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

Chilatherina sentaniensis

Introduction

The keeping of tropical fish species in aquaria is growing in popularity and has been booming during the lock down period attributed to the Covid19 Pandemic. Studies into mental health have proven that an aquarium can produce a soothing effect on the human mind that tends toward anxiety. This trend to worry about the future seems to be increasing in recent times. Studies have demonstrated stress reduction from viewing aquatic life in an aquarium, lower heart rates and decrease in blood pressure. (Clements 2019 and Cracknell 2016)

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

The Authors of this report will determine that the Lake Sentani Rainbowfish *Chilatherina sentaniensis* does not possess any of the aspects of an organism that will cause problems should it escape effective human control. These aspects are reproduced from a statement prepared for a Court Case in the NT when an aquarium shop bought unassessed imported aquatic life to a Darwin Aquarium Shop. The statement was to be presented for the prosecution in the witness box by author 1 of this report, however the accused pleaded guilty.

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) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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. 2021.FishBase. www.fishbase.org, (02/2021) https://www.fishbase.se/summary/Chilatherina-sentaniensis.html

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Lake Sentani © Photograph Johannes Graf Permission to use photo

Terms of Reference

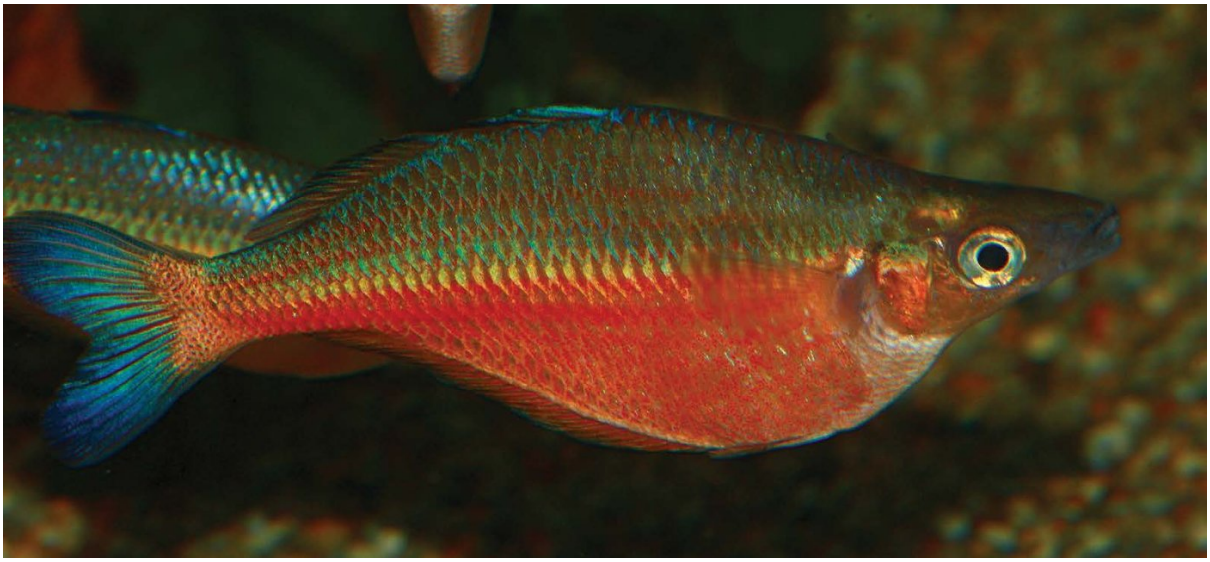
Overview: The rainbowfish genus *Chilatherina* consists of eleven species.

etymology: *Chilatherina* (origin - Chilatherina Greek) cheilos = lip + Greek, atherina, the Greek name for the eperlane

Characteristic differences to the closely related Rainbowfish genera *Melanotaenia* and *Glossolepis* are:

Chilatherina is closely related to Melanotaenia, the largest genus in the family. They differ chiefly with regard to jaw structure. In Chilatherina the lateral portion of the premaxillary is either straight or curved gently in a postero-ventral direction. The lower jaw is generally inferior to the upper jaw and the medial portion of the upper lip is swollen and profusely covered with teeth (Fig. 3). In addition, the head tends to be more slender and the snout relatively pointed compared with Melanotaenia. The latter genus by contrast, has a more or less abrupt downward bend in the lateral portion of the premaxillary with less swelling of the medial upper lip and fewer teeth on its surface. Moreover, the jaws are usually about even or the upper jaw is slightly inferior (Le. lower jaw protruding). The external jaw features of Chilatherina and Melanotaenia were illustrated by Allen (1980a).

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299. http://museum.wa.gov.au/sites/default/files/a%20revision%20of%20the%20rainbowfish%20genus%20chilatherina%20(melanotaeniidae).pdf



Chilatherina sentaniensis © Photograph Johannes Graf Permission to use photo

1. Provide information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Melanotaeniidae (Rainbowfishes)
Genus: *Chilatherina* (origin - Chilatherina Greek) cheilos= lip + Greek, atherina, the Greek ` name for the eperlane
Species: *Rhombatractus sentaniensis* Weber, 1908
Chilatherina sentaniensis (Weber, 1908)
Chilatherina sentaniensis, , Lake Sentani rainbowfish

Chilatherina sentaniensis

Chilatherina sentaniensis - © photo: Christophe Mailliet

Species Summary

Perhaps the most distinguishing feature of the Chilatherina genus is their deep, laterally compressed body that increases with age, particularly in males, and *Chilatherina sentaniensis* is no different. Their overall body colouration is silvery-blue or greenish on the upper back fading laterally to silverly orange. They have a diffuse blue or green mid-lateral band and narrow silver or light blue stripes between each horizontal scale rows. Males often show 6–8 reddish-brown bars on the lower sides of the body between the pectoral fin base and the level of the middle anal rays. However, colour can be variable depending on captive conditions. Males are more brightly coloured, larger, and deeper bodied than females. Males may reach a maximum size of 12 cm, but females are usually less than 10 cm.

Distribution & Habitat
Chilatherina sentaniensis are endemic to Lake Sentani and its tributaries streams. Lake Sentani is located some 10 kilometres west of Jayapura at the NE extremity of West Papua. It is an irregularly shaped lake with approximate dimensions of 28 km (E-W) by 19 km (N-S) and a surface area of 104 km2 . Its blue green waters are dotted with at least 16 small islands, and it is surrounded by hillsides in the south and the Cyclops Mountains in the north, which separate the lake from the Pacific Ocean. Lake Sentani is by far the largest of the West Papuan lakes and has a catchment area of about 600 km2 . About 35 small rivers flow into the lake, and there is one natural outlet in the south-eastern tip, via the Jafuri and Tami rivers to the Pacific Ocean near the Papua New Guinea border. The lake is divided into three main sections with recorded depths of 7 to 52 metres. According to surveys in 1970-71, 1984 and 1987 the lake is thermally unstratified, with surface temperatures of 29–32° and pH 6.2–6.8. Rainbowfishes are generally found around the margins of the lake. Large numbers are found congregating around submerged aquatic vegetation, fallen tree branches etc.

Because of its proximity to the provincial capital Jayapura and the large population around it, Sentani is no longer the pristine lake it once was. A survey by Samuel J. Renyaan in 1993 recorded 33 species of fish, of which 13 were introduced. Surveys have shown an increase in introduced species but the impact on the total fish population has not been documented. Fish are extensively raised in ponds and cages around the perimeter of the lake and the introduction of species (particularly carp and tilapia) has been both accidental and intentional.

Remarks
Chilatherina sentaniensis was originally collected from Lake Sentani and the Sekanto River during the 1899–1900 Siboga Expedition to the Dutch East Indies (West Papua). A large collection of specimens were also obtained from the lake by Marinus Boeseman during a collecting expedition for the Leiden Museum in 1954–1955. The lectotype of *Chilatherina sentaniensis*, preserved in the Amsterdam museum, shows a very long snout, which according to Gerald Allen, is an important distinguishing mark. In his 1982 book, “Rainbowfishes of Australia and New Guinea” Allen showed *Chilatherina sentaniensis* among the colour sketches, because he didn’t have any photographs of live specimens.

In 1982, live specimens of *C. fasciata* were collected from the Jafuri River and during the 1980s and early 1990s they were being distributed in the hobby as *Chilatherina sentaniensis*. In his Field Guide to the Freshwater Fishes of New Guinea of 1991 Gerald

Allen noted that probably all records of *Chilatherina sentaniensis* in the aquarium literature related to *C. fasciata* varieties and that the most recent collection of the true *Chilatherina sentaniensis* was made in 1954. In yet another book, Rainbowfishes in Nature and in the Aquarium, published in 1995, Gerald Allen showed a picture of a live specimen, with the remarkably long snout, that was collected in a small tributary stream flowing into the north-eastern end of Lake Sentani in 1991. Several specimens were netted along with *C. fasciata* and *Glossolepis incisus*. None of these specimens however, were collected live for the aquarium hobby.

The “genuine” *Chilatherina sentaniensis* does however, exist in the hobby and they have a much longer, more pointed head and usually 9–12 soft dorsal rays compared to 11–16 rays in *C. fasciata*. Live specimens were collected from the lake in 1991 by Charles Nishihira and distributed in the aquarium hobby. Specimens were also collected from a small tributary stream in 2004 and 2005. However, they have not been widely available and only a handful of enthusiasts are maintaining them in captivity.

There is some concern that *Chilatherina sentaniensis* may not occur in Lake Sentani anymore, only in some of the feeder streams. The only currently known location is “Carwash Creek” which is crossed by the road from Sentani to Jayapura. This creek is nowadays heavily polluted by upstream mining activities. In the last years, attempts to re-collect *Chilatherina sentaniensis* from this creek have been unsuccessful. It hasn’t been found at any other location so far (J. Graf 2009, pers. comm.).

Morphology

Chilatherina sentaniensis : hard *dorsal rays* : 5-7; soft dorsal rays: 9-12; hard anal jets: 1; soft anal jets: 21-26. 22-27 scales for the dorsal fin. 10-12 soft dorsal rays (Weber, 1922). Colour of specimens preserved in alcohol reddish brown above, silvery below, with a more or less pronounced black longitudinal stripe and sometimes with narrow transverse bands on the lower half of the body. Fins blackish.

C. fasciata : hard dorsal rays: 5-8; soft dorsal rays: 11-16; hard anal jets: 1; soft anal jets: 21-28. 19-21 scales for the dorsal fin. 13-16 soft dorsal rays (Weber, 1922). Colour of specimens preserved in alcohol brownish above, lighter towards the bottom, with a more or less pronounced black longitudinal stripe and a number of transverse narrow stripes, at approximately right angles to the longitudinal stripe on the lower half of the body. These transverse stripes are sometimes absent. Fins dim.

References

Froese, R. and D. Pauly. Editors. 2021.FishBase. World Wide Web electronic publication. www.fishbase.org, (02/2021)

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

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 11-13. E. J. Brill, Leiden, Netherlands

2. Provide information on the status of the species under the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES). For example, is the species listed on CITES Appendix I, II or III, and if so, are there any specific restrictions on the movement of this species? Include information on the conservation value of the species.

A search of Convention for International Trade in Endangered Species (CITES) checklist with the search terms “Rainbowfish” and “Chilatherina” revealed no results for those entities.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 11 species of Chilatherina listed.

Chilatherina alleni **listed as vulnerable**
https://www.iucnredlist.org/species/169522/147680522

Chilatherina axelrodi **listed as endangered**
https://www.iucnredlist.org/species/4628/147680647

Chilatherina bleheri **listed as endangered**
https://www.iucnredlist.org/species/4629/147680677

Chilatherina bulolo **listed as least concern**
https://www.iucnredlist.org/species/4630/147680735

Chilatherina campsi **listed as least concern**
https://www.iucnredlist.org/species/161079348/161079383

Chilatherina crassispinosa **listed as least concern**
https://www.iucnredlist.org/species/161079519/161079697

Chilatherina fasciata **listed as least concern**
https://www.iucnredlist.org/species/161079834/161080091

Chilatherina lorentzii **listed as near threatened**
https://www.iucnredlist.org/species/161080164/161080249

Chilatherina pagwiensis **listed as endangered**
https://www.iucnredlist.org/species/161080305/161080322

Chilatherina pricei **listed as vulnerable**
https://www.iucnredlist.org/species/161080365/161080369

Chilatherina sentaniensis **listed as critically endangered**
https://www.iucnredlist.org/species/4631/147680762

References

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

The IUCN Red List search facility locate accessed on 17 April 2021.
URL http://www.iucnredlist.org/details/4630/0

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, Glossolepis* 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.

WEBER, 1908, records: Nova Guinea, 5: 235—236, pl. 11, fig. 3. a. Lecto-holotype: 96 mm standard length (finest specimen out of 5 of the same length, apparently the one figured in 1908), ZMA 103093; type-locality: Sentani lake. 217 b. Lecto-paratypes: 109 ex, same data. Collector: N. Guinea Expedition, 1903. Males may reach a maximum size of 12 cm, but females are usually less than 10 cm.

References:

G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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)

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

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 11-13. E. J. Brill, Leiden, Netherlands

3.c The natural geographic range.

The IUCN Redlist states: This species is known only from Lake Sentani and small tributaries flowing into the lake near Jayapura, Papua Province, Indonesia (G.R. Allen pers. comm. 2019). It is now considered extant only at the eastern end of the lake (Kadarusman

pers. comm. 2019). This species is known only from the large freshwater Lake Sentani, which is approximately 30 km long and 2-5 km wide, and its small tributaries. It has a maximum size of around 8.5 cm SL (G.R. Allen pers. comm. 2019).

References:

Allen, G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

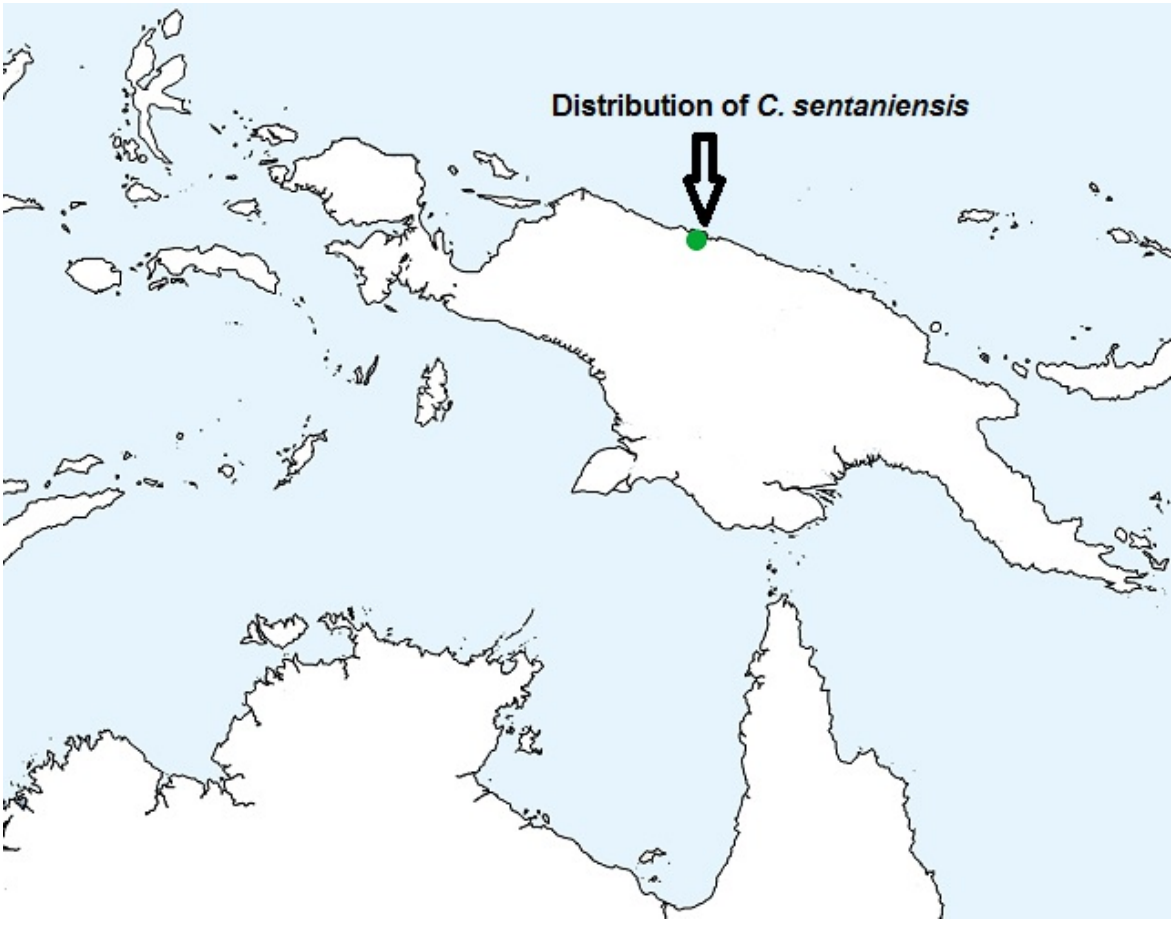
Boeseman, M. (1963) Notes on the fishes of western New Guinea 1. Zool. Mededelingen, 38(14); 221-242.

Graf, Johannes (2007). Chilatherina sentaniensis, how to recognize the real species? Original written in German in “Regenbogenfisch”, magazine of the International Rainbowfish Association (IRG), No 4 – 2007 Revised and supplemented English version

IUCN Redlist: https://www.iucnredlist.org/species/4631/147680762

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

3.d Habitat.



Chilatherina sentaniensis is assessed by the IUCN as Critically Endangered. The species is considered extant only at the eastern end of Lake Sentani and based on this it has an extent of occurrence (EOO) of 90 km^2. There is a single location based on the threat of predatory and competitive invasive species. There is also a continuing decline in habitat due to pollution from the nearby settlement.

The species was reported as being common in the 1950s. However, repeated attempts to collect the fish between 1980 and 2000 yielded only around ten specimens taken from a single creek in 1991. In 2015, under 30 individuals were collected in the east of Lake Sentani (Kadarusman pers. comm. 2019). The population size is considered to be low, but the trend is thought to be stable (Kadarusman 2019). However, this could potentially change due to the several invasive species present.

Major threats include, the human population living along the shore of Lake Sentani is rapidly increasing and was estimated at 25,000 in 1996. The population has continued to grow since the 1990s, and was estimated at 137,000 in 2014. The resultant pollution from domestic waste entering the lake is a threat to the species living there. A further threat to this fish comes from the introduction of exotic species, and associated disease, into its habitat, including carp, tilapia, walking catfish, barbs, snakehead, red devil cichlids and gouramies. There is also traditional gold mining to the west of the lake (G.R. Allen and Kadarusman 2019).

At least three species (*C. bleheri, C. fasciata, C. sentaniensis*) have lake dwelling populations. In stream habitats *Chilatherina* frequent shallow pools where the flow rate is gentle, however *C. bulolo* is often found in rapid flowing steep gradient creeks. Typically *Chilatherina* prefers sections of the stream or lake-shore which affords maximum exposure to sunlight. (Allen 1991)

References:

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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

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IUCN Redlist: https://www.iucnredlist.org/species/4631/147680762

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

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

The specific diet of *Chilatherina sentaniensis* was not recorded, but the diet of other members of the *Chilatherina* genus are well recorded. All rainbowfishes of the family *Melanotaeniidae* are reasonably similar in their dietary preferences. They are omnivores, eating a variety of small aquatic and terrestrial creatures and plant matter. Rainbowfishes have villiform teeth that extend outside their mouth around their lips to enable them to scrape

algae from submerged hard surfaces. The diet includes algae, ants, aquatic insect larvae and small crustaceans. (Allen 1991)

3.f Social behaviour and groupings

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

References :

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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

Graf, Johannes (2007). Chilatherina sentaniensis, how to recognize the real species? Original written in German in “Regenbogenfisch”, magazine of the International Rainbowfish Association (IRG), No 4 – 2007 Revised and supplemented English version

IUCN Redlist: https://www.iucnredlist.org/species/4631/147680762

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 stylised 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.

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.h natural predators

Rainbowfishes will form the diet of many predatory species of fish, water birds, aquatic reptiles and humans. The fish markets in Jayapura have dried rainbowfish for sale and they are eaten like biscuits. Some of the predatory fish families that eat rainbowfishes that occur in Australia and West Papua are; Ambassidae, Anguillidae, Apogonidae, Ariidae, Belonidae, Butidae, Carcharhinidae, Dasyatidae, Eleotridae, Gobiidae, Kuhliidae, Latidae, Lutjanidae, Megalopidae, Muraenidae, Osteoglossidae, Plotosidae, Sciaenidae, Synbranchidae, Terapontidae and Toxotidae. List compiled from Fishbase April 2021.

References:

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

Fishbase 2021:
https://www.fishbase.se/country/CountryChecklist.php?resultPage=8&what=list&trpp=50&c_code=598&cpresence=Reported&sortby=alpha&ext_CL=on&ext_pic=on&vhabitat=fresh

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

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

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

References:

Fishbase: https://www.fishbase.de/summary/chilatherina-sentaniensis.html

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

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

There are no scientific records of any work done on the reproductive biology of *Chilatherina sentaniensis.* Chilatherina *species are* well known in the aquarium trade and have been kept and bred by the authors since 1983 from stock obtained from Melbourne.

C. axelrodi, C. bleheri, C. bulolo, C. campsi C. crassispinosa, C. fasciata, were imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations.

References:

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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

4.a The age at maturity (first breeding)

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

References:

Allen, G.R. & 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*" at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.b How frequently breeding occurs

The authors could find no record or observation for *Chilatherina sentaniensis* but closely related *Chilatherina* species will produce about 40 to 100 viable eggs a day for several consecutive days in a two week period. This amount of egg production will continue during times of good water quality and abundant foods which would occur for several months before, during and shortly after the wet season.

References:

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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*" at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

4.c if the female can store sperm

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

References

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

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*" 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 *Chilatherina sentaniensis* but closely related *Chilatherina* species will produce about 40 to 80 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. & 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" 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). There are no naturally occurring *Chilatherina* species in Australia. Despite the fact that some species of *Chilatherina* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations in Australia.

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

There was no record or mention from Dr Allen of any hybrids of this species in its natural location. Hybridisation in rainbowfishes, although rarely occurring in nature, can be forced in

the aquarium by providing only one sex of two different species. A closely related 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 by the authors.

References:

Allen, G.R. and Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (pp9-16)

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 *Chilatherina sentaniensis* being hybridised in captivity nor any observations of hybrids in their natural habitat. Hybrids of other *Chilatherina* with *Melanotaenia* 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 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. Author 1 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 ChromosomalDiversification in Rainbowfishes(Melanotaeniidae, Teleostei)*" published Genes2020,11, 818; doi:10.3390/genes11070818

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 *Chilatherina* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Chilatherina sentaniensis* 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 https://www.fishbase.de/summary/Chilatherina sentaniensis.html

Froese, R. and D. Pauly. Editors. 2020. FishBase.
www.fishbase.org, version (12/2020). Accessed 17 Apr 2021

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.

Glossolepis incisus, has been assessed by Patricia Kialola for and on behalf of the Pet Industry Association of Australia. *Glossolepis leggetti* has been assessed by author 1 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.

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 *Chilatherina sentaniensis* into the Australian environment should it be released or escape effective human control. Author 1 contacted Mary Bomford after publication of the risk assessment calculator in 2004. A spreadsheet for scoring was produced and is reproduced and is attached with *Chilatherina sentaniensis* data below as Appendix B. Using Climatch v2.0 for PC (Australian Bureau of Agriculture and Resource Economics and Sciences - ABARES) November 2020.

Reference:

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

7a. ability to find food sources

Chilatherina sentaniensis 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 Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (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 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. Perhaps near Townville, Cairns and Darwin there maybe waters that will enable this fish to survive. 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 & Cross (1982), describes the fish as swimming in loose groups near the edge not at the surface nor near the bottom but all levels of mid water in 1 to 1.5 meters depth. This to me indicates that its habits are similar to all other members of the Melanotaeniidae family. They are relaxed, spread out and swim in loose groups during a normal day, form schools if attacked by predators or when travelling. A personal observation from Author 1, at night most rainbowfishes are hard against the bank in very shallow water away from nocturnal hunters in the deep water. This makes them an easy meal for Night Heron.

References:

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

Allen, G.R. and Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (pp9-16)

Graf, Johannes (2007). Chilatherina sentaniensis, how to recognize the real species? Original written in German in “Regenbogenfisch”, magazine of the International Rainbowfish Association (IRG), No 4 – 2007 Revised and supplemented English version

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

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 11-13. E. J. Brill, Leiden, Netherlands

7d. rate of reproducing

Chilatherina sentaniensis is similar to other members of that genus, producing between 40 and 200 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 Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (pp9-16)

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available at: http://www.mediafire.com/download/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 copy of Climex for PC, the process attracts a score of 3 for *Chilatherina sentaniensis* indicating the species has a very low chance of survival in Australian water ways. Attached as appendix B.

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 *Chilatherina sentaniensis* were to escape, 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.

Potential control measures include listing as a noxious species; eradication or containment programs (including movement controls) or broader education/awareness building campaigns such as labelling aquarium fish bags with messaging.

Even if somebody was prepared to transport expensive broodstock (plastic bags, oxygen, styrofoam boxes etc) to one of the possible suitable 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 that peacefully co-exist in many other habitats in Northern Australia. The naturally small restricted habitat of *Chilatherina sentaniensis* 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.

Chilatherina 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'

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

The species is considered extant only at the eastern end of Lake Sentani and based on this it has an extent of occurrence (EOO) of 90 km^2. There is a single location based on the threat of predatory and competitive invasive species. There is also a continuing decline in habitat due to pollution from the nearby settlement.

The species was reported as being common in the 1950s. However, repeated attempts to collect the fish between 1980 and 2000 yielded only around ten specimens taken from a single creek in 1991. In 2015, under 30 individuals were collected in the east of Lake Sentani (Kadarusman 2019). The population size is considered to be low, but the trend is thought to be stable (Kadarusman 2019). However, this could potentially change due to the several invasive species present.

Major threats include, the human population living along the shore of Lake Sentani is rapidly increasing and was estimated at 25,000 in 1996. The population has continued to grow since the 1990s, and was estimated at 137,000 in 2014. The resultant pollution from domestic waste entering the lake is a threat to the species living there. A further threat to this fish comes from the introduction of exotic species, and associated disease, into its habitat, including carp, tilapia, walking catfish, barbs, snakehead, red devil cichlids and gouramis. There is also traditional gold mining to the west of the lake (G.R. Allen and Kadarusman 2019).

At least three species (*C. bleheri, C. fasciata, C. sentaniensis*) have lake dwelling populations. In stream habitats *Chilatherina* frequent shallow pools where the flow rate is gentle, however *C. bulolo* is often found in rapid flowing steep gradient creeks. Typically *Chilatherina* prefers sections of the stream or lake-shore which affords maximum exposure to sunlight. (Allen 1991)

Allen mentions 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

Graf, Johannes (2007). Chilatherina sentaniensis, how to recognize the real species? Original written in German in "Regenbogenfisch", magazine of the International Rainbowfish Association (IRG), No 4 – 2007 Revised and supplemented English version

IUCN Redlist: https://www.iucnredlist.org/species/4631/147680762

IUCN red list of Threatened Species URL - https://www.iucnredlist.org/species/161080365/161080369/

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

If *Chilatherina sentaniensis* 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 *Chilatherina sentaniensis* is similar to other members of the *Chilatherina* genus the behaviour will be similar. Aquarium observations worldwide of *Chilatherina sentaniensis* 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 stylized 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://en.aqua-fish.net/fish/

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

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

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

8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Chilatherina sentaniensis* 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 12cmm (Weber 1907).

References:

Allen G.R. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

Allen, G.R. and Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (pp9-16)

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

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

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 11-13. E. J. Brill, Leiden, Netherlands

8.c habitat and local environmental conditions

Chilatherina sentaniensis 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 *Chilatherina* 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 *Chilatherina sentaniensis* (Fishbase records) diseases in other *Chilatherina* 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. found at: http://dianawalstad.com

There is no firm evidence, from all of the areas where other *Chilatherina,* 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. (1981) A Revision of the Rainbowfish Genus *Chilatherina* (Melanotaeniidae). Records of the Western Australian Museum 9(3): 279-299.

Allen, G.R. and Cross, Norbert J.(1982) Rainbowfishes of Australia and New Guinea. Angus and Robertson Publishers. ISBN 0-207-14604-7 (pp9-16)

Graf, Johannes (2007). Chilatherina sentaniensis, how to recognize the real species? Original written in German in “Regenbogenfisch”, magazine of the International Rainbowfish Association (IRG), No 4 – 2007 Revised and supplemented English version

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.

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

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, *C. axelrodi, C. bleheri, C. campsi and C. fasciata* have been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Chilatherina sentaniensis* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from North American and European breeders and then from commercial facilities to which these captive bred stocks are distributed.

Chilatherina sentaniensis poses no greater threat to Australian aquatic biodiversity than does the *Glossolepis* sp. *(G. incisus,* and *G. leggetti) are* currently permitted for import. 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, rainbowfish 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 4 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 *Melanotaeniidae* 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, *Chilatherina sentaniensis* will be used in the live fish ornamental aquarium display trade. *Chilatherina sentaniensis is* to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Seven of the eleven species of *Chilatherina* have been in Australia prior to 1983, *C. Axelrodi, C, bleheri, C. bulolo, C campsi, C. crassispinosa, C. fasciata, and C. sentaniensis*. Rainbowfish of the genus *Chilatherina* 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 *Chilatherina sentaniensis 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.

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

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

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

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11.a the containment, 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, Accessed 24 march 2021, available at: https://www.legislation.gov.au/Details/C2020C00127

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 *Chilatherina* which have been bred and traded in Australia since the 1970's when they were first imported legally by Barry Crockford of Melbourne, and continuously imported until 1986 when the importation of New Guinea rainbowfishes ceased. The importers of this fish will comply with provisions under conditions as outlined in advice 2009/24 issued by Biosecurity Australia 02 October 2009. *Chilatherina sentaniensis* 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 *Chilatherina sentaniensis* 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, Water and the Environment. Australian Department of Agriculture, Water and the Environment, 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 Author 1 is able to farm this species any surplus production will be handled as any other excess fish. Unwanted fish are euthanised by overdose of anaesthetic and used as aquatic plant fertiliser.

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

In the book by Robert Francis (2012) A Handbook of Global Freshwater Invasive Species , there are no references or instances of *Chilatherina* 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 *Chilatherina sentaniensis* 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 21/04/2021 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 21/04/2021. 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 *Chilatherina sentaniensis* 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 21/04/2021 shows *Chilatherina sentaniensis* is not listed on this schedule as noxious fish https://nt.gov.au/marine/for-all-harbour-and-boat-users/aquatic-pests-marine-and-freshwater/list-of-noxious-fish , and shows no *Chilatherina* 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. *Chilatherina sentaniensis* 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 21/04/2021 and can be accessed at:
https://www.daf.qld.gov.au/__data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Chilatherina* 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. *Chilatherina sentaniensis* is not listed as noxious or restricted in Western Australia.

West Australian Government Fish Resources Management Regulations 1995 current at April 2021, and accessed 21/04/2021 at,
http://www.fish.wa.gov.au/Documents/biosecurity/noxious_fish_list.pdf , and shows no *Chilatherina* 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 21/04/2021, is available at http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list#toc1 and shows no *Chilatherina* 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. *Chilatherina sentaniensis* is not listed as noxious in this Regulation.

The New South Wales noxious fish list accessed on 21/04/2021, is available at https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/pests-diseases/freshwater-pests/freshwater-finfish , and shows no *Chilatherina* 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. *Chilatherina sentaniensis* does not appear on this list. The list of Victorian Government declared noxious species is available.

The Victorian Fisheries Act accessed 21/04/2021 is available at https://vfa.vic.gov.au/operational-policy/pests-and-diseases/noxious-aquatic-species-in-victoria and shows no *chilatherina* 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 21/04/2021 can be found at: http://dpipwe.tas.gov.au/invasive-species/invasive-animals/invasive-freshwater-species there are no *chilatherina* 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 21/04/2021. 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 *Chilatherina* species listed.

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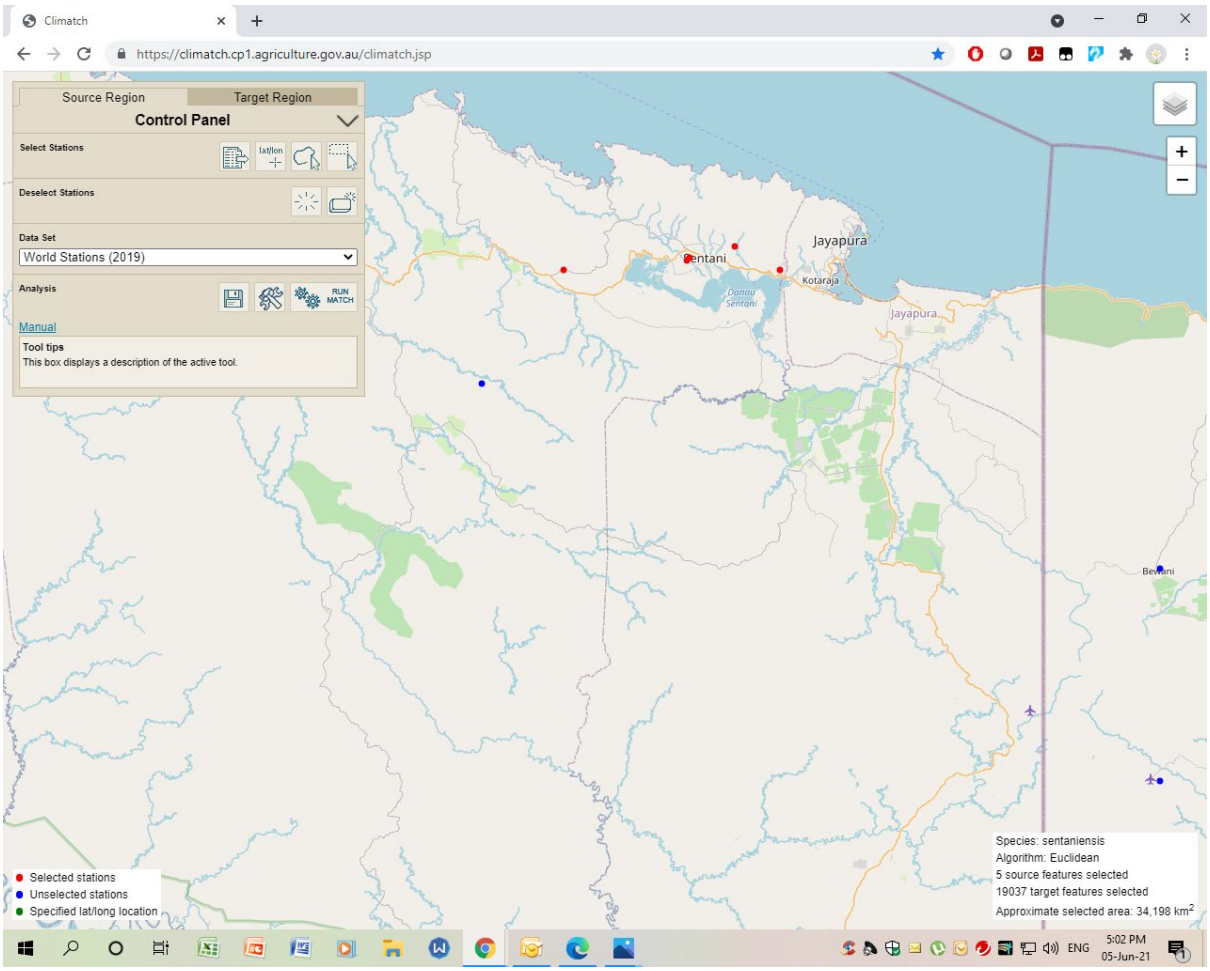
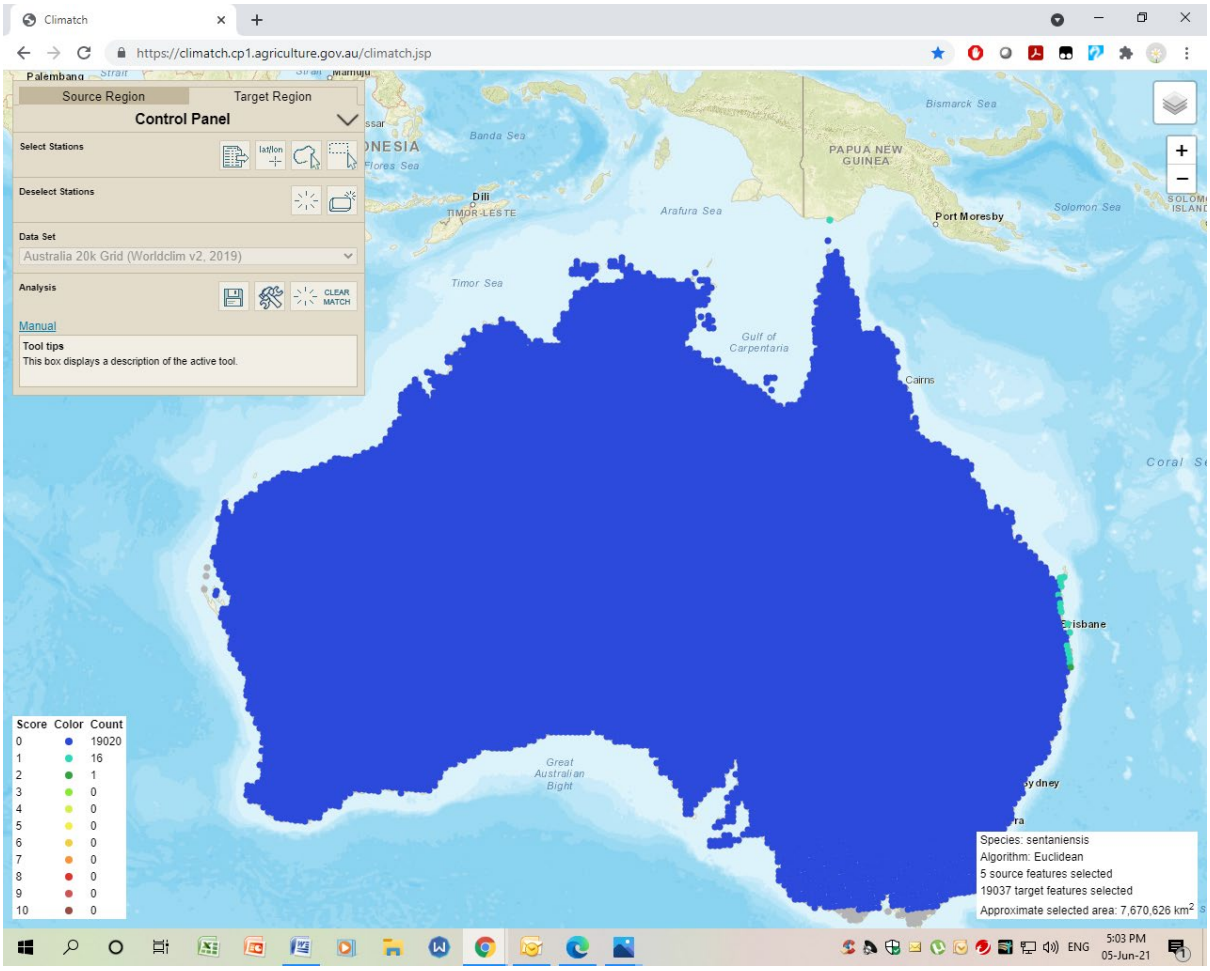
APPENDIX A – calculation of climate from *Chilatherina sentaniensis* distribution climate to Australian Climate





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 6th June 2021.)

BOMFORD ASSESSMENT

SPECIES: Chilatherina sentaniensis

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: 1 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

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

No. of squares : <3

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: Chilatherina
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: 3 (VERY LOW)

The score of 3 according to the assessment model gives the fish a very 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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