

New localities of the *Oryzias woworae* species group (Adrianichthyidae) in Sulawesi Tenggara

[Lokasi baru spesies grup *Oryzias woworae* (Adrianichthyidae) di Sulawesi Tenggara]

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Abstract

The *Oryzias woworae* species group, composed of *O. asinua*, *O. wolasi*, and *O. woworae*, is a group of the family Adrianichthyidae endemic to Sulawesi Tenggara (Southeast Sulawesi). Here, we report new localities of each of the three species in this group, which were collected during our field expeditions in 2014-2015. In total, six new localities were discovered throughout Sulawesi Tenggara, including Muna Island, suggesting that they may have wider species ranges than currently recognized. Some of the new localities were independent of the river systems of the known localities, suggesting that each species is genetically structured, and that the unit for conservation should be considered not as each species but as each local population.

Keywords: conservation unit, *Oryzias asinua*, *O. wolasi*, *O. woworae*, population structure.

Abstrak

Kelompok spesies *Oryzias woworae*, family Adrianichthyidae, terdiri atas *O. asinua*, *O. wolasi*, dan *O. woworae*, merupakan spesies endemik di Sulawesi Tenggara. Selama ekspedisi lapangan tahun 2014-2015, kami mencatat setiap spesies dari ketiga spesies dalam grup ini dijumpai di beberapa lokasi baru. Secara keseluruhan, enam lokasi baru telah ditemukan sepanjang daerah Sulawesi Tenggara, termasuk Pulau Muna, yang menunjukkan bahwa grup tersebut kemungkinan memiliki daerah persebaran lebih luas dari yang diketahui saat ini. Sebagian lokasi baru berasal dari sistem aliran sungai yang berbeda dengan lokasi yang telah diketahui selama ini. Hal ini menunjukkan bahwa tiap spesies terstruktur secara genetik, dan bahwa unit konservasi harus dipertimbangkan bukan untuk tiap spesies tetapi untuk tiap populasi lokal.

Kata penting: unit konservasi, *Oryzias asinua*, *O. wolasi*, *O. woworae*, struktur populasi.

Introduction

The family Adrianichthyidae, commonly referred to as ricefishes or as medaka in Japan, comprises two genera and 36 species, genus *Oryzias* (32 species) and genus *Adrianichthys* (four species) (Parenti 2008, Herder & Chapuis 2010, Magtoon 2010, Parenti & Hadiaty 2010, Asai *et al.* 2011, Herder *et al.* 2012, Parenti *et al.* 2013, Mokodongan *et al.* 2014). Although this family is broadly distributed throughout East and Southeast

Asia, 20 species, over half the family (16 in the genus *Oryzias* and four in *Adrianichthys*), live in Sulawesi, an island in the Indo-Australian Archipelago located on the equator (Parenti 2008, Herder & Chapuis 2010, Parenti & Hadiaty 2010, Herder *et al.* 2012, Parenti *et al.* 2013, Moko dongan *et al.* 2014). Interestingly, 19 of these 20 species are endemic to Sulawesi, and thus this island is considered a biodiversity hotspot for this family.

Recently, three species of *Oryzias*, i.e., *O. asinua*, *O. wolasi*, and *O. woworae* have satellite island of Sulawesi (Parenti & Hadiaty 2010, Paren-

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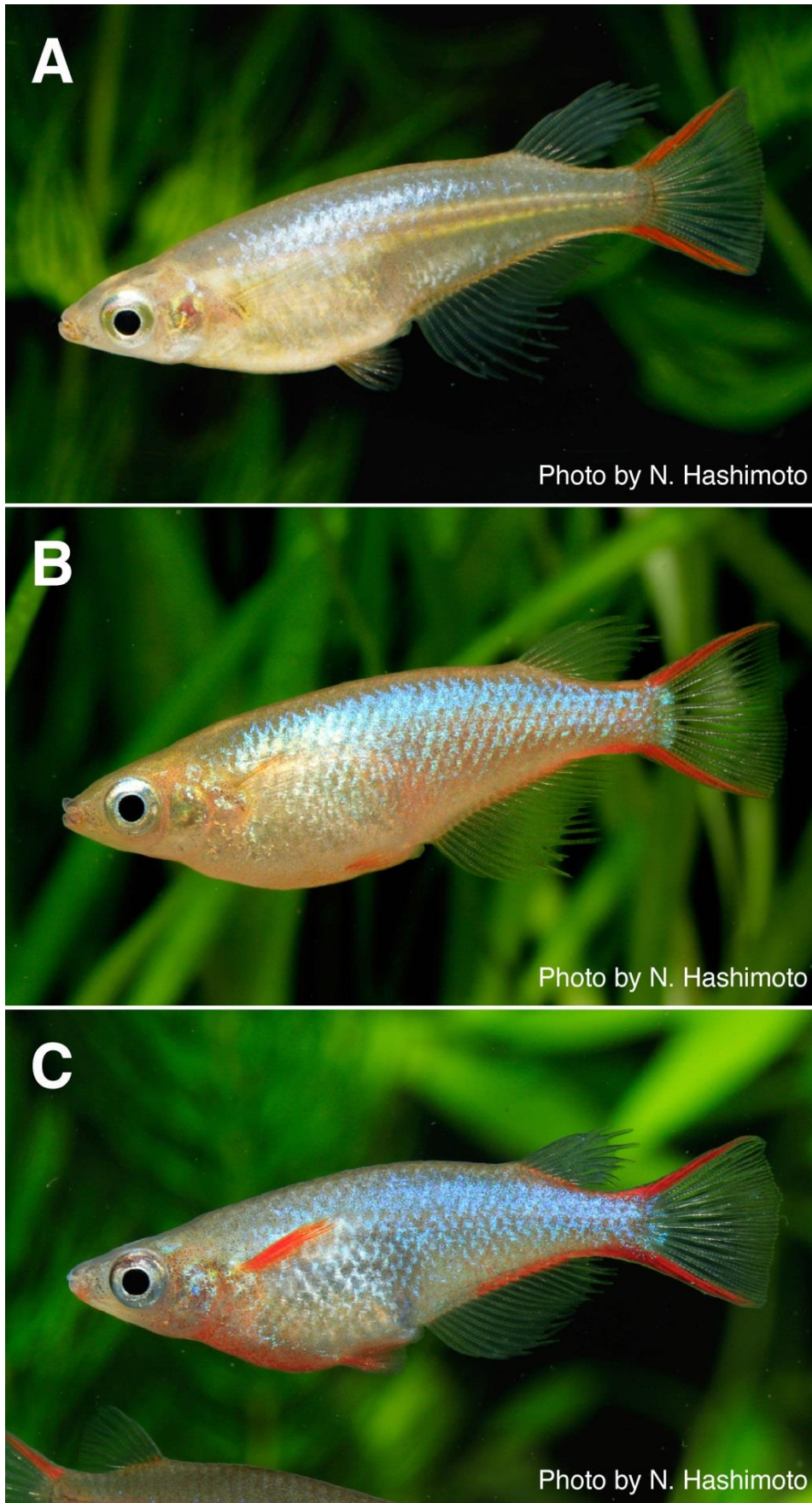


Figure 1. An adult male of A. *Oryzias asinua*, B. *O. wolasi*, and C. *O. woworae*.

ti *et al.* 2013). These three species, called the *Oryzias woworae* species group, share body colorations of silvery blue with red-orange margin on caudal fin (Figure 1), by which they are distinguished from the other *Oryzias* (Parenti *et al.* 2013). So far, distribution records of the *O. woworae* species group are limited. *O. asinua* and *O. woworae* are known only from the type locality, i.e., Sungai (River) Asinua in Kabupaten (Regency) Konawe and Fotuno Oe (Fountain) in Kabupaten Muna, respectively (Parenti & Hadiaty

2010, Parenti *et al.* 2013), and *O. wolasi* has been reported only from four localities in Kabupaten Konawe Selatan (South Konawe), including the type locality, i.e., Sungai Anduna.

In this study, we report several new localities of each of the three species in the *O. woworae* species group, which were collected during our field expeditions to Sulawesi Tenggara in 2014-2015. Based on the findings, we discuss population structures of the three species and their conservation.

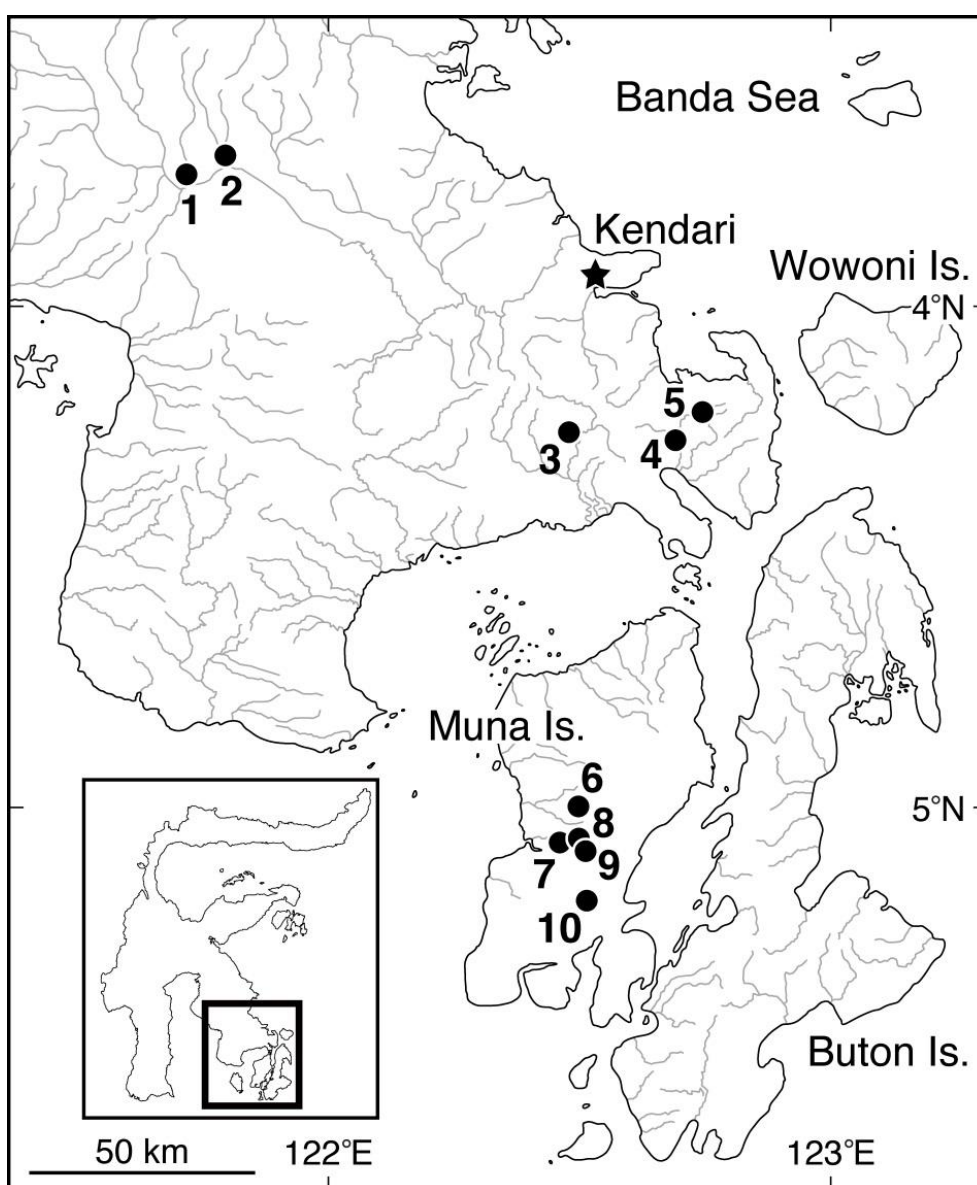


Figure 2. Map of Sulawesi Tenggara and localities of the *Oryzias woworae* species group. See Table 1 for the number of each locality.

Materials and methods

Field expeditions for the *Oryzias woworae* species group were conducted throughout Sulawesi Tenggara (Southeast Sulawesi) (Figure 2), including Muna Island, during November 2014 to November 2015. We searched for *Oryzias* from the surface of water and/or under water by snorkeling. When *Oryzias* were found, we collected them using a beach seine.

Oryzias collected from Kabupaten Konawe (Locality 1 and 2 in Figure 2) and Kabupaten Konawe Selatan (Locality 3-5 in Figure 2) were identified as *O. asinua* and *O. wolasi*, respectively, while *Oryzias* collected from Muna Island (locality 6-10 in Figure 2) were all identified as *O. woworae*, though Mokodongan & Yamahira (2015) suggested that taxonomic reexamination of this species group is required.

Results and discussion

Oryzias asinua had been known only from the type locality, Sungai (River) Asinua in Desa (Village) Asipako, which is a tributary of Sungai Konaweha (Parenti *et al.* 2013). During our field expeditions, however, we found *O. asinua* not only in Sungai Asinua but also in Sungai Ambekaeri in Desa Ambekaeri (Figure 3A, B, Table 1). Sungai Ambekaeri is another upstream tributary of Sungai Konaweha, located about 10 km apart from Sungai Asinua (Figure 2). This suggests that the population in Sungai Asinua and that in Sungai Ambekaeri may be a single meta-population having a certain degree of gene flows through individual dispersals. Molecular methods and population genetic analyses are needed to see if this is the case or not. We think that there may be still unknown populations of *O. asinua* along the Sungai Konaweha basin.

Table 1. Locality of the *Oryzias woworae* species group found during the field expeditions in 2014- 2015. Asterisks indicate new localities

Locality	Species	Latitude and longitude
1. Sungai Ambekaeri* (Desa Ambekaeri, Kecamatan Latoma, Kabupaten Konawe)	<i>O. asinua</i>	S03°45'47", E121°43'33"
2. Sungai Asinua (Desa Asipako, Kecamatan Asinua, Kabupaten Konawe)	<i>O. asinua</i>	S03°42'44", E121°47'58"
3. Sungai Anduna (Desa Anduna, Kecamatan Laeya, Kabupaten Konawe Selatan)	<i>O. wolasi</i>	S04°14'59", E122°29'01"
4. Sungai Moramo* (Desa Ulusena Jaya, Kecamatan Moramo, Kabupaten Konawe Selatan)	<i>O. wolasi</i>	S04°15'40", E122°42'00"
5. Air Terjun Moramo (Desa Sumbersari, Kecamatan Moramo, Kabupaten Konawe Selatan)	<i>O. wolasi</i>	S04°13'15", E122°44'42"
6. Oe Balano* (Desa Bente, Kecamatan Kabawo, Kabupaten Muna)	<i>O. woworae</i>	S05°00'24", E122°29'27"
7. Sungai Laweau* (Desa Latongku, Kecamatan Parigi, Kabupaten Muna)	<i>O. woworae</i>	S05°04'17", E122°27'49"
8. Motobano Oe* (Desa Laiba, Kecamatan Parigi, Kabupaten Muna)	<i>O. woworae</i>	S05°03'49", E122°29'26"
9. Fotuno Oe (Desa Wakumoro, Kecamatan Parigi, Kabupaten Muna)	<i>O. woworae</i>	S05°04'38", E122°30'24"
10. Sungai Waleale* ^a (Desa Waleale, Kecamatan Tongkuno Selatan, Kabupaten Muna)	<i>O. woworae</i>	S05°11'45", E122°30'36"

a: Locality reported by Mokodongan & Yamahira (2015)



Figure 3. Pictures of collection localities. A. Sungai Ambekaeri, B. Sungai Asinua, C. Sungai Anduna, D. Sungai Moramo, E. Air Terjun Moramo, F. Oe Balano, G. Sungai Laweau, H. Motobano Oe, I. Fotuno Oe, and J. Sungai Waleale.

Oryzias wolasi had been known not only from the type locality, Sungai Anduna in Desa Anduna, but also from three more localities, i.e., Sungai Wolasi in Desa Wolasi, Air Terjun (Waterfall) Moramo in Desa Sumbersari and a springfed coastal stream in Desa Ambolodangga (Parenti *et al.* 2013). As previously reported, *O. wolasi* was found in Sungai Anduna and Air Terjun Moramo also during our expeditions (Figure 3C, E, Table 1). In addition, we found a new locality of *O. wolasi* in Sungai Moramo in Desa Ulusena Jaya (Figure 3D, Table 1). Sungai Moramo is a river which flows from Air Terjun Moramo. Therefore, although the new locality is 7 km apart from Air Terjun Moramo (Figure 2), we suspect that these two populations are also a single meta-population. In contrast, the population in Air Terjun Moramo is known to be a genetically distinct population from that in Sungai Anduna (Mokodongan & Yamahira 2015). This probably reflects that Air Terjun Moramo and Sungai Anduna belong to different river systems, whose mouths open about 20 km apart from each other (Figure 2).

Oryzias woworae had been known only from the type locality, Fotuno Oe (Fountain) in Desa Wakumoro in Muna Island (Parenti & Hadiaty 2010). Mokodongan & Yamahira (2015) also reported *O. woworae* from Sungai Waleale in Desa Waleale in Muna Island (Figure 3J, Table 1), which was the second locality of the species. However, we could not find *O. woworae* from Sungai Waleale in our expeditions in 2014-2015, suggesting the possibility of extinction. During the expeditions, instead, we found three additional localities in Muna Island; Motobano Oe in Desa Laiba, Sungai Laweau in Desa Latongku, and Oe Balano in Desa Bente (Figure 3F-H, Table 1). Given that Motobano Oe and Sungai Laweau are connected with each other, these two populations

may be a single meta-population. Moreover, they are connected also with Fotuno Oe (Figure 3I); water from Fotuno Oe flow out through a river which connected with Sungai Laweau downstream. The water velocity of this river from Fotuno Oe was quite high, so we guess that *Oryzias* may not be able to swim up from downstream, suggesting that gene flows, if any, may be one directional. It remains to be clarified how the water flow affect their populations structures. On the other hand, the population in Sungai Waleale is known to be genetically distinct from the population in Fotuno Oe (Mokodongan & Yamahira 2015), probably reflecting that Sungai Waleale is independent from the Fotuno-Motobano system. This may be the case also for the population in Oe Balano, which is another independent fountain system. There are a lot of fountain systems in Muna Island, so genetically distinct *O. woworae* populations may remain to be found.

In summary, we discovered six new localities of the three species of the *O. woworae* species group. This suggests that they may have wider species ranges than currently recognized. Moreover, their distributions across multiple river systems suggest that each of these species is strongly genetically structured. Our preliminary molecular analyses support this view. If this is the case, the unit for conservation should be considered not as each species but as each local population. Further studies on their population structures are necessary to estimate effective conservation units of this endemic species group.

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