

**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.

## **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 Behavior 2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

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

**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.

**Saeed B., W. Ivantsoff and G. R. Allen** (1989) Taxonomic revision of the family Pseudomugilidae (Order Atheriniformes). *Australian Journal of Marine and Freshwater Research* 40: 719-787

## **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](http://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) 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:**

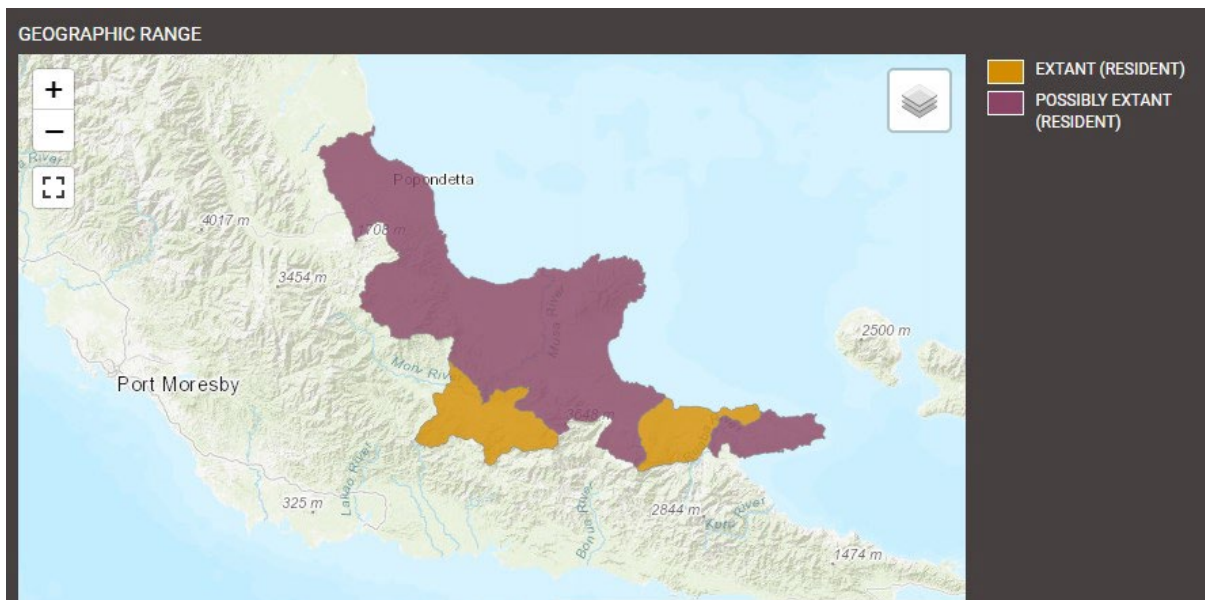
**Allen, G.R. & Cross, N.J.** (1982) "*Rainbowfishes of Australia and Papua New Guinea*". Published by Angus and Robertson

**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.

**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/g7qzn85ugde8v8o/Rainbowfishes.2011.pdf>

### 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.angfaqlid.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/g7qzn85ugde8v8o/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](http://www.fishbase.org), version (06/2022).

[https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&code=598&cpresence=Reported&sortby=alpha&ext\\_CL=on&ext\\_pic=on&vhabitat=fresh](https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&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](http://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 [REDACTED] 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.angfaqlid.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 wernerii*. 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://paaa.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, SrikuInath, 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 \(06/2022\).](http://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](http://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](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 from 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. 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, *Barringtonia 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 be 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<sup>®</sup> 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.

#### **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 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.

## 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 ██████████, 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.

## 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](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 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](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](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](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-fish> , 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://dpiwwe.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

**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. *Revue Française 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 Française d'Aquariologie* 12(3), 85-8.

**Allen G.R., S.H. Midgley and M. Allen** (2002) *Freshwater Fishes of Australia*. Western Australian Museum, Perth.

**Allen, G. R., and Moore, R.** (1981). *Pseudornugil paludicola*, a new species of freshwater blue-eye (Melanotaeniidae) from Papua New Guinea. *Revue Française d'Aquariologie* 7(4), 105-8.

**Allen, G. R., and Sarti, N.** (1983). *Pseudomugil cyanodorsalis*, une nouvelle espèce de blue-eye (Melanotaeniidae) d'Australie nord-occidentale. *Revue Française d'Aquariologie* 10(2), 47-50.

**Allen, G.R., Storey, A.W., and Yarrao, M** (2008). *Freshwater Fishes of the Fly River Papua New Guinea*. PT Freeport Indonesian Company, and Tropical Reef Research. ISBN 978-0-646-49605-4

**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.

**Allen, M.** Rediscovery of a jewel (*Kiunga ballochi*). *Fishes of Sahul* **19(3&4)**, 353-363.

**AMAZONAS (2016)** Species Snapshot. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Jan/Feb **5(1)** 92-96

**AMAZONAS (2020)** Species Snapshot. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Jan/Feb **9(1)** 92-96.

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

**ANGFA**, Australia New Guinea Fishes Association <https://angfa.org.au/>

**ANGFA “Code of Conduct”**

<https://www.angfa.org.au/about-constitution/206-angfa-code-of-conduct.html>

**ANGFA**, Australia New Guinea Fishes Association, (05/1990), Submission to 1990 IBM Conservation award review committee - Taronga Zoo. "Project Eachamensis" .. the saving of a species from extinction.

**ANGFA**, Australia New Guinea Fishes Association, (1993), The best of ANGFA Queensland Newsletters..the early years (1985-1992)

**ANGFA**. 2002. Response to the Thorogood report on *Glossolepis incisus*. Australia New Guinea Fishes Association. 15 p.

**ANGFA** Database available on the world wide web at URL <http://db.angfa.org.au>  
If reviewers require further information contact Author 1 for password access.

**Anon. 2001.** *Fish collection database of the National Museum of Natural History (Smithsonian Institution)*. Smithsonian Institution - Division of Fishes, Washington D.C.

**Aquagreen**, Aquarium and Pond Keepers Code of Conduct – available at URL - [https://www.aquagreen.com.au/files/Code\\_of\\_Conduct\\_V5.pdf](https://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf)

**Aquatic Notebook 2017.** (2015). Aquatic staff and readers. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Jan/Feb **6(1)** 6-7

**Arnold, K.E.** (2000). Kin recognition in rainbowfish (*Melanotaenia eachamensis*): sex, sibs and shoaling. PHD thesis, University of QLD.

**Arthington, A.H., Milton, D.A. and McKay, R.J.** (1983) "Effects of urban development And habitat alterations on the distribution and abundance of native exotic freshwater fish in the Brisbane region, Queensland". Australian Journal of Ecology, 8: 87-101.

**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

**Australian Government, Department of Agriculture,** Importing-Live-fish-Aus, Information and advice for importing live fish to Australia, published on the World Wide Web at Uniform Resource Locator <http://www.agriculture.gov.au/import/live-animals/importing-live-fish-aus>

**Australian Government, Quarantine Act 1908,** available at [http://www.austlii.edu.au/au/legis/cth/consol\\_act/ga1908131/](http://www.austlii.edu.au/au/legis/cth/consol_act/ga1908131/) Downloaded 17 July 2015

**Australian Quarantine Inspection Service (AQIS)** (July 1999) "Import Risk Analysis on Live Ornamental Finfish", available at: <http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/finalornamental.pdf> downloaded 17 July 2015 **Aqua-fish.net** – since 2005 - <https://en.aqua-fish.net/fish/doritys-rainbowfish>

**Axelrod, H.R., Burgess, W.E., Pronek, N. and Walls, J.G.** 1991. *Dr. Axelrod's Atlas of freshwater aquarium fishes*. T.F.H. Publications, Neptune City, New Jersey.

**Baensch, H.A. and Riehl, R.** 1985. *Aquarien atlas. Band 2*. Mergus, Verlag für Natur- und Heimtierkunde GmbH.

**Baillie, J. and Groombridge, B.** (editors and compilers). 1996. *1996 IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK.

**Beauforti (1960)** A series of miscellaneous publications zoological museum - Amsterdam No. 87 Volume 7 January 15, 1960 A list of type specimens of fishes in the Zoological Museum, University of Amsterdam. 1. Order Mugiliformes by J.J. Hoedeman (Zoological Museum, Amsterdam)

**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.

**Biosecurity Act 2015** as in force 25 march 2020, available on Federal Register of Legislation at Universal Resource Locator. Accessed 24 march 2021 <https://www.legislation.gov.au/Details/C2020C00127>

**Bleher, H.** A Pseudomugil account - with special remarks on then found on Aru Archipelago in 1907, 2004, 2007 *Fishes of Sahul* **22(4)**, 466-470.

**Bleher, H.** (2014). Back to the Aru Islands. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A Nov/Dec 2014 **3(6)** 22-31

**Bleher, H.** (2015). Reportage Etna Bay: A Primordial Paradise. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. May/June 2015 **4(3)** 66-73

**Boeck, H.H.** (2015). Discovering the blue eyes. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec 2017 **6(6)** 20-31

**Boeseman, M. (1963)** Notes on the fishes of western New Guinea 1. Zool. Mededelingen, 38(14); 221-242.

**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.

**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

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

**Carmody, G.** Ivantsoff's blue-eye - Emblem of Timika. Fishes of Sahul **27(4)**, 758-761.

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

**CITES** Species website with lists and search facility accessed on 17 April 2021.  
URL <http://www.cites.org/eng/disc/species.php>

**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.

**Corfield J, Diggles B, Jubb C, McDowall RM, Moore A, Richards A and Rowe DK** (2008). Review of the impacts of introduced ornamental fish species that have established wild populations in Australia'. Prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts. Available at:

<https://www.environment.gov.au/system/files/resources/fb1584f5-1d57-4b3c-9a0f-b1d5beff76a4/files/ornamental-fish.pdf> [Downloaded 17 April 2021]

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

**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 Behavior 2016, Vol. 48(10) 1242 –1269© 2015 SAGE Publications

**Crockford, L.B.** The Genus *Popondetta*, Fishes of Sahul **2(2)**, 66-68.

**Crockford, L.B.** *Pseudomugil paskai*, Fishes of Sahul **12(2)**, 561-562.

**Davis, MA, Grime, P and K Thompson** (2000) Fluctuating resources in plant communities: a general theory of invisibility. *Journal of Ecology*, 88: 528-534.

**DAWE** (2020b) "Import conditions for freshwater aquarium fish: Effective 18 July 2020. Department of Agriculture, Water and the Environment" [online] Available at: <https://bicon.agriculture.gov.au/BiconWeb4.0/ImportConditions/Conditions?EvaluatableElementId=482052&Path=UNDEFINED&UserContext=External&EvaluationStateId=7f1ea5c5-8bef-4b34-a789-987549620ff&CaseElementPk=1354044&EvaluationPhase=ImportDefinition&HasAlerts=False&HasChangeNotices=False&IsAEP=False> [Accessed 12 October 2020]

**Department of Agriculture and Water Resources** 2016, Biosecurity Import Risk Analysis Guidelines 2016: managing biosecurity risks for imports into Australia, Department of Agriculture and Water Resources, Canberra. ISBN 978-1-7600-3118-3 (online) This publication is available at [agriculture.gov.au](http://agriculture.gov.au).

**DOA** (2014) Importation of freshwater ornamental fish: review of biosecurity risks associated with gourami iridovirus and related viruses—Final import risk analysis report, Department of Agriculture, Canberra. Available online: <https://www.agriculture.gov.au/sites/default/files/style%20library/images/daff/data/assets/pdffile/0004/2404309/gourami-ira.pdf>

**EASystems** 2006 – Import Risk Assessment- Analysis of 10 species of fish. Report number 21397.9724. Department of the Environment and Heritage

**Environment Protection Biodiversity Conservation Act 1999** Australian Commonwealth Legislation available as an electronic publication from the world wide web at universal resource locator <https://www.legislation.gov.au/Details/C2021C00081> as in force 16 December 2020, accessed 24 march 2021

**Evers, Hans-Georg** (2017) Reportage - Timika, AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec **6(6)** 68-79.

**Evers, Hans-Georg** (2017) Editorial, AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec **6(6)** 4-5.

**Evers, Hans-Georg** (2019) Notes from the field. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Sep/Oct **8(5)** 80-89

**Evers, Hans-Georg** (2020) Notes from the field. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Mar/Apr **9(5)** 79-88.

**Flannery, Tim** (1994) "The Future Eaters: An Ecological History of the Australasian Lands and People", ISBN 0-8021-3943-4 ISBN 0-7301-0422-2

**Francis, Robert A.** (2012) A Handbook of Global Freshwater Invasive Species ISBN 978-1-84971-228-6 <https://www.fishbase.de/summary/Chilatherina-lorentzi.html>

**Fricke, R., Eschmeyer, W.N. and Van der Laan, R.** (eds). 2019. Eschmeyer's Catalog of Fishes: genera, species, references. Updated 07 October 2019. Available at: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>.

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



**Graf, Johannes** (2018) Reportage, Searching West Papua for new Rainbowfishes , AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec 2018 **7(6)** 52-63.

**Grant, E. M.** (1982). 'Guide to Fishes', 5th Edn. (Queensland Co-ordinator General's Department: Brisbane.)

**Giinther, A.** (1867a). Additions to the knowledge of Australian reptiles and fishes. Annals and Magazine of Natural History (series 3) 20, 45-68.

**Groombridge, B.** (ed.). 1994. *IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland and Cambridge, UK.

**Hammer, MP et al** (2018). Revision of the Australian Wet Tropics endemic rainbowfish genus Cairnsichthys (Atheriniformes: Melanotaeniidae), with description of a new species. Zootaxa, 4413 (2): 271–294.

**Hansen, B.** Inconspicuous by name and nature, Fishes of Sahul **9(2)**, 412-414.

**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

**Heemskerk, W.** (2022) Blue-eyes, beauties from Oceania, AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Jul/Aug **11(4)** 44-53.

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

**Herre, A.W.C.T.** (1935): New fishes obtained by the Crane Pacific expedition. Field Museum of Natural History, Publications, Zoological Series 18 (12), 383-438.

**Herre, A.W.C.T.** (1936): Fishes of the Crane Pacific Expedition. Field Museum of Natural History, Publications, Zoological Series 21 (1) 353-472.

**Hieronimus, Harro.** Aqualog (2002), Regenbogenfische und verwandte familien, all Rainbows and related families. ISBN 3-931702-80-4

**Hieronimus, Harro.** Aqualog Special (1999), Breathtaking Rainbows. ISBN 3-931702-51-0

**Hoedeman, J. J.** (1960). A list of type specimens of fishes in the Zoological Museum, University of Amsterdam. 1. Order Mugiliformes. Beaufortia 7(87), 211-17.

**Howeth, J.G, Gantz, CA, Angermeier, PL, Frimpong, EA, Hoff, MH, Keller, RP, Mandrak, NE, Marchetti, MP, Olden, JD, Romagosa, CM and DM Lodge** (2016). Predicting invasiveness of species in trade: Climate match, trophic guild and fecundity influence establishment and impact of non- native freshwater fishes. Diversity and Distributions, 22: 148–160.

**IUCN** 2022. The IUCN Red List of Threatened Species. Version 2022-1/ at: <https://www.iucnredlist.org> accessed August 2022.

**Ivantsoff, W., and Allen, G. R.** (1984). Two new species of Pseudornugil (Pisces : Melanotaeniidae) from Irian Jaya and New Guinea. Australian Zoologist 21(5), 479-89.

**Ivantsoff, W., and Johnston, P. G.** (1979). Clinal variation in electrophoretic and morphological characters between two nominal species of the genus *Pseudomugil* (Pisces : Atheriniformes : Pseudomugilidae). *Australian Journal of Marine and Freshwater Research* 30, 375-86.

**Ivantsoff W., P. Unmack, B. Saeed and Crowley L.E.L.M.** (1991) A red-finned blue-eye, a new species and genus of the family Pseudomugilidae from central-western Queensland. *Fishes of Sahul* 6(4): 277-282.

**Jenkins, A.** 2007. *Pers. comm.* SRLI Freshwater Fish Assessment Evaluation Workshop.

**Jordan, D. S., and Hubbs, C. L.** (1919). 'A Monographic Review of the Family Atherinidae or Silversides.' (Stanford University Press: Stanford.)

**Kadarusman, H.N, Hadiaty RK, Sudarto, P.E, Paradis, E and L Pouyand** (2012) Cryptic Diversity in Indo-Australian Rainbowfishes Revealed by DNA Barcoding: Implications for Conservation in a Biodiversity Hotspot Candidate. *PLoS ONE* 7(7): e40627.  
doi:10.1371/journal.pone.0040627

**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.

**Kailola, P.J.** 1987. *The fishes of Papua New Guinea. A revised and annotated checklist. Vol. 1. Myxinidae to Synbranchidae.* Research Section, Department of Fisheries and Marine Resources, Port Moresby, Papua New Guinea.

**Kailola, P.J.** 1991. *The fishes of Papua New Guinea: a revised and annotated checklist. Vol. III. Gobiidae to Molidae.* Research Section, Department of Fisheries and Marine Resources, Port Moresby, Papua New Guinea.

**Kailola, P.J.** (2004) Risk assessment of ten species of ornamental fish under the Environment Protection and Biodiversity Conservation Act 1999. DEH consultancy report, Australia.

**Lake, J. S.** (1971). 'Freshwater Fishes and Rivers of Australia.' (Nelson: Melbourne.)

**Lange, Gary** (2014) Raise and Shine. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec 2014

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

**Lawson, David** (1997) The Northern Territory Government policy "Strategy for Conservation through Sustainable Use of Wildlife"  
[http://www.nretas.nt.gov.au/\\_\\_data/assets/pdf\\_file/0018/11187/sustainable\\_utilisation\\_wildlife.pdf](http://www.nretas.nt.gov.au/__data/assets/pdf_file/0018/11187/sustainable_utilisation_wildlife.pdf)

**Leggett, R. and J.R. Merrick** (1987). *Australian Native Fishes for Aquariums,* Griffin Press.

**Leiper, G.** Honey blue-eye endangered?, *Fishes of Sahul* **2(2)**, 72.

- Lever, C.** (1996). *Naturalised Fishes of the World* Academic Press. ISBN 0-12-444745-725
- Lewis, F.** (1961). Australian aquarium fishes. *Finchat* October 1961, 17-19. Macleay, W. (1881). Description catalogue of Australian fishes. *Proceedings of the Linnean Society of New South Wales* 6, 1-138.
- Lundberg J.G., M. Kottelat, G.R. Smith, M.L. J. Stiassny and Gill A.C.** (2000) So Many Fishes, So Little Time: An Overview of Recent Ichthyological Discovery in Continental Waters. *Annals of the Missouri Botanical Garden* 87(1): 26-62.
- Lundvist. R.** (2017) Rainbowfishes and blue-eyes down under. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec **6(6)** 40-45.
- Macleay, W.** (1884). Notices of new fishes. *Proceedings of the Linnean Society of New South Wales* 9, 170-2.
- Majtánová, Unmack, Prasongmaneerut, Shams, Srikulnath, Ráb and Ezaz** (2020) "Evidence of Interspecific Chromosomal Diversification in Rainbowfishes (*Melanotaeniidae*, *Teleostei*)" published *Genes* 2020, 11, 818; doi:10.3390/genes11070818
- McCosker, J.** (1998). Mate choice and sexual selection in two species of Australian rainbowfish (*M. duboulayi* and *M. splendida splendida*): implication for speciation. Honours thesis, University of Queensland.
- McCulloch, A. R.** (1929). A checklist of the fishes recorded from Australia. *Records of the Australian Museum* 5(1), 1-144.
- McCulloch, A. R.** (1934). 'The Fishes and Fish-like Animals of New South Wales.' (Royal Zoological Society of New South Wales: Sydney.)
- McCulloch, A. R., and Whitley, G. P.** (1925). A list of fishes recorded from Queensland waters. *Memoirs of the Queensland Museum* 8(2), 125-82.
- McGuigan K., D. Zhu, G.R. Allen and C. Moritz** (2000) Phylogenetic relationships and historical biogeography of melanotaeniid fishes in Australia and New Guinea. *Marine and Freshwater Research* 52: 713-23.
- McNee, Alex** ( no date on publication ) "A national approach to the management of exotic fish species in the aquarium trade: An inventory of exotic freshwater species" Published by Bureau of Rural Sciences, Canberra
- Merrick, J. R., and Schmida, G. E.** (1984). 'Australian Freshwater Fishes.' (Griffin Press: Adelaide.)
- Moritz C.** (1994) Defining "Evolutionarily Significant Units" for conservation. *Trends in Ecology and Evolution* 9 :373-375.
- Munro, I. S. R.** (1958a). Family Pseudomugilidae. (Handbook of Australian Fishes, No. 24.) *Fisheries Newsletter* 17, 97-100.

**Munro, I. S. R.** (1958b). The fishes of New Guinea region: checklist of the fishes of New Guinea incorporating new records of species collected by the fisheries survey vessel Fairwind during the years 1948 to 1950. Papua New Guinea Agricultural Journal 10(4), 97-369.

**Munro, I.S.R.** 1967. *The Fishes of New Guinea*. Department of Agriculture, Stock and Fisheries, Port Moresby, New Guinea.

**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.

**Nijssen, J., Tuijl, L. van, and Isbriicker, I. J. H.** (1982). 'A Catalogue of Type-specimens of Recent Fishes in the Institute of Taxonomic Zoology (Zoologisch Museum), University of Amsterdam, the Netherlands.' [Instituut voor Taxonomische Zoologie (Zoologisch Museum), Universiteit van Amsterdam: Amsterdam.]

**Ogilby, J. D.** (1896). A new family of Australian fishes. Proceeding of the Linnean Society of New South Wales 21, 118-35.

**Ogilby, J. D.** (1897). A new genera and species of Australian fishes. Proceeding of the Linnean Society of New South Wales 22, 62-95.

**O'Leary, Rachel** (2018) A basement full of Rainbows, AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Nov/Dec 2014

**Panaquatic® Health Solutions Pty Ltd, 2009**, "Scientific review of the Biosecurity risks associated with the importation of rainbowfish for ornamental purposes", available at <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](http://www.agriculture.gov.au/SiteCollectionDocuments/ba/animal/horsesubmissions/2009-24a-1%20red%20rainbowfish%20attachment.pdf)

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

**Phelong, P.C.** (1996) "Climex: a system to predict the distribution of an organism based on climate preferences". Available as a download from West Australian Government universal resource locator <http://www.agric.wa.gov.au>

**Queensland Fisheries Act 1994.** Available at: <http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/F/FisherA94>

**Queensland Fisheries Regulation 1995.** Available at: [www.legislation.qld.gov.au/LEGISLTN/CURRENT/F/FisherR95](http://www.legislation.qld.gov.au/LEGISLTN/CURRENT/F/FisherR95)

**Report on Biodiversity and Tropical Forests in Indonesia** (2004) Prepared for USAID/Indonesia Jl. Medan Merdeka Selatan No. 3-5 Jakarta 10110 Indonesia.

**Roberts, T. R.** (1978). An ichthyological survey or the Fly River in Papua New Guinea with description of new species. *Smithsonian Contributions to Zoology* 281, 1-72.

**Rosen, D. E.** (1964). The relationships and taxonomic position of the halfbeaks, killifishes, silversides, and their relatives. *Bulletin of the American Museum of Natural History* 127, 217-68.

**Rosen, D. E., and Parenti, L. R.** (1981). Relationships of *Oryzias*, and the groups of atherinomorph fishes. *American Museum Novitates* 2719, 1-25.

**RSG**, Rainbowfish Study Group of North America, (1992), *The Best of the RSG*.

**Renyaan, S.J.** (1993). The Freshwater Fishes of Lake Sentani, Jayapura, Irian Jaya. *Proceedings of the Biological Society of New Guinea*, R. Hoeft, Ed., Wau Ecology Institute.

**Saeed B., W. Ivantsoff and G. R. Allen** (1989) Taxonomic revision of the family Pseudomugilidae (Order Atheriniformes). *Australian Journal of Marine and Freshwater Research* 40: 719-787.

**Schmida, G.E.** (2000) "*Rainbowfish, A Complete Pet Owners Manual*"

**Shipway, B.** (1947). Freshwater fishes of Barron River. *North Queensland Naturalist* 15, 1-8.

**Sokal, R. R., and Sneath, P. H. A.** (1963). 'Principles of Numerical Taxonomy.' (W. H. Freeman: San Francisco.)

**Tappin, A. R.** Blue-eyes revisited. *Fishes of Sahul* **9(2)**, 405-411.

**Tappin, A.R.** (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity Second Edition - 2011" at: <https://rainbowfish.angfaqld.org.au.htm>

**Tappin, A. R.** 2006. Home of the Rainbowfish. Available at: <http://members.optushome.com.au/chelmon/index.htm>.

**Tappin, A.R.** (2005) "Rainbowfishes ~ Their Care & Keeping in Captivity Second Edition - 2011" at: <http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf>

**Taylor, W. R.** (1964). The fishes of Arnhem Land. In 'Records of the American-Australian Scientific Expedition to Arnhem Land'. (Ed. R. L. Specht.) pp. 44-307. (Melbourne University Press: Melbourne.)

**UNEP-WCMC.** 2004. World Database on Protected Areas. Available at: <http://www.unep-wcmc.org/wdpa/>

**University of Queensland** (1998). Rainbowfish Workshop. Proceedings of workshop discussing various student projects – UQ and Griffith Universities

**Unmack P.J.** (2001) Biogeography of Australian freshwater fishes. *Journal of Biogeography*, 28(9): 1053-1089

**Unmack, P.** (2022) Conserving threatened Australian Rainbowfishes. AMAZONAS, Aquatic Media Press LLC, Rochester, U.S.A. Jul/Aug **11(4)** 34-43.

**Varjo, M., Koli, L. and Dahlström, H.** 2004. Kalanimiluuttelo (versio 10/03). Suomen Biologian Seura Vanamo Ry.

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

**Weber, M. 1907.** Süßwasserfische von Neu-Guinea. Ein Beitrag zur Frage nach dem früheren Zusammenhang von Neu-Guinea und Australien. In: Wichmann, A. (ed.), *Nova Guinea. Résultats de l'expédition scientifique Néerlandaise à la Nouvelle-Guinée en 1903*, pp. 201-267, plates

**Weber, M.** (1908). 'Nova Guinea. V. Zoologie.' (E. J. Brill: Leiden.) Weber, M. (1911). Die Fische der Aru und Kei Inseln: ein Beitrag zur Zoogeographie dieser Inseln. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft* 34, 1-49.

**Weber, M.** Professor at the University of Amsterdam, and **De Beaufort, L. F.** (1911) The fishes of the Indo-Australian Archipelago index of the Ichthyological papers of P. Bleeker Leiden —. E.J. Brill Ltd

**Weber, M. 1913.** Süßwasserfische aus Niederländisch Süd- und Nord-Neu-Guinea. *Nova Guinea. Résultats de l'expédition scientifique Néerlandaise à la Nouvelle-Guinée. Zoologie. Leiden* 9(4): 513-613.

**Weber, M.** (1913). Neue Beiträge zur Kenntnis der Süßwasserfische von Celebes: Ergebnisse einer Reise von E. C. Abendanon in Celebes. *Bijdragen tot de Dierkunde* 19, 197-213.

**Weber, M.** Professor at the University of Amsterdam, and **De Beaufort, L. F.** (1922) The fishes of the Indo-Australian Archipelago. iv heteromi, solenichthyes, synentognathi, perciformes, labyrinthici, microcyprini - Leiden E. J. Brill Ltd.

**Whitley, G. P.** (1932). Fishes. Great Barrier Reef Science Report 4(9), 278-9.

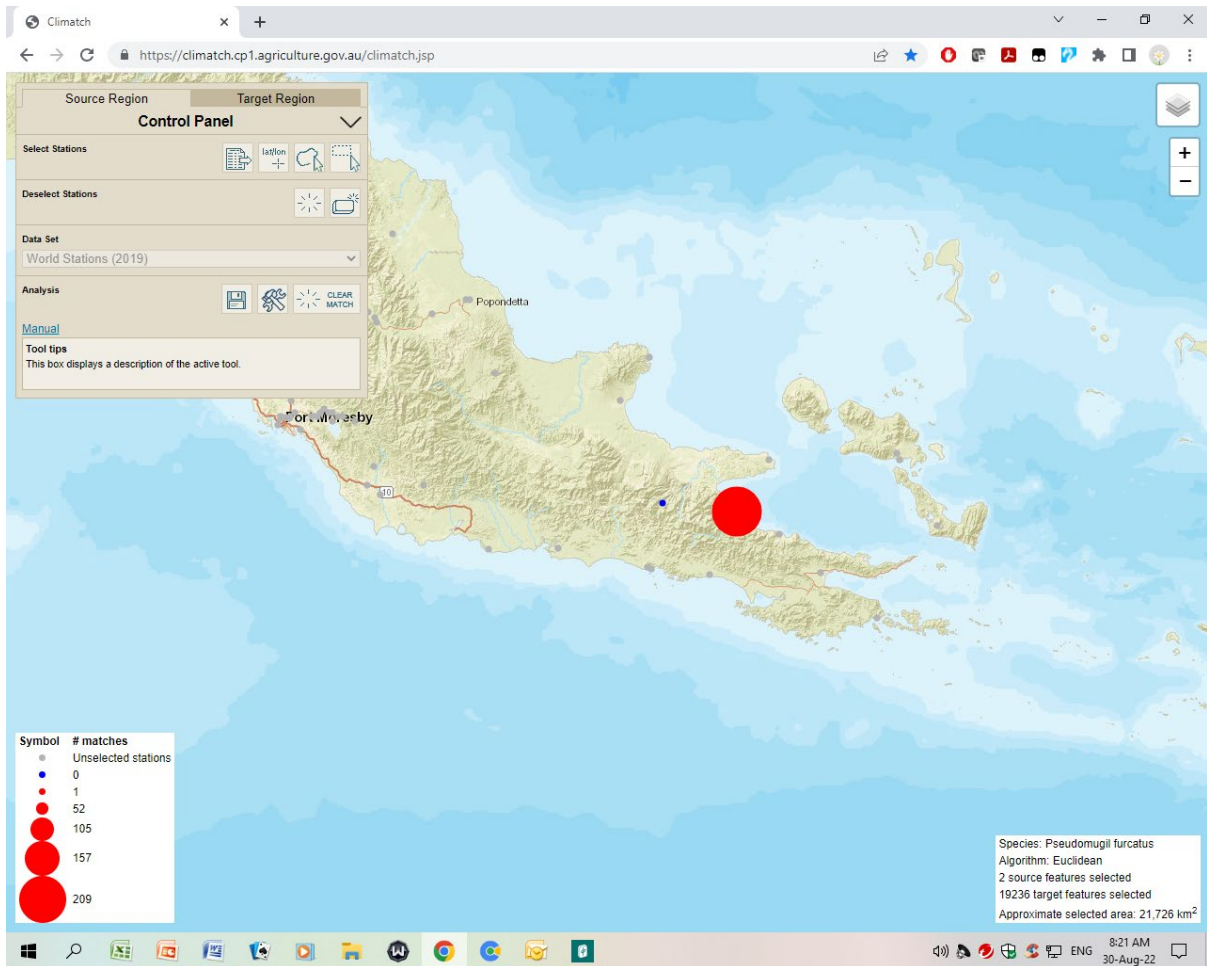
**Whitley, G. P.** (1935). Studies in ichthyology. Records of the Australian Museum 9, 223-9.  
**Whitley, G. P.** (1958). Blue-eyes. *Aqualife* 2(10), 14-19.

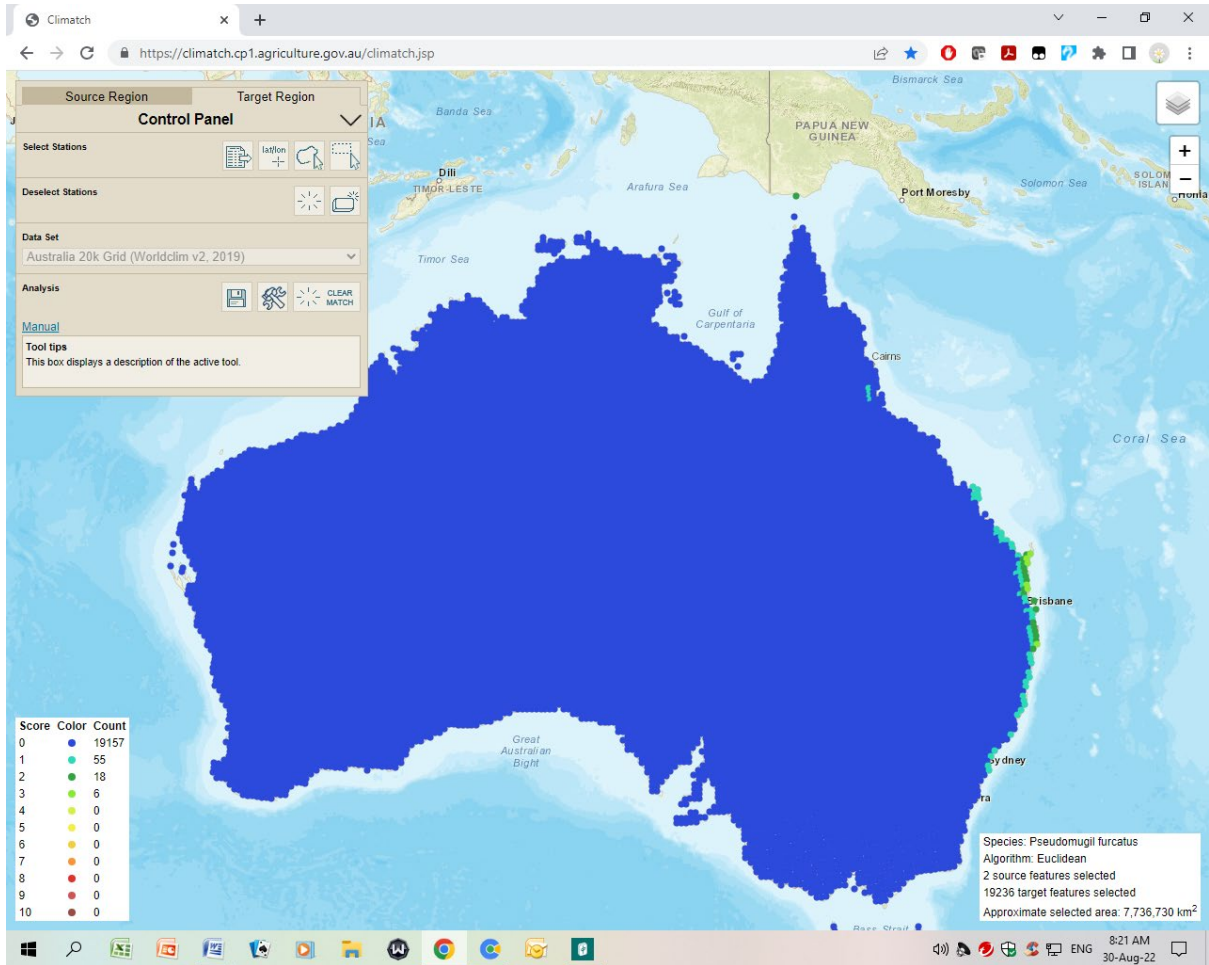
**Wilson, D.N. & Briggs, G.**(2004) "Aquarium and Pond Keepers Code of Conduct" available at [http://www.aquagreen.com.au/files/Code\\_of\\_Conduct\\_V5.pdf](http://www.aquagreen.com.au/files/Code_of_Conduct_V5.pdf)

**Wu, H.L., Shao, K.T. and Lai, C.F.** 1999. *Latin-Chinese dictionary of fishes names*. The Szeichan Press, Taiwan.

**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 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

**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

**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>