This cover page has been inserted by the Department of Climate Change, Energy, the Environment and Water to assist in accessing the applications for the following species:

No.	*Scientific name*	**Common name**	*Page Number*
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4	*Pseudomugil furcatus*	forktail rainbowfish	131
5	*Pseudomugil ivanstoffi*	Ivantsoff's blue-eye	172
6	*Pseudomugil luminatus*	red neon blue-eye	213
7	*Pseudomugil paskai*	Paska's blue-eye	256
8	*Pseudomugil reticulatus*	Vogelkop blue-eye	297

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A report to address the "Terms of Reference" for an application to include *Kiunga ballochi* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Kiunga Ballochi (male) - photo© Neil Armstrong



Creek at KM42.5 on Kiunga-Tabubil Highway where Kiunga ballochi was 'rediscovered' in 2007. Photo: © Andrew Storey

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Kiunga*
Species: *Kiunga Ballochi,* Balloch's Blue-eye, Glass Blue-eye, Kiunga Blue-Eye



Adult male *Kiunga ballochi* with its distinctive yellow fins tipped off with dark margins for dorsal, caudal and anal fins. Photo: © Mark Allen

Etymology

The genus is named after the village if Kiunga, the largest settlement in the area, where the type species occurs. *Kiunga ballochi* was named in honour of Dr. David Balloch, a biologist with the Ok Tedi Mining Company, who provided invaluable logistic support, and collecting assistance. His efforts were directly responsible for the discovery of this new species.

Species summary

Kiunga ballochi have a mainly transparent body with a silvery coloured stomach and opercula. The scales are thinly outlined with pepper-like melanophores. The midlateral line, ventral edge of caudal peduncle, and bases of dorsal, caudal, and anal fins have dense concentrations of melanophores. The dorsal fin spines are translucent yellow; the second dorsal, caudal, and anal fins have bold black borders and yellow submarginal bands. The remaining portions of these fins are transparent except the dorsal and anal fins that have narrow strips of yellow basally and the anterior half of the anal fin has mainly yellow membranes. The pectoral fins are transparent. All fins with soft rays are faintly outlined with black. They have a moderately deep body for a blue-eye. Maximum size to about 3 cm SL.

Introduction

Pseudomugilidae (Blue-eyes) are among the smallest (< 5 cm fork-length) bony fishes found in freshwater and brackish estuaries of southern New Guinea and northern Australia (Allen et al., 2008b). Nineteen species in three genera are currently known, of which 12 species in two genera (Kiunga and Pseudomugil) occur in New Guinea. Three species of Pseudomugil are shared with Australia, and three species of Pseudomugil and a monotypic genus (Scaturiginichtys vermeilipinnis) are endemic to Australia (Ivantsoff et al., 1991, Fairfax et al., 2007).

Blue-eyes	Distribution
K. ballochi, K. bleheri Pseudomugil (Popondichthys) connieae, P. (p.) furcatus, P. ivantsoffi, P. luminatus, P. majusculus, P. novaeguineae, P. paludicola, P. paskai, P. pellucidus, P. reticulatus	Endemic to NG
P. cyanodorsalis, P. signifier, P. mellis Scaturiginichtys vermeilipinnis	Endemic to Aust
P. gertrudae, P. inconspicuus, P. tenellus	Endemic to Aust and NG

Regional distribution of Blue-eyes. [NG = New Guinea, Aust. = Australia]

The genus Kiunga, first recorded from creeks north of the town of Kiunga, Western Province, Papua New Guinea (PNG), is endemic to PNG and currently has two species; K. ballochi (Kiunga Blue-eye) and K. bleheri (Bleher's Blue-eye). The genus was discovered in 1982 when K. ballochi was first recorded (Allen, 1983). Subsequently, a second species, K. bleheri was described (Allen, 2004). The genus differs from Pseudomugil based on a number of distinctive internal and external features including having vestigial and inconspicuous dorsal fins, a rigid keel-like structure mid-ventrally between pelvic and anal fins, and variations in skeletal features (Allen, 1983, Saeed et al., 1989, Allen et al., 2008b). The current knowledge of Kiunga shows it has a very limited distribution, and as such, may be susceptible to localised extinction.

Kiunga ballochi was first discovered during baseline surveys conducted for the Ok Tedi mine (Allen, 1983). Specimens were collected from "several small creeks…located approximately 30–50 km north of Kiunga…" (Allen, 1983). The creeks, accessed from a road being built to service the mine, were 'pristine', with no obvious disturbance apart from the new road crossings. Sampling was by seine net and took place during an El Niño-associated dry period when fish were concentrated and plentiful. Because the location of the type locality was estimated from a topographic map (Allen, 2007), it was difficult to determine its exact position, but subsequent surveys by various individuals and research organisations failed to collect *K. ballochi* from creeks in the vicinity of the type locality, between Kiunga and Ningerum. Three trips were made to the area by Heiko Bleher (in 1991, 1994 and 2003) in an attempt to secure specimens for the aquarium trade. He was unsuccessful in finding *K. ballochi*, despite rigorous sampling at the locality from where it was previously known and considered common. During the 1991 and 1994 survey however, specimens of a second species of Kiunga were collected (see below). The inability to relocate *K. ballochi* lead, in 2004, to the species being presumed extinct in the wild (see Allen, 2007).

Year of survey	Lead scientists and purpose
1982	Gerry Allen, with John Paska, sampled creeks along the new Kiunga-Tabubil highway as part of baseline surveys during construction of the Ok Tedi mine.
1991	Heiko Bleher, creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways in an attempt to capture specimens of K. ballochi for aquarium trade.
1994	Heiko Bleher, creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways in an attempt to capture specimens of K. ballochi for aquarium trade.
2003	Heiko Bleher, a third visit to creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways to attempt to capture specimens of K. ballochi but also gather new specimens of K. bleheri.
2005	Andrew Storey, Ross Smith and staff of Ok Tedi Mining Limited, to conduct fish diversity survey of the Fly River, sampling 50 sites throughout the system, capturing 84 native and 3 exotic species.
2007	Andrew Storey, Gerry and Mark Allen and Markson Yarrao to collect specimens and gather photographs for a proposed new book on the freshwater fishes of the Fly River.
2011	Andrew Storey, Gerry and Mark Allen and Markson Yarrao to conduct fish diversity survey of the Fly River, sampling 57 sites throughout the system, capturing 84 native and 5 exotic species.
2014	Baseline surveys of creeks north of Kiunga and in the Elevala River area, east of Kiunga by Horizon Oil.
2015	Andrew Storey and Markson Yarrao, 25 sites in the Ok Birim area as part of a baseline survey, recording 34 species of fish.
2018	Andrew Storey & Graham Mesa, 3 sites sampled by Horizon Oil in the Elevala subcatchment, and 6 creeks along the Drimkas Highway from Kiunga to the upper Fly.

Summary of past surveys for Kiunga in the Kiunga-Ningerum area.

Field work	1982	1991	1994	2003	2005	2007	2011	2014	2015	2018
K. ballochi	√	x	x	x	x	√	√	√	√	√
K. bleheri	x	√	√	√	x	√	√	x	x	x

Summary of recordings of *K. ballochi* and *K. bleheri* by past surveys of creeks in the Kiunga area, Western Province, Papua New Guinea. [Symbols: √ = recorded, x = not recorded]

In 2005, Gerry Allen, Markson Yarrao and Andrew W. Storey undertook a fish diversity survey of the Fly River system, including 26 creeks along the Kiunga to Tabubil highway. Sampling was by seine net and electrofisher, but failed to record any specimens of *K. ballochi* or its congener. In 2007 *K. ballochi* was subsequently listed in the International Union for Conservation of Nature (IUCN) Red List as Critically Endangered because of the perceived severe reduction in number of fish (abundance) since its initial collection in 1982 (Jenkins et al., 2009). It was not until 2007 that *K. ballochi* was 'rediscovered' (see Allen, 2007), during a survey of the Fly system to collect specimens and photographs for a new book on the freshwater fishes of the Fly River (Allen et al., 2008b). During that survey, and after considerable effort sampling many creeks along the same highway, four specimens of K. ballochi were eventually caught in a fine mesh seine in a creek 42.5 km from Kiunga In 2011 the junior authors Yarrao and Andrew W. Storey along with Gerry and Mark Allen conducted a follow-up fish diversity survey of the Fly system, in which 63 locations were sampled, including 21 creeks in the Kiunga-Tabubil area. This survey discovered a second population of *K. ballochi*, in a creek along a newly constructed road running from the Kiunga Tabubil Highway to the Bige dredge facility on the lower Ok Tedi.



Collecting Kiunga ballochi from a creek on the Bige access road, with Gerry Allen in the foreground, and authors Pita Amick and Andrew Storey, with local assistants, in the background. Photo: ©Mark Allen.

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Kiunga Ballochi* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical

discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

References
Allen, G. R. (1983). Kiunga ballochi, a new genus and species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Tropical Fish Hobbyist 32(2), 72-7.

Amick, Pita K., Yarrao, Markson., & Storey, Andrew W. (2020) A review of the genus Kiunga (Teleostei: Pseudomugilidae), with notes on distribution, potential environmental impacts and recommendations for research and conservation

Clements, Valentin, Rankin, Baker, Gee, Snellgrove, Sloman (2019) "*The effects of interacting with fish in aquariums on human health and well-being: A systematic review*" published by Institute of Biomedical and Environmental Health Research, School of Health and Life Sciences, University of the West of Scotland, Paisley, United Kingdom.

Cracknell, White, Pahl, Nichols & Depledge. 2016 "*Marine Biota and Psychological Well-Being: A Preliminary Examination of Dose–Response Effects in an Aquarium Setting*" published by Environment and Behavior2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms "Blue - eyes" and "*Kiunga*" revealed no results for those entities. (accessed 20 August 2022).

Kiunga ballochi has most recently been assessed for *The IUCN Red List of Threatened Species* in 2019. *Kiunga ballochi* is listed as Endangered under criteria B1ab(iii). This species is endemic to the Upper Fly River system of Papua New Guinea where it is only known from a couple of small creeks. The extent of occurrence (EOO) is 80 km^2. There is one location, based on the threats of settlements and road construction, as well as introduced species. These threats are leading to continuing decline in habitat.

It is suspected that this species has been severely impacted by habitat degradation. The primary threat is considered to be settlements and road building associated with the Ok Tedi mine and oil/gas exploration in the area (A.W. Storey pers. comm. 2020). It should be noted that there has been no direct impact from mining activities recorded on this species (A.W. Storey pers. comm. 2020). Invasive species also represent a threat to this species.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 2 species of Kiunga listed. The most recent assessments were recorded in 2019.

Kiunga ballochi *Kiunga ballochi* is listed as Endangered
https://www.iucnredlist.org/species/11021/147698670

Kiunga bleheri *Kiunga bleheri is* listed as Critically Endangered
https://www.iucnredlist.org/species/161077227/161077231

References:

Allen, G. R. (1983). Kiunga ballochi, a new genus and species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Tropical Fish Hobbyist 32(2), 72-7.

Amick, Pita K., Yarrao, Markson., & Storey, Andrew W. (2020) A review of the genus Kiunga (Teleostei: Pseudomugilidae), with notes on distribution, potential environmental impacts and recommendations for research and conservation

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Kiunga” revealed no results for those entities. (accessed 20 August 2022.).

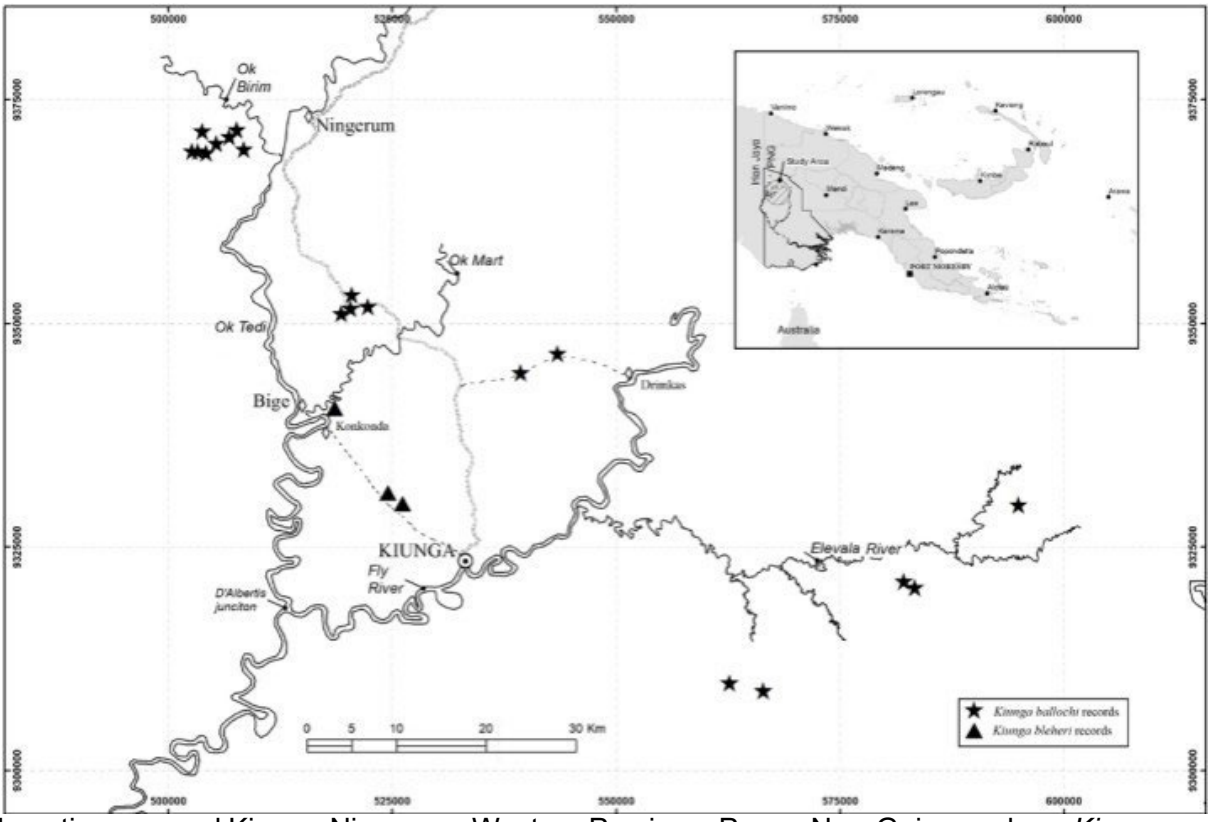
Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.).

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:



Locations around Kiunga-Ningerum, Western Province, Papua New Guinea, where *Kiunga* ballochi and *K. bleheri* have been collected since each was first discovered

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Holotype

Allen (1983) records the holotype as WAM P27797-001, male 24.5mm SL, small creek, a tributary of the Upper Fly River, about 40km north of Kiunga on Tabubil Road, Papua New

Guinea (approximately 5°52'S, 141°12'E), seine net, G. Allen and J. Paska, 16 September 1982.

Paratypes

Allen records the following paratypes, (Collected with holotype unless stated otherwise.) AMS I.23842-001. 5 specimens, 16.6-26.3mm SL; P.N.G. F.5363.01, 5 specimens, 17.1-29.2mm SL: RMNH 29230, 6 specimens, 19.5-25.7mm SL; WAM P27797.002, 40 specimens, 14.7-25.8mm SL; WAM P27798-001, 21 specimens, 18.0-28.0mm SL, small creek, a tributary of the Upper Fly River, about 50km north of Kiunga on Tabubil Road Papua New Guinea (approximately 5°51'S, 141°11'E), seine net, G. Allen and J. Paska, 16 September 1982; ZMA 119.072, 7 specimens, 14.8-22.9mm SL.

References:

Allen, G. R. (1983). Kiunga ballochi, a new genus and species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Tropical Fish Hobbyist 32(2), 72-7.

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.c The natural geographic range.

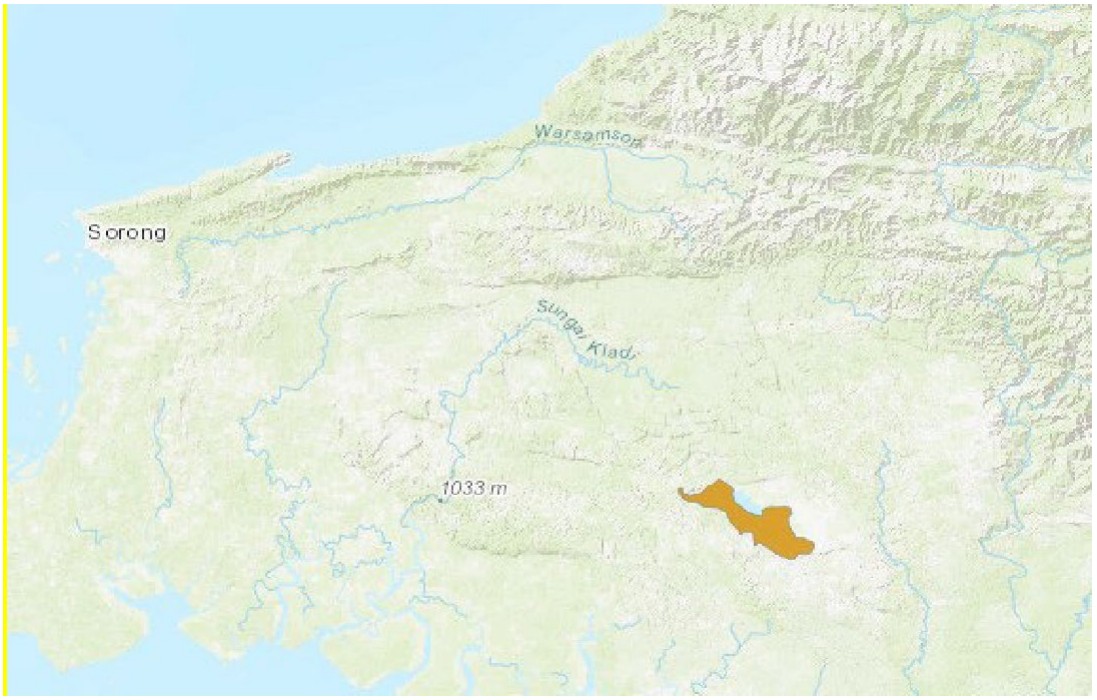
This species is known only from the Upper Fly River system of Papua New Guinea. Type specimens were collected in 1982 from small tributaries of the Ok Smak, a major tributary of the Ok Tedi, approximately 40-50 km north of the town of Kiunga. These streams cross the Tabubil-Kiunga road immediately north of the Ok Mart Bridge in the vicinity of Rumginae. Recent (2007-2012) attempts failed to record this species from creeks around the type locality, which are under increasing pressure from human settlement, but did record it from another small tributary crossing the highway, closer to Kiunga. Additional subpopulations have since been recorded from tributaries of the Ok Birim, to the west of the Ok Tedi main channel, and adjacent to the Papua New Guinea-Indonesian border (2014), and from several creeks crossed by a new road connecting Kiunga to Drimkas at the Upper Fly-Palmer River confluence (2018) (A.W. Storey pers. comm. 2020). A fourth subpopulation that appears to be this species was recently discovered (2018) in a small tributary of the Elevala River, which is a major tributary of the Upper Fly River, but located to the east of the Fly River, which substantially extends the range within the catchment (A.W. Storey pers. comm. 2020). This species is not likely to be found in the main stem of the Fly River. Additional surveys are required to establish the limits of distribution, particularly westwards into Papua Province of Indonesia, which lies immediately adjacent to the western extent of its current known range, but also further east, towards the Strickland River and beyond.

References

The IUCN Red List search facility (accessed 20 August 2022.) at located at URL
https://www.iucnredlist.org/species/11021/147698670

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf



Distribution range of *Kiunga Ballochi* © IUCN Redlist:
https://www.iucnredlist.org/species/161077487/161077492

References:

IUCN Redlist: accessed 20th August 2022 at:
https://www.iucnredlist.org/species/11021/147698670

3.d Habitat.

This is a demersal species that inhabits narrow, shallow, clear creeks and streams flowing through rainforest in flat or hilly terrain at elevations less than about 100 m above sea level . Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. Species from the family Pseudomugliidae normally congregate in schools. Individuals of this species can grow to a maximum size of about 3 cm SL

References:

IUCN Redlist: accessed 20th August 2022 at:
https://www.iucnredlist.org/species/11021/147698670

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Kiunga Ballochi* was not recorded by Allen (2001) but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1991) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; "Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac."

Reference:

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes

are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as “dither fish” to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae.

List compiled from **Fishbase** August 2022
at:https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including

There are no scientific records of any work done on the reproductive biology of *Kiunga Ballochi. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the author since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

Atheriniformes (Blue-eyes and relatives) are good aquarium fishes. New Guinea Blue-eyes have been collected by aquarists, taken overseas, and bred in captivity for commercial

purposes. This includes both species of Kiunga in the past. No attention has been given to the remaining native stock, or to establishing breeding populations from new wild populations to maintain genetic diversity. As infrastructural developments in the Kiunga – Ningerum areas are increasing, and with the everincreasing human population and associated local, land and water use activities, coupled with the potential natural threats, a serious decline, even extinction of the genus Kiunga is possible, and K. bleheri in particular given its limited distribution.

References

Amick, Pita K., Yarrao, Markson., & Storey, Andrew W. (2020) A review of the genus Kiunga (Teleostei: Pseudomugilidae), with notes on distribution, potential environmental impacts and recommendations for research and conservation

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Kiunga Ballochi* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Kiunga Ballochi* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Kiunga Ballochi* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct”
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Kiunga Ballochi* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Kiunga ballochi* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 27 August 2022 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Kiunga ballochi* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with *Kiunga ballochi* data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences -

ABARES) November 2020 the following calculations were produced a score for *Kiunga ballochi* data against the provisions in the assessment process.(accessed 6th June 2021.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Kiunga ballochi is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from the author, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Kiunga Ballochi is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process

indicates a score of 2 for *Kiunga ballochi* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Kiunga ballochi* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Kiunga ballochi* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Kiunga ballochi* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Kiunga ballochi was first discovered during baseline surveys conducted for the Ok Tedi mine (Allen, 1983). Specimens were collected from “several small creeks…located approximately 30–50 km north of Kiunga…” (Allen, 1983). The creeks, accessed from a road being built to service the mine, were ‘pristine’, with no obvious disturbance apart from the new road crossings. The maximum size of this species is around 30mm SL.

This species is assessed as Endangered. The extent of occurrence (EOO) is between 1,000-8,265 km^2, with a best estimate of under 5,000 km^2. There are four locations, based on four distinct subpopulations with different human dynamics at each. Settlements and road construction, both associated with the Ok Tedi mine, are leading to continuing decline in habitat. There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) “*Top End Native Plants*” published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) “*Floodplain Flora*” published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/species/161077487/161077492

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Kiunga ballochi* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Kiunga ballochi* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Kiunga ballochi* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.de/summary/Pseudomugil-reticulatus.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Kiunga ballochi* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 28mm (Allen 1981)

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_ballochi.htm

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Kiunga ballochi are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Kiunga ballochi* 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at:
http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Kiunga ballochi,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks* associated with the importation of rainbowfish for ornamental purposes" - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Kiunga ballochi* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Kiunga ballochi poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any

importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 27 August 2022].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Kiunga ballochi* will be used in the live fish ornamental aquarium display trade, as well as commercial fish farms. *Kiunga ballochi* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960’s.

If *Kiunga ballochi is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Kiunga ballochi* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Kiunga ballochi* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful, hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

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12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including: the species' current quarantine status, or pest or noxious status, or whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Kiunga ballochi* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Kiunga* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Kiunga ballochi* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017. The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no Kiunga species on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Kiunga ballochi* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Kiunga species* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Kiunga ballochi* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Kiunga species* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Kiunga species* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Kiunga ballochi* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Kiunga species* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Kiunga ballochi* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Kiunga species* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Kiunga species* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’

about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Kiunga* species listed.

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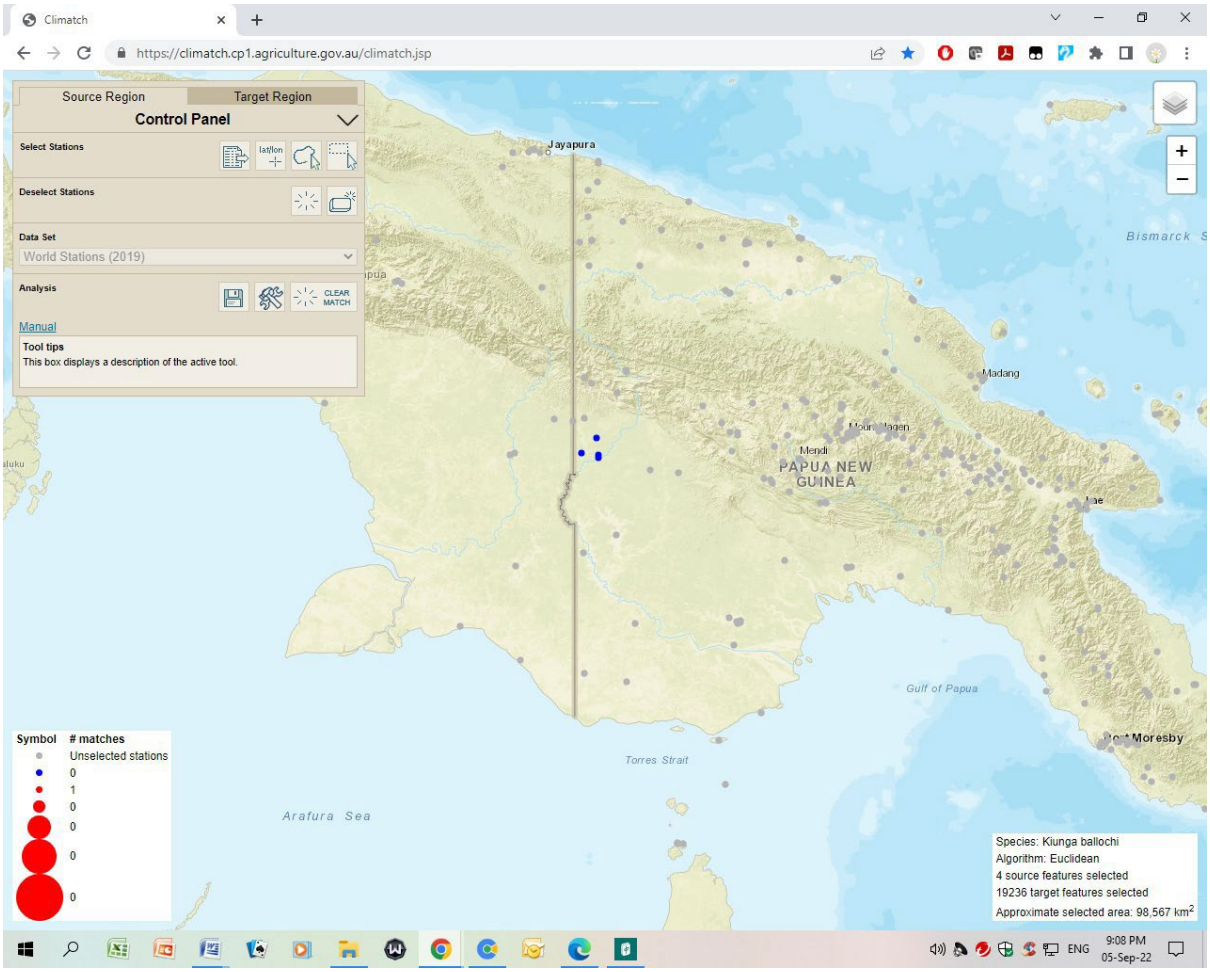
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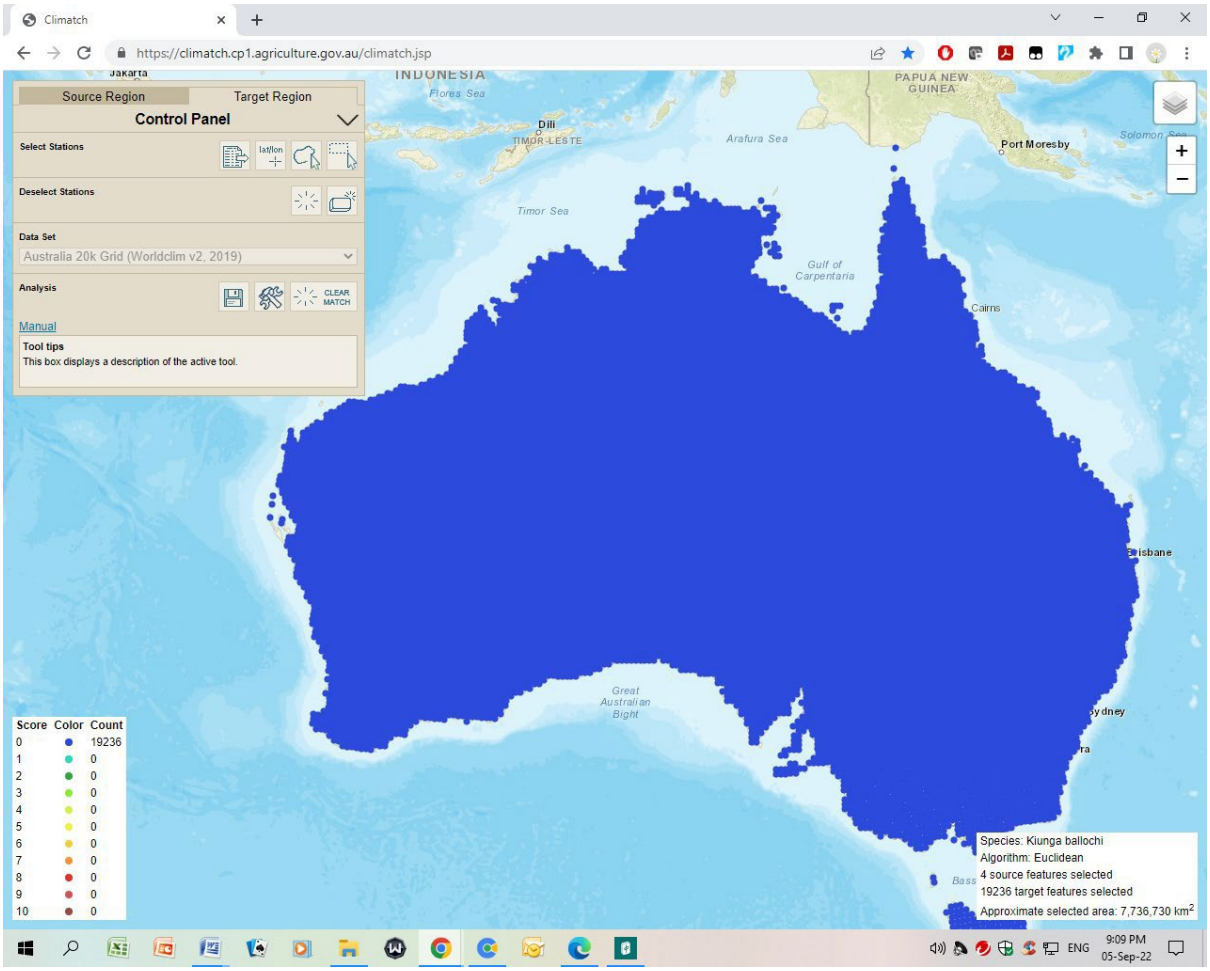
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APPENDIX A – calculation of climate from *Kiunga ballochi* distribution climate to Australian Climate.



Appendix B - Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)



BOMFORD ASSESSMENT

SPECIES: *Kiunga ballochi*

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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A report to address the “Terms of Reference” for an application to include *Kiunga bleheri* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Adult male Kiunga bleheri showing almost transparent fins, with black tips for dorsal and anal fins. Photo: © Gerald Allen



Aquarium-bred Kiunga bleheri, approximately 20 mm SL. Photo: © G. R. Allen.

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Kiunga*
Species: *Kiunga bleheri,* Bleher's blue-eye



Adult male *Kiunga bleheri* Photo: © Heiko Bleher

Etymology

The new species is named after Heiko Bleher of Milan, Italy who collected the type specimens and was first to observe it in the wild.

Species summary

Kiunga bleheri, new species, is described from 9 specimens, 16.7-28.4 mm SL, collected by H. Bleher in 1994 and 2003 from the Fly River system in the vicinity of Kiunga, Papua New Guinea. *Kiunga bleheri* is currently only known from a few small creeks crossed by the Kiunga-Konkonda Road, approximately 10-12 km west of Kiunga, in the Fly River system. They were reportedly first collected by Heiko Bleher in 1991 from Tare Creek, about 12 kilometres north of Kiunga on Konkonda Road, Papua New Guinea. Gerald Allen described this species in 2004. On first glance their general appearance looks similar to *Kiunga ballochi*. However, the morphological differences, nevertheless, are also obvious. It differs from *Kiunga ballochi*, also from the Kiunga area, on the basis of its much shorter second

dorsal and anal fins, significant modal difference in the number of second dorsal fin rays, 6 versus 5 transverse scale rows on the body, and in usually having most of the second dorsal and anal fin rays unbranched. Body colour is general semi-transparent with the second dorsal fin faintly yellowish on outer portion with irregular black margin. Maximum size about 3.0 cm SL.

Introduction

Pseudomugilidae (Blue-eyes) are among the smallest (< 5 cm fork-length) bony fishes found in freshwater and brackish estuaries of southern New Guinea and northern Australia (Allen et al., 2008b). Nineteen species in three genera are currently known, of which 12 species in two genera (Kiunga and Pseudomugil) occur in New Guinea. Three species of Pseudomugil are shared with Australia, and three species of Pseudomugil and a monotypic genus (Scaturiginichtys vermeilipinnis) are endemic to Australia (Ivantsoff et al., 1991, Fairfax et al., 2007).

Blue-eyes	**Distribution**
K. ballochi, K. bleheri Pseudomugil (Popondichthys) connieae, P. (p.) furcatus, P. ivantsoffi, P. luminatus, P. majusculus, P. novaeguineae, P. paludicola, P. paskai, P. pellucidus, P. reticulatus	Endemic to NG
P. cyanodorsalis, P. signifier, P. mellis Scaturiginichtys vermeilipinnis	Endemic to Aust
P. gertrudae, P. inconspicuus, P. tenellus	Endemic to Aust and NG

Regional distribution of Blue-eyes. [NG = New Guinea, Aust. = Australia]

The genus Kiunga, first recorded from creeks north of the town of Kiunga, Western Province, Papua New Guinea (PNG), is endemic to PNG and currently has two species; K. ballochi (Kiunga Blue-eye) and K. bleheri (Bleher's Blue-eye). The genus was discovered in 1982 when K. ballochi was first recorded (Allen, 1983). Subsequently, a second species, K. bleheri was described (Allen, 2004). The genus differs from Pseudomugil based on a number of distinctive internal and external features including having vestigial and inconspicuous dorsal fins, a rigid keel-like structure mid-ventrally between pelvic and anal fins, and variations in skeletal features (Allen, 1983, Saeed et al., 1989, Allen et al., 2008b). The current knowledge of Kiunga shows it has a very limited distribution, and as such, may be susceptible to localised extinction.

Kiunga bleheri was first discovered during baseline surveys conducted for the Ok Tedi mine (Allen, 1983). Specimens were collected from "several small creeks…located approximately 30–50 km north of Kiunga…" (Allen, 1983). The creeks, accessed from a road being built to service the mine, were 'pristine', with no obvious disturbance apart from the new road crossings. Sampling was by seine net and took place during an El Niño-associated dry period when fish were concentrated and plentiful. Because the location of the type locality was estimated from a topographic map (Allen, 2007), it was difficult to determine its exact position, but subsequent surveys by various individuals and research organisations failed to collect *K. ballochi* from creeks in the vicinity of the type locality, between Kiunga and Ningerum. Three trips were made to the area by Heiko Bleher (in 1991, 1994 and 2003) in an attempt to secure specimens for the aquarium trade. He was unsuccessful in finding *K. ballochi*, despite rigorous sampling at the locality from where it was previously known and considered common. During the 1991 and 1994 survey however, specimens of a second species of Kiunga were collected (see below). The inability to relocate *K. ballochi* lead, in 2004, to the species being presumed extinct in the wild (see Allen, 2007).

Year of survey	Lead scientists and purpose
1982	Gerry Allen, with John Paska, sampled creeks along the new Kiunga-Tabubil highway as part of baseline surveys during construction of the Ok Tedi mine.
1991	Heiko Bleher, creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways in an attempt to capture specimens of K. ballochi for aquarium trade.
1994	Heiko Bleher, creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways in an attempt to capture specimens of K. ballochi for aquarium trade.
2003	Heiko Bleher, a third visit to creeks along the Kiunga-Tabubil and Kiunga-Konkonda highways to attempt to capture specimens of K. ballochi but also gather new specimens of K. bleheri.
2005	Andrew Storey, Ross Smith and staff of Ok Tedi Mining Limited, to conduct fish diversity survey of the Fly River, sampling 50 sites throughout the system, capturing 84 native and 3 exotic species.
2007	Andrew Storey, Gerry and Mark Allen and Markson Yarrao to collect specimens and gather photographs for a proposed new book on the freshwater fishes of the Fly River.
2011	Andrew Storey, Gerry and Mark Allen and Markson Yarrao to conduct fish diversity survey of the Fly River, sampling 57 sites throughout the system, capturing 84 native and 5 exotic species.
2014	Baseline surveys of creeks north of Kiunga and in the Elevala River area, east of Kiunga by Horizon Oil.
2015	Andrew Storey and Markson Yarrao, 25 sites in the Ok Birim area as part of a baseline survey, recording 34 species of fish.
2018	Andrew Storey & Graham Mesa, 3 sites sampled by Horizon Oil in the Elevala subcatchment, and 6 creeks along the Drimkas Highway from Kiunga to the upper Fly.

Summary of past surveys for Kiunga in the Kiunga-Ningerum area.

Field work	1982	1991	1994	2003	2005	2007	2011	2014	2015	2018
K. ballochi	√	x	x	x	x	√	√	√	√	√
K. bleheri	x	√	√	√	x	√	√	x	x	x

Summary of recordings of *K. ballochi* and *K. bleheri* by past surveys of creeks in the Kiunga area, Western Province, Papua New Guinea. [Symbols: √ = recorded, x = not recorded]

In 2005, Gerry Allen, Markson Yarrao and Andrew W. Storey undertook a fish diversity survey of the Fly River system, including 26 creeks along the Kiunga to Tabubil highway. Sampling was by seine net and electrofisher, but failed to record any specimens of *K. ballochi* or its congener. In 2007 *K. ballochi* was subsequently listed in the International Union for Conservation of Nature (IUCN) Red List as Critically Endangered because of the perceived severe reduction in number of fish (abundance) since its initial collection in 1982 (Jenkins et al., 2009). It was not until 2007 that *K. ballochi* was 'rediscovered' (see Allen, 2007), during a survey of the Fly system to collect specimens and photographs for a new book on the freshwater fishes of the Fly River (Allen et al., 2008b). During that survey, and after considerable effort sampling many creeks along the same highway, four specimens of K. ballochi were eventually caught in a fine mesh seine in a creek 42.5 km from Kiunga In 2011 the junior authors Yarrao and Andrew W. Storey along with Gerry and Mark Allen conducted a follow-up fish diversity survey of the Fly system, in which 63 locations were sampled, including 21 creeks in the Kiunga-Tabubil area. This survey discovered a second population of *K. ballochi*, in a creek along a newly constructed road running from the Kiunga Tabubil Highway to the Bige dredge facility on the lower Ok Tedi.

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other

instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Kiunga bleheri* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

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2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms “Blue - eyes” and “*Kiunga*” revealed no results for those entities. (accessed 20 August 2022).

Kiunga bleheri has most recently been assessed for *The IUCN Red List of Threatened Species* in 2019. *Kiunga bleheri* is listed as Endangered under criteria B1ab(iii). This species is endemic to the Upper Fly River system of Papua New Guinea where it is only known from a couple of small creeks. The extent of occurrence (EOO) is 80 km^2. There is one location, based on the threats of settlements and road construction, as well as introduced species. These threats are leading to continuing decline in habitat.

It is suspected that this species has been severely impacted by habitat degradation. The primary threat is considered to be settlements and road building associated with the Ok Tedi mine and oil/gas exploration in the area (A.W. Storey pers. comm. 2020). It should be noted that there has been no direct impact from mining activities recorded on this species (A.W. Storey pers. comm. 2020). Invasive species also represent a threat to this species.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 2 species of Kiunga listed. The most recent assessments were recorded in 2019.

Kiunga ballochi *Kiunga ballochi* is listed as Endangered
https://www.iucnredlist.org/species/11021/147698670

Kiunga bleheri *Kiunga bleheri is* listed as Critically Endangered
https://www.iucnredlist.org/species/161077227/161077231

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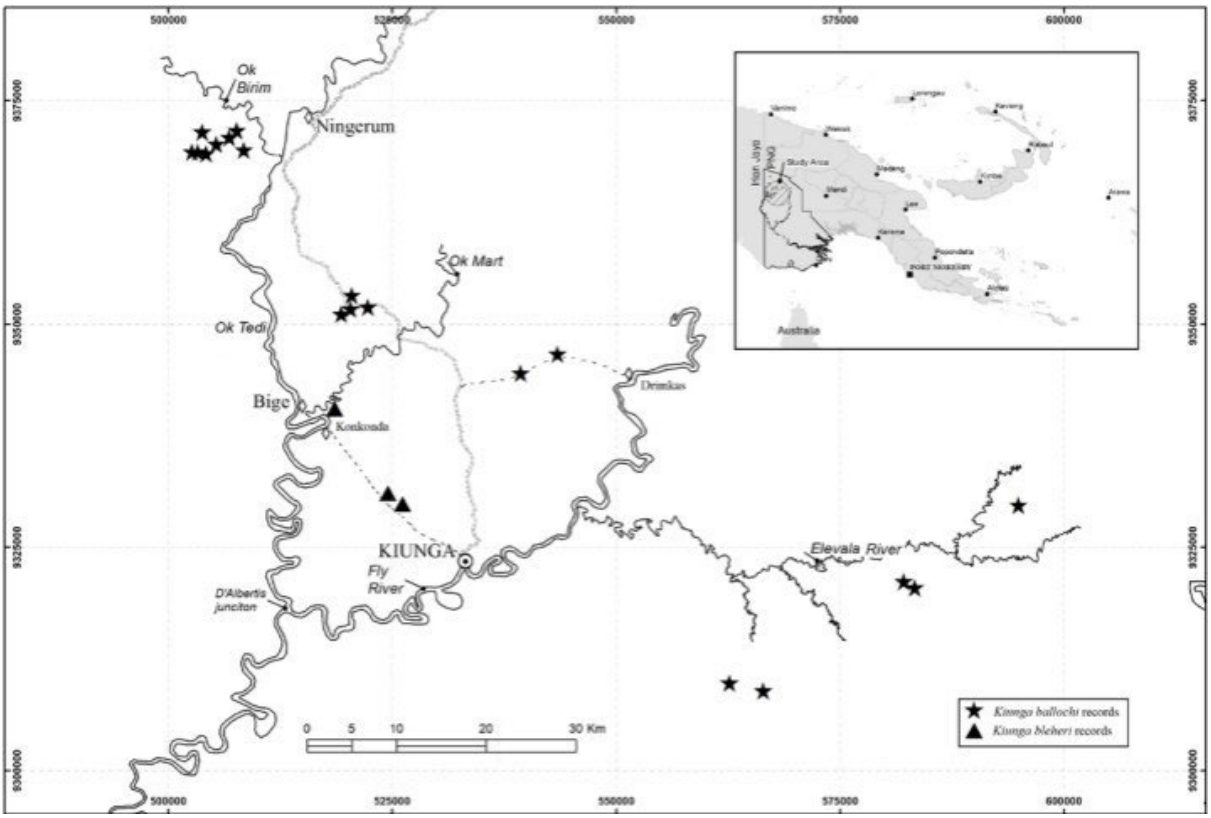
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Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:



Locations around Kiunga-Ningerum, Western Province, Papua New Guinea, where *Kiunga* ballochi and *K. bleheri* have been collected since each was first discovered

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Holotype
WAM 32455-001, male, 28.4 mm SL, Tare Creek, 11.5 km from central market of Kiunga on Konkonda Road (approximately 6°04'S, 141°13'E), Western Province, Papua New Guinea, collected by H. Bleher with dip nets, 7 November 2003

Paratypes
Allen records the following paratypes, AMS I.42990-001, 2 specimens, 24.1- 24.4 mm SL, collected with holotype; WAM 32455- 002, 4 specimens, 16.7-25.8 mm SL, collected with holotype; WAM P.31572-001, 2 specimens, 20.0-25.4 mm SL, 26 km north-east of Kiunga (approximately 5°58'S, 141°10'E), Western Province, Papua New Guinea, collected by H. Bleher with dip nets, 27 October 1994.

The type specimens from Tare Creek were collected about 1.5 km upstream from the road crossing. At this point the stream is about 2.5 m in width and during low water periods is only 50-80 cm deep. A group of approximately 80 K. bleheri were observed at the type locality, swimming in the middle of the stream where the current was relatively fast. Temperature (26.2°C), pH (6.0), and a conductivity value of 10 µS/cm were recorded. There was no aquatic vegetation.



Type locality of Kiunga bleheri. Photo: © H. Bleher.

References:

Allen G.R. (2004) *Kiunga bleheri*, a new Blue-Eye (Pisces: Pseudomugilidae) from fresh waters of Papua New Guinea, aqua, Journal of Ichthyology and Aquatic Biology 8 (2): 79-85.

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

3.c The natural geographic range.

Based on their current known distributions, and conditions at the locations from which K. ballochi and K. bleheri have been collected, the two species are allopatric and probably fill similar ecological niches in terms of food preference, habitat use and their tolerance to variation in water quality. All collecting sites are small and shallow (5 m wide x 1 m deep), slow-flowing creeks at elevations around 80 (± 20) m above sea level, with a daytime temperature range of 24–27o C, pH near neutral to slightly acidic (pH 5.7–7.8), and very fresh (EC < 30 µS/cm). During field work in 2011 (A.W. Storey unpubl. dat.), K. ballochi was collected from the riffle-pool interface of a slow-flowing creek along the road to Bige; K. bleheri were collected in a forest-fringed pool along the Konkonda Road. This species is endemic to the Upper Fly River system of Papua New Guinea, where it is known only from a couple of small creeks crossed by the Kiunga-Konkonda Road, approximately 10-12 km west of Kiunga, Western Province. It is suspected that this species has been severely impacted by habitat degradation. The primary threat is considered to be settlements and road building associated with the Ok Tedi mine and oil/gas exploration in the area (A.W. Storey pers. comm. 2020). It should be noted that there has been no direct impact from mining activities recorded on this species (A.W. Storey pers. comm. 2020). Invasive species also represent a threat to this species.



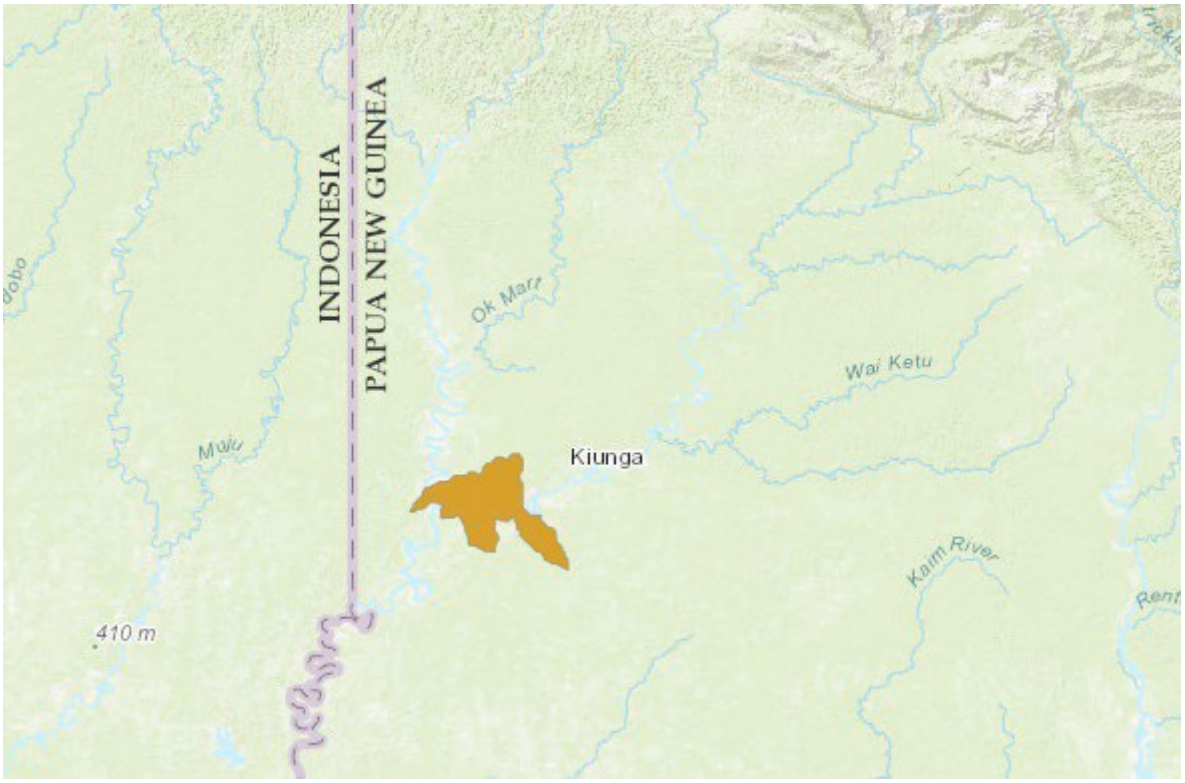
Tare Creek, Papua New Guinea, about 1 km above Konkonda road crossing. Kiunga bleheri occurs upstream of this point where the environment remains undisturbed. The habitat contains dense streamside foliage and a true aquatic plant, the reddish, round-leaved Barclaya morleti. Photo: © H. Bleher.

References

The IUCN Red List search facility (accessed 20 August 2022.) at located at URL https://www.iucnredlist.org/species/11021/147698670

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf



Reference:
Distribution range of *Kiunga bleheri* © IUCN Redlist:
https://www.iucnredlist.org/species/161077227/161077231

3.d Habitat.



This species has been recorded in clear, shallow streams in relatively flat or low foothill terrain amongst undisturbed rainforest at an elevation of about 100 m above sea level. Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. The maximum recorded size of this species is about 2.8 cm SL

References:

Allen G.R. (2004) *Kiunga bleheri*, a new Blue-Eye (Pisces: Pseudomugilidae) from fresh waters of Papua New Guinea, aqua, Journal of Ichthyology and Aquatic Biology 8 (2): 79-85.

IUCN Redlist: accessed 20th August 2022 at:
https://www.iucnredlist.org/species/11021/147698670

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Kiunga bleheri* was not recorded by Allen (2001) but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

This species has been recorded in clear, shallow streams in relatively flat or low foothill terrain amongst undisturbed rainforest at an elevation of about 100 m above sea level. Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. The maximum recorded size of this species is about 2.8 cm SL. Allen (2001) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; "Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males

with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac."

Reference:

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as "dither fish" to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae.

List compiled from **Fishbase** August 2022 at:
https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including

There are no scientific records of any work done on the reproductive biology of *Kiunga bleheri. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the author since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

Atheriniformes (Blue-eyes and relatives) are good aquarium fishes. New Guinea Blue-eyes have been collected by aquarists, taken overseas, and bred in captivity for commercial purposes. This includes both species of Kiunga in the past. No attention has been given to the remaining native stock, or to establishing breeding populations from new wild populations to maintain genetic diversity. As infrastructural developments in the Kiunga – Ningerum areas are increasing, and with the everincreasing human population and associated local, land and water use activities, coupled with the potential natural threats, a serious decline, even extinction of the genus Kiunga is possible, and K. bleheri in particular given its limited distribution.

References

Allen G.R. (2004) *Kiunga bleheri*, a new Blue-Eye (Pisces: Pseudomugilidae) from fresh waters of Papua New Guinea, aqua, Journal of Ichthyology and Aquatic Biology 8 (2): 79-85.

Amick, Pita K., Yarrao, Markson., & Storey, Andrew W. (2020) A review of the genus Kiunga (Teleostei: Pseudomugilidae), with notes on distribution, potential environmental impacts and recommendations for research and conservation

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Kiunga bleheri* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Kiunga bleheri* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Kiunga bleheri* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Kiunga bleheri* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Kiunga bleheri* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 27 August 2022 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Kiunga bleheri* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with *Kiunga bleheri* data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for *Kiunga bleheri* data against the provisions in the assessment process.(accessed 6th June 2021.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Kiunga bleheri is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from the author, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Kiunga bleheri is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in “Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models” A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Kiunga bleheri* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Kiunga bleheri* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Kiunga bleheri* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Kiunga bleheri* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

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Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Kiunga bleheri was reportedly first collected by Heiko Bleher in 1991 from Tare Creek, about 10 kilometres north-west of Kiunga, close to Konkonda on the Konkonda Road, Western Province, PNG. This species has been recorded in clear, shallow streams in relatively flat or low foothill terrain amongst undisturbed rainforest at an elevation of about 100 m above sea level. Its streams are relatively well shaded, but have occasional open patches exposed to sunlight. The maximum recorded size of this species is about 2.8 cm SL

This species is endemic to the Upper Fly River system of Papua New Guinea where it is only known from a couple of small creeks. The extent of occurrence (EOO) is 80 km^2. There is one location, based on the threats of settlements and road construction, as well as introduced species. These threats are leading to continuing decline in habitat. Therefore, this species is assessed as Critically Endangered.

There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/species/161077487/161077492

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Kiunga bleheri* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Kiunga bleheri* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Kiunga bleheri* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.se/summary/Kiunga-bleheri.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

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8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Kiunga bleheri* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 28mm (Allen 1981)

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
https://rainbowfish.angfaqld.org.au/Kiunga_bleheri.htm

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Kiunga bleheri are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Kiunga bleheri* 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Kiunga bleheri,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks* associated with the importation of rainbowfish for ornamental purposes" - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Kiunga bleheri* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Kiunga bleheri poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant

relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 27 August 2022].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Kiunga bleheri* will be used in the live fish ornamental aquarium display trade, as well as commercial fish farms. *Kiunga bleheri* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960’s.

If *Kiunga bleheri is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Kiunga bleheri* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Kiunga bleheri* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:

http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful, hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Aquagreen Aquarium and Pond Keepers Code of Conduct – available at URL - https://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 27 August 2022].

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including: the species' current quarantine status, or pest or noxious status, or whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Kiunga bleheri* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Kiunga* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade will not allow *Kiunga bleheri* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017. The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no Kiunga species on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Kiunga bleheri* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Kiunga species* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Kiunga bleheri* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Kiunga species* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Kiunga species* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Kiunga bleheri* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Kiunga species* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Kiunga bleheri* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Kiunga species* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Kiunga species* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’ about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Kiunga* species listed.

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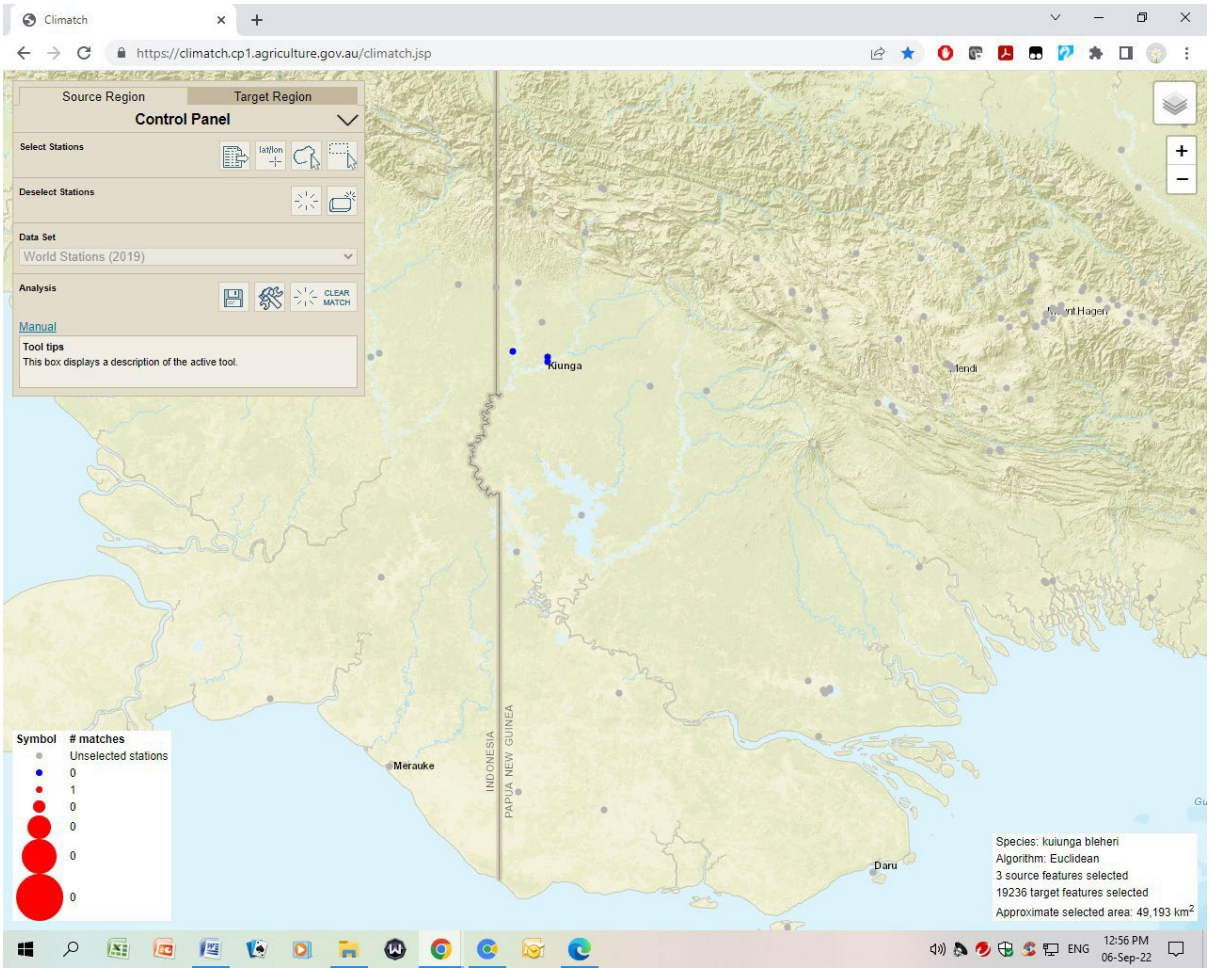
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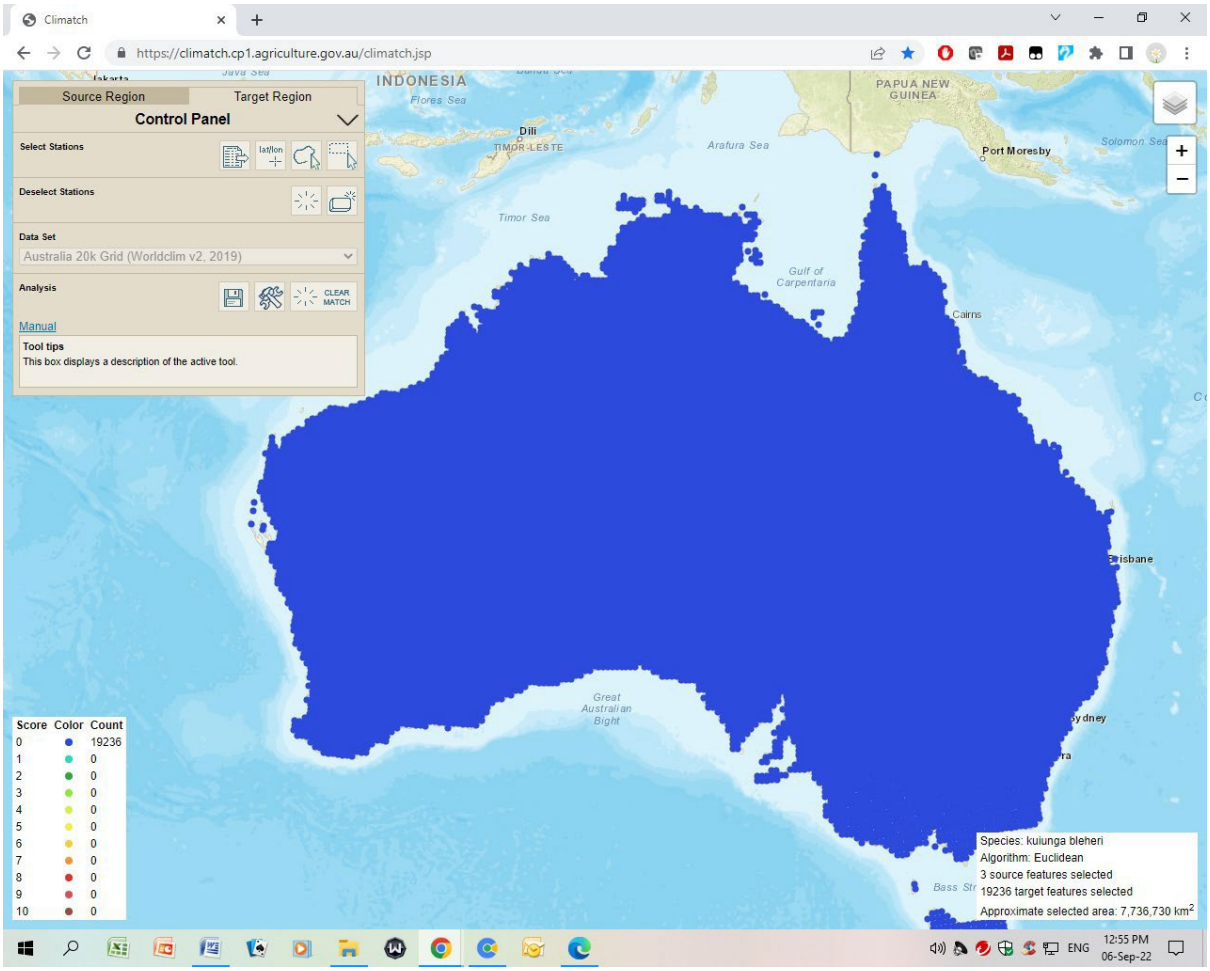
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APPENDIX A – calculation of climate from *Kiunga bleheri* distribution climate to Australian Climate.



Appendix B - Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)



BOMFORD ASSESSMENT

SPECIES: *Kiunga bleheri*

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

Bomford, Mary (2006) "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia

Bomford, Mary and Glover, Julie (June 2004) "*Risk assessment model for the import and keeping of exotic freshwater and estuarine finfish*", A report produced by the Bureau of Rural Sciences for The Department of Environment and Heritage.

Phelong, P.C. (1996b) "Climex: a system to predict the distribution of an organism based on climate preferences". Available at: http://www.agric.wa.gov.au

A report to address the "Terms of Reference" for an application to include *Pseudomugil connieae* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil connieae - Popondetta rainbowfish © Gunther Schmida

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: *Popondetta connieae*
Popondetta connieae(= popondichthys Allen, 1987
Pseudomugil connieae- Popondetta Rainbowfish



Pseudomugil connieae - Popondetta rainbowfish © Gerald R Allen

When *Pseudomugil connieae* were initially discovered they were mistakenly identified as *Pseudomugil furcatus*, a species described by Nichols in 1955, and later placed in a new genus called *Popondetta*. However, when Gerald Allen realised that they were a new species he called them *Popondetta connieae* after his wife Connie (Lagos) Allen. When it was discovered that the genus *Popondetta* already existed, he renamed hem *Popondichthys connieae*. However, in 1989 they were placed in the genus *Pseudomugil*, where they remain today.

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus *Pseudomugil* was erected by Kner in 1865 when he described *P. signifer* from Sydney. He and many other authors have placed this genus in a separate family, *Pseudomugilidae* (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family *Atherinidae* [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily *Melanotaeniinae*)]. McCulloch (1929) thought that this genus belonged in the family *Melanotaeniidae*. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed *Pseudomugil* in the family *Melanotaeniidae* on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. In the same paper, Allen also described a new genus*, Popondetta* (= *Popondichthys* Allen, 1987, preoccupied by a hemipterid genus Popondetta Woodward, 1978), with *Pseudomugil furcatus* as the type species. Allen (1980) and Allen and Cross (1982) believed that *Pseudomugil* and *Popondichthys* were closely related and that these genera were the most primitive members in the family *Melanotaeniidae*.

The author of this report will determine that *Pseudomugil connieae* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

Etymology
This species is named in honour of Dr. Allen's wife, Connie (Lagos) Allen as a small token of appreciation for her invaluable assistance over the years.

References

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Clements, Valentin, Rankin, Baker, Gee, Snellgrove, Sloman (2019) "*The effects of interacting with fish in aquariums on human health and well-being: A systematic review*" published by Institute of Biomedical and Environmental Health Research, School of Health and Life Sciences, University of the West of Scotland, Paisley, United Kingdom.

Cracknell, White, Pahl, Nichols & Depledge. 2016 "*Marine Biota and Psychological Well-Being: A Preliminary Examination of Dose–Response Effects in an Aquarium Setting*" published by Environment and Behavior2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms "Blue - eyes" and "*Pseudomugil*" revealed no results for those entities. (accessed 20 August 2022).

The IUCN indicates This species is assessed as Endangered. It has an extent of occurrence (EOO) of 2,500 km^2. There are between one and three locations based on threats related to development, which have resulted in a loss of the specific rainforest habitat of this species. Research into the population and distribution is urgently required, especially as this area is relatively unsurveyed and heavily developed.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/Pseudomugil-connieae.html

*The **IUCN Red List** of Threatened Species* 2020: https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T18544A147757093.en. Accessed on 24 August 2022.

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

Tappin, A.R., Home of the Rainbowfish. Updated 2018, available at: https://rainbowfish.angfaqld.org.au/Connieae.htm

The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.).

3. Provide information about the ecology of the species. Include, but do not restrict your response to:

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Allen (198) records the following:

Holotype.
Male, 3.2 mm SL, Auga Creek, about 5 km S. of Popondetta, Papua New Guinea (approximately 8°48'S, 148°13'E), using a small shrimp seine, G. Allen, 4 October 1978.
Paratypes.
8 specimens, 14.9-31.3 mm SL, Avindo Creek, about 15 km south of Popondetta, using a small shrimp seine. G. Allen, 5 October 1978 ;

PNG unregistered, 16 specimens, 14.5-29.4 mm SL, Avindo Creek, about 15 km south of Popondetta, using a small shrimp seine. G. Allen, 5 October 1978 ;

RMNH 28295, 9 specimens, 16.7-30.8 mm SL, Avindo Creek, about 15 km south of Popondetta, using a small shrimp seine. G. Allen, 5 October 1978 ;

USNM 224782, 8 specimens, 16.1- 35.0 mm SL, Avindo Creek, about 15 km south of Popondetta, using a small shrimp seine. G. Allen, 5 October 1978 ;

WAM P26409- 001, 32 specimens, 18.0-40.0 mm SL, Auga Creek, about 5 km S. of Popondetta, Papua New Guinea (approximately 8°48'S, 148°13'E), using a small shrimp seine, G. Allen, 4 October 1978.

WAM P26410-001, 12 specimens, 13.8-29.0 mm SL, Ahaemo Creek, about 10 km S. of Popondetta, seine, G. Allen, 5 October 1978 ;

WAM P26411-001, 30 specimens, 13.1-35.4 mm SL, Evundo Creek, about 8 km S. of Popondetta, seine, G. Allen, 4 October 1978 ;

WAM P26412-001, 10 specimens, 13.0-19.8 mm SL, Embi Creek near Popondetta, seine, G. Allen, 4 October 1978 ;

WAM P26416-001, 34 specimens, 11.8-32.2 mm SL, Endehi Creek, about 28 km W. of Popondetta on Kokoda Road, seine, G. Allen, 5 October 1978 ;

WAM P26417-001, 22 specimens, 14.5- 33.4 mm SL, Hunete Creek, about 33 km W. of Popondetta on Kokoda Road, seine, G. Allen, 5 October 1978 ;

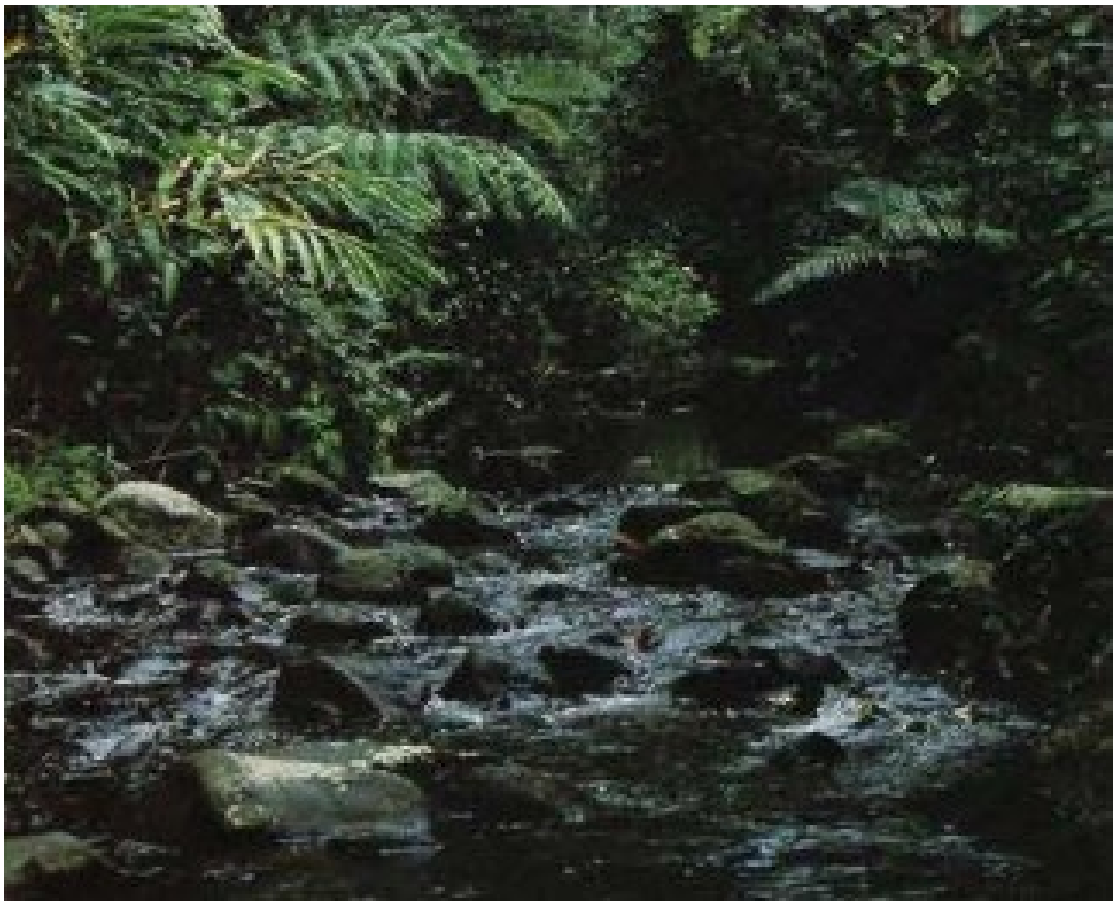
WAM P26418-001, 51 specimens, 16.4-33.6 mm SL, same data as AMS paratypes ;

ZMA 116.438, 10 specimens, 14.8-27.0 mm SL, same data as AMS paratypes.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf



Ahaemo Creek, near Popondetta, Papua New Guinea. This stream is abundantly populated with the Popondetta Rainbow. © Gerald R Allen

3.c The natural geographic range.

Pseudomugil connieae were initially collected in 1978 from Auga and Avindo Creeks, in the vicinity of Popondetta, situated on the northern side of the central dividing range, eastern Papua New Guinea. They are common in the vicinity of Popondetta and have been collected from a number of localities within a 25 km radius.



Distribution range of Pseudomugil connieae © IUCN Redlist:
https://www.iucnredlist.org/species/18544/147757093

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

IUCN Redlist: accessed 20th August 2022 at:
https://www.iucnredlist.org/species/18544/147757093

3.d Habitat.

The type specimens were collected within a 25 km radius of Popondetta. This area is situated a short distance inland from the Solomon Sea and is primarily a low river plain dissected by a number of meandering streams. Much of the area is virgin rainforest, but there are also large patches of cleared grassland. Most specimens were taken from small, relatively swift tributary streams in very clear water. Temperature and pH in these streams ranged from 24°-27°C and 7.7-7.9 respectively. The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. There are no other species of rainbowfishes in the streams occupied by *P. connieae.*

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of Pseudomugil connieae was recorded by Allen (1981) as follows: The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. There are no other species of rainbowfishes in the streams occupied by *P. connieae.*

The diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1982) describes the general behaviour of *Ps. connieae* as small schooling fishes in groups of 30 or more, easily observed from banks. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; "Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair

quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 15 to 20 days before hatching into well formed larvae with very small yolk sac."

References:

Allen G.R. & N.J. Cross (1982) Rainbowfishes of Australia and New Guinea. TFH Publications

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as "dither fish" to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Blue-eyes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase August 2022.

Reference:

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

Remarks

This species was first collected by Gerald Allen and Brian Parkinson in 1978. They collected approximately 250 specimens. However, mortalities were high and only eight specimens survived the journey back to Australia. Small numbers were eventually bred and circulated in the Australian hobby. However, they were never readily available in the hobby and this small group formed the base of all populations in Australia, which I might add has now almost disappeared. Heiko Bleher collected live specimens in 1982 and these were bred and distributed in Europe and form much of the available stock currently in Europe. I first obtained stock in 1985 and first bred them in 1986. Some of these were sent to Europe in 1994, which at the time there weren't many available in Europe. They are now in Europe, and the USA

4. Provide information on the reproductive biology of the species, including

Pseudomugil species are well known in the aquarium trade and has been kept and bred by the authors since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

Aquarium Breeding

The Popondetta rainbow is highly recommended as an aquarium fish. Because of the small size (maximum about 50 mm SL or slightly less than 2 inches) It should be kept alone or with similar sized fishes with a peaceful disposition. Ideal tank mates are the smaller species of blue-eyes (*Pseudomugil*), such as *P. gertrudae*, or the Threadfin Rainbow, *Iriatherina werneri*. The tank should be at least 40 litres and well planted including some floating-type vegetation.

Once or twice a day feedings of live baby brine shrimp and finely pulverised dry food such as Tetramin are recommended. For spawning a small tank measuring approximately 38 x 25 x 25 cm can be utilised. A thin layer of sand, a clump of Java Moss, a slow bubbling airstone, and 2-3 rafts of Riccia, a floating plant, will provide the necessary environment. The water depth should be about 15-20 cm. Either group spawning, with several members of each sex present, or pair spawning may be attempted with this set up. With pair spawning it may be necessary to try several pairings until a compatible couple are found. Another female should be substituted if the male appears overly aggressive, otherwise injury may result and the chances of spawning will be slim.

During courtship the male rapidly darts around the tank, periodically chasing the female and displaying its erected dorsal, anal, and pelvic fins. Eventually the male darts in among the floating plants followed closely by the female. The spawning usually occurs in the morning and only a few eggs are produced each day. These are suspended by tiny threads from the floating plants and can be seen at close inspection.. The incubation period lasts around 15-20 days at about 25-28°C. The eggs and fry can be left in the spawning tank with the parents or the adults may be transferred to another tank. Initially several feedings per day of a protozoan culture and a "dust" type fry food should be given. When properly cared for the fry grow rapidly. At an age of only 3-4 months the young fish are large enough to spawn. At this stage the males are about 25 mm SL and females measure 15-20 mm SL.

Reference:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

4.a The age at maturity (first breeding)

Blue-eyes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

Pseudomugil species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The author could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Blue-eyes are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Pseudomugil connieae* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would

always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct”
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil connieae* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid

between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil connieae* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 21 August 2022 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) **https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text**

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Pseudomugil connieae* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with Pseudomugil connieae data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for Pseudomugil connieae data against the provisions in the assessment process.(accessed 29th August 2022.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil connieae is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial

insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil connieae is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil connieae* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil connieae* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable

spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil connieae* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil connieae* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Pseudomugil connieae were initially collected in 1978 from Auga and Avindo Creeks, in the vicinity of Popondetta, situated on the northern side of the central dividing range, eastern Papua New Guinea. They are common in the vicinity of Popondetta and have been collected from a number of localities within a 25 km radius. The IUCN indicates This species is assessed as Endangered. It has an extent of occurrence (EOO) of 2,500 km^2. There are between one and three locations based on threats related to development, which have resulted in a loss of the specific rainforest habitat of this species. Research into the population and distribution is urgently required, especially as this area is relatively unsurveyed and heavily developed. There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil connieae* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil connieae* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil connieae* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.de/summary/Pseudomugil-connieae.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

The specific diet of Pseudomugil connieae was recorded by Allen (1981) as follows: The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. There are no other species of rainbowfishes in the streams occupied by *P. connieae.* . *Pseudomugil connieae* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 40mm (Allen 1981)

The diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Pseudomugil connieae are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil connieae* sp. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks associated with the importation of rainbowfish for ornamental purposes"* - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil connieae* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil connieae poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for "fresh" wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 21 August 2022].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil connieae* will be used in the live fish ornamental aquarium display trade. *Pseudomugil connieae* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Three species of New Guinea *Pseudomugil: connieae, furcatus,* and *gertrudae,* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960's.

If *Pseudomugil connieae is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil connieae* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil connieae* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful and hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Aquagreen Aquarium and Pond Keepers Code of Conduct – available at URL - https://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including:
the species' current quarantine status, or
pest or noxious status, or
whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil connieae* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Pseudomugil connieae* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Pseudomugil connieae* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Pseudomugil connieae* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Pseudomugil connieae* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Pseudomugil connieae* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’ about whether keeping the animal would result, or would be likely to result, in the spread of

prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

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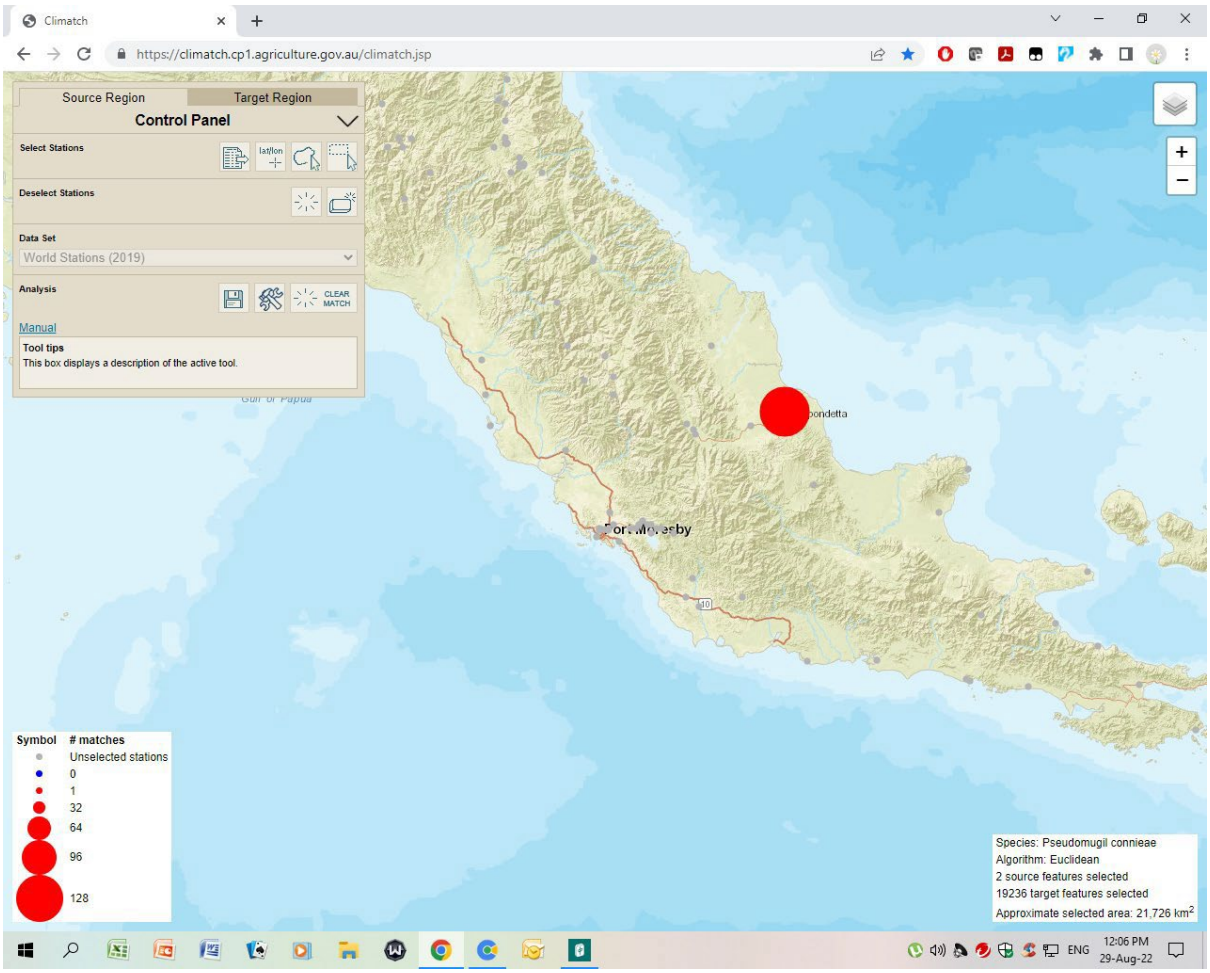
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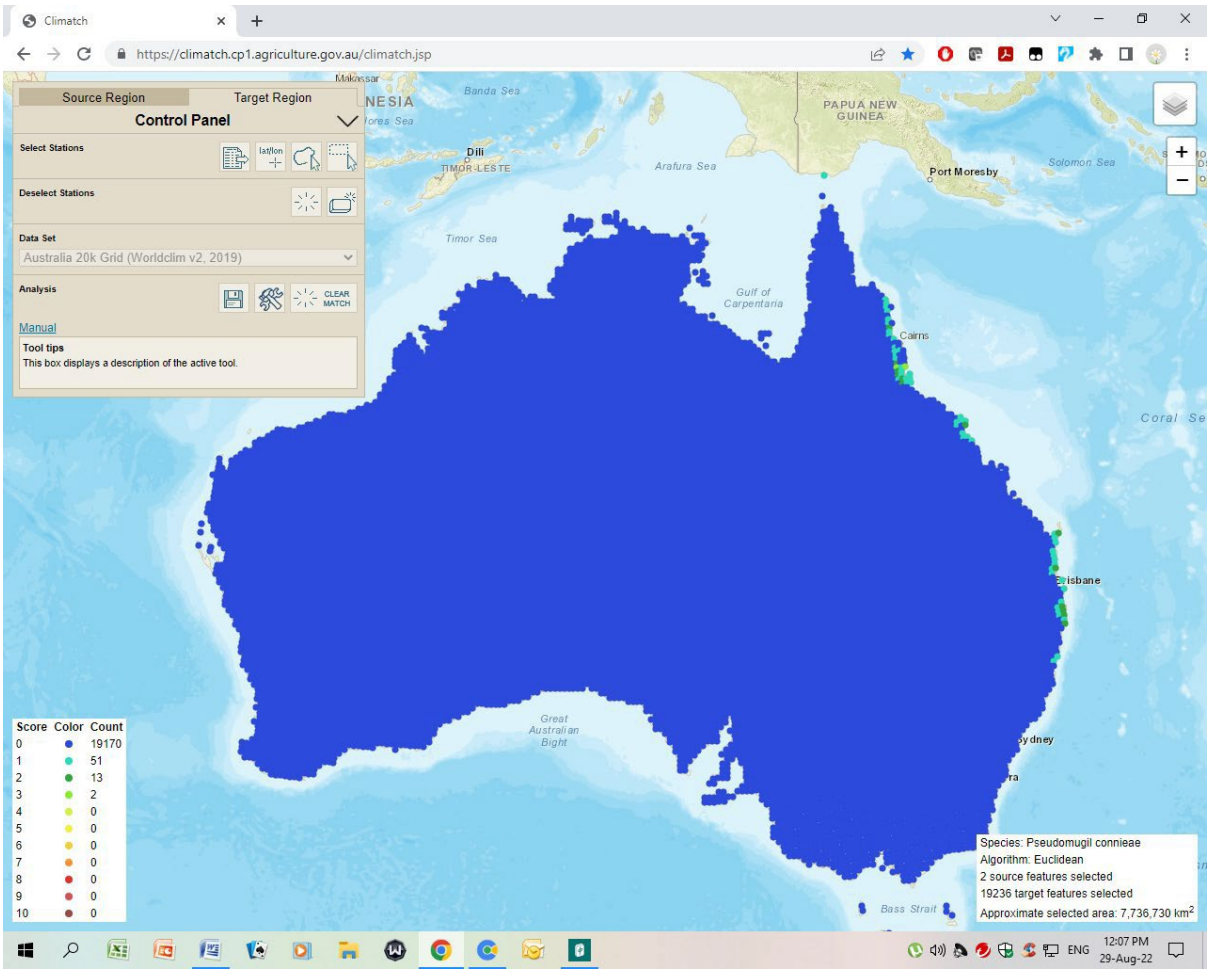
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APPENDIX A – calculation of climate from *Pseudomugil connieae* distribution climate to Australian Climate.





Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)

BOMFORD ASSESSMENT

SPECIES: Pseudomugil connieae

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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A report to address the “Terms of Reference” for an application to include *Pseudomugil furcatus* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil furcatus - Forktail rainbowfish © Gunther Schmida

P. furcatus is closely related to *P. connieae*. These two species can be distinguished by the coloration of the male and the second dorsal and anal fin ray counts. Other significant differences include the absence of the palatine dorsal notch and the pelvic posterior process together with a narrow pterosphenoid lateral process in *P. furcatus*, whereas the first two attributes are present in *P. connieae* together with a wide pterosphenoid lateral process.

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: Pseudomugil furcatus (Nicholls 1955)
Popondetta furcata: Allen 1980
Popondichthys furcatus: Allen 1987
Forktail Rainbowfish



Pseudomugil furcatus, Forktail Rainbowfish unknown photographer from internet. ©

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus *Pseudomugil* was erected by Kner in 1865 when he described *P. signifer* from Sydney. He and many other authors have placed this genus in a separate family, *Pseudomugilidae* (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family *Atherinidae* [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily *Melanotaeniinae*)]. McCulloch (1929) thought that this genus belonged in the family *Melanotaeniidae*. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed *Pseudomugil* in the family *Melanotaeniidae* on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. In the same paper, Allen also described a new genus*, Popondetta* (= *Popondichthys* Allen, 1987, preoccupied by a hemipterid genus Popondetta Woodward, 1978), with *Pseudomugil furcatus* as the type species. Allen (1980) and Allen and Cross (1982) believed that *Pseudomugil* and *Popondichthys* were closely related and that these genera were the most primitive members in the family *Melanotaeniidae*.

The author of this report will determine that *Pseudomugil furcatus* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

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2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms "Blue - eyes" and "*Pseudomugil*" revealed no results for those entities. (accessed 20 August 2022).

Pseudomugil furcatus has most recently been assessed for *The IUCN Red List of Threatened Species* in 2020. **The IUCN** indicated it is assessed as Data Deficient. This species is known only from two localities in eastern Papua New Guinea, in the Kwagila and Musa river basins. The population in the Musa river basin around Safia is probably threatened by logging, while threats to the population in the Kwagila basin are unknown. Given its restricted distribution and the limited information available on its population status and overall threats, it is assessed as Data Deficient.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

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Tappin, A.R., (2011) Home of the rainbowfish available at https://rainbowfish.angfaqld.org.au/Furcatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Type locality: Peria Creek, Kwagira River, Eastern Papua New Guinea; holotype in AMNH (20223); Munro 1958b: 155, 1967: 178 Allen (1982) records that males maximum size is around 50mm SL, and females to about 40mm SL, which is also reflected by Tappin, (2011)

References:

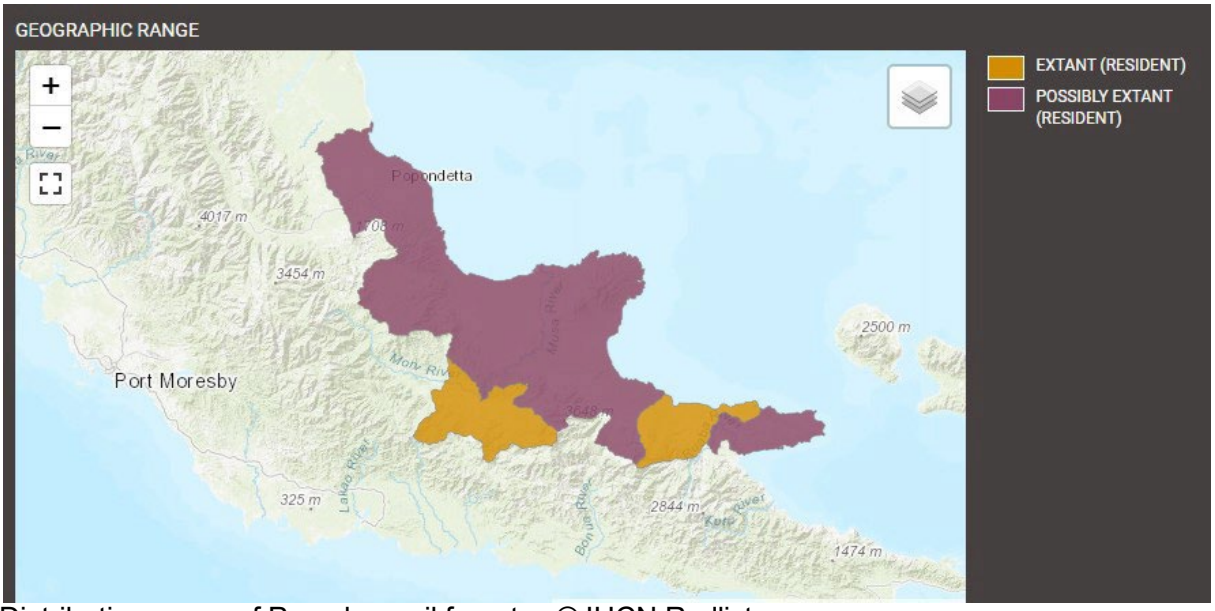
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3.c The natural geographic range.

Coastal plain and adjacent interior lowlands between Dyke Ackland Bay and Collingwood Bay at the eastern end of New Guinea, North of the central dividing range. Known from only two locations, the type locality near the village of Pumani, Peria Creek, Kwagira River, Eastern Papua New Guinea; about 15 kilometres from Collingwood Bay, *P. furcatus* has also been collected from Safia, about 56 km south of Dyke Ackland Bay, on the upper portion of the Musa River system.. In Safia, the species is relatively common in small, clear rainforest streams surrounded by thick vegetation.



Distribution range of Pseudomugil furcatus © IUCN Redlist:
https://www.iucnredlist.org/species/18545/162322140

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea*". Published by Angus and Robertson

IUCN Redlist: accessed 20th August 2022 at: https://www.iucnredlist.org/species/161080469/161080528

Nichols J.T. (1955) - Results of the Archbold Expeditions. No. 71. Two new freshwater fishes from New Guinea. *Am. Mus. Novit.* no. 1735 1-6.

3.d Habitat.

They are generally found in small, clear, relatively swift-flowing freshwater streams with abundant aquatic vegetation. Water conditions reported from their natural habitats are: Temperature 24-28.5°C; pH 7.0-8.0 and Hardness 90-180 ppm.

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of Pseudomugil connieae was recorded by Allen (1981) as follows: The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. There are no other species of rainbowfishes in the streams occupied by *P. connieae.*

The diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Tappin, A.R., (2011) Home of the rainbowfish available at https://rainbowfish.angfaqld.org.au/Furcatus.htm

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1982) describes the general behaviour of *Ps. connieae* as small schooling fishes in groups of 30 or more, easily observed from banks. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; "Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a

feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 15 to 20 days before hatching into well formed larvae with very small yolk sac."

References:

Allen G.R. & N.J. Cross (1982) Rainbowfishes of Australia and New Guinea. TFH Publications

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as "dither fish" to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Blue-eyes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase August 2022.

Reference:

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

Remarks

This species was originally named *Pseudomugil furcatus* in 1955 by John Treadwell Nichols, curator of recent fishes at the American Museum of Natural History. They were collected by Hobart M. Van Deusen during the Forth Archbold Expedition to New Guinea in 1953. In a review of the family Melanotaeniidae in 1980, they were separated from the *Pseudomugil* genus and placed in a new genus *Popondetta*, and the name was changed to *Popondetta furcata*. It was then later discovered that the genus name '*Popondetta*' was previously used and in 1987 they underwent another name change and were then called *Popondichthys furcatus*. Two years were to pass and following a review of the *Pseudomugil* genus in 1989, the blue-eye group, including *Popondichthys furcatus*, were placed in their own family Pseudomugilidae and they were returned to their original name of *Pseudomugil furcatus*. In 1981 live specimens were collected by Gerald Allen and Barry Crockford and were returned to Australia whereupon they were later bred and established in the aquarium hobby. They are widely available in Europe and the USA.

Reference:

Tappin, A.R., (2011) Home of the rainbowfish available at https://rainbowfish.angfaqld.org.au/Furcatus.htm

4. Provide information on the reproductive biology of the species, including

Pseudomugil species are well known in the aquarium trade and has been kept and bred by the authors since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

Aquarium Breeding

The Popondetta rainbow is highly recommended as an aquarium fish. Because of the small size (maximum about 50 mm SL or slightly less than 2 inches) It should be kept alone or with similar sized fishes with a peaceful disposition. Ideal tank mates are the smaller species of blue-eyes (*Pseudomugil*), such as *P. gertrudae*, or the Threadfin Rainbow, *Iriatherina werneri*. The tank should be at least 40 litres and well planted including some floating-type vegetation.

Once or twice a day feedings of live baby brine shrimp and finely pulverised dry food such as Tetramin are recommended. For spawning a small tank measuring approximately 38 x 25 x 25 cm can be utilised. A thin layer of sand, a clump of Java Moss, a slow bubbling airstone, and 2-3 rafts of Riccia, a floating plant, will provide the necessary environment. The water depth should be about 15-20 cm. Either group spawning, with several members of each sex present, or pair spawning may be attempted with this set up. With pair spawning it may be necessary to try several pairings until a compatible couple are found. Another female should be substituted if the male appears overly aggressive, otherwise injury may result and the chances of spawning will be slim.

During courtship the male rapidly darts around the tank, periodically chasing the female and displaying its erected dorsal, anal, and pelvic fins. Eventually the male darts in among the floating plants followed closely by the female. The spawning usually occurs in the morning and only a few eggs are produced each day. These are suspended by tiny threads from the floating plants and can be seen at close inspection.. The incubation period lasts around 15-20 days at about 25-28°C. The eggs and fry can be left in the spawning tank with the parents or the adults may be transferred to another tank. Initially several feedings per day of a protozoan culture and a "dust" type fry food should be given. When properly cared for the fry grow rapidly. At an age of only 3-4 months the young fish are large enough to spawn. At this stage the males are about 25 mm SL and females measure 15-20 mm SL.

Reference:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

4.a The age at maturity (first breeding)

Blue-eyes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

Pseudomugil species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The author could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Blue-eyes are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

Pseudomugil species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct”
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil furcatus* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil furcatus* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 21 August 2022 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) **https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text**

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Pseudomugil furcatus* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with Pseudomugil furcatus data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for Pseudomugil furcatus data against the provisions in the assessment process.(accessed 29th August 2022.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil furcatus small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil furcatus is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil furcatus* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes

so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil furcatus* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil furcatus* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil furcatus* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Pseudomugil furcatus were originally collected from Peria Creek, a tributary of the Kwagira (Kwagila) River, in eastern Papua New Guinea. They have also been collected from Safia, in the Musa River valley where they are relatively common in small, clear rainforest streams. They have a range in Papua New Guinea between Dyke Ackland and Collingwood Bays. They are generally found in small, clear, relatively swift-flowing freshwater streams with abundant aquatic vegetation. Water conditions reported from their natural habitats are: Temperature 24-28.5°C; pH 7.0-8.0 and Hardness 90-180 ppm. The This species is known only from two

localities in eastern Papua New Guinea, in the Kwagila and Musa river basins. The population in the Musa river basin around Safia is probably threatened by logging, while threats to the population in the Kwagila basin are unknown. Given its restricted distribution and the limited information available on its population status and overall threats, it is assessed as Data Deficient. It is likely that this species is threatened by habitat conversion due to logging around Safia. Other potential threats that occur within that area include oil palm plantations and alluvial gold mining with its associated pollution. Invasive species are also probably present, but there has been a lack of surveys to confirm this There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/ https://www.iucnredlist.org/species/18545/162322140

Tappin, A.R., (2011) Home of the rainbowfish available at https://rainbowfish.angfaqld.org.au/Furcatus.htm

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil furcatus* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil furcatus* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil furcatus* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.de/summary/Pseudomugil-connieae.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

The specific diet of Pseudomugil connieae was recorded by Allen (1981) as follows: The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. *Pseudomugil furcatus* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 40mm (Allen 1981)

The diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Pseudomugil furcatus are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil furcatus* sp. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks associated with the importation of rainbowfish for ornamental purposes"* - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil furcatus* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil furcatus poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any

importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

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10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil furcatus* will be used in the live fish ornamental aquarium display trade. *Pseudomugil furcatus* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, , cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960’s.

If *Pseudomugil furcatus is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

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Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil furcatus* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil furcatus* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful and hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

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https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

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12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including:
the species' current quarantine status, or
pest or noxious status, or
whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil furcatus* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Pseudomugil furcatus* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Pseudomugil furcatus* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Pseudomugil furcatus* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Pseudomugil furcatus* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Pseudomugil furcatus* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’ about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

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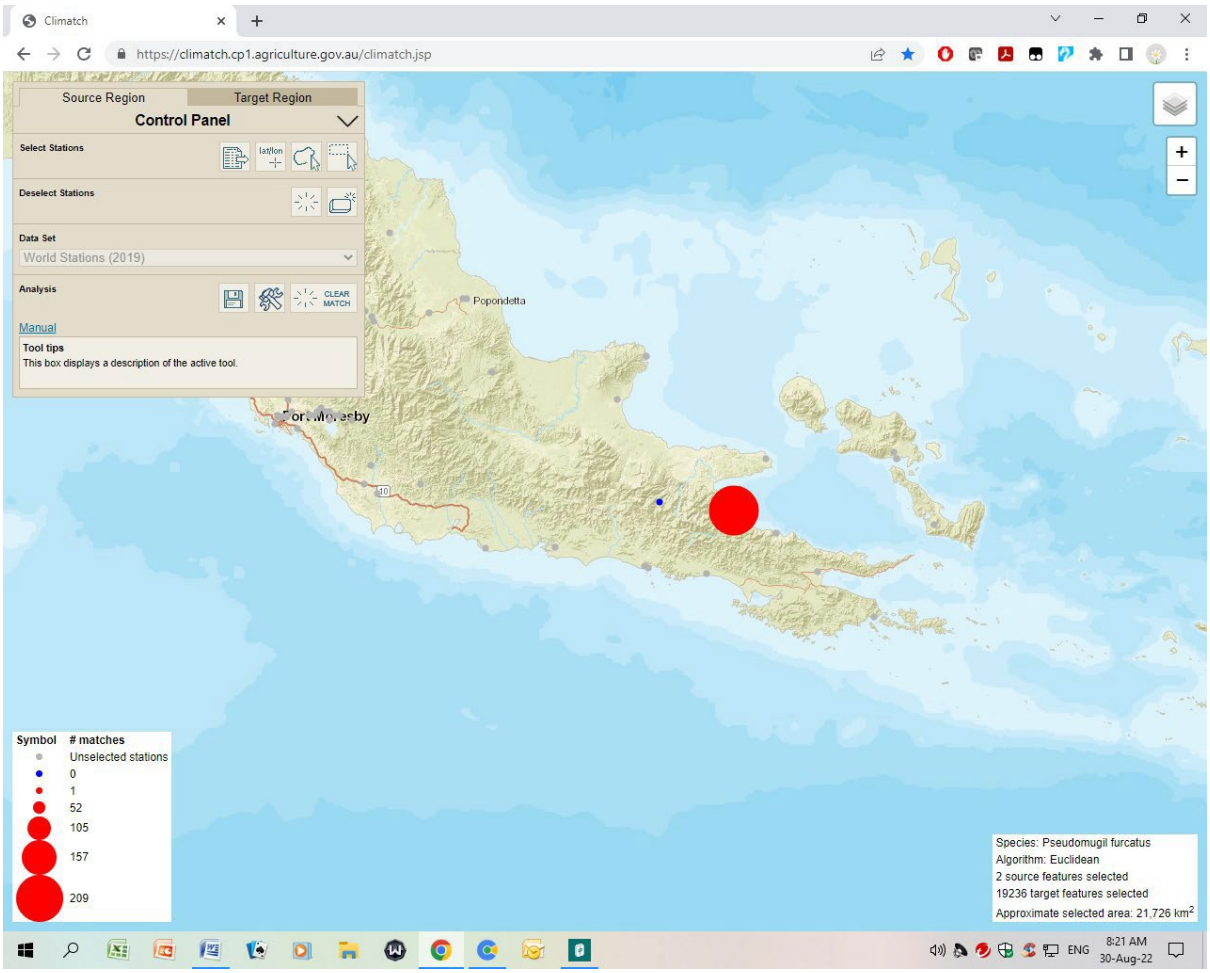
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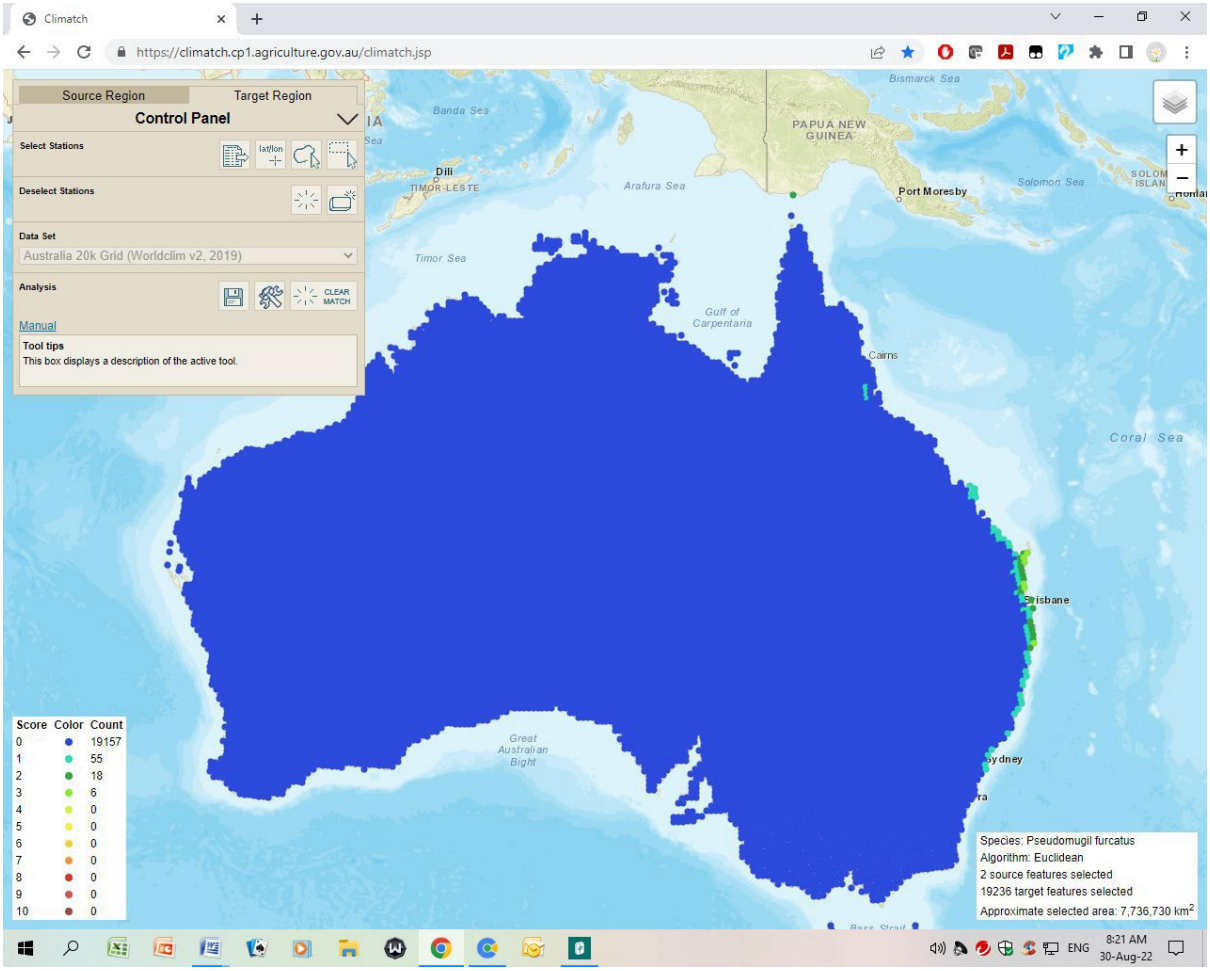
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APPENDIX A – calculation of climate from *Pseudomugil furcatus* distribution climate to Australian Climate.





Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)

BOMFORD ASSESSMENT

SPECIES: Pseudomugil furcatus

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : 2

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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A report to address the "Terms of Reference" for an application to include *Pseudomugil ivantsoffi* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil ivantsoffi [Kopi River] - photo© Gary Lange

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: *Pseudomugil ivantsoffi,* Ivantsoff's Blue-eye



Aquarium photograph of *Pseudomugil ivantsoffi*, approximately 28 mm SL, vicinity of Timika, Papua Province, Indonesia. Photo: © Gerald Allen

Remarks

In 2004, Iain Wilson and Charles Nishihira collected live specimens of this species from the Iwaka River (Deky Creek), which is a tributary of the Kamora River and the Kopi River, which is a tributary of the Minajerwi (Muamiua) River, along with specimens of *Pseudomugil novaeguineae*, *Pseudomugil pellucidus*, *Melanotaenia goldiei* and *Melanotaenia rubrostriata*. Additional live specimens have been collected from the Kopi and Wataikwa Rivers in the vicinity of Timika. Live specimens have also been collected Heiko Bleher. Two main varieties

(Deky Creek and Kopi River) are currently available in the aquarium hobby. This fish was initially identified as *Pseudomugil reticulatus*, based on the close resemblance of females from the Timika area to the single known example of that species collected about two kilometres east of Ayamaru (Ajamaru) Lake in the centre of the Vogelkop Peninsula. However, recent collections near the type locality of *Pseudomugil reticulatus*, which lies some 900 km northwest of Timika, revealed that the two populations are distinctive.

Etymology

Named ivantsoffi in honour of Walter Ivantsoff, of Macquarie University, Sydney, Australia, in recognition of his valuable contributions to our knowledge of atherinoid taxonomy.

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus Pseudomugil was erected by Kner in 1865 when he described P. signifer from Sydney. He and many other authors have placed this genus in a separate family, Pseudomugilidae (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family Atherinidae [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily Melanotaeniinae)]. McCulloch (1929) thought that this genus belonged in the family Melanotaeniidae. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed Pseudomugil in the family Melanotaeniidae on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. with Pseudomugil furcatus as the type species. Allen (1980) and Allen and Cross (1982) believed that Pseudomugil and Popondichthys were closely related and that these genera were the most primitive members in the family Melanotaeniidae.

The keeping of tropical fish species in aquaria is growing in popularity and has been booming during the lock down period attributed to the Covid19 Pandemic. Studies into mental health have proven that an aquarium can produce a soothing effect on the human mind that tends toward anxiety. This trend to worry about the future seems to be increasing in recent times. Studies have demonstrated stress reduction from viewing aquatic life in an aquarium, lower heart rates and decrease in blood pressure. (Clements 2019 and Cracknell 2016)

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Pseudomugil ivantsoffi* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease

Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

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2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms “Blue - eyes” and “*Pseudomugil*” revealed no results for those entities. (accessed 20 August 2022).

The IUCN reports: Ivantsoff’s Blue-Eye *Pseudomugil ivantsoffi* has most recently been assessed for *The IUCN Red List of Threatened Species* in 2019. *Pseudomugil ivantsoffi* is listed as Endangered under criteria B1ab(iii). It has an extent of occurrence (EOO) of 2,000 km^2, occurs in two locations (one in the forest tributaries and one in the peat swamps and associated main channel), and there is continuing decline in habitat.

This species is known only from the Timika region of Papua Province, Indonesia. It was previously confused with Pseudomugil reticulatus, a species restricted to the Ayamaru Lakes district of the Bird’s Head Peninsula (Ivantsoff et al. 1996).

This species occurs in shallow, clear, slow-flowing streams in dense lowland rainforest, and can also be found in sago-Pandanus swamps. It often occurs with Pseudomugil pellucidus, and is a good indicator of pristine forest conditions, although it can sometimes be found in altered habitats. It can grow to a maximum size of about 3.1 cm SL

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

-Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

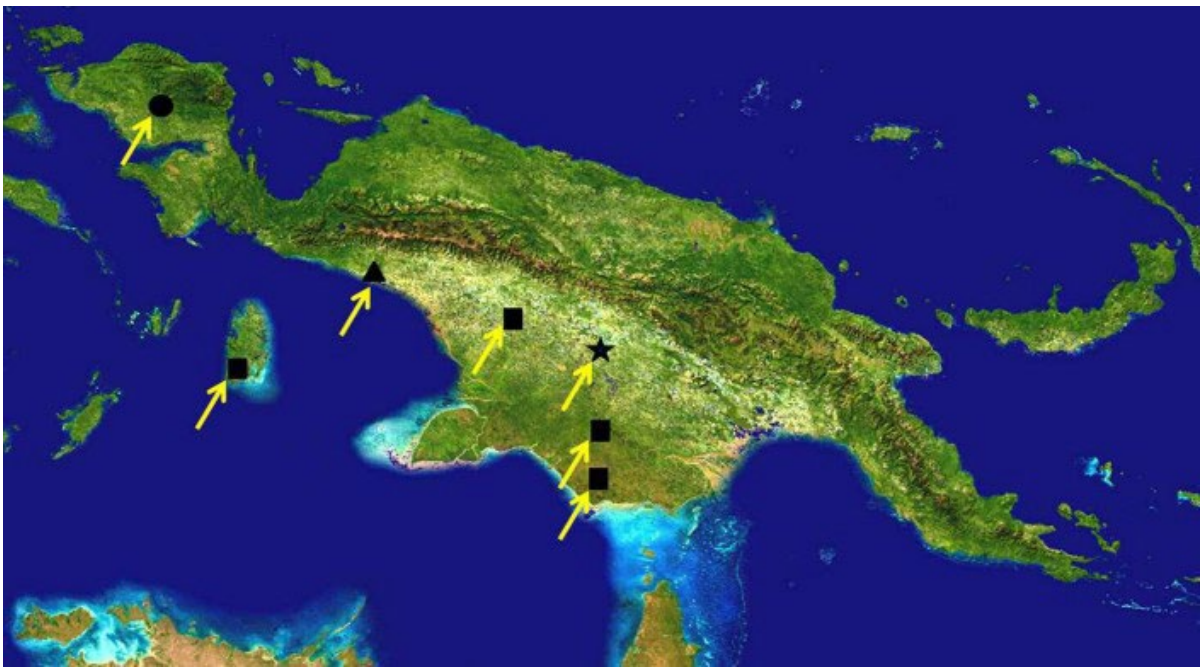
The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.).

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:

Pseudomugil ivantsoffi, a new species of blue-eye, is described on the basis of 60 specimens, 17.9-30.8 mm SL, collected from the Timika vicinity of southern Irian Jaya. The new species was formerly confused with *P. reticulatus*, which occurs in the vicinity of Lake Ayamaru on the Vogelkop Peninsula of Irian Jaya In 2004, Iain Wilson and Charles Nishihira collected live specimens of Pseudomugil pellucidus, P. ivanstoffi and Melanotaenia goldiei from the Iwaka River (Deky Creek), which is a tributary of the Kamora River. M. goldiei, M. s. rubrostriata, P. novaeguineae, P. pellucidus and P. ivantsoffi were collected in

small streams of the Kopi River, which is a tributary of the Minajerwi River. Live specimens have also been collected Heiko Bleher, and established in Europe and the USA..



Map of New Guinea showing approximate distribution of Pseudomugil luminatus and P. ivantsoffi (triangle), P. gertrudae (squares) P. paskai (star), and P. reticulatus (circle). Locations for P. gertrudae (from left to right): Aru Islands, Dekai, Bensbach River (lower), and Fly

References

Allen G.R. & S.J. Renyaan (1999) *Pseudomugil ivantsoffi* (Pseudomugilidae), a new species of blue-eye from the Timika region, Irian Jaya. Aqua, Journal of Ichthyology and Aquatic Biology 3(4): 163-168.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

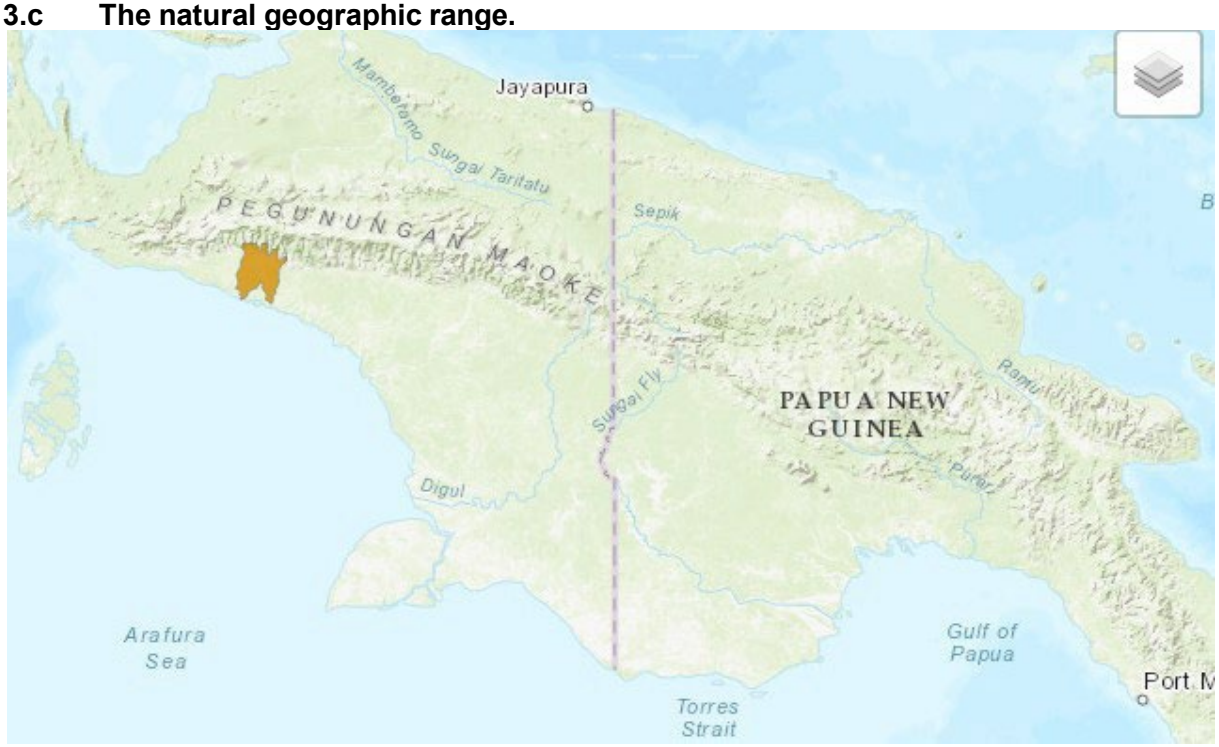
Allen (1999) records Holotype: I\AZB 10120, 27.5 mm SL, tributary of Kopi River about 1km E of Tembagapura Road (40 25"25'5 136'56.44'E) and It/ile 39 Camp of Freeport Mining Company, seine net, G. Allen and D. Norris, 2 August 1995. Paratypes: \AZB 10121, 15 specimens, 19.4-30.8 mm SL, collected with holotype; WAM P.31051-003, 2 specimens, 20.7-27.7 mm SL, tributary of Aikwa River, 15 km northwest of Timika near townsite of Kuala Kencana, seine net, G. Allen and D. Norris, 1 August 1995; WAIV P.31052-004, 4 specimens, 17.9-22.4 mm SL, tributary of lweka River, 15 km nofthwest of Timika near townsite of Kuala Kencana, seine net, G. Allen and S. Renyaan, 1 August 1995; WAIV P.31055-004, 14 specimens, 19.2-28.4 mm SL, collected with holotype; WAM P31057-004, 23 specimens, 19.3-27.7 mm SL, tributary of lweka River about 15 km northwest of Timika near Kuala Kencana townsite (approximately 4'24'5, 1 36'49'E), rotenone G.Allen and D. Norris,3August 1995;WAtt/ P.31298- 003, 1 specimen,22.4 mm SL, small tributary on north side of Freeport levee across Aikwa River (4'40.14'S. 136"56.72'E), rotenone, G. Allen, 24 April 1997.

References:

Allen G.R. & S.J. Renyaan (1999) *Pseudomugil ivantsoffi* (Pseudomugilidae), a new species of blue-eye from the Timika region, Irian Jaya. Aqua, Journal of Ichthyology and Aquatic Biology 3(4): 163-168.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.c The natural geographic range.



Distribution range of Pseudomugil ivantsoffi © IUCN Redlist:
https://www.iucnredlist.org/species/161077334/161077338

This species was collected from the Timika vicinity of southern Irian Jaya. The new species was formerly confused with *P. reticulatus*, which occurs in the vicinity of Lake Ayamaru on the Vogelkop Peninsula of Irian Jaya. It occurs in shallow, clear, slow-flowing streams in dense lowland rainforest, and can also be found in sago-Pandanus swamps. It often occurs with Pseudomugil pellucidus, and is a good indicator of pristine forest conditions, although it can sometimes be found in altered habitats. It can grow to a maximum size of about 3.1 cm SL.

References:

Allen G.R. & S.J. Renyaan (1999) *Pseudomugil ivantsoffi* (Pseudomugilidae), a new species of blue-eye from the Timika region, Irian Jaya. Aqua, Journal of Ichthyology and Aquatic Biology 3(4): 163-168.

IUCN Redlist: accessed 20th August 2022 at: https://www.iucnredlist.org/species/161077334/161077338#

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.d Habitat.

Pseudomugil ivantsoffi have been found in the tributaries of the Ajkwa, Iwaka, Wataikwa and Kopi Rivers in the Timika-Tembagapura region of West Papua. When first collected in 1995 this species was common in several creeks. The habitat consisted of small (1-2 m wide), shallow, slow-flowing streams in dense rainforest. The water was generally clear, but some were tannin-stained, with sparse aquatic vegetation. Bottom conditions included sand, gravel, cobble, and rocks. Water temperature and pH values ranged from 24-28°C and pH 6.7-7.8 respectively. Other fishes collected from these habitats include *Pseudomugil pellucidus*, *Pseudomugil novaeguineae*, *Melanotaenia goldiei*, *Melanotaenia rubrostriata*, and *Melanotaenia ogilbyi*.



Swamp habitat collection site of Pseudomugil ivantsoffi paratypes, near Timika, Papua Province, Indonesia. Photo: ©Hans-Georg Evers

Pseudomugil ivantsoffi habitats are shorter and narrower than the rivers which begin in the mountains and have enough volume from rainfall to dissolve the colouration. The blackwater streams all drain into the rivers.

The same species and habitat conditions were encountered in January 1997, but by the following year, after a prolonged El Niño related drought, the two species of *Pseudomugil*, as well as *Melanotaenia ogilbyi*, could not be found in any of the former areas. The Kuala Kencana housing development and recent forest destruction near the Kopi River sites may well have caused the local extinction of these species. However, they no doubt will continue to survive in primary forest to the immediate east and west of the Timika region.

The Timika region includes the following rivers: Kamora River (Kamora, Tuaba, Wataikwa, Iwaka) Wania River, Tipuka River, Ajkwa River, Minajerwi River (Minajerwi, Kopi, Aimua) Mawati River, Otokwa River, Mamoa River (Mamoa, Seruka) Atuka River (Atuka, Wapuka) [The Atuka River meanders north to its junction with the Kamora River, very close to the village of Mioko.]

The dark colouration in 'blackwater' streams is due to the presence of organic substances. This black or tea colouration is quite common in the area, due to extensive heath forest. These streams start in the heath and are shorter and narrower than the rivers which begin in the mountains and have enough volume from rainfall to dissolve the colouration. The blackwater streams all drain into the rivers.

References:

Allen G.R. & S.J. Renyaan (1999) *Pseudomugil ivantsoffi* (Pseudomugilidae), a new species of blue-eye from the Timika region, Irian Jaya. Aqua, Journal of Ichthyology and Aquatic Biology 3(4): 163-168.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Pseudomugil ivantsoffi* was not recorded by Allen (2001) but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1991) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for

Pseudomugil are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; “Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac.”

Reference:

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as “dither fish” to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase April 2021.

https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen G.R. & S.J. Renyaan (1999) *Pseudomugil ivantsoffi* (Pseudomugilidae), a new species of blue-eye from the Timika region, Irian Jaya. Aqua, Journal of Ichthyology and Aquatic Biology 3(4): 163-168.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including

There are no scientific records of any work done on the reproductive biology of *Pseudomugil ivantsoffi. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the authors since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Pseudomugil ivantsoffi* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Pseudomugil ivantsoffi* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Pseudomugil ivantsoffi* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical,

behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct”
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil ivantsoffi* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil ivantsoffi* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 04 Apr 2021 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) **https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text**

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Pseudomugil Ivantsoffi* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with Pseudomugil furcatus data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for *Pseudomugil ivantsoffi* data against the provisions in the assessment process.(accessed 29th August 2022.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil ivantsoffi is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron



Typical *Pseudomugil ivantsoffi* habitat, © GG. Allen

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil ivantsoffi is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil ivantsoffi* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil ivantsoffi* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil ivantsoffi* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil ivantsoffi* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory.

Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Pseudomugil ivantsoffi have been found in the tributaries of the Ajkwa, Iwaka and Kopi Rivers in the Timika-Tembagapura region of West Papua. The habitats consist of small (1-2 metre wide) shallow, slow-flowing streams in dense rainforest. Water is generally clear, but some are tannin-stained, with sparse aquatic vegetation. Bottom conditions included sand, gravel, cobble, and rocks. Water temperature and pH values ranged from 24–28 °C and pH 6.7–7.8 respectively. Other fishes collected from these habitats include Pseudomugil pellucidus, P. novaeguineae, Melanotaenia goldiei, M. splendida rubrostriata, and M. ogilbyi. The Timika region includes the following rivers: Kamora River (Kamora, Tuaba, Wataikwa, Iwaka) Wania River, Tipuka River, Ajkwa River, Minajerwi River (Minajerwi, Kopi, Aimua) Mawati River, Otokwa River, Mamoa River (Mamoa, Seruka) Atuka River (Atuka, Wapuka) [The Atuka River meanders north to its junction with the Kamora River, very close to the village of Mioko.] The dark colouration in 'blackwater' streams is due to the presence of organic substances. This black or tea colouration (these rivers are called kali kopi in Indonesian, or coffee stream – kali is Indonesian for river) is quite common in the area, due to extensive heath forest. These streams start in the heath and are shorter and narrower than the rivers which begin in the mountains and have enough volume from rainfall to dissolve the colouration. The blackwater streams all drain into the rivers. There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/ https://www.iucnredlist.org/species/18545/162322140

Tappin, A.R., (2011) Home of the rainbowfish available at https://rainbowfish.angfaqld.org.au/ivantsoffi.htm

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil Ivantsoffi* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil ivantsoffi* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil ivantsoffi* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.de/summary/Pseudomugil-connieae.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

The specific diet of Pseudomugil connieae was recorded by Allen (1981) as follows: The stomach contents of several paratypes indicate a diet consisting primarily of minute crustaceans and insect larvae with a small amount of algal matter. *Pseudomugil ivantsoffi* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 40mm (Allen 1981)

The diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

References:

Allen, G.R. 1981. *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. *Revue Française D'aquariologie* 8(2): 43-46.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Pseudomugil ivantsoffi are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil ivantsoffi*. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks associated with the importation of rainbowfish for ornamental purposes"* - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil ivantsoffi* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil ivantsoffi poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil ivantsoffi* will be used in the live fish ornamental aquarium display trade. *Pseudomugil ivantsoffi* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven

species of *Pseudomugil, connieae, , cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960's.

If *Pseudomugil ivantsoffi is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil ivantsoffi* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil ivantsoffi* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful and hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Aquagreen Aquarium and Pond Keepers Code of Conduct – available at URL - https://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including:
the species' current quarantine status, or
pest or noxious status, or
whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil ivantsoffi* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Pseudomugil ivantsoffi* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Pseudomugil ivantsoffi* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Pseudomugil ivantsoffi* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Pseudomugil ivantsoffi* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Pseudomugil ivantsoffi* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is 'reckless' about whether the animal is a prohibited animal and is also 'reckless' about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

Bibliography and relevant Readings:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Agriculture Department
http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

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Allen, G. R. (1983). Kiunga ballochi, a new genus and species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Tropical Fish Hobbyist 32(2), 72-7.

Allen G.R. (1987) *Popondichthys*, a replacement name for the melanotaeniid fish genus *Popondetta*. Japanese Journal of ichthyology 33 (4): 409.

Allen G.R. (1989) Freshwater Fishes of Australia. TFH Publications, Neptune City, New Jersey. USA.

Allen G.R. (1991) Field guide to the freshwater fishes of New Guinea. Christensen Research Institute, Madang, Papua New Guinea.

Allen, G.R., (1995) Rainbowfishes In Nature and in the Aquarium, Their identification, care and breeding. Tetra-Verlag Germany. ISBN 1-56465-149-5

Allen G.R. & N.J. Cross (1982) Rainbowfishes of Australia and New Guinea. TFH Publications

Allen, G.R., Hortle, Kent G., and Renyaan, Samuel J. (2000), Freshwater Fishes of the Timika Region New Guinea. PT Freeport Indonesian Company, and Tropical Reef Research. ISBN 0-646-40480-6

Allen, G. R., and Ivantsoff, W. (1982). Pseudornugil mellis, le honey blue-eye, une nouvelle espece de poisson arc-en-ciel (Melanotaeniidae) d'Australie orientale. Revenue Fran~aise d'Aquariologie 9(3), 83-6.

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

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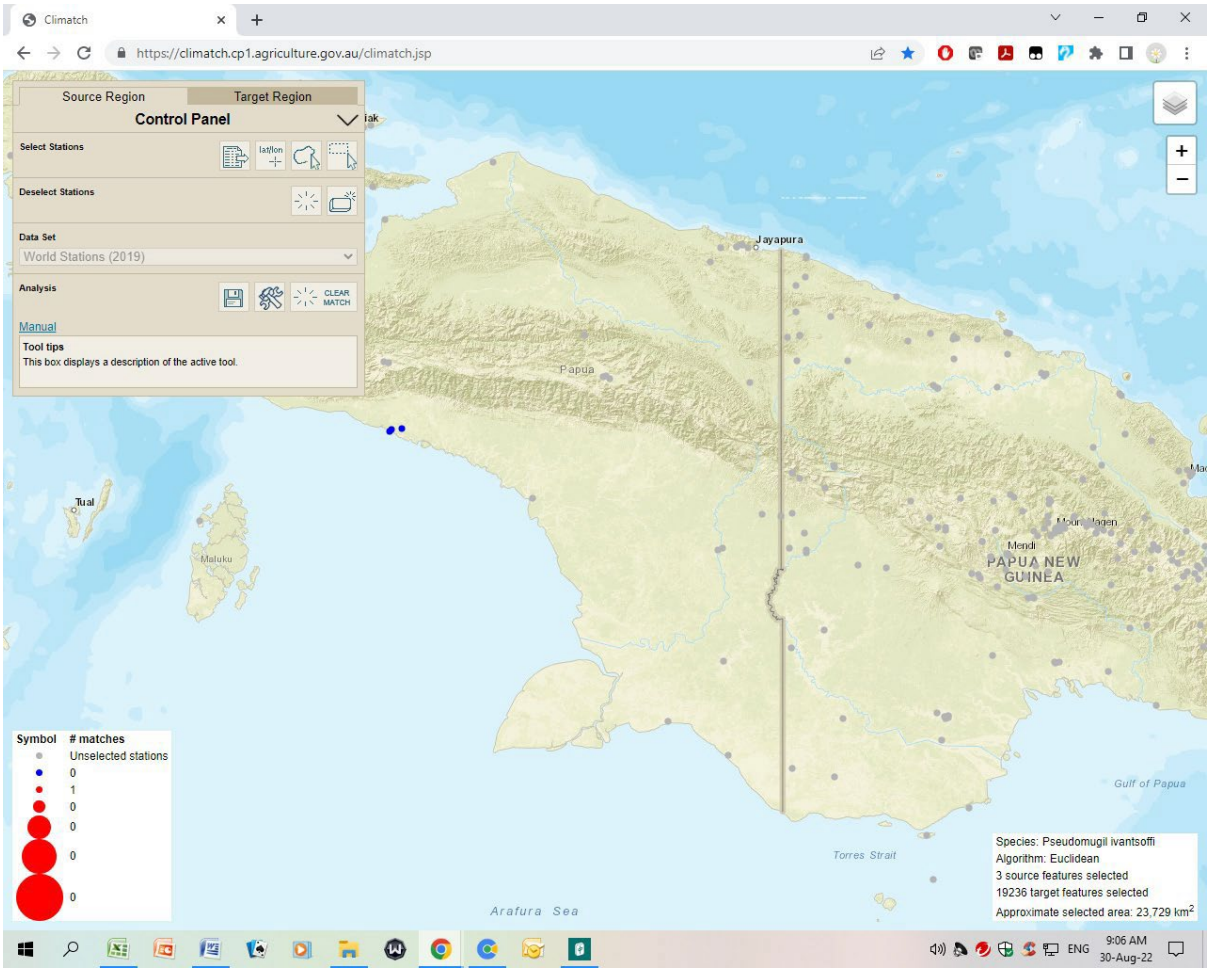
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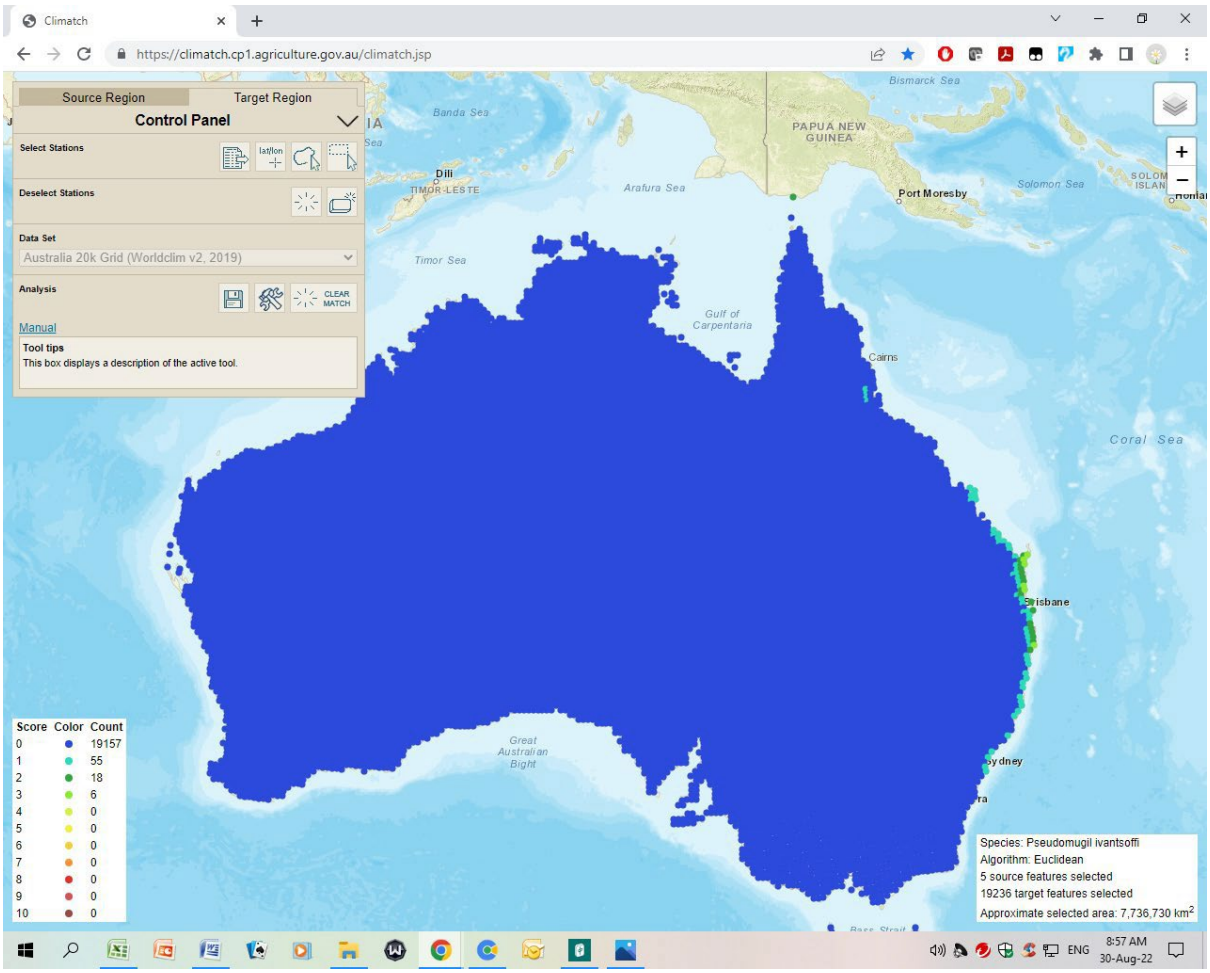
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Zhu D., B.G.M. Jamieson, A. Hugall and C. Moritz (1994) Sequence evolution and phylogenetic signal in control-region and cytochrome b sequences of rainbowfishes (Melanotaeniidae) in Molecular Biology and Evolution 11: 672-683.

APPENDIX A – calculation of climate from *Pseudomugil ivantsoffi* distribution climate to Australian Climate.





Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)

BOMFORD ASSESSMENT

SPECIES: Pseudomugil ivantsoffi

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

Bomford, Mary (2006) "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia

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Phelong, P.C. (1996b) "Climex: a system to predict the distribution of an organism based on climate preferences". Available at: http://www.agric.wa.gov.au

A report to address the “Terms of Reference” for an application to include *Pseudomugil luminatus* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil luminatus - photo© Taoyeah Deng

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: *Pseudomugil luminatus, Red Neon Blue Eye*



Aquarium photograph of Pseudomugil luminatus, male (upper) and female, approximately 20 and 15 mm SL, Timika District, Papua Province, Indonesia. Photo: ©Hans-Georg Evers

Reference

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus Pseudomugil was erected by Kner in 1865 when he described P. signifer from Sydney. He and many other authors have placed this genus in a separate family, Pseudomugilidae (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family Atherinidae [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily Melanotaeniinae)]. McCulloch (1929) thought that this genus belonged in the family Melanotaeniidae. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed Pseudomugil in the family Melanotaeniidae on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. In the same paper, Allen also described a new genus, Popondetta (= Popondichthys Allen, 1987, preoccupied by a hemipterid genus Popondetta Woodward, 1978), with Pseudomugil furcatus as the type species. Allen (1980) and Allen and Cross (1982) believed that Pseudomugil and Popondichthys were closely related and that these genera were the most primitive members in the family Melanotaeniidae.

The keeping of tropical fish species in aquaria is growing in popularity and has been booming during the lock down period attributed to the Covid19 Pandemic. Studies into mental health have proven that an aquarium can produce a soothing effect on the human mind that tends toward anxiety. This trend to worry about the future seems to be increasing in recent times. Studies have demonstrated stress reduction from viewing aquatic life in an aquarium, lower heart rates and decrease in blood pressure. (Clements 2019 and Cracknell 2016)

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Pseudomugil luminatus* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease

Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species

Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat

Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

References

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

Clements, Valentin, Rankin, Baker, Gee, Snellgrove, Sloman (2019) "*The effects of interacting with fish in aquariums on human health and well-being: A systematic review*" published by Institute of Biomedical and Environmental Health Research, School of Health and Life Sciences, University of the West of Scotland, Paisley, United Kingdom.

Cracknell, White, Pahl, Nichols & Depledge. 2016 "*Marine Biota and Psychological Well-Being: A Preliminary Examination of Dose–Response Effects in an Aquarium Setting*" published by Environment and Behavior2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms "Blue - eyes" and "*Pseudomugil*" revealed no results for those entities. (accessed 20 August 2022).

The IUCN *Pseudomugil luminatus* has most recently been assessed for *The IUCN Red List of Threatened Species* in 2019. *Pseudomugil luminatus* is listed as Endangered under criteria B1ab(iii). This species is assessed as Endangered. It has an extent of occurrence (EOO) of 2,000 km^2, occurs in two locations (one in the forest tributaries and one in the main channel and associated peat swamps, in which the species may now be extinct), and there is continuing decline in habitat. The type locality, which lies about 20–25 km upstream of the Aikwa River estuary, was severely altered by sediment tailings from the Freeport gold and copper mine in the late 1990s and this species and other swamp-associated fauna are presumed to no longer be present

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

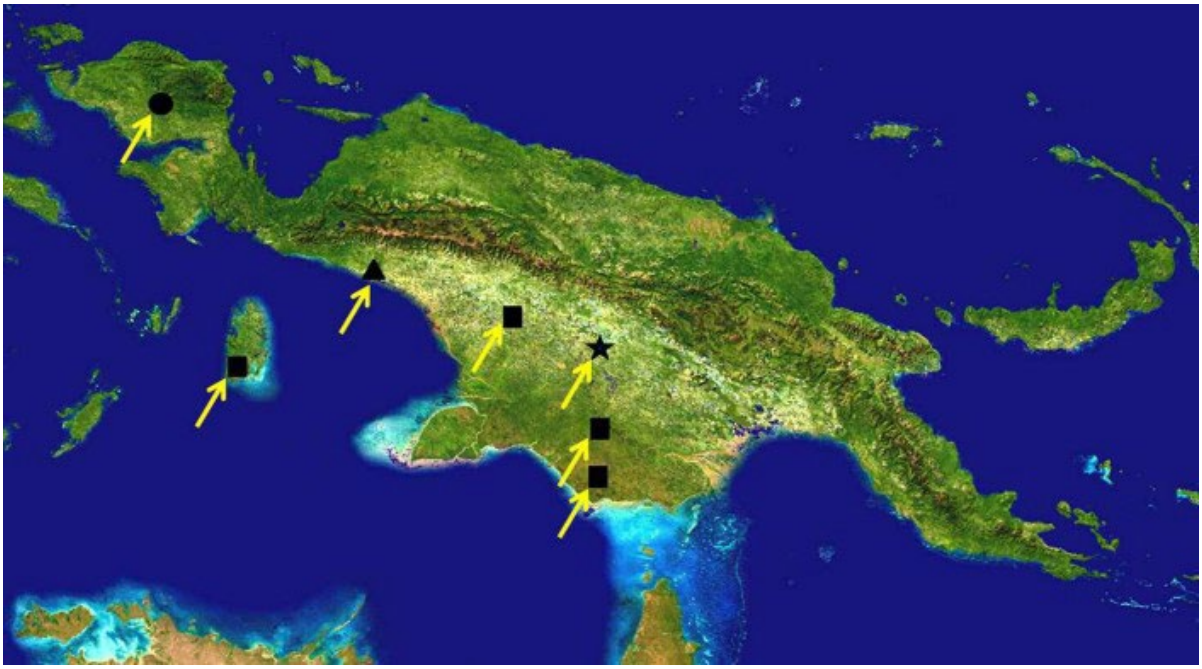
The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.).

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:

Etymology:

The new species is named luminatus (Latin: light up) with reference to the bright colours exhibited by adult males.



Map of New Guinea showing approximate distribution of Pseudomugil luminatus and P. ivantsoffi (triangle), P. gertrudae (squares) P. paskai (star), and P. reticulatus (circle). Locations for P. gertrudae (from left to right): Aru Islands, Dekai, Bensbach River (lower), and Fly

Remarks

Museum specimens of *Pseudomugil luminatus* were originally collected in 1997 from a Sago swamp in the vicinity of Timika in West Papua (4° 40.669'S, 136° 57.046'E) by G. Allen, S. Renyaan and K. Hortle, but were formerly identified as *Pseudomugil paskai*.

In 2011, a new blue-eye became available in the aquarium trade and sold under a number of different names such as *Pseudomugil* sp. "Red Neon", the name which was used by exporters in Thailand and Indonesia, "Pseudomugil iriani" and *Pseudomugil* cf. *paskai*. Initially it was thought that they were just a different coloured form of *Pseudomugil paskai* that differed slightly in colouration and fin shape. Then in 2013, a second colour form was imported from Indonesia. These were very similar, but the base body colour was more yellowish. The males are easier to distinguish from the original variant by having deep orange-coloured tips to the caudal fin and almost transparent pectoral fins, again with orange tips. However, there is little doubt that both colour varieties belong to the same species, although the yellow form also differs somewhat from the red in body shape: the former is somewhat slimmer and has a more pointed head. But the neon-coloured dorsal band alone makes the species unmistakable. The females of the two variants look extremely similar.

Pseudomugil luminatus is described on the basis of 117 specimens, 9.5–22.0 mm SL, collected from the vicinity of Timika, south-central New Guinea (Papua Province, Indonesia). Based on general appearance the new species is most similar to *P. paskai* from the upper Fly River system (Kiunga area) of Papua New Guinea. Both species possess scattered black spots on the median fins, and elongate filaments on the first dorsal and pelvic fins of adult males. However, the colour pattern of the new taxon is more vivid, incorporating a neon-blue stripe along the upper body, which is lacking in *P. paskai*. There are also modal differences in the number of anal-fin rays (usually 10 in *P. luminatus* vs 11), pectoral rays (almost always 9 in *P. luminatus* vs 9 or 10), and lateral scales (usually 25–26 vs 27–28). Genetic data also provide strong support for the separation of these species.

Reference

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Holotype. MZB 23010, male, 17.7 mm SL, sago swamp on northern side of Cross Levee Road, 4° 40.669'S, 136° 57.046'E, Mimika District, vicinity of Timika, Papua Province, Indonesia, rotenone, G. Allen, S. Renyaan & K. Hortle, 28 January 1997.



Preserved holotype of Pseudomugil luminatus, male, 17.7 mm SL, vicinity of Timika, Papua Province, Indonesia. Photo: © Gerald Allen

Paratypes. MZB 23009, 39 specimens, 9.6–19.2 mm SL, swamp about 2 km from Timika-Nabire Road, 4° 24.330'S, 136° 46.119'E, Iwaka River system, Mimika District, vicinity of Timika Papua Province, Indonesia, seine, J. Christian, H.-G. Evers & A. Wagnitz, 8 January 2015; MZB 23011, 13 specimens, 11.8–22.0 mm SL, swamp near Iwaka River, 4° 26.913'S, 136° 46.804'E, Mimika District, vicinity of Timika, Papua Province, Indonesia, seine, J. Christian, H.-G. Evers & A. Wagnitz, 8 January 2015; USNM 432495, 38 specimens, 10.5–17.2 mm SL, collected with MZB 23009; WAM P.31258–007, 20 specimens, 9.5–19.3 mm SL, collected with holotype; WAM P. 31298–001, 4 specimens, 11.8–18.9 mm SL, same data as holotype except 4° 40.140'S, 136° 56.720'E, 24 April 1997; WAM P.31257– Fishes Of Sahul March 2016 953 002, 14.1 mm SL, swamp on Aikwa River, approximately 4° 40'S, 136° 54'E, Port Site Road near kilometre 21, Mimika District, vicinity of Timika, Papua Province, Indonesia, rotenone, G. Allen & K. Hortle, 28 January 1997.

References

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.c The natural geographic range.

This species was previously locally common in sago-Pandanus swamp habitat with clear but darkly stained, slow-flowing water. However, it is now primarily found in streams in forests. Most of the paratypes of this species were taken from two sites in the Iweka River system at elevations of 45–60 m above sea level, with a water temperature of 26–28°C a pH of 4.8–7.2 and a conductivity of 7–126 µS/cm. The maximum size of this species is 2.2 cm SL



Distribution range of Pseudomugil luminatus © IUCN Redlist:

References:

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

IUCN Redlist: accessed 20th August 2022 at: https://www.iucnredlist.org/species/161077353/161077357

3.d Habitat.

: The new species is known only from south-central New Guinea in the vicinity of Timika, Papua Province, Indonesia. The habitat consists of sago-Pandanus swamp with clear (although darkly stained), slow-flowing water. The type locality, which lies about 20–25 km upstream of the Aikwa River estuary was severely altered by sediment tailings from the Freeport gold and copper mine in the late 1990s and this species and other swamp-associated fauna are presumed to be no longer present. Most of the paratypes were taken from two sites in the Iweka River system, approximately 31–36 km northwest of the type

locality at elevations of 45–60 m above sea level. Selected water quality values at the time of collection were as follows: temperature 26–28°C, pH 4.8–7.2, and conductivity 7–126 µS/cm

References:

Allen, G.R., Unmack, P.J., & Hadiaty, R.K. Pseudomugil luminatus, a new species of Blue-eye (Teleostei: Pseudomugilidae) from southern New Guinea, with notes on P. gertrudae, *Fishes of Sahul* **30(1),** 950 - 961.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Pseudomugil luminatus* was not recorded by Allen but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1991) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; "Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac."

Reference:

Tappin, A. R. 2006. Home of the Rainbowfish. Available at: http://rainbowfish.angfaqld.org.au/luminatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as "dither fish" to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase April 2021.

Reference

https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including

There are no scientific records of any work done on the reproductive biology of *Pseudomugil luminatus. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the author since 1983 from stock obtained from Melbourne. Three non native

Pseudomugil species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.



Pseudomugil luminatus spawning - photo© Taoyeah Den

4.a The age at maturity (first breeding)

The author could find no record of this information for *Pseudomugil luminatus* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Pseudomugil luminatus* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Pseudomugil luminatus* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

Allen G.R. & N.J. Cross (1982) Rainbowfishes of Australia and New Guinea. TFH Publications

ANGFA "Code of Conduct" https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil luminatus* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil luminatus* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 04 Apr 2021 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) **https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text**

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of Pseudomugil luminatus in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with Pseudomugil luminatus data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for Pseudomugil luminatus data against the provisions in the assessment process.(accessed 6th June 2021.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil luminatus is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from the author, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil luminatus is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil luminatus* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil luminatus* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil luminatus* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil luminatus* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

This species is assessed as Endangered. It has an extent of occurrence (EOO) of 2,000 km^2, occurs in two locations (one in the forest tributaries and one in the main channel and associated peat swamps, in which the species may now be extinct), and there is continuing decline in habitat. The Timika region has had large increases in the human population in recent decades due to migration for mining. Related threats to this species include land clearance for housing. There is a mining concession in the region, within which housing is not built. The impacts of mining (e.g. sedimentation) are primarily on the main stream of the river, and so this species is largely unaffected as it is found in the tributaries, rather than the main channel. However, this species previously also occurred in peat swamps, which have been severely reduced by sedimentation (G.R. Allen pers. comm. 2019). Oil palm plantations are also a threat to the west of Timika (Kadarusman pers. comm. 2019). There are also invasive species in the region (G.R. Allen and Kadarusman pers. comm. 2019). There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species
https://www.iucnredlist.org/species/161077353/161077357

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/Pseudomugil-luminatus.html

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil luminatus* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious

competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil luminatus* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil luminatus* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/Pseudomugil-luminatus.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Pseudomugil luminatus* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 90mm (Allen 1981)

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) “Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Pseudomugil luminatus are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil luminatus* sp. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil luminatus,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks associated with the importation of rainbowfish for ornamental purposes"* - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and

bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil luminatus* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil luminatus poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil luminatus* will be used in the live fish ornamental aquarium display trade. *Pseudomugil luminatus* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, , cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960’s.

If *Pseudomugil luminatus is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species

imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil luminatus* will be

kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil luminatus* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful and hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

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12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including: the species' current quarantine status, or pest or noxious status, or whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil luminatus* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection

and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Pseudomugil luminatus* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Pseudomugil luminatus* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations

1995 and prohibited to be imported into the State. *Pseudomugil luminatus* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Pseudomugil luminatus* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Pseudomugil luminatus* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is 'reckless' about whether the animal is a prohibited animal and is also 'reckless' about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

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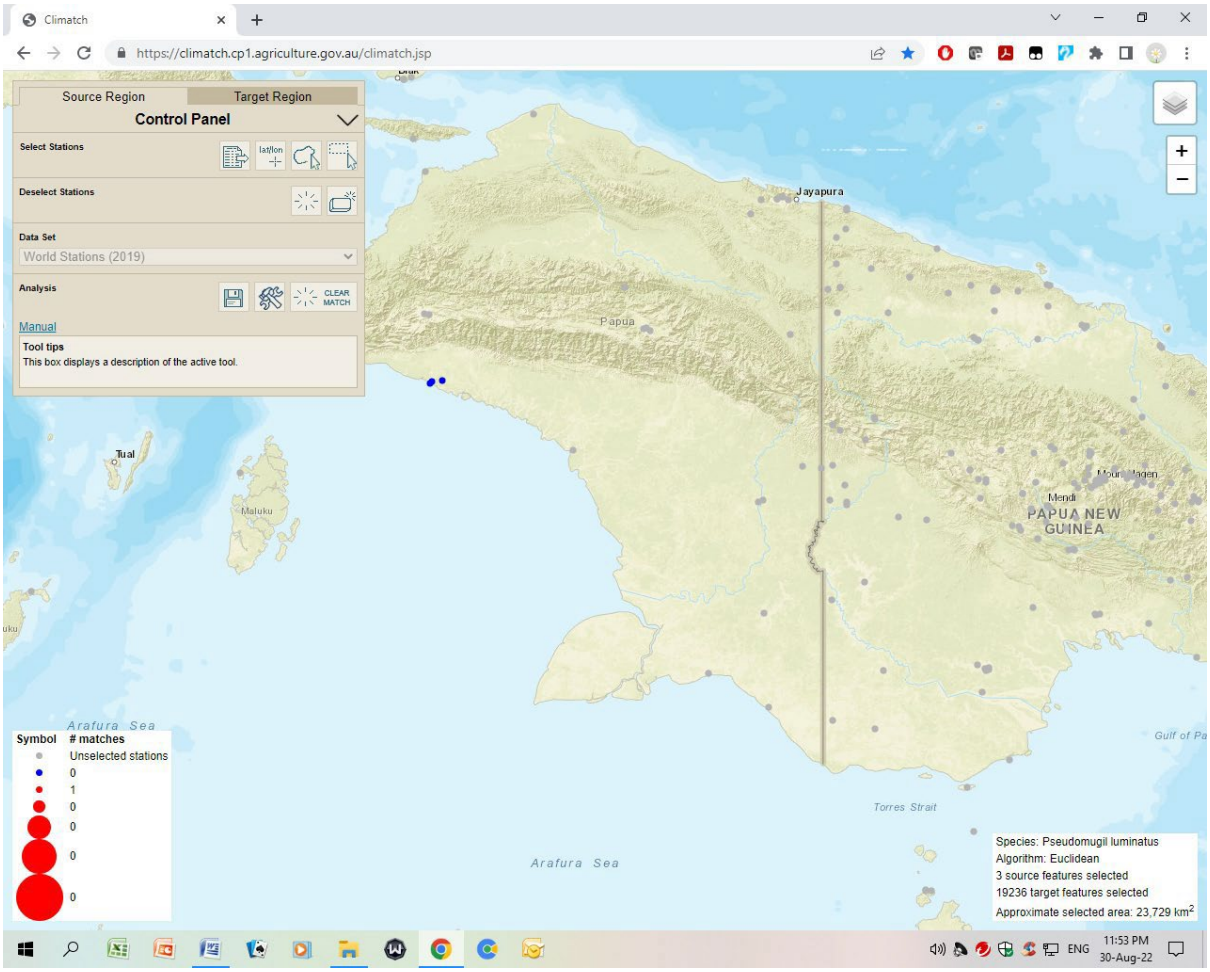
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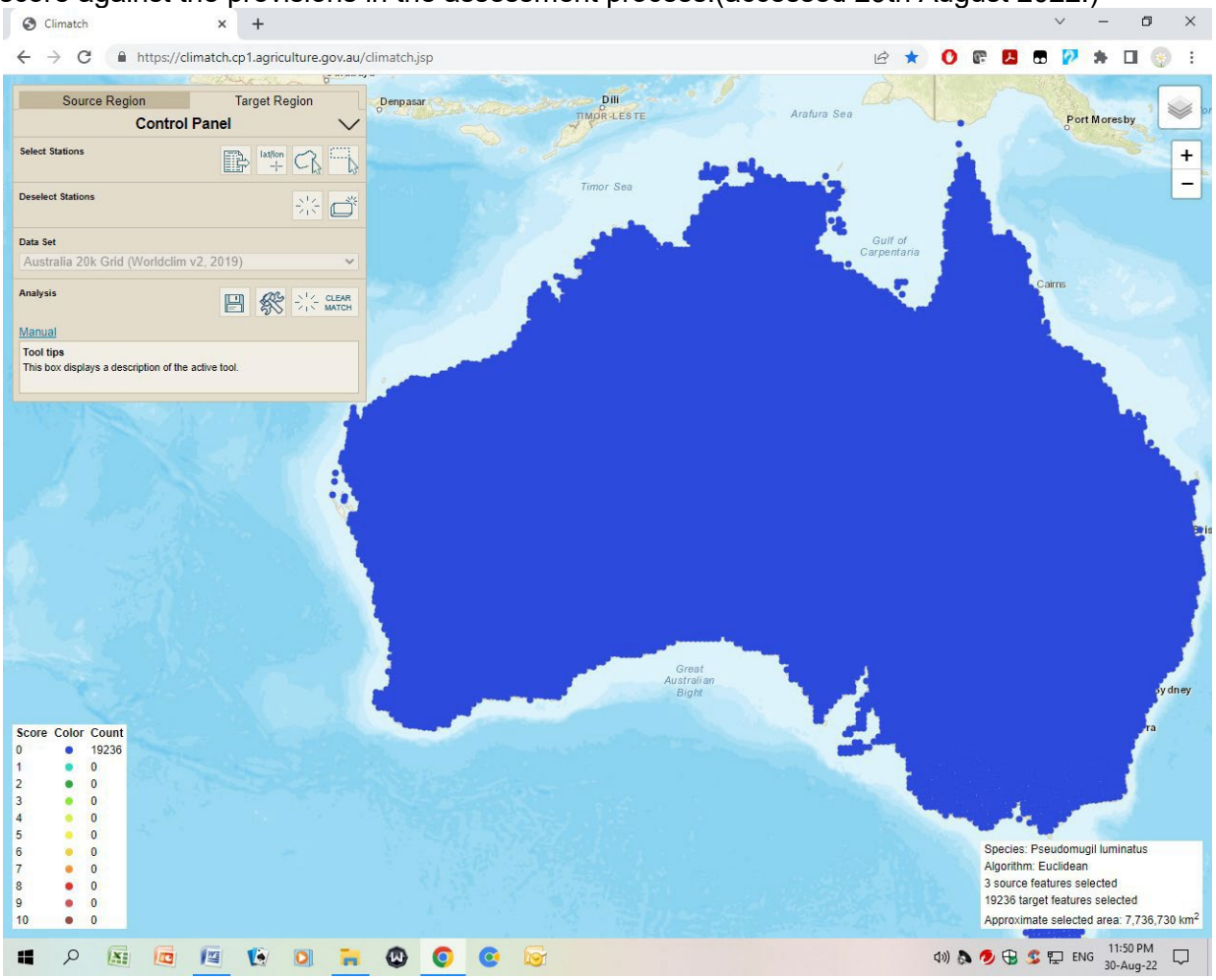
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APPENDIX A – calculation of climate from *Pseudomugil luminatus* distribution climate to Australian Climate.



Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)



BOMFORD ASSESSMENT

SPECIES: Pseudomugil luminatus

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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A report to address the “Terms of Reference” for an application to include *Pseudomugil paskai* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil paskai (Kiunga) - photo© Neil Armstrong

Etymology

The species is named paskai in honour of Mr. John Paska, former government fisheries technician, in recognition of his generous assistance during the first author visits to Papua New Guinea. He also participated in the collection of the type specimens of P. paskai."

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: *Pseudomugil paskai,* Paska's Blue-eye



Aquarium photograph of *Pseudomugil paskai*, male, approximately 20 mm SL, tributary of upper Fly River near Kiunga, Papua New Guinea. Photo: ©Gerald Allen

Species Summary

Pseudomugil paskai is a small slender-bodied species, usually not exceeding 35 mm in length. Two dorsal fins, very close together, the first much smaller than the second. Males have a semi-translucent body colour that is bluish ventrally and yellowish above the mid-lateral line, with narrow dark scale outlines. The fins are generally translucent with white or yellow margins and scattered oval black spots. Lobes of the caudal fin have either white, yellow or reddish tips. Pelvic fins are yellowish with elongated anterior rays. Females do not have spots on their fins and do not show the colours of the males.

This species occurs in rainforest habitat in low-hill terrain at elevations of about 100-150 m. Its streams are slow-flowing and either turbid or tea-coloured with abundant aquatic vegetation and pH and temperature ranges of 6.1-6.5 and 25-26ºC. It can grow to a maximum size of about 2.5 cm SL

Reference

The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.). https://www.iucnredlist.org/species/18547/147757519

Tappin, A. R. 2006. Home of the Rainbowfish. Available at: https://rainbowfish.angfaqld.org.au/Paskai.htm

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus Pseudomugil was erected by Kner in 1865 when he described P. signifer from Sydney. He and many other authors have placed this genus in a separate family, Pseudomugilidae (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family Atherinidae [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily Melanotaeniinae)]. McCulloch (1929) thought that this genus belonged in the family Melanotaeniidae. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed Pseudomugil in the family Melanotaeniidae on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. In the same paper, Allen also described a new genus, Popondetta (= Popondichthys Allen, 1987, preoccupied by a hemipterid genus Popondetta Woodward, 1978), with Pseudomugil furcatus as the type species. Allen (1980) and Allen and Cross (1982) believed that Pseudomugil and Popondichthys were closely related and that these genera were the most primitive members in the family Melanotaeniidae.

The keeping of tropical fish species in aquaria is growing in popularity and has been booming during the lock down period attributed to the Covid19 Pandemic. Studies into mental health have proven that an aquarium can produce a soothing effect on the human mind that tends toward anxiety. This trend to worry about the future seems to be increasing in recent times. Studies have demonstrated stress reduction from viewing aquatic life in an aquarium, lower heart rates and decrease in blood pressure. (Clements 2019 and Cracknell 2016)

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Pseudomugil paskai* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

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Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms “Blue - eyes” and “*Pseudomugil*” revealed no results for those entities. (accessed 20 August 2022).

Pseudomugil paskai has most recently been assessed for *The IUCN Red List of Threatened Species* in 2020. *Pseudomugil paskai* is listed as Critically Endangered under criteria B1ab(iii)+2ab(iii). This species is known only from small creeks around Kiunga, with an area of occupancy (AOO) and extent of occurrence (EOO) both with best estimates of 4 km^2 (and not thought to exceed 200 km^2). It was formerly common in the 1980s but is now considered rare, with recent attempts to find it being unsuccessful. This decline may be due to the threats of surrounding human settlements and resulting pollution, which are likely causing ongoing declines in habitat quality and area. This species is therefore assessed as Critically Endangered, and surveys are needed to determine its population status.

This species is known only from the Upper Fly River system of Papua New Guinea from a few small creeks along the Kiunga-Tabubil road, approximately 830-850 km upstream from the sea. Previous records from the Timika area of Papua Province, Indonesia were based on misidentifications of Pseudomugil luminatus. Photographs from the Aru Islands indicate the presence of a very similar fish, which is possibly P. paskai (G.R. Allen pers. comm. 2019).

This species has declined since the 1980s when it was described as common, and recent attempts to find it were unsuccessful. The cause of this decline is not certain, although a number of threats occur in the surrounding area. These include run off from the Kiunga-Tabubil main road and from surrounding settlements and resulting pollution. Introduced species are also a potential threat. The Oktedi River is impacted by the effects of mining, including sedimentation, fragmentation and habitat change, although the creek habitat of this species is likely to be less impacted.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

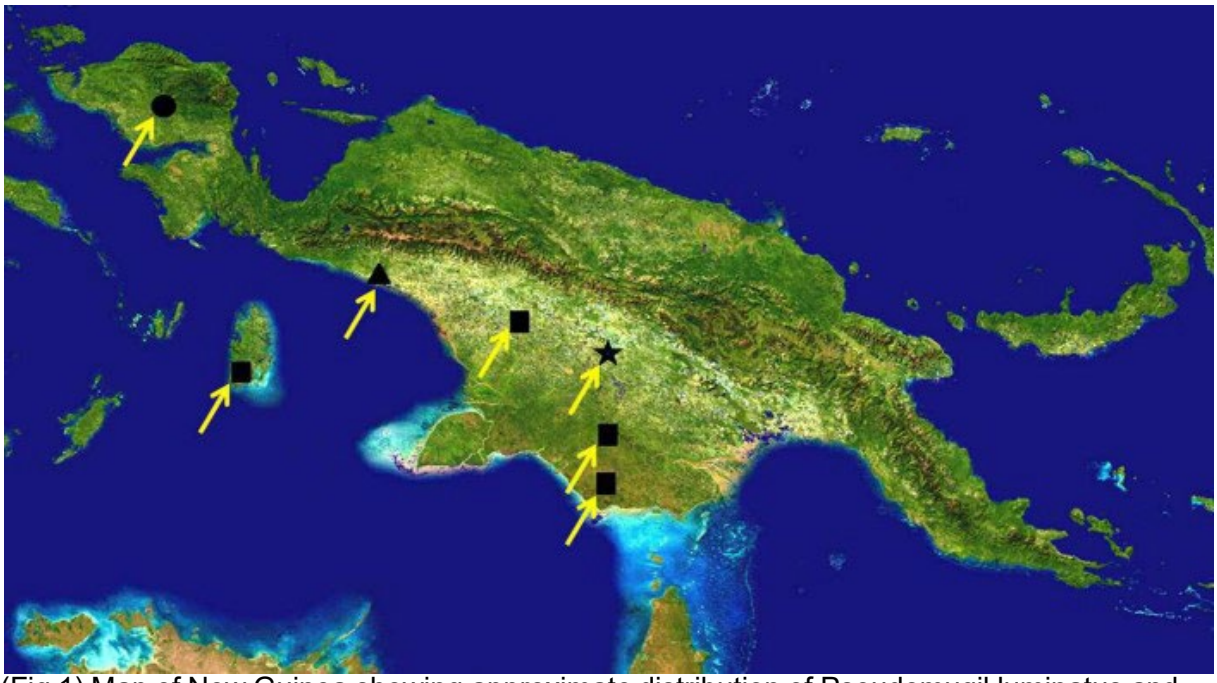
Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

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3. Provide information about the ecology of the species. Include, but do not restrict your response to:



(Fig 1) Map of New Guinea showing approximate distribution of Pseudomugil luminatus and P. ivantsoffi (triangle), P. gertrudae (squares) P. paskai (star), and P. reticulatus (circle). Locations for P. gertrudae (from left to right): Aru Islands, Dekai, Bensbach River (lower), and Fly

3.a Lifespan of the species.

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

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3.b Size and weight range.

Pseudomugil paskai was described on 204 individuals listed below.

Holotype.

WAM P28139-002,male,24,1mm SL, small tributary of Fly River, about 19 km north of Kiunga, on the Tabubil Road, Papua New Guinea (6°03'S, 141°18'E), collected with a small seine, by G. Allen and D. Balloch, 6 September 1983.

Paratypes
(collected at the same location of the holotype). AMS I. 24500-001, 14 specimens, 11,5 - 19,1mm SL ; PNG, 18 specimens, 11,2 - 18,1mm SL; RMNH 29399, 17 specimens, 10,9 - 19,8mm SL; USNM 266379, 17 specimens, 10,9 - 19,8mm SL; USNM 266379, 17 specimens, 12.3 - 17,2mm LS ; WAM P28139-003, 29 specimens, 13,0 - 23,6mm SL; WAM P28140 - 001, 18 specimens, 11,5 - 17,5mm SL, on 7 September 1983 ; WAM P27794 - 002, 58 specimens, 15,0 - 24,0mm SL, collected by G. Allen and J. Paska on 16 September 1982 ; ZMA 119.214, 15 specimens, 10,6 -17,4mm SL..

P. paskai is very similar to P. gertrudae in measurements, counts and most osteological characters, but different in colour and the shape of fins. P. paskai is distinguished from P. gertrudae and other species of Pseudomugil by the following: Median fins with few small oval spots in males only. Caudal fin lobes with whitish or reddish tips. Long first dorsal and pelvic fin rays. Anterior vomer straight. Parasphenoid with anterior fossa. No epipleural ribs on first vertebra. Caudal vertebrae without posterior process. Pelvic bone without anterior and posterior process.

References:

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.c The natural geographic range.



Distribution range of Pseudomugil paskai © IUCN Redlist: https://www.iucnredlist.org/species/18547/147757519

This species occurs in swampy lagoons, lakes, and small side channels of larger rivers, usually where there is abundant aquatic vegetation. It can reach a maximum size of about 11 cm SL. This species occurs on lowland floodplains of the Sepik, Ramu, and Markham river systems of Papua New Guinea. This species is abundant throughout much of its range and the population is considered stable

References:

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

IUCN Redlist: accessed 20th August 2022 at: https://www.iucnredlist.org/species/161080469/161080528

3.d Habitat.



Typical habitat of Pseudomugil paskai © Hans-Georg Evers

Pseudomugil paskai were collected by David Balloch and Gerald Allen in 1983. They are very similar to *Pseudomugil gertrudae*, but differ in colouration and fin shape. *P. paskai* are currently known only from a small creek, approximately 6° 03'S, 141° 18'E, 7.5 km north of Kiunga in the Fly River system of Papua New Guinea. They are a stream dwelling species occupying slow-flowing muddy or tea-coloured rainforest streams. Aquatic vegetation is generally abundant. The pH and temperature ranges recorded at the collection site were 6.0 - 6.5 and 25 - 26° Celsius.

This species occurs in rainforest habitat in low-hill terrain at elevations of about 100-150 m. Its streams are slow-flowing and either turbid or tea-coloured with abundant aquatic vegetation and pH and temperature ranges of 6.1-6.5 and 25-26ºC. It can grow to a maximum size of about 2.5 cm SL

P. paskai from the upper Fly River system (Kiunga area) of Papua New Guinea, which lies approximately 530 km east of the known range of P. luminatus (Fig. 1). The two species exhibit a similar appearance and general morphology, especially the pattern of scattered black spots on the median fins, and elongate filaments on the first dorsal and pelvic fins of adult males. Pseudomugil paskai in usually having 11 (69 % in P. paskai) anal-fin rays, 10 (45 % in P. paskai) pectoral-fin rays, and 27–28 (83 % in P. paskai) lateral scales. Moreover, the body and fins of adult males of Pseudomugil paskai are considerably paler and lack the neon-blue stripe along the upper body that is characteristic of P. luminatus.

This species was formerly common in the 1980s in the vicinity of Kiunga, but is now considered rare. Recent attempts to find this species were unsuccessful (G.R. Allen pers. comm. 2019), and the population is assumed to be declining.

References:

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/Pseudomugil-paskai.html

IUCN Redlist: accessed 20th August 2022 at: https://www.iucnredlist.org/species/18547/147757519

Tappin, A. R. 2006. Home of the Rainbowfish. Available at: https://rainbowfish.angfaqld.org.au/Paskai.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Pseudomugil paskai* was not recorded by Allen (2001) but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1991) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members

of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; “Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac.”

Reference:

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as “dither fish” to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase April 2021.

https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including

There are no scientific records of any work done on the reproductive biology of *Pseudomugil paskai. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the authors since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Pseudomugil paskai* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Pseudomugil paskai* but closely related *Pseudomugil* species will produce about 40 to 100 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) "Rainbowfishes, their care and keeping in captivity" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Pseudomugil paskai* but closely related *Pseudomugil* species will produce about 40 to 100 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species, *Glossolepis incisus* was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct”
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil paskai* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil paskai* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 04 Apr 2021 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of *Pseudomugil luminatus* in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is

reproduced and is attached with *Pseudomugil luminatus* data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for Pseudomugil paskai data against the provisions in the assessment process.(accessed 28th August 2022.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil luminatus is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland

Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from Author 1, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil paskai is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in “Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models” A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil paskai* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil paskai* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil paskai* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil paskai* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

Pseudomugil paskai has been collected in two small tributaries of the upper Fly River, in the vicinity of Kiunga, about 840 km upstream from the river mouth at Toro Pass (Fig. 6). The types were collected in calm, turbid pools, and in slow-moving streams with abundant vegetation, pH range of 6.3-6.5 and water temperatures of 25-26°C. The species was very abundant and up to 50 individuals were caught with each tow of a small shrimp seine. The rainbowfish Melanotaenia sexlineata (Munro) was equally common at these sites. Although this species was common around Kiunga in the 1980's recent attempts to find it have been unsuccessful This species occurs in swampy lagoons, lakes, and small side channels of larger rivers, usually where there is abundant aquatic vegetation. It can reach a maximum size of about 2.5 cm SL. There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

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IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil paskai* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil paskai* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil paskai* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression

is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

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8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Pseudomugil paskai* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 90mm (Allen 1981)

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

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8.c Habitat and local environmental conditions

Pseudomugil paskai has been collected in two small tributaries of the upper Fly River, in the vicinity of Kiunga, about 840 km upstream from the river mouth at Toro Pass. The types were collected in calm, turbid pools, and in slow-moving streams with abundant vegetation, pH range of 6.3-6.5 and water temperatures of 25-26°C. The species was very abundant and up to 50 individuals were caught with each tow of a small shrimp seine. The rainbowfish Melanotaenia sexlineata (Munro) was equally common at these sites.

This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil paskai* sp. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil paskai,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

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IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

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9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil paskai* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil paskai poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for “fresh” wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil paskai* will be used in the live fish ornamental aquarium display trade. *Pseudomugil paskai* are to be added to the live import list to legitimise the use

of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960's.

If *Pseudomugil paskai is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

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11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator: https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil paskai* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil paskai* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful and hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

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ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

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PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including: the species' current quarantine status, or pest or noxious status, or whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil paskai* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow *Pseudomugil luminatus* across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. *Pseudomugil luminatus* is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. *Pseudomugil luminatus* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. *Pseudomugil luminatus* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. *Pseudomugil luminatus* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’ about whether keeping the animal would result, or would be likely to result, in the spread of prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

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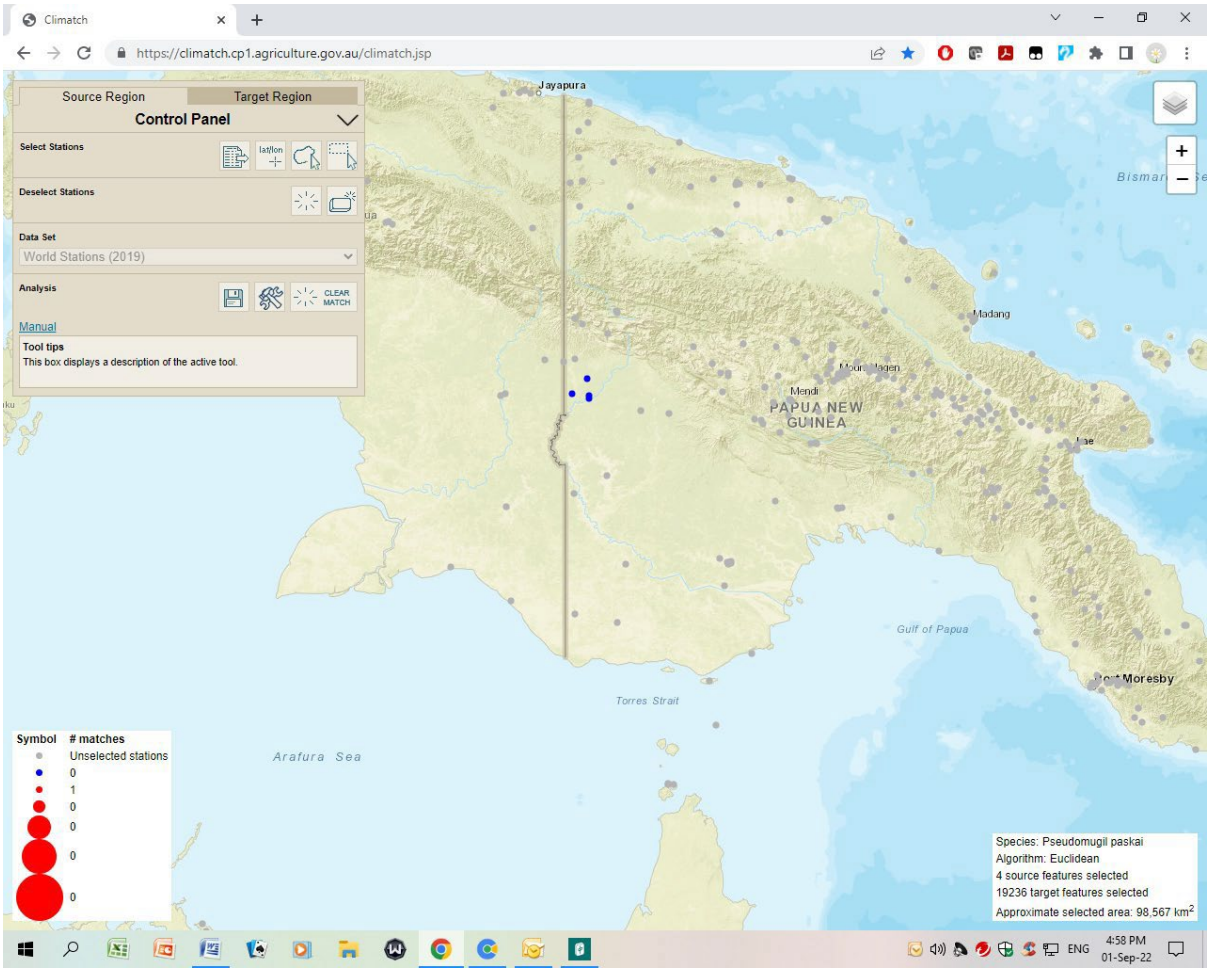
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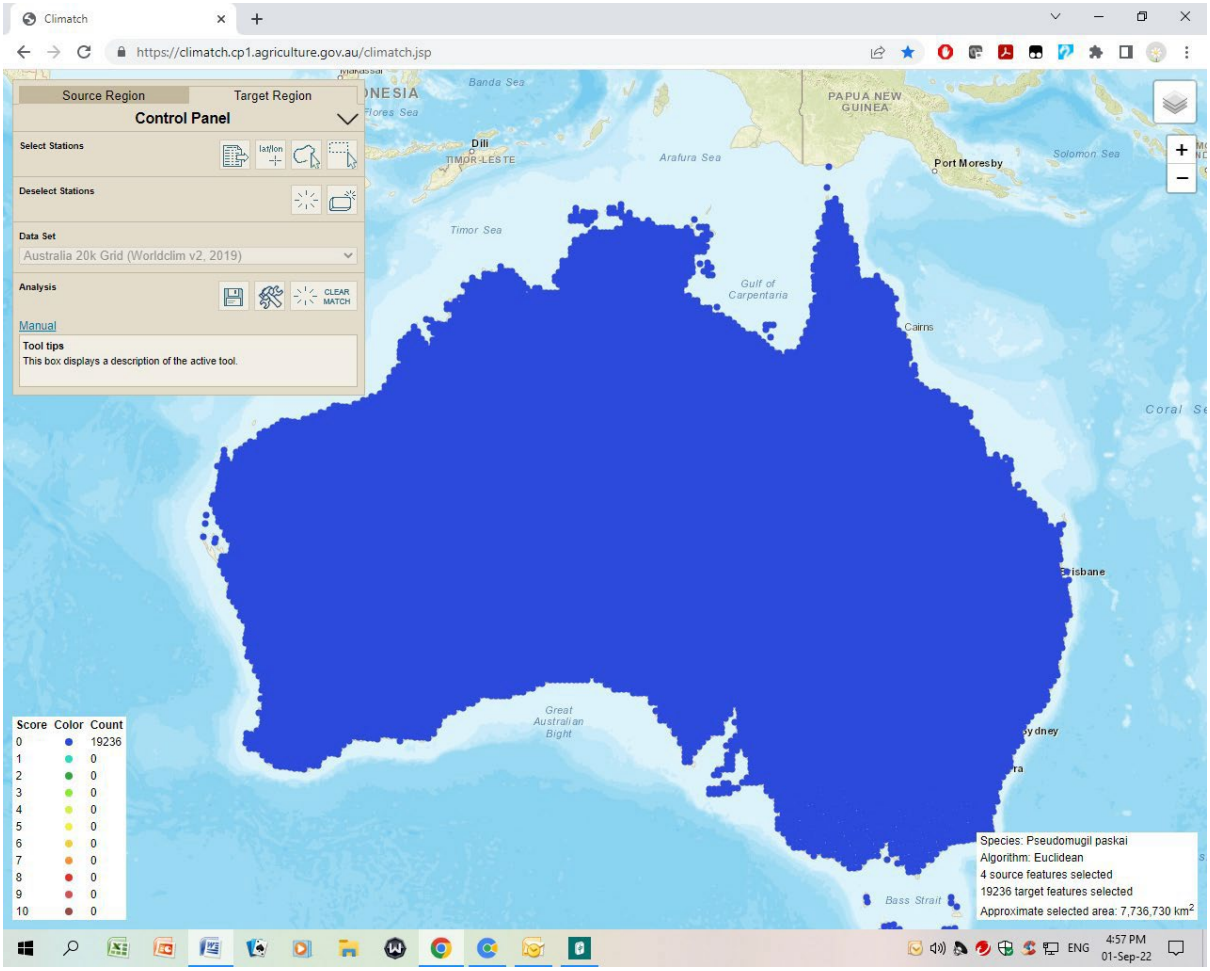
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APPENDIX A – calculation of climate from *Pseudomugil Paskai* distribution climate to Australian Climate.





Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)

BOMFORD ASSESSMENT

SPECIES: Pseudomugil paskai

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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A report to address the “Terms of Reference” for an application to include *Pseudomugil reticulatus* onto the allowable live imports list under the provisions of Section 303 EB, Environment Protection Biodiversity Conservation Act, 1999.



Pseudomugil reticulatus (male) - photo© Hans Herbert Boeck

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Pseudomugilidae - Blue Eyes
Genus: *Pseudomugil*: from the Ancient Greek ψευδής (*pseudes*), meaning 'false, lying, untrue', used here as a prefix, and the generic name *Mugil*.
Species: *Pseudomugil reticulatus,* Vogelkop blue-eye



Aquarium photograph of Pseudomugil reticulatus, approximately 24 mm SL, small creek near Lake Ayamaru, Birds Head Peninsula, West Papua Province, Indonesia - photo © Gerald Allen

Species summary

Pseudomugil reticulatus is a small, slender and laterally compressed species, growing to a length of around 3cm SL. Body colour in males light brown; abdomen and swim bladder region silvery. The ventral part of the breast is yellow. The upper half of the first dorsal fin, anterior half of the second dorsal and the edge of the anal fin is coloured brick-red. The dorsal and ventral contour posterior to the second dorsal and anal fins are edged with a similar red. The upper and lower third of the caudal fin is also red. The head has a red tinge while the ventral fins are pinkish-red. The eyes are intensely blue. The edges of some scales

on the abdomen are edged with black. Female specimens show a stronger reticular pattern and yellow fins (similar in colour as described by Allen and Ivantsoff in 1986). Body colour yellow brown, edges of scales outlined with chromatophores, edges of rays and spines peppered with chromatophores. Eggs are orange-red in colour.

Introduction

Blue-eyes are small colourful fishes that inhabit freshwater streams and brackish waters in Australia, Papua New Guinea, and some eastern islands of Indonesia. They are generally recognized as having evolved from a marine atherinid ancestor and share many anatomical characters with members of this family (Allen 1980; Allen and Cross 1982). The genus Pseudomugil was erected by Kner in 1865 when he described P. signifer from Sydney. He and many other authors have placed this genus in a separate family, Pseudomugilidae (Kner 1865; Munro 1958a, 1958b, 1967; Grant 1982), while others have included it in the family Atherinidae [Gunther 1867b; Shipway 1947; Rosen 1964; Lake 1971; Jordan and Hubbs 1919 (in the subfamily Melanotaeniinae)]. McCulloch (1929) thought that this genus belonged in the family Melanotaeniidae. Allen, in his generic revision of the rainbowfishes in 1980, likewise placed Pseudomugil in the family Melanotaeniidae on the basis of two shared characters-the jaw structure and the unique modification of pelvic fins. In the same paper, Allen also described a new genus, Popondetta (= Popondichthys Allen, 1987, preoccupied by a hemipterid genus Popondetta Woodward, 1978), with Pseudomugil furcatus as the type species. Allen (1980) and Allen and Cross (1982) believed that Pseudomugil and Popondichthys were closely related and that these genera were the most primitive members in the family Melanotaeniidae.

The keeping of tropical fish species in aquaria is growing in popularity and has been booming during the lock down period attributed to the Covid19 Pandemic. Studies into mental health have proven that an aquarium can produce a soothing effect on the human mind that tends toward anxiety. This trend to worry about the future seems to be increasing in recent times. Studies have demonstrated stress reduction from viewing aquatic life in an aquarium, lower heart rates and decrease in blood pressure. (Clements 2019 and Cracknell 2016)

The ornamental aquatic life, fish, invertebrates and aquatic plants industry is not like industries that produce food and shelter it is more like the Fashion Industry that relies on new products to excite customers to buy the latest trend. The rise of social media and other instant news forums has produced an intense interest in owning possessing the latest trend. This has happened recently with the smuggling of the small Mexican red crayfish and the Indonesian Assassin Snail. Neither of those are on the allowable import list. There is also a large Australia wide trade in red cherry shrimps and other small colourful crustaceans, all of which are smuggled except the native species from tropical NT and Qld.

The author of this report will determine that *Pseudomugil reticulatus* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. .

Disease
Introduced unassessed aquatic life entering Australia without appropriate quarantine or a risk assessment of the exporting country can carry exotic parasites and disease that may negatively impact on native species and aquaculture enterprises.

Competition with native species
Introduced unassessed aquatic life that escapes human control may breed into very large numbers out competing native species for food and space possibly causing local extinctions of native species.

Destruction of aquatic habitat
Introduced unassessed aquatic life that escapes human control may damage waterways by digging and moving substrate causing water to be clouded with silt, smothering plants and contributing to erosion.

Dangerous species
Introduced unassessed aquatic life that escapes human control may have features that are a danger to humans, large venomous spines, very sharp teeth, even high voltage electrical discharge and could pose a danger to recreational and commercial activities in natural waterways.

Impacts associated with Genetic Changes
Introduced unassessed aquatic life that escapes human control may be closely related to native aquatic life and be able to hybridise causing the loss of genetic diversity.

References

Clements, Valentin, Rankin, Baker, Gee, Snellgrove, Sloman (2019) "*The effects of interacting with fish in aquariums on human health and well-being: A systematic review*" published by Institute of Biomedical and Environmental Health Research, School of Health and Life Sciences, University of the West of Scotland, Paisley, United Kingdom.

Cracknell, White, Pahl, Nichols & Depledge. 2016 "*Marine Biota and Psychological Well-Being: A Preliminary Examination of Dose–Response Effects in an Aquarium Setting*" published by Environment and Behavior2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES).

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms "Blue - eyes" and "*Pseudomugil*" revealed no results for those entities. (accessed 20 August 2022).

Pseudomugil reticulatus has most recently been assessed for *The **IUCN Red List** of Threatened Species* in 2019. *Pseudomugil reticulatus* is listed as Critically Endangered under criteria B1ab(v). This species is assessed as Critically Endangered. It is a poorly known species with only a few specimens available. Collections in 1982 and 1999 found the species, but only following extensive searches for the species was it found again in 2019 in a single locality. It has a restricted extent of occurrence (EOO) of 20 km^2, is known only from one location based on the primary threat of predation by invasive species, and is experiencing continuing decline in the number of mature individuals due to this threat.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 15 species of Pseudomugil listed. The most recent assessments were recorded in 2019 and 2020. However, this site is missing *Pseudomugil cyanodorsalis*.

***Pseudomugil* connieae** Pseudomugil *connieae* is listed as Endangered
https://www.iucnredlist.org/species/18544/147757093

***Pseudomugil* cyanodorsalis** Not found in IUCN
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

Pseudomugil furcatus *Pseudomugil furcatus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18545/162322140

Pseudomugil gertrudae *Pseudomugil gertrudae* is listed as Least Concern.
https://www.iucnredlist.org/species/122906064/123382261

Pseudomugil inconspicuus *Pseudomugil inconspicuus* listed as Least Concern.
https://www.iucnredlist.org/species/161077247/161077318

Pseudomugil ivantsoffi *Pseudomugil ivantsoffi* is listed as Endangered
https://www.iucnredlist.org/species/161077334/161077338

Pseudomugil luminatus *Pseudomugil luminatus* listed as Endangered
https://www.iucnredlist.org/species/161077353/161077357

Pseudomugil majusculus *Pseudomugil majusculus* is listed as Data Deficient.
https://www.iucnredlist.org/species/18546/147757428

Pseudomugil mellis *Pseudomugil mellis* is listed as Endangered
https://www.iucnredlist.org/species/18543/123378987

Pseudomugil novaeguineae *Pseudomugil novaeguineae* is listed Least Concern.
https://www.iucnredlist.org/species/161077381/161077392

Pseudomugil paludicola *Pseudomugil paludicola* is listed as Least Concern.
https://www.iucnredlist.org/species/161077447/16107745

Pseudomugil paskai *Pseudomugil paskai* listed as Critically Endangered
https://www.iucnredlist.org/species/18547/147757519

Pseudomugil pellucidus *Pseudomugil pellucidus* is listed as Vulnerable
https://www.iucnredlist.org/species/169523/66421525

Pseudomugil reticulatus *Pseudomugil reticulatus* listed as Critically Endangered
https://www.iucnredlist.org/species/161077487/161077492

Pseudomugil signifer *Pseudomugil signifer* is listed as Least Concern.
https://www.iucnredlist.org/species/123358376/123382746

Pseudomugil tenellus *Pseudomugil tenellus* is listed as Least Concern.
https://www.iucnredlist.org/species/123358405/123382756

References:

Cites Species website with lists and search facility URL http://www.cites.org/eng/disc/species.php , the search terms “Blue-eyes", and "Pseudomugil” revealed no results for those entities. (accessed 20 August 2022.).

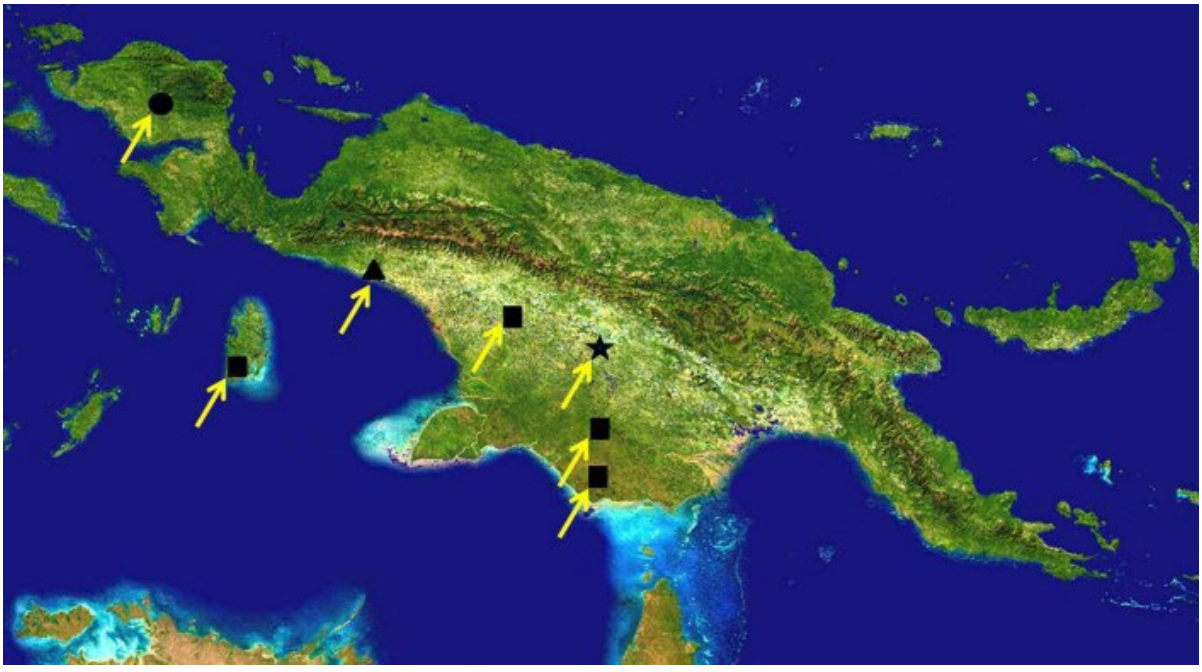
Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/Pseudomugil-cyanodorsalis.html

The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.).

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3. Provide information about the ecology of the species. Include, but do not restrict your response to:



Map of New Guinea showing approximate distribution of Pseudomugil luminatus and P. ivantsoffi (triangle), P. gertrudae (squares) P. paskai (star), and P. reticulatus (circle). Locations for P. gertrudae (from left to right): Aru Islands, Dekai, Bensbach River (lower), and Fly

3.a Lifespan of the species.

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

References:

Allen, G.R. & Cross, N.J. (1982) "*Rainbowfishes of Australia and Papua New Guinea"*. Published by Angus and Robertson

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Holotype

Allen (1995) records the holotype as a male 27.2mm SL, from the south shore of a small stream entering Lake Ajamaru, approximately 2km East from Ajamaru Village on the Vogelkop Peninsula, Irian Jaya, Indonesia (1017'S, 132°12'E), using a 10 foot seine net by G. Allen and H. Bleher, on 18th November 1982.

The new Pseudomugil is called reticulatus (from Latin: in the form of a network), in reference to its colouration pattern.

The only known specimen (at that time) was collected in a small tributary of Ajamaru Lake (Amaroe or Ajamaroe Meer on some maps).is located in the Vogelkop Peninsula at the western end of Irian Jaya and about 110 km southeast of the port of Sorong. The lake is located in a low, muddy basin, surrounded by hills and mountains at the headwaters of the Ajamaru River which flows into the Kais River, which finally flows into the Ceram Sea to the south. The area was described by Boeseman (1963), the only ichthyologist who had previously visited the area. The holotype was collected on the bank of a densely vegetated stream in clear running water of pH 7.5 and temperature 26 °C. Despite great effort, no other P. reticulatus was collected or observed, although many Melanotaenia boesemani were caught. Net fishing and underwater observations in the lake itself failed to acquire additional representatives of the new Pseudomugil. Several other fishes have been collected in the Ajamaru Basin, among them the Melanoteniides, Melanotaenia ajamaruensis Allen et Cross and M. boesemani Allen et Cross; the Plotoside Catfish, Tandanus brevidorsalis (Gunther); the Goby Glossogobius hoesei Allen et Boeseman: the Eleotrid Oxyeleotris fimbriata and the introduced Anabantid Trichogaster pectoralis. All these species were reported by Allen and Boeseman (1982).

References:

Allen, G. R., and Ivantsoff, W. (1986). Deux nouvelles especes de blue-eyes (Pseudomugil: Melanotaeniidae) de Nouvelle-Guide. Revue Franqaise d'Aquariologie 12(3), 85-8.

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.c The natural geographic range.

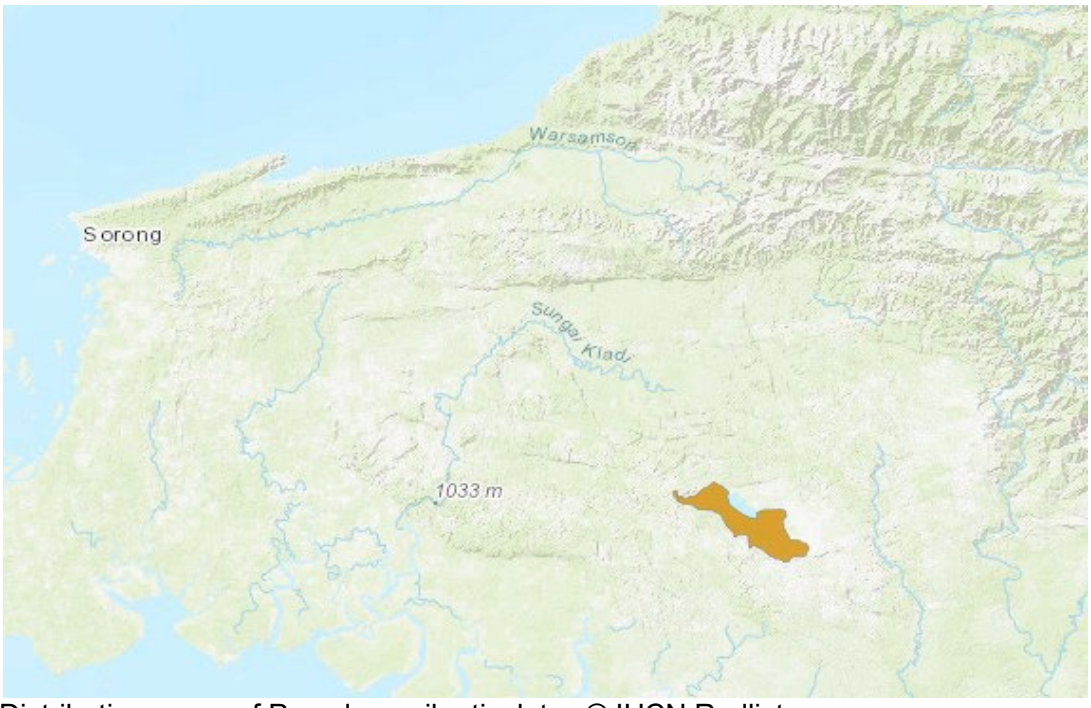
This species is known only from tributary streams flowing into Lake Ayamaru in the central Bird's Head Peninsula of West Papua Province, Indonesia. Aside from the holotype collected in 1982, the species was known only from 15 other specimens deposited at the Western Australian Museum collected in 1999 (G.R. Allen pers. comm. 2019). After extensive searches, a few individuals were also found at a single site in 2019 (P. Unmack pers. comm. 2019). It was erroneously reported from the Timika region of southern Papua Province, Indonesia by Ivantsoff et al. (1997) based on specimens of Pseudomugil ivantsoffi (G.R. Allen pers. comm. 2019).

References

The IUCN Red List search facility located at URL http://www.iucnredlist.org/search (accessed 20 August 2022.) at https://www.iucnredlist.org/species/161077487/161077492

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf



Distribution range of Pseudomugil reticulatus © IUCN Redlist:
https://www.iucnredlist.org/species/161077487/161077492

This species occurs in swampy lagoons, lakes, and small side channels of larger rivers, usually where there is abundant aquatic vegetation. It can reach a maximum size of about 11 cm SL. This species occurs on lowland floodplains of the Sepik, Ramu, and Markham river systems of Papua New Guinea. This species is abundant throughout much of its range and the population is considered stable

References:

IUCN Redlist: accessed 20th August 2022 at:
https://www.iucnredlist.org/species/161080469/161080528

3.d Habitat.

Pseudomugil reticulatus were collected about two kilometres east of Ayamaru (Ajamaru) Lake in the centre of the Vogelkop Peninsula. The lakes are located at the headwaters of the Ajamaru River which drains into the Kais River, eventually flowing into the Ceram Sea to the south. Habitat variable, from clear water (in some cases heavily stained with tannin) running swiftly over mud, gravel and sand, to slow-flowing water over similar terrain. Water temperature about 26-27°C; pH always slightly above neutral (7.1-7.6). They have also been collected from the Manggosa and Saengga rivers (Siripa Creek, Burma Hill Creek, Texas Creek) on the north coast of the Bomberai Peninsula. Both flow north into Bintuni Bay (Burnett et al., 2003).

The habitat of this species is subject to broad fluctuations in water levels. It is thought that these fluctuations became more severe in the 1990s, and are probably exacerbated by climate change. The primary threats are predation by birds and invasive species (including snakehead, tilapia, carp and goldfish). There are no conservation actions in place for this species. Research into the population and distribution is recommended because this species is poorly known, as it was difficult to catch even when the habitat was in good condition

References:

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available on the world wide web as a portable document format (PDF) at universal resource locator
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.e Diet, including potential to feed on agricultural plants

The specific diet of *Pseudomugil reticulatus* was not recorded by Allen (2001) but the diet of other members of the *Pseudomugil* genus are well recorded. All rainbowfishes of the family Melanotaeniidae are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

They are usually found where there is an abundance of aquatic vegetation in moderate turbid to clear, still to slow-flowing water. Young fish form aggregations around submerged logs and branches or among reeds and other shoreline vegetation. Allen (1991) describes the general behaviour of rainbowfishes as small schooling fishes generally less than 12 cm in length and common in most habitats below 1500m elevation. The habits of other members of *Pseudomugil* genus in captivity are well documented. Behavioural observations for *Pseudomugil* are typical for most rainbowfishes and may be considered indicative of the behaviour of *Pseudomugil*. Tappin (2005) gives the following general descriptions of rainbowfish behaviour in the aquarium ; “Rainbowfishes have very similar breeding habits, their food requirements are similar, and water that suits one particular species will suit all. All are of good-natured temperament and will live harmoniously, more or less, with one another. Rainbowfishes are a schooling fish, living in the midwater to the surface zone, often adjacent aquatic and emergent vegetation or snags in deeper water and in the quieter parts of streams at the head and bottom of riffles and rapids. From first light to mid morning dominant males will intensify in colour, select a feature such as a prominent piece of aquatic vegetation or small snag then attempt to lure and chase females into the area at the same time displaying erect fins to other nearby males trying to attract the same females. Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Females generally select the male they mate with and the pair quiver side by side for a few seconds near the chosen feature before a simultaneous release of eggs and sperm. The pair split apart in a rapid burst, scattering the fertilized eggs into the vegetation. The eggs have sticky filaments and are generally caught in the vegetation where they remain for 5 to 11 days before hatching into well formed larvae with very small yolk sac.”

Reference:

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.g territorial and aggressive behaviours

Males with close areas will sometime circle each other flaring their fins. This rarely causes any damage and as it is mostly stylized display to establish male dominance. Rainbowfishes are peaceful towards each other and other species except for the male displays mentioned earlier. Keepers of aggressive species such as some cichlids use rainbowfishes as “dither fish” to diffuse aggressive behaviour because they are able to keep out of the way and distract the aggressive species from hurting each other.

3.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried Glossolepis for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae.

List compiled from **Fishbase** August 2022
at:https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

3.i characteristics that may cause harm to humans and other species.

There are no really sharp spines or any toxins or venom in any member of the *Pseudomugil* family.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022).
https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

4. Provide information on the reproductive biology of the species, including



There are no scientific records of any work done on the reproductive biology of *Pseudomugil reticulatus. Pseudomugil* species are well known in the aquarium trade and has been kept and bred by the authors since 1983 from stock obtained from Melbourne. Three non native *Pseudomugil* species are well known in Australia; *Pseudomugil connieae, Pseudomugil furcatus,* and *Pseudomugil gertrudae (Aru Island)*. The members of this genus were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations. The author has researched

Australian aquarium shops on the internet, and has found some shops selling Ps. ivantsoffi, and Ps. luminatus.

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Pseudomugil reticulatus* but generally Rainbowfishes start to breed about 6 months of age and are reported to live for about 4 years in their natural habitat and up to 8 years in captivity.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b how frequently breeding occurs

The authors could find no record or observation for *Pseudomugil reticulatus* but closely related *Pseudomugil* species will produce about 5 to 15 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., Home of the Rainbowfish at:
http://rainbowfish.angfaqld.org.au/reticulatus.htm

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:
http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

The authors could find no record in any Rainbowfish books or papers examined of this family being able to store sperm. Rainbow fish are egg scatterers with eggs and sperm ejected simultaneously requiring both sexes for a successful fertile egg laying.

Reference

Tappin, A.R., (2011) “Rainbowfishes, their care and keeping in captivity” available at http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.d how many eggs or live-born young are produced at each breeding event

The authors could find no record or observation for *Pseudomugil reticulatus* but closely related *Pseudomugil* species will produce about 5 to 150 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.e if the species has hybridised with other species (both in the wild and in captivity) or has the potential to hybridise with any other species

Reports of naturally occurring rainbowfish hybrids in the wild are extremely rare. A report of naturally occurring hybrids between the genera *Melanotaenia* and *Chilatherina* can be found in Allen & Cross (1992) but there are no known naturally occurring hybrids between *Pseudomugil* sp. and *Melanotaenia* sp.. Despite the fact that some non native species of *Pseudomugil (Ps. connieae, Ps. gertrudae (Aru Island), Ps. furcatus)* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

Based on Allen (1989) and other works, the species in this genus have evolved in isolation from each other and almost certainly differences in courtship and spawning behaviour would have evolved at the same time (indeed, such isolating mechanisms must be available in this one habitat for two or more taxa to have evolved to the level of genus!). Distinct species as we know them have evolved as separate breeding units because of physicochemical, behavioural and recognition cues. These are complex and species-specific and effectively restrict hybridization. That many species of rainbowfish are being raised in ponds adjacent to each other by breeders in Asia and elsewhere (and it is so unlikely that the tanks would always be uncontaminated), negates the likelihood of easy hybridisation between this and other rainbowfish taxa. There are reports, both published and anecdotal, of hybridisation between the various species of *Melanotaenia, Pseudomugil, Chilatherina* and *Rhadinocentrus* as well as between genera. Virtually all of these have taken place either accidentally or on purpose under the artificial conditions within captivity.

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in the aquarium by providing only one sex of two different species. A rainbowfish species,

Glossolepis incisus was hybridized with a *Melanotaenia praecox* by an Australian fish importer in an attempt to create appealing aquarium subject for commercial purposes. The resulting offspring were infertile. Overseas (Europe and USA) some attempts have been made to establish “aquarium” strains of hybrids between various *Melanotaenia* species and none of these have become established in the trade, mainly because of hobby , club and market resistance to such crosses . The hobby groups overseas such as the RSG (Rainbowfish Study Group, in the USA) and the IRG (in Europe) and ANGFA here in Australia regularly advise hobbyists against buying or perpetuating such hybrids even when they are disguised under “pseudo-scientific” names such as *Melanotaenia marcii* etc. Hobbyists engage in continuous dialogue on various aspects of husbandry and conservation of rainbowfishes (as well as other species) on the Internet, social media and various discussion forums in several languages. The members of the Australia and New Guinea Rainbowfishes Association have a “Code of Conduct” that encourages enthusiasts to stay away from hybrid fish.

There are wild places that have many species of Rainbowfish living together, if hybridisation was common or easy there would only be one species with the features of the original 4 or 5 species at that location. The Mary River NT, at the southern end entry to Kakadu National Park has 4 species of Rainbowfish, *Melanotaenia trifasciata, M.exquisita, M.nigrans and M.splendida inornata*. No hybrids have been found there during many collections.

References:

ANGFA “Code of Conduct” https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

Tappin, A.R., (2011) “*Rainbowfishes, their care and keeping in captivity*” available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.f Fertility of Hybrid Progeny

There is no record of *Pseudomugil reticulatus* being hybridized in captivity nor any observations of hybrids in their natural habitat. Hybrids of other rainbowfish produce infertile offspring. Recent Scientific Genetic studies are inconclusive regarding the possible fertility of hybrid offspring. An Australian fish importer tried to make a more colourful hybrid between Melanotaenia praecox and Glossolepis incisus, they produced an hybrids but were unable to breed further fish from the hybrid, concluding it was infertile.

Majtánová and all, 2020, concluded that their DNA in the family Melanotaeniidae was sufficiently close for them all to hybridise. The author called an expert in the field of

rainbowfish for clarification and was reminded that rainbowfishes have been imported into Australia for many decades and none have caused any trouble from introductions to natural waterways, However there has been an hybridisation event in Running River a tributary of Barnett River Qld where a different Rainbowfish *Melanotaenia splendida splendida* has been introduced to a different Rainbowfish *Melanotaenia splendida* known as Running River Rainbowfish. Researchers for Australian National University have taken steps to preserve that over run species. However these are both in the *Melanotaenia splendida* group, very closely related.

References:

Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz (2020) "*Evidence of Interspecific Chromosomal Diversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

Froese, R. and D. Pauly. Editors. 2022. FishBase. World Wide Web electronic publication. www.fishbase.org, version (06/2022). https://www.fishbase.se/summary/SpeciesSummary.php?ID=22750&AT=blue+eye

5. Provide information on whether this species has established feral populations, and if so, where those populations are. Include information on whether this species has been introduced to other countries, even if it has not established feral populations.

There are no records of this fish being translocated to another place. Despite the fact that some species of *Pseudomugil* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Pseudomugil reticulatus* has been introduced to Europe and North America and has not established feral populations.

References:

http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Francis, Robert A. (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6

Froese, R. and D. Pauly. Editors. 2020. FishBase.www.fishbase.org, version (12/2020). Accessed 04 Apr 2021 https://www.fishbase.de/summary/

6. Provide information on, and the results of any other environmental risk assessments undertaken on the species both in Australia and overseas, including any Import Risk Analyses undertaken by Biosecurity Australia.

From the 'Rainbowfish" group, Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed and was advised by email on 8th October 2020 that the fish has been approved and has been added to the allowable import list as created by S.303EB of the Environment Protection Biodiversity Conservation Act of 1999. Currently, 17 species of rainbowfish are being assessed.

Panaquatic Health Solutions Pty Ltd conducted a review of the health risks associated with the importation of Rainbowfish for ornamental purposes.

References:

Amendment - List of Specimens Taken to be Suitable for Live Import (11/04/2005) **https://www.legislation.gov.au/Details/F2005L00922/Explanatory%20Statement/Text**

Panaquatic® Health Solutions Pty Ltd, 2009, "*Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes*", available as an electronic publication on World Wide Web Universal Resource Locator; https://www.baphiq.gov.tw/public/Data/910614193571.pdf

, or

http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1_red_rainbowfish_attachment.pdf

7. Assess the likelihood that the species could establish a breeding population in the Australian environment should it ever be released from effective human control. Include at least the following factors:

The 2006 refined model for risk assessment has been used to assess the possibility of establishment of Pseudomugil reticulatus in the Australian environment should it be released or escape effective human control. The author contacted Mary Bomford in after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with Pseudomugil reticulatus data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were produced a score for Pseudomugil reticulatus data against the provisions in the assessment process.(accessed 6th June 2021.), is attached at Appendix B.

Reference:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020

7a. ability to find food sources

Pseudomugil reticulatus is a small forage species that lives at the margins of its natural habitat, from near the surface to the bottom in 1 to 1.5 meters of clear water. It will have a similar diet to all other Melanotaeniidae that is an omnivorous consisting of small terrestrial insects fallen in the water, aquatic insects, small aquatic crustaceans and algae. The whole family has small villiform teeth designed to scrape periphyton form hard submerged surfaces. The species will be ok in any environment with suitable water quality along with other small forage fishes with a similar diet.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7b. ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)

There is very little climate match between Papua New Guinea, West Irian, and the Australian continent. See Bomford risk assessment score attached as appendix B. There are few places where a large population is near a suitable aquatic environment for this species. There are people in these places putting tropical exotic species in ponds that are in flood prone areas. 72 species of exotic aquarium fish were released into the Katherine River in the 1999 floods that put nearly 4 meters of water through the main street emptying the aquariums in the local pet shop. There have been no reports of ferals establishing in that river.

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020'

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

7c. ability to find shelter

Allen (1979), describes rainbowfish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from the author, at night

most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at:http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7d. rate of reproducing

Pseudomugil reticulatus is similar to other members of that genus, producing between 5 and 15 eggs several days in a row during a two week period in a time of good conditions. Fry survival would depend on the availability of small natural foods such as plankton, both zooplankton and phytoplankton.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

7e. any characteristics that the species has which could increase its chance of survival in the Australian environment.

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, G. incisus has been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also).

The risk assessment process for estimating the ability of a fish species establishing within the Australian environment was prepared by Mary Bomford in 2004 Using the provisions in "Risk assessment for the establishment of exotic vertebrates in Australia: recalibration and refinement of models" A report produced for the Department of the Environment and Heritage, Commonwealth of Australia 2004. Using the Climatch v2.0 for PC process indicates a score of 2 for *Pseudomugil reticulatus* indicating a very low chance of survival in Australian water ways. Attached as appendix A.

The natural spread of this species would occur similar to other rainbowfishes. Some of the spread mechanisms for rainbowfishes are upstream and downstream migrations especially in times of greater flow during wet season floods. Barriers such as waterfalls will prevent upstream migrations of rainbowfishes and the marine environment is devoid of rainbowfishes so the estuaries of rivers prevent rainbowfishes from moving to new rivers via the sea (Allen 1995).

If *Pseudomugil reticulatus* were to escape effective control is where the likelihood of accidental or intentional release is greatest. Since the most likely scenario for release into

the wild will be by aquarium escape into the disturbed habitats surrounding major centres of population the survival of this species is extremely unlikely.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to a natural habitats (e.g. Lake Argyle in W.A. or Lawn Hill Gorge National Park in Queensland) and these conspicuous fish were to avoid the formidable spectrum of natural predators (an array of waterbirds, an even larger array of predatory fish such as barramundi, grunters etc, file snakes, and so on) and the species became established it is most likely that it would peacefully co-exist with the other small forage species, just as several species of native rainbowfishes, glassfishes, hardyheads and small gudgeons peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Pseudomugil reticulatus* tends to suggest its behaviour is that of low invasiveness because it is not already widespread despite suitable habitat surrounding its natural distribution. It is also possible that locally predators in that area are efficient in controlling its numbers and reducing its spread into adjacent habitats. *Pseudomugil reticulatus* have no demonstrated salt tolerance therefore no tendency to invade other drainages via estuary migration (Allen and Cross 1982, Allen 1989, Allen 1991, Allen 1995, Allen et al 2002, Herbert and Peeters 1995, Lake 1978, Larson and Martin 1990, Leggett and Merrick 1987, Lever 1996, Merrick and Schmida 1984).

References:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8. Provide a comprehensive assessment of the potential impact of the species should it establish feral population/s in Australia. Include, but do not restrict your assessment to the impact of this species

This species is known only from tributary streams flowing into Lake Ayamaru. These are small, clear-water streams running through secondary forest with a sand/mud bottom and minimal aquatic vegetation. It can grow to a maximum size of about 28 mm SL This species is assessed as Critically Endangered. It is a poorly known species with only a few specimens available. Collections in 1982 and 1999 found the species, but only following extensive searches for the species was it found again in 2019 in a single locality. It has a restricted extent of occurrence (EOO) of 20 km^2, is known only from one location based on the primary threat of predation by invasive species, and is experiencing continuing decline in the number of mature individuals due to this threat. There is mention of a local practise of using crushed root compounds to poison fish. In the NT local use roots of *Derris trifoliata* and Freshwater

Mangrove, *Barrintonia acutangular*, both these plants occur in New Guinea and through SE Asia, many of these species that have bark and roots that are used to kill fish are common in North Australia and New Guinea.

References ;

Brock (1998) "*Top End Native Plants*" published by John Brock.

Cowie, Short, Osterkamp-Madsen (2000) "*Floodplain Flora*" published by Environment Australia and NT Parks and Wildlife

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/species/161077487/161077492

8.a similar niche species (ie. competition with other species for food, shelter etc.)

If *Pseudomugil reticulatus* were to establish in natural waterways, it would mix with the similar forage fishes and most likely school with local rainbowfishes, glassfishes, hardyheads, gudgeons and other similar species. It would be competing with the other small omnivores that eat small crustaceans, aquatic insects, terrestrial insects and algae. In some river systems in Australia, up to four species of rainbowfish coexist without either obvious competition or inter-breeding (e.g. Mary River, N.T., Jardine River, Qld.). It can be assumed that because *Pseudomugil reticulatus* is similar other members of the *Pseudomugil* genus the behaviour will be similar. Aquarium observations worldwide of *Pseudomugil reticulatus* have been recorded to be similar to other related fish from this genera are mid to surface dwellers, exhibiting little aggression toward other fish except from breeding males and this aggression is stylised display that is harmless and generally ignored by fishes of other species and mostly ignored by their own species except other males trying to attract available females.

References:

Aqua-fish.net – since 2005 - https://www.fishbase.de/summary/Pseudomugil-reticulatus.html

Herbert, B. and J. Peters (1995). Freshwater Fishes of Far North Queensland Department of Primary Industries, Queensland.

Larson, H.K. and K.C. Martin (1990). Freshwater Fishes of the Northern Territory. Northern Territory Museum, Darwin.

Morgan, David L., Allen, Gerald R., Pusey, Bradley J., and Burrows, Damien W. (2011) *A review of the freshwater fishes of the Kimberley region of Western Australia.* Zootaxa, 2816. pp. 1-64.

8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take

advantage of small crustaceans, aquatic and terrestrial insects when available. *Pseudomugil reticulatus* is a small omnivore, a second order consumer that itself would form part of the diet of larger predatory fishes. It is a species with a maximum recorded length of 28mm (Allen 1981)

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Tappin, Adrian. (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c Habitat and local environmental conditions

Pseudomugil reticulatus are mid water swimmer and thus cause no disturbance to the substrate or cause water turbidity. Their dietary components (algae and aquatic organisms) are abundant in any healthy ecosystem. This species breeds by laying eggs on aquatic vegetation or debris and does not damage the habitat doing so. They exhibit no parental care so have no extra biological advantage over other rainbowfish or other egg laying species.

The introduction of disease from the introduction of a *Pseudomugil reticulatus* sp. 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*. Any diseases that are carried into native waters by escaped *Pseudomugil* (Fishbase records diseases in other *Pseudomugil* species such as fin rot, flukes and general bacterial infections) are unlikely to be more lethal to Australian rainbowfishes than would diseases they may already by carrying. In particular, with Mycobacteriosis, a common captive disease of rainbowfish worldwide, there is no *Mycobacterium* species specific to melanotaeniids (ANGFA, 2002). Kahn et al. (1999) stated that mycobacteriosis equally affects a wide range of freshwater and marine aquarium fish in Australia.

Reference:

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Pseudomugil reticulatus,* are raised, that it has formed or will form feral populations. In the unlikely event that it would in northern Australia, those populations would be more likely to be under pressure from native Australian aquatic predators than would populations of other small exotic fishes (such as those of guppies and swordtails which are a permitted import to Australia and have formed feral populations) because their habits would be more 'familiar' to predators. There is no information that describes any control or eradication of this genus.

A disease import risk assessment report was prepared by Panaquatic Health Solutions for Biosecurity Australia concluded there were 4 diseases of concern but revealed that all these diseases also occur in Australian waters.

References:

Allen, G.R. and N.J. Cross (1982). Rainbowfishes of Australia and Papua New Guinea. Angus & Robertson. (pp9-16)

Hardy-Smith P., Jones R. and Kailola P. (2007) *"Scientific review of the biosecurity risks* associated with the importation of rainbowfish for ornamental purposes" - Prepared for Biosecurity Australia by Panaquatic® Health Solutions Pty Ltd

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/

Kahn, S.A., Wilson, P.W., Pereira, R.P., Hayder, H. and Gerrity, S.E. 1999. *Import Risk analysis on live ornamental finfish*. Canberra: Australian Quarantine and Inspection Service. 172 p.

Walstad, Diana (2017) Mycobacteriosis in Aquarium Fish. located at: http://dianawalstad.com

9. What conditions or restrictions, if any, could be applied to the import of the species to reduce any potential for negative environmental impacts (e.g. single sex imports).

Arthington et al. (1999) considered that there is a low or residual probability that New Guinea rainbowfishes would establish feral populations in Australia. Indeed, have been kept and bred here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Pseudomugil reticulatus* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from German breeders and then from commercial facilities to which these captive bred stocks are distributed.

Pseudomugil reticulatus poses no greater threat to Australian aquatic biodiversity. The distinctive colouration of this species, likely popularity of this species among hobbyists, and expectant relatively high price should together mitigate against any likelihood of accidental establishment of feral populations. It is unknown whether this species has any distinctive features that would make it readily identifiable at a small size, blue-eye fry at 10 millimetres are relatively difficult to differentiate to a species level. It is therefore recommended that any importation of these fish should be a minimum length of 2 centimetres for ease of identification.

Retailers/traders should be encouraged to engage in "best practice" and to provide relevant information brochures to buyers of this species. At present, there are numerous *Pseudomugil* species being kept in Australia that have been derived from very small numbers of fish, imported pre-1986 and surviving despite very narrow genetic variability. The genetic basis of this species will be considerably wider and thus the need for "fresh" wild stock imports at a later date will be unlikely. Importation of single sex or reproductively altered individuals would not be of any value to the recipient aquaculture business.

References:

Arthington, A. H.; Kailola, P. J.; Woodland, D. J.; Zaluki, J. M. (1999) Baseline environmental data relevant to an evaluation of quarantine risk potentially associated with the importation to Australia of ornamental finfish. Report to the Australian Quarantine and Inspection Service. Canberra, ACT, Department of Agriculture, Fisheries and Forestry

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

10. Provide a summary of the proposed activity, including the intended use of the species (e.g. pet, commercial, scientific).

If accepted for import, *Pseudomugil reticulatus* will be used in the live fish ornamental aquarium display trade, as well as commercial fish farms. *Pseudomugil reticulatus* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven species of *Pseudomugil, connieae, cyanodorsalis, furcatus, gertrudae, mellis, signifer, and tenellus* have been kept, bred here, and popular in Australia, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Blue-eyes of the genus *Pseudomugil* have been used as an ornamental species within the aquarium hobby and aquarium trade in Australia ever since their introduction in the 1960's.

If *Pseudomugil reticulatus is* added to the allowable import list it is logical that aquarium fish importers will most likely import this species as part of the normal numbers of species imported from the usual foreign sources of ornamental aquarium fishes that are acceptable to the conditions imposed by the Biosecurity Act 1915.

11. Provide detailed guidelines on the way in which the species should be kept, transported and disposed of in accordance with the types of activity that the species may be used for if imported into Australia. You must include:

The fish will be transported as per the conditions set down by the International Air Transport Association (IATA) guidelines and the provisions of AQIS policy document 99/2750a (AQIS 1999). The importation of the species will adhere to provisions of Biosecurity Australia advice 2009/24 issued 02 October 2009. Keeping in captivity, husbandry information is well documented by Tappin 2005.

References:

Biosecurity Australia. (2009) " **BIOSECURITY AUSTRALIA ADVICE 2009/30 EXTENSION OF POLICY TO INCLUDE THE IMPORTATION OF RED RAINBOWFISH FOR ORNAMENTAL PURPOSES".** Published by the Australian Government, available at: http://www.daff.gov.au/SiteCollectionDocuments/ba/memos/2009/2009-30.pdf Downloaded 17 Jul 2015.

Tappin, Adrian. (2005) "*Rainbowfishes ~ Their Care & Keeping in Captivity 2nd. Edition - 2011"* available at: http://www.mediafire.com/file/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

11.a the containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen

The specimens if approved for import will be imported under the same provisions and disease protocols as used for other ornamental fishes imported by Aquarium Importers and the current quarantine practices as outlined by Biosecurity Australia Advice 2009/24 of 2 October 2009. They will be kept in aquariums with lids inside buildings.

Reference:

Biosecurity Act 2015 as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator:
https://www.legislation.gov.au/Details/C2020C00127 Accessed 20 August 2022.

11.b the disposal options for surplus specimens

The species will be kept under the same conditions as any other members of the same genus would be kept in Aquaria. The Aquarium trade will treat this fish in a similar to other members of the genus *Pseudomugil* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Pseudomugil reticulatus* will be kept under conditions that mimic the water quality and diet that are as close as possible to the limited knowledge of its natural habitat.

There is a process in place under the provisions of the new Biosecurity Act 2015 for importing Ornamental Fishes and the disease protocols to prevent fish carrying disease into Australia. The proponents do not intend to import any *Pseudomugil reticulatus* into Australia but realise that other importers may do so. Any importer will have to follow the quarantine protocols put in place by the Department of Agriculture and Water Resources. Australian Government Department of Agriculture and Water Resources, conditions for importing live ornamental fish into Australia available at:
http://www.agriculture.gov.au/import/goods/live-animals/importing-live-fish-aus

If application is successful, hobbyists and commercial breeders are able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

References:

ANGFA "Code of Conduct"
https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html

Aquagreen Aquarium and Pond Keepers Code of Conduct – available at URL - https://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf

Caughey, A. and Armstrong, N. (1993). A code of ethics for ANGFA fishkeepers. *Fishes of Sahul* **7(4),** 332–334.

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [online] Available at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf [Accessed 17 April 2021].

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including:
the species' current quarantine status, or
pest or noxious status, or
whether it is prohibited or controlled by permit or licence in any state or territory.

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Pseudomugil reticulatus* being an invasive or noxious species, anywhere in the world.

12.a The Commonwealth Government

Regulation of fish imports is in two parts, biosecurity and possible risk to the environment. Environmental risk is controlled and assessed under provisions the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The list of allowable species of fishes for importation into Australia and *Pseudomugil* is not included on the current list. The current list of fishes allowed for importation occurs in section 303 EB of the Environment Protection and Biodiversity Conservation Act 1999 Information about importation of fishes is available on Department of The Environment and Energy web site accessed on 20/08/2022 at https://www.legislation.gov.au/Series/F2006B01053

The disease risk assessment used to be controlled by the provisions of the Quarantine Act 1908. The current legislation is the Biosecurity Act 2015 as in force 9th April 2020 available at https://www.legislation.gov.au/Details/C2020C00127 and accessed 20/08/2022. The Federal Department that changes its name regularly and is responsible for the administration of these acts this week is The Department of Agriculture, Water and the Environment which was established on 1 February 2020.

12.b The Northern Territory Government

The Northern Territory Fisheries Division Department of Industry, Tourism and Trade

will not allow Pseudomugil reticulatus across its border unless it has passed the Commonwealth guidelines for acceptance into Australia. The list of species of fishes allowed into the Northern Territory for ornamental fishes is the same as Commonwealth list under the provisions of the EPBC Act 1999 or native to Australia but with the possibility of having the species rejected if it is deemed unsuitable by the NT. Minister for Fisheries as outlined in section 26 of the Northern Territory Fisheries Regulations 2017.

The most current version of the Northern Territory Fisheries Regulations accessed on 20/08/2022 at: https://nt.gov.au/marine/for-all-harbour-and-boat-users/biosecurity/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , shows no *Pseudomugil* on that list

12.c The Queensland Government

The Queensland legislation to control possession of noxious fish called “Restricted Matter” comes under the provisions of the Biosecurity Act 2014, Schedule 2 lists Noxious Fish in the Restricted matter schedule . Part 6 of the Act lists further Noxious Fish. Pseudomugil reticulatus is not listed on this schedule as noxious fish or listed in the restricted matter schedule.

The most current version of Queensland Biosecurity Act 2014 accessed on 20/08/2022 and accessed at: https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Pseudomugil* on the list.

12.d The Western Australian Government

Under Regulation 176 of the Fish Resources Management Regulations 1995, a person must not bring into the State a species of fish not endemic to the State without the written approval, or written authority, of the Executive Director of the Department of Fisheries. Species listed as noxious under Schedule 5 of the Fish Resources Management Regulations 1995 and prohibited to be imported into the State. Pseudomugil reticulatus is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 20/08/2022 at, http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Pseudomugil* on that list.

12.e The South Australian Government

Section 49 of the Fisheries Act 1982 makes it an offence to import or sell exotic fish. The South Australian Fisheries regulations relating to exotic aquarium fish are the Fisheries (Exotic Fish, Fish Farming and Fish Diseases) Regulations 2000, Regulations under The Fisheries Act 1982. Part 6 of the regulations creates schedule 3 that lists the fishes exempt from Section 49 of the fisheries Act.

The South Australian Government of noxious fish list accessed 20/08/2022, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Pseudomugil* on that list.

12.f The New South Wales Government

New South Wales Fisheries Management Act 1994 No 38 sections 209, 210 and 211 declare certain fish and plants to be noxious and it is an offence to possess or sell noxious fish. Section 217 controls the importation of live fishes into the state. Section 340 of the New South Wales Fisheries Management (General) Regulations 2002 declares certain fish, aquatic invertebrates and plants to be noxious. Pseudomugil reticulatus is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 20/08/2022, is available at

https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Pseudomugil* on that list

12.g The Victorian Government

Section 75 of the Victorian Fisheries Act 1995, allows the declaration of certain species as "Noxious Aquatic Species". The Victorian Government publishes the Noxious Aquatic Species List on their web site. Pseudomugil reticulatus does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 20/08/2022 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *Pseudomugil* on that list.

12.h Tasmania

To import freshwater aquarium or pond fish into Tasmania the Inland Fisheries Service requires registration as a Fish Dealer. Certain species may be imported under permit with written consent of the Director of the Inland Fisheries Service. Species listed as Controlled under the *Inland Fisheries Act 1995* cannot be imported into Tasmania. These species include European carp **(*Cyprinus carpio*)** mosquito fish **(*Gambusia* spp.)** Didymo a freshwater algae **(*Didymosphenia geminata*)** and freshwater turtles.

The Tasmanian noxious list accessed on 20/08/2022 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species There are no *Pseudomugil* listed on the page.

12.i Australian Capital Territory

Under s. 155 of the Nature Conservation Act 2014, held under a nature conservation licence, or listed on Part 1 of the Live Import List, established under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Part 1 of the Live Import List identifies non-native animals that can be brought into Australia without a permit.

Under s. 22 of the Act, it is an offence for a person to keep a prohibited pest animal if the person is ‘reckless’ about whether the animal is a prohibited animal and is also ‘reckless’ about whether keeping the animal would result, or would be likely to result, in the spread of

prohibited animals of that kind. For example, a person who keeps a fish that is declared as a prohibited pest animal is unlikely to be committing an offence if they keep that fish isolated in a tank and do not allow it to spread into public waters. However, if the species is also declared as notifiable, that person will now be required to notify the ACT Government that the species is being kept.

Proposed Amendments to the Pest Plants and Animals (Pest Animals) declaration discussion paper (May 2019) was to be published in 2020. It was accessed on 20/08/2022. It can be found at

https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/3115/5807/4536/Proposed-Amendments-to-the-Pest-Plants-and-Animals-Declaration-ACCESS-3.pdf . There are no *Pseudomugil* species listed.

Bibliography and relevant Readings:

ABARES 2020, Climatch v2.0 (Australian Bureau of Agriculture and Resource Economics and Sciences) November 2020 Available at: https://climatch.cp1.agriculture.gov.au/

Agriculture Department
http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/new-legislation/submission/terrestrial-ecosystems.pdf

Allen G.R. (1980) - A generic classification of the rainbowfishes (Melanotaeniidae). *Rec. West. Austral. Mus.,* 8 (3) 449-490.

Allen G.R. (1981) *Popondetta connieae*, a new species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Revue française d'Aquariologie 8 (2): 43-46.

Allen, G. R. (1983). Kiunga ballochi, a new genus and species of rainbowfish (Melanotaeniidae) from Papua New Guinea. Tropical Fish Hobbyist 32(2), 72-7.

Allen G.R. (1987) *Popondichthys*, a replacement name for the melanotaeniid fish genus *Popondetta*. Japanese Journal of ichthyology 33 (4): 409.

Allen G.R. (1989) Freshwater Fishes of Australia. TFH Publications, Neptune City, New Jersey. USA.

Allen G.R. (1991) Field guide to the freshwater fishes of New Guinea. Christensen Research Institute, Madang, Papua New Guinea.

Allen, G.R., (1995) Rainbowfishes In Nature and in the Aquarium, Their identification, care and breeding. Tetra-Verlag Germany. ISBN 1-56465-149-5

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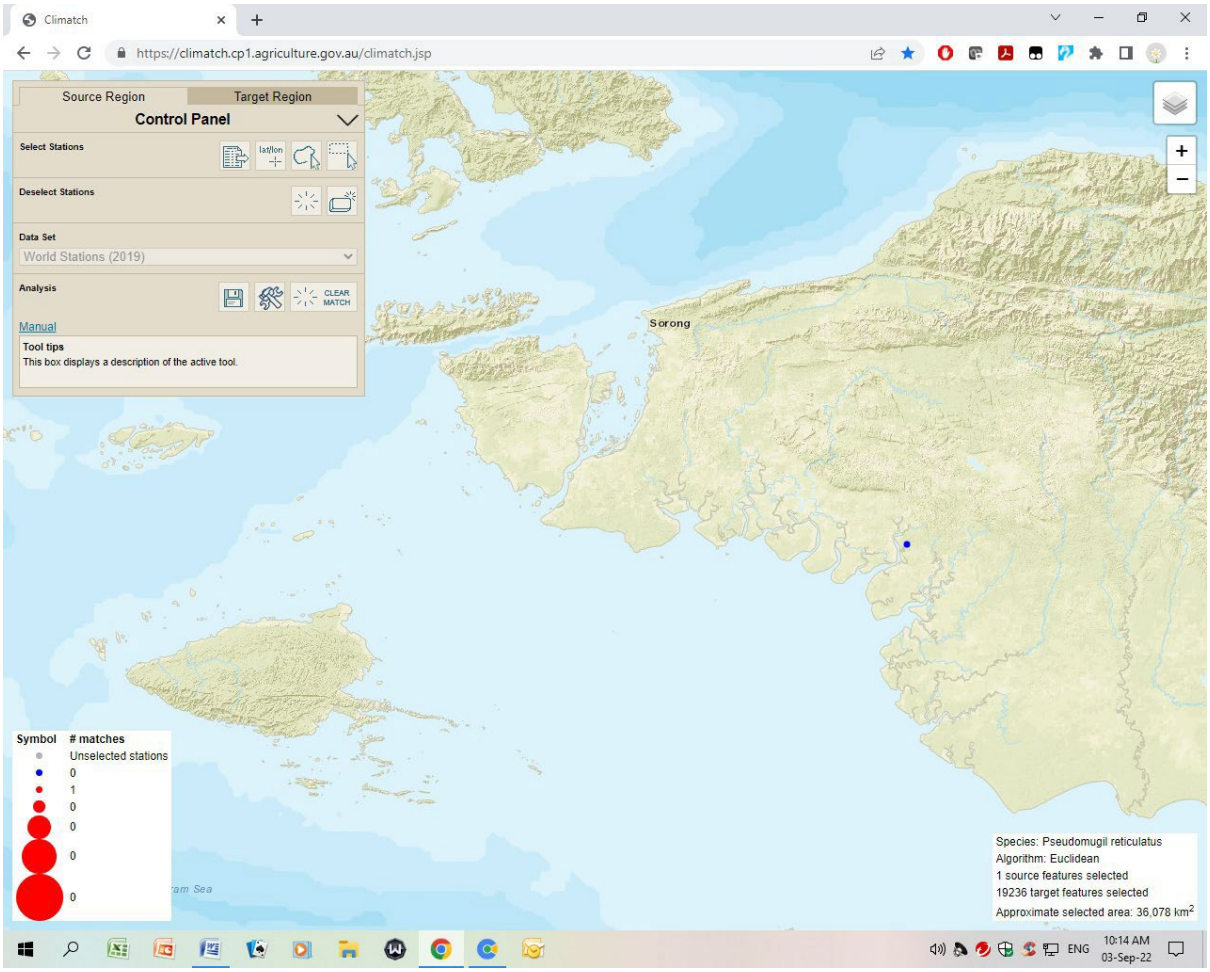
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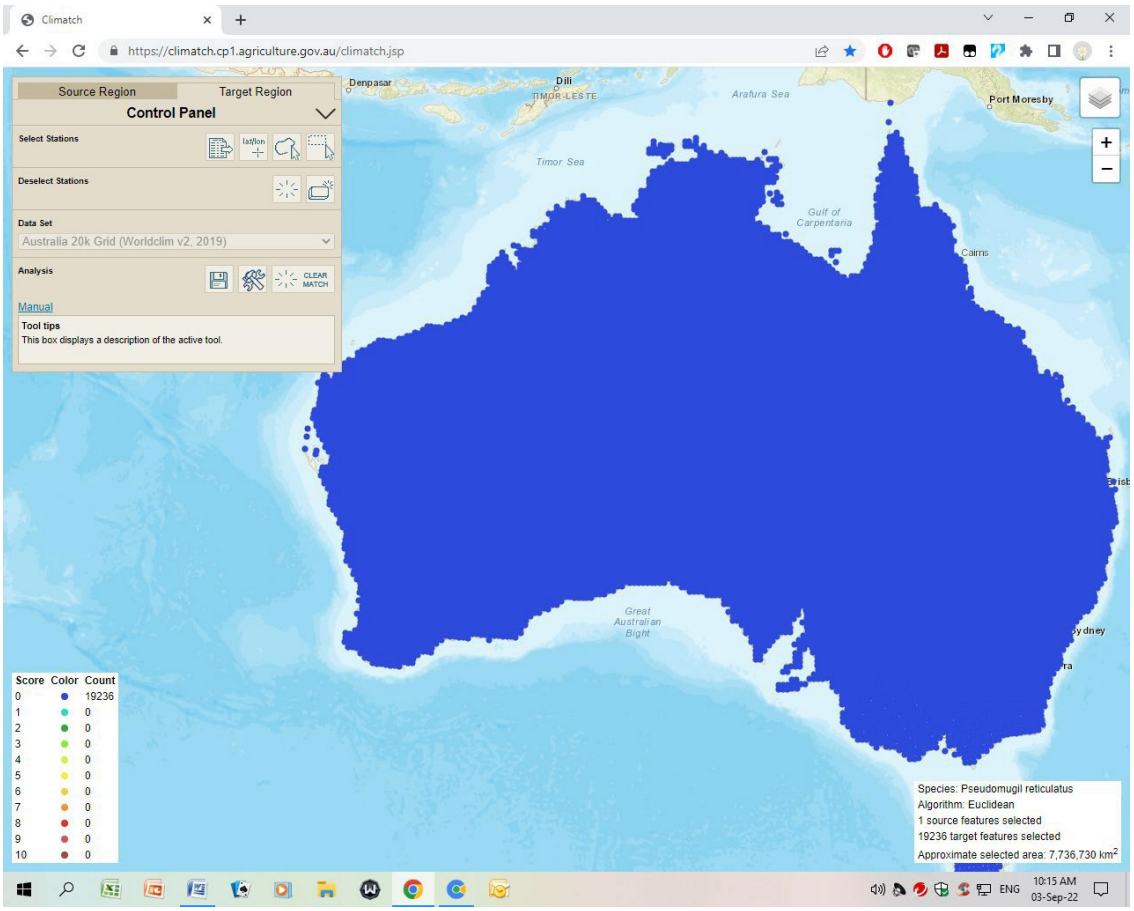
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APPENDIX A – calculation of climate from *Pseudomugil reticulatus* distribution climate to Australian Climate.





Appendix B

Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020 the following calculations were done to provide a score against the provisions in the assessment process.(accessed 29th August 2022.)

BOMFORD ASSESSMENT

SPECIES: Pseudomugil reticulatus

Score A. Climate Match (0-8)

Number of squares within 60% of the mean: (No. 5)	0
Number of squares within 50% of the mean: (No. 6)	0
Number of squares within 40% of the mean: (No. 7)	0
Number of squares within 30% of the mean: (No. 8)	0
Number of squares within 20% of the mean: (No. 9)	0
Number of squares within 10% of the mean: (No. 10)	0

Total = 0

Score: 0 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (1)

No. of squares : >1

Score: 0 (Ref: fishbase.org, googleearth.com)

Score C, Establishment

Locations of establishment incidence: nil - never introduced
Score: 1 (Ref: fishbase.org)

Score D, Introduction Success

Percentage of Introduction events that have been successful
Introductions nil
Successful: nil
Score: 1 (Ref: fishbase.org)

Score E, Taxa risk

Genus: Pseudomugil
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 0
Successful: 0 unknown
Score: 0 (Ref: fishbase.org / M. Bomford)

Total: 2 (VERY LOW)

The score of 2 according to the assessment model gives the fish a low chance of establishment.

Establishment Risk Rank	Establishment Risk Score
Extreme	**13**
Very High	**11–12**
High	**9–10**
Moderate	**6–8**
Low	**4–5**
Very Low	**≤ 3**

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