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# Prediction of Bird Habitat Suitability: Determination and Use of Environmental Parameters

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***Abstract***

*A suitable habitat will support biodiversity. Knowledge of habitat suitability is essential to understanding the extent of interaction between living organisms and their environment. This study aims to analyze the determination and use of types of environmental parameters in determining the suitability of bird habitat in an area. The type of research in this study is qualitative research sourced from literature studies using the Content Analysis method. The data used in this research is secondary data sourced from reading relevant literature in scientific journal articles. The results of this study found that the most influential parameters in determining bird habitat suitability are altitude, slope, vegetation density (NDVI), and distance from water sources. This is related to the comfort and safety of birds from predators, changes in environmental conditions, and poaching that threaten the extinction of the species.*

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***Abstrak***

*Habitat yang sesuai akan mendukung keanekaragaman hayati. Pengetahuan tentang kesesuaian habitat sangat penting untuk memahami sejauh mana interaksi antara organisme hidup dengan lingkungannya. Penelitian ini bertujuan untuk menganalisis penentuan dan penggunaan jenis-jenis parameter lingkungan dalam menentukan kesesuaian habitat burung di suatu wilayah. Jenis penelitian dalam penelitian ini adalah penelitian kualitatif yang bersumber dari studi literatur dengan menggunakan metode Content Analysis. Data yang digunakan dalam penelitian ini adalah data sekunder yang bersumber dari pembacaan literatur yang relevan pada artikel jurnal ilmiah. Hasil dari penelitian ini menemukan bahwa parameter yang paling berpengaruh dalam menentukan kesesuaian habitat burung adalah ketinggian, kelerengan, kerapatan vegetasi (NDVI), dan jarak dari sumber air. Hal ini berkaitan dengan kenyamanan dan keamanan burung dari predator, perubahan kondisi lingkungan, dan perburuan liar yang mengancam kepunahan spesies tersebut.*

## INTRODUCTION

Birds (Aves) are members of a group of vertebrate animals that have feathers and wings. (Alberto & Hermanto, 2023). Birds are included in one of five classes of animals that have a backbone, including warm-blooded animals, reproduce by laying eggs, and have feathers (Ardyansyah, 2023). Birds are one of the components of a balancing ecosystem because they act as main predators, seed dispersers, and pollinators for other living components (Putri, 2023).

Birds are wild animals that play an important role in forming food chains, supporting pollination, controlling pest populations, and spreading seeds, thereby helping forests regenerate naturally (MacKinnon et al., 2010). Birds are wild animals found in places dominated by vegetated environments (Bachri et al., 2020).

Birds are very useful in their ecological habitat and have a vital function in the natural environment. Birds also have economic and cultural value, both directly and indirectly in society. However, the existence of birds in their habitat can be disturbed by environmental changes (Maulidya et al., 2021).

Changes in environmental quality due to reduced vegetation and high levels of human activity also affect the loss of places to live, breed, and feed sources for birds which will ultimately result in a decline in bird populations (Nurdin et al, 2020). The decline in bird populations in a habitat or area can be caused by changes in infrastructure, loss of vegetation, illegal hunting activities, use of the area as a recreation area, and increased human activity (Aryanti et al., 2018). Apart from that, the widespread distribution of birds is also responsible for the decline or increase in bird populations. Each bird adapts to its habitat types, food availability, breeding activities, and social behavior (Mainase et al., 2016).

Birds need supporting elements to adapt to their living habitat (Labiro, 2022). Supporting elements (environmental parameters) support the survival of the species (Aldiansyah & Wahid, 2023). Each bird has a variety of environmental habitat conditions. This diversity is based on the ability of birds to adapt to their living environment (habitat) (Lamba & Pontororing, 2022). Environmental parameters supporting the suitability of bird habitat are different for each type of bird. These differences are the characteristics or ways of survival of each bird species in their habitat (Manik, 2018).

The many similarities and differences in environmental parameters as a carrying capacity for breeding and defending against threats to life need to be analyzed by type in each bird species. This analysis can help in establishing the suitability of habitat for each bird species. So this research aims to analyze the determination and use of environmental parameter types in establishing the suitability of bird habitat in an area.

## METHOD

### Research Type

The type of research on this topic is qualitative research using library research methods. Library research is a method of collecting data through understanding and researching theories from various literature related to the research to be carried out by researchers (Adlini et al., 2022). This research aims to collect data and information obtained from the library room, such as books, magazines, documents, notes historical stories, and others (Imah & Purwoko, 2018). The information obtained as references is later critically analyzed to support an idea under study.

### Data

The type of data in this research is secondary data. This data was obtained based on reading results sourced from books, scientific journals, and literature studies based on the results of research that has been conducted (Noviantoro, 2020). In this research, the data required is in the form of relevant information according to the focus of the study, namely the variable environmental parameters of bird habitat suitability sourced from articles in the last 15 years in scientific e-journals.

### Data Analyst

The analysis technique in this research is the content analysis method. This analysis is used to obtain valid inferences and can be re-examined based on the context (Kripendoff, 1993). In this analysis, a process of selecting, comparing, combining, and sorting various meanings is carried out until the relevant ones are found (Sabarguna, 2005).

## RESULT AND DISCUSSION

The environmental conditions of bird habitats are very dependent on the ability to adjust as a characteristic and form of survival. birds that are unable to adjust to the environmental conditions of their habitat will experience a decrease in population numbers. The cause of the decline in bird populations is the decreasing carrying capacity of the living environment of bird species such as infrastructure changes, loss of vegetation, poaching, utilization of recreational areas, and increased human activities.

The carrying capacity of bird life is very dependent on the environmental parameters of each bird species. these parameters can also be a form of self-protection for bird species. each bird species has different environmental parameters. this goes back to the type and life needs of each bird.

The results of the analysis of environmental parameters used in predicting the suitability of bird habitat are presented in Table 1. It can be seen that Ambagau (2010) used 8 parameters, Cahyana et al. (2015) used 9 parameters, Pramono et al. (2015) used 6 environmental parameters, Azmi et al. (2016) used 4 environmental parameters, Bramanthio (2019) used 7 environmental parameters, Gumilar (2021) used 5 environmental parameters, Aryanti et al. (2021) used 4 environmental parameters, Hidayat & Febriani (2021) used 5 environmental parameters, Lazuardi et al. (2022) used 10 environmental parameters, and Hadikusuma et al. (2023) used 6 environmental parameters. The analysis shows that elevation, slope, vegetation density (NDVI), and distance from water are the most frequently used parameters in establishing the suitability of bird habitat in an area.

**Table 1**. Results of Content Analysis Environmental Parameters.

| Parameter | Research Journal | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | *Hadikusuma et al. (2023)* | *Lazuardi et al. (2022)* | *Hidayat & Febriani, (2021)* | *Aryanti et al. (2021)* | *Gumilar (2021)* | *Bramanthio (2019)* | *Azmi et al. (2016)* | *Pramono et al. (2015)* | *Cahyana et al. (2015)* | *Ambagau (2010)* |
| Topography | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Slope | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| Vegetation density | ✓ | | ✓ | ✓ | ✓ | | ✓ | | ✓ | ✓ |
| Distance from river | ✓ | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| Distance from hot springs | | | | | | | | | | ✓ |
| Distance from settlement | ✓ | | | | | | | ✓ | ✓ | ✓ |
| Distance from road | ✓ | | | | ✓ | ✓ | | | ✓ | ✓ |
| Distance from encroachment | | | | | | | | | | ✓ |
| Distance from plantation | | | | | | | | ✓ | | |
| Distance from mangrove | | | | | | | | ✓ | | |
| Land use | | ✓ | ✓ | | | | ✓ | | | |
| Land cover | | | | | | ✓ | | | | |
| Temperature | | ✓ | | ✓ | | ✓ | | | ✓ | |
| Rainfall | | ✓ | | | | ✓ | | | ✓ | |
| Population density | | | | | | | | | ✓ | |
| Dispersal distance | | | | | | ✓ | | | | |
| Aspect | | ✓ | | | | | | | | |
| Solar radiation | | ✓ | | | | | | | | |
| Windspeed | | ✓ | | | | | | | | |
| Water vapor pressure | | ✓ | | | | | | | | |
| Bioclimatic | | ✓ | | | | | | | | |

## Topographic Parameter

The classification of topographic parameters in bird habitat suitability research consists of height, slope, and slope direction. This parameter greatly influences the suitability of the habitat of bird species.

According to Hadikusuma et al. (2023), in their research, they explained that the higher and steeper the slope in an area, the greater the number of encounters of the ivory-horned hornbill (*Rhinoplax vigil*). In connection with this, Aryanti et al. (2021) stated that at an altitude of 829–1,642 meters above sea level, there were 65 finds of Javanese eagles. Based on this, the suitability of bird habitat can be dominated in topographic areas considering that birds are known to be sensitive to environmental changes that cause bird habitats to be spread over relatively high, steep, and mountainous areas to avoid dangers that threaten their lives.

According to Widodo (2013), his research explained that there were 396.93 birds/km$^2$ population of bird species in the Mount Sawal, Ciamis. The existing bird habitat is dominated by mountain forest areas, upstream rivers, and cliff areas with steep slopes as a place of protection from disturbance by human activities (Nainggolan, 2017; Aryanti et al., 2018; Muliyanti et al., 2022).

## Environment Parameter

The classification of environmental parameters in bird habitat suitability research consists of vegetation density, distance from water sources, distance from hot springs, distance from rivers, land cover, and dispersal distance. In this classification of environmental parameters, less consideration is given to determining the habitat of bird species. This parameter is used only for several types of bird species that directly utilize these environmental parameters. For example, research conducted by Ambagau (2010). This research is related to the suitability of maleo bird habitat with environmental parameter variables in the form of distance from hot water, distance from rivers, and vegetation density. This happens because the maleo bird is only able to live in areas close to hot springs, water sources, and less dense vegetation.

The distance parameter from the water source is a parameter that can be considered compared to other environmental classification parameters. This is because water sources help the survival of birds, especially in wetland areas (Safitri, 2019). Several studies explain that several types of birds have high water needs. (Ayat, 2011; Harianto & Dewi, 2017).

## Anthropogenic Parameter

The classification of anthropogenic parameters in bird habitat suitability research consists of distance from settlements, distance from roads, distance from encroachment, land use, and population density. This parameter is no less important in establishing the suitability of bird habitat. This parameter is only needed for certain types of bird species by the survival needs of bird species that avoid human existence as a threat to extinction. Meanwhile, for species that are not yet threatened, ignore this parameter. The parameter of distance from encroachment and settlements has only been used by a few researchers. This is because any species can live anywhere, but due to habitat fragmentation and population decline (mainly due to anthropogenic activities) most of the species studied avoid human activities.

Meanwhile, the environmental parameter distance from the road is needed to establish the suitability of bird habitat. This happens because several types of birds are very concerned about human disturbance passing through or opening roads to enter bird habitat areas, for example, hiking trails (Margareta, 2010). This is by research conducted by Hadikusuma et al. (2023). The farther the distance from the road, the higher the number of bird species encounters. One of these bird species is the Faded Hornbill. his research showed that the distance from the road was 6,000 to 8,000 meters, and the number of encounters with the Helmeted Hornbill was 11 encounter points. There are more encounters at distances below 8000 meters where there are only 3 to 4 encounter points. Birds are animals that are highly sensitive to noise and human disturbance. Birds have a hearing sensitivity level that is 10x more sensitive than humans. Using the analogy that birds are living creatures, there are sensitive areas of bird hearing that can be subjected to sound at a certain sound pressure level that will touch the threshold of pain so that they feel uncomfortable and stay away from the sound (Palupi & Basuki, 2019; Andriani et al., 2023).

### Climate Parameter

The classification of climate parameters in bird habitat suitability research consists of temperature, rainfall, solar radiation, wind speed, water vapor pressure, and bioclimate. In this literature study, it was not considered in establishing the suitability of bird habitat. This happens because this classification parameter is only used for birds that utilize the influence of climate in their habitat. This is in line with research conducted by Lazuardi et al. (2022) regarding the suitability of the habitat of the honey buzzard (*Pernis ptilorhynchus*). This bird's habitat is very dependent on winter as its natural living habitat (Anggara, 2022).

### Biological Parameter

Biological parameters are those that consider the home range in terms of food requirements for bird species. The classification of biological parameters in bird habitat suitability research consists of distance from plantations and distance from mangroves. This parameter is not considered in this literature study, considering that only a few bird species live in areas where they feed and water sources. For example, research conducted by Pramono et al. (2015) related to the Asian Honey *sikep* bird (*Pernis ptilorhynchus*). This research shows that plantations and mangroves are the most influential parameters in mapping the habitat suitability of the Asian Honey *Sikep*. Plantations and mangroves are food sources and water sources for their habitat. According to Widodo, (2013), food sources have a significant effect on the number of bird species in their natural habitat. Food sources come from plantations, mangroves, rice fields, and vegetable and fruit fields which provide a place for birds to live as a source of food. The location of the food source is used as a nesting location for several types of birds whose habitat cannot be far from the food source (Nurhasanah, 2018).

### Environmental Parameter Variables on Bird Habitat Suitability.

Based on the results of literature studies conducted in relevant journals which refer to mapping the suitability of bird habitats. The suitability of a bird's habitat is determined by several determining variables. These determining variables are classified based on the needs of each bird species and the environmental conditions that influence the birds' habitat for living (Safanah et al., 2017). According to Rudiansyah & Radhi (2019) in his research, they explained that bird habitats are greatly influenced by environmental factors consisting of influences (climate, predators, food, water, space, and society).

The parameters used to determine the suitability of bird habitat are very diverse. The results of the analysis in several previous studies show that the use of environmental parameters in establishing the suitability of bird habitat can be classified into several types, namely topographic, environmental, anthropogenic, climatic, and biological.

The most influential environmental parameters in establishing the suitability of bird habitat are altitude, slope, vegetation density, distance from water sources, and distance from roads. This parameter is highly considered in establishing the suitability of bird habitat because it is influenced by the nature of birds which are sensitive to local environmental disturbances. Birds prefer to be at relatively high altitudes, steep slopes, dense vegetation density, close to water sources, and far from roads to consider the status of life threats (Ambagau, 2010; Cahyana et al., 2015; Hidayat & Febriani, 2021; Hadikusuma et al., 2023) However, some bird species ignore this parameter (Bramanthio, 2019; Lazuardi et al., 2022).

Other parameters such as distance from hot water, distance from settlements, distance from roads, distance from encroachment, distance from plantations, distance from mangroves, distance from agriculture, distance from rice fields, distance from forests, and land use. land cover type, temperature (temperature), rainfall, population density, land cover, dispersal distance, slope direction (aspect), solar radiation, wind speed, water vapor pressure, and bioclimate are parameters that are rarely used because these parameters are used based on the living needs of each type of bird

## CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded that the environmental parameters that have the most influence in establishing the suitability of bird habitat are height, slope, vegetation density, distance from water sources, and distance from roads. This parameter determines the suitability of bird habitat in an area. However, it needs to be emphasized that the use of other parameters

is also a support in establishing the suitability of bird habitat. These other parameters are adjusted to the characteristics and natural characteristics of each bird species in an area.

There is a limited availability of literature sources, such as books, journals, articles, and literature that indirectly cannot be accessed as a whole in providing information related to environmental parameters for bird species. So, it is necessary to use applications such as PRISMA or Vos Viewer as a bridge in adding reading sources, so that in the future related environmental parameters in building bird habitat suitability are more diligent in making a literature study.

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