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Community composition of dung beetle and population dynamics of *Tiniocellus spinipes* in a scrub jungle ecosystem

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Abstract

The community composition of dung beetles inhibiting the scrub jungle ecosystem was recorded by sampling beetles associated with dung pads. The survey period of two years yield 62159 individuals comprising of 33 dung beetle species belonging to the subfamilies Scarabaeinae, Coprinae and Aphodiinae. Scarabaeinae were found to be dominant in terms of species richness and abundance. *Aphodius conspurcatus*, *Aphodius prodromus* and *Tiniocellus spinipes* were the most dominant species. Further, the population dynamics of *T.spinipes* in relation to the temporal changes in the abiotic factors are also discussed as they appear to render the maximum ecological services.

INTRODUCTION

Dung beetles have been widely proposed as an ideal group for biodiversity inventories and monitoring, as they satisfy all of the criteria of a focal taxon and have been used in ecological research, biodiversity surveys and conservation work in many regions of the world [1]. Dung beetles are found in defined guilds that are functionally and taxonomically dependent upon the environment [2], [3], [4], [5]. Scrub jungle is rich in flora and fauna also form the life line of major herbivores. The scrub jungle within Madras Christian College campus, spread over 365 acres, and adjacent to the Vandalur Reserve Forest, was selected as it is the second largest scrub jungle in Asia with vegetation typically of the tropical dry evergreen forest type. This unique ecosystem spreads through the biologically diverse and productive habitat of native flora and fauna and is aesthetically blended with introduced vegetation. Seasonality is a common phenomenon in insect populations.

Seasonal fluctuations are often influenced by environmental factors including temperature, photoperiod, rainfall, humidity, variation in the availability of food resources, and vegetation cover such as herbs and shrubs [6], [7], [8], [9]. Climatic factors are effective on the survival, development and reproductive capacity of beetles. Their activities are mostly dependent on the environmental temperature for maintenance. Different levels of humidity and rainfall, likewise, increase or reduce the population of certain insect species [10]. Dung beetles are commonly associated with dung and extensive surveys have shown moderate populations in localized pockets. An attempt is made here to investigate the composition of dung beetle community in the scrub jungle and specifically study *Tiniocellus spinipes*, describing the pattern of population abundance and their dynamics in relation to the temporal changes in the abiotic factors of the environment.

MATERIALS AND METHODS

The scrub jungle was surveyed along the transect line cutting across the forest on a bimonthly basis. During every survey, 10 dung pads were randomly selected across the transect line and all species of dung beetles encountered were enumerated both in terms of the numbers of species as well as the number of individuals of each species. Beetles were collected by hand picking and water flotation methods. After enumeration they were released into the same habitat. All population counts were made during early morning hours between 7- 9 AM, followed by similar examination during 4-6 PM. This exercise was done every fortnight over a period of 2 years from January 2010 to December 2011.

Data analysis: For the interpretation of collected data, the year was divided into four periods: southwest monsoon - SWM (June to September), northeast monsoon - NEM (October to December), winter (January to February) and hot summer (March to May). Data pertaining to the abiotic factors such as monthly maximum and minimum temperatures, maximum and minimum relative humidity, and total rainfall was taken from the nearest meteorological station. The mean monthly data of the population was analysed statistically with the weather data by computing the Correlation coefficient.

RESULTS

A total of 62159 individuals comprising of 33 dung beetle species (Table I) from three sub families and ten genera were recorded during the present study (Table II). Scarabaeinae was the dominant family in term of species richness (23 species; 80% of genera) and abundance, followed by Coprinae (8 species; 10% of the genera). Aphodiinae was represented by only two species in the survey (Table 2). *Aphodius conspurcatus* (Linnaeus, 1758), *Aphodius prodromus* (Brahm, 1790) and *Tiniocellus spinipes* Roth, *1851* were the most common species.

Fig 1 describes dung beetle abundance patterns during different seasons. Most of the dung beetles were observed during the South west monsoon. The ideal breeding season for most of the dung beetles was South west monsoon and it continued till the north East monsoon. This is due to the fact that during these seasons scrub jungle receives sufficient rain and prevalence of conducive temperature (27ºC).

Among the three most common species of dung beetles observed in the ecosystem, *T. spinipes* was the most abundant. Obviously they must contribute the maximum to the ecological services rendered by dung beetles. Fig. 2 depicts the population

Table 1. List of dung beetles inhabiting the scrub jungle.

Species	**Nesting guild**	**Sub family**
Aphodius conspurcatus (Linnaeus, 1758)	D	Aphodiinae
Aphodius prodromus (Brahm, 1790)	D	Aphodiinae
Caccobius unicornis Fabricius, 1798.	T	Scarabaeinae
Caccobius vulcanus (Fabricius,1801)	T	Scarabaeinae
Copris carinicus Gillet, 1910.	T	Coprinae
Copris davisoni Waterhouse, 1891.	T	Coprinae
Copris excises Waterhouse, 1891.	T	Coprinae
Copris imitans Felsche, 1910.	T	Coprinae
Copris minutes (Drury, 1773)	T	Coprinae
Copris repertus Walker, 1858.	T	Coprinae
Copris signatus Walker, 1858.	T	Coprinae
Copris sinicus Hope 1842.	T	Coprinae
Digitonthophagus bonasus (Fab., 1898).	T	Scarabaeinae
Digitonthophagus gazella (Fab.,1787).	T	Scarabaeinae
Euoniticelles fulvus Goeze, 1777.	T	Scarabaeinae
Euoniticelles pallens Olivier, 1789.	T	Scarabaeinae
Euoniticelles pallipes (Fabricius,1781)	T	Scarabaeinae
Gymnopleurus gemmatus Harold, 1871	R	Scarabaeinae
Gymnopleurus koenigi Fabricius,1775.	R	Scarabaeinae
Oniticellus cinctus (Fabricius, 1775).	D	Scarabaeinae
Onthophagus amicus Gillet, 1925.	T	Scarabaeinae
Onthophagus centricornis (Fab., 1798)	T	Scarabaeinae
Onthophagus cervus (Fabricius, 1798).	T	Scarabaeinae
Onthophagus dama Fabricius, 1798).	T	Scarabaeinae
Onthophagus ensifer Boucomont, 1914.	T	Scarabaeinae
Onthophagus favrei Boucomont, 1914.	T	Scarabaeinae
Onthophagus hecta (Panzer, 1794).	T	Scarabaeinae
Onthophagus rectecornus (Lansb., 1883).	T	Scarabaeinae
Onthophagus tragoides Boucomont 1914.	T	Scarabaeinae
Onthophagus turbatus Walker, 1858.	T	Scarabaeinae
Sisyphus crispatus hirtus Wiedeman. 1823.	R	Scarabaeinae
Sisyphus neglectus Gory, 1833.	R	Scarabaeinae
Tiniocellus spinipes Roth, 1851.	T	Scarabaeinae

Table 2. Total number, percentage of genus, species and individuals collected per sub family.

Sub Family	No. Of genera	No. Of Species	No. Of individuals
Aphodiinae	1 (10%)	2 (6.061%)	15909 (25.594%)
Coprinae	1 (10%)	8 (24.242%)	7119(11.453%)
Scarabaeinae	8 (80%)	23 (69.697%)	39131 (62.953%)
Total (3)	**10**	**33**	**62159**

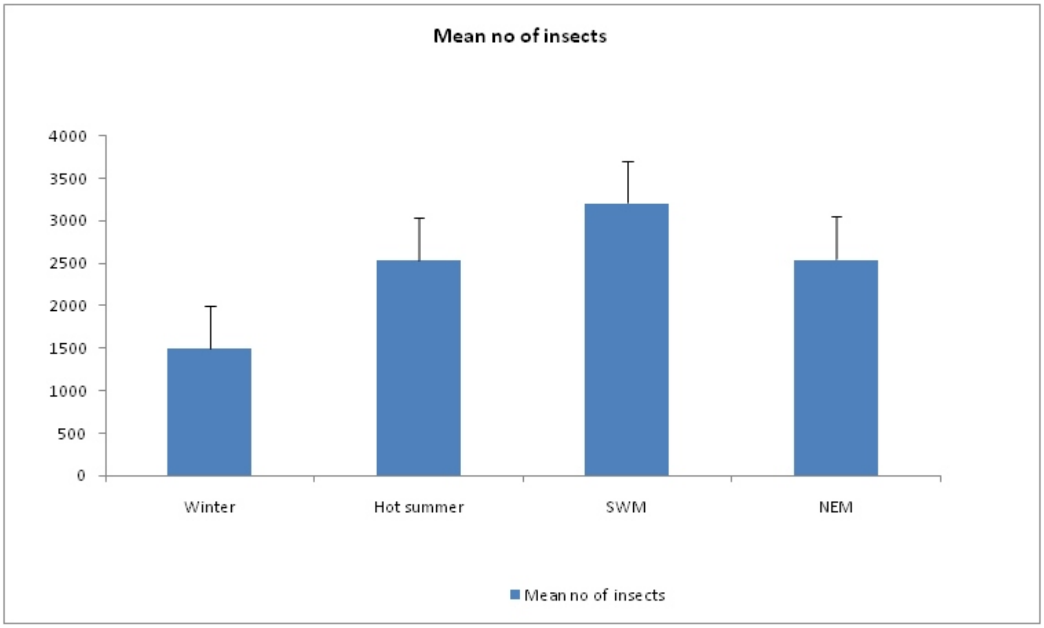

Fig 1. Seasonal abundance pattern of dung beetle community in Scrub jungle ecosystem.

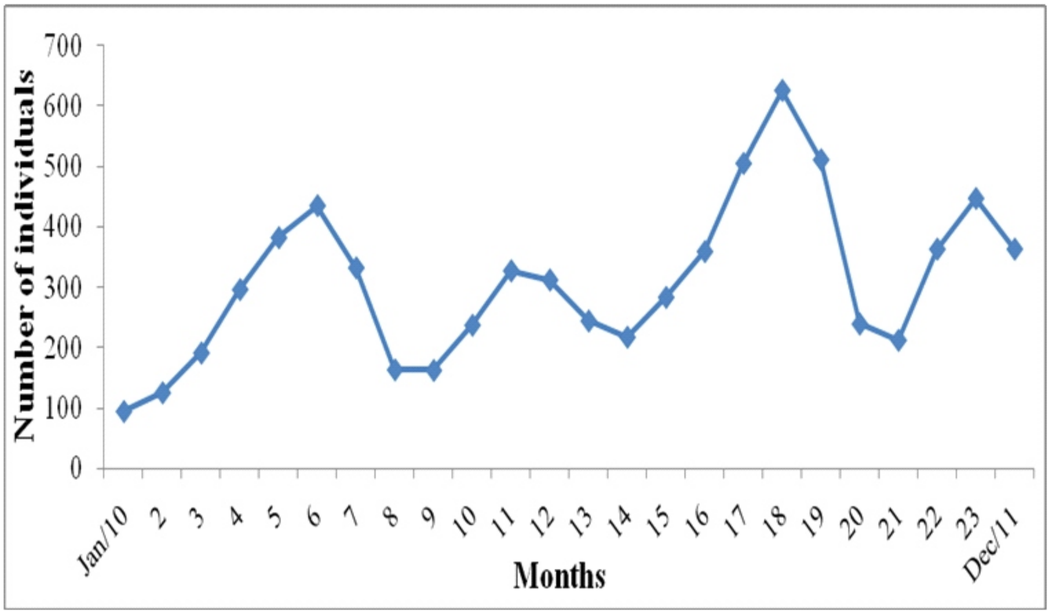

Fig 2. Population fluctuation of T.spinipes in Scrub jungle ecosystem.

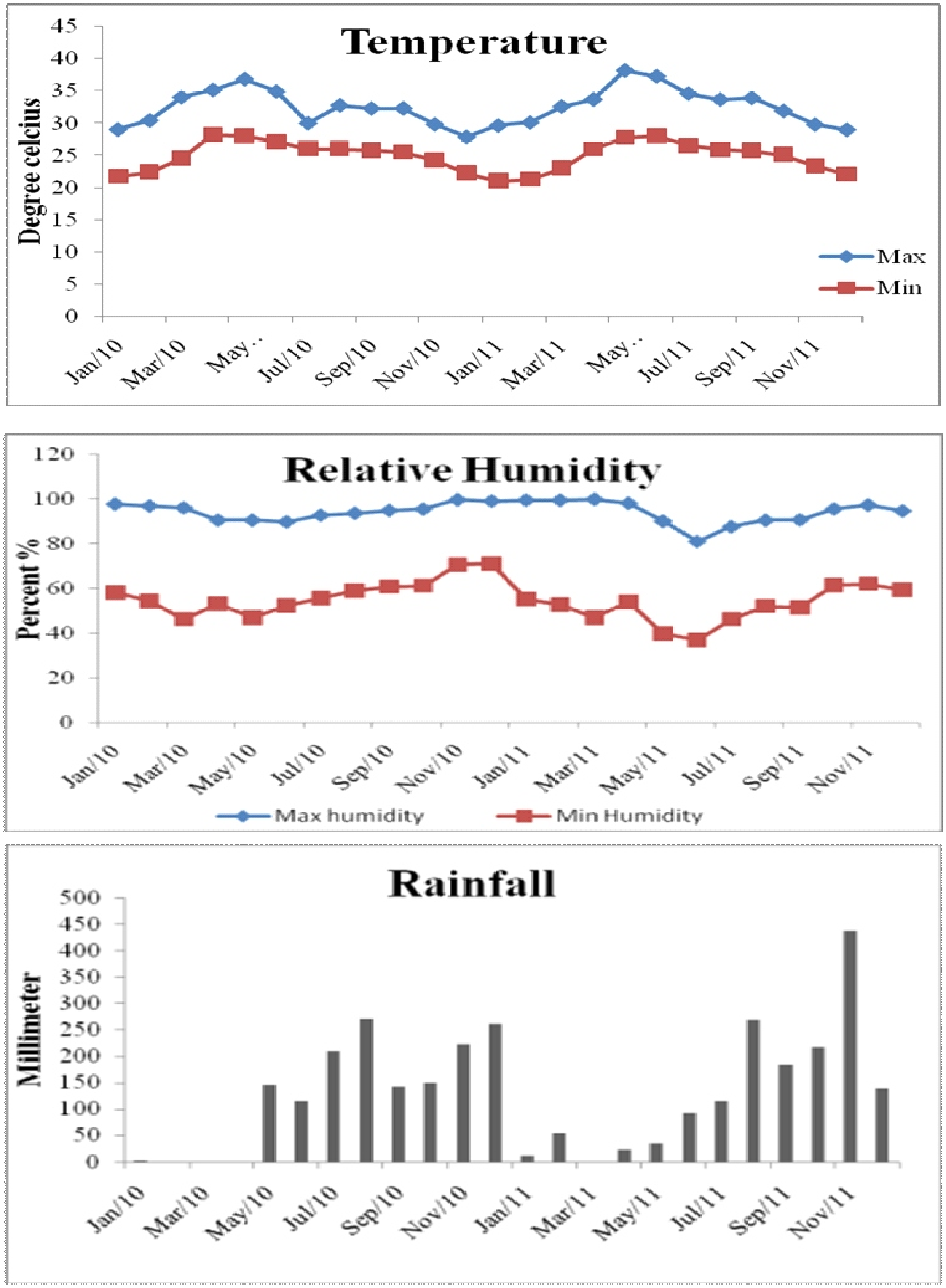

Table 2. Effect of different media on seed germination and required days to seed germination of *Acampe papillosa*

fluctuation of *T.spinipes* during the two years of monitoring at the selected scrub jungle ecosystem. Adults were recorded throughout the year. A bimodal peak was noticed during each year, one during June and another during December.

Analysis of the abiotic factors viz., minimum and maximum temperatures, minimum and maximum relative humidity and total rainfall of scrub jungle ecosystem indicate temperature (Maximum and minimum) was the least during December to January (21ºC to 28.16ºC) and peaked in May each year (27.933 ºC to 38.16 ºC). Relative humidity was low during the summer months of May-June, while during the cooler months of the year (December - February); the relative humidity was 99.7%. Each year there was rainfall in October. No rainfall was recorded during the months of February and March. Slight rainfall was recorded during the summer months. The maximum rainfall recorded was 435.9 mm during November 2011 (Fig 3).

Table 3. Correlation coefficient between T.spinipes population and abiotic factors.

Maximum temperature	Minimum temperature	Maximum humidity	Minimum humidity	Rainfall
0.4816	0.4901	-0.584	-0.398	0.1706

Rising environmental temperature beyond 35ºC during month of May acts as limiting factor on *T.spinipes* population resulting in a sudden drop in its density. A positive correlation value of 0.48 and 0.49 was computed between the population and the maximum and minimum temperature respectively. There was also a slight negative correlation between the population of *T.spinipes* and maximum relative humidity (Table III).

DISCUSSION

Dung beetles are important decomposer organisms, involved with nutrient recycling, seed dispersal and the control of vertebrate parasites (by removal of source of infection), and are therefore an important component of forest systems [11]. The species distribution and the Species abundance pattern were similar with that of the pattern observed by many researchers [6], [12], [13].

The abiotic factors such as temperature and rainfall play a vital role for dung beetles abundance. In tropical regions with distinct wet and dry seasons, many insect species attain maximum adult abundance during the wet seasons [14]. In agreement with the above observation, the present study also revealed that the dung beetle abundance and species diversity were more during South West Monsoon than during the other periods.

Dung being an epimeral food resource, they are available in the habitat throughout the year this cannot be the limiting factor. Since dung beetle *T.spinipes* is also available throughout the year and the species is able to adapt to the environment, the fluctuation in the population could be due to the abiotic factors. Many researchers carried forward the idea of the effect of increasing temperature typically accelerate the biological activity of the insects in general [15], [16]. The influence of temperature also corresponds to the observation on the development of *T.spinipes* in laboratory cultures where, as the room temperature increased beyond 35ºC, higher incidence of mortality in the culture was observed. Like other insects, the population of *T. spinipes* is governed by their innate ability to increase, under the influence of various environmental factors.

CONCLUSION

The composition of dung beetles community inhibiting scrub jungle shows that Scarabaeinae dominates Coprinae and Aphodiinae species. The abiotic factors also influence the dung beetle abundance. In addition to the abiotic factors there might be other limiting factors namely parasite (such as fungi, mites, gregarines, microsporidia and nematodes) and predators which greatly affect the dung beetle population.

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