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. Joanna Grabowska
2. Tomasz Kakareko
3. Karolina Mazurska

acomm01. Comments:

	degree	affiliation	assessment date
(1)	dr hab.	Department of Ecology and Vertebrate Zoology, Faculty of Biology and Environmental Protection, University of Lodz	20-01-2018
(2)	dr hab.	Department of Hydrobiology, Faculty of Biology and Environmental Protection, The Nicolaus Copernicus University, Toruń	24-01-2018
(3)	mgr	Institute of Nature Conservation of the Polish Academy of Sciences in Cracow	27-01-2018

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

Polish name: Trawianka

Latin name: ***Perccottus glenii*** Dybowski, 1877

English name: Amur sleeper

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: Two other names of the species can be found in the Polish literature language on the subject, that is 'golovieshka' and 'rotan', which are Russian names of this species. Moreover, Russians use the name 'rotan' in English language studies, instead of commonly used: Amur sleeper or Chinese sleeper.

Polish name (synonym I) rotan	Polish name (synonym II) gołowieszka
Latin name (synonym I) *Eleotris pleskei*	Latin name (synonym II) *Perccottus glehnii*
English name (synonym I) Chinese sleeper	English name (synonym II) Rotan

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: In Poland, this species was observed first time in 1992 in oxbowlakes of the Vistula River near Dęblin (Antychowicz 1994 – P). Since then, it has spread over the Vistula River basin, where it is found primarily in oxbowlakes and in slow-flow waters. Moreover, it also appears in natural and fish ponds, from which it temporary penetrates into nearby running waters. Locally very numerous (Witkowski 2012 - P). There are also individual reports confirming its presence in the Odra River basin (Grabowska et al. 2010, Witkowski 2012, Andrzejewski et al. 2011 - P). The species successfully reproduces in our waters (Grabowska et al. 2011 - P).

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

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

acomm05.	Comments: The species affects its environment through predation on fish, including protected species, as e.g.: the spined loach (*Cobitis taenia*), bitterling (*Rhodeus sericeus*), lake minnow (*Eupallasella percnurus*) and their eggs, amphibians: the smooth newt (*Triturus vulgaris*) and the northern crested newt (*T. cristatus*) – the species from the Habitats Directive Annex II, European common frog (*Rana temporaria*), moor frog (*R. arvalis*), pool frog (*R. lessonae*) and various aquatic invertebrates. The species is known for its voraciousness, which may shortly bring about drastic changes in species composition of small water reservoirs (Reshetnikov 2003, 2008, Grabowska et al. 2009 - P). Moreover, it may compete

with native fish species, especially when it occurres in high density. It is often found in fish ponds (Witkowski 2012 - P), where it may deplete food resources for breeding species or feed on their offspring and eggs. Sometimes the species is incidentally caught by anglers, but they are not interested in it due to its relatively small size, on the contrary – it is troublesome, since it eats bait. In the Far East of Asia, in its natural range of distribution, freshwater sleeper is an intermediate host for the Chinese liver fluke *Clonorchis sinensis* (Opisthorchidae family), for which the final hosts are mammals feeding on fish, including people. It causes serious disease of bile ducts – clonorchosis. However, the risk of infection with this parasite through Amur sleeper is insignificant, especially within its invaded range.

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:

The species spreads fast as a result of its spontaneous expansion from places of incidental introductions, often due to being brought with stocking material of Asian cyprinids (Bogutskaya and Naseka 2002, Reshetnikov 2004, 2010, 2013, Witkowski 2012 - P). Approximately 13 main centres were distinguished, from which after introduction the species spread into new areas in Eurasia (Reshetnikov and Ficetola 2011 - P). Their location determines current invaded range of the species. For example, the invasion centre for the Ukraine, Poland, Slovakia, Hungary, Serbia, Romania and Bulgaria was most probably a fish farm near Lvov, where the species was brought in 1980 as a contaminant of stocking material. Freshwater sleeper often settles in ponds and oxbowlakes. In rivers it stays rather rarely and temporary, however it uses them for fast long-distance transit, especially at high water levels, when flood wave carries them from oxbowlakes or floodplains to more distant areas of catchment (Witkowski 2012 - P). The species proves to have high tolerance to unstable environment conditions, including changes in water quality, oxygen deficiencies and reservoir freezing, which are adverse for other fish. This facilitates their expansion into different water types (Bogutskaya and Naseka 2002 - 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:

The species was introduced many times in different places, brought as contaminant of stocking material of Asian cyprinids: carp, the grass carp, the silver carp. Amur sleeper is often found in breeding ponds, where apparently it finds favourable environmental conditions, and thus it can be easily transported in the above-mentioned way (Košco et al.

2003, Reshetnikov 2004, 2010, 2013, Reshetnikov and Ficetola 2011 - P). This is also fostered by the scale of stocking with carp different artificial water bodies (fish ponds, commercial fishing grounds, dam reservoirs) and some open waters in Central Europe. It is believed that it is the main reason for rapid and wide expansion of Amur sleeper in the Vistula and Danube River basins (Bogutskaya and Naseka 2002, Reshetnikov and Ficetola 2011, Reshetnikov 2010, 2013 - P).

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:

First living specimens of Amur sleeper were brought to Europe by members of an expedition returning to St. Petersburg from the Amur River basin. After four years of breeding in an aquarium, in 1916 they released the fish into neraby park ponds. From there, the species spread unaided to adjacent waters. Much the same situation occurred in 1948 in Moscow, where few specimens were brought as a curiosity from an epxedition to the Far East, and then were unconcernedly released into open waters (Bogutskaya and Naseka 2002, Reshetnikov 2004, 2010 - P). Cases were reported, which involved deliberate introductions of Amur sleeper in former Soviet Union, because it was believed that due to its voraciousness this would help fighting the plague of mosquitoes. However, expected effect of these biomanipulations was not achieved (Bogutskaya and Naseka 2002, Witkowski 2012 - P). Sometimes, the species is grown by amateurs in aquaria, also in Poland. In the 1950s the fish was being sold during zoological exhibitions in Moscow, also offered as living bait (Reshetnikov 2010 - P). On Internet forums in Poland there is plenty of information on amateur aquaristical cultures of Amur sleeper (Grabowska 2017 – A). Therefore, the participation of aquarists and fishermen in uncontrolled introductions of this species cannot be excluded.

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:

Native range of the species' distribution includes various regions of the moderate climate zone in the Far East of Asia (stretches out from the southern coast of the Sea of Okhotsk – in the north, to the Yellow Sea – in the south, including i.a. the Amur River basin) (Bogutskaya and Naseka 2002 - P). Considering that the fish originates from the latitudes much like those in Europe, and the fact that it is highly tolerant to physical and chemical conditions in the environment, it can be stated that in Poland there are optimal climatic conditions for settling in of this species (Grabowska et al. 2010, Witkowski 2012 - P). Amur sleeper

	successfully reproduces in our waters (Grabowska et al. 2011 - P), which confirms that thermal conditions are optimal for all stages of its ontogeny.

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:

In Poland, this species is most often found in oxbowlakes of the Vistula, or in waters characterised by slow flow, with muddy bottom densely covered by aquatic plants. Moreover, it also appears in natural and breeding ponds, from which it periodically penetrates into nearby running waters (Witkowski 2012 - P), although it avoids fast-flowing water. It easily tolerates oxygen deficiencies, water temperature fluctuations, and organic contamination in water. The species forms self-sustaining populations (Grabowska et al. 2011 - P), and locally it is very abundant, which proves that our waters have optimal habitat conditions for the species settlement (Grabowska et al. 2010, Andrzejewski et al. 2011, Witkowski 2012 - P).

A3 | Spread

Questions from this module assess the risk of *the species* to overcoming dispersal barriers and (new) environmental barriers within Poland. This would lead to spread, in which vacant patches of suitable habitat become increasingly occupied from (an) already-established population(s) within Poland.

Note that spread is considered to be different from range expansions that stem from new introductions (covered by the Introduction module).

a11. The capacity of *the species* to disperse within Poland by natural means, **with no human assistance**, is:

	very low
	low
	medium
	high
X	very high

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

acomm11. Comments:

Expansion of population (Data type: B)

The history of Amur sleeper spread in the Vistula River is well-documented, however it should be emphasised that it covers its expansion down the river, while moving upstream (e.g. during penetration into tributary rivers) could be much slower. In Poland, the species was observed first time in 1993 in the oxbowlakes of the Vistula near Dęblin (Antychowicz 1994 - P). In the following years, its new locations were successively reported, while the fish was spreading down the river towards its estuary. In 1996, the species was observed in the Vistula and its oxbowlakes in its section between Solec and the estuary of Wieprz River (Terlecki and Pałka 1999 - P), then in 1997 near Otwock, Łomianki, Wyszogród, in Warsaw, and near Płock. Later, it was found in 1998 in the Włocławek Reservoir, and then in its part close to estuary, by Tczew (Witkowski 2012 - P). After being observed first time, within 6-7 years the species managed to settle in central and downstream part of the Vistula River, almost 600 km in length (Witkowski 2002, Grabowska et al. 2010 - P). Its expansion rate in the Vistula River reaches ca. 80-100 km/year. Most probably, the species uses high water levels and flood waves for long-distance migrations within the catchment. These are

periods, when old oxbowlakes and small water reservoirs in floodplains preferred by the species merge with the river (Witkowski 2012 - 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	level of confidence
		X	

acomm12. Comments:

The species was introduced many times in different places, brought with stocking material of Asian cyprinids: carp, the grass carp, the silver carp (Bogutskaya and Naseka 2002, Witkowski 2012, Reshetnikov 2013 - P). Amur sleeper is often found in fish ponds, from which it is carried randomly to other locations. This is also fostered by the scale of stocking with carp different artificial water bodies (fish ponds, commercial fishing grounds, dam reservoirs) and some open waters in Central Europe. For example, it is believed that fish farm near Lvov was the source of invasion in the Ukraine, Poland (1993), Slovakia (1998), Hungary (1997), Serbia (2001), Romania (2001) and Bulgaria (2005) – in parentheses there are the years the species was observed first time (Reshetnikov, 2010, 2013 - P). The farm was located near the Vistula River and Danube River watershed - that's why already in 1982 Amur sleeper was numerous 1 km farther, in the Dniester River tributary (the Wereszyca River). In 1988, individual specimens were observed in the Vistula River basin, in the San River tributary – the Wisznia River, near Polish-Ukrainian border. However, there is no way to show where the assistance of man ends and spontaneous proliferation starts, since both these processes are closely bound with each other. It means that bringing with stocking material of cyprinids forms the centre/source for further, probably already spontaneous expansion of species to adjacent waters, which is fostered by the procedures involving maintenance of ponds and harvest of breeding species (water release, bottom cleaning, elimination of undesired fish species - the so-called "weed", etc.). Nevertheless, combination of these two ways of fish proliferation is very efficient in case of this species. For example, the first reported case of observed Amur sleeper in the Odra River basin (P – Andrzejewski et al. 2011) concerned small tributary of the Warta River near Poznan. All 5 sites, where specimens of this species were caught, were located downstream of the fish farm, which most probably was the source for further species spreading in the new river system. The occurrence of Amur sleeper there as a result of spontaneous dispersion from the Vistula River basin may be probably excluded, considering that the sites located in the Odra River basin are at a linear distance of ca. 130-140 km from the Vistula River, as well as following the river network layout (no direct connections between these basins in this area) (Grabowska 2017- A).

A4a | Impact on the environmental domain

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

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

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

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

	inapplicable
	low
	medium
X	high

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

acomm13. Comments:

The species affects its natural environment through predation on a wide range of prey: various aquatic invertebrates (molluscs, insects, crustacea, annelida), fish and amphibians (Bogutskaya and Naseka 2002, Reshetnikov 2003, 2008, Koščo et al. 2008, Grabowska et al. 2009 - P). The species' diet changes with ontogenetic growth. With age the diet becomes richer in fish (its prey also included protected species and those listed in Annex II of the Habitats Directive (later HD), as e.g.: the spined loach, bitterling and lake minnow (priority species). Amur sleeper also feeds on amphibians: the smooth newt, the northern crested newt (the species from Annex II of the HD), European common frog, moor frog and pond frog (Reshetnikov and Manteifel 1997, Wolnicki and Kolejko 2008, Grabowska et al. 2009 - P). The species is known for its voraciousness, which may shortly bring about drastic changes in species composition in small water reservoirs, and considerable deterioration of biological diversity (Reshetnikov 2003, 2008, Koščo et al. 2008, Grabowska et al. 2009 - P). In Poland there are documented cases of significant drop in population, and even total extinction of lake minnow in small water reservoirs, which is observed shortly after the occurrence of freshwater sleeper there (Wolnicki and Kolejko 2008 - P).

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

	low
	medium
X	high

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

acomm14. Comments:

The species may compete for food and habitat with native fish species, especially when it occurs in high density. Since Amur sleeper is a food opportunist, it feeds on very diverse prey (Bogutskaya and Naseka 2002, Reshetnikov 2003, 2008, Koščo et al. 2008, Grabowska et al. 2009 - P), and it may deplete food resources for many native fish species, including these of special care it is concurrent with, as indicated by own observations (Grabowska 2017 - A). These include: bitterling, mud loach (*Misgurnus fossilis*), the spined loach, lake minnow, white-finned gudgeon (*Gobio albipinatus*) and golden spined loach (*Sabanejewia aurata*). It is worth mentioning here that regarding rivalry, the above-mentioned species are affected primarily by young Amur sleeper specimens, while older and larger ones affect them first of all by predation. Although there are no studies, which would assess the degree of dietary overlap of Amur sleeper and co-occuring fish in certain Polish waters and the effect of this impact on native species populations, there are reasons to state that it is considerable. First, it is indicated by the aforementioned, exceptionally high voraciousness and wide range of prey potentially "shared" by freshwater sleeper and native species (Bogutskaya and Naseka 2002, Reshetnikov 2003, 2008, Koščo et al. 2008, Grabowska et al. 2009 - P). Moreover, there are results of studies from other locations of its invaded range, e.g. the Selenga River delta (Lake Baikal catchment area), where Amur sleeper diet overlapped in 90 % with the diet of ide (*Leuciscus idus*), in 81 % with the crucian carp (*Carassius carassius*), in 67 % with the common roach (*Rutilus rutilus*), and in approximately 50 % with the common bleak (Litvinov and O'Gorman 1996, Bogutskaya and Naseka 2002 - P). Moreover, this species can make feeding impossible for native fish, aggressively obstructing their access to food. Although competitive interactions between freshwater

sleeper and native fish species have not been studied yet, an aggressive behaviour of the sleeper has been observed during a laboratory experiment with regard to a fish, which is not native in Poland – the European mudminnow (*Umbra kramerii*). During feeding freshwater sleeper was effectively driving away the mudminnow so that the latter could not catch the prey (Grabowska and Kakareko 2016 - A). By its size, body conformation, habitat preferences and biology, this small fish is much like e.g. our native lake minnow. Therefore, it can be assumed that freshwater sleeper would behave in the same aggressive way in relation to other co-occuring small-size species, including the above-mentioned species of special care. The observed extinctions and drops in lake minnow population after Amur sleeper occurrence (Wolnicki and Kolejko 2008 - P) may result not only from the species predatory nature, but also its competitive interactions.

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 belongs to the Odontobutidae family, which has no representatives in Polish fauna. Considering this, the cases of crossing with native fish species are impossible.

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

	very low
	low
	medium
X	high
	very high

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

acomm16. Comments:

In its natural range of distribution, Amur sleeper is a host for 67 species of different parasites (Reshetnikov 2013, Sokolov et al. 2014 - P), and within its invaded range it may be a host for approximately 100 different species (Sokolov et al. 2014, Reshetnikov 2013 - P), which have been already confirmed in parasitological examinations to appear on/in Amur sleeper body (Sokolov et al. 2014 - P). These are both new parasites, brought to Europe with Amur sleeper, and parasites which are common in waters occupied by Amur sleeper, appearing on bodies of many native fish species. Therefore, the species may participate in transmitting these parasites among other species in a given water body, and be their vector on the way to other waters during expansion. Thus, in both cases it may increase the frequency of infecting certain fish assemblage with them. Also, the same applies i.a. to some species of special care, which are co-occuring with Amur sleeper in many places. These are e.g.: bitterling, mud loach, the spined loach, lake minnow, white-finned gudgeon and golden spined loach (Grabowska 2017 - A). This impact has been evaluated as "high", since there are no reports stating that it would generate significant drops in populations of the species of special care. So far, two new for Europe parasite species were recorded, for which freshwater sleeper was a vector: cestoda *Nippotaenia mogurndae* (Košuthová et al. 2004 - P), which was observed on this species in Poland as well (Mierzejewska et al. 2012), and monogenean trematode *Gyrodactylus perccotti* (Ondračková et al. 2012 - P), found just on specimens from Poland. Both these parasites have not been found on native species.

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

X	low
	medium
	high

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

acomm17. Comments:

There are no known cases of the species impact on the integrity of ecosystems by disturbing the abiotic factors.

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:

The occurrence of Amur sleeper in the ecosystem induces many often irreversible changes in: trophic systems, species composition of macroinvertebrates (through predation), amphibians (through predation), fish (through predation, competition, and as a parasite vector (Reshetnikov 2013 - P). Particularly drastic changes resulting from the Amur sleeper occurrence take place in small, shallow water reservoirs, as e.g. oxbowlakes, ponds, small man-made water reservoirs. These habitats are crucial for maintaining biological diversity, i.a. because they often contain unique fauna of macroinvertebrates and vertebrates, they are the place of reproduction e.g. for amphibians or river fish, which use oxbowlakes for spawning and fry breeding. Just in habitats of this type Amur sleeper is co-occuring with many species of special care, as e.g. lake minnow, bitterling, mudloach, and great crested newt, which are affected by it in different ways (predation, competition, parasite vector), causing negative and hard to reverse changes. Observations in many locations showed drastic drop in population or even extinction of native macroinvertebrates, fish and amphibians, including species of special care, as e.g. lake minnow or great crested newt (Bogutskaya and Naseka 2002, Wolnicki and Kolejko 2008, Reshetnikov 2013 - P). Amur sleeper may become food for predatory native fish species, e.g.: perch (*Perca fluviatilis*) and pike (*Esox lucius*), and birds, e.g.: grey heron (*Ardea cinerea*), common gull (*Larus canus*), the European herring gull (*L. argentatus*), the black-headed gull (*Chroicocephalus ridibundus*), the great cormorant (*Phalacrocorax carbo*) (Reshetnikov 2013 – P).

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:

X	inapplicable
	very low
	low
	medium

	high
	very high

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

acomm19.	Comments: The species is a carnivorous animal.

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm20.	Comments: The species is an animal.

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

X	inapplicable
	no / very low
	low
	medium
	high
	very high

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

acomm21.	Comments: The species is an animal.

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

X	very low
	low
	medium
	high
	very high

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

acomm22.	Comments: The species is an animal, freshwater fish – it does not affect crops.

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

X	very low
	low
	medium

	high
	very high

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

acomm23. Comments:

This species - freshwater fish, is neither a host nor vector of pathogens and parasites harmful for plants.

A4c | Impact on the domesticated animals domain

Questions from this module qualify the consequences of *the organism* on domesticated animals (e.g. production animals, companion animals). It deals with both the well-being of individual animals and the productivity of animal populations.

a24. The effect of *the species* on individual animal health or animal production, through **predation or parasitism** is:

	inapplicable
	very low
	low
	medium
X	high
	very high

aconf20.	Answer provided with a	low	medium	high **X**	level of confidence

acomm24. Comments:

The species is often found in fish ponds and commercial fishing grounds (Witkowski 2012 - P), where it may feed on spawn and fry of breeding species (fish share in the diet is higher for large Amur sleeper specimens, Grabowska et al. 2009 - P). It may also compete with them, primarily depleting their food resources, because range of Amur sleeper prey includes these species, which are food for native fish species sourced from the wild and fish used for farming (Grabowska et al. 2009, Witkowski 2012, Reshetnikov 2013 - P). As a result, range of the species impact as a predator may induce losses in animal production, e.g. of the following species: common carp (*Cyprinus carpio*), golden carp (*Carassius gibelio*), and native species: tench (*Tinca tinca*), pike (*Esox lucius*), pikeperch (*Sander lucioperca*).

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

	very low
	low
X	medium
	high
	very high

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

acomm25. Comments:

There are no well-documented examples known that confirm the species impact on health of an individual animal or animal production resulting from attributes, which would be hazardous in case of direct contact. However, according to the laboratory observations of interactions with another fish species, which does not appear in Poland, that is the European mudminnow (*Umbra kramerii*) (Grabowska and Kakareko 2016 - A), it may be

	presumed that the species shows aggressive behaviour towards breeding fish it is concurrent with in ponds, as e.g. carp, tench, golden carp. The acts of aggression may result from rivalry, e.g. during feeding.

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

	inapplicable
	very low
	low
	medium
X	high
	very high

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

acomm26. Comments:

In its natural range of extent Amur sleeper is a host for 67 species of different parasites (Reshetnikov 2013, Sokolov et al. 2014 - P), and within its invaded range it may be a host for approximately 100 different species (Reshetnikov 2013, Sokolov et al. 2014 - P), which have been already confirmed in parasitological examinations to appear on/in Amur sleeper body (Sokolov et al. 2014 - P). These are both new parasites, brought to Europe with Amur sleeper, and parasites which are common in waters occupied by Amur sleeper, appearing on bodies of many native fish species. These include fish used for farming (pond farming) and for recreation (angling), such as: carp, golden carp, and native species: tench, pike, pikeperch. This is so important, because Amur sleeper is often found in fish ponds and commercial fishing grounds. The species may participate in transmitting these parasites among other species in a given water body, and be their vector on the way to other waters during expansion. Thus, in both cases it may increase the frequency of infecting certain fish groups with them (Reshetnikov 2013 - P). However, these are not parasites, which would cause diseases that demand reporting, involving permanent impairment of animal health.

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	high **X**	level of confidence

acomm28. Comments:

The species does not pose any hazard during direct contact with man.

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

	inapplicable
	very low
	low
X	medium
	high
	very high

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

acomm29. Comments:

Amur sleeper may be a vector for a parasite, which is potentially infectious for people. However, this risk is negligible, especially within its invaded range, because this parasite has not been observed yet in populations beyond Amur sleeper natural range of extent. Moreover, infection is possible when eating raw fish meat, and amur sleeper is not eaten by people, especially before thermal treatment. This parasite – the Chinese liver fluke *Clonorchis sinensis* (Opisthorchidae family) lives in the Far East, within Amur sleeper native range of extent, and as a parasite it is not specific for this species. Intermediate hosts for the liver fluke are water snails and fish (i.a. amur sleeper), and the final hosts are mammals feeding on fish, including people. In case of people, infection causes a serious disease – clonorchosis, which may lead e.g. to the development of cancers. It is estimated that 20 million of people in the world are infected with this parasite. In part of Europe, where freshwater sleeper has spread, people suffer from similar disease – opistorchiasis, caused by another species of fluke from the same family, for which intermediate hosts are also snails (i.a. species found in Amur sleeper food in Poland) and fish (native species concurrent with Amur sleeper in our waters). However, this fluke has not been found in Amur sleeper, therefore it is possible that it cannot be infected with this parasite (Reshetnikov 2013 - P). Moreover, same as in the case of the aforementioned Chinese liver fluke species, infection is possible only in case if people eat raw fish meat, which is rather improbable with Amur sleeper.

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: No significant cases of the species impact on infrastructure are known, and any influence of this sort is improbable. The species may reduce the quality of some comercial fisheries and fish ponds, since if it is abunadant, it may be caught with fishing rod instead of an expected breeding species. According to the amateur fishing rules (Regulation of the Minister of Agriculture and Rural Development of 12 November 2001 on the catch of fish and the conditions of breeding, fish farming and harvesting of other organisms living in the water – P), it is one of the species, which after catching cannot be released back to waters they were caught in, and thus there is a problem of utilising this unwanted catch. Anyway, in Internet fishing forums there is no information showing that this poses any aesthetic and/or sociological problem. Therefore, the extent of this phenomenon indicates rather marginal impact of the species on the infrastructure.

A5a | Impact on ecosystem services

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

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments: The species affects native fish species, i.a. those sourcedfrom the wild as well as breed in ponds, both negatively – reduces their populations by competition and feeding on their fry and eggs, and positively – as food for predatory fish (Bogutskaya and Naseka 2002, Reshetnikov 2013 - P). However, since Amur sleeper share in predatory fish diet is relatively poorly documented (Witkowski 2012 - P), contrary to its negative impact on native fish species exerted by it as a predator and competitor, the species impact on the supply services has been assessed as moderately negative.

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	high **X**	level of confidence

acomm32.	Comments: The species has no serious effect on regulation and maintenance services. Within its invaded range of distribution it may be a host for approximately 100 different parasite species (Reshetnikov 2013, Sokolov et al. 2014 - P). These are both new parasites, brought to Europe with Amur sleeper, and parasites which are common in waters occupied by Amur

sleeper, appearing on bodies of many native fish species, including species used for farming (pond farming) and for recreation (angling), such as: carp, golden carp, and native species: tench, pike, pikeperch. The species may participate in transmitting these parasites among other species in a given water body, and be their vector on the way to other waters during expansion. Thus, in both cases it may increase the frequency of infecting certain fish groups with them (Reshetnikov 2013 - P). However, these are not parasites, which would cause diseases that demand reporting, involving permanent impairment of animal health. Within its native range of distribution, the species is also a vector for the Chinese liver fluke, which may infect people; however the role of Amur sleeper in this process is rather marginal, since no infection of the species with this parasite within its invaded range has been confirmed. Moreover, due to its small size the fish is not eaten by people, especially raw, which may constitute the source of an infection with liver fluke.

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

The species obstructs fishing recreation in fish ponds (P – Witkowski 2012) and in commercial fishing grounds, where it is often found and sometimes caught (Grabowska 2017 - A). However, this fish is not desired by fishermen due to its small size. On the contrary, it poses a problem since it catches the hook and eats bait. Moreover, the amateur fishing rules (Regulation of the Minister of Agriculture and Rural Development of 12 November 2001 on the catch of fish and the conditions of breeding, fish farming and harvesting of other organisms living in the water – P), prohibit releasing these fish back to the environment they were caught in. Thus it becomes necessary to utilise this "unwanted" catch. For some fishermen it means throwing it "in the bushes", which contaminates the recreational area. Anyway, in Internet fishing forums there is no information showing that this causes any aesthetic and/or sociological problem. Therefore, the extent of this phenomenon indicates moderately negative impact of the species on cultural services (Grabowska 2017 - A).

A5b | Effect of climate change on the risk assessment of the negative impact of *the species*

Below, each of the Harmonia^{+PL} modules is revisited under the premise of the future climate. The proposed time horizon is the mid-21st century. We suggest taking into account the reports of the Intergovernmental Panel on Climate Change. Specifically, the expected changes in atmospheric variables listed in its 2013 report on the physical science basis may be used for this purpose. The global temperature is expected to rise by 1 to 2°C by 2046-2065.

Note that the answers to these questions are not used in the calculation of the overall risk score, but can be but can be considered when decisions are made about management of *the species*.

a34. INTRODUCTION – Due to climate change, the probability for *the species* to overcome geographical barriers and – if applicable – subsequent barriers of captivity or cultivation in Poland will:

	decrease significantly
	decrease moderately
X	not change

	increase moderately
	increase significantly

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

acomm34. Comments:

The species tolerates very well the wide range of temperatures in moderate climate, and it naturally settles in waters characterised by either lower or higher annual temperatures than those currently observed in Poland. Climate warming (within the anticipated range) will not increase the probability of the species introduction in waters it has not settled in yet.

a35. ESTABLISHMENT – Due to climate change, the probability for *the species* to overcome barriers that have prevented its survival and reproduction in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm35. Komentarz:

The species tolerates very well the wide range of temperatures in moderate climate and it is now present in many water bodies in Poland, where it reproduces successfully. Climate warming (within the anticipated range) will not increase the probability of the species introduction in waters it has not settled in yet.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm36. Comments:

The species tolerates very well the wide range of temperatures in moderate climate, and it naturally settles in waters characterised by either lower or higher annual temperatures than those currently observed in Poland. It is now present in many water bodies in Poland, and reproduces there successfully. Climate warming (within the anticipated range) will not affect the species proliferation.

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:

Water temperature rise will possitivly influence fecundity and survivability of Amur sleeper, which may considerably increase its density in many water bodies (Grabowska et al. 2011 - P). Thus, the share of the species in fish assemblages will grow, which may intensify competitive interactions with native fish species and build up its predatory pressure on macroinvertebrates, amphibians (newt larvae and frogs), and fish (eggs, fry, small size species), which are among their prey. Therefore, climate warming (within the anticipated range) may moderately increase the species impact on natural environment.

a38. IMPACT ON THE CULTIVATED PLANTS DOMAIN – Due to climate change, the consequences of *the species* on cultivated plants and plant domain in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38.	Comments:

This species does not affect crops and animal production. There is no possibility that this will alter due to climate changes.

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:

Water temperature rise will positivly influence fecundity and survivability of Amur sleeper, which may considerably increase its density in different water bodies, i.a. in fish ponds and commercial fishing grounds (Grabowska et al. 2011 - P). Thus, the share of the species in fish assemblages will grow, which may intensify competitive interactions with native fish species and build up predatory pressure on breeding species eggs and fry. Therefore, climate warming (within the anticipated range) may moderately increase the species impact on animal breeding.

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: It is rather improbable that the impact of this species on people would change due to climate warming.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm41.	Comments: It is probable that climate changes moderately extend the impact of Amur sleeper on some elements of infrastructure that is on fish ponds and comercial fisheries for anglers. This impact involves increase in Amur sleeper share in fish assemblages, which leads to decrease of functional and recreational quality of the aforementioned objects, since it is an undesired element there.

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)	0.63	0.92
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.67	0.67
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)	0.67	0.92
Overall risk score	0,67	
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: –

Data sources

1. Published results of scientific research (P)

Andrzejeski W, Golski J, Mazurkiewicz J, Przybył A. 2011. Trawianka *Perccottus glenii* – nowy, inwazyjny gatunek w ichtiofaunie dorzecza Warty Chrońmy Przyr. Ojcz. 67: 323-329

Antychowicz J. 1994. *Percottus glehni* w naszych wodach. Komunikaty Rybackie 2: 21-22

Bogutskaya NG., Naseka AM. 2002. Perccottus glenii Dybowski, 1877. Freshwater Fishes of Russia Zoological Institute RAS (http://www.zin.ru/ Animalia/Pisces/eng/taxbase_e/species_e/perccottus/ perccottus_e.htm)

Grabowska J, Kotusz J, Witkowski A. 2010. Alien invasive fish species in Polish waters an overview. Folia Zool. 59: 73 - 85

Grabowska J, Pietraszewski D, Przybylski M, Tarkan AS, Marszał L, Lampart-Kałużniacka M. 2011. Life-history traits of Amur sleeper, *Perccottus glenii*, in the invaded Vistula River: early investment in reproduction but reduced growth rate. Hydrobiologia 661: 197-210

Grabowska, J, Grabowski M, Pietraszewski D, Gmur J. 2009. Non-selective predator-versatile diet of Amur sleeper (*Perccottus glenii* Dybowski, 1877) in the Vistula River (Poland), a newly invaded ecosystem. J. Appl. Ichthyoly. 25: 451-459

Koščo J, Manko P, Miklisová D, Košuthová L. 2008. Feeding ecology of invasive *Perccottus glenii* (Perciformes, Odontobutidae) in Slovakia. Czech Journal of Animal Sciences 53: 479-486

Koščo J, Lusk S, Halačka K, Luskova V. 2003. The expansion and occurrence of Amur sleeper (*Perccottus glenii*) in eastern Slovakia. Folia Zool. 52: 329-336

Košuthová L, Letková V, Koščo J, Košuth P. 2004. First record of *Nippotaenia mogurndae* Yamaguti and Miyata, 1940 (Cestoda: Nippotaeniidae), a parasite of *Perccottus glenii* Dybowski, 1877, from Europe. Helminthologia 4: 55-57

Litvinov AG, O'Gorman R. 1996. Biology of Amur Sleeper (*Perccottus glehni*) in the Delta of the Selenga River, Buryatia, Russia. J. Great Lakes Res. 22: 370-378

Mierzejewska K, Kvach Y, Woźniak M, Kosowska A, Dziekońska-Rynko J. 2012. Parasites of an Asian Fish, the Chinese Sleeper *Perccottus glenii*, in the Włocławek Reservoir on the Lower Vistula River, Poland: In Search of the Key Species in the Host Expansion Process. Comp. Parasitol. 79: 23-29

Ondračková M, Matejusová I, Grabowska J. 2012. Introduction of *Gyrodactylus perccotti* (Monogenea) into Europe on its invasive fish host, Amur sleeper (*Perccottus glenii*, Dybowski 1877). Helminthologia 49: 21-26

Regulation of the Minister of Agriculture and Rural Development of 12 November 2001 on the catch of fish and the conditions of breeding, fish farming and harvesting of other organisms living in the water (Journal of Laws No 138, item 1559

Reshetnikov AN. 2010. The current range of Amur sleeper *Perccottus glenii* Dybowski, 1877 (Odontobutidae, Pisces) in Eurasia. Russian Journal of Biological Invasions 1: 119-126

Reshetnikov AN, Ficetola GF. 2011. Potential range of the invasive fish rotan (*Perccottus glenii*) in the Holarctic. Biol. Invasions 13: 2967-2980

Reshetnikov AN. 2003. The introduced fish, rotan (*Perccottus glenii*), depresses population of aquatic animals (macroivertebrates, amphibians, and fish). Hydrobiologia 510: 83-90

Reshetnikov AN. 2004. The fish *Perccottus glenii*: history of introduction to western regions of Eurasia. Hydrobiologia 522: 349-350

Reshetnikov AN. 2008. Does rotan *Perccottus glenii* (Perciformes: Odontobutidae) eat the eggs of fish and amphibians? J. Ichthyol. 48: 336-344

Reshetnikov AN. 2013. Spatio-temporal dynamics of the expansion of rotan *Perccottus glenii* from West-Ukrainian centre of distribution and consequences for European freshwater ecosystems Aqua. Invas.: 193-206

Reshetnikov AN, Manteifel YB. 1997. Newt-fish interactions in Moscow province: a new predatory fish colonizer, *Perccottus glenii*, transforms matapopulations of newts, *Triturus vulgaris* and *T. cristatus*. Advances in Amphibian Research in the Former Soviet Union 2: 1-12

Sokolov SG, Reshetnikov AN, Protasova EN. 2014. A checklist of parasites of non-native populations of the fish rotan *Perccottus glenii* (Odontobutidae). J. Appl. Ichthyol. 30: 574-596

Terlecki J, Pałka R. 1999. Occurrence of Perccottus glenii Dybowski 1877 (Perciformes, Odontobutidae) in the middle stretch of the Vistula River, Poland. Arch. Ryb. Pol. 7: 141-150

Witkowski A. 2002. Introduction of fishes into Poland: benefaction or plague? Nature Conserv. 59: 41-52.

Witkowski A. 2012. Trawianka Perccottus glenii Dybowski, 1877. In: Z. Głowaciński, H. Okarma, J. Pawłowski, W. Solarz (ed.). Gatunki obce w faunie Polski. Wyd. internetowe. Instytutu Ochrony Przyrody PAN w Krakowie: 423-428.

Wolnicki J, Kolejko M. 2008. Stan populacji strzebli błotnej w ekosystemach wodnych Polesia Lubelskiego i podstawy programu ochrony gatunku w tym regionie kraju. Monografia przyrodnicza. Wydawnictwo Liber-Duo s.c., Lublin.

2. Databases (B)

–

3. Unpublished data (N)

–

4. Other (I)

–

5. Author's own data (A)

Grabowska J. 2017. obserwacje własne own observation

Grabowska J, Kakareko T. 2016. obserwacje własne own observation