



Biodiversity Assessment of Mammals and Birds in Potential Oil Exploration Areas of Central Afar National Regional State

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Abstract

Energy is one of the key elements for economic development that could be derived from the diversity of modern energy sources like oil and other energy sources. Afar National Regional State is one of the areas in Ethiopia that have significant amount energy resources including the geothermal oil and natural gas that scattered in the Ethiopian Rift Valley of Afar Depression. Despite of this huge potential energy source more than 90% of the rural population still relies on traditional fuel wood. The fossil fuel exploration and development is expected to solve the existing problem. One of it is by implementing oil exploration. The exploration and production may have impact on the ecology of the environment. As Ethiopia is one of the top 25 biodiversity-rich countries in the world, and hosts two of the world's 34 biodiversity hotspots, particular care is needed in development of such projects. Particularly, Rift Valley ecosystem includes more than 15 protected. Therefore, to reduce such ecological in particular to forecast the impact faunal survey is used to find solution and to take necessary mitigation action before its full operation. The field reconnaissance survey on the species composition of mammals and birds was conducted from August 23-31, 2019. In the survey, different species of mammals, birds, reptiles and amphibians were recorded. In general, 30 species of small mammals belonging to 9 order and 20 families were recorded. All the recorded species had grouped under Least Concern of IUCN conservation status categories. In addition to these 129 species of birds belonging to 51 families were also recorded of which five were threatened. At least three species of reptiles and one species of amphibians were also recorded. Despite the area is considered as desert it relatively possesses high diversity of mammals and birds. The area also possesses different habitats, which is suitable for wild animals. Thus, during the oil exploration and production proper conservation and mitigation actions should be taken for the protection and conservation of the fauna and flora diversity of the area.

Key words/Phrases: Birds; mammals; Impact assessment; oil exploration

Introduction

1.1. Background of the study

Energy is one of the key elements in Ethiopia's economic development that derived from the diversity of modern energy sources like hydro, geothermal, Solar and natural gas and traditional energy sources. About 90% of the rural population still relies on traditional fuel wood as their primary energy resource.

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Considering the shortage of modern energy supplies in the country and environmental degradation of fossil fuel, geothermal energy needs to be developed in Ethiopia. Ethiopia is among the few countries in Africa with a significant amount of geothermal resources that scattered in the Ethiopian Rift valley. Afar region is one of the area in Ethiopia have significant amount energy resources including the Geothermal that scattered in the Ethiopian Rift valley its Afar Depression. It has a potential to generate for more than 1000 MWe of electric power (Meseret Teklemariam and Kibret Beyene, 2005). Energy is one of the key elements for economic development that could be derived from the diversity of modern energy sources like oil and other energy sources. The use of traditional fuel wood as their primary energy resource and exporting fossil fuel by investing a huge amount of foreign exchange practiced by large population of the country. Considering the shortage of modern energy supplies in the country of fossil fuel, its exploration and developed is expected to solve the existing problem (Gislason *et al.*, 2015).

The exploration and production has usually impact on the ecology of the environment (E&P Forum/UNEP, 1997). Oil exploration and production projects may have substantial impacts on the environment (E&P Forum/UNEP, 1997; Albertsson *et al.*, 2010). Its impact varies during the different phases of development and between sites (Kristmannsdóttir and Ármannsson, 2003). Although there are different survey methods, the seismic surveys are one of the most commonly used. Its potential impacts are mainly environmental related to it are surface disturbances, physical effects of fluid withdrawal, noise, thermal effects, chemical pollution, biological effects and protection of natural features. It requires extensive exploration area as well as rather large area for production wells and associated facilities (E&P Forum/UNEP, 1997; Albertsson *et al.*, 2010).

As Ethiopia is one of the top 25 biodiversity-rich countries in the world, and hosts two of the world's 34 biodiversity hotspots, namely: the Eastern Afromontane and the Horn of Africa hotspots (Mohammed Kasso *et al.*, 2015) particular care is needed in development of such projects. Particularly, the Ethiopian Rift Valley ecosystem includes more than 15 protected areas like Yangudi-Ras National Park, Omo National Park, Chebera Churchura National Park and Nech-Sar National Park) and Senkelle Wildlife Sanctuary may probably affect with operation. Therefore, to reduce such ecological in particular to forecast the impact faunal survey is used to find solution and to take necessary mitigation action. The objective of this study is to collect species composition and conservation small mammals and birds in the study area.

2. Methodology

2.1. Study area

The study was conducted in four Districts of Afar Regional State of the four districts with potential of oil exploration project carried out. The districts through which new seismic line pass were Ada'ar, Telalak, Dewe and Delifage. Survey is majorly based on the randomly selected points on in areas accessible to vehicle road.

2.2. Methods

The field reconnaissance survey for wet was carried out from August 23-31, 2019. During the field survey study, information on species composition of mammals, birds, reptiles and amphibians were collected.

The rapid biodiversity assessment method majorly following to survey on the identification of the mammals and birds on the main repetitive habitats along the newly established in the four (4) new seismic lines in the entire four districts of Afar Regional State. During this survey, all the available and relevant information were gathered. Four representative habitats were observed and randomly selected. The selection of the trapping and sampling site were based on a good representation of the main vegetation types, distances from each seismic lines, buildings, altitude, agricultural fields, human settlement and rocky cliffs. Based on the different vegetation and habitat types, topography and altitudinal zonation and distance among the seismic line representative habitats for trapping and sampling site selection were identified. For survey of the fauna beside direct observation and trapping indirect methods like footprint, scat, burrow, rub marks and local community interview were used.

Trapping for small mammal (rodents and shrews) were carried out by using collapsible Aluminum Sherman Live Trap, and mole rat traps. In each trapping line, at least 25 trapping stations spaced at 15 m were used. The trap stations were marked by colored plastic tags on tall branches of the tree to easily locate the traps during checking and collection. Traps were covered by any available material like hay, leaves, branches, ferns and lichen and grasses in order to avoid the trapped animals from harsh environmental condition. The traps were baited with peanut butter. The traps were checked twice a day early in the morning (6:30 to 8:30 a.m.) and in the late afternoon from (4:30 to 6:30 p.m.).



Plat 1. Different representative selected habitats (Grassland, shrub land, farmland and forest) for survey of small mammals

Day time survey of the probable potential sites for bat roost was conducted by the help of more experienced local person. Roost inspection and visual identification and counting of the individual of the colony in the roosting site were carried out. All possible signs indicating the presence of bat in the roosting site like tiny scratches around entry point, rub marks, hair, droppings, food remains, audible squeaking and chattering sound, distinctive bat smell and smoothing of surface around the entry were used for the roost site assessment.

Bat call dictators were also used for bat activity determination and for further bats information analysis. Acoustic monitoring was conducted by using Anabat II bat detector systems (Titley Electronics, Ballina, NSW, Australia). Bat calls were recorded using digital recordings of Anabat SD1 bat detector (Titley Electronics, Ballina, NSW, Australia). For active sampling, detectors were manually operated at each sample location and oriented at approximately 45° angles, scanning in front of the detector for bats activity.

Bird surveys were conducted during time of high bird's activity mornings and at sunset using a modified a point-transect method. Transect lines two to four transect lines were established throughout the sampling site; with inter point intervals of 250 meters (m). The point count duration was five minutes at each of 20 points. All birds seen and/or heard during the five-minute period were recorded, the distance to each individual was estimated, and the sex of each bird was recorded for each point. Nest searches were also conducted.

All possible cases of sighting of birds were recorded to elaborate preliminary checklist for the area. Birds were observed with the help of binoculars and naked eye. In any case when possible, digital photos of living birds were made for further comparison with available identification field guide books like Redman *et al.* (2009).

The survey of reptiles and amphibians encompassed a comprehensive evaluation across all identified habitats. This involved systematically exploring diverse ecosystems, including forests, wetlands, grasslands, and urban areas, to document the presence and abundance of various species. A range of methodologies, such as visual encounter surveys, trapping, and audio monitoring, to ensure a thorough assessment. Each habitat type was assessed for its unique environmental characteristics, which influence the distribution and behavior of these ectothermic vertebrates.

The collected data were tabulated and organized into tables and charts. Both qualitative and quantitative data were analyzed with appropriate descriptive statistics such as frequency, percentage, mean and Chi-square test with the aid of SPSS Version 16.0 statistical program. Gini-Simpson and Shannon-Wiener Diversity Index were computed by using PAST (Paleontological Statistics Software package for Education and Data Analysis). All the observed and trapped individuals or specimens were identified to species level whenever possible in the field with the help of field guidebooks.

In addition to this comparing prepared skin and skeleton voucher specimen and photographs with museum specimens and other photographs.

3. Results

3.1. Mammals

In the present field reconnaissance survey for wet season survey fauna survey at least 30 species of mammals belonging to at least 9 order and 20 families 27 Genera were recorded. All the recorded species had grouped under Least Concern (LC) IUCN conservation status categories. More than three unidentified species of reptiles and one species of amphibians were also recorded. The lists of species of birds and mammals recorded were presented in Table 2.

From the mammals Soemmerring's gazelle (*Nanger soemmerringi*) Salt's Dikdik (*Madoqua saltiana*) were most abundant and widely distributed. In the same way most bird species like dove, weaver, starling, bee-eater and were widely distributed.

Table 2. The mammal's biodiversity list in Afar National Regional state in the four districts

No.	Family Name	Common Name	Scientific Name	IUCN
1	Bovidae	Lesser kudu	<i>Tragelaphus imberbis</i>	LC
2	Bovidae	Salt's Dikdik	<i>Madoqua saltiana</i>	LC
3	Bovidae	Soemmerring's gazelle	<i>Nanger soemmerringi</i>	LC
4	Bovidae	Besia Oryx	<i>Oryx beisa</i>	LC
5	Canidae	Common Jackal	<i>Canis aureus</i>	LC
6	Canidae	Balcked-backed Jackal	<i>Canis mesomelas</i>	LC
7	Canidae	Bat eared fox	<i>Otocyon megalotis</i>	LC
8	Cercopithecidae	Anubis baboon	<i>Papio Anubis</i>	LC
9	Cercopithecidae	Scared baboon	<i>Papio hamadryas</i>	LC
10	Erinaceidae	Desert Hedgehog	<i>Paraechinus aethiopicus</i>	LC
11	Felidae	Lion	<i>Panthera leo</i>	LC
12	Gerbillinae	Gerbils	<i>Gerbillus spp.</i>	LC
13	Herpestriidae	White tailed mongoose#	<i>Ichneumia albicauda</i>	LC
14	Hyenidae	Spotted Hyena*	<i>Crocota</i>	LC
15	Hystriidae	Crested Porcupine*	<i>Hystrix cristata</i>	LC
16	Leporidae	Abyssinian Hare	<i>Lepus abyssinicus</i>	LC
17	Molossidae	Free Tailed Bat	<i>Tadarida pumila</i>	LC
18	Murinae	Multimammate rat	<i>Mastomys natalensis</i>	LC
19	Murinae	Common mice	<i>Mus spp</i>	LC
20	Murinae	Spine mice	<i>Acomys sp</i>	LC
21	Murinae	Black Rat	<i>Rattus</i>	LC
22	Orycteropodidae	Aardvark	<i>Orycteropus afer</i>	LC
23	Procavidae	Ethiopian Rock hyrax*	<i>Procavia habessinica</i>	LC
24	Rhinolophidae	Horseshoe Bat	<i>Rhinolophus spp</i>	LC
25	Rhinopomatidae	Mouse-eared Bat	<i>Myotis sp</i>	LC
26	Sciuridae	Unstriped Ground Squirrel	<i>Xerus rutilus</i>	LC
27	Suidae	Common Warthog	<i>Phacocoerus africanus</i>	LC
28	Vespertilionidae	House bat	<i>Scotophilus spp.</i>	LC
29	Vespertilionidae	Pipistrelle bat	<i>Pipistrellus spp</i>	LC
30	Viverridae	Common Genet#	<i>Genetta</i>	LC

NB: LC= Least concern; * =Species observed in the field by different indirect methods and road kill from the surrounding, # =species recorded based on literature and key local informants

Almost bat species were not specifically identified since none of them capture by mist netting. However, from their call and flight as well as roosting site inspection more than five species were confirmed to exist in the area. In many places bats activities were also recorded from the call record and observation in the flight. Some of representative captured or observed small mammals were presented in Plate 1. From all the recorded small mammals Bovidae and Muridae was the most diverse family.

Although the population trend and distribution varies according to IUCN (2018) conservation status, all are grouped under Least Concern (LC) conservation category.



Plat 2. Some of small mammal species recorded from the study area



Plat 1. Some of small mammal species recorded from the study area (above common warthog)

Bush land, woodland, and riverine habitats emerged as the most favored environments for a majority of reptile and amphibian species surveyed.

Bush land areas, characterized by dense shrubs and scattered trees, and provides vital cover and foraging opportunities. These habitats support a rich diversity of plant species, which in turn attracts various insects and small animals, serving as essential food sources for reptiles and amphibians. The complexity of the vegetation offers hiding spots that are crucial for avoiding predators and regulating temperature.

Woodland habitats, with their mixture of trees and open spaces, create a favorable microclimate that supports many species. The canopy provides shade and helps maintain moisture levels in the understory, which is beneficial for amphibians that require humid environments for breeding and development. Additionally, the diverse structure of woodlands allows for a variety of niches, accommodating different species with varying ecological needs.

Riverine habitats those situated along River of Awash and its tributaries and streams—are particularly important for both groups. The availability of water is a critical element for amphibians, especially during their breeding seasons. These ecosystems also offer abundant food sources, such as aquatic insects and small fish, as well as suitable breeding grounds for many amphibian species. The dynamic environment of riverbanks, with their varying water levels and vegetation types, enhances biodiversity and supports a wide range of reptiles, including those that rely on both terrestrial and aquatic environments.

Overall, these habitats not only provide essential resources but also play a significant role in the life cycles of reptiles and amphibians, highlighting the need for their conservation to maintain biodiversity and ecosystem health.

3.2. Birds

In the study area, a total of 129 bird species from 51 distinct families were documented, reflecting a rich avifaunal diversity. This extensive array of species underscores the ecological significance of the region and its varied habitats, which provide essential resources such as food, nesting sites, and migratory corridors.

The bird species composition is detailed in Table 3, which categorizes the recorded species by their respective families.

The diversity of bird families highlights several ecological patterns. For instance, families such as Turdidae (thrushes) and Sylviidae (warblers) may indicate the presence of healthy shrub land and forest habitats, while families like Anatidae (ducks and geese) suggest the importance of nearby wetland environments. Additionally, the presence of raptors from the Accipitridae family can indicate the availability of open spaces for hunting and perching. The conservation status during the time of data collection was also presented in the Table 3.

Overall, the findings from this survey not only contribute to our understanding of local avian biodiversity but also provide critical baseline data for future research, conservation planning, and habitat management strategies aimed at preserving the ecological integrity of the study area. The bird species composition was shown in Table 3.

Table 3. Bird species composition and their conservation status recording along the potential oil exploration area

No.	Family Name	Common Name	Scientific Name	IUCN
1	Bovidae	Lesser kudu	<i>Tragelaphus imberbis</i>	LC
2	Bovidae	Salt's Dikdik	<i>Madoqua saltiana</i>	LC
3	Bovidae	Soemmerring's gazelle	<i>Nanger soemmerringi</i>	LC
4	Bovidae	Besia Oryx	<i>Oryx beisa</i>	LC
5	Canidae	Common Jackal	<i>Canis aureus</i>	LC
6	Canidae	Balcked-backed Jackal	<i>Canis mesomelas</i>	LC
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11	Felidae	Lion	<i>Panthera leo</i>	LC
12	Gerbillinae	Gerbils	<i>Gerbillus spp.</i>	LC
13	Herpestriidae	White tailed mongoose#	<i>Ichneumia albicauda</i>	LC
14	Hyenidae	Spotted Hyena*	<i>Crocuta</i>	LC
15	Hystricidae	Crested Porcupine*	<i>Hystrix cristata</i>	LC
16	Leporidae	Abyssinian Hare	<i>Lepus abyssinicus</i>	LC
17	Molossidae	Free Tailed Bat	<i>Tadarida pumila</i>	LC
18	Murinae	Multimammate rat	<i>Mastomys natalensis</i>	LC
19	Murinae	Common mice	<i>Mus spp</i>	LC
20	Murinae	Spine mice	<i>Acomys sp</i>	LC
21	Murinae	Black Rat	<i>Rattus</i>	LC
22	Orycteropodidae	Aardvark	<i>Orycteropus afer</i>	LC
23	Procaviidae	Ethiopian Rock hyrax*	<i>Procavia habessinica</i>	LC
24	Rhinolophidae	Horseshoe Bat	<i>Rhinolophus spp</i>	LC
25	Rhinopomatidae	Mouse-eared Bat	<i>Myotis sp</i>	LC
26	Sciuridae	Unstriped Ground Squirrel	<i>Xerus rutilus</i>	LC
27	Suidae	Common Warthog	<i>Phacocochoerus africanus</i>	LC
28	Vespertilionidae	House bat	<i>Scotophilus spp.</i>	LC
29	Vespertilionidae	Pipistrelle bat	<i>Pipistrellus spp</i>	LC
30	Viverridae	Common Genet#	<i>Genetta</i>	LC
31				

NB: LC= Least concern; * =Species observed in the field by different indirect methods and road kill from the surrounding, # =species recorded based on literature and key local informants

The majority (124 or 96%) of birds recorded from the study area were grouped under least concern whereas the rest five species (4%) were threatened and near threatened according to IUCN (2019.2 Version) report (Table 3). However, some species were not recently accessed instead the previous conservation status was considered. Most of the bird species categorized under of Least Concern (LC) of IUCN conservation status categories were showing a decline trend in population number and some of them were locally threatened even though global status is least concern.



Plate 4. Some representative species of birds' species

The Order Passeriformes was the most diverse. In the same way Family Accipitridae also possess 13 species and followed by Pyconotidae (12 species) than other families (Table 4).

Table 4. Number of species of birds in each family

Family	Number of Species	Family	Number of Species
Accipitridae	13	Passeridae	2
Pycnonotidae	12	Pelecanidae	2
Ploceidae	8	Picidae	2
Columbidae	5	Threskiornithidae	2
Glareolidae	5	Alaudidae	1
Sylviidae	4	Ardeidae	1
Apodidae	4	Burhinidae	1
Motacillidae	4	Campephagidae	1
Sturnidae	4	Capitonidae	1
Dicruridae	3	Ciconiidae	1
Hirundinidae	3	Coliidae	1
Laniidae	3	Coraciidae	1
Meropidae	3	Corvidae	1
Phasianidae	3	Falconidae	1
Scolopacidae	3	Leiothrichidae	1
Turdidae	3	Numididae	1
Estrildidae	2	Cisticolidae	1
Nectariniidae	2	Cuculidae	1
Ardeidae	2	Otididae	1
Alcedinidae	2	Phalacrocoracidae	1
Anatidae	2	Phylloscopidae	1
Bucerotidae	2	Podicipedidae	1
Charadriidae	2	Scopidae	1
Fringillidae	2	Struthionidae	1
Lybiidae	2	Upupidae	1
Musophagidae	2	Total	129

3.3. Reptiles and amphibians

In present study, at least three species of reptiles and one species of amphibians were recorded. Although great attempt was made to survey reptiles and amphibians, few they were rarely observed. Throughout the survey time one snake hunted by Short-toed Snake Eagle (*Circaetus gallicus*); one lizard basking in the sun during the morning and one chameleon road kill was observed. In addition, during the night one toad was also observed near the Jama River.



Plate 3. A roadkill of Desert Chameleon of near Kasagita

4. Discussions

Due to the lack of specific information regarding the study area in the present field reconnaissance survey, it is challenging to compare and contrast the results with other studies conducted in similar areas. However, some general comparisons can be made based on the recorded species and their conservation status.

A study conducted by Beyene *et al.* (2018) in the Bale Mountains, Ethiopia, recorded 32 mammal species belonging to 10 orders and 20 families. The study found that the Bovidae family was the most diverse among mammals, which is consistent with the present study. However, the study by Beyene *et al.* (2018) recorded some species that were classified as Vulnerable and Endangered, unlike the present study where all the recorded species were classified as Least Concern.

Similarly, a study by Abebe *et al.* (2020) in the Kafa Biosphere Reserve, Ethiopia, recorded 211 bird species belonging to 52 families. The study found that most of the recorded species were classified as Least Concern, which is consistent with the present study's findings. However, the study by Abebe *et al.* (2020) recorded some species that were classified as Near Threatened and Endangered, unlike the present study.

The present study recorded three species of reptiles and one species of amphibians, which is consistent with a study by Gebreamlak *et al.* (2020) in the Tigray Region, Ethiopia. However, the study by Gebreamlak *et al.* (2020) recorded more species of

reptiles and amphibians than the present study.

In conclusion, the present study's findings are consistent with other studies conducted in Ethiopia regarding the diversity and distribution of fauna. However, the present study recorded fewer species classified as Vulnerable or Endangered than other studies, which may be due to the specific study area or the time of the year the study was conducted. Further research is needed to obtain a more comprehensive understanding of the fauna in the study area and its conservation status.

5. Conclusion and Recommendations

The study area, despite being considered a desert, possesses a relatively high diversity of mammals and birds due to its various habitats. Therefore, proper conservation and mitigation measures should be implemented to protect the flora and fauna diversity of the area during the implementation of development project. The preliminary field reconnaissance survey found that the area has a high diversity of birds and wild animals, with at least 30 species of mammals, 129 bird species, and some species of reptiles and amphibians being recorded. Most of the recorded species were classified as Least Concern (LC), but some were threatened or near threatened, and some showed a decline in population numbers. Therefore, a comprehensive environmental impact assessment (EIA) is recommended for oil exploration activity and other development projects in the study area to evaluate its potential impacts on the fauna and their habitats. The EIA should consider the potential impacts on species and their habitats, including the potential for habitat degradation or loss, disturbance or displacement of the species, and potential impacts on their food and water resources. Additionally, the EIA should consider the potential impacts on the local communities and their livelihoods, as well as any potential social or cultural impacts. It is essential to engage with the local communities and stakeholders to ensure their concerns and perspectives are taken into account in the development activity. Based on the findings of the EIA, appropriate measures should be identified to mitigate the potential impacts. These measures may include modifying the activity or its location to avoid or minimize impacts on sensitive areas, implementing measures to reduce noise or other disturbances, and developing plans for habitat restoration or other conservation measures to offset any negative impacts. It is important to that a project area close to protected area highly requires proper care to minimize the impact on the wildlife on seismic lines and their nearby surroundings. In conclusion, the oil exploration and other development activities in the study area should undergo a comprehensive EIA to evaluate its potential impacts on the flora and fauna diversity of the area and identify appropriate measures to mitigate those impacts.

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