Ants Respon to Air Humadity in Small Islands of Haruku

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Abstract. The international community is worried about the increasing number of disasters caused by climate change. The main effort is to carry out mitigation and adaptation programs. In this regard, one of the studies that needs to be done is to see ants as bioindicators of climate change. Sampling of ants is carried out by systematic sampling with a path length of 250 m and a width of 20 m as many as 10 lines. Line distance of 30 m. Three methods of taking ants were carried out, namely: (1) Hand Colecting (2) Pitfall trap and (3) Bait trap and preserved in 70% alcohol. The type of ant that has a strong correlation with air temperature and/or soil temperature will be more sensitive to climate change than the type with low correlation. Thus only certain types of ants can be used as bioindicators of climate change. From the results of the inventory of ants, 32 species of ants were obtained as many as 3,110 tails. Of the 32 types of ants, 5 of the most common species were found and the 5 least species were found. The types of ants that are included have a high correlation with soil temperature and air temperature, namely: Cardiocondyla nuda, Myrmicaria brunnea subcarinata, Polyrhachis bellicososa, Myrmoteras binghami and Crematogaster difformis. This type of ant is most rarely found at the study site. Ants that are less correlated with soil temperature and air temperature are: Polyrhachis abdominal, Hypoponera bugnioni, Leptogenys diminuta, Odonthoponera transversa infuscata and Oecophylla smaragdina subnitide. This type of ant is most easily found in the study location.

1. Introduction
Ant can be ascertained that the international community is currently concerned about climate change triggered by global warming. This can be understood because from time to time the effects of climate change are getting bigger and more real. The greatest impact is currently borne by the natural system. However, it turns out that the impact on humans will also be broader such as health, home, and food resources that are likely to be threatened by rising temperatures. The fact the impacts of climate change cannot be recovered and are massive on all continents and in the oceans. The impact is extreme weather such as heavy rain, storms with stronger strength, and heat waves. This heat wave has caused a large number of human casualties, as happened in Pakistan, India, Bangladesh and Sri Lanka. The heat wave disaster triggered by climate change can make parts of the country threatened uninhabited by the end of the century (Ghoshal, 2017). Beside that, continuous heat waves are also gripping parts of the Northern Hemisphere and destroying weather records in the United States, Canada, Europe and the Middle East (Dangerfield, 2018). Moreover, heat waves turned out not only to bring human victims but also animals like fish that occurred in Swiss waters. According to Macbeth (2018), heat waves have killed tons of Switzerland fish in the Rhine Rivers. The worst area due to heat waves is the stretch of the Rhine River stretches from Lake Constance to the Rhine Waterfall. The melting of the polar ice triggered rising sea levels, threatening the community, ecosystems, and coastal cities. Meanwhile, ocean acidification also has a broad impact on marine species including coral reefs. One of the important things is food security.
in every country in the world. This food security is very strategic because the yields of rice, corn and wheat will be affected by climate change in the period up to 2050, with about one-tenth of the projections showing losses of more than 25%. So agriculture will be further harmed after 2050, while demand for food will increase as the world population projection can reach nine billion (BBC Indonesia, 2014). Therefore, the world community is trying to overcome climate change with 2 main programs that need to be done, namely mitigation and adaptation. In this regard, one of the studies that needs to be done is to see various animals that can be used as bio-indicators of climate change.

In general Bioindicator or biological indicator is a species or population of animals, plants or microorganisms where their presence, vitality and response will change due to the influence of environmental conditions. Each species will respond to environmental changes depending on the stimulation (stimulation) it receives. The response given indicates changes that occur in an environment where the response given can be very sensitive, sensitive or resistant. In the ecological indicator category, organisms are used to show the effects of habitat changes, the possibility of fragmentation and climate change where the indicator taxa act as a substitute for a larger community. Thus there will be a response that can reduce the size of the population, changes in spatial distribution and changes in the history of his life. The response shown is representative of the response of other taxa in a habitat. Ants and birds can be used as bioindicators of climate change. For example, ants can act as ecological indicators in a forest area. The ability of these ants can respond to changes that occur in the ecosystem and detect changes that reflect the specific direction and rate of impact of a particular habitat ecosystem. The composition of ants in the ecosystem is very dependent on environmental conditions, where ants will experience changes in presence, vitality and response in the event of interference in the intended environment. Ants will respond if there is a disturbance to vegetation and soil as their habitat. Ants generally have a fairly stable population throughout the season and year. Its large and stable amount makes ants one of the important insect colonies in the ecosystem. Given the number of abundant ants that have an important role in complex interactions with the ecosystem they occupy. Ants are often used as bio-indicators in environmental assessment programs, such as forest fires, disturbances to vegetation, mining, logging of waste disposal forests, and land use factors (Wang et al. 2000).

Besides ants, birds are also able to act as ecological indicators because they are able to mark environmental damage and climate change. Birds act as indicators of climate change because they are very sensitive to environmental changes. This can be seen from the pattern of bird immigration. Birds are related to specific habitats and certain food sources. With the change of food supply in the forest area for example, it will affect the bird's diet. For example in subtropical climates, it is usually very easy to observe changes due to clear inter-season temperature differences, this can be observed from the response of birds that evade from areas where temperatures are increasing (Rahmad, 2016; Sotyati 2016; Winarni, 2016). Because ants can be used as indicators of climate change, it is necessary to research which types of ants are sensitive or not sensitive to climate change, especially from changes in soil temperature and air temperature in their habitat as presented in this paper.

2. Methods And Materials

The study was conducted in September 2020 in the protected forest of Haruku Island. The taking of ants as samples using the method (1) Hand Collecting (2) Pitfall trap and (3) Bait trap and preserved in 70% alcohol. Identification of the type of ant until the level of species found at the study site was carried out by using the book Identification Guide to The Ant Genera of The World (Bolton, 1997). Sampling is done by systematic sampling with a path length of 250 m and a width of 20 m line as many as 10 lanes. Line distance of 30 m. Of the types of ants obtained. Ant analysis is done to obtain information about abundance, diversity, wealth, distribution patterns and evenness of ant species.
3. Results and Discussion

**Ant Dispersal**

The spread of ants in the forest is in table 1 below

| No. | Ant Species                  | Frequency | Frequency Relatif | Total Individu |
|-----|------------------------------|-----------|-------------------|----------------|
| 1   | Acropyga moluccana roger     | 0.06      | 3.06              | 572            |
| 2   | Aenictus ceylonicus          | 0.04      | 2.04              | 527            |
| 3   | Anochetus graeffei           | 0.02      | 1.02              | 53             |
| 4   | Camponotus reticulatus roger| 0.02      | 1.02              | 88             |
| 5   | Cardiocondyla nuda           | 0.02      | 1.02              | 1213           |
| 6   | Crematogaster ampullaris     | 0.02      | 1.02              | 300            |
| 7   | Crematogaster elegans        | 0.06      | 3.06              | 347            |
| 8   | Dolichoderus beccarii        | 0.06      | 3.06              | 1022           |
| 9   | Dolichoderus thoracicus      | 0.06      | 3.06              | 506            |
| 10  | Dolichoderus thoracicus      | 0.06      | 3.06              | 1681           |
| 11  | Echinopla lineata_lineata    | 0.04      | 2.04              | 282            |
| 12  | Hypoponera bugnioni          | 0.04      | 2.04              | 102            |
| 13  | Leptogenys diminuta          | 0.10      | 5.10              | 100            |
| 14  | Lophomyrmex opaciceps        | 0.04      | 2.04              | 852            |
| 15  | Lophomyrmex sp               | 0.04      | 2.04              | 165            |
| 16  | Meranoplus bicolor           | 0.02      | 1.02              | 85             |
| 17  | Monomorium destructor        | 0.08      | 4.08              | 792            |
| 18  | Monomorium sp 1              | 0.02      | 1.02              | 692            |
| 19  | Monomorium sp 2              | 0.02      | 1.02              | 777            |
| 20  | Myrmoteras binghami          | 0.02      | 1.02              | 79             |
| 21  | Odonthoponera transversa infuscate | 0.02 | 1.02  | 1533           |
| 22  | Odontomachus tyrannicus      | 0.06      | 3.06              | 778            |
| 23  | Oecophylla smaragdina        | 0.02      | 1.02              | 1355           |
| 24  | Platythyrea parallela        | 0.14      | 7.14              | 49             |
| 25  | Polyrhachis bellicosa         | 0.10      | 5.10              | 127            |
| 26  | Polyrhachis abdominalis      | 0.04      | 2.04              | 229            |
| 27  | Polyrhachis dives            | 0.04      | 2.04              | 323            |
| 28  | Polyrhachis geminate         | 0.02      | 1.02              | 72             |
| 29  | Tapinoma melanocephalum      | 0.04      | 2.04              | 517            |
35 Technomyrmex albipes 0.06 3.06 478
36 Technomyrmex kraepelin 0.02 1.02 70
37 Technomyrmex sp 1 0.08 4.08 429
38 Tetramorium pacificum Mayr 0.06 3.06 1372
39 Tetramorium similimum 0.06 3.06 520
40 Tetramorium smithi 0.06 3.06 785
41 Tetramorium sp 1 0.04 2.04 235
42 Tetraponera nitida 0.04 2.04 296
43 Tetraponera sp 1 0.02 1.02 924
44 Tetraponera sp 2 0.02 1.02 1286

Total 1.96 100 23499

The results of the study found that *Dolichoderus thoracicus* in a considerable number reaching 1681, and the least identified, namely *Platythyrea parallela*, was as many as 49 individuals. *Dolichoderus thoracicus*, found in the forest, has a 12-segment antenna, does not have an antenna scrobe; the oval head; the eyes are located in the midline of the head, the eyes are relatively large; the mandible is triangular; the propodeum has no spines; the casket is visible with a rounded stomach. *D. thoracicus* ants are found in abundance because the area is located in the population of cocoa and teak trees as habitat. *D. thoracicus* is not a predator for other insects in the area this species usually nests and actively moves on trees, branches, leaves, and cocoa pods. The more colonies of *D. thoracicus* black ants on several types of trees in the forest, especially in the fruit, will make pests not dare to attack the fruit. The population of *D. thoracicus* black ants in the woods is thought to be influenced by food sources from small insects, nectar from acacia trees, and honeydew from mealybugs' secretions that attack of *Acacia mangium* in forest areas.

**Ants Respond to microclimate**

The response of the ants to humidity and air temperature in the forest shows that there are four types of ants showing a high response. They are *Cardiocondyla nuda, Odonthoponera tranversa infuscate, Crematogaster ampullaris* and *Oecophylla smaragdina*.

![Air Temperature](image1)

*Figure 1. Cardiocondyla nuda* response to humidity and air temperature
Figure 2. *Odonthoponera tranversa infuscate* response to humidity and air temperature

Figure 3. *Oecophylla smaragdina SUBNITIDA* response to humidity and air temperature
Ants have a high correlation with consecutive air temperatures and humidity in the study location. In general, this illustrates that because this type of ant is sensitive to air temperature, its distribution in its habitat becomes very limited. Forest climate change will alter the condition of the climate, which can be identified by altering the mean and or variability of its properties, which persists for a long period of time in the forest. Global warming is unmistakable, and the sequence of events over the last 100 years has shown this is an increase in the average global surface temperature (+0.74°C), a drop in glaciers and permanent snow in high mountains, rising sea levels, and an increase in the frequency of events such as floods and droughts on a global scale. Ambient temperatures of between 10 °C and 40 °C are typically drilled (search and collect) (Höldobler and Wilson[1990]). Temperatures below this range can be stressful because they are above the thermal tolerance and survival limits. Four ants act as a generalist species. They are an opportunist that uses food resources when they are available (spatially and seasonally). It also uses low-intensity and intensive aridity environments, which allows it to adapt to its large scale geography. Variations in the harvest patterns of the temperature-related species can be observed depending on the geographical location, but are similar to those of the ants normally cited at 25 °C - 32 °C. In haruku forest harvest patterns with regard to temperature were reported and the temperature ranges between 26°C and 32°C were observed.

4. Conclusion

Our results support the hypothesis that ant activity changes at high temperature and low humidity. Changes in air temperature and humidity are closely related to vegetation cover in forests. Our results also show that low variation in microclimate factors will significantly influence certain behavior patterns of ants in natural forests.
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