



Pararasbora moltrechti Regan, 1908, a senior synonym of *Aphyocypris amnis* Liao *et al.*, 2011 (Teleostei: Cyprinidae) in Taiwan with morphological and molecular evidence

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Abstract

The endemic cyprinid, *Pararasbora moltrechti* Regan, 1908 is briefly redescribed from central Taiwan. A more detailed description was first provided in Mandarin by Chen & Fang, 1999. A second, rather doubtful description error created a new cyprinid species, *Aphyocypris amnis* Liao *et al.*, 2011, which is almost identical to the original species. The new species was found in a small tributary of the Jushuei River basin, just 0.5 km from Lake Candidius—Sun Moon Lake, the same location where *P. moltrechti* was originally found. Chen *et al.* (2012) clearly noted this synonym in the remarks of the Red Data Fish Book in AGC. The incorrect scientific name was added to the Governmental protection list in AGC, causing further issues for conservation management. Solid evidence, not only from morphological data but also from increasing mtDNA documentation, supports the fact that the later published name is redundant. Mito-genetic results also suggest that they are the same species with no distinct genetic differentiation. Herein we clearly state that the *Pararasbora moltrechti* Regan, 1908 is the senior synonym of *Aphyocypris amnis* Liao *et al.*, 2011 (Teleostei: Cyprinidae) in Taiwan.

Key words: *Pararasbora moltrechti*, redescription, senior synonym, fish fauna, Cyprinidae, Taiwan

Introduction

The endemic cyprinid, *Pararasbora moltrechti* Regan, 1908 is briefly redescribed from central Taiwan. A more detailed description was first provided in Mandarin by Chen & Fang, 1999. Historically, Chen and Fang (1999) clearly stated that *Pararasbora moltrechti* Regan, 1908, can be found in both the Jushuei and Wu River basins.

However, in the Jushuei basin, Liao *et al.* (2011) unexpectedly described a new species, known as *Aphyocypris amnis*, from the Sun Moon Lake, where happens to have a very short locality distance of about 0.5 km from the type locality of Regan's *P. moltrechti*. Despite Chen *et al.* (2012) clearly stated the synonymy of *A. amnis* in the remarks of his Red Data Fish Book in AGC (Agriculture Council, restructured to Ministry of Agriculture on August 1, 2023), Taipei, the AGC did not follow the suggestions of the fish book they published. Detailed fish images and all relevant data have yet to be formally uncovered and compared.

The inclusion of an incorrect name in the governmental protection list by the Ministry of Agriculture (MOA) has caused numerous conflicts and problems for the conservation and management of Taiwanese wildlife.

Our provision of solid evidence for historical collections is not only based on morphological data, but also on the increasing use of mtDNA analysis (recently provided by Chen & Jang-Liaw, 2023), which has revealed that these results can effectively reiterate the truth of the redundant name as a junior synonym for the later one.

Herein the aim of this paper is to clearly state that *Pararasbora moltrechti* Regan, 1908 is the senior synonym of *Aphyocypris amnis* Liao *et al.* 2011 based on a brief discussion of the morphological data and molecular phylogenetic analysis.

Materials and methods

All fish were collected by using either a fish trap or a casting net in the small tributaries of three river basins. The fish specimens collected for the current survey in recent years will be deposited in either the fish collection of National Museum of Natural Science (NMNSF), Taichung or the Pisces collection of National Taiwan Ocean University (NTOUP), Keelung, Taiwan. The counts and measurements generally followed Chen and Chang (2007). The original mito-genetic data comparison and re-analysis among the three river basins in central Taiwan were cited and collected from Chen and Jang-Liaw (2023).

Systematics

Pararasbora moltrechti Regan, 1908

(Figs 1–6)

Pararasbota moltrechti Regan, 1908: 360 (Lake Candidius—Sun Moon Lake, Taiwan); Chen & Fang, 1999: 82.
Aphyocypris amnis Liao *et al.*, 2011: 658 (Jusheui River basin, Taiwan).



FIGURE 1. Lectotype of *Pararasbora moltrechti*, 54.8 mm SL, Lake Candidius, Nantou (Photo by I-Shiung Chen).

Material examined

Lectotype. BMNH 1909.4.28.24, 54.8 mm SL, coll. A. Moltrecht., Lake Candidius, Taiwan.

NMNSF000273, 7 specimens, 38.6–55.4 mm SL, Dajar River basin, Shinsher County, Taichung, Coll. NH Jang-Liaw, 13 November 2003.

NTOUP-2006-07-245, 10 specimens, 43.6–68.5 mm SL, Wu River basin, Nantou County, Taiwan, N.H. Jang-Liaw *et al.*, July, 2006.

NTOUP-2007-05-303, 14 specimens, 54.3–86.6 mm SL, Jushuei River basin, Nantou County, Taiwan, N.H. Jang-Liaw *et al.*, May, 2007.

Redescription

Dorsal fin 3+7; anal fin 3+7; pectoral fin 1+12–13; pelvic fin 1+7; gill racker modally 8; pharyngeal teeth 4, 4 – 4, 4; lateral fin scales 34–37; scales above lateral line 6–7; scales below lateral line 2; predorsal scale rows 19–20. No distinct difference between river basins.

Body elongate and compressed; a ventral keel extending from point of origin of pelvic fin to anus. All body proportion shown in Table 1. No distinct morphometric differences between the population of Wu–Dajar river basins and population of Jushuei River basins.

TABLE 1. Morphometry of *Pararasbora moltrechti* between two defined groups of sampling localities-river basins.

| Locality | Dajar & Wu River basins | | | Jushuei River basin | | |
|----------|-------------------------|-------|-------|---------------------|-------|-------|
| | min | max | mean | min | max | mean |
| SL | 38.6 | 68.5 | | 54.3 | 86.6 | |
| In SL | | | | | | |
| Bd | 24.2% | 30.3% | 26.5% | 23.1% | 25.4% | 24.2% |
| CL | 18.8% | 25.4% | 21.9% | 20.1% | 25.3% | 22.4% |
| CD | 12.1% | 14.9% | 13.2% | 11.8% | 13.4% | 12.6% |
| PDL | 55.8% | 59.6% | 58.0% | 55.3% | 57.3% | 56.3% |
| PNL | 62.0% | 73.3% | 67.3% | 65.5% | 67.9% | 66.7% |
| PPL | 22.2% | 30.3% | 27.3% | 25.8% | 28.2% | 27.1% |
| PPvL | 46.0% | 52.0% | 48.5% | 46.8% | 49.0% | 47.7% |
| D-FL | 17.3% | 24.1% | 20.6% | 18.1% | 21.2% | 19.4% |
| A-FL | 13.1% | 20.3% | 17.5% | 14.1% | 19.1% | 17.0% |
| P-FL | 17.8% | 23.1% | 20.9% | 18.2% | 20.8% | 19.2% |
| PLvFL | 15.0% | 19.0% | 16.5% | 14.3% | 17.2% | 16.0% |
| HL | 23.8% | 29.1% | 26.8% | 25.8% | 28.9% | 27.7% |
| In HL | | | | | | |
| HD | 66.3% | 85.6% | 74.0% | 67.9% | 78.5% | 73.6% |
| OD | 23.0% | 31.7% | 27.4% | 21.3% | 28.0% | 25.6% |
| SNL | 21.5% | 33.0% | 25.3% | 21.7% | 28.7% | 25.4% |

Head rather wide and moderately large. Eye very large. Snout rather short. Maxillary rather oblique, extending just beyond vertical of orbit. No barbel. Body with moderate cycloid scales. Dorsal fin origin closer to caudal fin base rather than snout. Dorsal and anal fin origin with larger anterior rays. Caudal fin forked.

Coloration when alive

Body brownish gray dorsally and mainly sliver laterally with some golden tone. Belly silver to white. Body scattered with vertical, small grayish black marks concentrating more densely in front of rear tip of anal fin base. Eye with a grayish region above pupil. Dorsal and anal fins grayish with somewhat pinkish to orange tones. Caudal fin generally grayish with pinkish centrally.

There are no distinct differences in coloration of specimens around these three different river basins in Taiwan.



FIGURE 2. *Pararasbora moltrechti* from Jushuei River basin, Nantou, Taiwan, 55.2 mm SL.



FIGURE 3. *Pararasbora moltrechti* from Jushuei River basin, Nantou, Taiwan, 64.3 mm SL.



FIGURE 4. *Pararasbora moltrechti* from Jushuei River basin, Nantou, Taiwan, 70.8 mm SL.



FIGURE 5. *Pararasbora moltrechti* from Jushuei River basin, Nantou, Taiwan, 78.3 mm SL.



FIGURE 6. *Pararasbora moltrechti* from Wu River basin, Nantou, Taiwan, about 75 mm SL.

Distribution

The species can be found in three main basins: The Dajar River basin, Wu River basin, and Jushuei River basin in Taiwan (Chen & Fang, 1999; Chen & Chang, 2005). It is an endemic species of Taiwan. However, some fish populations have been released and introduced into the Lanyang River basin, Ilan county, potentially seriously threatening and causing the degradation of the native population of *Aphyocypris kikuchii*.

Discussion and remarks

Outlook for young specimens as separate species, leading to junior synonymy

All specimens collected from the Jushuei River basin showed no differences from the type specimen of the lectotype. All collected specimens within the same population in the Jushuei River showed slight variations in the downward

profile of the lateral-line scale series. Therefore, larger fish specimens seemed to have a lower profile than the smaller, junior ones (the fish photos show the growing size from 55 mm to 78 mm SL). The holotype assigned for *Aphyocypris amnis* is particularly interesting as it is merely 39 mm SL. This is the main reason why these authors (Liao *et al.*, 2011) found such minor differences in larger specimens represented in Chen and Chang (2005), all of which are adult fish photos from adults about 70–100 mm SL. Our record of breeding *Pararasbora moltrechti* shows that they can grow to sizes larger than 110 mm SL (Yeh, unpublished data) in the Jushuei River basin, which is also the same type locality for naming *A. amnis*. Young scientists working on fish taxonomy often mistakenly select the intermediate morphology of small and medium-sized cyprinid fish to roughly determine superficial differences based on the allometric growth of lateral-body squamation development. Even in Liao *et al.*'s (2011) study, their holotype does not show the congruent downward profile indicated in their hand-drawn black-line drawing. All photos from Liao *et al.* (2011), and our collections from the Jushuei River basin presented in this paper, show no difference from the lectotype in terms of vertically scattered grayish-black marks. This is also very consistent with other populations in the Dajar and Wu River basins.

Allometric growth, a common phenomenon in developmental progress, can also be observed in *Opsariichthys pachypachelus* Gunther (Yeh, unpublished data).

In 2004, Dr. Fang Fang emphasized the importance of the final mature phase of cyprinid fish in accurately determining the true species boundary for precise cyprinid taxonomy. She advised ichthyologists to disregard the smaller or intermediate sizes of individuals that represent the allometric growth difference between younger and adult fish, based on her visit to Taipei and her field collections (Fang, personal communication). Although she captured over 30 fish samples of *Opsariichthys pachycephalus* in the Tanshuei River basin, Taipei, she only kept one larger adult, stating that the qualified adult size for her Cyprinid taxonomy was around around 130 mm SL. The remaining specimens of *Opsariichthys pachycephalus*, all of which were not of the qualified size, were released back into the rivers for population conservation.

Molecular evidence for the great similarity of the mitogenome between all three river basins

We rechecked the mito-genetic data employed by Chen and Jang-Liaw (2023) and re-analyzed the 22 fish samples of *P. moltrechti* from three river basins: Darjar (2), Wu (10), and Jushuei (10). We also tested the fish samples of *P. moltrechti* collected from the Jushuei river basin population, which is the type locality of the so-called *A. amnis*. Out of all the samples, only four haplotypes could be detected. When comparing the samples from the Dajar and Wu River basins to the Jushuei River basin, the K2P value ranged from 0.0018–0.0065 (2–7 bp point mutations) with an average of 0.0035 (Tables 2–3). However, the fish samples within the Jushuei River basin yielded a greater value of 0.0046 (5 bp), which is a larger distance than crossing to other different river basins. Therefore, not only does morphological evidence suggest that there is no need to separate the species level for just the Jushuei River basin of *Pararasbora moltrechti*. but mito-genetic identification also reconfirms this. Overall, the re-analysis suggests that there is intraspecific variation and all population members should be grouped into the typical *Pararasbora moltrechti*.

TABLE 2. The comparative values of intraspecific mtDNA divergences crossing the two defined locality groups of *Pararasbora moltrechti*.

| | |
|--|---|
| Intra-specific divergences crossing two defined groups bp (K2P value) | Jushuei River basin (Type locality of so-called <i>A. amnis</i>) |
| Dajar River & Wu River basins | 2–7 bp (0.0018–0.0065) (average 0.0035 among all) |

PS: all mtDNA sequence data cited from Chen and Jang-Liaw (2023).

TABLE 3. The values of intra-population differences of haplotypes in three different basins of *Pararasbora moltrechti*.

| River basins | Number of fish samples | Haplotype(s) | Intra-population differences of haplotypes in same basin bp (K2P value) |
|---------------|------------------------|--------------|---|
| Dajar River | 2 | 1 | 0 |
| Wu River | 10 | 1 | 0 |
| Jushuei River | 10 | 2 | 5 bp (0.0046) |

PS: all mtDNA sequence data cited from Chen and Jang-Liaw (2023).

Separation of two genera for *Aphyocypris* and *Pararasbora*

The molecular phylogenetic survey by Chen and Jang-Liaw (2023) also suggests that the *Aphyocypris* species member (at least two species) and *Pararasbora* species member (at least three species) are paraphyletic to each other. Therefore, *Aphyocypris* and *Pararasbora* have kept their own monophyletic groups mito-genetically. We agree to keep the same generic status as outlined in Chen and Fang (1999), Chiang *et al.* (2011) and Watanabe *et al.* (2020). We do not consider merging these two genera together immediately. In Taiwan, solid evidence reiterates the use of the original names *Aphyocypris kikuchii* and *Pararasbora moltrechti* as different genera in accordance with the original findings of Chen and Fang (1999), Chen and Chang (2005). Furthermore, the junior synonym, *Aphyocypris amnis*, should not be used.

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