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Ant Fauna (Hymenoptera, Formicidae) Recorded by Multiple Methods in Rilagala Forest Reserve in the Knuckles Range, Nuwara Eliya District, Sri Lanka

The Running Title for the Header: Ant Fauna of Rilagala Forest Reserve

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Abstract

Worker ants in a selected region of the Rilagala Forest Reserve, which is situated in Nuwara-Eliya District, Sri Lanka were surveyed for the first time on 26 July, 2019. Ants were collected from two localities by employing 100 m transects. Honey baiting, soil sifting and pitfall trapping were employed to collect worker ants in the area and ants in the forest edge were collected manually. Ants captured by honey baits were collected after one hour and the specimens in pitfall traps were collected after five hours. Collected ants were preserved in 85% ethanol. Mean Air (17±0.0 °C) and soil temperature (14±0.5 °C) and the range of litter depth (0 - 1 cm) were recorded.

Twenty-one species in 11 genera of four subfamilies, Dolichoderinae, Formicinae, Myrmicinae and Ponerinae recorded can be considered the preliminary inventory of ants in the region. Six endemic species, Nylanderia yerburyi, Polyrhachis rupicapra, Pheidole barraleti, Pheidole nodus, Pheidole hortensis and Pheidole butteli, were recorded and three ant species,

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Crematogaster subnuda, Leptogenys diminuta and Polyrhachis rupicapra, were recorded after more than 100 years of their last record from the country.

Keywords: *Rilagala Forest Reserve, Forest Ants, Endemic Ants, Ants in Nuwara-Eliya, ant sampling methods*

Introduction

The Central Highlands of Sri Lanka situated in the south-central part of the island comprises the Peak Wilderness Protected Area, the Horton Plains National Park and the Knuckles Forest Range and has been declared as a World Heritage Site by the UNESCO World Heritage Committee in July, 2010. Those montane forests are home to an extraordinary range of flora and fauna including several endangered species such as the western-purple-faced langur, the Horton Plains slender loris and the Sri Lankan leopard. The Knuckles Range situated in the Central Province of the country includes nine peaks and the Rilagala Forest Reserve (since 2007; altitude: 1605 m), a Montane Forest, lies in a peak among them (Sanjeewani et al. 2020). Rilagala Forest Reserve (GPS coordinates: 6°58'19.73"N/ 80°35'34.33"E and 6°59'9.23"N/ 80°34'21.06"E northern boundary; 6°57'18.96"N/ 80°34'29.90"E and 6°57'19.92"N/ 80°35'30.78"E southern boundary) lies in the wet zone of Nuwara Eliya District and has an area of 566.6 ha. It receives a mean annual rainfall above 4373 mm (Green & Gunawardene 1997).

Ants (Hymenoptera, Formicidae) are a major biotic component in the forests and they inhabit the forest floor, shrubs and the trees, any cavities, litter and any other substrates in the area. They serve as seed dispersers, decomposers and nutrient recyclers and are functional at many different trophic levels such as predator, prey, herbivore, mutualist and the detritivore (Alonso, 2010; Dias, 2014; Wheeler, 1910). However, ant inventories of the tropical forests in the world are limited (Fittkau & Klinge, 1973; Floren & Linsenmair, 2000; Wilkie et al., 2010). In Sri Lanka, ant inventories of a number of forests in many Districts (Dias & Perera, 2011; Dias et al., 2013; Dias & Ruchirani, 2014; Dias & Udayakantha, 2016a; Dias & Udayakantha, 2016b; Udayakantha & Dias, 2018; Dias & Udayakantha, 2019; Silva et al., 2017) including the Sinharaja

Forest Reserve (Gunawardene et al., 2008) have been documented. In Nuwara Eliya District, the average temperature ranges between 15-20 °C and the average monthly rainfall is reported to be around 150 mm (Climate-data, https://en.climate-data.org) showing a clearly different low air temperature throughout the year and the rainfall from that of the forests in other Districts in the country. Hence, the objective of the current survey is to sample ants from a Forest Reserve, namely, Rilagala Forest Reserve (RFR) to record the ant faunal diversity in a colder climate and selected environmental parameters at a selected locality in the forest.

Methodology

Sampling Localities in Rilagala Forest Reserve (RFR)

The present survey was conducted at two localities in the selected region of RFR at an approximately 1600 m of altitude (Figure 1). Locality 1 (GPS coordinates: 6°58'20.88"N; 80°35'34.75"E near the northern forest edge) was an area covered by *Imperata* spp. Locality 2 was located approximately 200 m away from the Locality 1 (GPS coordinates: 6°58'18.42"N and 80°35'35.47"E). The short canopy at the Locality 2 consisted of *Calophyllum walkeri* Wight, *Syzygium rotundifolium* Arn., *Syzygium sclerophyllum* Thw. and *Litsea* sp.

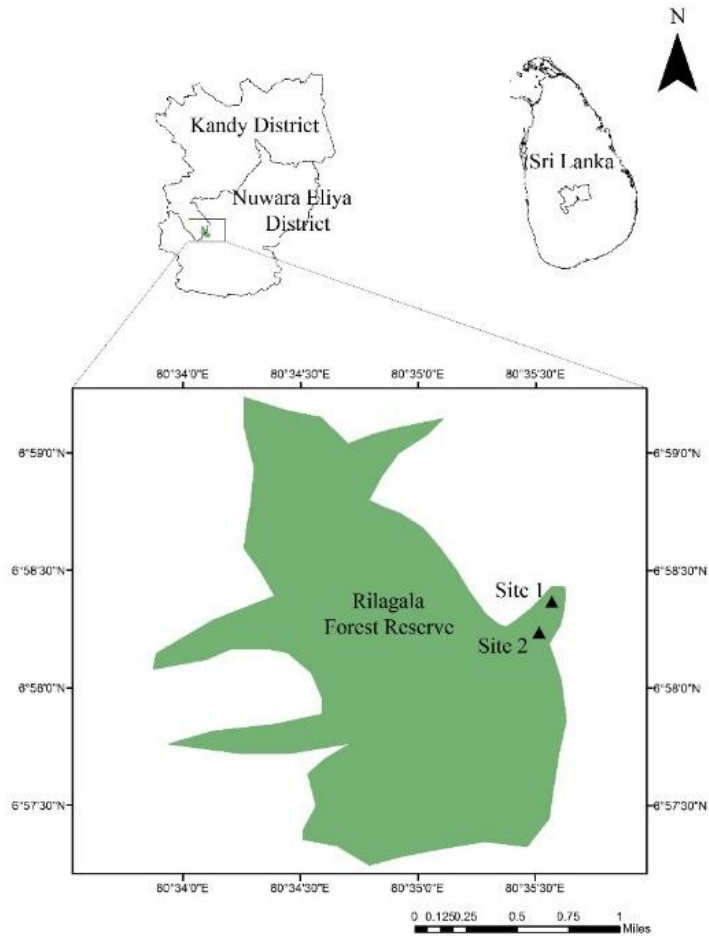

Figure 1 *Map showing the study sites at Rilagala Forest Reserve*

Ant Sampling and Identification

Worker ants were sampled by employing honey baiting, soil sifting, pitfall trapping and hand collection (litter sifting was not possible due to the lack of or very little litter availability) along a 100 m transect, which was laid at each locality on 26 July, 2019. Twenty-five pieces of gauze, each (2 x 2 cm) with a drop of honey, were placed at 4 m intervals along each of the two, 100 m transects, and the baits containing ants were collected into the bottles filled with 70 % ethanol, after an hour. Twenty-five soil samples (each of 5 × 5 × 5 cm), were taken 1 m right to each transect at 1 m intervals and sifted using a sieve and a white tray; Worker ants fallen to the white tray were preserved in

the bottles filled with 70 % ethanol. Twenty-five honey-baited pitfall traps (white plastic cups of 7.5 cm diameter at the mouth and 80 ml of volume; a twig with a drop of honey kept on the mouth) (Dias & Perera, 2011; Dias and Udayakantha, 2019) each half-filled with 50 % ethanol were set at 4 m intervals along each transect. After 5 hours, all fallen ants observed in the pitfall traps were preserved in the glass bottles filled with 70 % ethanol. Worker ants crawling on the ground or bushes within a radius of about 80 cm were collected for five minutes at 2 m intervals along each transect and collected into glass vials filled with 70 % ethanol using a paint brush (No. 0) or a pair of fine forceps. Collected ants were identified to the furthest possible taxonomic level using a Low Power Stereo-microscope (ZEISS Stemi-305) with reference to Bingham (1903), Bolton (1994, 2003), Dias (2014), Fischer et al. (2014), Francisco and Fisher (2015), Sarnat et al., (2015), Schmidt & Shattuck (2014), AntWeb, http://www.antweb.org and AntCat, http://www.antcat.org . The preliminary inventory of ants of the forest was compiled by pooling the observations made from each method. The dry-mounted and wet-preserved ant specimens were deposited at the Regional Centre for Asian Ant Research, University of Kelaniya, Sri Lanka.

Measurement of Environmental Parameters

Air and soil temperatures were measured at three representative places in each locality using a laboratory, mercury thermometer and a soil thermometer (Spectrum Technologies) respectively and the mean value of each parameter (Woodco M2707) for the selected region was calculated. The depth of leaf litter was measured at three random places in each locality using a ruler and the range of litter depth for the region is presented.

Results

Twenty-one ant species of 11 genera in four subfamilies: Dolichoderinae, Formicinae, Myrmicinae and Ponerinae were observed at the two localities (Table 1). Sampling methods that caught each ant species are also presented in Table 1. Eighteen species of nine genera in the four subfamilies: Dolichoderinae, Formicinae, Myrmicinae and Ponerinae were collected by

hand collection method and 13 species of eight genera in three subfamilies:Dolichoderinae, Formicinae and Myrmicinae were observed in honey baits. Soil sifting caught worker ants of three subfamilies: Dolichoderinae, Formicinae and Myrmicinae in seven genera and 11 species while pitfall trapping resulted two subfamilies, Formicinae, Myrmicinae, three genera and three species.

Table 1. *Ant subfamilies and species observed in Rilagala Forest Reserve and the species observed by each sampling method*

B - Honey baiting; H - Hand collection; P - Pitfall trapping; S - Soil sifting

Subfamily	**No.**	**Species**	**Sampling method**
Dolichoderinae	1	*Dolichoderus thoracicus* (Smith F., 1860)	B, H, S
Formicinae	2	*Camponotus irritans* (Smith F., 1857)	B, H, S
	3	*Camponotus opaciventris* Mayr, 1879	B, H, S
	4	*Camponotus thraso diogenes* Forel, 1909	B, H, S
	5	*Lepisiota modesta* (Forel, 1894)	B, S
	6	*Nylanderia indica* (Forel, 1894)	B, H, S
	7	*Nylanderia yerburyi* (Forel, 1894)	H, P
	8	*Polyrhachis rupicapra* Roger, 1863	H
Myrmicinae	9	*Crematogaster contemta* Mayr, 1879	B, S
	10	*Crematogaster subnuda* Mayr, 1879	H
	11	*Cardiocondyla kagutsuchi* Terayama, 1999	H

	12	*Lophomyrmex quadrispinosus* (Jerdon, 1851)	P
	13	*Pheidole barreleti* Forel, 1903	B, H, S
	14	*Pheidole butteli* Forel, 1913	B, H, S
	15	*Pheidole hortensis* Forel, 1913	H
	16	*Pheidole nodus* Smith F., 1874	H, P
	17	*Pheidole* sp. 5	B, H, S
	18	*Tetramorium bicarinatum* (Nylander, 1846)	B, H, S
	19	*Tetramorium tortuosum* Roger, 1863 (variety 1 and 2)	B, H, S
	20	*Tetramorium walshi* (Forel, 1890)	B, H, S
Ponerinae	21	*Leptogenys diminuta* (Smith F., 1857)	H

Six endemic ant species: *N. yerburyi*, *P. rupicapra*, *P. barraleti*, *P. nodus*, *P. hortensis* and *P. butteli* were recorded from the survey.

Mean air temperature of 17±0.0 °C, soil temperature of 14±0.5 °C and the range of litter depth: 0-1 cm were also recorded.

Discussion

Ant fauna in a Forest Reserve of Nuwara-Eliya District was surveyed for the first time and the first preliminary inventory of ants at Rilagala Forest Reserve is presented here. The hand collection method can be considered the most successful sampling method of ants in Rilagala Forest Reserve because of a relatively higher number of species collected by the method. Also, a considerable number of ants were collected by honey baiting and soil sifting methods, yet three species of ants only were caught in the pitfall traps. Due to

the rainy weather prevailed on this day, the pitfall traps were left in the field for a shorter time period (five hours) and it may have affected the collection.

Among the 341 valid ant species (including 82 endemic species) in 79 genera of 11 subfamilies in the checklist for the country (Dias et al., 2020), 6.2 % out of total number of species survive in the forest. Moreover, 7.3 % of the total endemic species was also reported from Rilagala Forest Reserve.

All other species except *N. indica*, *N. yerburyi*, *P. rupicapra*, *T. tortuosum*, *T. walshi* were recorded for the first time from Nuwara-Eliya District (Bolton, 1976; Bolton, 1977; Emery, 1893). After more than 100 years of last record (Bingham, 1903), *C. subnuda*, *L. diminuta* and *P. rupicapra* were reported in Sri Lanka.

Twenty-one species in 11 genera of four subfamilies: Dolichoderinae, Formicinae, Myrmicinae and Ponerinae can be considered a preliminary ant inventory of Rilagala Forest Reserve and it can be indicated that diverse ants can also survive at lower temperatures in the cold Montane Forests in Sri Lanka. Further ant surveys in such forests are encouraged to document ant diversity in the country.

Conclusions

Twenty-one species including five endemics in 11 genera of Dolichoderinae, Formicinae, Myrmicinae and Ponerinae were recorded in Rilagala Forest Reserve, Nuwara Eliya District, Sri Lanka.

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