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Beetles (Insecta: Coleoptera) in Andanan Watershed Forest Reserve, Mindanao, Philippines

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ABSTRACT

Beetles (Insecta, Coleoptera) fauna play a crucial role in the food web and serve as a valuable bioindicator of the ecosystem health. In the riparian forest zone of Andanan Watershed Forest Reserve, 52 species from 45 genera and 24 subfamilies were recorded. Scarab beetles (family Scarabaeidae) had the highest species richness, with eleven species, including the largest species, *Chalcosoma atlas*. Other phytophagous groups, such as longhorn beetles (Cerambycidae: 8 species) and weevils (Curculionidae: 7 species), were also documented. Additional families observed include Cantharidae, Carabidae, Chrysomelidae, Cicindelidae, Coccinellidae, Elateridae, Endomychidae, Lampyridae, Lucanidae, Lycidae, Meloidae, Passalidae, and Prionoceridae. Notably, the endemic tiger beetle *Calomera mindanaoensis*, found only in Mindanao, was recorded, along with the recently discovered species of scarab beetles – *Engertia lii* and *Philacelota leucothea*, reported in 2006 and 2019, respectively, and considered endemic to the Philippines. Additionally, the records of two cantharid beetles (*Cordylocera* and *Paradiscodon*), two elaterid beetles (*Lanelater* and *Paracalais*), and a blister beetle (*Zonitoschema*) may represent the first documentation of these groups in Mindanao.

Keywords: *Adephaga, Polyphaga, checklist, new records, watershed beetles*

1 Introduction

A key factor contributing to the remarkable success of beetles (Insecta, Coleoptera) lies in their distinct sclerotized body and modified forewings, which have evolved into rigid elytra that serve as protective sheaths for their delicate hindwings (Sharma et al. 2013). The intricate adaptation of their transformative life cycle to the specialized characteristics of their adult form also exemplifies the evolutionary prowess that has propelled beetles to unparalleled success in diverse ecosystems. Coleoptera, one of the largest insect orders, stands out as a pinnacle of biodiversity, encompassing an extraordinary number of species (Wankhade et al. 2014). Ubiquitous across various habitats, they play a pivotal role in maintaining environmental health and serve as effective bioindicators. Research highlights their sensitivity to changes in forest types and habitat microenvironments, underscoring their importance in assessing ecological conditions (Li et al. 2017).

The extensive diversity of beetles, marked by their adaptability to various habitats and prolonged lifespans, positions them as ideal biological indicators. Their multifaceted roles within ecosystems include significant contributions to ecological food webs, providing protein sustenance for species at higher trophic levels (Sushko 2017). Across beetle families, a wide range of ecological functions emerges – some species act as predators and decomposers of organic material (Rizal et al. 2019), while others are recognized as potential pests. Despite the potential for certain beetle species to be pests, their overall impact on ecosystems is nuanced and often beneficial. For example, ladybird beetles from the family Coccinellidae serve as valuable allies in pest control, with both

larvae and adults feeding on aphid colonies and mealy bugs (Brown et al. 2010). Similarly, ground beetles from the family Carabidae function as common predators, preying on various insects and arthropods. Dung beetles and other predatory terrestrial beetles from the Scarabaeiformia and Staphyliniformia groups contribute to pest reduction by efficiently managing populations in mammal dung (Brown et al. 2010). This complex interplay of beetles within ecosystems underscores their dual role as potential pests and indispensable contributors to ecological balance. Understanding these intricate relationships is crucial for appreciating the broader ecological significance of Coleoptera in maintaining the health and equilibrium of various ecosystems.

Studying beetle communities in specific habitats or restricted areas, such as oceanic islands, provides valuable insights into their biodiversity. Comprehensive species lists offer current assessments of ecosystem health and facilitate comparisons with historical data, enabling monitoring changes over time (Howden & Howden 2001). Mindanao, the second-largest island in the Philippines, contains various protected sanctuaries and is recognized as an important hotspot for biodiversity and a center for endemism. However, little is known about the diversity of Coleoptera, particularly in the Caraga region.

The Andanan Watershed Forest Reserve, located in Sibagat and Bayugan, Agusan del Sur, is home to a diverse range of endemic entomofauna across different habitat types (Domine & dela Cruz 2020, Guerzon et al. 2023, Sabuero et al. 2024). However, there is a lack of information on other entomofaunal records, particularly beetles, despite their potential value in forest management and conservation. The results of this study may provide significant insights, such as compiling a checklist of various taxa useful for monitoring coleopteran diversity, establishing a baseline for future research, and contributing to management practices aimed at protecting and conserving this insect group present in the Andanan Watershed Forest Reserve.

2 Materials and Methods

This study follows the entomofaunal survey (Domine & dela Cruz 2020, Guerzon et al. 2023, Sabuero et al. 2024) conducted in the Andanan Watershed Forest Reserve (AWFR) from the following dates: July 13–14; August 24–25; September 21–22 and 28–29, 2019. The collection adhered to the legal requirements outlined in R.A 9147, the Wildlife Resources Conservation and Protection Act, with a Gratuitous Permit (R13-2021-32) from the Protected Area Management Board of the DENR Caraga Region. A preliminary survey, documented through digital media and GPS coordinates, was conducted before the actual fieldwork. The collection is limited to terrestrial and above-ground habitats. Collection methods include opportunistic searching using hand and net-based techniques such as sweep-netting and beating. Collected specimens were initially sorted. A killing jar with phenol was used for large-sized specimens, while small beetles were placed into vials with 85% ethanol. Specimens were relaxed using phenol, then pinned and photo-documented. Coleopterists and other colleague experts validated identifications.

3 Results and Discussion

The Andanan Watershed Forest Reserve (AWFR) (Fig. 1) spans the provinces of Bayugan and Sibagat in Agusan del Sur. The watershed comprises both cultivated and secondary-growth forests, supporting a diverse array of flora and fauna. Three different collections sites were explored: Calaitan (8.7927°N, 125.7789°E), Berseba (8.8552°N, 125.8007°E), and Santo Niño (8.8451°N, 125.7871°E). No collections were conducted within the primary forest of the AWFR, as the secondary forest was more accessible during the sampling period. Beetle fauna were collected in riparian and lowland ecosystems, featuring mixed agricultural vegetation and patches of remaining secondary forests. Cultivated plantations of falcata (*Paraserianthes falcataria*), coconut trees (*Cocos nucifera*), corn (*Zea mays*), banana (*Musa paradisiaca*), cassava (*Manihot esculenta*), and various other root crops were observed in several areas, mostly upland. Fruit-bearing trees such as lanzones (*Lansium parasiticum)* and durian (*Durio zibethinus*) were also noted. Riparian zones, known for their high plant diversity and productivity, provide abundant habitats for animals. The canopy and shade from forest trees contribute to maintaining the pristine quality of water and supporting other vegetation growth (Cayasan et al. 2013).

A total of 45 genera of beetles were recorded in Andanan Watershed Forest Reserve. The majority of the composition belongs to the superfamilies Chrysomeloidea and Curculionoidea, which consist primarily of phytophagous beetles that depend heavily on plants and vegetation. Among the recorded groups, scarab beetles (Scarabaeidae: 11 species) had the highest species count, followed by longhorn beetles (Cerambycidae: 8), weevils (Curculionidae: 7), leaf-beetles (Chrysomelidae: 5), tiger beetles (Cicindelidae: 4) and click beetles (Elateridae: 4). The groups with the fewest species collected were Carabidae, Lucanidae, Coccinellidae, Cantharidae, Prionoceridae, Endomychidae, Lampyridae, Lycidae, Passalidae and Meloidae (Table. 1).

Coleopteran Fauna in Andanan Watershed Forest Reserve

Eight superfamilies (Tables 1 and 2) of beetles were identified in Andanan Watershed Forest Reserve, including the most diverse Chrysomeloidea (25%) and Curculionoidea (13.46%). Scarabaeoidea (26.92%) and

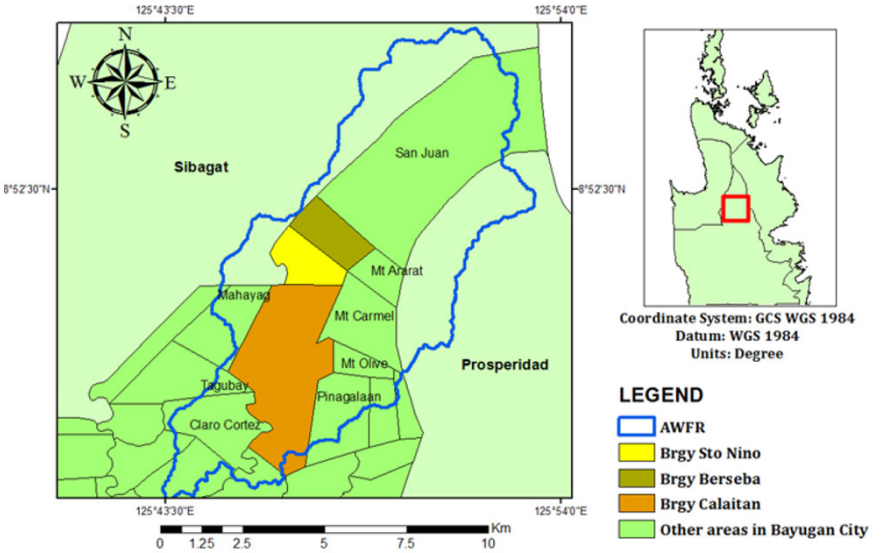

Figure 1. Location map showing the Andanan Watershed Forest Reserve (blue line) and the three collection sites of the study (Calaitan, Berseba, and Sto. Niño).

Table 1. Percent diversity of superfamilies and number of species from different family groups of beetles found in Andanan Watershed Forest Reserve.

Superfamily (% Diversity)	Family (Number of Species)
Caraboidea (9.62%)	Cicindelidae (4) Carabidae (1)
Chrysomeloidea (25%)	Cerambycidae (8) Chrysomelidae (5)
Cleroidea (1.92%)	Prionoceridae (1)
Cucujoidea (5.77%)	Coccinellidae (2) Endomychidae (1)
Curculionoidea (13.46%)	Curculionidae (7)
Elateroidea (15.38%)	Cantharidae (2) Elateridae (4) Lampyridae (1) Lycidae (1)
Scarabaeoidea (26.92%)	Lucanidae (2) Passalidae (1) Scarabaeidae (11)
Tenebrionoidea (1.92%)	Meloidae (1)

Caraboidea (9.62%) were also observed, along with representatives of Elateroidea (15.38%), Cucujoidea (5.77%), Cleroidea (1.92%), and Tenebrionoidea (1.92%) (Table 1).

Ground beetles from the family Carabidae are the only adephagan beetles found in Andanan Watershed Forest Reserve, represented by two subfamilies – Cicindelinae, commonly referred to as tiger beetles, noted for their aggressive predatory behavior and speed, and the genus *Chlaenius* (Fig. 2E) of subfamily Licininae. Three genera of tiger beetles were identified: *Calomera* (Fig. 2D), *Therates* (Figs 2A, 2B) and *Tricondyla* (Fig. 2C). *Tricondyla aptera* (Fig. 2C) is native to the Indo-Australian archipelago (Trautner & Schwaller 1994), as are most species of *Therates* (Figs 2A, 2B) (Santos 2014, Cabras et al. 2016). Additionally, species like *Calomera mindanaoensis* (Fig. 2D) are endemic to Mindanao island (Cassola 2011).

Several groups from the large families of Chrysomeloidea were recorded, including Cerambycidae (longhorn beetles) and Chrysomelidae (leaf beetles). Longhorn beetles were generally observed in woodlands, camouflaging against tree bark, while some species are known to mimic chrysomelids. Seven genera were identified: *Astathes* (Fig. 3H), *Choeromorpha* (Fig. 3G), *Glenea* (Fig. 3A), *Eustathes* (Fig. 3I), *Epepeotes* (Figs 3B, 3D), *Prosoplus* (Fig. 3E), and *Pterolophia* (Fig. 3F), which are also found in other regions of the Indo-Australian Archipelago (Vives 2015, Chemin 2011, Saha et al. 2013). Chrysomelid leaf beetles are closely associated with flowering plants, as they are primarily angiosperm feeders. In Andanan Watershed Forest Reserve, two subfamilies were identified – Cassidinae and Galerucinae. Cassidinae, commonly known as tortoise beetles, were represented by the genus *Aspidimorpha* (Fig. 4A). Meanwhile, Galerucinae was identified with three genera: *Aplosonyx* (Figs 4B, 4E), *Cassena* (Fig. 4D) and *Coeligetes* (Fig. 4C).

Families Coccinellidae and Endomychidae, belonging to the superfamily Cucujoidea, were found in the area. Coccinelid beetles, or ladybirds, were represented by two genera – *Coccinella* (Fig. 4G) and *Henosepilachna* (Fig. 4H) – noted for their predatory ability against aphids. Endomychidae, typically associated with feeding on fungal matter, was represented by the genus *Indalmus* (Fig. 4F). This genus was also included in the study of Shockley et al. (2009), which examined its distribution across various parts of Asia, including the Philippines.

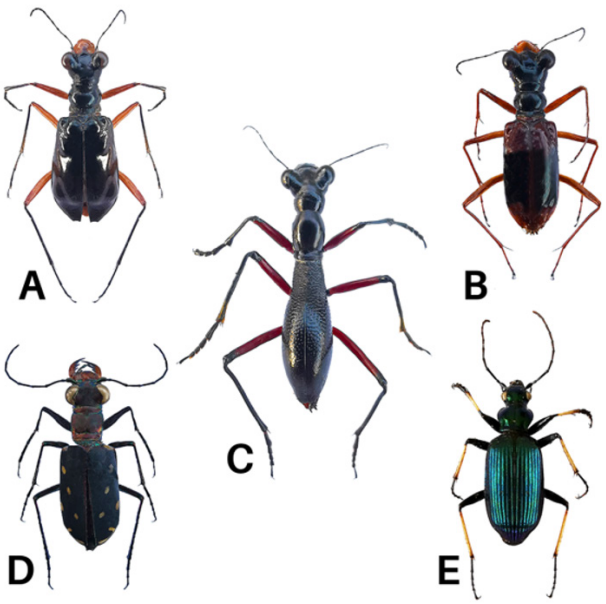

Figure 2. Tiger beetles [Cicindelidae] (A) *Therates coracinus*; (B) *Therates fulvipennis*; (C) *Tricondyla aptera*; (D) *Calomera mindanaoensis*; and a ground beetle [Carabidae] (E) *Chlaenius* sp.

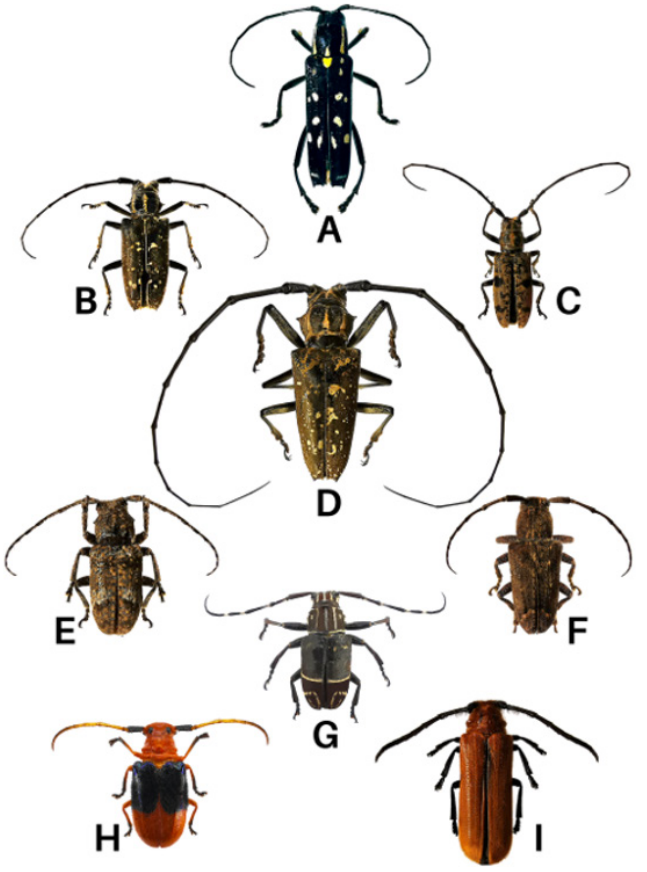

Figure 3. Longhorn beetles [Cerambycidae] (A) *Glenea beatrix*; (B) *Epepeotes desertus* ♀; (C) *Epepeotes plorator*; (D) *Epepeotes desertus* ♂; (E) *Prosoplus bankii;* (F) *Pterolophia jacta*; (G) *Choeromorpha mystica*; (H) *Astathes levis*; and (I) *Eustathes flava*.

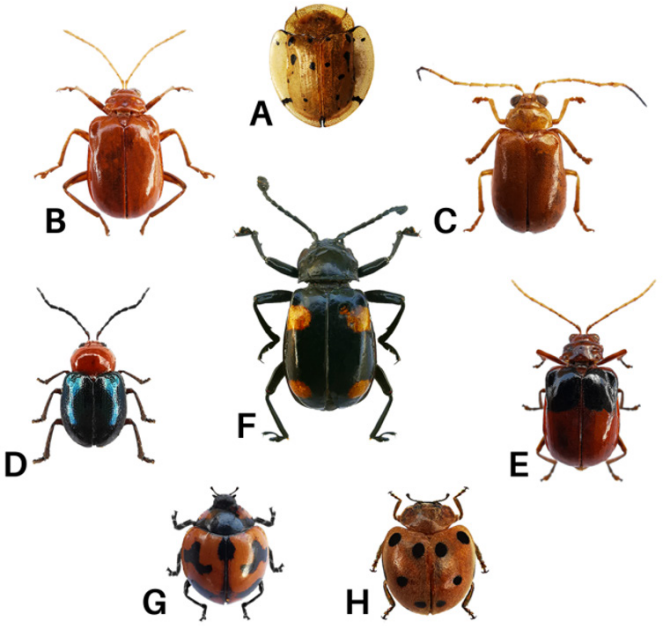

Figure 4. Leaf beetles [Chrysomelidae] (A) *Aspidimorpha miliaris*; (B) *Aplosonyx* sp. 1; (C) *Coeligetes* sp.; (D) *Cassena* sp.; (E) *Aplosonyx* sp. 2, a fungus beetle [Endomychidae]; (F) *Indalmus* sp., and ladybird beetles [Coccinellidae]; (G) *Cocinella transversalis*; (H) *Henosepilachna* sp.

Curculionoidea, one of the most megadiverse superfamilies, was represented by three subfamilies in the Andanan Watershed Forest Reserve: Dryophthorinae, Entiminae, and Molytinae. Members of the genus *Rhynchophorus* (Figs 5E, 5F) (palm weevils) from Dryophthorinae have been reported as a major pest affecting sago palms in Agusan del Sur, Mindanao (Abad 1983). Species from the genera *Calidiopsis* (Fig. 5A) and *Metapocyrtus* (Figs 5B, 5C) (Entiminae) are known for their diversity and endemism in Mindanao (Ballentes et al. 2006, Yap & Gapud 2007). Additionally, representatives of Molytinae, including the genera *Aclees* (Fig. 5G) and *Merus* (Fig. 5D), were also observed.

Four families of Elateroidea were identified in Andanan Watershed Forest Reserve: Cantharidae (soldier beetles), Elateridae (click beetles), Lampyridae (fireflies), and Lycidae (net-winged or trilobite beetles). The cantharid soldier beetles *Paradiscodon* (Fig. 6A) and *Cordylocera* (Fig. 6B) were previously reported in Borneo and other parts of the Oriental region (Aoki & Harada 1982, Geiser 2013), and their presence here may represent the first records in the Philippine archipelago. Similarly, *Lanelater* (Figs 6C, 6D) and *Paracalais* (Fig. 6F), two genera of click beetles, were recorded for the first time on Mindanao island. Also, a large and relatively common species, *Oxynopterus mucronatus* (Fig. 6E), was observed. A firefly from the genus *Vesta* (Fig. 6I), distributed in Taiwan and Continental China (Jeng et al. 2007), was collected as well. The larviform stage of a female lycid beetle *Platerodrilus* (Fig. 6H) was documented. Moreover, a single genus of Prionoceridae from Cleroidea, *Prionocerus* (Fig. 6J), was found and distributed throughout the Oriental Region.

In the superfamily Scarabaeoidea, three families were identified: Lucanidae (stag beetles), Passalidae (bess beetles), and Scarabaeidae (scarab beetles). Stag beetles from the genera *Prosopocoilus* (Fig. 7E) and *Odontolabis* (Fig. 7F), as well as *Leptaulax* (Fig. 7G) of the family Passalidae, were recorded. A study by Cruz et al. (2007) highlighted that these stag beetles are considered wildlife hotspots in southern Palawan and are vulnerable to illegal trade. Additionally, Iwase (1996) described several species of *Leptaulax* collected from various regions in the Philippines, including Mindoro, Ifugao, Negros and Mindanao.

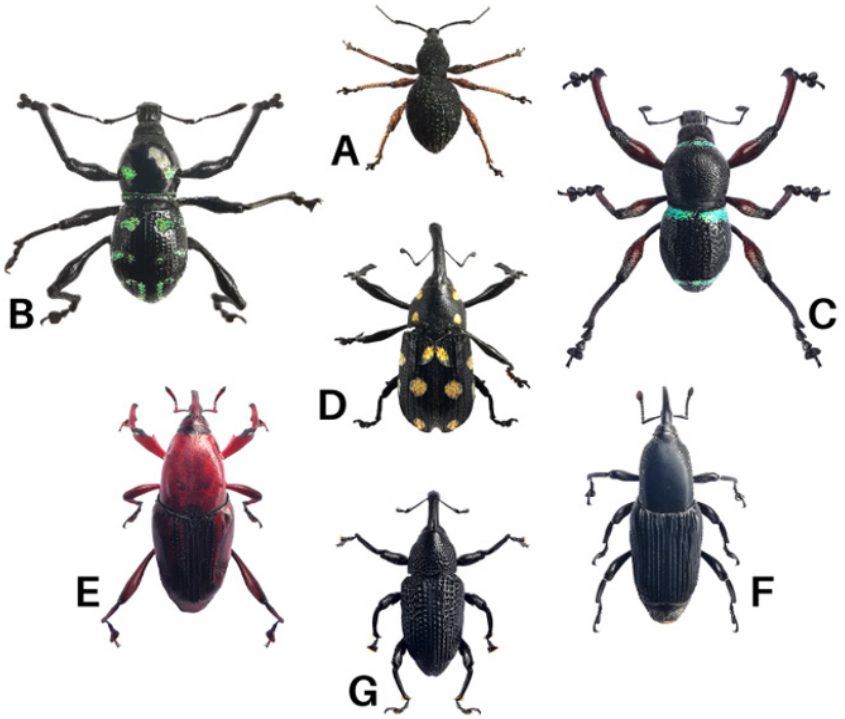

Figure 5. Weevils [Curculionidae] (A) *Calidiopsis* sp.; (B) *Metapocyrtus* sp. 1; (C) *Metapocyrtus* sp. 2; (D) *Merus* sp.; (E) *Rhynchophorus* sp. 1; (F) *Rhynchophorus* sp. 2; and (G) *Aclees hirayamai.*

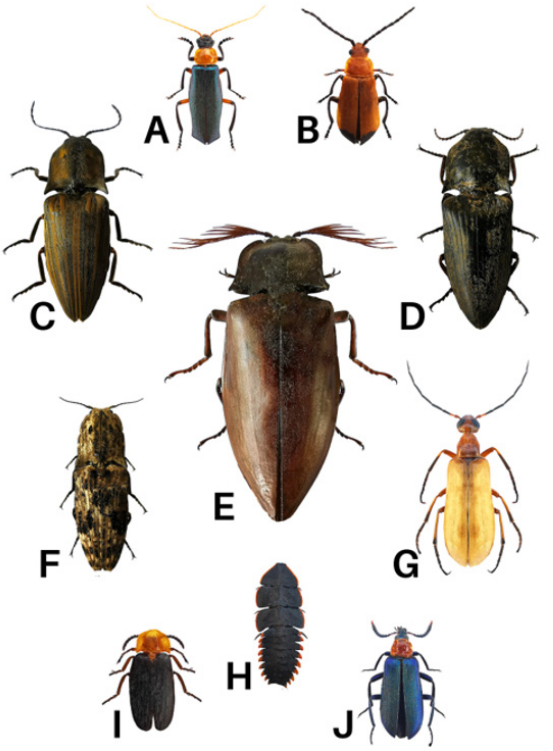

Figure 6. Soldier beetles [Cantharidae] (A) *Paradiscodon* sp.; (B) *Cordylocera atricornis*, click beetles [Elateridae]; (C) *Lanelater* sp. 1; (D) *Lanelater* sp. 2; (E) *Oxynopterus mucronatus*; (F) *Paracalais* sp., a blister beetle [Meloidae]; (G) *Zonitoschema* sp., a trilobite beetle [Lycidae]; (H) *Platerodrilus ruficollis* ♀, a firefly [Lampyridae]; (I) *Vesta* sp., and a small cleroid beetle [Prionoceridae]; (J) *Prionocerus coeruleipennis*.

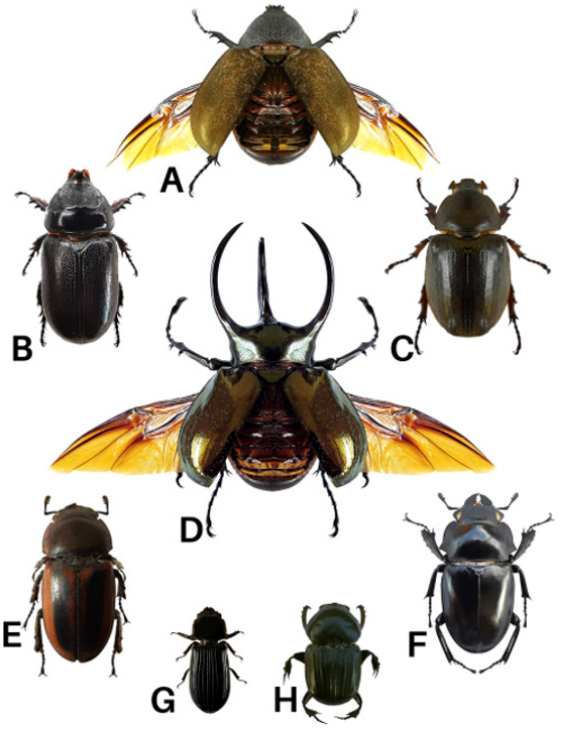

Figure 7. Rhinoceros beetles [Scarabaeidae] (A) *Chalcosoma atlas* ♀; (B) *Oryctes rhinocerus*, (C) *Xylotrupes pubescens*; (D) *Chalcosoma atlas* ♂, stag beetles [Lucanidae]; (E) *Prosopocoilus zebra*; (F) *Odontolabis* sp., a bess beetle [Passalidae]; (G) *Leptaulax* sp., and a dung beetle [Scarabaeidae]; (H) *Onitis falcatus*.

Scarabaeidae, the most diverse group within Scarabaeoidea, included eleven genera across five subfamilies. Among these, *Protaetia* (Fig. 8D) from Cetoniinae and the rhinoceros beetles from the genus *Chalcosoma* (Figs 7A, 7D), *Oryctes* (Fig. 7B), and *Xylotrupes* (Fig. 7C) were identified. Both male and female specimens of *Chalcosoma atlas* (Figs 7A, 7D) were collected in Andanan Watershed Forest Reserve. This large species, known for the prominent horns of the males, is common in Mindanao, with previous records from Mt. Apo (Kawano 1995). Several studies have reported significant damage to palm trees caused by *Oryctes* in Southeast Asia, particularly in the Philippines (Hinckley 1973, Zelazny & Alfiler 1987, Winotai 2014).

The subfamily Melolonthinae, commonly known as June beetles, includes three genera: *Engertia* (Fig. 8F), *Leucopholis* (Fig. 8G) and *Philacelota* (Fig. 8E). *Engertia lii* (Fig. 8F) and *Philacelota leucothea* (Fig. 8E) were first described in the Philippines by Keith (2006) and Prokofiev (2019), respectively, while *Leucopholis* species are widespread and notorious for causing damage to crops in the Philippines (Calcetas & Adorada 2017). Dung beetle *Onitis* (Fig. 7H) from the subfamily Scarabaeinae, which are entirely coprophagous, have distributions extending beyond Africa into the Palearctic and Oriental regions (Gupta et al. 2015). According to Cheung et al. (2018), *O. falcatus* (Fig. 7H) is the only dung beetle species found in the Philippines and was likely collected in this study area. Rutelinae, commonly called leaf chafers, were also recorded, with two genera represented: *Adoretus* (Fig. 8A) and *Anomala* (Figs 8B, 8C). Lastly, a single species of blister beetle from the family Meloidae, *Zonitoschema* (Fig. 6G), was also collected. In a 1982 paper by Mohamedsaid, four species of this genus were documented in Malaysia, suggesting that this might be the first record of this group in the Philippines.

According to Bouchard et al. (2017), among the six megadiverse families of beetles, five were collected in Andanan Watershed Forest Reserve – Curculionidae, Carabidae, Chrysomelidae, Cerambycidae and Scarabaeidae. However, the family Staphylinidae (rove beetles) was not reported during the expedition due to the unsuitable collection methods used. Rove beetles and other members of Staphyliniformia are relatively small

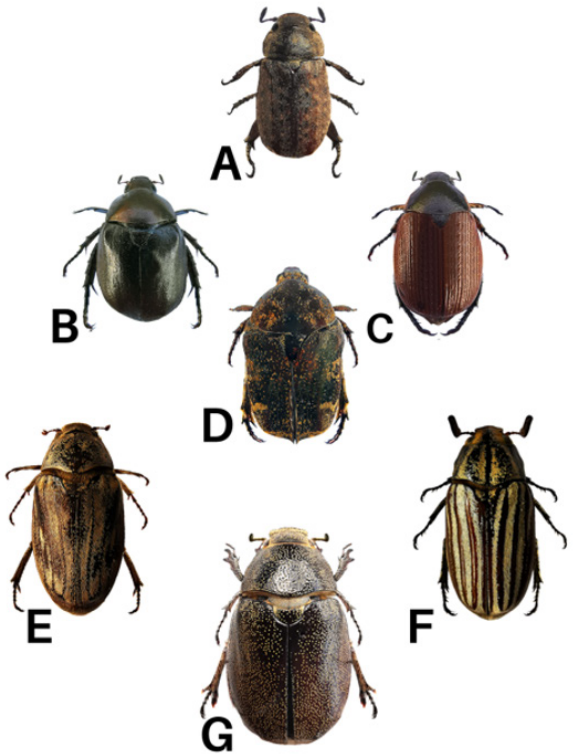

Figure 8. Leaf chafers [Scarabaeidae] (A) *Adoretus* sp.; (B) *Anomala* sp. 1; (C) *Anomala* sp. 2, a flower chafer [Scarabaeidae]; (D) *Protaetia fusca*, and scarab beetles [Scarabaeidae]; (E) *Philacelota leucothea*; (F) *Engertia lii*; (G) *Leucopholis* sp.

Table 2. Inventory checklist of beetles (Coleoptera) collected in Andanan Watershed Forest Reserve, showing various species from different taxa groups.

Suborder	Superfamily	Family	Subfamily	Genus	Species
Adephaga	Caraboidea	Cicindelidae	Cicindelinae	*Calomera* Motschulsky, 1862	*C. mindanaoensis* Cassola, 2000
				Therates Latreille, 1816	*T. coracinus* Erichson, 1834
				Tricondyla Latreille, 1822	*T. fulvipennis* Bates, 1878
		Carabidae			*T. aptera* Chevrolat, 1841
			Licininae	*Chlaenius* Bonelli, 1810	*Chlaenius* sp.
Polyphaga	Chrysomeloidea	Cerambycidae	Lamiinae	*Astathes* Newman, 1842	*A. levis* Newman, 1842
				Choeromorpha Chevrolat, 1849	*C. mystica* Pascoe, 1869
				Glenea Newman, 1842	*G. beatrix* Thomson, 1879
				Epepeotes Pascoe, 1866	*E. desertus* Linnaeus, 1758
				Eustathes Newman, 1842	*E. plorator* Newman, 1842
				Prosoplus Blanchard, 1853	*E. flava* Newman, 1842
				Pterolophia Newman, 1842	*P. bankii* Fabricius, 1775
					P. jacta Newman, 1842
		Chrysomelidae	Cassidinae	*Aspidimorpha* Hope, 1840	*A. miliaris* Fabricius, 1775
			Galerucinae	*Aplosonyx* Chevrolat, 1837	*Aplosonyx* sp. 1
				Cassena Weise, 1892	*Aplosonyx* sp. 2
				Coeligetes Jacoby, 1884	*Cassena* sp.
					Coeligetes sp.
	Cleroidea	Prionoceridae	Prionoceridae	*Prionocerus* Perty, 1831	*P. coeruleipennis* Perty. 1831
	Cucujoidea	Coccinellidae	Coccinellinae	*Coccinella* Linnaeus, 1758	*C. transversalis* Fabricius, 1781
				Henosepilachna Li, 1961	*Henosepilachna* sp.
		Endomychidae	Lycoperdininae	*Indalmus* Gerstaecker, 1858	*Indalmus* sp.
	Curculionoidea	Curculionidae	Dryophthorinae	*Rhynchophorus* Herbst, 1795	*Rhynchophorus* sp. 1
					Rhynchophorus sp. 2
			Entiminae	*Calidiopsis* Heller, 1913	*Calidiopsis* sp.
				Metapocyrtus Heller, 1912	*Metapocyrtus* sp. 1
					Metapocyrtus sp. 2
			Molytinae	*Aclees* Schönherr, 1833	*A. hirayamai* Kono, 1933
				Merus Gistel, 1857	*Merus* sp.
	Elateroidea	Cantharidae	Silinae	*Cordylocera* Guerin-Meneville, 1830	*C. atricornis* Guerin-Meneville, 1838
				Paradiscodon Wittmer, 1954	*Paradiscodon* sp.
		Elateridae	Agrypninae	*Lanelater* Arnett, 1952	*Lanelater* sp. 1
				Paracalais Neboiss, 1967	*Lanelater* sp. 2
					Paracalais sp.
			Oxynopterinae	*Oxynopterus* Hope, 1842	*O. mucronatus* Olivier, 1792
		Lampyridae	Amydetinae	*Vesta* de Castelnau, 1833	*Vesta* sp.
		Lycidae	Leptolycinae	*Platerodrilus* Pic, 1921	*P. ruficollis* Pic, 1942
	Scarabaeoidea	Lucanidae	Lucaninae	*Prosopocoilus* Westwood, 1845	*P. zebra* Olivier, 1789
				Odontolabis Hope, 1842	*Odontolabis* sp.
		Passalidae	Passalinae	*Leptaulax* Kaup, 1868	*Leptaulax* sp.
		Scarabaeidae	Cetoniinae	*Protaetia* Burmeister, 1842	*P. fusca* Herbst, 1790
			Dynastinae	*Chalcosoma* Hope, 1837	*C. atlas* Linnaeus, 1758
				Oryctes Hellwig, 1798	*O. rhinoceros* Linnaeus, 1758
				Xylotrupes Hope, 1837	*X. pubescens* Waterhouse, 1841
			Melolonthinae	*Engertia* Dalla Torre, 1913	*E. lii* Keith, 2006
				Leucopholis Dejean, 1833	*Leucopholis* sp.
				Philacelota Heller, 1900	*P. leucothea* Prokofiev, 2019
			Scarabaeinae	*Onitis* Fabricius, 1798	*Onitis falcatus* Wulfen, 1786
			Rutelinae	*Adoretus* Laporte, 1840	*Adoretus* sp.
				Anomala Samouelle, 1819	*Anomala* sp. 1
					Anomala sp. 2
	Tenebrionoidea	Meloidae	Nemognathinae	*Zonitoschema* Peringuey, 1909	*Zonitoschema* sp.

in size, mycophagous, saprophagous, algal feeders, and even predators of smaller insects, typically inhabiting heterotrophic niches. Despite this, plant-feeding beetles, such as weevils, leaf beetles, and longhorn beetles, were frequently observed. These groups, closely associated with flowering plants, demonstrate a remarkable diversity driven by this ecological relationship (Bouchard et al. 2017). Another diverse family collected were the scarab beetles, most of which are phytophagous,

relying on plants and plant structures for feeding. Several scarab species, particularly dung beetles, are saprophagous, feeding on decaying organic matter.

Scarab beetles were the largest specimens found among the collected beetles, particularly the atlas beetle *Chalcosoma atlas,* a common species in which both male and female individuals were collected. Other large specimens include members of the subfamily Dynastinae and family Lucanidae (stag beetles). A large elaterid beetle, *Oxynopterus mucronatus,* was also documented. However, smaller-sized beetle groups were not well represented due to the collection methods being biased towards more extensive, more conspicuous individuals, with a primary reliance on sweep net collection.

Most beetles found in Andanan Watershed Forest Reserve are native to the Oriental region or endemic to the Philippine archipelago. Some species are newly described or recently reported in the Philippines, such as the tiger beetle *Calomera mindanaoensis,* described in 2000 and endemic to Mindanao, and the scarab beetles *Engertia lii* (described in 2006) and *Philacelota leucothea* (discovered in 2019), both believed to be endemic to the Philippines. While all collected specimens were identified to the generic level, almost 50% remain unidentified at the species level, particularly among the weevils and leaf beetles.

The landscape and structure of the stream ecosystem play a crucial role in shaping the beetle diversity in Andanan Watershed Forest Reserve. This diversity may be influenced by the area's riparian forest, consisting of forest patches, moist ground, thick layers of leaf litter, and lowland areas, including agricultural lands. Beetles in the reserve display a wide range of habitat preferences (Banerjee, 2014), suggesting that they have developed ecological and biological adaptations suited to varying habitats and diets. Additionally, beetles are known to thrive in almost every type of habitat, with their diversity being particularly pronounced in tropical regions. It is also worth mentioning that Varela and Degamo (2016) reported several species of aquatic beetles in the nearby Agusan Marsh, possibly found also in the aquatic habitats of the Andanan Watershed.

4 Conclusion and Recommendations

Megadiverse phytophagous beetles have shown a significant number in Andanan Watershed Forest Reserve, such as weevils, leaf beetles, longhorn beetles, and scarab beetles, exhibiting that the vegetation structure of the area's riparian forest establishes a hospitable matrix for this beetle fauna. The island of Mindanao houses both mountainous regions and sanctuaries that are considered an essential hotspot for the biodiversity of endemic flora and fauna, while other forests are still not fully explored yet, possibly leading to new species and more new records of other insect fauna in the region.

This preliminary study focuses on the checklist of coleopteran fauna using basic and limited collection resources. Thus, it is recommended that other collecting techniques, such as several trapping collections (Malaise, light, flight-intercept, pitfall, and bait), be utilized to improve the assessment of beetle biodiversity in the area. The study also suggests conducting a survey and collection within the primary forest.

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Statement of Conflict of Interest

The authors declare no conflict of interest associated with the submission and publication of this manuscript.

Author Contribution

MCC Gultiano contributed to the collection of specimen materials from the field and the initial drafting of the manuscript. NAR Burias assisted in processing the materials through imaging and helped in reviewing and editing the manuscript. INB dela Cruz led the conceptualization of the study, and provided overall supervision, including collection of materials and revision of the paper.

All authors approved the final version of the manuscript.

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