Disclaimer: The applicant's report addressing the Terms of Reference is circulated for public comment in compliance with section 303EF (2b) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The views and opinions expressed in this report are those of the applicant and do not necessarily reflect those of the Australian Government or the Minister for the Environment and Water.

Synodontis petricola: Report addressing the Department of Agriculture, Water and the Environment terms of reference for proposed amendments to the *List of Specimens taken to be Suitable for Live Import* (Live Import List)

October 2022 (Updated May 2023)

Executive Summary

Consideration of the Department of Agriculture, Water and the Environment (DAWE) terms of reference for proposed amendments to the List of Specimens taken to be Suitable for Live Import (Live Import List) against information available for the dwarf spotted catfish (*Synodontis petricola*) indicates the risk of allowing the importation of the species would pose minimal biosecurity risk to Australia. The species has not been reported as having established in the wild outside its natural range despite being traded internationally for over 30 years. Related species such as *Synodontis nigriventris* have not established self-maintaining wild populations in Australia despite decades of importation. Small numbers of *S. petricola* already exist in the domestic hobby having been regularly bred and traded in Australia over the last 25 years ─ although these are not large commercial numbers of fish, these populations have not led to the establishment of feral populations in Australia.

Importantly, much of the information available about this species is from the ornamental fish hobby literature. The scientific literature focuses on the breeding of the species as ornamental fish, with a few general studies on Lake Tanganyika. There is little information in the scientific literature relating to establishment risks. The absence of such reports despite the many decades of worldwide trade is precisely because of the benign nature of the species since scientific study (and associated literature) focuses almost exclusively on species found to be invasive. Indeed, three of the five criteria used in the Bomford methodology (Bomford 2008) for determining establishment success (as used in the Department's own assessments) pertain to the presence or absence of reported historical establishment – the other two criteria being the species' climatic and geographical range. The absence of published scientific literature about the species should not therefore be the sole basis of decision making, especially when there is a long history of trade to draw on – to do so is considered outside the intended applicability of the Environment Protection and Biodiversity Conservation Act's precautionary principle.

Of the many species that would add value to the ornamental fish hobby sector in Australia, this species has been selected for application to add to the Live Import List largely because it is not considered invasive or otherwise ecologically harmful, nor associated with diseases exotic to Australia. It is a relatively small, benign species similar in many respects to fish already deemed appropriate to be imported into Australia.

Synodontis petricola would be a welcome addition to the species permitted live importation, especially given the growing popularity of the ornamental fish hobby in Australia and the significant economic and social benefits of the aquarium fish trade to Australia. The addition of *S. petricola* would be consistent with current import policy given it is closely related to and likely shares a similar environmental risk profile to other closely related species currently permitted live importation to Australia.

A structured risk assessment based on the methodology of Bomford (2008) estimated a 'low' risk, *S. petricola* also received a SARDI method risk score of 28 which is considered low risk. These results further support and reinforce the data already presented using the Bomford model and will enable high level of confidence in the data presented. *S. petricola* should be considered a lower risk than many if not most of the species currently permitted live importation to Australia. It is recommended that *S. petricola* is added to the Live Import List.

DAWE terms of reference

1. *Provide information on the taxonomy of the species.*

    - Dwarf spotted catfish, *Synodontis petricola* Matthes 1959

    - Actinopterygii (ray-finned fishes); Siluriformes (Catfish), Mochokidae (Squeakers or upside-down catfishes)

    - *Synonyms: S. multimaculatus* (misapplied)

    - *Common names*: petricola, dwarf lake synodontis, false cuckoo catfish (Seriously Fish n.d., Aquarium Central Online n.d.)

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.*

    - *Synodontis petricola* is not CITES listed.

    - This species is listed on the International Union for Conservation of Nature's Red List of Threatened Species as Least Concern (LC) as this species has a wide distribution, with no known major widespread threats (Ntakimazi 2006). Wild-caught fish are irregularly exported for the international aquarium fish trade (Kaiser and Rouhani 1999). The species is believed to be relatively common (Wright and Page 2006) and feature in most studies of the fish of Lake Tanganyika (e.g. Niyoyitungiye 2019, Sweke *et al.* 2016, Wright and Page 2006).

    - *Synodontis petricola* is endemic to Lake Tanganyika where it is widespread throughout the littoral zone (Van Steenberge *et al*. 2011, Niyoyitungiye 2019). Areas of Lake Tanganyika are subject to degradation through pollution, parts of the lake are overfished, and climate change threatens to warm the lake waters (Niyoyitungiye 2019, Sweke *et al*. 2016, Wright and Page 2006).

    - The species is readily spawned and raised in captivity (Kaiser *et al*. 1997, Sautter *et al*. 2007, Delk 2011).

3. *Provide information about the ecology of the species.*

    - As with most aquarium species, much of the information about the ecology, including environmental requirements, of *S. petricola* is not available in the peer reviewed scientific literature. Where such information is lacking, this assessment relies on hobbyist information websites, so applies largely to aquarium behaviour and requirements. (Delk 2011., Online Aquarium Shop n.d., Wright and Page 2006, Van Steenberge *et al*. 2011; Sweke *et al*. 2016, Niyoyitungiye 2019*.,* Matthes 1959 and Coulter 1991 cited by Wright and Page 2006., Aquarium Central Online n.d., Aquaholics n.d.)

- *Lifespan of the species:* Not reported, although in captivity the species reaches 30mm TL after one year (Kaiser and Rouhani 1999) and can breed at about this size (Delk 2011).

- *Size and weight range:* The species grows to a maximum of 13 cm in length (Online Aquarium Shop n.d.).

- *Natural geographic range*: All coastal areas of Lake Tanganyika *(*Wright and Page 2006, Van Steenberge *et al*. 2011; Sweke *et al*. 2016, Niyoyitungiye 2019*)*

- *Habitat*: Rocky areas within the lake's littoral zone, to a maximum depth of 30 m (Matthes 1959 and Coulter 1991 cited by Wright and Page 2006).

- *Diet, including potential to feed on agricultural plants*: Young individuals appear to be primarily carnivorous, feeding mainly on hydracarians, ostracods and insect larvae (trichopterans, chironomids) (Matthes 1959 cited by Wright and Page 2006). Adults feed on algae scraped from rocky substrates, and small invertebrates (Matthes 1959 and Coulter 1991 cited by Wright and Page 2006). Aquarium hobby sites also indicate that the species is omnivorous, unfussy about eating frozen, dried and live foods including rasping at vegetable matter such as peas (The Online Aquarium Shop n.d., Aquarium Central Online n.d.).

- *Social behaviour and groupings*: Details of social behaviour have not been reported, although aquarium sites such as Aquaholics (n.d.) mention that the species in aquariums is more active in small groups.

- *Territorial and aggressive behaviours*: None recorded. Some aquarist websites promote them as a peaceful tank species.

- *Natural predators*: Not reported but piscivorous birds, mammals or fish would likely prey on the species in the wild.

- *Characteristics that may cause harm to humans and other species*: No characteristics that may cause harm to human or other species have been reported in this species. FishBase reports the species as harmless to humans (Froese and Pauly n.d.─a). The species is confused with *S. multipunctatus* as both at time share the same common name Cuckoo catfish. *S. multipunctatus* has been reported to lay their eggs in the nests of Cichlids, eating the eggs of the cichlid before laying their own (Cohen *et al.* 2018). *S. multipunctatus* is already included on the list of species suitable for live import into Australia.

4. *Provide information on the reproductive biology of the species.*

   The reproductive biology of *S. petricola* is fairly well understood as it is routinely bred using hormone induced spawning techniques (Kaiser *et al.* 1997) or natural spawning (Delk 2011).

   - *Age at maturity (first breeding)*: Not reported, although the species reaches 30mm TL after one year in captivity (Kaiser and Rouhani 1999) and can breed at about this size (Delk 2011).

- *How frequently breeding occurs*: There is a 10-day spawning cycle in aquaria (Delk 2011).

- *Can the female store sperm*: No, the species is a broadcast spawners with external fertilisation.

- *How many eggs or live-born young are produced at each breeding event*: Delk (2011) observed 25-30 eggs being laid at each spawning. One female specimen from the wild was found to contain about 100 eggs (Matthes 1959 cited by Wright and Page 2006).

- *Has the species hybridised with other species (both in the wild and in captivity) or has it the potential to hybridise with any other species*: Hybridisation has not been reported in this species.

- *If the species can hybridise, are the progeny fertile*: N/A.

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.*

   The species has not been reported as having established feral populations outside of their natural geographic distribution (Froese and Pauly n.d.—a), despite being traded internationally as an aquarium species for over 30 years.

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.*

   A search of the scientific literature identified a recent risk assessment of the species by Millington M, Sierp M, Gaylard S (2022). This assessment used the SARDI method contained in the report Deveney, M. (2018) Assessing the risks associated with the Australian Trade in live ornamental fish species: development of a risk assessment tool. Importantly the SARDI methodology also considers the already existing risk associated with the trade of species already present in Australia, something overlooked by other models. The SARDI methodology compiles risk scores from responses to 40 separate risk queries covering three separate categories, the likelihood of release, likelihood of invasion, and consequences of invasion. It must also be recognized that the SARDI risk assessment was developed with funding from environment and invasive committee (EIC) and endorsed by all federal, state and industry stakeholders and participants in the EIC, as well as the aquatic pest vertebrate and invertebrate working group, as a suitable method to determine risk associated with the trade of ornamental fish already in Australia. *S. petricola* received a SARDI risk score of 28 (page 23) which is considered low risk. These results further support and reinforce the data already presented using the Bomford model and will enable high level of confidence in the data presented.

   The species is not on the BRS ‘grey list’ of likely high biosecurity risk ornamental fish species, i.e. non-native species that are present in Australia through historical imports that are not on the Live Import List, noting, the grey list is not extensive and does not cover all ornamental species that are historically present in Australia. It is also not one of

the species of non-native freshwater fish that are reported to have established self-sustaining populations in the wild in Australia (Corfield *et al*. 2008). However, the species is known to be captive bred and traded domestically in Australia (Jared Patrick, Premier Pet). It is further noted that the species has been present in Australia for at least 25 years (Jared Patrick, Premier Pet).

The addition of *S. petricola* to the Live Import List would be generally consistent with Australia's biosecurity arrangements for live fish given that the species is present in Australia and given that it is closely related to and likely shares a similar environmental risk profile with species such as *Synodontis nigriventris* and *S. multipunctatus* currently permitted live importation to Australia.

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.*

Assessing the risk of the potential of introducing a new organism into the environment involves assessing the risk of it becoming established and spreading and the likely impacts if establishment occurred. The risk assessment method 'Exotic Freshwater Fish Model 1' developed by Mary Bomford has been adopted by DAWE for its freshwater fish risk assessments (Bomford 2008). The following considers each of the risk factors considered by Bomford to be applicable to freshwater fish and is guided by the recent Australian Government risk assessment of glass catfish (DAWE 2020a). The specific criteria in the DAWE terms of reference template are also covered. The potential impacts of established feral populations are addressed in the next term of reference (#8). A structured risk assessment based on the Bomford methodology is at Appendix A.

Importantly, most of the information available about this species is from the ornamental fish hobby literature; there is little information in the scientific literature, especially as it relates to establishment risks. The absence of such reports despite the many decades of worldwide trade is precisely because of the benign nature of the species since scientific study (and associated literature) focuses almost exclusively on species found to be invasive. Indeed, three of the five criteria used in the Bomford methodology (Bomford 2008) for determining establishment success (as used in the Department's own assessments) pertain to the presence or absence of reported historical establishment – the other two criteria being the species' climatic and geographical range. The absence of published scientific literature about the species should not therefore be the sole basis of decision making, especially when there is a long history of trade to draw on – to do so is considered outside the intended applicability of the Environment Protection and Biodiversity Conservation Act's precautionary principle.

Of the many species that would add value to the ornamental fish hobby sector in Australia, this species has been selected for application to add to the Live Import List taking into account the fact that the species has not been reported to be invasive or otherwise ecologically harmful, nor associated with diseases exotic to Australia. It is a relatively small, benign species similar in many respects to fish already deemed appropriate to be imported into Australia.

- *Propagule pressure—the release of large numbers of animals at different times and places enhances the chance of successful establishment: S. petricola* is not known

to be a schooling species which means that it less likely to establish than schooling species. The species in its natural habitat lives in the littoral zone of a deep lake with fairly consistent year-round temperatures. It is conceivable that populations could establish in some of the large impoundments in northern Australia where temperatures are 24-29°C, although a requirement for alkaline water may not be met in most Australian environments – Lake Tanganyika surface waters are around 8.5-9 pH (Edmond *et al.* 1993, Niyoyitungiye 2019). It is unlikely therefore that enough fish would be released into a suitable receiving environment to establish a breeding population as a result of an accident or being deliberately released into the local waterways in or near populated areas. There are examples of tropical aquarium species such as *Poecilia reticulata* that have established small populations in disturbed habitats in urban and peri-urban areas like those found in Darwin, Cairns or Brisbane (Arthington et al. 1999). *S. Petricola* is not known to have established in the any such habitats overseas despite the trade in this species for decades. A moderate to high probability of establishing a self-sustaining population would require deliberate release into very specific waterways – it is unlikely therefore to happen at random; a risk similar to that noted for the glass catfish (*Kryptopterus vitreolus*) in a recent Departmental risk assessment (DAWE 2020a).

- *Climate match—introduction to an area with a climate that closely matches that of the species' original range*: Climatch (v2.0) was run with the source region set to circumscribe Lake Tanganyika. A climate match prediction was generated using the Euclidian algorithm applied to the 'world stations' data set. Climatch calculated a 'value 5' (Climate Euclidian Sum Level 5) of 2168, equating to a climate match score of 4 using recalibrated 'value 5' ranges for Climatch v2.0 provided by ABARES[1]. This value was increased to 5 because there were less than 12 source meteorological stations in the input area. DAWE (2020a) suggested the need for some caution in predicting climate suitability for freshwater aquatic species because Climatch is based on terrestrial climate measurements.

- *History of establishment elsewhere—previous successful establishment:* There are no reports on FishBase of introductions or establishment of this species outside its known natural range (Froese and Pauly n.d.─a). The absence of established populations outside its natural range is despite being actively traded internationally as an aquarium species for many years.

- *Overseas range*: The species is endemic to Lake Tanganyika, the world's longest and second largest (by volume) freshwater lake, situated within the borders of Tanzania, the Democratic Republic of the Congo (DRC), Burundi and Zambia.

- *Introduction success*: The species is not known to have established outside its native range. However, it can be assumed that the species has been released into non-native areas on many occasions over the last 30-plus years of international trade as an aquarium species. The introduction success rate is conservatively considered to be less than 0.25 (Bomford 2008).

[1] Recalibrated Climatch v2 'value 5' ranges corresponding to climate match scores 1-8: 1(0), 2 (1-276), 3(277-1036), 4(1037-2763), 5(2764-6907), 6(6908-10361), 7(10362-17268), 8 (>17268)

Taxonomic group—belonging to a family or genus which has a high establishment success rate: S. petricola belongs to the family Mochokidae (squeakers or upside-down catfishes). FishBase recognises 133 species of *Synodontis.* Of these, 15 species are reported in FishBase as traded internationally as commercial aquarium species. There are three reports of *Synodontis* species in the wild outside their natural range; the finding of a single specimen of *S. eupterus* in Croatia (Dulčić *et al.* 2018) and the 1996 report of *S. angelicus* and *S. nigriventris* in the Philippines (Froese and Pauly n.d.─b). The Croatian report is almost certainly an aquarium release and was found in water too cold in winter for a population to persist and the reports from the Philippines in FishBase is in error because it is a report of species imported into the country.

As internationally traded aquarium species, it is reasonable to assume that there would have been many instances of inadvertent or deliberate introductions of these 15 species of *Synodontis* around the world over the last few decades – conservatively assumed to be 50 introductions (likely to be more in reality) for the purposes of this risk assessment – and this level of introductions has resulted in one potentially established population.

If the Bomford (2008) methodology is applied to the genus *Synodontis*, where the genus success rate % = 100(Number of successful introductions to all countries of species in the genus/Total number of introductions to all countries of species in the genus), the 'genus level' taxa risk is 0/50 (0%).

Notably, the related *S. nigriventris* is on the current list of specimens taken to be suitable for live import and has been imported to Australia for over 40 years without wild populations being established. Furthermore, *S. petricola* already exist in the domestic hobby having been bred and traded in Australia for more than 25 years ─ although these are not large commercial numbers of fish, these populations have not led to the establishment of feral populations in Australia.

- *Ability to find food sources*: As an omnivore feeding primarily on benthic invertebrates and algae, the species is expected to find food sources in the unlikely event it is introduced into the wild.

- *Ability to survive and adapt to different climatic conditions (e.g. temperatures, rainfall patterns)*: Temperature range in Lake Tanganyika is 24-29°C, pH 8.5-9 and hardness 161-226 mg/L CaCO3 (Edmond *et al*. 1993, Niyoyitungiye 2019). Ranges from aquarium internet sites indicate some adaptability from the natural environment with temperature tolerances from 24-28°C, pH 7.5-8.5, and hardness of 10-35 dH (The Online Aquarium Shop n.d., Nanotanks Australia n.d., Aquaholics n.d.)

- *Ability to find shelter*: As a lake dwelling fish living amongst rocks there would be limited habitat in the type of lakes that have the required temperature and higher pH and hardness range in Northern Australia.

- *Rate of reproducing*: Overall rate is unknown. Each spawning observed by Delk (2011) indicated about 25-30 eggs laid at a time, repeatedly over a short period, and a 10-day spawning cycle. One female specimen from the wild was found to contain about 100 eggs (Matthes 1959 cited by Wright and Page 2006).

- *Any characteristics that the species has which could increase its chance of survival in the Australian environment*: The species is not considered to have any characteristics that would increase its likelihood of survival in the wild in Australia.

Using the SARDI method, specifically risk queries 25 to 40, show little to no consequences of invasion should *S. petricola* establish feral populations in Australia (Millington M, Sierp M, Gaylard S 2022). The SARDI risk assessment included a thorough review of all available literature showed that *S. petricola* has no recorded impacts on any wild or farmed aquatic species outside its natural range. It is not a parasitic species, nor is there any novel or notifiable diseases in the literature. It is not a migratory species, causes no harm to humans and has no records of altering the function of ecosystems, nor does it outcompete or prey on any fish species, beyond its natural range. It also cannot hybridise with any Australian native fish. Furthermore, there is no evidence in any literature, worldwide, that the species has ever caused any deleterious environmental, social, or economic impacts. (Millington M, Sierp M, Gaylard S 2022).

In summary, *S. petricola* is considered unlikely to establish, in main because the species is not reported to have established breeding populations outside its natural range despite being traded internationally as an ornamental species for many decades and because there are few areas in Australia expected to have habitat suitable for establishment. This conclusion can be ground-truthed to an extent by comparing the species with the related *S. nigriventris*, which has not established self-maintaining wild populations despite several decades of importation to Australia for the aquarium trade. Furthermore, *S. petricola* already exists in the domestic hobby having been bred and traded in Australia over the last 25 years ─ although these are not large commercial numbers of fish, these populations have not led to the establishment of feral populations in Australia.

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 on:*

- *Similar niche species (i.e. competition with other species for food, shelter etc.)*: In the unlikely event this species establishes in the wild in Australia, it may compete for benthic invertebrates with other small tropical benthic fish typically in habitats with muddy or rocky substrates. These niche species could include bottom feeders such as eel tailed catfishes (*Neosilurus* spp., *Porochilus* spp.). Some juvenile fish such as golden perch and grunters also feed on benthic invertebrates. No competition would be expected with mid-water or surface feeding fish. There are no reports in the scientific literature of any ecological impacts as a result of the species establishing outside its natural range in other countries. As noted in TOR 7 above, the absence of such reports is an indication of the benign nature of the species since scientific literature focuses almost exclusively on species that have some ecological impact.

- *Is the species susceptible to, or could it transmit any pests or disease*:
No significant pests or diseases of biosecurity concern have been associated with this species, including any of the diseases to which there are disease-specific risk management measures applied by DAWE for importation of ornamental fish to

Australia. No specific diseases of concern have been associated with *Synodontis petricola*.

- Probable *prey/food sources, including agricultural crops*: *S. petricola* feeds on benthic invertebrates and algae. It does not feed on any agricultural crops.
- *Habitat and local environmental conditions*: *S. petricola* has not been reported to change its environment or habitat. It is a lake dwelling fish with a narrow temperature tolerance range.
- *Control/eradication programs that could be applied in Australia if the species was released or escaped*: Potential controls 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.
- *Characteristic or behaviour of the species which may cause land degradation i.e. soil erosion from hooves, digging*: There are no reports of this species exhibiting any behaviours that my cause habitat degradation.
- *Potential threat to humans*: The species is not reported as posing any threat to humans (Froese and Pauly n.d.─a).

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, de-sexing animal prior to import etc.).*

   Potential environmental impacts from importation of live animals into Australia can take the form of direct pest risks or indirect risks associated with the introduction of new diseases that may be carried in imported stock. In the case of *S. petricola*, importation under Australia's current import conditions would reduce potential disease risks to an acceptable level, consistent with previous Australian Government disease risk analyses (Kahn *et al*. 1999, DOA 2014).

10. *Provide a summary of the types of activities that the specimen may be used for if imported into Australia (e.g. pet, commercial, scientific).*

    - *Benefit of this species for these activities*: Permitting importation of this species will support the ornamental fish industry. In a broader context, the ornamental fish hobby is an important one. Aside creating employment and contributing to the economy of all States and Territories, it has become especially important during the CoViD pandemic where individuals subject to movement restrictions turned increasingly to the hobby for recreation – the hobby therefore plays a significant part in helping alleviate the stressors associated with the pandemic and post-CoViD recovery, both from economic and social perspectives.

      The direct and indirect economic benefits of ornamental fish importation carry through the aquarium industry supply chain and into the hobby. The economic beneficiaries include, but are not limited to, aquarium fish importers, wholesalers, aquarium hard goods distributors, retail pet and aquarium shops, commercial and

hobby breeders as well as freight and logistics providers and other associated vendors.

Importantly, keeping ornamental fish fosters companion animal care which has benefits to society beyond the direct economic value of the trade. There are companionship as well as mental health benefits. There has never been a more important time for these benefits to flow through Australian society. The aquarium hobby also plays an often undervalued educational role, especially relevant to younger Australians. The benefits in this respect include, but are not limited to, an increased understanding of, and appreciation for, biology, chemistry, physiology as well as geography and natural history.

- *Potential trade in the species*: The species is routinely traded internationally and would be a welcome addition to the species permitted importation. In the order of 200,000 fish of the species are traded internationally and given the growing popularity of the hobby in Australia, the likely market demand in Australia for imported *S. petricola* would about 15,000 fish.

  Why this species has been chosen: Internationally, the species is in high demand by hobbyists. New catfish species would be popular in Australia, adding variety to the species available to Australian hobbyists. The species is not aggressive and compatible to keep in aquaria with other most other tropical species. Two other Synodontis catfishes, *S. multipunctatus* and S. *nigriventris* are currently permitted for import to Australia; *S. petricola* has the added attraction of attractive patterning and very peaceful disposition. Additionally, approval of this species would prevent future issues of confused identity with *S.multipunctatus* which have occurred on some past imports into Australia

  Although small numbers of this species are known to be present in the Australia hobby, although not available with the reliability or in sufficiently large commercial volumes needed by the industry. Imported stock would provide reliable access to the numbers, range in sizes and varieties (such as new colour morphs) needed to meet Australian hobby demand.

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.*

    - *The containment (e.g. cage, enclosure) and management standards for this species to prevent escape or release. This should also talk about the security standards for this specimen*: The fish will be transported as per the International Air Transport Association (IATA) guidelines and the provisions of the *BICON Import Conditions for Freshwater Aquarium Fish: Effective 18 July 2020* (DAWE 2020b).

    - *The disposal options for surplus specimens*: Fish will be imported for purposes of supplying the aquarium fish trade and as such no surplus specimens are expected. In the event of mortality, animals will be disposed as per the provisions of the *BICON Import Conditions for Freshwater Aquarium Fish: Effective 18 July 2020* (DAWE

2020b) and in accordance with the Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008).

12. Provide information on all other Commonwealth, state and territory legislative controls on the species, including:

    - *The species' current quarantine status*: The species is not currently on the permitted species list although closely related species are.

    - *Pest or noxious status*: The species is not listed on any state or federal pest or noxious species list.

    - *Whether it is prohibited or controlled by permit or licence in any state or territory*: The species is not prohibited or controlled by permit or licence in any Australian State or Territory.

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Appendix A: Bomford model risk assessment: *Synodontis petricola*

Assessing the risk of the potential of introducing a new organism into the environment involves assessing the likelihood of it becoming established and spreading and the likely impacts if the species does establish. The following analysis applies the assessment method for determining the risk of establishment of exotic freshwater fish introduced to Australia (Model 1) described in Bomford (2008) and is guided by the recent DAWE risk assessment of glass catfish (DAWE 2020a).

Bomford (2008) identified a range of factors that determined establishment success of freshwater fish, including propagule pressure, climate match, history of establishment elsewhere, geographic range and taxonomic group. These risk factors together with potential impacts should *Synodontis petricola* (Matthes 1959) establish wild populations in Australia are discussed below, as are the outputs of applying the Bomford (2008) methodology. These findings should be considered together with information addressing the DAWE terms of reference for proposed amendments to the *List of Specimens taken to be Suitable for Live Import (Live Import List)* in the body of this submission.

Establishment success

Propagule pressure—the release of large numbers of animals at different times and places

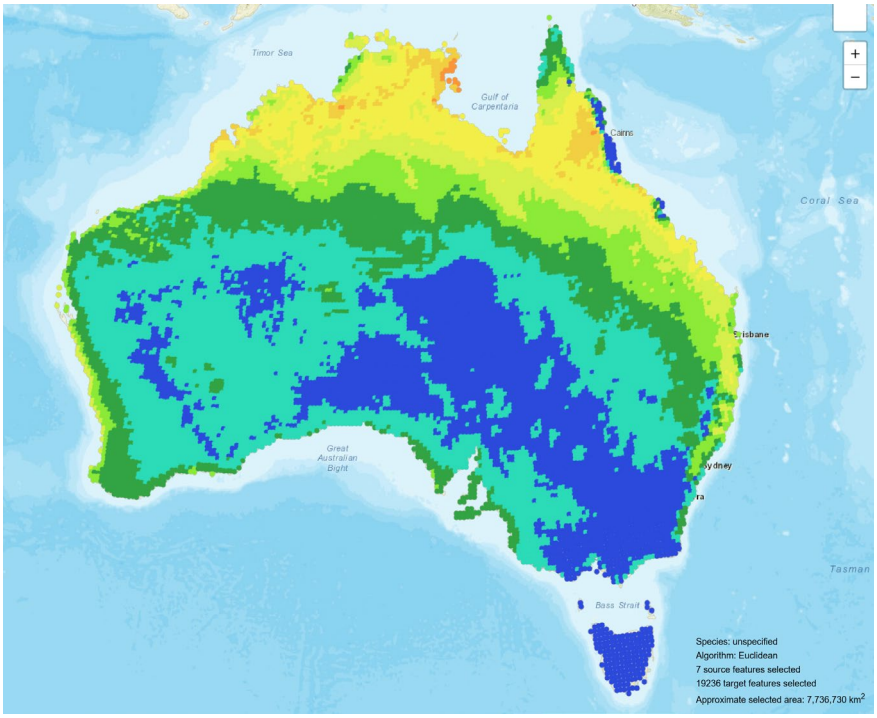
S. petricola is not known to be a schooling species which means that it less likely to establish than schooling species. The species in its natural habitat lives in the littoral zone of a deep lake with fairly consistent year-round temperatures. It is conceivable that populations could establish in some of the large impoundments in northern Australia where temperatures are 24-29°C, although a requirement for alkaline water may not be met in most Australian environments – Lake Tanganyika surface waters are around 8.5-9 pH (Edmond *et al.* 1993, Niyoyitungiye 2019). It is unlikely therefore that enough fish would be released into a suitable receiving environment to establish a breeding population as a result of an accident or being deliberately released into the local waterways in or near populated areas. There are examples of tropical aquarium species such as *Poecilia reticulata* that have established small populations in disturbed habitats in urban and peri-urban areas like those found in Darwin, Cairns or Brisbane (Arthington et al. 1999). *S. Petricola* is not known to have established in the any such habitats overseas despite the trade in this species for decades. A moderate to high probability of establishing a self-sustaining population would require deliberate release into very specific waterways – it is unlikely therefore to happen at random; a risk similar to that noted for the glass catfish (*Kryptopterus vitreolus*) in a recent Departmental risk assessment (DAWE 2020a).

Climate match—introduction to an area with a climate that closely matches that of the species' original range:

Climatch (v2.0) was run with the source region set to circumscribe Lake Tanganyika where the species is confirmed present – the source input area was approximately 147,519 km2 and comprised 7 meteorological stations. A climate match prediction was generated using the Euclidian algorithm applied to the 'world stations' data set. Climatch calculated a 'value 5' (Climate Euclidian Sum Level 5) of 2168, equating to a climate match score of 4 using

recalibrated ‘value 5’ ranges for Climatch v2.0 provided by ABARES[2]. This value was increased to 5 because there were less than 12 source meteorological stations in the input area.

DAWE (2020a) suggested the need for some caution in predicting climate suitability for freshwater aquatic species because Climatch is based on terrestrial climate measurements.



Score	0	1	2	3	4	5	6	7	8	9	10
Count	4274	6316	3130	1799	1549	1793	355	20	0	0	0

Figure 1 Climatch v2.0 output for *Synodontis petricola*

History of establishment elsewhere—previous successful establishment:

There are no reports on FishBase of introductions or establishment of this species outside its known natural range (Froese and Pauly n.d.—a). The species is unlikely to breed and form self-sustaining populations outside its optimal water temperature range of 24-29°C. The absence of established populations outside its natural range is despite being actively traded internationally as an aquarium species for many years.

Overseas range:

The species is endemic to Lake Tanganyika, the world’s longest and second largest (by volume) freshwater lake, situated within the borders of Tanzania, the Democratic Republic of the Congo (DRC), Burundi and Zambia. The lake’s area was used to determine a total

[2] Recalibrated Climatch v2 ‘value 5’ ranges corresponding to each climate match score (1-8): 1(0), 2(1-276),3(277-1036), 4(1037-2763), 5(2764-6907), 6(6908-10361), 7(10362-17268), 8 (>17268)

overseas range of 10, 1° latitude x 1° longitude grid squares for purposes of the Bomford (2008) assessment.

Introduction success:

The species is not known to have established outside its native range. However, it can be assumed that the species has been released into non-native areas on many occasions over the 30-plus years of trade worldwide as an aquarium species. The introduction success rate is conservatively considered to be less than 0.25 (Bomford 2008).

Taxonomic group—belonging to a family or genus which has a high establishment success rate:

S. petricola belongs to the family Mochokidae (squeakers or upside-down catfishes). FishBase recognises 133 species of *Synodontis.* Of these, 15 species are reported in FishBase as traded internationally as commercial aquarium species. There are three reports of *Synodontis* species in the wild outside their natural range; the finding of a single specimen of *S. eupterus* in Croatia (Dulčić *et al.* 2018) and the 1996 report of *S. angelicus* and *S. nigriventris* in the Philippines (Froese and Pauly n.d.─b). The Croatian report is almost certainly an aquarium release and was found in water too cold in winter for a population to persist and the reports from the Philippines in FishBase is in error because it is a report of species imported into the country.

As internationally traded aquarium species, it is reasonable to assume that there would have been many instances of inadvertent or deliberate introductions of these 15 species of *Synodontis* around the world over the last few decades – conservatively assumed to be 50 introductions (likely to be more in reality) for the purposes of this risk assessment – and this level of introductions has resulted in one potentially established population.

If the Bomford (2008) methodology is applied to the genus *Synodontis*, where the genus success rate % = 100(Number of successful introductions to all countries of species in the genus/Total number of introductions to all countries of species in the genus), the ‘genus level’ taxa risk is 0/50 (0%).

Notably, the related *S. nigriventris* is on the current list of specimens taken to be suitable for live import and has been imported to Australia for over 40 years without wild populations being established. Furthermore, *S. petricola* already exist in the domestic hobby having been bred and traded in Australia for more than 25 years ─ although these are not large commercial numbers of fish, these populations have not led to the establishment of feral populations in Australia.

Potential impacts of established feral populations

There is a single report of a single specimen of *S. eupterus* being found outside its natural range, likely released by an aquarist (Dulčić *et al.* 2018), despite being traded internationally as an aquarium species for over 40 years. There is no evidence of any detrimental impact caused by the establishment of the species. In the unlikely event this species establishes in the wild in Australia, it may compete for benthic invertebrates and algae with other small tropical benthic fish typically in habitats with muddy or rocky substrates. These niche species could include bottom feeders such as eel tailed catfishes (*Neosilurus* spp., *Porochilus* spp.).

Some juvenile fish such as golden perch and grunters feed on benthic invertebrates. No competition would be expected with mid-water or surface feeding fish.

Disease transmission to Australian fish and aquarium fish populations

No significant pests or diseases have been associated with this species, including any of the diseases to which there are disease-specific risk management measures applied for importation of ornamental fish to Australia. Botiid fishes as a group are considered of low risk in terms of disease risk in that they are subject to the minimum one-week post arrival quarantine isolation on importation to Australia (DAWE 2020b).

Bomford 2008 Exotic Freshwater Fish Risk Assessment Model

Common name	Dwarf spotted catfish, petricola
Scientific name	*Synodontis petricola* Matthes 1959
Date assessed	9 December 2021
Literature Search Type and Date:	FishBase December 2021

Risk criterion	**Value**	**Explanation**
A. Climate Match Score (1–8)	5	Climatch (v2) Euclidian Sum Level 5 (Value X) = 2168 equating to a climate match score of 4, increased to 5 because there were less than 12 source area meteorological stations.
B. Overseas Range Score (0–4)	1	*S. petricola* is estimated to occupy a total range of 10, 1° latitude x 1° longitude grid squares.
C. Establishment Score (0–3)	0	The species is considered to have been “introduced but never established”, representing an establishment score of 0.
D. Introduction Success Score (0–4)	1	The species is not known to have established outside its native range. However, after many decades of trade worldwide it can be assumed it has been released into non-native areas on many occasions. The introduction rate is conservatively considered (that is erring on the side of overestimation) to be <0.25, representing an introduction success score of 1.
E. Taxa Risk Score (0–5)	0	Conservatively, 50 past introductions of the 15 internationally traded species of the genus are assumed for the purposes of this risk assessment. There are no valid records on FishBase of a *Synodontis* species being established outside their native range. The ‘genus level’ taxa risk is therefore 0/50 (0%).

Summary	*Score*	*Rank*
Establishment Risk	7	Low

Conclusion

The estimated risk of ‘low’ using the Bomford (2008) methodology is generally lower than the risk that would be posed by many if not most of the species currently permitted live importation to Australia. It is recommended that *Synodontis petricola* is added to the Live Import List.