



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. Katarzyna Zając
2. Kamila Zając – external expert
3. Karolina Mazurska

acomment1.	Comments:	degree	affiliation	assessment date
(1)	dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	22-01-2018	
(2)	mgr	Institute of Environmental Sciences, Jagiellonian University, Kraków	22-05-2018	
(3)	mgr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	28-05-2018	

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

Polish name: Ślinik zmienny
Latin name: ***Arion distinctus*** Mabilie, 1868
English name: Darkface arion

acomm02.

Comments:

The darkface arion (*Arion distinctus*) was described by Mabille in 1868, however earlier it was known under common name as the garden slug *Arion hortensis* s. l. to determine the collective species for *A. hortensis*, *A. owenii* and *A. distinctus* (Iglesias and Speiser 2001, Kozłowski 2010, Welter-Schultes 2012 – P). From among species belonging to this complex, only the darkface arion (*A. distinctus*) appears in Poland (Riedel and Wiktor 1974, Wiktor 2004 – P).

Polish name (synonym I)

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Polish name (synonym II)

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Latin name (synonym I)

Arion cottianus

Latin name (synonym II)

Arion hortensis

English name (synonym I)

Small striped slug

English name (synonym II)

Garden slug

a03. Area under assessment:

Poland

acomm03.

Comments:

–

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

- | | |
|-------------------------------------|--|
| <input type="checkbox"/> | native to Poland |
| <input type="checkbox"/> | alien, absent from Poland |
| <input type="checkbox"/> | alien, present in Poland only in cultivation or captivity |
| <input type="checkbox"/> | alien, present in Poland in the environment, not established |
| <input checked="" type="checkbox"/> | alien, present in Poland in the environment, established |

aconf01.

Answer provided with a

low

X

medium

high

level of confidence

acomm04.

Comments:

The darkface arion has been brought to distant continents and proves to expand strongly in all directions (Wiktor 1973, 2004 – P). The species origin is not precisely known, although it is presumed that it has originally come from Western Europe (Wiktor 2004 – P). It appears in Apennine and Iberian Peninsula, and in the whole Western Europe including Great Britain. It is also present in Bulgaria, Romania, Ukraine, western Russia, and in former Yugoslavia countries (Croatia, Serbia and Slovenia). It spreads in Scandinavian countries (Norway, Sweden and Finland), and in the Baltic countries (Lithuania, Latvia and Estonia) (Welter-Schultes 2012 – P). The species sites are observed in northern part of Africa, the United States (Mc Donnell et al. 2009, Kozłowski 2010, – P), Canada (Forsyth 2004 – P) and New Zealand (Barker 1999, 2002 – P). In Poland, the darkface arion appeared first before 1973 (Głowaciński and Pawłowski 2011 – P). Wiktor (2004) states that the species occurs in western part of the country, in Lower Silesia, Greater Poland and Pomerania. The darkface arion status is not entirely known, the area of western Poland may belong to its primary range of extent and there it may be regarded as a native species (Welter-Schultes 2012 – P, Rowson 2017 – B). On the other hand, this species appears as a synanthrope, indicating that in some areas it is alien, and there are its sites known proving that they are not natural, e.g. near Elbląg (Wiktor 2004 – P). Considering the analysed literature information, it can be stated with little degree of certainty that within Poland the darkface arion *Arion distinctus* is alien, settled, and it appears in natural environment throughout the country.

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

- | | |
|-------------------------------------|------------------------------|
| <input checked="" type="checkbox"/> | the environmental domain |
| <input checked="" type="checkbox"/> | the cultivated plants domain |

<input checked="" type="checkbox"/>	the domesticated animals domain
<input checked="" type="checkbox"/>	the human domain
<input type="checkbox"/>	the other domains

acommm05.

Comments:

The darkface arion may cause considerable losses in vegetable crops, in particular cabbage, lettuce, celery and garden beets. It is also a pest for papilionaceous plants, winter rape, as well as strawberry and winter strawberry fruit (Kozłowski 2010 – P). The darkface arion has also an impact on wild plants, e.g. it consumes lesser celandine *Ficaria verna* flowers, thus affecting its reproduction (Prokop and Fedor 2016 – P). The darkface arion influences natural environment, and in particular other animals. It is an intermediate host for vertebrata parasites, e.g. nematode *Angiostrongylus vasorum* (Patel et al. 2014 – P), for which *Canidae* are the final hosts, including the red fox *Vulpes vulpes* (Demiaszkiewicz et al. 2014 – P) and wolf *Canis lupus* (Szczęsna et al. 2007 – P), but also domestic breed animals, dogs and cats (Schnyder et al. 2013, Tomczuk and Szczepaniak 2014 – P). The darkface arion is among the prey of predacious carabid beetles (*Carabidae*), e.g. protected European ground beetle *Carabus nemoralis* (Hatteland et al. 2013 – P), which shows opportunism as a predator by catching the prey, which is easiest to get at a certain moment. The darkface arion can affect human life to a little degree. The species has potential ability to spread nematode *Angiostrongylus cantonensis*, which causes human eosinophilic cerebrospinal meningitis (Cowie 2017, Bouwknegt et al. 2018 – P). Moreover, the darkface arion may be the vector of pathogenic bacteria (inducing gastrointestinal tract infections), which can be transmitted by the darkface arion onto vegetables (Sproston et al. 2006, Raloff 2007 – P). The darkface arions may transmit bacteria, e.g. *Clostridium botulinum*, which induce botulism (Gismervik et al. 2014 – P), or *Listeria monocytogenes* responsible for listeriosis (Gismervik et al. 2015 – P). High concentration of the darkface arions may result in contamination of silos containing green fodder (ensilages) with bacteria, thus posing a threat for breed animals health.

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:

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf02.

Answer provided with a

low	medium	high
		<input checked="" type="checkbox"/>

level of confidence

acommm06.

Comments:

The darkface arion is present and settled in Poland; it is sometimes regarded as a native species, especially in south-eastern part of the country (Rowson 2017 – B). It is capable of independent, natural relocation. In Poland, the species appeared before 1973 (Głowaciński and Pawłowski 2011 – P). It is present in western part of the country – Lower Silesia, Greater Poland and Pomerania (Wiktor 2004 – P). Kozłowski confirms that in recent years the slug has been observed also in Małopolskie and Opolskie Voivodeships (acc. to Kozłowski 2010 – P). Today, the darkface arion appears throughout the country, and in neighbouring countries (Germany, Slovakia, Czech Republic, Ukraine, Lithuania) (Juříčková et al. 2001, Horsák et al. 2004, Skujiene 2004, Gural-Sverlova and Gural 2016 – P).

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf03.	Answer provided with a	low	medium	high X	level of confidence
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acomment07. Comments:
 The darkface arion is settled in Poland. Its primary range of extent is not precisely known, however it is presumed that it originally comes from Western Europe (Wiktor 2004 – P). It appears in Apennine and Iberian Peninsula, and in the whole Central and Western Europe including Great Britain. Moreover, it is present in Bulgaria, Romania, Croatia, Slovenia and Serbia. The species sites are in Scandinavian Peninsula (e.g. Backeljau et al. 1983 – P), in the Baltic countries, in western Russia and Ukraine (Welter-Schultes 2012 – P). It is also present in northern part of Africa. It was incidentally brought to the United States, Canada and New Zealand (Barker 1999, Forsyth 2004, Kozłowski 2010 – P). In Poland, the species appeared before 1973 (Głowaciński and Pawłowski 2011 – P); the species is present in western part of the country – in Lower Silesia, Greater Poland and Pomerania (Wiktor 2004 – P), and it continuously increases its range of extent. In 1994 it was observed in Rzeszów and Poznań (Kozłowski et al. 1996 – P), and after 2006 – in Kęty, Oświęcim and Opole (Kozłowski and Kozłowski 2010 – P). The darkface arion long distance propagation mainly results from human activity. The species may proliferate to new areas with transports of goods (crop plants, pot plants, home garden materials, etc.).

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

aconf04.	Answer provided with a	low	medium	high X	level of confidence
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acomment08. Comments:
 The darkface arion is settled in Poland. According to risk assessment methodology *Harmonia*^{PL}, this determines selection of the response: high probability at significant degree of certainty. At the same time, it should be emphasised that there are no premises to state that this species could have been introduced in natural environment due to planned human activity. It has never been a subject of economic interest.

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:

<input type="checkbox"/>	non-optimal
<input type="checkbox"/>	sub-optimal
<input checked="" type="checkbox"/>	optimal for establishment of <i>the species</i>

aconf05.	Answer provided with a	low	medium	high X	level of confidence
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acom09. Comments:
 The darkface arion is settled in Poland, it is highly tolerant to climatic conditions, which is proven by its occurrence in different regions of the world (Western Europe, Norway, Bulgaria, Apennine and Iberian Peninsulas, Great Britain, Africa, the United States, Canada, New Zealand) – characterised by diverse environmental conditions (Bacheljau et al. 1983, Barker 1999, Forsyth 2004, Wiktor 2004, Kozłowski 2010 – P). The climatic conditions in Poland fully satisfy the species demands.

a10. Poland provides **habitat** that is

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

aconf06. Answer provided with a

low	medium	high X
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 level of confidence

acom10. Comments:
 The darkface arion is settled in Poland, where it has found suitable habitat conditions for its survival and reproduction. It lives mainly as a synanthrope and appears in gardens, parks, cemeteries, dumping grounds and rubbles, composts, greenhouses (Wiktor 2004, Kozłowski 2010 – P). It is present in forests and scrubs modified by human activity (Wiktor 2004 – P). More and more often it is found in arable and garden crops, where it poses serious threat to cultivated plants (Kozłowski 2010, Kozłowski and Kozłowski 2010 – P). The darkface arion reproduces in Poland, survives wintertime and establishes numerous, lasting populations, which proves that local habitat conditions are optimal for it.

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
- very high

aconf07. Answer provided with a

low	medium	high X
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 level of confidence

acom11. Comments:
 Dispersion from a single source (Data type: A)
 In Poland, the darkface arion appeared before 1973 (Głowaciński and Pawłowski 2011 – P). According to the literature information, the species is present in western part of the country, in Lower Silesia, Greater Poland and Pomerania, and it continuously increases its range of extent (Wiktor 2004 – P). In 1994 it was observed in Rzeszów and Poznań (Kozłowski et al. 1996 – P), in the years 1993-1996 in the area of Wałbrzych Basin and Foothills (Maltz 1999 – P), the Ostrzeszów Hills (Baucz-Malij 1998 – P), whereas after 2006 – in Kęty, Oświęcim and Opole (Kozłowski and Kozłowski 2010 – P). The fact of finding other sites of the darkface arion shortly after the species arrival in the country proves its considerable potential for spreading in Poland without the help of man. The darkface arion reaches highest population

levels in arable and garden crops, and from there, spontaneously and unaided by man, it colonises new sites characterised by the presence of non-drying areas, herbaceous vegetation and scrubs. Estimated annual distance covered by this slug can be considerable, over 50 km per year, and thus the species potential to spread without the help of man is significant.

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

<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high

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

acomm12. Comments:
 With the help of man, the darkface arion spreads at high rate. This species is strongly bound with environments to a large extent degraded by human activity, as well as with arable areas, where it is a serious pest for cultivated plants (Kozłowski 2012a, b – P). The species may proliferate to new areas with transports of goods (crop plants, pot plants, home garden materials, window boxes, etc.). More than 10 cases per a decade are expected, where the darkface arion specimens will relocate to a distance exceeding 50 km.

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:

<input type="checkbox"/>	inapplicable
<input checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

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

acomm13. Comments:
 The darkface arion impact on the native species as a predator, parasite or herbivore is insignificant since at the most it causes minor drops in populations of those native species, which are not of special care. The darkface arion is herbivorous; it appears not only in arable and garden crops (Kozłowski 2010, Kozłowski and Kozłowski 2010 – P) but it often proliferates in habitats adjacent to crops, where it damages herbaceous plants while feeding, e.g. greater burdock *Arctium lappa*, white goosefoot *Chenopodium album*, gallant soldiers *Galinsaga praviflora*, common nettle *Urtica dioica* (Kozłowski 2012b – P). In more natural environments, e.g. in river valleys, the darkface arion does not reach so high concentrations as in crops. On the other hand, in ruderal habitats, in which it may also appear in large numbers, precious species are rather not observed. Therefore, locally it may



have considerable effect on vegetation, but in the scale of entire Poland it causes only slight drops in the populations of those native species, which are not of special care (Riedel and Wiktor 1974, Kozłowski 2010, 2012a, b – P).

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

<input checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

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

acom14. Comments:
 It has not been observed that by competition the darkface arion would cause significant drops in the populations of native species, including those of special care. In environments, which are close to natural, this species does not reach high populations. Faunistic studies have proven that the darkface arion may live next to other land snail species without displacing them (Maltz 1999, Szybiak 2008 – P). Until now, it hasn't been observed that the presence of the darkface arion in natural environment would cause displacement of endangered and protected land snail species (e.g. lapidary snail *Helicigona lapicida*, cheese snail *Helicodonta obvolvata*, door snail *Charpentieria ornata*) (Maltz 1999 – P).

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

<input checked="" type="checkbox"/>	no / very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

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

acom15. Comments:
 The probability of the darkface arion impact on native species through crossing with them is low, because no cases of its crossing with other species are known (Foltz et al. 1982, Soroka and Skujiene 2011 – P). The effect of the darkface arion impact on the native species through crossing is low, since until now it hasn't been observed that it causes the loss of genetic integrity of those native species, which are not of special care.

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

<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input checked="" type="checkbox"/>	high
<input type="checkbox"/>	very high

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

acom16. Comments:
 The darkface arion, same as other *Arion* genus slugs, may be the host for a parasite – French heartworm nematode *Angiostrongylus vasorum*, which induces angiostrongylosis, a disease which may affect foxes, and not so often other carnivorous animals including wolves, coyotes and felids (Ferdushy et al. 2010, Majoros et al. 2010, Frączyk and Gawor 2014, Tomczuk and Szczepaniak 2014 – P). This disease is curable, although in extreme cases it may result in animal death (Frączyk and Gawor 2014 – P). Nematode *A. vasorum* has been found in wolves living in the Bieszczady Mountains (Szczęsna et al. 2007 – P).

A. vasorum has been characterised all over the world, including a dozen or so European countries. Currently, the parasite spreads increasing its geographical extent (Patel et al. 2014 – P). The cases of this nematode occurrence have been observed in foxes in Spain and Croatia (Frączyk Gawor 2014 – P), Portugal (Alho et al. 2018 – P), and Poland (Demiaszkiewicz et al. 2014 – P). The darkface arion may also host other nematode species, as e.g. *Angiostoma liimacis* (Angiostomatidae) or *Phasmarhabditis neopapillosa* (Rhabditidae) (Ross et al. 2010 – P), and parasites and pathogens from other systematic groups (South 1992, Barker 2004 – P). Nevertheless, the darkface arion impact on their spread and effect on wild native species has not been discovered. The impact on native species resulting from transmission of pathogens and parasites by the darkface arion may be characterised as considerable, because the darkface arion is a host and vector for pathogens and parasites, which pose a threat to native species, also those of special care (the nematode *A. vasorum* is a parasite found in wolves (Szczęsna et al. 2007 – P)), at the most causing minor drops in their populations.

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

<input checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

aconf13.	Answer provided with a	low	medium	high	level of confidence
		<input checked="" type="checkbox"/>			

acomment17. Comments:
 There is no information concerning the darkface arion impact on the integrity of terrestrial ecosystems in Poland by way of disturbing their abiotic factors. Nevertheless, it should be emphasised that until now, there have been no studies conducted on this sort of impact exerted by the species, even in the cases of its mass occurrence. Therefore, it is ultimately not sure if such an impact exists at all, and thus the answer has been given with little degree of certainty.

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

<input checked="" type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high

aconf14.	Answer provided with a	low	medium	high	level of confidence
				<input checked="" type="checkbox"/>	

acomment18. Comments:
 The possible impact of the darkface arion on the ecosystem integrity by way of disturbing its biotic factors is demonstrated by plant damage while the slug is feeding, and/or increasing the number of occurring in the environment predacious carabid beetles (*Carabidae*) protected in Poland. The darkface arion is sometimes the prey of predacious European ground beetle *Carabus nemoralis*, which devours the slug eggs and juveniles (Hatteland et al. 2013 – P). All in all, the darkface arion impact on the ecosystem integrity by way of disturbing its biotic factors may be characterised as minor, since the species may induce easily reversible changes regarding the processes occurring in habitats, which are not of special care.

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:

<input type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input checked="" type="checkbox"/>	very high

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

acomment19. Comments:
 The darkface arion is a serious pest for many species of vegetables, and ornamental, agricultural, orchard and herbaceous plants (Kozłowski and Kozłowski 2010, Kozłowski 2010, 2012a, b – P). It damages crops of common cabbage (*Brassica oleracea* var. *capitata* f. *alba*), lettuce (*Lactuca sativa* var. *capitata*), garden beet (*Beta vulgaris* var. *conditiva*), horseradish (*Armoracia lapathifolia*), strawberries, wild strawberries, winter rape (*Brassica napus* ssp. *napus*), sunflower (*Helianthus annuus*), celery (*Apium graveolens*), potatoes (*Solanum tuberosum*), Persian clover (*Trifolium resupinatum*), and maize (*Zea mays*) (Kozłowski 2010 – P). Moreover, it feeds on herbaceous and ornamental plants, such as garden dahlia (*Dahlia variabilis*) or elegant zinnia (*Zinnia elegans*). It damages greater burdock (*Arctium lappa*), white goosefoot (*Chenopodium album*), gallant soldiers (*Galinsoga praviflora*) and common nettle (*Urtica dioica*), in crops regarded as weeds (Kozłowski 2012b – P). The probability, with which the darkface arion feeds on crop plants, is high. It is expected that more than 2/3 of invaded plant crops will be affected. In the worst case the condition of plants or yield from a single crop will be reduced by more than 20% (significant effect).

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

<input checked="" type="checkbox"/>	inapplicable
<input type="checkbox"/>	very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

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

acomment20. Comments:
 The species is not a plant.

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

<input checked="" type="checkbox"/>	inapplicable
<input type="checkbox"/>	no / very low
<input type="checkbox"/>	low
<input type="checkbox"/>	medium
<input type="checkbox"/>	high
<input type="checkbox"/>	very high

aconf17. Answer provided with a

low	medium	high
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 level of confidence

acomm21. Comments:
The species is not a plant.

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

- very low
- low
- medium
- high
- very high

aconf18. Answer provided with a

low	medium	high X
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 level of confidence

acomm22. Comments:
The darkface arion will not affect the condition or yielding of crop plants through modification of agroecosystem properties, including circulation of elements, hydrology, physical properties, trophic networks, etc. The darkface arion damages crop plants directly as an herbivore, although its impact on crop integrity disturbance hasn’t been observed yet (Kozłowski 2010, Kozłowski 2012a, b – P).

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

- very low
- low
- medium
- high
- very high

aconf19. Answer provided with a

low	medium X	high
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 level of confidence

acomm23. Comments:
It hasn’t been observed that the darkface arion affects plant crops as a host or vector of pathogens and parasites harmful for these plants (Kozłowski 2010, Kozłowski 2012a, b – P). However, this matter hasn’t been explored very well. Few reports available indicate that slugs of the *Arion* sp. genus may transmit fungus *Alternaria brassicicola*, which induces alternariosis of cruciferous plants – that is the so-called black spot (disease) of brassicas. Hasan and Vago (1966 – P) were observing the *Arion* sp. genus slugs feeding on infected cabbage leaves. After a week they were finding viable conidia (spores) in their excreta. The species effect has been evaluated as minor, because *Alternaria brassicicola* is not entered in the EPPO lists.

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
- high
- very high

aconf20. Answer provided with a

low	medium	high
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 level of confidence

acomm24. Comments:
The darkface arion is a herbivorous species, and thus there have been no reports received as regards its impact as a predator or parasite on the health of a single animal or animal production.

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

- very low
- low
- medium
- high
- very high

aconf21. Answer provided with a

low	medium	high X
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 level of confidence

acomm25. Comments:
Until now, no impact of this species has been confirmed as regards health of an individual animal or animal production resulting from its inherent properties, which pose a threat in case of a direct contact.

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
- high
- very high

aconf22. Answer provided with a

low	medium	high X
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 level of confidence

acomm26. Comments:
There is a significant impact of the darkface arion on the health of single animals or animal production by way of transmitting pathogens and parasites harmful for these animals, because, same as other *Arion* genus slugs, it may be an intermediate host for parasitic nematode *Angiostrongylus vasorum*, which induces angiostrongylosis, a disease that may affect dogs, and not so often other carnivorous animals as *Felidae* (Ferdushy et al. 2010, Majoros et al. 2010, Frączyk and Gawor 2014, Szczepaniak et al. 2014, Tomczuk and Szczepaniak 2014 – P). This parasitic nematode lives in blood vessels of heart and lungs, inducing a disease, which is potentially lethal for these animals. The disease is curable, although in extreme cases it may result in animal death (Frączyk and Gawor 2014 – P). *A. vasorum* appears in many countries all over the world, i.a. it has been characterised in a dozen or so European countries. Currently, the parasite spreads increasing its geographical extent (Patel et al. 2014 – P). It has been found in dogs in Italy, Greece, Switzerland, Holland and Hungary (Frączyk and Gawor 2014 – P), in Portugal (Alho et al. 2018 – P), and in Poland (in dogs and cats) (Schnyder et al. 2013, Tomczuk and Szczepaniak 2014 – P). Other parasitic nematodes (e.g. Grewal et al. 2003, Ross et al. 2010 – P) and parasites and pathogens from other systematic groups (South 1992, Barker 2004 – P), for which breed animals are definitive

hosts, have been also found in land snails including those of *Arion* genus. However, the darkface arion *A. distinctus* influence on their proliferation and the impact on the species of breed and domestic animals has not been recognised.

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:

- inapplicable
- very low
- low
- medium
- high
- vert high

aconf23. Answer provided with a

low	medium	high
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 level of confidence

acomm27. Comments:
The darkface arion is not a human parasite.

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

- very low
- low
- medium
- high
- very high

aconf24. Answer provided with a

low	medium	high X
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 level of confidence

acomm28. Comments:
Despite the fact that the probability of the darkface arion meeting a man is high (more than 100 cases per 100,000 people in a year), its effect is minor. It may affect mental condition of people inducing their fear or repulsion (phobia), although the probability that such a condition occurs is low (rather less than one person per 100,000 people in a year), and it will not cause absence at work or permanent deterioration of organism functioning (Gustavson and Weight 1981 – P).

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

- inapplicable
- very low
- low
- medium
- high
- very high

aconf25. Answer provided with a

low	medium X	high
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 level of confidence

acommm29.

Comments:

Until now, no studies have been conducted on the parasites and pathogens dangerous for man and transmitted by the darkface arion. On the other hand, *Arion* genus slugs are intermediate hosts for parasitic nematodes, which include parasites inducing serious human diseases (Grewal et al. 2003 – P). Among them, the nematode *Angiostrongylus cantonensis* causes eosinophilic cerebrospinal meningitis. Adult specimens live as parasites in rats (definitive hosts). People get infected (secondary host) as a result of consuming raw, infected slugs (intermediate hosts), as well as vegetables and other foods contaminated by snail mucus. The disease appears in tropical and subtropical regions of the world, primarily in Southeast Asia. From there it has spread to the Pacific Basin countries, the Caribbean, and subtropical and tropical regions of both Americas. Until now, there have been a dozen or so cases of human infections with this parasite reported from eight European countries; although the infections took place out of Europe (Luessi et al. 2009, Maretić et al. 2009 – P). However, a single case not connected with travelling was observed in Israel (Fellner et al. 2016 – P). Moreover, infected rats and slugs were found in Spanish Tenerife (Martin-Alonso et al. 2015 – P). Probably, these incidents and climate warming in progress (Cowie 2017 – P) became the reason for including this parasite in the European ranking of human parasites, transmitted with food (Bouwknegt et al. 2018 – P). Any possible effect of the darkface arion on spreading of this parasite has not been examined in detail. Potentially, the darkface arion may be the vector of pathogenic nematode *A. cantonensis*, because it spreads with crop plants and vegetable food products, which might be contaminated by it. Currently, it is possible to point out the areas, in which both species appear at the same time, and where the slug could get infected. Moreover, slugs as the darkface arion, which occur in field and greenhouse crops and may appear in products including spinach and lettuces, are potential vectors for bacteria pathogenic for people, as e.g. *Campylobacter* spp. inducing dangerous diarrhoeas, and *E. coli Escherichia coli* (Migula) – serotype O157:H7. Gastrointestinal tract of animals, mainly birds, but also land snails, for which this bacterium is a commensal, is a natural reservoir for *Campylobacter* (Raloff 2007 – P). *E. coli* O157:H7 is a type of this bacterium, which is highly dangerous for man, mainly due to the production of SLT toxin inducing the so-called haemolytic-uremic syndrome (HUS), which may cause kidney damage. The sources of infection may include various domestic and wild animals, e.g. wild boars (*Sus scrofa*) approaching crops and bred bovine animals, as well as slugs present in crops (Sproston et al. 2006 – P). No possible impact of the darkface arion on spreading of this pathogen has been confirmed yet.

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:

- | | |
|-------------------------------------|-----------|
| <input checked="" type="checkbox"/> | very low |
| <input type="checkbox"/> | low |
| <input type="checkbox"/> | medium |
| <input type="checkbox"/> | high |
| <input type="checkbox"/> | very high |

aconf26.

Answer provided with a

low	medium	high
		X

level of confidence

acommm30.

Comments:

There is no information confirming that the darkface arion has or may have negative effect on the infrastructure. Although it leaves mucus trail while crawling, it does not affect 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:

<input checked="" type="checkbox"/>	significantly negative
<input type="checkbox"/>	moderately negative
<input type="checkbox"/>	neutral
<input type="checkbox"/>	moderately positive
<input type="checkbox"/>	significantly positive

aconf27.	Answer provided with a	low	medium	high X	level of confidence
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acomment31. Comments:
The darkface arion has highly negative effect on the supply services, and it affects catering services. The species is a serious pest for many species of vegetables, and ornamental, agricultural, orchard and herbaceous plants (Kozłowski 2010, 2012a, b – P). Moreover, it affects breeding of domestic and farm animals, because *Arion* genus slugs may be the vector for pathogens and parasites (South 1992. Ferdushy et al. 2010, Gismervik et al. 2014, 2015 – P). The darkface arion damages and devours juvenile plant organs, primarily seedlings and offshoots. While preying it may damage plants used to generate energy, e.g. sunflower and rape (Kozłowski and Jaskulska 2014 – P).

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

<input type="checkbox"/>	significantly negative
<input type="checkbox"/>	moderately negative
<input checked="" type="checkbox"/>	neutral
<input type="checkbox"/>	moderately positive
<input type="checkbox"/>	significantly positive

aconf28.	Answer provided with a	low	medium	high X	level of confidence
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acomment32. Comments:
The darkface arion has both positive and negative influence on control services. As a matter of fact, it does not affect air composition and climate, extreme phenomena, soil processes, pollution control and self-cleaning, although slugs belonging to this genus have some share in biological control: they consume dead organisms, seedlings, juvenile offshoots, fruit, but also seeds of some plants, which are relocated to other places in this way, and thus become germinable (e.g. wood anemone *Anemone nemorosa*, lesser celandine *Ficaria verna*; Türke et al. 2010 – P). Another example of the darkface arion positive impact on control services: these slugs belong to the prey of predacious carabid beetles, e.g. protected European ground beetle (Hatteland et al. 2013 – P). First of all, European ground beetle devours the slug eggs and juvenile specimens. Higher availability of the darkface arion will increase the population of predacious carabid beetles. Moreover, the *Arion* genus slugs also influence control of zoonotic diseases. They are intermediate hosts for parasitic nematodes, for which definitive hosts include other organisms, as vertebrates and people (Grewal et al. 2003 – P). It is an example of negative impact on control services. According to this information proving both positive and negative effect of the species on control services, “neutral effect” rating has been proposed.

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

- significantly negative
- moderately negative
- neutral
- moderately positive
- significantly positive

aconf29. Answer provided with a

low	medium	high
		X

 level of confidence

acomm33. Comments:
 The darkface arion has neutral effect on cultural services. This effect is in part positive – the species is a subject of scientific studies, e.g. in the context of its impact on plant crops and control methods (Kozłowski 2012a, b – P). On the other hand, the darkface arion has negative impact on aesthetic and recreational functions, because it is a pest for many species of vegetables, ornamental, agricultural, orchard and herbaceous plants grown in home/allotment gardens (Kozłowski 2010, 2012a, b – P). Moreover, it may induce fear and repulsion in people.

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

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

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

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf30. Answer provided with a

low	medium	high
X		

 level of confidence

acomm34. Comments:
 The probability that due to climate changes the darkface arion will overcome geographical barriers and other barriers connected with animal breeding or plant growing in Poland, will not change. The darkface arion is highly tolerant to climatic conditions, which is proven by its occurrence in different regions of the world (Western Europe, Norway, Bulgaria, Apennine and Iberian Peninsula, Great Britain, Africa, the United States, Canada, New Zealand). These locations are characterised by various environmental conditions (Backeljau et al. 1983, Barker 1999, Forsyth 2004, Wiktor 2004, Kozłowski 2010 – P). The species is present i.a. in arable areas, and this is where it primarily increases its range of extent. The darkface arion expansion in Poland does not seem to be connected with climate changes. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf31. Answer provided with a

low X	medium	high
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 level of confidence

acommm35. Comments:
The probability that due to climate changes the darkface arion will overcome the barriers, which until now have been hindering its survival and reproduction in Poland, will not change. Today, it is a settled species in Poland. The species is present i.a. in arable areas, and this is where it primarily increases its range of extent. Settlement of the darkface arion in Poland does not seem to be connected with climate changes. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf32. Answer provided with a

low X	medium	high
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 level of confidence

acommm36. Comments:
The probability that due to climate changes the darkface arion will overcome the barriers, which until now have been hindering its proliferation in Poland, will not change. It appears in western part of the country – in Lower Silesia, Greater Poland and Pomerania, and it continuously increases its range of extent (Wiktor 2004 – P). The species is present i.a. in arable areas, and this is where it primarily increases its range of extent. The darkface arion expansion in Poland does not seem to be connected with climate changes. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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
- increase moderately
- increase significantly

aconf33. Answer provided with a

low X	medium	high
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 level of confidence

acommm37. Comments:
The probability that due to climate changes the darkface arion effect on wild plants and animals, and habitats and ecosystems in Poland will be different, will not change. The species is present i.a. in arable areas, and this is where it primarily increases its range of extent, which seems to be unrelated with climate changes. Little degree of certainty for the

answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf34. Answer provided with a

low	medium	high
X		

 level of confidence

acomm38. Comments:
The darkface arion reaches its highest populations in plant crops, which seems to be unrelated with climate changes. More crop pests with much the same preferences may appear, capable of competing with the darkface arion. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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
- increase moderately
- increase significantly

aconf35. Answer provided with a

low	medium	high
X		

 level of confidence

acomm39. Comments:
The darkface arion is a vector and intermediate host for parasitic nematodes inducing diseases of domestic and farm animals. These diseases are more frequent in warm climatic zones; therefore climate warming may cause higher frequency of their occurrence in Poland. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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

- decrease significantly
- decrease moderately
- not change
- increase moderately
- increase significantly

aconf36. Answer provided with a

low	medium	high
X		

 level of confidence

acomm40. Comments:
The darkface arion belongs to the *Arion* genus that has proven to host the larvae of a nematode, which may cause human eosinophilic cerebrospinal meningitis. Expansion of this disease is connected i.a. with climate warming; therefore it has been deemed that the probability of increasing this species impact on people due to climate changes will grow moderately. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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
- increase moderately
- increase significantly

aconf37. Answer provided with a

low X	medium	high
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 level of confidence

acomment41. Comments:
No darkface arion impact on other objects in Poland has been proven, and it is not expected that climate changes would induce any impact of this type. Little degree of certainty for the answer given results from the lack of studies on the effect of climate changes on the darkface arion.

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)	0.13	0.83
Cultivated plants impact (questions: a19-a23)	0.42	0.83
Domesticated animals impact (questions: a24-a26)	0.38	1.00
Human impact (questions: a27-a29)	0.13	0.75
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	1.00	1.00
Impact (questions: a13-a30)	0.42	0.88
Overall risk score	0.42	
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 regularly repeated.

acomment42. Comments:
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3. Unpublished data (N)

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4. Other (I)

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5. Author's own data (A)

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