthium* are infected by cucumber mosaic virus (CMV) and mungbean yellow mosaic virus (MYMV) (Böszörményi and Bagi 2008 – P). These viruses can be transmitted by aphids to plants grown both in greenhouses and outdoors. At least 14 species of rust are known among the fungi. Of these, *Puccinia xanthii* has the greatest specificity towards the host and spreads along with the species of the genus *Xanthium*. Other species worth mentioning include *Alternaria helianthi* and *Plasmopara halstedii*, which are fungi that affect sunflowers and can infect riverside cocklebur (Böszörményi and Bagi 2008 – P, Plasmopara 2008 – I).
Of the pathogens mentioned, only the yellow bean mosaic virus is found on the EPPO List (A1).

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 species is a plant and does not show such effects.

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

	very low
	low
	medium
X	high
	very high

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

acomm25.	Comments:

In floodplain areas used for grazing, *Xanthium albinum* may have a negative impact on farm animals due to its highly poisonous seedlings (Brandes and Belde 2004 – I, Böszörményi and Bagi 2008 – P). Young riverside cocklebur plants, with up to 4 leaves are poisonous (the most dangerous are those with cotyledons). Young and sprouting seeds have similar properties. The plant may have poisonous effects on domestic animals: cows, horses, goats, pigs, sheep and hens. Older plants are not poisonous (Mowszowicz 1982 – P). *Xanthium albinum* is particularly dangerous for piglets of up to 6 months of age. For an animal weighing 40–45 kg, 500–600 g of fresh riverside cocklebur is poisonous. Strong symptoms of poisoning (e.g. nausea, vomiting, lowering of body temperature) occur in pigs during the first 24 hours after eating (Mowszowicz 1982 – P). Such impacts are also considered in relation to *Xanthium strumarium* spreading in Africa, including Ethiopia (Seifu et al. 2017 – P). It is suggested that livestock should not have access to areas controlled by riverside cocklebur, at least during its growing season or when young plants are present. It should be remembered, however, that ripe fruits (with a hardening, spiky crust) may also mechanically damage the digestive tract of animals.
We estimate the likelihood of *Xanthium* contact with a livestock as high. However, the effect (moderate symptoms of the disease, only young specimens have negative effects) is described as average. As a result, the impact of the species on animals is considered "high".

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:

Xanthium albinum is a plant and is not a host or vector of parasites or animal pathogens.

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 parasitic plant.

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

	very low
X	low
	medium
	high
	very high

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

acomm28. Comments:

Species of the genus *Xanthium* (*Xanthium strumarium* archeophyte?) were used in Poland in the old times for medicinal and colouring purposes (yellow colour) (Kluk 1811, Jundziłł 1830, Broda and Mowszowicz 2000, Sarwa 2001, Chrzanowska 2014 – P). Indians in North America use riverside cocklebur as food (Łuczaj 2004 – P). Cases of negative effects on human health have also been reported. According to Weaver and Lechowicz (1983 – P), the genus *Xanthium* is closely related to the genus *Ambrosia* and is also allergenic. However, due to the production of less pollen, species of this kind are not as dangerous as ragweed. In addition, the glandular trichomes covering the leaves and stems of riverside cocklebur release substances that can cause contact dermatitis in allergic people (Vinogradova et al. 2010 – P).
The probability with which *Xanthium* comes into direct contact with people is considered as medium, whereas the effect is small. As a result, the impact of the species on human health is estimated as "low".

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:

Species is a plant and is not a vector of human parasites or pathogens.

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:

X	very low
	low
	medium
	high
	very high

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

acomm30. Comments:

The massive occurrence of *Xanthium albinum* on beaches in river valleys worsens their quality, thus reducing their commercial value (Vinogradova et al. 2010 – 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
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

Xanthium strumarium, a species related to *X. albinum*, is used in modern Chinese medicine and for production of yellow dye. Seed oil is edible and may have antibacterial properties (Wolski et al. 2006, Sharifi-Rad et al 2016, Wikiwand 2018 – B). In the 1980s, its use in the treatment of breast cancer was considered (Böszörményi and Bagi 2008 – P). The name of the genus derives from the Greek word 'xanthos' meaning 'yellow', as in the past the infusion/decoction made from its fruit was used as a yellow hair dye (Wolski et al. 2006, Böszörményi and Bagi 2008 – P). However, negative aspects seem to prevail in the assessment of the impact of the species on ecosystem services. The substances contained in the spikes of involucres and seeds are growth inhibitors, which delay the germination of seeds and inhibit the growth of other plants (Wikiwand 2018 – B). *Xanthium albinum* is not eaten by animals due to its smell and woody and spiky involucre of female inflorescences. Its dense cover also prevents grasses underneath it from being eaten. As a result, riverside cocklebur reduces the value of fodder and the yield of meadows (Mikołajczak et al. 2008 – P). It has a very high reproduction rate and spreads very quickly in floodplains, e.g. in the Ujście Warty National Park. (Mikołajczak et al. 2008 – P). It worsens the quality of the beaches, and spiky involucres can hurt people's feet when they are relaxing on the beaches by the rivers (Vinogradova et al. 2010 – P). *Xanthium albinum* has a negative impact on animal reproduction through negative effects on animal health (Mowszowicz 1982 – P) and on the quality of wool from sheep grazing in areas dominated by cockleburs (Vinogradova et al. 2010 – P). The species is a weed in cultivated crops such as sugar beet (Tóth and Sikora 2016 – P) or sunflower (Kurdyukova 2014). In North America, soybean losses due to weed infestation with riverside cocklebur of up to 60% were reported (Vinogradova et al. 2010 – P).

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

There is lack of information in the literature on the direct impact of species on regulatory services. *Xanthium albinum*, when entering plant communities, changes them and creates its own dominating communities *Xanthio riparii-Chenopodietum rubri* (Matuszkiewicz 2001 – P). By changing biotic factors, it influences native species and plant communities.

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. Comments:

There is no information in the literature on this subject. By creating wide patches by the rivers, riverside cocklebur reduces the aesthetic value of the landscape of these areas, especially in autumn, when its dying shoots blacken. *Xanthium* can also reduce access to water and river beaches. As a result, the commercial attractiveness of the area occupied by the species is reduced, recreation and tourism are hindered. Assuming that the species spreads in Poland, its impact on cultural services should be assessed as 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 **X**	high	level of confidence

acomm34. Comments:

Xanthium albinum is widely recognised in Poland as an foreign, established species, an invasive neophyte that has already overcome geographical barriers and spreads spontaneously, both in anthropogenic, semi-natural and natural habitats (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). As a species that is thought to be of Central and South American origin (Löve and Dansereau 1959 – P), *Xanthium albinum* is likely to withstand the expected temperature rise well. This is confirmed by the fact that the species enters cultivation more frequently in countries with a slightly warmer climate than this of Poland (the Czech Republic, Russia, Ukraine). Forecasts of the spread of invasive species caused by climatic changes indicate the possibility of shifting the vertical ranges (Guo et al. 2018 – P). It is difficult to state unequivocally to what extent this will affect the riverside cocklebur population, but it is likely that the species will be able to grow on river stones in the previously uncolonised areas in the upper parts of the river valleys.

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:

In Poland, riverside cocklebur has the status of invasive neophyte established on a national scale (Mirek et al. 2002, Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P). The species spreads spontaneously across river valleys and synanthropic habitats. *Xanthium albinum* is already established across Poland and its status unlikely to change significantly. However, local fluctuations cannot be excluded; the intensity of extreme events, such as excessive spring or summer flooding, may result in a lower percentage of sprouting riverside cocklebur individuals (Mikołajczak et al. 2008 – P). Dry and hot summers can also cause *X. albinum* to dry out due to lack of water (Belde 1996 – P). Also dry and hot summers can cause the *X. albinum* to dry up due to the lack of sufficient water (Belde 1996 – P).

a36. SPREAD – Due to climate change, the probability for *the species* to overcome barriers that have prevented its spread in Poland will:

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm36. Comments:

Riverside cocklebur is already established in Poland (Tokarska-Guzik 2005, Tokarska-Guzik et al. 2012 – P) and has spread across the majority of country area (Zając and Zając 2001, 2015, Tokarska-Guzik 2005 – P). Forecasted extreme phenomena and related water floods in the valleys of larger rivers may contribute to the spread of the species' diasporas to new, previously unoccupied sites.

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. Comments:

Xanthium albinum is widely recognised in Poland as an foreign, established species, an invasive neophyte that has already overcome geographical barriers (Tokarska-Guzik et al. 2012 – P). It spreads spontaneously across Poland. The survival and the impact of the species on the natural environment will depend on the length of periods of droughts and rainfall.

Forecasted extreme phenomena and the passage of surge waves in the valleys of larger rivers may be a factor favouring the spread of the species' diasporas to new, previously unoccupied sites. Although observations of the Elbe Valley (Belde 1996, Brandes and Belde 2004 – P) indicate that longer periods of drought may be a limiting factor, contributing to withering of young riverside cocklebur specimens. Floods may also be a limiting factor. Long-term spring flooding or summer flooding significantly reduces the proportion of sprouting cockleburs (Mikołajczak et al. 2008 – P). In southern Europe, the negative significance of domination of riverside cocklebur in coastal dunes ecosystems is already being highlighted (Stanisci 2014 – P). Further spreading of the species may increase the negative impact on the natural environment (see a05, a14, a17, a18).

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:

In Poland, riverside cocklebur has a status of an invasive neophyte established on a national scale (Tokarska-Guzik et al. 2012 – P). Currently *Xanthium albinum* is considered a weed in countries located south and south-east of Poland. Therefore, the forecasted temperature increase may result in, at least, a partial establishment of the species in similar habitats (e.g. in Slovakia, Ukraine or Hungary). Therefore, the negative impact on cultivated crops is expected to increase moderately (see a20, a22).

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm39. Comments:

Xanthium albinum is already established in Poland (Tokarska-Guzik et al. 2012 – P) and is spread throughout most of the country (Zając and Zając 2001, 2015, Tokarska-Guzik et al. 2012 – P). Assumed climate change is within its tolerance limits. Possible further spread in river valleys in the future may be associated with a more widespread occurrence of riverside cocklebur on pastures and meadows located in floodplains. Further increase in the number of sites may result in an increased possibility of contact between livestock and the plant. Therefore, the need of excluding grasslands occupied by *Xanthium albinum* from use (at a younger stage of development when it is most toxic, or at an older stage when fruits mechanically damage the digestive tract) may cause difficulties in animal husbandry.

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

	decrease significantly
	decrease moderately

	not change
X	increase moderately
	increase significantly

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

acomm40. Comments:

X. albinum is already established in Poland (Tokarska-Guzik et al. 2012 – P) and spread across the country (Zając and Zając 2001, 2015, Tokarska-Guzik et al. 2012 – P). Considering the allergenic properties of its pollen (similar to ragweed pollen) and the possible irritation in sensitive people caused by the glandular trichomes covering the leaf surfaces, it can be assumed that if the population of *X. albinum* increases and becomes denser, the species will come in contact with humans more often, which will increase the likelihood of its impact on humans.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

The species is established in Poland (Tokarska-Guzik et al. 2012 – P). It can be assumed that the expected climate change, even if it results in a certain increase in the number of sites, will not have a significant impact on infrastructure.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	1.00	1.00
Environmental impact (questions: a13-a18)	0.55	0.90
Cultivated plants impact (questions: a19-a23)	0.25	1.00
Domesticated animals impact (questions: a24-a26)	0.75	1.00
Human impact (questions: a27-a29)	0.25	1.00
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	1.00	1.00
Impact (questions: a13-a30)	0.75	0.98
Overall risk score	0.75	
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: *Xanthium albinum* is included in the list of alien species which may pose a threat to the nature of Poland and of the European Union (Tokarska-Guzik et al. 2015 – I). It is on the list of invasive species on a national scale (e.g. Vinogradova et al. 2010, Tokarska-Guzik et al. 2012 – P). Further expansion of the range of the species will probably be associated with river valleys and synanthropic areas in cities (Tokarska-Guzik et al. 2012, Zając and Zając 2015 – P). After performing a risk assessment for Poland, *X. albinum* has been classified as a ‘ moderately invasive alien species’ with a total negative impact on the natural environment of 0.75 (a13–a30). It is widely spread across the country and has a high rate of further expansion (maximum score in the 'Invasion Process' module: 1.00). The highest score (0.75) was obtained in the 'Influence on animal breeding' module (a24–a26). The species enters natural and semi-natural habitats in river valleys and occupies them on a large scale, and into the synanthropic systems in big cities. Its presence in river valleys can change as a result of long spring and summer flooding as well as summer droughts. The negative impact of riverside cocklebur on various ecosystem components is confirmed (see a05). The species also enters protected areas, e.g. in Poland it appears in 3 national parks (Bomanowska et al. 2014 – P).

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