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Species Occurrence of Weevils in the Northern Part of Mt. Malindang Range Natural Park, Philippines

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Abstract

Weevils are small beetles with long, narrow snouts which is a characteristic of insects belonging to the Curculionidae family. A study on the species composition of weevils was conducted in the northern part of Mt. Malindang Range Natural Park last February 2023. Field investigations were done using a combination of transect walk and opportunistic sampling. A total of 195 individuals of weevils were recorded, comprising seventeen (17) species belonging to two (2) genera-*Metapocyrtus* and *Alcidodes*. *Metapocyrtus malindangensis* was observed in all sampling sites. Site 1 (Gandawan) had the highest species richness (N=13), and the highest species diversity (H'=2.016) was recorded in Site 2 (Lake Duminagat). Cluster analysis showed that weevil species in Lake Duminagat and Uluhan sa Dapitan have closer similarities. The study also recorded unidentified specimens that are potentially new to science. It is highly recommended that more explorations should be conducted to record the species occurrence of weevils in other parts of Mt. Malindang.

Keywords: Curculionidae, endemic, *Metapocyrtus*, opportunistic

Introduction

In terms of species richness and abundance, insects have achieved remarkable success. Since they are good dispersers and exploiters of almost all forms of organic matter, insects make up the largest group of organisms on Earth, accounting for roughly 66% of all animal species. They are essential to our food chains and form an important part of every ecosystem, providing valuable ecosystem services (Jankielsohn, 2018). Around 72% of the world's crops are dependent on insects for pollination (Dicke, 2017). There are 39 insect orders, with the most speciose group represented by the Beetles (Order: Coleoptera). With an estimated 1.5 million species, beetles make up about 40% of all known arthropod species. The Jurassic origin of many current lineages, high lineage survival, and diversification into a wide range of niches, including the use of all portions of plants, are the reasons behind the abundance of beetle species. (Stork et al., 2015).

Meanwhile, weevils are small beetles with long, narrow snouts which is a characteristic of insects belonging to the Curculionidae family. Many species of weevils are known to be agricultural and household pests. They are found on crops, plants, or in stored cereal grains around 40,000 species; Curculionidae is one of the largest coleopteran families. Most weevils have long, clearly elbowed antennae that can fold into distinct grooves on the snout. Weevils dead or various defense mechanisms against predators, such as camouflage, playing dead, or producing noxious chemicals. Overall, weevils have evolved a range of behaviors to adapt to their environments and maximize their chances of survival and reproduction. Weevils are one variety of tiny beetles. A small, multi-colored body and a large snout distinguish them. Hundreds of thousands of different types of weevils exist (Kunde, 2024). Despite their small size, plant beetles have a significant impact on the wider ecosystem. As plant pests, pollinators, and seed dispersers, they play an important role in plant reproduction and nutrient cycling, emphasizing their ecological importance. It is used as a bioindicator because it is very sensitive to changes in its conditions (Akmaljon & Fotima, 2024). Common documented threats to weevils are agricultural activities

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extending to forested areas, tourism, illegal logging, agri-development, and road construction (Patano, 2023).

With more than 7,100 islands, the Philippines is the second largest archipelago in the world (Ambal et al., 2012) and a megadiverse country (Mittermeier et al., 1998) with exceptionally high weevil species richness and endemism (Ballentes et al., 2006; Barsevskis, 2016). Weevils are small beetles that can be found worldwide. They can frequently be spotted chewing away at plant stems and leaves, and they are notorious for their destructive tendencies. Currently, there are more than 51,000 species of weevils in 4,600 genera of which Philippines contributes more than 400 species (Oberprieler et al., 2007). Recently, more discoveries were published by Filipino taxonomists and systematists, specifically from the genera *Pachyrhynchus* and *Metapocyrtus* (Cabras et al., 2021; Cabras et al., 2023; Cabras et al., 2024). The Philippine endemic weevils in the genus *Metapocyrtus* Heller, 1912 belonging to the tribe Pachyrhynchini, are recognized for their beautiful iridescent markings and are amongst the most well-studied beetle taxon in the Philippines (Cabras et al., 2021).

Mindanao is the second largest island in the Philippines and houses various mountains including Mt. Malindang Range Natural Park (MMRNP) which is poorly studied with the possibility of hoarding new species (Cabras et al., 2022). Malindang Range Natural Park (MMRNP) in Mindanao Island, Philippines, is identified as one of the key biodiversity areas in the Philippines and priority areas for conservation due to its rich biological resources [Ong et al., (2002), Ambal et al. (2012), DENR-BMB, (2016) and DENR, (2022)]. Surveys on arthropods in MMRNP collected 41 undescribed species of Curculionidae, all of which are likely to be endemic in Mindanao.

Although some surveys have been already conducted, there have been no available live photographs of the weevil species in its natural habitat and its description. In addition, no records of its host plants were available, which is very important for its survival. Thus, this study was done to assess the biodiversity of weevils in the northern portion of Mt. Malindang, specifically to determine their species composition, diversity, and description of species.

Materials and methods

Sampling Site

Sampling was conducted on February 2023 in the agroforested and montane forests of the northern portion of Mt. Malindang were surveyed. Mt Malindang Range Natural Park (MMRNP) straddles the province of Misamis Occidental and has a total area of 53,268 hectares (Figure. 1). The strict protection zone covers an area of 34,694, and the buffer zone is 18,334 hectares. The Park covers most of the areas above 800 m in the Mt Malindang range of eastern Mindanao, which rises to 2,404 m. The terrain is steep, rugged, and forested. Its rivers run radially out from the mountains, and a high proportion of the water in many of the major catchments in the region comes from the Park. The sites were selected due to the intact forest and vegetation, a favorable habitat for weevils. Disturbances were observed in the area, such as agricultural land development, timber poaching activity and deforestation.

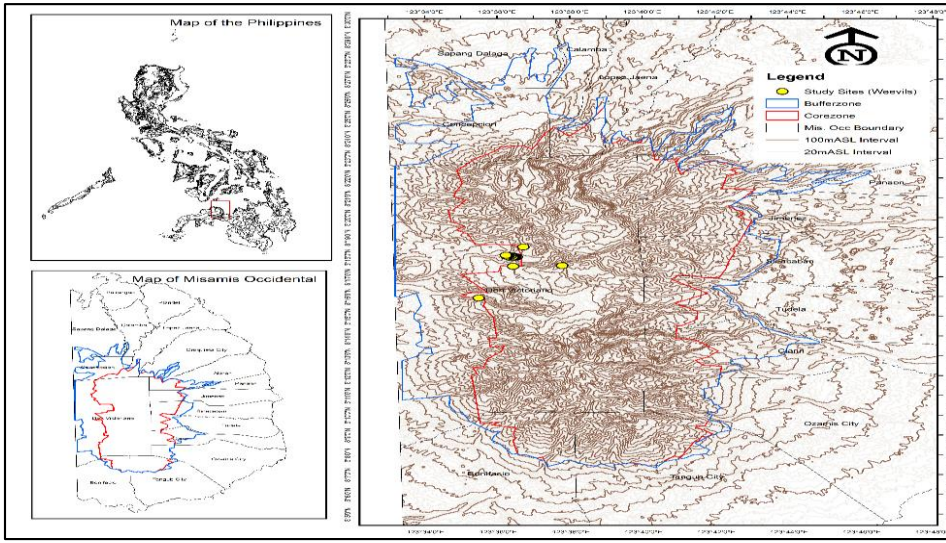

Figure 1. Map of the Philippines and Misamis Occidental showing the location of the study sites in Mt. Malindang Range Natural Park.

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Site 1 (Figure 2A) is located in Brgy. Gandawan has a total area of 1.019 sq. km or 101.9 has. The surrounding mountains have peaks of 1,635m, 1,716 m, and 1,678 m with an averaging slope of 33 degrees. (Hansel et. Al, 2004). Its vegetation is dominated by *Casuarina* and *Igem* species.

Site 2 (Figure 2B) is located in Brgy. Lake Duminagat. Approximately at Latitude 8°18'N and longitude of 123°37'E, with an altitude of approximately 1560 meters above sea level (masl). Ferns, liverworts, mosses, and epiphytes are abundant. The forest floor, along with the tree trunk and branches, were densely covered in moss. *Podocarpus, Dacrycarpus, Engelbartia, Myrica, and Syzigium* are spotted in this area (Villantes et al., 2024).

Site 3 (Figure 2C) is located in Uluhan sa Dapitan (8°18'26.3" N and 123°37'18.7" E), and it has an elevation between 1,200 and 1,780 masl. These montane woods are home to a diverse range of mosses, lichens, and epiphytes. Massive, straight-trunked, evergreen trees, including *Podocarpus* and *Casuarina*, are abundant. *Clethra lancifolia* Turcz., *Impatiens montalbanica* Hook.f., pitcher plants, and rattan were also observed (Villantes et al., 2024).

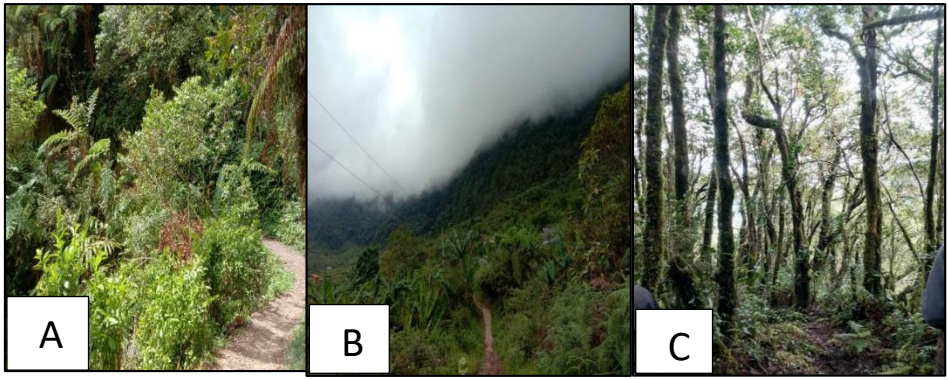

Figure 2. Sampling sites in Mt. Malindang Range Natural Park, A.) Gandawan B.) Lake Duminagat C.) Uluhan sa Dapitan

Sampling, Processing of Samples and Identification

The collection was done on flowering plants, ferns and shrubs using handpicking technique through a combination of transect walks and opportunistic sampling in Gandawan, Lake Duminagat, and Uluhan sa Dapitan. Specimens were collected and stored in the micro-centrifuge with naphthalene to preserve and maintain the colors. Morphological characters were observed under a stereo microscope and taken images using an Android phone camera with a microlens. Photographs and identifications were taken at Misamis University's Natural Science Laboratory. Plant associates of each species were photographed and identified by a forester. Notable behaviors and activities for each species were also seen and reported. Collected samples were identified based on the published articles, taxonomic keys, and monographs of Schultze (1923), Yoshitake (2012b), Rukmane and Barsevskis (2016), and Cabras et al. 2022.

Entry Protocol

Prior to collection, collecting permits were obtained from the Department of Environment and Natural Resources for the Gratuitous Permit no. RIO 2022-42 in compliance with Republic Act No. 9147 for the collection of specimens inside the protected area.

Statistical analysis

Biodiversity indices were determined using Paleontological Statistics (PAST) software and Bray-Curtis cluster analysis of weevil species was determined using BioDiversity PRO software version 2.0.

Results and Discussion

A total of 195 individuals of weevils were recorded. Specimens were located copulating, feeding, mating, and hiding in some parts of the plant leaves and branches in the three sampling sites. Seventeen (17)

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species belonging to two (2) genera,*Metapocyrtus* and *Alcidodes*, were recorded. *Alcidodes sp*. has one (1) species while *Metapocyrtus sp.* has sixteen (16) species. *Metapocyrtus malindangensis* was the most abundant species and was recorded in all sampling sites. Only one (1) individual was collected on *Alcidodes* sp. and was only observed in site 1 (Table 1).

Table 1. Species composition of weevils in the northern part of Mt. Malindang Range Natural Park.

	Sampling Site				
Species Name	**Gandawan**	**Lake Duminagat**	**Uluhan sa Dapitan**	**Total**	**Percentage (%)**
Alcidodes sp. 1	1			1	0.51
Metapocyrtus sp. 1			1	1	0.51
Metapocyrtus sp. 2		1		1	0.51
Metapocyrtus sp. 3		1		1	0.51
Metapocyrtus sp. 4	2	1		3	1.53
Metapocyrtus sp. 5	1	1		2	1.03
Metapocyrtus sp. 6	1	1		2	1.03
Metapocyrtus sp. 7		1		1	0.51
Metapocyrtus sp. 8	5	3		8	4.1
Metapocyrtus malindangensis 9	109	4	2	115	58.97
Metapocyrtus sp.10	19	7	1	27	13.85
Metapocyrtus sp. 11	11	3		14	7.18
Metapocyrtus sp. 12	9			9	4.62
Metapocyrtus sp. 13	1			1	0.51
Metapocyrtus sp. 14	6			6	3.08
Metapocyrtus sp. 15	1			1	0.51
Metapocyrtus sp. 16	2			2	1.03
Number of Individuals	168	23	4	195	100
Number of Species	13	10	3	17	

Metapocyrtus is the most common genus both in agroforest and montane ecosystems. All known *Metapocyrtus* species are endemic to the Philippines. *Metapocyrtus* species have high adaptability to environmental changes and have no specific food preference, which enables these species to survive in wide ranges of habitat types, especially in lower elevations (Cabras et al., 2017). This explains why more *Metapocyrtus* species are recorded in agroforests compared to montane forest ecosystems. The remaining sixteen (16) species are still undergoing further study regarding their identification. It indicates that the weevils are known for their high rate of endemism; therefore, all the others may be unknown.

Of the three (3) sampling sites, Lake Duminagat had the highest species diversity, with a diversity value of H'= 2.016 compared to Gandawan (H'=1.344) and Uluhan sa Dapitan (H'1.04) (Table 2). This could be due to the availability of their host plant and micro-habitat present in Lake Duminagat, while anthropogenic disturbances, road construction and agri-development are evident in Gandawan and Uluhan sa Dapitan. Only (3) unique species are recorded in site 3 (Uluhan sa Dapitan), a montane forest ecosystem. This implies that these species inhabit montane forest, more likely primary or secondary montane forest, and will not able to survive in an agroforest ecosystem (Mohagan et al., 2020). A more or less even distribution was recorded in all sampling sites except Site 1, which had a relatively low evenness, probably due to the abundance of *Metapocyrtus malindangensis*, which dominates the site. The significant dominance of this species in Gandawan was certainly one of the reasons why the Shannon diversity and evenness values were consistently lower compare to other sites. *Metapocyrtus malindangensis* is a recently described species of weevils that can only be found in Mt. Malindang (Cabras et al., 2022).

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Table 2. Biodiversity indices of the weevils in the Northern part of Mt. Malindang, Misamis Occidental.

	Site 1 (Gandawan)	Site 2 (Lake Duminagat)	Site 3 (Uluhan sa Dapitan)
Species	13	10	3
Individuals	168	23	4
Dominance_D	0.4435	0.1682	0.375
Shannon_H	1.344	2.016	1.04
Evenness_e^H/S	0.295	0.7505	0.9428

The application of Bray-Curtis analysis was demonstrated from observations on the three sampling sites, by which different forest ecosystem may be distinguished based on species counts at each sampling sites (figure 3). Lake Duminagat and Uluhan sa Dapitan have the most similarities with (22.13%) which means that there is high number of similar species found in the two area. This finding may be due to the vegetation types of the areas. These two sites are forested area and located in higher elevation. Meanwhile, Gandawan is the least similar with (20.60%) since it is an agro-forested area and located in lower elevation.

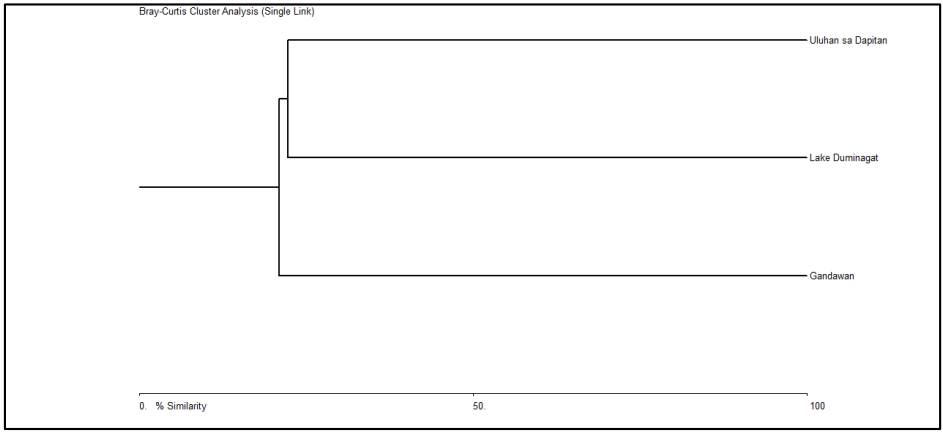

Figure 3. Bray-Curtis analysis on the species composition of weevils in the three sampling sites.

Species Account

Family Curculionidae

***Alcidodes sp.*1** (Figure 4). It was collected in Gandawan, feeding on the adaxial leaf of *Begonia sp.* It is about 1.3-1.5 cm long. **Body:** black with a brown line in the abdomen and the head part. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart-shaped segment. **Rostrum**: long, narrow, elongated beak or snout used for chewing. This is closely to species discovered by M.G. Ballentes et al, 2006 in Mt. Malindang.

Figure 4. *Alcidodes sp*.1

***Metapocyrtus sp*.1** (Figure 5). It was collected in Uluhan sa Dapitan perching on the dead branch. It is about 1.3-1.5 cm long. **Body**: metallic pink in the legs, head and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

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Figure 5. ***Metapocyrtus sp*. 1**

***Metapocyrtus sp*.2** (Figure 6). It was collected in Gandawan, crawling on an abaxial leaf of *Begonia sp.* It is about 1.4-1.5 cm long; **Body**: metallic pink in the legs, head and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart-shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

Figure 6. ***Metapocyrtus sp*. 2**

***Metapocyrtus sp*.3** (Figure 7). It was collected in Lake Duminagat, perching on the adaxial leaf of *Psidium guajava*. It is about 1 cm long; **Body**: black with metallic light green in the wing-case, and head. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart-shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

Figure 7. *Metapocyrtus sp*. 3

***Metapocyrtus sp*.4** (Figure 8). It was collected in Gandawan, crawling on the dead twigs. It is about 0.8-1 cm long; **Body**: brown with spike in the head and wing-case. **Antennae**: absent. **Antennae Club**: absent. **Foot**: heart -shaped segment. **Rostrum**: broad.

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Figure 8. ***Metapocyrtus sp.*** **4**

Metapocyrtus sp. **5** (Figure 9). It was collected in Uluhan sa Dapitan, perching on the dead branch. It is about 0.8-1 cm long; **Body**: mint green in the wing case and vertically in the head. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart-shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

Figure 9. ***Metapocyrtus sp.*** **5**

***Metapocyrtus sp*.6** (Figure 10). It was collected in Uluhan sa Dapitan, perching on the dead branch. It is about 1 cm long; **Body**: mint green in the wing case and vertically in the head. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart- shaped segment. **Rostrum**: broad.

Figure 10. ***Metapocyrtus sp.*** **6**

***Metapocyrtus sp*.7** (Figure 11). It was collected in Uluhan sa Dapitan, perching on the dead branch. It is about 0.5-1 cm long; **Body**: light brown in the wing case with green dots vertically in the head. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart- shaped segment. **Rostrum**: broad.

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Figure 11. ***Metapocyrtus sp.***

***Metapocyrtus sp*.8** (Figure 12). It was collected in Gandawan, hiding on abaxial leaf of an unidentified shrub. It is about 0.5-0.7 cm long; **Body**: metallic green in the head and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad.

Figure 12. ***Metapocyrtus sp.*8**

***Metapocyrtus malindangensis* 9** (Figure 13). It was collected in all sampling sites, mating, copulating, hiding and perching on an unidentified shrub, *Impatiens glandulifera*, and *Pteridium aquilinum*. It is about 0.8-1 cm long; **Body**: metallic green in the head and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart- shaped segment. **Rostrum**: broad. This is quite like the species discovered by Rivera et al., 2022 and M.G. Ballentes et al., 2006 in Mt. Malindang.

Figure 13. *Metapocyrtus malindangensis* 9

***Metapocyrtus sp*.10** (Figure 14). It was collected in Gandawan, hiding on abaxial leaf of an unidentified shrub. It is about 0.5-0.7 cm long; **Body**: metallic green in the head and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart- shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

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Figure 14. ***Metapocyrtus sp.*****10**

***Metapocyrtus sp*.11** (Figure 15). It was collected in a lake crawling on the terminal bud of *Conoclinium coelestinum.* It is about 0.5-1 cm long; **Body**: metallic aqua blue in the legs, head, and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad.

Figure 15. ***Metapocyrtus sp.*****11**

***Metapocyrtus sp*.12** (Figure 16). It was collected in Lake Duminagat, perching on the *Sicyos edulis.* It is about 0.6-1 cm long; **Body**: metallicc aqua blue in the legs, head, and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

Figure 16. ***Metapocyrtus sp*.12**

***Metapocyrtus sp*.13** (Figure 17). It was collected in Gandawan, copulating on the abaxial leaf of the *Conoclinium coelestinum*. It has 0.6-1 cm long; **Body**: metallicc blue green in the wing case, head, and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad. This is quite like the species discovered by M.G. Ballentes et al., 2006 in Mt. Malindang.

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Figure 17. ***Metapocyrtus sp.*****13**

***Metapocyrtus sp*.14** (Figure 18). It was collected in Gandawan, copulating on the adaxial leaf of *Begonia sp.* It has 0.3-0.4 cm long; **Body**: s metallic yellow green in the legs, wing-case, head, and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart- shaped segment. **Rostrum**: broad. Researchers believed that this is a new species of weevil.

Figure 18. ***Metapocyrtus sp.*****14**

***Metapocyrtus sp*.15** (Figure 19). It was collected in Gandawan, copulating on the adaxial leaf of *Begonia* sp. It has 0.3-0.4 cm long; **Body**: metallic yellow green in the legs, wing-case, head, rostrum, and with spikes. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad. Researchers believed that this is a new species of weevil.

Figure 19. *Metapocyrtus sp.*15

***Metapocyrtus sp*.16** (Figure 20). It was collected in Gandawan, copulating on the adaxial leaf of *Begonia* sp. It has 0.3-0.4 cm long; **Body**: metallic yellow green in the legs, wing-case, head, and rostrum. **Antennae**: elbowed. **Antennae Club**: tight merging into each other. **Foot**: heart -shaped segment. **Rostrum**: broad. Researchers believed that this is also a new species of weevil.

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Figure 20. ***Metapocyrtus sp.*****16**

Conclusion and Recommendations

The northern part of Mt. Malindang Range Natural Park hosts a significant number of weevil species. The study recorded a moderate species diversity across all sampling sites and also documented unidentified specimens that are potentially new to science. The existence of endemic weevil species in the area makes it a perfect spot for preservation and conservation. Increasing anthropogenic activities, tourism, agri-development, and road construction are among the major threats. Other threats, such as timber poaching and deforestation, are also evident. Strong environmental awareness should be conducted and implemented among the residents. The government must take legal action; restrictive measures must be undertaken to conserve and preserve the biological resources of Mt. Malindang.

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