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, Polish Academy of Sciences in Cracow	27-01-2018

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

Polish name: Babka marmurkowata (babka marmurkowa)

Latin name: ***Proterorhinus marmoratus*** (Pallas, 1814)

English name: Tubenose goby

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: Formerly this species was known as *Proterorhinus marmoratus*. Systematic revision and molecular studies have shown, however, the presence of two distinct taxa, which differ in terms of distribution of the species. *P. marmoratus* is found in the Black Sea basin (marine waters), while individuals recorded in freshwater should be classified as *P. seminularis* (Stepien and Tumeo 2006 – P). The proposed Polish name of the species – babka marmurkowata (babka marmurkowa) refers to the earlier Latin name: *marmoratus*, which means marbled. Nowadays, another Polish name is used more and more often, that is babka rurkonosa, which is a translation of the English name of the species, i.e. tubenose goby.

Polish name (synonym I) Babka marmurkowa	Polish name (synonym II) Babka rurkonosa
Latin name (synonym I) *Proterorhinus semilunaris*	Latin name (synonym II) -
English name (synonym I) Western tubenose goby	English name (synonym II) Tubenose bleny

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: The species originates from the Ponto-Caspian region. Since the first report in Poland in 2008 in Vistula River near Płock (Grabowska et al. 2008 – P), in a short time it has spread downstream with the river current to the estuary, and moreover, due to active dispersion upstream, it has reached over 270 km up the Vistula (Grabowska 2017 – A). It was also noted in the Vistula Lagoon, many tributaries of the Vistula, including the Bug. The species breeds in our waters without the human assistance and is very numerous locally (Grabowska 2017 – A).

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
	the human domain
	the other domains

acomm04.	Comments: In high density the species may negatively affect the environmental domain through competition for food and habitat with protected native species, including the European bullhead (*Cottus gobio*) (Regulation of the Minister of Environment of 16 December 2016 on protected animal species, Błońska et al. 2016 – P) and stone loach (*Barbatula barbatula*) (Błońska et al. 2017 – P). It may also reduce feed availability for native fish species, through

foraging on bottom invertebrates (Adamek et al. 2010, Vašek et al. 2014 – P). It also increases food base for native predators, fish and fish-eating birds. The same effect was confirmed in other alien goby species established in different habitats in Poland (Płąchocki et al. 2012 – N).

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 circumstances of the appearance of the species in Poland are not entirely clear (Grabowska et al. 2008 – P). One of the possible scenarios is the expansion of the species from Belarus, and more specifically from the Dnieper through Pripyat and Bug via the Royal Canal (Dnieper-Bug Canal), similarly as racer goby and monkey goby migrated, but in the case of tubenose goby, there is no evidence that this way it has penetrated to Poland. During intensive research of the Bug ichthyofauna in August 2007, no specimen of this species was found, and what is more, it was not on the Belarusian side, in the Dnieper-Bug Canal (Semenchenko et al. 2011 – P). It is intriguing to see the sudden appearance of tubenose goby, seven months later (in March 2008) in the Włocławek Reservoir (Lower Vistula). The species in Polish waters spread very quickly due to active dispersal (Grabowska, own observations, unpublished data, 2017 – A). Taking into account that the species is present in Pripyat (Semenchenko et al. 2011 – P) and the current rate of its expansion, it can be assumed that in the near future this river may become a way for tubenose goby to penetrate to Poland, if it was not previously in 2008.

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:

Introduction of the species in new places in large rivers of Europe, e.g. Danube, Rhine, Moselle, Dnieper, is associated with intensive river transport (passive transport e.g. in the form of eggs attached to different elements of submerged parts of barges and ships or as eggs, fry, or even mature individuals, in ballast waters). In addition, the probability of introduction is increased by anthropogenic alteration of the river banks that create extremely convenient habitats for species settlement and breeding, e.g. stone reinforcement in the vicinity of ports, bridges, spurs and above all the connection of large river basins with canals into inland waterways system (Wiesner 2005, Manne et al. 2013, Roche et al. 2013 – P). Further spreading of the species to new basins is expected in this way.

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:

Literature does not mention any incidents of human activities that would lead to the introduction of the species into the natural environment of Poland. However, such introductions cannot be ruled out, for example by aquarists, and as a result of using the species as live bait by anglers.

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:

Given the pace with which the species spreads in our waters (Szydłowska 2017 – P) and its abundance in some places (Płachocki 2017 – P), it can be stated with all conviction that in Poland there are optimal climatic conditions for its establishment. The species successfully reproduces in our waters without the human assistance (Valová et al. 2015 – P, Grabowska 2017 – A).

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 there are optimal habitat conditions for the species establishment, as evidenced by its current range, several years after the first report in Poland (Szydłowska 2017 – P). In many places in the Vistula, the species is very numerous, preferring places with the slowed flow, muddy bottom with dense vegetation in which hides from predators (Płachocki 2017 – P). It also prefers stony places, including reinforcement of banks in the vicinity of ports or bridges and spurs. These types of habitat are also breeding sites for tubenose goby, outside the shelter. The species successfully breeds in our waters without the human assistance (Valová et al. 2015 – P, Grabowska 2017 – A).

A3 | Spread

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

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

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

	very low
	low
	medium
	high
X	very high

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

acomm11. Comments:

Population expansion (type B data)

The species has great ability to spontaneously spread in Polish waters. It was first discovered in the Vistula River, near Płock in March 2008 (Grabowska et al. 2008 – P). In the same year, it was also caught in the Bug, near Terespol (A – J. Grabowska, own observations, unpublished data – A). In 2010, the species was recorded in the Vistula River tributary: Right Skrwa River, the following year in the Osa River (Vistula tributary). In 2011 it reached the estuary section of the Vistula River near Kiezmark (Szydłowska 2017 – P, Grabowska, own research, unpublished – A). At the same time, the species migrated upstream and in 2015 it reached a place about 270 km from the site where it was found for the first time in Poland (Grabowska 2017 – A).

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:

The spread of the species in European large rivers, such as the Danube, Rhine, Moselle, Dnieper is connected with intensive river transport (passive transport e.g. in the form of eggs attached to various elements of submerged parts of barges and ships or as eggs, fry, or even matured individuals, in ballast waters). In addition, the alteration of the river banks, e.g. stone reinforcement in the area of ports and bridges, are an exceptionally convenient habitat of the species, in which it is easy to settle. Such places are the source for numerous secondary introductions with river transport and as a result of spontaneous active dispersal. This is also facilitated by the connection of river basins with canals into inland water system (Wiesner 2005, Manne et al. 2013, Roche et al. 2013 – P). Further spreading of the species to new basins is expected in this way. The circumstances of the appearance of the species in Poland are not entirely clear (Grabowska et al. 2008 – P). One of the most likely scenarios is the expansion of the species from Belarus, and more specifically from the Dnieper through Pripyat and Bug via the Dnieper-Bug Canal, but during intensive research of the Bug fish fauna in 2007, no specimen of the species was found, and what is more, they were not caught in the Dnieper-Bug Canal (Semenchenko et al. 2011 – P). It was intriguing to see its sudden appearance in 2008 in the Włocławek Reservoir (Lower Vistula), but it must be mentioned that it was then caught near the River Shipyard in Płock, which deals, among others, with construction of barges (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
X	medium
	high

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

acomm13. Comments:

The species feeds on various benthic macroinvertebrates, among which, depending on the local availability, crustaceans dominate (Amphipoda, Isopoda – *Assellus* sp.), insect larvae: Chironomidae, Ephemeroptera, Trichoptera, Heteroptera (Adámek et al. 2010, Kocovsky et al. 2011, Vašek et al. 2014 – P). The examination of the content of alimentary tracts of the species during the breeding period of other fish species showed that, contrary to expectations, the share of eggs and fry was very small, and in addition it was the own species spawn (Vašek et al. 2014 – P). Therefore, the species interacts through predation with native species, but only with invertebrates. However, there are no studies on the diet of the tubenose goby in our waters, so it is difficult to indicate whether there are special care species among them. In addition, no special care species were recorded as a prey of tubenose goby in the studies carried out in other parts of the invaded range, e.g. in Slovakia, Germany, although it should be noted that in none of the available publications, the victims of tubenose goby were identified with the accuracy of the species.

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

	low
	medium
X	high

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

acomm14. Comments:

By feeding on various benthic macroinvertebrates (Adámek et al. 2010, Kocovsky et al. 2011, Vašek et al. 2014 – P), which are also food for many native fish species, the tubenose goby may potentially be a competitor for them and/or deplete their food resources. In addition, due to its habitat preferences, i.e. the presence of hiding places, it can compete with some native species for habitat. Especially in the breeding period, the male aggressively defends the place it chose to establish a nest. In a laboratory experiment, it was shown that for a species of special care, such as European bullhead, that has the similar reproductive behavior, the tubenose goby may be a competitor and aggressively hinder the access to the shelter, i.e. the potential nest site (Błońska et al. 2016 – P). It was also observed that in the presence of tubenose goby the European bullhead was displaced from

the most preferred habitat (Van Kessel et al. 2011 – P). The species also has a similar effect on other protected native species, i.e. stone loach, which in the presence of a male goby stays in the shelter for a significantly shorter time. For stone loach, this is not connected with reproductive behaviour, but depriving it of a shelter can, for example, expose it to more frequent attacks by predators (Błońska et al. 2017 – P). It is difficult to determine how the presence of tubenose goby will affect European bullhead and stone loach in the natural environment, because these species can avoid competition through resourse partitioning (Kakareko et al. 2013 – P). Previous observations provide contradictory information. For example, long-term monitoring studies have shown no negative impact of Ponto-Caspian gobies, including the analyzed species, on native fish populations, including European bullhead (Janáč et al. 2018 – P). On the other hand, the study of fish communities showed a decrease in the abundance of European bullhead population after the appearance of gobies (Van Kessel et al. 2016 – P).

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

X	no / very low
	low
	medium
	high
	very high

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

acomm15. Comments:

In Poland, in fresh waters, where tubenose goby occurs, there are no native species from the Gobiidae family, so crossbreeding is impossible. In the coastal zone of the Baltic Sea there are indeed native species of gobies, but tubenose goby probably will not penetrate there, due to salinity. In addition, there are no reports in the literature about crossing of tubenose goby with other goby species.

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 the study of three foreign species of gobies (including tubenose goby) in the Włocławek Reservoir, it was found that the fauna of the parasites of the studied gobies includes 24 taxa. Larval stages of flukes (i.e. metacercarias) from the genus *Holostephanus* spp., *Apatemon gracilis* and *Diplostomum gobiorum* and glochidia, i.e. larvae of some bivalves (swan mussel and mussel) which are parasites on the fish gills, dominated in the parasitofauna of tubenose goby. The Ponto-Caspian gobies from the Włocławek Reservoir were dominated by common parasites, also in native species. Some, such as *Holostephanus* spp. and *Echinochasmus* spp., rarely and in a small number found in local fish, have been abundantly represented in foreign species. In this case, foreign species of fish have become a factor supporting the development of the population of the mentioned parasites in the examined water body. Among the parasites of gobies also the species that have not been recorded earlier in the Włocławek Reservoir appeared, including *Apatemon gracilis*, found in native fish in other reservoirs, which was probably introduced to the Włocławski Reservoir with tubenose goby. A high level of infection of tubenose goby with *A. gracilis* metacercariae was observed in 2008, when the fish appeared in the reservoir. The analysis

of successive fish samples after the introduction of tubenose goby revealed the presence of a parasite both in foreign species (gobies and Amur sleeper), as well as in selected local species typical of the reservoir perch (*Perca fluviatilis*), ruff (*Gymnocephalus cernuus*), three-spined stickleback (*Gasterosteus aculeatus*). In the Włocławek Reservoir, tubenose goby coexists with special care species, i.e. bitterling (*Rhodeus sericeus*), mud loach (*Misgurnus fossilis*) and spined loach (*Cobitis taenia*), however there is no information that the co-occurrence with goby affects the population of the above mentioned species being for them a vector of parasite, because this type of research was not conducted. Diggenic flukes, which dominated the parasitofauna, can potentially infect another host – fish-eating birds, such as seagulls, terns, cormorants, grebes, living in the area of the Włocławski Reservoir (Mierzejewska et al. 2014 – P). Because the assessed effect concerns a very large group of animals occurring in the wild, it was defined as large, but with an average degree of certainty.

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 the ecosystem by disturbing its abiotic factors.

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

	low
X	medium
	high

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

acomm18. Comments:

The species affects ecosystems at different trophic levels, however, so far these changes are easily reversible and do not disturb the integrity of the ecosystem. However, as the species coexists with protected and special care species (i.e. listed in Annex II of the Habitats Directive, such as bitterling, spined loach,mudloach, European bullhead), its impact on the integrity of the ecosystem is assessed as medium. The presence of the species, especially in high density, can alter the tropic relations in the ecosystems by reducing the food base of native invertebrate-eating fish (Adámek et al. 2010, Kocovsky et al. 2011, Vašek et al. 2014 – P) and intensify interspecies competitive interactions for food and space (Błońska et al. 2016, 2017 – P). In addition, this species can be a food for predatory fish, birds and fish-eating mammals, which at the same time can reduce the predatory pressure on native species of fish. It can also be a vector of new parasites and a factor contribution the development of the parasite species population that are common in many native fish (Mierzejewska et al. 2014 – 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 does not affect the cultivation of plants by disturbing their integrity.

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:

The freshwater fish is not a host or vector of pathogens and parasites harmful to 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
X	very low
	low
	medium
	high
	very high

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

acomm24. Comments:

The species does not feed on fish species kept in ponds. In addition, the impact associated with predating on eggs and offspring of commercially important fish species (fishery and angling), should be assessed as very small, since no species has been found so far in fish ponds or in commercial fisheries for anglers. However, tubenose goby occurs in large reservoirs such as the Włocławek Reservoir where fry stocking and commercial catches are conducted, however, even here this effect should be assessed as very small, because although it is suspected that it may feed on fish eggs of economic importance, the analysis of the tubenose goby diet in the wild showed that the share of fish eggs is very small (Vašek et al. 2014 – P).

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

X	very low
	low
	medium
	high
	very high

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

acomm25.	Comments: The species is a small fish (reaches up to 11 cm in length), it is harmless during direct contact with a farm animal. In experimental studies, some aggressive behaviors were observed towards the native species of special care – European bullhead (Błońska et al. 2016 – P), however, there is no information about similar behaviors in relation to farmed species or those obtained economically from the wild.

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: So far the species has not been observed in fish ponds. However, as tubenose goby is present in large reservoirs, where fry stocking and commercial catches are conducted, e.g. in the Vistula Lagoon, Włocławek Reservoir, it can affect the production of animals (economically obtained fish) as a parasite vector for native fish species. The presence of parasites reduces their condition and the quality of meat in the context of consumption. As the studies conducted in the Włocławek Reservoir show, metacercaries of the flukes from the genus *Holostephanus* spp., *Apatemon gracilis* and *Diplostomum gobiorum* and glochidia dominated in the parasitofauna of tubenose goby. This species can introduce new parasites into waters where they have not been found before, resulting in the infection of native fish species, including those that can potentially be bred in ponds, as their additional stock, such as perch (*Perca fluviatilis*), gibel carp (*Carassius gibelio*). For example, *Apatemon gracilis* found in native fish species in other reservoirs was probably introduced into the Włocławski Reservoir along with tubenose goby. The high level of infection of the tubenose goby with metacercaria of *A. gracilis* flukes, i.e. its larval stages, was observed in 2008, when the fish appeared in the reservoir. The analysis of successive fish samples after introduction of the tubenose goby showed the presence of the parasite in some local fish species, typical of the reservoir, such as perch (*Perca fluviatilis*) and ruff (*Gymnocephalus cernuus*). In addition, in the studied reservoir species dominated in the parasites of tubenose goby, are also common in native fish species, so in this case foreign fish species became a factor contributing to the development of the mentioned parasite populations in the studied aquatic reservoir (Mierzejewska et al. 2014 – P). Because the assessed impact refers to a very large group of economically exploited fish in open waters, the influence was defined as large, but with an average degree of certainty.

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

acomm27.	Comments: The species is not a parasite.

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

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm29.	Comments: The species does not carry harmful for human pathogens and parasites. So far, no parasites were found that can infect a man after eating raw fish, which are present in various freshwater fish. In addition, due to the small body size of the species, these fish are not sourced for consumption. Thus, there is little chance of getting infected with such parasites for which a human could be a host.

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:

There are no known cases of tubenose goby affecting the infrastructure. The species is not found in fish ponds and on commercial fishing grounds. In addition, unlike Amur sleeper (*Perccottus glenii***),** stone moroko (*Pseudorasbora parva*) and brown bullhead (*Ameiurus nebulosus*), the species, is not included in the regulations of amateur fishing (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), which prohibits their re-release into the environment in which they were caught. Thus, it does not impose the necessity to utilize "this unwanted" trophy, which is often associated with contamination of the fishery, i.e. recreation area with fishes thrown e.g. "into bushes".

A5a | Impact on ecosystem services

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

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm31.	Comments:

Tubenose goby is not found in fish ponds and on commercial fishing grounds. However, in open waters it co-exists with economically-important fish species . If, after appearing in a given water reservoir, this species has become an important element of the predatory fish diet obtained commercially (by fishermen) and recreational (by anglers), its impact would be considered moderately positive. However, this type of data is missing.

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32.	Comments:

The impact of this species on regulatory services was defined as moderately negative due to the fact that it affects the parasites prevalence in fish assemblages in a given watres body. The study of three foreign species of gobies (including this species) conducted in the Włocławek Reservoir found that the list of parasites reported in the studied gobies covered 24 taxa, including flukes from the genus *Holostephanus* spp., *Apatemon gracilis* and *Diplostomum gobiorum*.

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

The species may have a slight influence on angling recreation in two ways: positive, as food for predatory fish and negative by depleting the food resources and through competition with native fish species. In both cases, there are no studies that would explicitly confirm this type of influence. Since these two effects are probably balanced, and at the same time the study did not show that it feeds on the eggs and fry of aquaculture species (Vašek et al. 2014 – P), the impact of the species was assessed as neutral. So far, tubenose goby was not found in fish ponds and on commercial fishing grounds. This species, unlike Amur sleeper (*Perccottus glenii*), stone moroko (*Pseudorasbora parva*) and brown bullhead (*Ameiurus nebulosus*), is not included in the regulations of amateur fishing (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), which prohibits their re-release into the environment in which they were caught. Thus, it does not impose the necessity of utilizing "this unwanted" gain.

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 has already inhabited many different waters in Poland and global warming will not change the probability of its introduction. Some authors believe that the rapid invasion of this species in different regions of Europe, like in the case of other gobies from the same region of Eurasia, is associated with the currently observed increase in mean annual temperatures (Harka and Bíró 2007 – P).

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm35. Comments:

The species has already inhabited many different waters in Poland, where it successfully reproduces and locally is very numerous, which means that it is established well and climate warming will not change the probability of its establishment in our waters.

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 has already inhabited many different waters in Poland and global warming will not change the likelihood of its further spreading, as the temperature does not constitute a barrier in the dispersion of tubenose goby.

a37. IMPACT ON THE ENVIRONMENTAL DOMAIN – Due to climate change, the consequences of *the species* on wild animals and plants, habitats and ecosystems in Poland will:

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm37. Comments:

The climate warming will not significantly change the impact of the species on the 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 is a freshwater fish, carnivorous, not affecting the cultivation and production of plants.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm39. Comments:

Climate warming will not increase the species impact on animal husbandry. So far, no species has been found in fish ponds or commercial fisheries, where it could affect fish production, and it is unlikely that it would inhabit this type of environment, as in the natural part of its range it is not found in fish ponds.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm40. Comments:

Climate warming will not increase the impact of the species on people.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

The species does not affect other objects and it is difficult to imagine that this would change as a result of global warming.

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)	0.46	0.92
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.25	0.50
Human impact (questions: a27-a29)	0.00	1.00
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	1.00	1.00
Impact (questions: a13-a30)	0.46	0.88
Overall risk score	0,46	
Category of invasiveness	potentially invasive alien species	

A6 | Comments

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

acomm42. Comments:

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4. Other (I)

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5. Author's own data (A)

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