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COMMUNICATION

SPECIES COMPOSITION AND ABUNDANCE OF RODENTS IN KAFTA-SHERARO NATIONAL PARK, ETHIOPIA: PRELIMINARY RESULTS

Alembrhan Assefa & Chelmala Srinivasulu

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SPECIES COMPOSITION AND ABUNDANCE OF RODENTS IN KAFTA-SHERARO NATIONAL PARK, ETHIOPIA: PRELIMINARY RESULTS

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Abstract: An ecological survey was conducted to assess the species composition and abundance of rodents in Kafta-Sheraro National Park, Ethiopia from June 2017 to April 2018 covering wet and dry seasons. Rodents were trapped using Sherman live traps from five selected habitat types—natural forest, bushland, grassland, farmland, and human settlement. A total of 209 individuals of rodents belonging to seven species were captured over 2940 trap nights, and three species of rodents were only observed. The trapped rodent species include *Mastomys natalensis*, *Stenocephalemys albipes*, *Rattus rattus*, *Mastomys awashensis*, *Acomys cahirinus*, *Arvicanthis niloticus dembeensis*, and *Mastomys erythroleucus*. *Lemniscomys striatus*, *Hystrix cristata*, and *Xerus rutilus* were only sighted during the study. *Mastomys natalensis* was the most abundant species (41.1%), followed by *Stenocephalemys albipes* (26.3%) and *Rattus rattus* (18.2%), whereas *Mastomys erythroleucus* (1.4%) was the least abundant species. The abundance of female (59.8%) was higher than male (40.2%). Of the total trapped rodents, 52.2% were adults, 32% sub-adult and 15.8% young. The abundance of rodents was varied among habitat types and between seasons. The results of the study revealed that the park has diverse species of fauna including rodents.

Keywords: Diversity, Horn of Africa, Rodentia, Tigray Region.

አህዮርት ጥናት (አጠቃላይ): በ ቃፍታ ሸራሮ ብሄራዊ ፓርክ ከ ሰኔ 2017 እስከ ሚያዝያ 2018 በ አይፕ ብዙሃንት ዙርያ ላይ የመስክ ጥናት ተደርጎዋል። አይጦችም ከ አምስት የተለያዩ መኖርያ አይነቶች ከ ጫካ፣ በሽላንድ፣ ግራሳንድ፣ የ እርሻ መሬት እና የሰው ሰፈራ ተሰብስበዋል። ባጣቃላይ 209 የሚያክል ብዛት ያላቸው ሰባት አይነት የ አይፕ ዝርያዎች በ 2940 የ ወጥመድ ምሽቶች ተጠምደዋል። ከተጠመዱት ዝርያዎች መካከል ማስቀማይል ናታሉንሲስ (ናታል ማልቴ ማሜት አይፕ)፣ ስተኖሰፋ-ላማይስ አልቢፒስ (ባለ ጎዎ አግር የ ኢትዮጵያ አይፕ)፣ ራተስ ራተስ (የ ቤት አይፕ)፣ ማስቀማይል አዋሽንሲስ (አዋሽ ማልቴ ማሜት አይፕ)፣ አኮማይስ ካሪንስ (ካይሮ ስፒሊ አይፕ)፣ አርቪካንተስ ኒሎቴክስ ደምቢኒስ (የ ሳር አይፕ) እና ማስቀማይል አርይትሮልይክስ (የ ጊኒ ማልቴ ማሜት አይፕ) ናቸው። በተጨማሪም ስድስት ዝርያዎች፣ ለሚኒስቴሪያል ስትርያተስ (ታይፒካል ስትሪፕት የ ሳር አይፕ)፣ ሂስትሪክስ ከሪስታታ (ጃርት) እና አንስትሪፕት ግራውንድ ስኩሪል (የመሬት አይፕ ቁን) ታይተዋል ግን አልተጠመዱም። ናታል ማልቴ ማሜት አይፕ በጣም ከፍተኛ የሆነ ቁጥር አስመዝግበዋል (41.1%) እንዲሁም ባለ ጎዎ አግር የ ኢትዮጵያ አይፕ (26.3%) እና የ ቤት አይፕ (18.2%) በቅድመ ተከተል ይቀጥላሉ። በተቃራኒ የ ጊኒ ማልቴ ማሜት አይፕ ብዛት በጣም አናሳ ነው። የ ሴት አይጦች (59.8%) ብዛት ከ ወንድ አይጦች ብዛት (40.2%) ይበልጣል። ከ አጣቃላይ የተጠመዱ አይጦች ብዛት፣ የ ጎልማሳዎች አይጦች ብዛት በከፍተኛ (52.2%) ተጠምደዋል እንዲሁም የ ከፊል ጎልማሳ (32.0%) እና የ ወጣት አይጦች ብዛት (15.8%) ይቀጥላሉ። የ አይጦች ብዛት በ መኖርያ አይነት እና በ ወቅት ይለያያል። የዚህ ጥናት ውጤት እንደምናየው በ ቃፍታ ሸራሮ ብሄራዊ ፓርክ ብዙ የተለያዩ ዝርያ ያላቸው አንስሳዎች አይጦችም ጭምር ይገኛሉ።

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Author Contribution: AA conceived, designed and conducted the fieldwork. CS supervised the research. Both the authors wrote the manuscript.

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INTRODUCTION

Globally, rodents are the most diverse and abundant group of mammals. Over 32 extant families, 468 genera and 2,277 species of rodents are recognized throughout the world, which represents 42% of the mammalian species (Wilson & Reeder 2005; Wolff & Sherman 2007). Similarly, in eastern Africa rodents are the most abundant and numerous, which account for 28% of the total recognized species of mammals (Afework 1996; Kingdon 1997). Ethiopia is among the countries with a high resource of biodiversity and endemism due to its wide variation in altitude ranges, geographical positions and climatic conditions (Leykun 2000; Lavrenchenko et al. 2007). A total of 320 mammalian species were recorded in Ethiopia, of which 84 species are rodents with 21% endemic (Afework 1996; Lavrenchenko et al. 2007).

Rodents are successful mammals in every continent and able to exploit wide ranges of habitat types (Lange et al. 2004; Workneh et al. 2006). Habitat structure, disturbance, and other important environmental factors affect the distribution pattern and abundance of rodents (Tadesse & Afework 2008; Demeke & Afework 2014). The knowledge on global distribution and diversity of mammals are not complete, especially so for small mammals including rodents, insectivores, and bats, as many taxa are still being discovered (Kingdon 1997; Wilson & Reeder 2005). Many investigations were conducted to study the distribution and abundance of rodents in different parts of Ethiopia (Messele & Afework 2012; Adugnaw & Messele 2016). Many areas of the country, mainly the northern highlands and lowlands, are underexplored due to the remoteness, inaccessibility, harsh conditions, and political instability in protected areas such as Kafta-Sheraro National Park (KSNP), Dessa'a National Priority Forest Area and other local forests. KSNP is the newly established national park of the country and comprises diverse fauna and flora; however, scientifically its wildlife, particularly small mammal diversity including rodent community, is not entirely known. The present study aims to assess the species composition and abundance of rodents in the unexplored KSNP.

MATERIALS AND METHODS

Study area

The study was conducted in KSNP (14.055–14.464 °N & 36.695–37.675 °E), northern Ethiopia (Fig. 1). KSNP is

located in the lowland part of western and northwestern Tigray regional state known for the highest peak of the country—Siemen Mountain, Ras Dashn. The altitudinal range of KSNP is between 568m and 1,163m with an average elevation of 870m. The national park was formerly established as Shire Wildlife Reserve area in 1968 and recognized as a national park in 2007 to safeguard the African Elephant and other biological resources. Initially the total area of the protected area was 5,000km² but currently, an area of 2,176.43km² has been accorded protected area recognition. The national park is bordered with three districts of the region; on the west is Kafta-Humera, on the east Tahtay-Adyabo, and on the south Welkayit. Eritrea borders the northern part of the national park. The agro-climate of the national park is identified with warmer temperature inclined to semi-arid climate. The national park is characterized by a uni-modal type of rainfall regime with one wet season and one dry season. It receives an annual average rainfall of 600mm, and high rainfall is during the wet season from the middle of May to the beginning of September. The average monthly temperature of the national park ranges from 18°C to 37.5°C. KSNP consists of spectacular topographic features that support diverse flora and fauna. The vegetation of the national park belongs to *Combretum-Terminalia*, *Acacia-Commiphora*, savanna grassland, and riparian woodlands type. KSNP is a host for 42 species of mammals, 200 species of birds, nine species of reptile, and various unstudied species of different animals and plants (Ethiopian Wildlife Conservation Authority 2015).

Grid design and trapping

Before the field survey, rodent collection permission was acquired from Ethiopian Wildlife Conservation Authority, Government of Ethiopia, and a preliminary survey was carried out to select study sites. Relevant information such as topography, climatic conditions, flora, fauna and others were gathered. Besides, habitat types of the park were identified based on the vegetation classification of the country (Yalden & Largen 1992) and five habitat types (Image 1), namely, natural forest, bushland, grassland, farmland, and human settlements, were selected for the study. A permanent live trapping grid was established at each of these five habitat types, and the trapping studies were conducted both during the wet and dry seasons. Each grid constituted an area of 4,900m² (70 x 70 m). A total of 49 Sherman live traps (7.6 x 8.9 x 22.9 cm) were set per each grid at 10m intervals between points. In each of the habitats studied, 49 traps were set for three consecutive days

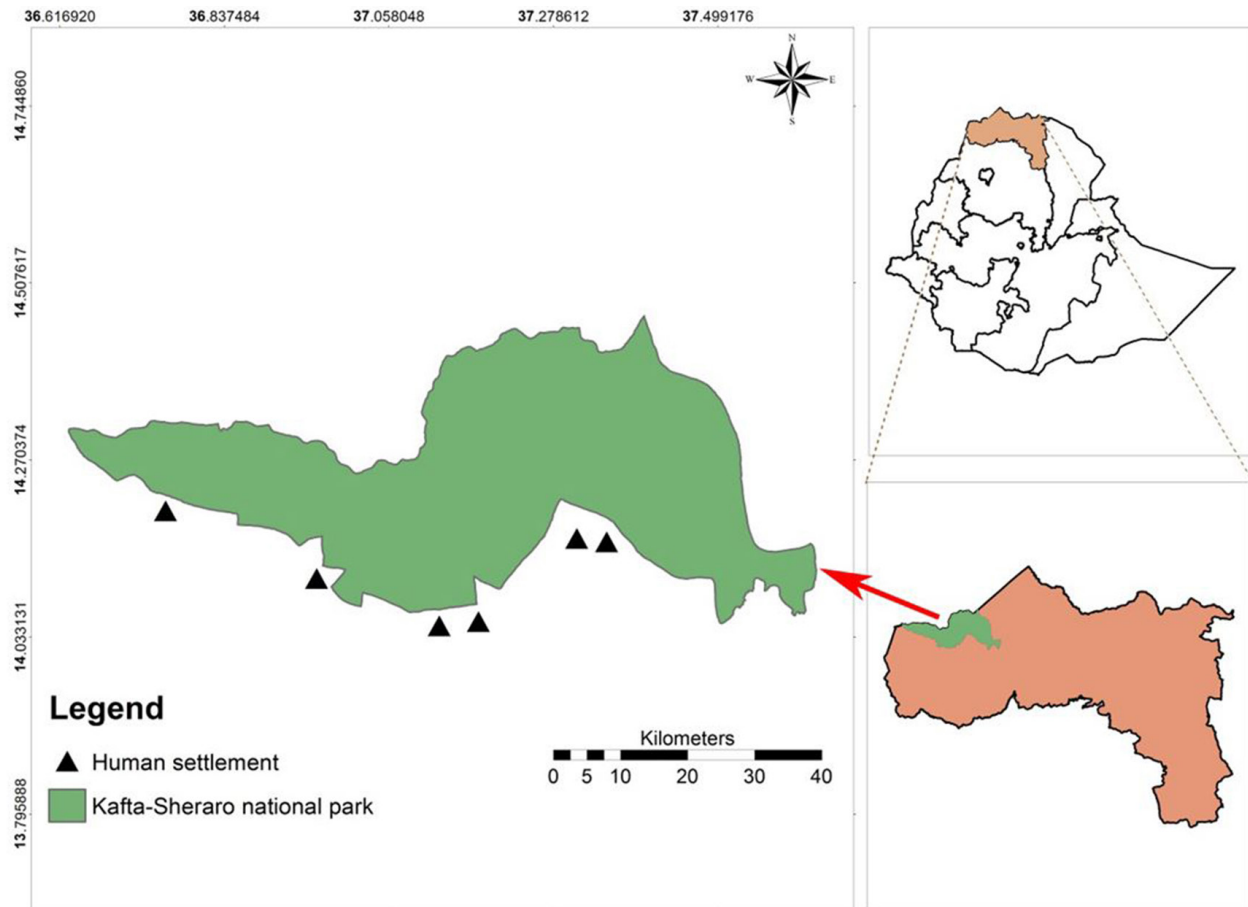


Figure 1. Kafta-Sheraro National Park (KSNP), Tigray Regional State, Ethiopia showing location of habitat types where rodent trappings were conducted.

amounting for 147 trap nights per habitat per season. During the present study 2,940 trap nights were spent in trapping efforts (147 trap nights x 2 seasons x 5 habitats). Peanut butter was mixed with crushed maize and rolled into small balls and then placed in the trap as bait. The traps were partially covered with leaves and grasses to prevent damage and death of trapped individuals. In order to locate the traps, each trap location was marked with yellow colored plastic tags on a branch of a nearby tree. Traps were checked early in the morning (07.00–09.00 h) and in the late afternoon (17.00–18.00 h) of each day for three consecutive days, and the bait was replenished as necessary to increase trapping success.

Each trapped rodent was collected and relevant data such as season, habitat type, station numbers, species type, body weight, sex, approximate age, and reproductive conditions were recorded. Sex of trapped rodents was determined based on their nipples, testes, and the distance between their anus and urethral opening. Their age was classified into

three categories—juvenile, sub-adult, and adult—and was determined based on their body size and weight, pelage color, and reproductive conditions (Taylor & Green 1976; Afework 1996). Reproductive conditions were determined based on the opening of the vagina (imperforated or perforated), size of nipples, and body weight for females, and the position of testicles (scrotal/ abdominal testes) for males (Taylor & Green 1976). Furthermore, necessary information such as morphometric measurements including body weight, lengths of head and body, hind foot, ear, tail, and other morphological characteristics of each trapped rodents were recorded. Representative species were collected as vouchers, and the voucher specimens were deposited in the collection of the Zoological Science Natural History Museum of Addis Ababa University, Addis Ababa. All trapped rodents were marked by toe-clipping and released at their capture site for further capture-mark-recapture studies. Species identification was following standard references (Afework 1996; Kingdon 1997). The

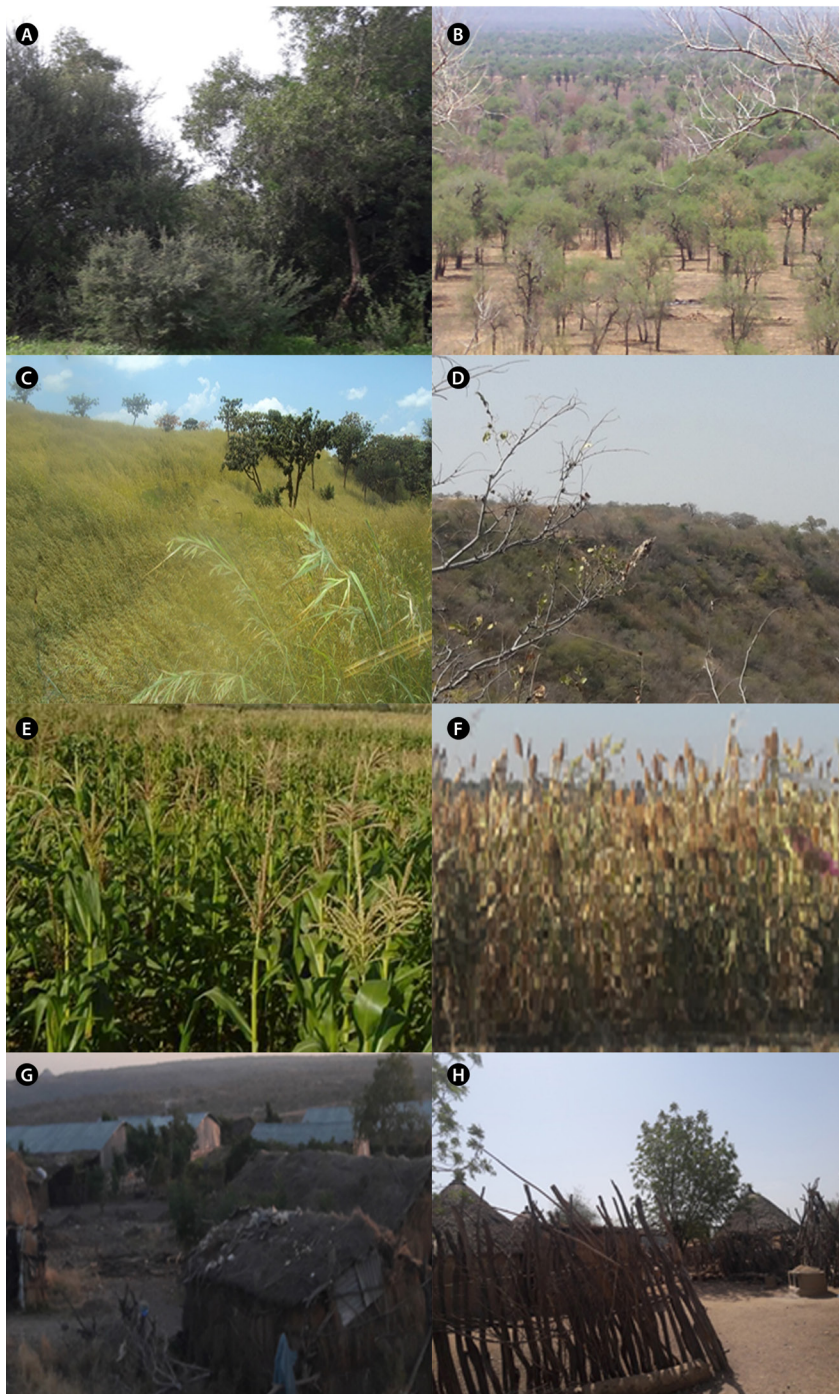


Image 1. Habitat types of Kafta-Sheraro National Park (KSNP), Ethiopia where rodent surveys were carried out; A & B - Natural forest | C - Grassland | D - Bushland | E - Farmland (Maize) | F - Farmland (Sorghum) | G - Human settlements (Adigoshu Military Camp) | H - Human settlements (Adebay Town). © Alembrhan Assefa.

species identification was further checked using cranio-dental morphology and morphometric measurements. Voucher specimens were compared with the specimens in the collection of the Zoological Natural History Museum of Addis Ababa University, Addis Ababa.

The collected data were analyzed using SPSS version

22 computer software programme. Two-way ANOVA was used to test the significant variation of rodent species trapped across different habitat types, seasons, sex, and age groups. Species richness and diversity were computed using Shannon-Weaver diversity index (Shannon & Weaver 1949). Shannon-Weaver diversity

index was calculated using the formula $H' = \sum (P_i) \ln (p_i)$. Where, H' - Shannon-Weaver diversity index, P_i - proportion of the total individuals belonging to i^{th} species in the sample, \ln - the natural logarithm and \sum - sum of the calculations. Evenness (E) was calculated using the formula, $E = H' / H'_{\text{max}}$. Where, $H'_{\text{max}} = \ln (S)$, S is the number of species and H' is Shannon diversity index. We used PAST software (Hammer et al. 2001) to prepare the species accumulation curve (Mao Tau function) to assess representativeness of the sampling effort of rodents during the study.

RESULTS

Totally ten species of rodents were recorded in the study, of which seven species were trapped, and three species were directly sighted. The trapped species included *Mastomys natalensis* (Smith, 1834), *Stenocephalemys albipes* (Rüppell, 1842), *Rattus rattus* (Linnaeus, 1758), *Mastomys awashensis* (Lavrenchenko, Likhnova & Baskevich, 1998), *Acomys cahirinus* (É. Geoffrey, 1803), *Arvicanthis niloticus dembeensis* (Rüppell, 1842) and *Mastomys erythroleucus* (Temminck, 1853), while the sighted species *Lemniscomys striatus* (Linnaeus, 1758), *Hystrix cristata* (Linnaeus, 1758), and *Xerus rutilus* (Cretzschmar, 1828). *Mastomys awashensis* and *S. albipes* are among the endemic rodent species of the country. A total of 258 captures of 209 individual rodents were trapped in 2940 trap nights during both the wet and dry seasons of the study. Of these 209 were new captures and 49 were recaptured. The total number of captures varied among species. *Mastomys natalensis* was the most abundant species constituting 41.1% of the total number of captures, followed by *S. albipes* (26.3%) and *R. rattus* (18.2%), respectively and *M. erythroleucus* (1.4%) was the least abundant species (Table 1).

M. natalensis and *R. rattus* were recorded in all habitat types (Fig. 2), while *S. albipes* and *M. awashensis* were captured in four habitats and absent from grasslands, *A. cahirinus* and *A. n. dembeensis* were captured in three habitats and absent from natural forests and farmlands, and *M. erythroleucus* was captured only from natural forest and farmland habitats. In the natural forests, *S. albipes* was the most captured species followed by *R. rattus*, while in all the other habitat types *M. natalensis* dominated (Table 2). There was significant variation in total number of captures with respect to species (Two-Factor ANOVA: $F_{6,4} = 19.339$, $p < 0.05$) but not among habitat types (Two-Factor ANOVA: $F_{4,24} = 1.507$, NS).

The species richness, diversity, and evenness of rodents varied among habitat types (Table 3). The highest species richness was recorded from bushland and human settlement habitats (6 species each), while the least was in grassland (4 species). The highest Shannon-Weaver diversity index was observed in human settlement ($H' = 1.41$), followed by bushland ($H' = 1.25$) and the least was in grassland ($H' = 1.11$) habitats. Grassland recorded the highest evenness ($E = 0.800$) and bushland had the lowest evenness ($E = 0.695$). The species accumulation curve for all habitat types (Fig. 3) has fully reach asymptote indicating that no more sampling effort is needed to capture all the expected rodent species of the park.

The number of captures and abundance of rodents during the wet and dry season was 128 (61.2%) and 81 (38.8%), respectively. During the wet season, *A. n. dembeensis* (75%), *S. albipes* (69.1%) and *M. natalensis* (58.1%) were highly recorded. *A. cahirinus* (83.3%) was recorded highly during the dry season while, *A. n. dembeensis* was the least recorded (25.0%). *M. erythroleucus* was only captured during the dry season (Table 4). The total number of captures of rodents did not vary significantly between seasons (Two-Factor ANOVA: $F_{4,15} = 0.732$, NS).

The sex ratio is in favour of females (1:1.48) with 59.8% of the total captures being female specimens (Table 5). In the wet season, more females than males were captured, but in the dry season the captures were more or less equal for both the sexes. There was significant variation between male and female individuals of *M. natalensis* (Two-Factor ANOVA: $F_{1,4} = 4.745$, $p < 0.05$), *A. cahirinus* (Two-Factor ANOVA: $F_{1,4} = 6.000$, $p < 0.05$), and *A. n. dembeensis* (Two-Factor ANOVA: $F_{1,4} = 4.800$, $p < 0.05$). Only *M. natalensis* (Two-Factor ANOVA: $F_{4,4} = 3.220$, $p < 0.05$) and *S. albipes* (Two-Factor ANOVA: $F_{4,4} = 5.756$, $p < 0.01$) have shown significant variation with respect to sexes in different habitats.

Adult rodents comprised the highest number of individuals (52.2%), followed by sub-adults (32.0%) and juveniles (15.8%) (Table 6). The number of individuals of all age groups was higher during the wet season than the dry season. Significant variation was observed among different age groups only in *M. natalensis* (Two-Factor ANOVA: $F_{2,4} = 5.756$, $p < 0.01$), *S. albipes* (Two-Factor ANOVA: $F_{2,4} = 3.310$, $p < 0.05$), and *A. cahirinus* (Two-Factor ANOVA: $F_{2,4} = 6.000$, $p < 0.01$).

Table 1. Species composition, relative abundance (RA) and conservation status (CS) of rodents in Kafta-Sheraro National Park (KSNP), Ethiopia.

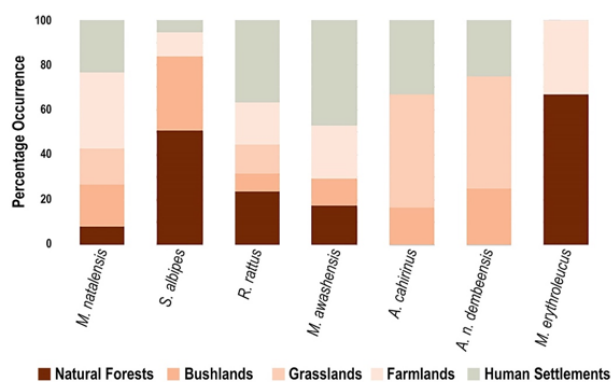
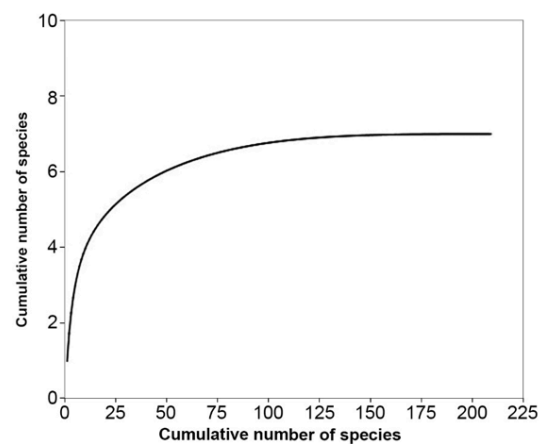
| Family | Scientific name | Common name | Total | RA (%) | CS | Voucher no. | |
|--------------|---|--|---------------------------|--------|----|-------------------------|---|
| Muridae | <i>Mastomys natalensis</i> (Smith, 1834) | Natal Multimammate Mouse | 86 | 41.1 | LC | ZNHM.AAU.KSNP-R.07.2017 | |
| | <i>Stenocephalemys albipes</i> (Rüppell, 1842) | Ethiopian White-footed Mouse | 55 | 26.3 | LC | ZNHM.AAU.KSNP-R.04.2017 | |
| | <i>Rattus rattus</i> (Linnaeus, 1758) | Black Rat/Roof Rat | 38 | 18.2 | LC | ZNHM.AAU.KSNP-R.09.2017 | |
| | <i>Mastomys awashensis</i> (Lavrenchenko, Likhnova & Baskevich, 1998) | Awash Multimammate Mouse | 17 | 8.1 | VU | ZNHM.AAU.KSNP-R.02.2017 | |
| | <i>Acomys cahirinus</i> (É. Geoffrey, 1803) | Cairo Spiny Mouse | 6 | 2.9 | LC | ZNHM.AAU.KSNP-R.10.2017 | |
| | <i>Arvicanthis niloticus dembeensis</i> (Rüppell, 1842) | African Grass Rat | 4 | 1.9 | LC | ZNHM.AAU.KSNP-R.13.2017 | |
| | <i>Mastomys erythroleucus</i> (Temminck, 1853) | Guinea Multimammate Mouse | 3 | 1.4 | LC | ZNHM.AAU.KSNP-R.11.2017 | |
| | <i>Lemniscomys striatus</i> (Linnaeus, 1758) | Typical Striped Grass Mouse | # | # | LC | - | |
| | Hystricidae | <i>Hystrix cristata</i> (Linnaeus, 1758) | Crested Porcupine | # | # | LC | - |
| | Sciuridae | <i>Xerus rutilus</i> (Cretzschmar, 1828) | Unstriped Ground Squirrel | # | # | LC | - |
| Total | | | 209 | 100 | | | |

= sighted species, CS = IUCN status, LC = Least Concern, VU = Vulnerable, ZNHM.AAU = Zoological Natural History Museum of Addis Ababa University, KSNP-R = Kafta-Sheraro National Park Rodent voucher number, - = no voucher number.

Table 2. Number and abundance (%) of rodent species among habitat types of Kafta-Sheraro National Park (KSNP), Ethiopia.

| Species | Habitat types | | | | |
|-------------------------|---------------|------------|------------|------------|------------|
| | NF | BL | GL | FL | HS |
| <i>M. natalensis</i> | 7 (14.28) | 16 (39.02) | 14 (58.33) | 29 (41.42) | 20 (41.66) |
| <i>S. albipes</i> | 28 (57.14) | 18 (43.90) | - | 6 (8.57) | 3 (6.25) |
| <i>R. rattus</i> | 9 (18.36) | 3 (7.31) | 5 (20.83) | 7 (10.00) | 14 (29.16) |
| <i>M. awashensis</i> | 3 (6.12) | 2 (4.87) | - | 4 (5.71) | 8 (16.66) |
| <i>A. cahirinus</i> | - | 1 (2.43) | 3 (12.50) | - | 2 (4.16) |
| <i>A. n. dembeensis</i> | - | 1 (2.43) | 2 (8.33) | - | 1 (2.08) |
| <i>M. erythroleucus</i> | 2 (4.08) | - | - | 1 (34.28) | - |
| Total | 49 | 41 | 24 | 47 | 48 |

NF = Natural forest, BL = Bushland, GL = Grassland, FL = Farmland, HS = Human settlement, - = no capture.

**Figure 2. Percentage composition rodent species captured from five habitats in Kafta-Sheraro National Park (KSNP), Ethiopia.****Figure 3. Species accumulation curve of rodent species in Kafta-Sheraro National Park (KSNP), Ethiopia.**

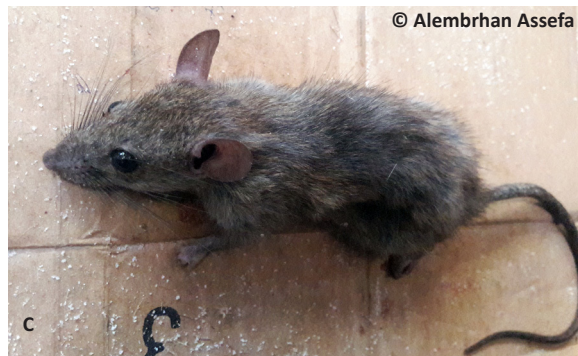


Image 2. Rodents trapped during the present study at Kafta-Sheraro National Park (KSNP), Ethiopia; A - *Mastomys natalensis* | B - *Mastomys awashensis* | C - *Mastomys erythroleucus* | D - *Stenocephalemys albipes* | E - *Acomys cahirinus* | F - *Arvicanthis niloticus dembeensis* | G - *Rattus rattus*.

Table 3. Diversity indices of rodents among habitat types in Kafta-Sheraro National Park (KSNP), Ethiopia.

| Habitat | No. of species | Total catch | H' | H _{Max} | E | D |
|---------|----------------|-------------|------|------------------|-------|--------|
| NF | 5 | 49 | 1.21 | 1.609 | 0.753 | 0.3861 |
| BL | 6 | 41 | 1.25 | 1.792 | 0.695 | 0.354 |
| GL | 4 | 24 | 1.11 | 1.386 | 0.800 | 0.4063 |
| FL | 5 | 47 | 1.14 | 1.609 | 0.705 | 0.4269 |
| HS | 6 | 48 | 1.41 | 1.792 | 0.787 | 0.2925 |

NF = Natural forest, BL = Bushland, GL = Grassland, FL = Farmland, HS = Human settlement, H' = Shannon-Weaver index, H_{Max} = natural logarithm of total number of species, E = Evenness, D = Dominance.

Table 4. Number and abundance (%) of rodents trapped during dry and wet seasons in Kafta-Sheraro National Park (KSNP), Ethiopia.

| Species | Seasons | | |
|-------------------------|------------|-----------|-------|
| | Wet | Dry | Total |
| <i>M. natalensis</i> | 50 (58.1) | 36 (41.9) | 86 |
| <i>S. albipes</i> | 38 (69.1) | 17 (30.9) | 55 |
| <i>R. rattus</i> | 25 (65.8) | 13 (34.2) | 38 |
| <i>M. awashensis</i> | 11 (64.7) | 6 (35.3) | 17 |
| <i>A. cahirinus</i> | 1 (16.7) | 5 (83.3) | 6 |
| <i>A. n. dembeensis</i> | 3 (75.0) | 1 (25.0) | 4 |
| <i>M. erythroleucus</i> | - | 3 (100.0) | 3 |
| Total (%) | 128 (61.2) | 81 (38.8) | 209 |
| No. of species | 6 | 7 | 7 |

Table 5. Sex distribution of rodents between wet and dry seasons in Kafta-Sheraro National Park (KSNP).

| Species | Wet season | | Dry season | |
|-------------------------|------------|------------|------------|------------|
| | F | M | F | M |
| <i>M. natalensis</i> | 33 (66.00) | 17 (34.00) | 21 (58.33) | 15 (41.66) |
| <i>S. albipes</i> | 27 (71.05) | 11 (28.94) | 9 (52.94) | 8 (47.05) |
| <i>R. rattus</i> | 16 (64.00) | 9 (36.00) | 7 (53.84) | 6 (46.15) |
| <i>M. awashensis</i> | 8 (72.72) | 3 (27.27) | 1 (16.66) | 5 (83.33) |
| <i>A. cahirinus</i> | - | 1 (100.00) | - | 5 (100.00) |
| <i>A. n. dembeensis</i> | - | 3 (100.00) | - | 1 (100.00) |
| <i>M. erythroleucus</i> | - | - | 3 (100.00) | - |
| Total | 84 (65.62) | 44 (34.37) | 41 (50.61) | 40 (49.38) |

F = female, M = male.

Table 6. Age distribution of rodents captured between seasons in Kafta-Sheraro National Park (KSNP), Ethiopia (values in parenthesis are percentage of age class in particular season).

| Species | Juvenile | | Sub-adult | | Adult | |
|-------------------------|-----------------------------|---------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| | Wet | Dry | Wet | Dry | Wet | Dry |
| <i>M. natalensis</i> | 10 | 5 | 18 | 9 | 22 | 22 |
| <i>S. albipes</i> | 7 | 1 | 15 | 5 | 16 | 11 |
| <i>R. rattus</i> | 5 | 1 | 9 | 5 | 11 | 7 |
| <i>M. awashensis</i> | 3 | 0 | 3 | 2 | 5 | 4 |
| <i>A. cahirinus</i> | 0 | 0 | 0 | 0 | 1 | 5 |
| <i>A. n. dembeensis</i> | 1 | 0 | 0 | 0 | 2 | 1 |
| <i>M. erythroleucus</i> | 0 | 0 | 0 | 1 | 0 | 2 |
| Total | 26 (20.31) | 7 (8.64) | 45 (35.15) | 22 (27.16) | 57 (44.53) | 52 (64.19) |

DISCUSSION

A total of 10 species of rodents were identified. Relatively similar representations of rodents were recorded previously in different protected areas of Ethiopia (Tilahun et al. 2012; Getachew & Afework 2015). High numbers of rodent species were reported

from Alatish National Park, Chebera-Churchura National Park and Chilalo-Galama Mountain range (Tadesse & Afework 2008). Various levels of habitat productivity, habitat structure and complexity, risk of predation, food availability, human activities, and cattle grazing influence species richness. KSNP is highly disturbed by anthropogenic activities such as gold mining and forest

destruction for agricultural expansion and charcoal production. Along with these biotic interventions livestock grazing is also rampant. These may be detrimental in rodent distribution within the park.

M. natalensis was the most abundant and widely distributed species in all habitat types studied, and was recorded in different habitat types including human settlements, and is considered as the most common pest species (Demeke et al. 2007; Tadesse & Afework 2008). Our observation on the abundance of this species agrees with earlier studies (Tilahun et al. 2012). However, higher abundance of *M. natalensis* has been reported in different areas (Manyingerew et al. 2006; Mohammed & Afework 2011; Mulungu et al. 2013). The high abundance of *M. natalensis* in different environments and habitats in its range could be due to its high reproductive potential, large litter size, ecological adaptability, and opportunistic food habit.

S. albipes was the second most abundant rodent species, is highly associated and abundant in natural forest habitats. Yalden & Lagen (1992) reported *S. albipes* as one of the most abundant and common endemic rodent species of Ethiopia. Similar abundance was reported from other areas in Ethiopia (Mohammed & Afework 2011), however, low abundance of this species was also reported by others (Tadesse & Afework 2008; Tilahun et al. 2012). *Rattus rattus* was the third most abundant rodent species in the study area, and was mostly associated with human settlements, an observation that agrees with Moussa et al. (2015). This species was as least abundant Wonji sugarcane plantation and Chebera-Churchura National Park (Serkebirhan et al. 2011); however, Meheretu et al. (2014) reported this species to be abundant.

The abundance of *A. cahirinus* in this study was consistent with earlier reports (Tilahun et al. 2012; Getachew & Afework 2015). Unlike the present study, high abundance of *A. n. dembeensis* were reported in different parts of Ethiopia (Tilahun et al. 2012). *M. erythroleucus* is the most and important maize pest in eastern Africa (Odhiambo et al. 2005), and it was the least abundant species recorded in the study. Interestingly, many individuals of this species were trapped from natural forests. Similar findings were reported by Tadesse & Afework (2008). Afework & Leirs (1997) reported the highest abundance of this species in Central Ethiopia. Variations in the abundance of these species in different areas might be due to the variations in vegetation cover, food supply, and predators.

The highest species richness and diversity of rodents in bushland and human settlement habitat types

contradicts with the findings of Demeke et al. (2007) and Moges & Dessalegn (2015), who reported that the bushland is structurally simple and comprises low biotic diversity. As compared to other habitat types of KSNP, bushland and human settlement habitats deliver relatively high shelter and food sources for rodents throughout the year.

The total number of captures and abundance of rodents was higher during the wet season than dry season, and agrees with those of Dawit & Afework (2008), (Serkebrerhan et al. 2011), and (Tilahun et al. 2012). Since the park is characterized by a uni-modal type of rainfall regime, high rainfall occurs during the wet season, as a result, there may be adequate shelter and food resources, which can contribute to high number of trapped individual rodents than the dry season. Several studies revealed that seasonal variation in weather conditions like rainfall affects the nutritional aspects, life strategies, and reproductive potential of rodents (Makundi et al. 2006; Tadesse & Afework 2008).

The sex ratio was found to be female biased, with more number of females captured than the males. Similar observations were reported by Tadesse & Afework (2008), however, in some areas male biased sex ratio was also reported (Manyingerew et al. 2006; Dawit & Afework 2008). This variation might be due to factors such as availability of food and microclimatic niches favouring females than males. Males being more abundant than the females could be due to their increased activity (Getachew & Afework 2015).

Out of the total trapped individuals, most captures were that of adults, and the least were that of juveniles. The probability of capturing more adults is may be due to their large home range, active movement, and fast capture ability. Adult animals have a higher social ranking, and cover wide home ranges, which causes higher capture rate than young individuals (Shanker 2001; Workneh et al. 2006). Higher numbers of individuals of all age groups were recorded during the wet seasons than dry seasons, and agree with findings of Makundi et al. (2006) and Getachew & Afework (2015). The seasonal variation among age groups might be due to the relationship between rainfall, seasonality in reproduction and seasonal based movement of rodents outside their home. During the present study, pregnant females of only four species were trapped. Higher pregnant females were recorded during the wet season than dry seasons, indicating that the more species reproduce more often in the wet season that may related with increased availability of food resources. Makundi et al. (2006) notified that seasonal variations in weather

condition, mainly the rainfall, determine the nutritious features, which influences rodent reproduction.

During the present study, we have also observed that some rodent species including *H. cristata*, *A. n. dembeensis*, *S. albipes*, and *M. natalensis* are consumed as food locally by the indigenous Kunama ethnic group. Tadesse & Afework (2008) and Assogbadjo et al. (2005) also reported the economic importance of rodents as food source for Gumuz people, Ethiopia and Benin, respectively. This could be due to the high nutrient content in meat of rodents and hunting-based feeding habit of the people. The present study reveals that rodent diversity in KSNP is a reflection of the habitat quality and their composition and abundance in different habitat types and seasons varied. Long-term monitoring and detailed studies on ecological aspects of the rodents is suggested for future to provide more scientific information and insights on the rodent diversity in one of the least-explored and eco-sensitive protected areas of Ethiopia.

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