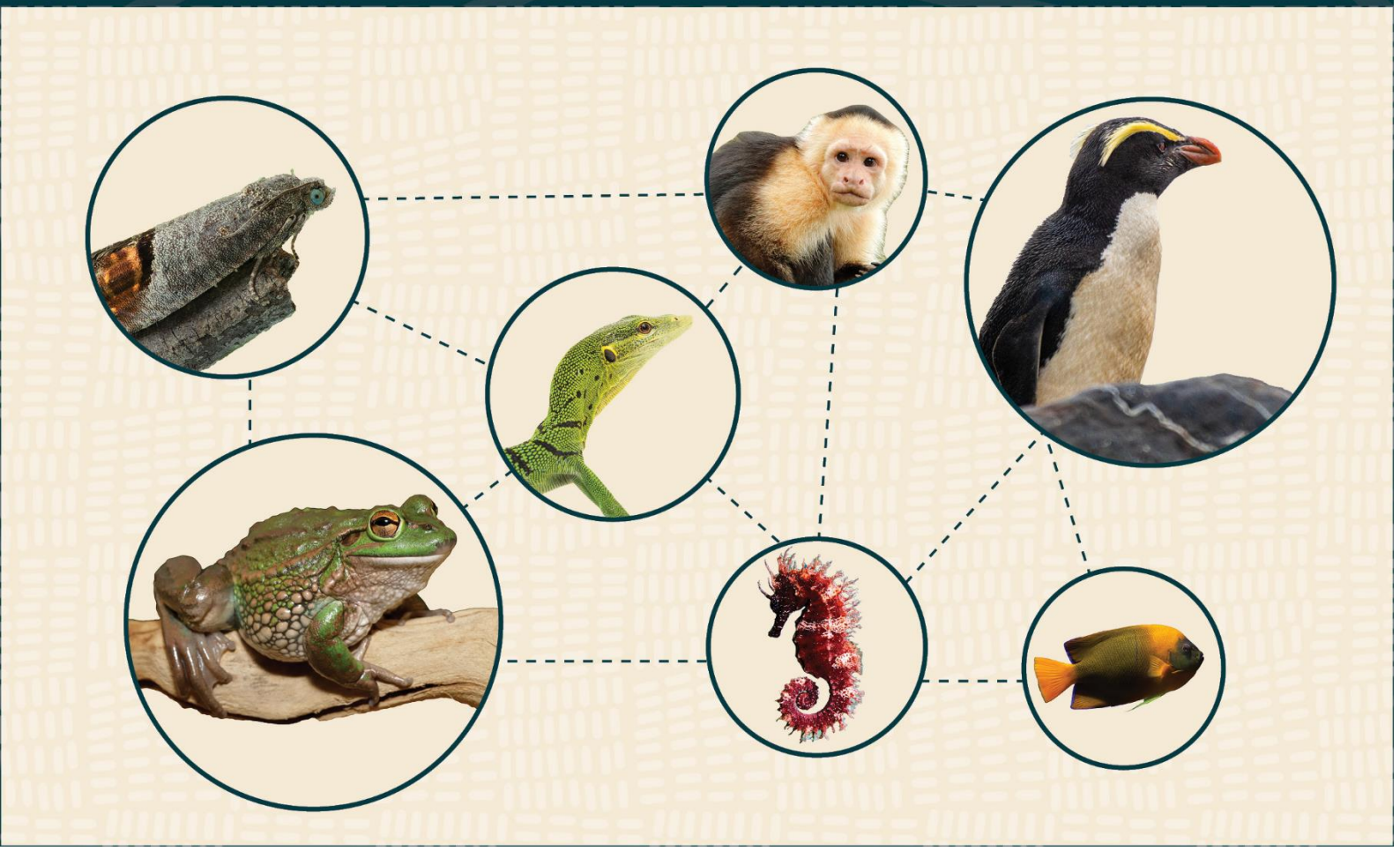
Australian Government
Department of Climate Change, Energy, the Environment and Water

Assessment of the Potential Impacts of 7 Species from the Genus *Glossolepis* 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

May 2023



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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

An application, prepared in accordance with s 303EE of the EPBC Act, to amend *the List of Specimens Taken to be Suitable for Live Import* (Live Import List) to include 7 species of rainbowfish from the genus *Glossolepis* was submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW). The 7 species were:

- *Glossolepis dorityi*, Grime rainbowfish
- *Glossolepis kabia*, Kabia rainbowfish
- *Glossolepis maculosa*, spotted rainbowfish
- *Glossolepis multisquamata*, Mamberamo rainbowfish
- *Glossolepis pseudoincisus*, Tami rainbowfish
- *Glossolepis ramuensis*, Ramu rainbowfish
- *Glossolepis wanamensis*, Lake Wanam rainbowfish

Risk assessments were undertaken to evaluate the likelihood of establishment and spread of the species in Australia, and the potential consequences of these 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.

Glossolepis is a genus of rainbowfishes from New Guinea, containing 9 species, 2 of which are included on Part 1 of the Live Import List, and the remaining 7 are assessed here. Rainbowfish are increasingly popular with aquarium hobbyists due to their ease of breeding, hardiness, bright colours and peaceful dispositions.

Under subsection 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. In the absence of any history of invasiveness and establishment, and a very low climate match, results from the Bomford Model show that all 7 *Glossolepis* species have a low establishment risk with minor-moderate potential impacts on the environment. Therefore, the department has determined that the 7 *Glossolepis* species do not pose a threat of serious irreversible damage.

However, 5 species are listed as Critically Endangered, Endangered or Vulnerable on the IUCN Red List. 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. 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. It is important that listing of threatened species on the Live Import List does not place pressure on wild stocks.

Recommendation: After critically examining and reviewing all available evidence and information, the department recommends listing *Glossolepis kabia* and *Glossolepis multisquamata* in Part 1 of the Live Import List, with the condition:

- of minimum length 4 cm SL

In consideration of their conservation status, the department recommends listing *Glossolepis dorityi, Glossolepis maculosa, Glossolepis pseudoincisus, Glossolepis ramuensis* and *Glossolepis wanamensis* in Part 2 of the Live Import List with the condition:

- Captive-bred specimens only, of minimum length 4 cm SL.

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1 Introduction

1.1 Purpose of the proposed import

An application was submitted to amend the *List of Specimens Taken to be Suitable for Live Import* (Live Import List) to include 7 *Glossolepis* species for ornamental fish breeding and trade purposes.

The applicant reports that 5 of these species (*G. kabia, G. maculosa, G. multisquamata, G. ramuensis* and *G. wanamensis*) are already in the trade in Australia, and so the request for these species to be added to the Live Import List is to legitimise the use of the species within Australia as an ornamental aquarium fish, and for commercial fish farming of these species.

The applications for *G. dorityi* and *G. pseudoincisus* are to allow these species to be imported to use for the ornamental freshwater fish trade in Australia (for pets).

1.2 Background on the Act

Under section 303EC of the *Environment Protection and Biodiversity Conservation Act 1999* (the 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 2021); 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 (section 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's 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 7 *Glossolepis* species was released for public comment from 12 January to 10 March 2022. This assessment report on the potential environmental impacts of listing the species was prepared in accordance with section 303EE of the EPBC Act. Under para 303EC(5)(a) the Minister must consider this report before amending the list.

Under subsection 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 2020). The *Glossolepis* genus contain 9 species that are restricted to northern New Guinea (Table 1) (Allen 2001).

Kingdom: Animalia

Phylum: Chordata

Superclass: Osteichthyes

Class: Actinopterygii

Infraclass: Teleostei

Order: Atheriniformes

Family: Melanotaeniidae

Genus*: Glossolepis* (Weber, 1907)

Table 1 Scientific and common names of the 7 *Glossolepis* species under assessment

Scientific name	Common name	Synonyms
Glossolepis dorityi (Allen 2001)	Grime rainbowfish	Dan Dority's rainbowfish zig-zag rainbowfish
Glossolepis kabia (Herre 1935)	Kabia rainbowfish	*Melanotaenia kabia*
Glossolepis maculosa (Allen 1981)	spotted rainbowfish	*G. maculosus* black-spotted rainbowfish
Glossolepis multisquamata (Weber & de Beaufort 1922)	Mamberamo rainbowfish	*Melanotaenia multisquamata* rosy rainbowfish Sepik rainbowfish red eye tiger
Glossolepis pseudoincisus (Allen & Cross 1980)	Tami rainbowfish	millennium rainbowfish Lake Ifaten rainbowfish
Glossolepis ramuensis (Allen 1985)	Ramu rainbowfish	-
Glossolepis wanamensis (Allen & Kailola 1979)	Lake Wanam rainbowfish	-

Taxonomic reference: Fricke, Eschmeyer & Van der Laan 2020

2.2 Description

Rainbowfish are sexually dimorphic – males are larger, more colourful and have more elongated fins than females (Tappin 2011). Differences between *Glossolepis* and other closely related rainbowfish genera (e.g., *Melanotaenia* and *Chilatherina*) are:

- tongue-shaped scales,
- increased number of gill rakers,
- first spine of the second dorsal fin longer than the first spine of the first dorsal fin and
- relatively elongated pectoral fins.

G. maculosa and *G. ramuensis* differ from other *Glossolepis* species in that they have a reduced number of gill rakers (Tappin 2011).

Table 2 Maximum length and physical descriptions of the 7 *Glossolepis* species under assessment

Scientific name	Maximum length (cm)[a]	Description
Glossolepis dorityi	11.5	**General**: 24-28 gill rakers (Allen 2001). **Males:** silvery reflections on back, nape and side of head. Dull orange or bronze stripes between each scale row of upper half of body; red-orange stripe between each scale row of lower half of body especially prominent during courtship activities; fins greenish to translucent, but with pinkish or red-orange hue on ventrals and basal half of anal and second dorsal. Deeper body than females with elongated posterior rays on the dorsal and anal fins (Tappin 2011). **Females:** generally greenish with silvery reflections (depending on light angle) and lacking orange or red-orange stripes between scale rows.
Glossolepis kabia	11.0	**General**: Greenish to silvery-blue with a rosy glow across the sides. Narrow orange stripes between each scale row, fins are translucent or green, but sometimes black. Orange stripes on the side are brighter in mature males, and dorsal and anal fin membranes have a silvery to yellow sheen (Tappin 2011).
Glossolepis maculosa	8.0	**Males:** Greenish-bronze dorsally grading to silvery-white on ventral half; lower portion of side with yellow suffusion posteriorly; 4 – 10 bluish-black spots along middle of side; fins blue-green with a hint of orange and black margins; second dorsal fin yellowish basally and anal fin with broad median band of yellow (Tappin 2011). 13-14 gill rakers (Allen 1985). The yellow colouration of the fins and body is more pronounced (Allen 1981). **Females**: drab but still show distinctive spots. Mature older females often show colouration similar to subordinate males, but have a shallower body/chest depth and smaller, more rounded fin edges (Tappin 2011).
Glossolepis multisquamata	11.0	**General**: Overall body colour olive-green to silvery with a rosy glow across the sides. A series of narrow, intense orange-red lines between each scale row, with translucent fins tinged with red or black (Tappin 2011). 19-23 gill rakers (Allen 1985). **Males:** bright red eye. Orange lines on the side are brighter in mature males. Elongated anal fin with a ragged appearance; second dorsal fin is also elongated and ragged (Graf & Stanton 2009).
Glossolepis pseudoincisus	8.0	**General:** Red colouration shown after 3-months of age. Pectoral fin uniformly pale, pelvic fin mainly pale (Tappin 2011). Very prominent red criss-cross lines

Scientific name	Maximum length (cm)[a]	Description
		on the gill plates after 1-year of age (Tappin 2011). 26-30 gill rakers (Allen 1985), 12-16 horizontal scale rows (Tappin 2011). **Females:** Strong horizontal zigzagging yellow stripes across whole body. Size up to 6 cm (Tappin 2011).
Glossolepis ramuensis	6.5	**General:** 13 gill rakers (Allen 1985). **Males**: greenish brown to purple on the back and white or mauve on the lower half. Several narrow orange longitudinal stripes on the side with those above and below the lateral line most vivid (Tappin 2011). 10 irregularly scattered black blotches on lower sides. Black stripe from upper rear edge of eye to pectoral fin base. Second dorsal and anal fins yellow on basal third, pelvic and pectoral fins mainly translucent. Scales relatively large, arranged in horizontal rows (Allen 1985). Young show a pattern of small spots on the side which disappear with age (Tappin 2011). **Females:** Shallower bodied than males with shorter first dorsal fin.
Glossolepis wanamensis	10.0	**General:** 19-23 gill rakers (Allen 1985), body depth of 4 – 5 cm (Tappin 2011). **Males**: Body colour is green with a rosy flush on the breast. Scale rows on lower half of body have narrow orange lines that become green-blue towards the caudal fin. Upper half of body is metallic green. **Females:** dull green with shorter fins (Tappin 2011). Elongated anal fin reaching a depth of nearly 3 cm and elongated second dorsal fins.

a size data from IUCN RedList or Tappin 2011

Figure 1 *Glossolepis* species under assessment, top row (from left to right*): G. dorityi, G. kabia, G. maculosa, G. multisquamata*; bottom row: *G. pseudoincisus, G. ramuensis, G. wanamensis*



Source: *G dorityi, G. maculosa, G. ramuensis, G. wanamensis* - Creative Commons Attribution-Share Alike 3.0; *G. kabia* © Johannes Graf (permission obtained 16/6/22), *G. multisquamata* & *G. pseudoincisus* © Siegfried Baesler (permission obtained 16/6/22).

2.3 Geographic distribution

The rainbowfish genus *Glossolepis* consists of 9 species occurring only in the northern half of New Guinea.

Table 3 Geographic distribution of the 7 *Glossolepis* species under assessment

Scientific name	Geographic distribution
Glossolepis dorityi	2 lakes in the Grime River region in northern West Papua (Allen, Hammer & Unmack 2020a).
Glossolepis kabia	Lowland floodplains of the Sepik, Ramu, and Markham River systems of Papua New Guinea (Allen, Kadarusman & Unmack 2020).
Glossolepis maculosa	Markham and Ramu river systems in Papua New Guinea (Allen, Kolkolo & Unmack 2020). Most specimens collected from a small, clear, slow flowing creek bordered by tall grass with dense cover of aquatic vegetation, pH of 7.8 and temperature of 25°C (Allen 1981).
Glossolepis multisquamata	Widespread in the Mamberamo River system Irian Jaya (Unmack, Allen & Kadarusman 2020)
Glossolepis pseudoincisus	Recorded from the Tami River system of northern Papua Province near the Indonesia-Papua New Guinea border, from Lakes Iwom and Yaniruk, and from Lake Ifaten at 110 m elevation near the southern shore of Lake Sentani (Allen & Kadarusman 2020).
Glossolepis ramuensis	Ramu and Gogol River systems of northern Papua New Guinea (Unmack, Allen & Kolkolo 2020).
Glossolepis wanamensis	Endemic to a single lake, Lake Wanam, 2 km wide on a plateau above the Markham Valley (Allen, Hammer & Unmack 2020b).

Figure 2 Geographic distribution of *Glossolepis* species under assessment



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

2.4 Habitat

Table 4 Habitat preferences of the 7 *Glossolepis* species under assessment

Scientific name	Habitat
Glossolepis dorityi	Around lake margins, among dense, abundant aquatic plant growth (Allen, Hammer & Unmack 2020a).
Glossolepis kabia	Occurs in floodplains, swampy lagoons, lakes, and small side channels of larger rivers, usually where there is abundant aquatic vegetation (Allen, Kadarusman & Unmack 2020), in moderate turbid to clear, still to slow-flowing water (Tappin 2011). Surface water temperature commonly varies between 28°C and 35°C, and the bottom waters between 24.8°C and 30°C (Tappin 2011).
Glossolepis maculosa	Inhabits high altitude (150-800 m) swamp lagoons, slow-flowing streams and quiet backwaters with dense aquatic vegetation and clear, slow-flowing creeks (Allen, Kolkolo & Unmack 2020). Most frequently found along grassy banks, sub-surface vegetation and submerged branches in still, clear water at temperatures between 18°C and 28°C (Tappin 2011).
Glossolepis multisquamata	Only rainbowfish documented to inhabit floodplains (Coates 1990). Benthopelagic, inhabits swampy lagoons, lakes, slow-flowing streams and small side channels of large rivers, usually below 100 m elevation. Found around sub-surface vegetation, submerged logs and branches, or among reeds and other shoreline vegetation. (Unmack, Allen & Kadarusman 2020).
Glossolepis pseudoincisus	Ox-bow lakes in areas of dense aquatic vegetation (Allen & Kadarusman 2020).
Glossolepis ramuensis	Small rainforest streams with clear water, gravel bottoms, and few aquatic plants; deeper pools among fallen tree debris (Unmack, Allen & Kolkolo 2020). Temperature ranges from 26°C and 29°C, pH 7.4 – 7.9.
Glossolepis wanamensis	It has been recorded around the lake margin in shallow, clear, sunlit water (Tappin 2011) among dense aquatic vegetation (Allen, Hammer & Unmack 2020b), submerged logs and branches or among reeds (Tappin 2011).

2.5 Diet

All members of the *Glossolepis* genus are opportunistic omnivores, feeding nearly 100% on live foods such as small invertebrates, small crustaceans, worms and zooplankton, taken across substrates or from surface waters (Coates 1990, Tappin 2011). Smaller fish are taken opportunistically (Tappin 2011). They will also consume plant matter including phytoplankton and aquatic plant material (Tappin 2011). The percentage of insects from terrestrial sources increases slightly in the wet season, with reductions in the percentage of these and slight increases in the percentage of crustaceans, detritus and 'other material' in the dry season (Tappin 2011).

2.6 Reproductive biology

The genera *Melanotaenia, Glossolepis* and *Chilatherina* live approximately 4 years in the wild and up to 8 years in captivity (Allen & Cross 1982). Rainbowfish start to breed at the age of 6 months.

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).

The number of eggs per spawn is dependent on the size of the female, but ranges from 40 – 250 eggs, with a 70 – 80% fertilisation rate (Tappin 2011). *Glossolepis* species will produce about 40 to 200 viable eggs a day for several consecutive days in a two-week period (Allen & Cross 1982). Eggs are negatively buoyant and are attached to submerged structures and substrates (e.g., roots, debris, vegetation). Eggs hatch after 5 – 7 days with larvae measuring 3 – 4 mm (Tappin 2011). The larvae are strong swimmers and begin feeding within hours of hatching.

Hermaphroditism has been reported in rainbowfish and may be relatively widespread (Tappin 2011).

Table 5 Species specific reproduction information

Scientific name	Comments
Glossolepis dorityi	No specific information known
Glossolepis kabia	Breed year round with a peak in the wet season. Become sexually mature at 6 cm (females) and 7 cm (males) (Tappin 2011). Egg size (0.69 mm) is much lower than reported for other rainbowfish species (1-2 mm), resulting in a higher fecundity (Tappin 2011).
Glossolepis maculosa	No specific information known
Glossolepis multisquamata	Fecundity is high compared to stream dwelling rainbowfish species (Coates 1990).
Glossolepis pseudoincisus	No specific information known
Glossolepis ramuensis	Spawning occurs from October to December, females produce 50 – 100 eggs (Tappin 2011).
Glossolepis wanamensis	No specific information known

2.7 Environmental tolerances

Glossolepis have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration. Rainbowfishes will not survive in barren environments and require cover to protect them from predators and to provide refuge from flow, which can include rocks, logs, fallen branches and vegetation (Tappin 2011).

Of most importance is dissolved oxygen, pH and temperature, while alkalinity, hardness and clarity are not of significance (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 5 – 38°C, although survival rates declines sharply when temperatures rise above 36°C (Tappin 2011). The tolerable and preferred ranges differ considerably – the former is where the fish can survive without associated problems, whereas the preferred range

is where physiological processes are optimised (Tappin 2011). The preferred ranges are outlined in Table 6, tolerable ranges would be greater than these preferred ranges.

Rainbowfishes can perform aquatic surface respiration to survive low oxygen concentrations for short periods (Tappin 2011).

Table 6 Preferred ranges of environmental parameters for *Glossolepis* rainbowfish

Water quality factor	Preferred ranges	Tolerable ranges
Temperature	22 – 28°C	5 – 36°C
pH	6.5 – 7.8	4 – 10
Hardness	50 – 250 ppm	-
Alkalinity	50 – 200 ppm	0 – 50 ppm
Carbon dioxide	< 10 ppm	0 – 20 ppm
Dissolved oxygen	> 5 ppm	Minimum level depends on species and temperature

Source: Tappin 2011

2.8 Hybridisation

Fish hybrids between closely related species can generally live to adulthood, and some are fertile, producing functioning gametes and a viable second generation. Those between distantly related species belonging to a different genus or family, on the other hand, have a hard time surviving, and even if they do, the majority of the hybrids produced lack reproductive ability. Interspecific hybrids have long been used in the aquaculture industry to transfer desirable traits such as increased growth rate or environmental tolerances (Bartley et al. 2001). These hybrids may be selected for aesthetic reasons, growth rate, or even to be fraudulently passed off as species with a high market value (Ng 2010). There is also the possibility of accidental, indiscriminate breeding of hybrids at fish farms.

Genetic evidence for hybridisation and introgression between some of the more closely related rainbowfish species exists (Unmack, Allen & Johnson 2013). At least 10 species of rainbowfish in Australia have been involved in hybridisation (Tappin 2011) - Allen & Cross (1982) reported on 2 naturally existing hybrids between the genera *Melanotaenia* and *Chilatherina*; McGuigan et al. (2000) and Unmack (2016) identified hybrids between *Melanotaenia* populations in the Northern Territory; and other *Melanotaenia* hybrids have been reported (Zhu et al. 1998, McGuigan 2001). Four taxa in the genus *Melantaenia* have been listed as threatened in Australia due to introgressive hybridisation with the translocated *M. splendida* (Moy et al. 2018).

No naturally occurring hybrids within the *Glossolepis* genus, nor between *Glossolepis* species and *Melanotaenia* species, are known. However, all rainbowfishes in the genera *Melanotaenia, Chilatherina* and *Glossolepis* are known to readily hybridise in captivity (Unmack, Allen & Johnson 2013).

In Australia, there are 12 native *Melanotaenia* species and no native *Glossolepis* species.

3 Species status and conservation

3.1 History in Australia

The applicant states that 4 *Glossolepis* species are well known in Australia after being imported prior to 1986 when controls were put into place - *G. maculosa, G. incisus, G. ramuensis* and *G. wanamensis*. None of these species are reported to have established self-sustaining populations in the wild in Australia (Corfield et al. 2008).

However, the introduction of new aquatic species is inherently difficult to monitor as, unlike land-based spread of an invasive species, alien fish often have the advantage of proliferating significantly before being detected (Ebner et al. 2020). The detection of invasive species is further hindered in remote, infrequently visited areas like northern Australia, where regular flooding events in the wet season assist the spread of alien species.

3.2 Related Live Import List listings

There are currently 2 *Glossolepis* species listed on Part 1 of the Live Import List (Table 7).

Table 7 Non-endemic *Glossolepis* species on the Live Import List.

Scientific Name	Common Name (Synonyms)
Glossolepis incisus of minimum length of 3.5 cm SL	red rainbow fish
Glossolepis leggetti of minimum length 4 cm SL	Leggett's rainbowfish

3.3 Related threat category listings

Within their native habitat none of these species are considered a pest.

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 which Australia is a party. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species.

None of these species 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.

The IUCN status for the 7 *Glossolepis* species are listed in Table 8.

Table 8 Conservation status of *Glossolepis* species under assessment. All species were last assessed in 2019.

Scientific name	IUCN status	Population trend	Threats
Glossolepis dorityi	Critically endangered (possibly extinct in the wild)	Decreasing	Aquaculture, habitat alteration and non-native species. The population is in continuing decline and severely fragmented due to non-native species (Allen, Hammer & Unmack 2020a).
Glossolepis kabia	Least Concern	Stable	Localised threats within the range of this species, but no major threats to the population overall (Allen, Kadarusman & Unmack 2020).
Glossolepis maculosa	Endangered	Unknown	Declines in habitat due to gold mining and oil palm plantations. Invasive species also represent a threat (Allen, Kolkolo & Unmack 2020).
Glossolepis multisquamata	Least concern	Stable	Region largely undisturbed, future threats include regional development plans, such as construction of forest concessions, oil palm plantations, coal mines, and the proposed Mamberamo Dam. Invasive species are also found within the distribution (Unmack, Allen & Kadarusman 2020).
Glossolepis pseudoincisus	Vulnerable	Stable	Settlements, oil palm plantations and invasive species (Allen & Kadarusman 2020).
Glossolepis ramuensis	Vulnerable	Unknown	Introduced non-native fish, oil palm plantations, mining operations, habitat alteration as a result of historical logging (Unmack, Allen & Kolkolo 2020).
Glossolepis wanamensis	Critically endangered	Unknown	Invasive non-native/alien species/diseases – tilapia, carp and gambusia (Allen, Hammer & Unmack 2020b).

3.4.3 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 to which Australia is a party. It provides a global platform for the conservation and sustainable use of migratory animals and their habitats.

None of these species are listed on the Convention on the Conservation of Migratory Species of Wild Animals.

4 Risk Assessment

4.1 The Bomford Risk Assessment Model

Modelling is used to assesses the risk of each *Glossolepis* species establishing and spreading in Australia, and any likely impacts on the Australian environment.

The likelihood of *establishment* was assessed under the Bomford Risk Assessment Model (Bomford 2008 – Chapter 4. Freshwater Fish) in accordance with the five key risk factors:

- Climate match
- Overseas Range Score
- Establishment Overseas
- Introduction Success
- Taxa Risk

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

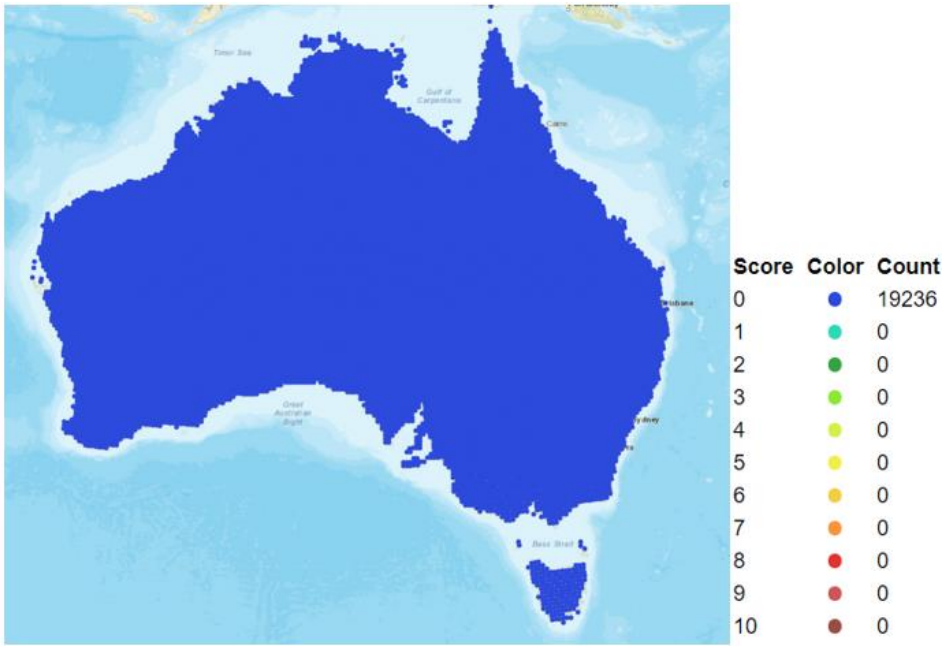
4.1.1 Climate match

Climatch v2.0 (ABARES 2020) was used to assist in identifying possible suitable habitat in Australia that the species could inhabit if released. Climatch v2.0 software is used to generate a map of the area with a climate that closely matches that of *Glossolepis* species' original range.

The Climatch maps for these species were generated from the distribution cited in the IUCN Red List (2020) (Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8). Climatch could not be generated for *G. wanamensis* as, due to its restricted distribution, no meteorological stations are present in its native range. In the absence of a climate match, and given its range sits within the native range for *G. maculosa*, the climate match score (CMS) for the latter species was used as a conservative estimate for the *G. wanamensis* assessment. The climate match score is increased by one increment as recommended by Bomford (2008) for species whose distribution contains 12 or fewer meteorological stations (in the source area). This resulted in a CMS of 2.

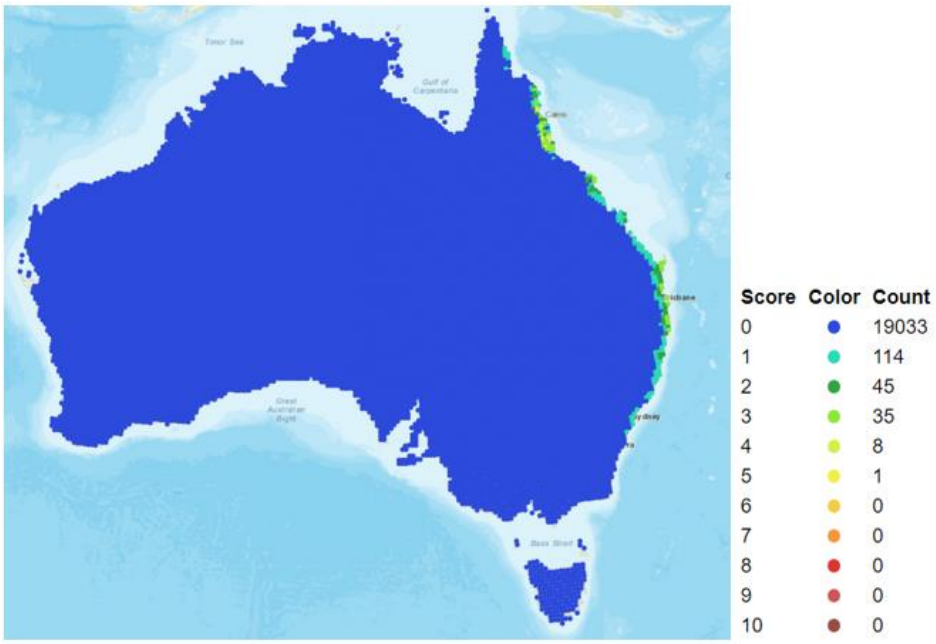
Climatch is based on terrestrial climate data and the target species is a freshwater fish, therefore the generated maps are not a completely accurate indicator of possible suitable habitat. In Australia, rainbowfish species are found almost everywhere that water is present, excluding extremely arid regions (which are mainly devoid of fishes) and the southernmost regions, where distribution is controlled by winter minimum temperatures (Tappin 2011). Distribution is broad, from the Murray-Darling tributaries in Victoria to Cape York, and west to the NW coast of WA. Floodplain and temporary wetland habitats are likely to be important for rainbowfish, and extensive floodplains lie adjacent to some of the largest northern rivers. For example, Kakadu may be inundated with floodwaters covering 2,700 km^2 in the wet season, and, during major floods, several rivers in the Gulf of Carpentaria merge to create wetlands covering 20,000 km^2 (Tappin 2011).

Figure 3 Australian climate-matching map for *G. dorityi*



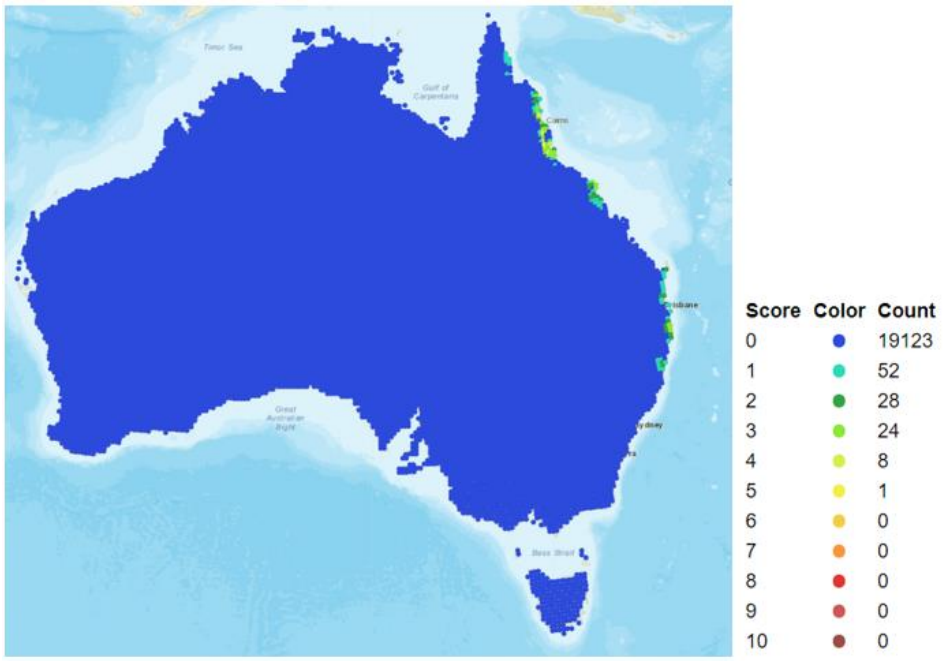
Source: Climatch

Figure 4 Australian climate-matching map for *G. kabia*



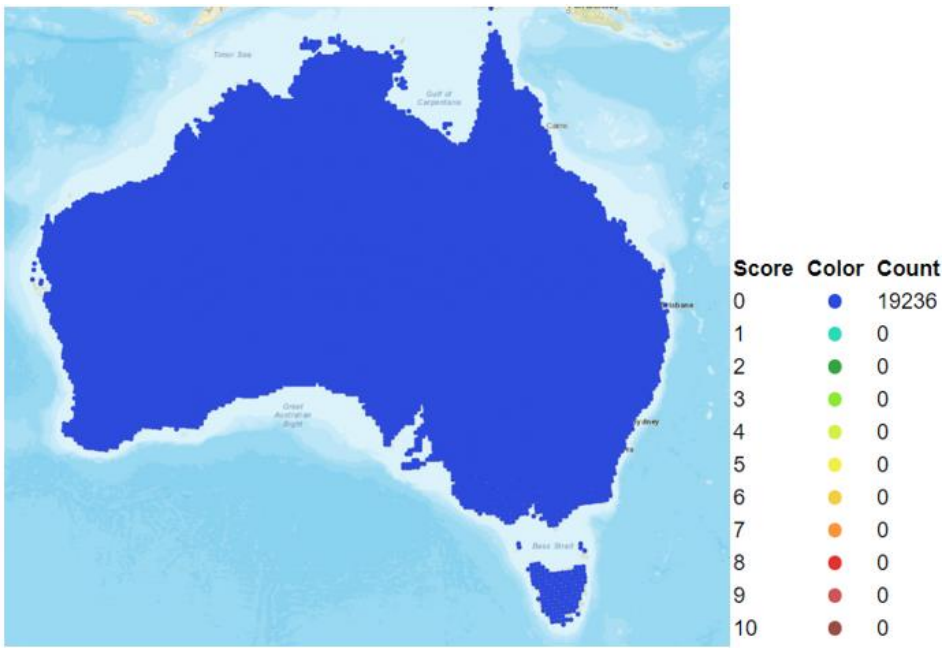
Source: Climatch

Figure 5 Australian climate-matching map for *G. maculosa*



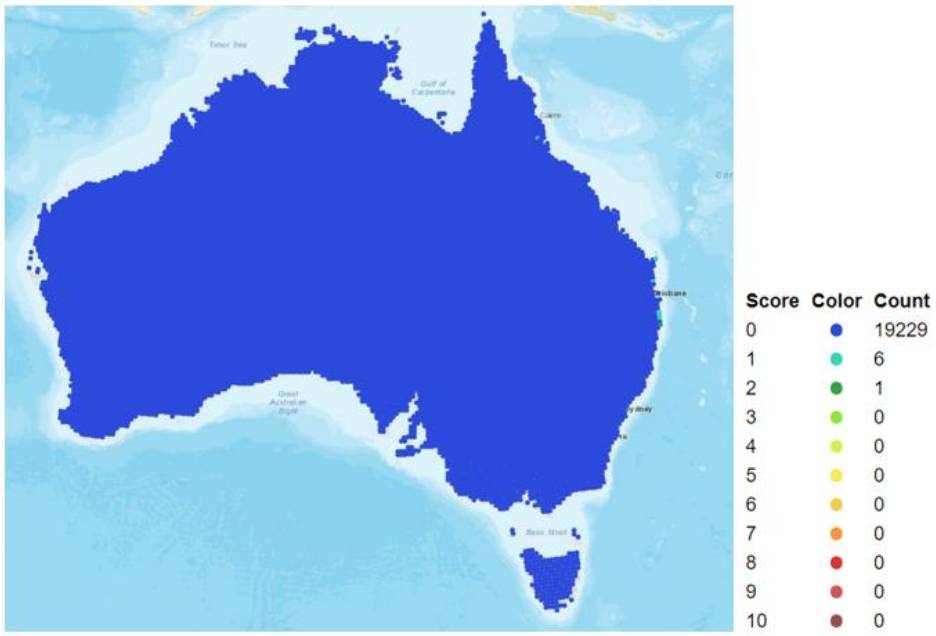
Source: Climatch

Figure 6 Australian climate-matching map for *G. multisquamata*



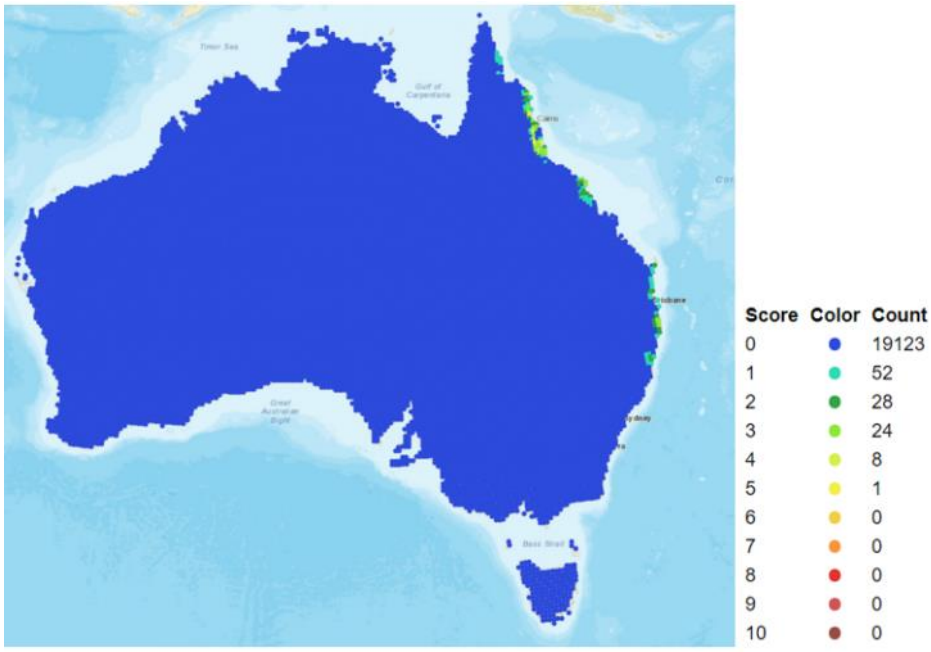
Source: Climatch

Figure 7 Australian climate-matching map for *G. pseudoincisus*



Source: Climatch

Figure 8 Australian climate-matching map for *G. ramuensis*



Source: Climatch

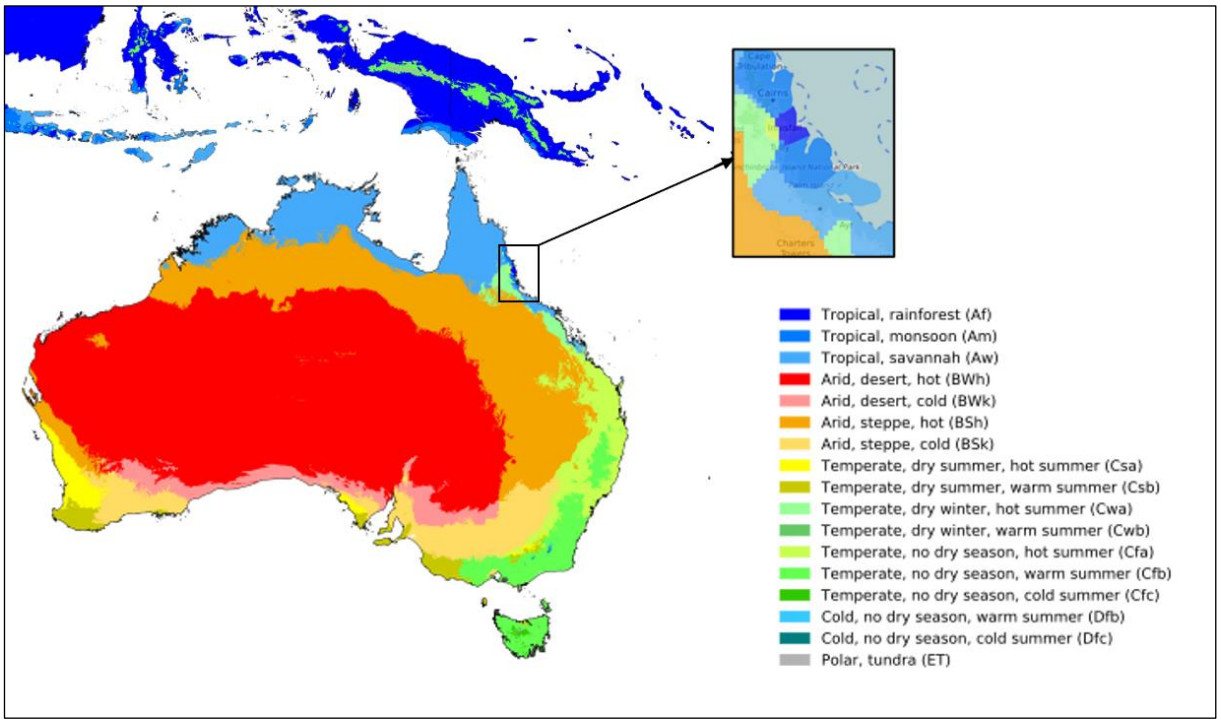
Köppen-Geiger Climate Zones

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). When comparing the Köppen-Geiger climate classification map to the species' native ranges (Figure 9Figure 9**Error! Reference source not found.**), the species can be found in 2 zones in Papua New Guinea: Af and Cfb. The Af zone is only found in a very restricted area of coastal northern Queensland in Australia (Figure 9) from approximately Mission Beach in the south to Fishery Falls in the north. The Cfb zone is present in Australia on the north-eastern coast of Queensland (Figure 9).

Arthington et al. (1999) considered that temperature is the most limiting environmental factor in Australia's freshwater that affects exotic finfish establishment. Rainbowfish are exposed to highly fluctuating temperatures in their natural environments, with temperatures fluctuating 8 – 12°C each day (Tappin 2011). The rivers in tropical northern Australia have average surface water temperatures of 30°C but may range from 25 – 38°C (Tappin 2011), well within the cited range for *Glossolepis* species (see section 2.7), and for New Guinea rivers. The surface temperatures of the lakes of the lower Sepik River are recorded between 28 – 31°C (Chambers 1987); water temperatures in the areas native to *G. dorityi* and *G. pseudoincisus* were found to be 30–31°C (Ohee 2013).

It is highly probably (if not certain), therefore, that the rivers and floodplains of northern Australia would provide suitable habitat for *Glossolepis* species.

Figure 9 Köppen-Geiger map of Oceania, including Papua New Guinea and Australia



Source: Source: Beck et al. (2018)

4.1.2 Overseas Range

The overseas range score is calculated by counting the number of grid squares (1° latitude x 1° longitude) in which an occurrence of the species is recorded in Fishbase (2022), excluding Australia. The distribution map was overlaid onto Google Earth to enable a count of the number of grid squares in which an occurrence of the species is recorded (Table 9).

Table 9 Number of 1° latitude x 1° longitude grid squares in which an occurrence of the species is recorded, and resultant overseas range score for *Glossolepis* species

Species	Number of 1° grid squares	Overseas range score
Glossolepis dorityi	1	0
Glossolepis kabia	14	2
Glossolepis maculosa	8	1

Glossolepis multisquamata	10	1
Glossolepis pseudoincisus	1	0
Glossolepis ramuensis	4	0
Glossolepis wanamensis	1	0

4.1.3 History of establishment elsewhere

A proven history of establishing exotic populations may indicate that a species has attributes that increase the risk of it successfully establishing in other areas (Bomford 2008). A moderate risk rank score of 1 (never introduced) is given where there are no recorded introductions, although a precautionary approach may warrant a higher risk score (Bomford 2008).

To date, there are no records in FishBase (Froese & Pauly 2022) of previous successful establishments of any *Glossolepis* species outside their natural range, therefore a score of 1 is warranted.

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).

4.1.4 Introduction Success

The introduction success score is calculated by counting the number of known successful introductions of the species worldwide, excluding Australia. This number is expressed as a proportion of the total number of introductions. A moderate introduction success score of 2 is given where there are no recorded introductions, although a precautionary approach could warrant a higher Introduction Success Score.

These species have not been introduced into the wild anywhere outside of their natural range and thus warrant an introduction success score of 2 (never introduced) (Froese & Pauly 2022). Other members of this genus are present in the aquarium industry in Australia (*G. incisus and G. leggetti*) and there are no known records of these species establishing a feral population within Australia.

4.1.5 Taxonomic group history of invasiveness

For fish 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. The taxa risk score is either a species' genus risk score, if there are greater than or equal to 4 introduction events for the species' genus, or a species' family risk score, if there are less than 4 introduction events (Bomford 2008).

Genus *Glossolepis*

There are only 2 other species of *Glossolepis* currently known*: G. incisus* and *G. leggetti*. Both species have one introduction record in the Philippines with unknown establishment success (Froese & Pauly 2022). Given that there are less than 4 reports of introductions at the genus level, it is appropriate to assess the risk at the Family level (Bomford 2008).

Family Melanotaeniidae

There are 7 genera and 96 species in the Family Melanotaeniidae, all freshwater species originating from northern and eastern Australia and New Guinea. Four species have been introduced outside of their natural range with no known establishments (Table 10). This gives a family success rate of 0% with more than 3 introductions, resulting in a Family Risk Score of 0.

Family Risk Score = 0, Very Low

Table 10 Introductions of species from the Family Melanotaeniidae

Species	Introduced to	Year	Establishment	Reference
Iriatherina werneri	Philippines	1996	Unknown	Torres 2022a
Melanotaenia boesemani	Philippines	1993	Unknown	Palomares 2022a
Melanotaenia lacustris	Philippines	Unknown	Unknown	Palomares 2022b
Melanotaenia nigrans	Philippines	1992	Unknown	Torres 2022b
Melanotaenia nigrans	USA	1930	Unknown	Torres 2022b

4.2 Bomford Model Results

The Bomford Model (2008) results (Table 11) shows a **low** establishment risk for all 7 *Glossolepis* species. This risk assessment and its results should be evaluated with additional information and data when it becomes available.

Table 11 Bomford Model results for the 7 *Glossolepis* species under assessment

Species	Climate match	Overseas range	History of establishment elsewhere	Introduction success	Taxa risk	Total	Establishment risk
Glossolepis dorityi	2	0	1	2	0	5	Low
Glossolepis kabia	2	2	1	2	0	7	Low
Glossolepis maculosa	2	1	1	2	0	6	Low
Glossolepis multisquamata	2	1	1	2	0	6	Low
Glossolepis pseudoincisus	2	0	1	2	0	5	Low
Glossolepis ramuensis	2	0	1	2	0	5	Low
Glossolepis wanamensis	2	0	1	2	0	5	Low

4.3 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 A). 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 impact results are based on published evidence as detailed throughout this report (Table 12).

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 12 Potential impacts from the establishment of *Glossolepis* species populations in Australia

Type of impact	Assessment	Rating
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.* No damage documented	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*. *Glossolepis* species are omnivorous and would prey upon small insects, crustaceans and algae. They would likely occupy a similar habitat to native rainbowfish in the NT and QLD, such as the Eastern rainbowfish (*Melanotaenia splendida* complex, Gomon & Bray 2022) and Running River rainbowfish (Bray 2017) and may compete with native fish for food. There are 16 native Melanotaeniidae species in Australia. Six of these native species are threatened, 3 of which would share a niche with the *Glossolepis* species being assessed (**Error! Reference source not found.**), so competition and niche overlap between these species could impact upon these threatened native species. They may also compete for shelter. *Glossolepis* are known to shelter under vegetation, logs or driftwood, so would compete with native species for similar refugia.	Moderate
Predation e.g., predation, parasitism, or intoxication, measurable as reductions in reproduction, survival, growth, or abundance. These impacts range from	*Predators directly or indirectly resulting in a decline of populations size of at least one native species but no changes in community composition.* Omnivores can have large impacts on aquatic communities. For example, even when introduced to sites where native fishes	Moderate

Type of impact	Assessment	Rating
population decline to population loss, including minor changes in the food web.	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). As an omnivore feeding primarily on small insects, the species is expected to find food sources and may impact on macroinvertebrate species in any waterway it is introduced into. They exhibit little aggression toward other fish except from conspecific breeding males, this aggression is non-physical stylised display.	
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, physical and/or structural characteristics detectable, with no reduction of fitness of native individuals.* The conspicuous colouration of these species increases the risk of predation in natural habitats. Rainbowfishes would be consumed by many predatory species of fish, water birds and aquatic reptiles (e.g., barramundi, grunters, file snakes). These species occupy a similar niche to native rainbowfish species and are therefore unlikely to impact or upset the ecological balance. They are also not ecological engineers (i.e., they do not modify habitat) and again would have no impact in habitat function. They are mid water to surface swimmers (Tappin 2011) and would cause no disturbance to the substrate during feeding so would not contribute to declines in water quality. They breed by laying eggs on aquatic vegetation or debris and do not damage the habitat doing so.	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.* *Glossolepis* spp. are not known to hybridise with other species within their genus nor with any other fish species. There are no native *Glossolepis* species in Australia. See 2.8.	Minimal
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 et al. 1997). This parasite has the potential to be a significant source of mortality for native fish species. Several 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	Minor

Type of impact	Assessment	Rating
	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). The introduction of disease from the introduction of a *Glossolepis* 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.	
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 it became established in Australia, it is unlikely to have any negative impacts on animal production or aquaculture etc.	Minimal
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.	*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)* No damage to infrastructure would be expected.	Minimal
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.* Not toxic nor harmful to humans.	Minimal

Type of impact	Assessment	Rating
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.	*Occasional small disturbance, only small percentage of human population affected.* If *Glossolepis* species were to establish in the wild in Australia, there may be impacts to fishing activities (whether directly through changes to fish structures through competition, or indirectly e.g., closures due to eradication or management activities).	Minor

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

Table 13 Threatened native rainbowfish species that may share a niche with *Glossolepis* species if they were to become established

Species	Environmental conditions	Geographic range	Conservation status and population trend (IUCN Redbook)	*Glossolepis* similar niche?[a]
Cairns rainbowfish, *Cairnsichthys rhombosomoides*	Temperature: 21°C - 25°C pH range: 7.2 - 7.6 (Torres 2022c)	Small streams in the central Australian Wet Tropics. (Ebner et al. 2019)	EN Decreasing	Yes
Lake Eacham rainbowfish, *Melanotaenia eachamensis*	Temperature: 23°C - 27°C pH range: 7.0 - 7.4 (Cruz 2022)	Endemic to the upper reaches of the Barron, North Johnstone and South Johnstone River catchments in Queensland (Unmack & Brown 2019)	EN Decreasing	Yes
Slender rainbowfish, *Melanotaenia gracilis*	Temperature: 22°C - 28°C Habitat: clear waters and minimal flow (Palomares 2022c)	Endemic to the Drysdale River and one small tributary of each of the Morgan River, King George River and Durack River in the Kimberly region of far NW Australia (Morgan 2019a)	EN Stable	Yes
Pygmy rainbowfish, *Melanotaenia pygmaea*	Temperature: 22 – 28°C Habitat: Fast flowing streams with frequent cascades and rapids, very clear water with little to no vegetation cover (Morgan 2019b, Palomares 2022d).	2 small tributaries of Prince Regent River; and at King's Cascade, in the Western Kimberly region of WA (Morgan 2019b).	VU Unknown	No
Utchee rainbowfish, *Melanotaenia utcheensis*	Environmental tolerances unknown. Habitat: moderate to fast flowing waters (Brown, Hammer & Unmack 2019)	Restricted to lowland tributaries of the north and south Johnstone River in North Queensland (Brown, Hammer & Unmack 2019)	EN Unknown	No
Ornate rainbowfish, *Rhadinocentrus ornatus*	Temperature 20°C - 28°C pH range: 5.4 - 6.5 Habitat: stagnant pools or streams with little or no	Subtropical freshwaters of coastal areas of the Great Diving Range between Rockhampton and Coffs Harbour; and on sandy islands off	VU Decreasing	No

Species	Environmental conditions	Geographic range	Conservation status and population trend (IUCN Redbook)	*Glossolepis* similar niche?[a]
	flow (Torres 2022d)	southern QLD (Arthington & Butler 2019)		

a *Glossolepis* preferred temperature 22 – 28°C, pH 6.5 – 7.8, habitat: moderate turbid to clear, still to slow-flowing water.

The consequences for the environment may be predominantly from competition for resources, and predation.

The ratings are estimates as the impacts are mostly unknown but, using the Precautionary Principle and considering the information above, a risk rating of **minor-moderate** for the environmental consequences is appropriate.

4.4 Risk Rating

Establishment Risk is the chance or probability that establishment will occur (Bomford 2008). Based on the risk assessment, the likelihood o*f* the 7 *Glossolepis species* establishing viable wild populations is **low**. The environmental impact and consequences of these species, should they become established, is moderate (Table 12).

4.5 Consultation - Concerns raised

The first consultation round seeking comment from state and territory government agencies and the public on the applicants' report was undertaken from 12 January to 10 March 2022.

A number of industry stakeholders and members of the public/hobbyists (Appendix B) 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.

Three submissions containing comments to be addressed were received. The specific comments are at Appendix B. Concerns raised and the applicants' responses are outlined in Table 14.

The department's reports were circulated with relevant state and territory government agencies for comment between 21 September and 24 October 2022. The New South Wales and Western Australian Governments responded with comments supporting the proposed amendment for these species. The South Australian Government responded with no comments (Appendix B).

Table 14 Summary of main concerns raised and the applicant's responses

Concern	Applicant's response
Conservation status and sustainability Many species are listed as threatened, but trade in listed species can be counterproductive to protection and compromise conservation efforts due to increased harvesting. 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	All 7 species are being sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Being widely available overseas suggests that there should not be any wild harvesting. 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. Sustainably captive-bred stock is currently available for 6 of the 7 species of *Glossolepis* species (not *G. maculosa*). Vets and Government licensing

Concern	Applicant's response
compound this issue by creating an incentive to harvest from the wild.	Authorities should be able to provide certification as to the source of the imported specimens. Wild specimens may be sought if there are none in captivity.
Identification issues The minimum size limit suggested by the proponent of 4cm should be applied to the importation of these species to reduce the chance of mistaken identity of juveniles with other similar looking fish species at the border.	There is no objection to the 4cm minimum size limit for the importation of rainbowfishes. This is already in place for the *Glossolepis* spp. on the allowable list.
Risk of introduction of pathogens to native population 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.	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.

4.6 Risk Mitigation

The Bomford Model indicates that these 7 *Glossolepis species* have a **low** risk of establishment in Australia. 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 4 cm 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. However, there may be limitations on the restrictions that can imposed through the Live Import List process.
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 of *Glossolepis* species should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species.
5. The applicant has suggested that the distinctive colouration of these species and likely popularity and expectant high price should together mitigate against any likelihood of accidental establishment of feral populations through incorrect disposal.

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. Measure 4 is not considered viable under the EPBC Act. Measure 5 may be an inhibitor in some cases but is not considered by the department to be a viable mitigation measure.

5 Discussion

The global aquarium trade is arguably the greatest biosecurity threat to freshwater ecosystems (Ebner et al. 2020). Ornamental fish present a significant risk to aquatic systems in Australia and have the potential to trigger or contribute to a future major aquatic animal pest or disease incursion, particularly in freshwater habitats (Moore, Marton & McNee 2010). A 2020 report by Ebner et al. highlighted the numerous existing and potential pathways for incursions from the aquarium trade into freshwater ecosystems in tropical Australia, encompassing the lands and waterways north of the Tropic of Capricorn. The lack of consolidated information relevant to tropical Australia in terms of biotic incursion of even the better documented taxa (e.g., freshwater fishes) and a lack of information on most taxa in the aquarium trade (e.g., diseases in the wild) creates a major biosecurity risk (Ebner et al. 2020).

One of the factors affecting establishment success is propagule pressure – successful species are introduced more times than unsuccessful species. The number of fish that escape or are released is likely to increase if more species are kept, in higher numbers, and in more locations. As a result, propagule pressure can be minimised by limiting the species that are kept in Australia, the number of collections that hold a species, the number of individuals held in each collection, and the security circumstances in which species are kept (Bomford 2008).

There is also no evidence of *Glossolepis* species successfully establishing elsewhere, nor is there evidence for any of the 96 species in the family Melanotaeniidae. Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. The Climatch map for these species indicated a very very low climate match. However, Climatch is based on terrestrial climate data and therefore is unlikely to be a true indicator of the potential range of non-endemic aquatic species. *Glossolepis* are tolerant of temperatures ranging from 5 – 38°C and have similar preferred temperature and pH ranges as native rainbowfish species in northern Australia. This suggests that the rivers and floodplains of northern Australia would provide suitable habitat for *Glossolepis* species.

In the absence any history of invasiveness and establishment, and a very very low climate match, results from the Bomford Model show that all 7 *Glossolepis* species have a **low establishment risk,** and moderate potential impacts on the environment if they were to establish.

In addition to the factors assessed under the Bomford Model, several other characters that are most frequently cited as being associated with successful fish invasions include exhibiting high physiological tolerance (Moyle & Marchetti 2006), r-selected life history strategies (high fecundity, rapid growth, early maturity) (Moyle & Marchetti 2006, Bomford 2008, Corfield et al. 2008, Chan et al. 2021), aggressive behaviour (Corfield et al. 2008), moderate size (Moyle & Marchetti 2006, Bomford 2008, Corfield et al. 2008), and dietary preferences (Moyle & Marchetti 2006). Therefore, in consideration of a recommendation for this species, the department considered the available information on this species, as summarised in Table 14.

Table 15 Considerations taken into account when forming a Live Import List recommendation for 7 species of *Glossolepis*

Consideration	Comments
Establishment risk	Low as per Bomford Risk Assessment
Impact analysis	Moderate impacts on Australian environment
Climate match	Very very low according to Climatch, although likely to be higher
Physiological tolerances	These species able to tolerate a wide temperature range from 5 – 38°C but are not salt tolerant. They can also survive low oxygen concentrations for short periods.
Fecundity	Low fecundity – ranges from 40 – 250 eggs per spawn
Spawning	Spawning over a 4 – 5 month period
Aggressive behaviour	Described as peaceful, not territorial or aggressive
Body size	Max size for these species ranges from 6.5 – 11 cm TL – relatively small maximum body size.
Dietary preferences	Omnivorous – mostly small invertebrates and crustaceans, and able to adapt their feeding regime to cope with seasonal changes in food abundance
Conservation status – IUCN Red Book	*G. kabia* and *G. multisquamata* are listed as Least Concern with stable populations. *G. pseudoincisus* is listed as Vulnerable but with stable populations. *G. ramuensis* is listed as Vulnerable with populations status unknown. *G. maculosa* is listed as Endangered with population status unknown. *G. dorityi* and *G. wanamensis* are listed as Critically Endangered, with *G. dorityi* possibly extinct in the wild and populations decreasing.

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 already under threat to Australia's approved list may further compound their conservation status by creating an incentive to harvest from the wild. With 2 species listed by the IUCN as Critically Endangered (one in decline and likely extinct), 1 species as Endangered, and 2 species as Vulnerable, it is important that listing of these species on the Live Import List does not place pressure on wild stocks.

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. In the absence of any history of invasiveness and establishment, and a very low climate match, results from the Bomford Model show that all 7 *Glossolepis* species have a low establishment risk with minor-moderate potential impacts on the environment if they were to establish, and do not pose a threat of serious or irreversible damage.

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 7 *Glossolepis* species 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.*

Results from the Bomford Risk Assessment Model (2009) show that 7 species of *Glossolepis* pose a low risk of becoming established in Australia.

Juveniles of these species would be difficult to distinguish from other species. Due to this characteristic, a minimum length of 4 cm SL is proposed to allow for positive identification of these species at the border.

After critically examining and reviewing all available evidence and information, the department recommends listing *Glossolepis kabia* and *Glossolepis multisquamata* in Part 1 of the Live Import List, with the condition:

- of minimum length 4 cm SL

In consideration of their conservation status, the department recommends listing *Glossolepis dorityi, Glossolepis maculosa, Glossolepis pseudoincisus, Glossolepis ramuensis* and *Glossolepis wanamensis* in Part 2 of the Live Import List with the condition:

- Captive-bred specimens only, of minimum length 4 cm SL.

Appendix A: Impacts assessment scoring criteria

Table 16 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 B: Comments received on the proposal to include 7 *Glossolepis* species on the Live Import List

Round 1

Consultation with the general public, stakeholders and state and territory government agencies on the applicants' report was undertaken from 12 January to 10 March 2022. Submissions containing comments to be addressed were received from Western Australia (WA), New South Wales (NSW), and Federation University (Table 17). Ten email responses supporting the proposal were received from members of the public and the aquarium industry. These raised no issues requiring additional information.

Table 17 Comments received during public consultation and response from applicant

Respondent	Major comments	Further information requested	Applicant response
NSW Department of Primary Industries (DPI)	NSW DPI supports the amendment to add these species to the Live Import List provided the following conditions are met: 1. The minimum size limit suggested by the proponent of 4cm should be applied to the importation of these species to reduce the chance of mistaken identity of juveniles with other similar looking fish species at the border. 2. 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. NSW DPI further notes that all other identified biosecurity risks are acceptable, and these 17 species of Rainbowfish pose very low risks to the Australian and NSW aquatic environment. 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	No further information required	There is no objection to the 4cm minimum size limit for the importation of rainbowfishes. This is already in place for the *Glossolepis* spp. on the allowable list 303EB EPBC Act. 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 by BICON Australian Biosecurity Import Conditions - available at: https://bicon.agriculture.gov.au/BiconWeb4.0/ViewElement/Element/Index?elementPk=1659368&caseElementPk=1752962 Importers of the species requested will only import from these countries. Model Health Certificate, Appendix 6: Health certification for freshwater ornamental finfish exported to Australia states that: Only finfish 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 approved for export to Australia, meeting standards of the Department of Agriculture and Water Resources.

Respondent	Major comments	Further information requested	Applicant response
	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 *Glossolepis* are declared as prohibited or notifiable matter under NSW legislation.		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 six (6) months prior to certification. All fish in the consignment have been in approved Export Premises for fourteen (14) days prior to export. The fish have not been kept in water in common with farmed foodfish (fish farmed for human consumption including recreational fishing) or koi carp. 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. 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 to NSW will also have to comply with any state legislation in place at the time of importation.
WA Department of Primary Industries and Regional Development (DPIRD)	In general, the Department of Primary Industries and Regional Development (DPIRD) considers the suite of 17 rainbow fish (in Chilatherina and *Glossolepis* 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. However, DPIRD WA does not support the addition of most of these fish due to sustainability concerns in their native environment. Lyer (2016) outlines how trade in listed species can be counterproductive to protection and compromise conservation efforts due to increased harvesting. as outlined below. Certification in developing countries is problematic and poorly managed. 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		Whilst the fish that, the WA Department of Primary Industries and Regional Development (DPIRD) have concerns about regarding their IUCN status, it is important to note that in most instances the fish population is stable or data deficient. There is considerable debate about the decline of natural species and what is the best thing that can be done to stop the march to extinction. Just monitoring does not work, it lets us know that they are going. The best way to protect species is to reverse the threatening processes that are causing the decline. The major causes affecting the decline of fishes in West Irian and Papua New Guinea are human activities, Palm Oil plantations, mining and habitat destruction. More up to date research needs to be undertaken, but the exorbitant costs involved to conduct field trip research makes this a very onerous task. We have found that these seven *Glossolepis* species are being commercially bred and/or farmed. **Millington, M D, Holmes , B J, and, Balcombe S R.** (March 2022) Systematic review of the Australian freshwater ornamental fish industry: the need for direct industry monitoring, report the following: Wild-capture fisheries and captive-based aquaculture constitutes an important part of imported stock. Seven of the species we identified as at risk of exploitation originate from continents involved in ornamental trade of wild fish (Asia: E. *bicolor, B.*

Respondent	Major comments	Further information requested	Applicant response
	Australia's approved list, may further compound this issue by creating an incentive to harvest from the wild.		*melanopterus, B. splendens, P. titteya, C. carpio;* Africa: *T. duboisi, O. mossambicus*) (Yi 2014), and may have been harvested from wild populations. Capture-based aquaculture continues to remain the only feasible and efficient means of production for a considerable number of top–traded ornamental species (Teletchea 2015). Indeed, an estimated 85% to 90% of the ornamental species produced in India are sourced from captive-based ornamental fisheries (Rani et al. 2013; Silas et al. 2011). Further, more than 70% of fish in the Singapore industry are harvested from wild populations in India, Asia, South America, and Africa (Yi 2014), and as Singapore is one of the leading exporters of freshwater ornamental fish and a main supplier to the Australian trade (O'Sullivan et al. 2008), these wild-caught fish will undoubtedly become part of the ornamental community in Australia. Demand for such fish remains high, as wild-type stock is championed by hobbyist groups over hybridised, line-bred progeny (M. Millington unpubl. data 2018). However, a ready supply of pure strain individuals is necessary to retain the wild type features that hobbyists' favour, and thus there continues to be a push by industry for further whitelisting of wild-caught species to supplement linebred stock (Toomes et al. 2020). Captive-based aquaculture must be pursued and prioritised as a replacement for high impact wild-caught fisheries to minimise further exploitation of the freshwater fish species by the Australian ornamental industry. This has been achieved in the past for ornamental species, including Boeseman's rainbowfish – *Melanotaenia boesemani* (Allen & Cross, 1980). Following their intense collection for ornamental purposes in the 1980s that severely threatened population resilience (IUCN 2021c), a switch to captive-bred production removed this threat and the species is no longer considered exploited by ornamental trade (IUCN 2021c). While these trade protections may not substantially reduce within-native-range impact for all imperilled species, given the sizeable ornamental industries internationally (Yi 2014; Hensen et al. 2010), Australia should set a global example to encourage other countries to also remove exploited species from import. A united front on exploitation and investment in advancing captive breeding techniques has the potential to remove capture-based ornamental fisheries from the industry and reduce the industry's environmental impact. There are also many instances of species becoming endangered in Australia, such as: **Gouldian finch decline**. The main threats potentially affecting seed resource availability for Gouldian Finches are grazing pressure exerted by stock and feral herbivores, and unfavourable fire regimes. Grazing intensity has been shown to be the factor most strongly correlated with historical granivorous bird species decline across the northern savannas, and

Respondent	Major comments	Further information requested	Applicant response
			data suggest that the negative impacts of grazing may be worse where pastoral settlement and grazing intensification occurred earlier, as in Queensland (Franklin et al. 2005). **Plains wanderer - *Pedionomus torquatus*** The major threat to the survival of the Plains-wanderer is the loss of sparse native grasslands and the condition of the grassland habitat that remains. They like it just right. If the grass cover becomes too thick or too sparse they abandon the site. Zoos Victoria is part of an Australian National Recovery Team, formed in an emergency effort to save the species from extinction **Red finned blue eye - *Scaturiginichthys vermeilipinnis*** The introduced and highly invasive fish Eastern Gambusia (*Gambusia holbrooki*) – also known as the mosquitofish – is the biggest threat to the Red-finned Blue-eye's survival. Eastern Gambusia compete with the Red-finned Blue-eye for food and habitat, display aggressive behaviour such as fin-nipping, and probably eat the eggs and newborn Red-finned Blue-eye (and other native fish). Gambusia are implicated in the extinction of Red-finned Blue-eye from seven springs since 1991. Added to this, Red-finned Blue-eye have most likely also been affected by habitat degradation caused by cattle and feral pigs that trample plants, increase turbidity, and degrade water quality to an intolerable level for Red-finned Blue-eye. **Bilby - *(Macrotis lagotis)*** Main threats to bilbies, Predation by foxes, feral cat and wild dogs, Competition with, and habitat degradation by, introduced herbivores (rabbits, cattle, camel), Inappropriate fire regimes, Climate change leading to a drier climate, Habitat loss and degradation due to mining and other developments, and Road mortality. We are extremely lucky that there are recovery plans and efforts to save these species including captive breeding programs, where there may be no plans to do the same in New Guinea, and West Papua. **References:** Hensen RR, Ploeg A, Fossa SA (2010) Standard Names for Freshwater Fishes in the Ornamental Aquatic Industry. OFI Educational Publication 5. Ornamental Fish International, The Netherlands, 146 pp Millington, M D, Holmes , B J, and, Balcombe S R. (March 2022) Systematic review of the Australian freshwater ornamental fish industry: the need for direct industry monitoring

Respondent	Major comments	Further information requested	Applicant response
			O'Sullivan D, Clark E, Morison J (2008) The Australian Ornamental Fish Industry in 2006/2007, Australian Government Fisheries Research and Development Corporation and Australian Government Department of Agriculture, Fisheries and Forestry, Project No. 2007/238. https://frdc.com.au/sites/default/files/products/2007-238-DLD.pdf (accessed 5 October 2021) Rani P, Immanuel S, Ananthan PS, Ojha SN, Kumar NR, Krishnan M (2013) Export performance of Indian ornamental fish - an analysis of growth, destination and diversity. Indian Journal of Fisheries 60(3): 81–86 Silas EG, Gopalakrishnan A, Ramachandran A, Anna Mercy TV, Kripan Sarkar, Pushpangadan KR, Anil Kumar P, Ram Mohan MK, Anikuttan KK (2011) Guidelines for Green Certification of Freshwater Ornamental Fish. The Marine Products Export Development Authority, Kochi, India, 106 pp Teletchea F (2015) Domestication level of the most popular aquarium fish species: is the aquarium trade dependent on wild populations? Cybium 40(1): 21–29 Toomes A, Stringham OC, Mitchell L, Ross JV, Cassey P (2020) Australia's wish list of exotic pets: biosecurity and conservation implications of desired alien and illegal pet species. NeoBiota 60: 43–59, https://doi.org/10.3897/neobiota.60.51431 Yi Y (2014) Developing Monitoring Tools for Tomorrow's Invasive Species Lists, DNA Barcodes, and Images for Ornamental Fish. PhD Thesis, National University of Singapore, Singapore, 172 pp
		How is source stock from the suppliers collected?	Hans-Georg Evers, a German aquarist, author, fish collector, who, from 2005 until 2018 was editor-in-chief of the aquarium magazine "AMAZONAS". Evers mainly travels to South America and Asia to discover new fish and import them for breeding. He has caught about 350 species of fish so far, many of them for the first time. The species *Oryzias evers*i, a ricefish from Sulawesi, and *Corydoras eversi*, a short -snouted mailed catfish from the Rio Araguaia area, Brazil, were named after their discoverers. Evers has authored and co-authored hundreds of professional articles and ten books, mostly on South American catfish. He has also written more than 1000 articles published in hobbyist magazines and scientific papers. Today, he works for the American issue of AMAZONAS as an editor. Along with Jeffrey Christian, the owner of Maju Aquarium in Java, started a project in 2011, that saw them collect a once only collection of brood stock from Western Papua and breed rainbowfish sustainably. In his article: Evers, H.G., Pinnegar, J.K., and Taylor, M.I (2019), Where are they all from? – sources and sustainability in the ornamental freshwater fish trade available at: https://onlinelibrary.wiley.com/doi/full/10.1111/jfb.13930 He writes a relevant case

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			study, . Case Study: WILD COLLECTING OF RAINBOWFISHES IN WEST PAPUA, FOR BREEDING IN CAPTIVITY, The rainbowfishes (Melanotaeniidae) are a family of small, colourful, freshwater fish found in northern and eastern Australia, New Guinea and several islands of Indonesia. Some melanotaeniids are now critically endangered as a result of over-collecting and hence trade is carefully restricted. Notably, Boeseman's rainbowfish Melanotaenia boesemani Allen & Cross 1980 is one of the most popular melanotaeniid species in the aquarium hobby. When fully matured, males display a very distinct pattern of half-and-half coloration marked by a brilliant blue anterior and bright yellow to orange-red posterior. Allen and Cross (1980) discovered the species whilst studying material originally collected in 1954–1955 by Marinus Boeseman and stored at the National Museum of Natural History in Leiden (Netherlands). The species is known only from the Ayamaru Lakes and tributaries and from Uter-Aitinyo Lake in West Papua; two locations that are 30 km apart and are separated by rugged karsts. After the first publication describing M. boesemani (Allen & Cross 1980), great interest arose in the potential commercial value of this species. It was introduced to the aquarist trade in 1983 and has steadily increased in popularity since then (Polhemus & Allen, 2007). In the mid-1980s, more than 60,000 males were caught and exported monthly from Ayamaru (Allen, 2007). Such over-exploitation quickly brought this species to the verge of extinction in its natural habitat. Consequently, this species was included on the IUCN Red List of endangered species (Allen, 1996) and only farmed animals are now permitted to be exported (Nugraha et al., 2015). Melanotaenia boesemani has however, been domesticated and produced in Indonesian fish farms since 1983 (Nugraha et al., 2015). Visits in 2013 suggest that the population in Lake Uter is stable and apparently healthy, but the Ayamaru lakes have been devastated through the introduction non-native fish species and by pollution, hence fish populations are severely threatened (Evers, 2014). There are currently 86 recognized species in the genus Melanotaenia Gill 1862 and several more in the genera *Glossolepis* Weber 1907 and Chilatherina Regan 1914. There is a great appetite to introduce more of these rainbowfishes into the freshwater aquarium trade. Melanotaeniids thrive in captivity and thanks to their often brilliant colours, small size and ease of breeding, are highly prized by aquarists. However, in order to avoid some of the same over-exploitation problems associated M. boesemani, and because many species have highly restricted home ranges, collectors are now working with taxonomists and breeding facilities, to secure new broodstock. They are then developing sustainable aquaculture practices, such that wild populations are not put at risk in the future. A particular focus in recent years has been the Birds Head Peninsula, West Papua Province, Indonesia where a multitude of

Respondent	Major comments	Further information requested	Applicant response
			novel species have been discovered (Allen et al., 2014, 2016; Kadarusman et al., 2012). Once in captivity it is relatively straightforward to maintain and breed most species of rainbowfish. If rainbowfishes are kept in a species tank with floating plants or a synthetic spawning mop, sooner or later fry will appear. Most rainbowfish species spawn every day, usually in the morning, with the males attracting the females and the pairs spawning in the plants. The tiny, crystal-clear eggs adhere to the plants with their sticky filament for about 10 days until the fry hatch. In Indonesia, large well-equipped breeding facilities have emerged, offering many different species and varieties. The Maju Aquarium is now regularly reproducing more than 40 different species of Indonesian rainbow fish under sustainable conditions (social and environmental aspects). Author 2 has been in contact with Maju aquarium and has confirmed that they currently have stock available on a sustainably commercial basis, the following *Glossolepis*: *Glossolepis incisus, Glossolepis ramuensis, Glossolepis pseudoincisus, Glossolepis wanamensis, Glossolepis multisquamata, Glossolepis kabia* Gidomen (locality), *Glossolepis dorityi*. This is 6 of the 7 species of *Glossolepis*, that we are seeking as additions to the allowable import list, that are being sustainably bred and raised. Maju Aquarium has previously exported fish on the Allowable Import List to Western Australia, with no problems. They complied with all regulations, and there are aware of Australia's biosecurity and quarantine procedures. Each of the 7 species listed may have an expedition story attached. Some are well documented in Aquarium Fish journals. The Authors of the reports to add the 7 species are well known within the Rainbowfish aquarium hobby. Author 1 has a fish named in his honour by the Ichthyologists at NT Museum and Canberra University, Melanotaenia wilsoni for David Wilson for his work with native fishes and finding new species and increasing distribution information. Where possible we will put a reference to the expeditions to collect these species.
		Is the applicant able to detail how often wild caught specimens are used from the source supplier?	Evers, Personal communications (2022) advises that it is generally very expensive to arrange an expedition to remote parts of Papua New Guinea or West Irian to collect wild rainbowfishes. indicate that from Germany, prior to covid lockdowns, that a typical 10-day expedition cost approximately $14,000 Australian dollars (9000 Euros) each, and that a minimum of 3 people travelled on most trips. This is a considerable expense to acquire fish species. Broodstock was only collected one time and deposited at Maju Aquarium in Java.

Respondent	Major comments	Further information requested	Applicant response
			Author 1 arranges expeditions into remote parts of the NT to collect different forms of native fish brood stock. The distances involved and logistics to get live fishes to captivity make wild caught specimens very expensive and makes no business sense to use wild specimens when rainbowfishes are more easily bred in captivity. This is also a protection mechanism when captive bred healthy fish are much less expensive than wild caught fish as well as less likely to suffer from any of the parasites and other disease-causing organisms from natural locations. Many of the collections are a once only expedition so wild specimens would only be sought if there are none in captivity.
		How can you provide evidence that the fish are sustainably sourced?	There is no question that when the fish are sourced from the USA, Asia or Germany that they will come from a well-managed fish farm. Vets and Government licensing Authorities should be able to provide certification as to the source of the imported specimens. It is just not good business practise to supply wild fish when farm raised are so much cheaper. An example is a report showing that one of Indonesia's easternmost regions is taking an unprecedented step toward sustainability Last week, the government of the province of West Papua, on the island of New Guinea, announced legislation establishing it as Indonesia's first "conservation province." What this means is that the government will ensure that all future economic activity and development will be sustainable. Overseas fish farms are concerned about Conservation and Sustainability, and it is easy to find comments such as below on Seagrest Farms web pages. We love fish. And we know you do too. Part of our mission at is to promote conservation and sustainability efforts so that everyone can continue to have these experiences both in their home aquariums and in the wild. We support both aquaculture and sustainable wild collection and hope to help guide you to make the best decisions possible. They also have a poster available on conservation and sustainability. Seagrest Farms: http://segrestfarms.com/index.cfm?fuseaction=content.posters Millington, M D, Holmes , B J, and, Balcombe S R. (March 2022) Systematic review of the Australian freshwater ornamental fish industry: the need for direct industry monitoring, report the following: Captive-based aquaculture must be pursued and prioritised as a replacement for high impact wild-caught fisheries to minimise further exploitation of the freshwater fish species by the Australian ornamental industry. This has been achieved in the past for ornamental species, including Boeseman's rainbowfish – Melanotaenia boesemani (Allen & Cross, 1980). Following their intense collection for ornamental purposes in the 1980s that severely threatened population

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			resilience (IUCN 2021c), a switch to captive-bred production removed this threat and the species is no longer considered exploited by ornamental trade (IUCN 2021c). Evers, et al. state: However, in order to avoid some of the same over-exploitation problems associated *M. boesemani*, and because many species have highly-restricted home ranges, collectors are now working with taxonomists and breeding facilities, to secure new broodstock. They are then developing sustainable aquaculture practices, such that wild populations are not put at risk in the future. A particular focus in recent years has been the Birds Head Peninsula, West Papua Province, Indonesia where a multitude of novel species have been discovered (Allen et al., 2014, 2016; Kadarusman et al., 2012). Once in captivity it is relatively straightforward to maintain and breed most species of rainbowfish. If rainbowfishes are kept in a species tank with floating plants or a synthetic spawning mop, sooner or later fry will appear. Most rainbowfish species spawn every day, usually in the morning, with the males attracting the females and the pairs spawning in the plants. The tiny, crystal-clear eggs adhere to the plants with their sticky filament for about 10 days until the fry hatch. In Indonesia, large well-equipped breeding facilities have emerged, offering many different species and varieties. The Maju Aquarium is now regularly reproducing more than 40 different species of Indonesian rainbow fish under sustainable conditions (social and environmental aspects).
		How can you prove all the fish sourced are captive bred?	There is no question that when the fish are sourced from the USA or Germany that they will come from a well-managed fish farm. Vets and Government licensing Authorities should be able to provide certification as to the source of the imported specimens. It is just not good business practise to supply wild fish when farm raised are so much cheaper. There is considerable debate about the decline of natural species and what is the best thing that can be done to stop the march to extinction. Just monitoring does not work, it lets us know that they are going. The best way to protect species is to reverse the threatening processes that are causing the decline. The major invasive species causing the decline of fishes in West Irian and Papua New Guinea is humans' activities. Large scale land clearing to produce oil palms by the straight hairs, a description from West Irian natives describing the new immigrants from Indonesia. (Personal communication with Dan Dority, the person who discovered *Glossolepis dorityi*, also the person who raised the alarm regarding the decline of the species). Wilson, co-

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			author of reports has toured ornamental fish and aquatic plant production farms in Malaysia and seen the impact of large oil palm plantations. Local Malaysian ornamental aquatic plant producers spoke of the disappearance of the small fishes of the streams within and surrounding the oil palm plantations adjacent their properties. The IUCN states, the tropical areas suitable for oil palm plantations are particularly rich in biodiversity. Oil palm development, therefore, has significant negative impacts on global biodiversity, as it often replaces tropical forests and other species-rich habitats. Globally palm oil production is affecting at least 193 threatened species, according to The IUCN Red List of Threatened Species. It has been estimated that oil palm expansion could affect 54% of all threatened mammals and 64% of all threatened birds globally. It also reduces the diversity and abundance of most native species. For example, it has played a major role in the decline in species such as orang-utans and tigers. Some 10,000 of the estimated 75,000–100,000 Critically Endangered Bornean orang-utans are currently found in areas allocated to oil palm. Every year around 750 to 1,250 of the species are killed during human-orang-utan conflicts, which are often linked to expanding agriculture. A small number of species can benefit from the presence of oil palm plantations, including species of wild pig, rodents and some snakes. Evers, et al. state: However, in order to avoid some of the same over-exploitation problems associated *M. boesemani*, and because many species have highly-restricted home ranges, collectors are now working with taxonomists and breeding facilities, to secure new broodstock. They are then developing sustainable aquaculture practices, such that wild populations are not put at risk in the future. A particular focus in recent years has been the Birds Head Peninsula, West Papua Province, Indonesia where a multitude of novel species have been discovered (Allen et al., 2014, 2016; Kadarusman et al., 2012). Once in captivity it is relatively straightforward to maintain and breed most species of rainbowfish. If rainbowfishes are kept in a species tank with floating plants or a synthetic spawning mop, sooner or later fry will appear. Most rainbowfish species spawn every day, usually in the morning, with the males attracting the females and the pairs spawning in the plants. The tiny, crystal clear eggs adhere to the plants with their sticky filament for about 10 days until the fry hatch. In Indonesia, large well-equipped breeding facilities have emerged, offering many different species and varieties. The Maju Aquarium is now regularly reproducing more than 40 different species of Indonesian rainbow fish under sustainable conditions (social and environmental aspects).

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The total island wide, Papua New Guinea and West Irian, introduction of larger South American, Asian and African species of fishes to increase food production and for mosquito control.

Species introduced to the Island of New Guinea (WI & PNG)

Family	Species	Common name
ANABANTIDAE	*Anabas testudineus*	Climbing Perch
BELONTIIDAE	*Trichogaster pectoralis*	Snakeskin Gourami
BELONTIIDAE	*Trichogaster trichopterus*	Threespot Gourami
CHANNIDAE	*Channa stricta*	Striped Snakehead
CICHLIDAE	*Oreochromis mossambica*	Tilapia
CICHLIDAE	*Coptodon rendalli*	Redbreast Tilapia
CLARIIDAE	*Clarias batrachus*	Walking Catfish
CYPRINIDAE	*Crassius auratus*	Goldfish
CYPRINIDAE	*Cyprinus carpio*	Common Carp
OSPHRONEMIDAE	*Osphronemus goramy*	Giant Gourami
POECILIIDAE	*Gambusia affinis*	Mosquito Fish
POECILIIDAE	*Poecilia reticulata*	Guppy
POECILIIDAE	*Xiphophorus helleri*	Swordtail
SALMONIDAE	*Oncorhynchus mykiss*	Rainbow Trout
SALMONIDAE	*Salmo trutta*	Brown Trout
SALMONIDAE	*Salvelinus fontinalis*	Brook Trout
SERRASALMIDAE	*Piaractus brachypomus*	Red Bellied Pacu

The island wide introduction of larger predatory species and Gambusia spp. (Mosquito Fish) combines with land clearing is the most likely cause of native fish decline. Collecting numbers of fishes in remote locations for commercial sale of wild collected fish is not viable as a business. Collections do occur in areas where there are large numbers of colourful rainbowfishes such as Boeseman's Rainbowfish Melanotaenia boesmani and this is concerning but will not end the species as quickly as invasive species or pollution from large scale industrial agriculture.

References:

Respondent	Major comments	Further information requested	Applicant response
			Allen, Gerald R (1991) "Freshwater Fishes of New Guinea", published by Christian Research Institute. De Smit, Olivia (2019) Conservation International https://www.conservation.org/blog/indonesian-province-leaps-ahead-in-conservation Evers, H.G., Pinnegar, J.K., and Taylor, M.I (2019), Where are they all from? – sources and sustainability in the ornamental freshwater fish trade available at: https://onlinelibrary.wiley.com/doi/full/10.1111/jfb.13930 Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (02/2022). https://www.fishbase.de/Country/CountrySpeciesSummary.php?c_code=598&id=5808 International Union for Conservation of Nature (IUCN) https://www.iucn.org/resources/issues-briefs/palm-oil-and-biodiversity Millington, M D, Holmes , B J, and, Balcombe S R. (March 2022) Systematic review of the Australian freshwater ornamental fish industry: the need for direct industry monitoring.
	***Glossolepis* spp.** Whilst the seven *Glossolepis* species listed in the proponent's various applications are not CITES listed; all are ICUN listed ranging from least concern to critically endangered (table 2). Many of the *Glossolepis* species have a limited distribution and supply for the aquarium trade is likely to include wild harvest. Additionally, breeders require source stock, likely to come from the wild. Whilst the proponent is proposing fish are sourced from breeders, once approved for the White List there are no processes in place to ensure that is the only source. DPIRD WA is not satisfied there are robust checks and balances in place to ensure the ongoing sustainable import into Australia once added to the White List.		***Glossolepis dorityi*** The IUCN reports, threats are aquaculture and non-native species are the primary threats to this species (P. Unmack pers. comm. 2019). An expanding human population due to government transmigration policy has resulted in severe habitat alteration over much of the Grime River area (G.R. Allen pers. comm. 2019). And population This species is likely to be extinct in Lake Nenggwambu (Lake Kali Biru) due to the presence of invasive tilapia and carp species. Individuals were collected from the lake in 2008 when the habitat was already heavily disturbed by carp. However, it is no longer possible to visit the lake as it is now fenced off by an aquaculture facility on the shoreline. No individuals were found in Lake Tum in 2015 or 2017, and it is also possibly extinct here (P. Unmack pers. comm. 2019) An excerpt from his article, Dr Gerald Allen: This article describes a new species of rainbowfish (Melanotaeniidae) belonging to the genus *Glossolepis*. It was collected by Dan Dority and David Price during a weekend outing to a small lake, about 68 km due west of Jayapura, Irian Jaya's capital city. Dan and David have been working in the Jayapura-Sentani area for several years, but only recently became aware of this location, which is part of a cluster of at least 15 floodplain lakes. I had flown over the

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	DPIRD WA do not support the addition to the White list of the five IUCN listed *Glossolepis* species rated above least concern (table 2). The two "least concern" species, *Glossolepis kabia* and *G. multisquamata*, could be considered for addition to the White List following a robust risk assessment assessing likelihood and consequence. **DPIRD WA Assessment of *Glossolepis kabia* (Kabia Rainbowfish)** DPIRD WA finds the environmental risk to WA of *Glossolepis kabia* to be acceptable for the reasons outlined below. *G. kabia* as a tropical species there is a moderate risk to be able to establish populations in the Kimberley region of WA. There is some risk that it could establish in suitable waters of the Pilbara as there is no comprehensive temperature tolerance information. Fishes temperature tolerances are often greater than the native or preferred temperatures quoted. The Kimberley and Pilbara regions are sparsely populated so the risk of release is low and correspondingly the propagule pressure from multiple releases is also low. It should be noted that over time human population densities in some areas are likely to increase and that it must be assumed that all fish in the aquarium trade will eventually escape or be released into suitable waters at some time. Additionally, climate change may increase the geographic area suitable for establishment. There is a very low risk of hybridisation with native rainbowfish stocks (*Melanotaenia* spp.) as there are no known natural hybrids, however, hybrids between the family groups that have been produced appear to be sterile. If *G. kabia* were released and able to establish, as a small omnivorous fish they are unlikely to have significant impact upon other fish species. There is likely to be some		lakes and photographed several of them during my first visit to Irian Jaya in 1982. But at that time access was poor and I did not consider trying to visit them. Now they can be reached in less than two hours by car from Lake Sentani. Dan and David collected the first specimens in April 2000. About four months later I had an opportunity to visit the Sentani area for a Conservation International training course and joined them for a day trip to the same lake, which is within one km of a well-travelled road. We used a small-meshed gill net to catch live aquarium specimens. These were photographed in Dan's home aquarium and the resulting photos were used to illustrate this article. Heiko Bleher, a well-known journalist and aquarium-fish collector, also visited the same lake or a nearby one earlier this year and obtained breeding stock for the aquarium trade, but the fish has yet to be released for public sale. Full article: Allen, Gerald R. (2001) A new species of rainbowfish (*Glossolepis*: Melanotaeniidae) from Irian Jaya, Fishes of Sahul, Journal of the Australia New Guinea fishes association, Volume 15, Number 3, PP766-775 This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. No wild fish can be harvested as the lake is fenced off by an aquaculture facility. Being widely available overseas suggests that there should not be any wild harvesting of this fish, as collecting this fish would be very expensive. We believe that this fish should be added to the allowable imports list. ***Glossolepis kabia*** There are no population threats, this species is abundant throughout much of its range and the population is considered stable (G.R. Allen pers. comm. 2019). No major threats to the population overall. In an excerpt from their article Johannes Graf and Hendrite Ohee, The *Glossolepis* from Mamberamo, Sepik and Ramu Rivers: Possible recognition of an additional species of Rainbowfish: *Glossolepis* kabia (Herre). Fishes of Sahul 23 (2), documented, *Glossolepis* samples from the Mamberamo, Sepik and Ramu River in New Guinea are compared. It is concluded that the *Glossolepis* from the Mamberamo River are *Glossolepis* multisquamata (Weber & de Beaufort). The *Glossolepis* from Ramu and Sepik Rivers hitherto considered as the same (not affecting the taxa G. ramuensis and G. maculosa) are possibly a distinct species. For those the taxon Melanotaenia kabia Herre, 1935 would be applicable and assigned to the genus *Glossolepis*, as the taxon *Glossolepis* kabia (Herre, 1935). Herre (1935) described Melanotaenia rosacea and Melanotaenia kabia based on samples from Nyaurangai, Sepik River (300 km from the sea), and Koragu, Kerame

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	niche overlap resulting in competition for space and resources with related or similar species. It is unlikely to result in any significant impact. The combination of the low likelihood of release and establishment in suitable waters, low environmental impact and the extremely low risk of hybridisation results in a negligible risk to the WA environment. **DPIRD WA Assessment of *Glossolepis multisquamata* (Mamberamo Rainbowfish)** DPIRD WA finds the environmental risk to WA of *Glossolepis multisquamata* to be acceptable for the reasons outlined below. *G. multisquamata* as a tropical species there is a moderate risk to be able to establish populations in the Kimberley region of WA. There is some risk that it could establish in suitable waters of the Pilbara as there is no comprehensive temperature tolerance information. Fishes temperature tolerances are often greater than the native or preferred temperatures quoted. The Kimberley and Pilbara regions are sparsely populated so the risk of release is low and correspondingly the propagule pressure from multiple releases is also low. It should be noted that over time human population densities in some areas are likely to increase and that it must be assumed that all fish in the aquarium trade will eventually escape or be released into suitable waters at some time. Additionally, climate change may increase the geographic area suitable for establishment. There is a very low risk of hybridisation with native rainbowfish stocks (Melanotaenia spp.) as there are no known natural hybrids, however, hybrids between the family groups that have been produced appear to be sterile. If *G. multisquamata* were released and able to establish, as a small omnivorous fish they are unlikely to have		River (350 km from the sea). Both species undoubtedly are *Glossolepis*, based on the crenulated margins of the scales, overhanging premaxillary and the drawing of a specimen of Melanotaenia kabia in Herre (1936). For Melanotaenia kabia the fins are described by Herre as follows: "The dorsal and anal rays are low, the last ray of the second dorsal about twice in the head, the first dorsal and anal a little higher, 1.33 to 1.5 times in the head". Weber's (1922) description of the second dorsal and anal fin rays reinforces the identity of this form, matching those samples from the Mamberamo basin. Full article: Graf, J. & Ohee, H.L. (2009): The *Glossolepis* from Mamberamo, Sepik and Ramu Rivers: Possible recognition of an additional species of Rainbowfish: *Glossolepis* kabia (Herre). Fishes of Sahul 23 (2), This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. Being widely available overseas suggests that there should not be any wild harvesting of this fish. We believe that this fish should be added to the allowable imports list. ***Glossolepis maculosa*** The IUCN (2020) reports, that there is no information on the population size or trend. Local threats are three gold mines in the Markham River system (U. Kolkolo pers. comm. 2019). Oil palm plantations are found throughout the valley of the Ramu River system (U. Kolkolo pers. comm. 2019). Invasive species also represent a threat (P. Unmack pers. comm. 2019). In his article Barry Crockford, (1985). *Glossolepis maculosa*. recorded, I have read of many instances how new specimens have become known to science and quite often it was due to a rare find by accident, or when a person was collecting or studying something already known to exist. The case in discovering *Glossolepis* maculosa was no exception. I had initially set out from Lae in Papua New Guinea to collect G. wanamensis and upon arriving at Lake Wanam, found it impossible to get local help to run out my seine and small nets, because of an accident involving a crocodile a few weeks before. Because of the stories I had heard and the nervousness of the local villagers to enter the lake, I tried collecting around the edges of the lake with a small hand seine without success. We fished again for about 2 hours without success. It was then decided to collect from a small clearwater stream entering the river. We began working our way up the stream without success, until we reached a pool where the stream almost petered out. With a single sweep of his seine Gerry collected 7 specimens of our elusive beauty, these were the only fish caught. About a month later

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significant impact upon other fish species. There is likely to be some niche overlap resulting in competition for space and resources with related or similar species. It is unlikely to result in any significant impact.

The combination of the low likelihood of release and establishment in suitable waters, low environmental impact, and the extremely low risk of hybridisation results in a negligible risk to the WA environment.

Table 2 Glossolepis spp. proposed for addition to the White List.
<table>
<tr><th>Species</th><th>IUCN Listing</th><th>DPIRD Response</th></tr>
<tr><td>Glossolepis dorityi (Grime Rainbowfish)
https://www.iucnredlist.org/species/161080437/161080455</td><td>critically endangered</td><td>No</td></tr>
<tr><td>Glossolepis kabia
This species is abundant throughout much of its range and the population is considered stable (G.R. Allen pers. comm. 2019). This species occurs on lowland floodplains of the Sepik, Ramu, and Markham River systems of Papua New Guinea (G.R. Allen pers. comm. 2019).
This species occurs in swampy lagoons, lakes, and small side channels of larger rivers, usually where there is abundant aquatic vegetation.</td><td>least concern</td><td>Yes</td></tr>
</table>
</td><td></td><td>
Gerry rang me from Perth and excitedly told me that this was indeed a new species. He had placed it into the Genus Glossolepis and named it maculosa because of the many spots along the lateral line, a name well-chosen I remember thinking, for it described the fish beautifully. Full article: Crockford, B. (1985). Glossolepis maculosa. Fishes of Sahul 3(1), 102–104.

In an excerpt from his paper, Gerry Allen, A new species of Glossolepis (pisces: Melanotaeniidae) from fresh waters of Papua New Guinea detailed, The species is known only from the type locality, a small stream flowing into the Omsis River about 500 m upstream from the Tablebirds Poultry Farm. This locality is situated about 22 km west of Lae. The Omsis is a tributary of the Markham River. All but one of the types were collected from a small, clear, slow flowing creek. The width ranged from about 0.5 to 3.0 m, and the depth from about 10 to 70 cm. The stream was bordered by tall grass and occasional patches of rainforest. The types were taken from a narrow (1.5 m) section containing a dense cover of aquatic vegetation. A pH of 7.8 and temperature of 25.0°C were recorded. The smallest gravid female among the type series is 36.7 mm SL. The species is named maculosa (Latin: spotted) with reference to the colour pattern. Special thanks are due B. Parkinson of Rabaul, Papua New Guinea and B. Crockford of Melbourne. Mr Parkinson accompanied the author throughout the 1980 visit and his assistance was instrumental to the success of the expedition. Mr Crockford is responsible for informing the author about the existence of G. maculosa prior to the 1980 New Guinea visit and kindly joined the expedition at Lae to assist with the capture of specimens. Full article: Allen, G.R., A NEW SPECIES OF GLOSSOLEPIS (PISCES: MELANOTAENIIDAE) FROM FRESH WATERS OF PAPUA NEW GUINEA. Rec. West. Aust. Mus. 1981, 9 (3): 301-306

In an excerpt from his article, Briggs, G., The spotted rainbow, reports New Guinea's spotted rainbowfish (Glossolepis maculosa) is one of the most unusually marked rainbowfish in the aquarium hobby. Male spotted rainbows are an impressive sight, with their golden-green bodies adorned with bold black spots. No other rainbow has such distinctive black spots - the only fish to come remotely close are some Chilatherina, (such as C. axelrodi and some morphs of C. fasciata). Despite its obvious beauty, this species has remained a rarity in aquarium circles, kept by only a few enthusiasts.

The spotted rainbowfish was discovered by ANGFA member Barry Crockford in 1979, (Crockford, 1985). At that time Barry had planned a trip to Lake Wanam. Unfortunately, he was unable to convince any locals to help him go fishing at Lake Wanam because of a recent crocodile "incident". Biding his time at nearby Omsis River, he ended up doing some collecting and in effect accidentally found several
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Respondent	Major comments			Further information requested	Applicant response
	It can reach a maximum size of about 11 cm SL (G.R. Allen pers. comm. 2019). https://www.iucnredlist.org/species/161080469/161080528				specimens of a then unknown species amongst Melanotaenia affinis and Chilatherina. Barry took back live specimens to Australia which became the foundation of aquarium stock of this species. In September 1980, Barry returned with Gerry Allen and after a lot of difficulty they managed to catch additional specimens. Gerry then described the fish as *Glossolepis* maculosa, the specific name an obvious reference to its many black spots. Amazingly, Barry never caught another spotted rainbow in the Omsis system, despite his best efforts during subsequent trips to the Omsis River (tributary of Markham River system) and Ramu River system in northern Papua New Guinea. Appears to be rarely found in Omsis R. (Crockford). Also occurs in swamps and slow flowing creeks in middle Ramu Valley (Allen, 1995), commonly found in Maram Creek in Ramu system. *Glossolepis* maculosa prefers shady habitats with dense aquatic vegetation (Crockford, pers. comm.) Water conditions: pH 7.5-7.8, temperature 25-28°C. They usually reach about 6 cm in total length, some aquarium specimens may grow to 7.5 cm (particularly females). Full article: Briggs, G., The spotted rainbow, Fishes of Sahul, V15-N3, pp 798-801 This fish is being commercially farmed and available from various fish farms in USA, Asia and Europe. Author 2 accessed various sites on the internet on 14/4/2022. Being widely available overseas suggests that there should not be any wild harvesting of this fish, as collecting this fish would be very expensive. This fish is certainly available. We believe that this fish should be added to the allowable imports list. ***Glossolepis multisquamata*** The IUCN records, this species is widespread in the Mamberamo River system. There are a number of localised threats but no major threats across the entire range. Therefore, it is assessed as Least Concern. Threats to this species, at present, the region which this species inhabits is largely undisturbed. However, future threats to biodiversity in northern New Guinea include regional development plans, such as construction of forest concessions, oil palm plantations, coal mines, and the proposed Mamberamo Dam. Invasive species are also found within the distribution. In an excerpt from his article, Barry Crockford, (1998) *Glossolepis* multisquamatus remarked, commonly known as the Sepik Rainbowfish, *Glossolepis* multisquamatus is one of five species of the genus *Glossolepis*. First discovered and described by Weber and de Beaufort in 1922 in Netherlands New Guinea, now Irian Jaya and later, by Herre, 1935, in New Guinea, now Papua New Guinea, G. multisquamatus remained in obscurity until 1978, when Allen brought back the first live specimens to Australia to be photographed and recorded in his book "Rainbowfishes of Australia and Papua New Guinea" (Allen and Cross). It was from these specimens that the stocks of fish
	***Glossolepis maculosa* (Spotted Rainbowfish)** https://www.iucnredlist.org/species/9269/147681182	endangered	No		
	***Glossolepis multisquamata* (Mamberamo Rainbowfish)** The species has a wide distribution, and the population trend is most probably stable (P. Unmack pers. comm. 2019). This species is found in the Mamberamo River system in northern Papua Province, Indonesia (G.R. Allen pers. comm. 2019). This is a benthopelagic species that inhabits swampy lagoons, lakes and small side channels of large rivers. It is one the only known floodplain dwelling rainbowfish and is usually found below 100 m elevation. It is usually found around sub-surface vegetation, submerged logs and branches, or among reeds and other shoreline	least concern	Yes		

Respondent	Major comments			Further information requested	Applicant response
	vegetation. This species can grow to a maximum size of about 11 cm SL (G.R. Allen pers. comm. 2019). https://www.iucnredlist.org/species/169502/147681206				presently in Australia were bred. Since then, it has slowly gained acceptance by breeders and hobbyists alike. This is hard to understand, for anybody who has seen a fully grown adult male is immediately impressed by its pleasant disposition, shape, form and colour. In full breeding colour it not only becomes impressive but a must for all who witness it in this condition. It would be fair to think that G. multisquamata has some strange ability to generate electric power from within for every scale, fin and line of colour instantly "light up", flashing like a neon sign. Although all rainbowfishes have this ability, to a greater or lesser degree, G. multisquamata would have to give the oscar winning performance, mere words are not enough to describe its full beauty. Full article: Crockford, B. (1998), *Glossolepis* multisquamata Fishes of Sahul 3(3) (126-127). In an excerpt from his article Neil Armstrong, THE MAMBERAMO RIVER'S MIGHTY MULTISQUAMATUS, (The Tiger Rainbowfish) wrote: It is nearly 20 years since *Glossolepis* multisquamatus first entered the hobby in Australia. Barry Crockford wrote about it in "Fishes of Sahul" in the early days of our journal, Vol.3, No.3, page 126-127. Yet despite the fact that this is one of our most beautiful rainbows, it has had very little exposure in the hobby. The original collection and description of *Glossolepis* multisquamatus was from the Idenburg River (now known as the Taritatu River, which is part of the Mamberamo River system, Irian Jaya (Weber and de Beaufort, 1922) — "Rainbowfishes of Australia and Papua New Guinea" by Dr. Gerald R. Allen and Norbert J. Cross. The fish known as the 'Tiger Rainbowfish' seems to represent the originally described species. The fish known to aquarists for nearly 20 years as the Sepik Rainbowfish from Papua New Guinea may even represent a different species. Body colour of G. multisquamatus from Sepik is greenish with orange to reddish horizontal stripes tapering off near caudal area of body. However, the colours may change in seconds to some other colour, for instance the anal fin is clear, but look again, within a minute it could be jet black. Body at times can display black vertical bars. The Mamberamo River form has a body colour of red, or green, or black, it depends on which male is the most dominant. He has random red reticulated scales on the belly area. The dorsal area has red stripes running along the body but can be rather hard to see when the fish is in full colour. He will be the bright red form nearly all the time and will usually display black vertical bars (hence the common name "Tiger Rainbowfish"). The most subdued male may be black all over the body and that includes all fins. The spawning colour is stunning, blood red body, almost a metallic red, fins red or reddish to black, but the dorsal area develops a brilliant metallic red stripe over the whole dorsal area, starting at the upper lip. The female is silverish with a much shorter anal fin than the male, although still with ragged edges.
	***Glossolepis ramuensis* (Ramu River Rainbowfish)** https://www.iucnredlist.org/species/9271/147681464	vulnerable	No		
	***Glossolepis pseudoincisus* (Tami River Rainbowfish)** https://www.iucnredlist.org/species/9270/147681435	vulnerable	No		
	***Glossolepis wanamensis* (Lake Wanam Rainbowfish)** The species has a wide distribution, and the population trend is most probably stable (P. Unmack pers. comm. 2019). This species is found in the Mamberamo River system in northern Papua Province, Indonesia (G.R. Allen pers. comm. 2019). This is a benthopelagic species that inhabits swampy lagoons, lakes and small side channels of large rivers. It is one the only known floodplain dwelling rainbowfish and is usually found below 100 m elevation. It is usually found around	critically endangered	No		

Respondent	Major comments	Further information requested	Applicant response
	sub-surface vegetation, submerged logs and branches, or among reeds and other shoreline vegetation. This species can grow to a maximum size of about 11 cm SL (G.R. Allen pers. comm. 2019). https://www.iucnredlist.org/species/9272/147681490 **Reference** Iyer, P., Raghavan, R., Dahanukar, N., Sood, N. & Molur, S. (2016). All that is green does not conserve: green certification of aquarium fishes in India. Current Science, 110 (11): 2053-2056		Full article: Armstrong, N., THE MAMBERAMO RIVER'S MIGHTY MULTISQUAMATUS, (The Tiger Rainbowfish) Fishes of Sahul 12(2) (571-573). This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. Being widely available overseas suggests that there should not be any wild harvesting of this fish. We believe that this fish should be added to the allowable imports list. ***Glossolepis ramuensis*** The IUCN (2020) reports, that there is no information on the population size or trend. Local threats are, introduced fish species pose a threat (P. Unmack pers. comm. 2019). In the Ramu River, oil palm plantations and mining operations are also found (U. Kolkolo pers. comm. 2019). In the Gogol River, there has been historic logging and so the habitat is primarily regrowth and gardens (U. Kolkolo pers. comm. 2019). An excerpt from his article, Dr Gerald Allen Three New Rainbowfishes (Melanotaeniidae) from Irian Jaya and Papua New Guinea: *Glossolepis* ramuensis is most closely allied to G. maculosa Allen (fig. 5) known only from a small tributary of the Lower Markham River. Both species have crenulate scale margins and a small premaxillary with relatively few teeth, typical features of the genus. However, they differ from the other five *Glossolepis* with respect to a reduced number of gill rakers and scales. *Glossolepis* ramuensis differs from G. maculosa only with respect to colour pattern and a slightly higher number of vertical scale rows (38 vs. 34-36). However, the two species may well have overlapping ranges of scale counts if more specimens of *Glossolepis* ramuensis become available. The holotype and only known specimen of G. ramuensis was obtained from a metre-wide tributary of the Ramu River flowing slowly through dense rainforest. The water was exceptionally clear with gravel bottom and very few aquatic plants except in occasional sun-lit pools. Temperature and pH readings of 28.5°C and 7.8 were recorded at the collecting site. The stream was inhabited by large numbers of the Highlands Rainbowfish (Chilatherina campsi) and a few North New Guinea Rainbows (Melanotaenia affinis). The species is named *Glossolepis* ramuensis with reference to the river system of the type locality. Full article: Allen. G.R. Three New Rainbowfishes (Melanotaeniidae) from Irian Jaya and Papua New Guinea. Rev. fr. Aquariol., 12 (1985), 2, 15 decembre 1985 An excerpt from his article, Dr Gerald Allen, Ramu Diary: One of the first collections was in a narrow creek only 200 meters upstream from the main river. We captured a

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			number of orange rainbowfish which at first glance I thought were of a species of Chilatherina. Later, at the CRI lab, a microscopic examination revealed it was *Glossolepis* ramuensis, which until now was known from a single specimen collected in 1985. We brought back live specimens and kept those in aquaria at the lab for the duration of our stay. Although not vividly coloured like some rainbows, they are nevertheless very attractive fish. Full article: Dr Gerald Allen, Ramu Diary, Tropical Fish Hobbyist February 1991. This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. Being widely available overseas suggests that there should not be any wild harvesting of this fish. Therefore, we believe that this fish should be added to the allowable imports list. ***Glossolepis pseudoincisus*** The IUCN reports, this species was common in the type locality in 2015, and the population trend is considered to be stable (Kadarusman pers. comm. 2019). Local threats to this species include settlements, oil palm plantations and invasive species (Kadarusman pers. comm. 2019). An excerpt from their article, Dr Gerald Allen and Norbert Cross DESCRIPTIONS OF FIVE NEW RAINBOWFISHES - (MELANOTAENIIDAE) FROM NEW GUINEA report, *Glossolepis* pseudoincisus is most closely allied to G. incisus. They differ from the other members of the genus by possessing more gill rakers on the first arch (26-32 vs. 19-23) and by having more pronounced crenulations on the scale margins. Boeseman (1963) gave a detailed description of the type locality in the Tami River region near Hollandia (now Jayapura). The site represents an isolated ox-bow lake of the Tami River with an estimated width of 35-40 m and uncertain depth. The lake is surrounded by heavy rainforest and steep banks. At the time of collection, the bottom was muddy with areas of dense aquatic vegetation. The gut contents of the types indicate a diet consisting mainly of small insects (such as ants) with lesser amounts of tiny crustaceans and algae. The gonads were poorly preserved, and it was therefore difficult to determine the minimum size at maturation. The smallest ripe female examined was 47 mm SE. The species is named pseudoincisus with reference to its similar appearance and geographic proximity to *Glossolepis* incisus. We are greatly indebted to Dr M. Boeseman of RMNH for the loan of his valuable collections from Irian Jaya which formed the basis of this study. We

Respondent	Major comments	Further information requested	Applicant response
			also thank Dr L. Knapp of USNM and Dr T. Roberts of the Tiburon (California) Center for Environmental Studies for providing the holotype of M. oktediensis, and Mr B. Smith of PNG for the paratypes of this species. Dr H. Nijssen of ZMA and Dr D. Rosen of AMNH sent loans of specimens used for comparisons. Finally, we thank Mrs C. Allen for her careful preparation of the typescript. Full article: Allen, G.R, and Cross, N.J., DESCRIPTIONS OF FIVE NEW AINBOWFISHES - (MELANOTAENIIDAE) FROM NEW GUINEA. Rec. West. Aust. Mus. 1980 8: (3) In an excerpt from his article Christophe Mailliet (2004) Those little red fish" Melanotaenia parva and *Glossolepis* pseudoincisus. wrote: When the successful import and breeding of this new rainbowfish was announced on the website of a German aquarium fish wholesaler in 2002, excitement was great in the rainbowfish community. Was this the mysterious *Glossolepis* pseudoincisus Allen & Cross, 1980, that had long been known only from preserved specimen and succinct drawings? H. Bleher, who had caught this fish in a small and isolated crater lake not far away from Jayapura (Lake Ifanten) in early 2001 was of that opinion, and he wrote on this website that world-renowned expert and ANGFA-Member Gerald Allen had come to the same conclusion. Out of the only 4 males and one female that survived the trip back to Germany, soon numerous offspring were bred and distributed in the aquarium hobby under the somewhat loud denomination of "Millennium Rainbowfish". Probably a good idea from a marketing point of view, however it does not tell much about the fish itself. Thus, I prefer to call it the "Lake Ifanten Rainbow", but to be entirely correct it should probably be called the "False Salmon-Red Rainbow" ("pseudo" = false, fake). In any case, this is another rainbowfish that has great potential to become an all-time favourite. What happened to these fish is unknown and probably they have never been imported to Europe (Mayland, 1981). Interestingly, young specimen and females of the Lake Ifanten Rainbow also show such bands, however they disappear in older males. Obviously, I am not an expert and detailed examination is needed here, but from pictures it also seems that the Lake Ifanten Rainbow has different pectoral fin ray counts than of G. pseudoincisus. However, Gerald Allen (pers comm.) confirmed their identity. He came to the conclusion after he examined 10 specimens and compared these with the type specimen in Leiden, the Netherlands. There is also a great danger of hybridisation with G. incisus due to the fact that females are nearly indistinguishable, and it cannot be stressed enough that these two species should never — I mean NEVER — be kept in the same tank. Full article: Mailliet, C. 2004. "Those little red fish" Melanotaenia parva and *Glossolepis* pseudoincisus. Fishes of Sahul 18(3), 58–67 This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various

Respondent	Major comments	Further information requested	Applicant response
			sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. Being widely available overseas suggests that there should not be any wild harvesting of this fish. We therefore ask that this fish should be added to the allowable imports list. ***Glossolepis wanamensis*** The IUCN reports, This species is assessed as Critically Endangered. It is endemic to a single lake with an area of occupancy (AOO) of only 4 km^2 . Introduction of non-native species into the lake has resulted in declines in population size, and there is one location based on this threat. Conservation actions have been undertaken but it is unclear if these have been successful and monitoring is recommended. This species was reportedly abundant when first collected in the 1970s but was difficult to find during searches carried out in 1994-1995. There was a large fish kill (including of invasive tilapia) as the result of an El Nino event in 1997 when the water level fell by 11 m. Following this, reasonably large numbers of individuals were collected in 1999, although the species is still not considered common and the current population trend is unknown. It has been collected recently, within approximately the last five years (P. Unmack pers. comm. 2019). Local threats are the introduction of exotic species, such as tilapia, carp and gambusia, into the lake over the last few decades have threatened this species. In an excerpt from his article Barry Crockford, *Glossolepis* wanamensis, reports, fish is known only from Lake Wanam approx 30 km west of Lae. In clear water, temperature 28°C, pH 7.8, Hardness 120 ppm. Inhabits all parts of the lake usually in small schools. It was with a sigh of relief that I set my heavy load of equipment to the ground and gazed out over the magnificent view of Lake Wanam. Approximately 12 square kilometres in area, the lake is situated on a high plateau above the Markham Valley and is surrounded on three sides by steep sloping kunigrass covered hills that run right down to its edge. The water is very warm, about 28°C, crystal clear and the lush aquatic vegetation that can be seen growing from its clear sandy bottom consists mainly of giant New Guinea Vallisneria and a form of fine Myriophyllum. In the shallower parts, large masses of Nymphaea can be seen growing 100 metres or more from the banks into the lake. Suddenly, all the hard work and effort seemed worthwhile and tiredness quickly gave way to excitement and expectation, for this was the home of *Glossolepis* wanamensis. Full article: Crockford, B. (1985). *Glossolepis* wanamensis. Fishes of Sahul 3(2), 113–116. In an excerpt from his article Barry Crockford, B. (1999). Lake Wanam revisited – a habitat under threat. Lake Wanam survey, reported, In 1992, Heiko Bleher, a German collector and also a member of ANGFA, took many specimens from the Lake and his

Respondent	Major comments	Further information requested	Applicant response
			collections and observations were similar to my own. He again collected in 1994 and it was during this period he noticed the first changes to the Lake. Tilapia populations had by this time increased dramatically and he managed to collect only seven G. wanamensis males and one only female. He returned in 1995 and again Tilapia infestation of the Lake had increased even further and only 2 very old male specimens of G. wanamensis were taken back to Germany. He also stated at this time a family was now living at the Lake. During the ANGFA convention held in Brisbane in 1998 discussions were held with Heiko re the situation at Lake Wanam and from those discussions it was decided that a further survey would have to be carried out as now It would appear that the Lake Wanam Rainbow could be in such low numbers as to cause concern for its future in the wild. After several months of discussion and preparation a team consisting of Matt Vincent (Melbourne Zoo), Barry Crockford (ANGFA) and Phil Littlejohn (Pet & Aquarium Industries P/L) met at the Rainforest Habitat on 5/6/99 with Peter Clarke in Lae, to conduct the survey. Full article: Crockford, B. (1999). Lake Wanam revisited – a habitat under threat. Lake Wanam survey, Fishes of Sahul 13(3), 621–629. In an excerpt from their article, Phil Littlejohn, and Matt Vincent, 1999 The Lake Wanam rainbowfish, Papua New Guinea field expedition, reported, Heiko Bleher (Editor in Chief of Aqua Geo-graphia) then made several trips into Lake Wanam to collect G. wanamensis for the European trade. He first noticed the apparent negative impact of the introduced African Tilapia, or Mozambique Mouth-brooder, Oreochromis mossambicus on Lake Wanam in 1992 and noted a dramatic increase in numbers of Tilapia by his following expedition in 1994. The scarcity of G. wanamensis in the Lake prompted him to return again in 1995, when he discovered a massive population explosion of Tilapia. The water was extremely turbid and his extensive search resulted in very few G. wanamensis being found, in fact only seven males and one female. Tilapia were in such large numbers that Heiko came to the conclusion that the only native fish species able to survive under these circumstances was the Fimbriate Gudgeon, Oxyeleotris fimbriatus. He was so convinced of the devastating effects of the Tilapia that he believed G. wanamensis would soon be extinct in the wild (Bleher, 1989). Although no causal link was established between the introduced Tilapia and the decline of the rainbowfish, these observations strongly suggested this to be the case. All Lake Wanam specimens were placed into a tank (1830x610x610cm) prepared some weeks prior to our arrival. After several hours, a number of fish were moved to other holding sites to minimise potential losses. A total of 21 male and 16 female fish were placed in a small pool inside the Butterfly House which houses a concrete pond approximately 5x3 metres and 45 cm deep, with a small waterfall and a bridge over the centre. Of these specimens, it was estimated that only 3-5 fish died

Respondent	Major comments	Further information requested	Applicant response
			over the next few weeks. A second group of 7 male and 9 female fish were released into the main lake inside the rainforest habitat at Lae, an area of some 3 square hectares. This lake contained the North New Guinea Rainbowfish and some turtles. No fish are known to have died from this group, however it is not possible to locate all individuals in such a large area. Both water bodies contain a large amount of aquatic vegetation for spawning sites and fish in the small pond are receiving supplementary feeding. Approximately 30 G. wanamensis males and all other specimens remain in the display holding tank. It is hoped that both populations will establish themselves in the two ponds over the next few months. Full article: Crockford, B., Littlejohn, P. and Vincent, M. (1999). The Lake Wanam rainbowfish, Papua New Guinea field expedition. Fishes of Sahul 13(3), 629–638. Following a report from Heiko Bleher that *Glossolepis* wanamensis (Lake Wanam Rainbowfish) was in serious danger of becoming extinct in the wild, the NT Government, Territory Wildlife Aquarium, Supervisor, Author 1, with NT Gov blessing as a conservation project bred large numbers of this species. When it was further reported that Mr Bleher's report was less than accurate the fish at the Territory Wildlife Park were sent to various members of the Australia New Guinea Fishes Association and the project was terminated. Author 2 has contacted the Rainforest habitat in Lae, and they confirmed that the species are still; there and numbers have increased greatly (April 2022) This fish is being commercially and sustainably farmed and available from various fish farms in USA, Europe, and Maju aquarium in Indonesia. Author 2 accessed various sites on the internet on 14/4/2022. This species is sought after by hobbyists in Europe, USA and Australia. Being widely available overseas suggests that there should not be any wild harvesting of this fish. We believe that this fish should be added to the allowable imports list.
Federation University	A separate application was submitted for each of the seventeen species. Because of time constraints, I am unable to comment on more than one, that of *Glossolepis dorityi.* I assume as there are only two genera involved, that the applications for the other species are similar. The map (Fig 1) for the species in one of the genera, *Glossolepis*, indicates that all species targeted are short range endemics living in mountain lakes in Papua New Guinea. The species has diversified, and I assume that each species is adapted to slightly different environmental conditions. As allegedly the fish for import will be sourced from existing aquarium stock overseas, I can only assume	No further information required – out of the scope of this assessment.	1. To suggest that all traders be licensed if they are not already, and that a condition of the permit 2. is that fish are not dumped live in the wild and that all buyers and keepers of these fish also be licensed with the same condition, would be an impossible system to maintain. With well over 1 million people keeping fish, the resources required to administer such a program would be enormous. Imagine if every fishkeeper in Australia needed a license to own any fish, the record keeping and administration tasks would be onerous. 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 by BICON Australian Biosecurity Import Conditions - available at:

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	that they are flexible in their ecological and feeding requirements and should they be accidentally or deliberates introduced to the wild they could survive in Australia if the climate was suitable. The application I read is relatively complete, but species and genus names should be in italics, and they are not always formatted correctly in the application. The aim of the application, as far as I can gather but it is not stated, is to provide stock for the aquarium trade i.e., for commercial gain. The main risk is that of escape or discarding the fish to the wild followed by establishment. Details are not given of temperature requirements. It is hard to see how this action can be prevented or guarded against. Risk of hybridisation with native species if accidentally released by an extreme weather event or by human error seems negligible. I make the following addition recommendations. **Recommendations** I suggest all traders be licenced if they are not already, and that a condition of the permit 2. is that fish are not dumped live in the wild and that all buyers and keepers of these fish also be licenced with the same condition. Each species of Rainbow Fish must be bar coded and bar codes be deposited in GenBank. Several examples of each life stage of each species be deposited in the permanent collections of at least two Australian Museums.		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: https://www.awe.gov.au/biosecurity-trade/import/industry-advice/2016/02-2016 states that: 1.Only finfish 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 approved for export to Australia, meeting standards of the Department of Agriculture and Water Resources. 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 six (6) months prior to certification. 5.All fish in the consignment have been in approved Export Premises for fourteen (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. 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 to NSW 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. Most Aquarium Fish traders have some form of Business License. Author 1 has a NT Government supervised Aquaculture License, license number C1/533 and leases an Aquarium Fish Collecting License number A12/1914. The NT Government supervises

Respondent	Major comments	Further information requested	Applicant response
			fish species and fish health on Author 1's fish farm, Aquagreen at Howard Springs. The Aquarium fish traders in the NT are all licensed. **2. Most rainbowfishes have already been barcoded and listed in GenBank.** Kadarusman et al (2012). Cryptic Diversity in Indo-Australian Rainbowfishes Revealed by DNA Barcoding: Implications for Conservation in a Biodiversity Hotspot Candidate 2012 available at: https://www.semanticscholar.org/paper/Cryptic-Diversity-in-Indo-Australian-Rainbowfishes-Kadarusman-Hubert/0378c97cef3f39c5ab89982dfc35c84a4044a7b3 and Unmack, Peter J. et al (2013). Phylogeny and biogeography of rainbowfishes (Melanotaeniidae) from Australia and New Guinea available at: https://www.researchgate.net/publication/234122621_Phylogeny_and_biogeography_of_rainbowfishes_Melanotaeniidae_from_Australia_and_New_Guinea Author 2 has 2 other documents (spreadsheets) that can be supplied if required, that show the GenBank reference number for these fish. **3. Most rainbowfish species are already present in Australian Museums due to the work of Dr Gerald R Allen**

Round 2

The department's reports were circulated with relevant state and territory government agencies for comment between 21 September 2022 and 24 October 2022. The New South Wales and Western Australian Governments responded with comments supporting the amendment. The South Australian Government responded with no comments.

Table 18 Comments received during Round 2 of consultation

Respondent	Major comments	Department's response
NSW Government	The NSW government supported the amendment to add these species to the Live Import List and was pleased that the condition of a minimum length of 4cm has been included. They also agreed with the decision to not list some species in Part 1 due to conservation concerns.	Noting their conservation status and concerns from the NSW and WA governments, 11 species are recommended for listing on Part 2 of the Live Import List with conditions.
Western Australian Government	The WA Government advised they were comfortable with the outcome and recommendations from these reviews.	Noting their conservation status and concerns from the NSW and WA governments, 11 species are recommended for listing on Part 2 of the Live Import List with conditions.
South Australian Government	No comment from the South Australian Government on the proposal to amend the Live Import List	

Glossary

Term	Definition
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EN	Endangered
EPBC	Environment Protection and Biodiversity Conservation Act 1999
GISD	Global Invasive Species Database
IUCN	International Union for Conservation of Nature
mm	Millimetres
ppm	Parts per million
spp	Species
TL	Total length
VU	Vulnerable

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