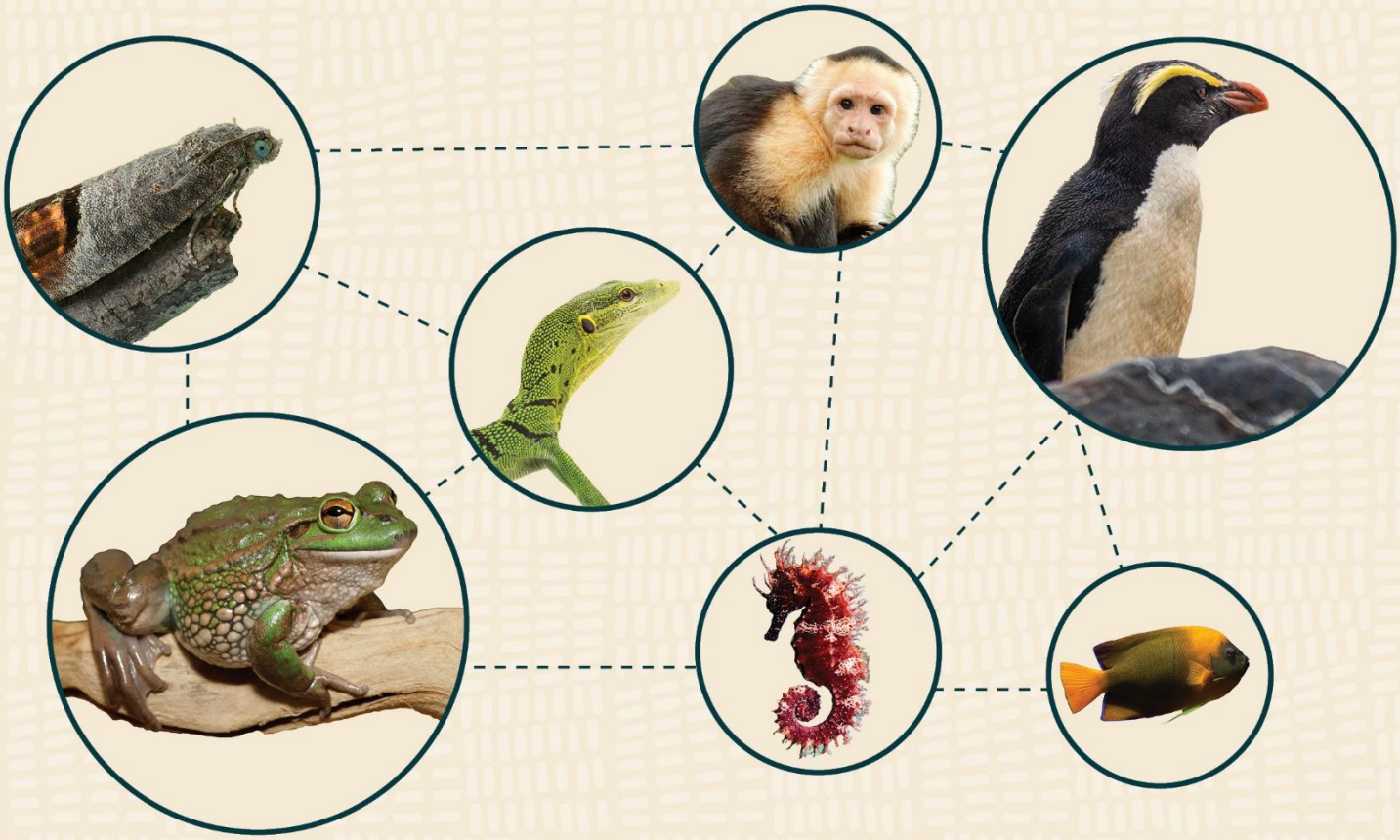
Australian Government
Department of Climate Change, Energy, the Environment and Water

Assessment of the Potential Impacts of 2 Species from the Genus *Kiunga* on the Environment

Consideration of an application under the *Environment Protection and Biodiversity Conservation Act 1999* to amend the List of Specimens Taken to be Suitable for Live Import



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Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

Executive summary

In 2022, applications to amend the Live Import List to include 2 species of rainbowfishes from the genus *Kiunga* were submitted to the Department of Climate Change, Energy, the Environment and Water. The applications were prepared in accordance with s 303EE of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The 2 species were:

- *Kiunga ballochi* (Balloch's blue-eye)
- *Kiunga bleheri* (Bleher's blue-eye)

Risk assessments were undertaken to evaluate the likelihood of establishment and spread of the species in Australia, and the potential impact(s) on the Australian environment. Several factors were considered during the assessments, including, but not limited to, available scientific evidence, biological and ecological traits of the species, environmental conditions for establishment (current and potential distribution of the species), conservation status, and potential impacts in the event of the establishment or spread of the species.

Kiunga is a genus of rainbowfish endemic to New Guinea and contains 2 species, *K. ballochi* and *K. bleheri*. The genus was discovered in 1982 when *K. ballochi* was first recorded (Allen 1983). *K. bleheri* was later described by Allen (2004). Both species have a restricted geographic distribution and therefore may be susceptible to localised extinction. Due to this, and their relatively recent discovery, little is known about their biology and ecology in their natural habitats. Rainbowfish are increasingly popular with aquarium hobbyists due to their ease of breeding, hardiness, bright colouration and dispositions.

Under ss 391(1) of the EPBC Act, the Minister for the Environment and Water must take account of the precautionary principle in making decisions. The precautionary principle is triggered by two threshold conditions: (1) a threat of serious or irreversible environmental damage (direct or indirect); and (2) scientific uncertainty as to the environmental damage. In the absence of any history of invasiveness and establishment, the Fish Invasiveness Screening Kit (FISK) showed that both *Kiunga* species present a low risk of invasiveness and the impacts assessment suggest minor potential impacts on the environment if they were to establish. These species have few undesirable traits and would likely be eaten by predatory fish, birds and reptiles. Therefore, the department has determined that the 2 species of *Kiunga* do not pose a threat of serious irreversible damage.

The conservation status of these species is of concern, as both are listed as Critically Endangered or Endangered on the IUCN Red List of Threatened Species. Subsection 303EN(3) of the EPBC Act states that the Minister must not issue a permit unless satisfied that the proposed import would not be likely to threaten the conservation status of a species or ecological community, or likely to threaten biodiversity. As a signatory to the Convention on Biological Diversity (CBD 2022), Australia has the responsibility to ensure that activities within our jurisdiction do not cause damage to the environment of other states or areas. It is important that listing of threatened species in the Live Import List does not place pressure on wild stocks.

Recommendation: In consideration of their conservation status, the department recommends listing *Kiunga ballochi* and *Kiunga bleheri* in Part 2 of the Live Import List with the condition:

- Captive-bred specimens only, of minimum length 2cm SL.

Contents

Executive summary ..... **iii**

1 Introduction **7**

1.1 Purpose of the proposed import 7

1.2 Background on the Act 7

2 Biology and Ecology **8**

2.1 Taxonomy 8

2.2 Description 8

2.3 Geographic distribution 9

2.4 Habitat 12

3 Species status and conservation **13**

3.1 History in Australia 13

3.2 Related Live Import List listings 13

3.3 Related threat category listings 13

3.4 Conservation status 13

4 Risk Assessment **15**

4.1 The FISK Risk Assessment Model 15

4.2 Consequences for the environment 22

4.3 Risk Rating 25

4.4 Consultation – Concerns raised 25

4.5 Risk Mitigation 26

5 Discussion **28**

6 Conclusion **30**

Appendix A: FISK Model Results **31**

Appendix B: Impacts assessment scoring criteria **36**

Appendix C: Comments received on the proposal to include 2 species of *Kiunga* in the Live Import List 42

Glossary **51**

References **52**

Tables

Table 1 Non-endemic rainbowfish species in the Live Import List 13

Table 2 Decision matrix to combine the level of climate match with water temperature match to determine the FISK response rating for Q2.01 16

Table 3 Introductions of species from the family Melanotaeniidae 18

Table 4 Potential impacts from the establishment of *Kiunga* spp. populations in Australia 23

Table 5 Summary of main concerns raised and the applicant's responses 26

Table 6 Comments received during public consultation and response from applicant 42

Table 15 Comments received during consultation Round 2 with states and territory governments ... 49

Figures

Figure 1 Adult *Kiunga ballochi* 9

Figure 2 Adult *Kiunga bleheri* 9

Figure 3 Geographic distribution of the genus *Kiunga*: *K. ballochi* extant (●) and possibly extant (●) distribution overlaps that of *K. bleheri*, which has an extremely restricted distribution in Papua New Guinea (●) 10

Figure 4 Locations around Kiunga, Papua New Guinea, where *Kiunga ballochi* (★) and *Kiunga bleheri* (▲) have been found 11

Figure 5 Köppen-Geiger map of Oceania 17

1 Introduction

1.1 Purpose of the proposed import

The applicant seeks to amend the *List of Specimens Taken to be Suitable for Live Import* (Live Import List) to include *Kiunga ballochi* (Balloch's blue-eye) and *Kiunga bleheri* (Bleher's blue-eye) for the ornamental aquarium fish trade in Australia.

1.2 Background on the Act

Under s 303EC of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the responsible Minister may amend the Live Import List by, relevantly, including a specimen in the list. Section 303EB of the EPBC Act dictates two parts to the Live Import List:

- Part 1 comprises specimens that can be imported without a permit under the EPBC Act. Part 1 must not include any organism listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and
- Part 2 comprises specimens that require a permit under the EPBC Act to be imported. For each specimen included in Part 2 of the list there is to be a notation regarding whether the inclusion is subject to restrictions or conditions. Restrictions or conditions may relate to a quantitative limit, the circumstances of import, the source of the specimen or the circumstances in which it was taken. Additional conditions may also be applied when the permit for import is issued.

Before amending the Live Import List, the Minister must consult with appropriate state, territory and Commonwealth ministers and may consult with other persons as appropriate and consider a report assessing the potential environmental impacts of the proposed amendment (s 303EC of the EPBC Act). When submitting an application to the department to amend the Live Import List, all applicants are required to provide a draft assessment report that addresses specific terms of reference published on the department website.

The department undertakes an assessment of the potential environmental impacts of the proposed amendment using the information in the applicant's draft report and any other sources of relevant information. The department also considers comments and information received through the public consultation process (including from states and territories). The application and accompanying draft report for the proposed amendment to the Live Import List to allow the import of *Kiunga ballochi* and *Kiunga bleheri* was released for public comment from 14 October to 24 November 2022. This assessment report on the potential environmental impacts of listing the species was prepared in accordance with s 303EE of the EPBC Act. Under ss 303EC(5)(a) the Minister must consider this report before amending the list.

Under ss 391(1) of the EPBC Act, the Minister must take account of the precautionary principle in making decisions. The precautionary principle is triggered by two threshold conditions: (1) a threat of serious or irreversible environmental damage (direct or indirect); and (2) scientific uncertainty as to the environmental damage.

2 Biology and Ecology

2.1 Taxonomy

Rainbowfishes are one of the most abundant families of freshwater fish in Australia and New Guinea with 112 species across 7 genera (Fricke, Eschmeyer & Van der Laan 2022). The genus *Kiunga* includes two species: *K. ballochi* and *K. bleheri* (Froese & Pauly 2022). The genus was discovered in 1982 when *K. ballochi* was first recorded by Allen (1983). This species was named in honour of Dr David Balloch. *K. bleheri* was later described by Allen (2004). Common names for *K. ballochi* include Balloch's blue-eye, glass blue-eye and Kiunga blue-eye. The common name for *K. bleheri* is Bleher's blue-eye.

Kingdom:	Animalia
Phylum:	Chordata
Superclass:	Osteichthyes
Class:	Actinopterygii
Infraclass:	Teleostei
Order:	Atheriniformes
Family:	Pseudomugilidae
Genus*:*	*Kiunga* (Allen 1983)
Species:	*Kiunga ballochi* (Allen 1983)
	Kiunga bleheri (Allen 2004)

2.2 Description

The family Pseudomugilidae are small (< 5 cm standard length (SL)), colourful fishes with slender compressed bodies and large eyes with an electric-blue iris (Allen 2004, Fishes of Australia 2022). The genus *Kiunga* differs from *Pseudomugil* by scalation, skull features, dentition, fin shape and counts (Allen 1983, Saeed et al. 1989).

K. ballochi has a transparent body with a silvery coloured stomach and opercula (Figure 1). Body scales are thinly outlined with pepper-like melanophores. The mid lateral line, ventral edge of caudal peduncle, and bases of dorsal, caudal, and anal fins have dense concentrations of melanophores. The dorsal fin spines are translucent yellow; the second dorsal, caudal, and anal fins have bold black borders and yellow submarginal bands. The remaining portions of these fins are transparent except the dorsal and anal fins that have narrow strips of yellow basally and the anterior half of the anal fin has mainly yellow membranes. The pectoral fins are transparent. All fins with soft rays are faintly outlined with black. Maximum size to approximately 3 cm SL (Allen 1983).

K. bleheri has a body that is semi-transparent with the second dorsal fin faintly yellowish on the outer portion with an irregular black margin (Figure 2). It differs from *K. ballochi* by its shorter second dorsal and anal fins, significant modal difference in the number of second dorsal fin rays, 6 versus 5 transverse body scale rows, and having most of the second dorsal and anal fin rays unbranched. Maximum body size is approximately 2.8 cm SL (Allen, Hammer & Unmack 2020b).

There is no obvious sexual dimorphism exhibited in *Kiunga* spp., in contrast with many melanotaeniids (Allen 1983).

Figure 1 Adult *Kiunga ballochi*



Source: Neil Armstrong (permission for use obtained from applicant)

Figure 2 Adult *Kiunga bleheri*



Source: Mark Allen (permission for use obtained from applicant)

2.3 Geographic distribution

The genus *Kiunga* is endemic to New Guinea, with both species found in the Upper Fly River system of Papua New Guinea (Figure 3). The Fly River is the largest river in New Guinea, with more than 108

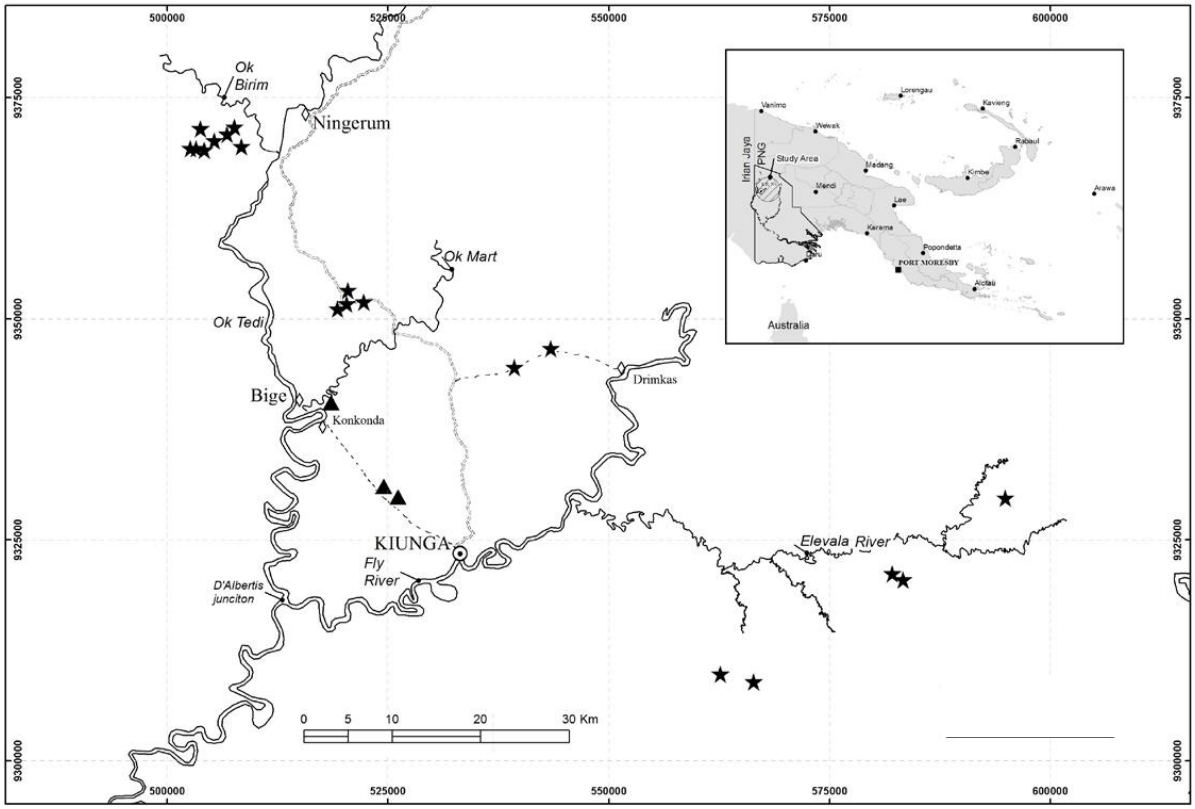
species of freshwater fishes, many of which are endemic, more than any other river system in New Guinea (Allen, Storey & Yarrao 2008). The Fly and Trans-Fly Region share a number of species with northern Australia (Allen 1991) including members of the family Pseudomugilidae. Although both *Kiunga* spp. occur in several creeks in the vicinity of the town Kiunga (Figure 3), the spatial extent of their distribution and environmental variables that determine their distribution are unknown (Amick et al. 2020).

Figure 3 Geographic distribution of the genus *Kiunga*: *K. ballochi* extant (●) and possibly extant (●) distribution overlaps that of *K. bleheri*, which has an extremely restricted distribution in Papua New Guinea (●)



Source: Map data from IUCN Red List, compiled by DCCEEW

Figure 4 Locations around Kiunga, Papua New Guinea, where *Kiunga ballochi* (★) and *Kiunga bleheri* (▲) have been found



Source: Modified from Amick et al. (2020)

Additional subpopulations of *K. ballochi* have been recorded from tributaries of the Ok Birim, to the west of the Ok Tedi main channel, and adjacent to the Papua New Guinea-Indonesian border, and from several creeks crossed by a new road connecting Kiunga to Drimkas at the Upper Fly-Palmer River confluence (Allen, Hammer & Unmack 2020a). A fourth subpopulation that appears to be this species was discovered in 2018 in a small tributary of the Elevala River, which is a major tributary of the Upper Fly River, but located to the east of the Fly River, which substantially extends the range within the catchment (Allen, Hammer & Unmack 2020a). This species is not likely to be found in the main stem of the Fly River. Additional surveys are required to establish the limits of distribution, particularly westwards into Indonesia, which lies immediately adjacent to the western extent of its current known range, but also further east, towards the Strickland River and beyond.

K. bleheri is endemic to the Upper Fly River system of Papua New Guinea, where it is known only from a couple of small creeks crossed by the Kiunga-Konkonda Road, approximately 10-12 km west of Kiunga, Western Province (Allen, Hammer & Unmack 2020b, Tappin 2015).

2.4 Habitat

Allen (1983) found *K. ballochi* in several narrow, shallow, clear creeks and streams flowing through dense rainforest with occasional sunlit clearings. Allen (1983) recorded water temperatures of 24-25°C and pH of 7.8. Tappin (2015) notes that a similar species of rainbowfish, *Pseudomugil novaeguineae*, was collected at the same location.

Allen (2004) found *K. bleheri* in clear, shallow rainforest streams and creeks in the Fly River system. These waterways lie in relatively flat or low foothill terrain amongst undisturbed rainforest at an elevation of about 100 m asl and are relatively well shaded, but have occasional open patches exposed to sunlight (Allen 2004). Allen (2004) recorded water temperature as 27°C, pH 5.9 and conductivity of 29 µS/cm (Tappin 2015).

3 Species status and conservation

3.1 History in Australia

There are no records or information to suggest that *Kiunga* spp. have established populations in Australia. Tappin (2015) states that live specimens of *K. ballochi* were imported into Australia but were destroyed in a house fire in February 1983. The applicant states that similar species of rainbowfishes from the genus *Pseudomugil* are well known in the aquarium trade in Australia, including *P. connieae*, *P. furcatus* and *P. gertrudae*.

The introduction of new aquatic species is difficult to monitor as fish may reproduce significantly before being detected (Ebner et al. 2020). The detection of invasive species may also be hindered in remote, infrequently visited areas, such as northern Australia, where regular flooding events in the wet season may assist the spread of alien aquatic species.

3.2 Related Live Import List listings

No *Kiunga* spp. are listed in the Live Import List. There are 2 similar species of rainbowfishes from the genus *Glossolepis*, family Melanotaeniidae, listed in Part 1 of the Live Import List (Table 1).

Table 1 Non-endemic rainbowfish species in the Live Import List

Scientific Name	Common Name
Glossolepis incisus of minimum length of 3.5 cm SL	Red Rainbowfish
Glossolepis leggetti of minimum length 4 cm SL	Leggett's Rainbowfish

3.3 Related threat category listings

Within their native habitat, neither *Kiunga* spp. are considered invasive or a pest on the National Priority List of Exotic Environmental Pests, Weeds and Diseases (DAFF 2022).

3.4 Conservation status

3.4.1 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species.

Neither *Kiunga* spp. are CITES-listed.

3.4.2 IUCN Red List of Threatened Species

Established in 1964, the International Union for Conservation of Nature (IUCN)'s Red List of Threatened Species is the world's most comprehensive information source on the global extinction risk status of animal, fungus and plant species.

K. ballochi was assessed by Allen, Hammer & Unmack (2020a) as Endangered B1ab(iii) with a decreasing population trend. This status was justified due to the restricted distribution and ongoing threats from human disturbance and habitat destruction. Previous Red List Assessments include Critically Endangered (2009), Critically Endangered (1996) and Vulnerable (1994).

K. bleheri was assessed by Allen, Hammer & Unmack (2020b) as Critically Endangered B1ab(iii) with a decreasing population trend. This status was justified due to this species being endemic to the Upper Fly River system of Papua New Guinea where it is only known from a couple of small creeks. Its population is threated by human disturbance and destruction and introduced species.

3.4.3 Convention on the Conservation of Migratory Species of Wild Animals

The Convention on the Conservation of Migratory Species of Wild Animals is an environmental treaty of the United Nations. It provides a global platform for the conservation and sustainable use of migratory animals and their habitats.

Neither *Kiunga* spp. are listed on the Convention on the Conservation of Migratory Species of Wild Animals.

4 Risk Assessment

4.1 The FISK Risk Assessment Model

The introduction of non-native fish species poses a significant risk to biodiversity (Vilizzi & Copp 2013). The likelihood of invasiveness was assessed using the Fish Invasiveness Screening Kit (FISK) (Copp, Garthwaite & Gozlan 2005). FISK is a proven tool to determine which species to restrict or ban with regard to importation and/or sale as ornamental or fishery enhancement species (Vilizzi et al. 2019). Focusing on multiple aspects of a species' biology, including life history (e.g., fecundity) and physiological tolerance, as well as indicators of a species' ecology, such as distributional range, trait-based risk assessments identify a species' innate likelihood of succeeding at an invasion stage in an introduced environment. Through the quantification of biological and ecological species traits, these risk assessments provide a straightforward and accurate means of identifying and predicting high- and low-risk species.

Using information compiled from research into these factors, the potential impacts of the establishment of feral populations can be estimated.

4.1.1 Domestication/Cultivation

Domestication is considered to have the potential of enhancing the fitness of some freshwater fishes over wild strains (i.e., increased growth rate, mating success and/or fecundity), and commercial production of ornamental species may also increase the intensity of introductions (i.e., propagule pressure) (Moyle & Marchetti 2006, Gozlan, Pinder, & Shelley 2002, Copp, Templeton & Gozlan 2007, Ebner et al. 2020, Chan, Zeng & Yeo 2021). Conversely, commercially produced ornamental fish are often selected for traits that may reduce their fitness, such as bright colouration or increased fin length which increases their vulnerability to predation and reduces their likelihood of establishment in new environments (Hill, Kapuscinsk & Pavlowich 2011, Thompson, Hill & Nico 2012).

Neither *Kiunga* spp. are reported to be highly domesticated or as being captive bred for at least 20 generations. There are no invasive subspecies or varieties recorded.

4.1.2 Climate and distribution

The likelihood of successful establishment and negative impacts is thought to be influenced by the similarity of the climatic conditions between the source and recipient areas. The risk of establishment increases as the climatic similarity between the species' native area and potential area of introduction increases (Moyle & Marchetti 2006, Hayes & Barry 2007, Chan, Zeng & Yeo 2021).

Climatch

Climatch v2.0 (ABARES 2020) was used for climate matching of target regions for each species to Australia, using the World Clim v2 sample (2019) dataset and all 16 climatic parameters for matching locations. Results were output in an Australia 20k Grid, showing climate matches to Australia. Due to their highly limited ranges, there were less than 12 meteorological stations in the input area for both species and so the highest possible response score to the climate matching question was applied by

default to invoke the precautionary approach recommended for FISK (Copp et al. 2005, Lawson et al. 2013). The level of climate matching derived at Euclidian Sum Level 5 is **High.**

Water temperature

Water temperature is the most limiting environmental factor in Australia's freshwater determining whether an exotic fish would establish self-sustaining populations. The lower lethal temperature is often the most important environmental factor limiting the distribution and spread of exotic tropical fish outside their native range, and this has been determined for several exotic freshwater fish species (Shafland & Pestrak 1982, Arthington et al. 1999, Gestring, Shafland & Standford 2010). In Australia, rainbowfish species are found almost everywhere that water is present, excluding extremely arid regions (which are mainly devoid of fishes) and the southernmost regions, where distribution is controlled by winter minimum temperatures (Tappin 2011). The *Kiunga* species under assessment inhabit streams ranging from 24-27°C (Tappin 2011, Amick et al. 2020), but this does not necessarily represent their tolerable ranges.

Water temperature suitability assessments, based on ABARES Water Temperature Reference Tool (WTRT) (Warnakula, Parsons & Mitchell 2023) and information from Tappin (2011), indicated that water temperatures in some areas of Australia (e.g., Cape York Peninsula) are **suitable** for *Kiunga* species. The rivers in tropical north-eastern Australia have average surface water temperatures of 30°C but may range from 25-38°C (Tappin 2011). For example, median water temperatures of the Tully-Murray floodplains range from 22.6-32.4°C (Godfrey et al. 2016). It is highly probable that the rivers and floodplains of tropical north Queensland would provide suitable habitat for the *Kiunga* species under assessment.

The results from Climatch and WTRF were combined using the decision matrix (Table 2) (Warnakula, Parsons & Mitchell 2023) resulting in an overall climate match of **High**.

Table 2 Decision matrix to combine the level of climate match with water temperature match to determine the FISK response rating for Q2.01

The level of climate match based on Climatch analysis	**Water temperature**	
	Suitable	Not suitable
High	High	Medium
Medium	High	Low
Low	Medium	Low

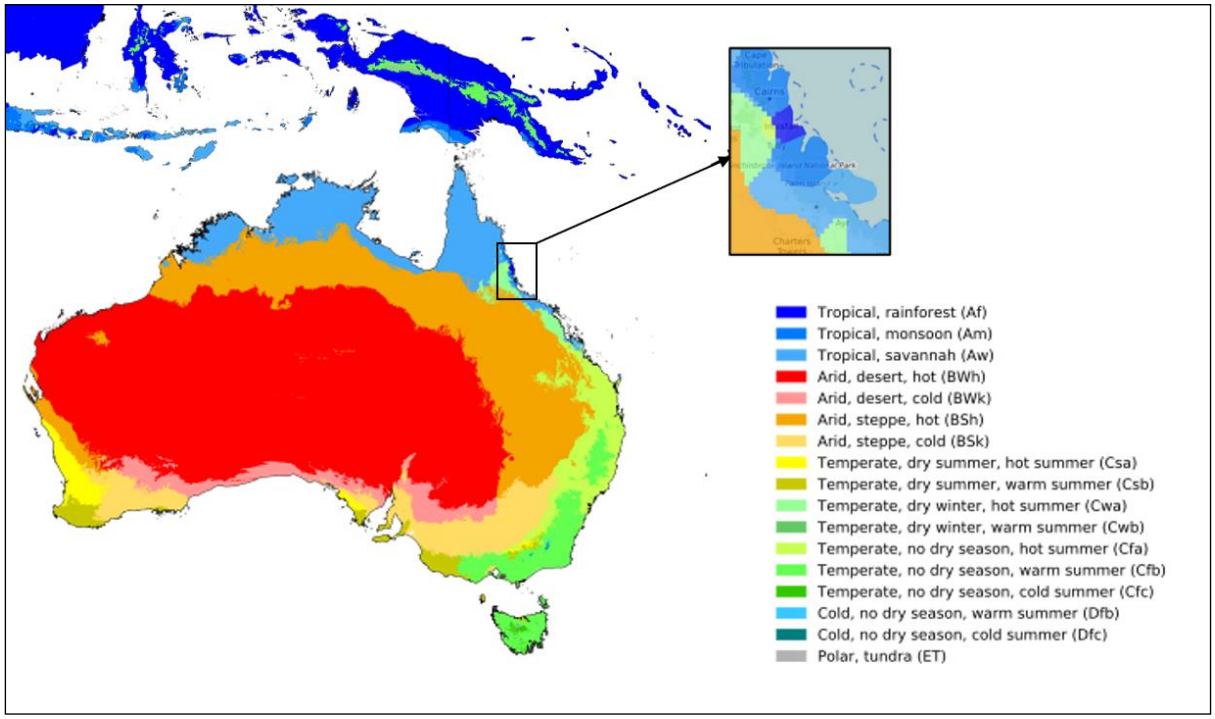
Quality of climate match data is considered **Medium** as climate matching was based on terrestrial climate data (Climatch v 2.0) and water temperature data (Warnakula, Parsons & Mitchell 2023). The WTRT relies on national datasets, which are limited for the tropics, and may also not capture micro-environmental variation or gradients in the water column. These limitations may create false instances of predicted unsuitability. If there are no water bodies that appear suitable this may be due to deficient data (Warnakula, Parsons & Mitchell 2023).

Köppen-Geiger Climate Zones

The Köppen-Geiger system classifies climate into five main classes and 30 sub-types and is based on threshold values and seasonality of monthly air temperature and precipitation (Beck et al. 2018). In species distribution models, climate variables are considered the primary driver to explain species ranges at larger spatial extents (Guisan & Zimmermann 2000).

The Köppen-Geiger climate classification map was compared to the species native ranges (Figure 5). Both species are found in the Af zone (tropical rainforest) on the island of New Guinea (Beck et al. 2018). This zone is characterised by constant high temperatures (at sea level and low elevations) with year round average temperatures of 18°C or higher and year–round average precipitation of at least 60 mm per month (PlantMaps 2022). This climate is dominated by the doldrums low-pressure system all year round, so has no natural seasons (PlantMaps 2022). In Australia, the Af zone is found in a very restricted coastal area in coastal north-eastern Queensland, from approximately Wongaling Beach in the south to Fishery Falls in the north and inland to Coorumba (Figure 5).

Figure 5 Köppen-Geiger map of Oceania



Source: Beck et al. (2018)

In Australia, rainbowfish species are found almost everywhere that water is present, excluding extremely arid regions (which are mainly devoid of fishes) and the southernmost regions, where distribution is controlled by winter minimum temperatures (Tappin 2011). In their natural environment, rainbowfishes are exposed to highly variable temperatures depending on the size and depth of the water body, with an overall water temperature range reported from 12 – 36°C (Tappin 2011).

4.1.3 Invasive elsewhere

Invasive history of a species or its relatives may be used to predict invasive potential (Kolar & Lodge 2022, Ribeiro et al. 2008, Chan, Zeng & Yeo 2021). For species with a history of introductions to new

areas, or with relatives in the same genus or family with such a history, previous establishment success rates should be considered a key predictor of future establishment success.

There are currently no known introductions or successful establishment of *Kiunga* spp. outside their range (Froese & Pauly 2022).

There are 7 genera and 96 species in the family Melanotaeniidae, all freshwater species originating from northern and eastern Australia and Papua New Guinea. There are reports that 4 species have been introduced outside their natural range, with no known establishments (Table 3). Arthington et al. (1999) suggests there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia.

Many species that are potential exotics have not been transported to and released in new environments, so they have not had the opportunity to demonstrate their establishment potential. Caution should be applied when using a history of establishment elsewhere to predict a species' establishment potential in Australia if the species being assessed has little or no history of previous introductions (Bomford 2008).

Table 3 Introductions of species from the family Melanotaeniidae

Species (Scientific name)	Country where introduced	Year introduced	Population established [a]
Iriatherina werneri	Philippines	1996	Unknown
Melanotaenia boesemani	Philippines	1993	Unknown
Melanotaenia lacustris	Philippines	Unknown	Unknown
Melanotaenia nigrans	Philippines	1992	Unknown
	USA	1930	Unknown

a data from Froese & Pauly (2022)

4.1.4 Undesirable traits

Freshwater fish introductions may have negative impacts due to one or more undesirable traits, such as competition, habitat alteration, parasitism, predation, disease transmission, hybridisation and/or alteration of habitat quality and function (Copp, Garthwaite & Gozlan 2005). The probable absence of natural predators in the receiving environment, traits relating to toxicity or dangers to human health, and the ultimate size of the species are also considered.

Species that reach a large ultimate size (greater than 15 cm) are more likely to outgrow their housing and be released into the wild than small species (Marchetti et al. 2004, Copp, Garthwaite & Gozlan 2005, Vila-Gispert Alcaraz & García-Berthou 2005, Duggan et al. 2006, Liu et al. 2017, Liang et al. 2020). Additionally, moderate size (> 10 cm and < 80 cm) is a good indicator of a species' ability to become abundant (Moyle & Marchetti 2006). *Kiunga* spp. have a small body size and do not grow larger than 3 cm SL (Froese & Pauly 2022).

There is no information to suggest that *Kiunga* spp. are poisonous or venomous, nor that they pose a risk to human health or are parasitic of other species (Froese & Pauly 2022).

Primary prey species may include small crustaceans and insect larvae, similar to other New Guinea rainbowfishes such as *Pseudomugil*. *Kiunga* spp. would not likely prey on any native species previously subjected to low (or no) predation.

Kiunga spp. would likely be predated on by predatory fish, water birds, reptiles and humans. Predatory fish families known to eat rainbowfishes include Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae (Froese & Pauly 2022). All families but Butidae, Dasyatidae, Latidae, Megalopidae, Muraenidae and Sciaenidae have native species present in Australia (NFA 2022).

Rainbowfishes can perform aquatic surface respiration to survive low oxygen concentrations for short periods (Tappin 2011). This may also be applicable for *Kiunga* spp. but is unknown.

Disease

Based on assessments of freshwater fishes in similar genera (such as *Pseudomugil*, *Chilatherina* and *Glossolepis*), these species may host, and/or be a vector, for one or more recognised non-native infectious agents. A variety of pathogens and parasites infect rainbowfishes, including *Ichthyophthirius multifilis* (causes white spot disease or 'Ich'), *Psicinoodinium pillulare* (causes velvet disease) and *Trichodina* (causes trichodiniasis) (Tappin 2011). Mortality of the desert rainbowfish (*Melanotaenia splendida* subsp. *tatei*) in the Finke River in Australia was attributed to an outbreak of the protozoan *Chilpodonella hexasticha* (Langdon et al. 1985). Leeches are occasionally seen on wild rainbowfishes causing chronic anaemia and development of secondary infections (Tappin 2011). Monogenean flatworms, cestodes, nematodes and coccdiai are also fairly common (Tappin 2011).

The bacteria *Aeromonas, Pseudomonas* and *Flavobacterium* can cause fin and tail rot. *Flavobactrium columnare*, which causes Columnaris disease, is ubiquitous on the skin of healthy fish worldwide and is a significant problem in warm water species (Bernardet & Grimont 1996). Hypoxia and death can occur in acute cases, and the disease is transmitted by direct contact with infected fish or contaminated water (Tappin 2011). Achlya, a fungus, is commonly found on wild-caught rainbowfish, and epizootic ulcerative syndrome ('red spot') disease has been reported from rainbowfish species in the Northern Territory (Tappin 2011).

A review of diseases associated with rainbowfish did not identify any pests or diseases associated with the family Melanotaeniidae that were not already identified in Australia (Hardy-Smith, Jones & Kailola 2007). Disease transmission as a result of the introduction of a *Pseduomugil* species into the natural environment is unlikely to pose any further risk than other endemic freshwater fish species as there are no known fish diseases or strains specific to Melanotaeniids.

4.1.5 Diet and feeding guild

Many fish species vary their diets due to ontogeny or opportunity (Jackson et al. 2001), and those that are predatory or omnivorous at some point in their life cycle are more likely to be successful invaders (Ricciardi & Rasmussen 1998), likely related to the high availability of food during the establishment phase of the invasion (Moyle & Marchetti 2006).

No specific information on the diet of *K. ballochi* and *K. bleheri* is available. However, these species are likely alike in their diet and feeding behaviours to species from similar genera, such as

Pseudomugil; they are opportunistic omnivores and consume a variety of small aquatic, terrestrial animals, and plant matter. Feeding, or other (foraging) behaviours, of *Kiunga* spp. is highly unlikely to reduce habitat quality for native Australian species or have an adverse impact on the environment.

4.1.6 Reproduction

Invasive ability is directly influenced by a species' life history traits including fecundity, spawning requirements, gamete viability and reproductive strategy. Species that have multiple spawning events, extended spawning seasons (Alcaraz, Vila-Gispert & García-Berthou 2005) and/or rapid growth rates all increase the likelihood of invasion (Moyle & Marchetti 2006). High fecundity is associated with invasion success, supported by a large body of work (Vila-Gispert et al. 2005, Howeth et al. 2016, Liu et al. 2017, Liang et al. 2020). However, Chan, Zeng & Yeo (2021) found that K-strategists with a lower absolute fecundity (such as *Poecilia reticulata*) that produce fewer but larger and more developed offspring, coupled with parental care, were more invasive. In some cases, parental investment may be more important to establishment than fecundity (Drake 2007). The dependence of a species on other species or specific habitat feature to complete its life cycle would limit invasive potential into areas in which these features are lacking.

Rainbowfishes from the genera *Melanotaenia*, *Pseudomugil* and *Chilatherina* are viewed by Allen and Cross (1982) as a single entity when regarding lifespan; they are said to live approximately 4 years in the wild but can live up to 8 years in captivity. Tappin (2011) suggested rainbowfishes from temperate waters have a longer life span than rainbowfishes from warm tropical areas.

Rainbowfish are non-seasonal spawners, spawning over a 4-5 month period when food is plentiful, aquatic vegetation is dense and larval survival is maximised. In floodplain rivers, there is a peak during the early wet season, but spawning also occurs in streams during the dry season (Tappin 2011). The extensive spawning strategy serves to offset the high mortality rates of larvae (as high as 99.99%, Tappin 2011). Factors that influence reproduction in rainbowfishes include temperature, water quality, flooding and water flow, photoperiod, rainfall, and food availability (Tappin 2011), with temperature and photoperiod the main factors.

Rainbowfish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for fertile offspring to be produced (Tappin 2011). Eggs adhere on submerged aquatic and riparian vegetation for 5-15 days before hatching into fry (Tappin 2011). Males are highly territorial over spawning sites, displaying to other males by flashing their fins. Once they have a spawning site, males will court a female, spawn, and then remain to defend the fertilised eggs once the female leaves (Tappin 2011).

Hermaphroditism, or the condition of having both male and female reproductive organs, has been reported in rainbowfish (Tappin 2011).

It is unknown what the minimum population size is to maintain a viable population for these species.

Hybridisation

Rainbowfishes are known to readily hybridise in captivity (Unmack, Allen & Johnson 2013), but there are no naturally occurring hybrids within the *Kiunga* genus. In Australia, there are 12 native

Melanotaenia species and 8 *Pseudomugil* species (Hoese 2014). There are no known records or information to suggest *Kiunga* spp. would hybridise with *Melanotaenia* or *Pseudomugil* spp.

No naturally occurring hybrids within the *Kiunga* genus, nor between *Kiunga* spp. and *Melanotaenia* spp., are known. There are reports, both published and anecdotal, of hybridisation between species in the genera *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus*, as well as between genera under artificial conditions in captivity.

4.1.7 Dispersal mechanisms

Dispersal ability is a primary determinant of invasiveness, both via natural and human-induced pathways (Moyle & Marchetti 2006). Dispersal mechanisms can be human assisted including deliberate or accidental stocking, bait bucket introductions, escapes, discarding or abandonment of aquarium fish, or cultural releases (Lintermans 2004). Natural abiotic factors can trigger dispersal such as floods (Arthington & Pusey 2003, King, Humphries & Lake 2003), use of stepping stone habitats and water velocity and flow (Pavlov 1994, Humphries, Serafini & King 2002). Dispersal may also be determined by biotic factors such as larval developmental stage (Lechner et al. 2016), migration (Lintermans 2004, Pavlov & Mikheev 2017), or through vector assistance (e.g., moved from one water body to another by birds).

Kiunga spp. may be dispersed by humans (accidental or deliberate release). It is not known if eggs or larvae are dispersed by currents, other organisms (e.g., birds) or flood water in the wild, however given other similar species of rainbowfishes, this is unlikely to occur.

Kiunga spp. are non-migratory.

4.1.8 Persistence attributes

Species that are tolerant of a wide range of environmental conditions (including temperature, salinity, water velocity, environmental disturbance and oxygen) are more likely to successfully establish than less tolerant species (Marchetti, Moyle & Levine 2004, Moyle & Marchetti 2006, Garcia de Lomas et al. 2009). Species under predation pressure are less likely to establish than those that have characteristics that resist predation or are introduced into areas where predators are absent (Moyle & Light 1996, Bajer et al. 2019, Poole et al. 2019). A host of studies have linked invasiveness with a lack of native predators in the invaded region (Bajer et al. 2012). However, susceptibility to predation does not preclude invasiveness (Copp et al. 2005, Hackerott et al. 2013).

K. ballochi and *K. bleheri* are allopatric and may inhabit similar ecological niches in terms of prey, habitat use and their tolerance to environmental variation. *Kiunga* spp. are found in small and shallow (5 m wide x 1 m deep), slow-flowing creeks at elevations around 80 (± 20) m asl (Amick et al. 2020). Due to their small size, *Kiunga* spp. may not physiologically adapt to rapid changes in their surroundings (Amick et al. 2020). Extreme weather condition such as the El Niño droughts (usually prolonged dry weather), which are predicted to increase in frequency and severity, may severely affect *Kiunga* spp. and lead to localised extinctions if watercourses become dry (Amick et al. 2020).

Kiunga spp. survival is not thought to be enhanced by human-mediated disturbances (i.e., habitat modification, degradation and destruction) or natural disruptions or events (i.e., floods, spates, desiccation), as both species have been, and continue to be, severely impacted by habitat

degradation (human settlements and road building associated with the Ok Tedi mine) and invasive species.

Storey et al. (2008) found that changes to fish assemblages in waterways near the Ok Tedi Mine in Papua New Guinea were mostly due to natural climatic factors, particularly El Niño-La Niña drought-flood cycles and algal blooms. Storey et al. (2008) found that fish populations were shown to recover only slowly in shallow lagoons affected by severe drought conditions, with extensive mats of floating grasses likely hindering fish recolonisation; fish stocks affected by an algal bloom recovered more quickly than stocks in lakes affected by drought.

It is unknown if *Kiunga* spp. are susceptible to piscicides at the doses legally permitted for use in Australia.

4.1.9 FISK Results

The FISK Risk Assessment Model resulted in a **low** risk rating for both *Kiunga* spp. The full results table has been combined for both species, as they concluded the same results, at Appendix A.

For both *Kiunga* spp., the certainty factor was 0.77 and there were 6 (12%) 'don't know' responses. The certainty factor suggests there was enough information to make robust risk assessments.

Aquaculture, environmental and other sectors are highly unlikely to be impacted, should *Kiunga* spp. establish.

4.2 Consequences for the environment

The magnitude and type of impacts by alien taxa vary greatly among ecosystems, and many of these impacts only become obvious or influential after the onset of invasion. Moreover, many impacts remain or are difficult to redress even if the alien taxa of concern are removed or controlled (Havel et al. 2015). In several ecosystems, spread, and/or impacts of non-native species occur several years or even decades following their introduction (Havel et al. 2015). Such time lags create difficulties for predicting their impacts.

Aquarium releases, either intentional or accidental, are commonplace events. Worldwide, these releases have led to the establishment of over 150 species, many on the "worst invasive species" list (Padilla & Williams 2004). Biological invasions of freshwater ecosystems have a large number of known and potential impacts on community structure and ecosystem function.

Eleven impact categories were assessed (Appendix B). In each of the 11 impact categories, the magnitude of impact is quantified with levels ranging from Minimal to Critical (Minimal-Minor-Moderate-Major-Critical).

The potential impacts to the environment, based on published evidence as detailed throughout this report, may be predominantly from competition for resources, and predation (Table 4Table 4). The ratings are estimates as the impacts are mostly unknown but, using the Precautionary Principle, a risk rating of **minor** for potential environmental impacts is appropriate.

Note that for most of these impacts, the scientific knowledge is sparse and for freshwater fish in general currently inadequate to allow reliable predictions.

Table 4 Potential impacts from the establishment of *Kiunga* spp. populations in Australia

Type of impact	Assessment	Rating
ENVIRONMENTAL IMPACTS		
Herbivory e.g., grazing, bark stripping, antler rubbing, feeding on algae, uprooting of aquatic macrophytes, restrictions in establishment, pollination, or seed dispersal of native species.	*No impact known or detectable; or very low level of herbivory, no major damage reported.* *Kiunga* ssp. have not been recorded as having any detectable impact on aquatic plants in their range.	Minimal
Competition e.g., competition for nutrients, food, water, space or other resources. May outcompete native species due to higher reproduction, resistance, longevity. In the beginning, might be slow change in species abundance but might lead to the local/global disappearance of a native species. Includes behavioural changes in outcompeted species and ranges from population decline to population loss.	*Causes declines in populations densities, but no changes in community composition.* *Kiunga* spp. would likely occupy a similar habitat to native Australian rainbowfishes (*Melanotaenia* spp.) in the Northern Territory and Queensland (Gomon & Bray 2022, Bray 2017). They may compete with native fish for food and habitat. There are 16 native Melanotaeniidae spp. in Australia: 6 are threatened and 4 may share a niche with *Kiunga* spp. *Kiunga* spp. may shelter under vegetation, logs or driftwood, so would compete with native species for similar refugia. Like other rainbowfish, they may exhibit little aggression toward other fish except from conspecific breeding males, this aggression is non-physical stylised display.	Moderate
Predation e.g., predation, parasitism, or intoxication, measurable as reductions in reproduction, survival, growth, or abundance. These impacts range from population decline to population loss, including minor changes in the food web.	*Predation on several abundant species, without significant impact on affected species or decline of their populations.* Introduced omnivores can have a detrimental impact on aquatic communities. For example, even when introduced to sites where native fishes already live, introduced fish have had large direct and indirect effects on stream invertebrates (Simon & Townsend 2003); and even tiny fish (e.g., *Gambusia* spp.) have reduced densities of native invertebrates and outcompeted native fishes (Pyke 2008). *Kiunga* spp. are likely omnivorous. There are unlikely to cause detrimental declines in prey populations in Australia.	Minor
Habitat and ecological community impacts e.g., changes in nutrient pools, increased water turbidity, modification of soil or water body properties, changes in hydrology, erosion, ecosystem functions, or other physical or structural changes. Includes modification of successional processes that may lead to reduced suitability (e.g., shelter) for native species, thus causing their disappearance.	*Change in chemical (e.g., eutrophication, nutrient-cycling), physical (e.g., soil compaction, structure, hydrology) and/or structural (e.g., felled trees, burrows, disturbance dynamics) characteristics detectable, with no reduction of fitness of native individuals.* Rainbowfishes would be consumed by many predatory species of fish, water birds and aquatic reptiles (e.g., barramundi, grunters, file snakes). *Kiunga* spp. occupy a similar niche to native rainbowfish species and are therefore unlikely to negatively impact native ecosystems.	Minimal
Hybridisation Hybridization with native species, leading to a reduced or lost opportunity for reproduction, sterile or fertile hybrid offspring, gradual loss of the genetic identity of a species, and/or disappearance of a native species, i.e., extinction.	*No hybridisation between alien species and native species observed in the wild, may be possible in captivity.* *Kiunga* spp. have not been reported to hybridise with each other or with other fish species.	Minimal

Type of impact	Assessment	Rating
Disease transmission Host or alternate host for native or alien diseases (viruses, fungi, protozoans or other pathogens) or parasites, impacts by transmission of diseases or parasites to native species.	*Parasites or pathogens directly or indirectly affecting fitness of native individuals without declines of their populations.* Live aquarium fish are the greatest risk group for introducing aquatic animal diseases in Australia (Corfield et al. 2008). Aquarium fish led to the spread of the goldfish ulcer disease that was introduced into Australia via infected goldfish, and which subsequently spread to native fish such as *Bidyanus bidyanus* (Silver Perch) (Corfield et al., 2008). Introduced fish are also the source of the Asian fish tapeworm *(Bothriocephalus acheilognathi*), which has caused substantial mortalities in *Hypseleotris klunzingeri* (Western Carp Gudgeon) in the Canberra region (Dove & Fletcher 2000). This parasite has the potential to be a significant source of mortality for native fish species. A variety of pathogens and parasites infect rainbowfishes, including *Ichthyophthirius multifilis* (causes white spot disease or 'Ich'), *Psicinoodinium pillulare* (causes velvet disease) and *Trichodina* (causes trichodiniasis) (Tappin 2011). Mortality of the desert rainbowfish (*Melanotaenia splendida* subsp. *tatei*) in the Finke River in Australia was attributed to an outbreak of the protozoan *Chilpodonella hexasticha* (Langdon et al. 1985). Leeches are occasionally seen on wild rainbowfishes causing chronic anaemia and development of secondary infections (Tappin 2011). Monogenean flatworms, cestodes, nematodes and coccdiai are also fairly common (Tappin 2011). *Achlya*, a fungus, is commonly found on wild-caught rainbowfish, and epizootic ulcerative syndrome ('red spot') disease has been reported from rainbowfish species in the Northern Territory (Tappin 2011). A review of diseases associated with rainbowfish did not identify any pests or diseases associated with the family Melanotaeniidae that were not already identified in Australia (Hardy-Smith, Jones & Kailola 2007).	Minor
ECONOMIC, SOCIAL AND CULTURAL IMPACTS		
Agriculture and forestry Damage to crops, pastures or plantations, horticultural and stored products, forests or forest products. Include direct feeding damage, seed dispersal, browsing on young trees, bark gnawing or stripping and antler rubbing, felling trees, defoliating them for nesting material.	*None, or only occasional damage or yield loss to crops or plantations (e.g., orchards), damage similar to native species, no change to forest structure or regeneration.* No adverse impacts on crops, plantations or forestry would be expected.	Minimal
Animal production Competition with livestock, transmission of diseases or parasites, predation, affecting livestock health, weakening or injuring livestock, pollution by droppings on farmland which domestic stock are then reluctant to graze, reduction of livestock accessibility to grazing land.	*None, or occasional competition with, or loss of yield in livestock or animal production.* If *Kiunga* spp. became established in Australia, they are highly unlikely to have any negative impacts on animal production, trade or aquaculture etc.	Minimal
Infrastructure Damage to human infrastructure, roads, buildings, dams, docks, fences, electricity cables (e.g., by gnawing or	*None or biological traits and lifestyle suggest potential damage to infrastructure (e.g., potential to increase soil erosion and decrease road stability, physical damage to property and infrastructure, disruption to transport and communications)*	Minimal

Type of impact	Assessment	Rating
nesting on them) or through pollution (e.g., by droppings), digging activities.	No impacts expected.	
Human health Injuries (e.g., bites, stings, scratches, rashes, accidents), transmission of diseases and parasites to humans. Impacts might affect human safety and cause traffic accidents. Via health costs, impacts usually lead to economic costs due to medication and treatments costs, as well as the consequences in productive losses from these impacts on workforce.	*None, or host of one or more harmless diseases with the possibility of infecting humans, not yet reported.* *Kiunga* spp. are not toxic nor harmful to humans.	Minimal
Social impacts Impact on human wellbeing. Noise disturbance, pollution of recreational areas, damage by trampling and overgrazing, restrictions in accessibility to habitats or landscapes of recreational value. Restrictions or loss of recreational activities, aesthetic attraction, touristic value, or employment possibilities, aesthetic values and natural or cultural heritage.	*None, or biological traits and lifestyle suggest potential for disturbance in recreational or residence areas (e.g., by noise, pollution).* No impacts expected.	Minimal
TOTAL ECONOMIC IMPACTS Cost to control/eradicate, cost to natural resources and amenity, cost to agriculture, fisheries and forestry industries, cost to potential export markets, cost to tourism	No economic impacts are expected should *Pseudomugil* establish in Australian waterways.	$0

Source: Adapted from Kumschick et al. 2012 and Nentwig et al. 2016

4.3 Risk Rating

The FISK Model returned an invasiveness risk rating of low for *K. ballochi* and *K. Bleheri*. The environmental impact and consequences of these species, should they become established, is minor (Table 4). Therefore, the overall risk these species pose to the Australian environment is **low.**

4.4 Consultation – Concerns raised

The first consultation round seeking comment from state and territory government agencies and the public on the applicants' reports was undertaken from Friday 14 October to Thursday 24 November 2022.

Three submissions containing comments to be addressed were received. Specific comments are at Appendix C. Concerns raised and the applicants' responses are outlined in Table 5.

A number of industry stakeholders and members of the public/hobbyists (Appendix C) cited that allowing the legal importation of such species could have the ability to reduce the 'need and desire' for the black-market trade in exotic fish.

Table 5 Summary of main concerns raised and the applicant's responses

Concern	Applicant's response
Conservation status and sustainability All but *P. furcatus* are IUCN listed as endangered (EN) or critically endangered (CR) and *P. furcatus* is listed as data deficient but has a very limited distribution, consequently it is likely to be vulnerable to overfishing. As a signatory to the Convention on Biological Diversity Australia has the responsibility to ensure that activities within our jurisdiction do not cause damage to the environment of other states or areas. If the species being considered are already under threat, adding the species to Australia's approved list, may further compound this issue by creating an incentive to harvest from the wild.	These species have various categories within the IUCN, and due to the threats of mining, palm oil, etc., they may become critically endangered and/or possibly extinct in their habitats. If they are added to the allowable import list as requested, the populations would be bred and maintained here, as many other rainbowfish have been for over 40 years - from one collection only. The owner of a Native Ornamental Fish producer has confirmed that if they are added, he will set up individual ponds for each species, and captive breed them for the ornamental fish trade in Australia. He currently farms other species, *Pseudomugil gertrudae*, (Spotted Blue-eye), *Pseudomugil tenellus*, (Delicate Blue-eye), *Pseudomugil cyanodorsalis* (Blue-back Blue-eye), *Pseudomugil sp.* (Golden Blue-eye), and has experience to produce them in large quantities for the trade. The applicant stated that the freshwater threats in Papua New Guinea, are not going to improve, but does that mean that captive bred specimens should not be available to aquarists worldwide
Source of imports Consideration should be given to applying conditions which limit the potential for wild populations to be harvested for import as aquarium fish e.g., fish can only be sourced from established, captive-bred sources.	The applicant stated that he/she has been in contact with importers here in Australia, and exporters from other countries. Overseas exporters list species available that are captive bred. As a result, there should be no harvesting from the wild.
Identification at the border As the maximum length of these species is generally no greater to 2cm to 4cm size, a minimum size limit may not be applicable. Will the Border Force officers be successful in identifying these species in order to reduce the chance of mistaken identity of juveniles with other similar looking fish species at the border? Can the proponent suggest and appropriate size limit to allow positive identification, with supporting evidence?	The applicant agreed that a minimum size of 2cm SL should be applied and contend that these species are identifiable at that size.
Health status Appropriate certification of health status (i.e., free from disease, viral agents) of the originating facility prior to importation of this species, and adherence to all other Australian import conditions including post arrival quarantine, should be ensured.	Any fish imported into Australia for ornamental purposes are subject to being listed on the EPBC Act as an allowable import species and must have appropriate health certification then be subject to quarantine protocols in place at the time. They will come through licensed premises with appropriate quarantine processes.

4.5 Risk Mitigation

In response to the comments received during the consultation rounds, the applicant provided the following risk mitigation measures:

1) It is recommended that any importation of these fish should be a minimum length of 2 cm SL for ease of identification.

2) The applicant has stated that all stocks would come initially from German breeders and then from commercial facilities to which these captive-bred stocks are distributed to ensure no pressure is placed upon wild populations.

3) Imported specimens will be subject to health certification requirements for freshwater ornamental (aquarium) fish, including inspection by a competent authority within 7 days prior to export; and undergo post-import quarantine.

4) Retailers or other traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species.

The department acknowledges the applicant's suggestions and agrees with measures 1 and 2. Due to the already low risk that these species pose to the Australian environment, the first proposed mitigation measure outlined above can be imposed as an import condition to further reduce the risk posed to an acceptable level.

For mitigation measure 2, the department suggests that sourcing from "captive-bred sources only" be imposed as an import condition to ensure no pressure is placed upon wild populations.

The measure at point 3 would mitigate the risk of disease transmission to a minimal level.

5 Discussion

The global aquarium trade is one of the greatest biosecurity threats to freshwater ecosystems (Ebner et al. 2020). Ornamental fish present a significant risk to aquatic ecosystems in Australia due to potential pest or disease incursions (Moore, Marton & McNee 2010). Ebner et al. (2020) highlighted the numerous existing and possible incursion pathways from the aquarium trade into freshwater ecosystems in tropical Australia, encompassing the lands and waterways north of the Tropic of Capricorn. There is a lack of information on biotic incursions relevant to tropical Australia and on most taxa in the aquarium trade (especially relating to diseases), which creates a major biosecurity risk (Ebner et al. 2020).

Propagule pressure may be used as an indicator of establishment success for invasive species. Successful invasive species are introduced more times than unsuccessful species. Commercial production of ornamental species may increase the intensity of introductions (Moyle & Marchetti 2006, Gozlan, Pinder, & Shelley 2002, Copp, Templeton & Gozlan 2007, Ebner et al. 2020, Chan, Zeng & Yeo 2021). This risk can be minimised in Australia by regulating species being imported, limiting the number of collections containing species, limiting the number of specimens in each collection and increasing the housing security when species are kept (Bomford 2008). Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Both *Kiunga* spp. have restricted distributions, and little is known about their biology and ecology.

Results from the FISK Model show that all both *Kiunga* species are low risk, and the impacts assessment suggest minor potential impacts on the environment if they were to establish. There is no evidence of *Kiunga* species successfully establishing elsewhere, nor is there evidence for any of the 96 species in the family Melanotaeniidae. *Kiunga* have similar preferred temperature and pH ranges as native rainbowfish species in northern Australia, suggesting that the rivers and floodplains of northern Australia could provide suitable habitat for *Kiunga* species.

Under ss 391(1) of the EPBC Act, the Minister must take account of the precautionary principle in making decisions. The precautionary principle is triggered by two threshold conditions: (1) a threat of serious or irreversible environmental damage (direct or indirect); and (2) scientific uncertainty as to the environmental damage. Results from the FISK Model show that both *Kiunga* spp. pose a low risk to the Australian environment and would have minor potential impacts should they establish. Therefore, the department has determined that these species do not pose a threat of serious irreversible damage.

The current scale of biodiversity loss in freshwater ecosystems is rapid and immense (Reid et al. 2019), and conservation of freshwater fishes and their habitats is of major concern. Subsection 303EN(3) of the EPBC Act states that the Minister must not issue a permit unless the Minister is satisfied that the proposed import would not be likely to threaten the conservation status of a species or ecological community; or likely to threaten biodiversity. Australia also has the responsibility under the Convention on Biological Diversity to ensure that activities within its jurisdiction do not cause damage to the environment of other states or areas. Adding species whose

conservation status is threatened to Australia's approved import list may further compound their conservation status by creating an incentive to harvest from the wild in the species country of origin.

Section 303EB(2) allows the Minister to impose conditions or restrictions to specimens in Part 2, including a restriction or condition relating to the source of the specimen (303EB(2)(b)). *K. ballochi* was assessed by Allen, Hammer & Unmack (2020a) as Endangered B1ab(iii) and *K. bleheri* was assessed by Allen, Hammer & Unmack (2020b) as Critically Endangered B1ab(iii); both with a decreasing population trend. Consideration must be given to the potential impact that listing these species in the Live Import List could have on wild stocks. Listing these species in as regulated specimens with a condition imposed to ensure imports are from captive-bred sources only would ensure no pressure is placed upon wild populations.

6 Conclusion

The department has reviewed the application to amend the List of Specimens Taken to be Suitable for Live Import (Live Import List) to include *Kiunga ballochi* and *Kiunga bleheri* and undertaken a risk assessment. During this process, the department independently reviewed all available information on the species and sought consultation from Commonwealth, state and territory agencies, the public and other experts, as is required under the *Environment Protection and Biodiversity Conservation Act 1999.*

Recommendation: In consideration of their conservation status, the department recommends listing *Kiunga ballochi* and *Kiunga bleheri* in Part 2 of the Live Import List with the condition:

- Captive-bred specimens only, of minimum length 2cm SL.

Appendix A: FISK Model Results

Question	Response	Certainty	Comments and references
Biogeography/Historical			
Domestication/Cultivation			
Is the species highly domesticated or widely cultivated for commercial, angling or ornamental purposes?	N	4	Available in the aquarium hobby, but not reported to be highly domesticated or as being captive bred for at least 20 generations.
Has the species established self-sustaining populations where introduced?	N	4	Never introduced. No references found.
Does the species have invasive races/varieties/sub-species?	N	4	No subspecies listed in FishBase.
Climate and Distribution			
What is the level of matching between the species' reproductive tolerances (native and introduced range) and the climate of the RA area?	3	3	High
What is the quality of the climate match data?	2	4	Quality of climate match data is considered Medium as climate matching was based on terrestrial climate data (Climatch v 2.0) and water temperature data (Warnakula, Parsons & Mitchell 2023).
Does the species have self-sustaining populations in three or more (Köppen-Geiger) climate zones?	N	4	FishBase lists as tropical (24°C - 26°C). Distribution covers 1 Köppen-Geiger zones (Af).
Is the species native to, or has established self-sustaining populations in, regions with similar climates to the RA area?	Y	3	Endemic to Lake in Irian Jaya. KG zone Af only found in small area on coast of northern Queensland, near Cairns. Areas of northern Australia likely conducive environments. Many rivers are floodplain rivers, which are important for rainbowfishes.
Does the species have a history of being introduced outside its natural range?	N	4	No history of introductions.
Invasive elsewhere			
Has the species established one or more self-sustaining populations beyond its native range?	N	3	No references found.
In the species' introduced range, are there impacts to wild stocks of angling or commercial species?	N	4	n/a
In the species' introduced range, are there impacts to aquacultural, aquarium or ornamental species?	N	4	n/a

Question	Response	Certainty	Comments and references
In the species' introduced range, are there impacts to rivers, lakes or amenity values?	N	4	n/a
Does the species have invasive congeners?	N	4	2 members of genus noted in FishBase, no evidence of establishment or invasiveness.
Biology/Ecology			
Undesirable traits			
Is the species poisonous/venomous, or poses other risks to human health?	N	4	FishBase status: Harmless. No references to the species being poisonous/venomous.
Does the species out-compete with native species?	N	3	No references found.
Is the species parasitic of other species?	N	4	No references found.
Is the species unpalatable to, or lacking, natural predators?	N	4	Not unpalatable to predators. Has natural predators similar to other rainbow fishes, including the following predatory fish families: Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae (Froese & Pauly 2022).
Does the species prey on a native species previously subjected to low (or no) predation?	N	3	*Kiunga* would not likely prey on native species previously subjected to low (or no) predation. Native predatory fishes occur in virtually every water body where their listed prey items are found.
Does the species host, and/or is it a vector, for one or more recognised non-native infectious agents?	N	3	A review of diseases associated with aquatic animals identified several pests or diseases associated with finfish (Animal Health Committee 2021).
Does the species achieve a large ultimate body size (i.e., >15 cm total length) (more likely to be abandoned)?	N	4	Max length is 3.0 cm SL.
Does the species have a wide salinity tolerance or is euryhaline at some stage of its life cycle?	N	3	Unsure of tolerance for pH (7.5 to ?), narrow tolerance for water temperature (24 °C to 26 °C) and no tolerance for salinity as only found in freshwater habitats.
Is the species able to withstand being out of water for extended periods (e.g. minimum of one or more hours)?	N	3	No references found.
Is the species tolerant of a range of water velocity conditions (e.g., versatile in habitat use)	N	3	Inhabits narrow, clear creeks flowing through rainforest in generally flat terrain.
Does feeding or other behaviours of the species reduce habitat quality for native species?	N	4	No references found.
Does the species require minimum population size to maintain a viable population?	?	4	No references found.

Question	Response	Certainty	Comments and references
Feeding guild			
If the species is mainly herbivorous or piscivorous/carnivorous (e.g., amphibia), then is its foraging likely to have an adverse impact in the RA area?			n/a
If the species is an omnivore (or a generalist predator), then is its foraging likely to have an adverse impact in the RA area	N	3	No specific information on the diet is available. *Kiunga* spp. likely are alike in their diet and feeding behaviours to spp. from similar rainbowfish genera, they are omnivores and consume a variety of small aquatic, terrestrial animals, and plant matter.
If the species is mainly planktivorous or detritivorous or algivorous, then is its foraging likely to have an adverse impact in the RA area?			n/a
If the species is mainly benthivorous, then is its foraging likely to have an adverse impact in the RA area?			n/a
Reproduction			
Does the species exhibit parental care and/or is it known to reduce age-at-maturity in response to environment?	N	4	Non guarders. Open water/substratum egg scatterers.
Does the species produce viable gametes?	Y	4	Viable gametes in wild populations.
Is the species likely to hybridize with native species (or use males of native species to activate eggs) in the RA area?	N	3	No evidence of hybridisation in this genus, and no native species of *Kiunga* in Australia.
Is the species hermaphroditic?	?	3	Hermaphroditism has been reported in rainbowfish and may be relatively widespread (Tappin 2011).
Is the species dependent on the presence of another species (or specific habitat features) to complete its life cycle?	Y	3	Specific habitat features - requires aquatic vegetation to deposit eggs and allow external fertilisation and development for wild populations to survive. No references found on important breeding sites.
Is the species highly fecund (>10,000 eggs/kg), iteropatric or has an extended spawning season relative to native species?	?	2	No references found.
What is the species' known minimum generation time (in years)?	1	3	Generally, rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity
Dispersal mechanisms			
Are life stages likely to be dispersed unintentionally?	N	3	Not a bait species.
Are life stages likely to be dispersed intentionally by humans (and suitable habitats abundant nearby)?	Y	2	Potential discards from people who abandon aquariums.

Question	Response	Certainty	Comments and references
Are life stages likely to be dispersed as a contaminant of commodities?	N	3	Would be very unlikely to be sold with other fishes; very low probability as contaminant of non-fish commodities.
Does natural dispersal occur as a function of egg dispersal?	N	3	Little is known about the specifics of reproduction, but eggs adhere to aquatic vegetation and not dispersed.
Does natural dispersal occur as a function of dispersal of larvae (along linear and/or 'stepping stone' habitats)?	?	2	Little is known about the specifics of reproduction, but likely no.
Are juveniles or adults of the species known to migrate (spawning, smolting, feeding)?	N	3	Restricted geographic range, not migratory.
Are eggs of the species known to be dispersed by other animals (externally)?	?	3	There is no proof, but it is possible if highly unlikely, that the eggs of rainbowfish have filaments that are mildly sticky and cause the eggs to catch in aquatic plants. It has been suggested they can attach to the legs of wading birds but this cannot be verified.
Is dispersal of the species density dependent?	?	1	No references found that address stock densities in the wild.
Persistence attributes			
Are any life stages likely to survive out of water transport?	N	3	No references found, but likely no.
Does the species tolerate a wide range of water quality conditions, especially oxygen depletion and temperature extremes?	N	3	Narrow environmental tolerances. Inhabits narrow, clear creeks flowing through rainforest in generally flat terrain. Due to their relatively smaller size, *Kiunga* spp. may not physiologically adapt to rapid changes in their surroundings (Amick et al. 2020).
Is the species readily susceptible to piscicides at the doses legally permitted for use in the risk assessment area?	Y	3	No evidence to suggest it would be immune to piscicides
Does the species tolerate or benefit from environmental disturbance?	Y	2	For other rainbowfishes, floodplains and temporary wetland habitats are important for spawning. In northern Australia, extensive floodplains lie adjacent to large rivers.
Are there effective natural enemies of the species present in the risk assessment area?	Y	3	Specific enemy unknown, but likely to be present.

Outcome:	Low
Mean certainty	3.3
Certainty Factor:	0.77
Sectors affected	

Aquacultural	-2
Environmental	1
Nuisance	0

Total questions	Answered	? Responses
A. Biogeography/Historical	**13**	**0**
1. Domestication/Cultivation	3	0
2. Climate and Distribution	5	0
3. Invasive elsewhere	5	0
B. Biology/Ecology	**33**	**6**
4. Undesirable traits	12	1
5. Feeding guild	1	0
6. Reproduction	7	2
7. Dispersal mechanisms	8	3
8. Persistence attributes	5	0
Total number of 'don't know' responses		**6**
% of 'don't know' responses		12%

Appendix B: Impacts assessment scoring criteria

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Herbivory	Can cause changes in reproduction, survival, growth, and abundance of plants in the invaded community, e.g., herbivory, grazing, bark stripping, antler rubbing, feeding on algae, or uprooting of aquatic macrophytes. Result in restrictions in establishment, pollination, or seed dispersal of native species. Range from population decline to population loss and include minor changes in the food web.	No impact known or detectable; or very low level of herbivory, no major damage reported.	Herbivory affecting several native species, without significant impact on affected species or decline of their populations.	Herbivory affecting several native species, at least one native species declining.	Herbivory affecting many native species, several declining in population size, recorded community change is reversible.	Herbivory or toxicity affecting native threatened species, decline of these species, replacement or even extinction of species, recorded community change is irreversible.
Competition	Concern at least one native species, e.g., by competition for nutrients, food, water, space or other resources. May outcompete native species due to higher reproduction, resistance, longevity. In the beginning, might be slow change in species abundance but might lead to the local/global disappearance of a native species. Includes behavioural changes in outcompeted species and ranges from population decline to population loss.	No effect on fitness of native species.	Causes reductions in individual fitness but no declines in native populations densities.	Causes declines in populations densities, but no changes in community composition.	Causes changes in community composition – reversible if alien species is removed.	Causes at least local extinction of species and irreversible changes in community composition.

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Predation	May concern single animal species or a guild, e.g., through predation, parasitism, or intoxication, measurable as reductions in reproduction, survival, growth, or abundance. These impacts range from population decline to population loss, including minor changes in the food web. . These impacts concern only free-living animals in the wild.	Negligible level of predation.	Predation on several abundant species, without significant impact on affected species or decline of their populations.	Predators directly or indirectly resulting in a decline of populations size of at least one native species but no changes in community composition.	Predators directly or indirectly resulting in local or population extinction of at least one native species, leading to changes in community composition, but changes are reversible when introduced species removed.	Predators directly or indirectly resulting in extinction of one or more native species (i.e. species vanish from communities at sites where they occurred before alien arrival), changes in community composition are irreversible.
Habitat and ecological community impacts	Impacts on characteristics of an ecosystem, its nutritional status (e.g., changes in nutrient pools, increased water turbidity, faecal droppings), modification of soil or water body properties, and disturbance regimes (changes in hydrology, erosion or soil compacting), changes in ecosystem functions (e.g., pollination or decomposition rates), or other physical or structural changes. Includes modification of successional processes that may lead to reduced suitability (e.g., shelter) for native species, thus causing their disappearance. The application of pesticides to control impacts might have side effects on non-target organisms.	Change in chemical (e.g., eutrophication, nutrient-cycling), physical (e.g. soil compaction, structure, hydrology) and/or structural (e.g. felled trees, burrows, disturbance dynamics) characteristics detectable, with no reduction of fitness of native individuals.	Moderate change in chemical, physical and/or structural characteristics, affecting fitness of native individuals without decline of their populations.	Major change in chemical, physical and/or structural characteristics, change in fauna and flora and/or successional processes, reversible.	Severe changes in chemical, physical and/or structural characteristics, decline of species and/or change in species composition, resulting in local extinction of at least one native species, leading to changes in community composition, but change are reversible when introduced species is removed.	Massive changes in chemical, physical and/or structural characteristics, endemic species and/or threatened species affected, decline of species and/or change in species composition, loss of habitat characteristics, damage of sites of conservation importance, irreversible.

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Hybridisation	Impacts are through hybridization with native species, usually closely related to the alien taxon, leading to a reduced or lost opportunity for reproduction, sterile or fertile hybrid offspring, gradual loss of the genetic identity of a species, and/or disappearance of a native species, i.e., extinction.	No hybridisation between alien species and native species observed in the wild, may be possible in captivity.	Hybridisation is observed in the wild but rare; hybrids weak, do not reach maturity, no decline of native populations.	Hybridisation is regularly observed in the wild; hybrids are vigorous but sterile, local decline of pure native populations but pure native species persists.	Hybridisation is common in the wild; F1 hybrids are vigorous and fertile, however offspring of F1 hybrids are weak and sterile; individuals of introduced species and hybrids discernible from pre natives, pure native populations can be recovered by removing the introduced species and hybrids.	Hybridisation is common in the wild; hybrids are vigorous and fertile, pure native populations cannot be recovered by removing the introduced species and hybrids resulting in local extinction of native species.
Disease transmission	Host or alternate host for native or alien diseases (viruses, fungi, protozoans or other pathogens) or parasites, impacts by transmission of diseases or parasites to native species.	Not a host of diseases transmissible to native species, or very low level of transmission; reduction of fitness of native individuals is not detectable.	Parasites or pathogens directly or indirectly affecting fitness of native individuals without declines of their populations.	Parasites or pathogens directly or indirectly resulting in a decline of populations size of at least one native species but no changes in community composition.	Parasites or pathogens directly or indirectly resulting in local or population extinction of at least one native species leading to changes in community composition, but changes are reversible when introduced species is removed.	Parasites or pathogens directly or indirectly resulting in local or population extinction of at least one native species, community changes are irreversible.

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Agriculture and forestry	Damage to crops, pastures or plantations, horticultural and stored products, forests or forest products. Include competition with crops by weeds, direct feeding damage, seed dispersal, reduced accessibility, usability or marketability through contamination and cosmetic changes. Impacts might affect forest regeneration through browsing on young trees, bark gnawing or stripping and antler rubbing. Damage includes felling trees, defoliating them for nesting material. Includes the need for applying pesticides which involve additional costs, reducing market quality. Impacts usually lead to an economic loss.	None, or only occasional damage or yield loss to crops or plantations (e.g., orchards), damage similar to native species, no change to forest structure or regeneration.	Damage or yield loss to crops common, damage or yield loss similar to native species, minor effect on forest growth, impact on seed dispersal. Some trade disruptions.	Regular damage or yield loss similar to native species through feeding on crops or through competition, occasional threat to stored food, constrains forest regeneration through browsing on young trees, damage to plantations, gnawing of bark, losses exceed impact of the native fauna, sometimes reaching high levels. Moderate trade disruptions.	Regular high damage or yield loss in fields or to stored food, fruit consumption; moderate to strong damage to mature forest through seed consumption, bark stripping or antler rubbing, death of trees by felling or flooding. Killing trees by defoliating them for nesting material. High trade disruptions.	Complete loss of yield or destruction of fields or plantations (e.g. orchards), or of stored food by consumption and contamination; very strong damage to mature forest through seed consumption, bark stripping. Massive trade disruptions.
Animal production	Competition with livestock, transmission of diseases or parasites, predation, affecting livestock health, weakening or injuring livestock, e.g., by stinging or biting, pollution by droppings on farmland which domestic stock are then reluctant to graze, reduction of livestock accessibility to grazing land, the need for applying pesticides which involve additional costs, reducing market quality. Impacts usually lead to an economic loss. This category refers to livestock, poultry, game animals, fisheries and aquaculture.	None, or occasional competition with, or loss of yield in livestock or animal production.	Competition with, or loss of yield in livestock or animal production, transmission of diseases to livestock or production animals in the native area, but not yet reported from the area of introduction. Little operational obstruction or removal/control cost. Some trade disruptions.	Competition more frequent with several livestock or production animal species, transmission of diseases reported, but infection rates low. Pollution by droppings on farmland which domestic stock are then reluctant to graze. Moderate trade disruptions.	Transmission of economically important diseases or hybridization with economically important game animals, fatalities uncommon. Large trade disruptions.	For animals, transmission of harmful diseases to or hybridization with livestock or production animals, fatalities reported. Massive trade disruptions.

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Infrastructure	Damage to human infrastructure, roads, buildings, dams, docks, fences, electricity cables (e.g., by gnawing or nesting on them) or through pollution (e.g., by droppings), digging activities on watersides, roadside embankments and buildings which may affect flood defence systems, traffic infrastructure or stability of buildings. Includes the need for applying pesticides and performing management and eradication programmes, their development and further administration costs, as well as costs for research and control. Impacts usually lead to an economic loss.	None or biological traits and lifestyle suggest potential damage to infrastructure (e.g., potential to increase soil erosion and decrease road stability, physical damage to property and infrastructure, disruption to transport and communications) but not yet reported.	Occasional damage with minor economic losses, e.g., damage to fences, impact through pollution, accumulations of droppings, minor increases in soil erosion.	Damage to fences and/or plantations, gnawing electricity cables, causing road accidents, nesting on current conductions. Moderate increase in soil erosion, moderate damage to property, buildings and infrastructure, frequent obstruction of waterways.	Considerable damage to property and infrastructure, with considerable economic costs, damage through burrowing or nesting in buildings. Major obstruction of waterway.	Considerable damage to flood defence systems or other critical infrastructure, major soil erosion, danger to human safety, threat to transport safety.
Human health	Injuries (e.g., bites, stings, scratches, rashes, accidents), transmission of diseases and parasites to humans, bioaccumulation of noxious substances, health hazard due to contamination with pathogens or parasites (e.g., through contaminated water, soil, food, or by faeces or droppings). Impacts might affect human safety and cause traffic accidents. Includes the need for applying pesticides which due to their low selectivity and/or residues might have side-effects on humans. Via health costs, impacts usually lead to economic costs due to medication and treatments costs, as well as the consequences in productive losses from these impacts on workforce.	None, or host of one or more harmless diseases with the possibility of infecting humans, not yet reported.	Host of several harmless diseases, indirect transmission or possibility of direct transmission, but only a small percentage of the human population at risk, health hazard from soil and water contamination caused by droppings, few cases reported.	Direct infection with one or more harmless diseases, occasional health threat through bites or other attacks, moderate number of cases reported.	Direct transmission of several diseases. Health threat through bites or other injuries happen more often, rarely fatal.	Vector of harmful diseases to humans and/or many diseases frequently transmitted. Health threat through bites or other injuries happen frequently, more often fatal.

Impact	Description	Minimal	Minor	Moderate	Major	Critical
Social impacts	Impact on human wellbeing. Noise disturbance, pollution of recreational areas (water bodies, rural parks, golf courses or city parks), fouling, eutrophication, damage by trampling and overgrazing, restrictions in accessibility to habitats or landscapes of recreational value. Restrictions or loss of recreational activities, aesthetic attraction, touristic value, or employment possibilities, aesthetic values and natural or cultural heritage.	None, or biological traits and lifestyle suggest potential for disturbance in recreational or residence areas (e.g., by noise, pollution).	Occasional small disturbance, only small percentage of human population affected.	Regular small disturbance, or occasional larger disturbance.	Regular larger disturbance. Recreational value of a habitat or a landscape strongly affected.	Massive disturbance; complete loss of recreational value of a habitat or a landscape.

Appendix C: Comments received on the proposal to include 2 species of *Kiunga* in the Live Import List

Round 1

Consultation with the public, stakeholders and state and territory government agencies on the applicants' report was undertaken from 14 October to 24 November 2022. Three submissions containing comments to be addressed were received (Table 6).

Table 6 Comments received during public consultation and response from applicant

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
New South Wales Department of Primary Industries	NSW DPI supports the amendment to add these species to the Live Import List provided the following concerns are considered: 1. As the maximum length of these species is generally no greater to 2 cm to 4 cm size, a minimum size limit may not be applicable. Will the Border Force officers be successful in identifying these species in order to reduce the chance of mistaken identity of juveniles with other similar looking fish species at the border? Can the proponent suggest and appropriate size limit to allow positive identification, with supporting evidence? 2. Seven out of 8 of these species are classified as either endangered or critically endangered, with the remainder being data deficient. Can the proponent provide evidence that these species will be harvested in a sustainable manner? 3. That appropriate certification of health status (i.e., free from disease, viral agents) of the originating facility prior to importation of this species, and adherence to all other Australian import conditions including post arrival quarantine is ensured. NSW DPI further notes that all other identified biosecurity risks are acceptable and Popondetta Rainbowfish (*Pseudomugil connieae*), Forktail Rainbowfish (*Pseudomugil furcatus*), Ivantsoff's Blue-eye (*Pseudomugil ivanstoffi*), Red Neon Blue-eye (*Pseudomugil luminatus*), Paska's Blue-eye (*Pseudomugil paskai*), Vogelkop Blue-eye	**Describe** method(s) to identify the 8 species of freshwater fish (6 species *of Pseudomugil* and 2 species of *Kiunga*) in order to reduce misidentification of specimens, especially juveniles, with other similar looking species. **Propose** appropriate body sizes for these species to allow their positive identification, with supporting evidence. **Provide** evidence that these species will be harvested in a sustainable manner.	It is suggested that the minimum size for the blue eyes should be 20mm. They are identifiable at that size. The author has been in contact with importers here in Australia, and exporters from other countries. Overseas exporters list species available that are captive bred. Any fish imported into Australia for ornamental purposes are subject to being listed on the EPBC Act as an allowable import species and must have appropriate health certification then be subject to quarantine protocols in place at the time. They will come through licensed premises with appropriate quarantine process to allow fish in good health at the other end of the process. Anyone importing allowable species into Australia will also have to comply with any state legislation in place at the time of importation. If Commonwealth Legislation allows a species to be imported then any attempt by the state to make those species noxious will be in contravention to the Constitution. Only certain countries are approved to export freshwater aquarium fish to Australia. they are: China, French Polynesia, Germany, Hong Kong, Indonesia, Malaysia, New Zealand, Singapore, Sri Lanka, Thailand, and The USA. They are listed as Effective 26 October 2012, by BICON Australian Biosecurity Import Conditions - available at:

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
	(*Pseudomugil reticulatus*), Bleher's Blue-eye (*Kiunga bleheri*) and Balloch's Blue-eye (*Kiunga ballochi*). It is noted that in Section 12.f in providing information on NSW legislative controls on the species the proponent has incorrectly referenced the Fisheries Management Act 1994 in a number of these applications. Control of aquatic species was transferred in 2017 to the Biosecurity Act 2015 which declares some fish, aquatic invertebrates and plants as prohibited matter under Schedule 2; and the Biosecurity Regulation 2017 which declares notifiable aquatic species under Schedule 1 Part 2. No species of *Pseudomugil* or *Kiunga* are declared as prohibited or notifiable matter under NSW legislation.	**Provide** method(s) and further information/evidence to ensure that appropriate certification of health status (i.e., free from disease, viral agents) of the export facility prior to importation of these species. **Correctly revise** any reference to the Fisheries Management Act 1994.	https://bicon.agriculture.gov.au/BiconWeb4.0/ViewElement/Element/Index?elementPk=1659368&caseElementPk=1752962 Health certification for freshwater* ornamental finfish exported to Australia * including all approved freshwater species other than goldfish, gouramis, bettas, paradise fish, cichlids and poeciliids. The model health certificate has been updated to reflect a departmental name change and re-formatted for consistency (Appendix 6). Updated model health certificates for imported ornamental (aquarium) finfish – Valid from 1 March 2016 - available at: https://www.agriculture.gov.au/biosecurity-trade/import/industry-advice/2016/02-2016 states that: 1) Only fish listed in the list of permitted live freshwater fish suitable for import are included in this consignment and are documented on the attached invoice. 2) The fish in the consignment have been inspected within seven (7) days prior to export and show no clinical signs of infectious disease or pests. 3) The export premises are currently approved for export to Australia as meeting standards under the Department of Agriculture, Water and the Environment. 4) All fish being held at the export premises exhibit no clinical signs of significant infectious disease or pests and are sourced from populations not associated with any significant disease or pests within the 6 months prior to certification. 5) All fish in the consignment have been in approved export premises for 14 days prior to export. 6) The fish have not been kept in water in common with farmed foodfish (fish farmed for human consumption including recreational fishing) or koi carp. 7) Adequate quarantine safeguards are in place to maintain the health status of the certified fish until export. The fish are effectively isolated in holding systems that prevent infection by direct contact with other fish or indirect contact via water, equipment or any other means.

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
			The current model health certificate is located at: Model health certificate form 1st March 2016 The author erroneously recorded in Section 12.f that Fisheries Management Act 1994. As pointed out above, The Biosecurity Act 2015 No. 24, which declares some fish, aquatic invertebrates and plants as prohibited matter under Schedule 2; and the Biosecurity Regulation 2017 which declares notifiable aquatic species under Schedule 1 Part 2. No species of *Pseudomugil* or *Kiunga* are declared as prohibited or notifiable matter under NSW legislation. The ACT can be found at: https://legislation.nsw.gov.au/view/pdf/asmade/act-2015-24
De-identified	The applications indicate: • should these species be added to the Live Import List, imported stock would be sourced from captive-bred populations overseas (e.g., "German breeders") which meet relevant provisions under the Biosecurity Act 2015 • a high demand and associated high prices for these species as aquarium fish in Australia • despite a limited genetic pool within currently-held captive populations of these species "the need for fresh wild stock imports at a later date will be unlikely" - noting this possibility is not excluded • should these species be added to the Live Import List, importers other than the applicant may also seek to bring some of these species into Australia • in their native habitats these species are listed on the IUCN red list as endangered Given these factors and the relative proximity of the native range of these species (Papua New Guinea) to Australian borders, consideration should be given to applying conditions which limit the potential for wild populations to be harvested for import as aquarium fish e.g., fish can only be sourced from established, captive-bred sources.	**Propose** import conditions to limit the potential for wild populations to be harvested.	It is suggested that the minimum size for the blue eyes should be 20mm. They are identifiable at that size. The author has been in contact with importers here in Australia, and exporters from other countries. Overseas exporters list species available that are captive bred. Any fish imported into Australia for ornamental purposes are subject to being listed on the EPBC Act as an allowable import species and must have appropriate health certification then be subject to quarantine protocols in place at the time. They will come through licensed premises with appropriate quarantine process to allow fish in good health at the other end of the process. Anyone importing allowable species into Australia will also have to comply with any state legislation in place at the time of importation. If Commonwealth Legislation allows a species to be imported then any attempt by the state to make those species noxious will be in contravention to the Constitution. Only certain countries are approved to export freshwater aquarium fish to Australia. they are: China, French Polynesia, Germany, Hong Kong, Indonesia, Malaysia, New Zealand, Singapore, Sri Lanka, Thailand, and The USA. They are listed as Effective 26 October 2012, by BICON Australian Biosecurity Import Conditions - available at: https://bicon.agriculture.gov.au/BiconWeb4.0/ViewElement/Element/Index?elementPk=1659368&caseElementPk=1752962 02-2016 - Updated model health certificates for imported ornamental (aquarium) finfish – Valid from 1 March 2016 - available at:

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
			https://www.awe.gov.au/biosecurity-trade/import/industry-advice/2016/02-2016 states that: Only fish listed in the list of permitted live freshwater fish suitable for import are included in this consignment, and are documented on the attached invoice. The fish in the consignment have been inspected within seven (7) days prior to export and show no clinical signs of infectious disease or pests. The export premises are currently approved for export to Australia as meeting standards under the Department of Agriculture, Water and the Environment. All fish being held at the export premises exhibit no clinical signs of significant infectious disease or pests and are sourced from populations not associated with any significant disease or pests within the 6 months prior to certification. 1. All fish in the consignment have been in approved export premises for 14 days prior to export. 2. The fish have not been kept in water in common with farmed foodfish (fish farmed for human consumption including recreational fishing) or koi carp. 3. Adequate quarantine safeguards are in place to maintain the health status of the certified fish until export. The fish are effectively isolated in holding systems that prevent infection by direct contact with other fish or indirect contact via water, equipment or any other means. The current model health certificate is located at: Model health certificate form 1st March 2016
Western Australian Department of Primary Industries and	In general, the Department of Primary Industries and Regional Development considers the suite of 6 Blue eye and 2 Rainbowfish (in *Kiunga* and *Pseudomugil* families) applications being considered for addition to the Federal permitted import list, "the White List", to be relatively low risk to the Western Australian environment.	**No further information required**.	The applicant provided information from the IUCN for each species, highlighting information that some species are captive bred with commercial quantities available. ***Kiunga ballochi*** The author accessed various sites on the internet on 24/01/2023 and found this species available only on two wholesalers websites

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
Regional Development	However, DPIRD WA does not support the addition of any of these fish (see Table 1) due to sustainability concerns in their native environment. All are IUCN listed as endangered (EN) or critically endangered (CR) and should therefore not be added to the permitted import list.		worldwide. This species was previously in Australia, but the author knows of none here at present. In 2020, the IUCN indicates this species is assessed as Endangered, reporting the following. **Justification:** This species is assessed as Endangered. The extent of occurrence (EOO) is between 1,000-8,265 km2 , with a best estimate of under 5,000 km2 . There are four locations, based on four distinct subpopulations with different human dynamics at each. Settlements and road construction, both associated with the Ok Tedi mine, are leading to continuing decline in habitat. **Previously Published Red List Assessments** 2009 – Critically Endangered (CR), 1996 – Critically Endangered (CR), 1994 – Vulnerable (V) **Geographic Range Description:** This species is known only from the Upper Fly River system of Papua New Guinea. Type specimens were collected in 1982 from small tributaries of the Ok Smak, a major tributary of the Ok Tedi, approximately 40-50 km north of the town of Kiunga. These streams cross the Tabubil-Kiunga road immediately north of the Ok Mart Bridge in the vicinity of Rumginae. Recent (2007-2012) attempts failed to record this species from creeks around the type locality, which are under increasing pressure from human settlement, but did record it from another small tributary crossing the highway, closer to Kiunga. Additional subpopulations have since been recorded from tributaries of the Ok Birim, to the west of the Ok Tedi main channel, and adjacent to the Papua New Guinea-Indonesian border (2014), and from several creeks crossed by a new road connecting Kiunga to Drimkas at the Upper Fly-Palmer River confluence (2018) (A.W. Storey pers. comm. 2020). A fourth subpopulation that appears to be this species was recently discovered (2018) in a small tributary of the Elevala River, which is a major tributary of the Upper Fly River, but located to the east of the Fly River, which substantially extends the range within the catchment (A.W. Storey pers. comm. 2020). This species is not likely to be found in the main stem of the Fly River. Additional surveys are required to establish the limits of distribution, particularly westwards into Papua Province of Indonesia, which lies immediately adjacent to the western

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
			extent of its current known range, but also further east, towards the Strickland River and beyond. **Population:** When it was first discovered in 1982, the species was reported as being moderately common. Attempts to locate the fish at the type locality in 1994-1995 were unsuccessful (A. Jenkins pers. comm. 2007). However, low numbers were found in 2007 (G.R. Allen pers. comm. 2019). Two other localities (Bige and Elevala) appear stable. **Current Population Trend:** Decreasing. **Habitat and Ecology:** This is a demersal species that inhabits narrow, shallow, clear creeks and streams flowing through rainforest in flat or hilly terrain at elevations less than about 100 m above sea level. Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. Species from the family Pseudomugliidae normally congregate in schools. Individuals of this species can grow to a maximum size of about 3 cm SL (G.R. Allen pers. comm. 2019). **Use and Trade:** This species has been collected for the aquarium trade but so far has not established (M. Hammer pers. comm. 2019). **Threats:** It is suspected that this species has been severely impacted by habitat degradation. The primary threat is considered to be settlements and road building associated with the Ok Tedi mine. Invasive species also represent a threat to this species. **Conservation Actions:** There are no conservation measures are in place at present for this species. Research into the population size, trends and distributions of this species are recommended, noting that new records have been found in recent years. The full report can be accessed at: Allen, G.R., Hammer, M. & Unmack, P. 2020. Kiunga ballochi. https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T11021A147698670.en It is uncertain if this fish is being commercially bred in large volumes at this stage. However, we are hopeful that it is, or that expeditions are planned to acquire this species. Therefore, we ask that this species be accepted onto the allowable fish import list. ***Kiunga bleheri***

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
			The author accessed various sites on the internet on 24/01/2023 and found this species available only on one wholesalers websites worldwide. The author knows of none here at present. In 2020, the IUCN indicates this species is assessed as Critically Endangered, reporting the following. **Justification:** This species is endemic to the Upper Fly River system of Papua New Guinea where it is only known from a couple of small creeks. The extent of occurrence (EOO) is 80 km^2. There is one location, based on the threats of settlements and road construction, as well as introduced species. These threats are leading to continuing decline in habitat. Therefore, this species is assessed as Critically Endangered. **Geographic Range Description:** This species is endemic to the Upper Fly River system of Papua New Guinea, where it is known only from a couple of small creeks crossed by the Kiunga-Konkonda Road, approximately 10-12 km west of Kiunga, Western Province (G.R. Allen pers. comm. 2019). **Population:** This species was common when it was first discovered in 1991, but is now considered rare (G.R. Allen pers. comm. 2019). **Current Population Trend:** Decreasing **Habitat and Ecology:** This species has been recorded in clear, shallow streams in relatively flat or low foothill terrain amongst undisturbed rainforest at an elevation of about 100 m above sea level. Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. The maximum recorded size of this species is about 2.8 cm SL (G.R. Allen pers. comm. 2019). **Use and Trade:** This species has been collected for the aquarium trade but so far has not established (M. Hammer pers. comm. 2019). **Threats:** It is suspected that this species has been severely impacted by habitat degradation. The primary threat is considered to be settlements and road building associated with the Ok Tedi mine and oil/gas exploration in the area (A.W. Storey pers. comm. 2020). It should be noted that there has been no direct impact from mining activities recorded on this species (A.W. Storey pers. comm. 2020). Invasive species also represent a threat to this species.

Respondent	Major comments	Further information requested	Applicant response (yellow highlights by applicant)
			Conservation Actions: There are no conservation actions in place for this species. Research into the population and distribution is recommended The full report can be accessed at: Allen, G.R., Hammer, M. & Unmack, P. 2020. *Kiunga bleheri.* https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T161077227A161077231.en It is uncertain if this fish is being commercially bred in large quantities at this stage. However, we are hopeful that it is, or that expeditions are planned to acquire this species. Therefore, we ask that this species be accepted onto the allowable fish import list.

Round 2

Consultation with state and territory government agencies on the department's risk assessment report was undertaken from 10 May to 17 June 2023. Submissions containing comments to be addressed were received from the Northern Territory, South Australian and Western Australian Governments (Table 7Table 6).

Table 7 Comments received during consultation Round 2 with states and territory governments.

Respondent	Major comments	Department's response
NT Government	The NT has no issues with allowing import of this cohort of fishes into Australia under the normal conditions for import of aquarium fish and the additional condition for these two genera that they be captive bred.	N/A
SA Government	Based on the overall risk rating of low, but noting uncertainties in the assessment, the listing of the 8 species in Part 2 of the Live Import List which comprises specimens that require a permit under the EPBC Act to be imported is not opposed, with support for the recommended conditions. Ornamental fish can carry infections of serious pathogens. It is suggested that a health certification be a requirement for exemptions to the import list to provide adequate protection from disease introduction.	As per BICON Australian Biosecurity Import Conditions, imported specimens will be subject to health certification requirements for freshwater ornamental (aquarium) fish, including inspection by a competent authority within 7 days prior to export; and undergo post-import quarantine.

Respondent	Major comments	Department's response
WA Department of Primary Industries and Regional Development	DPIRD supports the inclusion of the condition as an attempt to manage this risk. However, it should be acknowledged that the inclusion of that condition does not mitigate that risk entirely and its effectiveness is heavily reliant on others doing the right thing outside of Australia's legal reach. There remains the risk that the source of the captive-bred populations is from the wild and that the captive-bred gene pool will likely need some "refreshing" at some stage which may come from the wild stock. It is concerning that in the applicants response to previous concerns they are unsure if it is available commercially from breeding facilities and they are planning collecting expeditions. This would imply that this species will be collected from the wild and imported to Australia or the overseas facilities and then imported to Australia, either way a critically endangered species will be collected from the wild, which does not align with our international obligations.	The recommendations have been updated to reflect WA's comments, with *P. paskai* now not recommended to be listed due to conservation concerns.

Glossary

Term	Definition
asl	Above sea level
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EPBC	Environment Protection and Biodiversity Conservation Act 1999
FISK	Fish Invasiveness Screening Kit
GISD	Global Invasive Species Database
IUCN	International Union for Conservation of Nature
mm	Millimetres
ppm	Parts per million
SL	Standard length
spp	Species
TL	Total length

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