Anthropocene Science (2023) 2:71–80
https://doi.org/10.1007/s44177-023-00050-8

ORIGINAL ARTICLE

Composition, Relative Abundance, and Diversity of Medium and Large Mammals in Tirba Lake Awi Zone, Ethiopia

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Received: 3 May 2022 / Revised: 28 March 2023 / Accepted: 30 March 2023 / Published online: 12 April 2023
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Abstract

Understanding the diversity, abundance, and habitat preferences of the fauna is essential for determining the status and suggesting effective conservation actions. A study was conducted in Tirba Lake Awi zone, Ethiopia, to evaluate the wealth, diversity, and composition of the medium and large mammal communities. It is also important to consider how these parameters differ from one habitat type to another and from one season to another. Researchers collected data using a transect method. As a result of the study, 330 individuals and 11 different species of mammals were identified across four orders and six families. The result shows that globally threatened species like the Leopard (Panthera pardus) were included. In terms of seasonal variation in wild mammal abundance, the difference was statistically significant ($P \leq 0.001$). A total of 330 ± 26.2 wild mammals were recorded, of which 180 ± 11 (55%) were observed during the wet season and 150 ± 6.5 (45%) during the dry season. Olive Baboons (Papio Anubis) accounted for 30.61% of the 11 mammalian species with 101 individuals, followed by Vervet monkeys (Cercopithecus aethiops) with 16.67% and 55 individuals, respectively. Mammalian populations were statistically significant among habitat types, with the highest similarity index (SI = 0.8) observed between open forests and shrubland, followed by shrubland adjacent to Cliff sites (SI = 0.7). The shrubland habitat type ($H' = 1$) supports the greatest diversity of mammalian species, followed by the open forest habitat type ($H' = 0.8$). In terms of diversity among habitat types, dense forests had the lowest H' value (0.5). Based on the species similarity index, open forest and shrubland shared the most similarity of mammalian species (SI = 0.8), while shrubland and cliff sites hosted the least similar species (SI = 0.7). To conclude, our findings contribute significantly to the conservation of Ethiopia's mammal populations. As a result of our findings, managers of the area will be able to make effective conservation decisions, and researchers wishing to conduct related studies will be able to use the findings as a baseline for their research. Studies in the study area have revealed that anthropogenic factors interact with the mammals in the area, putting them at risk. It is imperative that these animals are protected through an urgent conservation program.

Keywords Biodiversity · Animals · Spread · Profusion · Species diversity · Tirba Lake · Ethiopia

1 Background

The research on large wild mammals is one phase of a continuing effort to document and describe the richness and distribution of Ethiopian mammals in remote and less accessible ecosystems (Girma and Worku 2020). They are able to colonize a variety of habitat types due to their diverse morphological, physiological, and behavioral adaptations. In terms of global distribution, they are among the most common species. In spite of this, human activities have changed the composition of mammal assemblages across vast areas (Li et al. 2021; Rodríguez 2021). Compared to smaller, commensal species, anthropogenic development and activities had either negligible or favorable effects on large, endangered species (Shamoon et al. 2018). To determine the status and suggest effective conservation measures, it is essential to understand the fauna's diversity, abundance, and habitat preferences (Gonfa et al. 2015). With a thorough faunal diversity inventory, including all vertebrates in all seasons,

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and tight park management, the ecosystem will be capable of supporting diverse biodiversity components (Gonfa et al. 2015). "The region's with high vegetation coverage against other ecosystems that would provide ample food, cover and space to attract large numbers of mammalian species to live in" (Bakala and Mekonen 2021). Habitats with greater area tend to contain higher number of species. "The medium and large size mammals to include all species with a body mass of greater than 1 kg, thus excluding all relatively small, terrestrial mammals" (Mercês et al. 2020). For conservation efforts to succeed, mammalian species must exist to preserve their residual populations (Beca et al. 2017). In forest ecosystems, large and medium-sized mammals are crucial for managing prey populations, spreading seeds, and interacting with predators (Bogoni et al. 2017; Botelho et al. 2012). Demand for bush-meat and other animal goods will increase strain on already reduced mammal communities as the human population continues to rise and spread (Dobbins et al. 2020; Bisi et al. 2019). One of the main causes of biodiversity loss is thought to be the conversion of natural habitats towards agricultural land use (Drouilly et al. 2018; Ishige et al. 2017). Given the unprecedented threats to biodiversity posed by anthropogenic disturbance, knowledge of the occurrences of species and communities enables an efficient and quick method to evaluate the status and susceptibility of mammals (Cavada et al. 2019; Woodgate et al. 2018). Understanding the diversity, abundance, and habitat preferences of the fauna is essential for determining the status and suggesting effective conservation actions (Rabira et al. 2015). The introduction of large and medium-sized mammals in this work serves as a springboard for the expansion of ecological inquiry into the consequences of habitat loss and fragmentation on the mammal community in the Tirba Lake region. In the Tirba lake, there is no any scientific study about large and medium mammals. Therefore the present study aims to the composition, relative abundance, and diversity of medium and large mammals in Tirba Lake Awi Zone, Ethiopia. This study also provides as a baseline for researchers planning similar ecological studies and for managers of the area to make successful conservation decisions.

2 Materials and Methods

2.1 Study Area Description

The study area is found in the Awi zone, the Amhara region of Ethiopia. The administrative center of the Awi zone is Injibara town. Agew Awi is one of the zones in the Amhara Region of Ethiopia. It is named for the Awi sub-group of the Agaw people, some of whom live in this zone. Agew Awi zone is bordered on the west by Benishangul-Gumuz Region, on the north by Semien Gondar zone, and on the east by Mirab Gojjam. According to Awi zone department of agriculture, 2018 report, most part of Awi zone is Woyena Dega (72%) followed by Dega (17%) and Kolla (11%). The area ranges from 700 to 2900 m.asl in altitude and the area having better annual rainfall distribution (800 to 2700 mm/year) in Amhara region (Kassaye et al. 2022). The temperature of the area ranges from 15 to 24 oC. From the total area of zone (8,935,520 ha) of land 297,133 ha (33.25%) is used for farm practices. However, most of the area in Awi zone 34.02% (76,554 ha plantation, 277,842 ha natural forest) covered with forest area. Range land and grazing land covers 24.3% (217,138 ha) area of land from total area and other land uses like infrastructure and settlement covers 8.38% (74,853 ha) area land (Kassaye et al. 2022; Derebe et al. 2022). The plant species like *Acacia decurrens, Juniperus procera, Cupressus lusitanica, Pinus radiata,* and *Eucalyptus globulus* were some of the frequently observed plant species in the study area. The area is also home to a variety of wild animals' that include amphibians, reptiles, birds, and mammals. *Papio anubis, Crocuta crocuta, Canis aureus, Panthera pardus, Felisserval, Sus scrosa* and *Colobus guereza,* are some of the frequently observed animals in the study areas. Like in every other community in the nation's highlands, farming and livestock raising are the main sources of income. Tirba Lake is found in Ankasha woredas in the Awi zone. It is geographically located between 10˚49′30" N to 11˚50′ 15" N and 36˚ 50′ 15"E to 36˚ 51′ 15"E (Fig. 1).

2.2 Methodology

Prior to the real study, a pilot survey was carried out to collect broad details via direct observation and interview regarding the forest area, accessibility, and animal type present in the study area. Setting a baseline for a species' long-term monitoring at a specific place requires an understanding of its range, abundance, and habit needs (de Jong et al. 2015). Therefore this study were collected in both the rain (we season) and dry seasons. December through April was regarded as the dry season and May through November as the rainy season, respectively, based on the area's rainfall distribution.

2.3 Study Structure and Data Gathering Strategy

Based on land cover characteristics, satellite pictures, and a preliminary survey, the area was stratified into homogeneous habitat types for this study. These habitat categories included cliff location, open forest, deep forest, and shrubland. In regions with uniform vegetation that were representational of each habitat type, line transects were routinely built. Data collection took place in the four sampled habitats using the line transect survey method (Gonfa et al. 2015;

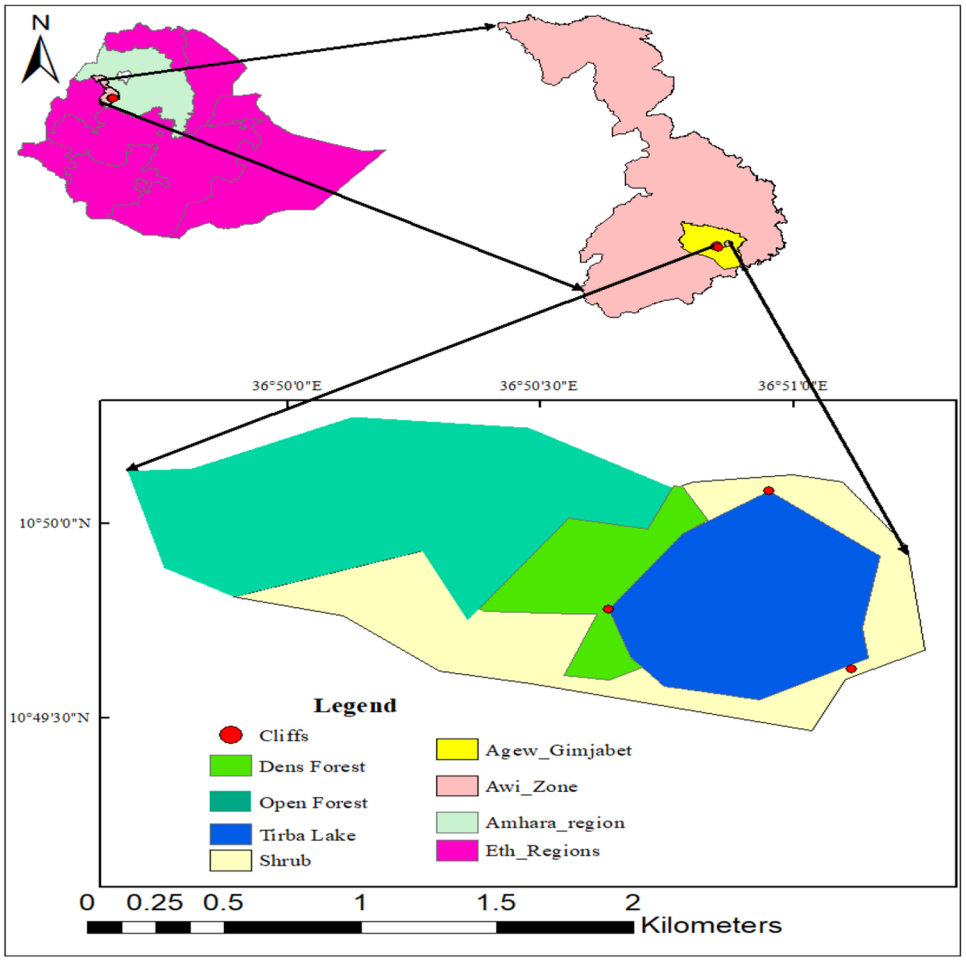

Fig. 1 The research area's map

Diriba et al. 2020). Along the line transect, direct observations were made, softly observing up to a distance of 100 m on either side (Diriba et al. 2020). To reduce animal disturbance caused by odours, the transect was oriented in the opposite direction from the wind. Thirty points were taken in Tirba Lake along eight transect lines used in the study. Depending on the scale of each habitat, different numbers of transects were used: at Tirba Lake, there were 2 transects for the dense forest, 3 for the open forest, and 3 for the shrub lands. Transect sizes varied according to habitat type: the longest measured 250 m in the open forest, while the shortest measured 100 m in the dense forest. There are 8 points on dense forest transects, 12 points on open forest transects, and 10 points on shrub transects, depending on habitat size and type. A line transect cannot be drawn in the cliff, however, point counting was used in caves beneath it. In the cliffs, one point was counted in each cliff, there were three cliffs. According to the area covered by each habitat, 40 transect lines were built, including 18 for wetland, 12 for woodland, 7 for riverine, and 6 for grassland habitats (Gonfa et al. 2015). Each transect's beginning and ending points were GPS tracked. Direct observations were used to identify animals and count their numbers, assisted by binoculars and mammal identification guides (Diriba et al. 2020). Fecal droppings, feed markings, foot prints, calls, and other indirect evidences were also documented in addition to direct observation (Rocha et al. 2019). To survey mammals, both direct and indirect methods can be used (Lyra-jorge et al. 2008). However, because the species identified from the data were subsets of the species seen during the normal survey, they were not included in the data analysis (Sutherland 2006). Each point was counted six times, three times during the wet season and three times during the dry season. Throughout the study period, four visits to each transect were made (Diriba et al. 2020). When observing an animal in the wild, the animal's English, native, and scientific names have been recorded. Date, time, habitat type, species name, number of individuals for each species, and GPS location are the data that were recorded. Two people were allocated to each transect and the transects were visited twice in a single day. Surveys were conducted between 6:00 and 10:00 a.m. and between 15:00 and 18:00 p.m., when it is believed that most animals are most active (Gonfa et al. 2015). To prevent competition, the activity patterns show

a temporal partition of the species that coexist in the same area (Oliveira et al. 2019). A prepared datasheet was used to record all of the animal species that were seen. Both the locals and a field reference book were used to identify the species of mammals. Using simultaneous counting and thorough observation of the feeding and sleeping locations of animals, especially in the cliffs, double-counting of the same species or individual animals at a time during the animal survey was prevented. To gather precise data, knowledgeable researchers with experience working with wild animals were recruited. Prior to undertaking animal counting and identifications, all observers got introductory training on how to use the methodology and utilization of field supplies and tools. Body weight was a criterion employed in the study to divide participants into medium-sized and large-sized groups. As a result, mammals weighing between 2 and 7 kg were classified as medium size, and everything above that was considered giant (Gonfa et al. 2015).

2.4 Calculation of Species Diversity

The Shannon diversity index was calculated using the formula below.

$$H' = -\sum pi * \ln(pi) \quad (1)$$

Pi is calculated as ni/N, where ni is the percentage of the total population of the ith species and $N = -\sum$ni, and H' is the Shannon–wiener index. This lessens the consequences of the order-of-magnitude gap in bird numbers between species using percent rather than absolute abundance estimates. This index provides a measure of `evenness' in the proportion of each species occurring within squares.

$$J' = H'/ln(S) \quad (2)$$

where J' is the Evenness index, H' is the Shannon–wiener index and used formula one and S is species richness.

The similarity among and between the habitats concerning the composition of species was computed using Sorenson's similarity index (SI):

$$(SI) = C2/S1 + S2 \quad (3)$$

S1 is the total number of species found in habitat 1, S2 is the total number of species found in habitat 2, and C is the number of species shared between the two habitats.

$$\text{Relative abundance (RA)}\,(\%) = n/N \times 100 \quad (4)$$

where N is the total number of individuals in the species and *n* is the number of individuals of the particular species that have been counted.

2.5 Data Analysis

During the study period, a table with a summary of all the data by season and habitat type was created. The Shannon–Wiener Diversity Index was used to calculate the distribution, abundance, and evenness of species between the wet and dry seasons as well as among different types of habitat, and SPSS version 20 was used to analyze the data. Excel 2016 was used to generate the relative abundance and species diversity index using prepared formulas. R studio also used for make graphs.

3 Results

3.1 Species Composition

11 mammalian species and 330 individuals were counted throughout this study. There are four orders and six families of those mammals (Table 1). Carnivora and Artiodactyla had two families in each and four species in Carnivora and three species in Artiodactyla. Carnivora was the largest order that included 2 families with 4 species. The more mammalian

Table 1 Animal species found in the Tirba Lake Awi zone, Ethiopia

Order	Family	Commen name	Sc. name	Local name
Carnivora	Felidae	Leopard	*Panthera pardus*	Neber
		Serval cat	*Felisserval*	Awurie dimet
	Hyaenidae	Spotted hyaena	*Crocuta crocuta*	Jib
		Commen jackal	*Canis aureus*	Qebero
Artidactyla	Bovidae	Bushbuck	*Traglaphus scriptus*	Dikula
	Suidae	Warthog	*Phacochoerus africanus*	Kerkero
		Wild pig	*Sus scrosa*	Yedur Asama
Primate	Cercopitheci	Vervet monky	*Cercopithecus aethiops*	Tota
		Colobus monky	*Colobus guereza*	Gureza
		Olive baboon	*Papio anubis*	Jinjero
Rodentia	Hystricidae	Porcupine	*Cercopithecus*	Jart

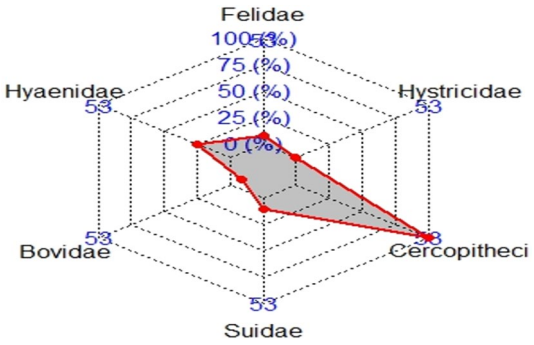

Fig. 2 Numbers of species among family in percents

population was recorded in the order of Primate, only one family, Cercopitheci (Three specie, 53%, 176 individuals), followed by Hyaenidae (18%, 60 individuals), Suidae (11%, 34 individuals), and Felidae (10%, 32 individuals); each with two species. The remaining families, Hystricidae (6%, 20 individuals) and Bovidae (2%, 8 individuals) were represented by single species (Fig. 2). The species composition of the wild mammalian population varies seasonally, according to observations (Fig. 3). The average numbers of animal species abundance among different habitat types with seasons were also observed (Table 2). There was a statistically significant difference in the mean seasonal variation in

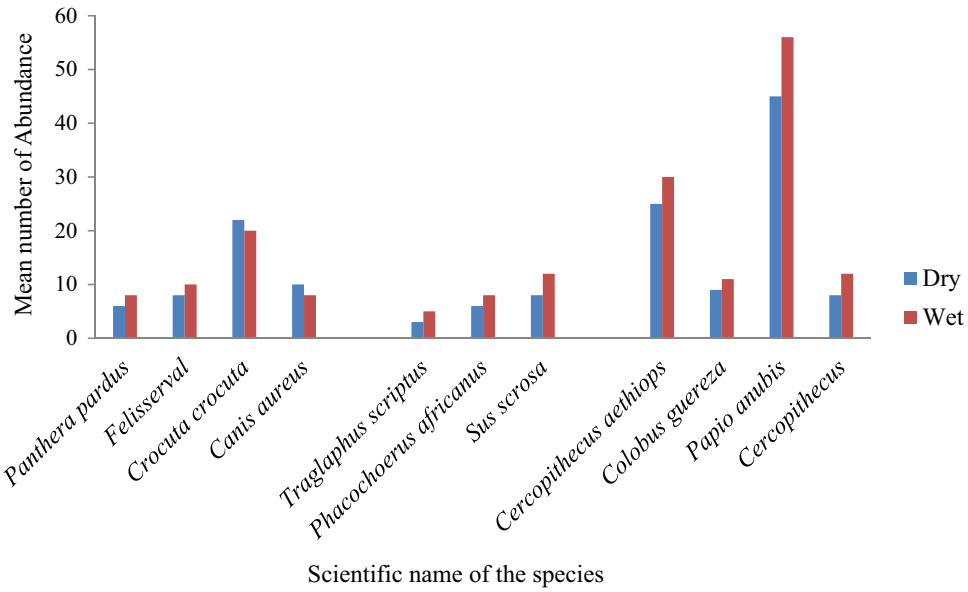

Fig. 3 Seasonal change in wild animal species composition and abundance in Tirba Lake, Ethiopia

Table 2 Seasonal averages of wild animal abundance in various habitat types in Tirba Lake

Average animal counts in various habitat types across seasons									
Species	Open forest		Shrub land		Cliff site		Dense Forest		Total animals observed
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	
P. pardus	0	0	0	0	3	5	3	3	14 ± 2.8
Felisserval	0	0	8	8	0	2	0	0	18 ± 2.8
C. crocuta	8	7	14	13	0	0	0	0	42 ±1.2
C. aureus	4	2	6	6	0	0	0	0	18 ± 5.6
T. scriptus	3	5	0	0	0	0	0	0	8 ± 2.8
P. africanus	2	6	4	2	0	0	0	0	14 ± 2.8
S. scrosa	2	4	2	4	4	4	0	0	20 ± 1.7
C. aethiops	4	6	2	3	0	0	17	23	55 ± 3.2
C.guereza	0	0	0	0	0	0	9	11	20 ± 2.5
P. anubis	11	16	10	14	22	28	0	0	101 ± 3.2
Cercopithecus	0	0	4	4	4	8	0	0	20 ± 2.8
Total	34	46	50	54	33	47	29	37	330 ± 26.2

wild animal abundance (df=1, P=≤ 0.001). Wild mammal populations totaled 330 ± 26.2, of which 180 ± 11 (or 55%) were spotted during the rainy season and 150 ± 6.5 (or 45%) during the dry (Table 3).

3.2 Relative Abundance

Among the 11 species of mammalians, the most prevalent baboon was the Olive baboon (*Papio Anubis*), comprising 30.61% with 101 individuals, Vervet monkey came in second (*Cercopithecus aethiops*), 16.67% with 55 individuals (Table 4). Although Leopard (*Panthera pardus*) and Warthog (*Phacochoerus Africanus*) contributed only 4.24% each, the least contributor was Common Bushbuck (*Tragelaphus scriptus*) 2.42% of the total recorded individuals (Table 5). The least numerous species in the research area included the Common Bushbuck, Leopard, and Warthog. Among the various habitat types, there was a statistically significant difference in the number of animal populations (df = 3, P=≤ 0.001) (Table 6). Among the four habitat type shrub land carry's higher mammalian populations followed by cliff site and open forest (Fig. 4).

Table 3 The population statistics of wild mammals during the rainy and dry seasons in Tirba Lake

Season	Mean	Std. Deviation	Std. Error	Min	Max	d*f*	*F*	Sig.
Dry season	150.0000	6.54654	2.31455	140.00	160.00	1	43.8	0.000
Wet season	180.0000	11.01946	3.89597	160.00	200.00			
Total	165.0000	17.79513	4.44878	140.00	200.00			

Table 4 Population mean of each species

Name of species	Mean	Std. Deviation	Std. Error	d*f*	*F*	Sig.
Pantherapardus	14.0000	2.82843	1.15470	10	469.2	0.000
Felisserval	18.0000	2.82843	1.15470			
Crocuta crocuta	42.0000	1.26491	0.51640			
Canis aureus	18.0000	5.65685	2.30940			
Traglaphus scriptus	8.0000	2.82843	1.15470			
Phacochoerus africanus	14.0000	2.82843	1.15470			
Sus scrosa	20.0000	1.78885	0.73030			
Cercopithecus aethiops	55.0000	3.22490	1.31656			
Colobus guereza	20.0000	2.52982	1.03280			
Papio anubis	101.0000	3.22490	1.31656			
Cercopithecus	20.0000	2.82843	1.15470			
Total	30.0000	26.27781	3.23457			

Table 5 Mammal species documented across habitats, along with their relative abundance in Tirba Lake, Ethiopia

Species	Open forest	Habitat			Total	R. Abundance
		Shrub land	Cliff site	Dense Forest		(%)
Panthera pardus (Leopard)	–	–	8	6	14	4.24
Felisserval (Serval cat)	–	16	*2*	–	18	5.45
Crocuta crocuta (Spotted hyaena)	15	27	–	–	42	12.72
Canis aureus (Commen jackal)	6	12	–	–	18	5.45
Traglaphus scriptus (Common Bushbuck)	8	–	–	–	8	2.42
Phacochoerus africanus (Warthog)	8	6	–	–	14	4.24
Sus scrosa (Wild pig)	6	6	8	–	20	6.06
Cercopithecus aethiops (Vervet monky)	10	5	–	40	55	16.67
Colobus guereza (Colobus monky)				20	20	6.06
Papio Anubis (Olive baboon)	27	24	50	–	101	30.61
Cercopithecus (Porcupine)	–	8	12	–	20	6.06
Total	80	104	80	66	330	100

Table 6 Populations of mammals by habitat types

Habitat type	Mean	Std. Deviation	Std. Error	Min	Max	*df*	*F*	Sig
Open forest	80.0000	5.77350	1.82574	70.00	90.00	3	113.7	0.000
Shrub land	104.0000	3.26599	1.03280	100.00	108.00			
Cliff site	80.0000	5.77350	1.82574	70.00	90.00			
Dense Forest	66.0000	3.19722	1.01105	60.00	72.00			
Total	82.5000	14.55141	2.30078	60.00	108.00			

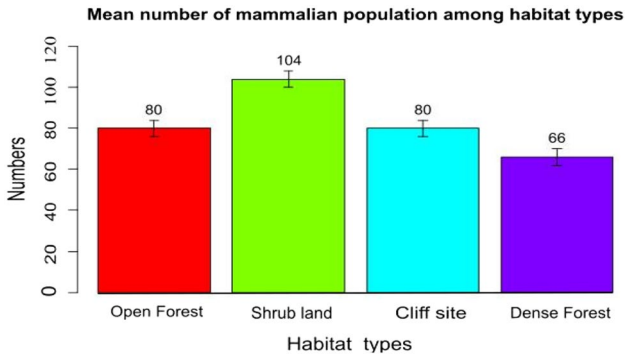

Fig. 4 Number of mammalian population among habitat types

3.3 Mammal Diversity Indices in the Four Types of Habitat

Shrub land contains the most diverse array of mammalian species out of the four habitat types ($H' = 1$) followed by Open forest ($H' = 0.8$). Dense forest was the lowest diversity among habitat type ($H' = 0.5$). Shrub land ($J = 0.5$) had the highest species evenness, and the other habitat types were fairly balanced ($J = 0.4$) for each (Table 7).

3.3.1 Species Similarity Index

The wild animal species' total Sorensen species similarity index across the four Tirba Lake habitat types was 1 (Table 8). Out of the four habitat categories, open forest and shrubland (SL = 0.8), showed the greatest degree of mammalian species similarity, and shrubland and cliff site was (SI = 0.7). Open forest with cliff site was (SI = 0.3) and cliff site with the dense forest was (SI = 0.25). The resemblance was minimal in Open forest with Dense forest and shrubland with dense forest (SI = 0.2) in each (Table 8).

4 Discussion

Tirba Lake has unique ecosystems; the Lake is surrounded by vegetation and also cliffs with mountains. The Lake is approximately surrounded by 60–100 m sloppy cliffs. The water in the Lake never flows like rivers, it is always stationary just like a cup of tea. And also the Lake is a source of water for different wild mammalians that live around it. Large and medium mammals thrive in dense forests, open forests, shrubland, and cliff sites. However, as compared to other studies in Ethiopia, the overall number of mammalian species recorded during the present study (11 species) was comparatively low. For instance (Gonfa et al. 2015) reviewed "28 species in Dati wolel national park" and (Girma and Worku 2020) reviewed "16 species in Geremba Mountain". Additionally, 1391 observations of 12 species of medium- and large-sized mammals from

Table 8 Wild animal species' similarity indices across various habitat types of Tirba Lake

Habitat types	No. of species per habitat	Species similarity index
Open forest vs Shrub land	7vs8	0.8
Open forest vs Cliff site	7vs5	0.3
Open forest vs Dense Forest	7vs3	0.2
Shrub land vs Cliff site	8vs3	0.7
Shrub land vs Dense Forest	8vs5	0.2
Cliff site vs Dense Forest	5vs3	0.25

Table 7 Indices of wild animal diversity in various habitat types of Tirba Lake

Habitat types	No. of Species	Populations	Diversity(H')	H_{max}	Evenness (J)
Open forest	7	80 ± 5.7	0.8	1.946	0.4
Shrub land	8	104 ± 3.2	1	2.08	0.5
Cliff site	5	80 ± 5.7	0.62	1.61	0.4
Dense Forest	3	66 ± 3.2	0.5	1.1	0.4

Wild mammal species' Simpson's similarity indices (SI) in relation to various habitat types of Tirba Lake

seven families and five orders were made in Wabe forest remnants in the Gurage zone of Ethiopia (Legese et al. 2019). Thirteen species of large and medium mammals, representing ten families and seven orders, were identified (Oliveira et al. 2019). However, a survey of big and medium-sized mammals in Wabe forest fragments, Gurage zone, Ethiopia is nearly identical to this study; a total of 12 mammal species from seven orders and seven families were documented there (Legese et al. 2019). Because not all mammalian species are listed, particularly medium-sized animals, which can be neglected and for which no different approach is used, the likelihood of the mammalian diversity appears to be lower (Gonfa et al. 2015; Pillco Huarcaya et al. 2020). Several scholars (Matias et al. 2011; Pires Mesquita et al. 2018) demonstrated a favorable relationship between animal species diversity and habitat heterogeneity. Out of the four habitat types in the research area, shrubland and open forest had the highest documented diversity of mammals due to the varied plant species assemblage that was present there. (Gonfa et al. 2015) mentioned Woodland and Riverine woodland as having a high diversity and even distribution of medium- and large-sized mammals. Contrarily, riverine woodland has the lowest composition and number of small mammals, according to (Meseret and Solomon 2014). The presence of water, food, and cover is frequently connected with the distribution and habitat association of animals (Yaba et al. 2011; Gonfa et al. 2015). Landscape level, fundamental biodiversity surveys are necessary to comprehend how climate change and land alteration may affect the distribution and richness of wildlife species (Woodgate et al. 2018). Land-use change had by far the biggest effects on large mammal communities, with areas of extensive livestock grazing and large wildlife exclusion attempts (Ferreira et al. 2020; Graham et al. 2019). In Tirba lake, there were different land use types mainly, crop land, grazing lands so it leads to distract the wild mammal population habitats, this is the main observational challenges. Given the unprecedented threats to biodiversity posed by anthropogenic disturbance, knowledge of the occurrences of species and communities enables an efficient and quick method of assessing their status and susceptibility (Cavada et al. 2019; Harvey et al. 2020). These variables may be to blame for the high abundance of animal species found in shrub-land (8 species) in our study. However, species richness alone cannot determine how much of the species pool is realized within local communities or the various effects of a species' loss on the communities due to its varying role in ecosystem functioning (Wen et al. 2019). Because the vegetation in the two habitats is so similar, the highest species similarity record between open forest and shrubland may be the result of this. (Gonfa et al. 2015) reported a similar outcome in Ethiopia's Dati Wolel National Park. The dominating mammalian species among the 11 species was the Olive baboon (*Papio Anubis*), followed by the Vervet Monkey (*Chlorocebus aethiops*).

Papio Anubis, Cercopithecus aethiops, and *Crocuta crocuta* were the species having the most records during the survey. During the study both medium and large in size mammalian were recorded. Large and medium-sized mammals are crucial to the health of forest ecosystems because they manage the population of prey, spread seeds, and engage in predation (Botelho et al. 2012; Guo et al. 2017; Suárez-Tangil and Rodríguez 2021; Rodríguez 2021). Due to their crucial importance in the functioning of ecosystems and vulnerability to human activity, medium- and large-bodied mammals are of interest to conservationists worldwide (Wen et al. 2019). Similar research in Wabe forest fragments in the Gurage zone of Ethiopia found the following medium and large mammals: Porcupine (*Hystrix cristata*), Honey badger (*Mellivera capensis*), Vervet monkey (*Chlorocebus aethiops*), Olive baboon (*Papio anubis*), and Colobus guereza (*Colobus guereza*), among the medium-sized mammals, and of the large mammals present in the research region included Spotted hyenas (*Crocuta crocuta*), Aardvarks (*Oryctropus afer*), bohor reedbucks (*Redunca redunca*), Oribis (*Ourebia ourebi*), and Common duikers (*Sylvicapra grimmia*) (Legese et al. 2019). In this study, the population of medium- and large-sized mammals was counted in 150 instances during the dry season and in 180 instances during the wet season. Generally speaking, summer is when there are the most mammal species and fewest mammal species in winter (Mysłajek et al. 2020). The choice of large and medium mammals for various types of forest habitat changed over time, which is tied to variations in the resources available and the environment in various forests (Zhang et al. 2019). In comparison to other studies, it is lower. For instance, 885 individuals of the species of medium and large mammals were documented during the dry season in Adaba Community Forest, West Arsi Zone, Southeast Ethiopia, whereas 1120 individuals were recorded during the wet season (Bakala and Mekonen 2021).

5 Conclusions and Recommendations

The study's conclusions show that Tirba Lake is home to numerous medium- and large-mammal species. This is the first ecological data on the variety of mammals in Tirba Lake, and it will help any organizations that are interested make wise conservation decisions as well as researchers who want to carry out effectiveness studies. To help with the creation of the management plan, studies on the population structure, spatiotemporal habitat use, and effects of human-induced actions on the park's mammals are required. These studies should be conducted in addition to tightening

law enforcement efforts to reduce the current human and livestock encroachment into the area. The study region has a high biological significance, and it concentrates on the medium- and large-sized fauna in an effort to advance our understanding on a wider range of topics. In Tirba lake, there were different types of various conservation challenges like expansions of crop production, over grazing, hunting and forest degradation. To avoid the depletion of prey and the degradation of habitat, conservation activities are necessary in the research region. Therefore, responsible forest management would be the optimum activity in the buffer zones and multiple-use zones of protected areas, having significantly less of an impact and causing less conflict than alternatives like agriculture or cattle grazing while still offering economic opportunities (Tobler et al. 2018). Numerous mammals in the research region are at danger due to interacting anthropogenic causes. To protect these species, a conservation program must be implemented immediately.

Acknowledgements The College of Agriculture, Food and Climate Science at Injibara University in Ethiopia financed the study. We would especially want to thank the dependable Woreda officials and subject matter experts who provided us with all the essential information.

Authors' Contributions BD was proposed the research idea and collected the data as well as organized the data in computer, did the analysis, interpretation, identification, wrote the manuscript and all the other necessary activities from the beginning to finalize the study. YD was also revised the manuscript for scientific content, manage the budgets and did the language check. BG also collect the data and give advice. Finally, all authors read and approved the final manuscript.

Funding Funding was provided by Injibara University, Ethiopia. All the activities that need a finance were covered by Injibara University, Ethiopia. If this funder was not availing this research was not studied as it is.

Availability of Data and Materials The data used and analyzed during the current study are available in the hand of the first author for further request if request is available from reviewers without disclosure of the interviewees. We provide the data for valid reason/justification. Anyone who can contact to Binega Derebe. Email: binegaderebe@gmail.com.

Declarations

Conflict of interests The authors have not declared any conflict of interests.

Ethics approval and consent to participate Animal handling or experimenting was not required for this study, it is just an observation-based study. All data collection procedures were done through observation in a far from Large and Medium mammals using binoculars, field guide books, that did not harm animals. However, the permission to observe Large and Medium animals in the study area were obtained from Injibara University and Ankasha woreda officers. Participants/respondents were briefed on the study and its purpose in their mother tongue. The informed consent of the study participants was obtained before the beginning of each survey/ local people who shows the study area/forest. Their responses had no personal, social or political consequences. We believed that there would not be significant risks to the participants. The Confidentiality of the data was ensured and access to raw data was allowed only after a joint agreement by the investigators involved in designing, conducting and financing the study.

Consent for publication This manuscript does not contain any individual person's data, and further consent for publication is not required.

References

Bakala F, Mekonen G (2021) Species diversity and relative abundance of medium and large-sized wild mammals: a study from Adaba Community Forest, West Arsi Zone. Southeast Ethiopia Afr J Ecol 59(2):538–543. https://doi.org/10.1111/aje.12827

Beca G, Vancine MH, Carvalho CS, Pedrosa F, Alves RSC, Buscariol D, Peres CA, Ribeiro MC, Galetti M (2017) High mammal species turnover in forest patches immersed in biofuel plantations. Biol Cons 210:352–359. https://doi.org/10.1016/j.biocon.2017.02.033

Bisi F, Gagliardi A, Cremonesi G, Mazzamuto MV, Wauters LA, Preatoni G, Martinoli A (2019) Distribution of Wildlife and Illegal Human Activities in the Lampi Marine National Park. Myanmar. https://doi.org/10.1017/S0376892918000486

Bogoni JA, Graipel ME, Oliveira-Santos LGR, Cherem JJ, Giehl ELH, Peroni N (2017) What would be the diversity patterns of medium-to large-bodied mammals if the fragmented Atlantic Forest was a large metacommunity? Biol Cons 211:85–94. https://doi.org/10.1016/j.biocon.2017.05.012

Botelho ALM, Calouro AM, Borges LHM, Chaves WA (2012) List Large and medium-sized mammals of the Humaitá Forest Reserve, southwestern Amazonia, state of Acre, Brazil. J Species Lists Distrib 8(6):1190–1195

Cavada N, Wors R, Scharff N (2019) A landscape-scale assessment of tropical mammals reveals the effects of habitat and anthropogenic. Disturb Commun Occupancy 2:1–15

de Jong M, Joss S, Schraven D, Zhan C, Weijnen M (2015) Sustainable–smart–resilient–low carbon–eco–knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. J Clean Prod 109:25–38. https://doi.org/10.1016/j.jclepro.2015.02.004

Derebe B, Derebe Y, Kassaye M (2022) Diversity, abundance, and habitat association of medium and large-sized mammals in Tiski Waterfall, Awi Zone, Ethiopia. Int J Zool 2022:1–9. https://doi.org/10.1155/2022/4927041

Diriba G, Tamene S, Mengesha G (2020) Diversity of medium and large mammals in the Loka Abaya. Ecol Evol. https://doi.org/10.1002/ece3.6649

Dobbins M, Broadbent E, Sollmann R, Menke S, Almeyda A (2020) An integrated approach to measure hunting intensity and assess its impacts on mammal populations. Ecol Evol. https://doi.org/10.1111/1365-2664.13750

Drouilly M, Clark A, O'Riain MJ (2018) Multi-species occupancy modelling of mammal and ground bird communities in rangeland in the Karoo: A case for dryland systems globally. Biol Cons 224:16–25. https://doi.org/10.1016/j.biocon.2018.05.013

Ferreira AS, Peres CA, Dodonov P, Cassano CR (2020) Multi-scale mammal responses to agroforestry landscapes in the Brazilian Atlantic Forest: The conservation value of forest and traditional shade plantations. Agrofor Syst 94(6):2331–2341. https://doi.org/10.1007/s10457-020-00553-y

Girma Z, Worku Z (2020) Large Mammal Diversity in Nensebo Forest. Int J Zool, Southern Ethiopia. https://doi.org/10.1155/2020/8819019

Gonfa R, Gadisa T, Habitamu T (2015) The diversity, abundance and habitat association of medium and large-sized mammals of Dati

Wolel. Int J Zool 7(2):112–118. https://doi.org/10.5897/IJBC2014.0808
Graham SI, Kinnaird MF, O'Brien TG, Vågen T, Winowiecki LA, Young TP, Young HS (2019) Effects of land-use change on community diversity and composition are highly variable among functional groups. Ecol Appl. https://doi.org/10.1002/eap.1973
Guo K, Liu H, Bao H, Hu J, Wang S, Zhang W, Zhao Y, Jiang G (2017) Habitat selection and their interspecific interactions for mammal assemblage in the Greater Khingan Mountains, northeastern China. Wildlife Biol 2017(1):00261. https://doi.org/10.2981/wlb.00261
Harvey AM, Beausoleil NJ, Ramp D, Mellor DJ (2020) A Ten-Stage Protocol for Assessing the Welfare of Individual Non-Captive Wild Animals: Free-Roaming Horses (Equus Ferus Caballus) as an Example. Animals 10(1):148. https://doi.org/10.3390/ani10010148
Ishige T, Miya M, Ushio M, Sado T, Ushioda M, Maebashi K, Yonechi R, Lagan P, Matsubayashi H (2017) Tropical-forest mammals as detected by environmental DNA at natural saltlicks in Borneo. Biol Cons 210:281–285. https://doi.org/10.1016/j.biocon.2017.04.023
Kassaye M, Derebe Y, Kibrie W, Debebe F, Gedamu B (2022) Carbon Stock And Spatial Dynamics In Natural Forests Of Awi Zone, Amhara Region, Northwestern Ethiopia: Implication For Climate Change Mitigation And Adaptation. Review. https://doi.org/10.21203/rs.3.rs-1365934/v1
Legese K, Bekele A, Kiros S (2019) A Survey of large and medium-sized mammals in Wabe forest fragments , Gurage zone, Ethiopia. https://doi.org/10.15406/ijawb.2018.04.00149
Li X, Bleisch WV, Liu X, Jiang X (2021) Camera-trap surveys reveal high diversity of mammals and pheasants in Medog. Tibet Oryx 55(2):177–180. https://doi.org/10.1017/S0030605319001467
Lyra-jorge MC, Ciocheti G, Pivello VR, Meirelles ST (2008) Comparing methods for sampling large- and medium-sized mammals: Camera traps and track plots. Eur J Wildlif. https://doi.org/10.1007/s10344-008-0205-8
Matias MG, Underwood AJ, Hochuli DF, Coleman RA (2011) Habitat identity influences species-area relationships in heterogeneous habitats. Mar Ecol Prog Ser 437:135–145. https://doi.org/10.3354/meps09273
Mercês MP, Alves-Silva KR, de Paula WS (2020) Checklist of large and medium-bodied mammals from four areas of Tocantins state. Central Brazil Lista De Espécies De Mamíferos De Médio e Grande Porte Em Quatro Áreas No Estado Do Tocantins, Brasil Central 15(3):18
Meseret C, Solomon Y (2014) Distribution and diversity of small mammals In Borena-Sayint National Park, South Wollo, Ethiopia: Implications of habitat specialization. Int J Biodiver Conser 6(5):415–421. https://doi.org/10.5897/ijbc2014.0685
Mysłajek RW, Olkowska E, Wronka-Tomulewicz M, Nowak S (2020) Mammal use of wildlife crossing structures along a new motorway in an area recently recolonized by wolves. Eur J Wildl Res 66(5):79. https://doi.org/10.1007/s10344-020-01412-y
Oliveira ECM, Machado FS, Zanzini AC (2019) Activity patterns of mammals at Quedas do Rio Bonito Ecological Park, Lavras City, Minas Gerais State, Brazil. Revista Agrogeoambiental. https://doi.org/10.18406/2316-1817v11n220191281
Pillco Huarcaya R, Beirne C, Serrano Rojas SJ, Whitworth A (2020) Camera trapping reveals a diverse and unique high-elevation mammal community under threat. Oryx 54(6):901–908. https://doi.org/10.1017/S0030605318001096
Pires Mesquita G, Domingo Rodríguez-Teijeiro J, Nascimento Barreto L (2018) Patterns of mammal subsistence hunting in eastern Amazon, Brazil: Mammal Hunting Patterns. Wildl Soc Bull 42(2):272–283. https://doi.org/10.1002/wsb.873
Rabira G, Tsegaye G, Tadesse H (2015) The diversity, abundance and habitat association of medium and large-sized mammals of Dati Wolel National Park, Western Ethiopia. Int J Biodivers Conserv 7(2):112–118. https://doi.org/10.5897/IJBC2014.0808
Rocha EC, Silva J, Silva PT, Araújo MS, Castro ALS (2019) Medium and large mammals in a Cerrado fragment in Southeast Goiás, Brazil: Inventory and immediate effects of habitat reduction on species richness and composition. Biota Neotrop 19(3):e20180671. https://doi.org/10.1590/1676-0611-bn-2018-0671
Rodríguez B (2021) Estimates of Species Richness and Composition Depend on Detection Method in Assemblages of Terrestrial Mammals. MDPI, Animals. https://doi.org/10.3390/ani11010186
Shamoon H, Cain S, Shanas U, Bar-Massada A, Malihi Y, Shapira I (2018) Spatio-temporal activity patterns of mammals in an agro-ecological mosaic with seasonal recreation activities. Eur J Wildl Res 64(3):35. https://doi.org/10.1007/s10344-018-1196-8
Suárez-Tangil BD, Rodríguez A (2021) Estimates of Species Richness and Composition Depend on Detection Method in Assemblages of Terrestrial Mammals. Animals 11(1):186. https://doi.org/10.3390/ani11010186
Sutherland, W. J. (2006). *Ecological Census Techniques: A handbook* (W. J. SUTHERLAND & U. of E. Anglia, Eds.; Second Edi). United States of America by Cambridge University Press, New York.
Tobler MW, Garcia Anleu R, Carrillo-Percastegui SE, Ponce Santizo G, Polisar J, Zuñiga Hartley A, Goldstein I (2018) Do responsibly managed logging concessions adequately protect jaguars and other large and medium-sized mammals? Two case studies from Guatemala and Peru. Biol Cons 220:245–253. https://doi.org/10.1016/j.biocon.2018.02.015
Wen Z, Cai T, Feijó A, Xia L, Cheng J, Ge D, Yang Q (2019) Using completeness and defaunation indices to understand nature reserve ' s key attributes in preserving medium- and large-bodied mammals. Biol Cons. https://doi.org/10.1016/j.biocon.2019.108273
Woodgate Z, Distiller G, Riain JO (2018) Variation in mammal species richness and relative abundance in the Karoo. Eur J. https://doi.org/10.2989/10220119.2018.1522513
Yaba M, Mekonnen T, Bekele A, Malcolm J (2011) Food selection and feeding behavior of giant mole rat (Tachyoryctes macrocephalus, Ruppell, 1842) from the sanetti plateau of bale mountains national park. Ethiopia. Asian J Appl Sci 4(7):735–740. https://doi.org/10.3923/ajaps.2011.735.740
Zhang Y, Liu X, Lv Z, Zhao X, Yang X, Jia X, Sun W, He X, He B, Cai Q, Zhu Y (2019) Animal diversity responding to di ff erent forest restoration schemes in the Qinling Mountains. China Ecological Engineering 136(June):23–29. https://doi.org/10.1016/j.ecoleng.2019.05.020

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