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

Glossolepis maculosus

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 spotted Rainbowfish *Glossolepis maculosus* 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 prosecutor in the witness box by the author of this report, however the accused offender 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 new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306

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. 2020. FishBase: www.fishbase.org, version (12/2020). https://www.fishbase.in/summary/Glossolepis-maculosus.html

Terms of Reference

1. Provide information on the taxonomy of the species.

Overview: The rainbowfish genus *Glossolepis* consists of nine species occurring only in the northern half of New Guinea. The name *Glossolepis* consists of two words from the Greek language: “glossa” = tongue “lepis” = scale and refers to the tongue-shaped scale margins.

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

- tongue-shaped scales,
- increased number of gill rakers,
- first spine of the second dorsal fin stronger than the first spine of the first dorsal fin and
- relatively elongated pectoral fins and enlarged teeth in the lateral wing of the remaxillary.

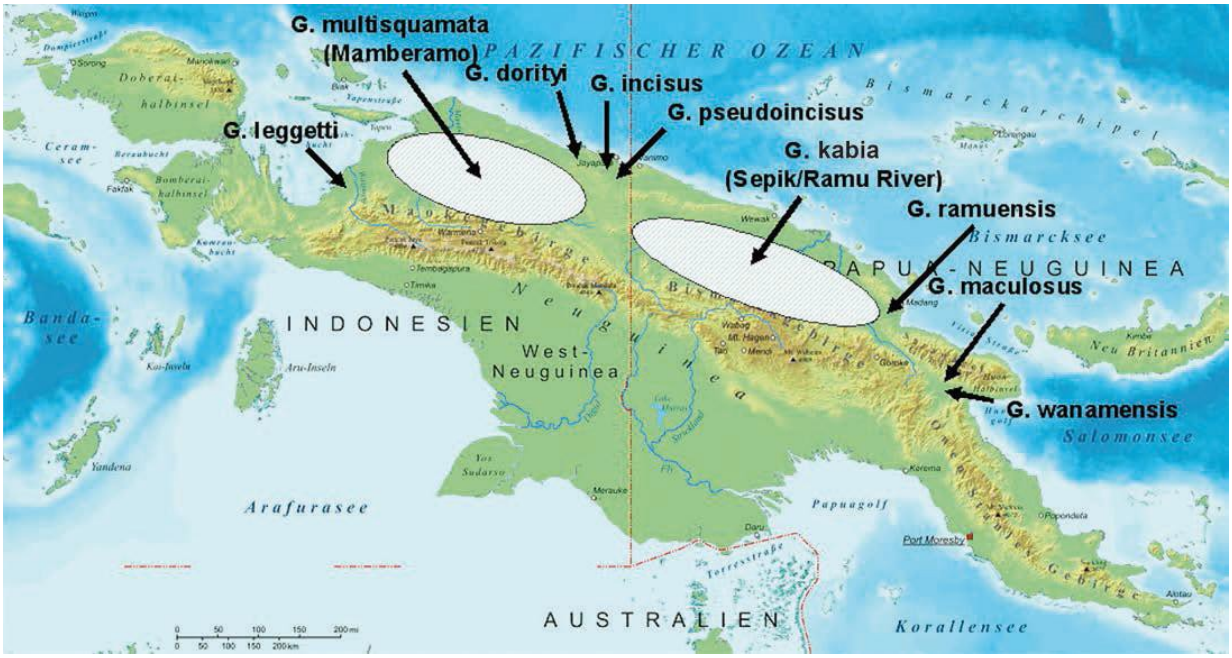

Fig. 1: Distribution of the genus *Glossolepis*. Map: Creative commons, modified.

Information on the taxonomy of the species.

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii (ray-finned Fishes)
Order: Atheriniformes (Silversides)
Family: Melanotaeniidae (Rainbowfishes)
Genus: *Glossolepis* (origin - *Glossolepis*: Greek, "glossa" = tongue, and "lepis" = scale which refers to the tongue shaped scale margins
Species: *Glossolepis maculosus,* spotted rainbowfish

Etymology:
Glossolepis: Greek, glossa = tongue + Greek, lepis = scale,
The species is named maculosus (Latin: spotted) with reference to the colour pattern
.

Reference:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Glossolepis maculosus

Glossolepis maculosus (male + female) - photo © Dirk Godlinski

Glossolepis maculosus has been found in the Omsis Creek close to Lae (a Markham River tributary) and at a second place near Brahman Mission in the Ramu valley. This species was discovered in 1979 by Barry Crockford, a Melbourne aquarist who, frustrated by a failed

attempt to reach Lake Wanam, fished in the nearby waters. Mr Crockford is responsible for informing the author about the existence of *Glossolepis maculosus* prior to the 1980 New Guinea visit and kindly joined the expedition at Lae to assist with the capture of specimens. The species reached Australia in 1980, and Europe and North America in 1987. Since then, it has been maintained in the aquarium hobby. This is a fact that we should be proud as well for other species being held in the hobby for decades without any imports. This species lives in slow flowing creeks and swamps. According to literature, it has been found occasionally together with G*. kabia, M. affinis, C. campsi and C. crassispinosa*. This is somewhat interesting as C. campsi and C. crassispinosa are known for living in faster flowing habitats The species is named maculosus (Latin: spotted) with reference to the colour pattern.

The IUCN classifies it as endangered: This species occurs in the Markham and Ramu river systems of Papua New Guinea. It has an extent of occurrence (EOO) of 4,300 km^2 and occurs in two locations based on the threat of invasive species. There are continuing declines in habitat due to mining and oil palm plantations.

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 “Rainbowfish” and “*Glossolepis”* revealed no results for those entities. (accessed 21 April 2021).

A search of the International Union for the Conservation Red List web site indicated the spotted Rainbowfish, *Glossolepis maculosus* as endangered. This species occurs in the Markham and Ramu river systems of Papua New Guinea. It has an extent of occurrence (EOO) of 4,300 km^2 and occurs in two locations based on the threat of invasive species. There are continuing declines in habitat due to mining and oil palm plantations. There are three gold mines in the Markham River system. Oil palm plantations are found throughout the valley of the Ramu River system. Invasive species also represent a threat. It has listed the threatening process as residential and commercial development, aquaculture and agriculture and invasive species introductions. (Accessed 6th May 2021). The use of local trees for poisons to catch fish for food was also mentioned as a threatening process. Any specimens imported if the application is improved will be from aquaculture in the USA or Europe. No wild collections will be made.

A search of the International Union for the Conservation of Nature (IUCN) Red List indicated there are 9 species of Glossolepis listed.

Glossolepis dorityi listed as critically endangered
https://www.iucnredlist.org/species/161080437/161080455

Glossolepis incisus listed as endangered
https://www.iucnredlist.org/species/9268/147681075

Glossolepis leggetti listed as least concern
https://www.iucnredlist.org/species/161080708/161080713

Glossolepis kabia listed as least concern
https://www.iucnredlist.org/species/161080469/161080528

Glossolepis maculosus listed as endangered
https://www.iucnredlist.org/species/9269/147681182

Glossolepis multisquamata listed as least concern
https://www.iucnredlist.org/species/169502/147681206

Glossolepis ramuensis listed as vulnerable
https://www.iucnredlist.org/species/9271/147681464

Glossolepis pseudoincisus listed as vulnerable
https://www.iucnredlist.org/species/9270/147681435

Glossolepis wanamensis listed as critically endangered
https://www.iucnredlist.org/species/9272/147681490

References:

The Cites Species website with lists and search facility URL
http://www.cites.org/eng/disc/species.php

The IUCN Red List search facility locate at URL http://www.iucnredlist.org/search

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 as a (PDF) at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

3.b Size and weight range.

Allen, G.R. (1981) records the Holotype of the species as being, male 46.2 mm SL, from a small tributary of Omsis River about 22 km west of Lae, Markham River System, Papua New Guinea (approximately 6°42'S, 146°47.5'E), caught by seine net, by G. Allen and B. Crockford, 27 September 1980. 6 Paratypes, between, 24.2-43.8mm standard length were collected with holotype, which is also reflected by **Tappin, A.R.,** (2011)

References:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

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

3.c The natural geographic range.

This species occurs in the Markham and Ramu river systems of Papua New Guinea

References:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

The IUCN Red List search facility locate at URL http://www.iucnredlist.org/search
Glossolepis maculosus : https://www.iucnredlist.org/species/9269/147681182

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

3.d Habitat.

All but one of the types were collected from a small, clear, slow flowing creek. The width ranged from about 0.5 to 3.0 m, and the depth from about 10 to 70 cm. The stream was bordered by tall grass and occasional patches of rainforest. The types were taken from a narrow (1.5 m) section containing a dense cover of aquatic vegetation. A pH of 7.8 and temperature of 25.0oC were recorded. The site is situated about 50 m upstream from the Omsis River. The remaining type was taken from a small side channel in the main stream-bed of the Omsis River. A number of seine hauls in the main river yielded two other rainbowfishes, Melanotaenia affinis (Weber) and Chilatherina campsi (Whitley). The type locality stream was also inhabited by these species, although they frequented the deeper sections in contrast to *Glossolepis maculosus*.

References:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

The **IUCN Red List** search facility locate at URL http://www.iucnredlist.org/search
Glossolepis maculosus : https://www.iucnredlist.org/species/9269/147681182

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

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

The specific diet of *Glossolepis maculosus* was not recorded by Allen(1981) but the diet of other members of the *Glossolepis* 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

Tappin (2011) 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 new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available as a (PDF) 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.

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.

Fishbase:
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 sharp spines, toxins or venom in any member of *the Melanotaeniidae* family.

References:

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

Fishbase: https://www.fishbase.de/summary/Glossolepis-maculosa.html

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 *Glossolepis maculosus. Glossolepis species are* well known in the aquarium trade and have been kept and bred by the authors since 1983 from stock obtained from Melbourne.

G. incisus, G. kabia, *G. maculosus*, *G. multisquamata, G. ramuensis* and *G. wanamensis* have been imported by various individuals from wild New Guinea populations up until 1986 when further import controls were placed on live ornamental fish importations.

4.a The age at maturity (first breeding)

The authors could find no record of this information for *Glossolepis maculosus* 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. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available as a (PDF) 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 *Glossolepis maculosus* but closely related *Glossolepis* 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 new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

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

4.c if the female can store sperm

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

Reference:

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

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

The authors could find no record or observation for *Glossolepis maculosus* but closely related Rainbowfish 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. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available as a (PDF) 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 *Glossolepis* species in Australia. Despite the fact that some species of *Chilatherina, and Glossolepis* 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 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

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

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

4.f Fertility of Hybrid Progeny

There is no record of *Glossolepis maculosus* 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. 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.

Reference:

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

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 *Glossolepis* have been kept as aquarium fish in Australia for several decades this genus has never established feral populations here. *Glossolepis maculosus* 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/Glossolepis.maculosus.html

Froese, R. and D. Pauly. Editors. 2020. FishBase.
www.fishbase.org https://www.fishbase.de/summary/Glossolepis-maculosus.html 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 alleni in the Australian environment should it be released or escape effective human control. The author 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 *Glossolepis maculosus* 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 *Glossolepis maculosus* data against the provisions in the assessment process.(accessed 6th June 2021.),

Reference:

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

7a. ability to find food sources

Glossolepis maculosus 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. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available as a (PDF) 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. 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 (1979), 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

Reference:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306

7d. rate of reproducing

Glossolepis maculosus 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. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306.

Tappin, A.R., (2011) "*Rainbowfishes, their care and keeping in captivity*" available as a (PDF) 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 provided to the author by Bomford process indicates a score of 3 for *Glossolepis maculosus* a very low chance of survival in Australian water ways, as shown in 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 *Glossolepis maculosus* 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 *Glossolepis maculosus* 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. *Glossolepis* 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.

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

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

Glossolepis maculosus *has* been found in the Omsis Creek close to Lae (a Markham River tributary) and at a second place near Brahman Mission in the Ramu valley. The IUCN list it as endangered It has an extent of occurrence (EOO) of 4,300 km^2 and occurs in two locations based on the threat of invasive species. There are continuing declines in habitat due to mining and oil palm plantations. There are three gold mines in the Markham River system (U. Kolkolo pers. comm. 2019). Oil palm plantations are found throughout the valley of the Ramu River system (U. Kolkolo pers. comm. 2019). Invasive species also represent a threat (P. Unmack pers. comm. 2019). Allen (pers conv) 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

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 *Glossolepis maculosus* 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 *Glossolepis maculosus* is similar other members of the *Glossolepis* genus the behaviour will be similar. Aquarium observations worldwide of *Glossolepis maculosus* 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://www.fishbase.de/summary/Glossolepis-maculosus.html

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

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

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

8.b probable prey/food sources

Generally rainbowfishes are omnivorous eating mainly algae which they scrape from harder surfaces with their villiform teeth that extend to the outside of the jaws. They will also take advantage of small crustaceans, aquatic and terrestrial insects when available. *Glossolepis maculosus* 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 55 mm (Allen 1981)

References:

Allen G.R. (1981) A new species of *Glossolepis* (Pisces: Melanotaeniidae) from fresh waters of Papua New Guinea. Records of the Western Australian Museum 9(3): 301-306

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 as a (PDF) at: http://www.mediafire.com/download/g7qzn85uqde8v8o/Rainbowfishes.2011.pdf

8.c habitat and local environmental conditions

Glossolepis maculosus 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 *Glossolepis* 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 *Glossolepis maculosus* (Fishbase records diseases in other *Glossolepis* 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 *Glossolepis,* 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 :

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, *G. incisus, Glossolepis kabia*, *G. maculosus*, *G. multisquamata, G.s ramuensis* and *G. wanamensis* have been here, and popular, for more than 35 years (and other New Guinea rainbowfishes are cultivated here also). Permitting *Glossolepis maculosus* into Australia would not create undue pressure on the populations in their native habitat as all stocks would come initially from European and North American breeders and then from commercial facilities to which these captive bred stocks are distributed.

Glossolepis maculosus poses no greater threat to Australian aquatic biodiversity than does the *Glossolepis* sp*. (Glossolepis. incisus,* and *glossolepis leggetti)* currently permitted for import. Another species *Glossolepis dorityi* is currently being assessed by the department. 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, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

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

If accepted for import, *Glossolepis maculosus* will be used in the live fish ornamental aquarium display trade. *Glossolepis maculosus* are to be added to the live import list to legitimise the use of the species within Australia as an ornamental aquarium fish. Six of the nine species of *Glossolepis* have been in Australia prior to 1983, two *G. incisus* and G. *leggetti* appear on the 'List of Specimens Suitable for Live Import' under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act. Rainbowfish of the genus *Glossolepis* 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 *Glossolepis maculosus 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 Second 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 specimens

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 24 march 2021

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 *Glossolepis* 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. *Glossolepis maculosus* 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 *Glossolepis maculosus* 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 Government 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 the author 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.

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:
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, (Accessed 17 April 2021) at: http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf

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 *Glossolepis* 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 *Glossolepis maculosus* 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 *Glossolepis maculosus* 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 *Glossolepis maculosus* 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 *Glossolepis* 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. *Glossolepis maculosus* 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 https://www.daf.qld.gov.au/_data/assets/pdf_file/0008/1398842/prohibited-restricted-invasive-fish.pdf , and there are no *Glossolepis* 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. *Glossolepis maculosus* 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 *Glossolepis* 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 *Glossolepis* 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. *Glossolepis maculosus* 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 *Glossolepis* 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. *Glossolepis maculosus* 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 *Glossolepis* 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 *Glossolepis* 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 *Glossolepis* listed.

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

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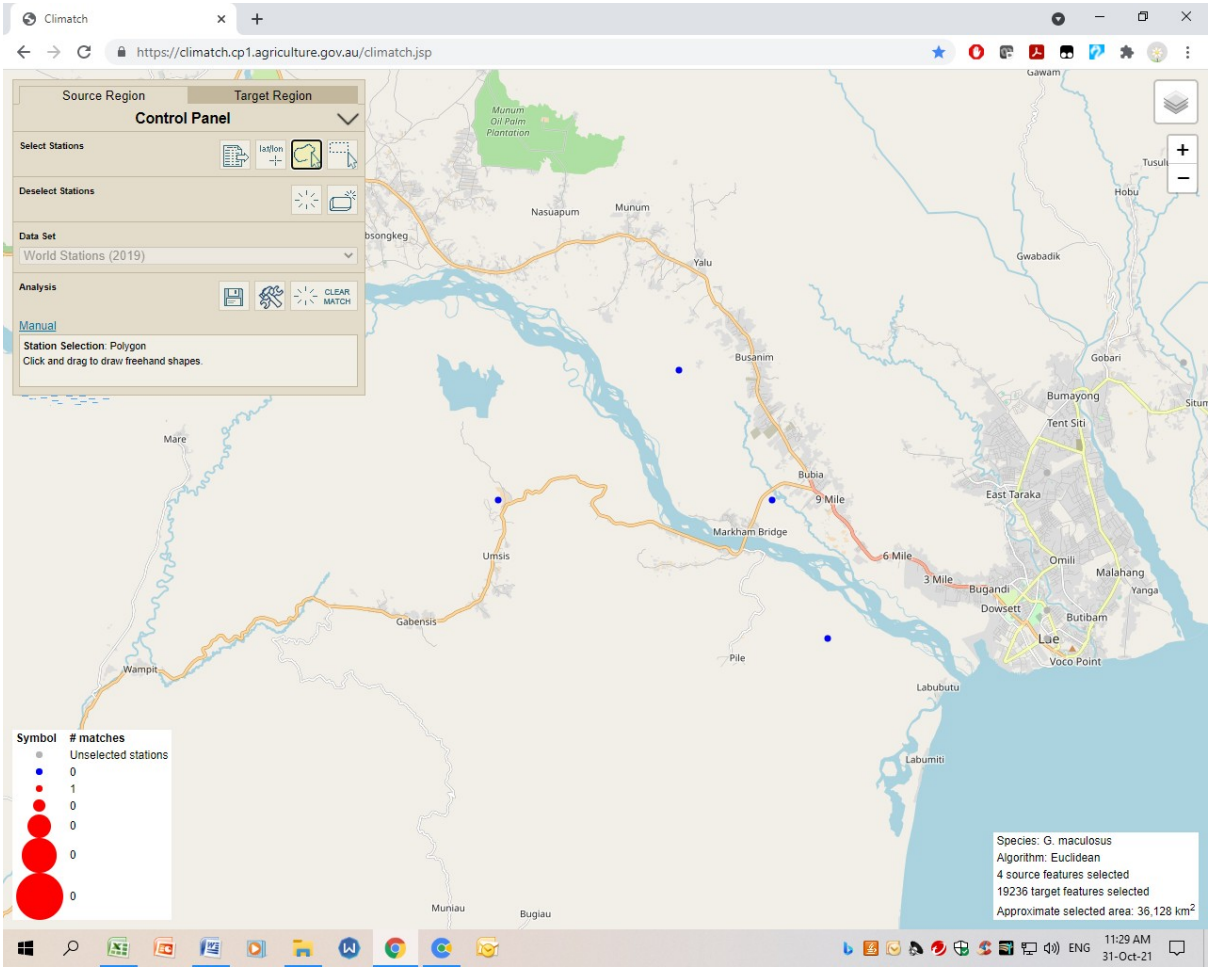
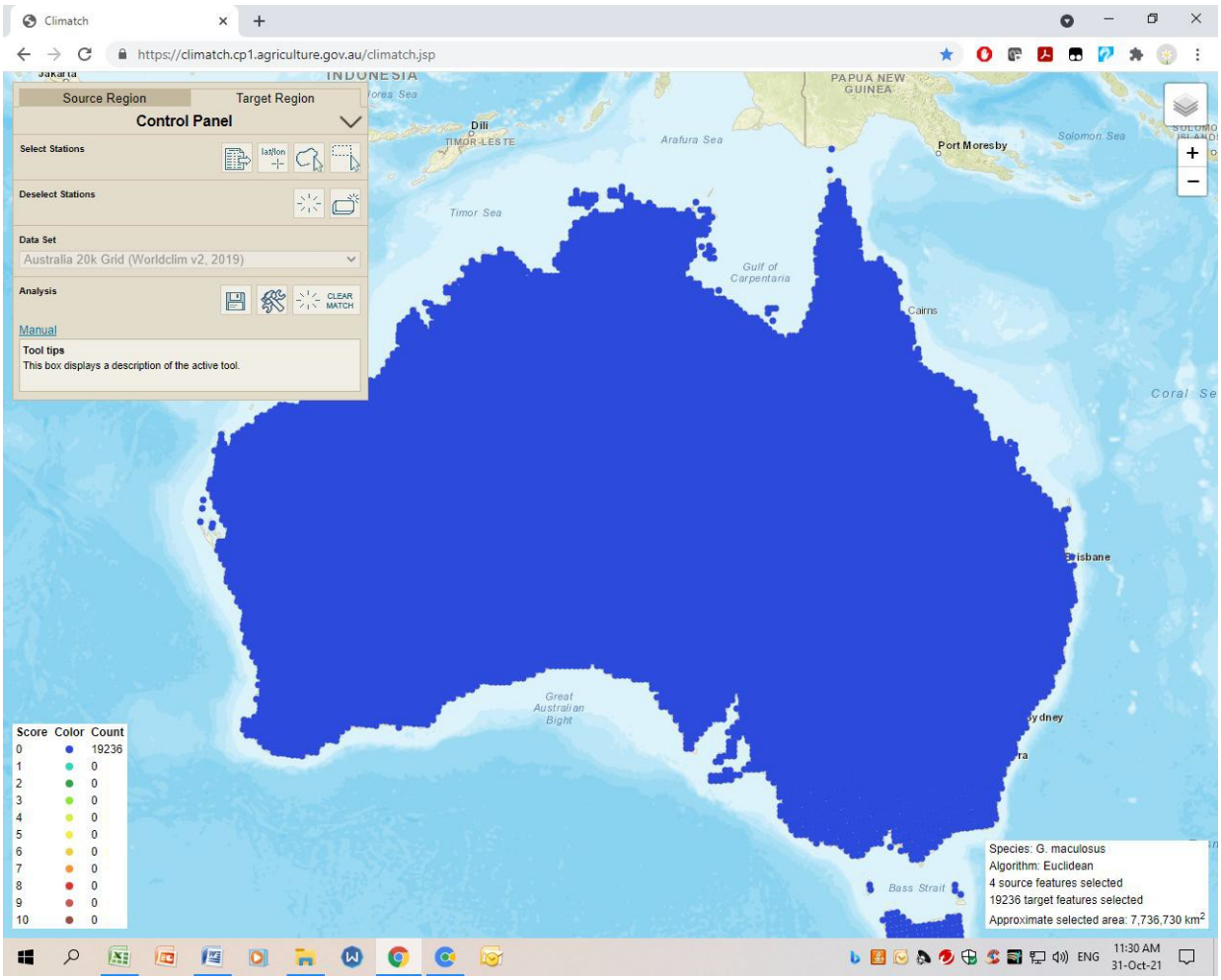
Appendix A – calculation of climate from *Glossolepis maculosus* distribution climate to Australian Climate.





APPENDIX B

BOMFORD ASSESSMENT

SPECIES: Glossolepis maculosus

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 = <3
Score: 1 (Ref: fishbase.org, PC CLIMATE)

Score B, Overseas Range

Number of 1° x 1° grids in which species occurs overseas. (3)
No. of squares : <4
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: Glossolepis
Introductions: 0
Successful: 0
Score: 0 (Ref: fishbase.org / M. Bomford)

Family: Melanotaeniidae (Rainbowfishes)
Introductions: 5
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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