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# Identification and Inventory of Lichen on Tree in the Rehabilitation Block of Sermo Kulon Progo Wildlife Reservation and Its Control in the Form of Booklets as Learning Sources

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**Abstract:** Lichens are one of the lower plants that rarely get attention. Thallus morphology of Lichenes. the lack of references to support learning about lichens causes the learning process to only focus on textbooks and worksheets, resulting in a lack of knowledge about lichens around them. This study aims to determine what types of lichens live on trees in the Sermo Kulon Progo Wildlife Sanctuary Rehabilitation Block, identify the results of the identification and inventory of lichens on trees in the Sermo Kulon Progo Wildlife Sanctuary Rehabilitation Block, and develop booklet identification and inventory of lichen on trees in the Sermo Kulon Progo Wildlife Sanctuary Rehabilitation Block as a learning resource. This study consisted of two stages, namely identification and inventory of lichen on trees in the Sermo Kulon Progo Wildlife Sanctuary Area Rehabilitation Block using exploratory descriptive methods and the development stage of identification and inventory booklets of lichen on trees with the development method 4 -D. Research on the identification and inventory of lichens on trees resulted in 30 species divided into 16 families with thallus foliose, crustose, fructicose, and squamulose types. The booklet was analyzed by 1 material expert, 1 media expert, and 1 biology teacher. The limited test was conducted by 24 students of class X MIPA SMAN 2 Banguntapan Bantul. Product quality assessment data was obtained from sheets in the form of a questionnaire. The results of the material expert assessment are included in the appropriate category with an average percentage of 83%, the assessment from media experts is included in the appropriate category with an assessment percentage of 80%, the assessment by the biology teacher is included in the very feasible category with an average percentage of 94%, and student assessments obtained an average percentage of 86.45% which indicates a very decent category. Based on this assessment, it can be concluded that the booklet is suitable to be used as a learning resource.

**Keywords:** *Booklet*, Exploration, Identification, Inventory, *Lichenes*.

## Introduction

Indonesia has an area of about 1.3% of the earth's area but has a high level of biodiversity. The high biodiversity is supported by Indonesia's forests, which are the ninth-largest forest in the world (Rachman, 2017). Lichen is one of the filler groups for biodiversity in Indonesia. According to Negi (2003), the total number of lichen species in the world reaches one hundred thousand (100.000) species. Suwarso (1995) added that based on data from Herbarium Bogoriensis Bogor, there are forty thousand rupiahs (40,000) species of lichen in Indonesia.

Lichen is one of the pioneer plants that have high biodiversity. This plant can be found widely in humid areas, highlands, arctic to tropical areas. Wide distribution because lichen is an organism resulting from a symbiotic association between two different organisms, namely algae (photobiont) and fungi (mycobiont). Form-Based on the thallus, lichens are divided into seven groups, namely foliose, fruticose, crustose, squamulose. (Hale, 1969; Dobson, 1992).


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Lichen has various benefits for humans and ecosystems. Lichen can be used for medicine, as a bioindicator of pollution, raw material for perfumes, and dyes. Especially the people of Yogyakarta have known lichen as one of the ingredients of traditional medicine for a long time. The type of lichen used by the community as medicine in herbal mixtures is the fruticose type from the genus Usnea sp which is often referred to as "woodwind or rasuk wind" (Sudirman, 2015).

Lichen also has an important role in the balance of the ecosystem. Lichen acts as oxygen supplier, succession agent, air pollution bioindicator, and air quality biomonitoring (Richardson, 1992; Negi, 2003; Eva, 2003; Rout et.al, 2010). The oxygen released by lichens from photosynthesis also contributes to the availability of oxygen for the people of Yogyakarta. As a succession agent, lichen is a pioneer in the formation of ecosystem balance. The diversity and presence of certain types of lichen can be used as an indicator of forest quality and measure the balance of a post-disaster forest (Rout et.al, 2010). The high diversity of lichens indicates a healthy ecosystem condition. While the loss of lichen in nature indicates an ecosystem imbalance.

Refers to the International Code of Nomenclature for algae, fungi, and plants, where "A taxon name shall be rejected if its character is derived from two or more discordant elements unless it is possible to select one of these elements as the satisfactory type. In general, at least in some respects, fungi play a dominant role in fungal-algae associations, which form lichens and it is customary to delimit classes and orders of Lichens especially on fungal characters (eg AscoLichen, BasidioLichen, Pyrenocarpales). In the end, Lichens cannot live independently, and this have resulted in the decision that the species name lichen refers to a pair of fungi, not to a symbiotic system.

Identification and inventory activities are carried out to obtain data in the form of quality and quantity of biodiversity, one of which is Lichen diversity in an environment. Identification is defined as an effort to determine the correct identity of a species in classification based on similarities to real specimens, both living and preserved (Tjitrosoepomo, 2009). Inventory is an activity to collect data or classify a type of biological that exists in an area. Inventory activities are needed to measure the potential of an area that includes aspects of diversity, distribution, and biological population including Lichen (Ahsan, 2010).

Biodiversity in an environment needs to be explored through identification and inventory activities. The Sermo area is one of the protected areas in the Special Region of Yogyakarta. Which is one of the Wildlife Sanctuaries (SM) under the auspices of the Yogyakarta Natural Resources Conservation Center.

Taking into account the ecological aspects, as well as the real conditions in the Sermo area, the Yogyakarta KSDA Balai divides the Sermo SM management block into 4 (four) blocks, namely: protection block, utilization block, rehabilitation block, and special block. In this study, Lichen observations were made on the rehabilitation block. This rehabilitation block is part of the damaged area and efforts are needed to restore the habitat according to its initial condition to support the increase in its carrying capacity. Parts of the area that are prioritized for rehabilitation are areas with a high level of damage pressure and vulnerable/critical areas.

Researchers have studied the diversity of lichens quite a lot, but there is still no research on the diversity of lichens in trees in the rehabilitation block of the Sermo Kulon Progo Wildlife Sanctuary. It was proven that there were no books, media, or similar journals that specifically discussed lichen diversity in the area so that it could potentially be used as a sampling area for lichen diversity. Another potential can also be seen from the results of a preliminary survey conducted in the area where 14 types of lichens were found which differ from the morphological structure including the shape of the thallus including foliose, crustose, leprosy, and fruticose as well as a large number of various colors. This becomes an urgency to research Lichen diversity in the Sermo Kulon Progo Wildlife Sanctuary area. The results of the identification and inventory of lichen diversity have the potential to be used as a source of information for the general public.

There is still a lack of public knowledge about the diversity and benefits of lichens, as well as a lack of literacy about the condition of lichens in the Sermo Kulon Progo Wildlife Sanctuary area, a research was conducted on the identification and inventory of Lichens (Lichen) on trees in the rehabilitation block of the Sermo Kulon Progo Wildlife Sanctuary and its carriers in the form of booklets as learning resources. This is intended to answer the problem of the lack of public knowledge about lichen. It is also used as reference data related to lichen diversity in trees in the Sermo Kulon Progo Wildlife Sanctuary Area Rehabilitation Block, especially related to its conservation interests so that potential can be developed.

Booklets are a combination of books with leaflets or books with small sizes such as leaflets. It is hoped that the community and students after reading the book will be more concerned about the existence of lichens by bringing up conservative policies. Based on the explanation above, a research was conducted with the title "Identification and Inventory of Lichens (Lichen) on trees in the Sermo Kulon Progo Wildlife Sanctuary Rehabilitation Block and its bearers in the form of booklets as learning resources",

## Materials and Methods

The form of research used is development research. This research includes two stages, namely 1) lichen identification and inventory research 2) lichen booklet development.

**Research Inventory and Identification of Lichens**

This type of research is exploratory descriptive research. Researchers seek, collect, describe, identify, take inventory, and interpret research data obtained in the field in a systematic, factual, and accurate manner. Sampling is intentional (purposive sampling), where the researcher determines the sampling by determining the special characteristics that are by the research objectives so that it is expected to be able to answer research problems. The samples obtained were then identified at the Integrated Biology Laboratory of UIN Sunan Kalijaga Yogyakarta. In the end, the results of this study were used as a booklet.

**Place and Time of Research**

The research was conducted at the Sermo Kulon Progo Wildlife Sanctuary Area Rehabilitation Block. The Lichen identification stage was carried out directly at the sampling location. The research was carried out in two stages, namely:

1. The preliminary survey stage is carried out in January 2021.
2. Sampling and identification stage in June 2021.

**Tools and Materials**

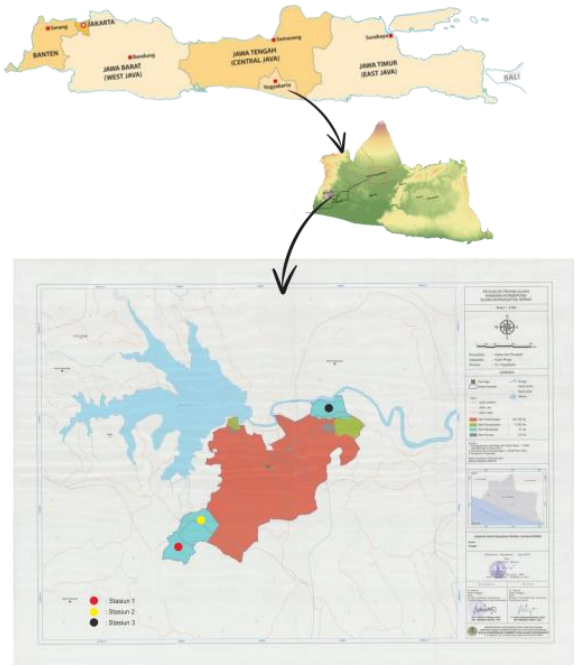
The equipment used to support this research includes stationery, camera, ruler, plastic rope, tape measure, pegs, tweezers, measuring cup, thermohygrometer, anemometer, luxmeter, soil tester, loop, Global Positioning System (GPS). The material needed is a sample of Lichen which was found in the sampling area in the Sermo Kulon Progo Wildlife Reserve.

**Research Step**

The research steps for the identification and inventory of lichens in the Sermo Kulon Progo Wildlife Sanctuary Area go through the following stages, including:

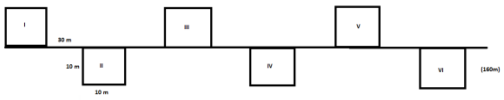
1. *Determining the location*

   The location of data collection begins with a survey of the location that will be used as a place of research to determine the sampling point. Sampling was determined by the purposive sampling method in the sampling area. This is done by drawing a straight line transect 160 m long with 3 areas, namely open areas, protected areas, and sloping areas.



2. *Measurement of Abiotic ParametersBeforeo sampling, abiotic parameters were measured first to determine what factors affect the growth of lichen, the measurement of abiotic factors includes:*
   a) Measure the humidity of the air using a thermohygrometer
   b) Measuring light intensity using a lux meter
   c) Measure wind speed using an anemometer
   d) Measuring pH using a soil tester
   e) Measuring the altitude of a place using the Global Positioning System (GPS)
3. *Sampling*
   Sampling was carried out using the purposive sampling method in a predetermined sampling area. Sampling was carried out by drawing a straight line transect 160 m long with 3 areas, namely open areas, protected areas, and sloping areas. 1 transect consists of 6 squared plots with a size of 10 m x 10 m so that there are 24 squared plots to determine the presence of lichen species in the research location.

   Observations started from the base to the branching of the tree. Sampling by purposive sampling is using a plastic rope and a meter, on the line transect. Tree selection was done by purposive sampling, based on trees that contained lichen and had a diameter of more than 15 cm. Tree species were taken randomly from all tree species, followed by morphological species identification using lichen identification guidelines. Determination of lichen zoning on host trees based on Johansson's method of dividing host tree zoning.



   Each lichen found was recorded based on where it grew, photographed, measured in diameter, and meas, ured for environmental factors in the form of coordinates, altitude, air temperature, humidity, and light intensity.
4. *Sample Identification*
   Then the sample will go through an identification process to determine the identity of the sample taken. Sample identification includes several stages, including:
   a) Observing and describing the morphological structure in the form of color, thallus shape, and reproductive structure of lichen samples that have been obtained from the research area
   b) Identifying Lichen samples by comparing the characteristics of the samples found with several identification sources which include:
      i. *The Lichen of British ColumbiaIllustratedd Key Part 1 Foliose and Squamulose Species* (Goward, dkk., 1994)
      ii. *The Lichen* (Hale, 1973)
      iii. *Identification of Lichen Substances* (Huneck, dkk., 1996)
      iv. *Lichen Determination Keys: Neotropical Genera* (Sipman, 2005)
      v. Valid and relevant web pages, articles, journals, theses, and photos.
5. *Sample Inventory*
   The plant inventory is carried out by recording the plants that have been found in the Sermo Kulon Progo Wildlife Reserve area. The results of the inventory are processed using Microsoft Word in the form of a table.
6. *Data Analysis Techniques*
   The results of the data obtained are then carried out with a qualitative descriptive analysis technique. Qualitative descriptive data analysis

techniques by describing each character from the samples found include grouping lichen types based on the Latin name and morphological form of Lichen, Lichen thallus type, number of Lichen colonies, Lichen benefits, Lichen substrate.

**Development of Booklets as Learning Resources**

At this stage, the data from descriptive qualitative research is then used as a booklet, namely the development of the Lichen booklet in the Kulon Progo Wildlife Sanctuary area. The research method used is the research and development method or Research and Development (R & D). The Research and Development method is a research method used to produce a certain product and to test the effectiveness of the product (Sugiyono, 2017:407). The development model chosen in this study refers to the stages of the modified 4-D development research by Thiagarajan. This development model is by the researcher's goal to produce a product in the form of a booklet obtained from the results of research and expert validation (Thiagarajan, 1974).

The 4D development model consists of 4 main stages, namely: Define, Design, Develop and Disseminate. In detail, the stages of research and development of the booklet are described as follows:

1. **Define:** This stage emphasizes the process of analyzing the needs of the booklet as a learning resource.
2. **Design:** In this planning stage, it aims to prepare a prototype of learning media.
3. **Develop:** In this phase, the product produced is booklet-based biology learning media. The media will then go through several stages as follows:
   a) Expert validation.
      At this stage, it asks for theoretical considerations from experts and practitioners about the validity of the prototype. Validators consist of biologists or material experts, media experts, and field practitioners, namely biology teachers. The validators were asked to validate the teaching media that had been produced at the design stage (prototype). Suggestions from the validator are used as considerations in the revision of the resulting developed teaching media. This validation aims to obtain data about the feasibility of the learning resources developed.
   b) Product Trial
      This activity was tested on class X SMA 2 Banguntapan Bantul aimed to find out the effectiveness of the learning media that has been made by researchers to make it easier for students to understand Biology material. Then in the implementation process, it is hoped that there will be criticism and suggestions as evaluation material by researchers before the learning media is patented to be used as a companion for student textbooks in the future. The trial was carried out with a small group trial by randomly taking 24 students of Class X MIPA SMA N 2 Banguntapan Bantul, then the students were given a booklet that had been revised based on the results of expert validation to read while doing the quizzes. After that, students are asked to give criticism or suggestions about the booklet product, if there are criticisms and suggestions, the product must be revised again.
   c) Data Collection.
      Here students are given a questionnaire to respond to the media that has been used. This questionnaire is used to find needs analysis, validate instruments, and booklet media products. The form of the questionnaire used by the researcher is a non-test questionnaire, where the questionnaire has provided answers and is arranged in the form of a checklist (√). This questionnaire is addressed to students, media experts, material experts, and Biology subject teachers for class X.
   d) Evaluation
      In this activity, the evaluation results will be considered to produce booklet-based learning media that are ready to be used, both when viewed from small-scale and large-scale trials. This revision activity was carried out to determine the level of

feasibility and effectiveness of the learning media in the form of the biology booklet.

4. **Disseminate**
   After a limited trial and the instrument has been revised, the next stage is the dissemination stage. The purpose of this stage is to disseminate pop-up media. In this study, only limited dissemination was carried out, namely by disseminating and promoting the final product of pop-up media on a limited basis to science teachers at SMAN 2 Banguntapan Bantul.

**Data Analysis Techniques**

Testing the feasibility of the Lichen booklet as a learning resource was carried out by analysis based on data from questionnaires or questionnaires given to lecturers as material experts, lecturers of learning media experts, biology teachers, and students of SMA N 2 Banguntapan Bantul.

| Criteria | Score |
|---|---|
| Strongly agree | 5 |
| agree | 4 |
| Disagree | 3 |
| Do not agree | 2 |
| strongly disagree | 1 |

Then the data collected is analyzed by calculating the average score of each aspect that is assessed

$$\overline{\mathbf{X}} = \frac{\Sigma \mathbf{X}}{\boldsymbol{n}}$$

Note:
$\overline{X}$ = Score

Then calculate the validation percentage value

$$V = \frac{N}{M} \times 100\%$$

Maximum score (M) = number of questions x largest score scale
Note:
V = Validation percentage value
N = Total Score obtained
M = Maximum score

The average assessment results obtained in the form of quantitative data are converted back into qualitative data regarding the Lichen booklet eligibility category so that conclusions can be drawn regarding the feasibility of the booklet based on the ideal conversion which is described as follows.

| No | Percentage | Criteria |
|---|---|---|
| 1 | 0%-20% | Strongly agree |
| 2 | 20%-40% | agree |
| 3 | 41%-60% | Disagree |
| 3 | 61%-85% | Do not agree |
| 4 | 85%-100% | strongly disagree |

The success indicator from the validation results by the validation of media experts, material experts, high school teachers, and students is said to be successful if the media eligibility criteria are at least 61%. If the results of the media validation have not reached that number, then the media is said to be inadequate and it is recommended not to use it because it needs to be revised (Rusmana, 2019).

## Result and Discussion

**Results of Inventory and Identification of Lichen on Trees**

Types of Lichen on Trees in the Rehabilitation Block of the Sermo Kulon Progo Wildlife Reserve. Based on the results of the research, the lichen types on trees found in the rehabilitation block of the Sermo Kulon Progo wildlife reserve were of fruticose, foliose, crustose, and squamulose types.

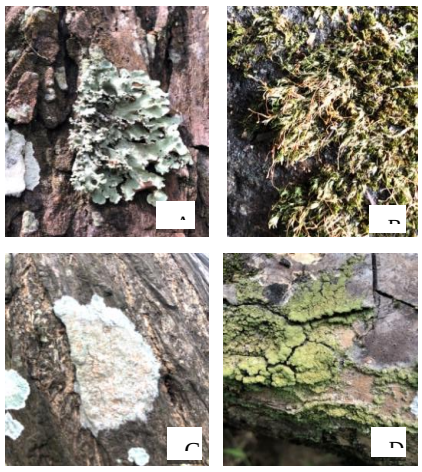
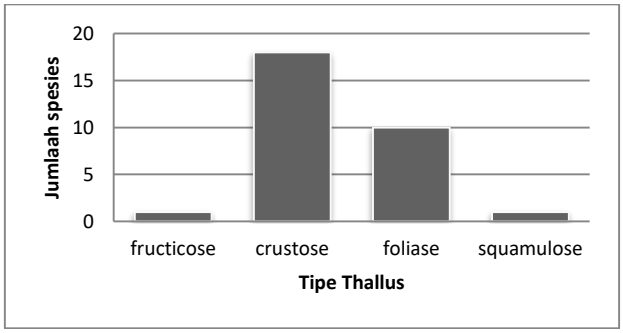


**Figure 1**. Thallus Types (A) Foliose, (B) Fructicose, (C) Crustose, (D) Squamulose

The number of lichen species found in the thallus fruticose type was 1 species, the crustose thallus type was found to be 18 species, the thallus foliose type was found to be 10 species, and the squamulose thallus type was found to be 1 species. The number of lichen species based on the type of thallus can be seen in the following graph:




**Graph 1**. Diagram of the Number of Lichen Species by Thallus Type

**Lichen species on trees in the Sermo Kulon Progo Wildlife Reserve Area Rehabilitation Block**

The results of the research on the identification and inventory of lichens in the rehabilitation block of the Sermo Kulon Progo Wildlife Sanctuary Area were found to have various types of lichens. The types of lichens found in the study were 30 species divided into 16 families.

| Family | Lichen species | station | | | ∑ Colony | Frequency of Species Encounter |
|---|---|---|---|---|---|---|
| | | I | II | III | | |
| Arthoniaceae | *Cryptotheca scripta* | 10 | 23 | 19 | 52 | 3% |
| | *Cryptothecia striata* | 34 | 49 | 27 | 110 | 7% |
| Bacidiaceae | *Bacidia viridifarinosa* | 9 | 11 | 16 | 36 | 2% |
| Caliciaceae | *Drynaria applanata* | - | 10 | 16 | 26 | 2% |
| Candelariaceae | *Candelariella reflexa* | - | 13 | 15 | 28 | 2% |
| Chrysotrichaeae | *Chrysothrix candelaris* | 10 | 27 | 12 | 49 | 3% |
| Graphidoideae | *Graphis subelegans* | 8 | 13 | .11 | 21 | 1% |
| | *Graphis scripta* | 17 | 23 | 4 | 44 | 3% |
| | *Graphis elegans* | 34 | 40 | 39 | 113 | 8% |
| Hymeneliaceae | *Aspicilia calcarea* | 10 | 13 | 9 | 32 | 2% |
| Lecanoraceae | *Lecidella elaeochroma* | 2 | 7 | 11 | 20 | 1% |
| | *Lecanora expallens* | 20 | 31 | 47 | 98 | 7% |
| Naetrocymbaceae | *Cystocoleus ebenus* | 14 | - | 22 | 36 | 2% |
| Opegraphaceae | *Opegrapha gyrocarpa* | 7 | 22 | 16 | 45 | 4% |
| Parmeliaceae | *Parmelia sulcata* | 10 | 24 | 25 | 59 | 4% |
| | *Parmotrema perlatum* | 3 | 12 | 15 | 30 | 2% |
| | *Punctelia borreri* | 2 | 32 | 17 | 51 | 3% |
| | *Flavoparmelia caperata* | 2 | 20 | 12 | 34 | 2% |
| | *Parmelia saxatilis* | 15 | 30 | 43 | 88 | 6% |
| | *Parmelia tiliacea* | 14 | 29 | 48 | 91 | 6% |
| | *Usnea comosa* | - | 13 | - | 13 | 0,9% |
| Phlyctidae | *Phlyctis argena* | 33 | 47 | 35 | 115 | 8% |

| Family | Lichen species | station | | | ∑ Colony | Frequency of Species Encounter |
|---|---|---|---|---|---|---|
| | | I | II | III | | |
| Physciaceae | *Drynaria confuse* | - | 11 | - | 11 | 0,7% |
| | *Pyxine cocoes* | - | 7 | 2 | 9 | 0,6% |
| | *Physcia aipolia* | 3 | - | 9 | 12 | 0,8% |
| Pyrenulaceae | *Pyrenula concatervans* | 1 | 14 | 18 | 33 | 2% |
| Stereocaulaceae | *Lepraria incana* | 27 | 52 | 39 | 118 | 8% |
| | *Lepraria umbicola* | 3 | 40 | - | 43 | 3% |
| Teloschistaceae | *Caloplaca sp* | 7 | 16 | 10 | 33 | 2% |
| | *Caloplaca marina* | 16 | 11 | 21 | 48 | 4% |
| **Number of Species found** | | 311 | 640 | 547 | 1498 | |

**Development of Lichen Booklet**

The results of the research on Identification and Inventory of Lichens (Lichen) in the Rehabilitation Block of the Sermo Kulon Progo Wildlife Reserve were used as a learning resource to support Lichen learning in schools in the form of booklets. This booklet serves as an information reference that can be used by students and the general public to help obtain information. The booklet contains the types of lichens in the Sermo Kulon Progo Wildlife Sanctuary Area Rehabilitation Block. Theoretically, booklets about Lichen are not yet fully known by students.

Based on the results of the development of the booklet Types of Lichens (Lichen) in the rehabilitation block of the Sermo Kulon Progo Wildlife Sanctuary area carried out by researchers, to determine the feasibility of the developed booklet, validation was carried out to experts. Based on the results of validation by material experts, the booklet Types of Lichens (Lichen) obtained a validation value percentage of 83.53% so the booklet of Lichen Types is materially valid. Based on the results of validation by media experts, the booklet Types of Lichens (Lichen) obtained a validity percentage value of 80%. So that this booklet of Lichen Types (Lichen) is presented properly or validly used without any revisions.

After the product is finished through the validation stage by material experts and media experts, then the product is then tested on the Biology teacher and students. The purpose of this trial is to determine the response to products that have been developed by researchers. The results of the biology teacher's trial showed that the average percentage score obtained was 94.29%, which means that the booklet product developed by the researcher was very feasible/valid. the average score of the booklet assessment of 24 students percentage result is 88.82% which indicates a very decent category.

## Conclusion

Based on the results of research on "Identification and Inventory of Lichens (Lichen) on Trees in the Rehabilitation Block of the Sermo Kulon Progo Wildlife Reserve and Its Bearers in the Form of Booklets as Learning Resources" it can be concluded as follows:

1. Types of lichen in trees found in the rehabilitation block of the Sermo Kulon Progo wildlife reserve area are fruticose, foliose, crustose, and squamulose. The number of lichen species found in the thallus fruticose type was 1 species, the crustose thallus type was found to be 18 species, the thallus foliose type was found to be 10 species, and the squamulose thallus type was found to be 1 species.
2. The results of the research on identification and inventory found 1,498 lichen colonies found on trees in the rehabilitation block of the Sermo Kulon Progo Wildlife Reserve which were divided into 30 species from 22 genera and 16 families, including the Arthoniaceae, Bacidiaceae, Caliciaceae, Chrysotrichaeae, Graphidaceae, Hymeneliaceae, Lecanoraceae,

Naetrocymbaceae, Opegraphaceae, Parmeliaceae, Phlyctidae, Phsciaceae, Pyrenulaceae, Stereocaulaceae, and Teloschistaceae. Lichen species Lepraria incana was the most common lichen species from the Stereocaulaceae family with 118 colonies, while Pyxine cocoes from the Physciaceae family were the least common lichen species with 9 colonies.

3. The booklet "Types of Lichen on Trees in the Sermo Kulon Progo Wildlife Sanctuary Rehabilitation Block" viewed based on a feasibility test by a material expert is included in the appropriate category with an average percentage of 83%, the assessment from media experts is included in the appropriate category with an assessment percentage of 80%, the assessment by the biology teacher is included in the very appropriate category with an average percentage of 94%, and the assessment from students obtains an average percentage of 86.45% which indicates a very decent category. Therefore, booklets can be said to be very suitable to be used as learning resources.

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