Mammalian Diversity, Abundance and Habitat Preferences in Godebe National Park, Amhara Regional State, Ethiopia

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Research Article

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Abstract

In Ethiopia, the number of protected areas is increasing mainly to conserve the biodiversity resources facing anthropogenic threats and thereby mitigate the ever-changing temperature change and its effects. The study was conducted in Godebe Park with the target of assessing the variety, distribution, abundance, and habitat preferences of untamed mammalian species within the park. A stratified sampling technique was wont to collect data using line transect across four major habitat types. The information were analysed employing a speed sheet and R software version 4.2. Fifteen mammalian species were identified by direct sighting and indirect indicators under five orders and ten families. Carnivora was the family richest, whereas Bovidae was the species’ richest family. Combretum - Terminalia Woodland was the species richest with the best diversity ($H' = 1.98$) and evenness ($J = 0.73$). Savana was the poorest in species richness whereas the smallest amount of diversity and evenness were recorded within the Riverine habitat ($H' = 1.15$) and ($J = 0.42$). The best similarity in species occurrences was between Combretum - Terminalia Woodland and Riverine habitats ($S = 0.75$) and therefore the least similarity was between Combretum - Terminalia Woodland and Savana (0.52). *Cercopithecus aethiops* were the foremost abundant (relative abundance = 46.22%) followed by *Hystrix cristata* (17.78%) whereas the smallest amount abundant was *Erythrocebus patas* (0.44%). The National park is endowed with moderate wild mammalian diversity distributed all told major habitat types. The foremost preferable habitat type was the riverine forest with the foremost abundant of *Cercopithecus aethiops*. The National park is surrounded by resettlements and commercial farming harbouring ecological threats. A way of ownership should be developed by stakeholders and officials so the threats to the park should be removed.

Introduction

Due to its wide range of altitudinal variation—110 meters below sea level at Dallol to 4543 meters above sea level at Simien Mountains National Park—Ethiopia is home to a diverse array of species. The nation's varied environments support a variety of life because of the elevational range difference [1 - 4]. Despite the fact that the growing human population and its associated requirements are causes of biodiversity loss [5], protected areas have been established and are being preserved, which has led to an increase in newly reported species. Since the creation of the first park (Awash) in 1966 until the present, there have been 27 national parks and 73 protected areas under different management regimes [6]. Endemism and the number of mammalian species increased from 277 [7] to 280 [8] with 31 endemics and 311 [9] with 55 endemics, as well as the number of protected areas, which increased from 9 to 27. Protected areas primarily provide two important functions: enjoyment and, consequently, economic growth from ecotourism, biodiversity conservation, and climate change mitigation [4, 10].

Mammals are ecosystem engineers who have the ability to alter ecosystem architecture and functions as well as boost habitat variety and biodiversity [11]. Mammals are numerous and diversified; they are thought to be indicators of the health of the ecosystem and the suitability of the habitat, and they offer a safety net for other species [12 - 14]. The majority of the animals and birds considered as potential
umbrella species are large mammals, but invertebrates are now receiving more attention. Due to their proximity to human populations, conspicuity, and need for a vast home range, large mammals deserve special consideration in conservation management since they are undergoing deterioration (double the hazard that small mammals face) [15, 16].

Identification of the natural resources and their conservation status would facilitate the implementation of conservation strategies in an effective manner [17]. When developing or enhancing management methods for protected areas, managers and specialists rely heavily on the abundance and distribution of the mammalian species. The ability to adapt to the climate, the availability of food, and predation all affect the habitat preferences of mammalian species, which vary among species, in space and time (season). To fully comprehend the variety and distribution in various environments, long-term study or monitoring procedures should be developed and put into practice [14].

A taxonomy of Ethiopia's vegetation zones refers to the research region as the Combretum-Terminalia Woodland Ecosystem [1]. The primary dangers to this kind of vegetation are wildfire, invasion, unrestricted grazing, and agricultural investment [1]. Godebe National Park, the site of this investigation, is not an exception and has the same issues.

One of the newest protected areas created to preserve the nation's natural riches and lessen the consequences of global climate change is Godebe National Park. There hasn't been any research on mammalian species done yet because this national park is young. The local government and the organizations in charge of managing the park had a pressing need for scientific knowledge about the classification, abundance, and ecological preferences of mammalian species. The findings of the study will therefore at the very least serve as a wake-up call for future research projects and will strengthen the conservation and oversight activities of the national park.

Material And Methods

Study area description

The "Godebe" national park is located in the Amhara Region's West Armachiho District, in the West Gondar Administrative Zone (Fig. 01). Geographically, it is situated between the latitudes of 13°01'20.51" and 13°02'18.10" N and the longitudes of 36°01'56.73" and 36°02'04.63" E, with an altitude between 718m and 1229m above sea level. It has a wooded forest area that is 18,987 acres large. Under the 'Kolla' agro-ecological zones is the woodland forest known as 'Godebe. The region receives 600-1100mm of yearly rainfall from June through August and experiences year-round temperatures between 38 and 48°C. According to [18], classification of Ethiopia's vegetation, the forest communities in Godebe National Park fall under the Combretum-Terminalia woodland and wooded grassland forest categories. The geography of the Godebe woodland forest is 54.52% plain, 31.87% sloppy, and 13.61% gorgy fields. According to data from the Amhara area culture, tourism, and parks development office. Eutric nitisols, Chromic vertisols, and Orthic luvisols are the three main soil types in the region.
According to the West Armachiho District office of culture and tourism, in the past few decades, the park was the home to big mammals like Elephants, lions, and Greater kudu. But, because of serious anthropogenic pressures, it is difficult to see such wildlife simply.

**Design and Data collection methods**

Because animal habitats are heterogeneous, it was necessary to stratify the research region based on vegetation types during the initial survey. There were four different strata: the Combretum-Terminalia Woodland, the Acacia Woodland, the Riverine Forest, and the Savanna.

By laying sample transects over the four stratified habitat categories, the stratified random sampling approach was utilized to gather data. According to the amount of each habitat type's area covered (Combretum - Terminalia Woodland = 8, Acacia Woodland = 4, Riverine Forest = 5, Savanna = 2), transect lines were laid up in proportion to that amount. Based on the geography and ecosystems, a total of 19 transect lines with lengths ranging from 1.5 km to 6 km were established. The study area's transect lines were measured and located using a handheld GPS (Garmin 60).

Mammal species were identified through direct observation and the use of markers along the transect lines. At locations where mammals were observed, GPS data were taken. In the field, mammals were recorded using their regional names, and afterwards identified using other sources [7, 9, 19–21].

**Data analysis**

Data were gathered, encoded, and then entered into MS Excel. The data were compiled into tables and graphs. Shannon-Wiener indices were used to examine the variety and evenness of mammalian species.

\[
H' = -\sum_{i=1}^{S} p_i \ln p_i
\]

Formula for the Shannon-Wiener index:

Where \( p_i \) = the percentage of individuals or the abundance of the ith species expressed as a fraction of overall abundance and \( \ln \) = log base n. \( H' \) = Shannon diversity index, \( S \) = the number of species. The Shannon-Wiener index value typically ranges from 1.5 to 3.5, with a few unusual occurrences surpassing 4.5. [22]. The evenness was determined using the formula \( J = H'/H'_{max} \), where \( J \) = evenness, \( H'_{max} = \ln(S) \), and \( S \) is the total number of species. The range of values for \( J \) is 0 to 1, with a greater value indicating a more evenly distributed species. With the help of the Sorensen similarity index, which was calculated using the formula \( S_s = 2a / (2a + b + c) \), where \( S_s \) is Sorensen's coefficient (index), \( a \) is the number of species shared between habitats, \( b \) is the number of species found in the first habitat, and \( c \) is the number of species found in the second habitat, the similarity of the mammalian species composition was evaluated. The formula for calculating relative abundance is: \( R.\text{ abundance} = n/N*100 \), where \( n \) is the total number of individuals of a certain species and \( N \) is the number of individuals that have been documented. The analysis was conducted using the R program version 4.2.
Results And Discussions

Mammalian Species Composition of Godebe National Park

Under five orders and ten families, fifteen mammalian species were identified (Table 01). The richest family belonged to the Order Carnivora, while the Bovidae and Cercopithecidae species families had the most species, with four and three species each respectively. The two orders (Carnivora and Artiodactyla) contain the maximum number of species, according to this conclusion, which is in line with those of [23, 24]. According to [25], the family Bovidae contained the greatest number of mammalian species and the order Carnivora was represented by the greatest number of families. Possible explanations for this resemblance include habitat or environmental parallels.

Table 01
Mammalian species composition and conservation status of the national park

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific name</th>
<th>Common name</th>
<th>Conservation status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artiodactyla</td>
<td>Bovidae</td>
<td>Sylvicapra grimmia</td>
<td>Common-duiker</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tragelaphus strepsoceros</td>
<td>Greater kudu</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ourebia ourebi</td>
<td>Oribi</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Traglaphus scriptus</td>
<td>Common-bushbuck</td>
<td>LC</td>
</tr>
<tr>
<td>Suidae</td>
<td></td>
<td>Phacochoerus africanus</td>
<td>Warthog</td>
<td>LC</td>
</tr>
<tr>
<td>Carnivora</td>
<td>Canidae</td>
<td>Canis aureus</td>
<td>Common jacal</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td>Viverridae</td>
<td>Civettictis civetta</td>
<td>African civet</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td>Felidae</td>
<td>Panthera pardus</td>
<td>Leopard</td>
<td>NT</td>
</tr>
<tr>
<td></td>
<td>Hyaenidae</td>
<td>Crocuta crocuta</td>
<td>Spotted Hyena</td>
<td>LC</td>
</tr>
<tr>
<td>Primate</td>
<td>Cercopithecidae</td>
<td>Cercopithecus aethiops</td>
<td>Vervet monkey</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Erythrocebus patas</td>
<td>Patas monkey</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Papio anubis</td>
<td>Anubis baboon</td>
<td>LC</td>
</tr>
<tr>
<td>Rodentia</td>
<td>Histicidae</td>
<td>Hystrix cristata</td>
<td>Porcupine</td>
<td>LC</td>
</tr>
<tr>
<td></td>
<td>Sciuridae</td>
<td>Funisciurus spp.</td>
<td>Squirrel</td>
<td>-</td>
</tr>
<tr>
<td>Tubulidentata</td>
<td>Orycteropodidae</td>
<td>Orycteropus afer</td>
<td>Aardvark</td>
<td>LC</td>
</tr>
</tbody>
</table>

LC = least concerned, NT = near threatened
A single mammalian species covered the majority of the families. Before the national park was established, there were 21 mammals, according to the baseline assessment study produced by the Amhara national regional state office of culture, tourism, and parks development [26]. The assessment report and the research’s findings differed in six cases of mammals. There are two possible causes for this. First, due to safety and road accessibility issues, data collection for this study was done during a dry season. Mammals may leave the national park if the rainy season is missed and go to nearby ecosystems outside of it, such as Sinnar Abdereg forest, which is being protected using the participatory forest management (PFM) method with the aid of non-governmental groups. Two: Not all of the locations where the baseline survey was carried out might not be incorporated into the National Park when it is constituted.

Diversity And Distribution Of Mammalian Species In Godebe National Park

The Combretum-Terminalia Woodland had the highest diversity ($H' = 1.98$) and evenness ($J = 0.73$) among the four habitat types, as shown in Table 02 below, making it the species-richest habitat type. The least variety and evenness were found in the Riverine ($H' = 1.15$) and ($J = 0.42$), whereas Savana had the lowest species richness. The national park had a decent diversity of mammals. Less variance in the elevation range is presumably to blame for this (data were recorded from 767 to 850 meters above sea level).

<table>
<thead>
<tr>
<th>Habitat types</th>
<th>Number of species</th>
<th>Diversity ($H'$)</th>
<th>Evenness ($J$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combretum - Terminalia Woodland</td>
<td>14</td>
<td>1.98</td>
<td>0.73</td>
</tr>
<tr>
<td>Acacia Woodland</td>
<td>7</td>
<td>1.79</td>
<td>0.66</td>
</tr>
<tr>
<td>Riverine</td>
<td>10</td>
<td>1.15</td>
<td>0.42</td>
</tr>
<tr>
<td>Savana</td>
<td>4</td>
<td>1.55</td>
<td>0.57</td>
</tr>
</tbody>
</table>

The national park has 225 species altogether, of which Combretum - Terminalia Woodland, Acacia Woodland, Riverine forest, and Savana include 59, 22, 137, and 7 species, respectively. Ten of the fifteen mammalian species were found in riverine environments, while 14 were found in Combretum-Terminalia Woodland. This was due to the fact that the Combretum-Terminalia Woodland habitat type predominates in the national park as opposed to the riverine, which was likely because the data was taken during the dry season when water shortage was more severe. According to [27], the distribution of mammalian species varied according to the season, with the riverine habitat having the maximum number of species and woodland and grassland in the dry season. The total number of mammalian species in [28] during the wet and dry seasons was 2298 and 1350, respectively.
The Combretum - Terminalia Woodland and Riverine habitats had the most similarity in species occurrences ($S = 0.75$), and the Combretum - Terminalia Woodland and Savana had the lowest similarity ($S = 0.52$) (Table 03). The difference in the number of species between the two environments may be the cause of this.

![Table 03](image)

### The Abundance Of Mammalian Species In Godebe National Park

The Vervet monkey (*Cercopithecus aethiops*), followed by the Porcupine (*Hystrix cristata*), was the most prevalent species type of mammal in the national park (46.22%). However, the Patas monkey, *Erythrocebus patas*, was the least frequent mammal in the national park (0.44%), and it was followed by carnivore species including the leopard, spotted hyena, and common jackal (Table 04). This is most likely a result of the nomadic lifestyle present there, which compels armed shepherds to kill carnivores in order to protect their domesticated livestock. The results of [24] who found that the order Primates was the most numerous, were identical to those of this study.
Vervet monkeys and porcupines were the two mammals that were most prevalent in the national park. This is consistent with the findings of [29], who discovered that Vervet monkeys were the most numerous, followed by Colobus baboons.

### The Mammalian Species Habitat Preference In The National Park

The second most common mammalian species (*Hystrix cristata*) was primarily restricted to this environment, despite the fact that Combretum - Terminalia Woodland was preferred by practically all mammalian species. The most numerous mammal order, *Cercopithecus aethiops*, a species kind of primate, loved the riverine habitat (Fig. 02). This might be because most wild mammal species require washing and the area along rivers is suitable for primates as well as because there is a lack of water and most of them need it. Savana was the least preferred habitat type. This could be as a result of increased

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat types</th>
<th>Total</th>
<th>R. abundance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CTW</td>
<td>AW</td>
<td>R</td>
</tr>
<tr>
<td><em>Sylvicapra grimmia</em></td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><em>Tragelaphus scriptus</em></td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Tragelaphus strepsoceros</em></td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><em>Ourebia ourebi</em></td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><em>Phacochoerus africanus</em></td>
<td>6</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><em>Canis aureus</em></td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><em>Civettictis civetta</em></td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><em>Panthera pardus</em></td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><em>Crocuta crocuta</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Cercopithecus aethiops</em></td>
<td>8</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td><em>Erythrocebus patas</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Papio anubis</em></td>
<td>2</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td><em>Hystrix cristata</em></td>
<td>25</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td><em>Funisciurus spp.</em></td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><em>Orycteropus afer</em></td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>59</td>
<td>22</td>
<td>135</td>
</tr>
</tbody>
</table>
exposure, difficulties with wild forest fires that make people vulnerable to attack, and a lack of food for browsers. Similar investigations carried out in Borena-Saynt National Park and Dati Wolel National Park revealed that the riverine environment is the second most abundant habitat after the forest and Erica woodland, respectively [25, 30]. It is likely that the riverine forests in the aforementioned cases are not situated in lowlands where there is a severe lack of water, as was the situation with our research location.

**Conservation Threats Of The National Park**

In the national park, where we were gathering information on mammalian species, we noticed a variety of practices that posed a threat to the environment. Among them were settlement, unrestricted grazing and movement of domestic animals, especially dogs, agricultural investment, deforestation and illicit wood collection for various uses, as well as the gathering of wild honey. This demonstrated that the national park’s management lacks a reliable surveillance and law enforcement apparatus. The absence of outposts in and around the national park, a lack of field equipment, especially cars, and a general lack of funding for effective national park management were the causes of this.

**Conclusion**

15 different mammalian species, 10 families, and 5 different orders, totaling 225 distinct species, were identified. These species were dispersed over 4 different habitat strata, with riverine habitats having the highest species abundance. Order The Carnivora family had the most species, with each family being represented by a single species, whereas the Bovidae family had the most species in the Artiodactyla order. A robust ecology with a prey-predator dynamic is present. The two primate species, Cercopithecus aethiops and Erythrocebus patas, as well as carnivore species, were the most and least common mammals in the national park, respectively. Rats were not recorded since they need special methods. The park had a moderate diversity of mammalian species spread over four main habitat types, with the Combretum-Terminalia and riverine habitats having the highest habitat preferences. During the dry season, while the data were being collected, there was a lack of water for the fauna.

The national park was recently created and has the ability to conserve biodiversity while being vulnerable to several environmental risks that could degrade the quality of the ecosystem. Threats to the park’s resources include settlement, free grazing, agricultural investment, wildfire, fuelwood gathering, and deforestation. The park is still inhabited by nomadic people and is used for livestock grazing. In addition to this, hunting is also done. On the other side, one of the hazards to wildlife is disease transmission. Along with the concern of the regional park management authority, all of these issues call for a sense of ownership by the stakeholders and higher officials.

Since the national park is new, it is open to many different types of research, including those on the diversity and abundance of rodents, evaluations of mammalian species or the quality of wildlife habitat, identification of birds and associations between their habitats, challenges, opportunities, and prospects for the national park, threat priorities, threat management strategies, and human-wildlife conflicts, among
others. In order to allow wildlife access to water sources, water points should be located and strengthened. A request for several projects to build outposts and manage management tasks is advised.

Declarations

Ethics and consent to participate

Not Applicable

Consent for publication:

Not Applicable

Availability of data and materials:

All data generated or analysed during this study are included in this published article [Godebe Data Wildlife]

Competing interest

The authors declare that there is no conflict of interest

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The field data collection was sponsored by the University of Gondar

Authors’ contribution

Getahun Tassew Melese: led the data collection process, analyse the data and wrote the manuscript

Muhabaw Taju: wrote the proposal, edit the manuscript

Acknowledgment

We would like to thank the University of Gondar to support this work and the Godebe national park staff

References


**Figures**
Figure 1

Study area location
Figure 2

habitat preferences of mammals in the national park

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- GodebeDataWildlife.xlsx