Philippine Journal of Science
150 (5): 1279-1306, October 2021
ISSN 0031 - 7683
Date Received: 06 Apr 2021

Amphibians and Reptiles of Mount Busa, Sarangani Province: a Glimpse of the Herpetological Community of Southern Mindanao, Philippines

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The herpetological knowledge of southern Mindanao is one of the largest gaps in Philippine herpetology. To augment this, we generated a comprehensive list of amphibians and reptiles found along the southern slope of Mount Busa in Sarangani Province, Philippines between June 2018 and August 2020 using opportunistic sampling in various microhabitats across different forest types. We recorded at least 68 species of herpetofauna, of which 28 species were amphibians and 40 species were reptiles. Around 65% of the species recorded are endemic to the Philippines. Mount Busa appears to harbor a relatively rich herpetological diversity that is needing conservation and scientific attention. Our study provides a glimpse of the herpetological diversity of southern Mindanao, but we emphasized that more field-based research is needed in nearby areas to improve our understanding of the herpetological community in the region, thereby overcoming Linnean and Wallacean shortfalls in our knowledge of Philippine amphibians and reptiles.

Keywords: biodiversity, Busa Mountain Range, herpetofauna, herpetofaunal inventory, Philippine herpetology, southern Mindanao biodiversity

INTRODUCTION

Our modern understanding of Philippine herpetofauna has greatly improved in the past decade, which increased the Philippine terrestrial vertebrate diversity – recognized likely as the highest estimate per land area on Earth (Brown *et al*. 2013a). The present-day patterns of diversity and endemism within the archipelago were shaped in part by the fluctuating sea levels during the Pleistocene glacial cycle, which partially interconnected smaller islands *via* land bridges (Heaney 1985). These amalgamations created larger island groups referred to as the Pleistocene Aggregate Island Complexes (PAICs; Brown and Diesmos 2002). The PAICs are considered zoogeographic sub-regions in the Philippines with distinct faunal compositions, herein referred to as faunal regions.

Much is known about the herpetofauna in the northern Philippines (Brown *et al.* 2012a, 2013b; Diesmos *et al.* 2005; McLeod *et al.* 2011; Oliveros *et al.* 2011; Devan-Song and Brown 2012; Gojo-Cruz *et al.* 2018) and central Philippines (Alcala *et al.* 2004; Bucol *et al.* 2011; Gaulke 2011; Siler *et al.* 2012a; Supsup *et al.* 2016), leaving gaps for studies in the southern portion of the archipelago –

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the majority of which encompasses the Mindanao faunal region, comprised of mainland Mindanao and the islands of Basilan, Dinagat, Leyte, Samar, Bohol, and several smaller adjacent islands (Brown and Diesmos 2002). Although our herpetological knowledge of the Mindanao faunal region is still limited, several reports attest to the highly diverse and unique assemblage of its herpetofauna that rivals other well-studied zoogeographic sub-regions in the Philippines (Diesmos *et al.* 2015; Sanguila *et al.* 2016; Leviton *et al*. 2018). This is particularly true for mainland Mindanao that harbors a high cryptic diversity masquerading under a few known recognized species (Evans *et al.* 2003; Sanguila *et al.* 2011; Brown *et al.* 2015; Welton *et al.* 2017).

Logistical difficulties and security reasons largely hamper contemporary field surveys in Mindanao, causing a continued dearth of its herpetological information (Brown 2015; Sanguila *et al.* 2016; Pitogo and Saavedra 2021). Despite these challenges, there is still a growing interest in herpetological field surveys in recent years, although these were geographically biased towards northeastern, central, and southeastern Mindanao (Delima *et al.* 2006; Ates and Delima 2008; Beukema 2011; Nuñeza *et al.* 2010; Sanguila *et al.* 2016, 2021; Supsup *et al.* 2017; Coritico *et al.* 2018; Baron *et al.* 2021). These have left the herpetological diversity of southern Mindanao (South Cotabato, Sultan Kudarat, Sarangani, and Davao Occidental provinces) and western Mindanao (Zamboanga del Norte, Zamboanga Sibugay, and Misamis Occidental provinces) significant knowledge gaps needing urgent scientific and conservation attention.

Our study aimed at filling the gap in the herpetological diversity of southern Mindanao by focusing field surveys along the southern slope of Mount Busa, the highest peak in the Busa Mountain Range. It is a key biodiversity area and an extremely important conservation priority site in the Philippines (Ong *et al.* 2002). The mountain range lies in the Zamboanga Peninsula-Daguma Range block, a relatively older landmass in the Philippines. It has origins from the Eurasian margin that coalesced with the more recent blocks of the central and eastern Mindanao in the Middle Miocene, forming the present-day Mindanao island (Sajona *et al.* 1997; Hall 2002; Yumul *et al.* 2004). The accretion of these islands could have possibly influenced the present-day patterns of diversity in the Busa Mountain Range, as paleoendemic lineages associated with the old landmass may have persisted or diversified *via* several evolutionary processes of diversification (Michaux 2010; Brown *et al.* 2013a).

The unique geological history of southern Mindanao may have contributed to the substantial level of biodiversity of the Busa Mountain Range (Brown 2015; Saavedra and Pitogo 2021; Senarillos *et al.* 2021). Unfortunately, unsustainable agricultural practices, timber extraction, wildlife poaching, and mining threaten this rich biodiversity (DENR 2020; PLGU Sarangani 2021; Senarillos *et al.* 2021). Thus, efforts to include the mountain range into the National Integrated Protected Areas System (NIPAS) of the Philippines through a legislative process are ongoing for its long-term conservation and management.

Here, we provide a species account of the herpetofauna of Mount Busa to contribute to the ongoing protection efforts for the Busa Mountain Range and facilitate succeeding studies on the herpetofauna in the southern Mindanao region. Although our work is site-based and may be limited in scope, the results still serve as an important step towards understanding the poorly-studied herpetological community of southern Mindanao, a long-overdue response to addressing the gaps in Philippine herpetological research.

MATERIALS AND METHODS

Study Area

The study focused along the southern slope of Mount Busa, Kiamba in Sarangani province. It lies southeast of the Daguma Mountain Range and west of Mount Melibengoy (also known as Mount Parker). It is the highest point in Sarangani that reaches 2,046 meters above sea level (masl). Mount Busa forms part of the Busa Mountain Range shared by the provinces of South Cotabato on the northern slope and Sarangani on the southern slope. This mountain range houses one of the last remaining primary forests in southern Mindanao, which are mostly biologically understudied. Three forest types along the southern slope of Mount Busa were identified based on the classification of Fernando and colleagues (2008) – lowland evergreen forest, lower montane forest, and upper montane forest (Figure 1) – all of which served as our survey sites. The following are brief descriptions of each forest type:

The lowland evergreen forest approximately ranges in altitude from 300–1,000 m. It is dominated by both primary- and secondary-growth dipterocarp trees. Canopy height often exceeds 20 m. It has several patches of farmed abaca (*Musa textilis*) up to 1,000 masl (Figure 1A). Tree ferns are sparse and are mostly confined near streams. Water bodies abound in this forest type where the two major streams flowing from Mount Busa merge, supplying the base water of the Panguil River (Figure 1B). Characteristic understory vegetations include the plants under the family Araceae, Acanthaceae, Orchidaceae, Poaceae, Thelypteridaceae, Polypodiaceae, and Urticaceae. The lowland evergreen forest was hard hit

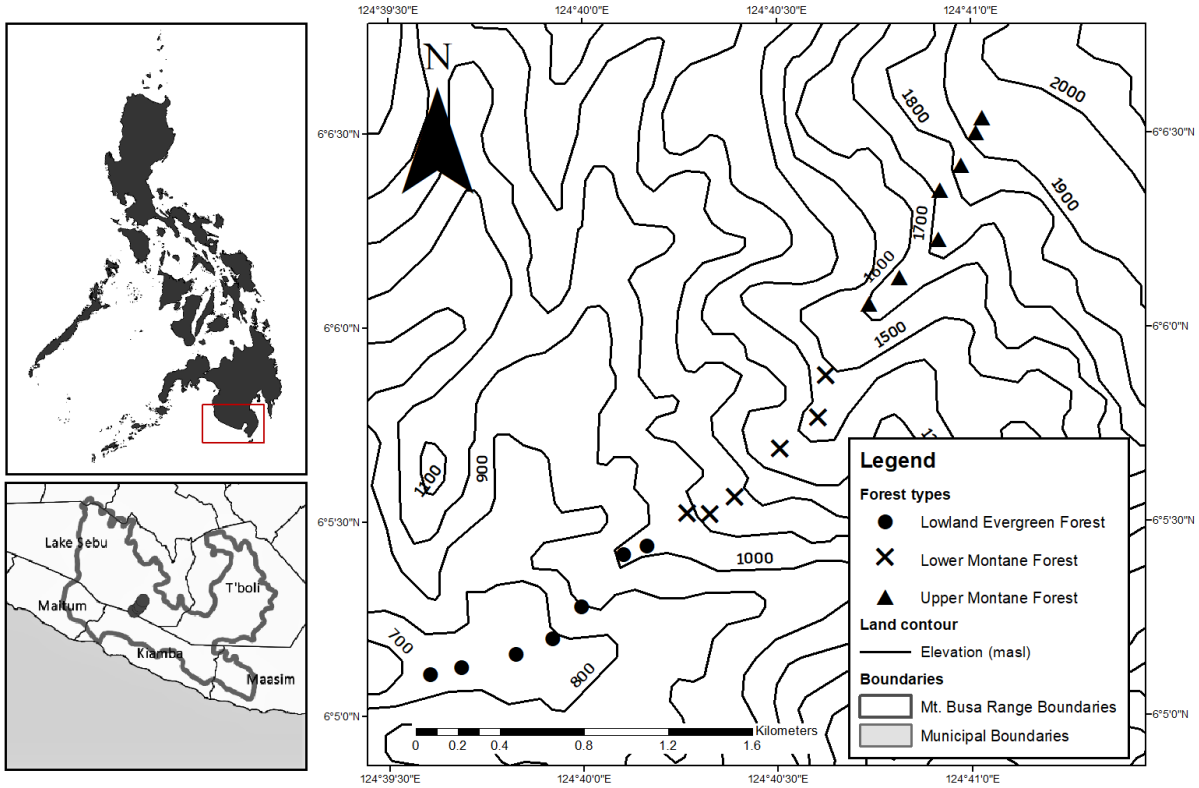

Figure 1. The contour map of Mount Busa in southern Mindanao, Philippines showing the forest gradient.

during the logging concessions in the Philippines in the 1990s (Brown 2015), hence the dominance of secondary-growth trees.

The lower montane forest approximately ranges in altitude from 1,001–1,600 m (Figures 2C and D). It is composed of primary forest trees with a few abaca patches. Canopy height is between 15–25 m. Trees are denser than in lowland evergreen. Epiphytic ferns (*Asplenium* spp., *Goniophlebium* spp., *Lepisorus* spp., and *Loxogramme* spp.) and tree ferns (*Cyathea* spp. and *Dicksonia* spp.) are more common. Characteristic understory vegetations include the plants under the family Arecaceae, Begoniaceae, Gesneriaceae, Poaceae, and Polypodiaceae. A small, ephemeral stream with a muddy substrate is present in the area (2 m wide). The forest floor is covered with thick leaf litter.

The upper montane forest, also known as mossy forest, approximately ranges in altitude from 1,601–2,046 m (Figures 2E and F). It is composed of primary forest trees and characterized by a mixture of dwarfed, irregularly-shaped trees and tall, broad-leafed trees partially covered with bryophytes, orchids, and other epiphytes. Canopy height ranges between 5–20 m. Tree ferns (*Cyathea* spp. and *Dicksonia* spp.) and various epiphytic plants abound in this forest type. Other characteristic understory vegetations includes the plants under the families Thelypteridaceae, Polypodiaceae, Balsaminaceae, Orchidaceae, and Melastomaceae. The forest floor is mostly blanketed with bryophytes, liverworts, and moist thick leaf litter with several rotten and friable coarse woody debris. There are also ephemeral swamps and small streams (max. 0.5 m wide).

Field Sampling

Repeated visit field surveys were done on the following areas: lowland evergreen forest (25–29 Jun 2018, 16–19 Apr 2019, 21–28 Aug 2019, 12–16 Feb 2020, and 15–18 Aug 2020) plus lower and upper montane forests (07–21 Jul 2019 and 04–14 Aug 2020). We spent 680.5 person-hours on field surveys. The bulk of fieldwork coincides with the general onset of the rainy season in the Philippines (June–August), which are the ideal months for herpetological fieldwork in the country (Brown *et al.* 2012a; Sanguila *et al.* 2016). However, the southern Mindanao region falls under climate cluster five, with an evenly distributed rainfall throughout the year that peaks between June–October and gradually decreases from November–April (Corporal-Lodangco and Leslie 2017).

Figure 2. The three forest types identified along the southern slope of Mount Busa: lowland evergreen forest, showing a patch of farmed abaca (A) and a lowland stream (B); lower montane forest (C–D); upper montane forest (E–F). Photos by K.M.E. Pitogo.

Opportunistic sampling was done to exhaustively search for amphibians and reptiles, which included the purposive examinations of most microhabitats in each forest type such as riparian vegetation, trees (branches, root buttresses, trunks, leaf axils), epiphytes (aerial ferns and orchids, moss mats, tree foliage), coarse woody debris, boulders, and various lentic and lotic bodies of water. These were done with the caveat that highly arboreal species (perching > 3 m from the ground) and cryptic fossorial species might have been missed.

Sampling was carried out during the day (10:00–12:00 hr and 13:00–15:00 hr) and night (18:00–21:00 hr) under different atmospheric conditions by four to six experienced individuals. Species were photographed *in situ* whenever possible. We collected select individuals as voucher specimens using standard preservation methodologies (McDiarmid 1994; Gotte *et al.* 2016). Field numbers (KMP) refer to the field series of K.M. Pitogo. The Philippine Department of Environment and Natural Resources (DENR) Region XII Office issued the fieldwork and collection permit (Gratuitous Permit No. 2019-23).

Species Identification

Species were identified or carefully characterized by morphology using published photographic guides, taxonomic papers, and identification keys [*e.g.* Brown and Alcala (1994), McGuire and Alcala (2000), Diesmos *et al.* (2015), Leviton *et al.* (2018), Weinell *et al.* (2019)]. Snout-vent length (SVL) and other taxonomic characters useful in identification were measured using a digital caliper (Mitutoyo 500-196-30, Japan) or a measuring tape. Species nomenclature follows the Amphibian Species of the World Online Reference (Frost 2020) and The Reptile Database (Uetz *et al.* 2021). The species' conservation status followed both the International Union for Conservation of Nature (IUCN) Red List of Threatened Species and the DENR Department Administrative Order (DAO) No. 2019-09.

RESULTS

We recorded at least 68 species of herpetofauna, of which 28 species were amphibians and 40 species were reptiles (Table 1). Around 65% of the species recorded are endemic to the Philippines, and 19% of the species do not have definite identification and may potentially be new and undescribed species. For the conservation status under the IUCN Red List, two species are listed as Vulnerable, 36 as Least Concern, two as Near Threatened, two as Data Deficient, while 13 have not been evaluated. However, under the Philippine Red List (DENR DAO 2019-09), only 11 species belong to the threatened category, of which two are listed as Vulnerable and nine as Other Threatened Species.

Species Accounts

Amphibians

Order Anuran

Family Bufonidae

***Ansonia muelleri* (Boulenger, 1887).** The Mindanao slender toad is found in most major mountains in Mindanao. The population in Mount Busa is considered a separate evolutionary significant unit (ESU) for conservation due to its genetic distinctiveness and may be considered a distinct species once more information on morphometrics, bioacoustics, and natural history are available (Sanguila *et al.* 2011). It was frequently observed in low-elevation fast-flowing streams, although some individuals were seen in forest interior away from water bodies up to 1,400 masl. Males produced a series of loud calls on rocks in between cascading waters. We observed gravid females between April–August. Specimens: KMP 0090 (lower montane); KMP 0184, 0202, 0243–0250 (lowland evergreen).

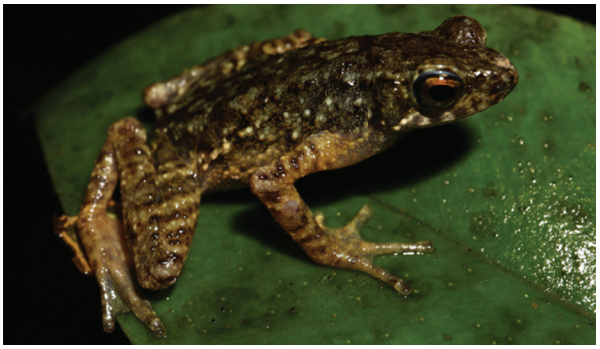

Figure 3. *Anosnia muelleri* found in the lowland stream. Photo by K.M.E. Pitogo.

Figure 4. *Pelophryne brevipes* found in the mid-montane forest. Photo by K.M.E. Pitogo.

***Pelophryne brevipes* (Peters, 1867).** The distribution of *P. brevipes* was once considered disjunct which includes the Philippine islands of Mindanao and Basilan and the Malay peninsula and Sumatra, Mentawi, and Natuna islands. A recent phylogenetic study concluded that the populations from the Malay peninsula and Sumatra are distinct species, now known as *Pelophryne ingeri*, and restricts *P. brevipes* to Mindanao (Matsui 2019); thus, the latter is now

Table 1. Checklist of the amphibians and reptiles in Mount Busa, Sarangani from Brown (2015) and this study. OTS – other threatened status; OWS – other wildlife species

No.	Species	Common name	IUCN Red List	DAO 2019-09	Philippine endemic
	AMPHIBIANS				
	Order Anura				
	Bufonidae				
1	*Ansonia muelleri* (Boulenger, 1887)	Mindanao slender toad	Least Concern	OWS	Yes
2	*Pelophryne brevipes* (Peters, 1867)	Zamboanga flathead toad	Least Concern	OWS	Yes
	Ceratobatrachidae				
3	*Platymantis* cf. *corrugatus* (Duméril, 1853)	Rough-backed forest frog	Least Concern	OWS	Yes
4	*Platymantis guentheri* (Boulenger, 1882)[a]	Gunther's wrinkled ground frog	Least Concern	OWS	Yes
5	*Platymantis rabori* Brown, Alcala, Diesmos, and Alcala 1997[b]	Rabor's forest frog	Least Concern	Vulnerable	Yes
6	*Platymantis* sp. 1 "Busa ground"	Forest ground frog	--	--	--
7	*Platymantis* sp. 2 "moss"	Forest ground frog	--	--	--
8	*Platymantis* sp. 3 "highland"	Forest ground frog	--	--	--
9	*Platymantis* sp. 4 "lowland"	Forest ground frog	--	--	--
	Dicroglossidae				
10	*Limnonectes leytensis* (Boettger, 1893)	Leyte wart frog	Least Concern	OWS	Yes
11	*Limnonectes* cf. *magnus* (Stejneger, 1910)	Mindanao fanged frog	Near Threatened	OTS	Yes
12	*Limnonectes* sp. "hump"	Fanged frog	--	--	--
13	*Occidozyga laevis* (Günther, 1858)[a]	Common puddle frog	Least Concern	OWS	Yes
	Megophryidae				
14	*Leptobrachium lumadorum* Brown, Siler, Diesmos, and Alcala, 2010	Mindanao litter frog	Least Concern	OWS	Yes
15	*Megophrys stejnegeri* Taylor, 1920	Mindanao horned frog	Least Concern	OTS	Yes
	Microhylidae				
16	*Chaperina fusca* Mocquard, 1892	Saffron-bellied frog	Least Concern	OWS	No
17	*Kalophrynus sinensis* Peters, 1867	Philippine sticky frog	Not Evaluated	OWS	Yes
18	*Oreophryne anulata* (Stejneger, 1908)	Mindanao cross frog	Least Concern	OWS	Yes
	Ranidae				
19	*Pulchrana grandocula* (Taylor, 1920)	Big-eyed frog	Least Concern	OWS	Yes
20	*Pulchrana guttmani* (Brown, 2015)[a]	Guttman's stream frog	Data Deficient	OWS	Yes
21	*Staurois natator* (Günther, 1858)	Mindanao splash frog	Least Concern	OWS	Yes
	Rhacophoridae				
22	*Leptomantis bimaculatus* Peters, 1867	Mindanao flying frog	Least Concern	OWS	Yes
23	*Nyctixalus spinosus* (Taylor, 1920)[a]	Spiny treefrog	Least Concern	OWS	
24	*Philautus acutirsotris* (Peters, 1867)	Pointed-snout tree frog	Least Concern	OWS	Yes
25	*Philautus leitensis* (Boulenger, 1897)[b]	Mindanao bush frog	Least Concern	OWS	Yes
26	*Philautus poecilius* Brown and Alcala, 1994[b]	Mottled tree frog	Least Concern	OWS	Yes
27	*Philautus* cf. *poecilius*	Tree frog	--	--	--
28	*Philautus* cf. *surdus* (Peters, 1863)[b]	Luzon bubble-nest frog	Least Concern	OWS	Yes
29	*Philautus worcesteri* (Stejneger, 1905)	Mindanao bubble-nest frog	Least Concern	Vulnerable	Yes
30	*Polypedates leucomystax* (Gravenhorst, 1829)	Common tree frog	Least Concern	OWS	No

No.	Species	Common name	IUCN Red List	DAO 2019-09	Philippine endemic
	Order Gymnophiona				
	Ichthyophiidae				
31	*Ichthyophis mindanaoensis* Taylor, 1960	Mindanao caecilian	Least Concern	OTS	Yes
32	*Ichthyophis* sp. "pointed tail"	Caecilian	--	--	--
	Order Lacertilia				
	Agamidae				
33	*Bronchocela* sp. 1		--	--	--
34	*Bronchocela* sp. 2		--	--	--
35	*Draco bimaculatus* Günther, 1864	Two-spotted flying lizard	Least Concern	OWS	Yes
36	*Draco cyanopterus* Peters, 1867	Flying lizard	Least Concern	OWS	Yes
37	*Draco mindanensis* Stejneger, 1908	Mindanao flying lizard	Vulnerable	OWS	Yes
38	*Draco ornatus* (Gray, 1845)	White-spotted flying lizard	Least Concern	OWS	Yes
39	*Gonocephalus* sp. "South Mindanao"	Forest dragon	--	--	--
40	*Hydrosaurus pustulatus* (Eschscholtz, 1829)	Philippine sailfin lizard	Vulnerable	OTS	Yes
	Gekkonidae				
41	*Cyrtodactylus annulatus* (Taylor, 1915)	Annulated bow-fingered gecko	Least Concern	OWS	Yes
42	*Gehyra mutilata* (Wiegmann, 1834)	Common four-clawed gecko	Not Evaluated	OWS	No
43	*Lepidodactylus* cf. *lugubris* (Duméril and Bibron, 1836)	Mourning gecko	Not Evaluated	OWS	No
	Scincidae				
44	*Brachymeles tiboliorum* Siler, Jones, Diesmos, Diesmos, and Brown 2012	Western Mindanao slender skink	Not Evaluated	OWS	Yes
45	*Emoia ruficauda* Taylor, 1915	Red-tail swamp skink	Data Deficient	OWS	Yes
46	*Eutropis cuprea* Barley, Diesmos, Siler, Martinez, Brown, 2020	Copper Sun Skink	Not Evaluated	OWS	Yes
47	*Lamprolepis smaragdina philippinica* (Mertens 1928)	Emerald tree skink	Not Evaluated	OWS	No/ssp. is endemic
48	*Parvoscincus* sp. 1 "midmontane"	Forest skink	--	--	--
49	*Parvoscincus* sp. 2 "lowland"	Forest skink	--	--	--
50	*Pinoyscincus* cf. *abdictus* (Brown & Alcala, 1980)	Filipino skink	Not Evaluated	OWS	Possibly endemic
51	*Pinoyscincus jagori jagori* (Peters, 1864)	Jagor's Sphenomorphus	Least Concern	OWS	Yes
52	*Pinoyscincus* cf. *mindanensis* (Taylor, 1915)[b]	Mindanao Sphenomorphus	Not Evaluated	OWS	Yes
53	*Sphenomorphus fasciatus* (Gray, 1845)	Banded Sphenomorphus	Least Concern	OWS	Yes
54	*Sphenomorphus* sp. "red tail"		--	--	--
55	*Tropidophorus partelloi* Stejneger, 1910	Partello's waterside skink	Least Concern	OWS	Yes
	Varanidae				
56	*Varanus cumingi* Martin, 1839	Cuming's water monitor	Least Concern	OTS	Yes
	Order Serpentes				
	Colubridae				
57	*Ahaetulla prasina preocularis* (Boie, 1827)	Philippine vine snake	Least Concern	OWS	No/ ssp. is endemic
58	*Boiga cynodon* (Boie, 1827)	Dog-toothed cat snake	Least Concern	OTS	No
59	*Cyclocorus nuchalis nuchalis* Taylor, 1923	Southern triangle-spotted snake	Least Concern	OWS	Yes

No.	Species	Common name	IUCN Red List	DAO 2019-09	Philippine endemic
60	*Dendrelaphis philippinensis* (Günther, 1879)	Philippine bronze-back tree snake	Not Evaluated	OWS	Yes
61	*Lycodon dumerilii* (Boulenger, 1893)[b]	Duméril's Asian wolf snake	Not Evaluated	OWS	Yes
62	*Pseudorabdion taylori* Leviton & Brown, 1959	Taylor's burrowing snake	Data Deficient	OWS	Yes
63	*Rhabdophis lineatus* (Peters, 1861)	Zigzag-lined water snake	Least Concern	OWS	Yes
64	*Rhabdophis auriculatus auriculatus* (Günther, 1858)	Günther's Philippine keelback snake	Least Concern	OWS	Yes
65	*Stegonotus muelleri* Duméril, Bibron, & Duméril 1854	Müller's ratsnake	Near Threatened	OWS	Yes
66	*Tropidonophis dendrophiops* (Günther, 1883)	Spotted water snake	Least Concern	OWS	Yes
	Elapidae				
67	*Naja samarensis* Peters, 1861	Southern Philippine cobra	Least Concern	OTS	Yes
	Lamprophiidae				
68	*Oxyrhabdium modestum* (Duméril, 1853)	Philippine shrub snake	Least Concern	Not Evaluated	Yes
69	*Psammodynastes pulverulentus* (Boie, 1827)	Common mock viper	Not Evaluated	Not Evaluated	No
	Pareidae				
70	*Aplopeltura boa* (Boie, 1828)	Blunt-headed slug snake	Least Concern	Not Evaluated	No
	Pythonidae				
71	*Malayopython reticulatus* (Schneider, 1801)	Reticulated python	Least Concern	OTS	Yes
	Viperidae				
72	*Trimeresurus* cf. *flavomaculatus* (Gray, 1842)	Philippine pit viper	Least Concern	OTS	Yes

[a]Species recorded by Brown (2015) but not in this study
[b]New distribution record for southern Mindanao

considered a Philippine endemic. Individuals in Mount Busa perch on surfaces of shrubs in the lower montane primary forest between 800–1,500 masl. Specimens: KMP 0129–0131, 0143–0146, 0153–0155.

Figure 5. *Platymantis* cf. *corrugatus* found in the lowland forest. Photo by K.M.E. Pitogo.

Family Ceratobatrachidae

***Platymantis* cf. *corrugatus* (Duméril, 1853).** The Mindanao population of this widely distributed Philippine-endemic species is considered a distinct lineage that warrants a full species recognition, distinguishable by their large body size and calls with a short note duration (Cobb 2016). Individuals were commonly observed in the low-elevation abaca areas, calling exposed on the forest floor at night (19:00–21:00 hr). Some were also observed during the day under leaf litter. Specimens: KMP 0297, 0298, 0309–0312, 0347, 0348.

***Platymantis rabori* Brown, Alcala, Diesmos, and Alcala 1997.** This is a widely distributed yet less commonly encountered species in Mindanao faunal region due to its naturally low-density populations and arboreal microhabitat preference (Sanguila *et al.* 2016). Their population appears to be declining due to the conversion of lowland forests into agriculture, plantations, and settlement areas. However, *P. rabori* is listed as Least Concern due to its wide area of occurrence (IUCN SSC Amphibian Specialist Group 2018). Our observation

Figure 6. *Platymantis rabori* found in the lowland forest. Photo by K.M.E. Pitogo.

extends the range of *P. rabori* to southern Mindanao. Specimens: KMP 0334, 0360.

***Platymantis* sp. 1 "Busa ground."** Several highly polymorphic ground *Platymantis* conservatively assigned under "Busa ground" were observed and collected between 900–2,000 masl. They have a dark brown tuberculate body and bright orange to red eyes, rarely yellow. Individuals were observed hiding under leaf litter and moss mats at night. Molecular studies are needed to ascertain the species since most of the recorded Mindanao *Platymantis* are still undescribed (Brown *et al.* 2015; Sanguila *et al.* 2016). Specimens: KMP 0009, 0066, 0069–0071, 0084, 0085 (upper montane); KMP 0088, 0089, 0092, 0094, 0105–0109, 0116 (lower montane).

Figure 7. *Platymantis* sp. 1 "Busa ground" found on the leaf litter from lowland to montane forests. Photo by K.M.E. Pitogo.

***Platymantis* sp. 2 "moss."** A few high-elevation *Platymantis* not assignable to any known species were observed around the peak (1900–2,046 masl). They have two continuous dorsal ridges from the supratympanic region to the sacral region, long dorsal ridges on the dorsum, and a lighter dorsal color than the rest of the body.

Figure 8. *Platymantis* sp. 2 "moss" found in the upper montane forest. Photo by K.M.E. Pitogo.

This species is more active in the morning (06:00–07:00 hr) producing a series of high-frequency calls sounding in the human ear like "Tiiit!". Individuals at night call under moss mats, hence the assigned name for the observed calling habit. Specimens: KMP 0064, 0072, 0076, 0100, 0101, 0104, 0110.

***Platymantis* sp. 3 "highland."** A few brightly colored individuals with distinguishable face masks were found between 1,400 and 2,046 masl, but they are distinguished from *P.* cf. *corrugatus* by the absence of dorsal ridges and smaller body size. Gravid females of this species are also smaller (27.75–27.69 mm) than the gravid females of *P.* cf. *corrugatus* (40+ mm) found in Mount Busa. They exhibit a bright orange to brown color, rarely dark purple. Individuals can be observed perched on leaf litter from 16:00–21:00 hr.

Figure 9. *Platymantis* sp. 3 "highland" found in the upper montane forest. Photo by K.M.E. Pitogo.

***Platymantis* sp. 4 "lowland."** A few distinctive ground frogs were collected in the low-elevation mixed secondary forest. However, we conservatively separated these individuals from *Platymantis* sp. 1 "Busa ground" due to the larger average body size of gravid females (33.6 mm *vs.* 26.8 mm) and the longer but less prominent dorsal

Figure 10. *Platymantis* sp. 4 "lowland" found in lowland forest mixed with abaca. Photo by K.M.E. Pitogo.

ridges. All specimens were seen during the day perched on leaf litter. Gravid females were collected in February. No calls were heard for this species. Specimens: KMP 0288, 0362, 0366, 0380.

Family Dicroglossidae

***Limnonectes leytensis* (Boettger, 1893).** This is a common species in aquatic habitats in the Mindanao faunal region readily distinguished by its small body size, rugose skin, and "v" mark on the scapular region (Siler *et al.* 2009). Individuals of *L. leytensis* perch on boulders and sand along the stream bank, while some hide in riparian shrubs. This species is also harvested for local consumption, though it is less preferred than the large-bodied *Limnonectes* species. Specimens: KMP 0181, 024–0242, 0365, 0367, 0378.

Figure 11. *Limnonectes leytensis* found in the lowland stream. Photo by K.M.E. Pitogo.

***Limnonectes* cf. *magnus* (Stejneger, 1910).** This large-bodied *Limnonectes* is widely distributed all throughout the Mindanao faunal region. Individuals were rarely observed in open areas and mostly found hidden in crevices and vegetation. The taxonomic status of this widespread low-elevation *L.* cf. *magnus* with respect to the high-elevation *L. magnus* at its type locality in Mount Apo warrants further investigation (Sanguila *et al.* 2016). This is also locally harvested for consumption. This species was tested positive for *Batrachochytrium dendrobatidis* (Bd) fungi, but there is no known harmful impact has been recorded yet (Diesmos *et al.* 2012). Specimens: KMP 0006, 0173, 0317, 0363.

Figure 12. *Limnonectes* cf. *magnus* found in the lowland stream. Photo by K.M.E. Pitogo.

***Limnonectes* sp. "hump."** One individual, presumably an adult male, was observed hidden under thick vegetation approximately 15 m away from a lowland stream. It is characterized by its distinctive wider head, more rugose dorsal skin, dorsal ridges, and densely distributed dorsal asperities all over the body. Some characters agree with the description of *Limnonectes ferneri* from southeastern Mindanao (Siler *et al.* 2009), but it differs in the presence of dermal ridges and its dorsal asperities do not form radial clusters. No other similar-looking Mindanao *Limnonectes* were found in the literature, so this may be a putatively undescribed species. Specimen: KMP 0266.

Figure 13. *Limnonectes* sp. "hump" found in the lowland stream. Photo by K.M.E. Pitogo.

Figure 14. *Leptobrachium lumadorum* found in the lowland forest. Photo by K.M.E. Pitogo.

Family Megophryidae

***Leptobrachium lumadorum* Brown, Siler, Diesmos, and Alcala, 2010.** This is a less frequently encountered species endemic to the Mindanao faunal region except in Samar, Leyte, Bohol, Dinagat, and Siargao. A few individuals of *L. lumadorum* were observed in abaca areas adjacent to the low-elevation mixed secondary forest in Mount Busa. Specimens: KMP 0186, 0313, 0314.

***Megophrys stejnegeri* Taylor, 1920.** This species can be the most frequently encountered amphibian in site-based herpetological surveys in Mindanao (Delima *et al.* 2006; Ates and Delima 2008; Baron *et al.* 2021). We encountered *M. stejnegeri* between 600–1,900 masl, suggesting a wide elevational range size of this species. In higher elevations, individuals were most often observed near or around small streams and swamps. Specimens: KMP 0081 (upper montane); KMP 0118, 0119 (lower montane); KMP 0187, 0346 (lowland evergreen).

Figure 15. *Megophrys stejnegeri* found in the montane forests. Photo by K.M.E. Pitogo.

Family Microhylidae

***Chaperina fusca* Mocquard, 1892.** This widespread but patchily distributed species is poorly understood, and its taxonomic status needs to be revisited (Sanguila *et al.* 2016). We encountered this species hidden in lowland abaca leaf axils during the day and perching on abaca leaves at night. When handled, it excretes a yellowish substance coming from the spots on its underside. Specimens: KMP 0290–0293, 0316, 0349, 0372, 0373.

Figure 16. *Chaperina fusca* found in the lowland forest. Photo by K.M.E. Pitogo.

***Kalophrynus sinensis* Peters, 1867.** This species is widespread in the Mindanao faunal region and is frequently encountered during the rainy season (Sanguila *et al.* 2016). This species was recently resurrected from the synonymy of *K. pleurostigma* (Zug 2015). The lone individual observed was found at night at 1,200 masl on the leaf litter of abaca.

Figure 17. *Kalophrynus sinensis* found in the lowland forest. Photo by K.M.E. Pitogo.

***Oreophryne annulata* (Stejneger, 1908).** This species reportedly differs from the similarly-looking *Aphantophryne nana* (formerly *Oreophryne nana*) in having subarticular tubercles (Brown and Alcala 1967), but this trait may vary across sites that require further investigation (Sanguila *et al.* 2016). We observed our specimen perching on a tree epiphyte in abaca patches adjacent to the village, suggesting tolerance to disturbance. Specimen: KMP 0289.

Figure 18. *Oreophryne anulata* found in the lowland forest. Photo by K.M.E. Pitogo.

***Pulchrana grandocula* (Taylor, 1920).** This common stream amphibian is widespread in Mindanao faunal region in both disturbed and undisturbed areas (Sanguila *et al.* 2016). They aggregate in carabao wallows and fishponds, while some solitary individuals perch on riparian shrubs. Polymorphism is evident for this species, particularly on the dorsal pattern. Individuals mostly have blotched dorsum, rarely dotted. This species was tested positive for Bd infection, but no known harmful impacts have been recorded yet (Diesmos *et al.* 2012). It lives in syntopy with the morphologically similar and enigmatic *Pulchrana guttmani*, which was known only from a single specimen collected in 1993 in Mount Busa, Sarangani (Brown 2015). Our extensive fieldwork in the area, however, did not produce any new additional specimens of *P. guttmani.* Specimens: KMP 0207–0213, 0252, 0253; KMP 0234, 0331, 0333, 0374 (juveniles); KMP 0335 (dotted morph).

Figure 19. *Pulchrana grandocula* found in the lowland streams. Photo by K.M.E. Pitogo.

***Staurois natator* (Günther, 1858).** This species is common throughout the Mindanao faunal region, although a further taxonomic investigation is needed for Basilan, Samar, and Leyte populations (Sanguila *et al.* 2016). We found them perching on rocks and overhanging riparian vegetation in lowland and mid-elevation streams (600–1,400 masl).

Figure 20. *Staurois natator* found in the lowland streams. Photo by K.M.E. Pitogo.

Gravid females were observed between June and July. Surprisingly, locals harvest this species for consumption. Specimens: KMP 0120 (lower montane); KMP 0179, 0206, 0239, 0277, 0307, 0322 (lowland evergreen).

Family Rhacophoridae

***Leptomantis bimaculatus* Peters, 1867.** Previously belonging to the genus *Rhacophorus,* a recent phylogenetic work resurrected the genus *Leptomantis*, of which *L. bimaculatus* is the type specimen (Jiang *et al.* 2019). This was the most frequently encountered amphibian in low-elevation streams, clinging to overhanging riparian vegetation. Large individuals perch on abaca leaves up to seven meters above the forest floor. Several breeding individuals were observed between June–August. Specimens: KMP 0235–0237, 0251, 0261, 0262, 0271–0274.

Figure 21. *Leptomantis bimaculatus* found in the lowland streams. Photo by K.M.E. Pitogo.

***Philautus acutirostris* (Peters, 1867).** The species is widely distributed in the Mindanao faunal region. It is distinguished by its nearly uniform grayish- or reddish-brown body color and distinctly pointed snout with usually a pale-colored projection at the tip (Brown and Alcala 1994). Very common in the lower montane forest

Figure 22. *Philautus acutirostris* found in the lower montane forest. Photo by K.M.E. Pitogo.

between 800–1,700 masl, this species perches on shrubs, epiphytic plants, and tree ferns up to 3 m above the forest floor. They become very active at around 18:00 hr and have a distinctive rattle call with a decremental pulse rate (Sanguila *et al.* 2016). Specimens: KMP 0077, 0079, 0080, 0096–0098, 0111–0114.

***Philautus leitensis* (Boulenger, 1897).** This species is widespread yet patchily distributed in Mindanao faunal region. It looks similar to its congener *P. acutirostris* but differs by its relatively less pointed snout and more extensive toe webbings (Brown and Alcala 1994). Ranging in altitude from 600–1,300 m, individuals perch on shrubs and other epiphytic plants up to three meters above the forest floor. Our observation extends the range of this species to southern Mindanao. Specimens: KMP 0125, 0126 (lower montane); KMP 0257, 0295, 0296, 0315 (lowland evergreen).

Figure 23. *Philautus leitensis* found in the lowland forest. Photo by K.M.E. Pitogo.

***Philautus poecilius* Brown and Alcala, 1994.** The current known distribution of *P. poecilius* is in northern, northwestern, and northeastern Mindanao (Diesmos *et al.* 2015). Distinguished by its more evident mottled coloration, this highly polymorphic species was the most abundant in the mossy forest. Some perches on understory shrubs, while several individuals were collected perching on fronds of tree ferns up to 4 m above the forest floor. Their number starts to decrease below 1,800 masl, suggesting that this species is a high-elevation specialist. Our observation is a major range extension of this species to the south. Specimens: KMP 0018, 0019, 0025–0028, 0034–0037.

Figure 24. *Philautus poecilius* found in the upper montane forest. Photo by K.M.E. Pitogo.

Figure 25. *Philautus* cf. *poecilius* found in the upper montane forest. Photo by K.M.E. Pitogo.

***Philautus* cf. *poecilius*.** Several distinct individuals of a high-elevation *Philautus* were observed in the mossy forest. It is distinguished from *P. poecilius* mainly by its bright uniform color pattern and from *P. aurifasciatus* group by its wider digital pads. Its body color ranges from bright orange to reddish-brown, mostly uniform or rarely having a darker dorsum resembling a complete or partial hourglass. This color pattern has not been reported in *P. poecilius* but may fall within its variability limits since *Philautus* are known to have high intraspecific variability in body coloration (Bossuyt and Dubois 2001). Nevertheless, we conservatively separate these individuals until further integrative taxonomic studies on *P. poecilius* are done. They perch exposed on leaves of understory shrubs lower than most *P. poecilius*. Juveniles were found under moss mats on dead logs and tree trunks. Specimens:

KMP 0012, 0013, 0015–0017, 0036, 0038, 0039, 0041, 0054, 0055.

***Philautus* cf. *surdus* (Peters, 1863).** This species is the most widely distributed among Philippine *Philautus,* with known records in Luzon, Catanduanes, Polillo, Bohol, and Mindanao (Diesmos *et al.* 2015). Although previous records show a high degree of species polymorphism, its protologue distinguished *P. surdus* by its larger size, relatively extensive toe webbings, and tubercles on the dorsum – especially at shoulder level on either side (Brown and Alcala 1994). Records in Mindanao were only from the northern and southeastern portions with no known specimens from the south. Thus, if confirmed, our observation extends its range to southern Mindanao. Further molecular studies on *P. surdus* may confirm that this is a complex of several cryptic species. Specimens: KMP 0102, 0128, 0152.

Figure 26. *Philautus* cf. *surdus* found in the lower montane forest. Photo by K.M.E. Pitogo.

***Philautus worcesteri* (Stejneger, 1905).** Widely distributed in the Mindanao faunal region, *P. worcesteri* is seldom observed due to the high microhabitat with which this species prefers to perch on. It is readily distinguished by its larger body size, uniform dorsal and ventral colorations, and extensive toe webbing (Brown and Alcala 1994). This species ranges in altitude between 700–1,900 m and perches higher than most other amphibians observed in Mount Busa. Specimens: KMP 0059, 0087, 0115, 0127.

Figure 27. *Philautus worcesteri* found in the upper montane forest. Photo by K.M.E. Pitogo.

Figure 28. *Polypedates leucomystax* found in the lowland forest. Photo by K.M.E. Pitogo.

***Polypedates leucomystax* (Gravenhorst, 1829).** This is a human commensal species able to tolerate a wide range of anthropogenic disturbances. In Mount Busa, this species more commonly perches on understory shrubs around human settlements and carabao wallows, while some perch higher on abaca leaves. Specimens**:** KMP 0185, 0233, 0329, 0330, 0364.

Order Gymnophiona
Family Ichthyophiidae

***Ichthyophis mindanaoensis* Taylor, 1960.** Despite its cryptic nature and fossorial habit, this species has now been recorded in different montane localities in Mindanao, although basic ecological studies are still needed to improve our understanding of this species (Diesmos 2012). It was previously observed in agricultural areas abutting primary forest patches and other man-made structures, suggesting tolerance to some degree of anthropogenic disturbance. Its taxonomy remains uncertain (Sanguila *et al.* 2016), which may require further molecular and morphological examinations among specimens collected all over Mindanao (Diesmos 2012). We collected three mature larvae of this species along the stream bank at 800 masl. Specimens: KMP 0299, 0301, 0302.

Figure 29. *Ichthyophis mindanaoensis* found in the lowland stream at 650 masl. Photo by K.M.E. Pitogo.

Figure 30. *Ichthyophis* sp. "pointed tail" found in the lowland stream at 650 masl. Photo by K.M.E. Pitogo.

***Ichthyophis* sp. "pointed tail."** An individual caecilian distinct from *I. mindanaoensis* was collected in a low-elevation stream. It has a pointed tail, light brown body color, and larger and more conspicuous skin glands. All were diagnostic characters to distinguish Philippine caecilian species (Taylor 1960). When in water, this individual actively moves in the water column in contrast to the still behavior of *I. mindanaoensis*. Studies on Philippine caecilians remain very scarce, thus future taxonomic and molecular work on this taxon may reveal undetected cryptic species (Diesmos 2012). Specimen: KMP 0300.

Reptiles
Order Lacertilia
Family Agamidae

***Bronchocela* sp. 1.** The Mindanao populations were previously identified as *Bronchocela cristatella* (Hallermann 2005), but we follow previous authors in not assigning these individuals to any known species until further integrative taxonomic studies of representative individuals are undertaken (Sanguila *et al.* 2016). This species is common in the low-elevation secondary forests and was often encountered clinging on to shrubs and hanging streamside vegetation. Specimens: KMP 0222, 0232, 0263, 0264, 0304.

Figure 31. *Bronchocela* sp. 1 found in the lowland forest. Photo by A.J.L. Saavedra.

***Bronchocela* sp. 2.** Observed in syntopy with *Bronchocela* sp. 1, individuals of this species are mainly distinguished by their larger ear diameter (3.5–4.3 mm *vs.* 2.3–3.3 mm), larger with more elaborate and longer nuchal crest (*vs.* short), and large strongly keeled mucronate scales on the ventrum, particularly on the scales covering the gular area (*vs.* smaller uniformly keeled scales). All are diagnostic characters used to distinguish *Bronchocela* species (Hallermann 2005; Grismer *et al.* 2015). These morphological differences from *Bronchocela* sp. 1 compelled us to separate these individuals, which will be needing further integrative taxonomic studies. However, we note that morphological differences have also been recorded in Luzon populations (Brown *et al.* 2012a, 2013b; McLeod *et al.* 2011). Specimens: KMP 0190, 0178, 0343.

Figure 32. *Bronchocela* sp. 2 found in the lowland forest. Photo by A.J.L. Saavedra.

***Draco bimaculatus* Günther, 1864.** This species is widely distributed in Mindanao, Samar, Leyte, Bohol, Dinagat, and Sulu archipelago. It is commonly found in both primary and secondary forests, as well as in coconut plantations abutting natural forests (McGuire and Alcala 2000). Previous records suggest that this species can tolerate some degree of disturbances (McGuire and Alcala 2000; Sanguila *et al.* 2016). We observed several individuals gliding in between tall trees in low-elevation mixed secondary forest. Specimens: KMP 0147, 0163–0166, 0214, 021.

***Draco cyanopterus* Peters, 1867.** This species is found mostly in coconut plantations in Mindanao, suggesting tolerance to disturbance (Sanguila *et al.* 2016). We commonly observed *D. cyanopterus* on tree branches during the day around the villages, gliding in between trees.

***Draco ornatus* (Gray, 1845).** This species occurs in the Mindanao faunal region and is found in both primary and secondary forests and coconut plantations abutting natural forests (McGuire and Alcala 2000). We observed an individual in an abaca area mixed with primary forest trees at 600 masl.

Figure 33. *Draco cyanopterus* found in lowland early secondary-growth forest. Photo by A.J.L. Saavedra.

Figure 34. *Draco mindanensis* found in the lowland forest. Photo by A.J.L. Saavedra.

***Draco mindanensis* Stejneger, 1908.** Previous observations of this species in the wild were all restricted to primary forests (Smith 1993; McGuire and Alcala 2000; David *et al.* 2006; Sanguila *et al.* 2016). However, our lone sub-adult specimen was captured upon landing on a boulder in a mixed early secondary forest at 650 masl, suggesting that it might be able to tolerate disturbed areas abutting primary forest patches. Naturally occurring in low numbers in primary and possibly mature secondary forests in Mindanao faunal region, *D. mindanensis* is the most threatened *Draco* species in the Philippines. Specimen: KMP 0167.

***Gonocephalus* sp. "South Mindanao."** There are currently three recognized species of *Gonocephalus* in the Philippines, but the range and distribution of these species remain to be a challenge due to problems in species identification. Although *Gonocephalus interruptus* is the only species with its holotype bearing a specific type locality data in Mindanao, characters used to define Philippine populations appear to be problematic (Taylor 1922). A phylogenetic analysis of Philippine *Gonocephalus* revealed 12 monophyletic divergent lineages, one of which includes the southern Mindanao population (Welton *et al.* 2017). This population may represent a putatively undescribed species or one of the three recognized species in the Philippines. Until further integrative taxonomic studies are undertaken, we refrain from identifying the populations in Mount Busa to any known recognized species. All specimens were collected at night sleeping on tree branches in lowland riparian habitats. Specimens: KMP 0275, 0327, 0342, 0343.

***Hydrosaurus pustulatus* Eschsholtz, 1829.** We observed a few individuals in the lowland riparian habitats in Mount Busa between 300–500 masl. But these individuals eluded capture. In a phylogeographic analysis of *H. pustulatus* in the Philippines (Siler *et al.* 2014), no genetic data was available for the southern Mindanao population that could help determine its relationship to other populations in the country, thus the need to secure specimens in future fieldwork in the region.

Family Gekkonidae

***Cyrtodactylus annulatus* (Taylor, 1915).** The re-description of this species delineates its geographic distribution to Visayas and Mindanao faunal regions, where it is widely distributed (Welton *et al.* 2009). This is the most encountered lizard in the low-elevation riparian corridors in Mount Busa, clinging to large boulders, hanging riparian shrubs, and woody debris. Specimens: KMP 0191, 0223, 0224, 0258–0260, 0278, 0280, 0318, 0338.

Figure 35. *Cyrtodactylus annulatus* found in lowland riparian habitats. Photo by A.J.L. Saavedra.

***Gehyra mutilata* (Wiegmann, 1834).** This house gecko is widespread in the Philippines and occurs in poorly lit residential habitats in contrast to other common house geckos. We found individuals on thatched walls in the villages around Mount Busa. This species was observed feeding on the flowers of a calabash tree in southcentral Mindanao, suggesting its potential role in pollination (Tanalgo and Hughes 2017). Specimens: KMP 382–384.

***Lepidodactylus* cf. *lugubris* (Duméril and Bibron, 1836).** This species is surprisingly absent in most herpetological diversity studies in Mindanao despite having a widespread distribution, although we note that the Philippine populations can be variable (Brown and

Figure 36. *Lepidodactylus* cf. *lugubris* found in the lowland forest. Photo by A.J.L. Saavedra.

Alcala 1978). Previous studies in the country recorded this species in a variety of habitats: from lowland coastal areas (Siler *et al.* 2012a; Supsup *et al.* 2016) to forested montane habitats (Brown *et al.* 2013b; Gojo-Cruz *et al.* 2018). Two specimens were collected at night in a mixed secondary forest between 600–700 masl crawling on epiphytic plants and abaca leaves. Differences in the shape of and pigmentation on the scansors of our specimens were observed, which may require further examination to ascertain the identification. Specimens: KMP 0279, 0319.

Family Scincidae

***Brachymeles tiboliorum* Siler, Jones, Diesmos, Diesmos, and Brown 2012.** This species known distribution is southern Mindanao and Misamis Oriental in the north. The northern population, however, may eventually be recognized as a distinct species pending the collection of additional adult specimens, restricting *B. tiboliorum* to southern Mindanao (Sanguila *et al.* 2016). We found our lone specimen under rotting abaca leaves at 700 masl. Specimen: KMP 0381.

Figure 37. *Brachymeles tiboliorum* found in the leaf litter of lowland forest. Photo by K.M.E. Pitogo.

***Emoia ruficauda* Taylor, 1915.** The only endemic *Emoia* species found in the Philippines has a disjunct distribution in Mindanao. It was described from the upper Agusan Valley and was later observed in the lowland habitats close to water bodies in Sarangani, Sultan Kudarat, and Zamboanga del Sur. It is regarded as a lowland species

Figure 38. *Emoia ruficauda* found in the lowland forest. Photo by A.J.L. Saavedra.

(0–300 masl) that prefers areas near freshwater (Gaulke and Alcala 2009). We observed individuals in vegetated areas near streams in the lowland mixed secondary forests, extending its upper elevational range to 600 masl. Specimens: KMP 0170, 0174–0177, 0336, 0337.

***Eutropis cuprea* Barley, Diesmos, Siler, Martinez, and Brown 2020.** A multilocus molecular analysis revealed seven morphologically conserved distinct genetic clades within the *E. multicarinata* complex occurring in the Philippines with overlapping distributions (Barley *et al.* 2013). One of these is *E. cuprea*, which was recently described from a revision of Philippine sun skinks (Barley *et al.* 2020). It occurs in syntopy with the morphologically very similar and widespread *E. caraga* in South Cotabato, posing difficulty in species delimitation without using molecular techniques. We conservatively assign this name to the Mount Busa population due to its extreme southern distribution, which is likely within the range of *E. cuprea*. We observed several individuals basking on leaf litter, woody debris, and boulders; they retreat to nearby crevices or holes when disturbed. Specimens: KMP 0219, 0220, 227, 0265, 0303, 0340.

Figure 39. *Eutropis cuprea* found in the leaf litter of lowland forest. Photo by K.M.E. Pitogo.

***Lamprolepis smaragdina philippinica* (Mertens, 1928).** Despite being common and tolerant of human disturbance, we only observed one individual of this species crawling on a tree trunk in the lowland secondary forest at 500 masl. We have not recovered additional specimens despite our extensive surveys in higher elevations (> 700 masl).

Figure 40. *Lamprolepis smaragdina philippinica* found in the early secondary-growth lowland forest. Photo by A.J.L. Saavedra.

***Parvoscincus* sp. 1 "midmontane."** A single specimen of a high-elevation diminutive skink was collected under woody debris at 1,300 masl. Its SVL is 30 mm and has a purplish-brown body, a dark brown dorsolateral band from head to tail, and numerous light brown flecks on its flank. These features are assignable to the *P. decipiens* species complex, although these do not match any known recognized species in the genus. An integrative taxonomic study on this species complex is necessary for proper identification. Specimen: KMP 0124.

Figure 41. *Parvoscincus* sp. "midmontane" found in the lower montane forest. Photo by A.J.L. Saavedra.

***Parvoscincus* sp. 2 "lowland."** This skink is assignable to the *P. decipiens* species complex. Its SVL ranges between 28–31 mm and has a reddish-brown dorsum, a dark brown dorsolateral band from head to tail, and a red-orange throat. Several individuals were observed under piles of rotting abaca leaves and leaf litter between 600–800 masl. Specimens: KMP 0225, 0226, 0231, 0353–0356, 0375, 0376.

Figure 42. *Parvoscincus* sp. "lowland" found on the leaflitter of abaca in the lowland forest. Photo by A.J.L. Saavedra.

***Pinoyscincus* cf. *abdictus* (Brown and Alcala, 1980).** We found a few individuals of this species among rocks along stream banks at 600 masl. They escape into crevices when disturbed or threatened. Specimens from Mount Busa exhibit obvious differences in the color pattern that may warrant further taxonomic investigations. Specimens: KMP 385–386.

Figure 43. *Pinoyscincus* cf. *abdictus* found in rock crevices in the lowland streams. Photo by K.M.E. Pitogo.

***Pinoyscincus jagori jagori* (Peters, 1864).** This large-bodied skink species is widespread in the Philippines. This species occurs in areas with varying levels of disturbance, from disturbed lowland to forested high-elevation areas up to 600 masl (Sanguila *et al.* 2016). We found our lone specimen at night at 1,200 masl on the forest leaf litter, making our observation an altitudinal range extension for this species.

Figure 44. *Pinoyscincus jagori jagori* found in the lower montane forest. Photo by A.J.L. Saavedra.

***Pinoyscincus* cf. *mindanensis* (Taylor, 1915).** This species was previously recorded in eastern Mindanao, Bohol, and Leyte and inhabits montane habitats compared to other *Pinoyscincus* species, which are larger, generalist, and mostly encountered in lower elevations. Individuals were observed basking on leaf litter in the lowland evergreen forest between 700–900 masl and escaped by climbing up the tree trunk when disturbed or threatened. Our specimens exhibit darker brown dorsal and tail coloration. Our observation is a geographic range extension of this species to southern Mindanao. Specimen: KMP 0230.

Figure 45. *Pinoyscincus* cf. *mindanensis* found in the lowland forest. Photo by A.J.L. Saavedra.

Figure 46. *Sphenomorphus fasciatus* found in the lowland forest. Photo by A.J.L. Saavedra.

***Sphenomorphus fasciatus* (Gray, 1845).** This morphologically distinctive *Sphenomorphous* species has a wide elevational range, commonly found in secondary low-elevation forests in Mindanao faunal region. Individuals were observed under a pile of rotting abaca leaves in lowland mixed secondary forest in Mount Busa. Specimen: KMP 0229.

***Sphenomorphus* sp. "red tail."** Individuals resemble a juvenile of the large-bodied *Otosaurus cumingii*, which is widespread in the Philippines. However, locals reported that our specimens are within the normal range of size of this species. We temporarily assigned these specimens under the genus *Sphenomorphus* until further taxonomic work is undertaken on this species. Specimen: KMP 0357, 0370.

Figure 47. *Sphenomorphus* sp. "red tail" found in the lowland forest. Photo by A.J.L. Saavedra.

***Tropidophorus partelloi* Stejneger, 1910.** This species is widespread yet patchily distributed in Mindanao island (Sanguila *et al.* 2016). It is distinguished by its spiny tail and light brown color with several pale crossbars on the dorsum. We observed this species in forests between 600–1,200 masl, along vegetated stream banks during the day. Individuals were seen fleeing into the water when disturbed. Previous records suggest that *T. partelloi* prefers less disturbed areas (Smith 1993; Beukema 2011). Specimens: KMP 0287, 0339.

Figure 48. *Tropidophorus partelloi* found in lowland streams. Photo by A.J.L. Saavedra.

Family Varanidae

***Varanus cumingi* Martin, 1839.** This species is widespread in Mindanao faunal region and commonly found in lowland habitats below 1,000 masl. We saw an individual basking by the road at 300 masl. Despite being common throughout its range, *V. cumingi* is threatened by commercial reptile skin trade and human consumption (Koch *et al.* 2013). This species is listed under CITES Appendix II, which means trade is controlled to avoid utilization incompatible with their survival.

Order Serpentes

Family Colubridae

***Ahaetulla prasina preocularis* (Boie, 1827).** It is regarded as a widespread species able to tolerate a varying degree of anthropogenic disturbance. We found several individuals in riparian shrubs around 600 masl during the day. Specimens: KMP 0351, 0352.

Figure 49. *Ahaetulla prasina preocularis* found in lowland streams. Photo by A.J.L. Saavedra.

***Boiga cynodon* (Boie, 1827).** This is a widespread species in the Philippines found in understory vegetation, arboreal, and riparian habitats in both primary and secondary forests (Siler *et al.* 2012a; Brown *et al.* 2013b; Sanguila *et al.* 2016). Individuals also show color and pattern variability, with some individuals having no pattern and a more uniform color (Brown *et al.* 2013b). A local found our lone specimen in the canopy of a coconut tree near the village. Specimen: KMP0191.

***Cyclocorus nuchalis nuchalis* Leviton, 1967.** Two subspecies of *C. nuchalis* occur in the Mindanao faunal region based on head scalation: *C. nuchalis nuchalis* and *C. nuchalis taylori* (Weinell *et al.* 2019). The former is distributed in south to western Mindanao and Basilan and the latter in eastern Mindanao, Leyte, and Samar. We observed one individual crossing the trail at 500 masl only during our reconnaissance; thus, no specimens were collected. The species has distinctive white spots along the lateral edge of ventral body scales.

***Dendrelaphis philippinensis* (Günther, 1879).** We observed several individuals of this species in the lowland forest of Mount Busa between 400–800 masl, although all eluded successful capture. We assigned this name due to the relatively less enlarged vertebral body scales and extreme southernmost distribution, which is within the distribution range of this species (Leviton *et al.* 2018).

***Lycodon dumerilii* (Boulenger, 1893).** This species is endemic and widespread in the Mindanao faunal region, but our observation is its first record in southern Mindanao. It is distinguished by its light crossbands throughout the body and tail. We found our lone specimen slithering on a boulder by a lowland stream at night. Specimen: KMP0134.

Figure 50. *Lycodon dumerilii* found in the lowland stream. Photo by A.J.L. Saavedra.

Figure 51. *Pseudorabdion taylori* found in the lower montane forest. Photo by K.M.E. Pitogo.

***Pseudorabdion taylori* Levtion & Brown, 1959.** Previous records of this species were mostly in southern Mindanao (Leviton *et al.* 2018). We found one specimen in the lower montane forest at 1,570 masl, actively slithering through leaf litter at night. Recent observations of its natural history (including the specimen here) have noted that this species is nocturnal and has a wide elevational range, occurring from undisturbed lowland evergreen to montane forests in southern Mindanao (Pitogo 2021). There is not much information available in the literature on the extent of occurrence and natural history of this species; hence, it is listed as Data Deficient in the IUCN Red List (Diesmos and Duya 2009). Specimen: KMP 0133.

***Rhabdophis lineatus* (Peters, 1861).** This species is widely distributed in the Mindanao faunal region. It is a frequently encountered species around the vicinity of streams and ponds in the lowland forest of Mount Busa, but individuals were observed up to 1,300 masl. It is easily distinguished by its reddish-brown body color and the distinctive white stripe across the supralabial scales. Previous records show that this species can tolerate heavy disturbance (Sanguila *et al.* 2016). Specimens: KMP 0267, 0344, 0345.

***Rhabdophis auriculatus auriculatus* (Günther, 1858).** This species has two subspecies both distributed in the Mindanao faunal region: the *R. auriculatus myersi* in western portions (including Bohol) and *R. auriculatus auriculatus* in the rest of Mindanao (including Samar and Leyte) (Leviton *et al.* 2018). They reportedly differ in the degree of light lateral body stripe (Weinell *et al.* 2019). This subspecies is widespread and abundant in Mindanao.

Figure 52. *Rhabdophis lineatus* found around the vicinity of lowland streams. Photo by A.J.L. Saavedra.

Figure 53. *Rhabdophis auriculatus auriculatus* found in the lower montane forest. Photo by A.J.L. Saavedra.

We found our lone specimen at 1,300 masl during the day, but several juveniles were also observed in lowland streams (300–600 masl). Specimen: KMP0132.

***Stegonotus muelleri* (Duméril, Bibron, & Duméril 1854).** This is a large species of rat snake of Papuan origin endemic to the Mindanao faunal region. Its occurrence in Samar is the northernmost distribution of a *Stegonotus* species (Kaiser *et al.* 2018). We found individuals crossing trails and coiling in fallen branches in the lowland evergreen forest of Mount Busa. It is listed as Near Threatened under the IUCN Red List, but we concur with the suggestions of previous authors to downgrade the species to Least Concern due to its widespread distribution (Sanguila *et al.* 2016). Specimen: KMP 0270.

Figure 54. *Stegonotus muelleri* found in the lowland forest. Photo by A.J.L. Saavedra.

***Tropidonophis dendrophiops* (Günther, 1883).** The genus *Tropidonophis* closely resembles *Rhabdophis* but can be distinguished by the background color of ventral body scales (Weinell *et al.* 2019). Most observations occur in Mindanao faunal region and are often associated with relatively undisturbed riparian areas (Sanguila *et al.* 2016). We found our lone specimen by a small stream at 700 masl. Specimen: KMP 0379.

Figure 55. *Tropidonophis dendrophiops* found in the lowland forest. Photo by K.M.E. Pitogo.

Family Elapidae

Naja samarensis Peters, 1861. This is a widely distributed and the lone true cobra species in the Mindanao faunal region, occupying a wide range of habitats. It is easily identified by its distinctive yellowish black body and its hood when threatened. Despite its common distribution, limited is known on the natural history and ecology of this species. Predation of *N. samarensis* on an invasive cane toad was reported reinforcing its role in pest control (Ravalo *et al.* 2019). We found one decomposing individual with a severed head near the village. Persecution of snakes out of fear is common in these rural villages.

Family Lamprophiidae

Oxyrhabdium modestum (Duméril, 1853). This species is widespread in the Mindanao faunal region, although there are also few records in Luzon Island (Leviton *et al.* 2018).

Figure 56. *Oxyrhabdium modestum* found in the lowland forest. Photo by A.J.L. Saavedra.

This is the most commonly encountered snake species in the lowland mixed secondary forest in Mount Busa. Most observations were in and around streams, rotting abaca leaves, understory layers of vegetation, and leaf litter both day and night. Specimens: KMP 0215, 0216, 0320, 0341, 0350.

Psammodynastes pulverulentus (Boie, 1827). This species has a widespread distribution, spanning from southern China down to most of South and Southeast Asia. It is a specialized skink predator owing to its unique dentitional morphology (Miller and Zug 2016). It is commonly observed in Mount Busa: coiled in tree branches, tree holes, streamside vegetation, rotting abaca leaves, and on the forest floor. This species has not been evaluated by the IUCN. Specimens: KMP 0228, 0268, 0269, 0358.

Figure 57. *Psammodynastes pulverulentus* found in the lowland forest. Photo by A.J.L. Saavedra.

Figure 58. *Aplopeltura boa* found in the lowland forest. Photo by A.J.L. Saavedra.

Family Pareidae

Aplopeltura boa (Boie, 1828). This species is widely distributed in Southeast Asia. It is commonly encountered in the riparian areas, eating mostly arboreal snails and slugs, particularly after heavy rains (Sanguila *et al.* 2016). Our juvenile specimen was found at 600 masl by the stream. Specimen: KMP 0371.

Family Pythonidae

Malayopython reticulatus (Schneider, 1801). The lone python species in the Philippines is widespread in the country. Almost every herpetological study reports this species occupying a wide range of habitats. A recent phylogenetic study found that *M. reticulatus* in the Philippines, except Palawan, formed a single haplotype group and may be considered an ESU for conservation (Murray-Dickson *et al.* 2017). Locals reported *M. reticulatus* or locally called "sawa" feeding on their domesticated chickens, which prompted us to include the species in the list despite not being observed firsthand.

Family Viperidae

Trimeresurus cf. ***flavomaculatus*** (Gray, 1842). This species is widespread in the Philippines, but future integrative taxonomic work is needed to determine if the Mindanao population is a separate evolutionary lineage. An adult individual was observed in the lowland riparian area in Mount Busa at 600 masl. We were not able to collect specimens.

Figure 59. *Trimeresurus* cf. *flavomaculatus* found in the lowland forest. Photo by A.J.L. Saavedra.

DISCUSSION

Previous herpetological field surveys in southern Mindanao have led to the rediscoveries of lost species (Siler *et al.* 2011; Pitogo and Saavedra 2021) and descriptions of new species restricted to the region (Siler *et al.* 2012b; Brown 2015; Barley *et al.* 2020). These milestones reinforce the indispensable role of empirical field-based investigations to understand the level and patterns of diversity in southern Mindanao. Our results contribute to the current knowledge by providing baseline information on the herpetofauna of Mount Busa. Most species encountered are endemic to the Mindanao faunal region, many of which are rarely observed and reported in the literature. These include the amphibians *P. rabori*, *P. poecilius*, *I. mindanaoensis*, and the reptiles *D. mindanensis*, *B. tiboliorum*, *E. ruficauda*, and *P. taylori*.

We report the range extensions of *P. poecilius*, *P. leitensis*, *P. rabori*, *P.* cf. *surdus*, and *P* cf. *mindanensis* to southern Mindanao, affirming their large extent of occurrence. This

study exemplifies how field surveys in less-studied areas can inform and support species conservation assessments (Brown *et al*. 2012a, 2013b; Sanguila *et al*. 2016; Supsup *et al.* 2017), particularly for Mindanao-endemic species on which limited studies are done to update their ecological information. The lack of ecological data for several Philippine herpetofauna not only hamper species conservation assessments [*e.g.* Gonzalez *et al.* (2018)] but may also wrongfully assign species into higher threat categories like the case of *Platymantis polillensis* (Brown *et al.* 2012a). Such errors can have repercussions in setting priorities for species conservation.

Field surveys are made difficult by identifying species on site, particularly those with high polymorphism and cryptic diversity. This difficulty hampers accurate species inventory and may lead to doubtful results if specimens are not carefully examined [see Supsup *et al.* (2017) and Pitogo *et al.* (2020)]. We therefore highly advise that future inventories collect enough voucher specimens and/or take clear photos showing diagnostic characters as the ideal practice in herpetological research. This practice not only enables future validation of reports but also facilitates further taxonomic work, which is still needed for many Philippine endemic species.

Several commonly occurring and widespread species of reptiles were not recorded despite our repeated visits and extensive fieldwork. We anticipate that future surveys in the Busa Mountain Range will record additional species of reptiles widespread in the Mindanao faunal region, such as the snakes *Coelognathus erythrurus*, *Calamaria lumbricoidea*, *C. gervaisii*, *Gonyosoma oxycephalum*, *Oligodon maculatus, Tropidolaemus philippensis*, *Rampothyplops cumingii*, and *Calliophis philippina*; and the lizards *Gekko gecko*, *Eutropis multifasciata*, *Eutropis lapulapu*, and *Pseudogekko pungkaypinit*. The snake *M. reticulatus* was included in the species list despite not being observed firsthand due to the compelling accounts and certainty of the local community and the widespread distribution of the species (Leviton *et al.* 2018).

A few of the amphibian species recorded by Rafe Brown and colleagues in their 1993 fieldwork in Mount Busa were not also observed. These were *P. guentheri*, *O. laevis*, *N. spinosus*, and the enigmatic *P. guttmani* described from a single specimen collected in Mount Busa, Sarangani (Brown 2015). These species may have been greatly reduced in numbers or extirpated after much of the original lowland forest of Mount Busa has been cleared or fragmented (Brown 2015; Pitogo and Saavedra 2021). Of particular interest is the *P. guttmani*, a species lost to science for more than two decades until its recent rediscovery in the northern slopes of the Busa Mountain Range in the South Cotabato Province (Pitogo and Saavedra 2021). Without the 1993 fieldwork, the existence of these species in Mount Busa would not have been known, attesting to the value of specimen collections as important sources of long-term datasets to track changes in herpetological communities.

Southern Mindanao's forest cover declined to more than 50% since the early 1990s (FMB 2018). Although the rate of deforestation in the Philippines has stabilized in recent years, agricultural expansion remains the key driver of the remaining forest cover loss (Carandang 2013), particularly in southern Mindanao (DENR 2020; PLGU Sarangani 2021; Senarillos *et al.* 2021). This threat is persistent in Mount Busa as regenerating lowland secondary forests in the area are selectively thinned for abaca farming, which is the main economic activity in nearby villages. Abacas start to encroach to higher elevations (up to 1,300 masl), which may significantly affect forest communities if left unregulated. Surprisingly, at least 80% of the species recorded in our surveys were observed in the lowland forest areas mixed with farmed abaca, suggesting that sustainable abaca farming practices may support diverse herpetological communities, although the effect of these practices on other taxa should be carefully studied and considered. This case highlights the value of integrating multiple-use lowland forests in conservation planning [*e.g.* Gillespie *et al.* (2015)].

The combined results of our field surveys and a few records of Brown (2015) identified at least 72 species of herpetofauna in Mount Busa – comprising about 32 species of amphibians, 24 species of lizards, and 16 species of snakes. Considering the limited area surveyed, the diversity is relatively high and comparable to other well-surveyed mainland provinces and mountain ranges in the Philippines: 76 species for Cebu province (Supsup *et al.* 2016), 68 species for Bulacan province (McLeod *et al.* 2011), 66 species for Caraballo Mountain Range (Gojo-Cruz *et al.* 2018), 61 species for Hamiguitan Mountain Range (Supsup *et al.* 2017), 59 species for Malindang Mountain Range (Nuñeza *et al.* 2010), 58 species for Ilocos Norte province (Brown *et al.* 2012a), and 41 species for Victoria-Anepahan Mountain Range (Supsup *et al.* 2020). However, we acknowledge that these differences are influenced by sampling coverage and effort (McCain and Grytnes 2010).

It is also noteworthy that amphibian diversity in Mount Busa is relatively high even without a single record of invasive alien species in the area. We expect that the current known diversity in this mountain range would significantly increase with additional field surveys in the intact forested portions in the municipalities of Maitum and Maasim in Sarangani and the northern slope in Lake Sebu and Tboli in South Cotabato. Our results provide the empirical data needed to justify the inclusion of the Busa Mountain Range into the NIPAS by virtue of Republic

Act No. 11038, otherwise known as the Expanded NIPAS Act of 2018. Such inclusion would mean a stronger legal framework for its conservation, as legislated protected areas will have their resources, management plan, and governing body.

Continued field surveys in the diverse habitats of southern Mindanao will eventually provide a much clearer picture of the region's amphibian and reptile diversity. Nevertheless, our results offer a glimpse of what was a previously unknown herpetological community in the southern reaches of the Philippines. Site-based faunal inventories are important sources of data for research, conservation, and education (Brown *et al.* 2001). Unfortunately, field surveys are becoming unpopular and are often relegated to lower importance in modern conservation science (Ríos-Saldaña *et al.* 2018).

Acknowledging the many challenges field biologists face in southern Mindanao (Brown 2015; Sanguila *et al.* 2016; Pitogo and Saavedra 2021), we highly encourage repeated visits and site-based herpetological surveys in the diverse habitats in South Cotabato, Sultan Kudarat, Sarangani, and Davao Occidental provinces. Only when these areas are extensively surveyed can we fully understand the herpetological community of southern Mindanao, overcoming Linnean and Wallacean shortfalls in our knowledge of Philippine amphibians and reptiles (Brown *et al.* 2012b).

ACKNOWLEDGEMENTS

Fieldwork is funded by The Rufford Foundation (Project No. 26752-1), United States Agency for International Development (through the Protect Wildlife program), Idea Wild, and the Philippine Department of Science and Technology graduate scholarship awarded to KMEP. The Philippine DENR Region XII Office provided the necessary fieldwork and collection permit (Gratuitous Permit No. 2019-23). We are grateful to the Municipal Government of Kiamba in Sarangani Province and the DENR–CENRO (Community Environment and Natural Resources Office) Kiamba for allowing KMEP and AJLS to conduct fieldwork in Mount Busa. We give our immense gratitude to the indigenous Tboli community of Sitio Tulad, headed by tribal chieftain Lorenzo Sinandon, for their significant contributions in data collection and for ensuring the team's safety while on the field. John Carlo Santos is also acknowledged for preparing the map of Mount Busa we used in this paper. Finally, we want to thank the two anonymous reviewers for improving the early version of this manuscript.

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