

Short Note

New Altitudinal Records of *Glaniopsis denudata* and *Glaniopsis hanitschi* (Teleostei: Gastromyzontidae) in Mount Kinabalu, Sabah, Malaysia

Chen Lin SOO* and Jasrul DULIPAT

Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, Kota Kinabalu, Sabah, Malaysia.

*Corresponding author email address: soo@ums.edu.my

Received 06 June 2026 | Accepted 09 July 2026 | Published 24 September 2026

Associate Editor: Ng Ting Hui

DOI: <https://doi.org/10.51200/jtbc.v23i.7756>

Locally known as *tengkalus* by the Dusun ethnic group, *Glaniopsis* is a genus of hillstream loaches in the family Gastromyzontidae. To date, the genus comprises four species, namely *G. denudata* Roberts, 1982, *G. gossei* Roberts, 1982, *G. hanitschi* Boulenger, 1899, and *G. multiradiata* Roberts, 1982 (Kottelat, 2012). These demersal fish inhabit tropical freshwater streams and are endemic to the island of Borneo. Among the four *Glaniopsis* species, *G. denudata* and *G. hanitschi* are commonly found inhabiting mountainous forest streams in the state of Sabah. Roberts (1982) noted that the holotype of *G. hanitschi* was collected from Sungai (Sg.) Kadamaian, Mount Kinabalu, Sabah, at an elevation of 640 m asl (meter above sea level), while other materials examined were collected from different forest streams in Mount Kinabalu, at elevations as high as 1500 m asl. As for *G. denudata*, it was also collected in Sabah at elevations of up to 1500 m asl. Samat (1990) found both species in forest streams up to 1580 m asl at Kinabalu Park. Recently, Soo et al. (2024) updated that both species live in forest streams up to 1645 m asl at Marai Parai, Kinabalu Park.

These two *Glaniopsis* species were also discovered in Sg. Mesilau at 1460 to 1470 m asl during Samat's (1990) study, prior to the construction of the Mesilau Substation. Mesilau Substation in Kinabalu Park, which was completed in 1998, is located at an elevation of 2000 m asl. Although the Mesilau Substation was formally closed in 2015 due to considerable damage to infrastructure caused by a 6.0 magnitude earthquake, the location of this substation provides relatively easy access to highland forest streams for fish surveys, notably of *Glaniopsis* species. Thus, this study aims to determine the upper altitudinal limit of *Glaniopsis* species in Mesilau Substation, Kinabalu Park.

Fish sampling was conducted at the Mesilau Substation at an elevation ranging from 1841 to 2252 m asl. Sampling regime and location are summarized in Table 1. Fish samples were captured and environmental parameters were measured simultaneously. The detailed procedure of field sampling and laboratory analysis is as described by Dulipat & Soo (2026). Each of the *Glaniopsis* specimens was temporarily assigned a unique field number (KP001), where “KP” stands for Kinabalu Park and the number represents the voucher field number. All field voucher specimens were kept in the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, and were designated for permanent deposition in two repository centres, namely the BORNEENSIS collection and the Sabah Parks collection, in alignment with best practices and established standards for specimen-based research transparency tracking (Sabaj, 2020, 2026; Ng et al., 2026).

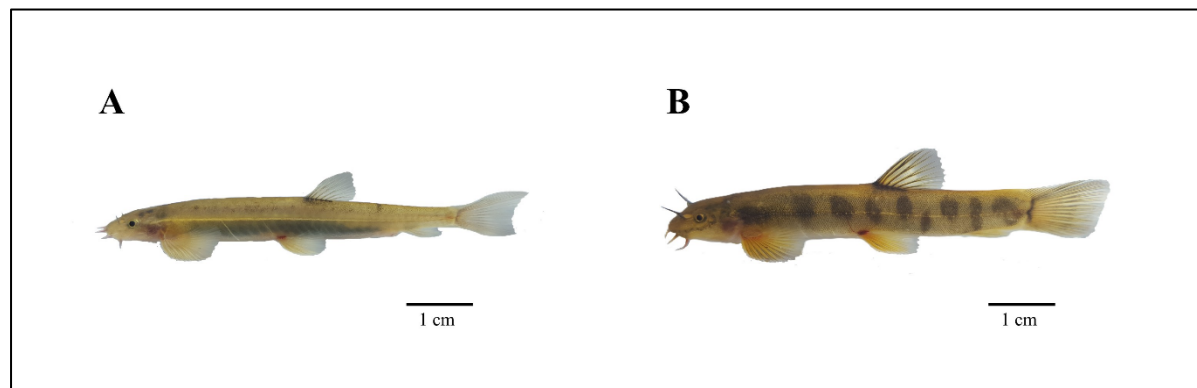
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Table 1: Details of sampling locations in the Mesilau Substation, Kinabalu Park, Sabah.

Sampling station (St)	Stream	Sampling Date	GPS Coordinates	Elevation (m asl)	Width (m)
St 1	Sg. Mesilau	27 September 2023	6°02'28.2"N 116°35'46.1"E	1841	8.0
St 2	Sg. Tibabar	27 September 2023	6°02'52.2"N 116°35'32.0"E	2014	3.0
St 3	Sg. Mesilau	27 September 2023	6°03'05.3"N 116°35'53.0"E	2015	4.5
St 4	Sg. Mesilau	5 April 2024	6°03'26.9"N 116°35'50.0"E	2152	2.2
St 5	Sg. Mesilau	5 April 2024	6°03'33.6"N 116°35'37.0"E	2252	2.5

Both species of *Glaniopsis* (Fig. 1) were found in the present study, as previously reported by Samat (1990). *Glaniopsis denudata* was found at the highest elevation of 2252 m asl, with only one individual captured at this point. On the other hand, the highest elevation recorded for *G. hanitschi* is 2015 m asl. The water qualities of forest streams in Mesilau Substation are listed in Table 2 and were classified as Class I according to the National Water Quality Standards for Malaysia. It is noteworthy that water temperature in Mesilau Substation, ranging from 15.2 °C to 16.0 °C, is comparatively lower than in other parts of Kinabalu Park, including Sayap (19.8 °C at 1000 m asl) and Marai Parai (16.3 °C at 1500 m asl) as recently reported by Soo et al. (2024) and Dulipat & Soo (2026), respectively, demonstrating that *Glaniopsis* species are adapted to a cooler water temperature.

**Figure 1:** A. *Glaniopsis denudata* and B. *Glaniopsis hanitschi* caught from Mesilau Substation.**Table 2:** Summary of *Glaniopsis* abundance (voucher field number in parenthesis) and water quality parameters of forest streams in the Mesilau Substation, Kinabalu Park, Sabah.

Sampling Station (St)	Fish Sample		Water Quality Parameters			
	<i>Glaniopsis denudata</i>	<i>Glaniopsis hanitschi</i>	Temperature (°C)	pH	DO (mg/L)	TSS (mg/L)
St 1	66 (KP547 - 612)	0	15.4	7.5	8.0	22.0
St 2	25 (KP516 - 540)	5 (KP511 - 515)	16.0	7.1	8.2	19.3
St 3	24 (KP487 - 510)	2 (KP485 - 486)	15.2	7.0	8.3	11.3
St 4	9 (KP943 - 951)	0	15.5	7.3	7.5	3.3
St 5	1 (KP942)	0	15.9	7.4	7.5	1.3

The top five highest peaks in Malaysia are all in the state of Sabah, with Mount Kinabalu at 4095 m asl. Table 3 summarizes the previous record for Malaysia's highest living altitude fishes above 1500 m asl, all of which are located in Sabah. Samat et al. (1996) surveyed Mount

Trusmadi, Malaysia's second-highest mountain, from 700 to 1600 m asl. However, the highest altitude freshwater fish on Mount Trusmadi was found at 1000 m asl. Most fish studies in Sarawak and Peninsula Malaysia had been conducted below 1500 m asl. Therefore, to our knowledge, the elevation record of *G. denudata* at 2252 m asl in this study is the highest distribution record of fishes in Malaysia, followed by *G. hanitschi* at 2015 m asl.

Globally, Zhu et al. (2021) reported a new highest altitudinal record of cyprinids, *Herzensteinia microcephalus* at 5350 m asl on the Qinghai-Tibet Plateau. The schizothoracines (Cyprinidae) are endemic freshwater fish on the Tibetan Plateau. They are the only taxa among the cyprinids capable of tolerating the harsh environments of the plateau. Prior to this record, the highest altitudinal fish was the Tibetan stone loach (Nemacheilidae: *Triplophysa*). In Malaysia, all fish species found inhabiting the highest altitudes are loaches from the family Gastromyzontidae, except for one species, *Sundoreonectes sabanus*, which is from the family Nemacheilidae (Table 3).

Table 3: The record of the highest living altitude fishes above 1500 m asl in Malaysia.

Site	Species	Elevation (m asl)	Remarks
Kinabalu Park (Mesilau)	<i>Glaniopsis denudata</i>	2252	Present study
Kinabalu Park (Mesilau)	<i>Glaniopsis hanitschi</i>	2015	Present study
Kinabalu Park (Marai Parai)	<i>Glaniopsis hanitschi</i>	1645	Soo et al. (2024)
Crocker Range Park (Telecom Tower)	<i>Sundoreonectes sabanus</i>	1800	Kavanagh (2002)
Kinabalu Park (HQ)	<i>Glaniopsis denudata</i>	1580	Samat (1990)
Kinabalu Park (HQ)	<i>Glaniopsis hanitschi</i>	1580	Samat (1990)
Kinabalu Park (HQ)	<i>Protomyzon whiteheadi</i>	1580	Samat (1990)

Zhu et al. (2021) attributed the distribution uplift of *H. microcephalus* to global warming, where recent glacial retreats on the Qinghai-Tibet Plateau have caused significant shifts in alpine fish distributions. Species range shift is undoubtedly one of the primary expected effects of climate change, but in our current study, it is more likely due to the lack of research on highland fish. The challenging mountainous terrain makes many high-altitude streams physically inaccessible for fish biodiversity surveys. In fact, most highland fish explorations in Malaysia, particularly Sabah, is conducted through scientific expeditions (e.g., Nyanti, 1995, Soo et al., 2024). The present study leverages the location of Mesilau Substation to survey freshwater fish at a higher elevation up to 2252 m asl. Documenting the upper limit of fish distribution is crucial, as such data is an important baseline for climate change studies and better conservation strategies. It is highly recommended that highland forest streams be regularly surveyed through modern tools such as eDNA, which is a less invasive and a more effective method of discovering rare species, particularly in highland forest streams with low fish diversity.

ACKNOWLEDGEMENTS

The authors would like to thank the Ministry of Higher Education (MOHE) for funding this project through the Fundamental Research Grant Scheme (FRGS/1/2022/WAB02/UMS/02/2). The authors gratefully acknowledge Sabah Park [Ref: TTS 100-6/2 Jld. 29], Sabah Biodiversity Centre (SaBC) [Ref: JKM/MBS.1000-2/2 JLD.16 (6) and JKM/MBS.1000-2/2 JLD. 17 (55)], and Animal Ethics Committee UMS [Ref: AEC 0014/2023], for granting the research permit and access license. This project would be impossible if not for the field assistance of Alvinus Joseph and Franey Joseph Chong from the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah.

DECLARATIONS

Research permit(s). Sabah Biodiversity Council: JKM/MBS.1000-2/2 JLD.16 (6) and JKM/MBS.1000-2/2 JLD. 17 (55). Sabah Parks: TTS 100-6/2 Jld. 29.

Ethical approval/statement. This study involving animal was approved by Animal Ethics Committee UMS [Ref: AEC 0014/2023] and animal was handled with humane treatment.

Generative AI use. The authors declare that generative AI has been used in compliance with the JTBC policies, and that we have reviewed and edited the content after using this tool/service and we take full responsibility for the content of the publication.

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