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RESEARCH ARTICLE

IDENTIFICATION OF PTERIDOPHYTA PLANTS IN JEMBER, EAST JAVA INDONESIA

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Abstract

Pteridophyta is a group of plants known by the common name Ferns. This plant is one of the constituent elements of the world's biodiversity, including in Indonesia. From many provinces in Indonesia, one of them is East Java Province, and one of the cities in this province is the city of Jember. The location of the research is, is in Kaliwates District, Jember City, East Java Province, Indonesia at position $8^{\circ} 11' 29-32'' S$ $113^{\circ} 41' 24-26'' E$ (google earth). There are still many types of plants that grow in this area and not many are known about the species, both from the herbaceous plants Spermatophyta, as well as from the Pteridophyta group. This study aims to identify the types of ferns/ferns, which are a group of Pteridophyta plants, which exist in this area. The research was carried out from December 2021 to January 2022. This research is exploratory descriptive research, which reveals facts that are found in the field and seek to describe them precisely. Sampling was carried out by roaming method throughout the target area. Green open space with an area of 5448 m^2 , which is part of approximately 184 m^2 area that is overgrown with ferns. Measurement of abiotic factors obtained regarding the average daily air temperature of 29.2° C , average humidity of 78%, and average wind speed of 2 km/hour. The results of the identification of ferns showed that in an area of 184 m^2 , there were 10 species of ferns from 6 families. Data on a total plot area of 20 m^2 sampled area, was obtained for each species with the following amounts: Family 1. Pteridaceae ; *Pityrogrammacalomelanos* (316), *Pterisensiformis* (68), *Pterisbiaurita* (16), *Pteris* sp. (427). family 2. Polypodiaceae; *Drynariaquersifolia* (354). family 3. Lomariopsidaceae; *Nephrolepisexaltata* (408), *Nephrolepis* sp (387). Family 4. Blechnaceae: *Blechnumorientale* (57). family 5. Tectariaceae; *Tectariaangulata* (12). Family 6. Thelypteridaceae; *Thelypteris* sp. (62). There are only 10 species of Pteridophyta found in the research location. *Pityrogrammacalomelanos*, *Drynariaquercifolia*, *Nephrolepisexalta*, *Nephrolepis* sp. and *Pteris* sp. *Pterisensiformis*, *Blechnumorientale*, *Ptelypteris* sp. *Pterisbiaurita* and *Tectariaangulata*.

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Introduction:-

Jember is a city located in East Java Province. The city of Jember has an area of 3,293.34 km² with a tropical climate with a daily temperature range of 23^o C - 32^o C, rainfall ranging from low to medium to heavy. The weather is sunny, sunny cloudy to cloudy.[1] . The location for the research sampling was at GriyaTegalBesar Residential, Kaliwates District, located in the southern part of the downtown Jember, The GriyaTegalBesar Residential complex with position 8^o 11' 29-32" S 113^o 41' 24-26" E (google earth) is a small Residential complex with an area of only about 1.1 Ha. (1,100,000 m²).

GriyaTegal

Besar Residential is large area with an atmosphere that tends to be hot, with a daily temperature from December 2021 to early January, 2022 range from 26^o C to 31^o C. The weather tends to be hot, because there are very few trees. This area tends to be open land filled with grass and small herbaceous plants and some ferns / Pteridophyta. The types of plants that consist of abundant grass plants, and other small herbaceous plants, as well as ferns / Pteridophyta that exist in this area are not yet identified. (There is no data / information containing plant species in this area). Grass plants, other herbs and Pteridophyta play an important role as soil protectors from direct rain and erosion. In addition to its role as a protector of the soil surface, the presence of plants is important to reduce heat and supply oxygen. Any types of plants that grow in this area are part of the richness of biodiversity in Jember region, so it is important to identify them.

Identification of plants is an activity to reveal and determine the identity of plants, related to the correct name and its proper place in the plant classification system. Classification is an arrangement of taxonomic levels of living things that are used to facilitate the grouping of living things. Identification and classification can be started with observing the morphological characteristics of the plants[2]. The morphological characteristics of plants will be observed and described to define the right scientific name of the plants. Observations on the characteristics of plants is the important step to describe those plants. Plants that have been described their morphological characteristics, then can be identified their scientific names. There are several ways that can be done to identify the scientific name of plants, namely by asking plant experts, by matching with herbarium specimens, by looking in the Indonesian floral books, by looking the photos of plants, or by using a determination key[2].

This research was conducted to determine the types of ferns (Pteridophyta) in the GriyaTegalBesar Residence area, in the city of Jember.

This research is a type of qualitative descriptive research that aims to describe, illustrate, interpret research data that has been carried out systematically, based on facts in the field [3].in his writings on qualitative research, cites Howard's (2012) opinion, that qualitative research is a concept, definition, metaphors, symbols and descriptions of something Qualitative research, is likely to be influenced by the subjectivity of researchers. But the subjectivity of researchers can be minimized by systematically collecting literature and prior knowledge [4].

Research Methods:-

The research was conducted in the city of Jember, East Java, specifically in the GriyaTegalBesar Residential Area, KaliwatesJember District, which is a Residential area of 11,000,000 m² large, with an area of green open land about 5448 m². Ferns grow in an area of approximately 184 m². Data collection for species identification was carried out using the roaming method in this 184 m² area, while the number calculation was carried out by plotting an area of 1 m² at 20 points. So, the area of the entire plot is 20 m². Sampling was carried out in this area, also calculating the number of ferns of each type, measuring the organs of the plant samples and taking pictures. The next stage, namely plant identification, was carried out at the Botany Laboratory belonging to the Biology Education Study Program, FKIP University of Jember. Sample plants that have not been identified by researchers were konfirm with collection of Purwodadi Botanical Garden Plant Conservation Center, located in Pasuruhan East Java Indonesia, for further identification. The research was done at December 2021 and early January 2022.

Research tools that are used in this research include: scissors, hand shovel, length measurement tool, ruler, knife, stationery, thread, plant press, digital camera, magnifying lens/loupe, as well as books to assist in the description and identification process. The books that are used namely: Plant MorphologyGembongTjitrosoepomo[5]; Plant Taxonomy (Pteridophyta): GembongTjitrosoepomo, 2009 [2], Flora for Schools in Indonesia: C.G.G.J Van Steenis, 1992 [6]. as well as photos of collections of relevant previous research results.

The materials needed in this research were: samples of ferns / Pteridophyta plants found in the research area, label paper, blotting paper, yarn, plastic bags, 90% alcohol, and cardboard.

Sampling method that is used in this research is the roaming method. This sampling method is done by exploring the entire research area. The pictures of plants as the samples are taken while the plants are still in their habitat. After taking pictures, plant samples were taken for further observation and a herbarium was made, if necessary.

Research Design:

This research was conducted in two stages. The first stage is determining the research area, measuring abiotic factors and taking samples and pictures in the field. The second stage is the description and identification of plants.

Results and Discussion:-

This research is located at GriyaTegalBesar Residence, Jember city, East Java. This location is located in the coordinates of 8° 11' 29-32 "S 113° 41' 24-26" E. (Google Earth). Results of daily abiotic factor measurements in the research area are taken from December 2021 to early January 2022. The abiotic factors measured included air temperature, humidity, and wind speed. The data shows that the average air temperature in the morning is 27.4⁰ C with 83% of humidity level. During the day, the average temperature is 30.2⁰ C with 74% of humidity level. In the afternoon, the average temperature is 29.8⁰ C with 76% of humidity level. The weather is often sunny to cloudy in the morning, sometimes it rains. At noon the weather is sunny to cloudy, and sometimes it also rains. In the afternoon, the weather is sometimes sunny, cloudy, and more often it rains. The average wind speed under normal conditions is 2 km/hour. Meanwhile, the weather forecast according to BMKG Jember[1]: air temperature ranges from 23⁰ – 30⁰ C, air humidity is between 70% - 90%, with sunny to cloudy weather, and high rainfall. Climatic conditions greatly affect the existence of plants.

The description results of the samples taken and observed, then become the basis for identification. The identification is done by matching the description results of the sample with pictures in the floral books, herbariums, and photos from previous research results. From the results of the identification process, it was found that the types of ferns are as listed in the following table.

Table 1:- Fern plants (Pteridophyta) found in the GriyaTegalBesarJember Residential Area and the number in 20 m²

| Fam/Genus | Species | Total in 20m ² |
|---|---|---------------------------|
| Pteridaceae(Fam. 1) Pityrogramma Pteris Pteris Pteris | <i>P. calomelanos</i> <i>P. ensiformis</i> <i>P. biaurita</i> <i>Pteris</i> sp | 316 68 16 427 |
| Polypodiaceae(Fam. 2) Drynaria | <i>D. quersifolia</i> | 354 |
| Lomariopsidaceae(Fam. 3) Nephrolepis Nephrolepis . | <i>N. exalta</i> <i>Nephrolepis</i> sp | 408 387 |
| Blechnaceae (Fam. 4) Blechnum | <i>B. orientale</i> | 57 |
| Tectariaceae(Fam. 5) Tectaria | <i>T. angulata</i> | 12 |
| Thelypteriaceae(Fam. 6) Thelypteris | <i>Thelypteris</i> sp. | 62 |

Based on the identification results, it was found that there were 10 species out of 6 families, namely: 1. Pteridaceae family; types of *Pityrogrammacalomelanos*, *Pterisensiformis*, *Pterisbiaurita*, *Pteris* sp. family 2. Polipodiaceae; *Drynariaquersifolia*. family 3. Lomariopsidaceae; *Nephrolepisexalta*, *Nephrolepis* sp. family 4. Blechnaceae; *Blechnumorientale*. family 5. Tectariaceae; *Tectariaangulata*. Family 6. Thelypteridaceae; *Thelypteris* sp.

Although the numbers of species and population of Ferns / Pteridophyta plants found in the research location are not many, however they are still a part of the data / wealth of Biodiversity.

In the effort of conserving plants, Pteridophyta is quite important to be one of the topics that are taught in schools up to university level.[7] stated that Pteridophyta plants are one of the topics studied in plant taxonomy lectures, Even the Pronunciation of plant scientific names, including Pteridophytas also learned in the schools. Pronunciation of plant scientific names is regulated in pronunciation regulation with several rules [8]. The plant taxonomy course also discusses plant types. New information about plant types or plant scientific names must be authorized by the ICBN [9] Plant taxonomy is the main part of Systematic, which consists of four components namely Description, Identification, Nomenclature and Classification.[10] Identification, description, inventory of plants is an important beginning step in plant conservation efforts, including the identification of Pteridophyta plants. Conservation of biological diversity (United Nations Convention on Biological Diversity - CBD) in 1992, ratified by more than 180 countries. The CBD is the main international legal instrument that explicitly recognizes the role of traditional knowledge as a resource in the context of biodiversity conservation and its sustainable development. One of the goals of the CBD is to conserve biodiversity[11]

The number of species and genera that are found in the study area were very few, because the nature of this fern tends to require a humid place and not too hot sunlight. Meanwhile the research location is an open place, with only a few trees. Place with only a few trees, resulting only a little shade. Exposure to direct sunlight has an effect on higher air temperatures, and generally lower humidity than in areas that have a greater number of trees. On the other hand, an area with lots of trees, resulting in a large area of shade, resulting in a relatively low light intensity. The intensity of light will affect temperature and humidity, that is the lower light intensity, resulting the lower temperature and the higher humidity [12]. Places like this, for example in areas with lots of trees, such as in city parks, bamboo gardens, or forests, are excellent habitats for ferns / ferns (Pteridophyta). These ferns are generally forest understoreys, but many are epiphytes / attached to twigs, branches or tree trunks in the forest. The forest is a place where people look for food, medicines and other things to fulfill their needs. The forest is also a place to look for materials for daily life needs, especially for people who live in areas around the forest. Several species of Pteridophyta which are commonly used as medicine and vegetable ingredients for some people are not found in this area.

The GriyaTegalBesar area is one of the lands that has undergone a switch function, namely from its original function as agricultural land (rice fields), to Residential/residential land, so that many plant species are threatened with disappearing from this area. Aquatic species of Pteridophyta such as *Marsileaacrenata*, and *Azolla* which are commonly found in the rice fields and community garden area in Indonesia, are no longer be found in this area. The higher conversion activity of land, forest and agricultural land for buildings, will bring a positive impact, that is increasing the pace of economic development and community welfare. However, there are also negative impacts, which are the higher risk of erosion and flooding, the decrease of food resources, and reduced availability of clean water [13]. The GriyaTegalBesar area has become very open, due to the conversion of rice fields and community gardens into Residential. Resulting in plant species in this area becoming less and less. No matter how small the number of plant species that exist, it is still important to carry out plant identification / inventory. The importance of carrying out a plant inventory, because the results are evidence or data on the wealth (plants) owned [12] Besides as evidence of the richness of biodiversity, plants are also a vital element of the earth's ecosystem. Plants play an important role in maintaining the atmosphere, which provides healthy air, because almost all the oxygen needed by animals and humans is produced by plants. So, without plants there would be no life on earth. Saving plants from extinction in their original habitat is an important issue [14]. The number of species threatened or at risk has increased, due to agricultural land and climate change. The results showed that there were only 10 species of Pteridophyta found in the GriyaTegalBesar Residential Area. Type *Pityrogrammacalomelanos*, 316/20m², *Drynariaquercifolia*, 354/20 m², *Nephrolepisexalta*, 408/20 m²*Nephrolepis* sp. 387/20 m² and *Pteris* sp. 427/20 m², there are five species with a large number, on average 378.4/20 m²*Pterisensiformis*, 68/20 m², *Blechnumorientale*, 57/20m² and *Thelypteris* sp. 62/20 m² were found to be small in number, on average 62.33/20 m², while *Pterisbiaurita* 16/20 m² and *Tectariaangulata* 12/20 m² were even found to be very small, on average 14/20 m².

Each species in the study location has a different distribution. *Pityrogramacalomelanos*, was found scattered throughout the study sites, both in places that are more exposed to the sun or in the shade. This type is slightly more resistant to sun exposure. In different places, this type gives a different appearance. *Pityrogramacalomelanos*, which is found in places that are more exposed to the sun, appears to be smaller in size with a leaf length of about 32cm, with a stalk 12cm long and a strand length of about 20cm. (size may vary depending on age and level of development) but still has a smaller size compared to those living in shady areas. The surface color of the leaves are yellowish green. In accordance with information from previous research, leaves that are more exposed to the sun are smaller in size with a lighter green color than other plants that live in the shady area [15]. While in a shady area, the length of the leaves can reach 87 cm, with a stalk length of about 35 cm, leaf blade 52 cm, (measurement data); with a darker green color of leaves. This species is easier to identify, due to the shape of the leaves and the distinctive silver color on the underside (abaxial) of the mature leaves. The location of the sorus/sori is on the abaxial of the leaf. The silver color on the abaxial of the mature leaves is due to the presence of scale-shaped trichomes. The characteristic of the presence of silver-colored trichomes is typical for the *Pityrogramacalomelanos* species. The more mature the leaves, the silver color will be more dominant, so they are often called as silver ferns (Figure 1).



Figure 1:- Silver fern *Pityrogramacalomelanos*

The silver color on the abaxial of the leaves will be covered / mixed with brown, because the leaves have produced spores in the sporangium that gathered to form sorus, which is called sori in many numbers and located on the abaxial of the leaf.

Drynariaquercifolia species, is the next species that is easily recognized, because it has two different types of leaves. The first type of the leaf called as nest leaves. The nest leaves are the leaf at the base of the rhizome, they are leaves with a deep incised edge with a length of about 32 cm and a width of 28 cm (measurement results). The leaves of this nest are crammed tightly together and they are forming a nest. So, they are called as nest leaves[6]. True leaves are very long, with a length of 132 cm and a width of 47 cm (measured) and can reach a length of up to 150 cm [6].The shapes of the leaves are elongated oval with a very deep incised edge / like vertical tears, between the lateral leaves' veins. Sorus (sori) is arranged in a double row along the lateral leaves' veins. The sori are yellowish when they are young, and turn into brown when they are old. This species is very easy to recognize because of the character of the leaves. There are two kinds of leaves, which are very different in shape and size (Figure 2 and Figure 3).



Figure 2:- Nest leaves in *Drynariaquercifolia*,



Figure 3:- True leaves in *Drynariaquercifolia*

Three other species that were widely distributed are *Nephrolepisexalta*, *Nephrolepissp.* and *Pteris sp.* These three research area, both in areas that are slightly more exposed to sunlight and in shady areas, but there are more numbers in the shady areas. The places where these three species are found are on the edge of the ditch, on the edge of the building wall near the ground, under several trees, at the bottom of a bamboo clump, also in other shady places in the GriyaTegalBesar Residential area.

Apart from the five species that were found in large numbers at the research area, there were three other species of Pteridophyta found in small numbers, namely: *Blechnum orientale* and *Thelypteris sp.* Among these three species, only *Blechnum orientale* does not have a special character that makes it easier to recognize. While *Pteris ensiformis* and *Thelypteris sp.* have special characters that make them easier to recognize. *Pteris ensiformis* has a distinctive character, namely that there are two different types of leaves. The leaves are sterile on each leaf blade, the leaflets at the very end are the longest. While fertile leaves with leaflets that have smooth edges at the bottom but have jagged edges. Sori is on the abaxial of the leaf above the leaf veins that run along the edge, covered by a thin folded edge leaf. There is also a transition form of leaf between fertile and sterile leaflets.

Thelypteris sp. has a special character that is easily recognizable, that is, each leaf consists of pairs of leaflets, where each pair of leaflets is separated by a distance of about 3 cm from the other pairs (measurement results). Then, all of the pairs of leaflets form elongated lanceolate with the widest part at the base, and getting narrower towards the end. The edges of the leaflets are incised, while the base is wider and the very ends are not incised and getting narrowest. The leaf stalks remain green even though they are mature (figure 4).



Figure 4:- *Thelypteris* sp.

In addition to the eight species that have been described, there are two more species were found in very few numbers, namely *Pteris biaurita* and *Tectaria angulata*. *Pteris biaurita* is easily recognized from its unique leaves. Each leaf of *Pteris biaurita* consists of a pair of leaflets at the bottom, and one largest leaflet at the tip. Paired leaflets, each leaflet is branched into two with unequal size / asymmetric, with deep incised leaflets edges. Sorus/sori did not found at the time of the research. Not many of this species are found. They are few in number and live attached to the bottom of the building wall close to the ground. Their habitat is located in the shady narrow places, so that they are protected from direct sunlight. As shown in Figure 5



Figure 5:- *Pteris biaurita*.

The species *Tectariaangulata* is also a species that can be easily recognized because of the unique character of its leaves. There are two types of leaves on each petiole. The first type is in the form of a single elongated ovoid shape leaf, with the bottom being incised on the left and right side. The second type is that each leaf consists of three leaflets, the middle leaf is the largest, and the two leaves at the bottom left and right are small. All of the three leaves form an ovoid elongated single leaf. Both types of leaves have the same characteristics, which are smooth leaf edges and brown abaxial of the leaf veins. This species is also very rarely found in the research area. Even if they are found, the number is also very small. Their habitat is also at the bottom of building walls near the ground, or hidden between rock crevices, very sheltered and under the shady place. The habitat of this species is moist and protected from direct sunlight. At the time of observation, no sorus / sori was found on the leaves (figure 6).

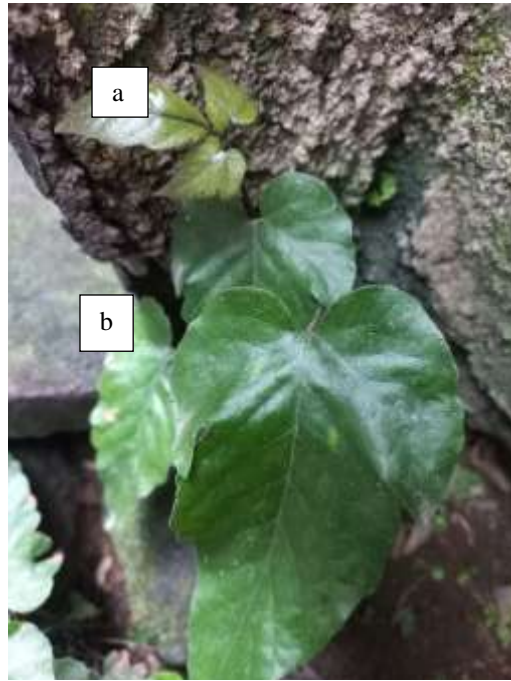


Figure 6:- *Tectariaangulata*.

- a. One stalk, three leaves
- b. One stalk, one leaf

Conclusion:-

Identification of Pteridophyta plants carried out in the GriyaTegalBesar Residential area, Kaliwates District, Jember City, East Java Province, Indonesia with positions 8° 11' 29-32" S 113° 41' 24-26" E (google earth) identified 10 species from 6 family namely: family 1. Pteridaceae; types of *Pityrogrammacalomelanos*, *Pterisensiformis*, *Pterisbiaurita*, *Pteris* sp. family 2. Polipodiaceae; *Drynariaquersifolia*. family 3. Lomariopsidaceae; *Nephrolepisexalta*, *Neprolepis* sp. family 4. Blechnaceae; *Blechnumorientale*. family 5. Tectariaceae; *Tectariaangulata*. Family 6. Thelypteridaceae; *Thelypteris* sp. of the 7 genera namely Pityrogramma, Drynaria, Nephrolepis, Blechnum, Pteris, Thelypteris and Tectaria. There are only 10 species of Pteridophyta found in the GriyaTegalBesar Residential Area. Type *Pityrogrammacalomelanos*, 316/20 m², *Drynariaquercifolia*, 354/20 m², *Nephrolepisexalta*, 408/20 m², *Nephrolepis* sp. 387/20 m² and *Pteris* sp. 427/20 m², there are five species with a large number, on average 378.4/20 m², *Pterisensiformis*, 68/20 m², *Blechnumorientale*, 57/20 m² and *Thelypteris* sp. 62/20 m² only few were found, on average 62.33/20 m², while *Pterisbiaurita* 16/20 m² and *Tectariaangulata* 12/20 m² were even found to be very few, on average 14/20 m².

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