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Hot-Spot Biodiversity Approach by using Birds as Indicators for Development of Ecotourism

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A B S T R A C T

Hot-spot biodiversity is a concentrated site of high species diversity, high species endemicity, and habitat uniqueness. Biodiversity disperses unevenly across the global, regional and regional scope. Hot-spot biodiversity developed into an approach to assessing the concentration of biodiversity at certain limits. The biodiversity hot-spot approach is conducted using indicator species such as bird species that are used as ecotourism development for sustainable forest exploitation. Research with objectives: Determine the location of biodiversity hot-spot within Production Forest Management Unit (PFMU) Wae Sapalewa area, measure the importance of hot spot location, and provide appropriate ecotourism form directions at hot spot locations. The research used survey method with area tracing technique to determine the biodiversity hotspots as well as Point Count and Encounter Rates method to collect information of indicator bird species. The results of the study determined 7 locations of biodiversity hot-spot within PFMU Wae Sapalewa area which contained tourist attraction object, in the form of bird species biodiversity with certain status. It is recorded as many as 122 species of birds; 4 endangered species globally, 9 species endemic Seram Island, 6 unique species, 21 types of limited distribution. This particular type of bird is classified into 27 species of "Bird Indicators" considered as objects of ecotourism attraction. Calculation Index of diversity type shows 7 hot-spot location has high diversity index value, calculation result of relative abundance of indicator bird species shows variation of abundance which is indicative of existence condition and status of bird species in hot spot location. The results of the analysis lead to the form of ecotourism in the form of ecotourism of special interest in the form of Bird Watching.

Introduction

Background

An important aspect of ecotourism development in a location is the existence of objects that have unique values and specific characteristics such as biodiversity. The existence of biodiversity does not spread evenly but is concentrated in a particular location. The locations that are concentrated in biodiversity are known as "hot-spot biodiversity" (Virk, 1988 in Indrawan *et al.*, 2007).

Hot-spot biodiversity can be an ecotourism management area and if you see the characteristics of biodiversity hot spots can be used as a priority governance area (Sujatnika *et al.*, 1995). Hot-spot biodiversity can also be classified as a strategic area. Law No.10 Year 1990 on Tourism states that the determination of strategic areas is done with attention to natural tourism resources and cultural potential. The area should be an important consideration in tourism execution. Hot-spot biodiversity will help ecotourism management in a location because most of the resources owned by the management organization will be directed to the hot spot location, so management will run maximally and effectively (Sujatnika *et al.*, 1995).

Location of hot-spot biodiversity is generally located within the forest area. Ridwan (2000) states that ecotourism can be developed in production forest areas and protected forests that have a specialty or uniqueness. Currently forestry development is directed to forest management in accordance with its main function and allocation, for which the government has issued a policy on development of Forest Management Unit based on Forestry Ministerial Decree No.230 / Kpts-II / 2003. Forest Management Unit (FMU) that has been established in Maluku Province as many as 22, one of them is PFMU Wai Sapalewa which is determined through Minister of Forestry Decree No. 336 / Ministry of Forestry-II / 2010 dated 25 May 2010, covering 67,057 ha located in North Seram Sub District, Central Maluku Regency.

One of the targets of FMU development is the utilization of environmental services that can be managed according to their designated areas at the site level. Utilization of environmental services can be done by developing ecotourism that aims to protect and preserve the environment (Lindberg, 1991). The development of ecotourism in forest areas in some countries has provided great benefits to the community (Fandeli, 2000). Ecotourism also supports natural resource conservation indicators (Agrawal and Redford, 2006). In addition, ecotourism also contributes greatly to the national income of a country (Wallace, 1993). Based on the benefits of ecotourism development, it is possible to develop ecotourism within the FMU area.

Ecotourism development is based on the potential of a forest area. Biodiversity is a potential that can be the object of tourist attraction. But it takes a picture of the concentration of biodiversity. For that purpose, this study will be conducted by determining the location of hot-spot biodiversity by using bird species as an indicator to provide an overview of biodiversity concentration within PFMU Wae Sapalewa area. Birds are used because they have been proven in many places as good indicators for assessing community diversity (Ricketts *et al.*, 1999 in Indrawan *et al.*, 2007).

The problem formulation

PFMU Wae Sapalewa is an FMU intended for timber forest production, where timber from tree becomes the core business for FMU. However, there are management blocks that are intended for other activities in the context of sustainable forest management, such as limited-scale nature tourism or ecotourism. PFMU Wae Sapalewa does not have the concept of ecotourism development in accordance with its potential, while the potential of ecotourism objects are scattered within its territory, but the data and information are not available properly.

Development of ecotourism by exploiting the potential of biodiversity as a tourist attraction is not easy, this condition requires an

effective approach method that can provide adequate data and information. Hot-spot biodiversity becomes a strategic approach for this purpose, where biodiversity is studied using birds as an indicator to know the diversity of communities.

Based on the above problem, the research question is how to determine the location of hot-spot biodiversity by using bird as indicator, and what form of ecotourism is most suitable to be applied in hot-spot locations of biodiversity within FMU Wae Sapalewa area.

Purpose

Determine the location of the habitat sample and study it into a hot-spot location of biodiversity within the PFMU Wae Sapalewa area.

Measure the importance of hot-spot biodiversity locations by measuring the diversity of the indicator bird species.
Provide direction of appropriate ecotourism form at the hot-spot location of biodiversity.

Materials and Methods

Location and time of study

The research was conducted in PFMU Wai Sapalewa area, North Seram District, Central Maluku District, Maluku Province. Implementation of research and writing of the results take place between 2015 and 2017.

Data collection

Terrestrial search and hot-spot location biodiversity determination

Regional searches are conducted to ensure biodiversity potential. Site search locations were selected based on a review of land cover maps and previous research report information, such as Natural History of Seram (Ian D. Edwards at all, 1993), territorial searches using work-paths, each region traced for 2 to 3 days.

Locations that have high biodiversity records of bird species are designated as habitat samples. The location of this habitat sample is further investigated to be designated as a hot-spot biodiversity location. Determining the location of habitat samples as hot-spot biodiversity locations used the following criteria for determining the location of biodiversity hotspots. The criteria are based on Law No.5 / 1990 on Conservation of Biological Natural Resources and Ecosystems; Sujatnika *et al.,* (1995); Law No. 41 Year 1999 on Forestry: Dobson *et al.,* (1997) and Flather *et al.,* (1998) in Indrawan *et al.,* (2007); Forest Area Conservation Center Region IX Ambon (2013);

Have a wealth of high biodiversity, according to region search results.
Includes protected areas such as river borders, springs, unique habitats, and attractive landscapes.
Includes the representation of various types of important land cover formations.
Includes Protected Forest Areas that already exist.
Excluding block of timber forest product processing according to PFMU Wae Sapalewa plan.
Form hot-spot areas wherever possible following the block or sub-block of PFMU management Wae Sapalewa to facilitate the orientation of border areas in the field.

Bird type data collection

The data collection method refers to Colin Bibby at all (1994) in Sozer *et al.,* (2000);

Point count is a circular area, where the observer stands in the middle while looking in all directions for data collection within 15

minutes. Point Count is placed in the work path or transect. Each Point Count in a transect is also called a data collection station**.**

Point point count in the field

Total length of transect at hotspot location 10.8 Km, divided by 4 work path along 2.7 Km.

The length of the Count Circle field is 300 m. long radius of circle 150 m. Point Count is placed in transect with distance between middle field 300 m.

Each transect has 10 Point Count, with 4 transects in each hot spot location, so there are 40 Count at each hot spot location.

Encounter rates is a way of collecting data variables to measure wealth and species diversity. The main data variables collected include; bird species, number of individual types, and hours of observation, as well as other data variables.

Analysis method

Relative abundance

Relative abundance is only intended for the analysis of bird species indicator species that are considered attractive as an ecotourism attraction.

Abundance class based on observation hours

The relative abundance of observation hours is based on the total time of observed bird species, then dividing the total time into several categories of abundance classes. The division of abundance classes was made according to the abundance class of Lowen *et al.*, (1996) in Sozer *et al.*, (2000) modified as presented below.

Abundance category	Abundance Value	Abundance Class
< 20 minutes	1	rare
21 – 50 minutes	2	Not common
51 – 100 minutes	3	Often
101 – 200 minutes	4	Common
> 201 minutes	5	Very common

Frequency of availability

Frequency of availability refers to the number of data collection stations in which a bird species is observed in comparison with the total number of stations used, Frequency of availability using the equations of Misra (1968);

$$\mathbf{Fi} = \frac{\textbf{Number of stations of i-species observed}}{\textbf{Number of all observation stations}} \times \mathbf{100\ \%}$$

Category of frequency of availability;
- Low (< 10 %)
- Medium (10 – 50 %);

Diversity Index

Diversity indices are used for analysis of all bird species encountered.

The wealth index (R_1), Margalef's equation (1958) in Bratawinata (2001).

$$R = \frac{(S - 1)}{Ln.\ N}$$

Information:
R = Wealth index of Margalef's type
S = the number of species observed
N = the number of individuals of all types
Ln = natural logarithm values

Category of wealth index:
R < 2,5 Low type of Wealth
2,5 > R < 4 Medium type of Wealth

Diversity Index (H'), the Shanon-Wiener equation (1949) in Bratawinata (2001).

$$H' = -\sum_{i=1}^{n} pi \ln pi$$

Keterangan:
H' = index of diversity
pi = $n_{i/N}$
n_i = the number of individual types of i
N = total number of individuals all type

Categories of diversity indexes:
- H < 1 Low diversity
- 1 > H' < 3 Medium diversity

The Equity Index, the Magurran equation (1988) in Soerianegara and Indrawan (2005).

$$E = \frac{H'}{H_{maks}}$$

Information:
E = uniformity index
H_{maks} = ln S
S = number of species

Categories of diversity indexes:
- E close to 0:
  Individual distribution between species is uneven
- E close to 1:
  Individual distribution among species is even distributed

Results and Discussion

Hot-spot biodiversity location

There are 11 locations selected in the territorial search, the condition of the area being searched is presented in Table 1.

The eleven locations searched have different species of birds. Table 2 shows that; there are 9 locations that have records of the diversity of bird species are high from 51 to 70 types namely; location of Masihulan, Mt. Kaluala, Huaulu, Roho, Mt. Kalapahin, Wai Puti-puti, Solea and Old Solea. While the two locations have a record of the diversity of bird species are low from 43 to 46 types namely; Mt. Pasasana and Rumasokat.

Based on consideration of location access, Solea lama as a location that is too far and isolated is removed, thus there are only 8 locations that are considered appropriate as the location of the sample habitat for further study. The distribution of the territorial search path and the location of the habitat sample are presented in Figure 2.

Based on Hot-spot Location Determination Criteria, referring to Map of PFMU Management Block Division Wae Sapalewa (Forest Area Conservation Center, 2013), which is associated with data of regional search results, the location of Melinani is removed because it is within the non-timber forest products utilization block.

Therefore, there are 7 locations which meets the Hot-spot criteria as the Hot-spot of Biodiversity location within the PFMU Wae Sapalewa area, see Table 3. The position and distribution of 7 Hot-spot Biodiversity locations in the PFMU Wae Sapalewa region is presented in Figure 3.

Figure 3 shows that there is a hot-spot location whose form and boundary follows completely as a management block; such as hot spot locations located in Protected Forests / Core Blocks, Production Forests / Special Blocks and Production Forests / Blocks of Protection. Then, there is a hot-spot location whose territorial boundary covers only a portion of the management block form, such as in Production Forest / Area utilization Block. Determining the shape and boundaries of hot spot locations in more detail utilizes the sub-block dividing boundaries, also using ridge areas and river borders.

Bird species diversity at hot-spot locations of biodiversity

Bird species found in 7 hot-spot locations recorded as many as 122 species, consisting of 96 Genus and 47 families.

There are 3 families whose dominant species are; COLUMBIDAE 14 types, then PSITTACIDAE 11 types, and ACCIPITRIDAE 9 types. Based on the status of the species, there are 4 endangered birds according to the IUCN list.

They are 6 unique birds species, 9 species of endemic birds of Seram Island and surrounding islands, and 21 limited bird species.

The bird species with specific status are classified as 27 species of indicator bird; namely the type that is considered interesting as the object of attraction of ecotourism. The overall profile of bird species found in hot-spot biodiversity locations is presented in the diagram form in Figure 4.

Bird species encounter in the hot-spot locations in detail is presented in Figure 5

In categories of total species, there are 3 locations of hot spots with the most total number of species, namely Hot-spot Solea as many as 98 species, Hot-spot Masihulan 97 types, and Hot-spot Wai cover 90 types. Then followed by Hot-spot Gn. Kaluala 87 type, Hot-spot Huaulu 85 type and 75 species of Roho Hot-spot.

Hot-spot Gn Kalapahin is a hot-spot location with the lowest total species of 65 species.

In the category of bird indicator, Hot-spot Masihulan and Gn. Kaluala has the most number of bird indicator species, as many as 25 species.

On Hot-spot Roho and Solea found 22 types, on the Hot-spot Gn. Kalapahin found 21 types, Hot-spot Huaulu found 20 species, and Hot-spot Wai Putiputi only found 19 species.

In the category of endemic bird species, the Hot-spot Masihulan and Gn. Kaluala encountered 8 types, then Hot-spot Roho; Gn. Kalapahin; and Wai Putiputi found 7 types, then Hot-spot Solea found 6 types, and in Hot-spot Huaulu only found 5 types.

In the category of bird species that are unique, the Hot-spot Masihulan and Gn. Kaluala found 6 types, on Hot-spot Solea there are 5 types, then on Hot-spot Huaulu, Roho, Gn. Kalapahin and Wai Putiputi there are 4 types.

In the category of endangered bird species, Hot-spot Masihulan has a slightly higher type of other locations as many as 3 types. While other hot-spot locations only have 2 or 1 type only.

Bird diversity index at hot-spot sites

An index of bird species diversity in hot-spot locations, presented in Table 4.

Margalef's wealth index

The Margalef (R1) value of the Margalef (R1) value index indicates that all hot-spot locations have a high to very high level of wealth index due to the resulting wealth index value 7.96515 - 11.21258 (R> 4). This condition is due to the high number of bird species found in all hot-spot locations; ranging from 65 to 98 types, as well as the total number of individuals recorded between 3,174 - 5,470 heads.

Separately per location, it is seen that the Hot-spot location of Solea and Masihulan has a higher type of wealth index than other hot-spot locations, 11.01675 in Masihulan and 11.21258 in Solea. Subsequently followed by Hot-spot Wai Putiputi 10.54128 and Gn.Kaluala 10.18233. While Hot-spot Gn. Kalapahin has the lowest wealth index of 7.96515.

Shannon-Wiener diversity index

The value of the Shanon-Winer Diversity Index (H ') indicates that; all hot-spot locations have high Diversity index, because they are above the criteria of H '> 3, ie between 3.14544 - 3.50508, this shows the level of spread of the individual number of each species is also high.

Separately per hot-spot location shows that Hot-spot Masihulan has the highest diversity index of 3.50508, followed by Hot-spot Solea 3.39336, then Hot-spot Huaulu 3.36120, and lowest is Hot-spot Gn. Kalapahin 3.14544.

The evenness index

The value of the Equivalency Index (E) indicates; all hot-spot locations have a fairly high evenness index between 0.73339 - 0.76619, tend to approach the number 1. The condition shows the spread of bird species at all hot-spot locations quite evenly and the distribution is quite stable.

Separately per hot-spot location shows that Hot-spot Masihulan has the highest evenness index of 0.76619, followed by Hot-spot Huaulu 0.75658, Hot-spot Gn. Kalapahin 0.7351, and so on the location where the lowest evenness index is Wai Hot-spot covers 0.73339.

Relative abundance of indicator bird types at hot-spot locations

Abundance class based on clock observation

The class of abundance based on observation hours states how long one species of bird can be observed (when the observer enters its habitat). Table 5 shows;

Abundance Rare with total observed time 3 - 20 minutes is found in 6 types, namely; *Accipiter e., Halcyon l., Myzomela b., Eos s., Eulipoa w.,* and *Lorius d.*

Abundance Rare to Uncommon with total observed time between 5 - 50 minutes; there are 7 types namely; *Rhipidura d., Ninox s., Pachycephala g., Tanysiptera g., Casuarius c.s, Ficedula b.,* and *Micropsitta b*.

Abundance Uncommon to Often with a total observed time between 22 - 95 minutes, there are in 5 types, namely *Ducula c., Alisterus a., Coracina a., Gymnophaps m.,* and *Coracina c.*

Abundance Uncommon to Common, with total observed time between 33 - 110 minutes, there are on 2 types namely; *Cacatua m.,* and *Charmosyna p.*

Abundance Often to Common, with total observed time between 70 - 165 minutes, there are on 3 types namely; *Rhyticeros p., Myagra g.,* and *Basilornis c.*

Abundance Common to Very common, with a

total observed time between 150 - 322 minutes, there are on 2 types namely; *Dicaeum v.*, and *Eos b*.

Abundance Very common, with a total observed time between 212 - 441 minutes, is present in 2 types; *Ducula p.* and *Philemon s.*

When viewed at the total time observed recapitulation per hot-spot location, it appears that; Hot-spot Masihulan has the highest observed total time for all types of indicator birds ie 2,302 minutes. Then, Hot-spot Huaulu 1.968 minutes, Roho Hot-spot 1888 minutes, Hot-spot Gn. Kaluala 1876 minutes, while 3 other hot-spot locations have a total recapitulation time observed all species of birds indicator was recorded lower.

Frequency of availability (Fi)

The resulting frequency value of the resulting state indicates how widely one species of bird spread at the site under study. Table 6 shows the frequency of availability of the indicator bird species varies greatly from very low ie 2.5% to very high reaching 100%.

High frequency of availability is found in 5 species of birds, namely; *Philemon s., Dicaeum v., Eos b., Ducula p., And Rhyticeros p.*, 5 species of birds have frequency value> 50,1% in all hot-spot locations even there are 2 types that have frequency of 100% in hot-spot Masihulan i.e., *Philemon s.,* and *Eos b.*

Medium frequency of availability with frequency value > 10,1% - 50% recorded on 9 species of bird that is; *Basilornis c., Myagra g., Cacatua m., Charmosyna p., Alisterus a., Coracina a., Rhipidura d., Pachycephala g.,* and *Coracina c*.

Low frequency of availability with frequency value <10,1% recorded on 13 species of bird that is; *Ducula c., Gymnophaps m., Ficedula b., Ninox s., Tanysiptera g., Accipiter e., Casuarius c., Myzomela b., Eos s., Micropsitta b., Halcyon l., Eulipoa w.,* and *Lorius d.*

When looking at the total value of the frequency of encounter per hot-spot location, the highest frequency of bird species indicator is found in 3 locations, namely; Hot-spot Masihulan of 795, Hot-spot Gn. Kaluala 737.5 and Hot-spot Solea 715. Then followed by Roho Hotspot 695 and Huaulu Hotspot 692.5, and the lowest total frequency value of availability is Hot-spot Gn. Kalapahin 572,5 and Wai Hot-spot 552.5.

Ecotourism guidance

The diversity and relative abundance values of bird species in the above discussion can be a strong argument when explaining the profile and status of interesting and important bird species to tourists visiting the hot-spot locations of biodiversity within PFMU Wae Sapalewa that are attracted to the diversity of bird species. The existence of 27 species of bird indicator that is considered attractive as a tourist attraction object directs the form of ecotourism that is appropriate in the area of PFMU Wae Sapalewa in the form of ecotourism of special interest in the form of bird species observation or better known as Bird Watching.

Based on the experience of the author and the information collected at the study site, the bird species that are often the object of observation in bird watching activities are the bird species of certain status, especially the endemic bird species such as; *Cacatua moluccensis*. Other types of unique status are also included in the Bird Watcher hunt list such as; *Microsiptta bruijni.* In addition to these types, the indicator bird species studied in this study could be offered to become a bird-eye object that is no less interesting.

The results of the analysis of the high wealth index can be used to convince tourists that the level of bird species wealthy in the Wae Sapalewa PFMU area is high. Moreover, the high diversity index of bird species can be used to convince tourists that the diversity of bird species in the PFMU Wae Sapalewa region is high.

The results of the analysis presented in relative abundance based on hours of observation can provide appropriate information to the tourism about the profile and status of bird species. It is such as in endemic bird species, of 9 species of endemic birds found in hot-spot locations recorded there are 4 types observed with a rare class of abundance i.e., *Eos semilarvata, Lorius domicella, Halcyon lazuli* and *Myzomela blasii.* 1 type observed with abundance class rare to uncommon, i.e., *Rhipidura dedemi*. 2 types are observed with uncommon abundance class to common, i.e., *Gymnophaps mada* and *Cacatua moluccensis*. 2 types observed with abundance classes are often to very common, ie; *Basilornis corythaix* and *Philemon subcorniculatus*. Hot-spot locations where such endemic bird species are found are also available to provide certainty for tourists on a sightseeing trip.

Often tourists expect to see relatively abundant species such as endemic Eos semilarvata and Lorius domicella, the information generated in this study provides real-world information on the ground and helps direct tourists to potential locations for encounters with these bird species thus providing certainty of encounter with the type of bird that is expected. The same conditions can be applied to other bird species of different status such as endangered bird species or unique bird species.

Field observation shows 80% of tourists who do eco-tourism bird watching are foreign tourists, with a prime location in Manusela National Park. While hot-spot locations that have been studied in this research become the location of transit or location of observation between during the national park area. By this research, the hot-spot locations of biodiversity within PFMU Wae Sapalewa area that have been studied can be an attractive ecotourism destination other than Manusela National Park.

Based on observations and information collected, it shows that wildlife species of bird species are more desirable as tourist attraction objects by tourists due to several factors;

Birds are the most attractive and most easily found in the forest area, the attraction of bird life is an object that can provide certainty of satisfaction in an ecotourism trip, when compared with other species of animals that are more difficult to find.

The physical beauty or morphology of birds through beautiful shades and fur colors is a major attraction for travelers with photographi hobbies, and new travelers trying to experience bird watching travel.

The presence status of some species of birds such as endemic species, limited distribution and threatened species globally become its own attraction, which many hunted by tourist. They have the target experience of observation collection of certain bird species in nature. Most tourists who hunt bird species with this particular status is the scientist or teacher at the place of origin.

The sound of wild birds in nature is a very interesting aspect, some bird species especially from a group of callers or passerine groups have a very melodious and very entertaining sound and

singing. Usually tourists who are obsessed with the sound of birds of a certain type is the scientists, they observe only to add to the collection of sound recordings of birds of interest.

Bird behavior is interesting to observe such as how to eat, roast, cluster, and clean the body, each type has different ways and characteristics that provide variation in the observation. Moreover, some bird species have unique dances that are unique to attract their partner.

The nature of birds that are hard to touch directly, can only be observed, convince that the object of attraction of ecotourism bird watching will exist in nature and can last a long time, unless the forest area in which their habitat is destroyed.

Ecotourism development related to forestry PFMU Wae Sapalewa

PFMU Governance Plan Model Wae Sapalewa (2013), states that; The development of ecotourism within the PFMU Wae Sapalewa area is possible as it seeks to exploit the potential of forest areas by meeting the criteria of sustainable forest exploitation. Data and information on the spread of wildlife and plants as well as the condition of tourist attraction / ecotourism become a part of concern in the preparation of PFMU Governance Plan Wae Sapalewa. Criteria for the distribution of wildlife and plants is done by endemic type approach, while the criterion of tourist attraction depends on the existence of tourist attraction in the form of waterfalls, caves, landscapes, etc.

The allocation and utilization of management blocks in PFMU Governance Wae Sapalewa provides sufficient opportunity for ecotourism business development within PFMU Wae Sapalewa area, of course, taking into account the criteria set for the designation and utilization of the management blocks. In addition, the development of ecotourism business will strengthen the allocation and utilization of management blocks outside the block of utilization of wood forest products, especially on special blocks; block of area utilization; and protection blocks.

The results of this study specifically show which locations or on which management blocks have ecotourism potential in the form of hot-spot biodiversity locations that can be utilized by PFMU Wae Sapalewa organization for ecotourism business development.

Development of ecotourism business within PFMU area Model Wae Sapalewa, can be a strategic consideration in the future, because in ecotourism there is no exploitation activity of tree stands, which is used only beauty, uniqueness, and adventure. If possible, ecotourism can be a long-term alternative income for PFMU Wae Sapalewa, and be a profitable business corporation if managed properly and professionally. This emphasizes that the implementation of ecotourism within PFMU Wae Sapalewa must pay attention to the conservation principle, where its management must also use conservation strategy (Dephutbun, 2000).

Ecotourism Bird watching is closely related to the conservation principle, because it is enjoyed only by the attractions and activities of various bird species in nature, without touching or catching. This form of ecological tourism is very precise in maintaining the integrity and authenticity of ecosystem within PFMU Wae Sapalewa region.

Table.1 Location of terrestrial search and territory conditions

No	Location	Physiographic Conditions	Closure Type Land
1	Masihulan	Wavy – low hill	Secondary lowland forests
2	Mount Kaluala	Wavy - low- hill	Primary lowland forest
3	Huaulu	Wavy - low- hill	lowland forests of ex-logging
4	Roho	Wavy	lowland forests of ex-logging
5	Mount Kalapahin	Hilly	Primary lowland forest
6	Mount Pasasana	Wavy - low- hill	lowland forests of ex-logging
7	Wai Putiputi	Wavy - low- hill	lowland forests of ex-logging
8	Rumasokat	Wavy - low- hill	lowland forests of ex-logging
9	Melinani	Wavy	lowland forests of ex-logging
10	Solea	Wavy - low- hill	lowland forests of ex-logging
11	Solea Lama	Ramps – Wavy	lowland forests of ex-logging

Table.2 Bird species diversity of territorial search results

Search Locations	Masihulan	Mount Kaluala	Huaulu	Roho	Mount Kalapahin	Mount. Pasasana	Wai Puti-puti	Rumasokat	Melinani	Solea	Solea Lama
Total Number of Types	70	69	54	53	51	43	58	46	54	66	58
Limited Spread Type	13	14	10	10	11	7	9	6	10	11	11
Type of Endemic	5	6	4	4	4	2	3	2	4	4	5

Table.3 Name of hot spot location and form of PFMU management block Wae Sapalewa

No.	Hot-spot Location Names	Form of Block Management PFMU Wae Sapalewa
1	Masihulan	HP / Block of Area Utilization
2	Mount Kaluala	HL / Core Block
3	Hualu	HP / Custom Block
4	Roho	HP / Block of Area Utilization
5	Mount Kalapain	HL / Core Block
6	Wai Putiputi	HP / Block of Area Utilization, dan HP / Block Protection
7	Solea	HP / Block of Area Utilization, dan HP / Block of Utilization non-timber forest products

Table.4 An index of diversity of bird species in hot spot locations

Location Hot spot	Number of Species (S)	Number of Individual (N)	Wealth Index (R1)	Diversity index (H')	The Evenness Index (E)
Masiuhlan	97	5.470	11.01675	-3.50508	-0.76619
Mt.Kaluala	87	4.588	10.18233	-3.34387	-0.74875
Huaulu	85	4.721	9.88933	-3.36120	-0.75658
Roho	75	3.452	9.02990	-3.22109	-0.74606
Mt. Kalapahin	65	3.174	7.96515	-3.14544	-0.75351
Wai Putiputi	90	4.233	10.54128	-3.30013	-0.73339
Solea	98	5.293	11.21258	-3.39336	-0.74011

Table.5 The relative abundance of bird indicator based on hours of observation

Species	Masihulan	Mount Kaluala	Huaulu	Roho	Mount Kalapahin	Wai Putiputi	Solea	Class Abundance
	Total Waktu Teramati (Menit)							
Ducula perspicillata [BST]	441	345	355	322	283	220	345	Very Common
Philemon subcorniculatus [En.S-BST]	330	222	270	259	207	212	245	Very Common
Dicaeum vulneratum [En.M - BST]	322	205	274	286	150	210	227	Common - Very Common
Eos bornea bornea [En.M - BST]	157	187	202	205	151	117	141	Common - Very Common
Rhyticeros plicatus [U]	125	100	170	125	90	99	125	Often – Common
Myagra galeata [BST]	162	125	108	99	90	90	80	Often - Common
Basilornis corythaix [En.S-BST]	130	86	125	70	78	80	95	Often – Common
Cacatua moluccensis [En.S,Kl-BST- VU]	110	101	80	90	85	24	50	Uncommon - Common
Charmosyna placentis [U]	55	40	90	60	33	110	100	Not common - Common
Alisterus amboinensis [U]	50	86	54	80	28	95	40	Uncommon - Often
Coracina atriceps [En.M - BST]	85	52	45	35	45	40	25	Uncommon – Often
Gymnophaps mada [En.S,B]	40	20	30	39	45	30	30	Uncommon – Often
Coracina ceramensis [En.M - BST]	55	34	22	25	25	23	24	Uncommon – Often
Ducula concina [BST]	45	30	54	0	0	0	54	Uncommon – Often
Rhipidura dedemi [En.S-BST]	30	42	10	50	48	24	36	Rare – Uncommon
Pachycephala griseonota [BST]	30	32	17	40	35	18	25	Rare – Uncommon
Ninox ***squamipila*** [BST]	25	25	24	25	5	15	25	Rare – Uncommon
Tanysiptera galatea [U]	22	25	0	30	0	25	40	Rare – Uncommon
Casuarius casuarius [U]	10	25	5	24	0	0	35	Rare – Uncommon
Ficedula buruensis [En.M - BST]	25	18	15	6	25	0	0	Rare – Uncommon
Micropsitta bruijnii [U]	15	30	0	0	15	0	0	Rare – Uncommon
Accipiter erythrauchen [En.M - BST]	5	7	18	3	20	0	14	Rare
Halcyon lazuli [End.S,A,H -BST - VU]	18	15	0	10	0	16	0	Rare
Myzomela blasii [End.S,B,A - BST]	3	7	0	0	8	0	0	Rare
Eos semilarvata [En.S- BST]	0	15	0	0	17	0	0	Rare
Eulipoa wallaceii [BST- VU]	0	0	0	0	0	0	12	Rare
Lorius domicella [En.S- BST - VU]	12	0	0	0	0	0	0	Rare
Total Time Recapitulation Observed	**2.302**	**1.876**	**1.968**	**1.883**	**1.483**	**1.448**	**1.768**	
Σ ***Common abundance classes***	5	3	3	1	3	2	2	High Abundance
Σ ***Very Common Abundance Class***	3	3	4	4	1	3	3	
Σ ***Often Abundance classes***	3	4	4	5	4	4	4	Medium Abundance
Σ ***Rare abundance Class***	8	8	12	9	11	13	8	Low Abundance
Σ ***Uncommon abundance class***	8	9	4	8	8	5	10	

Table.6 The frequency value of the availability of the indicator bird species at the hot-spot location

	Frequency of Type Availability at Hot-spot Location (%)							
Species	**Masihulan**	**Mount Kaluala**	**Huaulu**	**Roho**	**Mount Kalapahin**	**Wai Putiputi**	**Solea**	
Philemon subcorniculatus *End.S – BST*	100	90	90	75	77.5	77.5	95	
Dicaeum vulneratum *End.M – BST*	97.5	97.5	97.5	97.5	62.5	62.5	90	
Eos bornea *End.M - BST*	100	92.5	90	95	60	60	85	
Ducula perspicillata *BST*	92.5	77.5	82.5	75	75	75	95	
Rhyticeros plicatus *U*	72.5	57.5	65	65	52.5	52.5	50.2	
Basilornis corythaix *End.S – BST*	50	40	40	35	32.5	32.5	37.5	
Myagra galeata *BST*	42.5	42.5	50	35	30	30	30	
Charmosyna placentis *U*	42.5	27.5	52.5	27.5	27.5	27.5	55	
Cacatua moluccensis *End.S,Kl – BST – VU*	40	32.5	25	37.5	30	30	20	
Alisterus amboinensis *U*	27.5	52.5	22.5	45	17.5	17.5	27.5	
Coracina atriceps *End.M – BST*	30	22.5	17.5	15	15	15	17.5	
Pachycephala griseonota *BST*	12.5	15	7.5	17.5	15	15	20	
Rhipidura dedemi *End.S – BST*	7.5	15	2.5	17.5	20	20	12.5	
Coracina ceramensis *End.M – BST*	17.5	15	10	10	12.5	12.5	12.5	
Ducula concina *BST*	15	10	12.5	0	0	0	17.5	
Gymnophaps mada *End.S,B – BST*	5	5	5	10	10	10	5	
Ficedula buruensis *End.M – BST*	7.5	5	5	2.5	12.5	0	0	
Ninox *squamipila* *BST*	10	5	7.5	7.5	2.5	2.5	7.5	
Tanysiptera galatea *U*	7.5	7.5	0	10	0	7.5	15	
Accipiter erythrauchen *End.M – BST*	2.5	5	7.5	2.5	7.5	0	7.5	
Casuarius casuarius *U*	2.5	7.5	2.5	10	0	0	10	
Myzomela blasii *End.S,B,A – BST*	2.5	2.5	0	0	5	0	0	
Micropsitta bruijnii *U*	2.5	5	0	0	2.5	0	0	
Halcyon lazuli *End.S,A,H – BST – VU*	2.5	2.5	0	5	0	5	0	
Eos semilarvata *End.S – BST*	0	5	0	0	5	0	0	
Eulipoa wallaceii *BST- VU*	0	0	0	0	0	0	5	
Lorius domicella *En.S – BST – VU*	5	0	0	0	0	0	0	
Total	**795**	**737.5**	**692.5**	**695**	**572.5**	**552.5**	**715.2**	
Σ Kategori Tinggi > 50,1 %	5	6	6	5	5	5	6	
Σ Kategori Sedang 10,1 – 50 %	10	8	9	9	10	10	10	
Σ Kategori Rendah < 10 %	12	13	12	13	12	12	11	

Figure.1 Point count form and placement in transects

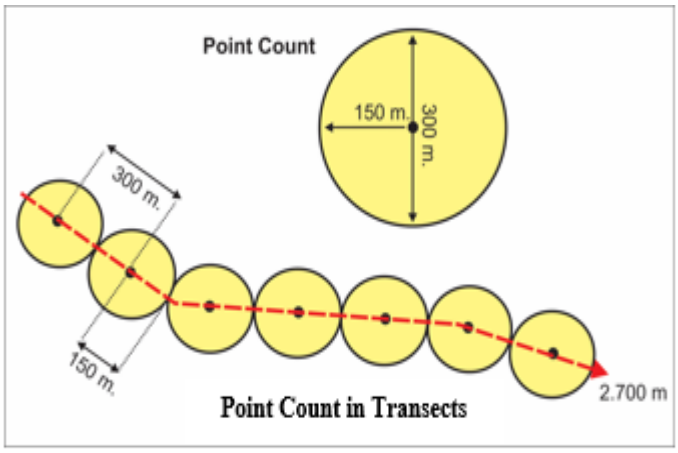
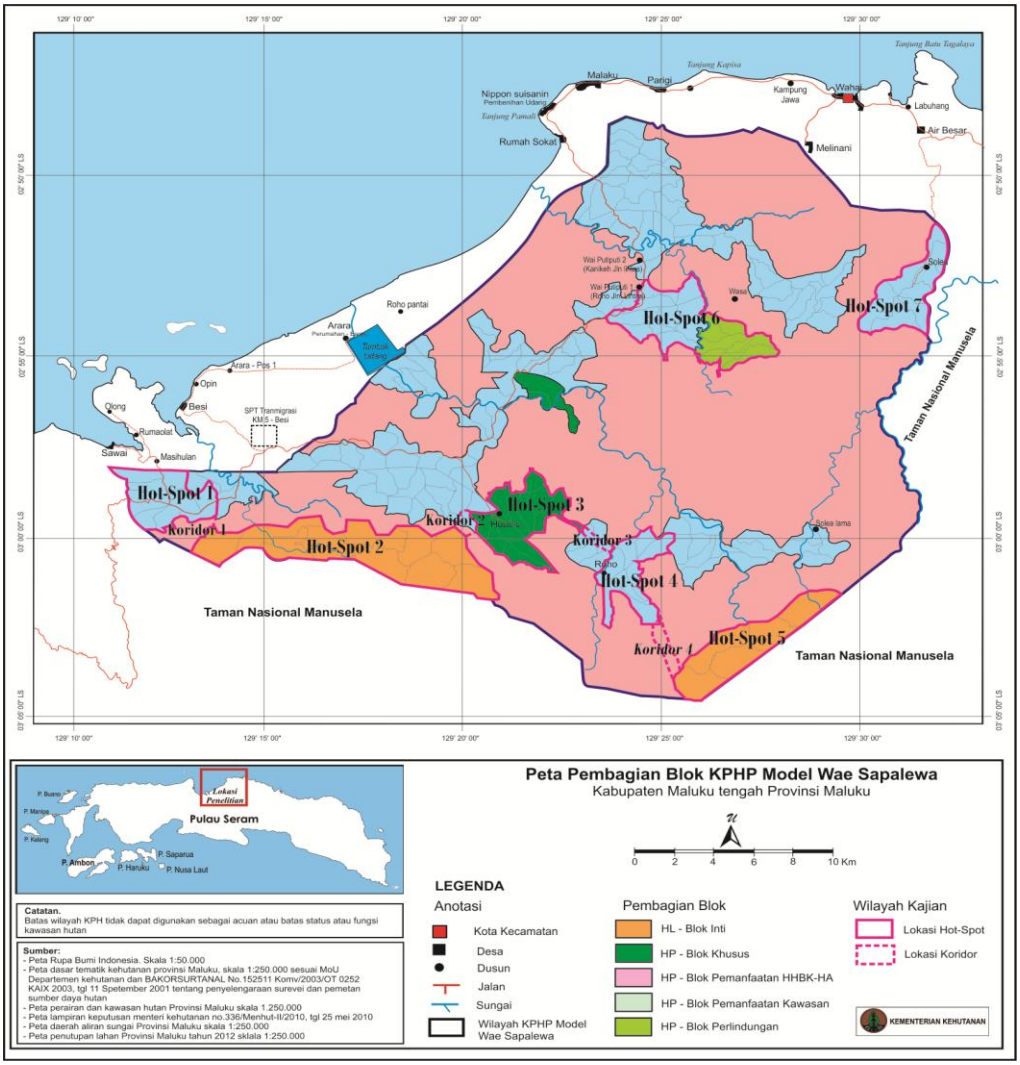


Figure.2 Distribution of the territorial search path Study Area and habitat sample distribution

Figure.3 Distribution of hot spot location on PFMU management block map Wae Sapalewa



Fugure.4 Graph of bird species encounter in 7 locations of biodiversity hot spots

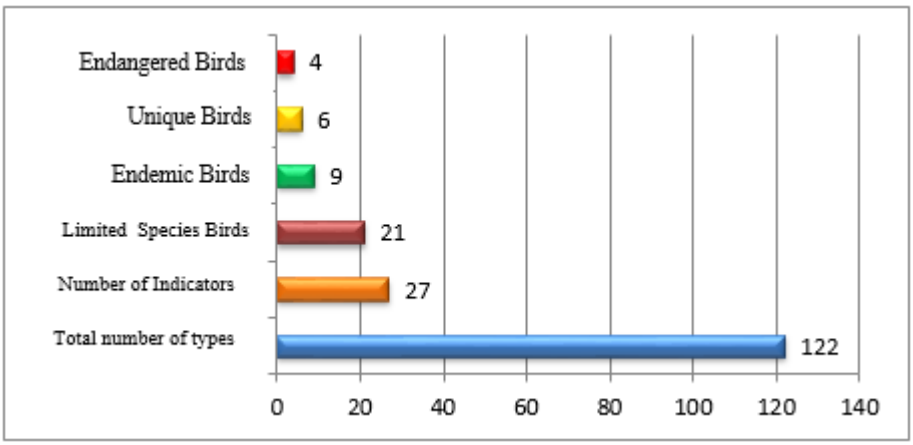
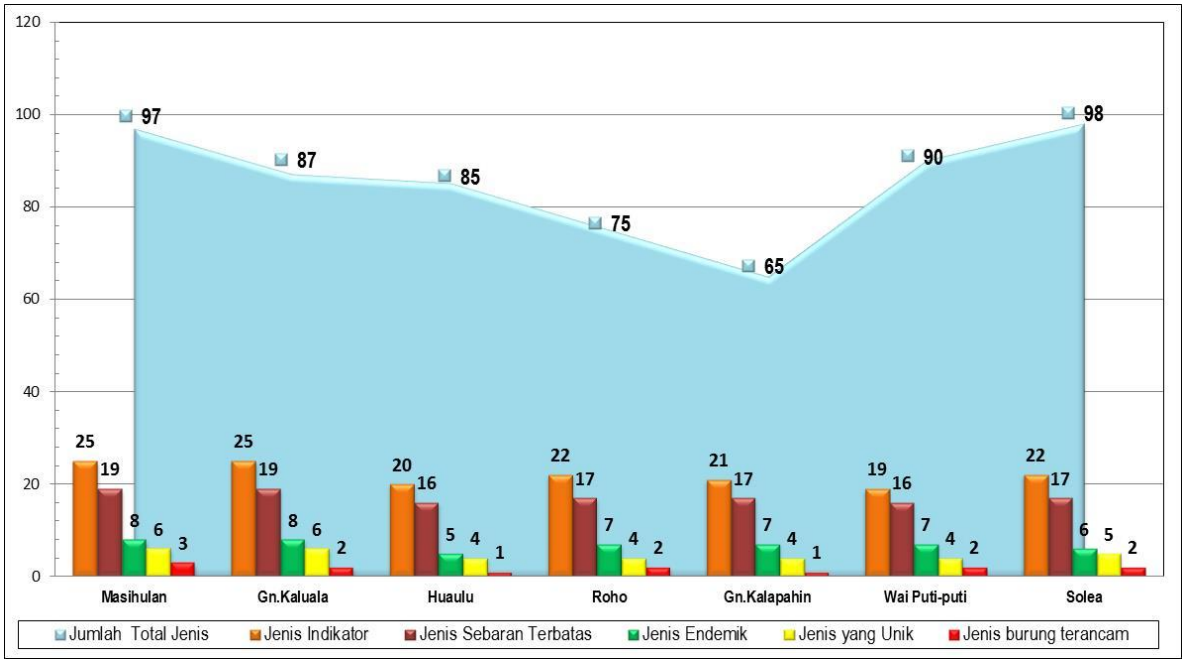


Figure.5 Encounter of the number of bird species per type category in 7 hot-spot locations



The development of ecotourism forms Bird watching not only shows the uniqueness of biodiversity in biodiversity hotspots locations within PFMU Wae Sapalewa, but also promotes the uniqueness of biodiversity in Seram Island and promotes the uniqueness of biodiversity in Maluku.

The conclusion of the studies is as follows:

PFMU Wai Sapalewa has the potential to become an ecotourism location because it has ecotourism attraction. This research has identified 7 hot-spot locations of biodiversity that can be the location of ecotourism attraction. There are 122 species of birds, 4 species of endangered birds, 9 species of Seram endemic birds, 6 species of birds are unique, and 21 species of limited birds.

The species diversity index of birds in all hot-spot locations shows a high value on the wealth index; index of diversity; and evenness index.

The relative abundance value indicates the variation of bird species abundance in hot spot locations. The variation of relative abundance values describes the profile and status of those species in PFMU Wae Sapalewa area.

A suitable ecotourism form applied within the PFMU area of Wae Sapalewa is a special interest ecological tour. Data and information on bird species that are available on biodiversity hot spots support the form of bird watching ecotourism or Bird watching.

Ecotourism development within PFMU Wae Sapalewa area is possible, as the effort becomes an effort to exploit the potential of forest area by fulfilling the criteria of sustainable forest exploitation.

Suggestion

In addition to the diversity of bird species, the PFMU Wae Sapalewa region also has a wealth of other biodiversity that must be explored and researched as it has potential as a tourist attraction object in the form of ecological tourism or

special interest tourism.

The criteria of animal dispersal maps and the attraction of tourist / ecotourism locations in PFMU Governance Model Wae Sapalewa is similar to the hot-spot location determination method in this study, therefore the information generated in this paper is believed to be used to strengthen efforts to exploit the potential of forest areas within to achieve sustainable forest management criteria.

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