Fiches on the species proposed to be included on the list of invasive alien species of Union concern

Working document presented in preparation of the 15th meeting of the Committee on IAS (18 June 2021)

Criteria for listing (Article 4(3) of Regulation 1143/2014):

Invasive alien species shall only be included on the Union list if they meet all of the following criteria:

a) they are found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;
b) they are found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;
c) they are, based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;
d) it is demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;
e) it is likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.

Elements to be taken in consideration when listing (Article 4(6) of Regulation 1143/2014):

When adopting or updating the Union list, the Commission shall apply the criteria set out in paragraph 3 with due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects. The Union list shall include as a priority those invasive alien species that:

a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;
b) are already established in the Union and have the most significant adverse impact.

Disclaimer:

The following narrative notes on the species considered for the third update of the list of IAS of Union concern are intended to support the discussions at the IAS Committee.

The information to compile these notes has been drawn from the underlying risk assessments and from the information brought by the IAS Committee members in the discussions at the IAS Committee, as well as other sources, including stakeholder input. As short summary notes, they cannot reflect the opinion of each of the Member States, nor can they describe the specific situation of the species in each Member State.

They are provided with the understanding that due to their concise size they can only present a summary of the available information and can therefore lead to serious misinterpretations if read out of context. It is strongly advised that readers also refer to the underpinning Risk Assessments (links provided in each fiche).

Contents

Terrestrial

Koenigia polystachya (Himalayan knotweed) - plant

Species name – common	**Himalayan knotweed**
Species name – scientific	*Koenigia polystachya*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/bfc87a22-1843-41d4-9922-2dfe42d04441/Koenigia_polystachya%202019-FINAL.docx
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/f2c8e5a5-28f0-4e63-ad60-5fc660b7d359/Annex%201b%20Koenigia%20polystachya%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to central and eastern Asia (China, Afghanistan, Bhutan, India, Myanmar, Nepal, Pakistan).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in AT, BE, CZ, FR, DE, IE, IT, NL, PL. - In foreseeable climate change conditions, it could also establish in DK, EE, FI, LV, LT, LU, RO, SK, SI, ES, SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with low confidence: the species can form dense monospecific stands, which can outcompete native plant species. The current populations within the EU are mainly found within man-made or disturbed habitats (such as along roads) with low or medium conservation value, although some of them may also be found in riparian ecosystems. However, it can potentially have high impacts on biodiversity (plants and invertebrate populations) if it spread into areas of higher conservation value. - **Ecosystem services**: Moderate with low confidence: Reduces the availability of nutrients in the soil; competes with trees, reducing shade along rivers; its leaf litter can prevent germination of native species. - **Economy**: the cost is estimated to be major with low confidence. Control costs for knotweed species can be high and involve significant resources and labour-intensive methods including removal of contaminated soils. - **Human health**: The species is not known to have impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present, especially to avoid its spread into areas of higher conservation value. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Restrictions on trading/selling the species, as well as management of pathways of unintentional introduction and spread (garden waste, soil movement), will be effective in preventing the introduction of the species into new areas.

	- **Early detection and rapid eradication (Articles 14 - 18)**: As new introductions are relatively unlikely, focus should be on early detection and eradication where it occurs. - **Management (Articles 19-20)**: Measures need to be implemented by all countries to be effective – else species could spread from one country to another. Once established, Himalayan knotweed is relatively difficult to control. Management practices should follow those applied to other knotweeds: physical, mechanical and chemical control methods can be used to tackle this species.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: awareness raising at a relatively low cost might be worthwhile and effective in limiting its spread via sale, garden waste, soil movement. - Early detection measures should be included in a general surveillance programme and would thus imply limited additional costs. - Management: an integral control strategy is needed, entailing relatively high costs, since successful eradication of just one patch is likely to take more than one year, and multiple treatments in most cases. If the population occurs along riverbanks or over a large area, eradication attempts may require investment over a number of years and methods might have to be combined (removal of above-ground foliage to be combined with rhizomes excavation or chemical application).
	- **Cost of inaction:** Further spread including into areas of high conservation value, where it could have a more significant impact on biodiversity than that recorded up to now in Europe.
	- **Cost-effectiveness:** As this species is not very popular, a sales ban would be cost-effective. Where it is established, management methods can be applied on a local scale, but manual control alone is not considered to be cost-effective for long-term management. Chemical control is cost-effective to eradicate/control small populations. Excavation of the rhizomes from the soil may be needed but costs can be high.
	Socio-economic aspects: *K. polystachya* has little socio-economic benefits in the risk assessment area apart from its value as an ornamental plant sold by the horticultural trade.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in part of the EU, but the area it occupies is still relatively limited except in Belgium and the Netherlands. There is scope for much wider spread, including to countries where it is not presently established.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has moderate adverse impacts. Prevention of its spread can be relatively cost-effective, while eradicating or managing it once established is challenging/costly.

Ambrosia confertiflora (Weakleaf bur ragweed) – plant

Species name – common	**Weakleaf bur ragweed**
Species name – scientific	*Ambrosia confertiflora*
Conclusion of the risk assessment	High risk with high uncertainty.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/a4aead5d-4327-4639-af9d-ecdd9798f950/Ambrosia%20confertiflora%20RA.docx
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/b8a15181-2ecc-4c5a-b7d8-803ab2efef35/details
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to southern west USA and northern Mexico.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently not recorded in the risk assessment area. - Under current climate conditions it could establish in the Mediterranean biogeographical region, mainly ES, IT, GR, CY, PT. - In foreseeable climate change conditions, *Ambrosia confertiflora* will be capable of establishing in the following countries: ES, FR, IT, EL, CY, PT, BG, RO, HU.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Assessed as high risk with high uncertainty: *Ambrosia confertiflora* forms dense stands that can outcompete native herbaceous species to the point that the understory completely lacks native species, in particular in humid habitats, in grasslands and in dry river beds. - **Ecosystem services**: Impact is high with moderate uncertainty. This plant modifies the vegetation cover and, consequently, the whole ecosystem. It is also a serious pest in cultivated fields and uses a large amount of water. - **Economy**: Socio-economic impacts are high with moderate uncertainty. *Ambrosia confertiflora* presents a high phytosanitary risk for the endangered area. It can become a serious pest in cultivated fields, citrus groves, vineyards and orchards (avocado, dates, and olives). It competes for nutrients and interferes with the harvest (mixes with crops which cannot be harvested properly). This plant may have, in particular, devastating effects on organic farming, where chemical application is prohibited. - **Human health**: Its prolific pollen, is reported as a severe allergen – causing hay fever and contact dermatitis in susceptible people.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to **prevent invasion into the risk assessment area, where this species is not currently established.** - systematic integration of this species in surveillance programmes is needed to support early detection and rapid eradication, as well as to prevent a potentially rapid spread in high risk areas of the risk assessment area if it is introduced.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: The species is introduced and spread mainly by unintentional pathways (contaminant of livestock, animal feed or mixture, machinery and equipment, travelers' clothes and shoes) and therefore prevention can be difficult. - **Early detection and rapid eradication (Articles 14 - 18)**: As the

	species is currently not present in Europe and given the difficulties to effectively prevent its introduction, early detection and rapid eradication are crucial for avoiding its establishment in the risk assessment area. Diligent scouting by natural resource professionals supported by citizen scientists will be required to readily detect new populations. - **Management (Articles 19-20)**: Once this species is established, it may spread fast (both via seeds and through rhizome spreading locally). Large infestations defy mechanical control. In such cases, the only option is to adopt an integrated approach, including containment and application of herbicides.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: Inspection of animal feed is already required under EU Directive 2002/32/EC. The cost of cleaning exported/ imported machinery/ equipment could be substantial. Cleaning outdoor recreation equipment (recreational users from infested areas may be a vector) should be relatively inexpensive. - Early detection and eradication: Early detection measures should be included in a general surveillance programme and would thus imply limited additional costs. - Management: Manual and mechanical control are primarily effective for early infestation/ young plants, so chemical control could be only option for rapid eradication for small invasive populations but linked to risks, in particular in wetlands/ riparian habitats.
	- **Cost of inaction:** the cost of inaction could significantly increase in the future, as failure to avoid its introduction into EU and/or failure to rapidly eradicate it if it was introduced would lead to need for management programmes to take place on a large scale. -
	- **Cost-effectiveness:** Particular emphasis to be put on prevention and early detection and rapid eradication, since action linked to this species can be integrated into existing ongoing activities, and avoiding establishment and spread will save costs of impact and management.
	- **Socio-economic aspects:** There are no known socio-economic benefits derived from the plant *Ambrosia confertiflora*.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established in the EU, but if it did establish it would be difficult to control its spread and it would have significant adverse impacts.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	-

Hakea sericea (Needlebush) – plant

Species name – common	**Needlebush**
Species name – scientific	*Hakea sericea*
Conclusion of the risk assessment	High risk – low to moderate uncertainty.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/4c3478d6-34c9-4431-b1a7-e631deacfa40/Hakea%20sericea%20RA.doc
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/7ebe09d6-a752-4b09-9b60-a394d27f7981/TSSR%20Task%202018%20Hakea%20sericea.pdf
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to southeastern Australia.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in FR, PT and ES; under current climate conditions, *Hakea sericea* could also establish in EL, IT, SI, HR. - Under the most extreme climate change scenarios it could also establish in IE, BE, NL, LU, DE, DK, SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** High impact with low uncertainty. Dense thickets of *H. sericea* are not unusual in the species' invaded range, where it alters the composition of plant and animal communities. It brings about significant reductions in species richness of the native plant community, with, under certain circumstances, also a risk of more intensive fires than those linked to native vegetation. It may also adversely reduce water run-off and increase competition for water in invaded communities. Some evidence was also found for impacts on small mammal communities, with reduced presence of herbivores compared with uninvaded stands. - **Ecosystem services:** High impact with moderate uncertainty. Main impacts on regulating services: increase in intensity of fires and adverse impacts on hydrological regimes. Also impacts on cultural ecosystem services by restricting access by forming dense impenetrable thickets of spiny shrubs. - **Economic:** Moderate with moderate uncertainty. Dense thickets of the plant are likely to restrict access for livestock, grazing, hunting and recreation in Mediterranean regions. There may also be indirect, but considerable, costs from impacts on water resources, biodiversity (in a socio-economic context) and amenities. - **Human health:** It can injure people with its sharp, spiny leaves.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU as there are still MS with suitable areas for establishment which have not yet been invaded.
4.3 (e) likely that the inclusion on	- **Prevention (Article 7)**: Banning importing, breeding, transporting, selling,

the Union list will effectively prevent, minimise or mitigate their adverse impact.	exchanging, growing and releasing this species in the environment within the EU will be key. Public awareness raising/ training targeting relevant entities or stakeholder responsible for forestry intervention in MS where this species is present could help preventing unintentional introduction and secondary spread, with special attention to areas where the species could be introduced (nurseries and gardens) and most suitable habitats. Citizens should also be made aware in relevant areas. - **Early detection and rapid eradication (Articles 14 - 18)**: This species should be included in MS surveillance systems in countries or areas where the species may establish. **In case of detection, an integrated control methodology approach is necessary** including hand pulling young plants, cutting bigger plants and careful disposal of any fruit to avoid seeds release and germination. - **Management (Articles 19-20)**: Where eradication is no longer an option (extensively invaded areas) containment, control and follow-up measures to monitor the success of such actions are necessary. In addition to the above measures, chemical and biological control may be used in the future, should acceptable solutions become available in EU.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: a ban on importing, selling and releasing this species in the environment is not expected to add much additional costs. However, for the ban to be most effective, it needs to be combined with education and awareness raising in order to achieve high compliance. - To prevent unintentional introductions and spread, awareness raising should also target citizens in relevant areas. Related costs may be reduced by integrating such activities into broader communication efforts on IAS. - Early detection and eradication: incorporating this species into existing surveillance system and citizen science programmes is expected to be (cost) effective, as *H. sericea* is morphologically quite distinct and easily identifiable. Priority should be given to habitats prone to invasion in MS where the plant is already present. Costs could be reduced by involving volunteers. Use of remote sensing may reduce costs of extensive field campaigns but might not work for small, nascent populations of *H. sericea*. Management: As an indication, up to €160 000 was spent in 2016-17 managing a population of approximately 12 ha in a Natural Park in the south of FR. It was further estimated that €10 000/ha was needed for the eradication of the species. In PT, control costs are estimated at €1 500/ ha. Management of the species to limit further spread will be cost effective considering the negative impacts are likely to increase with population expansion.
	- **Cost of inaction:** inaction will most probably result in the spread and establishment of the species in more MS and related negative impacts.
	- **Cost-effectiveness:** Since the only pathway of introduction identified is "plants for planting", the most cost-effective option to prevent the intentional introduction of *H. sericea* into Member States (MS) where it is absent, and its further spread in MS where it is present, will be banning its import, breeding, transporting, selling, exchanging, growing and releasing in the environment within and into the EU.
	- **Socio-economic aspects:** Available for sale as an ornamental plant, but it appears to be a very marginal product and not to have important value.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union	The species is established in the EU, but there is scope for much wider spread both in the MS in which it is established and in additional MS. It is at an early stage of invasion and listing can still be very useful to contain spread and prevent future introductions.

or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has significant adverse impact.

Celastrus orbiculatus (Oriental bittersweet) - plant

Species name – common	**Oriental bittersweet**
Species name – scientific	*Celastrus orbiculatus*
Conclusion of the risk assessment	Medium risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/5bbb8a67-6813-46f5-a44a-b4269f1438d8/details?download=true and annex to the risk assessment: https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/4bd57518-8465-4869-99e2-4dd6f2be40b6/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/f76f4c0f-0114-42c2-a626-56bc44eed8a1/details?download=true
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to eastern Asia (China, Korea, Japan, Russian Far East and Sakhalin Island).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in: AT, BE, CZ, DK, DE, LT, LV, NL, PL, SE. - In foreseeable climate change conditions, it is capable of establishing in almost all EU MS – in addition to the above, also in: BG, EE, ES, FI, FR, HU, IE, IT, LU, RO, SK, SI.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity**: Medium impact. This species shows detrimental interactions with indigenous endangered or rare species and habitats. It may, cause severe population declines in native species. It may colonise high conservation value habitats. It is most likely to establish in deciduous forests on moist soils, e.g. alluvial forests (Natura 2000 habitat type) or riparian forests. The presence of disturbance in forests and sufficient light may allow *C. orbiculatus* to become the dominant canopy species and significantly alter habitat conditions for native species as well as the biodiversity and functioning of mature forest ecosystems in the EU. Forest undergrowth can become overgrown with *C. orbiculatus*. It intercepts much light in the forest canopy and affects host growth, can result in its deformation, increases the risk of ice and makes trees more vulnerable to wind throw. - **Ecosystem services**: *C. orbiculatus* may impact timber production negatively because it suppresses regeneration and can totally overgrow young trees in forest plantations. It also has negative effects on ecosystem nutrient cycling. - **Economy**: It has negative impacts on silviculture and timber production, as it damages trees, making them worthless as timber

	and young trees can be totally overgrown in forest plantations. It also increases wind-throw. - Human health: The species is not known to have impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to eradicate the presently still relatively limited number of local populations to prevent further spread in the MS where this species is already present and prevent introduction into the MS where this species is not currently established. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Banning the trade of this species would contribute to prevention of new introductions and further spread. - **Early detection and rapid eradication (Articles 14 - 18)**: Monitoring of forests would be effective. Early stage of invasion offers a window of opportunity for control because population spread is slower due to limited light availability and the inability of the plant to reproduce sexually at this point. - **Management (Articles 19-20)**: In EU primarily chemical and mechanical measures are available. The plant can be sprayed with herbicides (applied to foliage or directly to the cut stumps). Mechanical, monthly mowing and digging out of roots will eventually eliminate *C. orbiculatus* (suitable for small populations in sensitive areas). Eradication of seedlings and adult plants prior to seed deposition may be an effective control strategy.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** - Prevention: Costs difficult to estimate and will vary between MS, however in general considerable effort is needed to train staff, develop identification tools for border customs, stakeholders and the general public. - Early detection and eradication: Monitoring might possibly more cost-effectively be carried out by forestry authorities and forest owners who have an economic interest in preventing the establishment of the species but this would require effort for targeted awareness raising. - Management: precise data are lacking on costs of (recurrent) control measures but mechanical treatments would require resources including labour (including voluntary if possible), hand tools and mower (terrain dependant), and also a skilled individual to undertake the post management monitoring work. Herbicide application to a single or few plants will require minimal effort, but skilled (and possibly licenced) labour is needed. In addition to the herbicide chemicals, spraying and safety equipment is required.
	- **Cost of inaction:** Containment and control are likely to be costly, which reinforces the need for preventive action in the area at risk.
	- **Cost-effectiveness:** The control of the species poses challenges once it has become established. Therefore, to prevent introductions in unaffected EU Member States (MS) or further spread into the areas where this species is not yet present, it is important to act at the earliest stage of invasion and to prevent additional introductions and further spread in those areas in which it is already present so as to avoid costs linked to managing the species when widely established.

	- **Socio-economic aspects:** It is still readily available from horticultural outlets and from online stores both as potted plants (including as bonsai), as well as seed. Rooted plants are of marginal importance to the horticultural trade. A ban on sale will have an economic effect on those producing the plants or cut branches, that will miss out on a part of their income or divert their attention to another similar plant species to make up for the loss of *Celastrus orbiculatus*.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is likely to have serious impact and is currently still at an early stage of invasion as only recorded in a few places and mostly in urban areas, so eradication is still a possibility in some of those places.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Not yet established to the point it would have significant impacts, but would if continued to spread.

Phytolacca americana (American pokeweed) – plant

Species name – common	**American pokeweed**
Species name – scientific	*Phytolacca americana*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/f7164720-23fd-461d-b7a9-af52fe7e327e/Phytolacca_americana_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/06708953-f712-4e14-9119-7bdf12dd6d60/8b.%20Phytolacca%20americana%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (including south-eastern Canada, eastern USA and the northeast of Mexico).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in AT, BG, HR, CY, CZ, FR, DE, EL, HU, IT, MT, NL, PT, RO, SK, SI, ES. - Under current climate conditions it can also establish in BE, EE, FI, LV, LT, LU, PL. In foreseeable climate change conditions, *Phytolacca americana* could also establish in DK, SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with low confidence. *P. americana* can form dense monocultures and outcompete native plant species and decrease species richness of invaded communities. Its impact may be mitigated by the fact that *P. americana* grows predominantly in ruderal, post-crop areas and forests following disturbance. It has, however, been identified by managers of protected areas as one of the top invasive plants. This species has been shown to alter arthropod community structure and appears to repel most earthworm species due to its allelopathic properties. - **Ecosystem services**: Moderate impact with medium certainty. The impact of the species on natural forest regeneration is often negative. *P. americana* may affect some recreational activities where it forms dense monocultures blocking access to recreational areas. - **Economy**: Moderate impact with low confidence. Locally, it is an important weed in maize crops in the risk assessment area (France). It can impact on woodland plantations, as this species will need to be cleared prior and right after planting of tree seedlings. *P. americana* can be poisonous to animals including sheep, cattle, horses and poultry (e.g. when found in pastures). - **Human health**: Minor impact with medium confidence. Children may become ill if they eat the berries.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming an even wider problem across the EU.
4.3 (e) likely that the inclusion on	- **Prevention (Article 7)**: Although the likelihood of *P. americana* entering via the

the Union list will effectively prevent, minimise or mitigate their adverse impact.	identified pathways (horticulture, release in nature for use, transport, stowaway on used machinery and equipment) is moderate, a sales ban would help to regulate this pathway for this species. - **Early detection and rapid eradication (Articles 14 - 18)**: Since *P. americana* predominantly spreads by seeds, measures seeking to mitigate its impact should focus on early detection and eradication of the species where it is not yet present. - **Management (Articles 19-20)**: *P. americana* can be managed with traditional methods, including the use of physical, mechanical or chemical methods.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: Ban from sale to be accompanied by awareness raising. - Early detection and eradication: Preventing the species' establishment should be the priority, as eradication can be difficult and may only be feasible over limited areas and during the early phase of establishment. - Management: Depending on the size of the infested area, eradication costs may be substantial. Effective removal of the above- and below-ground plant material is essential for the eradication of the species and this can be labour intensive. Repeated applications are likely to be required to exhaust the long-lived seed bank. Removing a small number of plants from a limited area (<1ha) may be feasible. At larger scales, the likelihood of successful eradication is likely to drop rapidly with significant increases in cost. Manual control alone may not be considered to be a cost-effective option for long-term management, as repeated interventions would be needed.
	- **Cost of inaction:** Inaction would result in further introductions and spread, causing longer-term management costs.
	- **Cost-effectiveness:** *P. americana* is not a significantly popular species in trade and therefore a ban on the sale of the species would be a reasonably cost-effective measure for preventing the movement, both from outside and within the RA area.
	- **Socio-economic aspects:** The species is sold in the EU as a horticulture plant. *Phytolacca americana* has numerous medicinal uses. A dye can be obtained from the fruit, which can be used as ink and a dye for clothes.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in several EU countries, but there is scope for wider spread and listing could help contain its spread.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is already established it has adverse impacts.

Cydalima perspectalis (Box tree moth) - insect

Species name – common	**Box tree moth**
Species name – scientific	*Cydalima perspectalis*
Conclusion of the risk assessment (overall risk)	High risk – high confidence
Link to Risk Assessment	https://circabc.europa.eu/sd/a/7ea45dc3-6cfe-47e5-803f-d850290707d3/Cydalima%20perspectalis%20november%202019-FINAL.doc
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/e224eb86-b1c5-4be4-97ca-904305ff8be2/Annex%204b%20Cydalima%20perspectalis%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	The species is considered to be native to India, China, Korea, Japan and the Russian Far East.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	*Cydalima perspectalis* is already present in the risk assessment area and in most EU countries: - Established in AT, BE, BG, HR, CZ, FR, DE, EL, HU, IT, LU, NL, PL, PT, RO, SK, SI, ES, SE - Capable of establishing and spreading all over Europe (also in CY, DK, EE, FI, IE, LV, LT, MT) -
4.3 (c) based on available scientific evidence, **likely to have a significant adverse impact on biodiversity** or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Massive impact with high confidence - the ecological impact on biodiversity and, potentially, various ecosystem services, is major to massive. Natural stands of the common box, *Buxus sempervirens* in Southern and Western Europe are quickly disappearing, resulting in a high likelihood that whole ecosystems will disappear, including local extinction of a high number of species closely linked to the plant. *Cydalima perspectalis* also constitutes an important threat to *Buxus balearica*, which is considered as "Near Threatened" in Spain, “Vulnerable” in Andalusia. It also occurs in the Balearic Islands and there is only a single population in Sardinia. - **Ecosystem services**: Major impacts with medium confidence. The ecological disappearance of native *Buxus* spp. stands is likely to have consequences on provisioning and regulating services. - **Economy:** Costs of damage and/or loss likely to be moderate (high confidence). Although not quantified, most costs are probably borne by municipalities and private gardeners who have to spray or use other management methods to control the box tree moth, including replacing *Buxus* by other plants. - **Human health:** The species is not known to have impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - Restrictions on the movement of *Buxus* plants and early detection / rapid eradication of the box tree moth can still help prevent introduction, establishment and spread on islands such as Mallorca and Sardinia. - Management will reduce negative impacts in priority areas where the species is already established.

4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention:** Restrictions on movements of Buxus spp. plants to Mallorca, where the box tree moth is not yet established, could prevent its introduction and spread and protect the natural stands of *Buxus balearica*. - **Early detection and rapid eradication (Articles 14 - 18)**: There is no method suitable for large scale eradication, since it is already widespread in most of the assessment area. Small-scale eradication can probably be achieved with a massive use of insecticides, but the treated area would quickly be re-invaded from neighbouring areas. - **Management (Articles 19-20)**: Once established, *Cydalima perspectalis* is very difficult to control. However, damage caused by this species can be managed on ornamental box trees using pesticides or biological control options. Pheromones and light traps can also be used to monitor populations and enhance the efficacy of biological and chemical control. The control of the moth on wild box stands is much more problematic. The use of insecticides is not allowed in forest areas in several countries and *Bacillus thuringiensis* cannot realistically be used to protect box tree stands over a long period. There is no method suitable for large-scale eradication.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	**Implementation cost:** - Early detection and rapid eradication: only feasible at initial stages of invasion. Of particular relevance to islands in which the species is not yet established and rare *Buxus balearica* occurs. - Management: many pesticides and some biological control agents have shown to be very effective against *C. perspectalis* on ornamental box trees. The cost of controlling *C. perspectalis* with *Bacillus thuringiensis* or chemicals in gardens and parks varies greatly. - Containment of further spread necessitates restrictions and/or additional controls on imports of *Buxus spp.* plants as well as of their movements within the EU. Such measures imply costs for the relevant authorities as well as for the horticultural sector.
	Cost of inaction: - If no area-wide management method is implemented to lower populations in natural stands of *Buxus spp.*, the risk is high that whole ecosystems will disappear, including many species (fungi, chromista, invertebrates) that live exclusively in these ecosystems/ are only recorded on *Buxus* species.
	Cost-effectiveness: - Coordinated action will be more cost-effective than the current scattered approach. - Mass trapping has already been tried but with limited success.
	Socio-economic aspects: - *Cydalima perspectalis* is not known to have any socio-economic benefits.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The box tree moth is already established in most of its potential range in the risk assessment area and in most EU countries, but there is scope for wider spread: only some areas in Southern Europe (Spain, Portugal, Greece, Southern Italy and Cyprus) are still to be invaded. Probably it has not yet reached some native stands of *Buxus* spp. in Southern France and Spain. Of particular importance is its probable absence in Mallorca where the endemic to the Mediterranean basin *Buxus balearica* occurs. It is not clear whether the moth has reached yet the *B. balearica* stands in Andalusia and Sardinia (though the box tree moth is present in Sardinia on cultivated box trees).

4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The box tree moth is present in almost all MS, and therefore coordinated action is needed to minimise its significant adverse impact on biodiversity: natural stands of *Buxus sempervirens* in Southern and Western Europe are quickly disappearing with significant negative impacts on biodiversity and cultural heritage (including ornamental *Buxus*).

Solenopsis geminata (Fire ant) - insect

Species name – common	**Fire ant**
Species name – scientific	*Solenopsis geminata*
Overall assessment of risk	Moderate risk - medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/85b869f8-861e-4162-a5e0-e07be3f8de6a/Solenopsis_geminata%20RA.docx
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/cb074865-39b2-49c6-9f5e-7e011f72141a/Annex%203b%20Solenopsis%20geminata%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the tropics and subtropics in northern South America, Central America including Mexico and possibly also South-eastern United States (Florida, Texas).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	• Currently not established in the risk assessment area. • Capable of establishing in HR, FR, EL, IE, IT, MT, PT, SI, ES, with increased potential in foreseeable climate change conditions.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity**: Moderate impact with medium confidence. Locally potentially major impact on arthropods, and small vertebrates if *S. geminata* were to establish and spread in the Mediterranean biogeographical region. *S. geminata* may interfere with plant seed dispersal by native ant species and directly predate, and therefore reduce the amount of seeds. However, it can, in some specific cases, contribute to dispersing native plant species. - **Ecosystem services**: Moderate impact with low confidence. It affects mutualistic interactions between plants and insects by reducing numbers of plant mutualists that protect the plant or disperse plant seeds. Foragers tend honeydew-producing homoptera, especially mealybugs, including root feeding species. Homopteran tending may increase pest populations and reduce crop seed set and yields. - **Human health**: Health impact, may be locally moderate to major: *S. geminata* can sting people and may cause an allergic reaction that requires medical care and, sometimes, causes anaphylaxis. The sting may produce an immediate, intense pain followed by red swelling. *S. geminata* has also been recently described as a potential vector of foodborne pathogens, resulting in foodborne illnesses. However, up to date, no transmission to humans or incidence of food contaminations have been recorded. - **Economy**: The economic impact may be locally moderate to major if *S. geminata* were to establish and spread in the Mediterranean and Atlantic coastal regions. *S. geminata* is considered to be an economically important pest ant in areas where it is introduced. However, data on the overall estimate of economic

	losses are unavailable. *S. geminata* colonies are common around urban areas and are considered urban pests in many countries. Foragers are attracted to electric fields and their chewing can cause damage to PVC coatings of electrical wiring, potentially causing electrical shorts and resultant fires. *S. geminata* activities can result in the failure of many types of mechanical (such as hay harvesting machinery and sprinkler systems) and electrical equipment. They also build mounds in lawns, steal seeds from seedbeds, and enter buildings and feed on a range of household foods. Losses in agricultural crops can be significant where this species is abundant. Forager ants have been recorded feeding on seeds and seedlings.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - In order to prevent its introduction into EU and its establishment in the MS where the species would be capable of establishing. It should be noted that the species has already been recorded in CY, EL, IT, NL, UK. - In order to start eradication programmes as soon as possible it is essential to develop contingency plans against this and other invasive ants at the European scale to be ready to respond adequately when ant introductions and establishments are detected and notified.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7):** Restrictions on keeping, sale, transport, exchange, breeding and release, as well as management of pathways of unintentional introduction and spread (e.g. transport of hay, cleaning equipment) will be effective in preventing the introduction of the species into new areas (low confidence) - to achieve prevention, a careful inspection of goods at port-of-exit should be associated with active prevention at ports-of entry. A careful inspection of the goods before shipment will decrease species dispersion and risks of invasion. All ant species, in particular queens and nests, should be destroyed immediately. - **Early detection and rapid eradication (Articles 14 - 18):** Rapid removal may be effective. Eradication of single nests can be achieved at low cost e.g. through heat or freezing; outdoors, the only effective control methods are chemical insecticides. - **Management (Articles 19-20):** An integrated approach is needed. Probably, there is no single method allowing, by itself, to control *S. geminata* if it were to be introduced in Europe. If *S. geminata* is already established chemical control will target not only the worker but also, and importantly, the queen, to kill nests. Options include broadcast granular bait-formulated products, treatment of individual ant colonies in mounds and surface or barrier treatments using contact insecticides.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: to increase its efficiency, careful inspection of goods at port-of-exit should be combined with an active prevention mechanism at ports-of-entry to prevent contamination. - Early detection and rapid eradication: eradication of single nests in buildings, contained environments and containers is rather straightforward and can be achieved at low cost. - Management: Data on the management costs of the congeneric *S. invicta* using insecticides in USA provide some indication. Conventional bait insecticides cost approximately US$10 per 0.4 ha for broadcast application, and with the cost of application, total treatment costs are approximately US$17 per 0.4 ha, but treatment effects last only 3–12 months.
	- **Cost of inaction:** - Failure to avoid introduction of the species and its subsequent establishment in a number of MS would result in recurrent costs from impacts including on agriculture as well as costs of measures to combat the species, including in agriculture and by households.

	- Efforts should be made to eradicate the nest(s) before queens escape in the wild. The eradication of *S. invicta* in early 2000s in Auckland covered less than 1 ha but cost NZ$1.4 million. In Australia, an eradication programme of *S. invicta* was evaluated at AUS$200 million. There was one established population in a building in the Netherlands, but it was eradicated using insecticides.
	- **Cost-effectiveness**: For prevention, an investment in capacity for inspection is needed, combined with a more risk-based approach to better target high risk items. On single nests in buildings, contained environments and containers eradication can be achieved at low cost using chemical insecticides.
	- **Socio-economic aspects**: There are no known benefits from this species in invaded ranges). It can cause nuisance to humans through their sting and the destruction of equipment such as electrical installations (including air conditioner units, computers, etc.)
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	While not yet established based on a global species distribution model, *S. geminata* could become established in the MS around the Mediterranean Basin. The species has a moderate to major environmental, economic and social impact elsewhere in the world. Similar impacts may occur in Southern Europe.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The species is currently not established in the EU.

Solenopsis richteri (Black imported fire ant) – insect

Species name – common	**Black imported fire ant**
Species name – scientific	*Solenopsis richteri*
Conclusion of the risk assessment	Moderate risk – low confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/add519b3-c6fb-44e4-a349-243a1185700d/Solenopsis_richteri_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/50d7e793-e135-4cd9-801a-dfbfc30a3e5d/Annex%202b%20Solenopsis%20richteri%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to South America: south-eastern Brazil, Uruguay, and northern Argentina.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Not yet recorded in the risk assessment area. - Capable of establishing in AT, CZ, FR, DE, IE, IT, PL, PT, SI, ES.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	There is no research on impacts of *S. richteri* but it is likely that *Solenopsis richteri* may have locally moderate to major environmental, economic and social impacts if it were to establish, similar to those of *S. invicta*. - **Biodiversity**: Moderate impact with low certainty. If *Solenopsis richteri* established, it is likely that it would impact adversely native biodiversity, in particular arthropods and small vertebrates. It would also impact on plant/insect interactions by reducing the abundance and richness of local ants and more broadly of ground active insects. It may also imperil lizards and birds, similar to the impact of *S. invicta*. Flora could be affected through various mechanisms (e.g. competition with native ant dispersers). - **Ecosystem services**: Moderate impact with low confidence. The impact magnitude will depend on densities. *Solenopsis richteri* damages cultivated field crops by feeding on seeds, seedlings and developing fruit (provisioning). It may interfere with beneficial insects that exert biocontrol activities in modified habitats (e.g. tending of homopteran pests: aphids, scale insects etc.), which they protect against natural enemies to collect their honeydew. Similarly to *S. invicta* , *S. richteri* could become a social nuisance, for instance parks and recreational areas might become unsafe for children. - **Economy**: Moderate impact with low certainty but may be locally major: some detrimental impacts on agriculture (e.g. stinging workers, domestic stock) and horticulture (e.g. stinging pickers, the mounds they build interfering with equipment) wherever the ant established. Impacts on infrastructure and (electrical) equipment also possible through their foraging and nesting activities. - **Human health**: significant medical consequences, even at low densities, due to human reactions to the venom.

4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent introduction into the EU and establishment in the MS where the species would be capable of establishing. - in order to start eradication programmes as soon as possible it is essential to develop contingency plans against this and other invasive ants at the European scale to be ready to respond adequately when ant introduction and establishments are detected and notified.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Inspection of imported goods and containers and destruction of nests and ants found at inspection. Quarantine inspections and treatments methods used in USA and China could be used in Europe, together with developing similar guidelines for invasive ants in general. Introduce legislation that officially considers ants as pests and creates related obligations to prevent their introductions. - **Early detection and rapid eradication (Articles 14 - 18)**: On single nests (e.g. found in confined container) destruction can be done manually through heat or freezing. Eradication of multiple nests, including in buildings, is better achieved using insecticides (baits). Eradication is more problematic outdoors – use of broadcast granular bait is recommended in such cases. - **Management (Articles 19-20)**: Chemical control (authorised insecticides against invasive ants (as bait or contact) ready for using. Pathogens could possibly be introduced in Europe (specific to one or a few *Solenopsis spp*) but so far effects have not been clearly shown. Integrated pest management might be needed and experience in USA can help with this.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: given the high costs that would be associated with equipping inspection services in Europe to cope with the vast amount of materials imported , a risk-based approach would be needed to target high risk items. Early detection and eradication will require increased investment in manpower. Management: insecticides (as bait or contact) can be used in case an invasion is detected. Conventional bait insecticides cost approximately US$10 per 0.4 ha for broadcast application, and with the cost of application, total treatment would amount to approximately US $17 per 0.4, but treatment effects last only 3–12 months.
	- **Cost of inaction:** Inaction may lead to the introduction and establishment of this species in a number of MS, resulting in recurrent costs from impacts, including on agriculture and measures to combat the species, including in agriculture and by households.
	- **Cost-effectiveness:** For prevention, an increased investment in manpower for inspection is needed, combined with a more risk-based approach to better target high risk items. On single nests in buildings, contained environments and containers, eradication can be achieved at low cost using chemical insecticides.
	- **Socio-economic aspects:** there are no known benefits to this species in invaded ranges, but it can cause nuisance to humans through their sting and the destruction of equipment such as electrical installations.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established and could have moderate impacts on biodiversity where it would establish. Limited literature is available for *S. richteri* but its impacts are expected to be similar to those of *S. invicta*.

4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The species is not yet established in the EU.

Solenopsis invicta (Red imported fire ant) – insect

Species name – common	**Red imported fire ant**
Species name – scientific	*Solenopsis invicta*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/da57b8d1-36bc-44c4-894d-4765da8a7d30/Solenopsis%20invicta%20RA.doc
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/c8d04a63-3fa6-4204-86db-f8874ff9ab86/Solenopsis_invicta%20mgt.doc
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to tropical South America (parts of Argentina and Brazil, Bolivia, Paraguay, Peru and Uruguay).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- The species is currently not established in the EU. - It is capable of establishing in in HR, CY, FR, EL, IT, MT, PT, SI, ES.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	It is among the most damaging invasive insects on earth (top 100 worst according to IUCN). - **Biodiversity**: Major impact with medium confidence. The impact on native biodiversity, in particular on arthropods, molluscs and small vertebrates (reptiles, birds, amphibians and mammals) may be locally major by direct predation, competition or stinging. *Solenopsis invicta* has been found to displace or reduce populations of native ants. It also attacks beneficial insects. Flora can also be affected through various mechanisms. Nest building and foraging activities of *S. Invicta* affects physical and chemical soil properties and strongly enhances plant growth through the increase of NH4. - **Ecosystem Services**: Major impact with medium confidence: *Solenopsis invicta* damages cultivated field crops by feeding on seeds, seedlings and developing fruit (provisioning). Impact may also be indirect through the tending of homopteran pests (aphids, scale insects, etc.), which they protect against natural enemies to collect honeydew. *S. Invicta* is a social nuisance – parks and recreational areas might become unsafe for children, for instance. - **Economy:** Major with medium confidence. Economic costs in invaded areas are mainly related to impact on agriculture (e.g., stinging workers, domestic stock) and on infrastructure and equipment (their mounds may damage roads and equipment and their foraging and nesting activities can result in the failure of many types of mechanical and domestic electrical equipment). - **Human health**: It can sting people and may cause allergic reaction. Millions of people are stung annually in south-eastern USA.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted	Concerted action at Union level is required: - in order to prevent establishment in the MS where the species would be capable of establishing under foreseeable climate conditions.

action at Union level is required to prevent their introduction, establishment or spread;	- in order to start eradication programmes as soon as possible, it is essential to develop contingency plans against this and other invasive ants at the European scale to be ready to respond adequately when ant introduction and establishments are detected and notified.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Inspection of imported goods and containers and destruction of nests and ants found at inspection. The species has already been intercepted during import inspections in the Netherlands. Quarantine inspections and treatments methods used in USA and China could be used in Europe, together with developing similar guidelines for invasive ants in general. Introduce legislation that officially considers ants as pests and creates related obligations to prevent their introductions. - **Early detection and rapid eradication (Articles 14 - 18)**: On single nests (e.g. found in confined container) destruction can be done manually through heat or freezing. Eradication of multiple nests, including in buildings, is better achieved using insecticides (baits). Eradication is more problematic outdoors, where the use of broadcast granular bait is recommended. - **Management (Articles 19-20)**: Chemical control (authorised insecticides against invasive ants (as bait or contact) ready for using. Pathogens could possibly be introduced in Europe (specific to one or a few Solenopsis spp) but so far effects have not been clearly shown. Integrated pest management might be needed and experience in USA can help with this.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** Prevention: given the high costs that would be associated with equipping inspection services in Europe to cope with the vast amount of materials imported, a risk-based approach would be needed to target high risk items. - Early detection and eradication: will require increased investment in manpower. The eradication of *S. invicta* in early 2000s in Auckland covered less than 1 Ha but cost NZ$1.4 million. - Management: Conventional bait insecticides cost approximately US$10 per 0.4 ha for broadcast application, and with the cost of application, total treatment costs amount to approximately US $17 per 0.4 ha, but treatment effects last only 3–12 months. Mound treatments with contact insecticides are much more expensive because *S. invicata* produces high number of mounds/ha.
	- **Cost of inaction:** Inaction may lead to the introduction and establishment of this species in a number of MS, resulting in recurrent costs from impacts on agriculture and measures to combat the species in agriculture and by households. Health sector costs are possible, as sting can lead to anaphylactic shock.
	- **Cost-effectiveness:** For prevention, an increased investment in manpower for inspection is needed, combined with a more risk-based approach to better target high risk items. On single nests in buildings, contained environments and containers, eradication can be achieved at low cost using chemical insecticides. Results of eradication programmes outdoors have been variable.
	- **Socio-economic aspects:** There are no known benefits from this species in invaded ranges, but it can cause nuisance to humans through their sting and the destruction of equipment such as electrical installations.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a	*Solenopsis invicta* species is not yet established and could have major impacts on biodiversity, ecosystem services and the economy where it would establish. It has previously been detected, so there is a real risk of introduction into the EU.

significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Not yet established in the EU.

Wasmannia auropunctata (Little Fire ant) – insect

Species name – common	**Little Fire ant**
Species name – scientific	*Wasmannia auropunctata*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/e782c7e9-a76c-4e72-b5db-0f58eaff4c4b/Wasmannia_auropunctata_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/f8913699-4cff-47ea-b34b-31f8db9a3fa4/4b.%20Wasmannia%20auropunctata%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to Central and South America.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established populations only in one location in southern ES. - Under current climate conditions, *Wasmannia auropunctata* could also establish in CY, EL, FR, HR, IE, IT, PT. Under foreseeable climate change conditions it could also establish in AT, CZ, DE, HU, SE, SI, SK.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with low confidence. *W. auropunctata* is one of the most harmful invasive ant species worldwide. It is an ecologically successful dominant ant which has massive impacts on other ants in nature, going as far as resulting in the eradication of almost 100% of the native ant species. Invasion of *W. auropunctata* is systematically followed by a reduction of biodiversity, initially through a major decrease in ants and other invertebrates (e.g. spiders, beetles) and small vertebrates. It also interferes negatively with seed dispersal of myrmecochorous plants. - **Ecosystem services**: Major impacts with medium confidence. *W. auropunctata* may interfere with seed dispersal activities of native ant species underpinning seed dispersal. It may also interfere with beneficial insects that exert biocontrol activities and increase pests (i.e. honeydew-producing homoptera which it tends). It is also a social nuisance in infested areas, disrupting outdoor activities that have a greater risk of contact with ants (e.g. picnics, gardening…). - **Economy**: Moderate impact with low confidence. Similar to that observed in presently invaded areas outside risk assessment area. It is a significant horticultural pest: field labourers may be unwilling to pick fruit in infested areas and this ant species enhances populations of honeydew producing homopterans (which damage their host plant), enhancing the occurrence of diseases, including viral and fungal infections, increasing cost of agricultural pest management. - **Human health**: Moderate impact with low confidence. *W. auropunctata* has a painful sting that may cause injury to humans (and domestic animals). The sting can cause irreversible corneal lesions leading to blindness. In its current area of distribution it is a social nuisance in infested areas and is considered an urban pest

	in many countries.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent introduction into the risk assessment area and prevent further spread of the small population already established in southern Spain. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: It is necessary to prevent its accidental entry. Quarantine inspections and treatments methods used in other continents could be used in Europe. Careful inspection of goods at port-of-exit should be associated with active prevention at ports-of-entry. Inspection for ants should not be species-specific but rather target invasive ants in general. - **Early detection and rapid eradication (Articles 14 - 18)**: A successful eradication programme is inseparable from an early detection of the infestation. Bait sticks and sniffer dogs can be used for detection. Early detection is critical as eradication outdoors is difficult, especially when populations have already reached high densities of nests and individuals within those nests. Eradication is possible only when populations are still very small or on small islands. Whether the aim is eradication, containment or control, insecticide-based methods are usually the only options. - **Management (Articles 19-20)**: An ant species not easily controlled with conventional pesticides. Nevertheless larger populations should be the target of containment measures relying on poisonous baits using various pesticides and attractants.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** - Prevention: An increased investment in manpower for inspection would be needed combined with a better risk based approach. - Early detection and eradication: Few quantitative data on costs of eradication campaigns are available. The largest eradication attempt is being conducted in Australia, where an infestation of 28 ha has been under a programme since 2006 for a cost of AU$ 9.9 million to date. - Management: The most efficient option is the use of bait-formulated products. Conventional bait insecticides cost approximately US$10 per 0.4 ha to broadcast apply, and with the cost of application, total treatment costs approximately US $17 per 0.4 ha, but treatment effects last only 3–12 months. Increased management expenditures can suppress infestations; reduce spread between sectors; and decrease long-term management costs, damage, and stings.
	- **Cost of inaction:** Major impacts on biodiversity, increasing costs of agricultural pest management, and nuisance to populations in infested areas.
	- **Cost-effectiveness:** Prevention and early eradication are by far the most cost-effective measures, in particular taking into account the difficulty to limit the spread and the damage the species can cause once established.
	- **Socio-economic aspects:** There are no direct economic benefits associated with this species.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse	*Wasmannia auropunctata* is established in the EU, in one specific location in southern Spain. Given that it is likely that it will be able to establish colonies in several MS, there is a need for measures to address pathways of introduction and limit further spread and if possible eradicate it in the risk assessment area.

impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has significant adverse impact.

Lampropeltis getula (Common kingsnake) – reptile

Species name – common	**Common kingsnake**
Species name – scientific	*Lampropeltis getula*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/50ff938c-1017-4774-a530-8784f05b26a1/Lampropeltis_getula_final_20191120.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/4529b8e1-143b-4da0-8332-d2228d85c682/Lampropeltis_getula_mgt.doc
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (from Atlantic to the Pacific coast).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- The species is currently not established in the EU. - Under current climate conditions it could establish in PT, ES, IT, EL, MT, CY. - In foreseeable climate change conditions, *Lampropeltis getula* could be capable of establishing also in BG, HR, FR, HU, RO.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity**: If established, *L. getula* would have a major impact on biodiversity (medium confidence), particularly as a generalist predator (i.e. of rodents and other small mammals, lizards and their eggs, snakes and their eggs, turtle eggs and hatchlings, frogs, salamanders, birds, bird eggs and chicks, and large invertebrates). When the available prey is rare or threatened, this species can pose a threat to many native European species – especially where the degree of endemism is high (e.g. Mediterranean island faunas). On the Canary Islands (an outermost region) it preys on several endemic reptile species whose population is declining. Native plant species or vegetation structure can also be impacted as far as omnivorous lizards on islands are important seed dispersers. This species may cause further adverse impacts, to a lesser extent, through competition and the spread of diseases (e.g. snake fungal disease) that could contribute to the extinction of wild snake populations. - **Ecosystem services**: *L. getula* has no known impact on provisioning and regulating ecosystem services. - **Economy**: Minor with low certainty – mostly indirect via loss of revenue and income from tourism and recreation if native endemic wildlife deteriorates. - **Human health**: Minimal impacts with high confidence. This species is neither aggressive nor venomous, though it has a painful bite. It is however a potential carrier/ reservoir for salmonella which is well known to pose a health risk to humans (but the risk is estimated as very low).
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment	Concerted action at Union level is required in order to prevent the introduction and establishment of this species in the risk assessment area.

or spread;	
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Appropriate legislation and codes of best practice can reduce risks posed by pet trade and deliberate introductions/releases. - **Early detection and rapid eradication (Articles 14 - 18)**: It is a readily identifiable species found in association with human activity. Encouraging rapid reporting of new incursions increases rapid response before the species can become established. For surveillance and monitoring in the EU, methods used for monitoring in its native range may be suitable (e.g. terrestrial drift fences with funnel and pitfall traps). While it proves labour intensive, *L. getula* can be located and captured by hand searching suitable habitats (including artificially created refugia), complemented with more targeted approaches to achieve eradication in a given area. Trained dogs may increase the effectiveness of searches. - **Management (Articles 19-20)**: In addition to the above, different kinds of traps may potentially be used, but most have their limitations. Particular effort is needed to prevent further dispersal e.g. through cargo traffic to other locations (inspection, control and trapping around ports and snake-proof fencing). Areas of high conservation value may be targeted for intensive snake control.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Inclusion in the Union list would result a ban on its trade and loss of respective income for the sector (though there is no indication that this is important). There is no information available on costs associated with the prevention, early detection and eradication methods described above. Management: The cost of managing this species in the future if the species were to establish are estimated to be major with low certainty. A LIFE project carried out in Gran Canaria has shown that despite considerable effort and resources (total budget of €640,000 (2016-2020) the number of snakes caught per year was still on the rise and the population still spreading with no concrete chance of achieving eradication. It can be assumed that management costs would be higher on the mainland.
	- **Cost of inaction:** Decline and possible local extinction of species of high conservation value, the ecosystem services they provide (e.g. seed dispersal by lizards) and loss of cultural value and associated attractiveness for tourism.
	- **Cost-effectiveness:** Prevention is by far the most cost-effective method. If *Lampropeltis getula* was released and managed to establish on the mainland, its spread might be very difficult and costly to contain.
	- **Socio-economic aspects:** This species has a certain economic value (found for sale on several European websites). It is a popular pet snake and, as such, may provide cultural services as a pet/ zoo animal. Owners of specimens at the time of inclusion on the list will be able to continue keeping these until the end of the animals' natural life, provided that they will be kept in contained holding and all appropriate measures are put in place to ensure that reproduction or escape are not possible.
4.6 The Union list shall include as a priority those invasive alien species that:	Where *Lampropeltis getula* is established outside its native range, it has shown its potential to have the most significant adverse impact on native wildlife, including on rare and threatened species. The species is

(a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	not yet established in the risk assessment area, but it has been recorded on several occasions, most likely escapes from confinement. Given that it is a popular pet species, there is a high risk that it could escape and establish viable populations, spreading and having a significant impact, similar to that in other invaded regions.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	

Pycnonotus cafer (Red-vented bulbul) – bird

Species name – common	**Red-vented bulbul**
Species name – scientific	*Pycnonotus cafer*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/121a1fd5-f233-466c-bc1e-8527ec2f90fa/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/b163c415-2600-44c4-aa9f-bb15e4324dc5/6b.%20Pycnonotus%20cafer%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the Indian Subcontinent, Southeast Asia, and Malay Peninsula.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in few locations in ES. - Under current (and future) climate conditions, *Pycnonotus cafer* is capable of establishing also in CY, EL, FR, IT, PT, MT.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	Expected to have moderate impact in the risk assessment area overall. - **Biodiversity**: This species would have a moderate impact on biodiversity (low confidence). It feeds on cultivated (food and ornamental) plants and is considered a major vector (seed dispenser) of some notoriously problematic IAS to which Mediterranean islands would be particularly exposed. It tends to be particularly attracted to the fruit of several IAS, acting as a vector of seeds. Impact on native bird species will mostly occur through competition for food or space, including harassment of native birds, but since *Pycnonotus cafer* mostly occurs in (peri)urban habitats, these impacts would likely mostly affect common bird species. *Pycnonotus cafer* could also have impacts via predation, in particular of insects and smaller (or juvenile) vertebrate prey like geckos and lizards (some endemic). - **Ecosystem services**: Major impact with medium confidence. *P. cafer* is a known pest species on horticultural and agricultural produce outside its native range. As a frugivorous bird, most damage is related to its diverse diet, that comprises fruits and berries, flowers and buds. Where introduced, it has in some cases caused major damage, including on red fruits such as tomatoes and strawberries and aubergine crops. There are many records of economic damages in invaded ranges. *Pycnonotus cafer* could also alter the species composition in the invaded range, impacting on several cultural ecosystem services. - **Economy**: Moderate impact with medium confidence. Mostly via impact on

	fruit and vegetable production mostly. Could involve costs associated with mitigating damage, such as using nets, repellents or other methods. - **Human health**: No social or human health impacts, although this species has been found to carry the zoonotic disease *Chlamydia sp.*
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent introduction or release into MS in which it could establish in case it was released or escaped**.** - in order to facilitate early detection and eradication of sightings in MS in which it could potentially establish, increasing the effectiveness of rapid response.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Introduction could effectively be prevented through restrictions on its trade and keeping as a pet. - **Early detection and rapid eradication (Articles 14 - 18)**: Encouraging rapid reporting of new incursions increases the likely success of rapid response (role of awareness raising and citizen science). - Traps, in particular fruit baits with or without live birds as decoy, are an effective method to catch *P. cafer.* Shooting can also be an effective method, but it is labour intensive, and thus rather appropriate for small number of birds during the early stages of establishment. - **Management (Articles 19-20)**: Methods other than the ones mentioned above may be applied, albeit they have had limited practical application to date: mist-nets to catch birds or protecting fruit and plants from damage through netting and the use of chemical deterrents.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Red-vented bulbuls have been successfully controlled in a variety of eradication and management programmes in their introduced ranges. Programmes have typically involved a combination of shooting and the use of traps containing decoy birds. However no information on the costs associated with such programmes is available.
	- **Cost of inaction:** Increase in costs for eradication and management and damage to crops and costs to the agricultural sector, including of having to protect the crops (e.g. netting) in affected areas.
	- **Cost-effectiveness:** Early detection and eradication will be most effective and help keep impacts and costs low.
	- **Socio-economic aspects:** *Pycnonotus cafer* is a popular pet species. Prices found online vary from € 165 – 250 per bird or € 250 per pair. Any control of established populations in the wild risk attracting some opposition, so prevention is preferable.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	While it is likely that this species is currently not established, there have been records in several countries, indicating the probability of intentional or unintentional releases into the wild (it is an appreciated pet) and the need to prevent these from happening through prevention of its trade and keeping as a pet.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	There appear to have been some small established populations in ES, although these might no longer exist. If populations were to establish more permanently and spread, this could result in impacts on biodiversity and damage to agriculture (fruit and vegetables pest).

Axis axis (Chital) – mammal

Species name – common	**Chital**
Species name – scientific	*Axis axis*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/4c75c9a3-9388-473c-8083-7643cdb46222/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/325e0981-0f31-4272-8f5d-c8bac923c085/5b.%20Axis%20axis%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to Asia, endemic of the Indian subcontinent, i.e. Nepal, Bhutan, Bangladesh and Sri Lanka.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in HR. - Under current climatic conditions, *Axis axis* could further establish in AT, BE, BG, CY, CZ, DK, FR, DE, EL, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SK, SI, ES, SE. - Under foreseeable climate change conditions, *Axis axis* could, in addition, also establish in EE and FI.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major with a low level of confidence. Depending on population density, this species may cause significant direct impacts on native vegetation, e.g. through browsing and bark stripping, and may have a number of indirect effects on fauna and ecosystem processes, amplifying the pressure ungulates cause on the natural environment. Negative impacts on regeneration of native forests have been reported in other invaded areas outside the risk assessment area. *Axis axis* feeds on many different plant species, resulting in negative impact on seedling and sapling survival. This species may contribute to modification of the forest understory. Deer trampling behaviour may degrade habitats and negatively affect native vegetation and increase erosion and runoff. Potential competitive displacement of native deer. Vegetation changes brought about by browsing and trampling axis deer are detrimental to other deer species as well as to other vertebrate and invertebrate species. Cascading effects on other species may extend to insects, birds, and other vertebrates. - **Ecosystem services**: Moderate with a low level of confidence. The axis deer may affect several ecosystem services through impacts on ornamental plants and agricultural crops through browsing and bark stripping. It may destabilise stream banks, causing increased erosion and sedimentation of waterways, with impacts both in the area of provisioning (plants, animals) and regulating ecosystem services (disease control, soil quality regulation, water conditions). - **Economy**: Moderate impact with a low level of confidence. *Axis axis* is capable of having an impact on sheep and cattle through overgrazing, as well as on cereal grain, legumes, and fruit commodities or in gardens, orchards and vineyards (when other forage is scarce). This species may also transmit infectious diseases to livestock and other deer, especially if deer density is high. - **Human health**: Moderate with a low level of confidence. As other deer, it may carry parasites and transmit infectious diseases directly

	to humans (e.g. via droppings in freshwater systems). The axis deer may also introduce new pathogens and cause road collisions.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - In order to reduce the risk of intentional or unintentional releases into the wild and establishment of new populations in the risk assessment area. - In order to support early detection and eradication.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: *Axis axis* has historically been introduced to new areas, primarily as an ornamental species for collections, as escapes from deer farms, or as an addition for hunting. The adoption and enforcement of appropriate legislation and codes of best practice to reduce the risks posed by these pathways should reduce the probability of further introductions. - **Early detection and rapid eradication (Articles 14 - 18)**: Axis deer are a highly visible and easily recognisable species. Encouraging rapid reporting of new incursions increases the likely success of rapid response. - **Management (Articles 19-20)**: Current deer management practice mainly relies on shooting. Eradication programmes for other deer species and ungulates have relied on shooting and have been successful over large areas of up to 6,000km^2. The potential use of contraceptives as a deer management tool attracts frequent public interest, but currently such approaches rely on catch and inject methods.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** No information is available on the costs of eradicating this deer species. Some information is available on costs and methods of large scale goat eradications from islands: successful removals from islands of up to 6000km^2 at a cost of around $10,500,000 ($1,750 per km^2) at 2011 prices, including the use of aerial hunting and judas animals. The costs per unit area from smaller programmes are likely to be substantially higher.
	- **Cost of inaction:** see biodiversity and economic impacts above.
	- **Cost-effectiveness:** cost- effectiveness of ungulate eradications has been improved through the use of helicopter shooting, judas animals to locate remaining individuals, night shooting combined with infra-red cameras, fences and natural barriers to break larger areas into smaller components, and dogs to help locate animals. Relying on citizen science or reports from hunters for early detection may increase cost effectiveness.
	- **Socio-economic aspects:** there is an economic value for the meat and this deer species has a value for recreational deer hunting.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	There is already a small established population in one MS (early stage of invasion), but potentially it could establish in almost all MS.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	See above.

Callosciurus finlaysonii (Finlayson's squirrel) – mammal

Species name – common	**Finlayson's squirrel**
Species name – scientific	*Callosciurus finlaysonii*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/1819fd11-3984-46e6-8c50-10c55d197b44/Callosciurus_finlaysonii_RA_final_20191120.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/f61c081a-cbce-43ea-bc82-f9d5f895a5dd/Annex%205b%20Callosciurus%20finlaysonii%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to South East Asia (from central Myanmar, Thailand, Laos, Cambodia to Vietnam).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in IT. - Under current climate conditions, *Callosciurus finlaysonii* could also establish in ES, HR, EL (potentially also CY and MT). - Under foreseeable climate change conditions it could also establish in FR and PT.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with low confidence. Data on impacts on native species and ecosystems are missing. However, impact can be inferred from other alien squirrel introductions in many European countries. Notably, interspecific competition with native species is likely, as particularly, both *S. carolinensis* and *C. erythraeus* are already threatening European red squirrel populations. *Callosciurus finlaysonii* is considered a predator of birds' nests in its native range, but no information is available for the introduced range. Transmission of pathogens could likely cause a risk, but, currently, it is not documented. The potential impact on native species such as the red squirrel or the endemic Calabrian black squirrel, woodland birds or dormouse is unknown but likely, especially considering impacts of other alien (tree) squirrels introduced and established in Europe. - **Ecosystem services**: Major with low confidence. Impacts would primarily lie in provisioning service – biomass/ cultivated terrestrial plants/ wild plants. Its intense bark stripping can cause (secondary) infections in trees. The species is also a seed dispenser and could be a vector or host of pathogens. In natural forests, this could influence forest structure, species composition, the amount of (standing) dead wood, forest management practices etc. - **Economy**: Major with low confidence. Primarily damage to forestry and plantations: most evident damage caused by *C. finlaysonii* is bark stripping. Damage to ornamental trees or nurseries can be important, though this has not been quantified in economic terms so far. Bark stripping increases the risk of fungal infections and invertebrate damage, which ultimately can reduce timber yield. Damage to electric cables and other infrastructure by the species has also been reported. - **Human health**: Minimal with low confidence. The role of the species in disease transmission, with introduced individuals acting as vector or host of pathogens

	that can harm native wildlife (and potentially humans) represents a knowledge gap and should be investigated. *C. finlaysonii* sampled in pet stores in Italy tested positive for *Dicrocoelium dendriticum* (d'Ovidio et al. 2014) that could infect humans.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to **prevent invasion into the MS where this species is not currently established** and **prevent further spread in the MS where this species is already present.** - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: *Callosciurus finlaysonii* is kept and traded through the pet trade. Adoption and enforcement of appropriate legislation (Art. 7 of the Regulation (EU) 1143/2014) and codes of best practice targeted to commercial and non-commercial owners in Europe would reduce the risks posed by these pathways and the probability of further introductions, escapes or releases. - **Early detection and rapid eradication (Articles 14 - 18)**: Encouraging rapid reporting of new incursions increases the likely success of rapid response before the species can become established. As regards methods to achieve eradication, live-trapping is already widely used to control invasive alien squirrels and is likely to be the most effective method for this species. Shooting can be an effective tool to supplement trapping, but its use can be limited by social and local regulatory considerations. - **Management (Articles 19-20)**: A combination of trapping and shooting are also likely to provide the most cost-effective methods for the long-term management of this species.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - **Prevention:** Since *Callosciurus finlaysonii* is readily distinguished from native species, encouraging rapid reporting of new incursions increases the chance of effective eradication. Raising public awareness and involving the general public in relevant areas (including citizen science initiatives) would also contribute to successful prevention. - **Early detection and eradication**: By way of comparison, Pallas's squirrel was eradicated in Flanders, Belgium, using traps. Sightings of this species had occurred over an area of nearly 3km^2 and 250 animals were removed within 5-years at a cost of EUR 200,000, including surveillance and post-eradication monitoring. Shooting can be an effective method, but it is labour intensive and therefore expensive. - **Management**: Cost are higher for established populations with a higher number of animals. As an indication, control actions in France for Palla's squirrel were planned at about EUR 100,000 per year for the period 2011-2014.
	- **Cost of inaction:** new escapes or releases are likely, resulting in impacts on biodiversity and economic damage (timber production) as well as long-term management costs of this species, especially if it spread too widely to make eradication impossible.
	- **Cost-effectiveness:** While prevention of its introduction is clearly the most cost-effective option, once established, a combination of trapping and shooting are also likely to provide the most cost-effective methods for the long-term management of this species. If the objective is eradication of a population, then shooting alone is unlikely to be effective.
	- **Socio-economic aspects:** The species is kept, bred, exchanged and traded as a pet in Europe. The typical price per individual animal is around 200-250 euros.
4.6 The Union list shall include as a priority those invasive alien species that:	The species is still at an early stage of invasion and only established in one MS. Listing could prevent new escapes or releases in other MS suitable for establishment.

(a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where it is established in the risk assessment area, *Callosciurus finlaysonii* has already shown to have negative impacts.

Castor canadensis (North American beaver) – mammal

Species name – common	**North American beaver**
Species name – scientific	*Castor canadensis*
Conclusion of the risk assessment	High risk – high confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/949d58de-0e33-4f10-9041-af46f6469347/details?download=true and annex to the risk assessment: https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/3c0ba11b-70e1-43dc-9020-19ad470012b0/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/6a1c0ad7-f6e7-4ccf-838c-29d104c5d63e/details?download=true
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (Canada, USA and northern Mexico).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in BE, DE, FI. - Under current climate and foreseeable climate change conditions, *Castor canadensis* could establish all over the EU.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Medium with low confidence**.** The effects of *C. canadensis* do not differ from those of the Eurasian beaver *C. fiber*. Beavers are ecosystem engineers that can significantly change geomorphology and hydrological characteristics of the landscape, that can result in increased habitat and species diversity at the landscape scale. Beaver foraging has a considerable impact on ecological succession, species composition and structure of plant communities. These impacts are mostly classified as positive within the native ranges of *C. fiber* or *C. canadensis*. In areas where both species are alien and either one of the species is introduced, these impacts are classified as negative. In areas where one of the species is endemic and the other is introduced, as in Europe, the impacts of both species are fairly similar. *C. canadensis* and *C. fiber* are unable to interbreed, so hybridisation is not an issue. However, the species share identical habitat requirements, leading to niche overlap potential and exclusive competition. Studies and field trials assessing the competitive ability of both species have been unable to produce a definitive answer to whether one species prevails over the other. However, *C. canadensis* is an efficient disperser and in areas it occupies first, it is possibly preventing the establishment of *C. fiber*. Recently modelling of *C. canadensis* and *C. fiber* movements and habitat requirements concluded that *C. canadensis* dominates and may slowly exclude *C.*

	fiber from wide stretches of its natural range. - **Ecosystem services**: The impact on the abiotic and biotic properties of ecosystems are expected to be high, as the establishment and activities of *C. canadensis* (dam building, canal digging and tree cutting) will considerably change the hydrological situation, modify habitats, impact ecological succession and disrupt food webs. At the level of landowners, many of the effects appear as disservices (e.g. beaver-induced flooding) but at landscapes that would normally be occupied by *C. fiber* could be considered positive. - **Economy**: Medium impact. *Castor canadensis* can damage forests and farmland resulting from tree felling and inundation following dam building. It can also damage dikes, dams and roads by digging holes and causing inundation. **- Human health**: Low impact with medium confidence. *Castor canadensis* may be a potential vector of tularaemia (type B), Giardia and Yersinia pseudotuberculosis, which may pose risks for human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	Given the difficulty in distinguishing between *C. canadensis* and *C. fiber*, all detection, monitoring and eradication measures require prior genetic testing or other measures requiring expertise for species determination. - **Prevention**: Inclusion of *C. Canadensis* on the Union list would result in restrictions effective in preventing escapes from zoos, wildlife parks, private collections and other establishments and intentional releases, as well as coordinated measures to address unaided spread into the EU. - **Early detection and rapid eradication**: Field surveys combined with DNA diagnostics and/or anal gland secretion analysis are effective in detecting new occurrences of *C. canadensis.* A combination of various methods (trapping, shooting etc.) are effective in achieving the rapid eradication after early detection. - **Management**: A combination of various methods (trapping, shooting etc.) are effective in managing the species. It is likely that sustained eradication campaigns can remove the species from large areas as was demonstrated by the earlier eradication of *C. fiber* and *C. canadensis* (e.g. *C. canadensis* is currently considered as eradicated in Luxembourg). Where widely spread (Finland) management measures are needed principally to contain *C. canadensis* and avoid its sympatric occurrence with *C. fiber*.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Costs are associated with carrying out surveys, species identification and eradication/management measures. Estimations of the costs of such efforts in EU are not available.
	- **Cost of inaction:** Inaction will lead to further spread of *C . canadensis*, resulting in more locations where it will co-exist with *C. fiber,* progressively rendering management efforts more costly and likely leading to replacement of *C. fiber* with *C. canadensis* that will result to increasing efforts and costs needed to improve the conservation status of *C. fiber*.
	- **Cost-effectiveness:** Cost-effectiveness is considered overall high as there is still scope to prevent further spread and avoid new

	establishments. - **Socio-economic aspects:** Adequate communication measures and awareness campaigns will be required for explaining the significance of the native *C. fiber* and the necessity to control *C. canadensis.* Campaigns should also address concerns in relation to hunting and animal welfare issues.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	*Castor canadensis* is established in the EU, but there is scope for much wider spread and measures are needed to contain its spread and, where possible, eradicate the species. Where the species is established, it has impacts similar to *C. fiber,* but the main impact lies in competition between the native *C. fiber* and *C. canadensis,* which in the long term might outcompete the former.

Freshwater

Pistia stratiotes (water lettuce) – plant

Species name – common	**Water lettuce**
Species name – scientific	*Pistia stratiotes*
Conclusion of the risk assessment	High risk – moderate uncertainty
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/0f9708c7-f432-4902-aca9-b2445590c72e/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/7c78b720-28c6-4944-b25a-a4859a3daa3d/details?download=true
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native range unclear, either South America, or pantropical
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established locally in FR, DE, SI (in DE, SI in thermal waters), - Capable of establishing also in PT, ES, IT, GR. - In foreseeable climate change conditions, *Pistia stratiotes* could also establish in BE, NL, HU, HR, BG.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity**: High impact (high uncertainty) – Freefloating aquatic species, forms dense mats, completely alters trophic dynamics, resulting in long term changes, threatens native species, - **Ecosystem services**: High impact (high uncertainty) – Alters water quality, limits water availability, restricts access for recreation and tourism. - **Human health**: High impact (high uncertainty) - Favours water-borne diseases, disease-carrying mosquitoes. - **Economy**: High impact (high uncertainty) – Interferes in irrigation and drainage systems, hydro-electric schemes, hinders navigation and fishing.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	- Restrictions and rapid eradication will help to prevent the introduction and spread into (parts of) the MS where this species is not currently established. Management will reduce negative impacts in priority areas where the species is established. - EPPO A2 list of pests recommended for regulation. - Regulated in ES and PT.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Restrictions on keeping, sale, transport, exchange, breeding and release, as well as management of pathways of unintentional introduction and spread (water sport equipment, contaminated sediment) will be effective in preventing the

	introduction of the species into new areas. Although once established, natural spread through fragments and seeds makes it difficult to contain. - **Early detection and rapid eradication** (Articles 14 - 18): Successful eradication of small infestations is possible, including follow-up until the last plant is removed. - **Management (Articles 19-20)**: Once established, this species is very difficult to control. This reinforces the need for prevention and rapid eradication.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: A trade ban would have a considerable impact on the ornamental trade. The characteristic of freezing in winter makes the species very profitable. According to the sector, there is no alternative for the species. In the UK, sales of Pistia increased significantly in 2018 (+ 500%), following the EU-wide ban on the water hyacinth. According to EPO/OFI, the retail value of Pistia in the EU would be approximately one million euro/year, and thousands of businesses would be involved. This indicates that the impact of a trade ban per business could remain reasonable, except for the most specialised businesses. Prevention of establishment would however prevent significant costs of eradication efforts / long-term management. Early detection and rapid eradication: only feasible in early invasion stage. Management: Very difficult to control, could entail very high costs.
	- **Cost of inaction:** Inaction would lead to further introductions and spread and very significant adverse impacts across parts of Europe. Casual occurrences in AT, BE, CZ, HU, IT, NL, PL, PT, RO, SI, ES indicate that the risk for establishment in new areas in EU is high.
	- **Cost-effectiveness:** Coordinated action will be more cost-effective than a scattered approach (the species is currently regulated in PT, ES).
	- **Socio-economic aspects:** Widely sold as ornamental plant, see above.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in a few locations in the EU, but there is scope for much wider spread.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Prevention of its spread can be relatively cost-effective while its eradication or management once established is challenging/ costly.

Limnoperna fortunei (Golden mussel) – mussel

Species name – common	**Golden mussel**
Species name – scientific	*Limnoperna fortunei*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/87d6bb8a-f9b5-4820-9e96-ee184257fd00/Limnoperna%20fortunei_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/0e05c490-f9ab-4c25-9a73-ce49ee877e15/Limnoperna_fortunei_mgt.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to Southeast China.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- It is not yet established anywhere in the EU. - Under the current climate, *Limnoperna fortunei* is capable of establishing in IT, MT, CY, EL, ES and FR. - In foreseeable climate change conditions, *Limnoperna fortunei* is capable of establishing in all MS (with lower likelihood in northern MS).
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major with medium confidence. *Limnoperna fortunei* is more tolerant to a wide range of conditions than the zebra mussel (e.g. it tolerates very polluted waters) and it has great adaptive and reproductive capacity. Considering the impacts already exerted by the zebra mussel in the invaded European range and the impacts of the golden mussel reported from South America, we can expect similar impacts in Europe on biodiversity and ecosystem services: *Limnoperna fortunei* is a biofouler that forms dense colonies. It has the ability to disturb nutrient cycles through its filtering activity and is associated to a substantial change in macroinvertebrate and macrophyte communities, leading to a general increase in abundance and richness (because it provides food and shelter to other invertebrates), but with a decline in gastropod and molluscs abundance and diversity (habitat and food competition). Increases in cyanobacterial blooms as well as active feeding in zooplankton are reported. It can be the intermediate host of trematodes that can affect fish. Golden mussel can outcompete threatened molluscs and colonise a wide range of habitats, including protected and endangered ones. - **Ecosystem services**: Major with low confidence. The golden mussel could change provisioning and regulating services, particularly water quality (disruption of nutrient cycles through filtering activity and deterioration of water quality). Cyanobacterial blooms could be enhanced, leading to possible problems of toxins in potable water. - **Economy**: Major with low confidence. Being a fouler organism, the costs are expected to be similar to those ones caused by the zebra mussel. Costs include

	awareness campaigns (e.g. check/clean and dry), damages to hydropower plants, clogging of water intakes, and damage to other artificial structures in the water; the contamination of food for markets and also costs of blockage to irrigation systems. - **Human health**: Minor with low confidence. Potential impact is related to toxic cyanobacterial blooms, that could lead to development of toxins in potable water.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	- Concerted action at Union level is required in order to prevent introduction and establishment of the species via its main pathway of introduction, namely as transport stowaway in ballast water and biofouling.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Given its primary pathway, as transport stowaway ship/ ballast water, it is important to target ships still using ballast water tanks (risk of containing larva in ballast water) originating from either South America or South East Asia. Ships originating from there should discharge treated ballast water in open sea before entering European ports, in line with the requirements of the IMO's Ballast Water Convention and its standards. - **Early detection and rapid eradication (Articles 14 - 18)**: Early detection would be essential if eradication is to be successful. - **Management (Articles 19-20)**: Management methods exist to remove fouling and manage populations in localised industrial settings (chemicals, dessication, oxygen deprivation, ozonation, and thermal treatment). Most of these are considered impractical for use in open waters.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost: Prevention**: Compliance with Ballast Water Convention will be effective in preventing the introduction of the species. The cost of managing the ballast water in line with the requirements of the Ballast Water Convention will be borne by the shipping companies but are not specific to this species as BWC is a horizontal measure that will contribute to the prevention of introduction of all species linked with this pathway. Ballast water management systems can cost up to US $5 million/ship with running costs of up to 2-3% of total operational costs for maintenance and management of chemical, filtration units or UV ballast water treatment systems. - **Early detection and eradication**: Freshwater monitoring programmes and other sampling by researchers for plankton and macroinvertebrates can provide early warning of the arrival of the species. Adults occurring in densely packed clusters would also be easily identifiable. Mechanical removal could be used to remove very localised populations; physical and chemical methods have been designed to control the species on man-made structures in industrial facilities and cannot be used for eradication of the species in open waters in the wild. It is possible that one of the methods could be used for rapid response if a population was isolated in a very small part of a waterbody, that could be surrounded by watertight booms, e.g., a docking area, or if a population was found in a very small water body, e.g. a pond. - **Management**: Fouling problems involve an increase in the number of personnel-hours devoted to cleaning and other maintenance procedures. Cost of treatments to achieve management include the cost of the control product and the manpower to carry out the eradication and subsequent clean –up and remediation of the habitat.
	- **Cost of inaction:** Eventually establishment of populations and increased cost of trying to contain their spread and costs linked to their impacts.

	- **Cost-effectiveness:** Encouraging compliance with Ballast Water Convention and rapid reporting of new incursions increases the likely success of rapid response before the species can become established, which is more cost-effective than having to manage established populations in the long-term and the costs related to their impacts. - **Socio-economic aspects:** No socio-economic benefits in the risk assessment area.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established in any EU MS. If it arrived and established in EU, it could be rapidly become difficult to eradicate and would have significant adverse impact.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	

Faxonius rusticus (Rusty crayfish) – crustacean

Species name – common	**Rusty crayfish**
Species name – scientific	*Faxonius rusticus*
Conclusion of the risk assessment	High risk – high confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/2dd52ce7-e814-4b26-a65f-ab2179896c9b/Faxonius_rusticus%20november%202019-FINAL.docx
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/ff04eea2-83a6-4e1e-844a-ca648729f746/Orconectes_rusticus_mgt.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to United States (Ohio river basin).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently not established in EU but it has been recorded in FR. - Capable of establishing under current climate conditions on almost all Member States.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Impact would be major with high confidence. It is one of the most invasive crayfish where it has been introduced outside its native range in US, affecting local biodiversity and ecosystems by its predatory and omnivorous habits (on aquatic plants, macroinvertebrates, fish eggs) and competitiveness. Being an aggressive and omnivorous species, it can cause a decrease in macrophyte cover, macroinvertebrates abundance and diversity, altering the ecosystem function, and most likely also nutrient cycling. Its feeding habit can change trophic interaction. It can also potentially transmit crayfish plague, lethal for native European crayfish. - **Ecosystem services**: Major impacts with high confidence. The species could have a major impact on all waterways in a diverse range of ways. For example, destabilising banks, causing access problems, and impacting flood defences. Mobilisation of sediment could affect water extraction and navigation, while predation on fish would impact on recreational and commercial freshwater fisheries. Furthermore, bathers may be deterred from using waters invaded by the species. - **Economy**: The impact of this species if it established in the risk assessment area would be major with high confidence. Given the species' ability to change ecosystem function, and its potential to establish over much of the EU, it may have a major economic cost. However, it is unclear how this species will interact with other invasive alien crayfish and if their impact would be greater than that of those already present. - **Human health**: The species does not present a human health risk.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to	Concerted action at Union level is required: - in order to prevent introduction and establishment of the species into EU.

prevent their introduction, establishment or spread;	
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Legislation (ban on sale of live specimens) can be very effective method of limiting the risk of introduction, but requires sufficient sustained enforcement. Such measures could be coupled with awareness raising (e.g. to avoid releases in the wild). - **Early detection and rapid eradication (Articles 14 - 18)**: Traps can be used for surveillance and monitoring in the EU, although they are not always efficient at low population density of the species. Using eDNA in such cases is an option. To achieve eradication, mechanical removal is usually coupled with other techniques (e.g. release of males sterilised with x-rays). Drainage of ponds or chemicals may be used in case of confined populations. - **Management (Articles 19-20)**: The methods mentioned above may be used for management, together with baited traps of various designs (mechanical removal) or physical methods such as diversion of rivers/ construction of barriers to contain a population. Biological control relying on native fish has been successfully applied in US in combination with other methods.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: Costs could be kept to a minimum by using existing enforcement processes. - Early detection and eradication: Traps require regular surveillance, which might be costly in the long term. - Management: long-term trapping programmes are necessary to be effective and this leads to a cost linked to manpower and traps.
	- **Cost of inaction:** In the absence of any action, the probability of establishment is considered to be very likely with very high confidence. Given the species' high degree of plasticity, it is likely to be very adaptive and to spread widely through a variety of habitats across the EU. After introduction and establishment, natural spread of the species is likely to occur through individual locomotion and population expansion within contiguous water systems.
	- **Cost-effectiveness:** Prevention remains the best way to deal with the species. Management practices can be effective at the early stage of invasion in a closed system. Once established, trapping during periods where females carry eggs has the greatest impact on the population.
	- **Socio-economic aspects:** In Europe, this species could have a moderate value as an aquarium species (less as food), although not too much due to its rather unappealing coloration compared to other alien crayfish. It could also have the potential to be promoted as a weed control species. There are other crayfish species available that pose no risk, therefore, the ban of live sale of rusty crayfish would have little or no impact.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established but would have significant adverse impact on biodiversity and the economy if it were introduced.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	

Xenopus laevis (African clawed frog) – amphibian

Species name – common	**African clawed frog**
Species name – scientific	*Xenopus laevis*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/d7d4ab02-265a-490a-9608-34e7062d59bd/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/3940810e-2e3c-4188-bcc8-6d505caed027/Annex%206b%20Xenopus%20laevis%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to southern Africa (South Africa, Lesotho, Swaziland, Malawi, Namibia, parts of Botswana, Zimbabwe, parts of Mozambique).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in the risk assessment area in FR, IT, and PT. - Under current climate conditions, *Xenopus laevis* may further establish in ES, SE, DE, NL, EL, IE, BE and DK - in foreseeable climate change conditions, this species could establish in all MS.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate with low confidence. *X. laevis* is as a generalist predator able to modify its diet according to available resources. Zoobenthos and zooplankton are likely to make up the largest contribution to its diet. Impact on other vertebrates may include preying on eggs and adults of native amphibians as well as of native fish. Evidence exists of the negative impact on local populations of amphibians, fish, and invertebrates. Benthic preys may include water snails. Species richness of native amphibians and a decline in in their reproduction was negatively related to the abundance of *X. laevis.* The most serious impact usually attributed to *X. laevis* is related to its potential role in the introduction and spread of the chytrid fungus, *Batrachochytrium dendrobatidis* (Bd), the cause of amphibian deaths and population declines in several parts of the world, to which *X. laevis* appears to be resistant. However, to date there is no evidence that *X. laevis* has functioned in this role of Bd vector or has caused impact on native amphibians through this mechanism. Moreover, parasites from its native range have been detected on Xenopus in the risk assessment area so it can't be ruled out these alien parasites could colonise new amphibian hosts in Europe. - **Ecosystem services**: Moderate with low confidence. *X. laevis* has been reported to negatively affect invaded ecosystems. Some impacts on provisioning (biomass: reared aquatic animals) and regulation and maintenance (regulation of physical, chemical, biological conditions: lifecycle maintenance, habitat and gene pool protection, pest and disease control, water conditions. Particular problematic could be its functioning as a pathogen vector and increasing water turbidity and nutrient release

	caused by its disturbing the sediment. - **Economy**: Minimal impact with low confidence. Due to increased predation and/or competition for food, *X. laevis* is known to interfere with aquaculture (e.g. farmed fish larvae, juvenile carp, freshwater prawn in aquaculture ponds), leading to possible economic loss. - **Human health**: The species is not known to have impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent new intentional or unintentional introductions/escapes into the wild in additional MS and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: In Europe, the occurrence of *X. laevis* in the wild is thought to be a consequence of its use as a research model in laboratories and as a pet. Adoption and enforcement of appropriate legislation and codes of best practice targeted to commercial and non-commercial owners in Europe to reduce the risks posed by these pathways should reduce the probability of further introductions. Raising awareness of the problems posed by the presence of this species in the wild should reduce the risk of further escapes or releases. - **Early detection and rapid eradication (Articles 14 - 18)**: The rapid reporting of new occurrences is necessary for a rapid response before the species can be established in new locations. A combination of methods, including traps, fyke-nets, hand-dipping and electro-fishing are favoured for rapid eradication. For a limited range of sites, pond-draining, destruction or the addition of salt to the waterbody may be appropriate. Small eradication campaigns have been carried out successfully, but these have only been possible in small areas and at an early stage of invasion. Chances of success are strongly influenced by the characteristics of the waterbodies affected (e.g. type, size, and overall network). - **Management (Articles 19-20)**: See above. In addition, fencing is already used to limit the movements and dispersal of amphibians and may play a role in limiting dispersal or protecting sites in specific circumstances.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Estimations of implementation costs are not available. Costs are associated with carrying out surveys and eradication/management measures. Additionally, inclusion of *X. laevis* on the list would result in loss of income due to ban of trade for the pet sector. Furthermore, continuation of research activities based on this species would require that hundreds of laboratories across EU are given a permit under Article 8 of the IAS Regulation. Both competent authorities and such laboratories would bear the related costs.
	- **Cost of inaction:** Given a very high likelihood of entry due to its presence in trade and in breeding facilities (in laboratories and as pets), a very high likelihood of establishment in the risk assessment area, and moderate natural spread once established, managing and eradicating the species could quickly become challenging in the case of inaction and related negative impacts inevitable.
	- **Cost-effectiveness:** Given the considerable potential for further spread of the species in EU, it is still considered cost-effective to include it on the Union list with a view to avoid increased impacts and management and damage costs that would result from further spread.

	- **Socio-economic aspects:** The species is very important as a biological model for research (endocrinology, developmental biology, and reproduction, including anatomical studies). It is also traded as a pet in some MS. Individual animals are sold for values between 1 euro to 11,30 euros depending on the MS.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in the EU, but there is scope for much wider spread.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it is proven to have moderate impacts on biodiversity and can have impacts on aquaculture.

Ameiurus melas (Black bullhead) – fish

Species name – common	**Black bullhead**
Species name – scientific	*Ameiurus melas*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/824e7fba-8de4-43c2-8f24-8cc0f87526d7/Ameiurus_melas_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/a9fd73c2-4424-46b3-ba06-21974acbdbd1/2b.%20Ameiurus%20melas%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the Great Lakes, Hudson Bay, and Missisippi River bain in most of the eastern and central United States and adjacent southern Canada and northern Mexico, south to the Gulf Coast.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in AT, BG, HR, CZ, FR, DE, HU, IT, PL, PT, RO, SK, SI, ES, NL. - In foreseeable climate change conditions, *Ameiurus melas* could probably establish in all EU MS.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with medium confidence. *A. melas* is an omnivorous bottom forager that feeds heavily on molluscs, so the species can pose a threat to endangered mollusc species. It has also been found to prey on native fish and frogs species, indicating impacts on a wide range of potential prey species as well as impacts through competition. Taking into account its voracity and aggressive behaviour, it might be reducing the amount of prey available to native predators. In areas of the EU characterised by elevated endemism, predation on endemics poses a considerable threat to biodiversity. Another indirect impact of *A. melas* on biodiversity can be through the generation of turbidity, which can reduce the feeding efficiency of visual-feeding native species. - **Ecosystem services and Economy**: Minor with low confidence. Overall absence of information on economic losses associated with *A. melas*. There is potential for a reduction in the perceived social and economic value of waters infested by *A. melas*. Introductions may hinder local commercial and sport fisheries through competition with target species. *A. melas* may also 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 away not only the money from recreational fishing but tourism (food, accommodation and transportation), all of which may provide economic opportunities locally. Other potential impacts include the transmission of fish diseases to some fish species native to the EU. - **Human health**: It can pose a public health risk, if eaten, due to their accumulation of contaminants when inhabiting polluted water. *A. melas* can cause a painful sting if pectoral spines puncture human flesh due to the small amounts of venom at the ends of the spines, which can cause pain for up to a week.
4.3 (d) demonstrated by a risk	Concerted action at Union level is required:

assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	- in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Given its pathways of entry – release in nature and escape from confinement (aquaculture/ aquarium species), for instance, because of flooding events, listing this species should help in preventing its breeding in captivity and related escapes or intentional releases, although its reputation as a nuisance species, including amongst anglers, makes it already less likely to be intentionally released for angling nowadays. The adoption and enforcement of appropriate legislation and codes of best practice could reduce the likelihood of introduction, in particular by limiting the risk of intentional spread of *A. melas* by anglers between and within Member States. - **Early detection and rapid eradication (Articles 14 - 18)**: Early detection of the species in newly infested sites is very hard due to the areas this species inhabits and their benthic, hidden life. The use of eDNA is a new promising tool here. Additional reporting from recreational fishermen of new findings of this fish would benefit the targeted monitoring for *A. melas*. Since establishment is very likely and suitable habitat for the species is widespread across the EU, early detection of any new population is critical as it is virtually impossible to eradicate *A. melas* once established in a water course. In small, closed waters (e.g. small lakes or ponds), eradication may be possible by chemical means (e.g. rotenone, though its use would not be acceptable in several EU countries) or by draining down of the water body. - **Management (Articles 19-20)**: *A. melas* can be killed by rotenone or other piscicides. However, it would be difficult (if not impossible) to make an effective eradication in large rivers. Mechanical removal using fyke nets, electrofishing and other fishing gear may be successful to manage ictalurid catfish populations in small confined areas. Targeted angling on this species can also be a part of the removal exercise.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - **Prevention**: Costs would mostly concern implementation of campaigns to increase awareness. Such campaigns typically cover more than one non-native (invasive) species thus spreading the costs per species. - **Early detection and eradication**: The costs would concern dedicated surveillance and monitoring and subsequent removal of the species. - **Management**: *Ameiurus melas* is difficult and costly to control. Investing in electrofishing equipment and fyke nets is needed. Additionally, gill nets and seine nets can be used. Prices of electrofishing gear are estimated to range from €750 to €4,000 and more; fyke nets are between €500 and €1,500, while gill nets are cheaper, but different mesh sizes need to be applied and high mortalities to non-target fishes may occur. The biggest costs are for operating these fishing gears and are an important extra cost to consider, as they are very labour intensive.
	- **Cost of inaction:** Likely establishment of new populations and related negative impacts.
	- **Cost-effectiveness:** The most cost-effective way of preventing new intentional introductions is to raise public awareness of the problems associated with the establishment of *A. melas.*
	- **Socio-economic aspects:** *A. melas* is not important in European aquaculture, but it could be still farmed in some countries. Production of *A. melas* from aquaculture in Europe (only reported in 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. - *A. melas* has also some marginal interest for sport fishing.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is already established in several MS.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	*A. melas* is established in the EU, but populations are often still relatively localised and intentional and accidental releases into open waters and translocations from existing populations continue to pose a risk for further spread and establishment across the EU.

Ameiurus nebulosus (Brown bullhead) – fish

Species name – common	**Brown bullhead**
Species name – scientific	*Ameiurus nebulosus*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/fbf4a56c-df05-4cdd-923f-58bca08620c5/Ameiurus_nebulosus_final_20201117.docx.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/45271606-c5d2-4302-a67b-95a214d95eee/3b.%20Ameiurus%20nebulosus%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America: Atlantic and Gulf Slope drainages in the Canadian provinces of Nova Scotia and New Brunswick to Mobile Bay, Alabama, USA, and from the St Lawrence River/Great Lakes, Hudson Bay and Mississippi River basins from Quebec west to Saskatchewan in Canada and south to Louisiana, USA.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in AT, BE, BG, HR, CZ, FI, DE, EL, HU, IT, PL, RO, SK, SI, NL. - In current and foreseeable climate change conditions, *Ameiurus nebulosus* could establish in all Member States.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with low confidence. *Ameiurus nebulosus* introductions may lead to changes in aquatic communities through their use of resources (food or space), with competition possible. It is a scavenger species as well as predacious, eating benthic organisms that occur within freshwaters: waste, molluscs, immature insects, terrestrial insects, leeches, crustaceans, worms, algae, plant material, fishes and fish eggs. This omnivorous fish species can form very dense populations and is able to dominate freshwater fish communities. Diet of large-sized *A. nebulosus* has been found to consist almost exclusively of juvenile fishes. Impacts recorded outside the risk assessment area are altered trophic flows, damaged ecosystem services, ecosystem change/habitat alteration, and modification of natural benthic communities, negative impacts on aquaculture/fisheries, reduced native, biodiversity, threat to or loss of endangered native species. However, there have been few studies providing evidence of negative impacts of the species in its introduced European range. - **Ecosystem services and Economy**: Minimal/ minor with low certainty. 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), but scientific studies of the impacts on ecosystem services (e.g. decline in use of water bodies due to invasive fish presence) are lacking. - **Human health**: Minimal impact with medium confidence. A painful wound can be inflicted by the sharp spines in the fins of A. nebulosus if they are not handled carefully. Toxins released by the fish contribute to the pain of the wound. In some waters, *A. nebulosus* have been found to contain elevated levels of contaminants, which could pose a problem in cases where this species is taken from contaminated waters and used as food.

4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent further releases in MS where it is already established as well as in MS where there are no established populations yet but where the species could establish.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Unauthorised introduction by anglers is estimated to be the main origin for new within- and between-member states introductions and spread. The adoption and enforcement of appropriate legislation and codes of best practice could reduce the likelihood of introduction. - **Early detection and rapid eradication (Articles 14 - 18)**: Early detection of the species in new infested sites is very hard due to the areas this species inhabits and their benthic, hidden life. The use of eDNA is a new promising tool here. Additional reporting from recreational fishermen of new findings of this fish would facilitate the targeted monitoring for *A. nebulosus*. Rapid eradication of the species is dependent on where and at what stage it is found. The potential to eradicate or control *A. nebulosus* populations depends on dispersal location and the level of establishment. In small enclosed water bodies, piscicides (rotenone) could be effective in eradicating population. However, using rotenone would not be acceptable in several EU countries. - **Management (Articles 19-20)**: Mechanical removal using fyke nets, electrofishing and other fishing gear may be successful in managing populations in small confined areas. Targeted angling can also be a part of the removal exercise of this species.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** - **Prevention**: Costs would mostly concern implementation of campaigns to increase awareness. Such campaigns would cover several species and costs would be spread. - **Early detection and eradication**: The costs would concern dedicated surveillance and monitoring and subsequent removal. **Management:** Management would be costly and difficult. Prices of electrofishing gear are estimated to range from €750 to €4,000 and more; fyke nets are between €500 and €1,500, while gill nets are cheaper, but different mesh sizes need to be applied and high mortalities to non-target fishes may occur. The biggest costs are for operating these fishing gears and are an important extra cost to consider, as they are very labour intensive.
	- **Cost of inaction:** Since this species is very adaptable, new entries into the wild are likely and would result in above mentioned impacts and challenges in eradicating or managing it.
	- **Cost-effectiveness:** The most cost-effective way of preventing intentional introductions in new locations is to raise public awareness of the problems associated with the establishment of *A. nebulosus*.
	- **Socio-economic aspects:** *A. nebulosus* is used in aquaculture in Italy but no indication of volume or value is provided. Economic benefits from *A. nebulosus* in aquaculture in the risk assessment area occur in Bulgaria - although the magnitude of these benefits remains uncertain – and Croatia and Romania (where it was reported by Eurostat (2018) to have decreased slightly from 5.8 tonnes live weight in 2008 to 4.03 in 2012). - There is also a marginal interest for *Ameiurus nebulosus* in sport fishing but it is now generally regarded as a nuisance species by anglers.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of	The species is established in the EU, but there is scope for wider spread.

invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	*Ameiurus nebulosus* is established in several MS, but populations are localised and in decline in some, and absent in other MS where it could establish. Therefore, listing the species could still contribute to reducing its spread through intentional releases and introduction to additional MS. Introductions, authorised or not, of *A. nebulosus* by anglers have occurred within and between EU MS in the past and are likely to continue despite declining interest in the species.

Channa argus (Northern snakehead) – fish

Species name – common	**Northern snakehead**
Species name – scientific	*Channa argus*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/2746a496-554a-4dd0-8bca-084177f1cdc0/Channa_argus_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/e7c88420-de52-43dd-8ed5-f4481872f3f8/1b.%20Channa%20argus%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to China, (South) Korea and Russia (i.e. more specifically Asia in the Amur southward to XI Jiang and Hainan Island, China).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Species not currently present in the risk assessment area. - In current climate conditions, *Channa argus* is capable of establishing in AT, BE, BG, HR, CY, CZ, DK, EE, FR, DE, EL, IE, IT, LV, LT, LU, MT, NL, PT, PT, RO, SK, SI, ES. - In foreseeable climate change conditions it could additionally establish in FI and SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with medium confidence. If *C. argus* were to be introduced to the risk assessment area and released or escaped to the environment, it would likely exert adverse impact on biodiversity, especially in small water bodies of naturally low species diversity. This is especially true of ponds, which are known to support disproportionately high aquatic biodiversity. *C. argus* is known to be highly predatory and can negatively affect in particular a variety of fish species (adult northern snakehead are highly piscivorous) but also crayfishes, dragonfly larvae, beetles, and frogs, amphibians and crustaceans. The presence of *C. argus* is likely to have a massive impact on the conservation status of both lakes and rivers, especially those containing endemic aquatic species. Even the introduction of a small number (<5) of *C. argus* specimens into an isolated spring habitat could result in extinction through predation of endemic spring-adapted fishes or crustaceans. Beyond predation, impacts through competition for food resources are also considered high. - **Ecosystem services**: Minimal impact with low confidence. *C. argus* poses a potential threat to aquatic ecosystem services associated with fisheries and aquaculture through the reduction of fish or crustacean stocks. Municipalities which rely on tourism from recreational fishing may suffer losses should northern snakeheads invaded their waters. - **Economy**: Moderate impact with low confidence. This species would present a potential economic threat to wild fish stocks and to fish culture interests, especially if this species enters culture facilities from adjacent waters. - **Human health**: Minor with low confidence – the potential risks to social/ human health appear limited, on the basis of current knowledge.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to	Concerted action at Union level is required: - *Channa argus* is available for sale on the internet and, although not very popular with aquarists or as live food, could still be imported. - Listing is meant to prevent its introduction and illegal release or dumping in the

prevent their introduction, establishment or spread;	environment and related risk of establishment of populations in suitable habitats, which are found throughout most of the risk assessment area.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Legislation (prohibition on the import, keeping and trade of *Channa argus*) is a key for prevention. Also important are public awareness raising as well as training of administration and staff to enforce the regulations. - **Early detection and rapid eradication (Articles 14 - 18)**: Reporting from recreational fishermen and commercial fishing vessels of new findings of this fish would benefit the targeted monitoring for the species. In small enclosed water bodies, the use of drain-down, mechanical removal (e.g. using traps, nets or electrofishing), and piscicides (rotenone) may be effective in eradicating populations, with the level of difficulty (or impossibility) of eradication increasing with the size, complexity and conservation value of the water body. However, the use of rotenone would not be acceptable in several EU countries. - **Management (Articles 19-20)**: Where eradication is impossible, mechanical removal, e.g. by electrofishing and use of other fishing gear, may be successful to contain and manage invasive fish populations. Targeted angling for the species can also be used as part of the removal and/or control exercise.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - **Prevention**: Costs would mostly concern implementation of campaigns to increase awareness. These would cover several species and costs would be spread amongst these. - **Early detection and eradication**: river surveys would be a continuous way of early detection. However, this can be a very expensive measure and it is not guaranteed to detect the species. A potentially cost-effective means of enhancing the detection of undesirable, prohibited non-native species is the use of environmental DNA (eDNA) approaches. - **Management**: Mechanical removal may be the only way to treat a system where chemical piscicides cannot be applied. Angling and increased fishing effort by amateurs could also be part of the overfishing effort.
	- **Cost of inaction:** it is moderately likely that *C. argus* will, at some point, be released, or will escape into the environment if imports into the risk assessment area continue. This could result in establishment, costly management and major impacts on biodiversity in particular.
	- **Cost-effectiveness:** it is widely accepted that prevention is more cost effective than management of the entry or establishment of such a species group.
	- **Socio-economic aspects:** There are no economic data available for northern snakehead in the aquarium trade, but the trade value is probably very low.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	If this species were to find its way in the wild within EU, then it would likely establish, spread and exert major impacts.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Not yet established.

Gambusia affinis (Western mosquitofish) – fish

Species name – common	**Western mosquitofish**
Species name – scientific	*Gambusia affinis*
Conclusion of the risk assessment	High risk – low confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/2d64f731-8c99-4a4c-91db-5f2d86b8f633/Gambusia_affinis_final_20201117.docx.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/9f289d64-d0d0-473d-b6c6-040b0cdc3ab1/Gambusia_mgt.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (USA and Mexico).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in IT. - Under current and foreseeable climate change conditions, *Gambusia affinis* is capable of establishing in AT, BE, BG, HR, CY, CZ, DK, FR, DE, EL, HU, IE, IT, LU, NL, PL, PT, RO, SK, SI, ES.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate impact with low confidence. Due to its very limited distribution (very locally in IT), evidence on the potential impacts of *G. affinis* is derived from other regions where it is established, as well as from the impacts of its close congener *G. holbrooki* which is already widely spread in EU. In the event of wider dispersal of *G. affinis* within the EU, it is likely that endemic fishes would be put at risk, thus potentially leading to reduced native biodiversity and even resulting in species extinction. - **Ecosystem services**: Moderate impact with medium confidence. *G. affinis* is likely to contribute to eutrophication processes in waters it invades. *G. affinis* prefers warmer waters, where eutrophication processes are also favoured. Such impacts are likely to be exacerbated in the future if water temperature rises. - **Economy**: Based on cost estimates in the USA, it is expected that establishment of *G. affinis* would result in major costs (in the range of 3 million EUR per year if 5% of suitable European and coastal waters were invaded) for control and restoration. - **Human health**: Moderate with low confidence. A potential adverse impact for human health of *G. affinis* appears to be that their presence favours bilharziasis (Schistosomiasis) vectors, the latter being parasitic blood flukes (trematodes) that have free-swimming larvae that penetrate the skin of persons swimming or wading in the water. Probably the most apparent adverse impact of *G. affinis* to human health and safety would be its role in contributing to eutrophication, i.e. poor water quality, which favours the development of water-borne diseases.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to tackle pathways such as pet/ aquarium trade and deliberate introductions for biological control, thus preventing further introductions and releases into the environment in the risk assessment area, which would highly likely result in the establishment of new populations.

4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: The adoption and enforcement of appropriate legislation and codes of best practice to reduce the risks posed by pet/aquarium trade and deliberate introduction for biological control should reduce the probability of further introductions. A prohibition on the keeping (as an aquarium fish), release (for mosquito control) and use of the species as live bait should be enforced. - **Early detection and rapid eradication (Articles 14 - 18)**: Electrofishing and fyke-netting are commonly used to monitor fish populations in rivers, canals and lakes. However, seine nets, traps and dip nets are more efficient in catching *Gambusia* and should therefore be used in addition. Post-eradication detection methods should normally combine both conventional and molecular techniques such as environmental DNA. The following methods may be suitable for depletion sampling and removal of fishes in the EU: electrofishing, seine nets, minnow traps, and fyke nets. The likelihood of successful eradication, however, is low, except in in ponds and small streams. An eradication strategy could consist of a combination of the drainage of ponds with *Gambusia* presence, possibly accompanied by lime treatment, and introduction of native predator species. The use of rotenone would not be acceptable in several EU countries and derogations of existing legislation to get permission to use rotenone would be difficult to obtain. - **Management (Articles 19-20)**: see above.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** - **Prevention**: Costs would be associated with implementing restrictions and raising public awareness of the risks posed by Gambusia. - **Early detection and eradication**: Costs would be associated with carrying out surveys and procurement of necessary material (nets etc.). Eradication in small ponds by depletion/drainage together with removal and temporary keeping of native species in containers could be in the range of EUR 20,000 per ha of water surface in small-medium sized ponds (based on published costs in UK) but would vary considerable depending on local conditions and size of water body. - **Management**: See above.
	- **Cost of inaction:** The establishment risk is 'very likely', and confidence is high, so inaction would sooner or later result in further releases and establishment of populations in additional MS with related negative impacts.
	- **Cost-effectiveness:** Given the species' limited socio-economic benefits, there is a strong case for prevention, especially since eradication once established would prove challenging and costly, if not impossible.
	- **Socio-economic aspects:** The species is available for sale in EU, most likely for release as biological control of mosquitos as it can feed on mosquito larvae and perhaps also as aquarium species or live food for carnivorous aquarium fishes. Globally, the species has been introduced widely as mosquito-control agent. However the benefits of mosquito control by *Gambusia* are negligible or at least comparable to those of native species and largely outweighed by its potential impacts on biodiversity. Its potential benefits are probably limited to a few locations where mosquito larvae are the main (or only) food available to the species and where native fishes or amphibians are not affected. Furthermore, its benefits for recreational fishing are marginal.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or	The species is currently only established in one location in the EU, so listing could contribute effectively to preventing its further spread and new introduction in other MS.

are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has significant adverse impact.

Gambusia holbrooki (Eastern mosquitofish) – fish

Species name – common	**Eastern mosquitofish**
Species name – scientific	*Gambusia holbrooki*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/c7e8f925-25b5-48f2-a04d-063592a6b617/Gambusia_holbrooki_final_20201117.docx.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/9f289d64-d0d0-473d-b6c6-040b0cdc3ab1/Gambusia_mgt.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (parts of the USA and Mexico).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in the risk assessment area in HR, CY, FR, EL, HU, IT, PT, ES, RO and SI. - Under foreseeable climate change conditions, *Gambusia holbrooki* is capable of additionally establishing in AT, BE, BG, CZ, DK, DE, IE, LU, NL, PL and SK.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with high confidence. Evidence of adverse impacts on biodiversity and ecosystem services is available for various locations in the world where *G. holbrooki* has been introduced. The aggressive and predatory behaviour of mosquitofish is considered to have adverse impacts on populations of small fish through predation and competition. In the Mediterranean biogeographic region, endangered small endemic fish are at risk of localised extinction due to *G. holbrooki* introductions/ presence. - **Ecosystem services**: Major impact with medium confidence. *G. holbrooki* has also been found to reduce rotifer, crustacean and insect populations, permitting the extraordinary development of phytoplankton blooms. Other impacts include increased turbidity, dissolved organic phosphorus and temperature, decreased dissolved inorganic phosphorus, and inhibition of *Spirogyra*. - **Economy**: Major with medium confidence. Although some control and restoration measures have been undertaken at least in the Iberian Peninsula, no published information on costs was found. Nevertheless, on the basis of information from USA, costs of damage and management are estimated to be substantial. - **Human health**: A potential adverse impact for human health of G. holbrooki appears to be that their presence favours bilharziasis (Schistosomiasis) vectors, the latter being parasitic blood flukes (trematodes) that have free-swimming larvae that penetrate the skin of persons swimming or wading in the water. Probably the most apparent adverse impact of G. holbrooki to human health and safety would be its role in contributing to eutrophication, i.e. poor water quality, which favours the development of water-borne disease.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted	Concerted action at Union level is required: - in order to prevent introductions (intentional and unintentional releases) and (natural) spread into the MS where this species is not currently established and

action at Union level is required to prevent their introduction, establishment or spread;	prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: To prevent further spread and new introductions, a prohibition on the keeping (as an aquarium fish), release (for mosquito control) and use of the species as live bait should be enforced. Stringent procedures should be put in place to check imported and within-EU consignments of fish intended for stocking. The adoption and enforcement of appropriate legislation and codes of best practice to reduce the risks posed by the pathways of introduction (pet/aquarium trade and introduction for biological control) should reduce the probability of further introductions. - **Early detection and rapid eradication (Articles 14 - 18)**: Methods for surveillance and monitoring may include electrofishing and fyke-netting however, seine nets, traps and dip nets are more efficient in catching *Gambusia* and should therefore be used in addition. Effective eradication is most likely to be achieved when new invasions are quickly reported. For small water bodies it could be achieved adopting an eradication strategy consisting of a combination of the drainage of ponds with *Gambusia* presence, possibly accompanied by lime treatment, and stocking water bodies with **native** predatory fish. - **Management (Articles 19-20)**. The following methods may be suitable for depletion sampling and removal of fishes in the EU: electrofishing, seine nets, minnow traps, and fyke nets. A piscicide can be used to kill newly-detected populations in smaller areas such as ponds, drainable larger water bodies (e.g. reservoirs), or small water courses but the use of rotenone would not be acceptable in several EU-countries and derogations of existing legislation to get permission to use rotenone would be difficult to obtain (since it kills all fish species and is also harmful to amphibians and aquatic invertebrates).
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - **Prevention**: Costs would be associated with implementing restrictions and raising public awareness of the risks posed by Gambusia - e.g. for outreach and production of leaflets. - **Early detection and eradication**: Costs would be associated with carrying out surveys and procurement of necessary material (nets etc.). Eradication in small ponds by depletion/drainage together with removal and temporary keeping of native species in containers could be in the range of EUR 20,000 per ha of water surface in small-medium sized ponds (based on published costs in UK) but would vary considerable depending on local conditions and size of water body. - **Management**: See above.
	- **Cost of inaction:** establishment risk is 'very likely', and confidence is high.
	- **Cost-effectiveness:** Small ponds are biodiversity hot spots, containing proportionally more species than rivers and lakes. So, a small investment (to manage the species in a small pond will have disproportionately higher positive impact for native biodiversity.
	- **Socio-economic aspects:** Although widely introduced as mosquito-control agents, reviews of such introductions suggests that these have not generated additional economic benefits, which other native fish were not already able to deliver. Overall, available literature worldwide on mosquito control reveal limited if any evidence that *G. holbrooki* is effective in reducing mosquito population densities or in reducing the incidence of mosquito-borne diseases. Potential benefits to society are probably limited to a few locations where mosquito larvae are the main (or only) food available to *G. holbrooki* and native fishes or amphibians are not affected.
4.6 The Union list shall include as a priority those invasive alien species	N/A.

that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The species is already established in the EU, but there is scope for new introductions and intentional and unintentional releases and wider spread. Where the species is established, it has the most significant adverse impact, in particular on biodiversity and ecosystems.

Brakish

Fundulus heteroclitus (Mumichog) – fish

Species name – common	**Mumichog**
Species name – scientific	*Fundulus heteroclitus*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/75c9c56e-2858-429f-8d7b-f1af443255f0/Fundulus%20heteroclitus%20november%202019-FINAL.doc
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/5b2106e1-3a7e-4d60-9723-8e2d2940694b/Annex%207b%20Fundulus%20heteroclitus%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America / Western Atlantic region: from Gulf of St. Lawrence (Canada) to northeast Florida, USA.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in PT and ES. - Capable of establishing under current (and also foreseeable climate change) conditions in BE, BG, DE, HR, CY, DK, FR, EL, IT, IE, MT, NL, PL, RO, SI, UK and possibly also EE, FI, LV, LT and SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** major impact with medium confidence. *F. heteroclitus* poses a potential threat by competition and/or predation of the endemic species, and may act synergistically with habitat destruction, resulting in a more profound negative impact. It seems to already impact endemic, endangered Iberian cyprinodontiforms. If introduced to other Mediterranean areas, it is likely to impact other endemic fauna. - **Ecosystem services**: Minor impact with medium confidence. The impact of mummichog on ecosystem services is caused by possible changes to the food web due to resource competition, predations, or spread of disease. This can possibly lead to diminishing of the provisioning of native species for fisheries and quality of nursery habitats. - **Economy**: Moderate impacts with low confidence: It could affect coastal areas where there are fisheries or aquaculture by changing ecosystem structure and functioning. - **Human health**: The species has no known impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU: A hardy species that tolerates a range of temperatures and salinities it is very likely to establish in most coastal areas of the EU, if introduced.
4.3 (e) likely that the inclusion on	- **Prevention (Article 7)**: In light of the multiple pathways of introduction

the Union list will effectively prevent, minimise or mitigate their adverse impact.	(including escape from confinement e.g. aquarium, research and ex-situ breeding) listing this species could help raise awareness of specific target audiences and reduce the risk of introduction. - **Early detection and rapid eradication (Articles 14 - 18)**: Monitoring of suitable habitats to allow for early detection is essential to avoid establishment and reproduction in the open habitats typical of this species, as it could easily form large populations before being detected and eradication would be impossible with current technologies. If only a few individuals arrived, particularly in winter when the species is not reproducing, containment and eradication might still be possible and would likely have to rely on using rotenone or nets to prevent spread and draining in the case of an isolated water body. However, the use of rotenone would not be acceptable in several EU countries. - **Management (Articles 19-20)**: If established in an area of a Member State, the methods mentioned above, mainly improving awareness, managing pathways and methods for eradication, would also be useful to support population control and reducing further spread. However, eradication might prove difficult: while rotenone has previously been used with some effect it is costly and probably often not feasible in the open habitats typical of this species.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** Prevention costs would be associated with enforcing restrictions for the pet/aquarium trade and preventing deliberate introductions. As it is reported in use by laboratories for research, these as well as competent authorities would have to bear administrative costs for permits under Article 8. - **Early detection and eradication**: Costs would be associated with monitoring the habitats suitable for its establishment and would depend on a number of factors (spatial and temporal extent, method, country, etc.). - **Management:** If established, there would be recurrent and probably high management costs.
	- **Cost of inaction:** Uncontrollable widespread establishment threatening other species occupying similar habitats and recurrent and probably high management costs.
	- **Cost-effectiveness:** Preventive action appears both needed in light of the pathways, reasonably inexpensive and way more effective than available eradication or management measures.
	- **Socio-economic aspects:** The main economic benefits would appear to reside in the fact that *F. heteroclitus* is a model species used extensive in experimental research, including in European laboratories. *F. heteroclitus* seems not present in the trade and rarely used by aquarium hobbyists.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in the EU but only in a limited number of places in ES and PT. There is scope for a much wider spread across Europe's benthic muddy saltmarsh environments found near major estuaries or lagoons areas in almost all MS with a coastline.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has proven a threat by competition and/or predation of the endemic species occupying very similar habitats.

Morone americana (White perch) – fish

Species name – common	**White perch**
Species name – scientific	*Morone americana*
Conclusion of the risk assessment	Moderate risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/0e31b42e-dc32-458d-b87b-04c209dc87e2/Morone_americana%202019-final.docx
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/2a664a9c-2919-4584-a38c-569f1d72f480/Annex%208b%20Morone%20americana%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to North America (Canada, USA), Atlantic (Northwest, Western Central).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- The species has not yet been recorded in the risk assessment area and is not established in any EU Member State. - Capable of establishing in the future in all EU MS under current and foreseeable climate change.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Impact would be moderate, with low level of confidence. Evidence from places it has been introduced to in the USA and Canada suggests that this species predates on fish eggs, adversely impacting on the recruitment of the predated fish population. However, it is unknown whether this predation on native fish eggs has exerted an adverse effect on biodiversity. Potentially, there is also a risk of infectious agents being introduced. - **Ecosystem services**: Minor impact with low confidence. *M. americana* is known to predate on the eggs of native fishes and to have the ability to outcompete other species for food. These pressures could have an indirect, i.e. minor, impact on cultural services. - **Economy**: minor impact with medium confidence. The possible negative impact of *Morone americana* is caused by predation on and competition with native species, which may include recreationally or commercially important species. - **Human health**: the species is not known to have impacts on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: in order to prevent introduction of the species into the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Enforcement of the existing legislation (2007 Regulation on the use of alien species in aquaculture, in combination with IAS Regulation if the species were to be listed) would effectively reduce the likelihood of entry via the existing vectors and pathways identified in the risk assessment. Furthermore, implementation of ballast water

	management systems is required to reduce the risk of introduction. - **Early detection and rapid eradication (Articles 14 - 18)**: A readily identifiable species. The only viable early detection way would be reporting of the fish from recreational fisherman and commercial fishing vessels. If discovered in a river system, then eradication measures may be applicable. Eradication methods include the use of a piscicide (e.g. rotenone, in smaller areas/ ponds) and alternative methods such as intensive netting and/or electrofishing, followed by euthanasia of the captured fish. However, the use of rotenone would not be acceptable in several EU countries. - **Management (Articles 19-20)**: Raise awareness amongst commercial and recreational fishers should species become established in risk assessment area to prevent spread or transportation. Introduction of predatory fish coupled with targeted fishing efforts (angling, fyke nets or seine netting) could also be employed to keep it restricted to a certain area.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** **Prevention**: Costs would be associated with the enforcement of the existing legislation to manage pathways of introduction in combination with awareness raising campaigns to avoid illegal introductions. **Early detection and eradication**: Estimates of costs of dedicated surveillance and monitoring and subsequent removal of this non-native fish species from the risk assessment area are likely to be moderately high. Cost implications of rapid eradication through netting could be significant, as the amount of labour and time required to carry it out this process increases with the increasing size of the water course or water body. In a small water body in which rotenone is an option estimates of costs of application could be low-to-medium depending on area to be treated. However, the use of rotenone would not be acceptable in several EU countries. **Management**: If the species established, depending on the area that has to be managed, the management costs could be significant.
	- **Cost of inaction:** Relatively uncertain as currently the likelihood of its introduction is low, but following introduction it would be able to establish and have adverse impacts.
	- **Cost-effectiveness:** The most cost-effective way of preventing the introduction of white perch *Morone americana* is enforcement of the existing legislation (including 2007 Regulation on the use of Aliens in aquaculture). This would effectively reduce the likelihood of entry via the existing vectors and pathways identified in the risk assessment (RA). Since prevention measures could to a large extent rely on existing legislation and obligations, it can be expected to outweigh by far the (ecological) costs associated with the potential establishment of the species.
	- **Socio-economic aspects:** Although *M. americana* is used as a food source for humans and is considered to be a popular sport fish throughout the native range, this is currently not the case in the EU.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established in the EU, but if it were introduced, it could establish and have adverse impacts across the EU.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union	The species is not yet established in the risk assessment area.

and have the most significant adverse impact.	

Marine

Rugulopteryx okamurae – algae

Species name – common	**Rugulopteryx okamurae**
Species name – scientific	*Rugulopteryx okamurae*
Conclusion of the risk assessment	High risk – high confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/3ea80df2-56d7-4c1f-80f7-ee8d3e91bb8a/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/b0fd7304-3e39-47be-a59c-bba2efd51c9d/details
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the warm and temperate North-western Pacific Ocean, of Korea, Japan, China, Taiwan and Philippines.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in ES and FR. - In current and foreseeable climate change conditions, *Rugulopteryx okamurae* could also establish in PT, IT, EL, HR, SI, CY and MT.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with medium confidence. *Rugulopteryx okamurae* exhibits an extraordinary competitive and colonisation capacity, resulting in rapid transformation of the benthic ecosystem, altering the structure of communities and affecting habitats such as kelp forests (including protected areas in the Natura 2000 Network) and resulting in loss of biodiversity by causing the physical displacement of the rest of the species due to the occupation of the substrate and preventing the fixation of larvae or propagules of other species. More specifically, in Southern Spain it has led to habitat modification due to rapid colonisation and monopolisation of marine ecosystems (affected communities include kelp forests eulittoral and infralittoral communities of seaweeds and epiphytic fauna of invertebrates) and accumulation of detached biomass. Regarding wildlife, numerous invertebrates, especially those of sessile life, are being affected by the development of *R. okamurae*, such as holothuria, shellfish crustaceans, sponges, the sea urchin *Sphaerechinus granularis*. - **Ecosystem services**: Major with medium confidence. Likely to result in losses in important ecosystem services, like refuge and breed habitat for fishes and invertebrates, among others. Recreational value and social services linked to touristic activities in a touristic hotspot in Europe have also been affected.

	- **Economy**: Massive impacts with high confidence. Establishment of *Rugulopteryx okamurae* results in significant economic losses because of its effects on numerous species, on which the fishing sector depends and the additional costs of cleaning fishing nets. Losses in the tourism sector, in particular from stranded seaweed on beaches, as well as the loss in ecosystems services are also important. Also the management of the resulting drifted material / biomass from beaches is very costly. In Spain, the total economic cost of impacts on fisheries and local administration for beaches management were reported to be 1,300,000 euros over a period of nine months. - **Human health**: There is no evidence of risks to human health, or animal or plant health linked to *R. okamurae*.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: The known pathways of its introduction and spread are unintentional (ballast water, hull fouling and marine aquaculture). Additional unintentional introductions of *R. okamurae* into the EU could be prevented through effective ballast water management, biofouling management and measures for the prevention of introduction (and secondary spread) of *R. okamurae* through shellfish imports and transfers. - **Early detection and rapid eradication (Articles 14 - 18)**: Early detection is achieved mainly via the implementation of scientific monitoring programmes focusing on susceptible areas (harbours, ports, marinas, etc.), in combination with citizen science. Manual removal is the only measure that is realistically available to be applied to the species following early detection, though even this measure is likely to be ineffective. - **Management (Articles 19**-20): See above – manual removal. The situation is complicated by the species' characteristics, such as high propagation capacity, due to vegetative and asexual structures that can easily escape from management strategies and due to its ability to grow on various substrates. As a result, other management measures effective against other macroalgae species are unlikely to be successful against *R. okamurae.*
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: Regarding Ballast Water Management and Treatment, costs vary according to the different adopted systems and include different ballast water treatment design, supply and installation of the equipment, training of staff, operating and maintenance costs and consumed fuel oil. There are also opportunity costs (associated with slowing ship speed or diversion to areas) and port costs as these need to have adequate ballast water and sediment reception facilities. These costs will be borne by the shipping companies but are not directly linked to the listing of this species. Implementation of the BWC is ongoing with all ships having to comply by 2024. As regards tackling of biofouling in accordance to IMO Biofouling (voluntary) guidelines – the main practices for the removal of biofouling from ships' hulls and niche areas are dry docking and in-water cleaning and treatment of niche areas. Costs vary according to the different systems adopted and the type of treated ships, as well as to different operating and maintenance costs. It is important to underline that the primary cost associated with fouling is the increased fuel consumption resulting from increased frictional drag, while the costs related to hull cleaning and painting are much lower than those. Economic effects of biofouling go far beyond the cost of control and eradication efforts. The cost of implementation of this measure

	will be borne by the shipping companies or private vessel owners. To prevent new introductions and spread via shellfish transfers within the EU would require new measures on the transfer of mussel consignments to be adopted at EU level to reduce the risk of the spread of marine invasive alien species in general, including *R. okamurae*. Simple changes to the shellfish transfer practice can reduce the risk of species introductions. The implementation costs could be significant for the producers, especially those with a limited production. The most significant cost for Member States relate to the systematic enforcement. - **Early detection and eradication/ management**: Existing monitoring methods can effectively detect new occurrences of *R. okamurae* and monitor changes in its coverage. There are numerous scientific monitoring programmes for the marine environment that are already applied in Member States. Costs of implementation for MS vary depending on whether there are already established population of *R. okamurae,* number of hotspots etc. These have a cost, particularly in the initial phases. If a removal programme is attempted, the most cost-effective option is incorporating volunteers already trained to identify *R. okamurae*, as those campaigns are very time consuming and they last for a long period, and will need a lot of staff and huge effort. Cost-effectiveness is however very low, given the low likelihood of success, but failure to implement population control campaigns would maintain and increase significant impacts of *R. okamurae.*
	Cost of inaction: It is overall accepted that the economic value of the resources at risk, even if these resources are only moderately impacted, far exceeds the costs of implementation of the BWMC. Beyond the impacts on biodiversity, *R. okamurae*, as recorded in relation to the invasive populations in Spain, can have economic impact associated to fishing activities (economic losses in captures by fisheries), beach management (removal of drifted material on the beaches) and negative impacts on the tourism sector related to them. It has been estimated that economic impacts from the species in Spain reached €1.3M in nine months. In light of this, it seems economically sensible to try to limit as much as possible the spread of the species which, once established, spreads quickly and might be impossible to eradicate.
	Cost-effectiveness: The prevention of additional unintentional introductions of *R. okamurae* into the EU territory, the prevention of secondary spread of the species to other areas in the EU, and the achievement of early detection of the algae populations are of great importance and considered as the most effective of measures that can be implemented for dealing with this species. Considering that prevention is always preferable and more cost-effective than subsequent management, especially for long-term measures, ballast water management that deals with all ballast-related invasive species simultaneously, is one of the most cost-effective measures available. Efficiencies of various technologies utilised for ballast water treatment are reviewed by many scientists, and can vary with treatment method, but the application of many combined methods appears to be most effective.
	Socio-economic aspects: There are no socio-economic benefits of *R. okamurae,* although the species is studied for the potential uses of its secondary metabolites.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established but still at a relatively early stage of invasion. Where it establishes, it can be expected to have significant adverse impacts.

4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The species is already established in ES and FR with significant adverse impact. It could establish in further 7 MS.

Schizoporella japonica – bryozoan

Species name – common	**Schizoporella japonica**
Species name – scientific	*Schizoporella japonica*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/125f621b-5c0c-4ea7-8da2-7d81c0cdacd1/Schizoporella_japonica_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/478d7217-9300-4f87-82bd-90b2e2627fee/10b.%20Schizoporella%20japonica%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to north-west Pacific from China to Japan.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in NL. - Capable of establishing under climate conditions and foreseeable climate change conditions, in BE, FR, IE, PT, ES, DK, DE and SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Moderate with low confidence. *S. japonica* is a competitor for space and is known to inhibit the growth of adjacent species. It has proved very capable of colonising and dominating natural and man-made habitat and competitively excluding or overgrowing native species with specifically a potential to impact benthic and under boulder communities intertidally and in the shallow subtidal. *S. japonica* is known to overgrow and smother bivalves, often causing mortality. Since bivalves such as mussels create biologically diverse habitat, loss of this habitat, which may be caused by overgrowing by *S. japonica,* has the potential to reduce biodiversity. 'Reefs' as designated for protection under the Habitats Directive include bivalve beds as well as a range of subtidal and intertidal hard substrates which are all suitable habitat for *S. japonica* to colonise. - **Ecosystem services**: Major with low certainty. *S. japonica* puts culturally significant activities such as shell fisheries at risk, because it is known to overgrow and smother bivalves, including commercially important mussels. - **Economy**: Major impact with low confidence. Associated costs are likely to be similar to those incurred due to other similar fouling organisms and fouling communities. It is also know that *S. japonica* fouls oysters, likely impairing their potential market value, by reducing product quality and increasing the cost associated with preparation and packaging. Impacts on shellfisheries via impact on bivalve health, quality and productivity, may increase costs, and reduce competitiveness with alternative, global providers of bivalve products, resulting in loss of revenue. Furthermore, areas with known population of *S. japonica* may be closed for export of live mussels and other bivalves. Fouling of commercial and recreational vessels is also likely to increase costs incurred by commercial and recreational boat owners and marina operators as a result of having to

	clean and maintain the vessels and equipment more often. - **Human health**: There is no evidence to suggest that *S. japonica* might directly impact human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Measures to prevent its introduction need to target the pathways of hull fouling movements and contaminant on aquaculture. Hull fouling is controlled via anti-fouling paints and cleaning practices both in the commercial and recreational sectors. The entry as contaminant in aquaculture can be tackled via Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture which defines the procedures to be followed to minimise the risk of introducing non-target alien species accompanying commercial shellfish spat and stocks. - **Early detection and rapid eradication (Articles 14 - 18)**: Given the small size of propagules and early colonies, the likelihood of monitoring detection attempts failing is very high. The level of expertise required to confirm identification of the species makes early identification and interception extremely unlikely. The use in future of eDNA monitoring may increase the chances of early detection. However, the open nature of marine systems mean that once established, eradication would not be possible. - **Management (Articles 19-20)**: There are no accounts of effective management of invasive populations of *S. japonica,* once established in the wild. Once present, management would be extremely difficult. Management of impacts over limited areas is possible. For example, manual cleaning of fouled bivalve stock and hull cleaning. However, any such activities would need to be repeated regularly and would likely incur high (potentially excessive) financial costs.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** Prevention: Anti-fouling paints have limited service life and require re-application at regular intervals, as they seem to be efficient for up to 1-1.5 years. In-water cleaning used as an additional tool to dry-docking; it can be combined with loading/unloading activities, is faster and can cost as little as 1/5 the cost of dry docking (but also linked to higher risk of introducing non-indigenous species than land-based cleaning in dry-docks). New technologies are currently being developed and trialled globally, which aim to remove and sterilise hull fouling using specialist equipment. Such initiatives may provide a relatively safe, cost effective alternative to dry-docking and the value of such systems in reducing the spread of invasive species should be given careful attention. The cost will be borne by the shipping companies or private vessel owners (for fishing and recreational vessels). Traditional dry-docking costs hundreds of thousands of euros, and the cost of reapplying a new layer of antifouling amounts to half the total cost.

	As regards the pathyway “Contaminant in Aquaculture”, since this legislation is already implemented, there would be no additional costs associated specifically with management for this species. Early detection and eradication: Once colonies are visible and easily detectable, they will likely already be reproductively viable, and eradication would be unlikely. Management: Reactive management for example physical cleaning of fouled mariculture stock may be effective in the short term, but the most likely method - cleaning by hand - can be very costly and time consuming.
	- **Cost of inaction:** Given the presence of established populations within the risk assessment area, in the absence of any efforts to contain its spread, it is very likely that *S. japonica* will be introduced unintentionally to other Member States.. Once established, *S. Japonica* has demonstrated the ability to grow fast and spread rapidly. Movement of bivalves is also likely to facilitate spread amongst MS due to limited regulation regarding the internal transfer of bivalves.
	- **Cost-effectiveness:** Given that once established it is almost impossible to eradicate, management consisting of recurrent measures that can contain it and slow down its spread are worth taking.
	- **Socio-economic aspects:** None identified.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	*S. japonica* is established in the EU, but still at an early state of invasion, so there is scope for much wider spread and negative impacts on a much larger scale.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has significant adverse impact.

Boccardia proboscidea – worm

Species name – common	**Boccardia proboscidea**
Species name – scientific	*Boccardia proboscidea*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/ui/group/98665af0-7dfa-448c-8bf4-e1e086b50d2c/library/b41111a7-5632-42bd-ba1c-e2aa4774c9c9/details?download=true
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/586619aa-7d73-4c89-a00c-408f3fea22c2/9b.%20Boccardia%20proboscidea%20Management%20Annex.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the Pacific coast of North America and possibly, Japan.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Currently established in BE, DE, ES, FR, IE, NL. - In foreseeable climate change conditions, *Boccardia proboscidea* could also establish in HR, DK, EL, IT, PT, SI, SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major with low confidence. This species' impact depends entirely on the densities the species attains and it is rather difficult to predict. Areas where untreated sewage effluents are discharged into the sea, as well as the immediate vicinity of aquaculture facilities could provide such hotspots for *B. proboscidea* proliferation. It can also establish in habitats that are naturally (and not as result of sewage etc.) organically enriched. *B. proboscidea* can compete for space with native mytilids, oysters and barnacles and possibly structuring algae, and, in a worst-case scenario, can smother and displace native species and alternative communities, as evidenced in other parts of the invaded range. Intertidal mussel and oyster beds/reefs are important habitats, both ecologically and commercially, and are potentially at risk as they constitute hotspots of introduction. In this case, population declines of native intertidal species may be evidenced, associated with changes in community structure, as well as structural impacts on both hard and soft substrates (the species' boring activity has the potential to permanently alter soft rock habitats potentially enhancing erosion processes). Currently, the strongest ecological impacts are reported from Helgoland, Germany, where there are signs of possible displacement of the native polychaete *P. ciliata* by high densities of *B. proboscidea,* as well as concerns about coastal erosion of abrasion platforms by its boring activity. - **Ecosystem services**: Moderate impact with low confidence. It can be hypothesised that *B. proboscidea* may impact food provisioning services by reducing shellfish biomass harvested from wild populations for direct consumption or use in aquaculture. The recreational and aesthetical value of rare, rocky intertidal habitats

	(e.g. see chalk cliffs) may also be impacted - **Economy**: Moderate with low certainty. Being a well-known shellfish pest, it may endanger wild and cultivated mollusc populations, particularly oysters, mussels and abalone. The economic impacts anticipated to occur primarily in association with cultivated and/or harvested from the wild populations of oysters and to a lesser extent with the abalone species *Haliotis tuberculata*, which supports both a wild fishery in France and small-scale aquaculture in France and Ireland. With respect to shellfish aquaculture, if *B. proboscidea* infests only the surface of the shells, it will not directly affect the biological performance of cultured shellfish, its mere presence however may have negative impacts on the half-shell oyster industry, reducing the presentation/desirability of oysters and their commercial value. Impacts may extend to wild abalone and mussel seed populations harvested for commercial purposes. - **Human health**: No evidence found.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Vessels transfer (either in ballasts or as fouling) is the most plausible pathway of its introduction. Introduction in EU marine waters and this will partly continue until the BWMC is fully implemented as compliance with the International Maritime Organisation's (IMO) D2 standard can decrease larval concentrations to undetectable levels, significantly reducing propagule (larval) pressure (planktonic larvae can be transported via ballast waters of commercial vessels and ferryboats). Existing management measures targeting contaminant on shellfish imported from outside the RA area reduce probability of introduction via this channel. Council Regulation (EC) No 708/2007 concerning use of alien and locally absent species in aquaculture defines the procedures to be followed to minimise the risk of introducing non-target alien species accompanying commercial shellfish spat and stocks. However the regulation does not apply to movements of locally absent species within the Member States "except for cases where, on the basis of scientific advice, there are grounds for foreseeing environmental threats due to the translocation". Restrictions on transfers based on the risk associated with the source areas is an effective management method. - **Early detection and rapid eradication (Articles 14 - 18)**: The species requires specialised taxonomic expertise for its identification, such that awareness raising and early warning systems are better designed with a focus on the training of professionals who are likely to encounter/collect it during the course of monitoring or other marine survey activities. Monitoring should focus on introduction hotspots - in the case of *B. proboscidea* in particular, organically enriched habitats (in the vicinity of introduction hotspots) should also constitute monitoring targets. Molecular tools and DNA barcoding of zooplankton samples may represent a further early detection approach. - **Management (Articles 19-20)**: Eradication of the species in the wild is considered unlikely. Mechanical removal would also entail removal of the associated substrate, something unrealistic, infeasible and unadvised. When applied over localised areas/populations, the drawbacks of chemical control may be acceptable if eradication of the species is achieved. Perhaps the most effective management measure (outside culture systems) would be to maintain organic matter content in water and sediments at levels that do not favor outbreaks of opportunistic

	polychaete species and ensure Good Environmental Status. To mitigate impacts in culture system a number of method have been tested and used to combat mudworm infestation of cultured bivalves and gastropods.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** Prevention: Costs related to Ballast Water Management and the implementation of IMO's D2 Standard are not specific to *B. proboscidea* but these refer to all marine alien species that can be introduced/spread with ballast water. The cost of installing Ballast Water Management Systems will be borne by the shipping companies. - Early detection and eradication: Indicatively, a proposed hotspot monitoring programme in Denmark for all marine alien species (covering thirteen port and three areas with discharges of cooling water) was estimated at approximately €125,000 per year for the period 2015-2017. - Management: No information is available on potential costs for management of established populations of *B. proboscidea*.
	- **Cost of inaction:** Inaction would result in further spread and establishments to additional MS with economic impacts in particular in the aquaculture sector (cultivated mollusc populations, particularly oysters, mussels and abalone) with limited options in terms of eradication and management.
	- **Cost-effectiveness:** Preventive measures are more cost-effective than having to contain established populations.
	- **Socio-economic aspects: None.**
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is already established in the EU, but there is scope for much wider spread.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has shown to have adverse impacts.

Perna viridis (Asian green mussel) – mussel

Species name – common	**Asian green mussel**
Species name – scientific	*Perna viridis*
Conclusion of the risk assessment	High risk – Medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/1863763c-ab77-4c80-9c2f-80f753844594/Perna_viridis_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/beb8c1de-c562-46ba-a808-828105b60ca1/Annex%209b%20Perna%20viridis%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the Indian coast and throughout the Indo-Pacific (where it ranges west from the Persian Gulf and east to New Guinea and Japan and New Guinea for north and south ranges, respectively.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- It has not been recorded nor is it established in EU. - Under current climate *Perna viridis* is capable of establishing in BG, HR, CY, FR, EL, IT, MT, PT, SI, ES and under future climate also RO.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major with low confidence. It is considered likely that *P. viridis* has the potential to displace native species, particularly other mussel species. The dense turf formed by the species may smother native species and alter existing habitats. Habitats of conservation importance, including seagrass beds, reefs and mudflats are most likely to be impacted. *P. viridis* is in particular known to colonise seagrass beds in high densities. Biogenic reefs formed by bivalves, polychaetes worms and other species are also important for biodiversity within the EU, and possible impacts would be likely to adversely affect the biodiversity value of these habitats. The potential to smother existing benthic communities would additionally pose a threat to slower growing benthic organisms, including corals, sponges and large, solitary bivalves (e.g. fan mussels) which could be smothered and overgrown. - **Ecosystem services**: Moderate with low confidence. The ecosystem services associated with seagrass beds (sediment stabilization, coastal defence and nursery area for commercially and culturally important species) and biogenic reefs are likely to be impacted should these species be displaced, smothered or otherwise impacted by *P. viridis*. Its consumption of plankton in high quantities may impact species and habitats, which provide food, coastal defence and cultural services. Specifically, reef-forming bivalve and worm species form biogenic reefs, which provide coastal defence, water quality maintenance and habitat for commercially and culturally important species (e.g. fish and invertebrates). Thus, services including coastal defence, provision of food, sediment stabilisation and provision of habitat for commercially and culturally important species might be adversely impacted. - **Economy**: Major with low confidence. *P. viridis* is known to be a serious fouling pest species. In particular, costs associated with removal from cooling pipes and

	reduced efficiency caused by fouling in power stations are likely to be high. Clogging internal pipes and moving parts in industry can potentially impair safety. Fouling of vessels can increase drag and consequently fuel consumption and costs. There is some evidence to suggest that *P. viridis* is able to smother commercially important species, including oysters and other species of mussel. These fisheries are of significant commercial importance in the EU and any impact would have serious economic and social consequences. - **Human health**: Mussels, including *P. viridis,* accumulate high levels of metals and contaminants from their environment and if consumed, these may have adverse impacts on human health. This threat to human health would be directly related to existing water quality within the area of establishment and it is anticipated that regulations governing the extraction of shellfish for food would limit the impact on human health.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent introduction and establishment in the EU**.**
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: The most likely pathways of entry being ballast water and hull fouling. - Until the Ballast Water Convention has been fully implemented the risk of the organism surviving passage via this pathway remains High. - Hull fouling is controlled via anti-fouling paints and cleaning practices both in the commercial and recreational sectors. In 2011, the IMO adopted Resolution MEPC.207(62) outlining the Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species. The Guidelines are supplemented by the Guidance for minimising the transfer of invasive aquatic species as biofouling (hull fouling) for recreational craft circulated as MEPC.1/ Circ.792. While in some cases these guidelines will be followed and the risk from well-maintained vessels will be relatively low, those operators that do not follow the guidelines will present a much higher risk. - To prevent its deliberate introduction for aquaculture, the effective enforcement of Regulation 708/2007 on Alien Species in Aquaculture will be necessary. - **Early detection and rapid eradication (Articles 14 - 18)**: Supporting monitoring programme under the Marine Strategy Framework Directive (MSFD) should be able to detect new introductions. This will in turn facilitate national rapid response processes. A method with a lot of potential for detecting marine non-native species is the use of environmental DNA (eDNA) detection. To attempt eradication Methods of treatment identified by the Australian authorities for managing the species includes i) draining, ii) flushing with freshwater or hot water, iii) chemical biocides, and iv) physical removal. - **Management (Articles 19-20)**: To implement a containment and control process movement controls of potential vectors may be introduced in addition to processes to limit the species distribution size to reduce impact and propagule pressure (e.g. ballast water, hull-fouling assessed on case by case basis depending on the use of the site). Basic principles for (certain) vector control and species management include i) draining, ii) flushing with freshwater or hot water, iii) chemical biocides and iv) physical removal.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: Costs to Member States will vary considerably between Member States, depending on extent of implementation, national policy and number of ports. Those linked to the compliance with standards under the Ballast Water Convention would largely be borne by the private sector operators.

	- Early detection and eradication: Since the above-mentioned monitoring is already in place there would be no additional costs associated specifically with this species. The establishment of rapid response process for this (or similar species) would potentially involve maintaining capacity to respond to new introductions, which means it is very difficult to determine the costs associated with this single species alone. - Management: Specific costs will vary depending on the type of equipment and the demand on its use. Monitoring, interception and removal programmes are likely to be costly and would need to be ongoing. In the marine environment such methods may not be able to provide 100% coverage and effectiveness.
	- **Cost of inaction:** If introduced in EU, its establishment it is likely to establish and have significant adverse impacts. If *P. viridis,* a highly fecund, fast growing species, tolerant of a wide range of environmental conditions, becomes established in the EU, eradication would likely not be an economically viable option due to the open nature of the marine environment and life history traits of the species**.**
	- **Cost-effectiveness:** Implementation of the Ballast Water Convention would be a cost-effective measure to prevent introduction, as relevant costs would be split over all relevant alien species.
	- **Socio-economic aspects:** *P. viridis* is a commercially valuable and important species for aquaculture throughout its native range due to its fast growth rate and large size. Its use for aquaculture in EU should be prevented in order to avoid the adverse impacts of the species on biodiversity. Because of its high tolerance, it also has a potential value as a bioindicator – it is considered as one of the best mussel species to test for bio-pollution.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is not yet established and is likely to have significant adverse impacts.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	N/A.

Rapana venosa (Veined rapa whelk) – mollusc

Species name – common	**Veined rapa whelk**
Species name – scientific	*Rapana venosa*
Conclusion of the risk assessment	High with medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/42b00761-b52e-4004-8666-fa88ec95f61b/Rapana%20venosa%20RA.doc
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/01b316d8-e368-4c38-9e30-0ac08a8f300a/details
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the temperate Western Pacific Ocean from the Sea of Japan, Yellow Sea, Bohai Sea, and East China Sea to Taiwan in the south.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Recorded in BG, IE, IT, FR, EL, ES, HR, NL, MT, RO, SI, UK. - Established in BG, IT, RO, SI. - In foreseeable climate change conditions, *Rapana venosa* could also establish in IE, BE, DK, DE, HR, NL, SE.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** major impacts with very high confidence. *R. venosa* is a voracious predator with a preference for mussels, oysters and other bivalves that can achieve high consumption rates. In the Black Sea it had massive impact on oyster banks where community structure was severely altered under selective predation of bivalve species. Some oyster species were exterminated with *Rapana* as a main reason. Reduced native bivalve availability may impact other species which prey on them, including species of crab, bird, fish, starfish and other predatory gastropods. - **Ecosystem services**: major impacts with high confidence. *R. venosa* affects ecosystem services primarily through its negative impacts on mussel and oyster beds and reefs. Directly impacts provisioning services for food and biotic materials. Negatively impacts bivalves and the biogenic structures they create which offer valuable regulating and maintenance services through water quality regulation (including clarity). - **Economy**: Cost assessed as massive with low certainty. *R. venosa* mainly impacts on mortality of mussel stocks, including in the aquaculture industry. In the Adriatic Sea, *R. venosa* disrupts the squid fishery (in Italy). In the North Sea *R. venosa* could become a severe competitor to the native whelk *Buccinum undatum*, a species of commercial importance. However, a *R. venosa* fishery has developed in the Black Sea for the past 30 years providing new sources of income and employment. - **Human health**: estimated to be major but local with very high confidence. With respect to health impacts in particular, the bioaccumulation of heavy metals, shellfish toxins and organic pollutants in the flesh and gut of *R. venosa*

	could pose health risks to consumers. If a market for the species is developed in Europe (or other countries of the invaded range) human health may be at risk.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Measures can be taken to address unintentional pathways of introduction. Ballast water management measures are to be applied as well as practices to control and manage biofouling and restrictions on bivalve transfers for aquaculture. - **Early detection and rapid eradication (Articles 14 - 18)**: *R. venosa* is a large conspicuous species, difficult to miss. However, its cryptic nature contributes to the improbability of observing invading individuals until they are large. The species is already integrated into early warning systems in some MS and it could usefully be integrated into all relevant ones alongside awareness raising. - **Management (Articles 19-20)**: Methods for containment of established populations exist but require long-term commitment. The management of *R. venosa* both as an IAS and as a fishery resource at the same time has been a very contentious and complex issue (destructive impact of fishing practices – non-destructive removals to be given priority i.e. fisheries with pots or traps).
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** Prevention: Costs related to shipping (ballasts/fouling) will be borne by the shipping companies and will not be specific to this species (cf Ballast Water Convention). - Early detection and eradication: Can be focused on introduction hotspots and involve citizen scientists in order to increase cost-effectiveness. - Management: Management measures exist, but likely require a long-term commitment over consecutive years over localised areas and would involve a considerable cost.
	- **Cost of inaction:** Much wider spread and associated impacts and costs.
	- **Cost-effectiveness:** Prevention can be cost effective in light of availability of existing programmes to prevent IAS introduction to which the species can be integrated. - Once established, priority should be given to minimising or mitigating negative environmental impacts of the invasion through intensive but non-destructive removals, rather than ensuring maximum sustainable yield.
	- **Socio-economic aspects**: A ban of imports or restrictions in the movement of shellfish seed/stock could have potentially significant economic implications for shellfish producers (but the alternative of allowing the risk of introduction may be even more harmful). - *R. venosa* is a part of human nutrition. As a result *R. venosa* is the subject of fishing trade flows and business opportunities between Bulgaria (and Turkey) and Japan, Korea and elsewhere in East Asia. In the 2010s *Rapana* fishery developed in Romania too, the catch being mainly exported to Bulgaria. Scientific research also suggests that some compounds from *R. venosa* could be a source of nutraceuticals products and future drug development.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the	The species is established in the EU, but there is scope for much wider spread.

Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established, it has significant adverse impact both on biodiversity and related economic activities.

Hemigrapsus sanguineus (Asian shore crab) – crab

Species name – common	**Asian shore crab**
Species name – scientific	*Hemigrapsus sanguineus*
Conclusion of the risk assessment	High risk with medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/68c73000-d788-46cd-8853-fa3b27e88bdb/Hemigrapsus%20sanguineus%20RA.docx
Link to note reviewing potential measures	https://circabc.europa.eu/ui/group/4cd6cb36-b0f1-4db4-915e-65cd29067f49/library/34fb7b1d-7c9a-4c9c-bfb0-345de027e5ed/details
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to western Pacific Ocean, from Hong Kong Island to Sakhalin Island (Hong Kong, Taiwan, China, Japan, Korea, Russia, 22°N to 49° N) (primarily rocky intertidal shores).
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- Established in BE, DE, DK, FR, NL. - Under current climatic conditions *Hemigrapsus sanguineus* is also expected to establish and spread in IE, SE and UK. - Under foreseeable climate change conditions, *Hemigrapsus sanguineus* could also establish in BG, ES, IE, RO, SE, UK. Also a low risk for localised populations in: CY, EL, HR, IT, SI, and MT.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** major impacts with high confidence. Invasions by this crab have in the past been accompanied by severe declines in native and non-native species of resident crabs. As a voracious omnivore and dominant predator with a clear preference for mussels and barnacles, it has the potential to significantly alter species' interactions, community structure and food webs in the intertidal zone. - **Ecosystem services**: Moderate impact with low confidence: *Hemigrapsus sanguineus* may impact provisioning services, specifically nutrition, by reducing shellfish biomass harvested from wild populations and aquaculture (mussel and oyster seed and juveniles). Moreover, these filter feeding bivalves and the biogenic structures they create offer valuable regulating and maintenance services through water quality regulation, water flow regulation and coastal protection and lifecycle maintenance by providing important feeding and nursery habitats. - **Economy**: *Hemigrapsus sanguineus* has moderate impacts with medium confidence. Based on its habitat and dietary preferences, the species could have substantial impacts on shellfish aquaculture in particular: it readily consumes juvenile mussels and oysters or bivalve spat. Its impacts on mussel aquaculture and wild seed populations harvested for commercial purposes could be significant, and thus likely to cause some economic damage to the related industries. - **Human health**: minimal with high confidence.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction,	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.

establishment or spread;	
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Following best practice as regards ballast water exchange and treatment as well as to control and manage biofouling are necessary to reduce the risk of introduction. (- **Early detection and rapid eradication (Articles 14 - 18)**: The probability of observing the initial introduction event is minimal, particularly at the larval or early life stages, but monitoring at introduction hotspots can increase the likelihood of early detection. Eradication is theoretically possible if detected soon after introduction, at low densities and before sexual maturity is reached (collection by hand and the use of traps) but in practice complete detection and eradication is highly unlikely. - **Management (Articles 19-20)**: If eradication is not possible at the core of the species' distribution, in which case re-introduction through natural dispersal will be very likely, it could still be theoretically possible to contain the invader and control the newly established populations with targeted removal activities surrounding the core or new populations.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention: Costs of ballast water convention implementation and biofouling related measures should not be attributed to this species specifically. A ban of imports or restrictions in the movement of shellfish seed/stock could have potentially significant economic implications for shellfish producers, particularly in areas where strict local/regional regulations controlling such movements are not already in place. - Early detection and eradication: Monitoring plans are being developed and implemented under the Marine Strategy Framework Directive (e.g. hotspot monitoring programme for all marine non-indigenous species). Thus, limited additional costs would result from integrating this species into these existing programs. - Management: Containment would most likely require a long-term commitment over consecutive years over localised areas and would involve a considerable cost.
	- **Cost of inaction:** High costs may be expected if the shellfish aquaculture sector is heavily impacted, but high uncertainty is associated with such an eventuality.
	- **Cost-effectiveness:** Preventive action is by far most cost-effective, since managing established population would come at considerable cost.
	- **Socio-economic aspects:** The species is not known to have any socio-economic benefits.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is already established in the EU, the potential for additional introductions and both natural and human-assisted spread is substantial.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established in the EU, ecological impacts are beginning to emerge, with more severe environmental and economic impacts likely to follow.

Lagocephalus sceleratus (Silver-cheeked toad fish) – fish

Species name – common	**Silver-cheeked toad fish**
Species name – scientific	*Lagocephalus sceleratus*
Conclusion of the risk assessment	High risk – medium confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/c992b6cb-e6b0-4d7c-9682-1ed6e3095e56/Lagocephalus_sceleratus_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/7dfbcab5-fec8-4f4c-89ac-89db39c9c8d6/Annex%2010b%20Lagocephalus%20sceleratus%20Management.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to tropical and sub-tropical water of the Indo-West Pacific including the Red Sea.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- The species is currently established in CY, EL and IT. - Under current and future climate conditions, *Lagocephalus sceleratus* is capable of establishing also in HR, FR, MT, PT, SI and ES.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with low confidence. Potentially major environmental impacts through predation. *L. sceleratus* has already attained significant densities and locally, where it has established, constitutes a worrying proportion of the ichthyofaunal biomass in shallow waters, based on small-scale fisheries catches. It is a voracious predator, with an ontogenetic shift in its diet from crustaceans and small fish to predominantly cephalopod molluscs as the age increases. There are growing concerns about its potential impacts on prey populations in these areas, especially on cephalopod species. Based on its high biomass in the ecosystem, trophic level, lack of predators and low magnitude of fisheries removals (removals only occur as bycatch) it is considered likely that it can significantly affect marine food webs. On the basis of currently available information, severe declines of native prey species populations may be anticipated beyond the local scale, but due to the poor level of documentation of the existing impacts, high uncertainty is associated with this assessment. - **Ecosystem services**: Major with medium certainty. The observed impact of *L. sceleratus* on ecosystem services is caused by changes introduced in the foodweb (e.g. over-competing native species and decreasing populations of prey species). Furthermore, the species' toxicity makes it hazardous for human consumption, which can negatively impact cultural values linked to recreational fishing. The expanding distribution and increasing abundance and biomass of *L. sceleratus* has the potential to inflict major impacts on ecosystem services (provisioning and cultural) throughout the Mediterranean. - **Economy**: Massive impact with medium confidence. *L. sceleratus* is notorious for

	attacking fish caught in fishers' nets and destroying the catch. Declines in wild stocks and catches of cephalopods, crustaceans and commercial fish species (e.g. red mullets) at the local scale have been attributed to predation by *L. sceleratus.* The species causes extensive damages to the gear and the catch of small-scale fishers, causing major economic losses (that can potentially become massive in the future) that have already led some fishermen to abandon fishing as a livelihood activity. Based on the estimates for Turkish fisheries and the recent information from Greece (Crete) indicating abandonment of commercial fishing due to unaffordable damages from *L. sceleratus,* the species has the potential to cause massive economic costs in the future, also because the Aegean populations and Adriatic records indicate that the species is able to survive and possibly flourish even in the colder regions of the Mediterranean Sea and extend into Atlantic waters. In addition, attacks and injuries by *L. sceleratus* to bathers could also act as a deterrent for the general public with potential implications for the tourism industry and could also impact recreational activities, primarily recreational fishing. - **Human health**: Major with medium confidence. The consumption of this highly toxic species has led to numerous severe poisoning incidents and fatalities and, despite marketing bans on the species and numerous awareness campaigns, unsuspecting consumers still remain vulnerable. Another threat to human health comes in the form of attacks and injuries by *L. sceleratus* to bathers. The number of the people at risk is expected to increase with further establishment and increasing populations.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to prevent invasion into the MS where this species is not currently established and prevent further spread in the MS where this species is already present. - action now will help prevent this species from becoming a wider problem across the EU.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: The main introduction pathway into the risk assessment area has been spread through natural dispersal across border from neighbouring countries (gradual progression from the Suez Canal towards the north-east Mediterranean). As it is already established in parts of the Mediterranean Sea and spreading unaided towards its western and northern basins, very little, if anything, can be done to prevent further introductions through natural dispersal. - **Early detection and rapid eradication (Articles 14 - 18)**: Due to its high toxicity and already manifested socio-economic and environmental impacts in the East Mediterranean, *L. sceleratus* is high on the radar of competent authorities and scientific/stakeholder/citizen scientist networks both for purposes of early detection and for awareness raising of the risk it poses to human health. Invasive species platforms and initiatives such as MedMIS, SeaWatchers are already contributing to the early detection of *L. sceleratus*, while monitoring can be achieved with survey programmes (e.g. the MEDITS surveys, FAO/GFCM activities) and commercial fishing activities. Eradication of this species is acknowledged to be impossible due to the already widespread and abundant populations, the high fecundity, mobility, long pelagic duration of the early life stages of the species and its spawning on sensitive habitats. However, theoretically, eradication may be possible for localised, newly established populations at low densities with limited dispersal capabilities. This would require an early warning system, monitoring efforts and a removal programme. - **Management (Articles 19-20)**: Population control that leads to minimising the severity of impacts and the risk of transfer to yet uncolonised areas is considered feasible. A removal programme would involve direct removal with intensive targeted fishing, especially during the spawning period, possibly combined with a bounty program. Several fishing methods can be employed (purse seines, trawls, longlines, trammel and gill nets, even angling) with appropriate modifications to minimise gear damage. Trawls are not recommended, as their use goes against EU Regulation 1967/2006, and would

	be destructive to native species and habitats. Regional co-ordination and policy integration with non-EU countries would be important both for monitoring and for population control efforts. - As an alternative to fisheries removals, mass trapping with pheromones may be considered a promising approach, one that is more species-specific and less damaging to the environment compared to less selective, more invasive removal methods. A possible measure for the management of the species could include harvesting for commercial purposes (pharmaceutical research) but it must be noted that the creation of a new market should be carefully implemented as it would introduce conflicting management objectives.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio-economic aspects	- **Implementation cost:** - Prevention, early detection and eradication: No information is available. - Management: In order to control its populations, the government of Cyprus has been buying specimens from artisanal fishermen since 2012, for €3/kg, with a total cost of €600,000 euro over five years (2012-2016) through a management plan partly covered by European fisheries funds. The amount was set rather approximately but seems to satisfy fishermen. Population control would most likely require a long-term commitment over consecutive years over localised areas (Barbour et al., 2011) and would involve a considerable cost.
	- **Cost of inaction:** Further unaided introductions are expected in currently uninvaded regions, in fact probability of spread is major with high confidence.
	- **Cost-effectiveness:** The example of Cyprus showed that intensive targeted fishery with a bounty system has not been successful in suppressing populations when *L. sceleratus* has attained significant densities.
	- **Socio-economic aspects:** *L. sceleratus* contains high concentrations of tetrodotoxin (TTX) in its tissues - a potent neurotoxin responsible for many human intoxications and fatalities each year. However, due to its paralytic effect, this neurotoxin could be used in the medical field, most notably as an analgesic to treat some cancer pains and as an agent to manage opiate withdrawal syndromes. Currently, the synthetic production of TTX is considered more cost-effective and reliable than production from harvested fish.
4.6 The Union list shall include as a priority those invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	The species is established in the EU, but there is scope for much wider spread and the species is expected to have a significant adverse impact.
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	The species is already established following entry through natural dispersal from neighbouring countries, with abundant populations in the Eastern Mediterranean and it is continuously expanding its range throughout the Mediterranean. It is considered likely to establish further populations in the Western Mediterranean, with higher probabilities of establishment along the western Italian coast, Sardinia, Corsica and the eastern part of Mediterranean France.

Pterois miles (Common lionfish) – fish

Species name – common	**Common lionfish**
Species name – scientific	*Pterois miles*
Conclusion of the risk assessment	High risk – high confidence.
Link to Risk Assessment	https://circabc.europa.eu/sd/a/42710eac-43b8-4d7b-b645-f91795d60097/Pterois%20miles_final_20201117.pdf
Link to note reviewing potential measures	https://circabc.europa.eu/sd/a/b9f91063-8dd5-4490-bf33-5511ded1c9af/Risk%20Management%20Annex_Pterois%20miles.docx
4.3 (a) found, based on available scientific evidence, to be alien to the territory of the Union excluding the outermost regions;	Native to the Indo-Pacific but restricted to the Indian Ocean, specifically from the Red Sea all the way down to the eastern South Africa, Arabian Sea, Persian Gulf, Gulf of Oman, Laccadive Sea, Bay of Bengal, Andaman Sea and Indonesian region.
4.3 (b) found, based on available scientific evidence, to be capable of establishing a viable population and spreading in the environment under current conditions and in foreseeable climate change conditions in one biogeographical region shared by more than two Member States or one marine subregion excluding their outermost regions;	- The species is currently established in CY and EL. - Under current climate, *Pterois miles* is also capable of establishing in IT, MT and under foreseeable climate change, this species could also establish in ES, FR, HR, PT and SI.
4.3 (c) based on available scientific evidence, likely to have a significant adverse impact on biodiversity or the related ecosystem services, and may also have an adverse impact on human health or the economy;	- **Biodiversity:** Major impact with high certainty. *P. miles* is expected to have a major effect on coastal communities of most of the Mediterranean in the near future, taking into account the considerably fast growth, early maturation, predation of and competition with native fish species. Lionfish are expected to cause long-term irreversible ecosystem changes, which spread beyond local areas but the impact might be different in each Mediterranean regions. As reported in the Western Atlantic, an increase in lionfish abundance at certain locations will likely coincide with a decline in the biomass of local fish species with the impacts likely to be felt at a regional scale. Biodiversity decrease will lead to decrease of population and ecosystem genetics. It is likely that the presence of lionfish will skew food webs towards a loss of higher trophic groups and a gain in lower order consumers as reported for other human disturbances. There is a general consensus where generalist invasive species replace specialists and subsequently leading to homogenisation of the communities with potential changes on ecosystem functioning and productivity, as well as result in the deterioration of ecosystem goods and services - **Ecosystem services**: Major impact with low certainty. In the Mediterranean, impacts from *Pterois miles* are expected, especially on provisioning ecosystem services after impacts on fishery industry, as well as on cultural ecosystem services with impacts on the diving industry and fishery. *Pterois miles* may have a significant impact on fishery yields, hence affecting provisioning services for nutrition. Other ecosystem services that are likely

	affected include provisioning services related to materials such as genetic materials from all biota and animal based resources. Lionfish invasion is likely to impact indirectly on the regulation and maintenance of ecosystem services related to mediation of waste, toxics and other nuisances by filtration/sequestration/storage/accumulation, and impacts on maintaining nursery populations and habitats. - **Economy**: Massive with low confidence. In other invaded ranges the main impacts are linked to high predation rates and decrease of native high economically important species, to the effort and time fishermen need to sort out the catch when lionfish are caught in the nets, and the loss of fishermen's time and resources if envenomation occurs. Dense populations of lionfish are likely to affect the diving industry due to possible envenomation on recreational divers, especially in caves/wrecks, causing fear and reduction in diving destinations attractiveness. If similar patterns are observed as in the case of the western Atlantic Ocean, the economic costs linked to fishing, recreation and tourism in the Mediterranean Sea could potentially be high given also the alarming rate of lionfish spread and establishment. - **Human health**: Moderate impact with low confidence. *P. miles* affects the health and the safe access to activities (recreational diving, fishing, swimming), since it is a highly venomous fish. The venom is delivered to the wound when the ray of the fin penetrates the skin of the victim. The majority of the envenomation reports occur in aquaria during lionfish handling. However, envenomation has been reported during recreational diving, by spear-fishers, and by fishermen during netting. Symptoms from lionfish envenomation include excruciating local pain that increases over time throughout the affected limb, marked inflammation, which causes important erythema, oedema and local heat and in some cases local cyanosis, paleness, vesicles and blisters are observed.
4.3 (d) demonstrated by a risk assessment carried out pursuant to Article 5(1) that concerted action at Union level is required to prevent their introduction, establishment or spread;	Concerted action at Union level is required: - in order to mitigate the lionfish invasion in the Mediterranean – i.e. slow down the likely invasion into the MS where this species could establish but is not currently present and prevent further spread in the MS where this species is already present or at least keep the populations at levels that reduce their impacts.
4.3 (e) likely that the inclusion on the Union list will effectively prevent, minimise or mitigate their adverse impact.	- **Prevention (Article 7)**: Introduction of *P. miles* in the Mediterranean Sea is unaided and unintentional. The possible pathways are primarily the Suez Canal with an additional vector represented by intentional releases from aquaria. Stowaway (ballast) should not be excluded. Measures for prevention therefore include barriers to the Suez Canal (e.g. salinity barrier or establishment of locks to decrease current movements) and awareness campaigns for the aquarium trade as well as trade prohibition of *Pterois miles*. Since the invasion of lionfish in the basin is at a mature level with high population levels in many areas (including EU countries), its introduction to suitable habitats of the EU cannot be prevented. However, prevention measures can limit the genetic diversity of lionfish in the Mediterranean and reduce lionfish spread within the basin. - **Early detection and rapid eradication (Articles 14 - 18)**: Measures in this category include early surveillance and scientific monitoring and targeted removal for early eradication. Measures for eradication should be limited to targeted areas where the lionfish is next anticipated, since eradication of the species from locations where it is established is highly unlikely. - **Management (Articles 19-20)**: Management actions can only control lionfish populations but not eradicate it or prevent its further expansion in European waters. Preliminary results of the RELIONMED project indicate that manual removals of lionfish through diver-led culling can be effective in controlling their population in priority areas. The frequency of lionfish removals (either in the form of coordinated diving removals or fishing pressure) may in fact allow for population control to as the minimum possible and mitigate lionfish impacts in priority areas, but it is not considered an ultimate tool for

	preventing its establishment. The most effective low-cost removal practices include spearfishing (polespear or speargun), vinyl/mesh hand-netting and Hawaian slings for large individuals. Many of these are restricted to divers, while other removal techniques that can be used by fishermen include traps and hook and line. In addition, citizen science monitoring, awareness measures, regional action, and market promotion are all very useful tools for management of lionfish.
4.6 due consideration to the implementation cost for Member States, the cost of inaction, the cost-effectiveness and the socio- economic aspects	- **Implementation cost:** - Prevention: The costs of reinstating a high salinity section in the Suez canal would be high to very high, but could be decreased if combined with other construction initiatives on the Suez Canal – hypersaline effluent of mega desalination plants in the vicinity of the Suez Canal could be used strategically. This would require international co-operation. Costs of awareness and education campaigns vary depending on the target group and platform used, but are estimated to be low and could be temporary. - Early detection and eradication: Surveillance systems are already in place, so they don't require substantial resources apart from maintenance and running costs. Early response (e.g. spearfishing a lionfish after its detection in a new area) should be promoted, since its costs will not be high, and despite low chances of avoiding the invasion in the new area, such measures might delay it. - Management: The approximate cost for organising a removal event with citizen divers in the framework of the RELIONMED project ranged between 500 and 960 euros (mean 730 euros). Nevertheless, a removal event with divers and a responsible authority/individual could also be organised at far less expense given that only one responsible person could supervise the event. It is also worth noting that most divers would be ready to pay fees to participate in lionfish removals. The costs of citizen science to complement official surveillance system was estimated to be low. The market (consumption and jewel-crafting) promotion incurs some costs for its development, but on the long-term it will provide both socioeconomic and environmental benefits.
	- **Cost of inaction:** It is very likely that *P. miles* will spread into additional MS in the Mediterranean Sea.
	- **Cost-effectiveness:** Trade prohibition of lionfish in the aquarium trade and awareness campaigns are cost-effective ways to prevent further spread and new introductions of lionfish through this pathway. - Cost-effectiveness of manually removing lionfish from selected locations can only be assured if divers (citizens) are allowed to remove lionfish under special permits. Targeted removals during peaks of lionfish numbers and reproduction season (i.e. summer period) can cause more impact to their population. In addition, participation of divers in removal events including competitions appear to have strong social benefits.
	- **Socio-economic aspects:** The lionfish could have some benefits for diving tourism and as a food source. When the spines are removed, the rest of the body is edible and often yields a 30% fillet out of the total biomass, with great palatability, mild flavour and rich in saturated and omega-3 fatty acids. The therapeutic and medicinal properties of the lionfish venom are being explored (preliminary evidence that its venom may be utilised in further cancer research and potentially in cancer therapy). Creating market niches is believed to be key to ensure the sustainability of the removal activity. Commercialising lionfish products can increase awareness and financially sustain fishermen or lionfish cullers. Direct beneficiaries include lionfish cullers, fish mongers and markets, seafood restaurants, jewel crafters, souvenir shops and, of course, those buying the product. Any social or economic benefits from lionfish in the Mediterranean should arise from the creation of market niches for removal of lionfish without encouraging a sustainable supply.
4.6 The Union list shall include as a priority those	The species is established in the EU, but there is scope for much wider spread.

invasive alien species that: (a) are not yet present in the Union or are at an early stage of invasion and are most likely to have a significant adverse impact;	
4.6 The Union list shall include as a priority those invasive alien species that: (b) are already established in the Union and have the most significant adverse impact.	Where the species is established outside its native range, it is proven to have significant adverse impact.