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# Bird Diversity and Abundanceits in the Area of the Raya Forest Park (Tahura) Central Sulawesi Andutilization as a Learning Media

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**Abstract**

*This study aimed to analyze the diversity and abundance of birds in the Grand Forest Park (TAHURA) of Central Sulawesi and to develop a poster based on the findings as a learning medium. The research employed a descriptive design using the Indices Ponctuel d'Abondance (IPA) method. Sampling was conducted at three observation stations within the TAHURA area. Research sites were selected through purposive sampling, with station distances arranged proportionally in areas with suitable vegetation density. Data were analyzed using the Shannon–Wiener diversity index to determine species diversity and the Van Balen abundance index to measure relative abundance. The results identified 21 bird species belonging to 13 families, including nine species endemic to the Sulawesi sub-region. Analysis showed that the average bird diversity index was in the moderate category, with a Shannon–Wiener value of H' = 1.88. The highest relative abundance index reached 41%, while the lowest was 1%, indicating variation in species distribution across the study area. The research findings were then transformed into a poster. Validation by content experts, design experts, and 24 students produced feasibility percentages of 80.67% and 91.81%, indicating that the developed poster was valid, practical, and suitable for biology learning.*

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## Introduction

Indonesia is one of the world's centers of biodiversity (megabiodiversity). In Indonesia there are 1,539 bird species and 381 species or 4% are endemic species that are naturally only found in Indonesia (Sujatmika, 1995).

Birds are fauna that can be found from the lowlands to the highlands, both in natural and unnatural areas. The Sulawesi plain supports about 224 species of land and freshwater birds, of which 41 are endemic species, and the highest number of endemic birds is found on the mainland of Sulawesi. The Sulawesi sub-region includes many satellite islands and island groups, most of which are unexplored flora and fauna, including bird species (Coates & Bishop, 2000).

As a component of the environment, birds can be used directly or indirectly as environmental bioindicators. Birds have provided many benefits in human life, both as a source of protein, pets, competitions, and hunting sports. However, the threat of poaching continues to increase led to a variety of bird species to be protected because the population is already in a state of near-threatened(nearthreatened)until threatened with extinction(endangered), such as the type of family Bucerotidae (Kuswanda, 2010).

Prabowo (2019) revealed that research on avifauna is important, because if an area has a high abundance of avifauna, it can be an indicator that environmental conditions are good. This is because avifauna have the ability to spread seeds, help pollination, are natural predators of other animals, and so on. Avifauna in carrying out their activities require a suitable habitat.

Bird communities are used as a balancer for forest ecosystems and indicators of environmental quality. This is because, birds as one component of the ecosystem that supports the life cycle of organisms in the form of food chains and food webs. In addition, birds are animals that live in almost all habitats on the earth's surface and are very sensitive to environmental damage Arini & Prasetyo, (2013). On the basis of these roles and benefits, the existence of birds needs to be maintained so that their sustainability is maintained and not threatened with extinction.

The Grand Forest Park (TAHURA) is one of the conservation areas that was confirmed through Ministerial Decree No.24/Kpts-II/1999 covering an area of 7,128 ha. According to current government administration, the Tahura area of Central Sulawesi is located in the Sigi Regency and Palu City. With buffer villages the areas in Sigi Regency include: Pombewe Village, Loru Village and Ngatabaru Village. There are also sub-districts

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supporting the area in Palu City, including: Layana Indah Village, Lasoani Village, Poboya Village, Tondo Village, and Layana Indah Village. According to Government Regulation No. 104 of 2015 concerning procedures for changing the allocation and function of forest areas. The forest park area (TAHURA) is divided into three areas, namely permanent production forest, limited production forest and permanent forest (Jamlis et al., 2016).

Forest destruction in Tahura as a bird habitat due to land clearing by the surrounding community for agriculture and gold mining land by the community and private companies. Increased community activities in the forest park area (TAHURA) which is used for agriculture, plantation, settlement, mining, and the use of timber forest products and others. These activities can result in environmental impacts as well as loss of habitat for birds. This is as stated by Butarbutar & Soemarno (2013), that exploiting nature without paying attention to its sustainability causes biodiversity as the support of human life to undergo many changes.

Grand forest park (TAHURA) is a forest area designated for research and development, education and training purposes. If managed properly, birds can be developed as a tourist attraction. One of the potential biodiversity in the area is birds. Birds can be used as an excellent indicator of environmental health and the value of biodiversity.

This research is relevant to the research conducted by Iksan (2015), which revealed the similarity of bird communities in the hammer valley, reported that overall bird species between study sites had a low level of comfort (<50%). The locations with the greatest similarity were Wera and Ngatabaru at 49%, then Wera and Paneki at 47% and Paneki and Ngatabaru locations at 43%. At all locations, there were 59 bird species with a total population of 849 belonging to 33 families. This study uses the IPA (Indices Ponctuel d'Abondance) method by using processing and analysis techniques entering all types of bird data into a table that can find bird species at different research locations.

Aris & Aunurohim (2013) revealed that birds are a natural wealth of high value, either directly or indirectly. The direct benefits of birds include an economic aspect that can be used as a bird ecotourism object. Indirectly it is also beneficial for science, especially those related to efforts to protect the lives of various types of birds.

This research is important to do to find out the various bird species in forming and maintaining the stability of the buffer forest in the Tahura Ecosystem Area. Furthermore, the results of this study can be used to add information to the Central Sulawesi Tahura database about data on bird diversity and abundance in the Tahura Ecosystem Area. In addition, the results of this study can also be a source of learning in schools in Central Sulawesi.

The objectives of this research were, among others:

1) To find out various bird species in forming and maintaining the stability of the buffer forest in the Tahura Ecosystem Area.
2) The results of the study can be used to add information to the Tahura Central Sulawesi database on data on the diversity and abundance of birds in the Tahura Ecosystem Area.
3) The results of this study can also be a source of learning in schools in Central Sulawesi.

The forest park (TAHURA) is one of the habitats for various types of birds that support the learning process. This is because the learning process is carried out outdoors (nature) which prioritizes proving existing theories. In addition, to get maximum results in receiving learning stimuli and responses, learning media are needed as supporting factors.

The diversity and abundance of bird species obtained from the results of the research conducted will be developed into learning media, one example is poster media. Poster media is a combination of images and text that provides clear information with an attractive decorative image display. Arsyad & Azhar (2005), revealed that learning media is used for the process of achieving a learning goal. In essence, the learning process is also a communication, so the learning media can be understood as a communication medium.

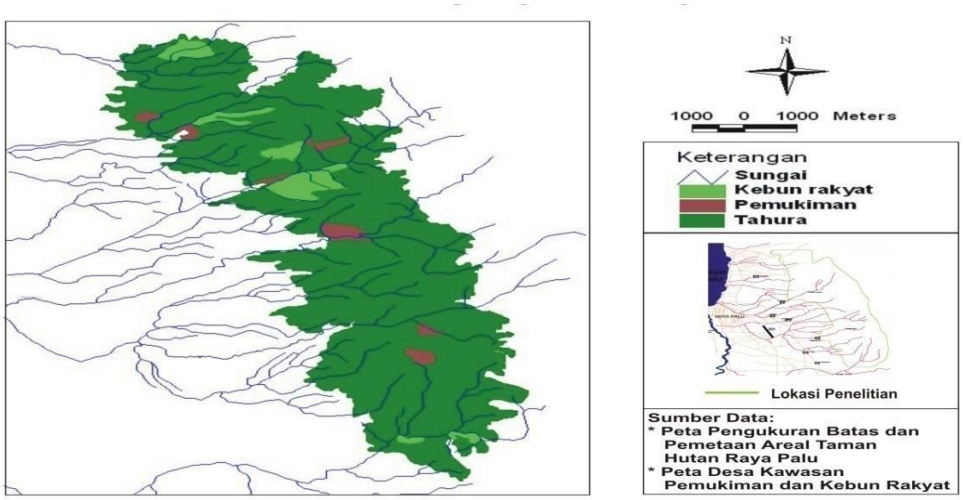
The use of poster media can facilitate understanding which is abstract in nature, so that it can provide an overview and information about the presence and types of birds that exist in the area of the Grand Forest Park (TAHURA) area of Central Sulawesi.

## Materials and Method

This research is a quantitative descriptive study. Descriptive research does not provide treatment, manipulation or change of independent variables, but describes a condition as it is and involves a descriptive process, recording, analyzing and interpreting data that occurs during the research (Arikunto, 2010).

This research was carried out in December 2021. The research location is in the Grand Forest Park (TAHURA) area of Central Sulawesi, the research location is presented in Figure 1.

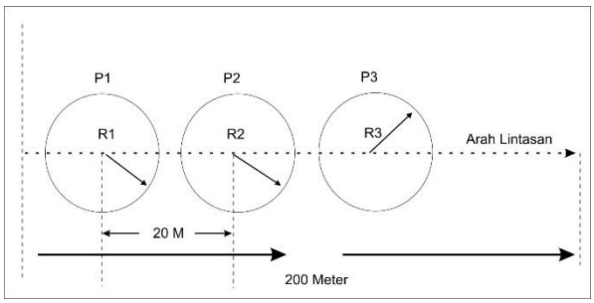
**Figure 1.** The Research Locations




study used the path method with data collection techniques using the IPA (method.*Indices Ponctuel d'Abondance)*). The IPA method is a bird observation method by taking samples from the community at a certain time and location (Hasibuan et al., 2018).

The shape of the unit in bird observation using themethod *IPA-Count* in this study is a circle with a diameter or circle radius that is adjusted to the average viewing distance (20 m), with the distance between point 1 and point 2 (20 m), the distance between point 2 to point 4, is (40 m) with a cross length (200 m) at the research location that has been determined. A sketch of theResearch method *IPA-Count* that will be carried out is presented in the image below.

**Figure 2.** Sketch of the form of the bird species inventory unit using themethod *IPA*




Description: P observation point, r = radius of circle determined by Average Visibility Ability (20 m).

The procedure in this study will be divided into several stages are:

***Preparation phase***

This preparatory stage consists of several activities, including the following:

1) Observation
2) Researchers conducted field observations to determine the location of observations in the TAHURA area of Palu City.
3) Setting Up Administration
4) The researcher prepared the necessary administration, namely a research permit from the S2 Science Education Study Program which was addressed to the TAHURA Office to conduct research activities on Bird Diversity and abundance in the Grand Forest Park (TAHURA) area of Central Sulawesi.
5) Preparing Tools and Materials
6) To borrow and procure tools and materials to be used in research.

***Sampling Implementation Stage***

Sampling techniques in this study are:

1) The research location at each station was determined *purposively* in the form of three observation lines on one side of the river flow, each of which represented the location of the top (upstream), middle (downstream), and bottom (downstream). The position of the distance between the lines in each station is regulated proportionally which still has a good vegetation density.
2) The length of the observation path used is 200 m and is divided into 10 observation points with an interval between points of 20 m. The length of time for observations at each point on one path is 20 minutes by recording each bird's diversity and the number of individuals that are seen or heard, then the observation is continued to the next point . Observations on each line in the same location (station) were carried out at the same time by different observer teams. Bird observations were carried out in the morning (06.00 – 10.00) and in the afternoon (14.00 – 17.00) WITA. According to Mackinnon *at al*

(2010), birds (except nocturnal birds) are animals that are active in the morning. Bird activity decreased towards noon and peak activity occurred in the afternoon although not as energetic as the morning.

3) Observations were repeated twice until no new species were found.
4) Data Identification and Analysis

The steps in data identification and analysis are as follows:

1) Identifying the diversity of birds found using identification books.
2) Count the number of abundance Diversity of birds found.
3) Analyzing the Diversity index of birds found.

***Stage of Making Learning Media***

The steps in making learning media in the form of posters include the following:

1) Take photos of each Diversity of birds obtained in the study.
2) Designing posters.
3) Perform validation by experts.
4) Print posters.

***Data analysis technique***

***Diversity Analysis***

Calculating the diversity index of Bird Diversity in the TAHURA area of Palu city, using the formula according to Shannon-Wienner (Odum, 1993) as follows:

$$H' = - \sum Pi \ ln \ (Pi) \text{ where } Pi = ni/N$$

Description :
H' = Shannon-Wienner diversity index
ni = Number of individuals one Diversity
N = Total number of individuals

***Abundance Analysis***

Bird abundance is the total number of individual birds found during observations. The calculation of the abundance of individual birds obtained using the formula according to Sugianto (1994) as follows:

$$Pi = \frac{Total\ Number\ of\ Species\ i}{Total\ Number\ of\ Birds\ in\ the\ Observation\ Area}$$

Note: Pi = Abundance value of each species

To determine the relative abundance (KR) at the location of bird species data collection, the following formula was used:

$$KR = \frac{Abundance\ of\ a\ kind}{Abundance\ of\ all\ kinds}\ x\ 100\%$$

Furthermore, the relative abundance index value classified into 3 categories, namely:
Low : >15%
Medium: 15-20%, and
Height : > 20%

***Learning Media Analysis***

1) Learning Media Validation

After the stage of making learning media is complete, then validation of learning media is carried out by expert lecturers. The purpose of this validation is to help improve the quality and find out the strengths and weaknesses that exist in the learning media.

2) Revision of Learning Media design

The revision of the learning media was carried out to improve the weaknesses of the learning media based on the results of the previous revision.

3) Learning Media Feasibility Trial

After the learning media has been validated by learning media experts, the next stage is the media trial phase for 15 students from the Biology Education Study Program , Faculty of Teacher Training and Education , Tadulako University. It aims to find out whether the media is suitable for use or not by using the formula for the percentage of assessment results and the percentage category for the feasibility of learning media according to Arikunto (2009) as follows:

Percentage of assessment results =

$$\frac{Number\ of\ selected\ scores}{Total\ score}\ x\ 100$$

The percentage category of the feasibility of learning media.

1) < 21% Very Inappropriate .
2) 21% - 40% Not Eligible .
3) 41% - 60% Fairly Eligible
4) 61% - 80% Eligible
5) 81% - 100% Very Eligible.

## Results and Discussion

***Types of Birds Found in the Forest Park Area (TAHURA) Central Sulawesi***

Based on the results of research that has been carried out, it was found 21 species of birds found in the research location, which were determined purposively Sampling, with three observation lines located on one side of the river flow, each of which represents the location of the

top (upstream), middle (downstream), and bottom (downstream). The results obtained are then presented in Table 1 and Figure 3.

**Table 2.** The number of individuals of each bird species found at each station in the TAHURA area of Central Sulawesi.

| No | Name Type | Station I | | Station II | | Station III | |
|---|---|---|---|---|---|---|---|
| | | Morning (06.00 - 10.00) | Afternoon (14.00 - 17.00) | Morning (06.00 - 10.00) | Afternoon (14.00 - 17.00) | Morning (06.00 - 10.00) | Afternoon (14.00 - 17.00) |
| 1 | *Rhyticeros cassidix* (Julang Sulawesi) | 0 | 2 | 0 | 0 | 0 | 0 |
| 2 | *Collocalia vanikorensis* (Walet Polos) | 12 | 0 | 10 | 8 | 22 | 0 |
| 3 | *Gerygone dorsalis* (Remetuk Panggul merah) | 3 | 1 | 1 | 2 | 2 | 0 |
| 4 | *Saxicola caprata* (Decu Belang) | 0 | 2 | 0 | 0 | 0 | 0 |
| 5 | *Meropogon forsteni* (Cirik-cirik Sulawesi) | 0 | 0 | 0 | 2 | 0 | 0 |
| 6 | *Culicicapa helianthea* (Sikatan Matahari) | 4 | 0 | 2 | 1 | 1 | 0 |
| 7 | *Cyornis sanfordi* (Sikatan Matin) | 2 | 1 | 3 | 2 | 0 | 0 |
| 8 | *Chalcophaps Indica* (Delimukan Zamrud) | 0 | 2 | 0 | 0 | 0 | 0 |
| 9 | *Zoosterops montanus (*Kacamata Gunung) | 0 | 3 | 0 | 2 | 1 | 0 |
| 10 | *Scissirostrum dubium* (Jalak Tunggir Merah) | 0 | 0 | 9 | 0 | 0 | 0 |
| 11 | *Ducula aenea paulina* (Pergam Hijau Sulawesi) | 8 | 0 | 6 | 0 | 0 | 0 |
| 12 | *Heinrichia calligyna* (Cingcoang Sulawesi) | 1 | 3 | 0 | 1 | 0 | 1 |
| 13 | *Ptilinopus melanospila* (Walik Kembang) | 4 | 0 | 0 | 0 | 0 | 0 |
| 14 | *Nectarinia jugularis* (Burung Madu Hitam) | 0 | 0 | 2 | 0 | 0 | 0 |
| 15 | *Anthreptes malacensis* (Madu Kelapa) | 0 | 0 | 1 | 0 | 0 | 0 |
| 16 | *Ducula forsteni* (Pergam tutu) | 4 | 2 | 0 | 0 | 0 | 0 |
| 17 | *Dicaecum aureolimbatum* (Cabai Panggul Kuning) | 3 | 2 | 3 | 0 | 0 | 0 |
| 18 | *Dicaeum selebicum* (Cabai Panggul kelabu) | 2 | 0 | 0 | 1 | 0 | 0 |
| 19 | *Prioniturus platurus* (Kring-kring Bukit) | 8 | 0 | 0 | 0 | 0 | 0 |
| 20 | *Phaenicophaeus calyorhynchus* (Kadalan Sulawesi) | 0 | 1 | 0 | 1 | 0 | 0 |
| 21 | *Malia Grata stresemanni* (Malia Sulawesi) | 0 | 0 | 1 | 0 | 0 | 2 |
| | Jumlah Total Individu | 51 | 19 | 38 | 20 | 26 | 3 |
| | Jumlah Total individu perstasiun | 70 | | 58 | | 29 | |

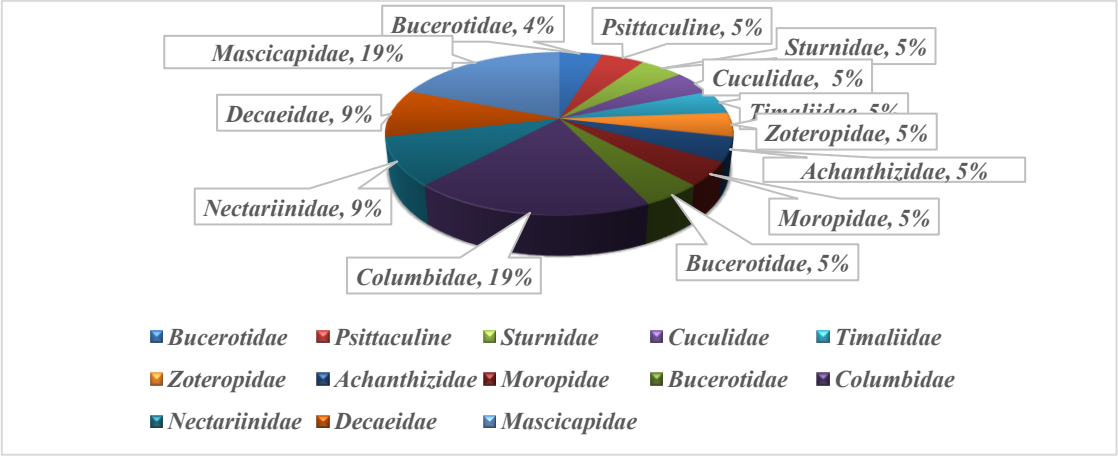



**Figure 3.** Presentation total bird species in each family.

Furthermore, from the research results obtained, 21 bird species from 13 families, namely the family *Bucerotidae, Psittaculine, Sturnidae, Cuculidae, Timaliidae, Zoteropidae, Achanthizidae, Moropidae and Bucerotidae* which can only be found as much as 1 species*, Columbidae* as much 4*types,Nectariinidae* as much as two*types,Decaeidae* much as 2 types and *Mascicapidae* A total of 4 species. The total presentation of bird species in each family can be seen in Figure 3.

Based on the results of the inventory conducted at each station I, II and III, it was found as many as 21 bird species consisting of 13 families, namelyspecies *Rhyticeros cassidix* (Sulawesi Julang), *Collocalia vanikorensis* (Swallow Plain), *Gerygone dorsalis* (Remetuk Panggul Merah), *Saxicola caprata* (Decu Striped), *Meropogon forsteni* (Sulawesi Characters), *Culicicapa helianthea* (Sun), *BrushCyornis sanfordi* (Sikatan Matin), *Chalcophaps Indica* (Delimukan Emerald) , *Zoosterops montanus (*Mountain Glasses), *Scissirostrum dubium* (Jalak Tunggir Merah), *Ducula aenea paulina* (Pergam Hijau Sulawesi), *Heinrichia calligyna* (Cingcoang Sulawesi), *Ptilinopus melanospila* (Walik Kembang), *Nectarinia* Black), *jugularisHoneybirdAnthreptes malacensis* (( Coconut Honey), *Ducula forsteni* (Pergam tutu), *Dicaecum aureolimbatumHip* (YellowChili), *Dicaeum selebicum (Grey Hip Chili), Prioniturus platurus* (Kring-kring Hill), *Phaenicophaeus calyorhynchus* (Sulawesi lizard) and *Malia Grata stressemanni* (Malia Sulawesi).

Based on the results of the study in table 1, it describes the types of encounters in the morning and evening. Observations were made in the morning from 06.00 to 10.00 am and in the afternoon from 14.00 to 17.00 pm. During the morning observation at station I, 11 species of birds were found and in the afternoon only 5 species of birds were found. At station II found 10 species of birds in the morning and 7 species in the afternoon. At station III only 4 species of birds were found in the morning and only 2 species of birds in the afternoon. At stations I and II, the highest number of birds was found compared to station III, this is because the location of the station is in a secondary forest area with dense vegetation, while at station III the number of birds encountered is very small, this is because this station has vegetation. very few trees. Vegetation is very important because it will be used by various types of birds to shelter from predators, nest and find food. In a habitat with various types of vegetation, it will support the availability of food for birds, so that birds will get more choices of types of food (Tews *et al*, 2004).

At the three research sites, the most common bird species were Collocalia vanikorensis (Swallow Polos) as many as 52, Ducula aenea paulina (Pergam Hijau Sulawesi) as many as 14 birds, Gerygone dorsalis (Remetuk Panggul Merah) and Scissirostrum dubium (Jalak Tunggir). Red) as many as 9 tails. While the least bird species found was Anthreptes malacensis (Honey Coconut) as much as 1 tail. The results obtained from the effective time of birds are at 09.01 to 12.00, because birds have a lot of activities in the form of looking for food so that many birds are found at that time. During the day, birds spend a lot of time resting and looking for places that are protected from direct sunlight. Wulandari (2019) revealed that vegetation in an area can cause different types of birds found in an area.

Lekipiou (2018) reveals that birds have the ability to live, the ability to move and the ability to adapt to a wide variety of types of habitats. An environment that is considered suitable as a place to live for birds will provide food, shelter and breeding grounds. Each species of bird has a different place to live, the place of life that is preferred by one type of bird is not necessarily suitable for other types of birds.

### *Diversity of Bird Species in the Forest Park Area (TAHURA) Central Sulawesi*

The results of the analysis show that there are differences in the level of bird diversity at each station. Diversity index values for each research station are presented in table 2 and Figure 4.

**Table 2.** Bird species diversity index for each observation station in the TAHURA area of Central Sulawesi.

| No | Jenis | Stasiun 1 | | Stasiun 2 | | Stasiun 3 | |
|---|---|---|---|---|---|---|---|
| | | ∑ | H' | ∑ | H' | ∑ | H' |
| 1 | *Rhyticeros cassidix* (Julang Sulawesi) | 2 | 0.10 | 0 | 0.00 | 0 | 0.00 |
| 2 | *Collocalia vanikorensis* (Walet Polos) | 12 | 0.30 | 18 | 0.36 | 22 | 0.21 |
| 3 | *Gerygone dorsalis* (Remetuk Panggul merah) | 4 | 0.16 | 3 | 0.15 | 2 | 0.18 |
| 4 | *Saxicola caprata* (Decu Belang) | 2 | 0.10 | 0 | 0.00 | 0 | 0.00 |
| 5 | *Meropogon forsteni* (Cirik-cirik Sulawesi) | 0 | 0.00 | 2 | 0.12 | 0 | 0.00 |
| 6 | *Culicicapa helianthea* (Sikatan Matahari) | 4 | 0.16 | 3 | 0.15 | 1 | 0.12 |
| 7 | *Cyornis sanfordi* (Sikatan Matin) | 3 | 0.13 | 5 | 0.21 | 0 | 0.00 |
| 8 | *Chalcophaps Indica* (Delimukan Zamrud) | 2 | 0.10 | 0 | 0.00 | 0 | 0.00 |
| 9 | *Zoosterops montanus (*Kacamata Gunung) | 3 | 0.13 | 2 | 0.12 | 1 | 0.12 |
| 10 | *Scissirostrum dubium* (Jalak Tunggir Merah) | 0 | 0.00 | 9 | 0.29 | 0 | 0.00 |
| 11 | *Ducula aenea paulina* (Pergam Hijau Sulawesi) | 8 | 0.25 | 6 | 0.23 | 0 | 0.00 |
| 12 | *Heinrichia calligyna* (Cingcoang Sulawesi) | 4 | 0.16 | 1 | 0.07 | 1 | 0.12 |
| 13 | *Ptilinopus melanospila* (Walik Kembang) | 4 | 0.16 | 0 | 0.00 | 0 | 0.00 |
| 14 | *Nectarinia jugularis* (Burung Madu Hitam) | 0 | 0.00 | 2 | 0.12 | 0 | 0.00 |
| 15 | *Anthreptes malacensis* (Madu Kelapa) | 0 | 0.00 | 1 | 0.00 | 0 | 0.00 |
| 16 | *Ducula forsteni* (Pergam tutu) | 6 | 0.21 | 0 | 0.00 | 0 | 0.00 |
| 17 | *Dicaecum aureolimbatum* (Cabai Panggul Kuning) | 5 | 0.19 | 3 | 0.15 | 0 | 0.00 |
| 18 | *Dicaeum selebicum (Cabai Panggul kelabu)* | 2 | 0.10 | 1 | 0.07 | 0 | 0.00 |
| 19 | *Prioniturus platurus* (Kring-kring Bukit) | 8 | 0.25 | 0 | 0.00 | 0 | 0.00 |
| 20 | *Phaenicophaeus calyorhynchus* (Kadalan Sulawesi) | 1 | 0.06 | 1 | 0.00 | 0 | 0.00 |
| 21 | *Malia Grata stresemanni* (Malia Sulawesi) | 0 | 0.00 | 1 | 0.07 | 2 | 0.18 |
| **Number of individuals per station** | | **70** | | **58** | | **29** | |
| **Diversity Index** | | **2.59** | | **2.12** | | **0.93** | |
| **Average** | | | | **1.88** | | | |

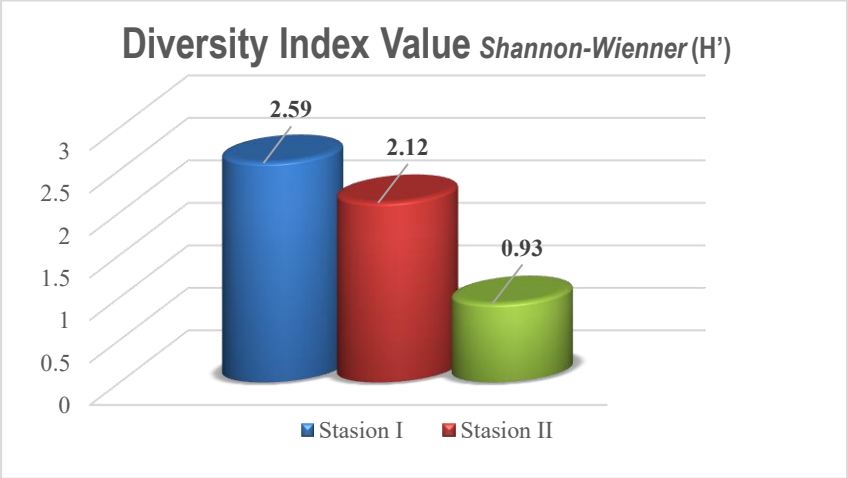



**Figure 4.** Graph of Bird Diversity Index Value in the Greater Forest Park (TAHURA) Central Sulawesi

Based on the results of data processing in Table 2 and Figure 4, analyzed using theDiversity Index *Shannon-Wienner* (H' ), visible differences at each observation station.

Based on the results of the study, the average value of the bird diversity index in the Grand Forest Park (TAHURA) area of Central Sulawesi was in the medium category, namely H'=1.88. The bird diversity index at each station is different, at stations 1 and 2 showing the moderate diversity category, namely H'= 2.59 and H'=2.12, this is influenced by several factors, such as plant vegetation factors, environmental physical conditions with low temperatures and high humidity. high so that birds

can take shelter from direct sunlight and can avoid being disturbed by predators or predators. Zaen (2018) revealed that bird diversity is defined as the number of bird species and their respective abundances in an area.

The observation locations for stations I and II are secondary forest areas, with denser vegetation and many large flowering and fruiting trees. According to Alikondra (2002) Secondary forest areas are a better habitat for birds than degraded areas or plantation land.

Arini & Prasetyo (2013) revealed that the increasing human need for land is one of the things that can cause changes in forest land cover. Changes that occur in a landscape will certainly have an impact on changes in the diversity of fauna species.

Unlike the case with station III which shows a low diversity category, namely H'=0.93, at this station tree vegetation is very sparse, with hotter temperatures and lower humidity, so that only a few bird species can be found. Alikodra (2002) revealed that diversity Bird species differ from one habitat to another, this is influenced and depends on environmental conditions and factors that influence it.

The diversity index found in the Grand Forest Park (TAHURA) of Central Sulawesi is also influenced by biotic environmental conditions such as the structure of plant vegetation which is still good, especially at station I which is in the upper part of the river, large trees such as thetree) can be found. *Ficus benjamina* tree (banyan), *Tectona grandis*(teak), *Acacia auricauliformis* (acacia), *Swietenia macrophylla* (Mahoni), *Ceiba petandra* (randu), *Santalun álbum* (Cendana) and *Shorea sp* (meranti). At Station II, the plant vegetation is dominated by cultivated plants such as *Aleuretes moluccana* (candlenut), *Arthocarpus altilis* (breadfruit), *Gmelina arbórea* (white teak), bananas, shrubs and grasses. Darmawan & Prasetya (2006) revealed that the factors that determine the presence of birds are the availability of food, a place to rest, a place to play, reproduce, build a nest, perch, no predators, and shelter in the habitat. The ability of an area to accommodate birds is determined by the area, composition and structure of vegetation, the number of ecosystem types and habitats. Birds will settle in a place if the demands of their life are met, including a habitat that supports all the needs of the bird itself and is safe from various kinds of threats. This is supported by the opinion of Iswandaru (2018), the diversity of birds in an area can indicate the condition of the area. The presence of birds is an indicator of whether the environment supports the life of the organism in terms of reciprocity with its environment.

At station III we rarely find large trees, slightly exposed vegetation dominated by cocoa, banana, corn and other cultivated plants as well as shrubs with slightly barren and hilly conditions, in this area we will also find several houses of residents who live and settled in the lower reaches of the river.

The low diversity at station III can also be caused by the high activity of residents in cutting trees for plantation land clearing such as cocoa, coconut and banana, as well as cultivated plants such as candlenut, breadfruit and jackfruit. Land clearing is also intended to plant corn so that the plant vegetation in the location is no longer good and tends to be more arid, so that under these conditions there are few bird species that can be found at the time of the study.

Sajithiran (2004) revealed that the diversity index proves that the biological wealth in an area is fully supported by the ecological conditions around it. Starting from the activities of other living things that coexist, the presence of predators, the availability of food, to the availability of a safe and comfortable place to live for these birds to breed.

Avifauna species diversity can be described as the richness or number of avifauna species found in an area. In ecology, generally biodiversity refers to avifauna animals which function to identify areas rich in biodiversity, so it is very important to take measures to protect and conserve them in order to prevent the decline in avifauna populations (Kamaluddin et al. 2019).

### *Relative Abundance (KR) of Bird Species in the Grand Forest Park (TAHURA) Area of Central Sulawesi.*

Analysis of individual bird abundance was obtained using the formula according to Van Balen (1984) *in* Sugianto (1994). From the results of the individual abundance analysis obtained, the relative abundance index (KR) of birds in the TAHURA area of Central Sulawesi was calculated. The results of processing the relative abundance data are presented in Table 3 and Figure 5.

**Table 3.** The relative abundance index (KR) of bird species per station in the TAHURA area of Central Sulawesi.

| No | Type | Station 1 | | | Station 2 | | | Station 3 | | | Value average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ∑ | Pi | KR | ∑ | Pi | KR | ∑ | Pi | KR | |
| 1 | *Rhyticeros cassidix* (Julang Sulawesi) | 2 | 0.03 | 3% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 1% |
| 2 | *Collocalia vanikorensis* (Walet Polos) | 12 | 0.17 | 17% | 18 | 0.31 | 31% | 22 | 0.76 | 76% | 41% |
| 3 | *Gerygone dorsalis* (Remetuk Panggul merah) | 4 | 0.06 | 6% | 3 | 0.05 | 5% | 2 | 0.07 | 7% | 6% |
| 4 | *Saxicola caprata* (Decu Belang) | 2 | 0.03 | 3% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 1% |
| 5 | *Meropogon forsteni* (Cirik-cirik Sulawesi) | 0 | 0.00 | 0% | 2 | 0.03 | 3% | 0 | 0.00 | 0% | 1% |
| 6 | *Culicicapa helianthea* (Sikatan Matahari) | 4 | 0.06 | 6% | 3 | 0.05 | 5% | 1 | 0.03 | 3% | 5% |
| 7 | *Cyornis sanfordi* (Sikatan Matin) | 3 | 0.04 | 4% | 5 | 0.09 | 9% | 0 | 0.00 | 0% | 4% |
| 8 | *Chalcophaps Indica* (Delimukan Zamrud) | 2 | 0.03 | 3% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 1% |
| 9 | *Zoosterops montanus (*Kacamata Gunung) | 3 | 0.04 | 4% | 2 | 0.03 | 3% | 1 | 0.03 | 3% | 4% |
| 10 | *Scissirostrum dubium* (Jalak Tunggir Merah) | 0 | 0.00 | 0% | 9 | 0.16 | 16% | 0 | 0.00 | 0% | 5% |
| 11 | *Ducula aenea paulina* (Pergam Hijau Sulawesi) | 8 | 0.11 | 11% | 6 | 0.10 | 10% | 0 | 0.00 | 0% | 7% |
| 12 | *Heinrichia calligyna* (Cingcoang Sulawesi) | 4 | 0.06 | 6% | 1 | 0.02 | 2% | 1 | 0.03 | 3% | 4% |
| 13 | *Ptilinopus melanospila* (Walik Kembang) | 4 | 0.06 | 6% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 2% |
| 14 | *Nectarinia jugularis* (Burung Madu Hitam) | 0 | 0.00 | 0% | 2 | 0.03 | 3% | 0 | 0.00 | 0% | 1% |
| 15 | *Anthreptes malacensis* (Madu Kelapa) | 0 | 0.00 | 0% | 1 | 0.02 | 2% | 0 | 0.00 | 0% | 1% |
| 16 | *Ducula forsteni* (Pergam tutu) | 6 | 0.09 | 9% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 3% |
| 17 | *Dicaecum aureolimbatum* (Cabai Panggul Kuning) | 5 | 0.07 | 7% | 3 | 0.05 | 5% | 0 | 0.00 | 0% | 4% |
| 18 | *Dicaeum selebicum (Cabai Panggul kelabu)* | 2 | 0.03 | 3% | 1 | 0.02 | 2% | 0 | 0.00 | 0% | 2% |
| 19 | *Prioniturus platurus* (Kring-kring Bukit) | 8 | 0.11 | 11% | 0 | 0.00 | 0% | 0 | 0.00 | 0% | 4% |
| 20 | *Phaenicophaeus calyorhynchus* (Kadalan Sulawesi) | 1 | 0.01 | 1% | 1 | 0.02 | 2% | 0 | 0.00 | 0% | 1% |
| 21 | *Malia Grata stresemanni* (Malia Sulawesi) | 0 | 0.00 | 0% | 1 | 0.02 | 2% | 2 | 0.07 | 7% | 3% |
| | **Amount** | **70** | | | **58** | | | **29** | | | **100%** |

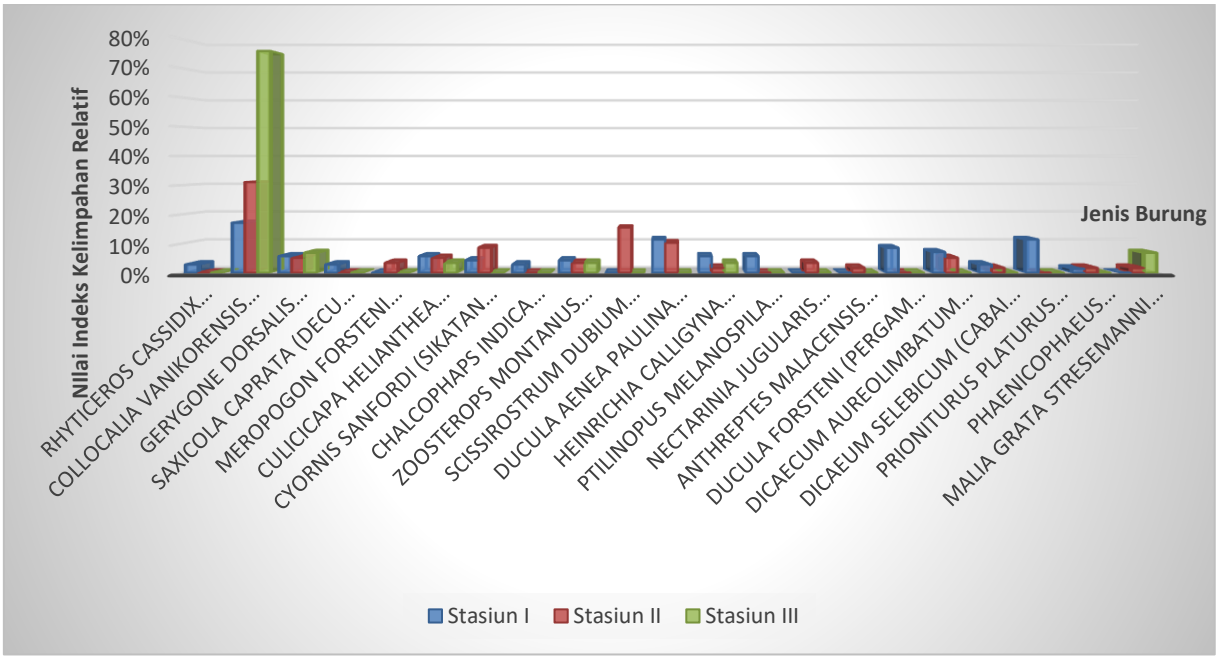



**Figure 5.** Graph of relative abundance index of Perstation Bird species in the Grand Forest Park (TAHURA) area of Central Sulawesi.

Based on the results of data processing in Table 3 which is then presented in graphical form in Figure 5, the highest average relative abundance index is the species of bird *Collocalia vanikorensis* (Walet Polos) with a value of 41% and the low relative abundance index value is the species *Rhyticeros cassidix* (Julang Sulawesi), *Saxicola caprata* (Decu Striped), *Meropogon forsteni* (Sulawesi characteristics), *Chalcophaps Indica* (Delimukan Emerald), *Nectarinia* Black), *jugularisHoneybirdAnthreptes malacensis* ((Coconut Honey) and *Phaenicophaeus calyorhynchus* (Sulawesi lizard) with a value 1%.

Bird abundance in the forest park area (TAHURA) Central Sulawesi shows the highest abundance index value is the bird species *Collocalia vanikorensis* (Walet Polos) with a value of 41% and can be found in all observation stations, this is because this bird is a type of bird that can live in all types of habitat from the lowlands to an altitude of ± 500 meters above sea level. The research location has many hollow cliffs that can support their habitat. Birds of this type also tend to fly in large groups, and nest in caves on the edge of damp cliffs. Adil *et al* (2010) revealed that a large dominance value also indicates that the bird has a wide range of tolerance and adaptability.

Ridwan (2015) revealed that in certain species the presence of competitors also affects the existence of birds in an area, especially species that require the same resources.

The lowest relative abundance index value with a value of 1% is *Rhyticeros cassidix* (Julang Sulawesi), *Saxicola caprata* (Decu Belang), *Meropogon forsteni* (Sulawesi characteristics),jugularis (Black Honeybird *Chalcophaps Indica* (Delimukan Emerald), *Nectarinia* ), *Anthreptes malacensis* (Honey Coconut) and *Phaenicophaeus calyorhynchus* (Sulawesi lizard).

Several bird species with the lowest abundance index values were endemic to the Sulawesi sub-region, such as *Rhyticeros cassidix* (Sulawesi Julang), *Saxicola caprata* (Decu Belang) and *Meropogon forsteni* (Sulawesi characteristics). One of the factors that causes the low abundance ofbird species *Rhyticeros cassidix* (Sulawesi Julang)is the frequent illegal hunting by local people who live around the TAHURA area of Central Sulawesi. This bird species is a bird that is almost extinct and is protected by law. No. 5/1990, PP No. 7/1999. Sekercioglu (2014) revealed that forest fragmentation and other forms of habitat disturbance may reduce the breeding success of most forest bird species equally, perhaps as a result of increased nest predation of all species, more sedentary species may be less able than other birds to "walk" through the non-forests of their territory. reproduce into small fragments containing sufficient resources.

Based on data analysis, the criteria for the abundance of bird species in the Central Sulawesi Grand Forest Park (TAHURA) were divided into two groups, a low abundance index and a high abundance index. Of the 21 bird species found, 20 bird species have a relative abundance index of >15% or are classified as low and there is only 1 species that has an abundance index of >20% or is classified as high. The abundance of individual bird species has a close relationship with the dominance of bird species. Bird species with high abundance in the Central Sulawesi

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Grand Forest Park (TAHURA) are the dominant bird species and vice versa. Abundance compares the number of individuals of a species with the number of individuals of all species. The higher the species abundance value, the greater the dominance of birds in the Central Sulawesi forest park (TAHURA).

***Environmental Physical Conditions in the TAHURA Region, Central Sulawesi.***

Physical environmental factors are very influential on the distribution and population of birds in the forest park area (TAHURA) Central Sulawesi, so in this study in addition to observing bird species at each station in the research location, environmental factors such as temperature, altitude, humidity and light intensity were also measured. . Welty and Baptista (1988) say that the distribution and population of birds in a habitat is influenced by environmental physical factors such as soil, water, temperature, sunlight and biological factors including vegetation and other animals. The results of the measurement of these environmental factors can be seen in Table 4.

**Table 4.** Physical environmental conditions in the TAHURA area of Central Sulawesi.

| No. | Parameter | Unit | Observation Station | | | Average |
|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | |
| 1 | Temperature | °C | 24 | 28 | 32 | 28 |
| 2 | Humidity | % | 73 | 64 | 58 | 65 |
| 3 | Light Intensity | Cd | 650 | 720 | 820 | 730 |
| 4 | Altitude | Mdpl | 578 | 538 | 495 | 537 |

Table 4 shows that each observation station has a physical condition different environmental chemistry. The lowest temperature and light intensity conditions are at station 1 with high humidity levels, this is influenced by the height and density of dense tree vegetation with conditions of heavy river water discharge in the upper reaches of the river. Meanwhile, the highest temperature and intensity are found at station 3, with low humidity levels, this is because at this location residents still get plantations in the form of candlenut, cocoa and coconut plants. At this station the tree vegetation is still lacking and slightly exposed, we even still find one last resident's house who lives and settles in the location of the grand forest park (TAHURA).

***Percentage of Feasibility Assessment of Learning Media in Poster Form by Validation Lecturers***

The results of the calculation of the percentage of feasibility assessment of learning media in the form of posters given by media validation lecturers. Details can be seen in Table 5.

**Table 5.** Percentage of poster eligibility by media validation lecturers

| No | Aspects observed | Rating Scale | | Total | Average | Percentage (%) |
|---|---|---|---|---|---|---|
| | | D1 | D2 | | | |
| A. | TITLE | | | | | |
| 1 | Match the title with the description of the image on the poster media | 4 | 4 | 8 | 4 | 80 |
| 2 | Accuracy of title position on poster media | 4 | 4 | 8 | 4 | 80 |
| 3 | Accuracy of title letter size on poster media | 4 | 4 | 8 | 4 | 80 |
| 4 | Appearance of title on poster media Actrative | 4 | 4 | 8 | 4 | 80 |
| B | DESCRIPTION OF MATERIALS | | | | | |
| 1 | Accuracy of font size on poster material description | 4 | 3 | 7 | 3.5 | 70 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Clarity of sentences in poster media descriptions | 4 | 4 | 8 | 4 | 80 |
| 3 | Systematics of writing on poster media descriptions | 5 | 4 | 9 | 4.5 | 90 |
| 4 | The attractiveness of displaying material descriptions on poster media | 4 | 4 | 8 | 4 | 80 |
| C | FIGURE | | | | | |
| 1 | Suitability of images with material descriptions on media poster | 4 | 4 | 8 | 4 | 80 |
| 2 | Quality of image display to be understood on poster media | 4 | 4 | 8 | 4 | 80 |
| 3 | The attractiveness of the image display on the poster media | 4 | 4 | 8 | 4 | 80 |
| D | TEXT DESCRIPTION IMAGE | | | | | |
| 1 | Accuracy of location of image captions on poster media | 4 | 4 | 8 | 4 | 80 |
| 2 | Ke colorimage captions on poster media | 4 | 5 | 9 | 4.5 | 90 |
| 3 | accuracy ofAccuracy of image caption text font size on poster media | 4 | 4 | 8 | 4 | 80 |
| 4 | display of image captions on poster media atractive ness of | 4 | 4 | 8 | 4 | 80 |
| Total | | | | | 60.5 | 1210 |
| Average | | | | | 4.03 | 80.67 |
| Score The average shows that the poster media is quite feasible to be tested. | | | | | | |

***Results of the Percentage of Feasibility Assessment of Learning Media in Poster Form by the Student Group***

After validation by the lecturer, then the poster learning media was tested on 2 groups of students consisting of a large group of 15 students and a large group of 15 students. small as many as 9 students. The details are presented in Tables 6 and 7.

**Table 6.** Presentation of the poster feasibility test by students in large groups

| No. | Aspects of assessment | Rating Scale | Percentage (%) |
|---|---|---|---|
| 1. | Do you think the display on this poster is attractive? | 4.60 | 92.00 |
| 2. | Do you think that the correct selection of the shape and size of the letters used in this poster is easy to understand? | 4.20 | 84.00 |
| 3. | How clear is the picture in this poster? | 4.47 | 89.33 |
| 4. | How is the clarity of the writing (text) in this poster? | 4.73 | 94.67 |
| 5. | Do you think the appearance of the image on this poster is interesting? | 4.93 | 98.67 |
| 6. | Can this poster help make it easier to know the types of birds? | 4.93 | 98.67 |
| 7. | Is the Latin writing used in this poster correct? | 4.73 | 94.67 |
| | Total Score | 32.60 | 652.00 |
| | Average | 4.66 | 93.14 |
| | Average value indicates that the posters deserves to be tested | | |

**Table**7.Presentation of the poster feasibility test by students in small groups

| No. | Aspects of assessment | Rating Scale | Percentage (%) |
|---|---|---|---|
| 1. | Do you think the display on this poster is attractive? | 4.33 | 86.67 |
| 2. | Do you think that the correct selection of the shape and size of the letters used in this poster is easy to understand? | 4.33 | 86.67 |
| 3. | How clear is the picture in this poster? | 4.11 | 82.22 |

| | | | |
|---|---|---|---|
| 4. | How is the clarity of the writing (text) in this poster? | 4.78 | 95.56 |
| 5. | Do you think the appearance of the image on this poster is interesting? | 4.78 | 95.56 |
| 6. | Can this poster help make it easier to know the types of birds? | 4.67 | 93.33 |
| 7. | Is the Latin writing used in this poster correct? | 4.67 | 93.33 |
| | Total Score | 31.67 | 633.33 |
| | Average | 4.52 | 90.48 |
| | Average value indicates that the posters deserves to be tested | | |

Based on Table 5 the results obtained by the two lecturers validation validation media has a value of 80.67% or feasibility study media such as posters is feasible for tested.

Based on Tables 6 and 7, the validation results obtained with the percentage of eligibility of 93.14% for the large group and 90.48% for the small group. This percentage is considered worthy to be tested.

Media is one component of communication, namely as a messenger from the communicator to the communicant. Based on this definition, it can be said that learning media is a means of intermediary in the learning process. In the learning process, learning media is needed because in essence the teaching and learning process is a communication process, delivering messages from the introduction to the recipient.

Poster is a visual combination of a strong design, with color, and a message with the intention of attracting the attention of passers-by but long enough to understand the idea of the poster's content in their memory. The use of appropriate and consistent poster learning media can be useful for teachers in increasing students' motivation and interest in learning biology subjects, so that teachers can optimize all the potential that exists within each student.

Sulistiyono (2015) reveals that the application of image media in learning activities needs to involve text as a means of delivery. The combination of image and text media can be framed by the use of poster learning media.

Bird species obtained from the results of research that have been carried out, are documented through photos that produce images.

Images of these bird species were used to make posters. The poster contains basic and in-depth information about birds but is limited to the species found at the time of the study. Posters can help students identify bird species, can also be used by teachers as a reference for supporting materials on biodiversity, animal classification and can also be used as a teaching medium to increase knowledge about birds and can increase student motivation in the teaching and learning process. In general, the learning process of students in class usually only learns in theory or only discusses in general related to various types of diversity of living things. So that students do not know much about the diversity of bird species in the surrounding environment. With this research, which is then presented in the form of an attractive poster, it can be used as a supporting reference for additional biology learning material, especially biodiversity material, because with that students can easily study bird diversity and bird classification without having to carry out direct observation activities.

Poster is a publication media consisting of writing, pictures, or a combination of the two with the aim of providing information to the general public and can be used as a learning resource. Making posters is done by making observations about suitable media as an output from the results of research that has been carried out so that they can be used as learning media. After the data was obtained during the research, the next step was to design learning resources in the form of posters from pictures of bird species found and identified. Furthermore, after the product design has been validated by a media expert lecturer, the weaknesses and shortcomings of the poster can be identified and then repaired to produce a better and more effective product. The poster learning media that has been repaired and redesigned is then tested on 2 groups of students consisting of a large group of 15 students and a small group of 9 students from the Biology Education and Teacher Training Program, Tadulako University. The assessment was carried out using an instrument in the form of a questionnaire. Based on the results of the poster assessment conducted by students who stated that the learning resource in the form of posters was appropriate to be used as a learning resource and could support the learning process with the percentage of large groups of 93.14% and the percentage of small groups being 90.48%. This small group trial aims to identify and anticipate any initial obstacles or problems that will arise when this product is used. The large group trial aims to determine the level of feasibility of learning

media in terms of their attractiveness and effectiveness in helping the learning process.

Based on the percentage obtained, the poster learning media is suitable for use as a tool for students in learning and can be used as an alternative media because it can attract attention.

## Conclusion

There are 21 species of birds consisting of 13 families, namely families *Bucerotidae, Psittaculine, Sturnidae, Cuculidae, Timaliidae, Zoteropidae, Achanthizidae, Moropidae and Bucerotidae* which can only be found as many as 1 species*, Columbidae* as many as 4types,*Nectariinidae* as much as two*types,Decaeidae* much as 2 types and *Mascicapidae* A total of 4 species

The average bird diversity index in the Grand Forest Park (TAHURA) area of Central Sulawesi is in the medium category, namely H'=1.88. The bird diversity index at each station was different, at stations I and II showed a medium diversity category, namely H'= 2.59 and H'=2.12, while at station III it showed a low category, namely H'=0.93, this was influenced by several factors, such as plant vegetation factors, environmental physical conditions, so that birds can take shelter from direct sunlight and can avoid predators or predators.

The abundance of bird species in the TAHURA forest park, Central Sulawesi, was recorded to be divided into two groups. Based on the results of data analysis, of the 21 bird species, 20 species of birds were found to have a relative abundance index of >15% or classified as low and there was only 1 species that had an abundance index of >20% or classified as high.

From the presentation of the poster assessment conducted by students who stated that the learning resource in the form of a poster was appropriate to be used as a learning resource and could support the learning process, the percentage of large groups was 93.14% and the percentage of small groups was 90.48%.

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