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SHORT COMMUNICATION

Collembola Assemblage in Degraded Gelam Forest, Bachok, Kelantan

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Abstract: A study of collembola or aslso known as soil springtail (Hexapoda: Entognatha) assemblage inhabiting oligotrophic nature associated with beach ridges interspersed swales soil (BRIS) was executed in degraded gelam forest mapped as Rusila series. A composite sampling was used to collect the specimens. A total of 235 individuals were obtained, representing 5 epigean families namely, Entomobryidae, Hypogastruridae, Isotomidae, Odontellidae and Sminthuridae. Hypogasturidae was the most numerically abundant with 37% of total individuals followed by Entomobyridae (36%) and Odontellidae (10%). The least families recorded with 8% and 9% of total individuals were represented by Isotomidae and Sminthurididae respectively. Most species appeared to be hygrophilous (81%) whilst hydrophilous constitutes 19%. The hygrophilous Collembola was the most numerically abundant as compared to hydrophilous Collembola. Although currently not much is known about collembolan community on degraded gelam forest, the results depicted here show the occurrence of Collembola individuals will substantially support the ecosystem service particularly in soil decomposition. A better understanding of within-site relationship of soil collembolan to soil element concentration would increase future understanding of their community in degraded and non-degraded gelam forests.

Keywords: Collembola, Hexapoda, soil springtail, gelam forest.

INTRODUCTION

Collembola is one of the most widespread and numerous soil arthropod groups [1]. In soil ecosystem, Collembola plays an important role in decomposition of organic matter; soil formation; nutrient cycling and all basic features in the functioning of forest ecosystems [2]. The diversity of collembolan communities and population density are influenced by many aspects of the soil such as pH, aeration, organic matter composition, nutrient availability, humus type and vegetation cover [3]. According to Cassagne *et al.* [4], Collembola is a good representative of soil faunal diversity. They can affect the amount of biomass and the activity of microbial communities, either directly through selectively feeding on fungi and bacteria, or indirectly by dissemination of microbial propagules, and the alteration of nutrient availability [5].

The knowledge on the soil arthropod diversity and distribution particularly soil springtails within rainforest in Peninsular Malaysia is still rather inadequately known. According to [6] (2004), a number of taxa constituting bulk of taxonomic knowledge on Malaysia Collembola had been described by Yoshii from 1959 to 1983; nevertheless the latter generally did not provide information relating to their habitats. Knowledge of Collembola is quite limited, despite of their abundance, probably they neither directly harmful nor beneficial to man [7].

A comparative study on Collembola diversity in two different vegetation types namely lowland and hill dipterocarp forests in Kelantan by Norashikin *et al*. [8] elucidated that the diversity values differed due to the difference in altitudes and vegetation types. Most of the species encountered within these vegetation were hygrophilous and widespread in tropical forest litter [8]. To date, no attempts was made for collembolan studies inhabiting oligotrophic nature associated with beach ridges interspersed swales soil (BRIS). The extent of BRIS soil associated ecosystem continuously decreasing following conversion to other land uses and degradation from human activities [9]. A well-drained soil of the ridges is mapped as Rudua Series whereas soil in the depression area and underwater throughout

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the year is mapped as the Rusila Series [10]. Swampy site of BRIS soil on Rusila Series [11] is dominated by *Melaleuca cajuputi* [12]. In between monsoon and non-monsoon month there are areas in low water table part of BRIS ecosystem that are trapped with rain water and formed a swamp [13]. It is prone to degradation and easily turns into a sparse grassland or "padang" vegetation following disturbance, particularly following repeated fire [13]. The changes in the soil environment in relation to degradation or land conversion may have a crucial effect on soil biota activities and diversity.

Collembola that constitutes 20-50% of the soil microarthropods [14] responds relatively quickly to changes in soil chemistry [4], pH [15] and microhabitat conditions like moisture [16]. Soil-dwelling Collembola is widespread and ecologically specialized, therefore they are often recommended as bioindicators of management-induced changes in soil quality and soil health [17]. Collembola are depicted as fungivores, with many studies highlighting strong linkages between fungi and Collembola species [18]. Other studies highlighted clear positive relationships between euedaphic collembolans and microbial biomass [19], while less obvious relationships were depicted for epedaphic ones. Furthermore, different feeding preferences of epedaphic and euedaphic species upon fungi have been highlighted [20].

Most of the collembolan studies were conducted in agricultural or tropical forest soils, whereas this study was executed in a BRIS soil which very scanty been done. The previous study on BRIS soil were merely focusing on the plants soil contents as compared to the community on microarthropod particularly on collembolan community. The positive effects of Collembola on belowground may have consequences on on plant soil feedbacks [21].

The aim of this study was to assess the collembolan assemblage in degraded gelam forest that has becomes sparse grassland utilized by locals for their livestock grazing yard. The information gathered from this study will serve as baseline documentation on the current status of collembolan assemblage from the ecosystem associated with BRIS soil.

MATERIALS AND METHODS

Study site

The study was executed in a degraded gelam forest in Bachok, Kelantan (5º59'22.8'N, 102º23'33.4''E) adjacent to Universiti Malaysia Kelantan, Bachok Campus. In the late 1980s, the coverage area of this gelam forest was recorded approximately 11,020 hectares (Malaysian Wetlands Working Group,1987). Nevertheless, to date, the extension swampy gelam forest areas of BRIS soil on Rusila Series in Bachok had gradually decreased and some of the areas were degraded into grassland. The swampy area with low retention brackish water was dominated by *Melaleuca cajuputi* or known as gelam. The area has a typical humid tropical climate with a mean air temperature of 30.7ºC. The soil pH in the study site was found to be approximately 5.1 and 6.3.

Sampling technique

Three sampling plots were designated with an area of 100 m^2 per plot. A composite sampling was used to collect the specimens. At each sampling plot, twenty soil cores were taken, giving 60 soil samples for the entire study site (n=60). The soil cores (25 cm depth) were taken with a steel cylinder (15 cm diameter). Soil samples were swiftly placed into sealed plastic bags then transported to laboratory for extracting the sampled Collembola. They were extracted within a week by using Tullgren Funnels, a standard method proposed by Macfadyen (1957) and preserved into 70% alcohol solution with 5% of glycerin. Collembola were sorted and quantified under a light microscope (400 x magnification). Samples were identified by referring to Freshwater Invertebrates of the Malaysian Region (2008).

RESULTS AND DISCUSSION

A total of Collembola comprising of 235 individuals from 5 epigean families namely, Entomobryidae, Hypogastruridae, Isotomidae, Odontellidae and Sminthurididae were collected over soil samplings. As shown in Figure 1, Hypogasturidae was the most numerically abundant with 37% of total individuals. *Ceratophysella communis* was the dominant species, comprising about 82% of total Hypogasturidae collected. Entomobyridae was recorded as a second abundant family in the study site with 36% of total individuals represented by 2 species namely, *Setogaster sp.* and *Lepidocytoides sp.* Odontellidae represented 10% of the assemblage with 1 species namely *Superodontella sp.* The least families recorded with 8% and 9% of total individuals were represented by Isotomidae and Sminthurididae respectively. Both were represented by 1 species namely *Isotomurus sp*. and *Sminthurides sp.* respectively.

Most species of the Collembola encountered were mainly hygrophilous (81%) whilst hydrophilous constitutes 19%. The occurrence of hygrophilous Collembola comprising of Hypogasturidae, Entomobryidae and Odontellidae on the degraded gelam forest was numerically abundant could be due to higher organic matter and humus content in the study site. Battigelli *et al.* [22]. Explained that organic matters supplies nutrients and improves soil porosity which creates a suitable habitat for soil mesofauna.

Collembola enhances and inhibits dead organic decomposition not as primary decomposer but mainly as microflora regulators of belowground food web [23]. The least occurrence of hydrophilous or known as 'aquatic associates' Collembola comprising of Isotomidae and Sminthuridae may be associated to their less adaptations to moist habitat such as this degraded gelam forest.

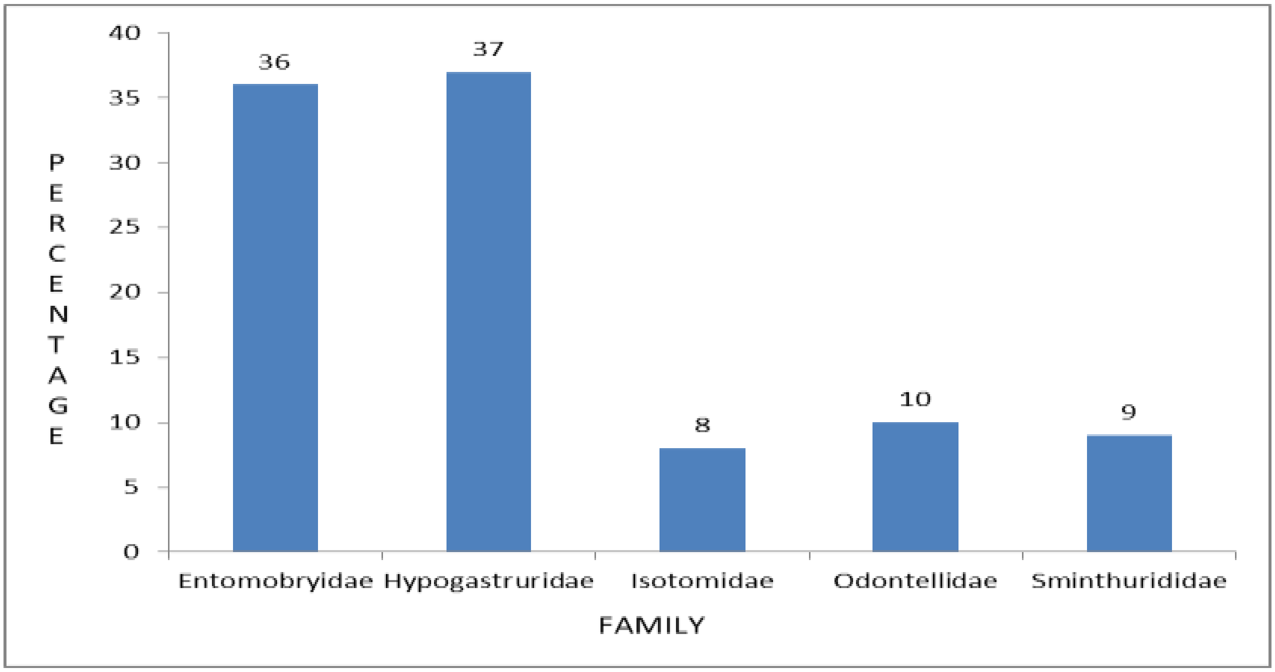

Figure 1: Collembolan assemblage in degraded gelam forest in Bachok, Kelantan

CONCLUSION

The study demonstrated the occurrence of collembolan assemblage inhabiting oligotrophic nature associated with beach ridges interspersed swales soil (BRIS) in degraded gelam forest mapped as Rusila series. The hygrophilous Collembola was the most numerically abundant as compared to hydrophilous Collembola. Although currently not much is known about collembolan community on degraded gelam forest, the results depicted here show the occurrence of Collembola individuals will substantially support the ecosystem service particularly in soil decomposition. A better understanding of within-site relationship of soil collembolan to soil element concentration would increase future understanding of their community in degraded and non-degraded gelam forests. Further studies need to be executed to offer a plausible explanation appertaining to this study.

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REFERENCES

[1] Bardgett R.D. 2005. The Biology of Soil. A community and ecosystem approach. Oxford University Press.

[2] Kumssa D.B., van Aarde R.J, Wassenaar T.D. 2004. The regeneration of soil micro-arthropod assemblages in a rehabilitating coastal dune forest at Richards Bay, South Africa. Africa Journal Ecology 42:346–354.

[3] Cole, L., Staddon, P.L., Sleep, D., Bardgett, R.D. 2004. Soil animalsinfluence microbial abundance, but not plant-microbial competition for soil organic nitrogen. Funct. Ecol. 18, 631–640

[4] Cassagne, N.; C. Gers& T. Gauquelin 200). Relationships betweenCollembola, soil chemistry and humus types in forest stands (France). Biology and Fertility of Soils 37: 355-361. doi:10.1007/s00374-003-0610-9

[5] Coulibaly, Sékou F. M., Bruna R. Winck, Marthe Akpa-Vinceslas, Laurent Mignot, Marc Legras,

Estelle Forey and Matthieu Chauvat. 2019. Functional Assemblages of Collembola Determine Soil Microbial Communities and Associated Functions. Front. Environ. Sci., 02 May 2019 | https://doi.org/10.3389/fenvs.2019.00052

[6] Deharveng L 2004. Recent advantages in Collembola systematics. Pedobiologia 48: 415–433.doi: 10.1016/j.pedobi.2004.08.001.

[7] Hopkin, S.P. 1997. Biology of the Springtails (Insecta: Collembola). Oxford University Press, Oxford.

[8] Norashikin, F., Syahmi, H & Siti Aisyah, N.2017. A comparative study of soil springtails (Insecta: Collembola) in lowland and hill dipterocarp forests. Proceeding of Seminar of Ecology Malaysia.

[9] Jamilah, M.S., Jarina, M.J., Ahmad, A.B. 2009. BRIS ecosystem, *Melalueca* swamp and Jambu Bongkok Forest Reserve-first Nature Park of Terengganu. Proceeding Gunung Gagau Expedition Seminar, Kenyir Lake View and Spa Resort, Tasik Kenyir, Terengganu, 10-12 May.

[10] Azizah Chulan, O.Yaacob, A.J.M. Kamal, S. Paramanathan. 1983. Distribution of VA Mycorrhizal sporesin sandy beach soils under cashew. PERTANIKA. 6:15-20.

[11] Mohd. Ekhwan Hj. Torman, Mazlin Mokhtar, Muhamad Barzani Gazim, Nor Azlina Abd. Aziz. 2009. Analysis of the physical characteristics of BRIS Soil in Coastal Kuala Kemaman, Terengganu, Research Journal of Earth Sciences. 1:1-6.

[12] Lim, S.C. and Mohd. Shukari Midon. 2001. Timber of gelam (*Melaleuca cajuputi* Powell). Timber Technology Bulletin No.23.

[13] Mitchell, B.A. 1963. Forestry and Tanah Beris. Malayan Forester. 26:160-170.

[14] Jing, S., Huifu, W., Rumei, X. 2005.Differences in soil arthropods communities alog a high altitude gradient at Shergyla Mountain, Tibet, China. Arctic Alpin Research 37:261-266.

[15] Ponge, J.F. 2000.Acidophic Collembola:living fossils? Control Biology Laboratory Kyoto University. 29:65-74.

[16] Xu, G.L., Kuster,T.M., Dobbertin, M., Li, M.H. 2012. Seasonal exposure to drought and air warming affects soil Collembola and mites. PloSONE. 7:e43102.

[17] Ponge, J.-F., Gillet, S., Dubs, F., Fedoroff, E., Haese, L.,Sousa, J.P., Lavelle, P.2003. Collembolan communities as indicators of land use intensification. Soil Biol. Biochem. 35, 813–826.

[18] A'Bear, A. D., Boddy, L., and Hefin Jones, T. 2012. Impacts of elevated temperature on the growth and functioning of decomposer fungi are influenced by grazing Collembola. *Glob. Chang. Biol.* 18, 1823–1832. doi: 10.1111/j.1365-2486.2012.02637.x

[19] Perez, G., Decaëns, T., Dujardin, G., Akpa-Vinceslas, M., Langlois, E., and Chauvat, M. 2013. Response of collembolan assemblages to plant species successional gradient. *Pedobiologia* 56, 169–177. doi: 10.1016/j.pedobi.2013.04.001.

[20] Nakano, M., Ochiai, A., Kamata, K., and Nakamori, T. 2017. The preference of *Morulina alata* (Collembola: Neanuridae) feeding on some fungal sporocarps and the effects of passage through the gut on spores. *Eur. J. Soil Biol.* 81, 116–119. doi: 10.1016/j.ejsobi.2017.06.005

[21] Kutáková, E., Cesarz, S., Münzbergová, Z., and Eisenhauer, N. 2018. Soil microarthropods alter the outcome of plant-soil feedback experiments. *Sci. Rep.* 8:11898. doi: 10.1038/s41598-018-30340-w

[22] Battigelli, J.P, Spence, J.R., Langor, D.W., Berch, S.M. 2004. Short term impact of forest soil compaction and organic matter removal on soil mesofana density ad oribatid mite density. Canadian Journal For Research. 34: 1136-1149.

[23] Visser, S. 1985. Role of the soil invertebrates in determining the composition of soil microbial communities. In: Fitter, A.H., editor. Ecological interactions in soil: plants, microbes and animals. Oxford: Blackwell Scientific.297-317.