

STUDY ON COLEOPTERAN FAUNA IN SOIL AND LITTER OF WAGA NATURAL FOREST RESERVE IN SRI LANKA

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INTRODUCTION

Fertile top soil is a valuable natural resource, forming the life sustaining layer of the earth. Due to leaf fall and semi decomposed plant materials the surface covering of the soil is known as the litter layer. Both litter and soil are favorable habitats for living organisms (Anderson, 1983). The soil contains a diverse population of arthropods. They are viewed as regulators of the decomposition of the forest.

Coleopterans are the largest order of insects, and those that are associated with soil and litter are a numerically and functionally diverse group (Dindal 1990, Edirisinghe 1997, Qader and Edirisinghe, 2012). These organisms play an integral part in the above- and below-ground food webs, and can impact litter decomposition (Witkamp and Crossley, 1966, Peterson and Luxton, 1982) and nutrient dynamics within the soil/litter interface (Lattin, 1993).

Soil and litter Coleopterans are cosmopolitan, rich in species and yet poorly studied because of their small size and cryptic habitats. However they play a major role in nutrient cycling and contribute valuable data to the study of comparative biodiversity and conservation. Due to their species richness and cosmopolitan occurrence they are used as indicator species for identifying habitat differences.(Sakchoowong *et al.*,2008).

Because of the ubiquitous distribution and functional diversity of ground and litter dwelling Coleopterans, habitat conditions and habitat perturbations could have profound impacts on their abundance and diversity.

In the view of above facts, the study was undertaken with the following objectives; to identify the litter and soil Coleopterans in three habitats, to estimate the population density of Coleopterans in three habitats and to study the correlation between physical and chemical factors with population density.

METHODOLOGY

Three microhabitats were selected in the *Indikada* Forest Reserve, Waga as the study sites, namely a disturbed site (the site which is interfered by human activities),an undisturbed site (the site which is not interfered by human activities) and a riverine site (the site which is adjacent to the river). In each study site 50m x 50m plots were selected for sampling. During the study period (September 2010 – April 2011), monthly samples of litter and soil were collected, using standard quadrant method. (0.2m×0.2m×0.1m) In each plot four soil and four litter samples were collected in a stratified random way. Additional samples were collected to determine the chemical properties (soil pH, soil moisture) and physical properties (soil temperature, wind speed, light intensity) were measured at the spot using field instruments. The soil and litter samples were investigated by extraction method, floatation method and Winkler's sieving method (for litter) to extract the animals and they were identified and classified by using standard keys. The data were analyzed by using Minitab programme.

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RESULTS AND DISCUSSION

In all three study sites, adult and larval forms of ten Coleopteran families were observed. The identified Coleopterans belong to five major families, Carabidae, Staphylinidae, Scarabaeidae, Scolytidae and Elateridae (25-90 Number per square meter N/m^2) and five minor families, Curculionidae, Phyrochroidae, Coccinellidae, Chrysomelidae and Cerambycidae (5-15 N/m^2).

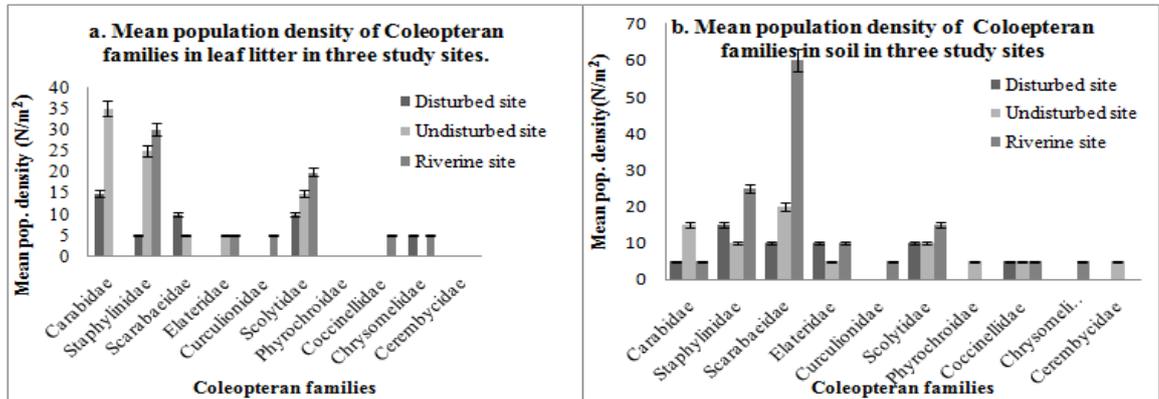


Figure 1: Comparison of mean population densities of Coleopteran fauna in litter and soil.

Figure 1.a, shows that the families Carabidae, Staphylinidae and Scolytidae were more abundant in litter fauna in the three study sites than the other Coleopteran families. In soil fauna Carabidae, Staphylinidae, Scarabaeidae, Elateridae, Coccinellidae and Scolytidae are the most frequently present Coleopteran families in the three study sites. Fig.1a and 1b clearly shows that the Coleopteran family Phyrochroidae was recorded only in undisturbed soil and was not recorded in the litter of any other sites.

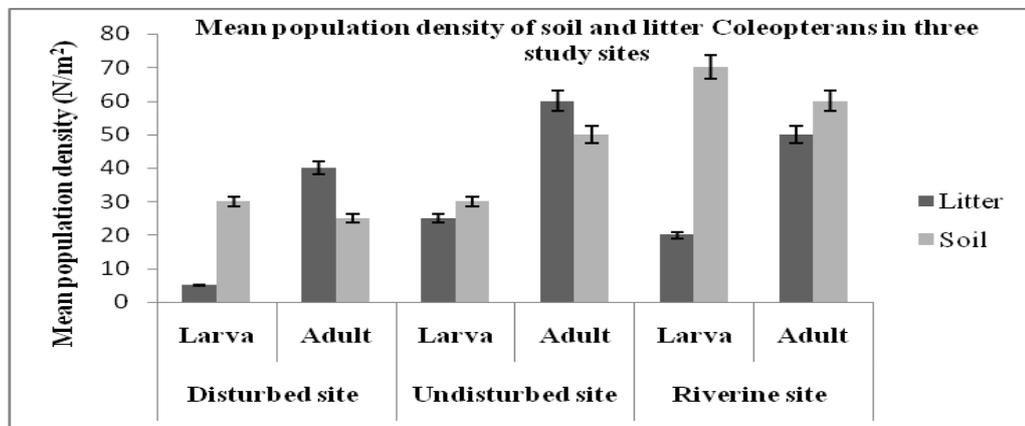


Figure 2: Comparison of mean population densities of larval and adult Coleopterans in soil and litter.

According to Figure 2, mean population density of soil Coleopterans were significantly higher ($p>0.05$) than the litter Coleopterans ($p<0.05$). The riverine site recorded the highest population density of soil and litter Coleopterans (260 N/m^2) than the disturbed and undisturbed sites (100 N/m^2 and 165 N/m^2 respectively). This may be because favourable conditions (chemical or physical) in riverine habitats support high density of Coleopterans. Adult Coleopterans in the undisturbed site were significantly ($p>0.05$) higher than other two sites. The same observations has been found in Sinharaja wet zone forest and Sigiriya dry zone forest by Edirisinghe (1997). Furthermore, population density of the larval forms of Coleopterans were significantly high in the riverine site ($p>0.05$). Correlation coefficients for physical and chemical factors and mean population density of soil and litter Coleopterans.

Table 1: Correlation coefficients for physical and chemical factors verses mean population density of soil and litter Coleopterans.

	Annual rainfall	Soil temperature	Soil moisture content	Soil acidity	Habitat type		
					Undisturbed	Disturbed	Riverine
Mean population density	-0.48	-0.57	0.35*	0.67*	0.54*	-0.12	0.78*

*Significant in 5% confidence level

The variation patterns of soil and litter Coleopterans are usually associated with changing physical and chemical factors. This variation was subjected to statistical analysis (p values) by correlation. According to Table 1, physical and chemical factors greatly influence the mean population density of Coleopterans. According to the correlation coefficients, soil moisture content, soil acidity and habitat type show significant positive correlation to high population density. When the soil moisture and soil acidity increases, mean population density of Coleopterans increased. Similar observations were reported in a study conducted previously at the same site by Qader and Edirisinghe (2012).

Mean population density showed a significant negative correlation with annual rainfall, soil temperature and disturbance. Natural conditions like, rainfall and temperature and human influence like disturbances to the forest community seems to have a negative effect on the growth and development of Coleopterans.

The population density of soil Coleopterans in the riverine site is higher than in other sites. According to the previous study conducted in the same sites, high soil acidity (pH= 5.3 - 6.2) was recorded in the riverine soil than in the other two sites. (Qader and Edirisinghe, 2012). Coleopteran larvae prefer acidic conditions rather than basic conditions for their survival. Therefore the high acidity level in the riverine site is more favourable to Coleopterans and may contribute to high population density of soil Coleopterans in the riverine site compared to other sites.

The undisturbed site is a natural forest type and therefore a high amount of litter is present. The high density of litter Coleopterans recorded in the undisturbed site may be due to the feeding habitats of Coleopterans, feeding on leaves and other plant debris in the litter. Therefore a high population density of litter Coleopterans was recorded in the undisturbed site. The low coleopteran densities were recorded in the disturbed site compared to the other two sites. Similar observations has been observed in disturbed and undisturbed forest land in the Amani nature reserve, Tanzania by Patricia and Theogene (2005) This indicates that when their habitat type is disturbed population density of Coleopterans is decreased.

CONCLUSIONS

There are five main coleopteran families that show vast distribution in all three habitats in the Waga natural forest reserve. The main Coleopteran families are Carabidae, Scolytidae, Staphylinidae, Elateridae and Scarabaeidae. The other five minor families recorded in these sites are Curculionidae, Phyrochroidae, Coccinellidae, Chrysomelidae and Cerambycidae. The population densities of Coleopterans in soil and litter is closely related to habitat type (in riverine and undisturbed habitats population density is high).

High Coleopteran densities were recorded in riverine and undisturbed sites. High density in riverine site is completely due to soil inhabiting Coleopterans and in undisturbed site this high density is due to litter inhabiting Coleopterans. It is very clear that the high population density of larval Coleopteran forms is recorded in the riverine site. Rainfall and the population density of soil and litter fauna are significantly correlated. When soil moisture content and soil acidity increases population density of Coleopterans increases and when annual rainfall

and soil temperature decreases population density increases. Therefore population density of Coleopterans is significantly correlated with changing physical and chemical factors and that indicates that they play a major role in soil ecosystems.

REFERENCES

- Anderson, J.M. (1983) Nitrogen and cation release by macrofauna feeding on leaf litter and soil organic matter from deciduous woodlands, *Soil Biol. Biochem.* 15: 463-467.
- Dindal, D. L. (1990) *Soil biology guide* (ed), John Wiley and Sons, New York.
- Edirisinghe, E.A.D.N.D.,(1997) (M.Phil. Thesis) Comparative study of soil and litter Arthropods fauna in Singharaja wet zone forest and Sigiriya dry zone forest in Sri Lanka.
- Lattin, J. D. 1993. Arthropod diversity and conservation in old-growth northwest forests. *Am. Zool.* 33: 578-587
- Patricia, N., Theogene, N. (2005) A comparative study of Coleoptera diversity and abundance in disturbed and undisturbed forest in Amani Nature Reserve.
- Peterson, H., and Luxton, M. (1982) A comparative analysis of soil fauna populations and their role in decomposition processes. *Oikos* 39: 287-388.
- Qader, M.M. and Edirisinghe, E.A.D.N.D. (2012) Distribution of soil and litter fauna in three different habitats in Waga Natural Forest Reserve in Kalutara District Sri Lanka, Annual Academic Sessions, OUSL 2012-9912; 230-233.
- Sakchoowong, W., Jaitrong, W., Ogata, K., Nomura, S. and Chanpaisaeng, J. (2008) Diversity of soil-litter insects: Comparison of the pselaphine beetles (Coleoptera: Staphylinidae: Pselaphinae) and ground ants. (Hymenoptera: Formicidae) *Thai Journal of Agricultural Sciences* 41(1-2):11-18.
- Witkamp, M., and Crossley, D.A. (1966) The role of arthropods and microflora in breakdown of white oak litter. *Pedobiologia*, 6: 293-303

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