

Morphological character analysis of *Rasbora borneensis*



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ARTICLE INFO

Article history

Submission

September 12, 2023

Revision

December 8, 2023

Accepted

December 26, 2023

Keywords

Rasbora Borneensis

Morphology

Morphometric

West Kalimantan

ABSTRACT

Rasbora borneensis is a local fish of West Kalimantan that has the potential to be developed as farmed fish and biomedical research model animals. The utilization of fish potential as aquaculture animals and biomedical research model animals requires data on the biological aspects of these fish. Data from Fish Base (2023) shows that until now the biological information of *Rasbora borneensis* is still very limited, both morphological, anatomical, and reproductive data. This study aims to analyze the morphological characters of *Rasbora borneensis*. The results of this study show that there are morphological differences between male and female *Rasbora borneensis* fish. Female fish show a rounded flat body shape, while male fish show a flat body shape. The measurement results show that the morphometric ratio of male and female fish is different. However, when viewed based on variations in the size of the specimens used, there are several sizes that have the same value.



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Conflict of interest: The authors declare no conflicts of interest.

Introduction

Kalimantan Island is the island with the highest freshwater fish diversity in Indonesia. Murdy et al. stated that Kalimantan Island has more than 394 species of fish, and 149 of them are endemic fish (38%)¹. One of the freshwater fish species distributed in Kalimantan Island is the genus *Rasbora*. The genus *Rasbora* that can be found in Kalimantan include *Rasbora argyrotaenia* and *Rasbora borneensis*¹⁻³. *Rasbora borneensis* is a local fish typical of West Kalimantan. It is also known locally as the Malay Seluang fish¹. *Rasbora borneensis* can generally be found in small rivers that have been influenced by human activities⁴.

Rasbora borneensis is a fish of the genus *Rasbora* that has the potential to be developed as farmed fish and biomedical research model animals. Budiharjo stated that fish from the genus *Rasbora* have high selling prices and demand, short rearing periods, and do not require large areas of land⁵. In addition to its potential as a farmed fish, *Rasbora borneensis* also has the potential to be developed as an animal model in biomedical research. Currently, many fish have been developed as animal models for biomedical research. Some of them are zebrafish (*Danio rerio*), medaka (*Oryzias latipes*), turquoise killifish (*Nothobranchius furzeri*), and goldfish (*Carassius auratus*)⁶⁻⁸.

Utilizing the potential of fish as aquaculture animals and biomedical research models requires data on the biological aspects of the fish^{9,10}. Morphological characteristics are

important biological aspects to know. Common morphological characteristics in fish include morphometrics and meristics. These characters are used to detect fish diversity in nature and populations for cultivation^{11,12}. Morphometrics can be used to illustrate differences in body shape when compared to other statistical methods¹³.

Data from Fish Base (2023) shows that until now the biological information of *Rasbora borneensis* is still very limited, both morphological, anatomical, and reproductive data¹⁴. This study aims to analyze the morphology characteristic of *Rasbora borneensis* in the Sungai Kakap Rivers, West Kalimantan.

Method

The research was conducted in March-May 2023. The research was divided into two parts, namely sampling and sample analysis. Sampling was conducted in the lower Kakap River, Kubu Raya Regency, West Kalimantan. *Rasbora borneensis* fish samples were collected using gill nets, nets and hooks. A total of 20 fish were fixed using NBF for morphological and morphometric data collection.

The fixed fish were grouped into male and female groups. Morphometric character measurements were made using vernier calipers and basic fish anatomical landmarks. Morphological characters measured on the head, truncus, and caudal (Fig 1). Some distance parameters measured in morphometric observations are shown in Table 1.

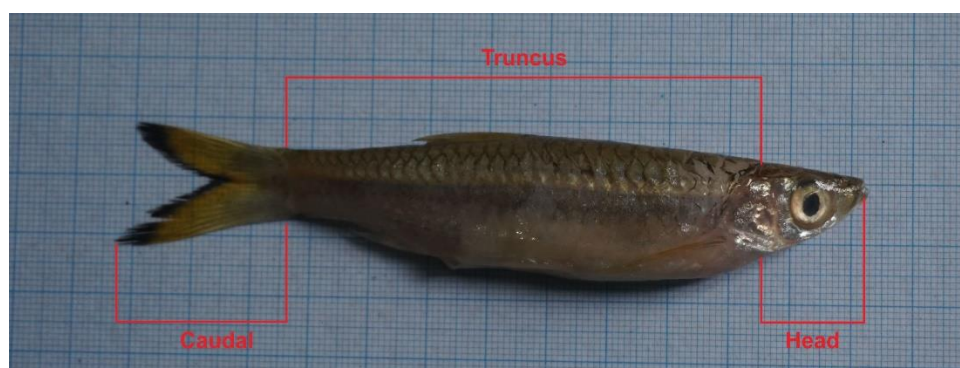


Fig 1. Fish morphology is categorized into head, truncus, and caudal

Table 1. Morphometric Characteristic Measurement

	Mark	Distance description
Head	A1	Lower anterior end of mouth-posterior end of mouth
	A2	Anterior end of upper mouth-posterior end of mouth
	A3	Anterior end of upper mouth-anteroventral end of operculum
	A4	Anterior end of upper mouth-anterior end of eye
	A5	Anterior end of upper mouth-dorsal end of operculum
	A6	Anterior end of upper mouth-posterior end of head
	A7	Posterior end of head-dorsal end of operculum
	A8	Posterior end of head-anteroventral end of operculum
	A9	Anterior base of abdominal fin-anterior tip of upper mouth
	A10	Anteroventral end of operculum-posterior end of mouth
	A11	Eye diameter
	A12	Posterior end of eye-dorsal end of operculum
	A13	Dorsal end of operculum-dorsal base of pectoral fin
Truncus	B1	Posterior end of head-ventral base of pectoral fin
	B2	Posterior end of head-anterior base of abdominal fin
	B3	Posterior end of head-anterior base of anal fin
	B4	Posterior end of head-anterior base of dorsal fin
	B5	Anterior base of dorsal fin-anterior base of abdominal fin

	B6	Anterior base of dorsal fin-anterior base of anal fin
	B7	Anterior base of dorsal fin-posterior base of anal fin
	B8	Anterior base of dorsal fin-posterior base of dorsal fin
	B9	Anterior base of dorsal fin-anterior base of anal fin
	B10	Anterior base of dorsal fin-posterior base of anal fin
	B11	Anterior base of dorsal fin-ventral base of caudal fin
	B12	Anterior base of dorsal fin-dorsal base of caudal fin
	B13	Ventral base of caudal fin-posterior base of anal fin
	B14	Posterior-anterior base of anal fin
	B15	Anterior base of anal fin-anterior base of abdominal fin
Caudal	C1	Dorsal base of caudal fin-posterior base of anal fin
	C2	Dorsal base of caudal fin-ventral base of caudal fin
	C3	Dorsal base of caudal fin-midpoint of caudal fin base
	C4	Dorsal base of caudal fin-dorsal tip of caudal fin
	C5	Dorsal tip of caudal fin-midpoint of caudal fin base
	C6	Dorsal tip of caudal fin-central point of caudal fin tip
	C7	Midpoint of caudal fin base-midpoint of caudal fin tip
	C8	Ventral tip of caudal fin-central point of caudal fin tip
	C9	Ventral tip of caudal fin-midpoint of caudal fin base
	C10	Ujung ventral sirip caudal-pangkal ventral sirip caudal
	C11	Midpoint of caudal fin base-ventral base of caudal fin

Results and Discussion

Differences in the size and morphology of males and females are found in many animals. Female animals generally have a larger size and length compared to male animals. This can be seen in spiders, insects, fish, amphibians, and reptiles¹⁵. Morphological observations on *Rasbora borneensis* fish show differences in head size, dorsal and abdominal body shape, and caudal fin shape. The morphology of *Rasbora borneensis* fish is shown in Fig 2.



Fig 2. Morphological structure of female (A) and male (B) *Rasbora borneensis*. Description: 1. Maxilla, 2. mandible, 3. nostril, 4. eye, 5. nape, 6. operculum, 7. linea lateralis, 8. dorsal fin, 9. pectoral fin, 10. ventral fin, 11. anal fin, 12. caudal trunk, 13. caudal fin.

The morphological characters of *Rasbora borneensis* can be distinguished by sex. Male individuals have an elongated flattened body shape, a more pointed head, a bright yellow body, and have faded ventral fins. While female fish have a rounded flat body shape, rounded head, bright yellow body color, and faded ventral fins. The differences in morphological characters of male and female *Rasbora borneensis* fish are shown in Table 2.

Table 2. Morphological characters of male and female *Rasbora borneensis*

Morphological Characters	Sex	
	Male	Female
Total Length (cm)	4-12	5-14
Weight (g)	1.5-12	1.6-14
Body Shape	Flattened Elongated	Flattened Rounded
Head Shape	Tapered	Rounded
Dorsal Section	Flattened	Elevated
Abdominal Fins	Flat	Rounded
Ventral Fin	Faint Yellow	Faint Yellow
Body Color	Bright Yellow	Bright Yellow
Tail Fin	Bright Yellow	Bright Yellow

The cranial part of the dorsal fin in female fish is more elevated, while in male fish it looks more sloping. The abdominal part of the male fish looks flatter, while the female fish looks more convex. These results are in accordance with the research of Dorado et al., which states that the dorsal part of female *Cyprinidae* looks more convex. This adaptation is used to compensate for the convex shape of the fish's abdomen. The caudal fin of male fish has a longer and pointed branching tip, while female fish look shorter and wider¹⁶.

Morphometric measurements were carried out based on modifications of fish anatomical landmarks according to Strauss, including 39 points from the head, body, to the tail. Morphometric measurements are divided into 3 parts based on the division of the fish body structure, namely the head, body, and tail¹⁷. Head morphometry is carried out through 13 measurement distances including the size of the mouth, operculum, and eyes. The head morphometry ratio of *Rasbora borneensis* fish is shown in Fig 3.

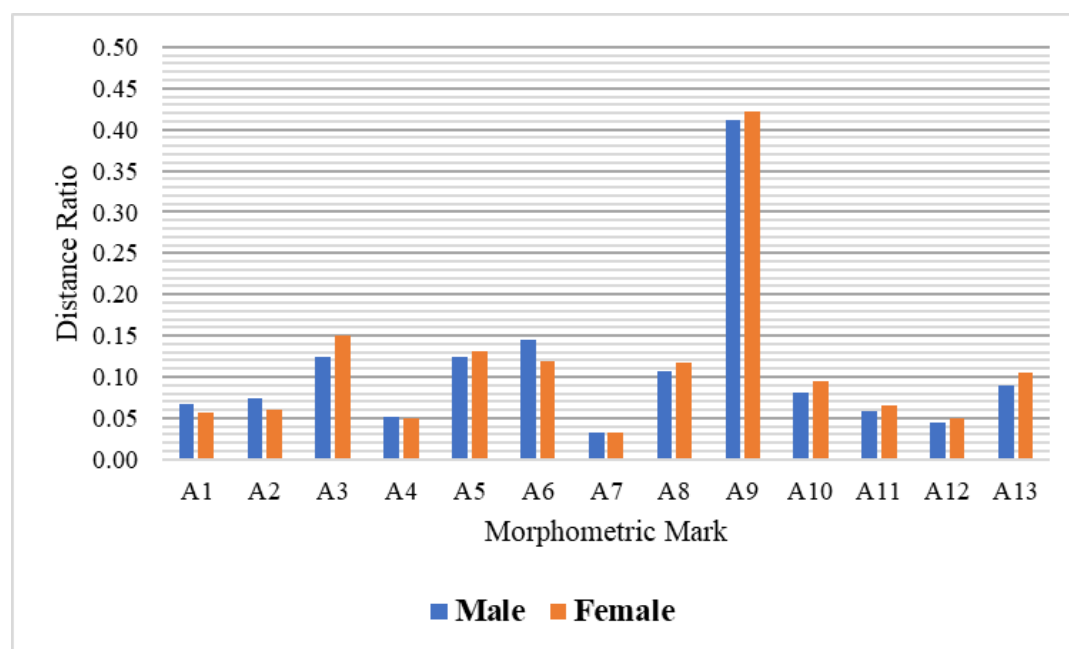


Fig 3. Morphometric ratio of head region characters to total length of male and female *Rasbora borneensis*

The morphometric ratio of head region characters to total fish length showed that the distance from the tip of the maxilla to the posterior end of the mouth (A1) and the tip of the mandible to the posterior end of the mouth (A2) in male fish was greater than in female fish. This data supports the mouth shape of male fish which is more pointed than female fish. These results differ from the research of Retnoaji which states that the distance from the tip of the maxilla and mandible to the posterior end of the mouth in female *Rasbora lateristriata* fish is greater than that of males¹⁵. Meanwhile, other character data on the head region of *Rasbora borneensis* fish show variations between males and females, although some have the same value.

Morphometric ratio measurements in the body region were carried out at 15 points which included measurements of the distance between the base of the fins, the size of the base of the fins, and the distance between the dorsocaudal and the base of the fins. The morphometric ratio of body area characters is shown in Fig 4. The morphometric ratio of body area characters to total fish length shows that the distance between the dorsocaudal base and the ventral base of the pectoral fin (B1), the dorsocaudal base and the ventral base of the pelvic fin (B2), and the dorsocaudal base and the anterior base of the anal fin (B3) in female fish is greater than that in male fish. These three characters are characters that distinguish male and female fish. Female fish are larger and rounded compared to male fish, so the distance between the dorsocaudal base of the head and the base of the dorsal fin, pelvic fin, and anal fin is also greater.

Furthermore, the distance between the anterior and posterior base fins of the dorsal fin (B6) of female fish is also greater than that of male fish. This supports the morphological shape of the dorsal part of the female fish which is more rounded than the male fish. In contrast to the character of the dorsal fin, the distance between the anterior and posterior base of the anal fin of male fish is greater than that of female fish. Overall, there were variations in the morphometric ratio of various body region characters between male and female fish.

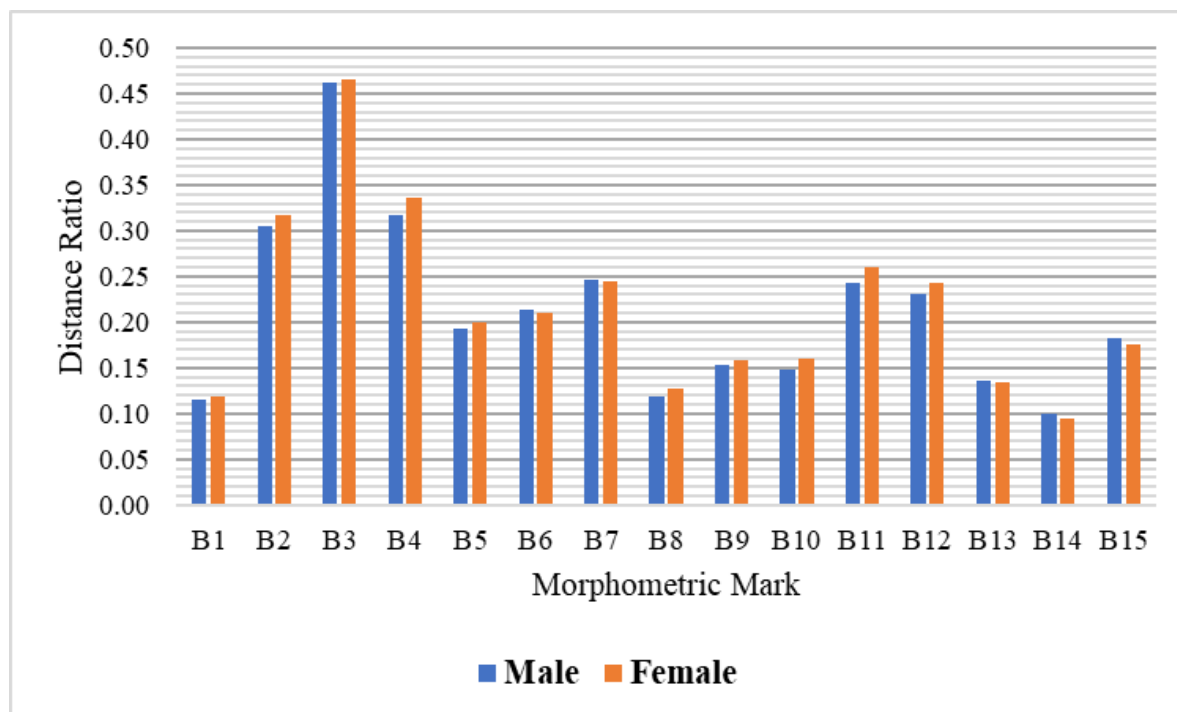


Fig 4. Morphometric ratio of body region characters to total length of male and female *Rasbora borneensis*.

Morphometric ratio measurements in the caudal region were carried out at 11 points which included measuring the distance between the anal fin and caudal fin and the distance on the caudal fin. The morphometric ratio of caudal region characters is shown in Fig 5. The measurement results show that overall the female fish has 10 characters that are larger than the male fish. Fins in fish play a role in maneuvering in water. The shape and area of the fins greatly affect the capacity of fish to maneuver¹⁸. Larger caudal fins in fish than in males help larger fish to maneuver and optimize movement.

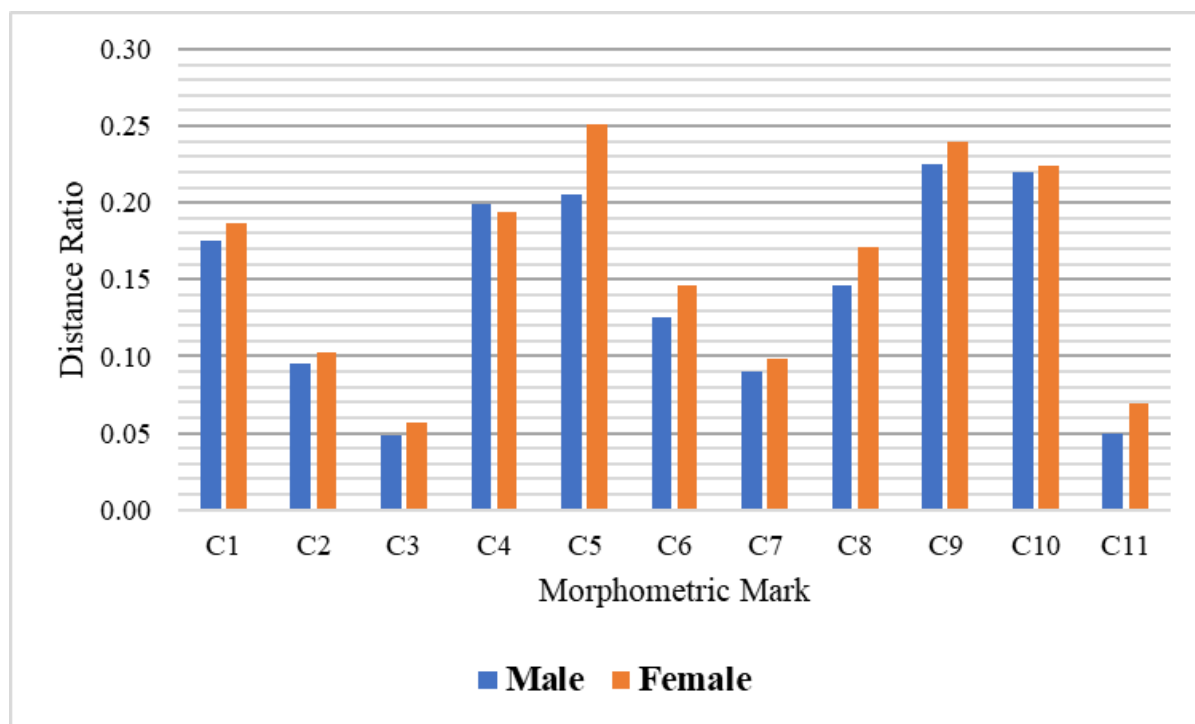


Fig 5. Morphometric ratio of caudal region characters to total length of male and female *Rasbora borneensis*.

Male and female *Rasbora borneensis* have morphological differences, but the results of morphometric measurements vary greatly between male and female fish. The main character distinguishing between groups of taxa is the difference in morphometric characters in the head and tail regions. Characters in these areas are related to food preferences and swimming activities^{19,20}.

Conclusion

This study show that there are morphological differences between male and female *Rasbora borneensis* fish. Female fish show a rounded flat body shape, while male fish show a flat body shape. The measurement results show that the morphometric ratio of male and female fish is different. However, when viewed based on variations in the size of the specimens used, there are several sizes that have the same value.

Acknowledgment

Thank you to P3MI Institut Teknologi dan Kesehatan Muhammadiyah Kalimantan Barat for providing funding for this research. Thank you to the lecturers and staff of Institut Teknologi dan Kesehatan Muhammadiyah Kalimantan Barat who have provided material and moral support.

References

1. Kottelat, M., Whitten, A. J., Kartikasari, N. & Wirjoatmodjo, S. *Freshwater fishes of Western Indonesia and Sulawesi*. *Copeia* (1994). <https://doi.org/10.2307/1447208>
2. Rosadi, E. Hasil tangkapan ikan Seluang Batang (*Rasbora Argyrotaenia* Blkr 1850) berdasarkan umur bulan (Moon Age) di Sungai Barito Kalimantan Selatan. *Fish Sci.* **4**, 12 (2014).
3. Suryadi, K. S., Junardi, J., & Setyawati, T. R. Keanekaragaman jenis ikan di hilir Sungai Sekadau Kalimantan Barat. *J. Protobiont* **8**, 82–87 (2019). <https://doi.org/10.26418/protobiont.v8i2.34035>
4. Kottelat, M. & Widjanarti, E. The fishes of Danau Sentarum National Park and the Kapuas Lakes Area, Kalimantan Barat, Indonesia. *Raffles Bull. Zool.* **13**, 139–173 (2005).
5. Budiharjo, A. Selection and potential aquaculture of “wader” fish of the Genus *Rasbora*. *Biodiversitas J. Biol. Divers.* **3**, 225–230 (2002). <https://doi.org/10.13057/biodiv/d030203>
6. D’Angelo, L., Lossi, L., Merighi, A. & de Girolamo, P. Anatomical features for the adequate choice of experimental animal models in biomedicine: I. Fishes. *Ann. Anat.* **205**, 75–84 (2016). <https://doi.org/10.1016/j.aanat.2016.02.001>
7. Pratama, S. F., Retnoaji, B. & Ana, I. D. Effects of Carbonate Hydroxyapatite (CHA) on the development of heart and cranium cartilage of Zebrafish (*Danio rerio* Hamilton, 1882) Larvae. *Chiang Mai Univ. J. Nat. Sci.* **21**, 1–16 (2022). <https://doi.org/10.12982/CMUJNS.2022.041>
8. Pratama, S. F., Ana, I. D. & Retnoaji, B. The effect of Carbonate Hydroxyapatite (CHA) dental implant material on the early development of Zebrafish embryos (*Danio rerio*) . *Proc. 3rd KOBICongr. Int. Natl. Conf. (KOBICINC 2020)* **14**, 307–312 (2021). <https://doi.org/10.2991/absr.k.210621.052>
9. Retnoaji, B. *et al.* Embryonic development of Indonesian native fish yellow rasbora (*Rasbora lateristriata*). *J. King Saud Univ. - Sci.* **35**, 102810 (2023). <https://doi.org/10.1016/j.jksus.2023.102810>
10. Zahro, H., Anshori, K., Fransisco, S., Rosa, A. A. & Retnoaji, B. Reproductive aspect and embryonic development of Wader pari Fish (*Rasbora lateristriata* Bleeker 1854) from Malang East Java . *Proc. 7th Int. Conf. Biol. Sci. (ICBS 2021)* **22**, 540–544 (2022). <https://doi.org/10.2991/absr.k.220406.076>
11. Dwivedi, A. K. & Dubey, V. K. Advancements in morphometric differentiation: A review on stock identification among fish populations. *Rev. Fish Biol. Fish.* **23**, 23–39 (2013). <https://doi.org/10.1007/s11160-012-9279-1>
12. Eagderi, S., Poorbagher, H., Moshayedi, F. & Hosseini, S. Original article morphological development and allometric growth patterns of *Acipenser persicus* Borodin, 1897 (Actinopterygii, Acipenseridae) during early development. **5**, (2017).
13. Baur, H. & Leuenberger, C. Analysis of ratios in multivariate morphometry. *Syst. Biol.* **60**, 813–825 (2011). <https://doi.org/10.1093/sysbio/syr061>
14. Fish Base. *Rasbora borneensis* Bleeker, 1860. <https://fishbase.net.br/summary/Rasbora-kalbarensis.html> (2023).
15. Retnoaji, B. *et al.* *Tata Cara Pemijahan Ikan Wader Pari (Rasbora lateristriata)*. (UGM Press, 2023).
16. Dorado, E. L., Torres, M. A. J. & Demayo, C. G. Sexual dimorphism in body shapes of the spotted barb fish, *Puntius binotatus* of Lake Buluan in Mindanao, Philippines. *AACL Bioflux* **5**, 321–329 (2012).
17. Strauss, R. & Bookstein, F. The truss: Body form reconstructions in morphometrics. *Systematic Biology* **31**, 113–135 (1982). <https://doi.org/10.1093/sysbio/31.2.113>

18. Nacua, S., Dorado, E. L., Torres, M. A. & Demayo, C. Body shape variation between two populations of the white goby, *Glossogobius giuris* (Hamilton and Buchanan). *Res J Fish Hydrobiol* **5**, 44–51 (2010).
19. Muchlisin, Z. A. Potensi ikan air tawar di aceh sebagai dasar untuk pengembangan budi daya. *J. Ikhtiologi Indones.* **13**, 91–96 (2013).
20. Herler, J., Kerschbaumer, M., Mitteroecker, P., Postl, L. & Sturmbauer, C. Sexual dimorphism and population divergence in the Lake Tanganyika cichlid fish genus *Tropheus*. *Front. Zool.* **7**, 1–10 (2010). <https://doi.org/10.1186/1742-9994-7-4>

Author contributions

All authors contributed to this article. The conception and design, material preparation, data collection, and analysis were performed by **[Sandi Fransisco Pratama]**, **[Yuyun Nisaul Khairillah]**, **[Pasmawati]** and **[Fitriagustiani]**. The first draft of the manuscript was written by **[Sandi Fransisco Pratama]**. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.