



REPORT IMPLEMENTATION ACTIVITY



Prey Animal Inventory and Habitat Assessment of Komodo
Dragons in Nanga Bere Village, West Manggarai Regency
2024



ACTIVITY IMPLEMENTATION REPORT

**PROJECT *INVESTING IN THE KOMODO DRAGON AND OTHER GLOBALLY
THREATENED SPECIES IN FLORES***

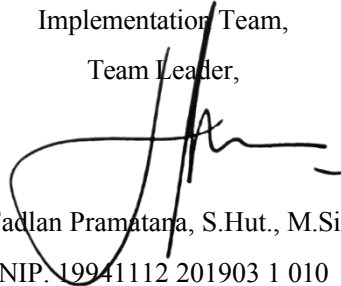
**PREY ANIMAL INVENTORY AND HABITAT ASSESSMENT OF KOMODO
DRAGONS IN NANGA BERE VILLAGE, WEST MANGGARAI DISTRICT**



RATIFICATION SHEET OF
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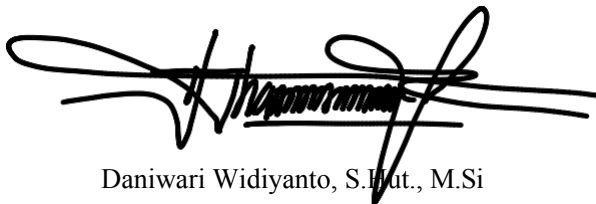
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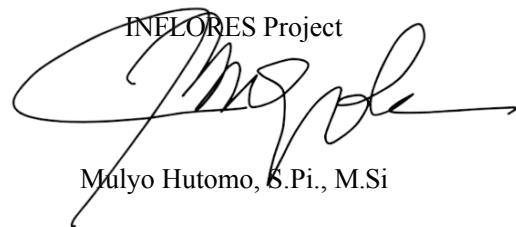
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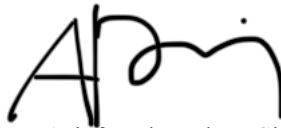
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ABSTRACT

Species conservation is not only centered on the main species, but needs studies from various aspects, including prey animal studies and habitat ecology to support the preservation of the main species. Nanga Bere Village is one of the areas in the western part of Flores Island that is home to Komodo dragons. Conflicts between villagers and Komodo dragons occurred when people started moving from mountainous areas to lowland areas around the coast, which affected the population of Komodo dragons in the village. Updating information on prey animals and habitat descriptions in the village is important for the continued conservation of Komodo dragons and their prey animals. Inventory activities are carried out by modeling the distribution of species. The resulting model can be the basis for further conservation actions in habitats that are predicted to have potential as prey animal habitats. The model can be generated from the processing of coordinate point data obtained through direct and indirect data collection. Seven types of prey animals were recorded in both direct and indirect encounters, including wild boar, monkey, civet, deer, cow, buffalo and goat. Nanga Bere Village is predicted to have suitable habitat for prey animals covering 8465.12 Ha (78.36%) with details of 1052.48 Ha (9.74%) predicted to have low suitability, 4543.25 Ha (42.06%) medium suitability, and 2869.39 Ha (26.56%) high suitability. These results illustrate the potential of food sources and habitats for the sustainability of Komodo dragon species conservation with the dominant land cover in this village is savanna area. The study also resulted in the highest importance index of plants in the shrub land cover, namely *G. Sepium* species at the pole level and *S. Pinnata* species at the tree level. Habitat protection through various partnership schemes including with the Nanga Bere village community needs to be realized. Conservation actions through socialization, knowledge improvement, and mutual benefit schemes with the community are one alternative so that the condition of prey animals and their habitats is maintained in supporting the conservation of komodo dragon species.

INTRODUCTION

The author thanks God Almighty for giving strength, perseverance, and abundant blessings so that the Report on the Implementation of Prey Animal Inventory Activities and Komodo Habitat Studies in Nanga Bere Village, West Mangarai Regency can be completed. The author would also like to thank various parties who have jointly supported the implementation of the activity. This report contains the prey animals of Komodo dragons, including the type and distribution of suitable habitat to support the conservation of Komodo dragons in Nanga Bere village, West Manggarai Regency. This report is expected to be one of the bases for policy making and further conservation actions in Nanga Bere village.

Thus this report is prepared, the author also feels that the report on the implementation of this activity is far from perfect. Therefore, any input in the form of suggestions and constructive criticism is highly appreciated. Hopefully this report can be useful for the author and readers.

Kupang, December 2024

Compilation Team

LIST CONTENTS

ENDORSEMENT SHEET	ii
ABSTRACT	iii
FOREWORD.....	iv
TABLE OF CONTENTS.....	v
TABLE OF TABLES	vi
TABLE OF FIGURES	vii
APPENDIX LIST	viii
CHAPTER I INTRODUCTION.....	1
a. Background	1
b. Problem Formulation	2
c. Objective	2
d. Benefits	2
e. Scope.....	2
CHAPTER II THEORETICAL FRAMEWORK.....	3
a. Theoretical Foundation	3
b. Hypothesis.....	3
CHAPTER III METHODS.....	3
a. Basis of Implementation	3
b. Implementation Time	3
c. Implementation Team	3
d. Data Collection Method	4
e. Data Analysis Technique.....	7
CHAPTER IV DISCUSSION	8
a. Overview of Location and Object of Activity	8
b. Description of Activity Results.....	9
c. Hypothesis Testing.....	30
CHAPTER V CLOSING	31
a. Conclusion	31
b. Suggestions	31
OVERVIEW	31
APPENDIX.....	42

LIST TABLE

Table 1. Details of the implementation team for the prey animal inventory and komodo dragon habitat study in Nanga Bere village.	3
Environmental variables used in the study.....	4
Table 3. List of plant species in Nanga Bere village.....	11
Table 4. Highest INP value in each land cover and vegetation level.....	12
Table 5. Classification of slope value based on vegetation class.....	15
Classification of NDVI values (KLHK, 2012).....	17
Table 7. Distribution of bioclimatic variable values on Komodo dragon prey animal encounters.....	21
Table 8. Multicollinearity test results of environmental variables.....	25
Percent contribution to the distribution model output.....	27
Table 10. Results of <i>overlaying</i> encounter points with distribution model output.....	29
Table 11: Results of <i>overlaying</i> encounter points with model output classification.....	30

LIST FIGURES

Illustration of a plant survey plot line.....	6
Location of Nanga Bere village, a) Elevation distribution; b) Land cover distribution.....	8
Figure 3. Indirect encounters with Komodo dragon prey, a) tracks; b) feces; c) puddles.....	9
Direct encounters of Komodo dragon prey animals, a) Cattle; b) Goats; c) Monkeys	9
Figure 5. Distribution of Komodo dragon prey items by encounter type.....	10
Figure 6. Vegetation analysis data collection locations in areas with shrub land cover	12
Figure 7. Graph of elevation value distribution with komodo dragon prey points.....	14
Figure 8. Graph of the distribution of slope values with the point of prey of komodo dragons.....	15
NDVI value distribution graph with komodo dragon prey species hotspots	16
Figure 10. Distribution graph of NDMI values with komodo dragon prey points	17
Figure 11: Distribution graph of distance values from roads to komodo dragon prey points	18
Figure 12 Graph of the distribution of distance from the river with the point of prey of komodo dragons	19
Figure 13. Distribution graph of distance values from settlements with komodo dragon prey points	20
Figure 14. Climatic factor graph of Nanga Bere village in 2022	22
Spatial autocorrelation graph of SDM Toolbox (Moran Index).....	23
Figure 16. Results of spatial autocorrelation analysis of Komodo dragon prey encounter points	23
Figure 17. AUC results of the komodo dragon prey habitat suitability model.....	26
<i>Response curves of NDVI variables with Komodo dragon prey encounter points.....</i>	<i>27</i>
Figure 19. Output of the prediction model of habitat suitability for Komodo dragon prey species.....	28
Figure 20. Classification of komodo dragon prey habitat suitability prediction model output	29

LIST OF ATTACHMENTS

Prey Animal Tally Sheet42

Appendix 2. Plant Tally Sheet.....43

CHAPTER I INTRODUCTION

a. Background

Komodo dragons (*Varanus komodoensis* Ouwens, 1912) are the largest living lizards of the *Varanidae* family and are categorized as *Endangered* (EN) according to the IUCN red list (Jessop et al., 2021). Komodo dragons are listed in Appendix I of CITES, which indicates that trade in the species is prohibited both live and in body parts (UNEP-WCMC (Comps.), 2024). In the Komodo National Park area, the species is distributed in four populations located on Komodo Island, Rinca Island, Gili Motang, and Nusa Kode (Ariefiandy et al., 2017; Ciofi & De Boer, 2004; Jessop et al., 2007; Purwandana et al., 2014). The spread of species is inseparable from habitat conditions and available food sources for prey animals (Doherty et al., 2022; Matthiopoulos et al., 2015). There are at least five large mammals that are the main prey animals for Komodo dragons on Rinca Island, namely deer, buffalo, horses, pigs and long-tailed monkeys (Mustari et al., 2011).

Species conservation is not only centered on the main species, but requires studies from various aspects, including studies of prey animals and habitat ecology to support the sustainability of the main species (Chakraborty & Das, 2014; Wegge et al., 2009; Wolf & Ripple, 2016). The Natural Resources Conservation Agency (BBKSDA) and the Komodo Survival Program (KSP) have conducted many studies on Komodo dragons and their prey animals. Monitoring and further studies are fundamental considering that Komodo dragons are protected and endangered (Jessop et al., 2021). In addition to the Komodo National Park area, the species is also distributed in several pockets of habitat on Flores Island, including in the north (Pota, Torongpadang, Riung, and Wolo Tado) and in the west (Wae Wuul, Lenteng, Nepa, to the Nanga Bere Village area) (Ciofi & De Boer, 2004; Jessop et al., 2021). In the Riung Nature Reserve area, 238.9 ha (59.03%) of the total area was recorded as suitable habitat for Komodo dragon prey, with details of 77.91 ha of low suitability, 101.96 ha of medium suitability, and 59.13 ha of high suitability (Ciofi & De Boer, 2004). 59.13 ha of high suitability (Pramatana et al., 2023). This information can be used as a basis for conservation action even in the absence of the main species. Habitat pockets with prey resources have the potential to sustain the Komodo dragon (Berger-Tal et al., 2020).

Nanga Bere Village is one of the areas in the western part of Flores Island that is home to Komodo dragons. The village area is quite difficult to access as it requires the use of sea transportation to get to the village. Conflicts between the villagers and the Komodo dragons occurred when people started moving from the mountainous area to the lowland area around the coast, which affected the population of Komodo dragons in the village. Updating information on prey animals and habitat description in the village is important for the sustainability of komodo dragon and prey species conservation. Species distribution modeling is one alternative in predicting the relationship of a species with its environmental characteristics (Austin, 2007; Norberg et al., 2019).

This modeling has great potential and is widely applied in various fields of ecology and conservation (Elith et al., 2011; Wang et al., 2020). *Maximum Entropy for Species Distribution Modeling* (MaxEnt) is a tool containing an algorithm that can predict the potential distribution of a species using animal encounter points (Phillips, 2005). The use of MaxEnt to predict prey animals is quite popular in producing a habitat suitability model (Hill et al., 2024; Pramata et al., 2023; Putra & Mustika, 2020; Trainor et al., 2014). The resulting model can be the basis for further conservation action in habitats that are predicted to have potential as a species habitat.

b. Problem Formulation

- What are the prey species of Komodo dragons in Nanga Bere Village?
- How much habitat area is suitable for komodo dragon prey in Nanga Bere Village?
- What is the condition of potential komodo dragon habitat in Nanga Bere Village?

c. Objective

To identify the prey species of Komodo dragons, including the distribution of suitable habitat for prey animals, and to describe the potential habitat of Komodo dragons in Nanga Bere Village.

d. Benefits

Enriching data and information and providing a basis for other activities or research related to prey animals and Komodo dragon habitat in Nanga Bere Village. This study also provides practical benefits for various parties, including benefits for the Natural Resources Conservation Center of East Nusa Tenggara Province (BBKSDA NTT), which is the basis of information in the formulation or ecological recommendations for the protection of Komodo endemic species and their prey animals in Nanga Bere Village. In addition, this study provides practical benefits for the local government, namely as information, input, suggestions, and recommendations in the preparation of management plans at the village / kelurahan, sub-district, and district levels. This study will also provide benefits to the community by providing economic benefits and increasing knowledge related to conservation through community involvement in research activities.

e. Scope

The scope of the prey animal inventory and habitat assessment of Komodo dragons in Nanga Bere Village includes direct and indirect encounters that allow data to come from the discovery of tracks, feces, or other signs of animal presence, as well as information from local communities. This study is also limited by several aspects including resources including time, cost, and energy as well as some physical and climatic conditions at the study site.

CHAPTER II FRAMEWORK THEORY

a. Foundation Theory

The conservation of komodo dragons is not only centered on the main species, but requires studies from various aspects, including prey animal studies and habitat ecology to support the sustainability of komodo dragons. There are at least five large mammals that are the main prey animals of Komodo dragons on Rinca Island, namely deer, buffalo, horses, pigs, and long-tailed monkeys. Species distribution modeling is one of the alternatives in predicting the relationship between a species and its environmental characteristics. This modeling has great potential and is widely applied in various fields of ecology and conservation. The resulting model can be the basis for further conservation action in habitats that are predicted to have potential as a species habitat.

b. Hypothesis

There are komodo dragon prey animals in Nanga Bere Village with habitat conditions that support the sustainability of komodo dragon and prey animal conservation.

CHAPTER III METHODS

a. Basis Implementation

This activity is carried out on the basis of a self-management contract Number: PK.09/K.5.TU/PEG.3/11/2024 concerning Biodiversity Inventory Activities in the Mbeliling Protected Forest Preservation Area and Monitoring of Komodo Prey Animals and Habitat in the Nanga Bere Preservation Area.

b. Time Implementation

The survey was conducted in Nanga Bere Village, West Manggarai Regency on November 29 - December 8, 2024.

c. Team Implementation

The implementation team consisted of a team of researchers and field staff of UPT KPH Kabupaten Manggarai and West Manggarai (Table 1).

Table 1. Details of the implementation team for prey animal inventory and komodo dragon habitat study in Nanga Bere village

No.	Name / NIP	Position
1.	Fadlan Pramatana, S.Hut, M.Si / 19941112 201903 1 010	Teaching Staff at Nusa Cendana University
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3.	Orlando Calvin Apu, S.Hut	Alumni of Undana Forestry Study Program
4.	Adityo Umbu Djaga Ladu Tanggu, S.Hut	Alumni of Undana Forestry Study Program
5.	Yohanes Ceasar Kolo Meko, S.Hut	Alumni of Undana Forestry Study Program
6.	Yosefaldhy Nomleni	Student of Undana Forestry Study Program
7.	Yeseldus Suhardi Goa, S.Hut	Staff of UPT. FMU Manggarai and West Manggarai
8.	Antonius Padua Sensi, A.Md.Hut	Staff of UPT. FMU Manggarai and West Manggarai

d. Prey Animal Encounter Point

Data Collection Method

Prey animal encounter point data will be collected by taking coordinate points of both direct and indirect encounters (feces and tracks) (Pramatana et al., 2023). Data collection is carried out using *rapid* observation or *rapid assessment* methods by observers walking along the path that can be traveled and taking coordinate data (Bismark, 2011). Data collection is assisted using a form from KoboCollect which is *web-based*, so that data will be inputted immediately along with the information (Palla et al., 2016).

Environmental Variables

Geographic information systems through distribution modeling is one of the tools that can link the presence of a species with its environmental values (Franklin, 2010). Remote sensing and GIS approaches are widely used by researchers to determine the bio-ecology or environmental variables of a species (Bai et al., 2018; McCarthy et al., 2015; Remya et al., 2015). This data can be used to describe, further analyze, as a basis for decision making, and others. Data collection methods for environmental variables are further detailed in Table 2.

Environmental variables used in the study

Data Source	Data Collection Method	Environmental Variable Data
<i>Digital Elevation Model</i> (DEM)	Downloaded from DEMNAS	Elevation Slope
<i>Imagery</i>	Filtering, Data Analysis, Download from <i>Google Earth</i> <i>Engine</i>	<i>NDVI</i> <i>NDMI</i>
RBI	Download from inageoportal	Distance from Road
Data Source	Data Collection Method	Environmental Variable Data
		Distance from Water Source Distance from Settlement

a. Elevation and Slope

Elevation and slope variables are generated from processing *Shuttle Radar Topography Mission* (SRTM) data or *Digital Elevation Model* (DEM) data with an accuracy of 8 meters from the National DEM. Elevation variables can be formed from the process of clipping or cutting the DEM raster based on the *maximum extend* or boundary of the study area. DEM data can be further processed with the *slope tool* on ArcMap's *spatial analyst tool* to produce slope variables.

b. NDVI and NDMI

The value of this variable is obtained from the processing of Landsat images using *near infrared* waves and *red* waves, resulting in the reflection of values on each object on the earth's surface (Green & Mumby, 2000). As for the NDMI variable, this variable is obtained from the processing of Landsat images using *Near Infrared* and *Shorwave Infrared* (Jin & Sader, 2005).

$$NDVI = \frac{NIR - RED}{NIR + RED}; \text{ and}$$

$$NDMI = \frac{NIR - SWIR1}{NIR + SWIR1}$$

Description

NIR : Band 4 in the Landsat 8/9
image
RED : Band 5 in the Landsat 8/9
image
SWIR1 : Band 6 in the Landsat
8/9 image

c. Distance Variable

The distance variables used in this modeling are distance from main roads, distance from settlements, and distance from water sources. Distance variables are generated from processing river, road and settlement data (BIG RBI data in 2017) using the *euclidean distance tool* in the ArcMap *spatial analyst tool*. The analyzed environmental variable data can be directly utilized as a form of remote sensing and GIS approach.

remote sensing and GIS approach to describe the bioecology of a species. This variable data can also be further analyzed as a whole to predict the location of species habitat suitability in the study.

d. Bioclimatic Variables

Bioclimatic variables are generated from data processing downloaded from worldclim.org. Bioclimatic variables are then subjected to a *clipping* process or raster cutting based on the *maximum extend* or boundary of the study area. There are 19 bioclimatic variables that can be used in describing habitat (Fick & Hijmans, 2017).

e. Prediction of Prey Animal Habitat Suitability

Determination of habitat suitability is processed through spatial modeling using *Maximum Entropy Species Distribution Modeling software* (MaxEnt 3.4.1). Spatial modeling data processing using MaxEnt requires animal presence point data in .csv format and environmental variables in ASCII (.asc) format (Phillips, 2005). Environmental variables processed in MaxEnt must have been tested for multicollinearity (Baek et al., 2019; Li & Ding, 2016; Oxoli et al., 2017). All environmental variables in this study were subjected to correlation analysis and environmental variables that had an absolute value of 0.5 will be removed and not continued in the processing process on MaxEnt *software* (McCarthy et al., 2015; Pramata et al., 2023).

Vegetation

Plant species data collection was carried out using the plot method. Observers will make a 20x20 m plot as the first plot and 100 m apart to re-create the same size plot as the next plot (Figure 1) (Cinda et al., 2019; Hamidun & Baderan, 2014). A total of 10 plots will be created for each land cover, representing a 1-km area.

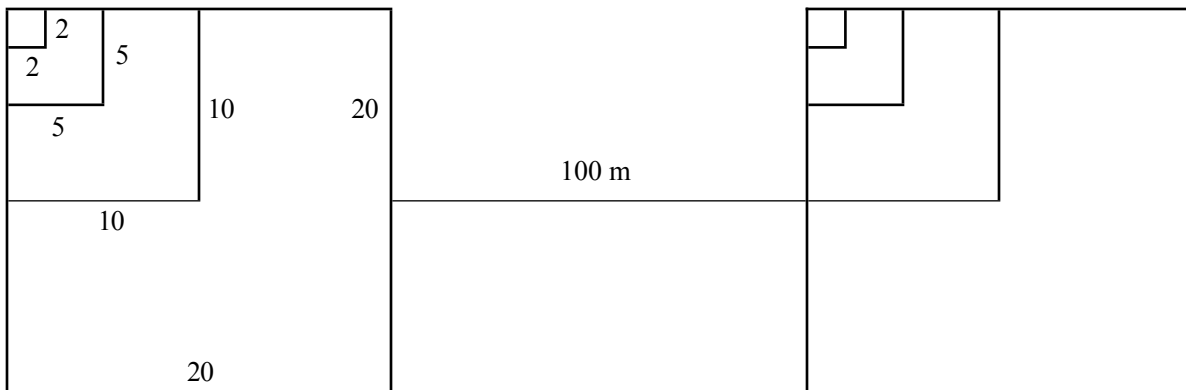


Figure 1: Illustration of Plant Survey Plotted Pathway

Observers will observe seedling and understory species in 2x2 m plots, sapling species in 5x5 m plots, pole species in 10x10 m plots, and tree species in 20x20 m plots and then record the species and number of individuals found (Rosminah et al., 2024). In this survey, observers need to be accompanied by local people who understand plant species to facilitate survey activities.

e. Data Analysis Technique

Species presence point data to be processed in MaxEnt will be better if it has a high quantity and is evenly distributed in the study location. If the presence points tend to gather or cluster, it is necessary to do thinning first (*rarefying*) so that the resulting spatial modeling output is more optimal (Cleasby et al., 2020; Cursach et al., 2020; Naimi et al., 2014). Environmental variables that are free from multicollinearity and species presence points that are evenly distributed are then processed with the following steps (Phillips, 2005): 1) Display the response curve of the variables to the species presence point, 2) Running *jackknife* to measure the level of influence of environmental variables on species presence points, 3) Saving MaxEnt output results in logistic and ASCII (.asc) format, 4) Setting the *random test percentage* to 30% and checking the *random seed* column, 5) Setting the *replicates* as many as 10 times, 6) Setting the type of repetition process to *Bootstrap*, and 7) Set the maximum iterations to 5000 so that the process can generate algorithms with sufficient time to produce the desired output (Cabrera & Lee, 2020; Kornejady et al., 2017; Rahmati et al., 2016).

The results of MaxEnt *software* processing are divided into three classes with *geometrical interval*, which is a data classification that divides data into intervals determined based on a certain geometric sequence. Validation of the MaxEnt model results can also be done by looking at the AUC (*Area Under Curve*) value, if the AUC value is below 0.5 then the model is not acceptable, while if the AUC value is 0.5 - 0.7 then the model has a fairly good accuracy value or low accuracy, and if the AUC value is 0.7 - 0.9 then the model has medium accuracy, and if the AUC value is more than 0.9 then the model has high accuracy (Lobo et al., 2008; Phillips, 2005).

For plant species, the data from vegetation analysis is used to generate data on vegetation density, dominance, frequency, and Index of Importance (INP). This data can be used as potential supporting vegetation for the life of Komodo dragons and their prey in nature. Vegetation analysis data is calculated using the following formulas (Indriyanto, 2012):

$$\text{Density (K)} = \frac{\text{Number of Individuals of a Species}}{\text{Total Area of Sample Plots}}$$

$$\text{Relative Density (KR)} = \frac{\text{Density of a Species} \times 100\%}{\text{Density of All Species}}$$

$$\text{Dominance (D)} = \frac{\text{Base Field Area}}{\text{Area of All Sample Plots}}$$

$$\text{Relative Dominance (DR)} = \frac{\text{Dominance of a Species} \times 100\%}{\text{Dominance of All Species}}$$

$$\text{Frequency (F)} = \frac{\text{Number of Plots Found of a Species}}{\text{Total Number of Plots}}$$

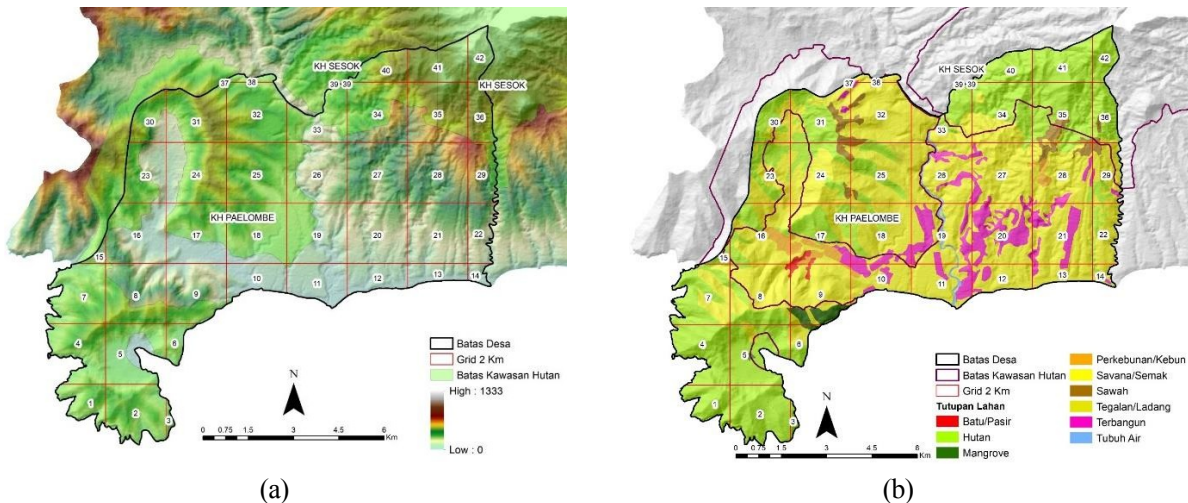
$$\text{Relative Frequency (FR)} = \frac{\text{Frequency of a Species} \times 100\%}{\text{Frequency of All}}$$

$$\text{Species Important Value Index (INP)} = \text{KR} + \text{DR} + \text{FR}$$

CHAPTER IV DISCUSSION

a. General Description of Location and Object Activities

Nanga Bere Village is one of the areas in the western part of Flores Island that is home to Komodo dragons. This village area is quite difficult to access since it requires the use of sea transportation to get to the village. Based on the National *Digital Elevation Model* (DEMNAS) data, Nanga Bere Village is in the elevation value range of 0 - 1,333 meters above sea level. This data can be used as the basis for determining sampling in order to represent the entire observation area. The working map is also made based on land cover data which is divided into 9 land cover classes, namely rock/sand, forest, mangrove, plantation, savanna/shrub, rice field, moor/field, built-up land, and water body (Figure 2).



Location of Nanga Bere Village, a) Elevation distribution; b) Land cover distribution

Conflicts between villagers and Komodo dragons occurred when people started to move from mountainous areas to lowland areas around the coast, which affected the population of Komodo dragons.

Komodo dragon species in the village. Updating information on prey animals and habitat descriptions in the village is important for the continued conservation of komodo dragons and their prey animals.

b. Description of Prey

Animal Distribution Activity

Results

The results of the prey animal inventory and habitat assessment of Komodo dragons in Nanga bere village recorded seven types of prey animals including wild boars, monkeys, goats, buffaloes, civets, deer, and cows. 188 prey animal points were recorded, with 15 points in the form of direct encounters and 173 points in the form of indirect encounters. The points with indirect encounters were 14 points in the form of tracks, 30 points in the form of feces, 1 point in the form of puddles, and 128 points came from information from villagers (Figure 3). Direct encounter points recorded six goats, 61 buffaloes and 17 monkeys (Figure 4). The distribution of Komodo dragon prey in Nanga Bere village is presented in more detail in Figure 5.

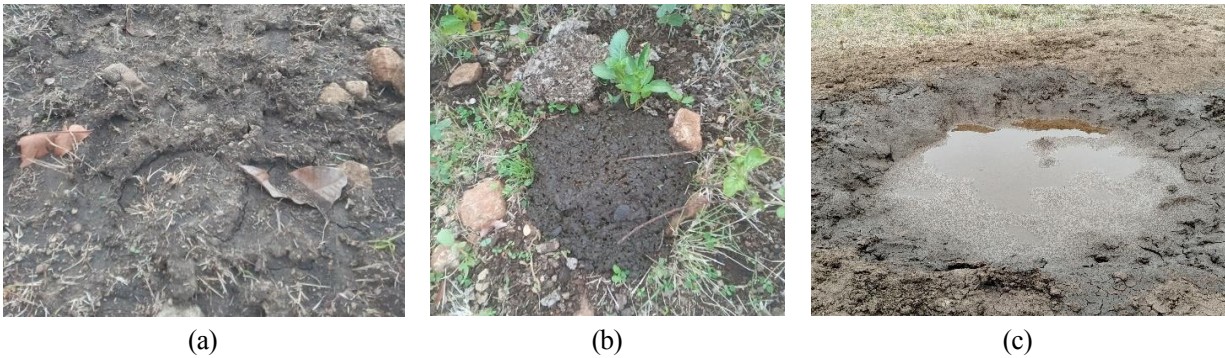


Figure 3. Indirect encounters of Komodo dragon prey: a) tracks; b) feces; c) puddles.



Direct encounters with Komodo dragon prey animals, a) Cow; b) Goat; c) Monkey.

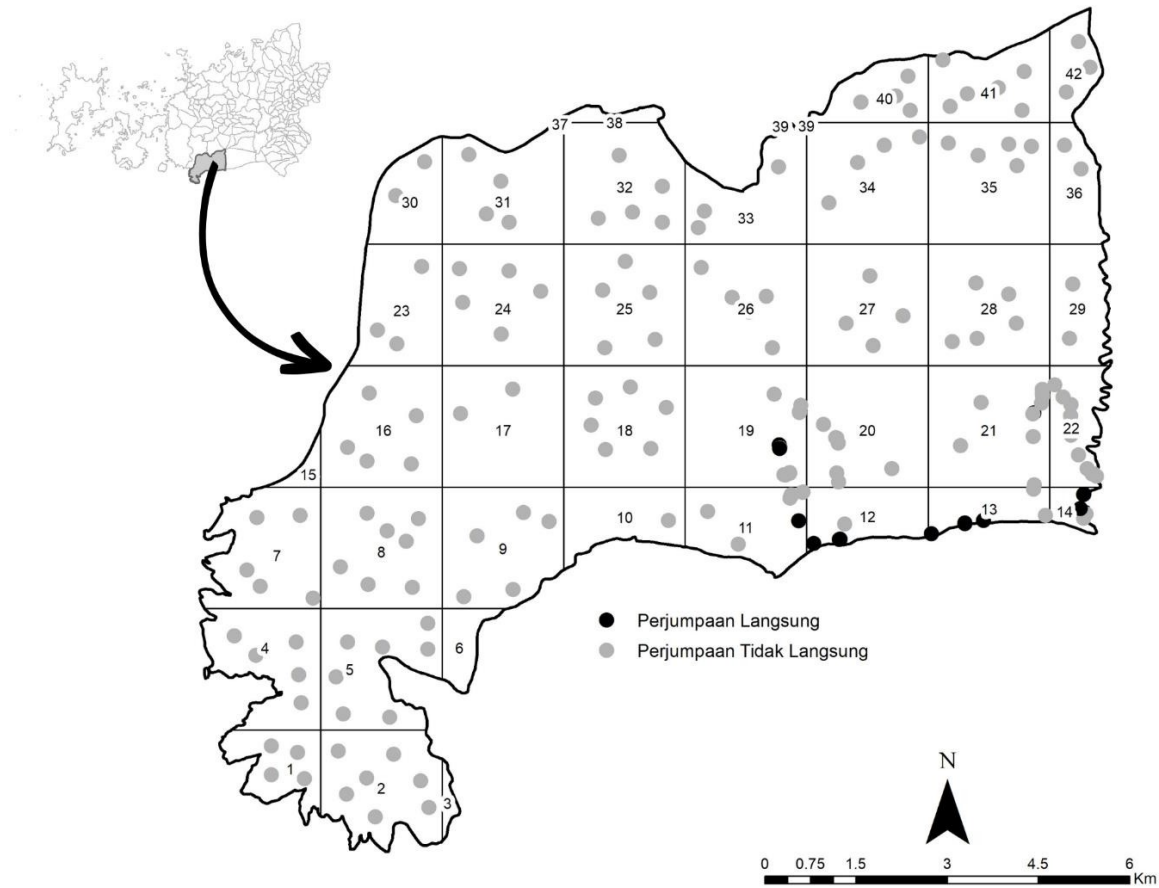


Figure 5. Distribution of Komodo dragon prey animals by encounter type

The long-tailed *macaque* (*Macaca fascicularis*), one of the Komodo dragon's prey animals, can be found from coastal areas to lowland forest areas. This species is categorized as *Endangered* according to the IUCN red list (IUCN, 2024). Hansen et al. (2022) reported that this species inhabits several habitat types including forest areas, savannas, shrubs, grasslands, wetlands, caves / rocks, mangroves, and others at an altitude of 0 to 2250 meters above sea level. Long-tailed monkeys are a type of species that colonize or group, making it easy to identify the species. Long-tailed macaques face a variety of threats including poaching, trade, and biomedical research, resulting in an estimated 40% population decline in the last three generations and a predicted 50% decline in the next generation (Hansen et al., 2022). Another prey animal of Komodo dragons is the *wild boar* (*Sus scrofa*). This species can be found in a variety of habitat types including forest habitats, savannas, shrubs, grasslands, wetlands, and others (Keuling & Leus, 2019). This species was not directly encountered and we only obtained information from villagers and encountered signs of presence in the form of puddles that might be used by wild boars for wallowing. Nanga Bere villagers reported that this species is usually only found in forested areas and is difficult to spot directly. Some

Researchers with the object of study wild boar (*Sus scrofa*) use *camera traps* to calculate the population and density of wild boars because they are difficult to find directly (Massei et al., 2018; Peris et al., 2019; Schütz et al., 2024; Wibowo, 2021).

Another wild prey animal of Komodo dragons is the Timor deer (*Rusa timorensis*). This species can be found in a variety of habitat types including forest, savanna and grassland habitats (Hedges et al., 2015). This species was not directly encountered and we only obtained information from villagers and encountered signs of presence in the form of feces. Nanga Bere villagers reported that this species can usually be found in grassland / savanna areas as well as forested areas. However, we did not have any direct sightings during the survey. *Timorensis deer* range in altitude from 0 - 900 m above sea level and in some areas, the species makes seasonal movements to fulfill its various needs (Hedges et al., 2015). Hunting activities for various body parts including meat, antlers, and skin are still a major threat to this species so that the IUCN categorizes its population trend as declining (Hedges et al., 2015; IUCN, 2024).

Vegetation Analysis

Prey animal inventory activities and komodo dragon habitat assessment in Nanga Bere village recorded a total of 15 plant species with details of 13 species from 10 families can be identified and as many as 2 plant species are only identified at the local name level. Vegetation analysis was conducted on the shrub land cover type because field conditions did not allow to reach the land cover of forested areas (Figure 6). Plant species observed during the prey animal inventory and Komodo dragon habitat assessment in Nanga Bere village are shown in Table 2.

Table 3. List of plant species in Nanga Bere village

No.	Local Name	Family	Scientific Name
1.	Banyan	Moraceae	<i>Ficus benjamina</i>
2.	Bidara	Rhamnaceae	<i>Ziziphus mauritiana</i>
3.	Faloak	Malvaceae	<i>Sterculia quadrifida</i>
4.	Kapok	Malvaceae	<i>Ceiba pentandra</i>
5.	Waru	Malvaceae	<i>Hibiscus tiliaceus</i>
6.	Gamal	Fabaceae	<i>Gliricidia sepium</i>
7.	Johar	Fabaceae	<i>senna siamea</i>
8.	White Teak	Lamiaceae	<i>Gmelina arborea</i>
9.	Kedondong	Rubiaceae	<i>Morinda citrifolia</i>
10.	Kedondong hutan	Anacardiaceae	<i>Spondias pinnata</i>
11.	Porch	Sapindaceae	<i>Schleichera oleosa</i>
No.	Local Name	Family	Scientific Name
12.	Forest Noni	Araliaceae	<i>Heptapleurum arboricola</i>
13.	Pulai	Apocynaceae	<i>Alstonia scholaris</i>

14. Horse Tread

15. Gelangga

Vegetation analysis data were collected in the Nanga Bere village area as many as 20 plots in areas with shrub land cover. The data from this vegetation analysis was then analyzed to obtain an important value index (INP) at each vegetation level. Vegetation types that have the highest INP value at each vegetation level are more fully presented in Table 4.



(a)



(b)



(c)



(d)

Location of vegetation analysis data collection in areas with shrub land cover Table 4. Highest INP values for each land cover and vegetation level

Land Cover	Vegetation Level	Local Name	Scientific Name	INP (%)
Shrubs	Pole	Gamal	<i>Gliricidia sepium</i>	140.53
	Tree	Kedongdong Forest	<i>Spondias pinnata</i>	46.82

The pole-level plant species with the highest INP value is Gamal (*Gliricidia sepium*). This species is a type with a tree habitus with small to large sizes and can grow naturally in tropical areas to areas dominated by dry climates (Midgley & Thomson, 2019). This species has a very wide distribution in various countries including Australasia, America, Africa, and Tropical Asia including the Lesser Sunda Islands in Indonesia (WFO, 2024a). Gamal plants have strong adaptability and can grow in areas with low fertility soil types to clay soil types (Midgley & Thomson, 2019). Gamal leaves can usually be utilized by the surrounding community as cattle feed as forage for livestock (Bahri, Hasan, et al., 2023; Bahri, Zainudin, et al., 2023; Sadipun et al., 2016).

Another plant species at the tree level with the highest INP value is the forest kedondong (*Spondias pinnata*). This species is a type with a tree habitus that occupies various habitat types including tropical forests, seasonal forests, open areas, and is even able to adapt to degraded areas (Amitha Bachan & Devika, 2024). This plant is able to adapt to the altitude range from 0 to 1200 meters above sea level and is able to associate with several other plant species, namely *Lagerstroemia microcarpa*, *Glochidion zeylanicum*, *Schleichera oleosa*, *Mangifera indica*, and others (Amitha Bachan & Devika, 2024). These species are distributed in several countries including China, Bangladesh, India, Nepal, Pakistan, Sri Lanka, and many more in the Asia-Temperate and Asia-Tropical regions including the Lesser Sunda Islands in Indonesia (WFO, 2024b). These two types of plants at the pole and tree levels can provide habitat in the form of *shelter* and food sources for several types of Komodo dragon prey animals in Nanga Bere village.

Environmental Variables

The use of geographic information systems to determine the value of environmental variables on the presence of wildlife is very helpful in estimating the bioecology of a species (Leempoel et al., 2017; Mujtahidah et al., 2023). In this study, 26 environmental variables and 188 direct and indirect encounter points were used to describe the bioecology of komodo dragon prey. The environmental variables used include elevation, slope, vegetation forage index (*Normalized Difference Vegetation Index*), site moisture index (*Normalized Difference Moisture Index*), distance from roads, distance from rivers, distance from settlements, and 19 *bioclimatic variables* referring to (Fick & Hijmans, 2017).

a. Elevation (V1)

Many researchers use elevation variables to describe the alleged habitat and presence of a species at a location (Hidayat & Febriani, 2021; Margareta, 2010; Mujtahidah et al., 2023). Elevation will affect various factors, including climatic, edaphic, and physical factors of a habitat (Wahyudi, 2023; Wasis et al., 2023). A species tends to choose locations with

abundant resources and a supportive environment for its survival (Manshur et al., 2015; Purnomo & Pudyatmoko, 2011; Safirda et al., 2020). Thus, this variable can describe the level of adaptation of a species to its environment. Nanga Bere Village has an area with a range of altitude values ranging from 0 - 1333 meters above sea level (DEMNAS). A graph of the distribution of altitude values against the meeting point of Komodo dragon prey is presented in Figure 7.

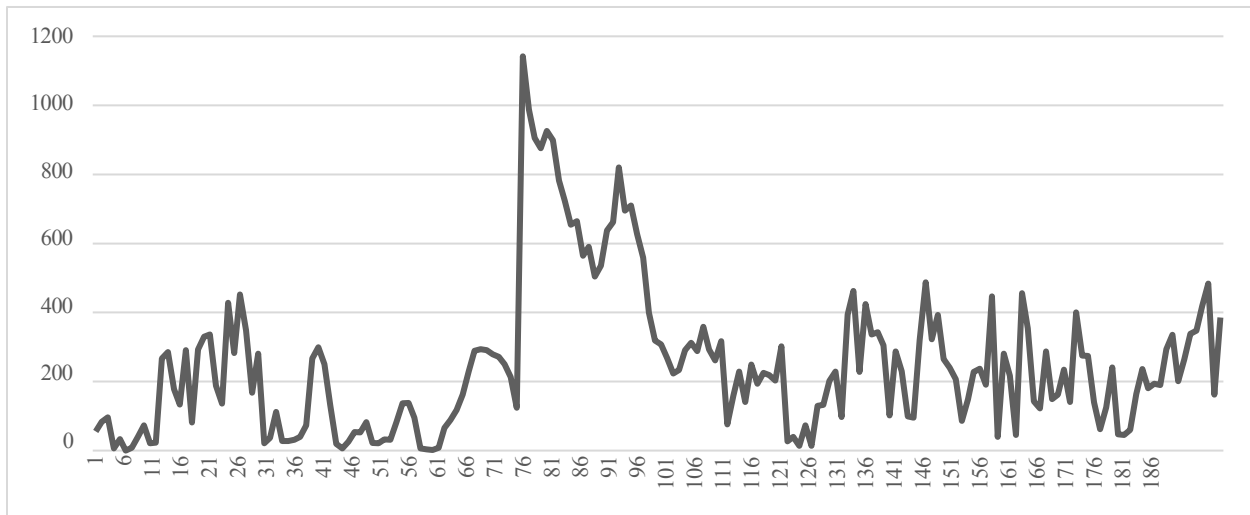


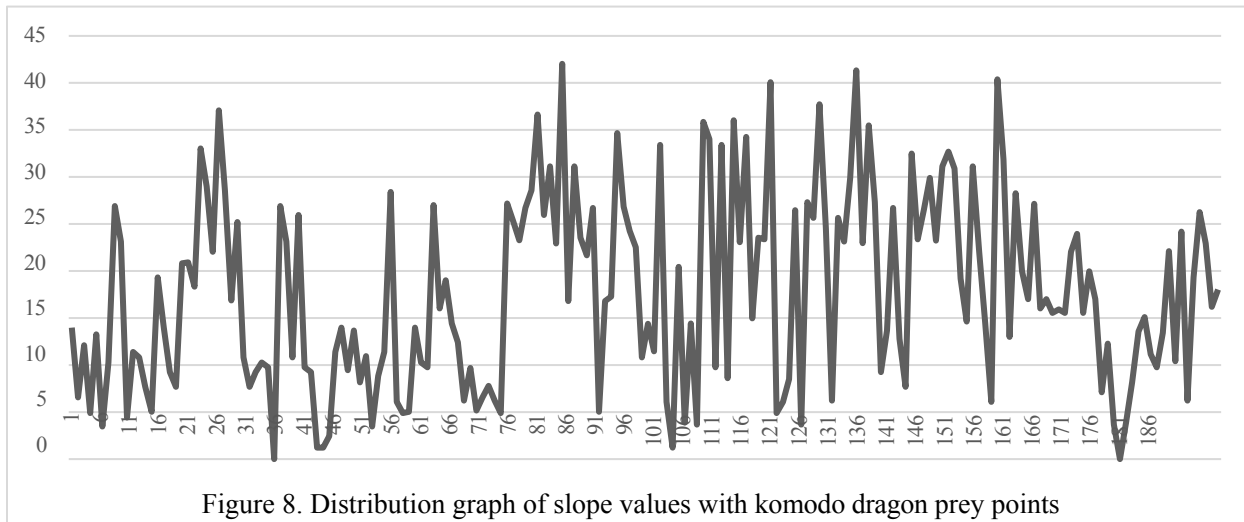
Figure 7: Graph of elevation value distribution with komodo dragon prey points

The graph shows that encounters with Komodo dragon prey animals are in the elevation value range of 0 - 1142 meters above sea level. Komodo prey animals are spread from coastal areas to the lowlands. Prey animals that can be found in coastal areas include cattle, goats, buffaloes, and monkeys. The prey species found in coastal areas are dominated by livestock from village communities that are often released to forage in grassland / savanna areas. Furthermore, Komodo dragon prey animals that can be found in lowland areas include deer, monkeys, and wild boars. These three prey species mostly inhabit habitats with forest land cover in the northern part of Nanga Bere village. Long-tailed monkeys can be found in the altitude range of 0 - 2250 meters above sea level (Hansen et al., 2022), deer can be found in the altitude range of 0 - 900 meters above sea level (Hedges et al., 2015), and wild boars can be found from 0 meters above sea level in coastal areas (Keuling & Leus, 2019). In the Nanga Bere village area, information from the surrounding community that these three types of komodo prey animals can be found in lowland forested areas because the coastal area has a lot of human activity, so it is quite difficult to see in this area.

b. Slope (V2)

Slope variables can affect several species, including large mammals because these species will be difficult to find in steep land conditions (Azdin et al., 2021; Nurdiansyah & Novita, 2015; Widodo et al., 2019). Slope variables can describe and

influence various factors including human activity disturbance (Hidayat & Febriani, 2021), vegetation density (Magdalena & Roziqin, 2021), and climatic and edaphic factors (Sandrawati et al., 2016; Sitepu et al., 2017). Locations that have steep slope values represent low human activity due to difficult accessibility (Gunawan & Sihombing, 2017; Rakuasa et al., 2022). A graph of the distribution of slope values against the meeting point of Komodo dragon prey is presented in Figure 8.



The graph shows that encounters with Komodo dragon prey are in the range of slope values 0⁰- 42⁰. There is a reference that reports the relationship between slope value and *Normalized Difference Vegetation Index* (NDVI) so that it can describe vegetation cover based on slope value (Sukristiyanti et al., 2010). The classification of NDVI values based on slope values is presented in Table 5.

Table 5. Classification of slope values based on vegetation class

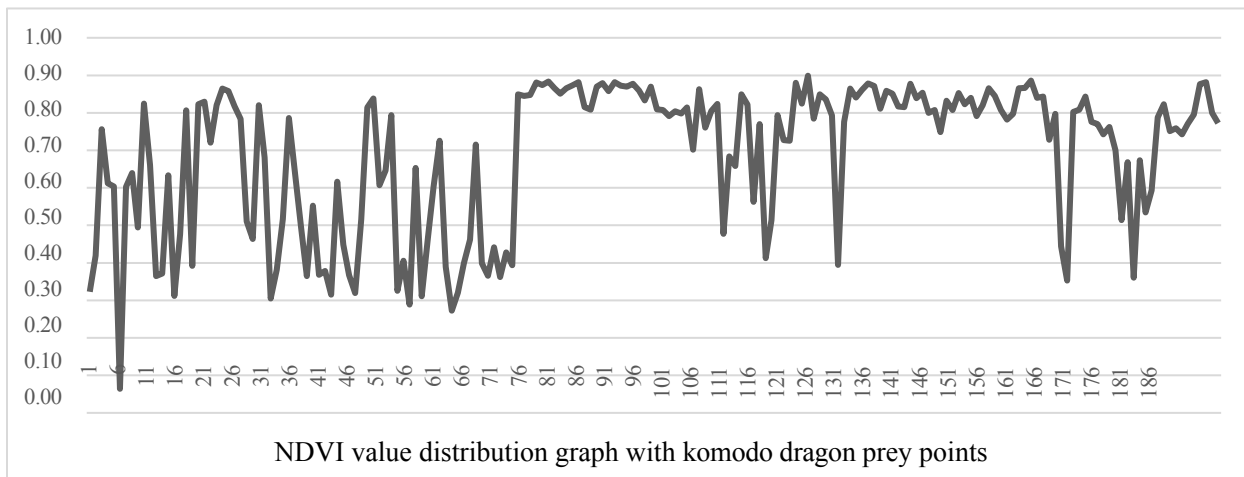
No	NDVI Classification	Slope Severity Value
1.	No vegetation	<5 ⁰
2.	Very sparse vegetation cover	5 ⁰ - 8 ⁰
3.	Sparse vegetation cover	>8 ⁰ - 15 ⁰
4.	Medium vegetation cover	>15 ⁰ - 25 ⁰
5.	Dense vegetation cover	>25 ⁰ - 35 ⁰
6.	Very dense vegetation cover	>35 ⁰

When referring to the above classification, Komodo dragon prey animal encounters are scattered in non-vegetated areas, very sparse vegetation to very dense vegetation. This is in accordance with the class division

The land cover of Nanga Bere village is based on KLHK land cover data in 2022 as well as land cover data based on the West Manggarai Regency Spatial and Regional Plan (2021-2041) which divides the Nanga Bere village area into 9 land cover classes, namely rock/sand, forest, mangrove, plantation, savanna/shrub, rice field, moor/field, built-up land, and water body. Prey species of goats, cows, and buffaloes are mostly found in areas with savanna land cover close to community settlement areas in coastal areas. Meanwhile, deer and monkey prey species based on community information can be found in various habitat types including forest and savanna areas that are quite far from residential areas, so the level of human activity disturbance is quite low. Finally, for wild boar prey species, based on community information, this species can only be found in lowland forested areas with dense to very dense vegetation.

c. *Normalized Difference Vegetation Index (NDVI) (V3)*

The value of this variable is obtained from the processing of Landsat images using *near infrared* waves and *red* waves, resulting in the reflection of values on each object on the earth's surface (Green & Mumby, 2000). According to Febrianti & Sofan (2014), NDVI can be utilized to show foliage biomass and forecast vegetation distribution at a location. The value of pixels transformed into NDVI ranges from -1 to 1, where the non-vegetation class is -1 to 0 and the vegetation class is 0 - 1 (Sudiana & Diasmara, 2008). A graph of the distribution of NDVI values against the meeting point of Komodo dragon prey is presented in Figure 9.



The graph shows that encounters with Komodo dragon prey were in the NDVI value range of 0.06 - 0.90. According to Sudiana & Diasmara (2008), the NDVI value range between -1 - 0 is a picture of the earth's surface with non-vegetation cover while the value range 0 - 1 is a picture of the surface with vegetation cover.

surface with vegetation cover. Furthermore, the Ministry of Environment and Forestry (MoEF) classifies NDVI values based on vegetation density as follows (Table 5).

Classification of NDVI values (MoEF, 2012)

Class	NDVI value	Description
1	-1 to -0.03	Land without vegetation
2	-0.03 to 0.15	Very low greenness
3	0.15 to 0.25	Low greenness
4	0.26 to 0.35	Medium greenness
5	0.36 to 1.00	High greenness

Based on the distribution graph of NDVI values with Komodo dragon prey encounters, it illustrates that prey animals are scattered in areas with low to high greenness. This result is in accordance with the condition of land cover in Nanga Bere village, which is dominated by savanna land cover and forested areas in the north and southwest. Potential Komodo prey animals are scattered throughout the Nanga Bere village area, making it a potential Komodo dragon habitat as previously reported (Ciofi & De Boer, 2004).

d. *Normalized Difference Moisture Index (NDMI) (V4)*

The value of this variable is obtained from the processing of Landsat images using *Near Infrared* and *Shortwave Infrared* (Jin & Sader, 2005). The NDMI value is dynamic because it is strongly influenced by other factors, such as evaporation and transpiration so that the NDMI value is very likely to change on different image recording dates (Muryati, 2019). The graph of the distribution of NDMI values towards the meeting point of Komodo dragon prey is presented in Figure 10.

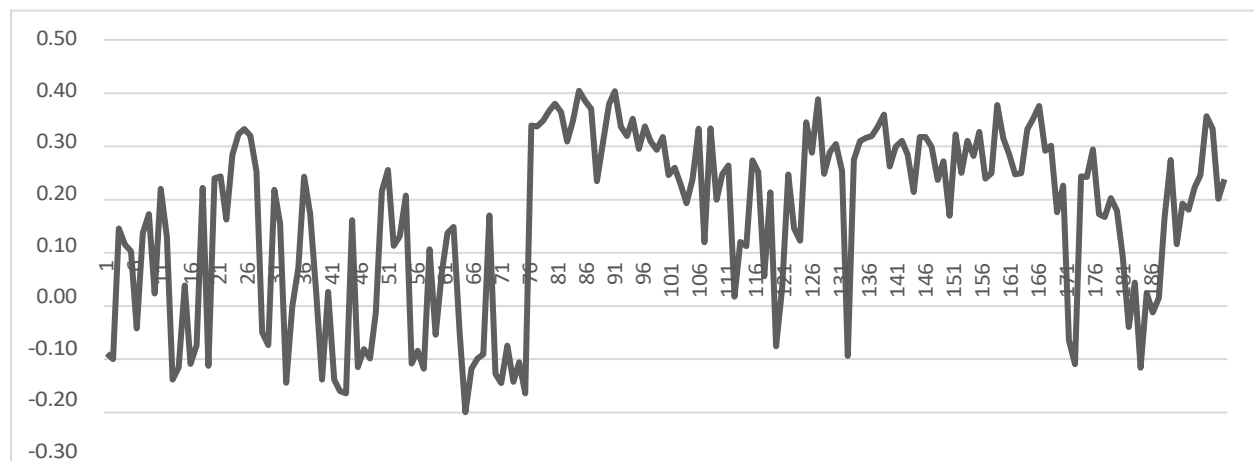


Figure 10. Distribution graph of NDMI values with komodo dragon prey animal points

The graph above shows that encounters with Komodo dragon prey are in the range of NDMI values -0.20 - 0.40. NDMI values range from -1 to 1, the greater the NDMI value indicates a location has high soil moisture (Jin & Sader, 2005). NDMI values of more than 0.20 indicate moisture conditions in the humid category, NDMI values ranging from 0.1 - 0.2 indicate moderate moisture conditions and NDMI values <0.1 indicate dry category moisture conditions (Goodwin et al., 2008). Based on the graph of the distribution of NDMI values with Komodo dragon prey encounters, it illustrates that prey animals are scattered in areas with soil moisture varying from low to high.

e. Distance from Road (V5)

Nanga Bere Village can be accessed using land transportation and sea transportation, but if accessed using land transportation will experience difficulties because it has poor road conditions, especially during the rainy season. Road data is obtained from the source of Rupa Bumi Indonesia (2017). There are several local access roads that are often traveled by people in Nanga Bere village. The variable distance from the road can describe the ability of a species to adapt to human activities (Pramatana et al., 2021). The graph of the distribution of distance values from the main road to the meeting point of Komodo dragon prey is presented in Figure 11.

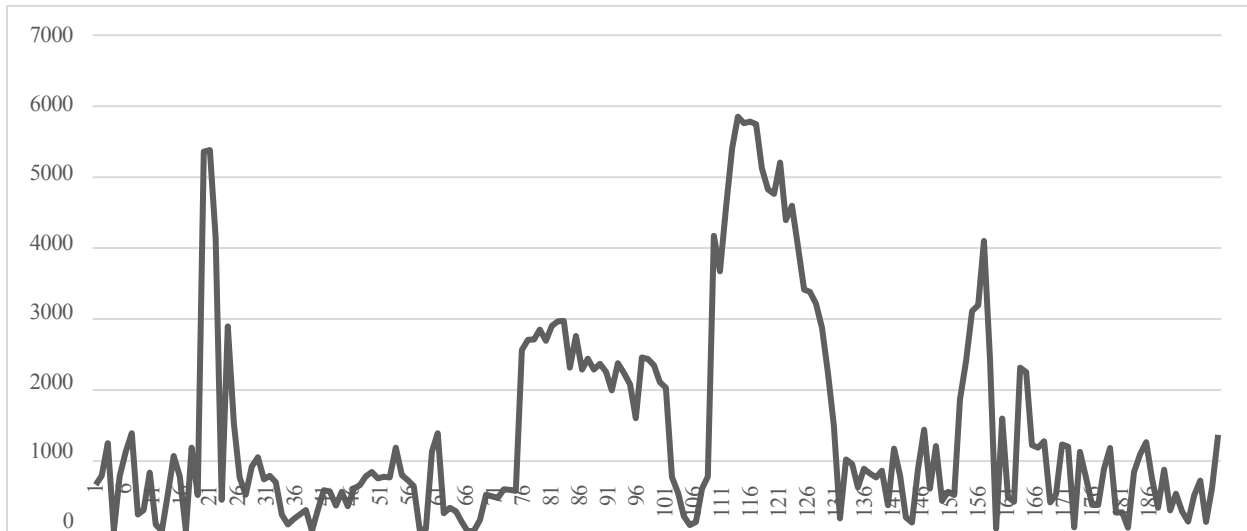


Figure 11: Distribution graph of distance values from the road to komodo dragon prey points

The graph above shows that encounters with Komodo dragon prey are in the range of distance from the main road of 8 - 5852 meters. The closest distance of prey animals to the road is 8 meters, this is in accordance with field conditions which illustrate that there are livestock around the settlement that are released to look for forage. The farthest distance of prey animals

with the road is 5852 m, this is based on community information about wild boar prey species in areas with forested land cover in the north and southwest.

f. Distance from River (V6)

Water sources including river flow are one of the components needed for wildlife (Alfila & Radhi, 2019; Alikodra & Surianegara, 2002; Arief et al., 2015; Pramata et al., 2022). The existence of this water source is sometimes even a gathering place for several species including mammals (Hamidun et al., 2012). A graph of the distribution of distance values from the river source to the meeting point of Komodo prey animals is presented in Figure 12.

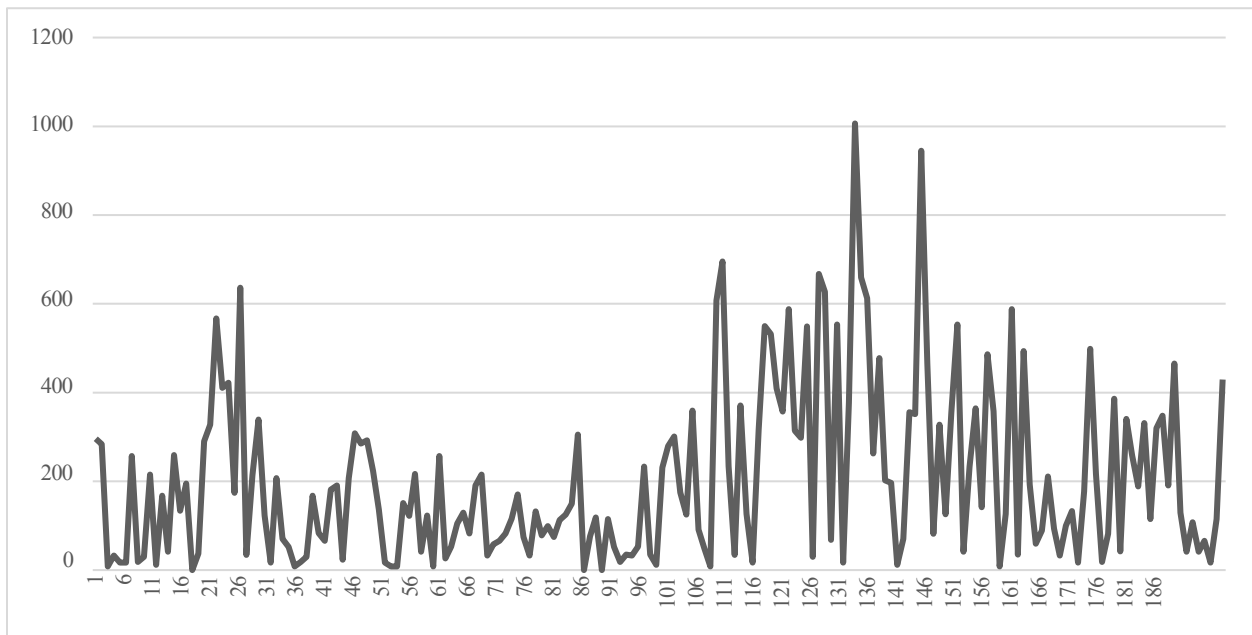


Figure 12: Distribution graph of distance values from the river to the komodo dragon prey point

The graph shows that encounters with komodo prey animals are in the range of distance values from water sources of 0 - 1006m. The water source data used is the flow of rivers and tributaries from the Rupa Bumi Indonesia map (2016 - 2017) (Geospatial Information Agency of the Republic of Indonesia, 2017). Each species tends to choose habitat locations that have abundant resources for its survival (Alikodra & Surianegara, 2002; Rohiyani et al., 2014; Rudiansyah & Radhi, 2019). Intact habitats that can provide water resources, food, cover, shelter, and low disturbance to a species will become the natural habitat of the species (Alikodra & Surianegara, 2002).

g. Distance from Settlement (V7)

This variable tends to describe the same thing as the distance from the road variable, which looks at the ability of a species to human activities and describes the possibility of threats to the species (Pramatana et al., 2002).

to the species (Pramatana et al., 2021). Settlements in Nanga Bere village tend to spread from the center of the village towards the southeast and south of the village. A graph of the distribution of distance values from settlements to Komodo dragon prey meeting points is presented in Figure 13.



Figure 13. Graph of the distribution of distance values from settlements to komodo dragon prey points

The graph shows that encounters with komodo prey animals are in the range of distance values from settlements 42 - 6593 m. Based on information from the Nanga Bere village community, the ancestors of the village lived and farmed in the lowland forest area in the north. Over time, the people of Nanga Bere village began to move towards the coastal area to facilitate accessibility in fulfilling their needs. This community shift has caused conflicts between the community and the Komodo dragons that have habitats in the coastal areas of Nanga Bere village. The decline in the komodo dragon population is suspected to have occurred during the conflict when the villagers moved to the coastal area. Until now, information about the presence of komodo dragons still exists in Nanga Bere Village but only limited and very far from residential areas.

h. Bioclimatic (*WorldClim*) (V8 - V26)

Global macro-climate variables at 1km resolution can help describe the climatic factors of a species. The climate variable data used is data from 1970 - 2000 (Fick & Hijmans, 2017). The data used are 19 bioclimatic variables that are more detailed related to precipitation and temperature. The variable values for each Komodo dragon prey animal meeting point can be seen in Table 7.

Table 7. Distribution of bioclimatic variable values for komodo dragon prey encounters

Environmental Variables	Lowest Value	Highest Value	Average
Bio - 1 (⁰ C)	21.24	26.71	25.43
Bio - 2 (⁰ C)	7.30	7.92	7.60
Bio - 3 (⁰ C)	71.82	73.84	72.54
Bio - 4 (⁰ C)	71.66	78.63	75.16
Bio - 5 (⁰ C)	26.12	32.14	30.59
Bio - 6 (⁰ C)	16.12	21.30	20.12
Bio - 7 (⁰ C)	10.00	10.99	10.48
Bio - 8 (⁰ C)	21.55	26.77	25.53
Bio - 9 (⁰ C)	20.15	25.89	24.54
Bio - 10 (⁰ C)	22.05	27.56	26.28
Bio - 11 (⁰ C)	20.15	25.69	24.38
Bio - 12 (mm)	1424.34	3170.11	1794.05
Bio - 13 (mm)	280.34	597.31	348.00
Bio - 14 (mm)	18.00	65.38	28.13
Bio - 15 (mm)	70.98	79.31	76.49
Bio - 16 (mm)	742.52	1567.18	917.96
Bio - 17 (mm)	67.84	215.69	101.18
Bio - 18 (mm)	352.34	887.09	473.45
Bio - 19 (mm)	85.11	215.69	114.11

Bioclimatic variables can help describe macro climatic factors in a location (Fick & Hijmans, 2017). Researchers utilize these variables to model the distribution of a species (Booth, 2018, 2022; Waltari et al., 2014). When referring to the data of bioclimatic variable 1 (average annual temperature) on komodo prey encounters, this variable has a range of values between 21.24⁰C - 26.71⁰ C with an average value of 25.43⁰ C. The data with the next annual value range is bioclimatic variable 12 (average annual rainfall). Komodo dragon prey encounters with average annual rainfall have a range of values between 1424.34 mm - 3170.11 mm with an average value of 1794.05 mm. These results when compared to the climatic factors in Nanga Bere village in 2022, have similar values with an average temperature of 25.80⁰C with a total rainfall of 2464.3 mm (Figure 14) (Zepner et al., 2021).

Nangabere, East Nusa Tenggara, Indonesia

8.82S, 119.914E | Elevation: 213 m | Climate Class: Am | Years: 2022-2022

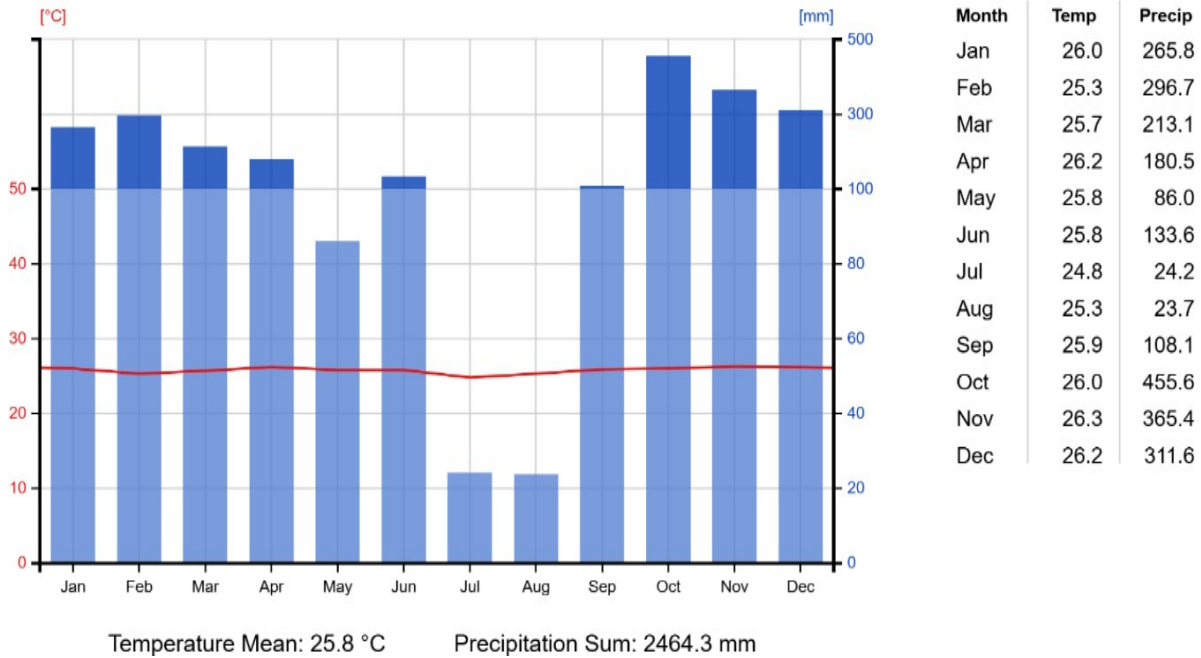


Figure 14. Climatic factor graph of Nanga Bere village in 2022.

The climatic factor value of Nanga Bere village supports the growth of vegetation that results in a land cover dominated by savanna and forested areas. This land cover is very supportive of Komodo dragon prey species. In addition, the dry climatic land cover provides a suitable natural habitat for key Komodo dragon species in the village.

Prediction of Komodo Prey Animal Habitat Suitability

a. Spatial Autocorrelation and Multicollinearity Tests

The data used to predict the habitat suitability of Komodo dragon prey is 188 encounter points with 15 points in the form of direct encounters and 173 points in the form of indirect encounters. Then the encounter data was reduced to eliminate spatial autocorrelation that might produce bias in the output of the maximum entropy analysis (Baek et al., 2019; Perkins-Taylor & Frey, 2020; Pramatana et al., 2023). Data reduction using *Incremental* spatial analysis and the help of *SDM toolbox* which is an *extension to* ArcGIS software based on the Global Moran index (Brown, 2014a; Brown et al., 2017). This *toolbox* helps analyze the presence of points that have spatial autocorrelation (Brown, 2014b). This analysis displays a graph of distance peaks where spatial autocorrelation between points is suspected (Brown, 2014b) (Figure 15).

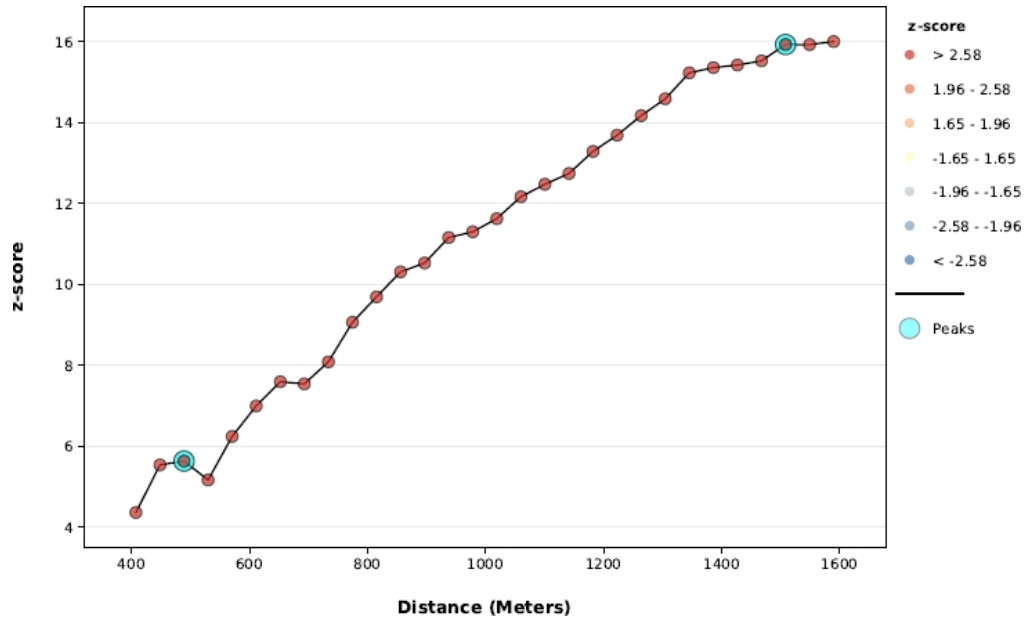


Figure 15. SDM Toolbox spatial autocorrelation graph (Moran Index)

The results of the spatial autocorrelation analysis test produced the first peak point value at a distance of 489.13 m and the maximum peak point that is predicted to have a connection between points is at a distance of 1508.14 m. The distance value is a cluster area suspected of having a connection between points. The distance value is a *cluster* area that is suspected to have a connection between the encounter points. Thus, a total of 188 encounter points that have a range of distance values between points ranging from 0 - 489.13 m will be eliminated because they contain strong relationships between points that allow bias in the distribution model output (Brown, 2014b) (Figure 16).



Results of spatial autocorrelation analysis of Komodo dragon prey encounter points

The results of the analysis using *Incremental Rarefying* in *SDM Toolbox* resulted in 103 encounter points that were free from spatial autocorrelation to reduce bias in the *maximum entropy* model output. The next stage is a multicollinearity test on environmental variables to eliminate strong correlation relationships between variables (Baek et al., 2019; Li & Ding, 2016). This multicollinearity test also aims to improve the accuracy of the resulting *maximum entropy* model output (Merow et al., 2013; Songchitruksa & Zeng, 2010). Multicollinearity between variables can also cause significant variables to be detected to be insignificant in statistical tests (Shrestha, 2020). The multicollinearity test between variables was carried out using Microsoft Excel 2021 software by eliminating one of the variables that had an absolute correlation value of 0.5 (greater than 0.5 and smaller than -0.5) (McCarthy et al., 2015; Pramataka et al., 2023) (Table 8).

Table 8. Multicollinearity test results for environmental variables

EV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
1	1.00																										
2	0.47	1.00																									
3	0.42	0.38	1.00																								
4	0.49	0.41	0.94	1.00																							
5	0.23	0.21	0.27	0.29	1.00																						
6	-0.01	0.34	0.18	0.13	0.28	1.00																					
7	0.18	0.31	0.31	0.32	0.41	0.24	1.00																				
8	-0.97	-0.44	-0.50	-0.56	-0.19	0.07	-0.20	1.00																			
9	-0.28	-0.38	-0.72	-0.70	-0.67	-0.38	-0.35	0.31	1.00																		
10	0.38	0.24	0.36	0.40	0.59	0.13	0.42	-0.43	-0.53	1.00																	
11	-0.07	-0.06	-0.21	-0.29	-0.24	-0.18	0.00	0.12	0.29	-0.60	1.00																
12	-0.95	-0.48	-0.58	-0.64	-0.29	0.01	-0.25	0.99	0.45	-0.51	0.18	1.00															
13	-0.96	-0.43	-0.45	-0.52	-0.13	0.10	-0.17	1.00	0.23	-0.39	0.10	0.97	1.00														
14	-0.33	-0.38	-0.70	-0.69	-0.71	-0.36	-0.40	0.36	0.98	-0.68	0.38	0.50	0.29	1.00													
15	-0.96	-0.44	-0.49	-0.56	-0.18	0.08	-0.19	1.00	0.30	-0.43	0.13	0.99	1.00	0.35	1.00												
16	-0.97	-0.44	-0.50	-0.57	-0.21	0.07	-0.20	1.00	0.33	-0.44	0.12	0.99	0.99	0.38	1.00	1.00											
17	-0.96	-0.45	-0.51	-0.58	-0.20	0.06	-0.21	1.00	0.33	-0.45	0.14	0.99	0.99	0.38	1.00	1.00	1.00										
18	-0.97	-0.44	-0.50	-0.56	-0.19	0.07	-0.20	1.00	0.31	-0.43	0.11	0.99	1.00	0.36	1.00	1.00	1.00	1.00									
19	0.96	0.39	0.40	0.47	0.13	-0.13	0.12	-0.99	-0.19	0.38	-0.09	-0.96	-0.99	-0.25	-0.99	-0.99	-0.99	-0.99	1.00								
20	0.96	0.39	0.40	0.48	0.13	-0.13	0.13	-0.99	-0.19	0.38	-0.10	-0.96	-1.00	-0.25	-0.99	-0.99	-0.99	-0.99	1.00	1.00							
21	0.94	0.39	0.43	0.49	0.10	-0.11	0.14	-0.99	-0.21	0.37	-0.09	-0.96	-0.99	-0.26	-0.99	-0.98	-0.98	-0.99	0.99	0.99	1.00						
22	-0.88	-0.37	-0.36	-0.40	0.07	0.10	-0.09	0.92	0.05	-0.23	0.01	0.87	0.94	0.10	0.92	0.91	0.91	0.92	-0.94	-0.94	-0.96	1.00					
23	0.96	0.40	0.42	0.50	0.15	-0.12	0.14	-0.99	-0.22	0.39	-0.10	-0.97	-1.00	-0.28	-0.99	-0.99	-0.99	-0.99	1.00	1.00	0.99	-0.93	1.00				
24	0.95	0.40	0.44	0.50	0.10	-0.11	0.15	-0.99	-0.21	0.36	-0.09	-0.96	-0.99	-0.26	-0.99	-0.99	-0.98	-0.99	0.99	1.00	1.00	-0.96	0.99	1.00			
25	0.95	0.35	0.32	0.40	0.10	-0.17	0.07	-0.97	-0.12	0.35	-0.07	-0.93	-0.98	-0.18	-0.97	-0.97	-0.97	-0.97	1.00	0.99	0.98	-0.94	0.99	0.98	1.00		
26	0.93	0.39	0.45	0.51	0.07	-0.10	0.14	-0.98	-0.21	0.34	-0.07	-0.95	-0.98	-0.26	-0.98	-0.98	-0.98	-0.98	0.99	0.99	1.00	-0.97	0.98	1.00	0.97	1.00	

Notes: 1 = Elevation; 2 = Slope; 3 = NDVI; 4 = NDMI; 5 = Distance from Road; 6 = Distance from River; 7 = Distance from settlement; 8 = Annual Mean Temperature; 9 = Mean Diurnal Range; 10 = Isothermality; 11 = Temperature Seasonality; 12 = Max Temperature of Warmest Month; 13 = Min Temperature of Coldest Month; 14 = Temperature Annual Range; 15 = Mean Temperature of Wettest Quarter; 16 = Mean Temperature of Driest Quarter; 17 = Mean Temperature of Warmest Quarter; 18 = Mean Temperature of Coldest Quarter; 19 = Annual Precipitation; 20 = Precipitation of Wettest Month; 21 = Precipitation of Driest Month; 22 = Precipitation Seasonality; 23 = Precipitation of Wettest Quarter; 24 = Precipitation of Driest Quarter; 25 = Precipitation of Warmest Quarter; 26 = Precipitation of Coldest Quarter

Table 8 shows the results of the multicollinearity test between 26 variables using 103 encounter points that are free from spatial autocorrelation. This multicollinearity test produces six variables that are free from correlation between variables and will be further analyzed as input to maximum entropy. Variables that are free from multicollinearity tests include elevation, slope, NDVI, distance from rivers, distance from settlements, and bioclimatic 4 (*Temperature Seasonality*).

b. *Maximum Entropy* Prediction of Habitat Suitability of Komodo Prey Animals

The maximum entropy analysis using MaxEnt software version 3.4.1 resulted in an *Area Under Curve* (AUC) value of 0.716 with a standard deviation of 0.0545 (Figure 17). The AUC value is used for model validation tests because it can indicate the accuracy of species distribution model predictions (Lobo et al., 2008). The distribution model is acceptable if it has a value > 0.5 , indicating that species encounters and variables overlap (Fielding & Bell, 1997; Phillips, 2005; Swets, 1988). If the AUC value is < 0.5 , it indicates that the model output is no better than using a random sample (Phillips, 2005).

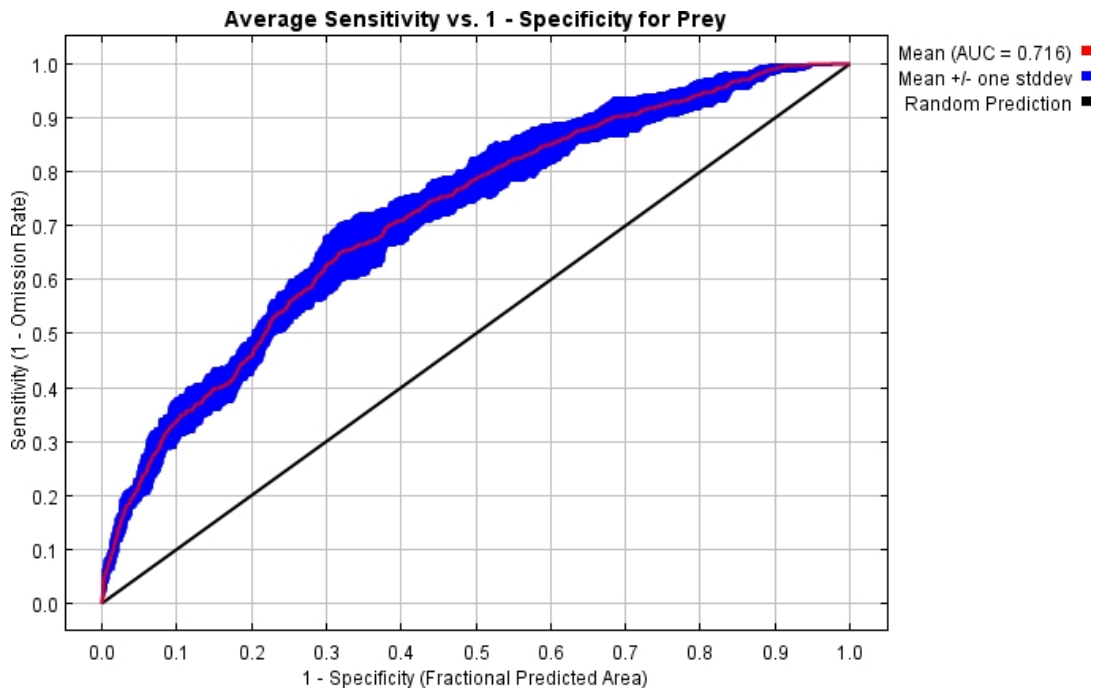


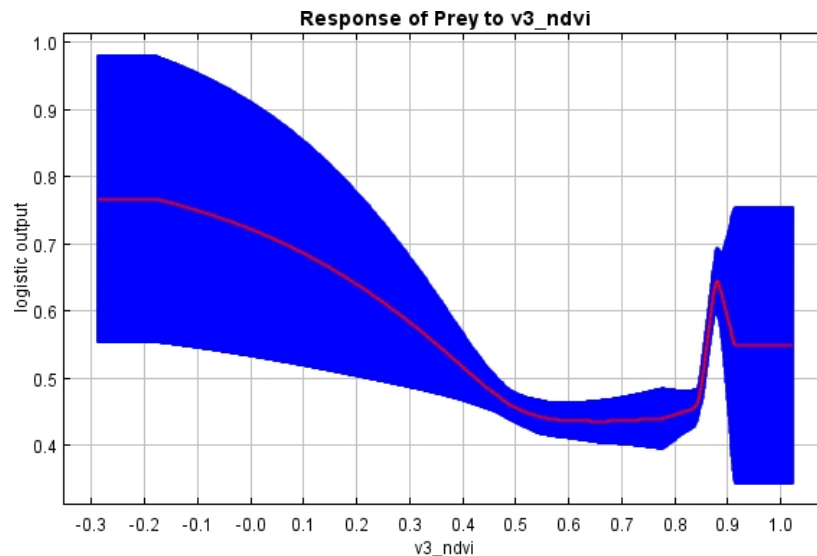
Figure 17. AUC results of the komodo dragon prey animal habitat suitability model

The *maximum entropy* analysis with six environmental variables resulted in the percent contribution of each variable to the model output (Phillips, 2005). The highest contribution value of the variables to predict the habitat suitability of komodo dragons is the NDVI variable with a value of 25.60% and the lowest contribution value to the model output is the slope variable with a value of 6.40%. 6.40 %. The percent contribution of each variable to the output of the komodo dragon prey habitat suitability model is more fully presented in Table 9.

Table 9. Percent contribution to the distribution model output

Environmental Variables	Percent Contribution (%)
<i>Normalized Difference Vegetation Index</i>	25.6
Distance from River	24.3
Elevation	21.4
Distance from Settlement	14.3
<i>Temperature Seasonality</i>	7.9
Slope	6.4

The *Normalized Difference Vegetation Index* (NDVI) variable has the highest percent contribution value to the model output. When referring to the results of the *NDVI Response Curves* (Figure 18), it can be seen that Komodo dragon prey encounters are predicted to be easily found in areas with low NDVI values and predicted encounters slope until NDVI values around 0.7, then increase again at NDVI values of 0.8 - 0.9.



Response curves of NDVI variables with Komodo dragon prey encounter points

These results illustrate several types of Komodo prey animals found in savanna land cover that has low NDVI values, including cattle, buffalo and goats, which are livestock around community settlements. Other prey animals predicted based on the information from the villagers are scattered in savanna areas far from settlements and forest areas, namely wild boar, monkeys, and deer. Thus, areas with forest land cover will have high NDVI or vegetation forage index values. However, basically all environmental variables are inseparable from each other as constituents of Komodo prey animal habitat. The results of the analysis only illustrate the variables with the greatest contribution to the resulting model output.

The logistic prey distribution model output produces raster data with an index value range of 0.146544 - 0.771547. Locations with values close to 0 illustrate that the location is allegedly not suitable for komodo prey animal habitat or the chance of finding prey animals is very small. While locations with values close to 1 illustrate the alleged location that is suitable for komodo dragon prey habitat or the chance of encountering prey animals is greater. *Maximum entropy* analysis also produces a *logistic threshold* percentile value for repetition of analysis as a lower threshold for determining locations that are considered suitable and unsuitable (Pramatana et al., 2023; Rahman et al., 2022). The logistic threshold value of the model output is 0.3593, thus locations with a logistic value of 0 - 0.3593 are interpreted as unsuitable locations for komodo prey animal habitat and locations with a value of > 0.3593 are interpreted as suitable locations for komodo prey animal habitat Figure 19.

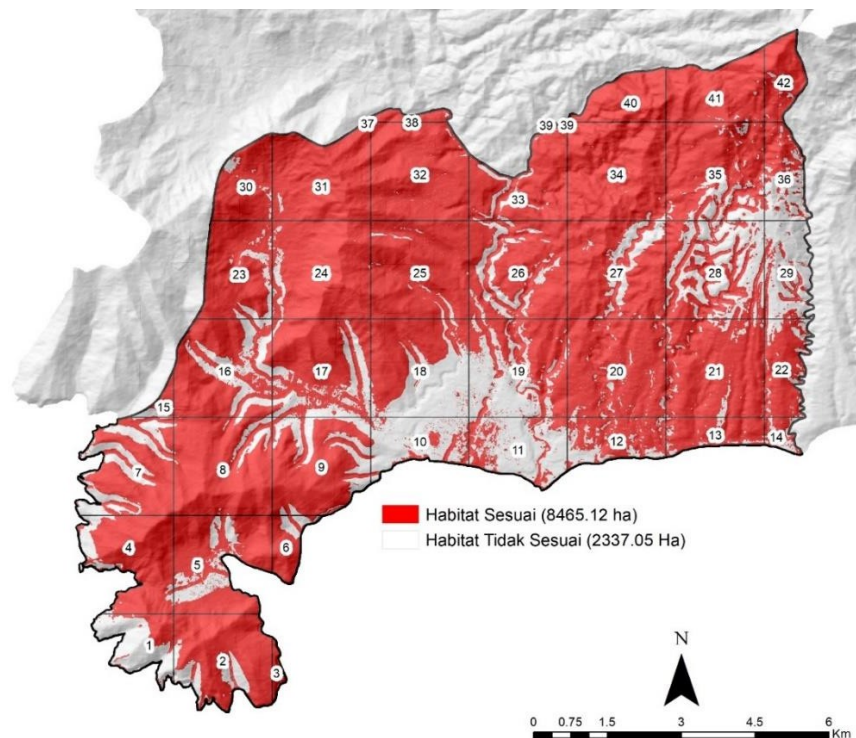


Figure 19. Output of the prediction model for the suitability of komodo prey animal habitat

The figure above shows a prediction map of Komodo dragon prey habitat suitability in Nanga Bere village with an unsuitable habitat area of 2337.05 Ha (21.64%) and a suitable habitat area of 8465.12 Ha (78.36%). >Validation of the *maximum entropy* output model uses the AUC value with the criteria that the model is acceptable if the AUC value is 0.5 (Fielding & Bell, 1997; Phillips, 2005; Swets, 1988). The model output has an AUC value of 0.716 which is interpreted as an acceptable model. Several other methods for modeling the distribution of a species need to validate by *overlaying* encounter points with the resulting model, such as the use of *Principal Component Analysis (PCA)*, linear regression, and other methods.

(PCA), linear regression, and logistic regression (Fitriana et al., 2016; Hermawan et al., 2019; Pramatana et al., 2022; Saadudin et al., 2012). If the results of the *maximum entropy* model are *overlaid* with points that are free from autocorrelation (103 points) and initial points (188 points), the validation of the appropriate class is 91.26% and 86.17%, respectively. *Overlaying* the Komodo dragon prey encounter points with the model output is presented in Table 10.

Table 10. Results of *overlaying* encounter points with distribution model output

Suitability Class	Autocorrelation Result Point	Percentage (%)	Starting Point	Percentage (%)
Not Suitable	9	8.74	26	13.83
Suitable	94	91.26	162	86.17
Total	103	100.00	188	100.00

Many researchers classify the output of species distribution models in suitable locations into three classes (low, medium, and high), four classes (low, medium, high, and very high), or five classes (very low, low, medium, high, very high) (Ardiani et al., 2023; Aryanti et al., 2021; Fitriana et al., 2016; Kusumanegara et al., 2017; Pramatana et al., 2022, 2023; Saadudin et al., 2012) and many more. If the locations identified as suitable habitat for Komodo dragons are divided into three classes (low, medium, and high), the model output can be seen in Figure 20 with the *overlaying* value of encounter points in each class presented in Table 11.

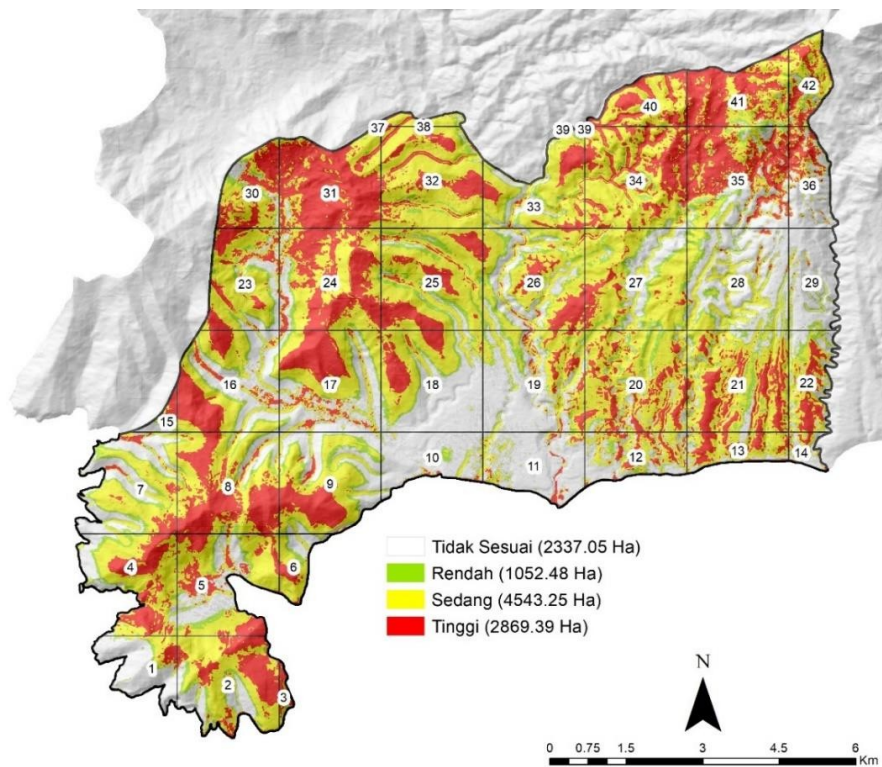


Figure 20. Classification of komodo dragon prey habitat suitability prediction model output

Table 11. Results of *overlaying* encounter points with model output classification

Suitability Class	Autocorrelation Result Point	Percentage (%)	Starting Point	Percentage (%)
Not Suitable	9	8.74	26	13.83
Low Suitability	8	7.77	13	6.91
Medium Suitability	37	35.92	72	38.30
High Suitability	49	47.57	77	40.96
Total	103	100.00	188	100.00

Figure 20 shows the output map of the komodo dragon prey habitat suitability prediction model that has been classified into three classes (low, medium, and high). The predicted area of low suitability class is 1052.48 ha (9.74%), medium suitability class is 4543.25 ha (42.06%), and high suitability class is 2869.39 ha (26.56%) of the total area of Nanga Bere village. When referring to Table 10, *overlaying the* encounter points with the output of the classified habitat suitability model results in 8 encounter points in the low suitability class, 37 encounter points in the medium suitability class, and 49 encounter points in the high suitability class based on the spatial autocorrelation test results. Meanwhile, using the starting point resulted in 13 points in the low suitability class, 72 points in the medium suitability class, and 77 points in the high suitability class.

c. Disclaimer

The results of this habitat suitability model can be used as a basis for species management and conservation actions for future Komodo dragon prey. However, the resulting distribution model is dynamic and can change (expand or narrow) following the development of future monitoring results. Locations that are identified as having suitability classes (low, medium and high) but where Komodo dragons have never been found can be targeted as future monitoring locations to validate and enrich encounter points that can then be used as input again in the *maximum entropy* analysis.

c. Testing Hypothesis

There are seven types of prey animals in Nanga Bere village including wild boar, monkey, civet, deer, cow, buffalo, and goat. Habitat conditions support the sustainability of prey animal conservation with model results illustrating that 8465.12 Ha (78.36%) is suitable habitat with details of 1052.48 Ha (9.74%) predicted to have low suitability, 4543.25 Ha (42.06%) medium suitability, and 2869.39 Ha (26.56%) high suitability. Habitat conditions that support the conservation of prey animals are the main aspect as a potential food source in the conservation of komodo dragons.

CHAPTER V CLOSING

a. Conclusion

Seven types of prey animals were recorded both in direct and indirect encounters including wild boar, monkeys, civets, deer, cattle, buffalo, and goats. Nanga Bere Village is predicted to have suitable habitat for prey animals covering 8465.12 Ha (78.36%) with details of 1052.48 Ha (9.74%) predicted to have low suitability, 4543.25 Ha (42.06%) medium suitability, and 2869.39 Ha (26.56%) high suitability. These results illustrate the potential of food sources and habitats for the sustainability of komodo dragon species conservation with the dominant land cover in this village in the form of savanna areas.

b. Suggestion

Habitat protection through various partnership schemes including with the Nanga Bere village community needs to be realized. Conservation actions through socialization, knowledge improvement, and mutual benefit schemes with local communities are one alternative so that the condition of prey animals and their habitats is maintained in supporting the conservation of komodo dragons.

BIBLIOGRAPHY

- Alfila, I., & Radhi, M. (2019). Wildlife Behavior in the Mammal Class. *Birueun: Almuslim University*.
- Alikodra, H. S., & Surianegara, I. (2002). *Wildlife management*. Forestry Faculty Publishing Foundation.
- Amitha Bachan, K. H., & Devika, M. A. (2024). *Spondias pinnata*. The IUCN Red List of Threatened Species 2024: E.T169579321A169589670. Accessed on December 27, 2024
- Ardiani, D., Jaelani, L. M., Aldiansyah, S., Tambunan, M. P., Indrawan, M., & Wibowo, A. A. (2023). The Effect of Human Disturbance on the Spatial Distribution of Anoa (*Bubalus Sp.*) Using MaxEnt Modeling. *IOP Conference Series: Earth and Environmental Science*, 1127(1), 012020.
- Arief, H., Mijiarto, J., & Rahman, A. (2015). Diversity and protection status of wildlife in PT Riau Sawitindo Abadi. *Conservation Media*, 20(2).
- Ariefiandy, A., Purwandana, D., Nasu, S. A., Benu, Y. J., Chrismiawati, M., Kamil, P. I., Imansyah, M. J., Ciofi, C., & Jessop, T. (2017). Komodo monitor lizard field guide. *Denpasar (ID): Yayasan Komodo Survival Program*.
- Aryanti, N. A., Susilo, T., Ningtyas, A. N., & Rahmadana, M. (2021). Spatial Modeling of Javan Hawk- Eagle (*Nisaetus bartelsi*) Habitat Suitability in Bromo Tengger Semeru National Park. *Journal of Sylva Lestari*, 9(1), 179-189.

- Austin, M. (2007). Species distribution models and ecological theory: a critical assessment and some possible new approaches. *Ecological Modeling*, 200(1-2), 1-19.
- Azdin, F. R., Pollo, H. N., & Kainde, R. P. (2021). Occupancy Rate of Lowland Anoa (*Bubalus depressicornis*) in Nantu Wildlife Sanctuary. *COCOS*, 8(8).
- Baek, S., Kim, M.-J., & Lee, J.-H. (2019). Current and future distribution of *Ricania shantungensis* (Hemiptera: Ricaniidae) in Korea: Application of spatial analysis to select relevant environmental variables for MaxEnt and CLIMEX modeling. *Forests*, 10(6), 490.
- Bahri, S., Hasan, S., Natsir, A., & Sirajuddin, S. N. (2023). *SIJAGAL (Cow-Corn-Gamal) Integration System*. Widina Publisher.
- Bahri, S., Zainudin, S., Ilham, F., & Tahir, M. (2023). Land Reclamation and Feed Provision for Beef Cattle through Gamal (*Gliricidia maculata*) Planting in Dambalo Village, Tomilito District, North Gorontalo Regency. *Journal of Agricultural Technology Community Service*, 2(1), 1-8.
- Bai, D.-F., Chen, P.-J., Atzeni, L., Cering, L., Li, Q., & Shi, K. (2018). Assessment of habitat suitability of the snow leopard (*Panthera uncia*) in Qomolangma National Nature Reserve based on MaxEnt modeling. *Zoological Research*, 39(6), 373.
- Berger-Tal, O., Blumstein, D. T., & Swaisgood, R. R. (2020). Conservation translocations: a review of common difficulties and promising directions. *Animal Conservation*, 23(2), 121-131.
- Bismark, M. (2011). Standard Operating Procedures (SOPs) for Species Diversity in Conservation Areas. *Bogor: Balitbang Kehutanan*.
- Booth, T. H. (2018). Why understanding the pioneering and continuing contributions of BIOCLIM to species distribution modeling is important. *Austral Ecology*, 43(8), 852-860.
- Booth, T. H. (2022). Checking bioclimatic variables that combine temperature and precipitation data before their use in species distribution models. *Austral Ecology*, 47(7), 1506-1514.
- Brown, J. L. (2014a). SDM toolbox: a python-based GIS toolkit for landscape genetic, biogeographic and species distribution model analyses. *Methods in Ecology and Evolution*, 5(7), 694-700.
- Brown, J. L. (2014b). SDMtoolbox User Guide. Available on: [Http://Www. Sdmtoolbox. Org](http://www.Sdmtoolbox.Org).
- Brown, J. L., Bennett, J. R., & French, C. M. (2017). SDMtoolbox 2.0: the next generation Python-based GIS toolkit for landscape genetic, biogeographic and species distribution model analyses. *PeerJ*, 5, e4095.

- Cabrera, J. S., & Lee, H. S. (2020). Flood risk assessment for Davao Oriental in the Philippines using geographic information system-based multi-criteria analysis and the maximum entropy model. *Journal of Flood Risk Management*, 13(2), e12607.
- Chakraborty, K., & Das, S. S. (2014). Biological conservation of a prey-predator system incorporating constant prey refuge through provision of alternative food to predators: a theoretical study. *Acta Biotheoretica*, 62, 183-205.
- Cinda, F. G., Panambe, N., & Peday, M. H. (2019). Vegetation Analysis of Woody Plants in the Lowland Tropical Forest Area of the Wondiwoi Mountains Nature Reserve. *Papuasias Forestry Journal*, 5(1), 79-92.
- Ciofi, C., & De Boer, M. E. (2004). Distribution and conservation of the Komodo monitor (*Varanus komodoensis*). *Herpetological Journal*, 14(2), 99-107.
- Cleasby, I. R., Owen, E., Wilson, L., Wakefield, E. D., O'Connell, P., & Bolton, M. (2020). Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping. *Biological Conservation*, 241, 108375.
- Cursach, J., Far, A. J., & Ruiz, M. (2020). Geospatial analysis to assess distribution patterns and predictive models for endangered plant species to support management decisions: a case study in the Balearic Islands. *Biodiversity and Conservation*, 29, 3393-3410.
- Doherty, T. S., Geary, W. L., Jolly, C. J., Macdonald, K. J., Miritis, V., Watchorn, D. J., Cherry, M. J., Conner, L. M., González, T. M., & Legge, S. M. (2022). Fire as a driver and mediator of predator-prey interactions. *Biological Reviews*, 97(4), 1539-1558.
- Elith, J., Phillips, S. J., Hastie, T., Dudík, M., Chee, Y. E., & Yates, C. J. (2011). A statistical explanation of MaxEnt for ecologists. *Diversity and Distributions*, 17(1), 43-57.
- Febrianti, N., & Sofan, P. (2014). Green open space in DKI Jakarta based on spatial and spectral analysis of Landsat 8 data. *Proceedings of National Seminar on Remote Sensing 2014*, 498-504.
- Fick, S. E., & Hijmans, R. J. (2017). WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas. *International Journal of Climatology*, 37(12), 4302-4315.
- Fielding, A. H., & Bell, J. F. (1997). A review of methods for the assessment of prediction errors in conservation presence/absence models. *Environmental Conservation*, 24(1), 38-49.

- Fitriana, F., Prasetyo, L. B., & Kartono, A. P. (2016). Preferential habitat of Belitung tarsier (*Cephalopachus bancanus saltator* Elliot, 1910). *Conservation Media*, 21(2), 174-182.
- Franklin, J. (2010). *Mapping species distributions: spatial inference and prediction*. Cambridge University Press.
- Goodwin, N. R., Coops, N. C., Wulder, M. A., Gillanders, S., Schroeder, T. A., & Nelson, T. (2008). Estimation of insect infestation dynamics using a temporal sequence of Landsat data. *Remote Sensing of Environment*, 112(9), 3680-3689.
- Green, E. P., & Mumby, P. J. (2000). *Remote Sensing Handbook for Tropical Coastal Management; Edwards, A.J., Ed.; United Nations Educational, Scientific and Cultural Organization: Paris, France, 2000*. ISBN 92-3-103736-6.
- Gunawan, H., & Sihombing, V. S. (2017). Habitat preferences of Javan leopards (*Panthera pardus melas* Cuvier 1809) in western Java. *Journal of Forest Research and Nature Conservation*, 14(1), 35-44.
- Hamidun, M. S., & Baderan, D. W. K. (2014). Vegetation analysis of bolyohuto limited production forest of Gorontalo province. *Gorontalo: Gorontalo State University*.
- Hamidun, M. S., Baderan, D. W., & Modjo, M. L. (2012). Wildlife Potential for Ecotourism Development in Nantu Wildlife Reserve Area, Gorontalo Province. *National Seminar of the Indonesian Biological Society XIII*, 88-96.
- Hansen, M. F., Ang, A., Trinh, T. T. H., Sy, E., Paramasivam, S., Dimalibot, J., Jones-Engel, L., Ruppert, N., Griffioen, C., Gray, R., Phiapalath, P., Doak, N., Kite, S., Nijman, V., Fuentes, A., & Gumert, M. D. (2022). *Macaca fascicularis ssp. fascicularis (amended version of 2022 assessment)*. He IUCN Red List of Threatened Species 2022: E.T195351957A221668305. <https://doi.org/https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T195351957A221668305.en>. Accessed on December 27, 2024
- Hedges, S., Duckworth, J. W., Timmins, R., Semiadi, G., & Dryden, G. (2015). *Rusa timorensis*. He IUCN Red List of Threatened Species 2015: E.T41789A22156866. <https://doi.org/https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T41789A22156866.en>. Accessed on December 27, 2024
- Hermawan, R., Hikmat, A., Prasetyo, L. B., & Setyawati, T. (2019). Spatial Distribution Model and Habitat Suitability of Invasive Species of Mantangan (*Merremia peltata* (L.) Merr.) in Bukit Barisan Selatan National Park. *Journal of Nusa Sylva*, 17(2), 80-90.

- Hidayat, R. A., & Febriani, N. (2021). Habitat Distribution Probability Modeling to Determine Priority Areas for Helmeted Hornbill (*Rhinoplax Vigil*) Conservation in Silokek Geopark, Sijunjung Regency. *Biological Conservation*, *17*(1), 35-43.
- Hill, J. L., Grisnik, M., Hanscom, R. J., Sukumaran, J., Higham, T. E., & Clark, R. W. (2024). The past, present, and future of predator-prey interactions in a warming world: Using species distribution modeling to forecast ectotherm-endotherm niche overlap. *Ecology and Evolution*, *14*(3), e11067.
- Indriyanto. (2012). *Forest ecology*. Bumi Aksara.
- IUCN. (2024). *The IUCN Red List of Threatened Species*. Version 2024-2. <https://www.iucnredlist.org>. Accessed on December 27, 2024
- Jessop, T., Ariefiandy, A., Azmi, M., Ciofi, C., Imansyah, J., & Purwandana, D. (2021). *Varanus komodoensis*. The IUCN Red List of Threatened Species 2021: E.T22884A123633058. <https://dx.doi.org/10.2305/IUCN.UK.2021-2.RLTS.T22884A123633058.en>. Accessed on December 27, 2024
- Jessop, T. S., Madsen, T., Ciofi, C., Imansyah, M. J., Purwandana, D., Rudiharto, H., Ariefiandy, A., & Phillips, J. A. (2007). Island differences in population size structure and catch per unit effort and their conservation implications for Komodo dragons. *Biological Conservation*, *135*(2), 247-255.
- Jin, S., & Sader, S. A. (2005). Comparison of time series tasseled cap wetness and the normalized difference moisture index in detecting forest disturbances. *Remote Sensing of Environment*, *94*(3), 364-372.
- Keuling, O., & Leus, K. (2019). *Sus scrofa*. The IUCN Red List of Threatened Species 2019: E.T41775A44141833. <https://doi.org/https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41775A44141833.en>. Accessed on December 27, 2024
- MOEF. (2012). *Regulation of the Minister of Forestry Regarding the Second Amendment to the Regulation of the Minister of Forestry Number P. 32/Menhut-Ii/2009 Regarding the Procedures for Preparing Technical Plans for Forest and Watershed Land Rehabilitation (RTk RHL-DAS)*. Jakarta: Watershed Forest and Land Rehabilitation (Rtk RHL-DAS).
- Kornejady, A., Ownegh, M., & Bahremand, A. (2017). Landslide susceptibility assessment using maximum entropy model with two different data sampling methods. *Catena*, *152*, 144-162.
- Kusumanegara, A., Kartono, A. P., & Prasetyo, L. B. (2017). Suruli habitat preferences in Mount Ciremai National Park. *Conservation Media*, *22*(1), 26-34.

- Leempoel, K., Duruz, S., Rochat, E., Widmer, I., Orozco-terWengel, P., & Joost, S. (2017). Simple rules for an efficient use of geographic information systems in molecular ecology. *Frontiers in Ecology and Evolution*, 5, 33.
- Li, Y., & Ding, C. (2016). Effects of sample size, sample accuracy and environmental variables on predictive performance of MaxEnt model. *Polish Journal of Ecology*, 64(3), 303-312.
- Lobo, J. M., Jiménez-Valverde, A., & Real, R. (2008). AUC: a misleading measure of the performance of predictive distribution models. *Global Ecology and Biogeography*, 17(2), 145-151.
- Magdalena, I., & Roziqin, A. (2021). Utilization of Sentinel-2A Image for Vegetation Density in Terms of Slope in Batam Island. *ABEC Indonesia*, 9, 811-827.
- Manshur, A., Kartono, A. P., & Masy'ud, B. (2015). Habitat characteristics of Javan Pangolin (*Manis javanica*) in Mount Halimun Salak National Park. *Conservation Media*, 20(1).
- Margareta, R. (2010). Spatial modeling of white nest swallow (*Collocalia fuciphaga*) habitat using GIS (Geographic Information System) in an effort to develop swallow nest cultivation in Central Java (Case Study of Grobogan Regency and Semarang Regency). *Saintekmol: Journal of Science and Technology*, 8(2).
- Massei, G., Coats, J., Lambert, M. S., Pietravalle, S., Gill, R., & Cowan, D. (2018). Camera traps and activity signs to estimate wild boar density and derive abundance indices. *Pest Management Science*, 74(4), 853-860.
- Matthiopoulos, J., Fieberg, J., Aarts, G., Beyer, H. L., Morales, J. M., & Haydon, D. T. (2015). Establishing the link between habitat selection and animal population dynamics. *Ecological Monographs*, 85(3), 413-436.
- McCarthy, J. L., Wibisono, H. T., McCarthy, K. P., Fuller, T. K., & Andayani, N. (2015). Assessing the distribution and habitat use of four felid species in Bukit Barisan Selatan National Park, Sumatra, Indonesia. *Global Ecology and Conservation*, 3, 210-221.
- Merow, C., Smith, M. J., & Silander Jr, J. A. (2013). A practical guide to MaxEnt for modeling species' distributions: what it does, and why inputs and settings matter. *Ecography*, 36(10), 1058-1069.
- Midgley, S., & Thomson, L. (2019). *Gliricidia sepium*. The IUCN Red List of Threatened Species 2019: E.T136055124A136055133. <https://doi.org/https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T136055124A136055133.en>. Accessed on December 27, 2024

- Mujtahidah, T., Hidayati, S., Jailani, A. Q., Sari, A. N., Aji, M. T., & Armando, E. (2023). Bioecology and Distribution of Dwarf Snakehead (*Channa limbata*, Cuvier 1831) Based on Geographic Information System in Progo River, Magelang, Central Java. *Journal of Aquaculture & Fish Health*, 12(3).
- Muryati, N. (2019). *Analysis of Rice Field Drought Levels Using Landsat 8 and Thermal Imagery (Case Study: Gading Rejo District, Pringsewu Regency)*. Sumatra Institute of Technology.
- Mustari, A. H., Djuanda, T. D., & Sihite, J. (2011). Potential of Large Mammals as Prey for Komodo Dragons (*Varanus komodoensis* Ouwens 1912) on Rinca Island, Komodo National Park, East Nusa Tenggara. *Conservation Media*, 16(1).
- Naimi, B., Hamm, N. A. S., Groen, T. A., Skidmore, A. K., & Toxopeus, A. G. (2014). Where is positional uncertainty a problem for species distribution modeling? *Ecography*, 37(2), 191-203.
- Norberg, A., Abrego, N., Blanchet, F. G., Adler, F. R., Anderson, B. J., Anttila, J., Araújo, M. B., Dallas, T., Dunson, D., & Elith, J. (2019). A comprehensive evaluation of predictive performance of 33 species distribution models at species and community levels. *Ecological Monographs*, 89(3), e01370.
- Nurdiansyah, A., & Novita, E. (2015). *Geographic Information System Application for Mapping Banteng Habitat Suitability*.
- Oxoli, D., Prestifilippo, G., & Bertocchi, D. (2017). Enabling spatial autocorrelation mapping in QGIS: The hotspot analysis Plugin. *GEAM. Geoingegneria Ambientale E Mineraria*, 151(2), 45-50.
- Palla, F., Le Bel, S., Chavernac, D., & Cornélis, D. (2016). *New technologies: mobile data collection system implications for wildlife management in Central Africa*.
- Peris, A., Closa-Sebastià, F., Marco, I., Serrano, E., & Casas-Díaz, E. (2019). Baiting improves wild boar population size estimates by camera trapping. *Mammalian Biology*, 98, 28-35.
- Perkins-Taylor, I. E., & Frey, J. K. (2020). Predicting the distribution of a rare chipmunk (*Neotamias quadrivittatus oscuraensis*): Comparing MaxEnt and occupancy models. *Journal of Mammalogy*, 101(4), 1035-1048.
- Phillips, S. J. (2005). A brief tutorial on Maxent. *AT&T Research*, 190(4), 231-259.
- Pramatana, F., Aini, Y., Rammang, N., Mau, Y. S., Arsa, I. G. B. A., & Mahmud, A. (2023). Predicting of Komodo dragon's potential prey habitat suitability using MaxEnt in Riung Nature Reserve, Flores, East Nusa Tenggara, Indonesia. *Biodiversity Journal of Biological Diversity*, 24(6).

- Pramatana, F., Hernowo, J. B., & Prasetyo, L. B. (2021). Effects of Human Factors in the Existence of Bali Starling (*Leucopsar rothschildi*) through Geographic Information System Approach in West Bali National Park and Nusa Penida Bali. *Conservation Media*, 26(2), 118-127.
- Pramatana, F., Hernowo, J. B., & Prasetyo, L. B. (2022). Population and Habitat Suitability Index Model of Bali Starling (*Leucopsar rothschildi*) in West Bali National Park. *Journal of Sylva Lestari*, 10(1), 26- 38.
- Purnomo, D. W., & Pudyatmoko, S. (2011). Habitat Characteristics of Banteng (*Bos javanicus* d'Alton, 1823) in Rowobendo Resort of Alas Purwo National Park. *Biota: Scientific Journal of Life Sciences*, 16-25.
- Purwandana, D., Ariefiandy, A., Imansyah, M. J., Rudiharto, H., Seno, A., Ciofi, C., Fordham, D. A., & Jessop, T. S. (2014). Demographic status of Komodo dragons populations in Komodo National Park. *Biological Conservation*, 171, 29-35.
- Putra, M. I. H., & Mustika, P. L. K. (2020). Incorporating in situ prey distribution into foraging habitat modeling for marine megafauna in the Solor waters of the Savu Sea, Indonesia. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30(12), 2384-2401.
- Rahman, D. A., Condro, A. A., & Giri, M. S. (2022). *Species Distribution Model: Maximum Entropy*. IPB Press.
- Rahmati, O., Pourghasemi, H. R., & Melesse, A. M. (2016). Application of GIS-based data driven random forest and maximum entropy models for groundwater potential mapping: a case study at Mehran Region, Iran. *Catena*, 137, 360-372.
- Rakuasa, H., Sihasale, D. A., & Latue, P. C. (2022). Land Cover Model in Watersheds of Ambon City in 2031: Case Study of Wai Batu Gantung, Wai Batu Gajah, Wai Tomu, Wai Batu Merah and Wai Ruhu Watersheds. *Journal of Soil and Land Resources*, 9(2), 473-486.
- Remya, K., Ramachandran, A., & Jayakumar, S. (2015). Predicting the current and future suitable habitat distribution of *Myristica dactyloides* Gaertn. using MaxEnt model in the Eastern Ghats, India. *Ecological Engineering*, 82, 184-188.
- Rohiyani, M., Setiawan, A., & Rustiati, E. L. (2014). Bird species diversity in pine forest and mixed forest of Muarasipongi, Mandailing Natal Regency, North Sumatra. *Sylva Lestari*, 2(2), 88-98.
- Rosminah, R., Ginting, M. S., Sari, S. P., Marimpan, L. S., Nabilah, R., Noviana, L., Nahas, A. E., Hasibuan, H. S., Heraningsih, S. F., & Pertiwi, N. (2024). *Ecology and Environmental Science*. Yayasan Kita Tulis.

- Rudiansyah, R., & Radhi, M. (2019). *Wildlife behavior in the bird class (aves)*.
- Saadudin, A. M., Hikmat, A., & Prasetyo, L. B. (2012). Habitat suitability mapping of *Rafflesia rochussenii* Teijsm. et Binn. in Tapos Resort of Gunung Gede Pangrango National Park. *Conservation Media*, 17(3).
- Sadipun, M. M., Jelantik, I. G. N., & Mullik, M. L. (2016). Nutrient Utilization in Abandoned Female Bali Cattle Fed Gamal Leaf Based Fermented Complementary Feed with Different Energy Levels. *JAS*, 1(4), 43-45.
- Safirda, F., Abdullah, A., Muhibbuddin, M., Huda, I., & Syafrianti, D. (2020). Analysis of Ardeidae Bird Feedin The Coastal Ecosysrtem of Johan Pahlawan Sub-District West Aceh Regency. *Biology Education: Scientific Journal of Biology Education*, 12(2), 93-98.
- Sandrawati, A., Setiawan, A., & Kesumah, G. (2016). Influence of slope class and land use on soil physical properties in Cirata Reservoir Buffer Area, Cipeundeuy District, West Bandung Regency. *Soilrens*, 14(1).
- Schütz, A. K., Louton, H., Fischer, M., Probst, C., Gethmann, J. M., Conraths, F. J., & Homeier-Bachmann, T. (2024). Automated Detection and Counting of Wild Boar in Camera Trap Images. *Animals*, 14(10), 1408.
- Shrestha, N. (2020). Detecting multicollinearity in regression analysis. *American Journal of Applied Mathematics and Statistics*, 8(2), 39-42.
- Sitepu, F., Selintung, M., & Harianto, T. (2017). Influence of rainfall intensity and slope on erosion with landslide potential. *Journal of Engineering Research*, 21(1), 23-27.
- Songchitrukksa, P., & Zeng, X. (2010). Getis-Ord spatial statistics to identify hot spots by using incident management data. *Transportation Research Record*, 2165(1), 42-51.
- Sudiana, D., & Diasmara, E. (2008). Vegetation index analysis using NOAA/AVHRR and TERRA/AQUA-MODIS satellite data. *Seminar on Intelligent Technology and Its Applications, 2008*, 423-428.
- Sukristiyanti, S., Hartono, H., & Suyono, S. (2010). Evaluation of Soil Erosion Potential Using Remote Sensing Technology and Geographic Information System in Upper Bodri Watershed. *Indonesian Geography Magazine*, 24(2), 142-156.
- Swets, J. A. (1988). Measuring the accuracy of diagnostic systems. *Science*, 240(4857), 1285-1293.
- Trainor, A. M., Schmitz, O. J., Ivan, J. S., & Shenk, T. M. (2014). Enhancing species distribution modeling by characterizing predator-prey interactions. *Ecological Applications*, 24(1), 204-216.

- UNEP-WCMC (Comps.). (2024). *The Checklist of CITES Species Website*. CITES Secretariat, Geneva, Switzerland. Compiled by UNEP-WCMC, Cambridge, UK. <http://checklist.cites.org>. Accessed on December 27, 2024
- Wahyudi, V. O. (2023). *Abundance of Mesofauna and Soil Macrofauna in Cikaniki Resort of Mount Halimun Salak National Park*.
- Waltari, E., Schroeder, R., McDonald, K., Anderson, R. P., & Carnaval, A. (2014). Bioclimatic variables derived from remote sensing: Assessment and application for species distribution modeling. *Methods in Ecology and Evolution*, 5(10), 1033-1042.
- Wang, G., Wang, C., Guo, Z., Dai, L., Wu, Y., Liu, H., Li, Y., Chen, H., Zhang, Y., & Zhao, Y. (2020). Integrating Maxent model and landscape ecology theory for studying spatiotemporal dynamics of habitat: Suggestions for conservation of endangered Red-crowned crane. *Ecological Indicators*, 116, 106472.
- Wasis, B., Winata, B., & Safaaturrohmah, N. U. (2023). Soil Fauna Abundance and its Relationship with Site Characteristics in Submontane Vegetation in Gunung Gede Pangrango National Park. *Journal of Tropical Silviculture*, 14(03), 201-208.
- Wegge, P., Odden, M., Pokharel, C. P., & Storaas, T. (2009). Predator-prey relationships and responses of ungulates and their predators to the establishment of protected areas: a case study of tigers, leopards and their prey in Bardia National Park, Nepal. *Biological Conservation*, 142(1), 189-202.
- WFO. (2024a). *Gliricidia sepium (Jacq.) Kunth*. Published on the Internet. <http://www.worldfloraonline.org/taxon/wfo-0000178022>. Accessed on December 27, 2024
- WFO. (2024b). *Spondias pinnata (L.f.) Kurz*. Published on the Internet. <http://www.worldfloraonline.org/taxon/wfo-0001049363>. Accessed on December 27, 2024
- Wibowo, A. (2021). Camera trap based niche partitioning model of medium size ungulates and its implications on tiger's prey availability in SE Asian rainforest. *BioRxiv*, 2021-2028.
- Widodo, W., Darmawan, A., Wulandari, C., & Dewi, B. S. (2019). Daily Range Preferences of Sumatran Elephant (*Elephas maximus sumatranus*) in Bukit Barisan Selatan National Park. *Journal of Sylva Lestari*, 7(Sept), 309-320.
- Wolf, C., & Ripple, W. J. (2016). Prey depletion as a threat to the world's large carnivores. *Royal Society Open Science*, 3(8), 160252.

Zepner, L., Karrasch, P., Wiemann, F., & Bernard, L. (2021). ClimateCharts. net-an interactive climate analysis web platform. *International Journal of Digital Earth*, 14(3), 338-356.

