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Arboreal Tiger Beetles Recorded from Lowland Crop Cultivations in Sri Lanka

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ABSTRACT

Purpose: Thirty-one species of arboreal tiger beetles are known from Sri Lanka of which 25 species are endemic. However, their habitat types are poorly documented and the available records are far outdated. Therefore, a survey of tiger beetles was carried out to determine their present occurrence with emphasis on agricultural habitat types.

Research Method : Forty-six locations of the country, covering eighteen districts, all provinces, representing a majority of bioclimatic zones except those in Montane Sri Lanka were surveyed for arboreal tiger beetles. Sampling was conducted using the visual encounter method. Collected beetles were identified using taxonomic keys and descriptions.

Findings : Eight species of arboreal tiger beetles were collected from the survey. Majority of the species (06) were collected from crop cultivations of coconut and also from tea, fruit farms, betel leaf, cinnamon and pepper. Four species of *Derocrania* and two species of *Tricondyla* were recorded from the cultivations and all had fused elytra and hence unable to fly. *Derocrania scitiscabra* was the dominant arboreal tiger beetle species in the crop cultivations.

Originality/ Value : The study documents hitherto unrecorded habitat types for a poorly documented important beetle group of Sri Lanka. It further provides information for future research on the possibility of using arboreal tiger beetles as bio-control agents of insect pests of agricultural crops.

Keywords: Crop cultivations, Arboreal tiger beetles, *Derocrania*, *Tricondyla*

INTRODUCTION

Arboreal tiger beetles are predatory insects found predominantly in the tropical and subtropical regions of Asia (Toki *et al.*, 2017). They are found on trees mainly in forested areas such as *Pogonostoma* sp. inhabiting tree trunks in primary forests of Madagascar (Andriamampianina *et al.*, 2000), species of *Tricondyla* and *Neocollyris* found on trees in secondary and primary forests of Philippines (Trautner and Schawaller, 1996), *Neocollyris* sp. in green vegetation of forests of Kerala, India (Saha and Halder, 1986) and *Ctenostoma* sp. found in tropical moist forests of Costa Rica (Franzen, 2004). Furthermore, species of *Neocollyris* and *Therates* have been recorded from mixed agricultural ecosystems of Philippines (Cabras and Wiesner, 2016), and *Neocollyris* from coffee plantations in Vietnam

(Toki *et al.*, 2017).

Arboreal tiger beetles of Sri Lanka belong to five genera – *Collyris*, *Neocollyris*, *Protocollyris*, *Derocrania*, *Tricondyla*, and their habitat types are mostly unknown except *Neocollyris* and *Derocrania* who have been recorded from forests (Fowler, 1912) and no recent information is available.

However, it is likely that arboreal tiger beetles can occur in habitat types other than in forests,

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as do terrestrial tiger beetles, recorded from Sri Lanka by Dangalle *et al.*, 2012; Dangalle, 2013; Dangalle *et al.*, 2014; Thotagamuwa *et al.*, 2016a; Thotagamuwa *et al.*, 2016b; Thotagamuwa *et al.*, 2017.

Thus, a survey of arboreal tiger beetles was carried out to document their habitat types in the country (Abeywardhana *et al.*, 2019). The present article reports a preliminary finding of this ongoing study – a new habitat type for arboreal tiger beetles, species encountered in this habitat type and locality records.

MATERIALS AND METHODS

Study Area

Forty-six locations in 18 districts representing all provinces and climatic zones of Sri Lanka were surveyed for arboreal tiger beetles from August 2017 to June 2019. Majority of the bioclimatic zones of the country were covered by the survey, except montane zones (Wijesinghe *et al.*, 1993). Several habitat types such as coastal areas, beaches, marshlands, forests, woodlands, river banks, reservoir banks, urban areas and habitats disturbed by human activities, and crop cultivations were included in the survey. The large-scale and small-scale crop cultivations included coconut, tea, mango, pineapple, banana and cashew, cinnamon, pepper and stands of betel leaf.

Collection and identification of arboreal tiger beetles

Arboreal tiger beetles were collected by visual encounter surveys (VES) for a time period of 10 hrs; (8.00hrs. – 18.00hrs.) in a given location. When beetles were encountered, three specimens per site were collected using a standard insect net or by hand picking and preserved in 70% alcohol. Specimens were identified using taxonomic keys of Fowler (1912).

RESULTS AND DISCUSSION

Arboreal tiger beetles recorded from lowland crop cultivations

Arboreal tiger beetles were found in 13 of the 46 locations surveyed. The habitat type of seven of the 13 locations were large to small-scale crop cultivations. Six species of arboreal tiger beetles belonging to the two genera; *Derocrania* and *Tricondyla* were identified from the crop cultivations. Four of the species recorded belonged to the genus *Derocrania*, two species to the genus *Tricondyla* (Table 01 and Figure 01).

The identified specimens of collected arboreal tiger beetle species have been deposited in the insect collection in the Department of Zoology and Environment Sciences, University of Colombo and bear the voucher specimen numbers LA_DOZE.28 to LA_DOZE.56.

This is the first record of arboreal tiger beetles from crop cultivations of Sri Lanka although terrestrial tiger beetles have been documented previously from such habitats. They are *Cylindera (Oligoma) paradoxa* from a rubber and tea estate in Keeragala, Ratnapura (Thotagamuwa *et al.*, 2017), and *Cylindera (Ifasina) labioaenea* from rubber estates of the lowland wet zone (Thotagamuwa A. Personal Communication, May 2018). However, the ecological role of the terrestrial tiger beetles of Sri Lanka in agricultural lands has not been studied as their occupancy in agro-ecosystems is rare when compared to other habitat types. However, as arboreal tiger beetles occur more frequently in crop cultivations than in other habitats, their ecological role in crop cultivations of Sri Lanka is worth studying.

According to past literature arboreal tiger beetle species belonging to five genera are found in Sri Lanka. Of them, the three genera – *Collyris*, *Neocollyris*, *Protocollyris*, do not have fused elytra and are able to fly (Dangalle, 2018). However, species of the other two genera, *Derocrania* and *Tricondyla*, found in the crop cultivations have fused elytra and are unable to fly. As to why arboreal tiger beetles that are unable to fly are found in the study sites is unclear. Tiger beetles are visual predators on small live arthropods (Cornelisse *et al.*, 2013) and forage in

search of ants (Satoh and Hayaishi, 2007), other insects, spiders and small crustaceans (Rewicz and Jaskula, 2018). Most of these arthropods are non-fliers and accounts for the largest percentage of animal biomass and biodiversity in agro-ecosystems (Naureen *et al.*, 2019). The presence of large numbers of wingless arthropods may attract the flightless arboreal tiger beetle species more than the species with flying ability. Further,

the genera *Derocrania* and *Tricondyla* comprise of larger tiger beetles than the genera *Collyris*, *Neocollyris* and *Protocollyris* (Fowler, 1912). Large sized tiger beetle species have been known to predate upon small sized tiger beetle species (Hoback *et al.*, 2008) and thus may be the reason why large and small sized species do not occur together.

TABLE 01: Collection locations of arboreal tiger beetles with their habitats and micro-habitats.

	Location	Spatial Coordinates	Habitat Type	Micro-habitat of Beetles	Beetle Species Collected
1.	Dambadeniya, Kurunegala District, North-Western Province (Intermediate zone)	7°39'98" N 80°17'60" E	Coconut cultivation	Coconut tree trunk 10 – 25 cm above ground.	<i>Derocrania scitiscabra</i>
2.	Opanayaka, Ratnapura district, Sabaragamuwa province (Wet zone)	6°62'55" N 80°64'62" E	Tea cultivation	Tea bushes	<i>Derocrania scitiscabra</i>
3.	Mahawa, Kurunegala district, North-Western province (Intermediate zone)	7°69'12" N 80°26'28" E	Coconut cultivation	Coconut tree trunk closer to the ground.	<i>Derocrania scitiscabra</i>
4.	Malsiripura, Kurunegala district, North-Western province (Intermediate zone)	7°61'89" N 80°54'73" E	Coconut cultivation mixed with pepper.	Coconut tree trunk.	<i>Derocrania scitiscabra</i>
5.	Aralaganwila, Polonnaruwa district, North-Central province (Dry zone)	7°76'25" N 81°15'55" E	Betel cultivation	On vines	<i>Derocrania scitiscabra</i>
6.	Vellankulam, Mannar district, Northern province (Dry zone)	9°18'65" N 80°15'01" E	Fruit farm consisting of mango and cashew	Trunk and branches of trees	<i>Derocrania concinna</i> <i>Derocrania nietneri</i> <i>Tricondyla granulifera</i> <i>Tricondyla gounellei</i>
7.	Waulpane, Ratnapura district, Sabaragamuwa province (Wet zone)	6°43'23" N 80°72'31" E	Mixed cultivation of cinnamon and pepper	On ground amongst cultivation	<i>Derocrania concinna</i> <i>Derocrania schaumii</i>
8.	Thoppigala, Batticaloe district, Eastern province (Dry zone)	7°49'73" N 81°24'52" E	Forest	Trunk and branches of trees	<i>Derocrania nietneri</i>
9.	Bodinagala, Kalutara district, Western province (Wet zone)	6°72'45" N 80°15'59" E	Forest	Trunk and branches of trees	<i>Neocollyris bonelli</i>
10.	Kirinda, Hambantota district, Southern province (Dry zone)	6°24'04" N 81°33'69" E	Area surrounding a reservoir	Trunk and branches of trees	<i>Tricondyla gounellei</i>
11.	Bibile, Moneragala district, Uva province (Intermediate zone)	7°17'59" N 81°29'64" E	Home garden	On a tree log	<i>Derocrania scitiscabra</i>
12.	Beliatta, Hambantota district, Southern province (Dry zone)	6°10'61" N 80°71'06" E	Woodland	Bark of tree trunks	<i>Derocrania scitiscabra</i>
13.	Kantalai, Trincomali district, Eastern province (Dry zone)	8°38'39" N 81°00'85" E	Woodland	Trunk and branches of trees	<i>Derocrania scitiscabra</i>

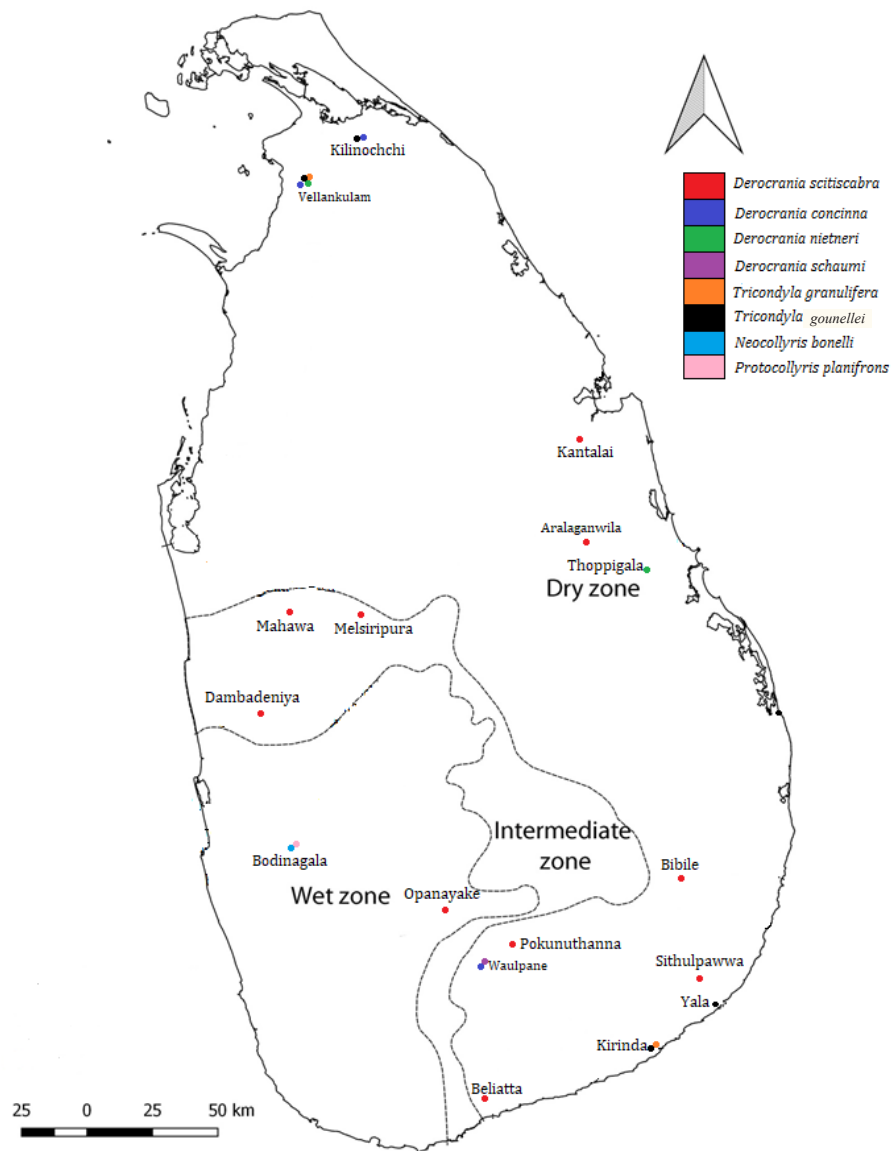


Figure 01: Distribution of arboreal tiger beetle species in recorded locations.

The most common arboreal tiger beetle species found from the crop cultivations was *Derocrania scitiscabra*. The species was found from five agricultural lands of which three were coconut cultivations and the others a tea estate and a betel leaf cultivation. The coconut cultivations were located in the Kurunegala district of the intermediate zone of the country while the tea estate was located in Opanayaka, Ratnapura district of the wet zone. The betel leaf cultivation was in the dry zone in Aralaganwila of Polonnaruwa district (Table 01 and Figure 01). *Derocrania scitiscabra* has been recorded more than a century ago from the forests of Kandy (Fowler, 1912), but never in agricultural lands with crop cultivations. However, their micro-habitat has been recorded as trunks of trees by

Fowler (1912), which is confirmed by the present study.

Derocrania scitiscabra occurred as the only arboreal tiger beetle species in all of its locations and did not co-occur with other arboreal tiger beetle species. Other species of the genus *Derocrania* such as *D. concinna* and *D. nietneri* co-occur in the fruit farms of Vellankulam, and *D. concinna* and *D. schauimi* in cinnamon and pepper cultivations of Waulpane were found to co-occur. The species at Vellankulam further co-occur with two other species of the genus *Tricondyla*, *T. granulifera* and *T. gounellei*, and were found on the trunks and branches of mango and cashew trees (Table 01). The present study recorded *Tricondyla gounellei* for the first time in Sri Lanka.

Furthermore, the present study recorded four arboreal tiger beetle species to co-occur in the fruit farms of Vellankulam.

Co-occurrence is a common phenomenon observed in different species of tiger beetles for different reasons. It has many advantages such as providing thermoregulation, camouflaging against birds and other potential vertebrate predators and synchronizing reproduction and dispersal (Bhargav and Uniyal, 2008). However, co-occurrence initiates competition amongst species for resources (Brosius and Higley, 2013) and therefore, tiger beetles that co-occur are known to display many physiological and behavioral responses to partitioning of niches within the habitats to reduce competition (Ganeshaiyah and Belavadi, 1986; Hoback *et al.*, 2000; Satoh and Hori, 2004). Niche partitioning and habitat segregation may not be possible in coconut and other crop cultivations occupied by *Derocrania scitiscabra*, due to the lack of a diversity of niches for resource partitioning. The agricultural farms in Vellankulam and Waulpane provides a diversity of niches for the successful co-occurrence of arboreal tiger beetles.

Characters of the lowland crop cultivations selected by arboreal tiger beetles

According to the present study, lowland crop cultivations with coconut were the most common habitat type of arboreal tiger beetles even though they were also found in tea, betel leaf, cinnamon, pepper and fruit cultivations. This was also evident in Philippines when arboreal tiger beetles were recorded from the Mati Protected Landscape which has now been converted to a farmland. Arboreal tiger beetles of genus *Neocollyris* was found in crop areas thriving with coconut, corn, tamarind and fruit trees (Cabras and Wiesner, 2016). The species recorded from Sri Lanka were found on tree trunks closer to the ground level and on branches, bushes, vines and one species on the ground among crop plants (Table 01).

Tiger beetles are predatory insects that prey upon a large spectrum of insects including Coleoptera, Hymenoptera, Orthoptera, larvae of Lepidoptera, arachnids and small crustaceans (Rewicz and

Jaskula, 2013). Crop cultivations consist of such prey in the form of pests, pollinators and members of food webs. Therefore, the habitat preference of arboreal tiger beetles to crop cultivations maybe associated with the prey types and densities that they offer. Further, according to Jaskula (2013) tiger beetles have shown a vegetarian feeding behavior and feed on seeds of maize crop and fruits in periods with low prey availability. As crop cultivations offer both suitable prey and vegetarian foods, preference of arboreal tiger beetles to such habitats can be speculated.

The arboreal tiger beetles of the genera *Neocollyris* and *Tricondyla* are reported to oviposit on young branches of Arabic coffee and Liberian coffee trees. The larvae of these genera develop, pupate and emerge as adults from interior branches indicating the importance of coffee plants in the completion of the tiger beetle life cycle (Toki *et al.*, 2017). The crop cultivations of Sri Lanka may also consist of particular plant species that are required for the life cycle completion of arboreal tiger beetles of the country.

CONCLUSIONS

Lowland crop cultivations are suitable habitats for arboreal tiger beetles of Sri Lanka. Most of the crop cultivations occupied by these beetles are coconut cultivations. However, species were also observed in tea plantations, fruit farms, betel leaf, cinnamon and pepper cultivations. Six species of arboreal tiger beetles of two genera – *Derocrania* and *Tricondyla*, were found from the lowland crop cultivations, of which the majority of species represented genus *Derocrania*. All species of arboreal tiger beetles recorded from crop cultivations had fused elytra and were unable to fly, while those capable of flight were not recorded from such crop cultivations. *Derocrania scitiscabra* was the dominant arboreal tiger beetle species of the crop cultivations of Sri Lanka and occurred as the only arboreal tiger beetle species in all locations. However, the other species of *Derocrania* and species of *Tricondyla* co-occurred in their respective habitats.

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