Recovery of soil arthropods after 1-year forest fires in Mount Merapi National Park Yogyakarta

To cite this article: M Sholikha *et al* 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **434** 012291

IOP Conf. Series: Materials Science and Engineering **434** (2018) 012291 doi:10.1088/1757-899X/434/1/012291

Recovery of soil arthropods after 1-year forest fires in Mount Merapi National Park Yogyakarta

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Abstract. In 2010, pyroclastic flow from eruption of Mount Merapi caused forest fire. Forest fires have an effect on changing soil chemical physics conditions and will directly alter the community of soil arthropods. This study aims to determine the recovery of arthropods after 1-year forest fires. The study area was in conducted severe burnt forest (Kis), medium burnt forest (Gam), light burnt forest (Gal). The study was conducted on September to October 2011 in dry season and March 2012 in wet season. Soil samples were collected by Stratified Random Sampling method. The results showed that the highest number of genus were found in Gam forest: 13 genera (dry season) and 38 genera (wet season). The highest number of individual were found in Kis forest in two seasons: 85 and 241 individuals /1900 cm3 respectively. The genus Prabhergia and Oppiella are the dominant genera, except in Gal forest dominated by Dolichopodidae. Vegetation growth and the restoration of habitat affected in the development of the soil arthropod community. Imigration and soil moisture affected on increased number of genera and individual in all study site. The results of this study can be used to manage the tropical forest ecosystem of Mount Merapi after fire.

1. Introduction

Forest fires in Mount Merapi National Park was an ecological system. Forest fires was often repeated following the eruption of Mount Merapi. In 2010, eruption of Mount Merapi produced pyroclastic flow that could destroyed and caused forest fires that were divided into three types: severe burnt forest, medium burnt forest and light burnt forest (TS Djohan: Pers. Comm.) Fire can change the diversity, composition and abundance of species in the ecosystem (Sasal et al. 2008 & Moretti et al., 2004). Forest fires causing loss of detritus for the soil arthropod community.

Soil arthropods play an important role in the nutrient cycle in an ecosystem. Their microbial activity and fungal hyphae grazing regulate the rate of decomposition of organic matter and increase the rate of nutrient releasing the ecosystem [1] [2] [3]. Studying the composition of the arthropod community can be used forassess the damage and learn the process of recovery of ecosystem [4].

The presence of soil arthropod community after fire could be used to study post-fire forest, so that that condition could be used to study of recovery forest ecosystem after fire. This is due to the presence of functional groups of the soil arthropod community will respond to the presence of detritus and the changes in the composition of the soil arthropod community follow the succession of vegetation that occurs in an ecosystem [5] [6] [7].

Studies about effects fire on soil arthropod community has been overwhelming done in temperate forests [3] [5] [7] [8] [9] [10], but information about post-fire soil arthropod response in tropical forests, especially in Indonesia is very limited. One of them is who conducted the preliminary study on soil collembola after pyroclastic flow attact in the river bank area of the River Boyong Yogyakarta. The study provides limited information about response of soil arthropod post-fire because it is limited to the collembola community

Therefore in this study, it was aimed to investigate recovery soil arthropods after 1 year forest fire in Mount Merapi National Yogyakarta as tropical forest ecosystem. We asked 1). Which genus are found in burned sites; 2). Which organism of functional groups are found in burned sites. It is expected that the results obtained can complement information about recovery of forest ecosystem after fire, especially in Indonesian.

2. Method

The study area was conducted in the 1years old forest was divided into three type: severe burnt forest (Kis) in Kinahredjo, medium burnt forest (Gam) and light burnt forest (Gal) in Gandok Forest (Fig. 1). The study was conducted on September to October 2011 in dry season and March 2012 in wet season.

Soil samples were collected by Stratified Random Sampling on plots measured in 20x20 m. Soil samples were gathered from the topsoil layer (upper 10 cm). Total soil samples were 140 units. Extraction of soil samples used Tullgren Funnel for 72 hours. All Samples were preserved in a mixture of 70 % alcohol and glycerin solution. NO3, NH4, PO4 and C organic were measured. The observation and counting the number of individual was performed with using dissecting microscope. The Collected sampel was identified using identification keys of Soil Biology Guide [11].

3. Result and Discussion

Number of genera, family and individual in the 1 year -old forest increased during the wet season. Highest number of genera and family was medium burnt forest (Gam). It was 38 genera and 32 families. However, the highest number of individual was found in severe burnt forest (Kis), as many as 241 individuals/1900 cm3 (Fig. 2). Soil moisture, vegetation growth and migration of genus likely to be factors caused on increase number of genera and individual in the 1 year -old forest. Migration could be through by water runoff, wind and active movement. Mechanism of migration bring the genera presented in 1 year -old forest.


Severe Burnt Forest (Kis)


Light Burnt Forest (Gal)

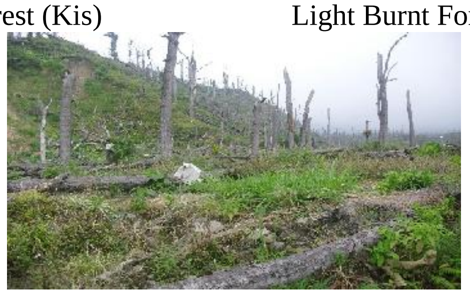
Medium Burnt Forest (Gam)

Figure 1. Study Site of three type forest after fire in Mount Merapi Natinal Park Yogyakarta

Recovery of soil arthropod community after the fire, occurs due to species dispersal factors from the outer region [12]. High rainfall during the wet season, most likely bringing in genera present in severe burnt forest (Kis), medium burnt forests (Gam) and light burnt forest (Gal). Rainfall data also shows a high rainfall average of 20-30 mm (Fig.3). Wind movement was likely to bring genera in Kis, Gam) and Gal forest. Fires have caused these locations to be more open areas, thus causing ground animals from the outside more easily enter. The active movement of genera such as Coecobrya, Folsomia, Lepidocyrtus also caused an increase genera ini GAm forest. The hight number of individual in Gal forest as many as 239 individuals / 1900 cm3 (Fig. 2) in the wet season, possibly also due to abundant litter input and increasing of soil moisture. Vegetation in this location was more dense, tree stands was regrowth and forest floor overgrown with ferns with thick enough.

Prabhergia, Oppiella and Lysigamasus (Fig. 4) were genera that always presented in two seasons (dry and wet) and in all study site. Among these genera, Prabhergia was dominant, except in the light burnt forest (Gal) were dominated by Dolichopodidae. Abundance of Prabhergia in the 1 year-old forest (Gam and Kis) indicates that this genera was fire tolerant and able to establish after fire. Number of individual Prabhergia in dry and wet season were 22 individual/1900 cm3; 43 individual/1900 cm3 in Gam forest and 31 individual/1900 cm3; 71 individual/1900 cm3 in Kis forest. Migration and soil moisture were likely to be determine on presence of Prabhergia in these forest.

Micro phytophagous and predator were dominant groups in all study. In dry season, functional groups in the I year-old forest was only composed by three functional groups. Vegetation growth and increase of soil moisture were factors that caused growth of soil arthropod community during wet season.

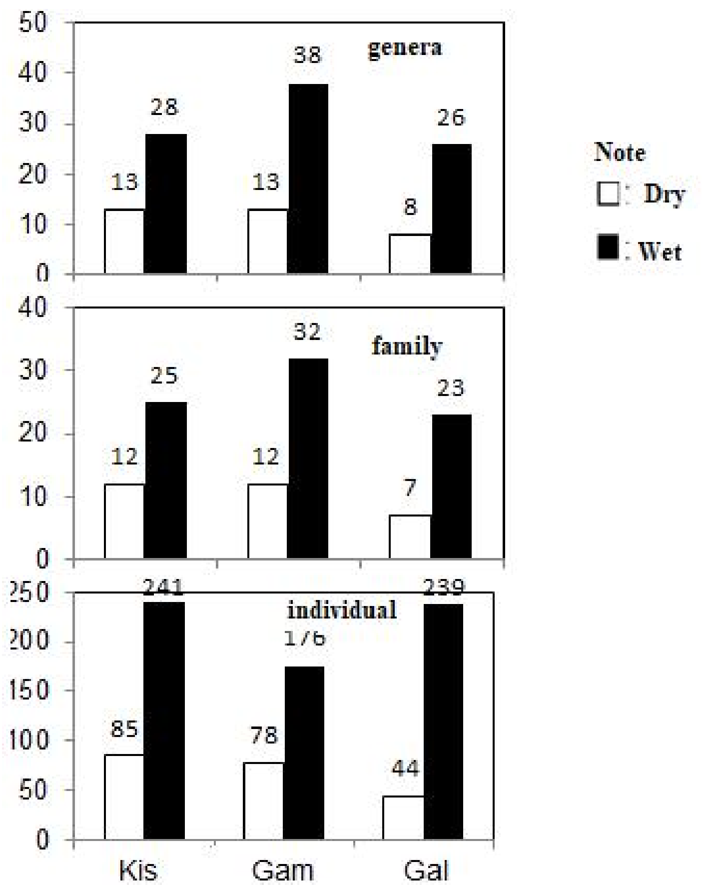

Figure 2. Number of genera, family dan individual in severe burnt forest (Kis), medium burnt forest (sGam) and light burnt forest (Gal)

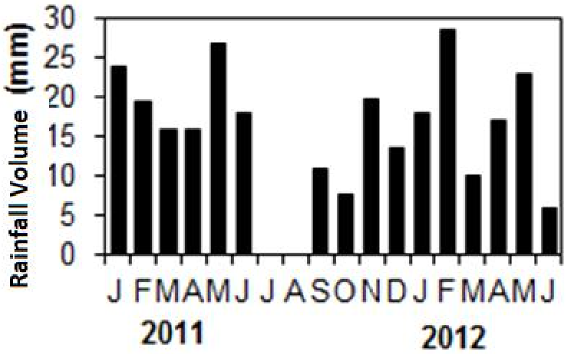

Figure 3. Rainfall volume during one year

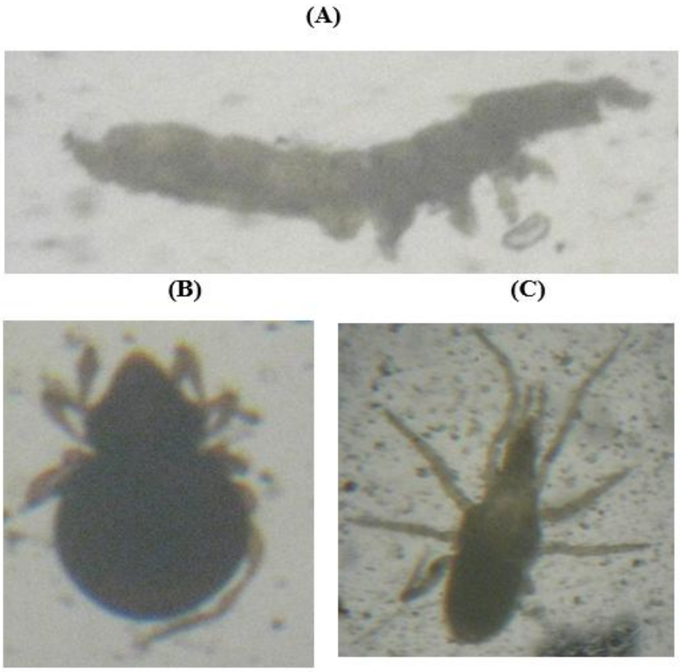

Figure 4. (A) Pharbegia; (B) Oppiella; (C) Lysigamasus

4. Conclusion

Recovery of soil arthropod soil community on the slopes of Mount Merapi was determined by the recovery of vegetation and habitat conditions. Soil moisture and genus migration determine the presence of soil arthropod community in Mount Merapi National Park Yogyakarta.

Acknowledgement

We acknowledge Universitas Islam Negeri Sunan Gunung Djati Bandung. We thank to all participant for their help with filed collection and/or technical support.

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