Comparative study of collembola community on burnt forest areas and unburn forest areas in ijen crater nature park Banyuwangi

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Abstract. Forest fire is one of the most crucial environmental and forestry issues in Indonesia. Forest fires are also frequent in the Ijen Crater Nature Park. Forest fires cause loss of filter and humus which is source of food for soil animals. One of the soil animals that inhabit litter and soil is Collembola. This study aims to compare Collembola community in burnt and unburnt areas of Ijen Crater Nature Park. As well as to know the relation of abiotic factors with diversity, evenness, and richness of Collembola in burnt and unburnt areas. This research is a descriptive explorative research. Data retrieval is done with line transect method. The result showed that Collembola index value on burnt and unburnt areas are significantly different. The dominant species in the burnt area is Onychiurus sp, whereas in the unburnt area is Isotomurus sp. The result of abiotic factor regression analysis showed that temperature, humidity and pH level have relation to index of Collembolas diversity, evenness and richness.

1. Introduction
Forest fire is one of the most crucial environmental and forestry issues which is a local and global concern that often occurs in Indonesia [1]. Changes in the structure of the forest ecosystem in the form of damage to land and vegetation beneath the layers seemed to occur after a forest fire. Fire has an impact on the chemical and biological properties of soil in the form of increased concentrations of NH4+, P, Na, K, Mg, Ca, Mn, Cu, Zn, and B. Water repellency, increase in soil pH, death of soil organisms decreasing the frequency of organic nitrogen and an increase in the frequency of inorganic nitrogen is also an impact of forest fires [2].

The condition of lower vegetation can be seen from the presence of soil animals, one of which is Collembolan. Collembolan acts as a remodel of organic matter, indicators, changes in soil conditions, balancing soil fauna, predators, pests and pollinators [3]. Collembolan has more abundance on land that has a closed canopy closure, so if there is a forest fire will result in reduced abundance of collembolan on the land [4].

This study aims to compare the composition and color of the collembolan environment on burned and unburned land based on the condition of nature reserves and natural tourism parks in the Ijen crater, which is one of the nature conservation areas in East Java province, there are still illegal forest burning activities in both the nature reserve and in natural tourism park area. Data obtained from the Indonesian Center for Conservation of Natural Resources reported that there were always forest fires in the nature reserve area and Ijen Crater Nature Tourism Park from 2012-2018. The fire is thought to have originated from cigarette sticks and fire jumps from other regions [5].
2. **Methods**

The type of research applied is descriptive exploratory research. The sampling locations are in the Ijen Crater Nature Reserve and Natural Tourism Park on burning and unburned land in May-June 2018. These locations are: (1) Banyupait Block and (2) Paltudin Block. Each location has an area of ± 2 ha. This study, data collection was carried out in 5 stages, namely (1) Sampling of soil samples, (2) collembola extraction, (3) identification of collembola, (4) elongation of environmental parameters, and (5) N-Total levels. Calculation of diversity index (H'), abundance (E) and wealth (R) using the Shannon-Wiener index.

3. **Results and Discussion**

Figure 1 shows data. The location for sampling collembola sampling points located in the non-nature reserve area of Mount Ijen. The green zone is unburning area and natural resources area. The red area is the burn area and non-natural resources area. The data that take on this location can be seen on Table 1, Table 2 and Table 3.

![Figure 1. Map of location points for sampling research](image)

Table 1 shows *Brachystomella* sp., *Coecobrya* sp., *Folsomia* sp., *Folsomides centralis*, *Folsomides parvulus*, *Isotomurus* sp., *Lepidocyrtus* sp., *Onychiurus* sp., *Phrabergia* sp., *Proisotoma* sp., *Prothaporura* sp., *Pseudachorutes* sp., dan *Willemia* sp. Is a type of collembolan found in all locations both the location of burning and non-burning location.

Table 2 shows the results of the analysis of the calculation of diversity index (H'), evenness (E), and wealth (R) collembola on burnt land shows 1 <H' <3 which means it is included in the criteria of moderate diversity. E > 0.6 so that it is included in the high collembolan evenness. R = 3.5-5.0 so that the richness is classified as moderate, while R > 5.0 shows high specific wealth. Tables 3 Average of Diversity, Evenness, and Richness of Collembola in Non-Burning Land.
Table 1 Composition of Collembola species in the nature reserve and natural tourism parks of the Ijen crater

| Species               | Area       | Total | Average |
|-----------------------|------------|-------|---------|
|                       | Burning    | Unburn I | Unburn II |
| Brachystomella sp.    | 2          | 14     | 5        | 21       | 7.0 |
| Cephalachorutes sp.   | 2          | 2      | 6        | 10       | 3.3 |
| Coecobrya sp.         | 6          | 30     | 12       | 48       | 16.0 |
| Folsomia sp.          | 22         | 9      | 3        | 34       | 11.3 |
| Folsomides centralis  | 103        | 159    | 140      | 402      | 134.0 |
| Folsomides parvulus   | 122        | 77     | 69       | 268      | 89.3 |
| Hemisotoma sp.        | 8          | 6      | 0        | 14       | 4.7 |
| Homidia sp.           | 4          | 4      | 0        | 8        | 2.7 |
| Isotomurus sp.        | 223        | 173    | 165      | 561      | 187 |
| Lepidocyrtus sp.      | 23         | 27     | 4        | 54       | 18.0 |
| Megalothorax sp.      | 0          | 1      | 1        | 2        | 0.7 |
| Onychiurus sp.        | 296        | 86     | 126      | 508      | 169.3 |
| Phrabergia sp.        | 136        | 48     | 39       | 310      | 103.3 |
| Proisotoma sp.        | 138        | 145    | 42       | 325      | 108.3 |
| Prothaporura sp.      | 23         | 32     | 17       | 72       | 24  |
| Pseudachorutes sp.    | 29         | 18     | 18       | 65       | 21.7 |
| Pseudoisotoma sp.     | 10         | 8      | 0        | 18       | 6.0 |
| Siamanura sp.         | 0          | 4      | 2        | 6        | 2.0 |
| Willemia sp.          | 158        | 15     | 15       | 188      | 62.7 |
| Total                 | 1205       | 858    | 664      |          |     |

Tables 2. Average of diversity, evenness, and richness of Collembola in burning land

| Transek | H’ | E   | R   |
|---------|----|-----|-----|
| 1       | 1.583 | 0.911 | 5.384 |
| 2       | 1.508 | 0.907 | 4.983 |
| 3       | 1.474 | 0.908 | 4.797 |
| 4       | 1.425 | 0.894 | 4.639 |
| 5       | 1.364 | 0.851 | 4.670 |
| 6       | 1.25  | 0.883 | 3.768 |
| 7       | 1.307 | 0.946 | 3.751 |
| 8       | 1.270 | 0.856 | 4.189 |
| 9       | 1.277 | 0.943 | 3.594 |
| 10      | 1.247 | 0.9   | 3.621 |

Table 3 shows the results of the analysis of the calculation of diversity index (H’), evenness (E), and Richness (R) collombola on burnt land shows 1 <H’ <3 which means it is included in the criteria of moderate diversity. E > 0.6 so that it is included in the high collombolan evenness. R = 3.5-5.0 so that the richness is classified as moderate, while R> 5.0 shows high specific wealth [6].

The results of research on collombolan species found in the nature reserve and natural tourism park of the Ijen crater obtained 19 species composed of 18 genera, 7 families and 3 orders. Collombolan species that are found in both burning and unburned land include Hemisotoma sp., Brachystomella sp., Coecobrya sp., Folsomia sp., Folsomides centralis, Folsomides parvulus, Isotomurus sp., Lepidocyrtus sp., Onychiurus sp., Phrabergia sp., Proisotoma sp., Prothaporura sp., Pseudachorutes sp., Homidia sp., Megalothorax sp., Pseudoisotoma sp., Siamanura sp., and Willemia sp. Abundant and diverse types of collombolan closely related to the ability of individuals to adapt to changes in the environment and food sources so that soil fauna can be used as a bioindicator of soil quality [7].
Abiotic factor conditions also affect the presence of soil epifauna. Colembolan has a pH range of 2-9 [8]. Soil temperature conditions also affect because high temperatures will accelerate the rate of growth and accelerate the loss of groundwater flow rate which accelerates the death of organisms [9]. Colembola requires temperature conditions between 5 °C -15 °C. temperature and humidity have a bearing on the influence of colembola life. Because humidity has a major role in the distribution of colembolan [10]. The content of organic N compounds is the content most needed by microorganisms to decompose organic matter. Increased colembolan density causes N mineralization in the soil due to high soil moisture. Microorganisms such as fungi and bacteria are the main food for colembolan so that its presence affects the evenness of colembolan [11]

Based on the t test diversity (H’) and wealth (R) showed there were significant differences in burned and unburned land. The diversity of colembolan in burnt land is lower than unburnt land. Diversity is identical to the stability of an ecosystem, that is, if the diversity of an ecosystem is high then the condition of that ecosystem tends to be stable [12]. The evenness index t test (E) on burned and unburned land revealed no significant difference. This is because the distribution of colembolan in both lands is relatively high. Evenness index is influenced by the food chain, which means the longer the food chain, the higher the evenness index [13]. The epifauna evenness index value shows value less than 1 which means that the distribution of individual abundance at each point is uneven. Equity refers to how the abundance of species (number of individuals) is evenly distributed within a community [14].

Fires cause disturbance to the existence of colembolan, but can recover in a period of 1 to 2 years afterwards. This is consistent with previous research conducted by Forests in 1976 which stated that colembolan returned to normal in the second year after a fire in the Finnish pine forest. This is because colembolan occupies a deep location in the soil and some others move to the deeper layers of soil in response to high temperatures [15].

4. Conclusion
The results of research on colembolan species found in the nature reserve and natural tourism park of the Ijen crater obtained 19 species composed of 18 genera, 7 families and 3 orders. Colembolan species that are found in both burning and unburned land include *Hemisotoma* sp., *Brachystomella* sp., *Coecobrya* sp., *Folsomia* sp., *Folsomides centralis*, *Folsomides parvulus*, *Isotomurus* sp., *Lepidocyrtus* sp., *Onychiurus* sp., *Phrabergia* sp., *Proisotoma* sp., *Prothaporura* sp., *Pseudachorutes* sp., *Homidia* sp., *Megalothorax* sp., *Pseudoisotoma* sp., *Siamanura* sp., and *Willemia* sp. Forest fires affect colembolan diversity because colembolan diversity on burnt land is lower than unburnt land.
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