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ANEURETUS SIMONI EMERY OCCURRENCE AND THE ANT COMMUNITY OBSERVED BY MULTIPLE METHODS AND REPEATED SAMPLING IN "POMPEKELLE", SRI LANKA

Ratnayake K. S. Dias
Department of Zoology and Environmental Management, University of Kelaniya, Sri Lanka.

A B S T R A C T

The ant community of "Pompekelle" is of special interest due to the presence of island-endemic *Aneuretus simoni* Emery among them. Frequency of occurrence and proportional abundance of *A. simoni* workers and, species richness and composition of ant community were investigated using several sampling methods simultaneously on six visits to the forest from February to November 2004. Day time sampling of ants was carried out along ten, 100 m transects by mini-Winkler extraction, soil sifting, pitfall trapping, honey and canned fish baiting, leaf litter sifting, timed hand collection and beating tray method. Honey baits at 1 m height on trees and honey-baited pitfall traps on the ground were also set overnight. *Aneuretus simoni* workers were detected on all occasions. Honey baiting and litter sifting in day time caught the workers more often than canned fish baits, soil sifting, day time pitfall traps and night pitfall traps. Detectability of *A. simoni* was irregular in the ten transects but the frequency of occurrence ranged from 30-80 percent and the species comprised 1-6 percent of workers collected on each of the six occasions. It was a permanent minor component in the forest despite its absence in the area of transect 8. Fifty species of 36 genera in 11 subfamilies including the resident species, *A. simoni*, *Anochetus* sp., *Anoplolepis gracilipes*, *Camponotus* sp., *Hypoponera* sp. 2, *Lophomyrmex quadrispinosus*, *Myrmicaria brunnea*, *Odontomachus simillimus*, *Pheidole* sp. 7, *Pheidologeton* sp., *Prenolepis* sp., *Solenopsis* sp. and *Technomyrmex albipes* and other occasional ant species can be considered the first preliminary ant inventory of the forest.

Keywords: Sri Lankan Relict Ant, forest ants, ant sampling, fossil ants, insect survey.

INTRODUCTION

The second-growth forest around the city reservoir in Ratnapura, currently known as "Pompekelle" was recorded a habitat of *Aneuretus simoni* Emery (Sri Lankan Relict Ant) by Wilson et al. (1956). It is an evergreen secondary forest (GPS co-ordinates: 6° 41' and 6° 42' N; 80° 23' and 80° 24' E) of 13 ha and situated between 85 - 110 m of Mean Sea Level. Hundred and two species of flora including thirteen endemics have been recorded from the forest (Anonymous Ratnapura municipal council). It receives both southwest monsoon and inter-monsoon rain from May to September and air temperature ranges from 29^0C - 34^0C annually. Construction of roads and buildings subsequently by Ratnapura municipal council changed the forest immensely since 1955 and currently, most of the regions in the forest are highly disturbed by the humans. The forest floor is usually covered with a thick leaf litter layer. Absence of *A. simoni* was reported in "Pompekelle" in 1979 (Jayasuriya and Traniello 1985) but it was recovered in the forest in 2001 (Dias 2004). The ant community of "Pompekelle" was investigated through February, March, May, July, September and November using mini-Winkler extraction, soil sifting, pitfall trapping, honey and canned fish baiting, leaf litter sifting, timed hand collection and beating tray method (Romero and Jaffe 1989, Majer and Delabie 1994, Agosti and Allonso 2001, Bestelmeyer *et al*. 2000, Hashimoto *et al*. 2001, Ogata 2001) simultaneously in 2004. I report here the occurrence, positive methods, frequency of occurrence in ten random transects and relative

* Corresponding Author:
Email: rksdias@kln.ac.lk

abundance of *A. simoni* workers and, the species richness and species composition observed in "Pompekelle" on each occasion and throughout 2004.

MATERIALS AND METHODS

Field and laboratory methods: Ten locations of "Pompekelle" were surveyed for ants using several sampling methods along a 100 m transect laid in each of the locations on 17-20 February, 23-26 March, 25-27 May (six locations could only be covered due to heavy raining followed by a landslide), 25-27 July, 25-27 September and 26-29 November in 2004. Worker ants were sampled by (a) mini-Winkler sacks, (b) soil sifting, (c) pitfall trapping, (d, e) honey and canned fish baiting, (f) leaf litter sifting using a sieve and a white tray, (g) timed hand collection and (h) beating tray method. Within each transect:

(a) Five polythene bags were filled with leaf litter from five different 1 m^2 areas sampled at 20 m intervals along the transect and the litter in each bag was transferred to a mini-Winkler sack kept in the laboratory. The worker ants emerging after 48 h were preserved in 85% ethanol.

(b) Ten soil samples (each 20 x 20 wide x 10 cm deep) taken at 10 m intervals along a line which was parallel and 1 m left of the transect were sifted through a mesh and a white tray. All ants seen with the naked eye were collected into glass vials filled with 85% ethanol.

(c) Ten cups (volume:110 cm^3) half-filled with soap water were set during day time in the soil at 10 m intervals along a line parallel to 1 m right of the transect, with the mouth of the cups flush with the surface soil level. Also, ten plastic cups of 110 cm^3, each honey-baited and half-filled with 50% ethanol, were set in the evening in the soil along three transects and were collected at around 7:00 h in the following morning.

(d, e) Twenty five baits of each honey and canned fish (Jack Mackerel in natural juice with added salt), on a 5 x 5 cm piece of gauze, were placed alternately at 4 m intervals along the transect and the pieces of gauze and attending ants were collected after one hour into a plastic bottle filled with 50% ethanol.

(f) Ten litter samples (each of one full sieve) taken at 10 m intervals along the transects were sifted into a white tray and ants seen with the naked eye were collected into glass vials filled with 85% ethanol.

(g) Worker ants crawling on the forest floor were hand-collected for 10 minutes, around a point approximately 10 m apart from the next, with ten such points in each transect.

(h) Ten trees at 10 m intervals along each transect were beaten by a pole and ants fallen to the polythene sheet were collected into glass vials filled with 85% ethanol.

In addition, honey baits at 1 m height on trees and honey-baited pitfall traps on the ground were also set overnight along three transects. Collected ants were preserved in 85% ethanol and number of *A. simoni* workers and other ants in each sample was recorded. Identification of worker ants to the furthest possible taxonomic level was completed under a low power stereo-microscope at suitable magnifications with reference to Bolton (1994, 2003) and the ant repository at the Department of Zoology, University of Kelaniya, Sri Lanka and with the assistance of Prof. Seiki Yamane, Kagoshima University, Japan. Percentage frequency of occurrence of *A. simoni* in the ten transects and its percentage relative abundance among the total number of ants caught were calculated. Scientific names of ants are presented according to AntWeb, http://www.antweb.org., (2014). Homogeneity of species richness values observed on six visits was tested using the Chi-square Homogeneity test.

Measurement of environmental parameters: During each survey, air and soil temperature at the start, middle and end points of each transect were measured using a thermometer and the mean value per transect was recorded. Depth of the leaf litter layer was measured in the same manner using a ruler, and the mean depth (cm) per transect was recorded. Similarly, three subsamples of soil from each transect were brought to the laboratory and soil humidity (Brower et al. 1998) of each transect was recorded. The mean value of each parameter was estimated from the measurements in ten locations on each occasion.

RESULTS

Species composition and species richness of worker ants: Table 1 shows that worker ants belonging to eleven subfamilies including Aneuretinae, thirty six genera and fifty species were recorded from the six visits to "Pompekelle" in 2004. Number of subfamilies recorded on each of 1- 6 occasions was 9, 10, 5, 8, 5 and 7, respectively. Thirteen species, *Aneuretus simoni*, *Anochetus* sp., *Anoplolepis gracilipes*, *Camponotus* sp., *Hypoponera* sp. 2, *Lophomyrmex quadrispinosus*, *Myrmicaria brunnea*, *Odontomachus simillimus*, *Prenolepis* sp., *Pheidole* sp. 7, *Pheidologeton* sp., *Solenopsis* sp. and *Technomyrmex albipes* were common to all occasions. *Centromyrmex feae*, *Cerapachys* sp., *Pachycondyla* (*Bothroponera*) sp., *Pristomyrmex* sp.,

Protanilla sp., *Pseudolasius* sp. and *Strumigenys* sp. were recorded on one or two occasions whereas other species were recorded on three to five occasions. Significantly higher species richness was recorded in March than that observed on other occasions (Chi-square = 12.2656; $p<0.05$). Next most diverse ant community was noticeable in February. Significantly lower species richness, 23, was observed in May and September but different species were recorded on the two occasions (Table 1).

Table 1. Continued. Species richness and composition of worker ants recorded from "Pompekelle" in February, March, May, July, September and November in 2004 showing the *A. simoni* presence and the overall ant community observed through six occasions.

Subfamily	Species	Feb.	March	May	July	Sep.	Nov.	Overall
1. Aenictinae	*Aenictus* sp.	√	√	-	√	-	-	√
2. Amblyoponinae	*Amblyopone* sp.	-	√	-	√	-	√	√
3. Aneuretinae	*Aneuretus simoni** Emery	√	√	√	√	√	√	√
4. Cerapachyinae	*Cerapachys* sp.	-	-	-	√	-	√	√
5. Dorylinae	*Dorylus* sp.	√	√	-	-	-	-	√
6. Dolichoderinae	*Dolichoderus* sp.	√	√	-	√	√	-	√
	Tapinoma indicum Forel	√	√	-	-	-	-	√
	Tapinoma melanocephalum Fabricius	-	√	-	-	-	√	√
	*Technomyrmex albipes** (F. Smith)	√	√	√	√	√	√	√
	Technomyrmex bicolor Emery	-	-	-	-	√	√	√
7. Formicinae	*Anoplolepis gracilipes** (Smith)	√	√	√	√	√	√	√
	Camponotus sp. 1*	√	√	√	√	√	√	√
	Oecophylla smaragdina Fabricius	√	√	-	√	-	√	√
	Paratrechina longicornis Latreille	√	√	-	-	-	-	√
	Polyrhachis sp.	-	√	√	√	-	√	√
	Prenolepis sp.*	√	√	√	√	√	√	√
	Pseudolasius sp.	√	√	-	-	-	-	√
8. Leptanillinae	*Protanilla* sp	√	√	-	-	-	-	√
9. Myrmicinae	*Cataulacus* sp.	√	√	-	√	-	-	√
	Calyptomyrmex sp.	√	√	√	√	√	-	√
	Crematogaster sp.	-	-	-	√	-	-	√
	*Lophomyrmex quadrispinosus** (Jerdon)	√	√	√	√	√	√	√
	Meranoplus bicolor Guerin-Meneville	√	√	-	-	-	-	√
	Monomorium sp.	√	√	-	√	√	√	√
	Myrmicaria brunnea Saunders*	√	√	√	√	√	√	√
	Carebara sp.1	√	√	-	√	-	-	√
	Carebara sp. 2	√	√	-	-	-	-	√
	Pheidole sp. 1	√	√	-	-	-	√	√
	Pheidole sp. 2	-	√	-	-	-	-	√
	Pheidole sp. 3	-	-	√	√	√	-	√
	Pheidole sp. 7*	√	√	√	√	√	√	√
	Pheidole sp. 8	-	-	-	√	-	-	√
	*Pheidologeton diversus** (Jerdon)	√	√	√	√	√	√	√
	Pristomyrmex sp.	-	-	-	-	√	√	√
	Solenopsis sp.*	√	√	√	√	√	√	√
	Strumigenys sp.	-	√	-	-	-	-	√
	Tetramorium sp. 1	√	√	√	-	-	-	√
	Tetramorium sp. 2	√	√	√	√	√	-	√
	Tetramorium bicarinatum (Nylander)	√	√	√	√	-	-	√

10. Ponerinae	*Anochetus* sp.*	√	√	√	√	√	√	√
	Centromyrmex feae (Emery)	-	-	-	-	-	-	√
	Hypoponera sp. 1	√	√	√	√	-	-	√
	Hypoponera sp. 2*	√	√	√	√	√	√	√
	Leptogenys sp.	-	√	-	√	√	√	√
	*Odontomachus simillimus** F. Smith	√	√	√	√	√	√	√
	Pachycondyla sp.1	√	√	-	√	√	√	√
	Pachycondyla sp. 2	-	√	-	-	-	-	√
	Pachycondyla sp. 3	√	√	√	√	√	-	√
	Pachycondyla (Brachyponera) sp.	-	√	-	-	-	-	√
11. Pseudomyrmecinae	*Tetraponera allaborans* Walker	√	√	√	-	-	-	√
	Total No.	35	43	23	32	23	24	50

* common to six visits √ - Present - Absent.

Scientific names are given according to AntWeb, http://www.antweb.org., (2014); morpho-species numbers are according to author's collection kept at the Department of Zoology, University of Kelaniya, Sri Lanka.

Ecological aspects of *A. simoni* workers: Table 2 summarizes the sampling methods that caught *A. simoni* workers in each transect laid on each occasion, percentage frequency of occurrence in transects, 30% - 80%, and relative abundance of the species, 1% - 6%, observed on each occasion. Apparently, honey baiting and litter sifting in day time caught the workers more often than canned fish baits, soil sifting, day time pitfall traps and night pitfall traps. Honey-baited tree traps, mini-Winkler extraction or beating tray method did not collect *A. simoni* workers. Also, presence of *A. simoni* workers was observed at the transects 9 and 10 on other five occasions except in May (where sampling of ants could not be carried out due to heavy raining and a landslide in the forest) and the detection of the species was inconsistent in the other transects. The species was never recorded from the transect eight in 2004.

Table 2. Sampling methods that caught *A. simoni* workers in each transect laid and percentage frequency of occurrence (transect-wise) and relative abundance of this species in "Pompekelle".

- None was effective CB – Canned fish baits HB – Honey baits HC – Hand Collection LS – Litter sifting PT – Day time pitfall traps NPT – Night pitfall traps SS – Soil sifting.

Year 2004	Transect No.											
	1	2	3	4	5	6	7	8	9	10	Frequency of occurrence%	Relative abundance
February	HB	HB LS	-	-	-	LS	-	-	CB NPT	LS PT	50	1% (n = 2054
March	HB LS PT NPT	HB LS	CB LS HC	HC	-	HB	HB CB	-	LS	HB CB LS	80	4% (n = 2579)
May	HB CB LS	-	-	HB	HB LS	HB CB LS	*	*	*	*	60	6% (n = 739)
July	-	-	-	-	CB	HB SS	-	-	HB CB LS	LS	40	3% (n =1618)
September	HB PT NPT	-	-	-	-	-	-	-	HB LS	HB	30	1% (n = 1782)
November	LS	LS	-	-	LS	HB CB LS SS	-	-	HB LS SS	LS	60	2% (n = 1764)

*The locations that could not be sampled due to the sudden heavy raining and a land slide.

Environmental parameters: Mean values of air temperature, soil temperature, depth of leaf litter and soil humidity (Table 3) indicated the existence of more or less comparable environment on each sampling occasion. The highest soil humidity and the lowest litter depth were noticeable in May.

Table 3. Environmental parameters of "Pompekelle" on six sampling occasions in 2004 (mean ± S.D.).

Parameter	February	March	May*	July	September	November
Air temperature(^{0}C)	29.5 ± 2.3	28.3 ± 1.8	25.8 ± 1.0	27.0 ± 0.7	28.0 ± 1.6	28.6 ± 1.7
Soil temperature(^{0}C)	25.8 ± 0.9	26.6 ± 0.97	27.0 ± 1.1	26.1 ± 0.5	27.1 ± 1.7	28.0 ± 1.6
Mean Litter depth (cm)	3.5 ± 0.38	3.1 ± 1.2	1.8 ± 0.59	3.4 ± 0.42	3.3 ± 0.46	3.3 ± 1.7
Soil humidity%	22.0 ± 3.0	24.0 ± 2.5	34.0 ± 5.6	31.7 ± 3.2	30.8 ± 2.1	30.8 ± 1.6

* Means from six locations only.

DISCUSSION

Ant community of "Pompekelle" was surveyed using multiple simultaneous methods for the first time and similar comparative findings are not currently available. Eleven of the 12 subfamilies recorded from Sri Lanka (Dias 2008) and 36 of the 62 ant genera recorded from the island were observed in "Pompekelle" indicating a high diversity of ants in this human-disturbed forest. Members of Ectatomminae were never observed in this forest or other recent surveys conducted (Dias and Perera 2011) in Sri Lanka. Five subfamilies, Aneuretinae, Dolichoderinae, Formicinae, Myrmicinae and Ponerinae (according to current classification) and all genera, *Pheidole*, *Myrmicaria*, *Paratrechina, Technomyrmex*, *Polyrhachis*, *Camponotus* and *Technomyrmex* except *Ponera* and *Euponera* reported by Wilson *et al*. (1956) from "Pompekelle" were recorded in 2004 (Table 1). Lower soil humidity values resulted from lesser rainfall in February and March may be a reason for observing higher number of ant species on the two occasions than those observed on each of the other occasions. Due to heavy rainfall and a landslide in "Pompekelle" in May, six locations were only surveyed for ants so that a lower species richness was recorded. Similarly, lower species richness due to the heavy raining was observed in September. Wilson *et al*. (1956) and Dias (2004) recorded *Aneuretus simoni* from "Pompekelle" on a single occasion and the present results confirmed its continuous existence in the forest in 2004 for the first time, which is contrary to the evidence for extinction of this species in 1979 (Jayasuriya and Traniello 1985). Species richness recorded on each visit ranged from 23-43 and did not represent the ant community in the forest but that of repeated sampling rose to 50 indicating the importance of such sampling in a survey. Environmental conditions such as soil temperature (25.8 ^{0}C to 28 ^{0}C in 2004) and soil humidity (22% to 34% in 2004) (Table 2) were within the ranges observed in the Gilimale Forest Reserve (Dias and Perera 2011), another habitat of the species, and seemed favourable for the survival of this rare and endemic species. Values of frequency of occurrence as well as relative abundance of *A. simoni* showed that it was a permanent, minor component of the ant community in 2004. It appeared that honey baits and litter sifting resulted *A. simoni* more often than other sampling methods. Also, it was attracted to both honey and canned fish baits on some of the occasions indicating its omnivorous food habit (Wilson et al. 1956, Jayasuriya and Traniello 1985). It should be diurnal in habit because very few workers were very occasionally observed in night pitfall traps. The species listed in Table 1 can be considered the first preliminary inventory of ants of "Pompekelle". In future studies, it will serve as a reference for ant researchers and ecologists. Presence of generalists, opportunistic and tramp ant species indicated severe human interference in "Pompekelle" and need for conservation of this forest to protect *A. simoni* and the other rare species recorded in Table 1.

CONCLUSIONS

1. Soil sifting, day and night pitfall trapping, baiting, leaf litter sifting and timed hand collection inconsistently caught *A. simoni* workers. Apparently, honey baiting and litter sifting in day time more often caught them than other methods.
2. *Aneuretus simoni* existed in "Pompekelle" throughout 2004 except along the transect 8. It is a permanent minor component of the ant community of the forest.
3. Species richness of ants recorded on each visit ranged 23 - 43 but rose to 50 due to the sampling on six such occasions.
4. Fifty ant species of 36 genera in 11 subfamilies recorded for the first time by multiple sampling methods and repeated sampling can be considered the first preliminary inventory of "Pompekelle".

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