The diversity of fern in Petungkriyono mixed forest
Pekalongan, Central Java

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Abstract. Fern are group of seedless vascular plants (Tracheophyta). Fern have a wide distribution in Indonesia. The aim of this study is for know the types of ferns in the mixed forest of Petungkriyono. The research method used in the cruiised method by exproling the entire mixed forest in Petungkriyono. The number of fern species found in the mixed forest of Petungkriyono is 44 species that belong to 14 families. The Snannon index of fern in mixed forest was 3.09. Therefore Petungkriyono mixed forest having a medium diversity level of fern. Humidity, temperature, light intensity and soil pH in the mixed forest of Petungkriyono are suitable for growing ferns.

1. Introduction
Indonesia is a country located on the equator with a tropical climate. This makes Indonesia has a wealth of abundant flora and fauna. One of the many flora groups and widespread distribution is the ferns. Ferns are one component of the forest ecosystem that has functions both ecologically and economically. The ecological function of ferns, among others, is as vegetation cover, produce litter for soil nutrient formation, and producers in the food chain [1] and can be used as an environmental bioindicator because of its cosmopolitan nature.

In addition to ecological functions, fern has economic functions. Ferns can be used as ingredients of traditional medicines, ornamental plants and can be consumed as vegetables. But behind the many benefits there is still little research on ferns in Indonesia. If examined further, there are still many potentials that can be developed from ferns. This needs to receive considerable attention in its management.

Petungkriyono has various types of vegetation including mixed forests, pine forests, and coffee plantations. Research carried out in mixed forests. Mixed forest is a forest consisting of two or more types of plants with the same canopy. Mixed forest has the characteristics of an environment with high humidity. Ferns generally grow in high humidity environments. This study aims to determine the diversity of ferns in mixed forests in Petungkriyono.

2. Methods

2.1. Fern sampling
Sampling was done by cruiised method. Cruise method, namely by direct observation and exploring each location point that can represent the types of ecosystems or vegetation in the area under study.
The study was conducted by exploring each station. Ferns found were documented and taken for collection.

2.2. Fern identification
Identification is done by looking at the morphological characteristics of ferns such as leaves, stems, roots and spores. If the ferns found do not have spores, their vegetative organs are identified.

2.3. Data analysis
Data analysis was performed with Shannon Wiener diversity index. According to Brower et al [2], species diversity index calculated by the Shannon Wiener formula:

\[ H' = - \sum pi \ln pi \]

Information:
- \(pi\): \(n_i/N\)
- \(H'\): Diversity index
- \(n_i\): Number of individual types
- \(N\): Number of individual types

2.4. Measurement of environmental factors
Environmental factors measured include air humidity, temperature, light intensity and soil pH.

3. Results and discussion
The results of the study of diversity of ferns in mixed forests of Petungkriyono obtained 44 species of ferns that belong to 14 families. Species of ferns in mixed forests in Petungkriyono can be seen in table 1.

| No. | Families       | Species                     | Total |
|-----|----------------|-----------------------------|-------|
| 1   | Polypodiaceae  | Aglaomorpha heraclea        | 5     |
|     |                | Belvisia sp                 | 13    |
|     |                | Drynaria quercifolia        | 3     |
|     |                | Goniophlebium percusum      | 5     |
|     |                | Lepisorus longifolius       | 1     |
|     |                | Leptochilus sp              | 9     |
|     |                | Microsorum heterocarpum     | 3     |
|     |                | Microsorum membranifolium   | 14    |
|     |                | Selligaea albidosquamata    | 1     |
|     |                | Pyrrosia nummularisfolia    | 9     |
|     |                | Pyrrosia piloselloides      | 7     |
|     |                | Selligaea stenophylla       | 5     |
|     |                | Sp 12                       | 1     |
| 2   | Tectariaceae   | Tectaria sp                 | 8     |
|     |                | Tectaria angulata           | 1     |
|     |                | Tectaria impressa           | 1     |
| 3   | Aspleniaceae   | Asplenium nidus             | 84    |
|     |                | Asplenium cuneatum          | 17    |
|     |                | Asplenium caudatum          | 3     |
| Family               | Species                        | Number of Individuals |
|---------------------|--------------------------------|-----------------------|
| Athyriaceae         | Deparia japonica               | 8                     |
|                     | Diplazium esculentum           | 6                     |
|                     | Diplazium proliferum           | 21                    |
| Marattiaceae        | Angiopteris evecta             | 1                     |
| Pteridaceae         | Antrophyum semicostatum        | 11                    |
|                     | Antrophyum parvulum            | 6                     |
|                     | Pteris biaurita                | 2                     |
|                     | Vittaria sp                    | 4                     |
| Selaginellaceae     | Selaginella intermedia         | 51                    |
|                     | Selaginella opaca              | 2                     |
|                     | Selaginella plana              | 13                    |
| Nephrolepidaceae    | Nephrolepis brownii            | 57                    |
|                     | Nephrolepis bisserata          | 2                     |
|                     | Nephrolepis sp                 | 40                    |
| Davalliaceae        | Davallia sp                    | 7                     |
|                     | Davallia denticulata           | 2                     |
| Cyatheaceae         | Cyathea sp                     | 2                     |
| Thelypteridaceae    | Christella hispidula           | 3                     |
|                     | Christella sp                 | 10                    |
|                     | Macrothelypteris toresiana     | 14                    |
| Lycopodiaceae       | Huperzia squarrosa             | 1                     |
| Dryopteridaceae     | Bolbitis heteroclita           | 34                    |
| Hymenophyllaceae    | Crepidomanes minutum           | 8                     |
|                     | Hymenophyllum sp               | 9                     |
| Sp 13               | Sp 13                          | 1                     |

The most common family of fern is Polypodiaceae, which is 13 species. According to Muhimmatin [3] the family of Polypodiaceae is one of the largest fern families and has habitat in the tropics. Eames in Muhimmatin [3] said that of all the living ferns, most are members of the family Polypodiaceae, so Polypodiaceae is a common tribe. As many as 13 of the 14 species of ferns in the Polypodiaceae family found included epiphytic ferns, according to Lagoria [4] most epiphytic ferns belong to the family of Polypodiaceae.

The types of ferns of the family Polypodiaceae are mostly epiphytes, the rhizomes that propagate on the ground or trees, with varying enthal shapes. Many of its members are ornamental plants such as Drynaria and Platycerium [5]. According to Sofiyanti [6] the family of Polypodiaceae has the characteristics of a long and creeping rhizoma, and a single leaf that is generally thick and fleshy.

The least found families of ferns are Dryopteridaceae, Lycopodiaceae and Marattiaceae. Dryopteridaceae family has the characteristics of the emergence of roots on the front side of the rhizome and leaves that are not hairy. This is consistent with the opinion of Moran et al [7] that morphologically the Dryopteridaceae family is characterized by the presence of roots in the ventral part of the rhizome. Different forms of fertile and sterile leaves. Hairless leaves and sori form rows.

Fern with the highest number of individuals in mixed forests are Asplenium nidus with a total of 84 individuals. Asplenium nidus is a type of fern that belongs to the Aspleniaceae family. This is in
accordance with the opinion of Holltum [8] One of the genera in Aspleniaceae is Asplenium nidus. *Asplenium* is generally used as an ornamental plant by the public. This is in accordance with the statement of Pranita [9] that *Asplenium* is one of the genera of ferns that are beneficial to human life, namely as an ornamental plant, as a green manure material, as one of the ingredients in the making of bouquets, is an ecosystem controller and is one of the plants oxygen-producing. *Asplenium nidus* lives attached to the trunk and branches of trees, mixed forests there are many trees so that many *A. nidus* are found. This is in accordance with the opinion of Mansur [10] that *A. nidus* lives by sticking to the trunk or branches of the host tree to get light and protection from the hot sun.

Diversity index value is found in mixed forests, which is 3.09. Diversity index value is determined by the number of species and evenness of the number of individuals of each type. In mixed forests the highest number of ferns (44 species) was obtained and the evenness index was also highest. The dense canopy of a mixed forest makes the air humidity at the mixed forest station become higher and lower temperatures. compared to the other two stations. The average temperature in mixed forests is 24 °C and humidity on average 79%, such environmental conditions cause many ferns to grow in mixed forests.

Based on the diversity index value, mixed forests have a higher ecosystem stability in terms of fern plant communities compared to pine forests and coffee plantations. This is in accordance with the opinion of Fachrul [11] that a community generally consists of various types of plants, the higher the diversity of plant species, the more stable the ecosystem.

4. Conclusion
The number of fern species found in the mixed forest of Petungkriyono is 44 species that belong to 14 families. Petungkriyono mixed forest having a medium diversity level of fern. Humidity, temperature, light intensity and soil pH in the mixed forest of Petungkriyono are suitable for growing ferns.

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