Baltic J. Coleopterol. 21(2) 2021
ISSN 1407 - 8619

Updated Distribution Records of *Pachyrhynchus* Germar, 1824 (Coleoptera: Curculionidae: Entiminae) from the Philippines with Biogeographic Affinities

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Rukmane-Bārbale A., Cabras A. A. 2021. Updated Distribution Records of *Pachyrhynchus* Germar, 1824 (Coleoptera: Curculionidae: Entiminae) from the Philippines with Biogeographic Affinities. *Baltic J. Coleopterol., 21(2): 199 - 211.*

A total number of 4245 specimens (2405 males and 1840 females) of the genus *Pachyrhynchus* Germar, 1824 from DUBC wereexamined. The current number includes 147 species and 21 subspecies out of known 171 species and 27 subspecies. Overall, 160 species and 27 subspecies are recorded from the Philippines (except Palawan and Sulu), 8 species from Taiwan, and 4 species from Indonesia. New distribution records are provided and geographical data were compared with extensive literature records, type species localities, and data from various museum collections, concluding a massive dataset of biogeographical affinities of the genus *Pachyrhynchus.*

Key words: *Pachyrhynchus*, biogeography, endemism, PAIC, conservation.

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INTRODUCTION

Pachyrhynchus Germar, 1824, a genus coveted by both entomologists and hobbyists for its bright iridescent elytral markings and coloration is a member of the tribe Pachyrynchini with a Philippine centered distribution. The tribe Pachyrynchini is one of the most conspicuous beetles in the world which belongs to the hyperdiverse family Curculionidae with approximately 51,000 species (Oberprieler et al. 2007). The tribe currently has 17 genera with the latest addition of the genus *Enoplocyrtus* Yoshitake 2017 and *Trichomacrocyrtus* Yoshitake 2018 from Luzon Island (Yoshitake 2017; 2018). The unique geographic distribution of the *Pachyrhynchus* which is limited to the oceanic islands of the Philippines, Taiwan, Japan, and Moluccas is of great interest to biogeographers (Starr, Wang 1992). Owing to its fused elytra and lack of flight ability, long-distance dispersal of this genus is unlikely. However, recent collections reveal a much wider

distribution of this genus as additional materials were obtained.

The unique biogeographical origin of the Philippines together with its favorable habitats is one of the reasons for its very high level of endemism. The Philippines is considered as one of the 18 megadiverse countries in the world with one of the highest levels of endemism despite contributing only 0.2% of the world's land area. The more than 7,000 islands of the Philippines which are mostly oceanic contribute to 5% of the total biodiversity of the world. The islands which are now politically called Philippines are the result of a series of subduction and the movement of the Sunda, Sahul Shelf, and the Philippine plates, strike-slip fault formation, and a series of volcanic activities (Yumul 2009). The collision which resulted in subduction dating back to the Miocene period had led to the formation of various island arc systems in the country including that of the island fringes in Luzon which extends to Orchid and Green Island which now belongs to Taiwan and the Moluccas serving as a pathway for species exchange.

Since the country's islands are volcanic in origin except for the Palawan micro continental block which is believed to have drifted towards the Philippines with the birth of the West Philippine Sea, islands emerged at different times with several islands being considered as rather old such as Luzon and other islands are new such as Bicol, Camiguin and Sibuyan, and the Sulu islands which surfaced only much later (Telnov 2011; Heaney and Regalado 1998). The unique geologic activities starting from the Mesozoic and the recurring coalescence and fragmentation of several islands which gave rise to aggregate islands connected by land bridges in the last Pleistocene epoch explains the majority of the species distribution and demarcation in the country although some taxa do not follow the said Pleistocene Aggregate Island Complex model (PAIC) (Siler et al. 2010).

ir biogeographic affinities. Because the study of the genus *Pachyrhynchus* is still in the documentation phase, efforts for conservation priorities of this genus have been compromised. The present paper provides an updated distribution of species from the Philippines based on recent collections with inputs onbiogeographic affinities of the species and its implication on conservation efforts for this taxon.

MATERIAL AND METHODS

The list and distribution of species are obtained by an extensive literature review (Schultze 1923, 1925, 1934; Yoshitake 2012; Bollino, Sandel 2015; Rukmane, Barsevskis 2016; Rukmane 2018) and examination of collection:
DUBC - Daugavpils University Beetle Collection (Daugavpils, Latvia) (Table 2).

Identification was conducted using a stereo microscope Zeiss Stemi 1000 and comparing morphological characters using the taxonomic keys and examining type materials in MTD (Dresden, Germany) and NHML (London, Great Britain).

Model for biogeographic distribution makes use of the Pleistocene Aggregate Island Complex (PAIC) wherein islands were grouped on the possible aggregation based on the last Pleistocene epoch. In the last Pleistocene epoch, islands separated by 120 meters deep were connected by land bridges which eventually disappeared as the water began to rise to its current state giving rise to separate islands. However, faunal exchanges were evident that certain groups of islands share similar species of flora and fauna. The following four large PAICs namely Greater Luzon (Luzon, Polillo, Catanduanes, Marinduque, and adjacent small islands), Greater Mindanao (Mindanao, Samar, Leyte, Bohol, Maripipi, Biliran, Dinagat, Siargao, Basilan, and adjacent small islands), Greater Negros-Panay (Panay, Guimaras, Negros, Cebu, Masbate, and adjacent small islands) and Greater Palawan (Palawan, Busuanga, Calamian, Culion, Balabac, and adjacent small islands) are consistently recognized as faunal demarcation in the country. Luzon is further divided in administrative regions: Cordillera Administrative Re-

gion (Abra, Apayao, Benguet, Ifugao, Kalinga, Mt. Province), Ilocos Region (Ilocos Norte, Olocos Sur, La Union, Pangasinan), Cagayan Valley (Batanes, Cagayan, Isabela, Nueva Vizcaya, Quirino), Central Luzon (Aurora, Bataan, Bulacan, Nueva Ecija, Pampanga, Tarlac, Zambales), Calabarzon (Batangas, Cavite, Laguna, Quezon, Rizal), Bicol Region (Albay, Camarines Norte, Camarines Sur, Catanduanes, Masbate, Sorsogon); Marinduque Island; Mindoro Island; Panay Island; Sibuyan Island; Visayas: Western Visayas (Aklan, Antique, Capiz, Guimaras, Iloilo, Negros Occidental), Central Visayas (Biliran, Eastern Samar, Leyte, Northern Samar, Samar, Northern Leyte); Libucan Island; Cebu Island; Bohol Island; Mindanao: Zamboanga Peninsula (Zamboanga del Norte, Zamboanga del Sur, Zmboanga Sibugay), Northern Mindanao (Bukidnon, Camiguin, Lanao del Norte, Misamis Occidental, Misamis Oriental), Davao Region (Davao de Oro, Davao del Norte, Davao del Sur, Davao Occidental, Davao Oriental), Soccskargen (Cotabato, Sarangani, South Cotabato, Sultan Kudrat), Caraga Region (Agusan del Norte, Agusan del Sur, Dinagat Islands, Surigao del Norte, Surigao del Sur), Bangsamoro (Basilan, Lanao del Sur, Maguindanao, Sulu, Tawi-Tawi). Additionally for biogeographical analyses are added Taiwan, Japan, Indonesia.

RESULTS

Distribution of *Pachyrhynchus* in the Philippines

In the monograph of Schultze (1923), he has listed 85 species and 13 subspecies. In the succeeding years until his last publication in 1934, he described numerous more species of *Pachyrhynchus* such as *P. davaoensis* and *P. reicherti* among others. Since Schultze's last publication, the study on this genus remained dormant for nearly a century until recent discoveries of Yoshitake, Bollino, Sandel, Rukmane, Barševskis, Cabras, Medina described a significant number of new species and subspecies. An increase in the number of species was obtained for less explored islands such as Samar, Leyte, and Mindanao. A significant increase in the number of species was recorded for Mindanao which has an increase of 14 to 50 species as more species were described from Mt. Apo Natural Park and Bukidnon highlands and new distributional records emerged. Schultze considers Mt. Apo Natural Park and Bukidnon as the center of diversity of this genus in Mindanao. A fair number of species was added to the data of Luzon whose number of species rose from 55 to 79. Still, the island with the most number of species in the country is Luzon followed by Mindanao, Samar, and Leyte (Fig. 1).

From 85 species, the number of *Pachyrhynchus* species now in the Philippines is 160 and more species will probably be added in the succeeding years although more studies should be conducted in species delineation as there are intraspecific variations among the population. Of the 160 species, 79 or 46% are from Luzon, 50 or 29% are from Mindanao while the rest are from other major islands such as Samar and Visayas with 19 species (11%), Mindoro with 9 species (5%), and 8 species (5%) from Panay and Lubang. A significant rise in the number of species was recorded from Mindanao (14 to 50) with the recent discovery of several species from Mt. Apo Natural Park and Bukidnon highlands. The biogeographic distribution of the genus is clearly oceanic in origin which explains why islands like Palawan and Sulu are devoid of representative species. There are no representative species from Palawan whose flora and fauna are more similar to mainland China than the Philippines and Sulu PAIC which also have unique species from mainland Mindanao. The absence of representative species in Palawan PAIC and Sulu PAIC is not astonishing since *Pachyrhynchus* has no population in Borneo or mainland Asia and seems to have a purely oceanic distribution. The Pleistocene Aggregate Island Complex (PAIC) is also evident in the distribution of many species in this taxon. The restricted distribution of this group can be attributed to its fused elytra making them flightless, their specific habitat prefer-

ence in forested mountain ecosystems, or mountain ridges giving them a high level of endemicity. All the Philippine species of *Pachyrhynchus* are endemic with some species showing a much-restricted distribution to a single island or locality.

In the monograph of Schultze, out of the 85 species, 80 or 94% are exclusive to a single island whereas only five namely *P. erichsoni*, *P. moniliferus, P. signatus, P. speciosus*, and *P. venustus* are widely distributed. An updated distributional record shows that 13 species have a wider distribution and are not restricted to a single island. Of the 13 species, three have a Philippine-wide distribution: *P. moniliferus* from Luzon PAIC (Islands of Cagayan Valley), Mindoro and Samar; *P. multipunctatus* from Luzon and its subspecies from Samar; *P. erichsoni* from various islands of the Philippines. The rest are restricted within the PAIC regions such as Greater Mindanao (*P. speciosus, P. regius, P. venustus, P. signatus*) and Greater Luzon (*P. orbifer, P. phaleratus, P. decussatus, P. apicatus, P. moellendorfi, P. rukmaneae*). The rest of the 147 species has a restricted distribution to a single island. The species with Philippine wide distribution is astonishing since long-distance dispersal of this group seems impossible with their flightless ability and restriction to mountain ecosystems. These species should be further studied with molecular data in order to know if the species from the various islands are conspecific. Species with Philippine wide distribution may have possibly originated at a much older time scale in the Miocene-Pliocene epoch and have dispersed through vicariance and diversified to islands as far as the Ryukyu and Mollucas. A further phylogenetic analysis would confirm this. It is also possible that these species may have crossed short-distance oceanic barriers during the Miocene-Pliocene epoch and have drifted to nearby islands together with some plants as Schultze (1923) mentioned that these beetles can survive floating in water for a longer period of time. Su et al. (2014) also mentioned the drifting of host plants as one of the possible mechanisms of cross-island dispersal to facilitate passive

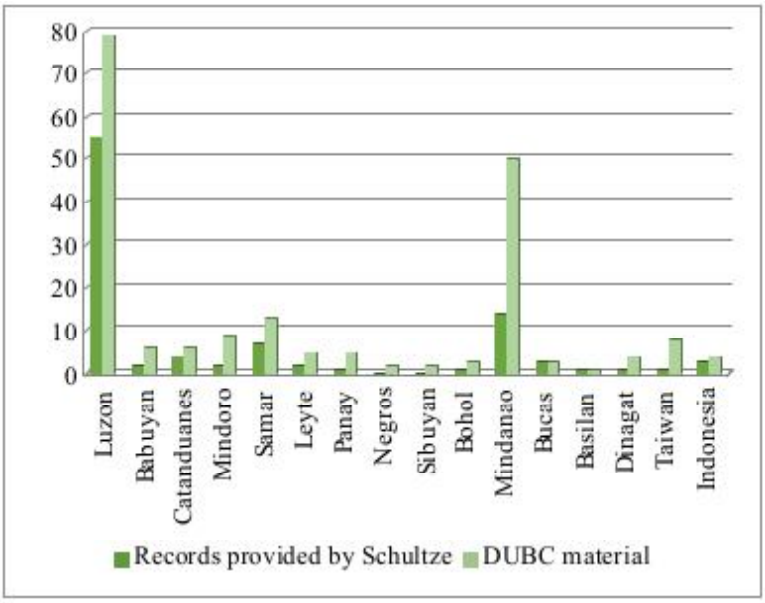

Fig. 1. Comparison of species richness by largest Philippine Islands

Table 1. Comparison of species richness by largest Philippine Islands

Greater Luzon PAIC	Cordillera	*P. orbifer*; *P. orbifer* ssp. *gemmans*; *P. orbifer* ssp. *azureus*; *P. orbifer* ssp. *murinus*; *P. moniliferus* ssp. *stellulifer*; *P. zebra*; *P. stellio*; *P. rugicollis*; *P. sphaericollaris*; *P. reticulatus*; *P. cruciatus*; *P. annelifer*; *P. annulatus*; *P. schultzei; P. erosus; P. congestus;* ssp. *caerulans;* ssp. *pavonius*; ssp. *ocellatus*; ssp. *mirabilis; P. morio; P. taylori;* ssp. *metalescens; P. sanchezi; P. benguetanus; P. sumptuosus; P. pulchellus; P. inclytus; P. igorota; P. gloriosus;* ssp. *abbreviatus; P. nobilis; P. pinorum;* ssp. *transversalis; P. tristis; P. lacunosus; P. dubiosus; P. consobrinus; P. argus; P. ochroplagiatus; P. perpulcher; P. disgestus; P. cagayanus; P. equester; P. bollinoi; P. cinereomaculatus; P. sumptuosoides; P. atronitens; P. abranus*
	Ilocos	*P. orbifer; P. orbifer* ssp. *gemmans; P. orbifer* ssp. *murinus; P. congestus* ssp. *aedamlayroni; P. chlorites; P. sumptuosus; P. perpulcher; P. barsevskisi; P. kirklayroni; P. florulentus*
	Cagayan Valley	*P. orbifer; P. orbifer* ssp. *gemmans; P. orbifer* ssp. *azureus; P. orbifer* ssp. *murinus; P. orbifer* ssp. *striatomaculatus; P. orbifer* ssp. *callainus; P. moniliferus; P. moniliferus* ssp. *stellulifer; P. moniliferus* ssp. *babuyanensis; P. phaleratus; P. stellio; P. rugicollis; P. sphaericollaris; P. erichsoni* ssp. *eschscholtzi; P. multipunctatus; P. annelifer; P. schultzei; P. baluganus; P. congestus;* ssp. *caerulans;* ssp. *pavonius;* ssp. *mirabilis; P. viridans; P. chlorites; P. gemmatus;* ssp. *purpureus; P. taylori; P. sanchezi; P. sarcitis; P. dohrni; P. eques; P. sumptuosus; P. pulchellus; P. inclytus; P. igorota; P. semperi; P. gloriosus; P. nobilis; P. pinorum;* ssp. *transversallis*; *P. lacunosus; P. ochroplagiatus; P. perpulcher; P. rizali; P. disgestus; P. cagayanus; P. barsevskisi; P. rebus; P. sagittatus; P. tetramaculatus; P. disargus; P. bollinoi; P. cinnereomaculatus; P. callainimaculatus; P. sumptuosoides; P. florulentus; P. niisatoi; P. septentrionalis; P. abranus*
	Central Luzon	*P. orbifer; P. moniliferus; P. zebra; P. phaleratus; P. phaleratus* ssp. *dannylayroni*; *P. sellio; P. rugicollis; P. reticulatus; P. cruciatus; P. erichsoni* ssp. *eschscholtzi; P. apicatus; P. congestus* ssp. *pavonius;* ssp. *mirabilis; P. chlorites; P. gemmatus; P. sanchezi; P. dohrni; P. psittaculus; P. psittacinus; P. gloriosus; P. ochroplagiatus; P. cagayanus; P. barsevskisi; P. cinereomaculatus; P. yuukae; P. caeruleus; P. septentrionalis*
	Calabarzon	*P. orbifer; P. moniliferus;* ssp. *chevrolati;* ssp. *stellulifer; P. zebra; P. stellio; P. reticulatus; P. cruciatus; P. erichsoni* ssp. *eschscholtzi; P. confusus; P. rufopunctatus; P. apicatus; P. pseudoproteus; P. baluganus; P. lorquini; P. psittaculus; P. gloriosus; P. rizali; P. masatoshii; P. rochaorum; P. niisatoi; P. yukae*
	Bicol	*P. moniliferus; P. moniliferus* ssp. *chevrolati; P. phaleratus; P. decussatus; P. decussatus* ssp. *catanduanensis; P. rugicollis; P. reticulatus; P. circulatus; P. erichsoni* ssp. *eschscholtzi; P. septentrionalis*
	Marinduque	*P. moniliferus; P. phaleratus* ssp. *badiovittatus; P. erichsoni* ssp. *eschscholtzi; P. moellendorffi* ssp. *marinduquanus; P. marinduquensis; P. rukmaneae; P. rukmaneae* ssp. *paucisignatus*
Mindoro PAIC		*P. moniliferus* ssp. *stellulifer; P. halconensis; P. rufopunctatus; P. apicatus; P. galeraensis; P. pseudhalconensis; P. domino; P. valainisi; P. mindoroensis;*
Lubang		*P. mohagani; P. tilikinesis; P. lubanganus*
Romblon Island Group- Sibuyan		*P. noeli; P. naokae*
Negros-Panay PAIC	Negros	*P. negrosensis;*
	Panay	*P. moniliferus* ssp. *chevrolati;* ssp. *herbidus; ; P. jugifer; P. moellendorffi; P. felipeae; P. franciscoi; P. layroni*
	Cebu	*P. multipunctatus* ssp. *endoi*

Table 1. *Continuation*

Greater Mindanao PAIC	Samar	*P. libucanus P. speciosus; P. regius; P. samarensis; P. latifasciatus; P. erichsoni; P. bucasanus* ssp. *ornatus; P. venustus; P. smaragdinus; P. elegans; P. shavrini; P. ilgas; P. conformis; P. sakaii; P. moniliferus;*
	Leyte	*P. speciosus; P. regius; P. schoenherri; P. erichsoni;*
	Bohol	*P. speciosus; P. multipunctatus; P. yoshitakeorum*
	Zamboanga Peninsula	*P. atrocyaneus; P. zamboanganus; P. torresi; P. imitans; Pachyrhynchus yoshitakei*
	Northern Mindanao	*P. speciosus; P. regius; P. postpubescens; P. erichsoni; P. apocyrtoides; P. sulphureomaculatus; P. smaragdinus; P. ardentius; P. corpulentus; P. amabilis; P. chamissoi; P. davaoensis; P. tadauchii; P. hirokii; P. naokii; P. pseudamabilis; P. subamabilis; P. tikoi; P. cabrasae; P. nitcisi; P. anitchtchenkoi; P. orientalis; P. neoabsurdus; P. banglas; P. esperanza; P. sergejevae; P. ottomerkli; P. circulimaculatus; P. octoannulatus; P. reicherti*
	Davao	*P. speciosus; P. erichsoni; P. signaticollis; P. apocyrtoides; P. ardentius; P. amabilis; P. davaoensis; P. tadauchii; P. hirokii; P. pseudamabilis; P. apoensis; P. kraslavae; P. cabrasae; P. anitchtchenkoi; P. miltoni; P. occidentalis; P. notocruciatus; P. reicherti*
	Soccskargen	*P. speciosus; P. apocyrtoides; P. semiignitus; P. venustus; P. sulphureomaculatus; P. ardentius; P. amabilis; P. davaoensis; P. tadauchii; P. hirokii; P. naokii; P. pseudamabilis; P. subamabilis; P. caeruleovittatus; P. apoensis; P. tikoi; P. nitcisi; P. antonkozlovi; P. anichtchenkoi; P. occidentalis; P. notocruciatus; P. octoannulatus; P. reicherti*
	Caraga	*P. speciosus; P. regius; P. erichsoni; P. signatus; P. bucasanus; P. signaticollis; P. apocyrtoides; P. venustus;* ssp. *insulanus; P. sulphureomaculatus; P. ardentius; P. davaoensis; P. tadauchii; P. pseudamabilis; P. kraslavae; P. cabrasae; P. nitcisi; P. antonkozlovi; P. anitchtchenkoi; P. orientalis; P. esperanza; P. riculimaculatus; P. yoshitakeorum*
	Bangsamoro	*P. infernalis; P. hirokii; P. naokii; P. subamabilis; P. basilanus; P. sphenomorphoides;*

transport of eggs, larvae, and adults in the case of Philippine planthoppers. Furthermore, some species may have been transferred from one place to another through the cultivation of plants as observed in the genus *Metapocyrtus.*

Based on the selected division in administrative regions, some of the species seems to appear in more than one region (Table 1). While regions like Zamboanga Peninsula and Bangsamoro remain rather isolated with individual, unique species, in Caraga, Soccskargen, Davao, and Northern Mindanao species flow are possible and part of the species overlap. For example, *P. anitchtchenkoi* is present at all four regions of Mindanao with exception of Zamboanga and Bangsamoro. Overall Zamboanga Peninsula is represented by three species, Northern Mindanao by 30 species, Davao by 18 species, Soccskargen by 23 species, Caraga by 22 species and Bangsamoro by six species making Northern Mindanao species richest region. In Luzon situation is similar as part of the species are present at more than one region. Conditionally those regions in most cases are connected by land boarders allowing species to spread and exchange. Species richest region of the Greater is Cagayan Valley with 47 species, followed by Cordillera with 39 species, Central Luzon with 25 species, Calabarzon with 20 species, Ilocos and Bicol with 8 species each and Marinduque with 6 species.

Table 2. DUBC material of Pachyrhynchus representing species presence at various localities (Individuals examined: m - male, f - female)

Species	**Individuals examined**	**Localities**
P. abranus Heller, 1912	1m, 1f	Nueva Vizcaya, Abra
P. amabilis Schultze, 1922	65m, 36f	Bukidnon, Davao, Lanao, Mt. Kalatungan, Intavas, Alamada, Cotabato, Mt. Apo
P. anitchtchenkoi Rukmane & Barševskis, 2016	42m, 18f	Lanao, Agusan, Compostela, Sarrangani, Bukidnon
P. annelifer Heller, 1912	9m, 4f	Ifugao, Compostela, Benguet, Nueva Vizcaya
P. antonkozlovi Rukmane & Barševskis, 2016	6m, 7f	Cotabato, Surigao, Sarrangani
P. apicatus Schultze, 1922	6m, 12f	Aurora, Mt. Halcon
P. apocyrtoides Schultze, 1922	5m, 7f	Surigao, Agusan, Cotabato, Davao
P. apoensis Yoshitake, 2012	37m, 31f	Cotabato, Bukidnon, Davao, Sarrangani
P. ardentius Schultze, 1919	6m, 7f	Bukidnon, Davao, Sarrngani
P. atronites Yoshitake, 2019	5m, 6f	Kallinga, Abra
P. atrocyaneus Schultze, 1922	8m, 9f	Zamboanga
P. banglas Bollino, Sandel & Rukmane, 2017	11m, 6f	Cabanglasan, Bukidnon
P. barsevskisi Rukmane, 2016	77m, 29f	Aurora, Quirino, Dingalan, Madela, Nueva Ecija, Ilocos
P. baluganus Schultze, 1924	3m, 3f	Quirino, Nagtipunan, Tapsoy
P. benguetanus Schultze, 1923	1f	Ifugao
P. bollinoi Rukmane-Bārbale, 2020	16m, 7f	Ifugao, Nueva Vizcaya, Mt. Province, Barlig
P. cabrasae Rukmane & Barševskis, 2016	19m, 31f	Bukidnon, Agusan, Davao
P. cagayanus Heller, 1929	14m, 17f	Cagayan, Kallinga, Quirino, Isabela, Dingalan
P. caeruleovittatus Yoshitake, 2012	4m, 6f	Sarrangani, Cotabato
P. chlorites Chevrolat, 1881	23m, 17f	Quirino, Calayan, Babuyan, Banaue, Ilocos, Nueva Vizcaya, Cagayan, Aurora, Isabela
P. cinereomaculatus Rukmane-Bārbale, 2020	1m, 2f	Ifugao, Nueva Vizcaya, Aurora
P. circulatus Heller, 1912	2m, 3f	Catanduanes, Pandan
P. circulimaculatus Yoshitake, 2019	4m, 1f	Agusan, Rosario
P. conformis Yoshitake, 2017	4m, 2f	Hinabangan, Samar
P. congestus Pascoe, 1871	97m, 57f	Aurora, Benguet, Nueva Vizcaya, Kasibu, Ifugao, Mt. Province, Bontoc, Cadaclan, Quirino, Kallinga
P. consobrinus Schultze, 1922	35m, 12f	Mt. Province, Tineg (Abra)
P. corpulentus Schultze, 1922	16m, 16f	Bukidnon, Cabanglasan, Intavas
P. cruciatus Schultze, 1923	24m, 42f	Aurora, Abra, Banaue
P. cumingi Waterhouse, 1841	1m, 1f	Bohol Island
P. davaoensis Schultze, 1934	13m, 14f	Agusan, Bukidnon, Cotabato, Davao, Surigao
P. decussatus Waterhouse, 1841	2m	Catanduanes, Pandan
P. disgestus Heller, 1912	8m, 9f	Ifugao, Nueva Vizcaya
P. disargus Rukmane, 2019	3m	Nueva Vizcaya: Kasibu, Kayapa
P. domino Rukmane, 2016	1m, 1f	Baco, Mt. Halcon
P. elegans Waterhouse, 1841	29m, 20f	Samar Island: Hinabangan, Lope De Vega
P. erichsoni cf.	28m, 26f	Hinabangan, Marabot, Sogod, Cabanglasan, Surigao, Dinagat, Davao, Agusan, Bukidnon,

Table 2. *Continuation*

P. erichsoni Waterhouse, 1841	26m, 19f	Marinduque, Aurora, Cagayan, Sorsogon, Quirino, Nueva Vizcaya
P. erosus Schultze, 1920	2m, 5f	Benguet, La Trinidad, Abatan
P. esperanza Bollino, Sandel & Rukmane, 2017	12m, 12f	Agusan, Surigao
P. franciscoi Rukmane & Cabras, 2018	4m, 10f	Panay: Aklan, Antique, Culasi
P. felipeae Rukmane & Cabras, 2018	11m, 24f	Panay: Aklan, Antique, Culasi
P. florulentus Yoshitake, 2019	3m, 2f	Nueva Vizcaya, Cagayan, Ilocos
P. galeraensis Schultze, 1934	7m, 10f	Mindoro
P. gemmatus Waterhouse, 1841	26m, 24f	Aurora, Cagayan, Santa Ana., Nueva Vizcaya, Isabela, Quirino
P. gloriosus Faust, 1895	42m, 54f	Isabela, Rizal, Ifugao, Nueva Vizcaya, Kallinga, Aurora
P. halconensis Schultze, 1922	2f	Mt. Halcon
P. hirokii Yoshitake, 2012	27m, 20f	Bukidnon, Cotabato, Lanao, Davao
P. igorota Schultze, 1917	8m, 4f	Ifugao, Mt. Province, Nueva Vizcaya
P. ilgas Rukmane, 2017	1m	Lope De Vega
P. inclytus Pascoe, 1871	23m, 18f	Ifugao, Mt. Province, Bontoc
P. jugifer Waterhouse, 1841	1m, 3f	Panay, Aklan
P. kraslavae Rukmane & Barševskis, 2016	7m, 6f	Compostella, Agusan, Davao, Surigao
P. kirklayroni Rukmane, 2019	1m	Ilocos, Adams
P. lacunosus Heller, 1912	127m, 18f	Nueva Vizcaya, Ifugao, Benguet
P. layroni Rukmane & Cabras, 2018	3m, 6f	Panay, Antique
P. latifasciatus Waterhouse, 1841	28m, 20f	Lope De Vega, Samar
P. marinduquensis Rukmane & Barševskis, 2016	27m, 12f	Marinduque, Camarined, Mt. Malindig, Buenavista
P. miltoni Cabras & Rukmane, 2016	2f	Davao, Marilog
P. mindoroensis Rukmane & Hava, 2020	6m, 4f	Puerta Galera, Mt. Halcon
P. moellendorffi Heller, 1899	22m, 29f	Antique, Marinduque
P. moniliferus Germar, 1824	71m, 55f	Babuyan, Quirino, Cagayan, Aurora, Marinduque, Camiguin, Calayan, Catanduanes, Belance, Rizal, Isabela, Mt. Province, Pinukpuk, Nueva Vizcaya, Benguet, Mt. Halcon, Baco, Camarines, Batangas, Lope De Vega
P. multipunctatus Waterhouse, 1841	3m, 2f	Nueva Vizcaya
P. naokii Yoshitake, 2012	10m, 15f	Cotabao, Lanao
P. negrosensis Schultze, 1924	3m, 5f	Negros: Mt. Canlaon, Benedicto
P. neoabsurdus Rukmane, 2017	2f	Bukidnon
P. niisatoi Yoshitake, 2017	31m, 13f	Nueva Vizcaya, Quirino, Tapsoy, Quirino, Rizal
P. nitcisi Rukmane & Barševskis, 2016	30m, 27f	Sarrangani, Cotabato, Agusan, Bukidnon
P. nobilis Heller, 1912	31m, 31f	Quirino, Nueva Vizcaya, Isabela, Ifugao, Mt. Province
P. notocruciatus Yoshitake, 2017	f	Cotabato, Alamada
P. occidentalis Rukmane, 2017	19m, 21f	Sarrangani, Cotabato, Davao
P. ochroplagiatus Heller, 1912	10m, 7f	Aurora, Nueva Vizcaya
P. octoannulatus Yoshitake, Bollino & Sandel, 2019	33m, 18f	Lanao, Wao

Table 2. *Continuation*

P. orbifer Waterhouse, 1841	148m, 133f	Nueva Vizcaya, Aurora, Quirino, Madela, Tapsoy, Dinapigue, Isabela, Ifugao, Mt. Province, Benguet, Apayao, Cagayan, Isabela, Sta. Ana, Laguna, Mt. Polis, Kallinga, Nagtipunan, Ambaguio, Dupax
P. orientalis Rukmane, 2017	4m, 6f	Bukidnon, Surigao
P. phaleratus Waterhouse, 1841	26m, 40f	Quirino, Isabela, Aurora
P. perpulcher Waterhouse, 1841	17m, 28f	Isabela, Babuyan, Camiguin, Quirino, Ilocos, Nueva Vizcaya, Cagayan
P. pinorum Pascoe, 1871	25m, 6f	Nueva Vizcaya, Benguet, Ifugao, Mt. Province
P. postpubescens Schultze, 1922	11m, 27f	Bukidnon, Intavas, San Fernando, Panamokan
P. pseudamabilis Yoshitake, 2012	44m, 42f	Bukidnon, Cotabato, Davao, Mt. Apo, Agusan
P. pseudhalconensis Rukmane, 2016	16m, 11f	Baco, Puerta Galera, Mt. Halcon
P. psittacinus Heller, 1912	1f	Marivales - Bataan
P. pulchellus Behrens, 1887	18m, 12f	Nueva Vizcaya, Ifugao, Mt. Province
P. rebus Rukmane, 2016	m	Quirino
P. regius Schultze, 1922	4m, 4f	Agusan, San Fernando, Leyte, Samar
P. reicherti Schultze, 1929	46m, 14f	Cotabato, Davao, Bukidnon
P. reticulatus Waterhouse, 1841	30m, 35f	Camarines Bicol, , Catanduanes, Aurora, Abra
P. rizali Schultze, 1934	11m, 15f	Cagayan: Sta. Ana, Gonzaga; Quirino
P. rufopunctatus Waterhouse, 1841	2f	Mt. Halcon
P. rugicollis Waterhouse, 1841	11m, 10f	Sorosogon, Bulusan, Ifugao, Bataan, Zambales, Aurora, Nueva Vizcaya
P. rukmaneae Barševskis, 2016	16m, 18f	Marinduque, Boac
P. sagittatus Rukmane, 2019	1m	Quirino
P. samarensis Schultze, 1923	48m, 46f	Samar, Lope De Vega
P. sanchezi Heller, 1912	60m, 18f	Ifugao, Nueva Vizcaya, Mt. Province, Aurora, Isabela
P. sarcitis Behrens, 1887	18m, 15f	Cagayan, Babuyan, Quirino, Camiguin, Isabela
P. schoenherri Waterhouse, 1841	1m, 1f	Leyte: Mahaplag
P. schultzei Schultze, 1917	25m, 20f	Mt. Province, Ifugao, Nueva Vizcaya
P. semperi Heller, 1912	18m, 6f	Babuyan Island
P. septentrionalis Yoshitake, 2017	15m, 11f	Cagayan, Aurora
P. sergejevae Rukmane, 2018	2m, 1f	Bukidnon
P. shavrini Rukmane & Barševskis, 2016	47m, 47f	Lope De Vega, Hinabangan
P. signaticollis	17m, 11f	Compostella, Agusan, Surigao
P. smaragdinus Behrens, 1887	27m, 30f	Bukidnon, Marabot, Lope De Vega, Hinabangan
P. speciosus Waterhouse, 1841	32m, 16f	Bukidnon, Davao, Sarangani, Surigao, Visayas, Samar, Leyte, Dinagat
P. sphaericollaris Schultze, 1923	2m, 5f	Callinga, Cagayan
P. sphenomorphoides Yoshitake, 2012	19m, 4f	Zamboanga
P. stellio Heller, 1912	20m, 24f	Nueva Vizcaya, Benguet, Rizal, Rodriquez, Mt. Province, Barlig, Aurora, Isabela
P. subamabilis Yoshitake, 2012	78m, 36f	Cotabato, Bukidnon, Lanao
P. sulphureomaculatus Schultze, 1922	3m, 1f	Agusan, Bukidnon, Surigao
P. sumptuosus Schultze, 1917	38m, 24f	Apayao, Bontoc, Kallinga, Nueva Vizcaya, Ilocos
P. sumptuosoides Yoshitake, 2017	2m, 2f	Cagayan, Kallinga, Luisiana, Apayao

Table 2. *Continuation*

P. shavrini Rukmane & Barševskis, 2016	47m, 47f	Lope De Vega, Hinabangan
P. tadauchii Yoshitake, 2012	53m, 36f	Agusan, Bukidnon, Sarrangani, Surigao, Davao, Compostella
P. taylori Schultze, 1922	2m, 5f	Nueva Vizcaya, Kallinga, Ifugao
P. tetramaculatus Rukmane, 2019	1m, 1f	Nueva Vizcaya
P. tikoi Rukmane, 2016	14m, 15f	Mt. Apo, Bukidnon
P. torresi Rukmane, 2018	5m, 6f	Zamboanga
P. valainisi Rukmane & Barševskis, 2016	1f	Mt. Halcon
P. venustus Waterhouse, 1841	38m, 38f	Cotabato, Surigao, Sarrangani, Hinabangan, Lope De Vega, Sogod, Marabot
P. yoshitakeorum Yoshitake, Bollino & Sandel, 2019	4m, 2f	Bohol, Dinagat
P. zamboanganus Yoshitake, 2012	7m, 9f	Zamboanga
P. zebra Schultze, 1917	5m, 4f	Aurora, Runruro, Rizal

Biogeographic Affinities of *Pachyrhynchus*

The distribution of Pachyrynchini has always baffled early entomologists such as Heller and Schultze. The unique distribution of the tribe which has its center of diversity in the Philippines especially Luzon and has some representative species in island fringes of Taiwan, Mollucas and Papua New Guinea led Heller to believe that the pachyrynchinids reached the Philippines in the most recent period through the south via the Celebes Sea which was contested by Schultze as no highly modified or specialized forms of pachyrynchinids are widely distributed in Borneo, Celebes, Java or Sumatra (Dickerson et al. 1928). Rather, Schultze believed that since Luzon is the apparent center of diversity for this group, it is where they have originated and from there species of pachyrynchinids have reached other islands, However, during that time, knowledge on the distribution was only based on dispersal and extinction and land bridges since it was only in 1924 that Wegener published his work in tectonic plates (Wegener 1924). Without knowledge on plate tectonics it is difficulty to fully account for the distribution of life based on geological history.

As for the genus *Pachyrhynchus*, although it has the most widespread distribution as compared to other genera of the tribe Pachyrynchini, its distribution is uniquely limited to the Philippines with more than a hundred species, Taiwan with eight species and Indonesia with four species. Due to the inability for flight, *Pachyrhynchus* species has very limited dispersal ability. Another factor preventing long distance dispersal is the ecologic preference of *Pachyrhynchus* which favors higher elevation in forested mountainous ecosystems or mountain ridges as compared to its counterpart *Metapocyrtus* (Cabras et. al 2016). This further enables the species in this group to have a limited geographic distribution. More studies is needed to understand the ecological preferences of this group.

Based on the updated distribution of the *Pachyrhynchus* species, Schultze seem right in his idea that *Pachyrhynchus* have originated from Luzon owing to the high diversity and species richness in Luzon. This agrees with the findings of Van Dam et al. (2021) that “the subsequent radiations of lineages on Mindanao all descended from Luzon lineages” and that there was no back colonization that took place.

Conservation

The endemism of the species of Philippine *Pachyrhynchus*, limited geographic distribution and habitat preference which is highly associated with forested mountain ecosystems and mountain ridges makes this group one of the best candidate for extinction with current rate of habitat degradation. Currently, the country is already considered as one of the hottest of hotspots due to the alarming habitat loss. Because the study of the genus is still at the documentation phase, efforts for conservation priorities have been compromised. The mountain ecosystems of the Philippines which are the habitat of the species from this genus are experiencing one of the highest levels of habitat degradation with only less than 20% remaining forested mountain ecosystems. According to Diesmos et al. (2002), clearance and habitat fragmentation especially of the mountainous forest and lowland dipterocarps affect 85% of the fauna. *Pachyrhynchus* which seem to prefer higher elevation of the forests are clearly highly at risk of extinction.

Habitat degradation especially in the mountain ecosystems serve as one of the greatest threats to the survival of the *Pachyrhynchus* species in the wild. For example in one area in Marilog District where a new species *P. miltoni* was discovered, the area where the species was found experiences slash and burn farming which basically replaces old growth trees with crops such as *Zea mays, Theobroma cacao*, coffee and other economically valuable crops. This is alarming since *Pachyrhynchus* are more restricted with their diet compared to *Metapocyrtus*. There is no data yet on how these species can adapt to habitat degradation.

As for any protection status, there is no protection status for this group. Among the roughly 22,000 insects described in the Philippines today, only 2 orders have members which are considered as threatened. This includes members of the order Lepidoptera such as *Delias magsadana, Graphium megaera, Idea electra* and order Odonata such as *Risiocnemis antonieae, Risiocnemis seidenschwarzi* and *Coelicia exoleta* among others. However, in the case of the coleoptera, there are only a handful assessed speciesdespite the high level of endemism, restricted geographic distribution of most species, high association with forested mountain ecosystems, alarming level of habitat degradation, illegal poaching of these species and other obvious anthropogenic threats it experiences in the wild. This calls for scientific workers to provide an assessment of the distribution and threats on the species of beetles especially the highly endemic ones so that it can be considered as threatened even just on the local level.

On the other hand, although members of the beetle group including *Pachyrhynchus* are not considered as threatened, their habitats in the montane ecosystems are protected by some laws such as the National Integrated Protected Area System (NIPAS) which declares several mountains in the Philippines to be of considerable value to conservation. This NIPAS system declares several mountains as Protected Area thus preserving and protecting biodiversity as a whole. However as observed in other countries, protected areas in other countries when analysed based on its effectiveness in biodiversity conservation is considered inadequate.

Future Research Direction

Phylogenetic analysis would verify the hypothesis presented in this paper. More researches on the ecology, biology and distribution of this genus will be very helpful in explaining its unique distribution. More conservation efforts especially in the assessment of its population is necessary to pass local laws and conduct conservation activities for the conservation and protection of these species and their habitats including their food plants.

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Received: 12.08.2021
Accepted: 21.12.2021
Published: 30.12.2021.