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COMMUNICATION

TIGER BEETLES (COLEOPTERA: CICINDELINAE) OF DAVAO REGION, MINDANAO, PHILIPPINES

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Tiger beetles (Coleoptera: Cicindelinae) of Davao Region, Mindanao, Philippines

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Abstract: An assessment of tiger beetles in select mountains of Davao region including Mt. Hamiguitan (MHRWS), Marilog District (MD), Davao City (DC), Sta. Cruz Davao del Sur (SCD), and Davao de Oro (DO) is herein presented. Materials were collected between December 2017 and February 2019 through a combination of opportunistic and standard light trapping methods. Twenty-two species belonging to 9 genera were recorded with 64% endemic in the Philippines. Nine (9) species are recorded from MHRWS, 6 from MD, 8 from DC, 5 SCD, and 14 from DO (formerly Compostela Valley Province). Tiger beetles showed consistent habitat preferences particularly riparian species which includes the genera Calomera, Thopeutica, Therates, Prothyma, Cyllindera, and Heptodonta. Strictly arboreal species include Tricondyla, Therates, and Neocollyris. Strict epigeic species include but not limited to the genera Calomera, Tricondyla, Thopeutica, Cyllindera, Heptodonta, Neocollyris, and Prothyma. Endemic species such as *Heptodonta lumawigi* (Wiesner, 1980), *Thopeutica (Thopeutica) anichtchenkoi* (Wiesner 2015), *Thopeutica (Thopeutica) milanae* (Wiesner, 1992), *Thopeutica (Thopeutica) rolandmuelleri* Cassola, 2000 and *Thopeutica petertaylori* (Medina, Cabras, Wiesner, 2019) prefers a more intact forests while others such as *Cyllindera (Ifasina) discreta elaphroides* (Dokhtouroff 1882), *Calomera mindanaoensis* (Cassola, 2000) and *Necollyris* sp. could tolerate disturbed secondary forest even agricultural lands. New distribution record for *Heptodonta lumawigi* (Wiesner, 1980) and *Thopeutica (Thopeutica) milanae* (Wiesner, 1992) for Marilog District were also recorded. Ecological data and conservation status of tiger beetles are also presented. Conservation actions are deemed necessary in the remaining green spaces in Davao City that hosts tiger beetle fauna should also be conducted.

Keywords: Conservation, davao region, diversity, Philippines.

Filipino abstract: Pag-lista sa tanan tiger beetles gikan sa mga bukid sa rehiyon sa Davao, apil ang Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS), distrito sa Marilog, Sta. Cruz Davao del Sur, ug Davao de Oro (sa una probinsya sa Compostela Valley) gipahigayon sa mga bulan sa Desyembre 2017 ug Pebrero 2019 ginamit ang opportunistic ug light trapping nga mga pamaagi. Baynte dos ka mga species ilalum sa syam ka mga genera ang na lista diin 64% ang makita lamang sa Pilipinas. Syam ka mga species ang na lista gikan sa MHRWS, unom gikan sa distrito sa Marilog, walo gikan sa nagka lain-lain green nga mga lugar sa syudad sa Davao, lima gikan Sta. Cruz, ug katorse gikan sa Davao de Oro. Ang mga tiger beetles nagpakita ug specific nga pinuy-anan, partikularmente mga species namuyo duol sa sapa sama sa Calomera, ug mga species sa sapa jud mismo makita sama sa Thopeutica, Therates, Prothyma, and Cyllindera. Mga species makita ibabaw sa kahoy sama sa Tricondyla ug Neocollyris. Ang uban species sama sa *Heptodonta lumawigi* (Wiesner, 1980), *Thopeutica (Thopeutica) anichtchenkoi* (Wiesner, 2015), *Thopeutica (Thopeutica) milanae* (Wiesner, 1992), *Thopeutica (Thopeutica) rolandmuelleri* Cassola 2000, ug *Thopeutica (Thopeutica) petertaylori* (Medina, Cabras, Wiesner, 2019) nagapamili ug бага nga lasang. Sa laing bahin, *Cyllindera (Ifasina) discreta elaphroides* (Dokhtouroff, 1882), *Calomera mindanaoensis* (Cassola, 2000), ug *Necollyris* sp. maka agwanta ug medyo guba na nga lugar, ug gamay nga lasang. Naay duha ka mga species, *Heptodonta lumawigi* (Wiesner, 1980) ug *Thopeutica (Thopeutica) milanae* (Wiesner, 1992) na lista sa unang higayon sa distrito sa Marilog. Gipakita usab ang status sa nahibilin nga mga tiger beetles gikan sa rehiyon sa Davao. Ang presyensa sa mga tiger beetles sa mga green nga mga lugar sa syudad sa Davao nagpamatuod nga aduna pa gayud nahibilin nga species sa lugar nga angay natong ampingan ug protektahan.

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For Author details, Author contribution & Acknowledgements see end of this article



INTRODUCTION

The tiger beetles are predatory beetles recognized by their lengthy legs, prominent sickle mandibles, 11 segmented filiform antennae, and a pair of conspicuous large compound eyes (Pearson 1998). Their size ranges from 6mm to the extent of 45mm (Pearson 1998). Recent revisions of Lopez-Lopez & Vogler (2017) and a comprehensive molecular phylogeny of tiger beetles of Gough et al. (2018) placed the taxon into a separate family Cicindilidae. Among the insect taxa, tiger beetles are a bioindicators of biodiversity (Pearson & Cassola 1992) and information can be gathered by analyzing their habitat specificity, presence of endemic species, and a possible translation of patterns to related taxa (Nose 1990; Morgan et al. 2000).

The Philippines is home to a high number of unique species of Cicindilinae. In 1992, Wiesner recorded 94 species of Cicindelid in the Philippines. Between 1990 and 2000, Cassola & Pearson (2000) listed 130 tiger beetles wherein 111 are endemic, making the Philippines the fifth in terms of the absolute number of tiger beetles, and ranked third based on endemism behind Madagascar and Australia. More recently, Cabras et al. (2016) listed a total of 155 tiger beetle species and 18 subspecies, of which 130 are endemic in the Philippines. Additionally, six new species were added by Dheurle (2016), Zettel & Pangantihon (2017), Zettel & Wiesner (2018), raising the list to 161 tiger beetles in the Philippines.

Consequently, tiger beetle studies in the Philippines are still scant mostly focusing on taxonomy with very few faunistic data (Wiesner 1980, 1988a, 1988b, 1989, 1992a, 1992b, 2015; Bogenberger 1988; Naviaux 1992, 2002; Cassola 2000, 2011; Cassola & Ward 2004; Cassola & Zettel 2006; Deuve 2015; Dheurle 2015; Cabras et al. 2016). In Mindanao, only Davao de Oro (formerly Compostela Valley) and Davao Oriental Province, particularly in Mainit Hot Spring Protected Landscape (MHSPL) and Mati Protected Landscape, have published data on tiger beetle fauna (Cabras et al. 2016). This paper presents the list of tiger beetles in Mt. Hamiguitan Range Wildlife Sanctuary Davao Oriental, Sta. Cruz Davao del Sur, green spaces of Davao City, and upland forests of Marilog District Davao City. Notes on their ecology and conservation status, which are an essential reference for conservation and monitoring purposes, are also presented.

MATERIALS AND METHODS

Collection of tiger beetles was done using opportunistic sampling and light trapping for Mt. Hamiguitan Range Wildlife Sanctuary (MHRWS) Davao Oriental [6°44'08.000"N, 126°08'33.810"E], Sta. Cruz Davao del Sur [6°52'27.000"N, 125°22'04.320"E], green spaces and lowland forest of Davao City [7°03'56.540"N, 125°35'36.910"E], mountain forests of Marilog District [7°26'31.070"N, 125°15'23.310"E] (Figure 1) from December 2017 to February 2019. Additional data from Davao de Oro [7°21'21.080"N, 126°11'00.220"E] is also included (Cabras et al. 2016b).

The daily collection was conducted using insect net and light trapping for nocturnal sampling from 18.00h to 22.00h. Collected specimens were killed using ethyl acetate and placed in 90% ethanol. Species identification was made by examining morphological characters were observed under Luxeo 4D and Nikon SMZ745T stereomicroscopes. Stacked digital habitus images were taken with Nikon D5300 digital camera and Sigma 18-250. All images were then stacked and processed using a licensed version of the software Photoshop CS6 Portable with reference to taxonomic keys and published articles of Wiesner (1980, 1988a, 1988b, 1989, 1992a, 1992b, 2015), Cassola (2000, 2011), Cassola & Ward (2004), and Cabras et al. (2016).

RESULTS AND DISCUSSION

A total of 22 species belonging to nine genera were collected in all sampling sites (Table 1). Nine species were recorded from MHRWS, six from the mountain forests of Marilog District Davao City, eight from the urban green spaces of Davao City, five from Sta. Cruz Davao del Sur, and 14 species from Davao de Oro. Of the 22 species, nine (41%) are Philippine endemic, five (23%) are Mindanao endemic, four (18%) are distributed to Southeast Asia, and two (9%) are Oriental species. Five (23%) species are threatened according to the latest DENR Administrative Order (2017) <https://www.philippineplants.org/dao-2017-11.pdf>, while the other seventeen (77%) species are Data Deficient.

The most widespread species shared by almost all areas include *Calomera mindanaoensis* (Cassola, 2000), *Cylindera (Ifasina) discreta elaphroides* (Dokhtouroff, 1882), *Neocollyris (Heterocollyris) similior* (Horn, 1893), *Therates fasciatus fasciatus* (Fabricius, 1801), *Therates fulvipennis everetti* (Bates, 1878), and *Tricondyla (Tricondyla) aptera punctipennis* (Chevrolat, 1841)

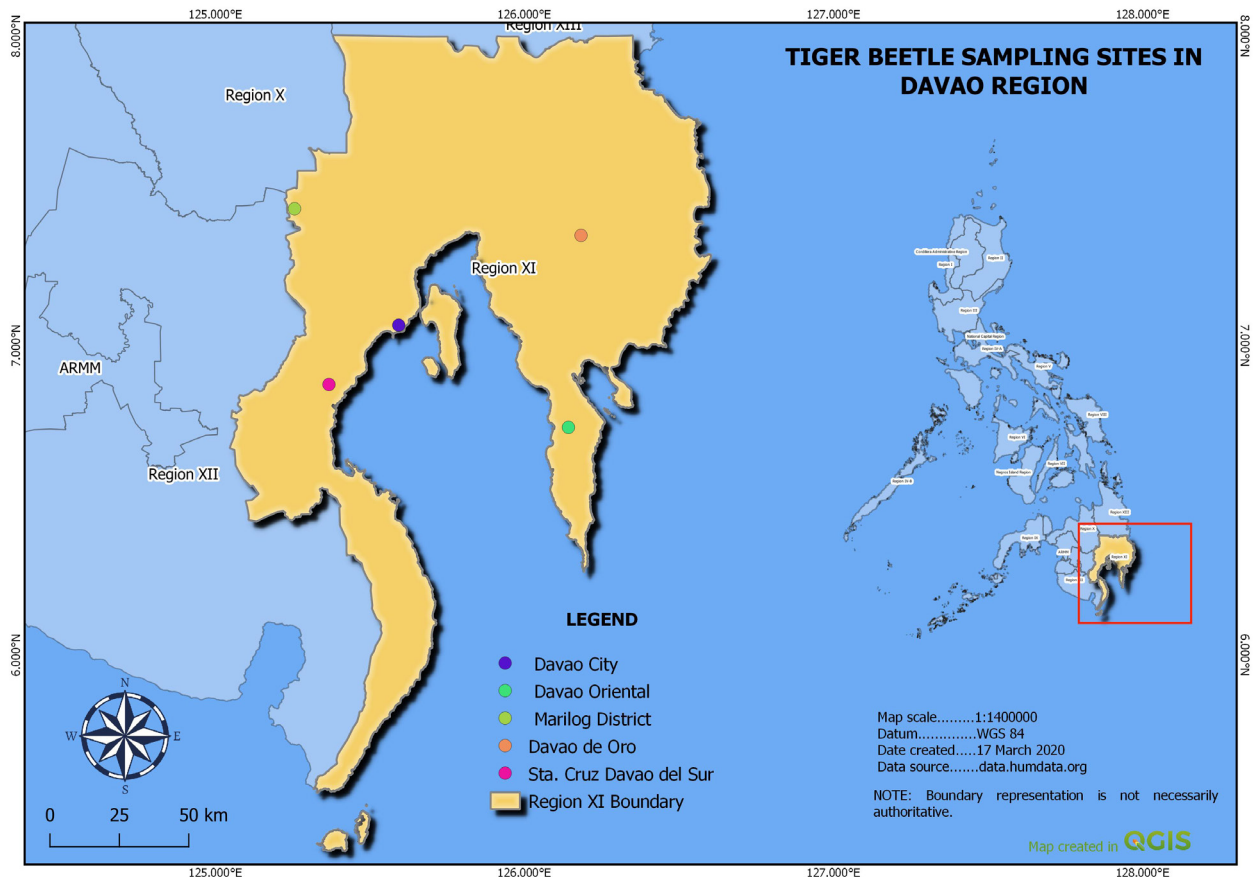


Figure 1. Sampling sites in Davao Region.

(Image 1). The genus *Cylindera* is the most speciose with four species recorded, followed by *Therates*, *Tricondyla*, and *Thopeutica* with three species each. The genera *Calomera* and *Neocollyris* were represented by two species, while the rest of the genera, viz., *Heptodonta* and *Prothyma* with one species each, and *Thopeutica* with three species. Cabras et al. (2016) enumerated five subspecies of *Therates fasciatus*, of which two subspecies are found in the Davao Region. Two out of three species of *Calomera* in Mindanao are also recorded in Davao Region, namely *Calomera mindanaoensis* (Cassola, 2000) and *Calomera lacrymosa* (Dejean, 1825). Two of the recently described *Thopeutica* from Mindanao were also recorded in Davao Region, namely *Thopeutica (Thopeutica) anichtchenkoi* (Wiesner, 2015) and *Thopeutica (Thopeutica) rolandmuelleri* Cassola, 2000. A new species of *Thopeutica* was also discovered in Compostela Valley, awaiting description. *Thopeutica (Thopeutica) milanae* (Wiesner, 1992) was also recorded for the first time in Davao Region, specifically in the mountain forests of Marilog District. It was initially known to be endemic in Leyte. Moreover, additional specimens were recorded for Samar and Mindanao by

Cassola & Ward (2004) and Cabras et al. (2016).

Most species of tiger beetles are matched to a specific environmental condition, which makes the diversity of the fauna strongly determined by the availability and variety of suitable habitats (Willis 1967; Knisley 1984). In general, tiger beetles preferred river edges, water beaches, dunes, sandy flats, woodland paths, grasslands, and areas with dirt roads, trails, sandpits, and spoil deposits (Knisley 2011). The difference in habitats including physical parameters such as soil characteristics, plant composition, and the presence of bare patches of the ground determine their composition since these species need bare spots of the field as a habitat requirement both for adults and larvae (Dreisig 1980). For adults, the presence of sunlight is an essential physical factor in maintaining their high body temperature to enhance speed and effectiveness in catching their prey. Majority of the tiger beetles captured during day time were collected in open spaces where sunlight can penetrate and near river edges and cliffs. Species like *Heptodonta lumawigi* (Wiesner, 1980), *Thopeutica (Thopeutica) anichtchenkoi* (Wiesner, 2015), *Thopeutica (Thopeutica) milanae* (Wiesner,

Table1. List of tiger beetles in Davao Region with their geographic distribution and conservation status. MH—Mt. Hamiguitan Range Wildlife Sanctuary | MD—Marilog District | DC—Davao City | SCDS—Sta. Cruz, Davao del Sur | CVP—Compostela Valley Province | PE—Philippine Endemic | O—Oriental region | ME—Mindanao Endemic | SE—Southeast Asia | OTS—Other Threatened Species | DD—Data Deficient.

Species	MH	MD	DC	SCDS	CVP	GD	CS
<i>Calomera lacrymosa</i> (Dejean, 1825)					✓	PE	OTS
<i>Calomera mindanaoensis</i> (Cassola, 2000)	✓		✓	✓	✓	PE	OTS
<i>Cylindera (Ifasina) mouthiezi</i> (Dheurle, 2015)					✓	ME	DD
<i>Cylindera (Ifasina) discreta elaphroides</i> (Dokhtouroff, 1882)	✓		✓		✓	PE	DD
<i>Cylindera viduata</i> (Fabricius, 1801)				✓		O	DD
<i>Cylindera (Eugrapha) excisa</i> (Schaum, 1862)					✓	SE	DD
<i>Heptodonta lumawigi</i> (Wiesner, 1980)		✓				PE	OTS
<i>Lophyra striolata</i> (Illiger, 1800)				✓		O	OTS
<i>Neocollyris (Heterocollyris) similior</i> (Horn, 1893)	✓		✓		✓	ME	DD
<i>Neocollyris</i> sp.			✓	✓		-	DD
<i>Prothyma (Symplecthyma) heteromallicollis heteromallicollis</i> (Horn, 1909)	✓		✓			ME	DD
<i>Therates coracinus coracinus</i> (Erichson, 1834)					✓	SE	OTS
<i>Therates fasciatus fasciatus</i> (Fabricius, 1801)	✓	✓	✓		✓	SE	DD
<i>Therates fasciatus quadrimaculatus</i> (Horn, 1895)	✓	✓				PE	DD
<i>Therates fulvipennis everetti</i> (Bates, 1878)	✓	✓	✓		✓	PE	DD
<i>Thopeutica (Thopeutica) anichtchenkoi</i> (Wiesner, 2015)					✓	ME	DD
<i>Thopeutica (Thopeutica) milanae</i> (Wiesner, 1992)		✓				PE	DD
<i>Thopeutica (Thopeutica) rolandmuelleri</i> Cassola, 2000					✓	ME	DD
<i>Thopeutica (Thopeutica) petertaylori</i> (Medina, Cabras, Wiesner, 2019)					✓		
<i>Tricondyla (Stenotricondyla) cavifrons</i> (Schaum, 1862)	✓			✓		PE	DD
<i>Tricondyla (Tricondyla) elongata</i> (Horn, 1906)					✓	PE	DD
<i>Tricondyla (Tricondyla) aptera punctipennis</i> (Chevrolat, 1841)	✓	✓	✓		✓	SE	DD

1992), *Thopeutica (Thopeutica) rolandmuelleri* Cassola, 2000, and *Thopeutica* sp. are habitat-specific and prefer a more intact forest habitat. Few species like *Cylindera (Ifasina) discreta elaphroides* (Dokhtouroff, 1882) and *Calomera mindanaoensis* (Cassola, 2000), can thrive in relatively disturbed habitats. Both were collected in the University of Mindanao campus and remaining green spaces in Bago Gallera as well as a mixed agricultural farm in Matina Pangi Davao City, Philippines.

Riparian species of tiger beetles include *Calomera mindanaoensis* (Cassola, 2000), *Calomera lacrymosa* (Dejean, 1825), *Cylindera (Ifasina) mouthiezi* (Dheurle, 2015), *Cylindera (Ifasina) discreta elaphroides* (Dokhtouroff, 1882), *Cylindera viduata* (Fabricius, 1801), *Cylindera (Eugrapha) excisa* (Schaum, 1862), *Heptodonta lumawigi* (Wiesner, 1980), *Lophyra striolata* (Illiger, 1800), *Prothyma (Symplecthyma) heteromallicollis heteromallicollis* (Horn, 1909), *Therates coracinus coracinus* (Erichson, 1834), *Therates fasciatus fasciatus* (Fabricius, 1801), *Therates fasciatus quadrimaculatus*

(Horn, 1895), *Therates fulvipennis everetti* (Bates, 1878), *Thopeutica (Thopeutica) anichtchenkoi* (Wiesner, 2015), *Thopeutica (Thopeutica) milanae* (Wiesner, 1992), *Thopeutica (Thopeutica) rolandmuelleri* (Cassola, 2000), and *Thopeutica* sp. were collected in open riparian ecosystem or at least a few meters away from the river bank. Arboreal species such as *Tricondyla* and *Neocollyris* were mostly captured on shrubs' branches and tree trunks, considering the genus *Tricondyla* (Latreille, 1822) is a tree-dwelling species. Because of this, most species are found on tree trunks or the ground, going from one tree to another. *Tricondyla (Stenotricondyla) cavifrons* (Schaum, 1862) and *Tricondyla (Tricondyla) aptera punctipennis* (Chevrolat, 1841) as well as *Neocollyris (Heterocollyris) similior* (Horn, 1893) and *Neocollyris* sp. prefers mixed agricultural to secondary forests ecosystem with shaded areas.

Species such as *Heptodonta lumawigi* (Wiesner, 1980), *Thopeutica (Thopeutica) milanae* (Wiesner, 1992), and *Prothyma (Symplecthyma) heteromallicollis*

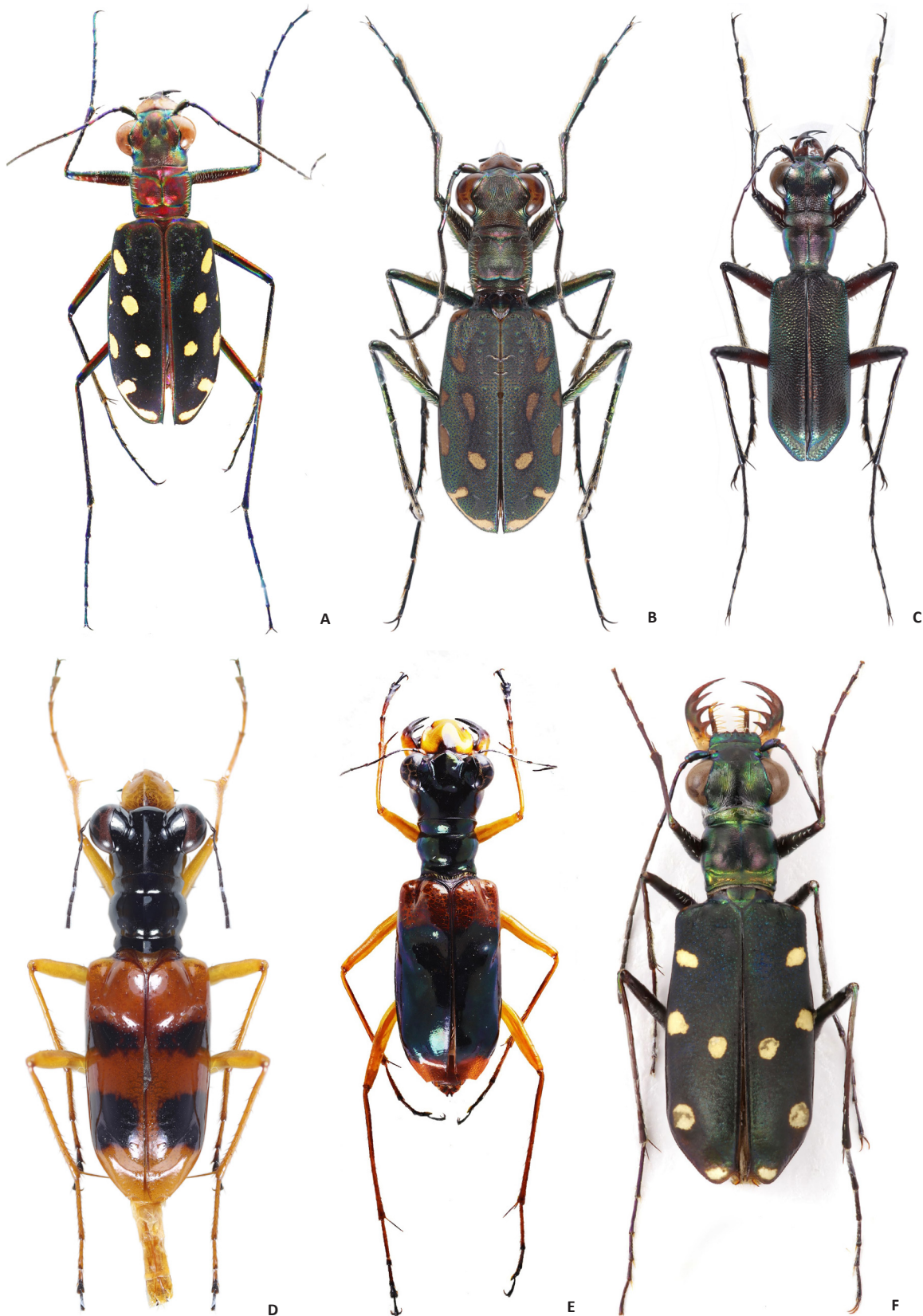


Image 1. Tiger beetles in Davao region: A—*Calomera mindanaoensis* (Cassola, 2000) | B— *Calomera lacrymosa* (Dejean, 1825) | C - *Heptodonta lumawigi* (Wiesner, 1980) | D —*Therates fasciatus quadrimaculatus* Horn 1895 | E— *Therates fulvipennis everetti* (Bates 1878) | F—*Thopeutica petertaylori* (Medina, Cabras, Wiesner, 2019). © A,D - H. Ramillano | B,C,E - C. Torrejos & R. Cabras | F - J. Wiesner.



Image 2. Tiger beetles in their natural habitat. A—*Heptodonta lumawigi* (Wiesner, 1980) | B—*Thopeutica (Thopeutica) milanae* (Wiesner, 1992) | C—*Calomera mindanaoensis* (Cassola, 2000) | D—*Therates fulvipennis everetti* (Bates, 1878). © A. Cabras.

heteromallicollis (Horn, 1909) were observed on steeply sloping areas near creeks and rivers (Image 2B,C). *Heptodonta lumawigi* (Wiesner, 1980) seemed to favor sloping creeks but also collected along with the road cuts in open spaces (Image 2A). The high preference of this species to inhabit intact forest habitat might be one of the reasons why this species is recorded under threatened species. *Heptodonta lumawigi* (Wiesner, 1980) was first believed to be endemic to Panay when Wiesner recorded it in 1980. New specimens, however, were recorded by Cassola (2000) in Mt. Parker, South Cotabato, listing the species as widely spread in the Philippines. This is also the first time that *H. lumawigi* is recorded in the forest of Marilog District, Davao City. The species under the genus *Therates*, on the other hand, are commonly found near the rivers, usually in the leaves of shrubs and ferns. At times, two species of *Therates* can co-exist in the same riverine area such as *Therates fulvipennis everetti* (Bates, 1878) and *Therates fasciatus fasciatus* (Fabricius, 1801). All species of *Therates* share the same habitat type, shrubs in relatively disturbed secondary forests system, and shaded riverine sandy areas (Image 2D).

The remaining green spaces of Davao City harbors eight species a testament of the importance of keeping

the green spaces within urban areas for species to thrive and continue living. It is interesting to note that *Cylindera (Ifasina) discreta elaphroides* (Dokhtouroff, 1882) is documented both within the campus of the University of Mindanao Matina and in the secondary forests of Bago Gallera. *Neocollyris* sp. and *Calomera mindanaoensis* (Cassola, 2000) were captured in Shrine Hills, Matina, and in the agricultural ecosystem in Matina Pangi, respectively. Cassola & Ward (2004) observed different species of tiger beetles have various adaptations to the changing environment. Similar findings were observed by Cabras et al. (2016). The present list is more numerous compared to tiger beetle fauna in Calanasan Apayao Province which (Medina et al., 2020) which is dominated by old growth secondary forests. The other five species of tiger beetles from Davao City, viz., *Prothyma (Symplecthyma) heteromallicollis heteromallicollis* (Horn, 1909), *Tricondyla aptera punctipennis* (Chevrolat, 1841), *Neocollyris (Heterocollyris) similior* (Horn, 1893), *Therates fasciatus quadrimaculatus* (Horn, 1895), and *Therates fulvipennis everetti* (Bates, 1878) were documented in a pristine lowland secondary forests in Calinan and Baguio districts.



Image 3. Tiger beetle habitat in Mt. Hamiguitan and Marilog districts. A—Habitat of *Thopectica* (*Thopectica*) *milinae* (Wiesner, 1992) | B—Habitat of *Tricondyla* species | C—Habitat of *Therates* species | D—Habitat of *Prothyma* (*Symplecthyma*) *heteromallicollis heteromallicollis* (Horn, 1909). © M.N.D. Medina.

CONCLUSION & RECOMMENDATION

Davao Region hosts a good number of tiger beetles with 22 species record with 64% endemism (Table 1). Five (23%) are listed as threatened species, which calls for immediate conservation efforts. The astonishing number of tiger beetles in the remaining green spaces of Davao City is a testament to the importance of keeping the urban that houses tiger beetles and other animal

species. Tiger beetles of Davao Region show consistent habitat preferences to forested and riverine ecosystems. In the face of deforestation and conversion of forest habitats, tiger beetles, which are linked with forested habitats, are highly at risk of extinction. This calls for more expeditions and inventories to assess extant populations leading towards conservation.



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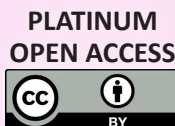
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