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

Pseudomugil connieae - Popondetta rainbowfish © Gunther Schmida

Information on the taxonomy of the species.

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

Pseudomugil connieae - Popondetta rainbowfish © Gerald R Allen

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

Introduction

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

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

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

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

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

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

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

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

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

References:

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

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

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

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

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

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

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

3.a Lifespan of the species.

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

References:

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

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

3.b Size and weight range.

Allen (198) records the following:

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

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

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

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

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

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

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

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

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

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

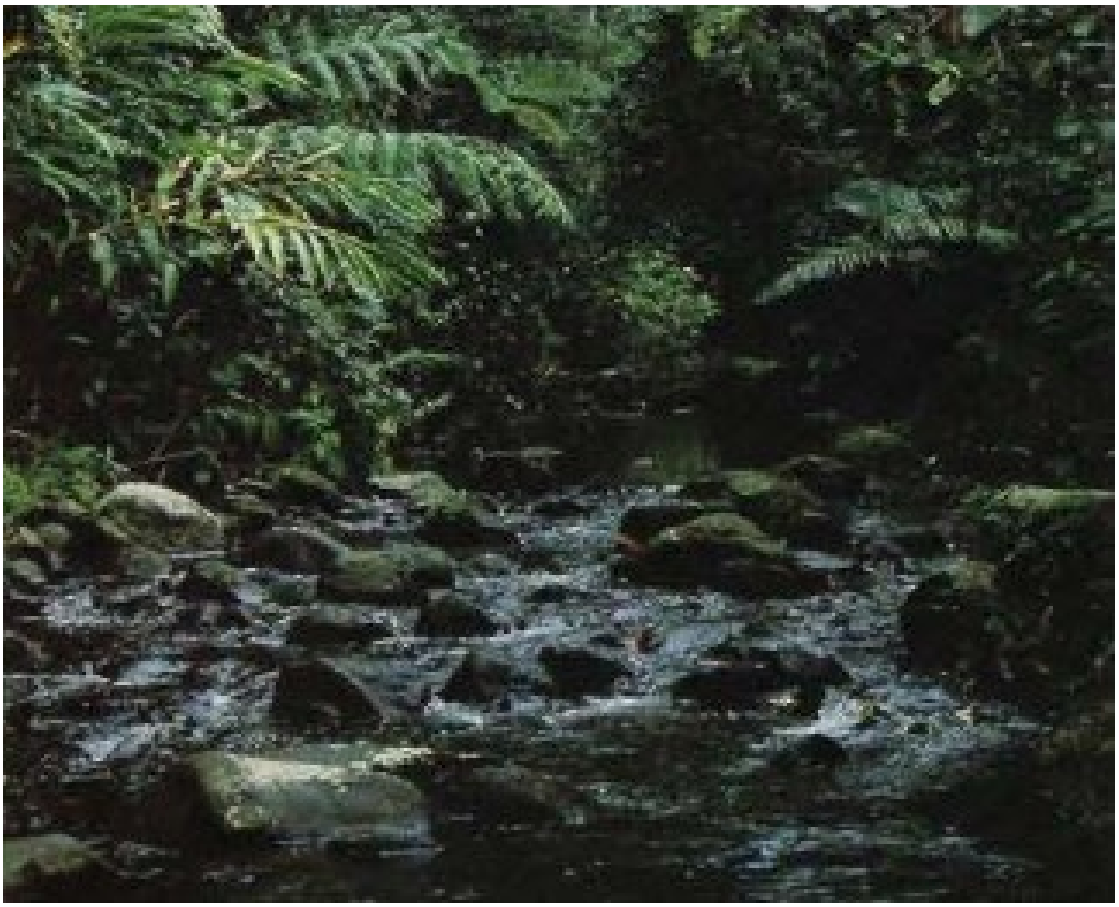
WAM P26418-001, 51 specimens, 16.4-33.6 mm SL, same data as AMS paratypes ;

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

References:

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

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



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

3.c The natural geographic range.

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

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

References:

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

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

3.d Habitat.

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

References:

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

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

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

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

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

References:

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

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

3.f Social behaviour and groupings

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

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

References:

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

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

3.g territorial and aggressive behaviours

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

3.h natural predators

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

Reference:

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

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

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

References:

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

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

Remarks

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

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

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

Aquarium Breeding

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

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

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

Reference:

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

4.a The age at maturity (first breeding)

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

References:

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

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

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

4.b how frequently breeding occurs

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

References:

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

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

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

4.c if the female can store sperm

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

Reference

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

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

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

References:

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

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

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

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

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

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

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

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

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

References:

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

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

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

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

4.f Fertility of Hybrid Progeny

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

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

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

References:

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

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

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

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

References:

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

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

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

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

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

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

References:

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

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

, or

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

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

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

Reference:

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

7a. ability to find food sources

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

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

References:

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

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

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

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

References:

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

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

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

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

7c. ability to find shelter

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

References:

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

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

7d. rate of reproducing

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

References:

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

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

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

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

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

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

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

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

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

References:

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

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

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

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

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

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

References ;

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

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

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

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

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

References:

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

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

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

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

8.b probable prey/food sources

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

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

References:

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

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

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

8.c Habitat and local environmental conditions

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

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

Reference:

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

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

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

References:

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

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

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

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

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

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

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

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

References:

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

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

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

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

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

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

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

References:

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

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

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

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

Reference:

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

11.b the disposal options for surplus specimens

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

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

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

References:

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

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

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

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

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

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

12.a The Commonwealth Government

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

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

12.b The Northern Territory Government

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

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

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

12.c The Queensland Government

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

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

12.d The Western Australian Government

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

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

12.e The South Australian Government

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

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

12.f The New South Wales Government

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

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

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

12.g The Victorian Government

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

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

12.h Tasmania

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

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

12.i Australian Capital Territory

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

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

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

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

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

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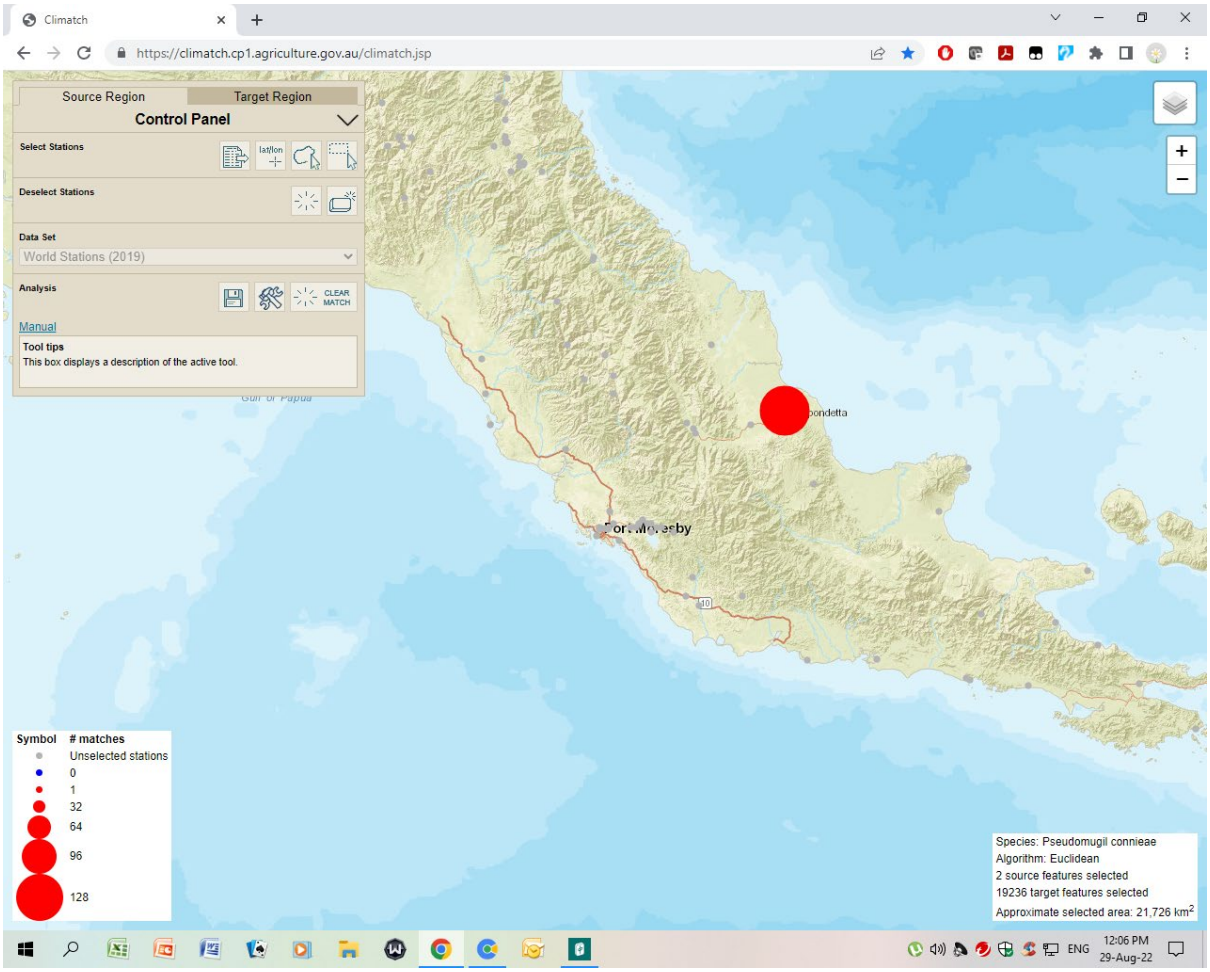
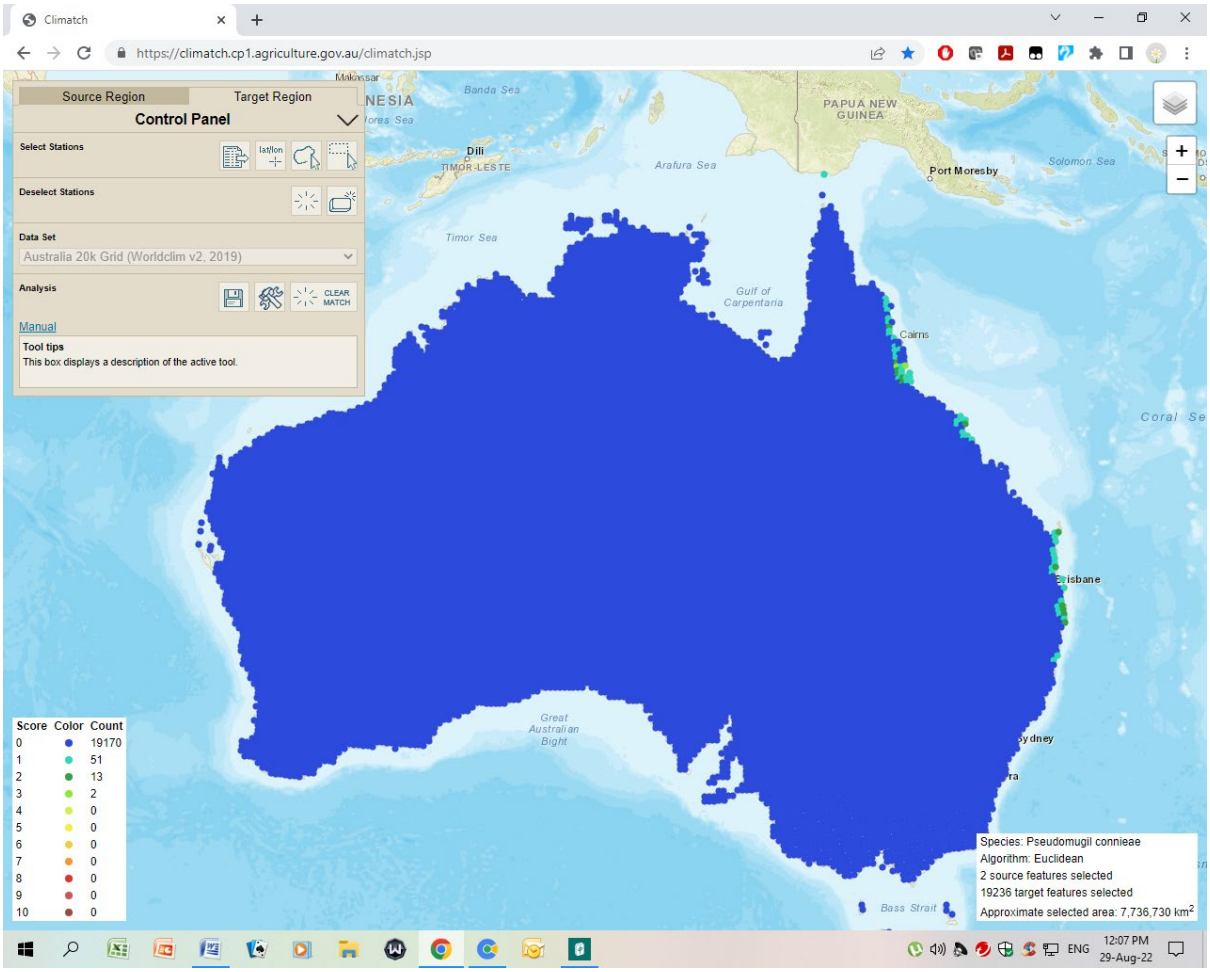
APPENDIX A – calculation of climate from *Pseudomugil connieae* distribution climate to Australian Climate.





Appendix B

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

BOMFORD ASSESSMENT

SPECIES: Pseudomugil connieae

Score A. Climate Match (0-8)

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

Total = 0

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

Score B, Overseas Range

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

No. of squares : >1

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

Score C, Establishment

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

Score D, Introduction Success

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

Score E, Taxa risk

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

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

Total: 2 (VERY LOW)

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

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

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