



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. Rafał Martyka – external expert
2. Piotr Tryjanowski – external expert
3. Karolina Mazurska

acomment1.	Comments:	degree	affiliation	assessment date
(1)		dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	08-05-2018
(2)		prof. dr hab.	Institute of Zoology, Poznań University of Life Sciences	28-05-2018
(3)		mgr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	29-05-2018

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

Polish name: Aleksandretta obrożna
Latin name: ***Psittacula krameri*** (Scopoli 1769)
English name: Ring-necked parakeet

acommm02.	Comments:		
	Polish name (synonym I)	–	Polish name (synonym II)
	Latin name (synonym I)	<i>Psittacus krameri</i>	Latin name (synonym II)
	English name (synonym I)	Rose-ringed parakeet	English name (synonym II)

a03. Area under assessment:

Poland

acommm03.	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	medium	high X	level of confidence
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acommm04.	Comments:
	Rose-ringed parakeet was observed for the first time in Poland ca. 1994 (Gatunki obce w Polsce 2018 – B). Since then these parrots are observed at various frequency and in different parts of Poland. According to data from the Polish database of bird records, in the years 2009-2018 rose-ringed parakeets were reported in 15 atlas fields (10 x 10 km), with the total number of 55 records (Ornitho.pl 2018 – B). In most cases single birds, rarely two individuals at the same time, were observed (Ornitho.pl 2018 – B, Komisja Faunistyczna 2018 – I). Among all the reported cases, attention should be drawn to observations of these parrots in Nysa, in the south of Poland (Opole Province), where 2-5 individuals were regularly observed in the years 2015-2017 (Komisja Faunistyczna 2018 – I). In 2018, the first successful nesting of this species in Poland was reported in Nysa (Szeląg et al. 2018 – N, Tryjanowski 2018 – A). A pair of parakeets was also seen in summer and autumn in Bytom in 2014 (Komisja Faunistyczna 2018 – I). The above facts indicate the species occurs in the natural environment and has been established in Poland.

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 checked="" type="checkbox"/>	the other domains

acommm05.	Comments:
	Rose-ringed parakeet has a negative impact on all domains subjected to the risk assessment. The impact of this species on the natural environment includes the competition for breeding sites with native species of birds and bats occupying tree hollows, aggressive behaviour towards native species, sometimes leading to their death, adverse effects on vocal communication of native bird species and their foraging behaviour, and transmission of pathogens (Strubbe and Matthysen 2009, Peck 2013, Hernández-Brito et al. 2014, Peck et al. 2014, Menchetti et al. 2016, Yosef et al. 2016, Covas et al. 2017, Mori et al. 2017, Hernández-Brito et al. 2018 – P). The effect on cultivated plants mainly refers to

damage to fruit plants (orchards, vineyards) and crops, ornamental shrubs and trees in parks and gardens. This is commonly expressed by eating and damaging fruits and seeds, stripping leaves from trees and polluting plants by defecation (Andreotti et al. 2001, Butler 2003, Peck 2013, Menchetti et al. 2016 – P, Fletcher and Askew 2007, Van Kleunen et al. 2010 – I). The effect on the animal production is largely connected with the possibility of spreading diseases dangerous to health and life of farmed animals, mainly ornithosis, avian influenza and Newcastle disease (Suwa et al. 1990, Mase et al. 2001, Pisanu et al. 2018 – P). The impact on humans is related to transmission of diseases potentially serious to humans (ornithosis, avian influenza) and an increase in noise level caused by vocalisation of those parrots (Peck 2013, Pisanu et al. 2018 – P). Stripping leaves from trees and polluting by defecation in recreational areas (e.g. parks, gardens) has a negative effect on other facilities (Peck 2013, Menchetti et al. 2016 – P).

A1 | Introduction

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

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

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

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

acomm06.	Comments:
	In the wild, rose-ringed parakeet was observed for the first time in Poland ca. 1994 (Gatunki obce w Polsce 2018 – B). Since then this species is observed at various frequency and in different parts of Poland. According to data from the Polish database of bird records, in the years 2009-2018 rose-ringed parakeets were reported in 15 atlas fields (10 x10 km), with the total number of 55 records (Ornitho.pl 2018 – B). In most cases single birds, rarely two individuals at the same time, were observed. Multiple cases of reporting rose-ringed parakeets within the last 10 years in Poland, including records of individuals staying in the same area for a longer time (Komisja Faunistyczna 2018 – I), and documented successful breeding of in the south of Poland in 2018 (Szeląg et al. 2018 – N, Tryjanowski 2018 – A) indicate that the species has been established in Poland and climatic and environmental conditions are suitable. In this case, the risk assessment criteria for the Harmonia ^{+PL} Procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland determine the answer: high probability with high level of confidence.

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	level of confidence
				X	

acomm07.	Comments:
	The species is established in Poland (see answers to questions a04 and a06), therefore in accordance with risk assessment criteria for Harmonia ^{+PL} the following answer should be

indicated: high probability with high level of confidence. However, the probability of introducing rose-ringed parakeet to the natural environment in Poland through unintentional human actions (e.g. as as 'stowaway' in the means of transport or in the luggage) is almost zero.

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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acommm08. Comments:
 The species is established in Poland (see answers to questions a04 and a06), therefore in accordance with risk assessment criteria for Harmonia^{+PL} the following answer should be indicated: high probability with high level of confidence. In many European countries, this parrot was a popular bird for domestic breeding (cage breeding) which was a reason for importing to Europe many thousands of individuals (Pârâu et al. 2016, Souviron-Priego et al. 2018 – P). Only since 2007, there has been a significant reduction of imports of this species to European Union countries, resulting from introducing strict regulations on health and quarantine of selected species of birds imported to EU countries (Pârâu et al. 2016 – P, Komisja Europejska 2007 – I). Popularity of this species for home breeding suggests that its spread was partially the effect of escaping from cages (Souviron-Priego et al. 2018), but in most cases this parrot seems to be intentionally introduced into the environment by humans (CABI 2018 – B). Consequently, it led to development of many wild populations of this species in several European countries (Pârâu et al. 2016 – P, CABI 2018 – B). This process began in the 1960s and still continues. In 2015, 90 wild populations of rose-ringed parakeet occurred in 10 countries of Western and Southern Europe, with a total number of 85 000 individuals (Pârâu et al. 2016 – P). In Poland, this species is also bred in captivity, and it can be easily bought (sale offers available online, e.g. OLX 2018a and OLX 2018b – I), but it is difficult to assess the scale of this issue. Most records of this species in Poland have been probably of individuals that escaped from the captivity or were intentionally released to the environment by humans, which is the main source of spreading of the species in the country.

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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acommm09. Comments:
 The species is established in Poland (see answers to questions a04 and a06), therefore in accordance with risk assessment criteria for Harmonia^{+PL} the following answer should be indicated: climatic conditions optimal for establishment with high level of confidence. Rose-ringed parakeet prefers monsoon tropical, dry savannah, steppe, and warm temperate

climate with dry summer and winter (CABI 2018 – B). However, this species can tolerate a wide spectrum of climate conditions (CABI 2018 – B). Stable populations of this species, in areas nearest to Poland and with similar climate conditions, are found in Western Germany. In Poland, air temperatures above 10°C in spring and summer, and above 0°C in autumn and winter, seem to be optimal climate conditions (CABI 2018 – B). Frosty and snowy winters with very low temperatures (lasting for at least 2-3 months a year) can be regarded as climate restrictions preventing the spreading of this species and establishing stable populations in Poland. However, according to observations made in Germany, this species can survive for a longer time at temperatures achieving -15°C (CABI 2018 – B). Physiological tests on this species confirm that it can adapt to low temperatures (Thabethe et al. 2013 – P). As in Europe rose-ringed parakeet usually occupies urbanised areas, where climate conditions tend to be milder (it is warmer, especially in winter) than in other areas, and where there are abundant sources of food (feeders, dustbins etc.), chances to survive winter months are considerably high. The above is confirmed, for example, by the presence of a few individuals in Nysa (Opole Province) for 4 consecutive years (Komisja Faunistyczna 2018 – I), which led to first breeding of this species in Poland (Szeląg et al. 2018 – N, Tryjanowski 2018 – A). On the other hand, their nesting in the colder climate (the northern parts of Europe) can adversely affect hatching success and increase of the breeding population, mainly due to phenological mismatch between the beginning of breeding and the development of trees (Luna et al. 2017 – P).

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

 level of confidence

acommm10. Comments:
 The species is established in Poland (see answers to questions a04 and a06), therefore in accordance with risk assessment criteria for Harmonia^{+PL} the following answer should be indicated: optimal conditions for the species establishment, with high level of confidence. Rose-ringed parakeet occupies a wide spectrum of habitats, both in areas of its native occurrence and invaded ones (Khan et al. 2004 – P, CABI 2018 – B). In Europe, this species mostly occupies the anthropogenic areas (urban and agricultural landscapes) inhabiting different types of wood, trees, parks, greens, gardens, cemeteries, fields, and crops (Butler 2003, Peck 2013, Menchetti et al.) 2016 – P, CABI 2018 – B).

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 X	high
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 level of confidence

acomm11. Comments:
 Assessment (Type of data: C)
 Rose-ringed parakeet is considered to be a relatively sedentary species (Butler 2003 – P). Little is known about its dispersal (CABI 2018 – B). According to available information on daily movements of these parrots, the flight distances between feeding grounds and roost sites are from few to maximum 15 km (Kahl-Dunkel and Werner 2002, Butler 2003 – P). The available data indicates that the spreading rate of this species is relatively slow. Populations in Great Britain increase their home ranges by 400 m per year (Butler 2003 – P). Recent British data demonstrate that since 1968 (when first breeding parrots were noticed in the wild) till the second decade of 21st century rose-ringed parakeet expanded its home range by 4400%. In the Netherlands, between 1998 and 2010, this species increased its range by 239% (Pârâu et al. 2016 – P). Taking into account data on the species distribution, collected over the years in those countries, its natural capability of spreading in Poland has been assessed as high.

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
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 level of confidence

acomm12. Comments:
 The appearance of rose-ringed parakeets in the wild in Western Europe was mainly caused by intentional release by humans or as a result of escapes from aviaries (Souviron-Priego et al. 2018 – P, CABI 2018 – B). Combined with import and trade of this species on a large scale in Europe, it led to its invasion (Pârâu et al. 2016, Souviron-Priego et al. 2018 – P). In Poland, this parrot is also kept for home breeding and in parrot houses (which have become very popular recently). This is also a traded species, sale offers are available online (e.g. OLX 2018a and OLX 2018b – I). According to data from ornithological databases and reports (Ornitho.pl 2018 – B, Komisja Funistyczna 2018 – I), this species is recorded at different frequencies in various parts of Poland. All observed individuals have probably escaped from breeding aviaries, but they could have also been intentionally released (however, the scale of such events is difficult to assess). Such cases can cause the appearance of new populations in Poland irrespective of the natural ways of spreading. Assuming this species is widespread in Poland, individuals living in the wild are likely to be caught for breeding as pets. This can even more increase the rate of spread of rose-ringed parakeets, because birds kept in new areas may become a potential new source of introductions into the environment (e.g. intentional release or escapes). Thus, the anthropogenic effect on spreading of this species is assessed as high (more than 10 cases are expected per decade).

A4a | Impact on the environmental domain

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

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

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

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

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

aconf09.	Answer provided with a	low	medium X	high	level of confidence
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acomment13. Comments:
 Rose-ringed parakeet is a herbivorous species. It feeds on seeds, fruits, flowers and nectar of various species of plants (Perrin 2012 – P, CABI 2018 – B). Detailed studies on food composition of this species in India revealed that its diet is mainly composed of cereal and tree seeds (Saini et al. 1994 – P). Parrots from the population occupying cities in Western Europe also started to eat plant food found in bird feeders (Clergeau and Vergnes 2011 – P, CABI 2018 – B). The adverse effect of herbivorous diet of rose-ringed parakeet on populations of native flora has not been documented yet. However, this species cause serious damage to cultivated plants in areas of its native occurrence (Sidhu and Kler 2018 – P), and in invaded areas as well (Butler 2003 – P). Taking into account the above facts and considering that rose-ringed parakeet is widespread in Poland, its impact on native flora has been assessed as medium (this species can only cause a slight declines in population of native species of particular concern or significant declines in population of other native species).

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

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

aconf10.	Answer provided with a	low	medium	high X	level of confidence
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acomment14. Comments:
 Rose-ringed parakeet is a very serious competitor for native species of birds, mainly belonging to secondary cavity nesters, as well as for mammals, and even bees (Strubbe and Matthysen 2009, Hernández-Brito et al. 2014, Menchetti et al. 2016, Yosef et al. 2016, Hernández-Brito et al. 2018 – P). This mainly results from breeding requirements of the species, that is, availability of appropriate tree hollows. Rose-ringed parakeet has been reported to effectively compete with native wood nuthatches *Sitta europaea* and Eurasian hoopoes *Upupa epops* for tree hollows which results in the local population decline of the native species (Strubbe and Matthysen 2009, Yosef et al. 2016 – P). In Spain, these parrots were reported to cause a significant population decrease of endangered greater noctule bat *Nyctalus lasiopterus* due to aggressive displacement from tree hollows, often resulting in the death of bats (Hernández-Brito et al. 2018 – P). The population of native species may not be directly affected by an increase in breeding density of rose-ringed parakeets, but they can be displaced to suboptimal habitats, like in the case of scop owls *Otus scops* (Mori et al. 2017 – P). However, some studies did not confirm the negative effect of thisparrot on native species of secondary cavity nesters (Newson et al. 2011 – P), and they even indicated that some species of birds could benefit from the presence of these parrots (Hernández-Brito et al. 2014 – P). Rose-ringed parakeets are very aggressive towards native species and often force them to leave tree hollows hat they occupy (Hernández-Brito et al. 2014, Menchetti et al. 2016, Yosef et al. 2016, Hernández-Brito et al. 2018 – P). These cases are confirmed by reports on fatal attacks of these parrots on native species of birds and mammals (Menchetti et al. 2016, Covas et al. 2017 – P). There are no clear explanations for

such a behaviour. Attacks are probably related to defence of breeding sites, and to competition for hollows and for food (Covas et al. 2017 – P). Moreover, the sheer presence of rose-ringed parakeets (even without aggressive behaviour) has a negative effect on foraging behaviour of native species of birds (Peck et al. 2014 – P). In general, competitiveness of rose-ringed parakeets with native species can affect them negatively, particularly in case of species occupying tree hollows (secondary cavity nesters, e.g. wood nuthatch, starling *Sturnus vulgaris*, Eurasian hoopoe and bats). Assuming the species is widespread in Poland, its competitiveness may have a significant impact on native fauna (significant drops in the populations of native species of conservation concern).

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

- no / very low
- low
- medium
- high
- very high

aconf11. Answer provided with a

low	medium	high X
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 level of confidence

acomm15. Comments:
Rose-ringed parakeet can interbreed with other species of parrots producing fertile offspring (CABI 2018 – B). In the wild, such hybrids were observed in invaded areas in Europe (Postigo 2016 – P, CABI 2018 – B). Native bird species in Poland are neither phylogenetically related to rose-ringed parakeet, nor to parrots in general. Therefore, the likelihood of interbreeding with native bird species is minimal. Assuming the wide distribution of this parrot in Poland and taking into account the above facts, the effect of rose-ringed parakeet on the likelihood of interbreeding with native species of birds is none/very low.

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

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

aconf12. Answer provided with a

low	medium	high X
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 level of confidence

acomm16. Comments:
Rose-ringed parakeet is a vector for pathogenic viruses, bacteria, protozoans, fungi, parasitic nematodes and arthropods (the detailed list is in the paper by Pisanu et al. 2018 – P). Among those pathogens and parasites, particularly important are *Chlamydia psittaci* and *C. avium* (Suwa et al. 1990, Pisanu et al. 2018 – P), avian influenza virus – H9N2 strain (Mase et al. 2001 – P), and paramyxovirus – serotype 1 (Grund et al. 2002 – P). Ornithosis caused by chlamydia, avian influenza, and Newcastle disease caused by paramyxovirus are included on the list of the World Organization for Animal Health (OIE). Wide distribution of rose-ringed parakeets in Poland is a potential exposure source of native species of birds to those pathogens and diseases even though this impact should be rather restricted to urbanised areas. In Europe, these parrots mainly occupy urban or suburban areas. Moreover, it is a sedentary species with daily flight distances up to 15 km (Kahl-Dunkel and Werner 2002 – P, CABI 2018 – B). Taking into account the above, the impact of rose-ringed parakeet on native species by hosting pathogens or parasites has been assessed as very high.

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

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

aconf13.	Answer provided with a	low	medium X	high	level of confidence
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acom17. Comments:
 Outside the breeding season, rose-ringed parakeet forms large aggregations with high numbers of birds feeding and roosting together (Butler 2003, Peck 2013, Menchetti et al. 2016 – P). Such large flocks of parrots in resting sites or feeding grounds can potentially introduce significant amounts of biogenic elements (excreta) into the soil. This can locally change chemical and physical properties of soil, which can result in disturbance of plant cover, however, there are no detailed studies on this issue (Menchetti et al. 2016 – P). Moreover, vocalisation of rose-ringed parakeets is intensive (Arora et al. 2012 – P); therefore, flocks of this species can increase the noise level. Such noise pollution is reported to have negative effects on vocal communication of native bird species (Peck 2013 – P). The significance of this species for ecosystem by affecting its abiotic properties is rather local, largely limited to urban and suburban areas. At worst the species can cause hardly reversible process changes in ecosystems that are not of conservation concern, so the impact of rose-ringed parakeets has been assessed as medium.

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

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

aconf14.	Answer provided with a	low	medium X	high	level of confidence
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acom18. Comments:
 Rose-ringed parakeet as a herbivore can contribute to dispersion of various species of plants. This species feeds on native and alien species of plants in gardens and urban parks (Peck 2013 – P), so it can potentially contribute to spread of alien species in local flora and to changes in plant cover (Runde et al. 2007, Menchetti and Mori 2014 – P). The indirect effect of these parrots on native plant cover caused by dispersion of native species of plants can be dangerous because it may lead to significant changes in native plant communities, and then affect the cycle of biogenic elements in the whole ecosystem (Vila et al. 2011 – P). However, this parrot usually occupies urban or suburban areas, which are themselves changed. At worst, the species can cause hardly reversible process changes in ecosystems that are not of conservation concern, so the impact of rose-ringed parakeets on ecosystem by affecting its biotic properties has been assessed as medium.

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

- low
- medium
- high
- very high

aconf15. Answer provided with a

low	medium X	high
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 level of confidence

acommm19. Comments:
 Rose-ringed parakeet in its native range is considered as one of the most serious pests for crops producing fruit and seeds (Saini et al. 1994, Sidhu and Kler 2018 – P, CABI 2018 – B). In Europe, the invaded areas are also reported to suffer from multiple damage of crops and ornamental plants caused by this species (Peck 2013, Menchetti et al. 2016 – P). In some cases, crop losses were important regarding the economy (Butler 2003 – P, Fletcher and Askew 2007, Van Kleunen et al. 2010 – I). In Europe, the following areas is particularly vulnerable to damage: orchards (Van Kleunen et al. 2010 – I), vineyards (Butler 2003 – P, Fletcher i Askew 2007 – I) and cereal fields (Andreotti et al. 2001). Unfortunately, the majority of damage caused by rose-ringed parakeets in Europe has not been precisely evaluated. Therefore it is difficult to unequivocally define the scale of this issue (Menchetti et al. 2016 – P). This species commonly occupies urban areas, however, flocks of those parrots can fly to suburban, and even rural areas to acquire preferred food and consequently, cause damage to crops. Therefore, its effect on cultivated plants might be very high assuming the parrot is widespread in Poland and its local populations are large (likelihood – high, consequence – high).

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

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

aconf16. Answer provided with a

low	medium	high
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 level of confidence

acommm20. Comments:
 This 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:

- inapplicable
- no / very low
- low
- medium
- high
- very high

aconf17. Answer provided with a

low	medium	high
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 level of confidence

acommm21. Comments:
 This 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

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

aconf18.	Answer provided with a	low	medium X	high	level of confidence
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acommm22. Comments:
 Rose-ringed parakeet causes losses in crops, mainly by eating fruits, seeds and other parts of plants (Saini et al. 1994, Sidhu and Kler 2018 – P, CABI 2018 – B). While feeding, parrots destroy fruits or other parts of plants which are not finally consumed. Sometimes, it causes the death of plants (Fletcher and Askew 2007 – I). Cases of lost foliage of trees chosen as roost sites were also reported (Peck 2013 – P). Additionally, feeding flocks of these parrots can pollute crops by defecation and disturb the local cycle of bioelements in the soil. Thus, rose-ringed parakeet can probably disturb the integrity of crops, particularly fruit orchards, vineyards and cereals (Andreotti et al. 2001, Butler 2003 – P, Fletcher and Askew 2007, Van Kleunen et al. 2010 – I). Assuming the widespread occurrence of rose-ringed parakeet in Poland and its high numbers, the effect of this species on the cultivation system's integrity has been assessed as medium (likelihood – medium, consequences – medium).

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

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

aconf19.	Answer provided with a	low	medium	high X	level of confidence
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acommm23. Comments:
 No cases have been reported so far that rose-ringed parakeet was or can be a potential host to or a vector for pathogens or parasites that are harmful to cultivated 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:

<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

aconf20.	Answer provided with a	low	medium	high	level of confidence
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acommm24. Comments:
 This species is a herbivorous animal.

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

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

aconf21.	Answer provided with a	low	medium X	high	level of confidence
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a25. Comments:
The effect of rose-ringed parakeet on individual animal health or animal production by having properties that are hazardous upon direct contact, has not been observed so far. Despite the species is highly aggressive and fatal attacks on wild birds and mammals are reported (Menchetti et al. 2016, Covas et al. 2017 – P), the likelihood to cause injuries or death of breeding animals through the direct contact with this parrot is very low. Assuming that this species becomes widespread in Poland, its effect on farm animals has been assessed as medium (likelihood – medium, consequences – high).

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

<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

aconf22.	Answer provided with a	low	medium	high X	level of confidence
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a26. Comments:
Rose-ringed parakeet is a vector for *Chlamydia psittaci* and *C. avium* bacteria, and viruses of avian influenza – H9N2 strain and paramyxovirus – serotype 1 (Mase et al. 2001, Grund et al. 2002, Pisanu et al. 2018 – P). All those pathogens cause diseases included in the list of the World Organization for Animal Health (OIE). Rose-ringed parakeets living in the wild have not been so far reported as an exposure source of breeding animals to one of those diseases. However, large aggregations of these parrots occupying areas near poultry farms may potentially be the source of spread Newcastle disease (contagious viral bird disease caused by paramyxovirus). In turn, chlamydia (especially *C. avium*) transmitted by this species can be another source of these bacteria, apart from feral pigeons *Columba livia f. urbana* which commonly occur in urban areas (Pisanu et al. 2018 – P). The additional way of transmitting these bacteria in the environment can increase a risk of ornithosis among wild and farm birds. Taking into account the above facts and assuming that rose-ringed parakeet becomes widespread in Poland, its effect on farm animals by transmitting pathogens has been assessed as very high.

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:
This species is not a 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:
Rose-ringed parakeet exhibits high aggression towards other species of birds and mammals. It is usually related to defence of their breeding sites, and competition for hollows and food (Hernández-Brito et al. 2014, Menchetti et al. 2016 – P). No attacks on humans have been reported so far. Due to its aggression and cases of fatal attacks on birds and mammals (Covas et al. 2017 – P), incidental direct contacts with humans are probable (e.g. parrots are likely to attack humans to defend their breeding sites). It shall be emphasized that this parrot is vocally active and their large aggregations can significantly increase the noise level (Peck 2013, Menchetti and Mori 2014 – P). Consequently, the comfort of humans staying near those aggregations of birds deteriorates (particularly if this effect is permanent). Taking into account the above and assuming that this species becomes widespread in Poland, its effect on humans has been assessed as medium (consequences – low, likelihood – high).

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	high X
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 level of confidence

acomm29. Comments:
Rose-ringed parakeets living in the wild can be a reservoir of *Chlamydia psittaci* and *C. avium* bacteria, and viruses of avian influenza – H9N2 strain and paramyxovirus – serotype 1 (Mase et al. 2001, Grund et al. 2002, Pisanu et al. 2018 – P). Chlamydia transmitted from this species to humans can cause the development of ornithosis (parrot fever). This disease can cause serious health problems, it can occasionally results in death (ca. 1% of all cases). Humans can be infected through the direct contact with birds, or the contact with their feathers or excrements (Choroszy-Król et al. 2007 – P). Viruses are mainly harmful to animals, but can incidentally cause health problems in humans (avian influenza virus, paramyxovirus).

Because in Europe rose-ringed parakeet lives near humans (parks, gardens, crops, etc.), the likelihood of transmitting those pathogens to humans is high. Assuming this species becomes widespread in Poland, its effect on human health by transmitting pathogens has been assessed as high.

A4e | Impact on other domains

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

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

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

aconf26.	Answer provided with a	low	medium	high X	level of confidence
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acomment30. Comments:
This species tends to colonise more or less urbanised areas, readily occupies different types of green areas (parks, greens, gardens, cemeteries, woods) in Western Europe, using them as breeding and roosting sites (Butler 2003, Peck 2013, Menchetti et al.) 2016 – P). Numerous aggregations of these parrots, especially in roosting sites, can lead to destruction of green (recreational) areas because trees are stripped of leaves and these areas are polluted by defecation (Peck 2013, Menchetti et al. 2016 – P). These effects are partly or even completely irreversible. Assuming that the species becomes widespread and numerous in Poland, the likelihood of such events can be high. Therefore, effects of this species on infrastructure have been assessed as high.

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
- neutral
- moderately positive
- significantly positive

aconf27.	Answer provided with a	low	medium	high X	level of confidence
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acomment31. Comments:
Effects of rose-ringed parakeet on provisioning services are assessed as very negative because this species has a negative effect on cultivated plants by eating, destroying and polluting them by defecation (see answers to questions: a19, a22) and may negatively affect farm animals because of transmitting pathogens which develop ornithosis, avian influenza and Newcastle disease (see answer to question a26).

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

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

aconf28. Answer provided with a

low	medium	high X
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 level of confidence

acomm32. Comments:
Effects of this parrot on regulating services are assessed as moderately negative. It is the consequence of negative impact related to transmitting avian influenza virus, paramyxovirus, and two species of chlamydia (see answers to questions a16 and a26). Additionally, this species can disturb the cycle of biogens in the soil due to pollution by defecation and spread of alien species of plants (see answers to questions a17 and a18).

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 X	high
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 level of confidence

acomm33. Comments:
The effect of rose-ringed parakeet on cultural services is considered as moderately negative because large flocks can destroy green (recreational) areas by stripping leaves from trees and polluting vegetation and soil by defecation (see answer to question a30). In Poland, it is visually attractive and exotic species kept for home breeding and in parrot houses. Therefore, this species can be positively perceived by humans, and is regarded as a desirable element in the natural environment. However, the society can start to perceive this species negatively as it destroys plants, causes pollution by defecation, transmits dangerous pathogens and increases the noise level by intensive vocalisation.

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
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 level of confidence

acomment34. Comments:
 Rose-ringed parakeet has already overcome geographical barriers as this species is currently widespread in many European countries (Pârâu et al. 2016 – P, Szeląg et al. 2018 – N, Komisja Faunistyczna 2018 – I). In Poland, this species is still rare. Rose-ringed parakeet prefers monsoon tropical, dry savannah, steppe, and warm temperate climate with dry summer and winter, but it can tolerate a wide spectrum of climatic conditions (CABI 2018 – B, see answer to question a09). In a cooler climate, phenological mismatches can limit an increase in breeding populations and hatching success (Luna et al. 2017 – P). In this way, climate changes resulting in global warming will improve living conditions of this species in Poland. This can increase the hatching success, and as a result the occurrence range will become broader and the abundance of rose-ringed parakeets will increase. Therefore, climate changes are considered to enhance moderately the likelihood of overcoming further geographical barriers in Poland.

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	medium X	high
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 level of confidence

acomment35. Comments:
 Rose-ringed parakeet is an established species in Poland but it cannot be considered as numerous. This species can occupy areas of a wide spectrum of climate conditions (CABI 2018 – B), but cooler regions of Europe can adversely affect the hatching success and the increase of breeding populations (Luna et al. 2017 – P). Therefore, the predicted changes in climate (warming) in Poland will improve the breeding success, and will favour further expansion and the growth of population of this species. Consequently, the predicted changes in climate will have a positive impact on establishment of this species in Poland.

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	medium X	high
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 level of confidence

acomment36. Comments:
 Rose-ringed parakeet is an established species in Poland. It means that this species has overcome barriers preventing its spreading in Poland, but still it cannot be considered as numerous. This species occupies areas of a wide spectrum of climate conditions (CABI 2018 – B), but cooler regions of Europe can adversely affect the hatching success and the

population growth (Luna et al. 2017 – P). Consequently, the predicted changes in climate (warming) will have a positive impact on the reproduction of this species, which is likely to increase its population size and contribute to its spread in Poland.

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	medium	high X
-----	--------	------------------

 level of confidence

acomment37. Comments:
Rose-ringed parakeet has a negative impact on natural environment through competition, transmitting pathogens, and to a lower extent, through herbivory and affecting abiotic and biotic properties in the ecosystems (see answers to questions a13, a14, a16-a18). Due to global warming, the negative effect of this species on natural environment is likely to increase, as this climate change may positively affect the spread of these parrots in Poland and increase their population size (higher hatching success, improved survival rate in autumn and winter).

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
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 level of confidence

acomment38. Comments:
The species has a negative impact on cultivated plants through herbivory and, to a lower extent, through affecting integrity of the cultivation system (see answers to questions a19 and a22). Thus, assuming the global warming, rose-ringed parakeet is expected to improve its survival rate in winter and the breeding success, which can cause that the species will become widespread and increase its population size. For that scenario, the adverse effect of the species on plant crops is likely to increase moderately.

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
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 level of confidence

acomment39. Comments:
Negative impact of this species on animal production is largely manifested by transmitting pathogens and, to a lower extent, by having properties that are hazardous upon direct

contact (see answers to questions a25 and a26). Due to global warming, the negative effect of this species on animal production is likely to increase as this climate change may positively affect the spread of these parrots in Poland and increase their population size (higher hatching success, improved survival rate in autumn and winter).

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
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 level of confidence

acomm40. Comments:
The impact of rose-ringed parakeet on humans is largely manifested by transmitting pathogens dangerous to their health and life, and to a lower extent, by pollution by defecation and noise (see answers to questions a28 and a29). Climate changes (global warming) can increase the survival rate of parrots in winter and improve their hatching success, which is very likely to increase their population size and spreading rate in Poland. Consequently, this species is likely to increase its negative impact on humans.

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

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

aconf37. Answer provided with a

low	medium	high X
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 level of confidence

acomm41. Comments:
The species has a negative impact on green areas used for recreation mainly by destroying plants and polluting these areas with defecation (see answer to question a30). Climate changes (global warming) can increase the population size of this species and broaden the occurrence range (due to improved survival rate in winter and higher hatching success). As a consequence, its negative impact on other objects will increase.

Summary

Module	Score	Confidence
Introduction (questions: a06-a08)	1.00	1.00
Establishment (questions: a09-a10)	1.00	1.00
Spread (questions: a11-a12)	0.88	0.75
Environmental impact (questions: a13-a18)	0.58	0.75
Cultivated plants impact (questions: a19-a23)	0.50	0.67
Domesticated animals impact (questions: a24-a26)	0.75	0.75

Human impact (questions: a27-a29)	0.63	1.00
Other impact (questions: a30)	0.75	1.00
Invasion (questions: a06-a12)	0.96	0.92
Impact (questions: a13-a30)	0.75	0.83
Overall risk score	0.72	
Category of invasiveness	moderately invasive alien speciesp	

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.

acom42. Comments:
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