

Freshwater fish species composition of Mount Timolan Protected Landscape, Zamboanga del Sur

***¹Maricris G. Cudal, ¹Liberty Grace L. Calimbo, ²Bryan Gel S. Larede and ¹Jasper B. Locson**
¹Zamboanga del Sur Provincial Government College, Aurora, Zamboanga del Sur, Philippines
²Provincial Environment and Natural Resources Office, Zamboanga del Sur
**Corresponding author:*
cudalmaricrisG@gmail.com

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ABSTRACT

In this study, research on the fish composition and abundance in the freshwater ecosystem of Mount Timolan Protected Landscape, Zamboanga del Sur, Philippines is presented. The Mount Timolan Protected Landscape is reported as a forest reserved because of its watershed importance. However, studies on fish fauna on its freshwater ecosystem have never been studied. Monthly sampling of fish fauna was conducted in the four established stations in the MTPL from December 2018 to May 2019 revealed a total of 2,422 individuals representing 12 species from 9 families. Shannon-Weiner Diversity Index ('H) and Simpsons Dominance (D) was found to be high with values of 2.59 and 1.02, respectively. Interestingly, this study revealed an established population of native of species in Upper Nilo stream with no other introduced species found. Monitoring study is further recommended to evaluate the current status of the fish species of freshwater ecosystem of Mount Timolan Protected Landscape.

Keywords: *dominance; ichthyofauna; introduced species; fish species monitoring; native species.*

INTRODUCTION

Freshwater ecosystem to-date face challenges worldwide and there have been no comprehensive global analysis of freshwater biodiversity available compare to those recently completed for terrestrial ecosystems and even basic global mapping of inland water to estimate changes in the degree of lakes, rivers and wetlands is deficient (Myers et al., 2000; Dudgeon et al., 2005). As cited by Tessema and Mohamed (2016), freshwater biodiversity has declined more rapidly than the terrestrial and marine biodiversity over the past 30 years (Jenkins, 2003). Hence, regardless of its facing threats, the conservation efforts continue to lag far behind that of terrestrial and marine systems (Abell et al., 2007). In order to protect the freshwater biodiversity, research studies on fish diversity, abundance and distribution are crucial to develop management and conservation programs (Hashemi et al. 2015; Pusey et al., 2010).

In Philippines and other countries of Southeast Asia, freshwater fishes are diverse; unfortunately, recent studies on ichthyofauna are poorly known and up-to-date references are scares. Hence, several efforts were done by some institutions and various organizations to prime the biodiversity analysis of the Philippine's riverine ecosystems (Guzman & Capaque, 2014). In some riverine systems of Mindanao, diverse assortments on ichthyofauna studies were documented. In Iligan River, a total of 27 species belonging to 8 families were collected- of which 3 species were unidentified (Requieron & Demayo, 2015). In Bugang River, Iligan City, a total of 38 freshwater fish species were documented (Guzman &

Capaque, 2014). Hubilla-Travis (2008) makes an inventory of freshwater fauna in Agusan Marsh and was able to document a total of 11 freshwater fishes. In Bukidnon, studies on freshwater ecosystem were limited mostly on the water quality (Adajar et al., 2018; Bertomen et al., 2018; Marin & Jamis 2016; Opiso et al., 2014) and land management practices (Puno 2018) of major rivers in the province. Quimpang et al. (2015) was able to document a total of 34 freshwater fish species in five established long-term ecological research (LTER) sites in Mindanao.

Mount Timolan Protected Landscape (MTPL) is a major natural landscape of Zamboanga del Sur, located in the border towns of Tigbao, Lapuyan, Guipos and San Miguel with a total area of 2,224.54 ha. The MTPL is reported as a forest reserved, because of its watershed importance. It forms the headwaters of neighboring municipalities, the Dinas River and Labangan River and is mainly the source of river systems for irrigation in the lowland municipalities of Tigbao, San Miguel and Guipos. Some major rivers like Limonan, Lapuyan and Kumalarang River also traversed in MTPL. To the extent of our knowledge, there were only at least three significant studies of terrestrial fauna conducted in Mount Timolan Protected Landscape. Paguntalan et al. (2011) were able to document a total of 93 bird species in Lake Maragang, the lone crater lake of MTPL of which five species recorded are listed in the IUCN as threatened species, 36 as endemic in the Philippines and four species which are endemic in Mindanao. The vulnerable species of *Ansonia* (Philippines slender toads) were also documented in the MTPL by Sanguila et al. (2011). Earliest study was conducted by Aspe and James (2016) of the Western Philippines University and Maharishi University of Management, respectively. The later study revealed one new species of native earthworm (*Polypheretima zamboangensis*) in the MTPL. Despite of its being an important ecological landscape and watershed importance, no assessment studies were conducted in the freshwater ecosystem of MTPL and freshwater fish fauna of the protected area have never been studied. Thus, this study was conducted to serve as the first-generation research and to provide baseline data of freshwater fish fauna in the freshwater ecosystem of Mount Timolan Protected Landscape.

METHOD

Study site and duration of the study

Fish fauna sampling were carried out in the month of December 2018 to May 2019 in Mount Timolan Protected Landscape freshwater ecosystem (Figure 1), specifically in the Lake Maragang, Mensabok swamp and Limas and Upper Nilo stream. Three stations were established in lake and swamp, namely: inlet, middle and outlet. The stretched of Limas and Upper Nilo stream were divided into three stations, namely: upstream, midstream and downstream. Land uses surrounding the study sites were also recorded.

Lake Maragang is used for ecotourism and recreational site in the MTPL and host by the endemic and vulnerable species of Philippine duck (*Anas luzonica*) classified under the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN). Mensabok swamp on the other hand is surrounded by rice field nested by domestic duck. The Limas stream is the downstream of Bagtikan trail primarily use for river trekking. Whereas, the Upper Nilo stream is situated in the lowland area of MTPL surrounded by rice field and residential area.

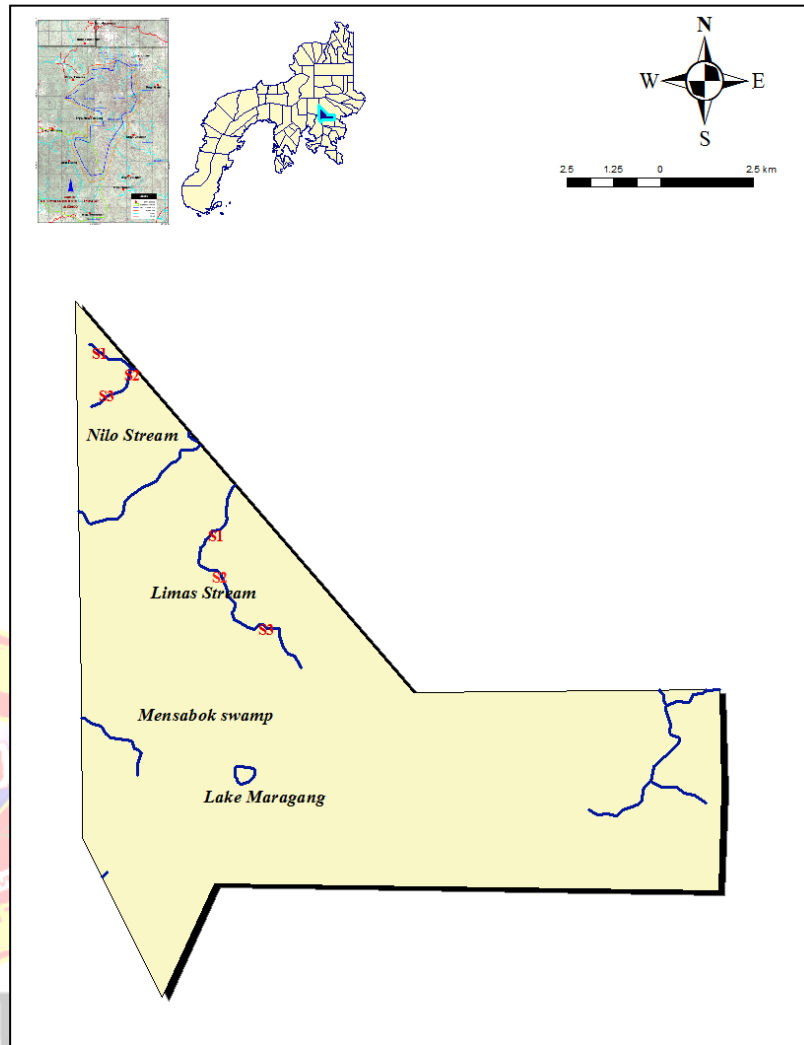


Figure 1. Map of Mount Timolan Protected Landscape showing the established study sites (modified after map from ArcGIS ver. 10.4).

Entry protocol

In consonance to the provisions of Republic Act 9147 of 2001, wildlife Gratuitous Permit (GP) from the Department of Environment and Natural Resources office (DENR-IX) was secured prior to the collection of voucher specimens of freshwater fish fauna for identification and taxonomic purposes. As such, pursuant to EO 247 (Bioprospecting) and RA 9147 (Wildlife Resources Conservation and Protection Act), prior informed consent from the heads of the communities and Local Government Units were also obtained, specifically asking for an approval to use the electricfishing method in their respective streams.

Fish collection and identification

Monthly sampling of fish collection was done along the established three sampling points in the Lake Maragang and Mensabok swamp gill net (approximately mesh size of 1.2mm x 1.2 mm), hook-and line method and improvised trap locally known as “*bubo*”. Electricfishing method accompanied by hand net was used in Limas and Upper Nilo stream (10 volts) to stun the fish.

This method was intentionally used to catch specific fish species of interest were seining and other passive gears are not applicable (Paller et al. 2011). Fish specimens were collected during day and night time and were identified at genus level on-site and further identified in the laboratory. Identification were done by examining the morphometric and physical characteristics of the fish such as standard length (SL), color, number of fins, present of barbells, mouth and tail shape, body and mouth structure. References like Conlu (1986) and Herre (1953) and FishBase were used for fish species identification.

Fixation and preservation of fish samples

The technique used to fix the collected fish samples were adapted using the method used by Labatos and Briones (2014). Specimens with >100 mm SL were placed directly in a 70% ethyl alcohol, whereas, a slit on the right side of fish samples were made for larger specimens with <100 mm SL and were submerged directly in a 37% formalin solution and stands for about 3-4 hours before transferring in a diluted formalin solution (10%) for a week. Specimens were then washed and soaked in a tap water for a week before subjecting in a 20%, 50% and 70% ethyl alcohol for another one week per alcohol series. Lastly, specimens were sorted per species and placed in a freshly prepared 70% ethyl alcohol for permanent storage.

RESULTS AND DISCUSSION

A total of 2,422 individuals representing 12 species from 9 families of freshwater fish species were collected from the month of December 2018 to May 2019 (Table 1; Figure 2). Among the 2,422 total individuals collected, *Oreochromis niloticus* accounts the highest value collected in Lake Maragang and Mensabok swamp in terms of abundance with values of 32% and 42.71%, respectively. Whereas, *Puntius binotatus* was found to be higher in Limas and Upper Nilo stream with values of 32.06% and 36.57%, respectively. In terms of species richness, Cyprinidae has accounts the highest with a total of 3 species followed by Gobiidae (2), other family only represented with only one species. Hence, among the collected freshwater fish species, *Glossogobius illimis*, *Barbodes binotatus*, *Schismatogobius insignis*, *Puntius binotatus*, *Anguilla marmorata*, and *Pterocryptis* sp. are recorded native species. Other collected species are introduced species with economic value.

In terms of species richness, Lake Maragang harbors the highest value with a total of 7 species. This is quite close to the recorded freshwater fish species (11) in Lake Lakewood, Zamboanga del Sur by Superales et al. (2013) and in the Lake Duminagat, Misamis Occidental with a total of six species of fish fauna (Quimpang et al. 2018). The Shannon-Weiner Diversity Index ('H) and Simpsons Dominance (D) in Mount Timolan Protected Landscape were found to be high with values of 2.59 and 1.02, respectively (Table 1). The high dominance value recorded in the study area may be attributed to single species in large quantity relative to other species (Paller et al. 2011).

Table 1. Collected freshwater fish species and their abundance in the established stations of Mount Timolan Protected Landscape, Zamboanga del Sur, Philippines (December 2018 - May 2019).

Family	Species	Lake Maragan	Mensabok Swamp	Limas Stream	Upper Nilo Stream
Poeciliidae	<i>Poecillia reticulata</i> (Peters, 1859) ^{IS}				12.1%
Osphronemidae	<i>Trichogaster trichopterus</i> (Pallas, 1770) ^{IS}	16.2%			
Cyprinidae	<i>Cyprinus carpio carpio</i> (Linnaeus, 1758) ^{IS}		27.4%		
	<i>Puntius binotatus</i> (Valenciennes, 1842) ^{NS}	15.1%		32.1%	36.8%
	<i>Barbodes binotatus</i> (Valenciennes, 1842) ^{NS}	11.4%		15.8%	36.3%
Cichlidae	<i>Oreochromis niloticus</i> (Linnaeus, 1758) ^{IS}	32.1%	42.7%		
Channidae	<i>Channa striata</i> (Bloch, 1793) ^{IS}	9.9%			
Gobiidae	<i>Glossogobius illimis</i> (Hoese and Allen, 2012) ^{NS}			11.5%	
	<i>Schismatogobius insignis</i> (Herre, 1927) ^{NS}			9.0%	
Clariidae	<i>Clarias batrachus</i> (Linnaeus, 1758)	6.6%	29.9%		10.8%
Anguiliidae	<i>Anguilla marmorata</i> (Quoy & Gaimard, 1824) ^{NS}	8.6%		12.3%	4.2%
Siluridae	<i>Pterocryptis</i> sp. ^{NS}			19.4%	
Species Richness:		7	3	6	5
Shannon-Weiner Index (H')		2.59			
Simpson's Dominance Index (D):		1.02			

Note: ^{NS} (Native species); ^{IS} (Introduced species)

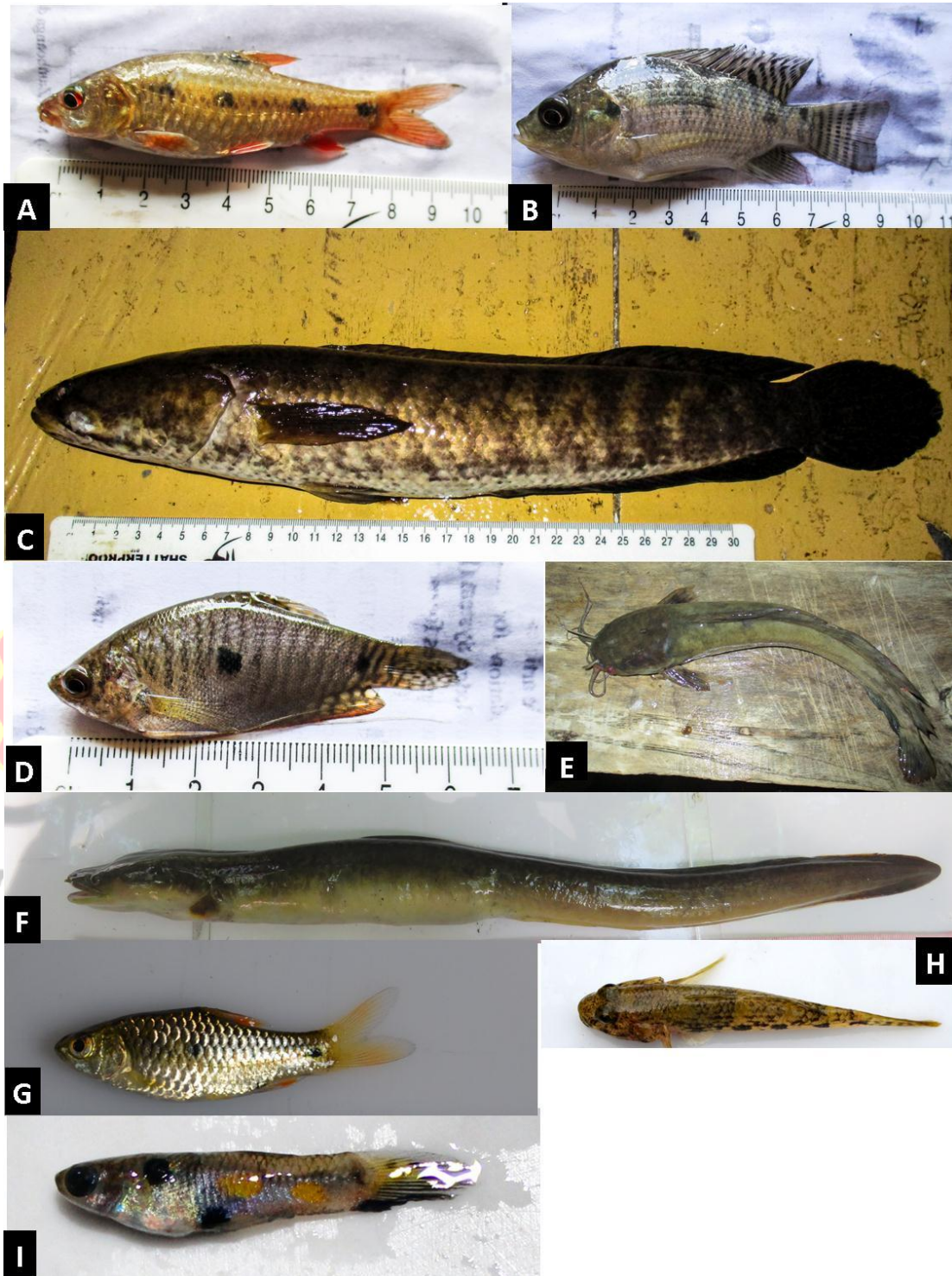


Figure 2. Some of the collected freshwater fish species in the Mount Timolan Protected Landscape (December 2018-May 2019). (A) *B. binotatus*; (B) *O. niloticus*; (C) *C. striata*; (D) *T. tricopterus*; (E) *C. batrachus*; (F) *A. marmorata*; (G) *P. binotatus*; (H) *G. illimis*; and (I) *P. reticulata*

The presence and high percentage of the native *P. binotatus* in the Limas and Upper Nilo stream adheres to the study of Ismail (2011) that *P. binotatus* is found in most riverine system of Mindanao specifically in the provinces of Zamboanga, Bukidnon, Misamis and Lanao and were believed as the ancestor of all the native cyprinids in the Philippines. A large number of native species *C. batrachus* was found was found in Mensabok swamp (29.9%).

On the basis of Bray-Curtis Analysis, this study reveals closed difference of the total number of species collected per station (Figure 3). Among the sampling sites, Upper Nilo and Limas stream showed high similarity of species (approximately 50%), whereas, Mensabok swamp and Lake Maragang showed less similarity of species (approximately 40%).

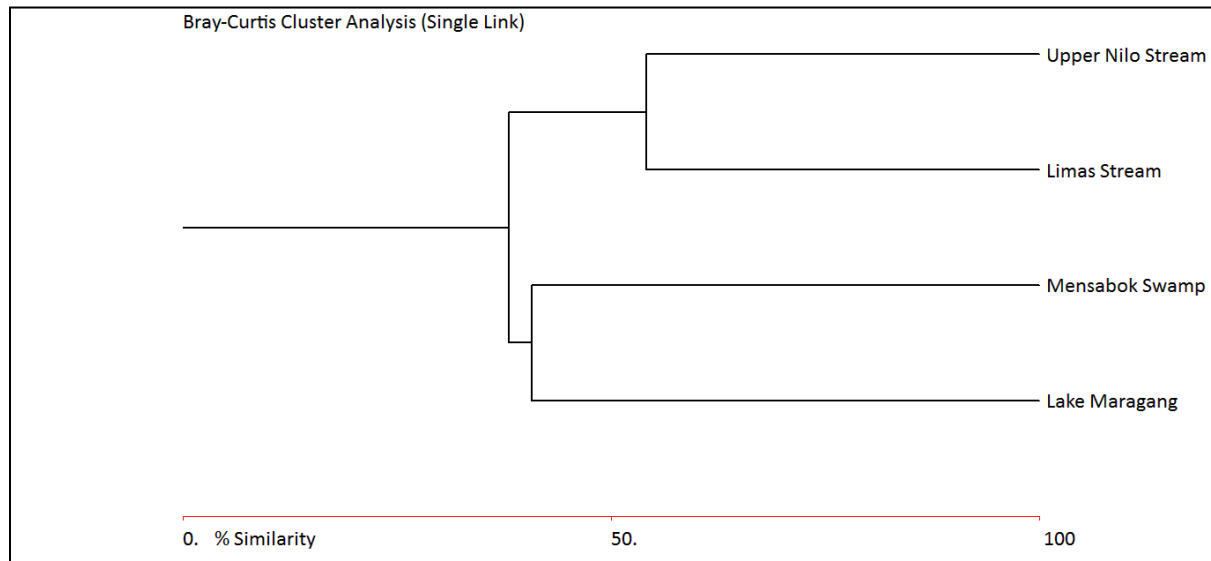


Figure 3. Bray-Curtis analysis showing the similarity of species collected between study sites of Mount Timolan Protected Landscape.

Equal numbers of native and introduced species were recorded in this study. High numbers of introduced freshwater fish species were observed in Lake Maragang (4), followed by Mensabok swamp (3), with no other native species found. Hence, all of the introduced species collected have economic values; except for the species of *T. trichopterus* found only in Lake Maragang. According to some literatures, *T. trichopterus* was reported to have possible negative impact in a freshwater ecosystem. The introduced species *T. trichopterus* and other species of genus *Trichogaster* was reported to have established a wide population in the Philippines possibly because of its popularity as an ornamental fish. The *T. trichopterus* have been also reported to have invasive potential compared to other non-indigenous freshwater fish species, however their direct impacts on native fishes still remains unknown (Bomford and Glover 2004). Geheber et al. (2010) reported that other members of the genus *Trichogaster* carry a number of pathogenic diseases (Liao and Liu 1989). This corroborates with the findings of Yooyen et al. (2006) who have found a one species of trematode (*Clinostomum philippinensis*) in the gills of *T. microlepis* which was first recorded to be present in *C. striata* species in the Philippines (Valasquez 1959 as cited by Yooyen et al. 2006). In such case, this suggests that *T. trichopterus* and *T. microlepis* may serve as a vector and possess to transmit diseases and parasites to other native fishes and

other fishes for potential for aquaculture (Geheber et al. 2010). The presence of non-indigenous species of *P. reticulata* in Upper Nilo stream may attribute a negative impact in the stream that may result to the possible decline of native freshwater fish species in the stream. As cited by Quimpang et al. (2018), *P. reticulata* also known as guppy is considered as threat to native members of Cyprinids in United States (Sigler & Sigler, 1987). The species was also reported as a carrier of trematode parasites (Nico & Martin, 2001) and parasitic nematode (Eldredge, 2000) which may lead to high mortality rate of the native fish species in a riverine system. Lastly, among the species collected, *O. niloticus*, *C. carpio carpio*, *C. striata*, *C. gariiepinus* and *A. marmorata* are consumed by the locals for food based on personal interviews conducted with the local residents.

CONCLUSION

Mount Timolan Protected Landscape freshwater ecosystem has a high diversity of fish fauna primarily composed of 6 native species and 6 introduced species. The introduced *O. niloticus* were found to be abundant in Lake Maragang and Mensabok swamp. Whereas, the native *P. binotatus* was highest in Limas and Upper Nilo stream. In terms of species richness, Lake Maragang harbors the highest value (7) followed by Limas stream (6) and Upper Nilo stream (5) with Mensabok swamp as the least (3). Likewise, presence of some introduced species (*T. trichopterus* and *P. reticulata*) in Lake Maragang and Upper Nilo stream, respectively, may possess threat of possible parasitic infections in some native fish. Among the collected freshwater fish species, 5 recorded species are consumed by the locals primarily for food based on personal interviews during the conduct of study. Lastly, this study revealed an established population of native of freshwater fish species in Nilo stream with no other introduced species found. Hence, monitoring study and research on physico-chemical parameters in the study site is further recommended to evaluate the current status of the fish species of freshwater ecosystem of Mount Timolan Protected Landscape.

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CONFLICT OF INTEREST

The author declares that they have no conflict of interest in any forms in the subject matter or materials discussed in this paper.

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CONTRIBUTION OF INDIVIDUAL AUTHORS

Maricris G. Cudal devised the project, gives the main conceptual ideas and proof outline and wrote the whole manuscript. Maricris Cudal and the rest of the authors performed the actual sampling and worked out almost all of the technical details.

