Botia histrionica: Application 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)

September 2021

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 Burmese border loach (*Botia histrionica*) indicates the risk of allowing the importation of the species would pose minimal biosecurity risk to Australia. Notably, *B. histrionica* is not reported to have established breeding populations outside its natural range overseas despite being traded internationally for over 40 years and similar species such as *B. lohachata* have not established self-maintaining wild populations in Australia despite over 16 years of importation. Furthermore, populations of *B. histrionica* likely exist in the domestic hobby having been intermittently traded in Australia over the last 20 years ─ these have not led to the establishment of feral populations in Australia.

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 is an indication of the benign nature of the species since scientific study (and associated literature) focuses almost exclusively on invasive species that have some ecological impact. 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 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.

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

A structured risk assessment based on the methodology of Bomford (2008) estimated a 'moderate' risk, generally consistent with the risk that would be posed by most of the species currently permitted live importation to Australia. It is recommended that *B. histrionica* is added to the Live Import List.

DAWE terms of reference

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

   - Burmese border loach, *Botia histrionica* Blyth 1860.
   - Actinopterygii (ray-finned fishes); Cypriniformes (Carps); Botiidae (loaches); Sub-family Botiinae.
   - Synonyms: Nil, although included in the *Botia histrionica* complex (Grant 2007).
   - Common names: Burmese Loach, Golden Zebra Loach, Silver Striped Loach (Sanford 2008, Seriously Fish nd─a).

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.

- *B. histrionica* is not CITES listed.
- This species is listed on the IUCN Red List as being of Least Concern (LC) (Chaudry 2010). Day and Barat (2015) incorrectly list the fish as vulnerable according to IUCN.
- *B. histrionica* is reported from the Indian state of Manipur, Yunnan Province in China (upper Ayeyarwady River basin), and throughout much of Myanmar including the Ayeyarwady, Sittaung, Salween and Ataran river drainages.
- *B. histrionica* is bred commercially for the aquarium trade.

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

Virtually all information about *B. histrionica* asides from taxonomic information comes from hobbyist information sites so mostly applies to aquarium behaviour and requirements. Some websites do give some information on diet in the wild. In India *B. histrionica* is considered an important food species as well as an ornamental species (Devi *et al*. 2020). *Botia* spp. live in clear slow flowing mountain streams shaded by the forest (Menon 1999, Tropical Fish Keeping 2013, Froese and Pauly nd–a). The species is nocturnal but adapts quickly to aquarium conditions, feeding during daytime and showing a preference for live animal feeds like daphnia, worms and brine shrimp. *B. histrionica* is a benthic feeder but can feed mid and surface water (Dey and Barat 2015). All Botiids are recommended for snail control in aquaria.

The species is gregarious in aquaria, suggesting they live in small groups in the wild. Aquarium water requirements are for very pure water maintained at 22-28°C, pH at 6.0-7.5 and hardness (mg/L) 36 to 179, with most websites recommending at least weekly if not more regular water changes and high filtration levels.

There is no published information on breeding fecundity of this species. One study on a mountain species (*B. almorhae*) found that it bred in the northern hemisphere spring in slow flowing water, producing 908-3616 eggs (Joshi and Pathani 2009). Another species (*Botia dario*) produced 5245 to 53754 eggs averaging 31833 (Hossain *et al*. 2007). Day and Barat (2015) documented the breeding of ornamental fish *Botia histrionica* in captivity with use of synthetic hormones.

- *Lifespan of the species*: 6 years in aquaria (Aqua-Fish.net nd).
- Size and weight range: *Botia histrionica* grows to about 110-130mm total length (Seriously Fish nd–a). Juveniles appear very similar to *B. kubotai, B. almorhae*, and *B. rostrata.*
- *Natural geographic range*: *Botia histrionica* has been recorded from Manipur in India, Yunnan Province, China (upper Ayeyarwady River basin), and throughout much of Myanmar including the Ayeyarwady, Sittaung, Salween and Ataran river drainages (Seriously Fish nd–a).
- *Habitat*: No detailed habitat descriptions for *B. histrionica* have been published. However, the rivers in areas from which it is collected are clear, slow flowing sections

of forest shaded mountain streams with a sand/gravel substrate. These conditions correspond with the aquarium requirements.

- *Diet, including potential to feed on agricultural plants*: *B. histrionica*, like most Botiids, may eat small portions of plants but is not considered a threat to planted aquaria. The natural diet comprises aquatic molluscs, insects, worms, and other invertebrates (Seriously Fish nd─a).

- *Social behaviour and groupings*: *B. histrionica* is gregarious as are all Botiids, preferring to live in groups of over 5 as they maintain complex social hierarchies (Seriously Fish nd─a). All botiids are also known to nip the fins of larger, slow moving fish with large fins (Seriously Fish nd─a).

- *Territorial and aggressive behaviours*: Not territorial but may nip fins in aquaria.

- *Natural predators*: Not reported but piscivorous birds, mammals or fish in their habitat would likely prey on them.

- *Characteristics that may cause harm to humans and other species*: No characteristics that may cause harm to human or other species have been reported. *B. histrionica* does have sub-ocular spines which could cause minor injury if carelessly handled.

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

   There is no published scientific information on the reproductive biology of this species.

   - *Age at maturity (first breeding)*: 3 years.

   - *How frequently breeding occurs*: Breeding frequency in the wild has not been reported. About three spawns a year are expected from a female under aquaculture conditions.

   - *Can the female store sperm*: Not known but unlikely as there is no intromittent organ. They are egg layers so fertilisation is external.

   - *How many eggs or live-born young are produced at each breeding event*:
   There is no published information on the fecundity of this species in the wild. Under aquaculture conditions, the fecundity is estimated to be in the order of 200 eggs per spawn. Joshi and Pathani (2009) reported a mountain species, *Botia almorhae* producing 908-3616 eggs depending on size. Another species, *Botia dario* produced 5245 to 53754 eggs averaging 31833 (Hossain *et al*. 2007).

   - *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*: There are no reports of hybridisation in wild populations. Hybridisation with other Botiids during captive breeding has been reported (Seriously Fish nd─b).

   - *If the species can hybridise, are the progeny fertile*: Not known.

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 population outside of their

natural geographic distribution, despite being traded internationally for the aquarium trade for over 30 years in volumes in the order of 1.5 million fish per year.

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 did not identify any previous environmental risk assessment of this species. The species is not on the BRS 'grey list' of ornamental fish species, i.e. non-native species that are present in Australia through historical imports that are not on the Live Import List, nor is it 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). It is however noted that the BRS grey list is currently under review by a technical working group of the Vertebrate Pest Committee and is being amended to better reflect the ornamental fish species historically present and traded in Australia. It is further noted that *B. histrionica* has been present and intermittently traded domestically in Australia in the past and small numbers likely persist as aquarium specimens.

   The addition of *B. histrionica* to the Live Import List would be generally consistent with Australia's biosecurity arrangements for live fish given that the species is closely related to and shares a similar environmental risk profile with the clown loach (*Chromobotia macracanthus*), the dwarf chain loach *(Ambastaia sidthimunki)* and the yoyo loach (*Botia lohachata*), all of which are 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 put forward by Bomford (2008) has been adopted by DAWE for its assessments. The following considers each of the risk factors considered in Bomford (2008) to be applicable to freshwater fish and is guided by the recent DAWE risk assessment of glass catfish (DAWE 2020a). The specific criteria in the DAWE template terms of reference 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 is an indication of the benign nature of the species since scientific study and associated literature focuses almost exclusively on invasive species that have some ecological impact. 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 not considered invasive or otherwise ecologically harmful.

   - *Propagule pressure—the release of large numbers of animals at different times and places enhances the chance of successful establishment: Botia histrionica* is generally nocturnal and lives in clear slow flowing mountain streams shaded by forest (Menon 1999, Tropical Fish Keeping 2013, Froese and Pauly nd─a). The opportunity to find shelter in the event of deliberate or inadvertent release into the wild in Australia would

be limited to a few streams in the wet tropics of far northern Australia. A moderate to high probability of establishing a self-sustaining population would require deliberate release into these very specific waterways – it is unlikely therefore to happen at random (DAWE 2020a). It is unlikely that enough fish would be accidently or deliberately released into a suitable receiving environment to establish a breeding wild population.

- *Climate match—introduction to an area with a climate that closely matches that of the species' original range:* Climatch was used to assist in identifying possible habitats in Australia that the species could inhabit if released (Bomford, 2008). *Botia histrionica* is endemic to India (Manipur and Nagaland) and from Myanmar. It has a widespread distribution in the Irrawaddy and Chindwin basins (Chaudhry 2010). Climatch (original v1.0) was run with the source region set to circumscribe an area in Myanmar consistent with that described in Chaudhry (2010). A climate match prediction was generated using the Euclidian algorithm applied to the 'world stations' data set. Climatch calculated a 'value X' (Climate Euclidian Sum Level 5) of 1016, equating to a climate match score of 6. DAWE (2020a) suggested the need for some caution in predicting climate suitability for freshwater aquatic species because Climatch is based on terrestrial climate measurements. The new upgraded version of Climatch (v2.0) was not used in this assessment because its improved mapping resolution results in higher output values that are yet to be calibrated for purposes of applying the Bomford methodology.

- *Overseas range: B. histrionica* is endemic to India (Manipur and Nagaland) and Myanmar. It has a widespread distribution in the Irrawady and Chindwin basins. The species is estimated (using 'mapcoordinates.net') to occupy a total 36, 1^{o} latitude x 1^{o} longitude grid squares (Bomford 2008).

- *History of establishment elsewhere—previous successful establishment:* There has been no recorded establishment of wild populations of *B. histrionica* outside its natural range, despite likely inadvertent or deliberate introductions as an internationally traded aquarium species. The species is considered to have been "introduced but never established" (Bomford 2008).

- *Introduction success:* The species is not known to have been released or established. However, after many decades of trade worldwide it can be assumed it has been released into non-native areas on many occasions. 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:* FishBase recognises 10 species of *Botia* of which two species, *Botia dario* and *Botia lohachata* are reported as having established in the wild outside the countries of their natural range (Froese and Pauly n.d.–b). If the Bomford (2008) methodology is applied to the genus *Botia*, then of a total 10 species, 4 are traded as ornamental species and of this 4, there are 2 reported populations (representing two species) that have been found potentially established (introduced but unknown whether these introductions have led to establishment of wild populations) outside the countries to which they are native. As internationally traded aquarium species, it is reasonable to assume that there would have been many instances of inadvertent or deliberate introduction of these four species around the world – conservatively, 25 past introductions are assumed for the purposes of this risk assessment. However, there

are only two records (representing only two species) on FishBase of *Botia* species being found to have established wild populations outside the countries to which they are native. The 'genus level' taxa risk is therefore 2/25 (8%). Notably, *Botia lohachata* a species similar to *B. histrionica* is on the current list of specimens taken to be suitable for live import, has been imported to Australia for at least 40 years and has not established wild populations.

- *Ability to find food sources*: As a carnivore feeding primarily on benthic invertebrates, 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)*: *B. histrionica* lives in apparently pristine clear water streams in Myanmar and India. The species requires tropical climate in water with a 6.0–7.5 pH, a water hardness of 0–10 dGH and a temperature range of 22 to 28°C. This climatic range together with its stream habitat requirements limits the potential geographical range where the species could theoretically establish to a very few streams in the wet tropics of far northern Australia.

- *Ability to find shelter*: As a stream dwelling tropical fish with an affinity towards slow flowing, shaded streams with soft, clean, clear water, opportunity to find shelter in the event of deliberate or inadvertent release into the wild would be limited to a few streams in the wet tropics of far northern Queensland.

- *Rate of reproducing*: Reproductive rate (the number of offspring that a female produces during its lifetime) data in wild population have not been reported. Under aquaculture conditions, females are productive for about 3 years, spawning three times a year and produce in the order of 200 eggs per spawning.

- *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.

In summary, the likelihood of establishment is considered to be very low, in main because *B. histrionica* is not reported to have established breeding populations outside its natural range despite being traded internationally as an ornamental species for over 30 years and because there are few areas in Australia expected to have habitat suitable for the species to establish. This conclusion can be ground-truthed by comparing *B. histrionica* with similar species such as *Botia lohachata* that have not established self-maintaining wild populations despite excess of 16 years of importation to Australia for the aquarium trade. Furthermore, captive aquarium populations of *B. histrionica* likely exist in the domestic hobby – these have not resulted in 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 sandy or gravel substrates. These niche species could include bottom feeders such as eel tailed catfishes (*Neosilurus* spp., *Porochilus* spp.) or juvenile eels (*Anguilla*

reinhardtii). No competition would be expected with mid-water or surface feeding fish. Most of the lower reaches of potential habitat streams are dominated by species that penetrate freshwaters from the sea or require saline water for breeding. 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 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. The loaches are as a group 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). Botiids are especially susceptible to white spot of fish (*Ichthyophthirius multifiliis*) as are most fish with small or no scales (including Neosilurids). Another disease (called skinny disease) has is relatively common in imported loaches and is thought to be caused by the flagellate parasite *Spironucleus* sp. (Seriously Fish nd─a). This parasite is found throughout the world in most vertebrates but is poorly characterised although they may be reasonably species specific (Williams *et al*. 2011).

- *Probable prey/food sources, including agricultural crops*: *B. histrionica* feeds on benthic invertebrates. It does not feed on any agricultural crops.

- *Habitat and local environmental conditions*: *B. histrionica* has not been reported to change its environment or habitat. It is a stream dwelling fish with an affinity towards natural, clear waters.

- *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 may 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 *B. histrionica*, 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 are turning 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 available to hobbyists in Australia. In the order of 1.5 million fish of the species are traded internationally and the likely market demand in Australia would represent about one percent of this, especially given the growing popularity of the hobby in Australia.

    - *Why this species has been chosen*: Internationally, the species is in high demand by hobbyists. New loach 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. Three close relatives, the clown loach (*Chromobotia macracanthus*), the dwarf chain loach *(Ambastaia sidthimunki)* and the yoyo loach (*Botia lohachata*), all very popular aquarium fish, are currently on the list of specimens taken to be suitable for live import.

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.

    - *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 state or territory.

REFERENCES

Aqua-Fish.net (nd) “Burmese loach - Botia histrionica” [online] Available at: https://en.aqua-fish.net/fish/burmese-loach [Accessed 10 November 2020]

Bomford M (2008) Risk assessment models for the establishment of exotic vertebrates in Australia and New Zealand: validating and refining risk assessment models. Invasive Animals Cooperative Research Centre, Canberra. Available online: https://pestsmart.org.au/wp-content/uploads/sites/3/2020/06/Risk_Assess_Models_2008_FINAL.pdf [Downloaded 1 November 2020]

Corfield J, Diggles B, Jubb C, McDowall RM, Moore A, Richards A and Rowe DK (2008). Review of the impacts of introduced ornamental fish species that have established wild populations in Australia’. Prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts. Available online: https://www.environment.gov.au/system/files/resources/fb1584f5-1d57-4b3c-9a0f-b1d5beff76a4/files/ornamental-fish.pdf [Downloaded 1 November 2020]

Chaudhry S (2010). *Botia histrionica*. *The IUCN Red List of Threatened Species* 2010: e.T166538A6231989. https://www.iucnredlist.org/species/166538/6231989. Downloaded on 19 October 2020.

DAWE (2020a) Risk Assessment to add *Kryptopterus vitreolus* to, and remove *Kryptopterus bicirrhis* from, the Environment Protection and Biodiversity Conservation Act 1999 List of Specimens taken to be Suitable for Live Import August 2020. Department of Agriculture, Water and the Environment. [online] https://environment.gov.au/system/files/consultations/1b591465-8486-450a-b12f-2f824fd925ca/files/glass-catfish-risk-assessment.pdf [Accessed 1 November 2020].

DAWE (2020b) Import conditions for freshwater aquarium fish: Effective 18 July 2020. Department of Agriculture, Water and the Environment. Available at: https://bicon.agriculture.gov.au/BiconWeb4.0/ImportConditions/Conditions?EvaluatableElementId=482052&Path=UNDEFINED&UserContext=External&EvaluationStateId=7f1ea5c5-8bef-4b34-a789-2987549620ff&CaseElementPk=1354044&EvaluationPhase=ImportDefinition&HasAlerts=False&HasChangeNotices=False&IsAEP=False] [Accessed 12 October 2020].

Devi NP, Devi CHB, Landge AT, Deshmukhe G and Jaiswar AK (2020) Fish diversity of Imphal river, Manipur: Socioeconomic importance and IUCN status. Journal of Entomology and Zoology Studies 2020; 8(4): 216-221

Dey A and Barat S (2015) Spawning biology and captive breeding of vulnerable loach *Botia histrionica* (Blyth) in Cooch Behar, West Bengal, India. European Journal of Experimental Biology: 5(10): 46-48

Froese R and Pauly D Editors (nd–a) “*Botia histrionica*” [online] Available at: https://www.fishbase.se/summary/Botia-histrionica.html [Accessed 1 November 2020]

Froese R and Pauly D Editors (nd–b) “Scientific Names where Genus Equals Botia”: FishBase search results for species belonging to the genus Botia [online] Available at: https://www.fishbase.se/search.php [Accessed 1 November 2020]

Grant S (2007) Ichthyofile Number 2: 1-106 Fishes of the genus *Botia* Gray, 1831, in the Indian region (Teleostei: Botiidae).

Kahn SA, Wilson DW, Perera RP, Hayder H and Gerritty SE (1999). Import Risk Analysis on Live Ornamental Finfish. Canberra: Australian Quarantine and Inspection Service. 187 pages. Available online: https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/ba/animal/horsesubmissions/finalornamental.pdf [Downloaded 1 November 2020]

Menon AGK (1999) Check list - fresh water fishes of India. Rec. Zool. Surv. India, Misc. Publ., Occas. Pap. No. 175, 366 p. Available online: http://faunaofindia.nic.in/PDFVolumes/occpapers/175/index.pdf [Downloaded 12 November 2020]

PIAA (2008) Pet Industry Association of Australia (PIAA) National Code of Practice (PIAA 2008) [http://piaa.net.au/wp-content/uploads/2015/03/PIAA-CodeofPractice.pdf] Accessed 12 October 2020.

Sanford S (2008) "Loaches online: *Botia histrionica*" [online] Available at: https://www.loaches.com/species-index/botia-histronica [Accessed 10 November 2020]

Seriously Fish (nd—a) "Seriously Fish. Species Profile: *Botia histrionica*" [online] Available sat: https://www.seriouslyfish.com/species/botia-histrionica/ [Accessed 10 Nov 2020].

Seriously Fish (nd—b) "Seriously Fish. Species Profile: *Botia kubotai*" [online] Available at: https://www.seriouslyfish.com/species/botia-kubotai/ [Accessed 10 Nov 2020].

Tropical Fish Keeping (2013) "*Botia histrionica*" [online] Available at: https://www.tropicalfishkeeping.com/threads/botia-histrionica.192249/ [Accessed 12 November 2020]

Williams CF, Lloyd D, Poynton SL, Jorgensen A, Millet COM (2011) *Spironucleus* species: Economically Important Fish Pathogens and Enigmatic Single-Celled Eukaryotes. J Aquac Res Development S2:002. doi:10.4172/2155-9546.S2-002

Appendix A: Bomford model risk assessment: *Botia histrionica*

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 *Botia histrionica* (Blyth 1860) 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

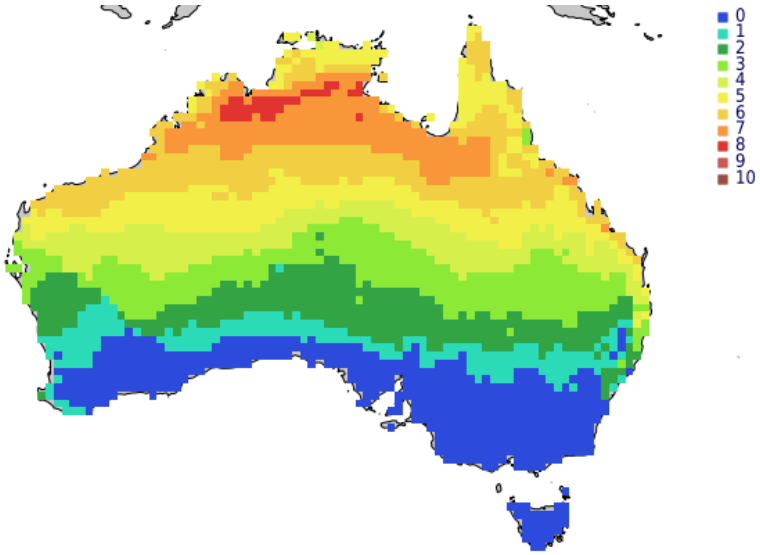
Propagule pressure—the release of large numbers of animals at different times and places

B. histrionica is generally nocturnal and lives in clear slow flowing mountain streams shaded by forest (Menon 1999, Tropical Fish Keeping 2013, Froese and Pauly nd–a). As such, opportunity to find shelter in the event of deliberate or inadvertent release into the wild would be limited to a few streams in the wet tropics far northern Queensland. A moderate to high probability of establishing a self-sustaining population would require deliberate release into these very specific waterways – it is unlikely therefore to happen at random (DAWE 2020a). It is unlikely that enough fish would be accidently or deliberately released into a suitable receiving environment to establish a breeding wild population.

If permitted importation *B. histrionica* would be freely available in Australia through aquarium stores. The species would be common enough in Australia that theft due to lack of availability is unlikely. Only a very deliberate and planned release might result in establishment of the species, although the limited potentially suitable habitats and their remoteness from populated areas makes this scenario highly unlikely.

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

Climatch (v1.0) was run with the source region set conservatively to circumscribe an area in Myanmar consistent with that described in Chaudhry (2010). A climate match prediction was generated using the Euclidian algorithm applied to the 'world stations' data set (Figure 1). Climatch calculated a 'value X' (Climate Euclidian Sum Level 5) of 1016, equating to a climate match score of 6. DAWE (2020a) suggested the need for some caution in predicting climate suitability for freshwater aquatic species because Climatch is based on terrestrial climate measurements. The recently released upgraded version of Climatch (v2.0) was not used in this assessment because its improved mapping resolution results in higher output values that are yet to be calibrated for purposes of applying the Bomford methodology.



Score	0	1	2	3	4	5	6	7	8	9	10
Count	505	218	363	392	291	364	386	234	32	0	0

Figure 1 Climatch output for *Botia histrionica*

History of establishment elsewhere—previous successful establishment:

There have been no recorded establishment of wild populations of *B. histrionica* outside its natural range, despite likely inadvertent or deliberate introductions as an internationally traded aquarium species. The species is considered to have been "introduce but never established" (Bomford 2008).

Overseas range:

B. histrionica is endemic to India (Manipur and Nagaland) and from Myanmar. It has a widespread distribution in the Irrawaddy and Chindwin basins. The species is estimated to occupy a total of 36, 1° latitude x 1° longitude grid squares (Bomford 2008).

Introduction success:

The species is not known to have been released or established. However, after many decades of trade worldwide it can be assumed it has been released into non-native areas on many occasions. 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:

FishBase recognises 10 species of *Botia* of which two species, *Botia dario* and *Botia lohachata* are reported as having established in the wild outside the countries of their natural range (Froese and Pauly n.d.–b). If the Bomford (2008) methodology is applied to the genus *Botia*, then of a total 10 species, 4 are traded as ornamental species and of this 4, there are 2 reported populations (representing two species) that have been found potentially established (introduced but unknown whether these introductions have led to establishment of wild populations) outside the countries to which they are native. As internationally traded aquarium

species, it is reasonable to assume that there would have been many instances of inadvertent or deliberate introduction of these four species around the world – conservatively, 25 past introductions are assumed for the purposes of this risk assessment. However, there are only two records (representing only two species) on FishBase of *Botia* species being found to have established wild populations outside the countries to which they are native. The 'genus level' taxa risk is therefore 2/25 (8%). Notably, *Botia lohachata* a species similar to *B. histrionica* is on the current list of specimens taken to be suitable for live import, has been imported to Australia for at least 40 years and has not established wild populations.

Potential impacts of established feral populations

As there are no reports of *B. histrionica* establishing feral populations, the likelihood of serious direct impacts are not certain, although unlikely. If 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 sandy or gravel substrates. These niche species could include bottom feeders such as eel tailed catfishes (*Neosilurus* spp., *Porochilus* spp.) or juvenile eels (*Anguilla reinhardtii*). No competition would be expected with mid-water or surface feeding fish. Most of the lower reaches of potential habitat streams are dominated by species that penetrate freshwaters from the sea or need saline water to breed.

B. histrionica poses a minor impact risk to the Australian environment as they have been freely traded internationally for many years, with no evidence of establishment of feral populations or any detrimental impact in any other country.

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	Burmese border loach
Scientific name	*Botia histrionica* (Blyth 1860)
Date assessed	11 January 2021
Literature Search Type and Date:	FishBase December 2020

Risk criterion	Value	Explanation
A. Climate Match Score (1–8)	6	Climatch (v1.0) Euclidian Sum Level 5 (Value X) = 1016. This value equates to a climate match score of 6.
B. Overseas Range Score (0–4)	4	Estimated to occupy a total 36, 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	Never known to have been released or established. However, after many years of trade worldwide it can be assumed it has been released into non-native areas on many occasions. The introduction success rate is conservatively considered <0.25, representing an introduction success score of 1.
E. Taxa Risk Score (0–5)	2	As internationally traded aquarium species, it is reasonable to assume that there would have been many instances of inadvertent or deliberate introduction of the four *Botia* species traded internationally as ornamental fish – conservatively, 25 past introductions are assumed for the purposes of this risk assessment. There are only two records (representing two species) on FishBase of *Botia* species being found to have potentially established wild populations outside the countries to which they are native. The 'genus level' taxa risk is therefore 2/25 (8%).

Summary	*Score*	*Rank*
Establishment Risk	13	Moderate

Conclusion

The estimated risk of 'moderate' using the Bomford (2008) methodology is generally consistent with the risk that would be posed by most of the species currently permitted live importation to Australia. It is recommended that *Botia histrionica* is added to the Live Import List.