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. Karolina Mazurska
2. Wojciech Solarz
3. Henryk Okarma

acomm01. Comments:

	degree	affiliation	assessment date
(1)	mgr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	17-05-2018
(2)	dr	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	30-05-2018
(3)	prof. dr hab.	Institute of Nature Conservation, Polish Academy of Sciences in Cracow	31-05-2018

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

Polish name: Mandarynka

Latin name: ***Aix galericulata*** (Linnaeus, 1758)

English name: Mandarin duck

Współfinansowano w ramach projektu nr POIS.02.04.00-00-0100/16 pn. *Opracowanie zasad kontroli i zwalczania inwazyjnych gatunków obcych wraz z przeprowadzeniem pilotażowych działań i edukacją społeczną* ze środków Unii Europejskiej w ramach Programu Infrastruktura i Środowisko 2014-2020

acomm02.	Comments:

Polish name (synonym I) –	Polish name (synonym II) –
Latin name (synonym I) –	Latin name (synonym II) –
English name (synonym I) Mandarin	English name (synonym II) –

a03. **Area** under assessment:

Poland

acomm03.	Comments: –

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

	native to Poland
	alien, absent from Poland
	alien, present in Poland only in cultivation or captivity
	alien, present in Poland in the environment, not established
X	alien, present in Poland in the environment, established

aconf01.	Answer provided with a	low	medium	high **X**	level of confidence

acomm04.	Comments: The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I). The species has been reported in Poland since 1963/1964 (Tomiałojć and Stawarczyk 2003 – P). The following reports on the species were from 1981, 1984-1985 and 1989-1993, and since 1995 the Mandarin duck has been recorded each year. By the end of 2005 the Mandarin duck was reported in Poland 114 times (Stawarczyk et al. 2017 – P), and by the end of 2017 – about 500 times (Solarz 2018 – N). In 1999 individuals of this species were released in the Łazienki Królewskie park in Warsaw (Luniak et al. 2001 – P). The first brood of the Mandarin duck in Poland was reported in 2001 from this locality (Tomiałojć and Stawarczyk 2003 – P). The birds disperse outside the Łazienki park, mainly to other parks in Warsaw and in neighbouring towns. In 2016, 38-43 females with a total of 253 ducklings were reported in Mazowieckie province (Avifaunistic Commission 2017 – P). There are also reports on 4 nesting sites of this species in non-synanthropic habitats in Lower Silesia, Greater Poland and Opole provinces (Kąkol and Stajszczyk 2008, Stawarczyk et al. 2017 – P). In Poland the Mandarin duck is an extremely rare nesting species (40-50 pairs), with a significant growth of the population (Stawarczyk et al. 2017 – P).

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

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

acomm05.	Comments: The Mandarin duck has a negative impact on 3 domains: the natural environment, domesticated animals domain and the human domain. The impact on the natural environment results primarily in competition (Głowaciński 2011, Lever 2013, van Kleunen and Lemaire 2014 – P), interbreeding with native species (McCarthy 2006, van Kleunen and Lemaire 2014 – P) and hosting pathogens (Yeh et al. 2011, Kim et al. 2012, Kwon et al. 2017

– P, CABI 2018 – B, Najberek 2018 – N), including those listed by the World Organization for Animal Health (OIE). The impact on domesticated animals and on humans is also associated with hosting these pathogens, including the highly pathogenic Asian avian influenza virus, lethal to humans and animals (HPAI, strains H5N1 and H5N6).

A1 | Introduction

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

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

	low
	medium
X	high

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

acomm06. Comments:

The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I), which according to the methodology of risk assessment Harmonia^{+PL} Procedure of negative impact risk assessment for invasive alien species and potentially invasive alien species in Poland (henceforth Harmonia^{+PL}) indicates the choice of answers: high probability and high level of confidence. The species has been reported in Poland since 1963/1964 (Tomiałojć and Stawarczyk 2003 – P). The following reports on the species were from 1981, 1984-1985 and 1989-1993, and since 1995 the Mandarin duck has been recorded each year. By the end of 2005 the Mandarin duck was reported in Poland 114 times (Stawarczyk et al. 2017 – P), and by the end of 2017 – about 500 times (Solarz 2018 – N). In 1999 individuals of this species were released in the Łazienki Królewskie park in Warsaw (Luniak et al. 2001 – P). The first brood of the Mandarin duck in Poland was reported in 2001 from the Łazienki Królewskie park (Tomiałojć and Stawarczyk 2003 – P). The birds disperse outside the Łazienki park, mainly to other parks in Warsaw and in neighbouring towns. In 2016 38-43 females with a total of 253 ducklings were reported in Mazowieckie province (Avifaunistic Commission 2017 – P). There are also reports on 4 nesting sites of this species in non-synanthropic habitats in Lower Silesia, Greater Poland and Opole provinces (Kąkol and Stajszczyk 2008, Stawarczyk et al. 2017 – P).

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

	low
	medium
X	high

aconf03.	Answer provided with a	low	medium	high **X**	level of confidence

acomm07. Comments:

The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I), which according to the methodology of risk assessment adopted in Harmonia^{+PL} indicates the choice of answers: high probability and high level of confidence. Because of the size of this bird and its behaviour, the probability for the species to be introduced into Poland's natural

	environment by unintentional human actions (e.g. accidental introduction with imported goods or as a hitchhiker in means of transport or in travellers' luggage) is virtually zero.

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

	low
	medium
X	high

aconf04.	Answer provided with a	low	medium	high **X**	level of confidence

acomm08. Comments:

The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I), which according to the methodology of risk assessment adopted in Harmonia^{+PL} indicates the choice of answers: high probability and high level of confidence. In the 18th century Mandarin ducks were introduced for the first time in Great Britain (Lever 2013 – P), in the 1920s in Germany (Witt 2003 – P), and in the 1950s in Belgium (Vermeersch et al. 2004 – P). The birds were introduced into urban parks for ornamental purposes. Populations of this species in the Netherlands come from birds released or escaped from captivity (van Kleunen and Lemaire 2014 – P). The population in Switzerland was formed by individuals that escaped from a zoo (Kestenholz 1997 – P). In 1999 individuals of this species were released in the Łazienki Królewskie park in Warsaw (Luniak et al. 2001 – P), which has led to the establishment of this species in Poland. Mandarins in Poland are popular birds kept by private individuals in semi-open conditions (e.g. OLX 2018a, OLX 2018b, OLX 2018c – I). Because some of these birds are still able to fly, a number of individuals observed in the natural environment are certainly escapees or individuals released from captivity. The frequency of escapes and releases is certainly higher than 10 cases per decade.

A2 | Establishment

Questions from this module assess the likelihood for *the species* to overcome survival and reproduction barriers. This leads to *establishment*, defined as the growth of a population to sufficient levels such that natural extinction within *the area* becomes highly unlikely.

a09. Poland provides **climate** that is:

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

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

acomm09. Comments:

The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I), which according to the methodology of risk assessment adopted in Harmonia^{+PL} indicates the choice of answers: optimal climate and high level of confidence. In the natural range of its distribution Mandarins during the breeding season occur in areas of different types of humid continental climate, and in winter they migrate to areas of subtropical climate (according to the Köppen climate classification). In Japan the Mandarin duck is a resident species and is found in the region of subtropical climate and humid continental climate with hot summers. In areas where the species has been introduced, it has lost its migratory behaviour and become resident. Within its secondary range it also occurs in regions with a different climate than in the area of its natural range (e.g. in areas with an oceanic climate)

a10. Poland provides **habitat** that is

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

aconf06.	Answer provided with a	low	medium	high **X**	level of confidence

acomm10. Comments:

The Mandarin duck is an established species in Poland (DAISIE 2008 – B, Stawarczyk et al. 2017 – P, Alien species in Poland 2018 – B, Avifaunistic Commission 2018 – I), which according to the methodology of risk assessment adopted in Harmonia^{+PL} indicates the choice of answers: optimal habitat and high level of confidence. Both in the area of its natural and secondary range, habitats occupied by Mandarin ducks include ponds, lakes, rivers, wetlands and swamps, surrounded by deciduous forest or shrubs (van Kleunen and Lemaire 2014 – P). The presence of coastal vegetation that provides shelter is important for this species. The availability of old hollow trees providing nesting sites for the species is also important. The Mandarin duck is often found in parks and other habitas with access to stagnant or flowing waters and old trees (van Kleunen and Lemaire 2014 – P).

A3 | Spread

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

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

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

	very low
	low
	medium
	high
X	very high

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

acomm11. Comments:

Dispersal from a single source (Data type: A)
The European population of this species is considered resident, but numerous data indicate the very high capacity of the Mandarin duck to disperse in the area of its secondary range. For example, an individual ringed in London in summer 1930 was recovered in Hungary in spring of the following year (over 1500 km distance), and two birds ringed in November 1962 in Oslo were reported the next day 900 km away, in Northumberland, England (Witt 2003 – P). Based on the available data related to ringing Mandarin ducks, Dubois (2007 – P) suggests that some individuals that became established in France come from the British population.

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

	low
	medium
X	high

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

acomm12. Comments:

Mandarin ducks in Poland are popular decorative birds kept in private collections in semi-open conditions (e.g. OLX 2018a, OLX 2018b, OLX 2018c – I). Because some of these birds are still able to fly and are not sufficiently guarded by their owners, a number of individuals observed in the natural environment are certainly escapees from captivity. Due to considerable interest in breeding this species, people may capture individuals from free-living populations and then transport them, even over considerable distances, for keeping in captivity. As a result of possible escapes or releases, the species may disperse to new areas. It is also possible that injured birds captured in the wild can be transported to animal rescue centres and zoos, from where they may also escape. It is also possible that Mandarin duck individuals brought to animal rescue centres for veterinary care are intentionally released after treatment. Therefore, the potential frequency of the dispersal of this species by human actions is high (the estimated number of unintentional and intentional introductions into the natural environment is higher than 10 cases per decade).

A4a | Impact on the environmental domain

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

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

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

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

	inapplicable
X	low
	medium
	high

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

acomm13. Comments:

Mandarin ducks feed on aquatic plants, and seeds of trees, e.g. oak, beech, hazel. The spring and summer diet of this species includes invertebrates (e.g. snails, insects) and small fish (van Kleunen and Lemaire 2014 – P). The negative effect of the Mandarin duck through predation/herbivory has not been reported so far, and thus was assessed as low.

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

	low
X	medium
	high

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

acomm14. Comments:

Because the Mandarin duck is a species nesting in tree cavities, it can compete for nesting sites with native large hollow-nesting birds, especially with the Goldeneye (*Bucephala clangula*), the Goosander (*Mergus merganser*) and the Red-breasted merganser (*M. serrator*) (Głowaciński 2011 – P). The competition for nesting sites between the Mandarin duck and the Goldeneye and the Goosander was reported from Scotland (Lever 2013 – P). In England, this species probably competes for nesting sites with the following bird species: the Stock dove (*Columba oenas*), the Little owl (*Athene noctua*), the Tawny owl (*Strix aluco*), the Barn owl (*Tyto alba*), the Jackdaw (*Corvus monedula*), the Kestrel (*Falco tinnunculus*), the Great tit (*Parus major*), and the Mallard (*Anas platyrhynchos*) (Lever 2013 – P). Mandarin ducks can also compete for food with other species of birds. So far, reports have indicated its competition with the Jackdaw, the Starling (*Sturnus vulgaris*), the Moorhen (*Gallinula chloropus*), the Stock dove, the Collared dove (*Streptopelia decaocto*) and the Woodpigeon (*Columba palumbus*) (Lever 2013 – P). All these species, except the Mallard and the Woodpigeon (game species), are strictly protected, and therefore they are species of special concern. However, there are no data confirming that competition between the Mandarin duck and the aforementioned species can cause a serious decline in their numbers (van Kleunen and Lemaire 2014 – P). Thus, the negative effect of the species through competition was assessed as medium.

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

	no / very low
	low
	medium
X	high
	very high

aconf11. Answer provided with a

low	medium	high	level of confidence
		X	

acomm15. Comments:

The Mandarin duck interbreeds with other duck species from the Anatidae family, which according to the methodology of risk assessment adopted in Harmonia^{+PL} indicates that probability of such events should be rated as high. As sporadic cases of hybridization were reported (McCarthy 2006 – P), it can be expected that in Poland it can lead to insignificant loss of genetic integrity, both in species of special concern and in other species (medium effect). The overall impact on native species due to hybridisation should nevertheless be considered as high. The Mandarin duck most often interbreeds with another alien species in Poland, the Wood duck (*Aix sponsa*), although no such case has been reported so far from Poland. Less often it hybridises with the Mallard, a native species to Poland. In addition, interbreeding with other species has been reported: the Gadwall (*Mareca strepera*), the Long-tailed duck (*Clangula hyemalis*), the Laysan duck (*Anas laysanensis*), and the Redhead (*Aythya americana*) (McCarthy 2006, van Kleunen and Lemaire 2014 – P). Of all these species only the Gadwall (species of special concern) and the Mallard (game species) are native species breeding in Poland.

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
X	very high

aconf12. Answer provided with a

low	medium	high	level of confidence
		X	

acomm16.	Comments: The Mandarin duck is a vector for at least 4 pathogenic viruses: Asian highly pathogenic avian influenza virus (HPAI, strains: H5N1 and H5N6), West Nile virus (WNV), avian pox virus (APV) (Yeh et al. 2011, Kim et al. 2012, Kwon et al. 2017 – P, CABI 2018 – B, Najberek 2018 – N). Avian influenza and West Nile fever are diseases listed by the World Organization for Animal Health (OIE), and therefore are subject to mandatory reporting. Avian influenza virus, especially the most dangerous strain, H5N1, is highly lethal to birds, including those living in the wild. The West Nile virus also causes significant morbidity and causes the death of wild birds, mainly from the Corvidae family (CDC 2018 – I). Avian pox is a typical endemic, rather mild and self-limiting disease in wild birds, but in isolated populations, e.g. on islands (Vargas 1987, van Riper and Forrester 2004, Munro, 2006 – P), it can cause high morbidity and mortality (CABI 2018 – B). According to the methodology adopted in the Harmonia^{+PL} procedure, the effect of the Mandarin duck is assessed as very high because of the fact that the Mandarin duck hosts pathogens subject to mandatory reporting.

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

X	low
	medium
	high

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

acomm17.	Comments: There is no evidence supporting the negative effect of the Mandarin duck on ecosystem functions (Harmonia 2011 – B, van Kleunen and Lemaire 2014 – P). Therefore, the effect of the Mandarin duck on ecosystem integrity by affecting its abiotic properties in European countries, including Poland, was assessed as low, even if the species spreads on a wide scale in Poland.

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

X	low
	medium
	high

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

acomm18.	Comments: There is no evidence supporting the negative effect of the Mandarin duck on ecosystem functions (Harmonia 2011 – B, van Kleunen and Lemaire 2014 – P). Therefore, the effect of the Mandarin duck on ecosystem integrity by affecting its biotic properties in European countries, including Poland, was assessed as low, even if the species spreads on a wide scale in Poland.

A4b | Impact on the cultivated plants domain

Questions from this module qualify the consequences of *the species* for cultivated plants (e.g. crops, pastures, horticultural stock).

For the questions from this module, consequence is considered 'low' when presence of *the species* in (or on) a population of target plants is sporadic and/or causes little damage. Harm is considered 'medium' when *the organism's* development causes local yield (or plant) losses below 20%, and 'high' when losses range >20%.

a19. The effect of *the species* on cultivated plant targets through **herbivory or parasitism** is:

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm19. Comments:

Because no impact of the Mandarin duck on cultivated plant targets through herbivory was reported from countries where this species is numerous (Kumschick and Nentwig 2010, Kumschick et al. 2015 – P), it should be concluded that if the Mandarin duck spreads in Poland, it will have no or very low impact on this domain.

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

X	inapplicable
	very low
	low
	medium
	high
	very high

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

acomm20. Comments:

The Mandarin duck is not a plant species.

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

X	inapplicable
	no / very low
	low
	medium
	high
	very high

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

acomm21. Comments:

The Mandarin duck is not a plant species.

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

X	very low
	low
	medium
	high
	very high

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

acomm22.	Comments: So far, the effect of the species on cultivated plant targets through affecting the cultivation system's integrity has not been reported.

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

X	very low
	low
	medium
	high
	very high

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

acomm23.	Comments: So far there have been no reports on the Mandarin duck hosting pathogens or parasites that are harmful to cultivated plants. There are also no reasons to conclude that they can be discovered in further studies.

A4c | Impact on the domesticated animals domain

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

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

	inapplicable
X	very low
	low
	medium
	high
	very high

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

acomm24.	Comments: The Mandarin duck is mainly a herbivore; in spring and summer it also feeds on invertebrates (e.g. snails, insects) and small fish (van Kleunen and Lemaire 2014 – P). Because no impact of the Mandarin duck on animal production through predation has been reported from countries where this species is numerous (e.g. Belgium), it should be concluded that if the Mandarin duck spreads in Poland, it will have no or very low impact on this domain.

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

X	very low
	low
	medium
	high
	very high

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

acomm25. Comments:

Because no impact of the Mandarin duck on individual animal health or animal production by having properties that are hazardous upon direct contact has been reported from countries where this species is numerous (e.g. Belgium), it should be concluded that if the Mandarin duck spreads in Poland, it will have no or very low impact on this domain.

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
X	very high

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

acomm26. Comments:

The Mandarin duck is a vector for at least 4 pathogenic viruses: Asian highly pathogenic avian influenza virus (HPAI, strains: H5N1 and H5N6), West Nile virus (WNV), avian pox virus (APV) (Yeh et al. 2011, Kim et al. 2012, Kwon et al. 2017 – P, CABI 2018 – B, Najberek 2018 – N). Avian influenza and West Nile fever are diseases listed by the World Organization for Animal Health (OIE), and therefore are subject to mandatory reporting. H5N1 and H5N6 viruses cause high morbidity and mortality in poultry, and H5N1 virus also in pigs, cats and dogs. West Nile fever can cause mortality in horses, and also affects dogs, cats, rabbits and other species. Avian pox is dangerous for poultry and can cause up to 60% mortality in non-immunized chickens (CABI 2018 – B). According to the methodology adopted in the Harmonia^{+PL} procedure, the effect of the Mandarin duck is assessed as very high because of the fact that the Mandarin duck hosts pathogens causing notifiable diseases.

A4d | Impact on the human domain

Questions from this module qualify the consequences of *the organism* on humans. It deals with human health, being defined as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (definition adopted from the World Health Organization).

a27. The effect of *the species* on human health through **parasitism** is:

X	inapplicable
	very low
	low
	medium
	high
	vert high

aconf23.	Answer provided with a	low	medium	high	level of confidence

acomm27. Comments:

The Mandarin duck is not a parasitic species.

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

X	very low
	low
	medium
	high
	very high

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

acomm28. Comments:

Because no impact of the Mandarin duck on human health by having properties that are hazardous upon direct contact has been reported from countries where this species is numerous (e.g. Belgium), it should be concluded that if the Mandarin duck spreads in Poland, it will have no or very low impact on this domain.

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
X	very high

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

acomm29. Comments:

The Mandarin duck is a vector for at least 4 pathogens, including viruses dangerous to humans: Asian highly pathogenic avian influenza virus (HPAI, strains: H5N1 and H5N6), and West Nile virus (WNV) (Yeh et al. 2011, Kim et al. 2012, Kwon et al. 2017 – P, Najberek 2018 – N). These diseases are listed by the World Organization for Animal Health (OIE), and therefore are subject to mandatory reporting. Avian influenza (strain H5N1) is a deadly disease for humans. Humans can become infected by contact with sick animals or objects contaminated with animal faeces. According to WHO, the mortality rate in humans infected with the H5N1 virus in 2003-2009 was about 60% (WHO 2009 – I). The first case of avian influenza in humans caused by infection with H5N6 was reported in 2014 (WHO 2014 – I). To date, several cases have been reported, of which three were fatal. West Nile fever is a disease from the group of haemorrhagic fevers, which can be manifested, for example, by nausea, vomiting, difficulty in swallowing, torticollis, muscle weakness, gait disorders, coordination disorders, Parkinsonism, and consciousness disorders. Fatal cases of this disease have also been reported. According to the methodology adopted in the Harmonia^{+PL} procedure, the effect of the Mandarin duck is assessed as very high because of the fact that the Mandarin duck hosts pathogens causing notifiable diseases.

A4e | Impact on other domains

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

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

X	very low
	low
	medium
	high
	very high

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

acomm30. Comments:

Because no impact of the Mandarin duck on infrastructure has been reported so far from countries where this species is numerous (e.g. Belgium), it should be concluded that if the Mandarin duck spreads in Poland, it will have no or very low impact on this domain.

A5a | Impact on ecosystem services

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

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm31. Comments:

The effect of the Mandarin duck on provisioning services was defined as moderately negative due to the fact that this species has a negative effect on farm animals by hosting pathogens, including those listed by the World Organization for Animal Health (OIE): avian influenza and West Nile fever (cf. Q a26).

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

	significantly negative
X	moderately negative
	neutral
	moderately positive
	significantly positive

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

acomm32. Comments:

The effect of the Mandarin duck on regulation and maintenance services was defined as moderately negative due to the fact that this species has a negative effect on biological regulation (regulation of zoonotic diseases) by hosting pathogens, including those listed by the World Organization for Animal Health (OIE): avian influenza and West Nile fever (cf.Q a16 and a26).

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

	significantly negative
	moderately negative
X	neutral
	moderately positive
	significantly positive

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

acomm33. Comments:

So far the effect of the Mandarin duck on cultural services has not been reported. The species is very appealing and may be perceived by some people as a desirable element of the ecosystem. However, because the presence of the Mandarin duck may have an adverse effect on the native fauna, this species may also be perceived in negative terms.

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

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

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

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm34. Comments:

The Mandarin duck has already overcome geographical barriers and is present in the natural environment of Poland, but it can not be considered a numerous species in the country (Stawarczyk et al. 2017 – P). In the natural range of its distribution Mandarin ducks occur in areas of humid continental and subtropical climate, and in winter they migrate to areas of warmer climate. It is also found in its secondary range, e.g. in the region of oceanic climate. Although this species is currently being introduced into the natural environment as a result of escapes or releases from captivity, it seems that climate change may moderately increase the probability of the Mandarin duck's introduction to Poland as a result of the expansion of populations established in Western Europe.

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
X	increase moderately
	increase significantly

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

acomm35.	Comments:

The Mandarin duck is already an established species in Poland, but it can not be considered numerous in the country (Stawarczyk et al. 2017 – P). In the natural range of its distribution the Mandarin duck in winter migrate to areas of warmer climate. In its secondary range, the species has lost its migratory behaviour, so it is possible that the expected climate change will have a positive effect on this species, and as a result the Mandarin duck will increase its reproductive success and thus its population will increase.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm36.	Comments:

The Mandarin duck has already overcome geographical barriers that prevented its spread in Poland, but it can not be considered a numerous species in the country (Stawarczyk et al. 2017 – P). In areas of the species' natural range, individuals migrate in winter to areas of warmer climate. In areas where the species has been introduced, it has lost its migratory behaviour, but it winters mainly in synanthropic habitats, where it benefits from milder climate and food provided by humans. Thus it is possible that the expected climate change will increase the reproductive success of the species and thus its population will spread faster.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm37.	Comments:

The species has a negative impact on the environmental domain through competition and interbreeding with native species and by hosting pathogens (cf. Q a14-a16). The expected climate change is likely to increase its reproductive success, and consequently increase population size and promote expansion, which may increase the negative impact of the Mandarin duck on the environmental domain.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm38. Comments:

Currently the species has no impact on cultivated plants and the plant domain. It is unlikely that this impact will change as a result of expected climate change.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm39. Comments:

The species has a negative impact on animal production by hosting pathogens (cf. Q a26). The expected climate change is likely to increase its reproductive success, and consequently increase population size and expansion rate, which may increase the negative impact of the Mandarin duck on animal production.

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

	decrease significantly
	decrease moderately
	not change
X	increase moderately
	increase significantly

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

acomm40. Comments:

The species has a negative impact on humans by hosting pathogens (cf. Q a29). The expected climate change is likely to increase its reproductive success, and consequently increase population size and expansion rate, which may increase the negative impact of the Mandarin duck on humans.

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

	decrease significantly
	decrease moderately
X	not change
	increase moderately
	increase significantly

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

acomm41. Comments:

So far no impact of this species on other domains has been reported. It is unlikely that this will change as a result of expected climate change.

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)	0.38	0.92
Cultivated plants impact (questions: a19-a23)	0.00	1.00
Domesticated animals impact (questions: a24-a26)	0.33	1.00
Human impact (questions: a27-a29)	0.50	1.00
Other impact (questions: a30)	0.00	1.00
Invasion (questions: a06-a12)	1.00	1.00
Impact (questions: a13-a30)	0.50	0.98
Overall risk score	0.50	
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.

acomm42. Comments:

As a result of the conducted risk assessment procedure, the Mandarin duck was classified as an alien species with low invasiveness in Poland. The maximum score for the negative impact of the species (0.50) was found for the module related to the negative impact on humans (questions: a27-a29). It should be noted, however, that the categories of invasiveness in this assessment have been designated a priori, without knowledge of the actual distribution of this parameter, and the maximum score obtained for the Mandarin duck (0.50) is only 0.01 lower than the pre-defined limit (0.51), above which the species is classified as moderately invasive.

It should also be noted that in the module related to the impact on the environmental domain (questions a13-a18) the impact of the Mandarin duck was assumed as very high in the section regarding hosting pathogens and parasites (a16), high in the section regarding interbreeding (a15), and moderate in the section regarding competition (a14). Therefore, despite the fact that the overall score for the impact of the Mandarin duck on the environment has been reduced (to 0.38) due to a lower impact in other parts of this module, it should be borne in mind that in some aspects the presence of this species in the environment may have very negative consequences. In addition, new aspects of negative impact may be revealed as the population size and species range increase in Poland, which in recent years has taken place very dynamically. Therefore, scores in this assessment should not be regarded as constant and should be revised on a regular basis.

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