Risk assessment template developed under the "Study on Invasive Alien Species – Development of risk assessments to tackle priority species and enhance prevention"
Contract No 07.0202/2018/788519/ETU/ENV.D.2[1]

Name of organism: *Ameiurus melas* (Rafinesque, 1820)
Common name: black bullhead

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Risk Assessment Area: The risk assessment area is the territory of the European Union, excluding the outermost regions.

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[1] This template is based on the Great Britain non-native species risk assessment scheme (GBNNRA). A number of amendments have been introduced to ensure compliance with Regulation (EU) 1143/2014 on IAS and relevant legislation, including the Delegated Regulation (EU) 2018/968 of 30 April 2018, supplementing Regulation (EU) No 1143/2014 of the European Parliament and of the Council with regard to risk assessments in relation to invasive alien species (see https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32018R0968).

Contents

SECTION A – Organism Information and Screening

A1. Identify the organism. Is it clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank? including the following elements: • the taxonomic family, order and class to which the species belongs; • the scientific name and author of the species, as well as a list of the most common synonym names; • names used in commerce (if any) • a list of the most common subspecies, lower taxa, varieties, breeds or hybrids As a general rule, one risk assessment should be developed for a single species. However, there may be cases where it may be justified to develop one risk assessment covering more than one species (e.g. species belonging to the same genus with comparable or identical features and impact). It shall be clearly stated if the risk assessment covers more than one species, or if it excludes or only includes certain subspecies, lower taxa, hybrids, varieties or breeds (and if so, which subspecies, lower taxa, hybrids, varieties or breeds). Any such choice must be properly justified.

Response: *Ameiurus melas* belongs to the genus *Ameiurus* (Rafinesque, 1820), which is part of the Siluriformes (catfishes), Ictaluridae (Gill, 1861), North American freshwater catfishes (Froese & Pauly, 2019):

Kingdom Animalia

Phylum Chordata

Class Actinopterygii

Order Siluriformes

Family Ictaluridae

Ictaluridae consists of eight genera (one extinct) and 67 species of which 51 are extant (12 with fossil records) and 16 extinct (Arce-H. et al., 2016). Monophyly of living Ictaluridae is well supported by molecular data analysed using parsimony and model-based methods. These analyses found further support for the monophyly of the genus *Ameiurus*. This genus is represented by 16 species of which nine are fossils (Arce-H. et al., 2016).

According to the Integrated Taxonomic Information System (www.itis.org) *Ameiurus* spp. comprises of the following species:

- *Ameiurus brunneus* (Jordan, 1877) – snail bullhead
- *Ameiurus catus* (Linnaeus, 1758) – white catfish, white bullhead
- *Ameiurus melas* (Rafinesque, 1820) – black bullhead

- *Ameiurus natalis* (Lesueur, 1819) – yellow bullhead
- *Ameiurus nebulosus* (Lesueur, 1819) – brown bullhead
- *Ameiurus platycephalus* (Girard, 1859) – flat bullhead
- *Ameiurus serracanthus* (Yerger and Relyea, 1968) – spotted bullhead

Synonyms (non-valid) for *A. melas* are *Silurus melas*, *Ictalurus melas* and *Ictalurus melas melas*. Common name for *A. melas* is black bullhead but also used are black catfish, yellow belly bullhead or hornedpout (Froese & Pauly, 2019).

Ictalurid catfish species (also referred to as bullheads) have an adipose fin between their dorsal and tail fins. They have a rounded tail which will help to distinguish them from small channel catfish, *Ictalurus punctatus*, that have a forked tail. Ictalurid catfishes have no scales, their bodies are covered with taste buds, and will be very slippery to handle. Finally, ictalurid catfishes have a single, sharp spine in the dorsal and pectoral fins. Like other members of the Ictaluridae, black bullhead also has barbels ('whiskers') under their chin that help them locate food (Scott and Crossman, 1973).

Ameiurus melas (black bullhead) is known to hybridise naturally with their close congeners *A. nebulosus* and *A. natalis* (Hunnicutt et al., 2005).

The species in the genus are sometimes very difficult to distinguish from each other, especially *A. melas* and *A. nebulosus* (Wheeler, 1978). The often used identification criteria (e.g. colouration, serration of the pectoral spine) have proven to be unreliable characters and thus led to confusion of the species identity (Kottelat & Freyhof, 2007). As a consequence, many reported records of both black and brown bullhead in the risk assessment area are probably wrong and therefore the actual distribution of both species in the RA area remains unclear. The RA for *A. melas* is based on all available literature and expert judgment but may possibly include data from *A. nebulosus*. However, many features of both species are believed to be alike or equal, therefore conclusions for one species may also be valid for the other and vice versa.

One of the main distinguishing features that distinguish *A. melas* and *A. nebulosus* is that the *A. melas* has a weak serration on the trailing edge of the pectoral spines; whereas for *A. nebulosus*, the pectoral spine edge comprises regular saw-like barbs. The colour pattern also varies with *A. melas* being mainly dark, whereas *A. nebulosus* is usually mottled, but may be solid also (CABI, 2019).

However, in a dedicated study after examining dozens of both brown and black bullhead, Decru and Snoeks (2011) conclude that the most important external feature to distinguish between *A. melas* and *A. nebulosus* is the colouration of the caudal and anal fin membrane (). *Ameiurus melas* always has a black-and-white radiation on the caudal and anal fins, whereas *A. nebulosus* clearly does not have this. *Ameiurus melas* has lightly coloured fin rays with the tissue between the fin rays always dark, which causes this black-and-white radiation. For *A. nebulosus* the entire fins are rather light in colour.

Confusion between species could be possible, so identification of other species in the genus as *A. melas* or *A. nebulosus* cannot be ignored (Lenhardt et al., 2011).

The known common names of *Ameiurus melas* in European languages other than English are the following: NL: zwarte Amerikaanse dwergmeerval, DK: sort dværgmalle, PL: sumik czarny, DE:

Schwarzer Katzenwels, FR: poisson-chat, barbotte noire, IT: pesce gatto, ES: pez gato negro, bagre torito negro, AT: Schwarzer Zwergwels, FI: mustapiikkimonni, PT: peixe-gato, SE: svart dvärgmal.

A2. Provide information on the existence of other species that look very similar [that may be detected in the risk assessment area, either in the environment, in confinement or associated with a pathway of introduction]

Include both native and non-native species that could be confused with the species being assessed, including the following elements:

- other alien species with similar invasive characteristics, to be avoided as substitute species (in this case preparing a risk assessment for more than one species together may be considered);
- other alien species without similar invasive characteristics, potential substitute species;
- native species, potential misidentification and mis-targeting

Response:

There are two species of the genus *Ameiurus* in the risk assessment area, the black and the brown bullhead (Wheeler, 1978). There is a high degree of morphological similarity between *A. nebulosus* and *A. melas*. Differences have been mentioned in the previous question. In the risk assessment area, currently only brown *A. nebulosus* and black bullhead *A. melas* are established. Other species (white and yellow bullhead) were only recorded very occasionally. There are a number of reports of the introduction of *A. natalis* (yellow bullhead) into Italy (Holčík, 1991). However, there is no reliable evidence for this (CABI, 2019). Confirmed presence exists for *Ameiurus catus* (white catfish) only in the UK (Britton and Davies, 2006; Zięba et al., 2010).

A3. Does a relevant earlier risk assessment exist? Give details of any previous risk assessment, including the final scores and its validity in relation to the risk assessment area.

Response: *Ameiurus melas* has been ranked in several European countries/regions as representing a “medium” or “high” risk of being invasive using the fish invasiveness screening kit (FISK: Copp et al.,2009).

Ameiurus melas was classified as “high” risk for England & Wales (Copp et al. (2009).

Puntila et al. (2013) concluded that the risk of invasion for southern Finland was “medium”.

In Balkans Region, this species has a “medium-high” risk to become invasive (Simonović et al., 2013).

Piria et al., (2016) categorised *A. melas* as “high” risk of being invasive for Croatia and Slovenia.

The species is categorised as “high” risk of being invasive in the drainage basin of Lake Balaton, Hungary (Ferincz et al., 2016).

For the Iberian Peninsula, Almeida et al. (2013) classified the species as “very high” risk of being invasive.

Tarkan et al. (2014) categorised the species as “high” risk for Turkey, which is part of the frontier between Asia and Europe (Anatolia and Thrace).

Outside Europe, this species was identified as a potentially high-risk noxious species as a result of a rapid risk assessment approach that was developed in Australia (Moore et al., 2010). The Department of Fisheries of the Government of Western Australia (2013) included this species in State’s Noxious Fish List.

The species has been translocated within its native North America, introduced into the Pacific Northwest and reported for British Columbia, Canada, in the mid-1980s (Forbes and Flook, 1985) but no detailed risk screening could be found for that area.

A4. Where is the organism native?

including the following elements:

- an indication of the continent or part of a continent, climatic zone and habitat where the species is naturally occurring
- if applicable, indicate whether the species could naturally spread into the risk assessment area

Response: Native to the Great Lakes, Hudson Bay, and Mississippi River basins in most of the eastern and central United States and adjacent southern Canada and northern Mexico, south to the Gulf Coast (Gulf Coast drainages from Mobile Bay in Georgia and Alabama to northern Mexico) (Page and Burr, 1991); apparently not native to the Atlantic Slope (Fuller and Neilson, 2017). *Ameiurus melas* inhabits pools, backwaters, and sluggish current over soft substrates in creeks and small to large rivers; impoundments, oxbows, and ponds (Froese & Pauly, 2019). CABI (2019) mentions lakes, reservoirs and ponds as primary habitat with irrigation channels, rivers and streams as secondary or tolerated habitat. Climatic zones in North America include temperate and continental zones (CABI, 2019).

A5. What is the global non-native distribution of the organism outside the risk assessment area?

Response: Introduced widely outside the native range (Rose, 2006). Apart from Europe, it has been introduced also in Chile (Iriarte et al., 2005; Froese and Pauly, 2019), Mexico (Page and Burr, 1991; Froese and Pauly, 2019), to many states in the USA, and western parts of Canada (Scott & Crossman, 1973; Forbes and Flook, 1985).

A6. In which biogeographic region(s) or marine subregion(s) in the risk assessment area has the species been recorded and where is it established? The information needs be given separately

for recorded and established occurrences.

A6a. Recorded: List regions

A6b. Established: List regions

Freshwater / terrestrial biogeographic regions:

- Alpine, Atlantic, Black Sea, Boreal, Continental, Mediterranean, Pannonian, Steppic

Marine regions:

- Baltic Sea, North-east Atlantic Ocean, Mediterranean Sea, Black Sea

Marine subregions:

- Greater North Sea, incl. the Kattegat and the English Channel, Celtic Seas, Bay of Biscay and the Iberian Coast, Western Mediterranean Sea, Adriatic Sea, Ionian Sea, Central Mediterranean Sea, Aegean-Levantine Sea.

Comment on the sources of information on which the response is based and discuss any uncertainty in the response.

For delimitation of EU biogeographical regions please refer to https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2 (see also Annex V).

For delimitation of EU marine regions and subregions consider the Marine Strategy Framework Directive areas; please refer to https://www.eea.europa.eu/data-and-maps/data/msfd-regions-and-subregions/technical-document/pdf (see also Annex V).

Response (6a): Atlantic, Boreal, Mediterranean, Pannonian, Continental

Response (6b): Atlantic, Boreal, Mediterranean, Pannonian, Continental

A7. In which biogeographic region(s) or marine subregion(s) in the risk assessment area could the species establish in the future under current climate and under foreseeable climate change? The information needs be given separately for current climate and under foreseeable climate change conditions.

A7a. Current climate: List regions

A7b. Future climate: List regions

With regard to EU biogeographic and marine (sub)regions, see above.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the risk assessment (e.g. increase in average winter temperature, increase in drought periods)

The assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

Response (7a): Following Climatch (Peel et al. 2007) all biogeographic regions, except probably the Alpine region, of the risk assessment area have at current climate more or less suitable climate for establishment of *A. melas*.

Atlantic Region

Black Sea Region

Boreal Region

Continental region

Mediterranean region

Pannonian Region

Steppic Region

Response (7b): Britton et al. (2010a) ran a comparison of mean Climatch scores between 2009 and 2050 for *A. melas* in the UK. *Ameiurus melas* has an increased climate match with the source region in 2050 when compared with 2009. This species is likely to benefit from climate warming in England and Wales, this prediction was then tested using water temperature modeling. One can expect that similar benefit is true for regions between 50° and 55° N as modeled by Britton et al. (2010a).

Atlantic Region

Black Sea Region

Boreal Region

Continental region

Mediterranean region

Pannonian Region

Steppic Region

A8. In which EU Member States has the species been recorded and in which EU Member States has it established? List them with an indication of the timeline of observations. The information needs be given separately for recorded and established occurrences.

A8a. Recorded: List Member States

A8b. Established: List Member States

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

The description of the invasion history of the species shall include information on countries invaded and an indication of the timeline of the first observations, establishment and spread.

Response (8a):

- Austria (Wiesner et al., 2010) – first record unknown
- Belgium (Verreycken et al., 2007)) – first record *ca*. 1882
- Bulgaria (Pehlivanov et al., 2016, Stefanov, 2019) – first record 2013
- Croatia (Jelić et al., 2010;) – first record *ca.* 2005
- Czech Republic (Hartvich and Lusk, 2006) –first record *ca.* 2003
- France (Holčík, 1991; Rutkayová et al., 2013)) – first record *ca.* 1885
- Germany (Wolter et al., 2000; Wiesner et al., 2010)) – first record *ca.* 1987, but probably already present earlier.
- Hungary (Bódis et al., 2012)) – first record *ca.* 1985
- Italy (Holčík, 1991; Rutkayová et al., 2013)) – first record *ca.* 1900
- Poland (Nowak et al., 2010a; Holčík, 1991; Rutkayová et al., 2013) – first record *ca.* 1900
- Portugal (Ribeiro et al., 2006) – first record *ca.* 2002
- Romania (Wilhelm, 1998; Gaviloaie and Falka, 2006) – first record *ca.* 1968
- Slovakia (Koščo et al., 2004; Rutkayová et al., 2013) – first record *ca.* 1999
- Slovenia (Piria et al., 2016) – first record unknown
- Spain (Elvira, 1984; Copp et al., 2016)) – first record *ca.* 1950
- Sweden, recorded in 2014 at one location and successfully eradicated in 2015 (Brockmark, 2015; GBIF Secretariat, 2018)
- The Netherlands (Holčík, 1991; Rutkayová et al., 2013)) – first record *ca.* 1900
- UK (Holčík, 1991; Rutkayová et al., 2013) – first record *ca.* 1880

Response (8b): There are established populations in 15 EU Member States. Most introductions ended in established populations but establishment dates are almost never published. In general, establishment date is not so much different from date of first record (see 8a):

- Austria (Wiesner et al., 2010)
- Bulgaria (Pehlivanov et al., 2016, Trichkova et al., 2018, Stefanov, 2019, Vancheva et al., 2020)
- Croatia (Ćaleta et al., 2011)
- Czech Republic (Musil et al., 2008)
- France (Thiero Yatabary, 1981; Copp, 1989; Keith et al., 2011; Cucherousset et al., 2006a)
- Germany (Arnold, 1990; Wolter and Röhr, 2010)
- Hungary (Pintér, 1991; Bódis et al., 2012)
- Italy (Bianco, 1998; Copp et al., 2016; Pedicillo et al., 2008)
- Poland (Nowak et al., 2010a, 2010b; Grabowska et al., 2010)
- Portugal (Almaça, 1995; Gante and Santos, 2002; Ribeiro et al., 2006)
- Romania (Wilhelm, 1998; Copp et al., 2005a; Gaviloaie and Falka, 2006)
- Slovakia (Koščo et al., 2010)
- Slovenia (Piria et al., 2016)
- Spain (Miranda et al., 2010, De Miguel et al., 2014)
- The Netherlands (Verreycken et al., 2010; NDFF and RAVON/ANEMOON, 2018)
- UK (Lever, 1977; Wheeler, 1978; Copp et al., 2016) but the only confirmed population has been eradicated (UK Environment Agency, 2014)

A9. In which EU Member States could the species establish in the future under current climate and under foreseeable climate change? The information needs be given separately for current climate and under foreseeable climate change conditions.

A9a. Current climate: List Member States

A9b. Future climate: List Member States

With regard to EU Member States, see above.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the risk assessment (e.g. increase in average winter temperature, increase in drought periods)

The assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment with a clear explanation of the assumptions is provided.

However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4–1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9–2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

Response (9a): This species could probably establish in all the EU Member States, given its broad native range (Scott and Crossman, 1973), also in the Member States which currently are not known to have established populations:

- Austria (Wiesner et al., 2010)
- Belgium (Verreycken et al., 2007)
- Bulgaria (Pehlivanov et al., 2016, Trichkova et al., 2018, Stefanov, 2019, Vancheva et al., 2020)
- Croatia (Ćaleta et al., 2011)
- Cyprus
- Czech Republic (Musil et al., 2008)
- Denmark
- Estonia
- France (Copp, 1989; Keith et al., 2011; Copp et al., 2016; Cucherousset et al., 2006a)
- Finland
- Germany (Arnold, 1990; Wolter and Röhr, 2010)
- Greece (Barbieri et al., 2015)
- Hungary (Pintér, 1991; Bódis et al., 2012)
- Italy (Bianco, 1998; Pedicillo et al., 2008; Copp et al., 2016)
- Ireland
- Latvia
- Lithuania
- Luxembourg (Copp et al., 2016)
- Malta
- Poland (Nowak et al., 2010a, 2010b)
- Portugal (Almaça, 1995; Gante and Santos, 2002; Ribeiro et al., 2006)
- Romania (Wilhelm, 1998; Copp et al., 2005a; Gaviloaie and Falka, 2006)

- Slovakia (Koščo et al., 2010; Copp et al., 2016)
- Slovenia (Piria et al., 2016)
- Spain (Miranda et al., 2010, De Miguel et al., 2014; Copp et al., 2016)
- Sweden
- The Netherlands (Verreycken et al., 2007, 2010; NDFF and RAVON/ANEMOON, 2018)
- UK (Lever, 1977; Wheeler, 1978; Copp et al., 2016)

Response (9b): Same as 9a, see question 7b for establishment under climate change.

A10. Is the organism known to be invasive (i.e. to threaten or adversely impact upon biodiversity and related ecosystem services) anywhere outside the risk assessment area?

Response:

Nearly all risk assessments (see A3) rank *A. melas* as 'medium' or 'high' risk of being (or becoming) invasive in the member states of the risk assessment areas. *Ameiurus melas* could negatively affect native ichthyofauna through direct predation and competition. This species is abundant in its native range; capable of securing and ingesting a wide range of food; gregarious; has a broad native range; high reproductive potential; longevity (10 years); highly adaptable to different environments; invasive in and outside its native range; a habitat generalist; tolerant of shade and poor quality waters (Cucherousset et al., 2007). Given its characteristics, it can be considered potentially invasive for all the countries where it has established populations.

An indirect impact of *A. melas* on biodiversity can be through the generation of turbidity (e.g. Braig and Johnson, 2003 for the USA), which can reduce the feeding efficiency of visual-feeding native species (reviewed in Copp et al., 2016).

In the risk assessment area several North-American ictalurid fish species were introduced around 1900 for aquaculture purposes but also for stocking in impoverished European rivers. The latter proves the hardiness of these species and their ability to thrive is harsh conditions (Verreycken et al. 2010). Black bullhead is able to survive low oxygen concentrations for prolonged periods. It is a food generalist and has an omnivore diet. *Ameiurus* species are nocturnal zoophagophores, feeding on other aquatic species within the ecosystem. These species are predators of small fishes and larvae that have identical microhabitat requirements, such as aquatic invertebrates of which insect larvae are preferred. Ictalurid fish species feed on molluscs, fishes, algae, plant material and terrestrial invertebrates (Scott and Crossman, 1973; Brylinski and Chybowski, 2000; Leunda et al., 2008; Ruiz-Navarro et al., 2015). Black bullhead can even feed in turbid waters, by using its chin barbels (Scott and Crossman, 1973). *Ameiurus melas* predates on a wide variety of invertebrates, small vertebrates and fish eggs. Its parental care of eggs and young reduce mortality in the young and thus result in a higher survival. Moreover, it can erect its dorsal and pectoral spines as a defense against predators (Scott and Crossman, 1973).

In standing waters, this species can form dense populations (Keith et al., 2011). Moreover, ictalurid catfishes, including black bullhead, are potential vectors of non-native parasites (Scholz and Cappellaro, 1993; Sheath et al., 2015, Vancheva et al., 2020).

A11. In which biogeographic region(s) or marine subregion(s) in the risk assessment area has the species shown signs of invasiveness? Indicate the area endangered by the organism as detailed as possible.

Freshwater / terrestrial biogeographic regions:

- Alpine, Atlantic, Black Sea, Boreal, Continental, Mediterranean, Pannonian, Steppic

Marine regions:

- Baltic Sea, North-east Atlantic Ocean, Mediterranean Sea, Black Sea

Marine subregions:

Greater North Sea, incl. the Kattegat and the English Channel, Celtic Seas, Bay of Biscay and the Iberian Coast, Western Mediterranean Sea, Adriatic Sea, Ionian Sea, Central Mediterranean Sea, Aegean-Levantine Sea

Response: Atlantic, Continental, Boreal, Pannonian & Mediterranean

A12. In which EU Member States has the species shown signs of invasiveness? Indicate the area endangered by the organism as detailed as possible.

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

Response:

- Bulgaria (Pehlivanov et al., 2016, Trichkova et al., 2018, Stefanov, 2019, Vancheva et al., 2020)
- Croatia (Ćaleta et al., 2011)
- France (Cucherousset et al., 2006a)
- Germany (Nehring et al., 2015)
- Hungary (Koščo et al., 2010; Kováč, 2015)
- Italy (Amori et al., 1993; Novomeská et al., 2013)
- Poland (Nowak et al., 2010a, 2010b)

- Portugal (Garcia-de-Lomas et al., 2009; Miranda et al., 2010)
- Romania (Kováč, 2015)
- Slovakia (Koščo et al., 2010)
- Slovenia (Piria et al., 2016)
- Spain (Garcia-de-Lomas et al., 2009; Miranda et al., 2010)
- The Netherlands (NDFF and RAVON/ANEMOON, 2018)

A13. Describe any known socio-economic benefits of the organism.

including the following elements:

- Description of known uses for the species, including a list and description of known uses in the Union and third countries, if relevant.
- Description of social and economic benefits deriving from those uses, including a description of the environmental, social and economic relevance of each of those uses and an indication of associated beneficiaries, quantitatively and/or qualitatively depending on what information is available.

If the information available is not sufficient to provide a description of those benefits for the entire risk assessment area, qualitative data or different case studies from across the Union or third countries shall be used, if available.

Response: Ictalurid catfishes are not important in European aquaculture, but they have been or still are farmed in some countries, e.g. Italy (Bianco and Ketmaier, 2016; Sicuro et al., 2016).

The yearly European aquaculture production and value of *A. melas* in the early 2000s (mean for 2000–2004) is in 9th position (473.4 tons; 1,770,700 US$; value = 3.74 US$/kg) (Turchini and de Silva, 2008). *A. melas* has low benefits in sport fishing and very low benefits in the pet trade.

Production of *A. melas* from aquaculture in Europe (only Italy) excluding hatcheries and nurseries (from 2008 onwards) according to Eurostat (2018) varied between 43.2 t in 2013 to 245.75 t in 2010, with a mean yearly production of 148,2 t for the period 2010-2015.

SECTION B – Detailed assessment

Important instructions:

- In the case of lack of information the assessors are requested to use a standardized answer: "No information has been found."
- With regard to the scoring of the likelihood of events or the magnitude of impacts see Annexes I and II.
- With regard to the confidence levels, see Annex III.
- Highlight the selected response score and confidence level in **bold** but keep the other scores in normal text (so that the selected score is evident in the final document).

1 PROBABILITY OF INTRODUCTION

Important instructions:

- **Introduction** is the movement of the species into the risk assessment area (it may be either in captive conditions and/or in the environment, depending on the relevant pathways).
- **Entry** is the release/escape/arrival in the environment, i.e. occurrence in the wild and is treated in the next section (N.B. introduction and entry may coincide for species entering through pathways such as "corridor" or "unaided)".
- The classification of pathways developed by the Convention of Biological Diversity (CBD) should be used. For detailed explanations of the CBD pathway classification scheme consult the IUCN/CEH guidance document[2] and the provided key to pathways[3].
- For organisms which are already present in the risk assessment area, only complete this section for current active pathways and, if relevant, potential future pathways.

Q. 1.1. List relevant pathways through which the organism could be introduced. Where possible give details about the specific origins and end points of the pathways as well as a description of any associated commodities.

For each pathway answer questions 1.2 to 1.7 (copy and paste additional rows at the end of this section as necessary). Please attribute unique identifiers to each question if you consider more than one pathway, e.g. 1.2a, 1.3a, etc. and then 1.2b, 1.3b etc. for the next pathway.

In this context a pathway is the route or mechanism of introduction of the species.

The description of commodities with which the introduction of the species is generally associated shall include a list and description of commodities with an indication of associated risks (e.g. the volume of trade; the likelihood of a commodity being contaminated or acting as vector).

If there are no active pathways or potential future pathways this should be stated explicitly here, and there is no need to answer the questions 1.2–1.9

[2] https://circabc.europa.eu/sd/a/738e82a8-f0a6-47c6-8f3b-aeddb535b83b/TSSR-2016-010%20CBD%20categories%20on%20pathways%20Final.pdf
[3] https://circabc.europa.eu/sd/a/0aeba7f1-c8c2-45a1-9ba3-bcb91a9f039d/TSSR-2016-010%20CBD%20pathways%20key%20full%20only.pdf

Pathway name: N/A

- *Ameiurus melas* is already widespread in Europe, and currently there are no active introduction vectors, as the species is not known to be imported to the RA area from outside of the EU (expert judgment by the authors). So, the original vectors and pathways for the species introduction into Europe, i.e. fisheries (angling/sport purposes), ornamental use and aquaculture, are no longer considered to be active. Unauthorised intentional and accidental releases are believed to be restricted to within and between members states and these are therefore assessed in the 'Entry' and 'Spread' sections.

Q. 1.2a. Is introduction along this pathway intentional (e.g. the organism is imported for trade) or unintentional (e.g. the organism is a contaminant of imported goods)?

RESPONSE	intentional unintentional	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.3a. How likely is it that large numbers of the organism will be introduced through this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of introduction based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in introduction whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.4a. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.5a. How likely is the organism to survive existing management practices during transport and storage along the pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.6a. How likely is the organism to be introduced into the risk assessment area undetected?

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.7a. Estimate the overall likelihood of introduction into the risk assessment area based on this pathway?

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

End of pathway assessment, repeat Q. 1.3 to 1.7 as necessary using separate identifier.

Q. 1.8. Estimate the overall likelihood of introduction into the risk assessment area based on all pathways and specify if different in relevant biogeographical regions in current conditions.

Provide a thorough assessment of the risk of introduction in relevant biogeographical regions in current conditions: providing insight in to the risk of introduction into the Union.

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

Q. 1.9. Estimate the overall likelihood of introduction into the risk assessment area based on all pathways in foreseeable climate change conditions?

Thorough assessment of the risk of introduction in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk.

With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the likelihood of introduction (e.g. change in trade or user preferences)

The thorough assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment of likely introduction within a medium timeframe scenario (e.g. 30-50 years) with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4-1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9-2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

RESPONSE	very unlikely unlikely moderately likely likely very likely	**CONFIDENCE**	low medium high

Response: N/A

2 PROBABILITY OF ENTRY

Important instructions:

- Entry is the release/escape/arrival in the environment, i.e. occurrence in the wild. Entry is not to be confused with spread, the movement of an organism within the risk assessment area.
- The classification of pathways developed by the Convention of Biological Diversity (CBD) should be used. For detailed explanations of the CBD pathway classification scheme consult the IUCN/CEH guidance document[4] and the provided key to pathways[5].
- For organisms which are already present in the risk assessment area, only complete this section for current active or if relevant potential future pathways. This section need not be completed for organisms which have entered in the past and have no current pathway of entry.

Q. 2.1. List relevant pathways through which the organism could enter into the environment.

For each pathway answer questions 2.2 to 2.7 (copy and paste additional rows at the end of this section as necessary). Please attribute unique identifiers to each question if you consider more than one pathway, e.g. 2.2a, 2.3a, etc. and then 2.2b, 2.3b etc. for the next pathway.

In this context a pathway is the route or mechanism of entry of the species into the environment.

If there are no active pathways or potential future pathways this should be stated explicitly here, and there is no need to answer the questions 2.2–2.8

Pathway name:

a) RELEASE IN NATURE (Fishery in the wild)

b) ESCAPE FROM CONFINEMENT (“Aquaculture” and “Pet / Aquarium / Terrarium species (including live food for such species)”)

a) RELEASE IN NATURE (Fishery in the wild)

Q. 2.2a. Is entry into the environment intentional (e.g. the organism is released for a specific purpose) or unintentional (e.g. the organism escapes from a confinement)?

RESPONSE	intentional	**CONFIDENCE**	high

[4] https://circabc.europa.eu/sd/a/738e82a8-f0a6-47c6-8f3b-aeddb535b83b/TSSR-2016-010%20CBD%20categories%20on%20pathways%20Final.pdf
[5] https://circabc.europa.eu/sd/a/0aeba7f1-c8c2-45a1-9ba3-bcb91a9f039d/TSSR-2016-010%20CBD%20pathways%20key%20full%20only.pdf

Response: There is past evidence of intentional releases to the environment for the purposes of fish stocking (Künstler, 1908; Wittenberg et al., 2006; Keith et al. 2011). Fish species valued by anglers are often reared in aquaculture facilities and then released into the wild to enhance local fish populations (i.e. stocking). Although black bullhead is not much valued by anglers and rather regarded as a pest species, a recent case of a reservoir stocking with *A. melas* happened in Bulgaria by reservoir owners and anglers who were not aware of the species' bad reputation (Trichkova, pers. comm.).

Q. 2.3a. How likely is it that large numbers of the organism will enter into the environment along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of entry into the environment based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in entry whereas for others high propagule pressure (many thousands of individuals) may not).

RESPONSE	unlikely	**CONFIDENCE**	medium

Response: The reputation of *A. melas* as a pest species by anglers (Cucherousset et al., 2006b) makes it less likely to be intentionally released in angling waters and less likely to be used in fish stockings, and its use in aquaculture also appears to have reduced dramatically except in certain localised areas.

Q. 2.4a. How likely is the organism to enter into the environment within the risk assessment area undetected?

RESPONSE	unlikely	**CONFIDENCE**	low

Response: If *A. melas* were to be used for regulated fish stocking then obviously the entry into the environment would be known but illegal stocking of this species is probably not going to be reported. However, the reputation of *A. melas* as a pest species by anglers (Cucherousset et al., 2006b) makes it less likely for this species to be intentionally released in angling waters, both legally and illegally. .

Q. 2.5a. How likely is the organism to enter into the environment during the months of the year most appropriate for establishment?

RESPONSE	likely	**CONFIDENCE**	medium

Response: Fish stocking is normally undertaken during periods of the year that maximise potential survival, i.e. late winter/early spring, which coincides with the lead into the reproductive period.

Q. 2.6a. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host in the environment?

RESPONSE	likely	**CONFIDENCE**	high

Response: In the pathway of entry "RELEASE IN NATURE (Fishery in the wild)", the individuals are usually released into an environment with suitable habitat as this is the purpose of the stocking. *Ameiurus melas* is generally regarded as a nuisance species by anglers and therefore is less likely to be intentionally released in angling waters. However, there are still cases of reservoir stocking with *A. melas* in the risk assessment area (Bulgaria) by reservoir owners and anglers who do not know the species (Trichkova, pers. comm.).

Q. 2.7a. Estimate the overall likelihood of entry into the environment within the risk assessment area based on this pathway?

RESPONSE	possible	**CONFIDENCE**	medium

Response: *Ameiurus melas* is generally regarded as a nuisance species by anglers and therefore is less likely to be intentionally released in angling waters. However, there are still cases of recent stocking with *A. melas* in the risk assessment area (Bulgaria) (Trichkova, pers. comm.) therefore the likelihood of continued releases of this species into locations where it currently does not exist remains moderate.

End of pathway assessment, repeat Q. 2.2 to 2.7. as necessary using separate identifier.

b) ESCAPE FROM CONFINEMENT ("Aquaculture / mariculture" and " Pet / aquarium / terrarium species (including live food for such species)").

Q. 2.2b. Is entry into the environment intentional (e.g. the organism is released for a specific purpose) or unintentional (e.g. the organism escapes from a confinement)?

RESPONSE	unintentional	**CONFIDENCE**	high

Response: Black bullheads could be kept in aquaria as a pet species or used for aquaculture purposes (both the aquarium trade and aquaculture after all are mentioned as previous introduction pathways) and escape from confinement into the environment. However, apparently, ictalurid catfishes are not important in European aquaculture, but they have been or still are farmed in some countries, e.g. Italy (Bianco and Ketmaier, 2016; Sicuro et al., 2016) and also the use of this species in the aquarium trade seems to be very limited.

Q. 2.3b. How likely is it that large numbers of the organism will enter into the environment along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- discuss how likely the organism is to get onto the pathway in the first place. Also comment on the volume of movement along this pathway.
- an indication of the propagule pressure (e.g. estimated volume or number of individuals / propagules, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if relevant, comment on the likelihood of entry into the environment based on propagule pressure (i.e. for some species low propagule pressure (1–2 individuals) could result in entry whereas for others high propagule pressure (many thousands of individuals) may not).

RESPONSE	unlikely	**CONFIDENCE**	medium

Response: Similar to many species, *A. melas* could escape from aquaculture facilities during extreme hydrological events if the facilities are located on or near rivers (e.g. De Groot, 1985; Walker, 2004). However, the declining interest in the species for both angling and aquaculture suggests that large numbers are unlikely.

Q. 2.4b. How likely is the organism to enter into the environment within the risk assessment area undetected?

RESPONSE	unlikely	**CONFIDENCE**	low

Response: Accidental escape from aquaculture facilities could occur through extreme hydrological events or loss of facility integrity and will probably only be noticed if the loss of fish is substantial. Otherwise this escape would probably go undetected. Escape from aquaria would be less likely to go unnoticed.

Q. 2.5b. How likely is the organism to enter into the environment during the months of the year most appropriate for establishment?

RESPONSE	likely	CONFIDENCE	medium

Response: Flooding events in Europe are normally during late winter/early spring, though in some cases during summer, which coincides with the lead into the reproductive period (spring) or the pre-autumn conditions that permit the fish the opportunity to escape and adapt to open waters and develop towards reproduction the following spring.

Q. 2.6b. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host in the environment?

RESPONSE	likely	CONFIDENCE	medium

Response: Similar to many species, *A. melas* can be spread accidentally or through intentional (but unauthorised) introductions (Nowak et al., 2010a, 2010b). However, *A. melas* is generally regarded as a nuisance species by anglers and therefore is less likely to be intentionally released in angling waters. Nevertheless, since aquaculture facilities are often close to the suitable habitats for bullhead (irrigation channels, lakes, ponds, reservoirs), it is likely that if individuals escape from aquaculture they will transfer to a suitable habitat

Q. 2.7b. Estimate the overall likelihood of entry into the environment within the risk assessment area based on this pathway?

RESPONSE	possible	CONFIDENCE	medium

Response: In view of the continued aquaculture use of the species in some parts of the EU (e.g. Italy; Eurostat, 2018), albeit relatively few, the likelihood of accidental escapes of the fish from aquaculture facilities, and for the accidental translocation of this species as a contaminate of authorised fish consignments, into novel locations remains moderate.

End of pathway assessment, repeat Q. 2.2 to 2.7. as necessary using separate identifier.

Q. 2.8. Estimate the overall likelihood of entry into the environment within the risk assessment area based on all pathways in current conditions and specify if different in relevant biogeographical regions. Provide a thorough assessment of the risk of entry into the environment in relevant biogeographical regions in current conditions.

RESPONSE	possible	**CONFIDENCE**	medium

Response: Both intentional and unintentional releases of this species are possible at this time. However, confidence in this assessment is ‘medium’.

Q. 2.9. Estimate the overall likelihood of entry into the environment within the risk assessment area based on all pathways in foreseeable climate change conditions and specify if different in relevant biogeographical regions. Thorough assessment of the risk of entry in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk, specifically if likelihood of entry is likely to increase or decrease for specific pathways.

RESPONSE	possible	**CONFIDENCE**	medium

Response: Near-future climatic conditions are unlikely to modify the intentional use or the accidental release of this species, so scoring is the same as in Q2.8.

3 PROBABILITY OF ESTABLISHMENT

Important instructions: • For organisms which are already established in parts of the risk assessment area, answer the questions with regard to those areas, where the species is not yet established.

Q. 3.1. How likely is it that the organism will be able to establish in the risk assessment area based on the history of invasion by this organism elsewhere in the world (including similarity between other abiotic conditions within it and the organism's current distribution)?

RESPONSE	very likely	**CONFIDENCE**	high

Response: This species is already established in several EU countries.

Q. 3.2. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in the risk assessment area?

RESPONSE	widespread	**CONFIDENCE**	high

Response: In its native and introduced ranges, *A. melas* inhabits irrigation channels, lakes, ponds and reservoirs, which are principal habitats. Rivers and streams are secondary habitats (Scott and Crossman, 1973). *Ameiurus melas* is said to be most abundant in smaller water bodies, especially artificial and heavily managed ponds. It is considered a warm-water species (CABI, 2019; Copp et al., 2016; Leunda et al., 2008). There is an abundance of the species' preferred habitat types within the risk assessment area. *Ameiurus melas* can tolerate poor river conditions, and has a wide temperature tolerance, ranging between 8 and 30ºC (Baensch and Riehl, 1991; Cucherousset et al., 2007). Indeed, *A. melas* has the ability to tolerate, survive or adapt to a wide variety of environmental conditions. *Ameiurus melas* is a typical limnophilic species and one of the most tolerant fish species capable of resisting water pollution (Ribeiro et al., 2008; Nowak et al., 2010a). For example, Cucherousset et al. (2007) found *A. melas* to rank amongst the top two species in the Brière Marsh in terms of tolerance index, coefficient of water quality flexibility and temperature of upper avoidance. Increased eutrophication can benefit the growth of this species. The lack of native competitors and predators could lead to a further range expansion in the risk assessment area. The species' establishment following introduction has likely been facilitated by its life-history plasticity (Jarić et al., 2015; Copp et al., 2016; Jaćimović et al., 2019) and its generalist, omnivore diet with feeding aided, even in turbid waters, by its chin barbels (Scott and Crossman, 1973). All of these factors contribute to the *A. melas*'s high potential as a successful invader (Gante and Santos, 2002; Koščo et al., 2004; Dextrase and Mandrak, 2006; Copp et al., 2016), with the ability to occupy almost all the inland water surfaces in the risk assessment area. In particular, *A. melas* could especially become invasive in the southern parts with warmer waters (Scott and Crossman, 1973). Indeed, the numerous dams constructed for river regulation and as hydropower plants in Europe are an excellent opportunity for further expansion of its range (Cvijanović et al., 2005, 2008; Johnson et al., 2008).

Q. 3.3. If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?

RESPONSE	N/A	**CONFIDENCE**	high

Response: There is no evidence available to suggest that the species requires another taxon for any critical stage of its life cycle.

Q. 3.4. How likely is it that establishment will occur despite competition from existing species in the risk assessment area?

RESPONSE	very likely	**CONFIDENCE**	high

Response: In a review of various studies, Copp et al. (2016) reported that the increasing trend in distribution and abundance of *A. melas* in some European countries has coincided with the decline of *A. nebulosus* (Nowak et al., 2010b). These contrasting patterns have led to suggestions that *A. melas* has been displacing *A. nebulosus*, but this is not true for Belgium where *A. melas* is not present and *A. nebulosus* is in decline (Verreycken et al., 2010). This was subsequently reviewed by Béres (2018): "The research findings confirm the hypotheses that the invasion of *A. melas* started and has not finished yet, and this species invading new habitats gradually replaces *A. nebulosus* not only in the natural waters in Hungary but even all over Europe (Harka 1997, Garcia-de-Lomas et al. 2009, Wilhelm 1998, Gante and Santo 2002, Luck et al. 2010, Popa et al. 2006, Nowak et al. 2010b, Kapusta et al. 2010, Movchan et al. 2014, Wilhelm et al. 1998)." By contrast, in the River Po, Italy, *A. melas* is reported to have declined in the 1990s following its introduction in the early 1900s (Castaldelli et al., 2013).

However, the two species have overlapping native distributions in North America (Fuller and Neilson (2017), so this pattern of *A. melas* replacement of *A. nebulosus* may simply be coincidental. However, further study is needed to determine whether or not this is an artefact or indicative of *A. melas* displacing *A. nebulosus*.

Q. 3.5. How likely is it that establishment will occur despite predators, parasites or pathogens already present in the risk assessment area?

RESPONSE	very likely	CONFIDENCE	high

Response: There is little information on how predators, parasites or pathogens could affect *A. melas*. Avian predators exist throughout the EU, but in Iberia, the only possible predatory fishes are non-native. In general, there does not appear to be any predators, parasites or pathogens in European water bodies, with a range of small native species likely to be the most impacted due to predation. By virtue of their strong pectoral and dorsal spines, which can lock into an erect position when threatened, adult *A. melas* are well protected from predation by all but the largest fish predators in their native range in Canada. Although present in juveniles, the spines are less robust, rendering juveniles more susceptible to predation by fishes with a wider range in size. Within its native range, predators include members of the families pike (*Esox* spp.) and pikeperch (*Sander* spp.) (Scott & Crossman, 1973; Hanchin et al., 2002), and there are representatives of both families in many parts of the risk assessment area.

Q. 3.6. How likely is the organism to establish despite existing management practices in the risk assessment area?

RESPONSE	very likely	CONFIDENCE	medium

Response: As with many fish species, it is virtually impossible to eradicate *A. melas* once established in a water course. However, in small, closed waters (e.g. small lakes or ponds), eradication of fish ,in general, may be possible by chemical means (e.g. rotenone) or by draining down of the water body (Britton et al., 2010b), including *A. melas* from an isolated pond in Essex, England (UK Environment Agency, 2014). Other known attempts to eradicate *A. melas* in the risk assessment area include intensive removals from the Brière Marsh, France which was only partly successful, probably because of the large area to be fished (Cucherousset et al., 2006a). There was one successful eradication attempt in Bulgaria by draining down a small reservoir (surface area of 170 x 10^3 m^2) for a period of three months (T. Trichkova, pers. comm.).

Q. 3.7. How likely are existing management practices in the risk assessment area to facilitate establishment?

RESPONSE	unlikely	CONFIDENCE	low

Response: No evidence found to suggest management practices will facilitate the species' establishment, though in some countries inadequate screening of fish consignments (for stocking) could result in the accidental dispersal of *A. melas* (e.g. Copp et al., 2010).

Q. 3.8. How likely is it that biological properties of the organism would allow it to survive

eradication campaigns in the risk assessment area?

RESPONSE	likely	**CONFIDENCE**	high

Response: Moore et al. (2010) classify *A. melas* as "high" about the "hardiness" criterion used as an indicator of the species' ability to tolerate, survive, or adapt to a wide range of temperatures, pH, salt or freshwater aquatic environments, or the ability to survive out of water for extended periods of time. Indeed, *A. melas* has considerable tolerance of water pollution, turbidity, low oxygen concentration, elevated temperatures and a range of pH values (Cucherousset et al., 2007; Novomeská et al., 2013). The species biological traits appear to facilitate the ability of *A. melas* to recover from population crashes (Jaćimović et al., 2019) and unsuccessful eradication attempts (Marchetti et al., 2004). As a result of this tolerance and their bottom habit, *A. melas* is most difficult to eradicate both physically and chemically, the species being less sensitive to the piscicide 'rotenone' than some other species (Ling, 2002). That said, successful eradication of *A. melas* from a small pond in Essex, England, the only know extant population of *A. melas* in the UK, has been reported (UK Environment Agency, 2014). An unsuccessful attempt in France to eradicate *A. melas* from the Brière Marsh, France, by intensive removals involved the use of traps and electrofishing equipment (Cucherousset et al., 2006a).

Q. 3.9. How likely are the biological characteristics of the organism to facilitate its establishment in the risk assessment area?

including the following elements:

- a list and description of the reproduction mechanisms of the species in relation to the environmental conditions in the Union
- an indication of the propagule pressure of the species (e.g. number of gametes, seeds, eggs or propagules, number of reproductive cycles per year) of each of those reproduction mechanisms in relation to the environmental conditions in the Union.

If relevant, comment on the likelihood of establishment based on propagule pressure (i.e. for some species low propagule pressure (1-2 individuals) could result in establishment whereas for others high propagule pressure (many thousands of individuals) may not.

RESPONSE	very likely	**CONFIDENCE**	medium

Response: This species is already established within the RA area. *A. melas* become sexually mature between ages 1–3 years (Copp et al., 2016) (with maximum reported age of 10 years (Froese & Pauly, 2019)) and are relatively fecund, producing between 2 000 and 3 800 eggs during each spawning period. Males guard the nest for up to 10 days after hatching (Etnier and Starnes, 1993), and then the young-of-the-year juveniles form a dense ball-shaped shoal that follows the female around until the older juveniles begin to disperse. The feeding behaviour *of A. melas* is omnivorous/generalist/opportunistic, and the species demonstrates life-history plasticity (Scott and Crossman, 1973; Ribeiro et al., 2008; Jarić et al., 2015; Copp et al., 2016; Jaćimović et al., 2019).

Additionally, *A. melas* is resistant to domestic and industrial pollution (Scott and Crossman, 1973) and can survive in a range of temperatures (0–25ºC), with an upper lethal temperature of 23–35°C (Scott and Crossman, 1973). The species is also said to withstand low dissolved oxygen levels (0.3 mg/L) (CABI, 2019). In Moore et al. (2010), all *Ameiurus* species, except *A. serracanthus*, are said to present a moderate population growth, according to the criterion "resilience", which indicates the rate of population doubling as an indicator of the rate of potential population growth.

Q. 3.10. How likely is the adaptability of the organism to facilitate its establishment?

RESPONSE	likely	**CONFIDENCE**	high

Response: The species' tolerance of a vast array of water quality variables enhances its ability to adapt to, and live in, a range of freshwater habitats, including those threatened with drought (Cucherousset et al., 2007). This is apparent in the species' establishment in various global locations outside its native range, including Europe (Copp et al., 2016) and western North America (Scott and Crossman, 1973; Forbes and Flook, 1985). The species' feeding behaviour is omnivorous/generalist/opportunistic, and it demonstrates considerable life-history plasticity (Scott and Crossman, 1973; Ribeiro et al., 2008; Jarić et al., 2015; Copp et al., 2016; Jaćimović et al., 2019).

Q. 3.11. How likely is it that the organism could establish despite low genetic diversity in the founder population?

RESPONSE	possible	**CONFIDENCE**	low

Response: No evidence was found to suggest that low genetic diversity would reduce this species' chances of establishment. A genetic study of North American populations (native range) found that *A. melas* is "relatively stable over time or the population is comprised of more geographically structured sub-populations" (Padhi, 2010). The reported expansion of *A. melas* in Central Europe (Béres, 2018) would suggest that there are no genetic constraints on the species in Europe.

Q. 3.12. If the organism does not establish, then how likely is it that casual populations will continue to occur? Consider, for example, a species which cannot reproduce in the risk assessment area, because of unsuitable climatic conditions or host plants, but is present because of recurring introduction, entry and release events. This may also apply for long-living organisms.

RESPONSE	possible	**CONFIDENCE**	medium

Response: As stated here above, *A. melas* inhabits lakes, ponds, reservoirs, rivers and streams, brackish waters, estuaries and irrigation channels, and it is able to tolerate, survive, or adapt to a wide range of temperatures, pH, salt or freshwater aquatic environments (Scott and Crossman, 1973). As such, failure to establish is unlikely, but if establishment is not achieved, then persistent as a casual is very likely, though a casual fish is not likely to persist beyond 10 years (max. lifespan is about 10 years (Froese & Pauly, 2019)).

Q. 3.13. Estimate the overall likelihood of establishment in the risk assessment area based on the similarity between climatic conditions within it and the organism's current distribution under current climatic conditions. In addition, details of the likelihood of establishment in relevant biogeographical regions under current climatic conditions should be provided.

Thorough assessment of the risk of establishment in relevant biogeographical regions in current conditions: providing insight in the risk of establishment in (new areas in) the Union.

RESPONSE	very likely	**CONFIDENCE**	high

Response: Both the native and EU ranges of this species encompass five climate type zones (Peel et al., 2007), with four of these shared by the native and EU ranges (Cfa, Dfa, Dfb, Dfc), as such establishment in the risk assessment area, even in other parts where it is not yet established, is very likely under current climatic conditions.

Q. 3.14 Estimate the overall likelihood of establishment in the risk assessment area under foreseeable climate change conditions. In addition, details of the likelihood of establishment in relevant biogeographical regions under foreseeable climate change conditions should be provided.

Thorough assessment of the risk of establishment in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk.
With regard to climate change, provide information on

- the applied timeframe (e.g. 2050/2070)
- the applied scenario (e.g. RCP 4.5)
- what aspects of climate change are most likely to affect the likelihood of establishment (e.g. increase in average winter temperature, increase in drought periods)

The thorough assessment does not have to include a full range of simulations on the basis of different climate change scenarios, as long as an assessment of likely establishment within a medium timeframe scenario (e.g. 30–50 years) with a clear explanation of the assumptions is provided. However, if new, original models are executed for this risk assessment, the following RCP pathways shall be applied: RCP 2.6 (likely range of 0.4–1.6°C global warming increase by 2065) and RCP 4.5 (likely range of 0.9–2.0°C global warming increase by 2065). Otherwise, the choice of the assessed scenario has to be explained.

RESPONSE	very likely	**CONFIDENCE**	high

Response: With climate change affecting the water temperature, an increase in water temperature is likely to facilitate this species' (Britton et al., 2010a) establishment in more areas. Britton et al. (2010a) ran a comparison of mean Climatch scores between 2009 and 2050 for *A. melas* in the UK. *Ameiurus melas* has an increased climate match with the source region in 2050 when compared with 2009. This species is likely to benefit from climate warming in England and Wales, this prediction was then tested using water temperature modeling. One can expect that similar benefit is true for regions between 50° and 55° N as modeled by Britton et al. (2010a). As such, it is likely to establish in more areas where previously the water temperature would be too low to reproduce. This would facilitate establishment in countries with a current colder climate such as UK (Britton et al., 2010a) and Poland, where the species was already reported within the last decade (Nowak et al., 2010a). The increase in temperature would allow *A. melas* to spread and establish more widely into all biogeographic regions except probably the Alpine.

4 PROBABILITY OF SPREAD

Important instructions: - Spread is defined as the expansion of the geographical distribution of an alien species within the risk assessment area. - Repeated releases at separate locations do not represent continuous spread and should be considered in the probability of entry section. In other words, intentional anthropogenic "spread" via release or escape ("jump-dispersal"), should be dealt within the entry section. However, as repeated releases contribute to the spread of the target organism in the risk assessment area, the relevant pathway(s) should be briefly discussed here too, with an explicit reference to the entry section for additional details.

Q. 4.1. How important is the expected spread of this organism within the risk assessment area by natural means? (List and comment on each of the mechanisms for natural spread.) including the following elements: - a list and description of the natural spread mechanisms of the species in relation to the environmental conditions in the risk assessment area. - an indication of the rate of each of those spread mechanisms in relation to the environmental conditions in the Union. The description of spread patterns should include elements of the species life history and behavioural traits able to explain its ability to spread, including: reproduction or growth strategy, dispersal capacity, longevity, dietary requirements, environmental and climatic requirements, specialist or generalist characteristics.

RESPONSE	moderate	**CONFIDENCE**	medium

Response: Within its native range in North America, most natural dispersal of *A. melas* has occurred at local levels (Fuller et al., 1999). In European waters, the dispersal mechanism of *A. melas* is not clear, but it is likely to be associated with accidental and illegal introductions (Nowak et al., 2010a, 2010b), combined by natural spread between neighboring countries via natural and human-made water courses (Panov et al., 2009). Despite being established in several European countries for over a century, the natural dispersal of *A. melas* has been relatively slow. Dense populations have formed in standing waters only, with movements of adult *A. melas* tending to be localised (Bouvet et al., 1982, 1985). After hatching, the young of both *A. melas* and its close congener, *A. nebulosus*, form dense ball-shaped shoals that follows the female around for approximately a month prior to local dispersal. Therefore, this species is less likely to spread rapidly than some other species.

Natural dispersal occurs along rivers e.g. in Bulgaria and Romania this species spread along the Danube River but it is also aided by interconnected waterways as was the case in Bulgaria where *A. melas* dispersed through the canal systems into the inland waters (Popa et al. 2006, Pehlivanov et al. 2016, Trichkova et al. 2018, Stefanov 2019).

Nonetheless, *A. melas* is now the most widespread North American ictalurid catfish in Europe (Pedicillo, 2008), being widely dispersed in some countries, e.g. Italy (Bianco, 1998), France (Keith et al., 2011) and Portugal (Almaça, 1995), but localised in others, such as Spain (Doadrio et al., 1991), Germany (Arnold, 1990), and formerly in England (Lever, 1977; Copp et al., 2016) where it is now possibly extirpated (UK Environment Agency, 2014).

Q. 4.2. How important is the expected spread of this organism within the risk assessment area by human assistance? (List and comment on each of the mechanisms for human-assisted spread and provide a description of the associated commodities.) including the following elements: • a list and description of the anthropogenic spread mechanisms of the species in relation to the environmental conditions in the Union. • an indication of the rate of each of those spread mechanisms in relation to the environmental conditions in the Union.

RESPONSE	moderate	**CONFIDENCE**	high

Response: As reported here above, *A. melas* can be spread accidentally or through intentional (but unauthorised) introductions (Nowak et al., 2010a, 2010b), but because it is generally regarded as a nuisance species by anglers, it is less likely to be released intentionally by anglers. This would be a reversal of past practices in Poland, where intentional introductions of its close congener (*A. nebulosus*) continued up to about the year 2000 (Witkowski, 2002; Kapusta et al., 2010) leading to the introduction of *A. melas* presumably as a contaminant species (Kapusta et al., 2010; Nowak et al., 2010a, 2010b). The intentional stocking of *A. melas* for recreational fishing purposes has decreased in recent years. In Czech Republic, quite recently, evidence was obtained on unintentional introduction of *A. melas* with carp stocking from Croatia to the fishponds in the Třeboň district in 2003 (Koščo et al., 2004; Lusk et al., 2010). The expansion was human helped in some cases, for example it was imported to Hungary from Italy in 1980 (Harka, 1997).

Just outside the EU, in Serbia, there's poor control of the stocking procedure. Apart from the small carp, some amount of *A. melas*, pumpkinseed *Lepomis gibbosus* and topmouth gudgeon *Pseudorasbora parva* are always found in the stocking material. Thus, many Serbian waters are still being unintentionally stocked with non-native fish (Lenhardt et al., 2010), including locations where *A. melas* has established (Jaćimović et al., 2019). In Ukraine, *A. melas* was probably introduced together with the commercial fisheries introduction of *A. nebulosus*, where it has become invasive locally but is said to be spreading rapidly (Kvach and Kutsokon, 2010).

Q. 4.2a. List and describe relevant pathways of spread. Where possible give detail about the specific origins and end points of the pathways. For each pathway answer questions 4.3 to 4.9 (copy and paste additional rows at the end of this section as necessary). Please attribute unique identifiers to each question if you consider more than one pathway, e.g. 4.3a, 4.4a, etc. and then 4.3b, 4.4b etc. for the next pathway. including the following elements: • a list and description of pathways with an indication of their importance and associated risks (e.g. the likelihood of spread in the Union, based on these pathways; likelihood of survival, or reproduction, or increase during transport and storage; ability and likelihood of transfer from

the pathway to a suitable habitat or host). Where possible details about the specific origins and end points of the pathways shall be included.
- an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication.
- All relevant pathways should be considered. The classification of pathways developed by the Convention of Biological Diversity shall be used.

Pathway names: a) CORRIDOR - Interconnected waterways/basins; and b) RELEASE IN NATURE - Other intentional release. ???c) UNAIDED (Natural dispersal)??? => no, see 4.1.

a) CORRIDOR - Interconnected waterways/basins

Q. 4.3a. Is spread along this pathway intentional or unintentional (e.g. the organism is a contaminant of translocated goods within the risk assessment area)?

RESPONSE	unintentional	**CONFIDENCE**	high

Response: Secondary, natural dispersal on an organism following its release is most likely to be an unintentional consequence of the entry, both the intentional release and the unintentional escape, of organisms into a new drainage basin (assessed in the 'Probability of Entry' section here above).

Q. 4.4a. How likely is it that a number of individuals sufficient to originate a viable population will spread along this pathway from the point(s) of origin over the course of one year?

including the following elements:

- an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication
- if appropriate, indicate the rate of spread along this pathway
- if appropriate, include an explanation of the relevance of the number of individuals for spread with regard to the biology of species (e.g. some species may not necessarily rely on large numbers of individuals).

RESPONSE	possible	**CONFIDENCE**	medium

Response: Following the intentional release or the unintentional escape of organisms into a new drainage basin (assessed in the 'Probability of Entry' section here above), the number of individuals involved in secondary dispersal within the new drainage basin would depend on the numerical size of that basin's source population and on the connectivity between the point source and the remainder of the drainage basin. However, it is possible that there would be sufficient numbers dispersing over the course of the year, given the likelihood of floods/spates during certain seasons, which increase connectivity (e.g. Copp, 1989; Amoros and Bornette, 2002).

Q. 4.5a. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very likely	**CONFIDENCE**	high

Response: Natural dispersal does not involve storage, but survival during natural spread (i.e. ‘transport’) along water courses and canals is very likely, with subsequent reproduction possible. Indeed, the reproduction of some fish species is triggered and facilitated by inundation of the flood plain (e.g. northern pike *Esox lucius*). For *A. melas*, little is known of their migrations, except for movements within and between floodplain water bodies in France (Bouvet et al., 1985; Cucherousset et al., 2007). The distribution of *A. melas* in a partially-abandoned side-channel (Lône des Pêcheurs) of the Upper River Rhône was observed by Bouvet et al. (1982) to be relatively uniform along its 1.6 km extent. Marked *A. melas* in that side-channel were reported to bury themselves in the sediments during winter (Bouvet et al., 1985), and once emerged post-winter, the species were abundant until March, but disappeared in the spring, returning each year in the autumn at the same location where initially captured, thus demonstrating site fidelity. Within the side channel, displacements of the marked *A. melas* ranged from 0 to 900 m to the channel’s upstream extent, and up to 640 m in a downstream direction. The presence of young-of-the-year *A. melas* in this same side channel during summer (Copp, 1989) suggests that not all adults migrate out, or that adults from elsewhere migrate into such off-river habitats to spawn. This migratory behaviour in *A. melas* is, not surprisingly, similar to that of its close congener, *A. nebulosus* (Sakaris et al., 2005).

Q. 4.6a. How likely is the organism to survive existing management practices during spread?

RESPONSE	very likely	**CONFIDENCE**	high

Response: Unless there is a specific monitoring programme and rapid-response protocol that targets pest fish species, it is very likely the organism would survive existing management practices because their dispersal along water ways will not be detected. There is a multitude of bibliographic sources that demonstrate the difficulty of detecting rare fish species in running waters.

Q. 4.7a. How likely is the organism to spread in the risk assessment area undetected?

RESPONSE	likely	**CONFIDENCE**	high

Response: Unless there is a species-specific sampling programme that involves conventional and environmental DNA detection methods, the species' spread along water ways will be detected only by anglers perhaps and/or incidental encounters during routine monitoring.

Q. 4.8a. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host during spread? (including, where possible, details about the specific origins and end points of the pathway)

RESPONSE	likely	**CONFIDENCE**	medium

Response: Most water ways involve proximity to some form of flood plain that contains still waters, which are the preferred habitat of *A. melas* (Scott and Crossman, 1973) and their young-of-the-year (Copp, 1989), and most EU water courses are subjected to floods and spates that result, even in regulated systems, in the overflow of the water course into the adjacent flood plain.

Q. 4.9a. Estimate the overall potential rate of spread within the Union based on this pathway? (please provide quantitative data where possible).

RESPONSE	slowly	**CONFIDENCE**	medium

Response: In European waters, natural spread of *A. melas* could be within and between countries via water courses (Panov et al., 2009; Nowak et al., 2010a, 2010b). However, as described here above, *A. melas* is a relatively sedentary species (Bouvet et al., 1982, 1985), which suggests relatively-low natural dispersal.

b) RELEASE IN NATURE - Fishery in the wild

Q. 4.3b. Is spread along this pathway intentional or unintentional (e.g. the organism is a contaminant of translocated goods within the risk assessment area)?

RESPONSE	intentional	**CONFIDENCE**	high

Response: Release of *A. melas* for angling (i.e. stocking) within a drainage basin is an intentional movement of the species, and can help the species to further spread within the RA area (e.g. Copp et al., 2005b). The stocking of *A. melas* is areas without existing populations is considered under the section 'Entry'.

Q. 4.4b. How likely is it that a number of individuals sufficient to originate a viable population will spread along this pathway from the point(s) of origin over the course of one year? including the following elements: • an indication of the propagule pressure (e.g. estimated volume or number of specimens, or frequency of passage through pathway), including the likelihood of reinvasion after eradication • if appropriate, indicate the rate of spread along this pathway • if appropriate, include an explanation of the relevance of the number of individuals for spread with regard to the biology of species (e.g. some species may not necessarily rely on large numbers of individuals).

RESPONSE	moderately likely	**CONFIDENCE**	low

Response: This will depend upon how many fish were released for stocking but usually large numbers of specimens of both sexes are released, probably a sufficient number of these specimens to originate a viable population can spread depending on whether the point of origin is a closed water or a open water from whether migration is possible. However confidence is low.

Q. 4.5b. How likely is the organism to survive, reproduce, or increase during transport and storage along the pathway (excluding management practices that would kill the organism)?

RESPONSE	very likely	**CONFIDENCE**	high

Response: Human-assisted storage and transport is normally undertaken with the intention of maximum survival of the organism, so as to achieve the intended purpose at the point of new release. So, it is very likely that the organism will survive the relatively short translocation within the same drainage basin for release to a previously-uninhabited part of that drainage basin. Reproduction is highly unlikely during such short transport and/or storage.

Q. 4.6b. How likely is the organism to survive existing management practices during spread?

RESPONSE	very likely	**CONFIDENCE**	medium

Response: With regard to releases for the purpose of stocking the fish into a new location within the same drainage basin, whether authorised or not, management of the fish stocks by the person(s) undertaking the release of fish can be assumed to be with the intent of the species' survival. In the case of an unauthorised release, existing management practices of the government authorities are unlikely to affect the survival of the translocated fish except if they disperse out of the stocked (intended) location into adjacent waters that are subject to control of government agencies. As such, survival of existing management practices is highly likely.

Q. 4.7b. How likely is the organism to spread in the risk assessment area undetected?

RESPONSE	likely	**CONFIDENCE**	high

Response: Unless there is a species-specific sampling programme that involves conventional and environmental DNA detection methods, the species' spread along water ways will be detected only by anglers perhaps and/or incidental encounters during routine monitoring. In the case of unauthorised releases within the same drainage basin, these are likely to be clandestine and therefore unlikely to be detected.

Q. 4.8b. How likely is the organism to be able to transfer from the pathway to a suitable habitat or host during spread? (including, where possible, details about the specific origins and end points of the pathway)

RESPONSE	very likely	**CONFIDENCE**	high

Response: In the case of intended release to a new part of the same drainage basin, this is assumed to be into suitable habitat, so as to achieve the purpose of the stocking, whether authorised or not.

Q. 4.9b. Estimate the overall potential rate of spread within the Union based on this pathway? (please provide quantitative data where possible).

RESPONSE	slow	**CONFIDENCE**	medium

Response: Unlike natural dispersal of *A. melas*, which is relatively slow, translocations by humans would normally be at least moderate if the species is of interest. However, *A. melas* is generally considered to be a nuisance/pest (Nowak et al., 2010a, 2010b), so translocation of this species, whether authorised or not, is likely to be slow.

End of pathway assessment, repeat Q. 4.3 to 4.9. as necessary using separate identifiers.

Q. 4.10. Within the risk assessment area, how difficult would it be to contain the organism in relation to these pathways of spread?

RESPONSE	difficult	**CONFIDENCE**	high

Response: It is well known that containment and eradication of fish, once in a water course, is difficult, if not impossible (e.g. Tyus and Saunders, 2000). Basically, the likelihood of containing and extirpating a fish species from a water course is inversely related to the size (width, depth, water discharge) of the water course. Whereas, containment and potential eradication is possible in smaller, enclosed waters (Britton et al., 2010b).

Q. 4.11. Estimate the overall potential rate of spread in relevant biogeographical regions under current conditions for this organism in the risk assessment area (indicate any key issues and provide quantitative data where possible). Thorough assessment of the risk of spread in relevant biogeographical regions in current conditions, providing insight in the risk of spread into (new areas in) the Union.

RESPONSE	slow	**CONFIDENCE**	medium

Response: As described here above, *A. melas* is a relatively sedentary species, which suggests relatively slow natural spread. Also, this species is of lesser interest to anglers and therefore less likely to be stocked often.

Q. 4.12. Estimate the overall potential rate of spread in relevant biogeographical regions in foreseeable climate change conditions (provide quantitative data where possible). Thorough assessment of the risk of spread in relevant biogeographical regions in foreseeable climate change conditions: explaining how foreseeable climate change conditions will influence this risk, specifically if rates of spread are likely slowed down or accelerated.

RESPONSE	slow	**CONFIDENCE**	medium

Response: Relatively little is known of the dispersal potential of *A. melas*, but in its close congener, *A. nebulosus* in its native North American range, telemetry studies have demonstrated a preference for warmer waters (Kelso, 1974; Richards and Ibara, 1978; Crawshaw et al., 1982; Sakaris et al., 2005), which could suggest that an increase in mobility may be expected under warmer climate conditions. Both of these *Ameiurus* species appear to share a sedentary existence (e.g. Bouvet et al., 1982, 1985; Sakaris et al., 2005; Millard et al., 2009), suggesting that any such increased mobility of *A. melas* is likely to be modest. Most water ways involve proximity to some form of flood plain that contains still waters, the preferred habitat of *A. melas* (Scott and Crossman, 1973; Copp, 1989), and the incidence (frequency and intensity) of extreme hydrological variations is projected to increase in many EU water courses under future climate conditions. This would result, even in regulated systems, in the overflow of the water course into the adjacent flood plain, thus enhancing the dispersal of *A. melas*, though not as rapidly as species of greater, natural migratory inclination.

Dispersal is, however, a complex process and it is unclear what a warmer climate per se means in terms of increased dispersal rate as e.g. climate change also may bring longer and more severe periods of drought.

5 MAGNITUDE OF IMPACT

Important instructions:

- Questions 5.1-5.5 relate to biodiversity and ecosystem impacts, 5.6-5.8 to impacts on ecosystem services, 5.9-5.13 to economic impact, 5.14-5.15 to social and human health impact, and 5.16-5.18 to other impacts. These impacts can be interlinked, for example a disease may cause impacts on biodiversity and/or ecosystem functioning that leads to impacts on ecosystem services and finally economic impacts. In such cases the assessor should try to note the different impacts where most appropriate, cross-referencing between questions when needed.
- Each set of questions starts with the impact elsewhere in the world, then considers impacts in the risk assessment area (=EU excluding outermost regions) separating known impacts to date (i.e. past and current impacts) from potential future impacts (including foreseeable climate change).
- Only negative impacts are considered in this section (socio-economic benefits are considered in Q. A.7)

Biodiversity and ecosystem impacts

Q. 5.1. How important is the impact of the organism on biodiversity at all levels of organisation caused by the organism in its non-native range excluding the risk assessment area?

including the following elements:

- Biodiversity means the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
- impacted chemical, physical or structural characteristics and functioning of ecosystems

RESPONSE	major	**CONFIDENCE**	medium

Comment: A review of non-native species in British Columbia (Voller and McNay, 2007) reported *A. melas* to be an omnivorous bottom forager that feeds heavily on molluscs, so the species can pose a threat to endangered mollusc species. Other studies have reported a clear impact, that *A. melas* can extirpate a *Gasterosteus* population in two years (Cannings and Ptolemy, 1998), with predation of *Gasterosteus* eggs (Backhouse, 2000). In their translocated North American range, introduced *A. melas* prey on endangered humpback chub *Gila cypha* in the Little Colorado River, which is believed may significantly affect the native species by depleting numbers and reducing recruitment (Marsh and Douglas, 1997). Introduced *A. melas* is believed to be at least partially responsible for the decline of the Chiricahua leopard frog *Rana chiricahuensis* in southeastern Arizona (Fuller and Neilson, 2017). Hughes and Herlihy (2012) conclude that piscivorous alien fishes, which included *A. melas*, are associated with reduced population sizes of native prey species, at least during the summer low-flow period, and are potential threats to prey species persistence.

A major concern with *A. melas* is its association with degraded or impacted ecosystems, which are considered more susceptible to invasion (Moyle, 1986), and the increased turbidity created by *A. melas* in mesocosm experiments (Ohio, USA) can exert impacts on ecosystem function (Braig and

Johnson, 2003). Increased turbidity may be detrimental to macrophytes, thereby causing major shifts on community level, this effect may be expected as a consequence of the presence of *A. melas*, especially when occuring in high densities cf. *A. nebulosus*.The species' close congener, *A. nebulosus* is known to have extirpated the *Gasterosteus* species pair from a lake in British Columbia, Canada (Hatfield, 2001). In the Pacific Northwest, there are several lakes where the only native fish species is *Gasterosteus aculeatus*, which is present in distinct limnetic and littoral forms.

Q. 5.2. How important is the current known impact of the organism on biodiversity at all levels of organisation (e.g. decline in native species, changes in native species communities, hybridisation) in the risk assessment area (include any past impact in your response)?

Discuss impacts that are currently occurring or are likely occurring or have occurred in the past in the risk assessment area. Where there is no direct evidence of impact in the risk assessment area (for example no studies have been conducted), evidence from outside of the risk assessment area can be used to infer impacts within the risk assessment area.

RESPONSE	major	**CONFIDENCE**	medium

Comment: Savini et al. (2010), in a review of the impacts caused by the most important 25 aquatic alien species intentionally introduced in European waters, recorded ten references of potential impacts by *A. melas*: bioaccumulation (storage and magnification toxic substances in tissues), community dominance (species causing quantitative changes in community structure in becoming the dominant species), competition (for food or for space with native species) and predation (predatory activity on native species). However, the references for these citations are not provided either in Savini et al. (2010) nor in the contract report (Occhipinti Ambrogi et al., 2008) from which that article was derived. Gozlan (2010) reported that *A. melas* was the fish species introduced to Spain that posed the greatest potential for ecological impact, however, without citing the sources of supporting evidence.

In the species' introduced European range, there has in fact been little study of the species' impacts (Copp et al., 2016), and most simply examined the species' diet and that of native species, information upon which inferences of threats to native species have been made. For example, a coincidental disappearance or decline in native (and Iberian endemic) species, with an increase in the number of alien species, including *A. melas*, was reported for the Doñana wetland, southern Spain (Moreno-Valcárcel et al., 2012).

One of the rare studies to demonstrate direct predation by *A. melas* was in a small pond in England where roach *Rutilus rutilus*, a very common species through most of the EU, was found to represent 30% of the diet (Ruiz-Navarro et al., 2015). That study was undertaken just prior to the eradication of *A. melas* from that pond (UK Environment Agency, 2014). However, in areas of the EU characterised by elevated endemism, predation on endemics poses a considerable threat to biodiversity. The most prominent study has been of *A. melas* piscivory in three Iberian river systems: in one river, the main fish prey were native (endemic) species whereas in the two other rivers *A. melas* piscivory mainly involved alien invasive fishes (Leunda et al., 2008), see more details further down.

In France, experimental studies have found that the predation efficiency of age-1 native northern pike *Esox lucius* was reduced in the presence of age-1 *A. melas* due to behavioural interference

(Kreutzenberger et al., 2008). Whether or not this interference, within the relatively small confines of the 200 L tanks, is replicated in nature remains to be seen – an important issue because laboratory-demonstrated interactions are not necessarily observed between the co-occurring species in open waters (see Kakareko et al., 2016).

Another, indirect impact of *A. melas* on biodiversity can be through the generation of turbidity (e.g. Braig and Johnson, 2003), which can reduce the feeding efficiency of visual-feeding native species (reviewed in Copp et al., 2016). In order to assess environmental and economic impacts of alien and invasive fish species in Europe using the generic impact scoring system, Van der Veer and Nentwig (2015) calculated the impact points obtained by the generic impact scoring system in six environmental impact categories for *A. melas*. (herbivory, predation, competition, transmission of diseases, hybridization and ecosystem alteration). Comparing with the mean score for the 40 alien established fish species, five of the scores for environmental impact (except Hybridization) were greater in the case of *A. melas*.

In the Slovak part of the middle Danube (Slovakia), the virtual disappearance of small benthic native species (e.g. European bullhead *Cottus gobio*, white-finned gudgeon *Gobio albipinnatus*, stone loach *Barbatula barbatula*) from the local fish communities coincided with invasive non-native fishes, which included *A. melas* (Černý, 2006; Novomeská & Kováč, 2016). In Hungary, *A. melas* is listed as coming to dominate the fish community but no impacts are identified (Bódis et al., 2012).

In Spain and Portugal, Leunda et al. (2008) showed that *A. melas* are preying on native fish species such as *B. graellsii, P. miegii* and *G. lozanoi*. Even if only fish bony remains (e.g. scales, opercula, cleithra and pharyngeal arches) were identified in *A. melas* stomachs, egg predation could not be excluded. Probably, egg predation was not detected because of rapid digestion. Due to the generalist and opportunistic feeding habits of this species, Leunda et al. (2008) analysed data from Spain and Portugal indicating impacts on a wide range of potential prey species as well as impacts through competition. In this study, *A. melas* consumed plant material, terrestrial prey and co-occurring fish species (native or exotic), taking the most abundant and available prey. Therefore, this species might be reducing the amount of available prey for native predators.

Leunda et al. (2008) found that the diet composition of *A. melas* is similar to the diet described for some co-occurring Iberian native species. Taking into account the voracity and aggressive behavior of *A. melas*, the diet similarity might lead to an unfavourable competition for the same food resources, subsequently, displacing native fishes to suboptimal food resources. And in a lagoon in the Spanish province of Zamora, *A. melas* is considered the cause of decline of the common parsley frog *Pelodytes punctatus* and the Iberian painted frog *Discoglossus galganoi* (MAPAMA, 2013).

Q. 5.3. How important is the potential future impact of the organism on biodiversity at all levels of organisation likely to be in the risk assessment area?

See comment above. The potential future impact shall be assessed only for the risk assessment area.

RESPONSE	major	**CONFIDENCE**	medium

Comment: This species is able to establish across a wide range of climatic zones, so the predicted warmer conditions for virtually all of the EU is unlikely to modify the likely magnitude of impacts by *A. melas* in the future.

Q. 5.4. How important is decline in conservation value with regard to European and national nature conservation legislation caused by the organism currently in the risk assessment area? including the following elements: • native species impacted, including red list species, endemic species and species listed in the Birds and Habitats directives • protected sites impacted, in particular Natura 2000 • habitats impacted, in particular habitats listed in the Habitats Directive, or red list habitats • the ecological status of water bodies according to the Water Framework Directive and environmental status of the marine environment according to the Marine Strategy Framework Directive

RESPONSE	major	**CONFIDENCE**	medium

Comment: There is evidence from the risk assessment area of potentially negative impacts such as predation on native species by *A. melas* (see comments in response to Q. 5.2), however evidence of competition (for food and/or space) requires further study, given that competition can be difficult to demonstrate. Changes in water transparency, due to increased turbidity (Braig and Johnson, 2003), could affect all the ecosystems where this species is present.

Under the Water Framework Directive (WFD), any decline in native species, and/or an increase in non-native species, can affect ecological status, however in their study, Hermoso et al. (2010) did not include *A. melas* in their calculations of Index of Community Integrity for the River Guadiana (Spain) because the species' prevalence was below 5%.

A few examples of the presence of *A. melas* in sites of nature conservation value include:
Spain, where *A. melas* is present (but no information on impacts is provided) in the:
• National Park Tablas de Daimiel [6].
• Doñana Natural Area (Moreno-Valcárcel et al., 2012).
• Biosphere Reserve and Regional Park "Cuenca Alta del Manzanares" near the city of Madrid (Pino-del-Carpio et al., 2010).

France, where *A. melas* is included in the list of fish species recorded (but no information on impacts is provided) on the Natura 2000 site of the Lower Valley Doubs - Doubs and Clagu (Muséum National d'Histoire Naturelle, 2016).

Q. 5.5. How important is decline in conservation value with regard to European and national nature conservation legislation caused by the organism likely to be in the future in the risk assessment area?

[6] https://www.castillalamancha.es/sites/default/files/documentos/paginas/archivos/doc_1_es0000013_0.pdf

including the following elements: • native species impacted, including red list species and species listed in the Birds and Habitats directives • protected sites impacted, in particular Natura 2000 • habitats impacted, in particular habitats listed in the Habitats Directive, or red list habitats • the ecological status of water bodies according to the Water Framework Directive and environmental status of the marine environment according to the Marine Strategy Framework Directive

RESPONSE	moderate	**CONFIDENCE**	low

Comment: If current climate carries on getting warmer, this suggests that this species could spread more rapidly than the current 'slow' spread, and this species could have a greater adverse impact on native species and aquatic ecosystems that are the subject of conservation interest and legislative protection.

Ecosystem Services impacts

Q. 5.6. How important is the impact of the organism on provisioning, regulating, and cultural services in its non-native range excluding the risk assessment area? • For a list of relevant services use the CICES classification V5.1 provided as an annex. • Impacts on ecosystem services build on the observed impacts on biodiversity (habitat, species, genetic, functional) but focus exclusively on reflecting these changes in relation to their links with socio-economic well-being. • Quantitative data should be provided whenever available and references duly reported. • In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer "No information has been found on the issue". This is necessary to avoid confusion between "no information found" and "no impact found".

RESPONSE	minimal	**CONFIDENCE**	low

Comment: Although *A. melas* is mentioned in papers that discuss non-native species impacts on ecosystem services (e.g. Gozlan, 2010), no evidence of ecosystem services impact is presented. However, in water bodies used by anglers, their perception of the angling value may be reduced by the species' presence (unpublished statements from discussions with anglers). For example, *A. melas* can cause a painful sting if pectoral spines puncture human flesh due to the small amounts of venom at the ends of spine, which can cause pain for up to a week (Rose, 2006; Etnier and Starnes, 1993). However, scientific studies of the impacts on ecosystem services (e.g. decline in use of water bodies due to invasive fish presence) are lacking. Ictalurid catfishes can also pose a public health risk, if eaten, due to their accumulation of contaminates when inhabiting polluted waters (review by Savini et al., 2010; Department of Environmental Conservation. New York State, 2017).

Q. 5.7. How important is the impact of the organism on provisioning, regulating, and cultural services currently in the different biogeographic regions or marine sub-regions where the species has established in the risk assessment area (include any past impact in your response)? • See guidance to Q. 5.6.

RESPONSE	minor	**CONFIDENCE**	low

Comment: As mentioned above, painful wounds can be inflicted by the sharp spines in the fins of *A. melas* if they are not handled carefully, and *A. melas* have been found to contain elevated levels of contaminants, which poses a risk in cases where this species is taken from contaminated waters and eaten.

Q. 5.8. How important is the impact of the organism on provisioning, regulating, and cultural services likely to be in the different biogeographic regions or marine sub-regions where the species can establish in the risk assessment area in the future? • See guidance to Q. 5.6.

RESPONSE	N/A	**CONFIDENCE**	**-**

Comment: No published evidence has been found that would allow to answer this question.

Economic impacts

Q. 5.9. How great is the overall economic cost caused by the organism within its current area of distribution (excluding the risk assessment area), including both costs of / loss due to damage and the cost of current management. • Where economic costs of / loss due to the organism have been quantified for a species anywhere in the world these should be reported here. The assessment of the potential costs of / loss due to damage shall describe those costs quantitatively and/or qualitatively depending on what information is available. Cost of / loss due to damage within different economic sectors can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage.

RESPONSE	minor	**CONFIDENCE**	low

Comment: The economic impact assessment by Van der Veer G. and Nentwig (2015) indicated ‘0’ impacts for *A. melas*, which is likely to have been based on the absence of information rather than hard evidence, given that no studies are known to have been undertaken on the economic losses associated with *A. melas*. In certain cases of wild establishment, *A. melas* introductions have the potential to hinder local commercial and sport fisheries through competition with target species (CABI, 2019).

There is also potential that *A. melas* can have a negative economic impact on communities as this fish can be a "nuisance" species taking lines/bait intended for other species. Anglers not targeting this species might therefore move on to *A. melas* free waters, taking not only the money from recreational fishing but tourism (food, accommodation and transportation), all of which may provide economic opportunities locally (CABI, 2019).

Q. 5.10. How great is the economic cost of / loss due to damage (excluding costs of management) of the organism currently in the risk assessment area (include any past costs in your response)?

- Where economic costs of / loss due to the organism have been quantified for a species anywhere in the EU these should be reported here. Assessment of the potential costs of damage on human health, safety, and the economy, including the cost of non-action. A full economic assessment at EU scale might not be possible, but qualitative data or different case studies from across the EU (or third countries if relevant) may provide useful information to inform decision making. In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer "No information has been found on the issue". This is necessary to avoid confusion between "no information found" and "no impact found". Cost of / loss due to damage within different economic sectors can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage.

RESPONSE	minor	**CONFIDENCE**	low

Comments: Anglers are in general annoyed by this species, which takes their baits and is difficult, due to its poisonous spines, to remove from their fishing lines, and the species can increase turbidity levels in some cases (as mentioned above). This suggests the potential for a reduction in the perceived social and economic value of waters infested by *A. melas*. The scarcity of published evidence on this suggests that impacts are sufficiently minimal as not to warrant study. That said, a study for Great Britain and Ireland (Gallardo and Aldridge, 2013) included *A. melas* in the list of 12 aquatic species potentially causing greatest ecological and economic harm. However, there was only one confirmed population of *A. melas* in Great Britain and Ireland – it was located in an isolated, private-owned field and located a long distance from any connecting water course, and that population was eradicated in 2014 (UK Environment Agency, 2014). As such, more information is needed in order to estimate the potential economic costs of *A. melas* in the EU.

Q. 5.11. How great is the economic cost of / loss due to damage (excluding costs of management) of the organism likely to be in the future in the risk assessment area?

- See guidance to Q. 5.10.

RESPONSE	minor	**CONFIDENCE**	low

Comments: Currently, there is no technical or scientific data upon which to estimate such costs. In the event that *A. melas* benefits from future climate conditions and expands its EU range, then one may assume that there would be a reduction in the perceived social and economic value of waters infested by the species.

Q. 5.12. How great are the economic costs / losses associated with managing this organism currently in the risk assessment area (include any past costs in your response)?
• In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer "No information has been found on the issue". This is necessary to avoid confusion between "no information found" and "no impact found".

RESPONSE	minor	**CONFIDENCE**	medium

Comments:

It can be assumed that, although widely spread in the risk assessment area, overall no systematic effort has been undertaken to manage the species across the RA area.

The economic costs of eradication of *A. melas* could be relatively modest or very high, depending upon the extent of the species' spread, the size of the water bodies it invades, etc. The cost of the operation to remove *A. melas* from the small pond in Essex (UK Environment Agency, 2014) was ≈£5000–£10000 (≈€5400–€10900), including personnel costs (Animal and Plant Health Agency, personal comm.), however all of the angling club's fish were lost due to the rotenone treatment.

Similar range of costs are reported by other invasive fish eradications in the U.K., e.g. for topmouth gudgeon *Pseudorasbora parva*, it was found that the costs of eradication increase with increasing larger waterbody size (e.g. Britton et al., 2010a, 2010b), but on average £20K GBP per hectare (≈ €22k/ha) (Britton et al., 2008).

Another example is the cost of eradicating northern snakehead *Channa argus* from a small pond in Crofton, Maryland (U.S.A.), which was estimated to be $110k USD (≈ €100k). This included personnel time for planning meetings, field application of the piscicide, and disposal of the dead fish (Courtenay and Williams, 2004). In 2010 alone, the US federal government committed $78.5 million in investments to prevent the introduction of Asian carp to the Great Lakes, where they would threaten Great Lakes fisheries and could negatively impact remaining populations of endangered or threatened aquatic species (U.S. Fish and Wildlife Service, 2012).

Q. 5.13. How great are the economic costs / losses associated with managing this organism likely to be in the future in the risk assessment area?
• See guidance to Q. 5.12.

RESPONSE	minor	**CONFIDENCE**	low

Comments: The costs identified in the comments to Q. 5.12 would be expected to increase should the species spread more widely, as is suggested in the 'Spread'.

Social and human health impacts

Q. 5.14. How important is social, human health or other impact (not directly included in any earlier categories) caused by the organism for the risk assessment area and for third countries, if relevant (e.g. with similar eco-climatic conditions).
The description of the known impact and the assessment of potential future impact on human health, safety and the economy, shall, if relevant, include information on • illnesses, allergies or other affections to humans that may derive directly or indirectly from a species; • damages provoked directly or indirectly by a species with consequences for the safety of people, property or infrastructure; • direct or indirect disruption of, or other consequences for, an economic or social activity due to the presence of a species. Social and human health impacts can be a direct or indirect consequence of the earlier-noted impacts on ecosystem services. In such case, please provide an indication of the interlinkage.

RESPONSE	minimal	**CONFIDENCE**	medium

Comments: *Ameiurus melas* can cause a painful sting if pectoral spines puncture human flesh. *Ameiurus melas* contain small amounts of venom at the ends of spine which can cause pain for up to a week. (Rose, 2006; Etnier and Starnes, 1993). Additionally, *A. melas* could pose a public health risk if consumed due to its accumulation of contaminates when inhabiting polluted waters (Savini et al., 2010; Department of Environmental Conservation. New York State, 2017).

Q. 5.15. How important is social, human health or other impact (not directly included in any earlier categories) caused by the organism in the future for the risk assessment area.
• In absence of specific studies or other direct evidences this should be clearly stated by using the standard answer "No information has been found on the issue". This is necessary to avoid confusion between "no information found" and "no impact found".

RESPONSE	minimal	**CONFIDENCE**	low

Comments: As mentioned above, painful wounds can be inflicted by the sharp spines in the fins of *A. melas* if they are not handled carefully, and *A. melas* have been found to contain elevated levels of contaminants, which poses a risk in cases where this species is taken from contaminated waters and eaten.

Other impacts

Q. 5.16. How important is the impact of the organism as food, a host, a symbiont or a vector for

other damaging organisms (e.g. diseases)?

RESPONSE	major	CONFIDENCE	high

Comments: *A. melas* is a susceptible species to host *Aphanomyces invadans* related to the Epizootic ulcerative syndrome. In the EU Regulation 2018/1882[7], *A. melas* is listed as vector of Viral Haemorrhagic Septicaemia (VHS) and Infectious Haematopoietic Necrosis (IHN). The species also hosts *Edwardsiella ictaluri* in liver and spleen kidney. This parasite is related to *Enteric septicaemia* of catfish and *Edwardsiellosis* (Buller, 2014). *Ameiurus melas* also hosts *Flavobacterium columnare*, which is related to the Columnaris disease (Buller, 2014), and it is highly susceptible to two ranaviruses: European Catfish Virus (ECV) and Epizootic Haematopoietic Necrosis Virus (EHNV) (Gobbo et al., 2010). Ranaviruses pose a potential threat to fishes and amphibians.

The *A. melas* population in England has also been shown to host *Ligictaluridus pricei* population (Sheath et al., 2015). In Italy, *A. melas* has been attributed to the introduction of the exotic cestode *Corallobothrium parafimbriatum*, though further spread of the cestode with its fish host to other countries has not been reported. *Acanthocephalus anguillae*, adopted by *A. melas*, is the common parasite of native fishes (about 40 species) in Slovakia (Košuthová et al., 2009).

Based on morphological and molecular data, Vancheva et al. (2020) recorded two monogenean parasites in *A. melas* from Srebarna Lake (Bulgaria). The parasites are specific of North American ictalurid fishes and alien to Europe. *Ligictaluridus pricei* (Ancyrocephalidae) is the first record from Bulgaria, while *Gyrodactylus nebulosus* (Gyrodactylidae) is the first record from Europe and the Palaearctic Region.

Q. 5.17. How important might other impacts not already covered by previous questions be resulting from introduction of the organism?

RESPONSE	minimal	CONFIDENCE	medium

Comments: None have been encountered in the literature search.

Q. 5.18. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in the risk assessment area?

RESPONSE	major	CONFIDENCE	low

[7] https://eur-lex.europa.eu/legal-content/en/TXT/PDF/?uri=CELEX:32018R1882&from=EN

Comments: It is not well known how predators, parasites or pathogens could affect *A. melas* and any information available indicates there are no other organisms that would control it naturally: At least in Spain, the only possible piscivorous fishes will also be non-native, there are such predators of *A. melas* in both its native and introduced European ranges, i.e. members of the pike family (*Esox* spp.) and pike perches (*Sander* spp.). However, some piscivorous fishes are unable to predate ictalurid catfishes, including both *A. melas* and *A. nebulosus,* due to their sharp, strong dorsal and pectoral spines that may lock into an erect position when predated upon (Mandrak, 2009). Although present in juveniles, the spines are less robust making juveniles more susceptible to predation by fishes with a wider range in size. These spines, combined with the species' nocturnal feeding regime, make *A. melas* an uncommon prey item for most fish species. However, some piscivorous birds, such as cormorants and herons, as well as some turtle species, will occasionally consume the young and small adults of ictalurid catfishes (CABI, 2019).

Q. 5.19. Estimate the overall impact in the risk assessment area under current climate conditions. In addition, details of overall impact in relevant biogeographical regions should be provided.

Thorough assessment of the overall impact on biodiversity and ecosystem services, with impacts on economy as well as social and human health as aggravating factors, in current conditions.

RESPONSE	moderate	**CONFIDENCE**	low

In the species' introduced European range, there has in fact been little study of the species' impacts (Copp et al., 2016). The scarcity of evidence of impacts in the risk assessment area, mainly due to a lack of such studies, makes it difficult to assess the species current impacts. In view of the species' relatively limited current, localised distribution, the overall impacts in the RA area are likely to be moderate, being minimal-to-minor in some areas and perhaps moderate-to-major in specific areas.

Q. 5.20. Estimate the overall impact in the risk assessment area in foreseeable climate change conditions. In addition, details of overall impact in relevant biogeographical regions should be provided.

Thorough assessment of the overall impact on biodiversity and ecosystem services, with impacts on economy as well as social and human health as aggravating factors, under future conditions.

RESPONSE	moderate	**CONFIDENCE**	low

Although the potential enhancement of establishment potential under conditions of climate warming is likely, the scarcity of evidence of impacts in the risk assessment area, mainly due to a lack of such studies, makes it difficult to assess the species current and future impacts. The overall impacts in the RA area in the future are likely to be moderate, being minimal-to-minor in some areas and perhaps moderate-to-major in specific areas.

RISK SUMMARIES			
	RESPONSE	**CONFIDENCE**	**COMMENT**
Summarise Introduction*	very unlikely	medium	*A. melas* is already present in several EU countries due to previous introduction vectors (aquaculture, ornamental use and sports fishing), but there are no active introduction vectors known. New introductions from its native regions (N. America) therefore seem very unlikely, consequently also new entries in the EU are very unlikely. Transport between and within member states remains possible (see Spread section).
Summarise Entry*	possible	medium	Introductions (authorised or not) of *A. melas* by anglers have occurred within and between EU countries in the past and is likely to continue, though perhaps less frequently due to the declining interest for aquaculture and the increasing anglers' view of the species as a pest.
Summarise Establishment*	very likely	high	*Ameiurus melas* is established in several EU countries, but there is some evidence of populations declining. *Ameiurus melas* can inhabit a wide range of freshwater ecosystem, and therefore could potentially adapt easily to the climatic conditions in some countries where it currently does not exist, if allowed to be translocated. The species is tolerant of poor water quality, including contaminants, and a wide range of water temperatures. The lack of native competitors and predators in some locations could lead to a further range expansion in Europe, though in other locations native predators (pikes, pikeperches) are present. The degree of invasiveness of *A. melas* is facilitated by its

			plasticity in life-history traits, its parental care, its elevated tolerances to poor water quality conditions, and its generalist/opportunistic feeding behaviour.
Summarise Spread*	slow	medium	*A. melas* has been established in several European countries for over a century now and natural dispersal seems to be slow. The spread of *A. melas* through human-assisted intentional (and accidental) introductions seems to be rather slow as *A. melas* is often regarded as a nuisance species by anglers and therefore increasingly less likely to be intentionally released in angling waters.
Summarise Impact*	moderate	low	*Ameiurus melas* may affect the native fauna in various ways, including: 1) predation on native species, especially threatened/protected species; 2) resource exploitation and/or behavioural interference, which deprives, or reduces the access of, native species of food; 3) increased turbidity, which can modify the feeding efficiency of visual predators; and 4) physical injury (from the spines of *A. melas*) to native predators (e.g. snakes, fish) that attempt to predate *A. melas*. There are some reports of impacts in Europe and elsewhere, which highlight the need to consider occurrences of *A. melas* in sites of nature conservation interest, e.g. national parks and nature reserves. Hybridisation with native species is extremely unlikely, if not impossible, given that the Family Ictaluridae is not native to the risk assessment area. So, hybridisation is possible only with other non-native ictalurid catfishes present in the RA area, e.g. *A. nebulosus* and channel catfish *Ictalurus punctatus*.

			Ameiurus melas is a susceptible species to host bacteria, fungi and other organisms. It is highly susceptible to two ranavirus. Ranaviruses pose a potential threat to fishes and amphibians. Although there are no detailed studies of economic losses due to this species, in some cases, *A. melas* introductions have had the potential to hinder local commercial and sport fisheries through interference with the commercial/sport species. Published studies that report on the economic costs associated with managing this species derive from North America and from the U.K., providing a means to estimate costs per unit area of infested water body whereby eradication feasibility is greater in still water sites than in running waters, and feasibility decreasing in both types of water with increasing size *Ameiurus melas* can cause a painful sting if pectoral spines puncture human flesh, which affects anglers' perceptions of a water body, thus lowering the social and economic value of infested water bodies.
Conclusion of the risk assessment (overall risk)	moderate	medium	The species' distribution includes several EU countries but populations are localised and there is one report of *A. melas* declining (River Po, Italy). Introduction is unlikely due to vectors and pathways having mostly ceased to operate, but intentional and accidental releases of *A. melas* into open waters and translocations from existing populations continue to pose a moderate risk. This potential for entry to open waters is probably the main means of dispersal of the species, which is known to be

			relatively sedentary, so natural spread is slow. The fact that the species has established in various EU countries evidences its relatively high risk of establishment. Potential impacts include increased turbidity, especially in smaller water bodies and potential decreases in the ecosystem services (mainly angling), with some concern expressed over *A. melas* presence in national parks and nature reserves (especially in Iberia), though studies of economic loss produced by *A. melas* are lacking. Other potential impacts include the transmission of fish diseases to some fish species native to most of the EU (e.g. European catfish *Silurus glanis*).

*in current climate conditions and in foreseeable future climate conditions

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Distribution Summary

Please answer as follows:
Yes if recorded, established or invasive
– if not recorded, established or invasive
? Unknown; data deficient

The columns refer to the answers to Questions A5 to A12 under Section A.
For data on marine species at the Member State level, delete Member States that have no marine borders. In all other cases, provide answers for all columns.

Member States

	Recorded	Established (currently)	Possible establishment (under current climate)	Possible establishment (under foreseeable climate)	Invasive (currently)
Austria	Yes	Yes	Yes	Yes	-
Belgium	Yes	-	Yes	Yes	-
Bulgaria	Yes	Yes	Yes	Yes	Yes
Croatia	Yes	Yes	Yes	Yes	Yes
Cyprus	-	-	Yes	Yes	-
Czech Republic	Yes	Yes	Yes	Yes	-
Denmark	-	-	Yes	Yes	-
Estonia	-	-	Yes	Yes	-
Finland	-	-	Yes	Yes	-
France	Yes	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes	Yes
Greece	-	-	Yes	Yes	-
Hungary	Yes	Yes	Yes	Yes	Yes
Ireland	-	-	Yes	Yes	-
Italy	Yes	Yes	Yes	Yes	Yes
Latvia	-	-	Yes	Yes	-
Lithuania	-	-	Yes	Yes	-
Luxembourg	-	-	Yes	Yes	-
Malta	-	-	Yes	Yes	-

Netherlands	Yes	Yes	Yes	Yes	Yes
Poland	Yes	Yes	Yes	Yes	Yes
Portugal	Yes	Yes	Yes	Yes	Yes
Romania	Yes	Yes	Yes	Yes	Yes
Slovakia	Yes	Yes	Yes	Yes	Yes
Slovenia	Yes	Yes	Yes	Yes	Yes
Spain	Yes	Yes	Yes	Yes	Yes
Sweden	Yes	-	Yes	Yes	-
United Kingdom	Yes	-	Yes	Yes	-

Biogeographical regions of the risk assessment area

	Recorded	Established (currently)	Possible establishment (under current climate)	Possible establishment (under foreseeable climate)	Invasive (currently)
Alpine	-	-	-	-	-
Atlantic	Yes	-	Yes	Yes	-
Black Sea	-	-	Yes	Yes	-
Boreal	Yes	Yes	Yes	Yes	Yes
Continental	Yes	Yes	Yes	Yes	Yes
Mediterranean	Yes	Yes	Yes	Yes	Yes
Pannonian	Yes	Yes	Yes	Yes	-
Steppic	-	-	Yes	Yes	-

Marine regions and subregions of the risk assessment area

	Recorded	Established (currently)	Possible establishment (under current climate)	Possible establishment (under foreseeable climate)	Invasive (currently)
Baltic Sea	-	-	-	-	-
Black Sea	-	-	-	-	-
North-east Atlantic Ocean	-	-	-	-	-
Bay of Biscay and the Iberian Coast	-	-	-	-	-
Celtic Sea	-	-	-	-	-
Greater North Sea	-	-	-	-	-
Mediterranean Sea	-	-	-	-	-
Adriatic Sea	-	-	-	-	-
Aegean-Levantine Sea	-	-	-	-	-
Ionian Sea and the Central Mediterranean Sea	-	-	-	-	-
Western Mediterranean Sea	-	-	-	-	-

ANNEX I Scoring of Likelihoods of Events

(taken from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005)

Score	**Description**	**Frequency**
Very unlikely	This sort of event is theoretically possible, but is never known to have occurred and is not expected to occur	1 in 10,000 years
Unlikely	This sort of event has not occurred anywhere in living memory	1 in 1,000 years
Possible	This sort of event has occurred somewhere at least once in recent years, but not locally	1 in 100 years
Likely	This sort of event has happened on several occasions elsewhere, or on at least one occasion locally in recent years	1 in 10 years
Very likely	This sort of event happens continually and would be expected to occur	Once a year

ANNEX II Scoring of Magnitude of Impacts

(modified from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005)

Score	Biodiversity and ecosystem impact	Ecosystem Services impact	Economic impact (Monetary loss and response costs per year)	Social and human health impact, and other impacts
	Question 5.1-5	*Question 5.6-8*	*Question 5.9-13*	*Question 5.14-18*
Minimal	Local, short-term population loss, no significant ecosystem effect	No services affected[8]	Up to 10,000 Euro	No social disruption. Local, mild, short-term reversible effects to individuals.
Minor	Some ecosystem impact, reversible changes, localised	Local and temporary, reversible effects to one or few services	10,000-100,000 Euro	Significant concern expressed at local level. Mild short-term reversible effects to identifiable groups, localised.
Moderate	Measureable long-term damage to populations and ecosystem, but reversible; little spread, no extinction	Measureable, temporary, local and reversible effects on one or several services	100,000-1,000,000 Euro	Temporary changes to normal activities at local level. Minor irreversible effects and/or larger numbers covered by reversible effects, localised.
Major	Long-term irreversible ecosystem change, spreading beyond local area	Local and irreversible or widespread and reversible effects on one / several services	1,000,000-10,000,000 Euro	Some permanent change of activity locally, concern expressed over wider area. Significant irreversible effects locally or reversible effects over large area.
Massive	Widespread, long-term population loss or extinction, affecting several species with serious ecosystem effects	Widespread and irreversible effects on one / several services	Above 10,000,000 Euro	Long-term social change, significant loss of employment, migration from affected area. Widespread, severe, long-term, irreversible health effects.

[8] Not to be confused with “no impact”.

ANNEX III Scoring of Confidence Levels

(modified from Bacher et al. 2017)

Each answer provided in the risk assessment must include an assessment of the level of confidence attached to that answer, reflecting the possibility that information needed for the answer is not available or is insufficient or available but conflicting.

The responses in the risk assessment should clearly support the choice of the confidence level.

Confidence level	**Description**
Low	There is no direct observational evidence to support the assessment, e.g. only inferred data have been used as supporting evidence *and/or* Impacts are recorded at a spatial scale which is unlikely to be relevant to the assessment area *and/or* Evidence is poor and difficult to interpret, e.g. because it is strongly ambiguous *and/or* The information sources are considered to be of low quality or contain information that is unreliable.
Medium	There is some direct observational evidence to support the assessment, but some information is inferred *and/or* Impacts are recorded at a small spatial scale, but rescaling of the data to relevant scales of the assessment area is considered reliable, or to embrace little uncertainty *and/or* The interpretation of the data is to some extent ambiguous or contradictory.
High	There is direct relevant observational evidence to support the assessment (including causality) *and* Impacts are recorded at a comparable scale *and/or* There are reliable/good quality data sources on impacts of the taxa *and* The interpretation of data/information is straightforward *and/or* Data/information are not controversial or contradictory.

ANNEX IV Ecosystem services classification (CICES V5.1, simplified) and examples

For the purposes of this risk assessment, please feel free to use what seems as the most appropriate category / level / combination of impact (Section – Division – Group), reflecting information available.

Section	Division	Group	Examples (i.e. relevant CICES "classes")
Provisioning	**Biomass**	**Cultivated *terrestrial* plants**	Cultivated terrestrial plants (including fungi, algae) grown for nutritional purposes; Fibres and other materials from cultivated plants, fungi, algae and bacteria for direct use or processing (excluding genetic materials); Cultivated plants (including fungi, algae) grown as a source of energy *Example: negative impacts of non-native organisms to crops, orchards, timber etc.*
		Cultivated *aquatic* plants	Plants cultivated by in- situ aquaculture grown for nutritional purposes; Fibres and other materials from in-situ aquaculture for direct use or processing (excluding genetic materials); Plants cultivated by in- situ aquaculture grown as an energy source. *Example: negative impacts of non-native organisms to aquatic plants cultivated for nutrition, gardening etc. purposes.*
		Reared animals	Animals reared for nutritional purposes; Fibres and other materials from reared animals for direct use or processing (excluding genetic materials); Animals reared to provide energy (including mechanical) *Example: negative impacts of non-native organisms to livestock*
		Reared *aquatic* animals	Animals reared by in-situ aquaculture for nutritional purposes; Fibres and other materials from animals grown by in-situ aquaculture for direct use or processing (excluding genetic materials); Animals reared by in-situ aquaculture as an energy source *Example: negative impacts of non-native organisms to fish farming*
		Wild plants (terrestrial and aquatic)	Wild plants (terrestrial and aquatic, including fungi, algae) used for nutrition; Fibres and other materials from wild plants for direct use or processing (excluding genetic materials); Wild plants (terrestrial and aquatic, including fungi, algae) used as a source of energy *Example: reduction in the availability of wild plants (e.g. wild berries, ornamentals) due to non-native organisms (competition, spread of disease etc.)*
		Wild animals (terrestrial and aquatic)	Wild animals (terrestrial and aquatic) used for nutritional purposes; Fibres and other materials from wild animals for direct use or processing (excluding genetic materials); Wild animals (terrestrial and aquatic) used as a source of energy *Example: reduction in the availability of wild animals (e.g. fish stocks, game) due to non-native organisms (competition,*

			predations, spread of disease etc.)
	Genetic material from all biota	**Genetic material** from plants, algae or fungi	Seeds, spores and other plant materials collected for maintaining or establishing a population; Higher and lower plants (whole organisms) used to breed new strains or varieties; Individual genes extracted from higher and lower plants for the design and construction of new biological entities *Example: negative impacts of non-native organisms due to interbreeding*
		Genetic material from animals	Animal material collected for the purposes of maintaining or establishing a population; Wild animals (whole organisms) used to breed new strains or varieties; Individual genes extracted from organisms for the design and construction of new biological entities *Example: negative impacts of non-native organisms due to interbreeding*
	Water[9]	**Surface water** used for nutrition, materials or energy	Surface water for drinking; Surface water used as a material (non-drinking purposes); Freshwater surface water, coastal and marine water used as an energy source *Example: loss of access to surface water due to spread of non-native organisms*
		Ground water for used for nutrition, materials or energy	Ground (and subsurface) water for drinking; Ground water (and subsurface) used as a material (non-drinking purposes); Ground water (and subsurface) used as an energy source *Example: reduced availability of ground water due to spread of non-native organisms and associated increase of ground water consumption by vegetation.*
Regulation & Maintenance	**Transformation** of biochemical or physical inputs to ecosystems	**Mediation of wastes or toxic substances** of anthropogenic origin by living processes	Bio-remediation by micro-organisms, algae, plants, and animals; Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals *Example: changes caused by non-native organisms to ecosystem functioning and ability to filtrate etc. waste or toxics*
		Mediation of nuisances of anthropogenic origin	Smell reduction; noise attenuation; visual screening (e.g. by means of green infrastructure) *Example: changes caused by non-native organisms to ecosystem structure, leading to reduced ability to mediate nuisances.*
	Regulation of physical, chemical, biological conditions	**Baseline flows and extreme event** regulation	Control of erosion rates; Buffering and attenuation of mass movement; Hydrological cycle and water flow regulation (Including flood control, and coastal protection); Wind protection; Fire protection *Example: changes caused by non-native organisms to ecosystem functioning or structure leading to, for example, destabilisation of soil, increased risk or intensity of wild fires etc.*

[9] Note: in the CICES classification provisioning of water is considered as an abiotic service whereas the rest of ecosystem services listed here are considered biotic.

		Lifecycle maintenance, habitat and gene pool protection	Pollination (or 'gamete' dispersal in a marine context); Seed dispersal; Maintaining nursery populations and habitats (Including gene pool protection) *Example: changes caused by non-native organisms to the abundance and/or distribution of wild pollinators; changes to the availability / quality of nursery habitats for fisheries*
		Pest and disease control	Pest control; Disease control *Example: changes caused by non-native organisms to the abundance and/or distribution of pests*
		Soil quality regulation	Weathering processes and their effect on soil quality; Decomposition and fixing processes and their effect on soil quality *Example: changes caused by non-native organisms to vegetation structure and/or soil fauna leading to reduced soil quality*
		Water conditions	Regulation of the chemical condition of freshwaters by living processes; Regulation of the chemical condition of salt waters by living processes *Example: changes caused by non-native organisms to buffer strips along water courses that remove nutrients in runoff and/or fish communities that regulate the resilience and resistance of water bodies to eutrophication*
		Atmospheric composition and conditions	Regulation of chemical composition of atmosphere and oceans; Regulation of temperature and humidity, including ventilation and transpiration *Example: changes caused by non-native organisms to ecosystems' ability to sequester carbon and/or evaporative cooling (e.g. by urban trees)*
Cultural	**Direct, in-situ and outdoor interactions** with living systems that depend on presence in the environmental setting	**Physical and experiential** interactions with natural environment	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions; Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions *Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that make it attractive for recreation, wild life watching etc.*
		Intellectual and representative interactions with natural environment	Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge; Characteristics of living systems that enable education and training; Characteristics of living systems that are resonant in terms of culture or heritage; Characteristics of living systems that enable aesthetic experiences *Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that have cultural importance*

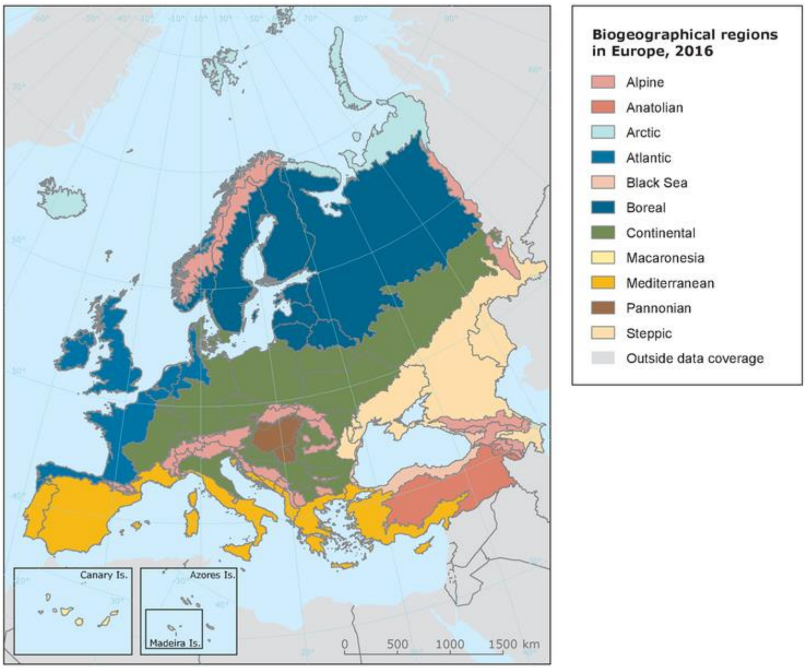
	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	**Spiritual, symbolic** and other interactions with natural environment	Elements of living systems that have symbolic meaning; Elements of living systems that have sacred or religious meaning; Elements of living systems used for entertainment or representation *Example: changes caused by non-native organisms to the qualities of ecosystems (structure, species composition etc.) that have sacred or religious meaning*
		Other biotic characteristics that have a **non-use value**	Characteristics or features of living systems that have an existence value; Characteristics or features of living systems that have an option or bequest value *Example: changes caused by non-native organisms to ecosystems designated as wilderness areas, habitats of endangered species etc.*

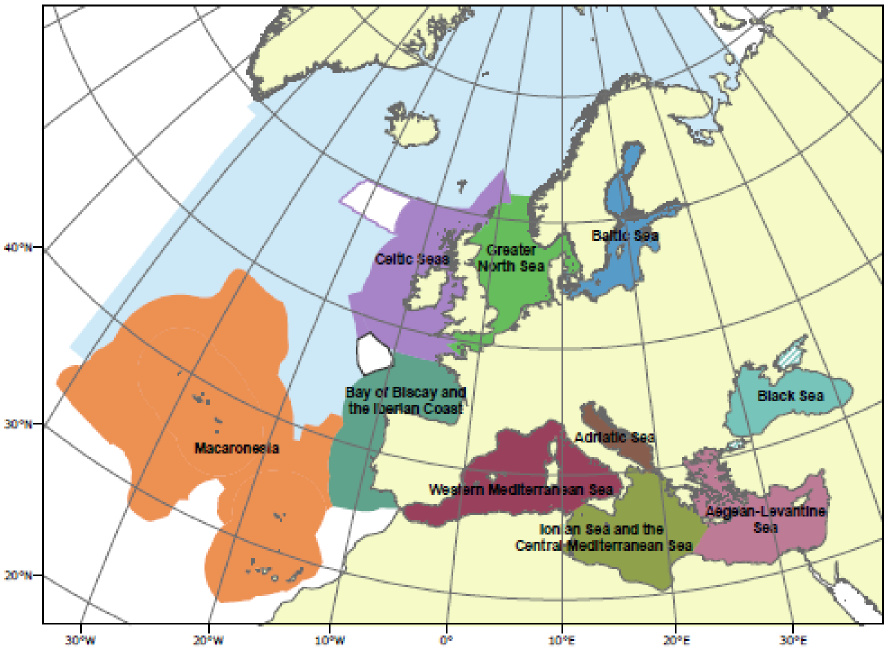
ANNEX V EU Biogeographic Regions and MSFD Subregions

See https://www.eea.europa.eu/data-and-maps/figures/biogeographical-regions-in-europe-2 , http://ec.europa.eu/environment/nature/natura2000/biogeog_regions/

and

https://www.eea.europa.eu/data-and-maps/data/msfd-regions-and-subregions-1/technical-document/pdf





ANNEX VI Delegated Regulation (EU) 2018/968 of 30 April 2018

see https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32018R0968