

Research Paper

Population status and activity pattern of desert warthog (*Phacochoerus aethiopicus*) in Abijata-Shalla Lakes National Park, Ethiopia

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ABSTRACT

Desert warthogs (*Phacochoerus aethiopicus*) are common pig specie in the sub Saharan region of Africa in particular South Western Ethiopia. A study on the population dynamics and activity pattern of Desert warthog was carried out on both wet and dry season 2010/11 in Abijata-Shalla Lakes National Park. The ground total count method was employed in the park. The count ranged between 72 and 46 individuals. Females comprised 48.30% while males 33.06%. The herd size altered with seasons. Large herds were frequently observed during the wet season and smaller groups during the dry season. About 71% of the total time was spent in feeding and 20% in resting. There were two feeding peaks, one in the morning and another in the afternoon, and one resting peak in the middle of the day. Desert Warthogs are in decline and face continued threats through human activities in the form of competition for foraging habitat with domestic livestock and settlements in their former range.

Key words: Warthog, feeding, diurnal activity pattern, seasons, Ethiopia.

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INTRODUCTION

Based on genetic evidence two distinct species of warthogs were recognized in Africa specifically the *Phacochoerus africanus*, common warthog, and the *Phacochoerus aethiopicus*, the desert warthog (Kleiman et al., 2004). The extant warthog range extends discontinuously across the sub-Saharan region of Africa (Wilson and Reeder, 1993). These two species are distinguished largely through the presence and absence of functional incisors and external appearance (d'Huart and Grubb, 2005).

The common warthog is distributed widely over Africa. Desert warthogs occur in the sub-Saharan region of Africa and especially in south-western Ethiopia. They are found in southern, south-western and eastern Ethiopia where grassland and open woodland is found. But until recently, very little research has been devoted to investigating Desert warthog ecology, and there have been no organized surveys of its distribution and population densities in

Ethiopia.

Desert warthogs inhabit dry savannas and grasslands species, though they have higher tolerance for dry condition than common warthogs and so can inhabit in more arid and desert-like conditions (Mendoza and Palmqvist, 2007). Such difference may be indications of evolutionary divergence, leading them to grow a different capacity for water conservation and differences in behavioral ecology on its harsh natural environment (Kingdon, 1997). The size of Desert warthogs in Ethiopia not yet measured but according to Somers and Penzhorn (1992) they are large, over 1 m long and generally more than 0.5 m tall at the shoulder. There is a significant sexual dimorphism; males are significantly larger than females. Warts distinguishing between sexes; males have much larger and easily seen warts with larger tusks, Juveniles are with much reduced warts and no tusks (Cumming, 1975).

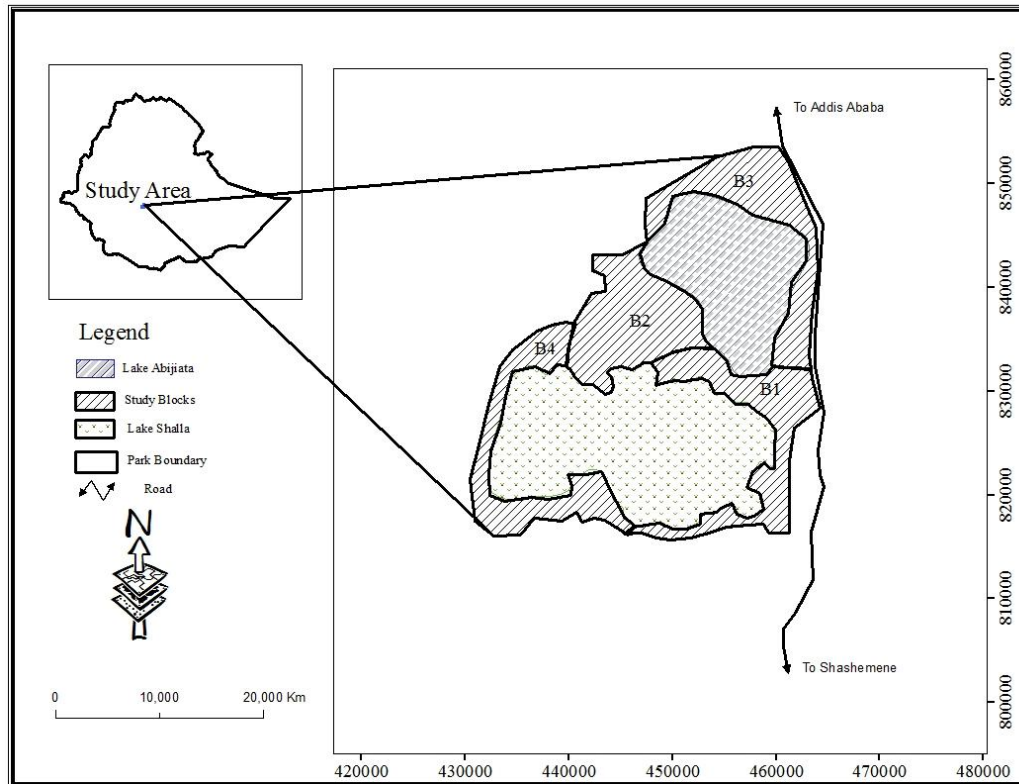


Figure 1. Map of Abijata-Shalla Lakes National Park and the study area.

Reproduction may be markedly seasonal. They inhabit areas with distinct dry and rainy seasons and tend to breed towards the end of the wet season (peaking around early April). Females of desert warthog are polyestrous, with estrous periods lasting for about 72 h (d'Huart and Grubb, 2001). Females give birth in the park after the rainy season ended mainly during late September and it is common to see a female with 3 to 4 piglets. Young emerge from the burrow to feed on grasses at about 3 weeks of age, though they are not fully weaned until they are about 6 months old. Piglets follow the mother wherever she goes, suckling as much as every 40 min, using her as shade from the hot sun (Mason, 1985).

Desert warthogs eat a variety of grasses and shrubs, and occasionally fruits and insects. An important component of their diet is underground rhizomes, bulbs, and tubers, all of which are dug up with the tusks and snout (Nyafu, 2009). They have specialized multi-cusped hypsodont third molar and reduced premolars which makes them well-adapted to grazing (Mendoza and Palmqvist, 2007).

Desert warthogs are considered in decline and face continued threats through human persecution in the form of hunting and competition for foraging habitat with domestic livestock (Muwanika et al., 2003). In areas where human persecution is intense many populations have become somewhat nocturnal, a change from their normal

diurnal lifestyle (Kingdon, 1979). Desert warthogs are limited in numbers and possibly possess discontinuous distribution, contracting range, and potential levels of exploitation qualify this species for the 'Vulnerable' category (International Union for Conservation of Nature, 1996).

Given the decrease in natural habitat along with population number of the species, a critical need to evaluate the current population status and activity pattern of warthog in the park is essential. Information on activity pattern, distribution and population status of warthog especially in Ethiopia is limited. So, this study will fill the gap in gathering additional information on the species.

MATERIALS AND METHODS

Study area

Abijata-Shalla Lakes National Park (ASLNP) is one of the scenically beautiful spot of Ethiopia, possessing major natural resources like naturally blue and pink colored lakes. The vegetation zone of the study site is generally classified as savannah, Acacia trees and *Ficus* savannah. The total area of the Park reached 887 km², of which 482 km² is covered by Lakes Abijata and Shalla (Figure 1). The area

Table 1.Total count of warthogs during wet and dry seasons.

Season	B ₁	B ₂	B ₃	B ₄	Total
Wet	11	28	10	23	72
Dry	20	11	6	9	46
Mean	15.5±5.43	19.5±4.56	8±3.2	16 ±4.1	59±7.4

encompasses an altitude ranging between 1250 m and 1360 m. The annual pattern of rainfall in the region is bimodal, with a short rainy season during March to April and a long rainy season during June to September.

The study covers both wet and dry seasons. Quantitative data were collected during both seasons on the population size, structure, habitat utilization and diurnal activity pattern of warthog. For the purpose of this investigation, the park area was divided into four blocks (Figure 1). The whole population was counted, rather than a smaller sample of the whole to estimate population size. This was based on silent detection as accomplished by Norton-Griffiths (1978), Sutherland (1996) and Kumssa and Bekele (2008). Total estimation of warthog population in the Park required intensive coverage of the whole study area in both dry and wet seasons. Good visibility and close approaching to the animal made accurate census with a reasonable degree of accuracy. Direct observation was made by unaided eye and/or using pentax 8-20x 24 binoculars depending on the distance between the observer and focal animals as well as the topography of the habitat. There was minimal human error in counting warthog, because they are seen singly or in very small group. Additionally the counting blocks were selected based on natural boundaries and/or artificial boundaries that are noticed easily if there is movement of animals from one block to the other. Counts usually commenced when desert warthogs were most active and when there is Vigilant from 06 to 10:30 h during morning and from 17.00 to 18.00 h during late afternoon. Every total count ended with a maximum of 2.5 h in a day. During the census, detailed observation of the entire herd was collected.

Warthogs were assigned to one of the three age classes. The classes are the adult male and female, sub-adult male and female, and unknown sex (young). To identify the animals into such groups the methods of Bradley (1972), Lewis and Wilson (1979), Bowyer (1984) and Kumssa and Bekele (2008) were employed. The habitats in the park were classified as woody grassland, woodland and open grassland. The vegetation type in which the warthogs were observed was recorded in order to analyze the wet and dry season distribution of the animal.

The activity pattern of desert warthogs followed the one described by Altman (1974). Scan samples of activities were taken at 5 min intervals for all visible members of a group at a distance of 5-10 m. The technique involves classifying the behavior into a number of specific activities and noting which

one is being carried out in a given time (Mason, 1982). Only the descriptive names of behavior patterns are given here. The following categories were used for the activity pattern (feeding, resting, walking, standing, socializing and others). The process was repeated on 20 individuals at random at three time periods: early morning, noon and dusk (Lehner, 1996). Both the population status and activity patterns were divided into wet and dry seasons.

Data collected were analyzed using SPSS version 17 computer software program. Data was described using descriptive statistics and responses compared using chi-square test and one-way ANOVA.

RESULTS

Data on observations of warthog using the total count are given in Table 1. The maximum number of Desert warthog population counted in wet season was 72 and the lowest number was 46 in the dry season. Fluctuation in number of warthog in each counting block was observed. There is an increase in the number during the wet season. There was a significant difference between wet and dry seasons ($\chi^2=4.56$, $df=1$, $p<0.05$). There were differences in the mean number of warthog observed during wet and dry season in the different study blocks. The highest record during the wet seasons was 28 from block 2. The lowest mean was 10 in block 3. During the dry season, the highest mean was 20 in block 1 (park head quarter) and the lowest was 6 in block 3. Data on population counts in the study blocks 1, 2 and 4 showed a significant differences ($\chi^2=16.03$, $df=1$, $p<0.05$) with more warthog during the wet season in B₂ and B₄ and during the dry season in B₁. An extrapolation of the sample block area population to the total terrestrial area of the park (405 km²) was 154 individuals.

Out of the 59 individuals sighted during the present observation period, adult females comprised 38.98% and adult males 27.12%. Sub-adult females and sub-adult males comprised 9.32 and 5.94%, respectively and young 18.64%. Adult male to female, adult to young and sub adult male to female showed significant differences between the sex and age structure in both wet and dry seasons ($\chi^2=2.35$, $df=1$, $p<0.05$) (Figure 2). The sex ratio of warthog is given in Table 2. The male to female ratios was 1:1.3 and 1: 1.7 during the wet and dry seasons, respectively. There was a significant difference ($\chi^2=5.21$, $df=1$, $p<0.05$) between

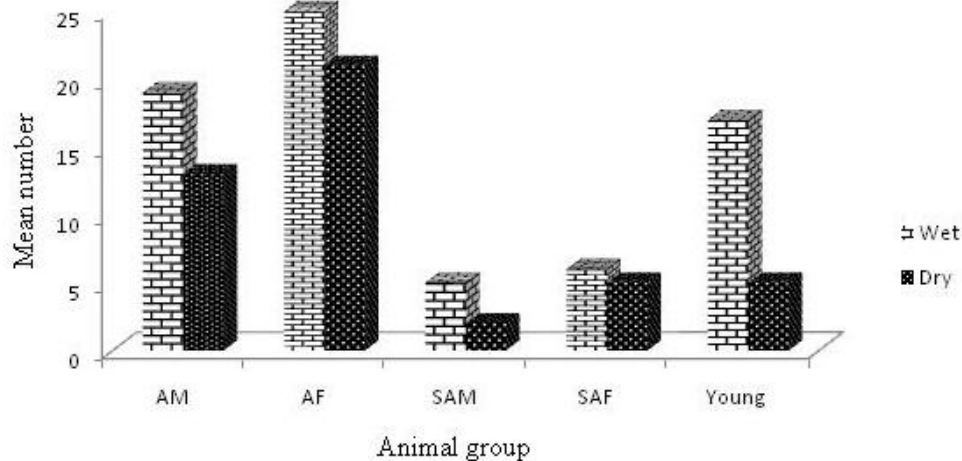


Figure 2. Mean number of different age and sex categories of warthog observed during wet and dry seasons (AM=adult male, AF=adult female, SAM=sub-adult male, SAF=sub-adult female).

Table 2. Age and sex categories of the warthogs observed during the wet and dry seasons.

Season	Sex and agecategory			
	AM: AF	SAM:SAF	M:F	Ad: Yg
Wet	1: 1.3	1:1.2	1:1.3	1:2.6
Dry	1: 1.4	1:2:5	1:1.7	1:6.8

AM=adult male, AF=adult female, SAM=sub-adult male, SAF=sub-adult female, Ad= adult, Yg= Young

Table 3. Group size of warthog during wet and dry seasons.

Season	Total number	Range of group size	Mean group
Wet	72	3-8	5±2
Dry	46	3-6	4±1.5

Table 4. Distribution of Warthog based on vegetation structure.

Season	Wooded grassland	Woodland	Open grassland
Wet	38	25	13
Dry	16	9	17

males and females at different seasons.

The age ratio of adult to young during the wet season was 1:2.6 and during the dry season it was 1:6.8 which showed a significant difference ($\chi^2 = 3.14$, $df=1$, $p<0.05$). The age ratio of male to female during the wet and dry seasons showed a significant difference ($\chi^2 = 5.23$, $df=1$, $p<0.05$).

The herd size ranged from 4 to 6 individuals. The mean herd size observed during the wet and dry season was 5 ± 1.3 and 4 ± 0.2 , respectively. The herd size was not significantly different between seasons (Table 3). A herd is

usually composed of one adult female and male and their offspring including sub-adult females.

The distribution of warthog at different habitat types during wet and dry seasons is given in Table 4. During the wet season, 50% of the animals were recorded grazing in wooded grassland. Open grassland had only 18.05% of the warthog during this season. During the dry season, they were more frequently observed in the open grassland vegetation (45.65%), whereas their percentage occurrence in wooded grassland was only 34.78%. The distribution of

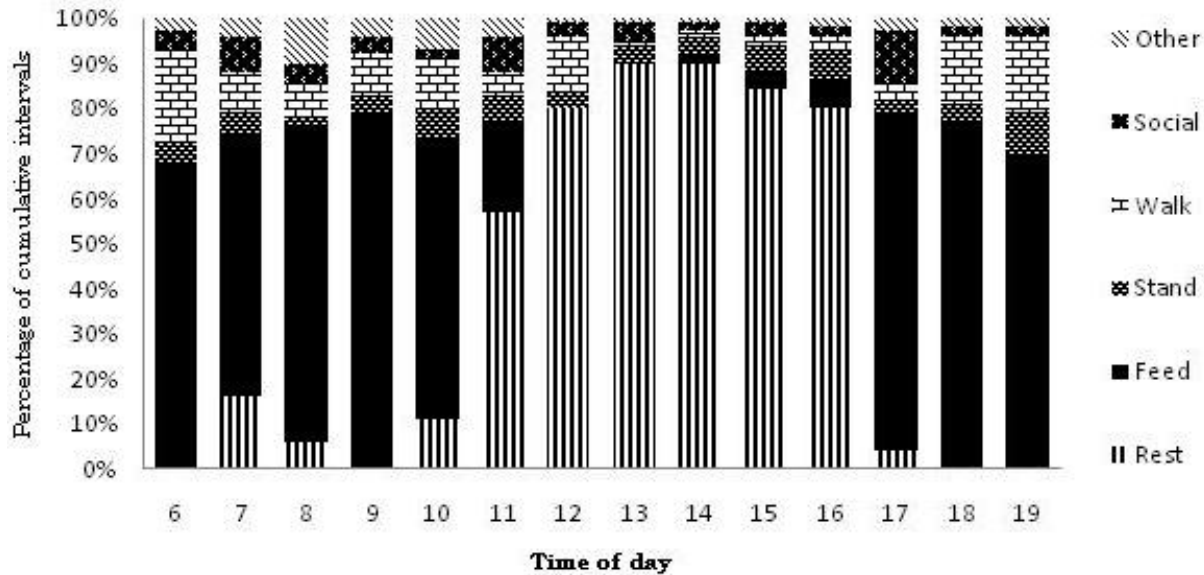


Figure 3. The daily activity patterns of warthogs during the wet seasons.

warthog in all vegetation type showed a significant variation ($\chi^2 = 6.12$, $df=2$, $p < 0.05$) between seasons.

The daily activity patterns were divided into two seasons. During the wet season on an average, 42.21 and 38% of the individuals were involved in feeding and resting activities, respectively. Walking, standing, socializing and other activities were recorded at 6.43, 4.93, 4.22 and 4.21% of the animals, respectively during the wet season (Figure 3). Thus the percentage of animals involved in feeding and walking was higher during the dry season than during the wet season and showed significant difference between seasons ($\chi^2 = 12.3$, $df=1$, $P < 0.05$). On the other hand, resting and other activities were more pronounced during the wet season than during the dry season and showed significant difference ($\chi^2 = 6$, $df=1$, $P < 0.05$). A comparison of the percentage of animals involved in standing and social activities showed no significant variation between wet and dry seasons ($\chi^2 = 14$, $df=1$, $P > 0.05$). There were feeding peaks from 08:00 to 09:00 h during the wet season, but the morning feeding peak was extended up to 010:00 h during the dry season. The feeding peak in the afternoon was between 17:00 h and 18:00 h during both seasons. A resting peak was observed in both seasons around the mid-day but it extends more to the late afternoon during wet seasons than the dry season. They were less active between 10:00 and 15:00 h during the wet season and between 10:00 and 14:00 h during the dry season. Although there were more number of animals active during the dry season than during the wet season, this was not significantly different ($\chi^2 = 9$, $df=1$, $P > 0.05$). During the dry season, 51.57% were feeding and 25.43% were resting. During the dry season, standing, walking, socializing and other activities occupied 12.14, 5.93, 3.14 and 1.79%, respectively (Figure 4).

Among the different age and sex structures, there were significant differences in the time spent in foraging between sub-adult females (Figure 5c) and adult males (Figure 5b) ($\chi^2 = 11$, $df=1$, $P > 0.05$). There is also significant difference in the time spent in foraging between sub-adult males and adult males ($\chi^2 = 5$, $df=1$, $P < 0.05$). Walking in the adult males showed a significant difference among all other age groups ($\chi^2 = 15$, $df=1$, $P < 0.05$). However, there was no significant difference in the time spent resting, standing, socializing and other activities in all age groups (Figures 5a, c and d). Warthogs allots the majority of their time for feeding (71%) followed by resting (20%) (Figure. 5e).

Main means of livelihood of the local population in and adjacent to the Park are crop cultivation and livestock. The average number of animal per household is 18. They mostly depend on the park for food (wild fruits, crops, smaller quantity of fish, honey), freshwater and raw materials (construction wood, wood for agricultural tools and household furniture, thatching grass, charcoal wood, fuel wood, animal fodder and medicinal resources). There is no significant difference in the use of the Park services by these households. For example, 96 and 91% of the households from inside and outside of the Park possess arable land for crop cultivation inside the Park. In addition, 94 and 91% of the households from inside and outside the Park, respectively, use animal fodder from inside the Park.

DISCUSSION

There have been relatively few studies conducted on this species. Despite high fecundity of warthogs, the population is in decline due to high predation rate of the young before

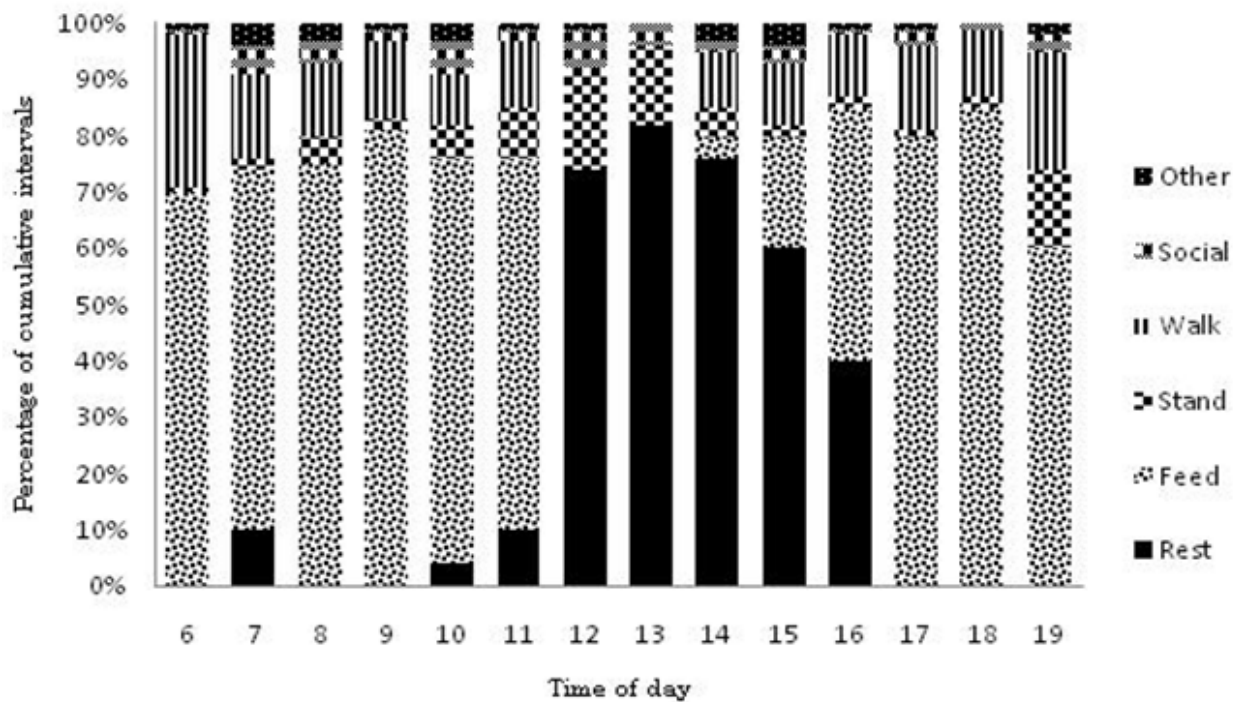


Figure 4. The daily activity pattern of warthogs during the dry seasons.

they join the next age group. Sub-adult males prefer solitary life which may expose them to predation pressure and decrease of the quality of their habitat range. This shows that unless proper care and attention is given for the species in the area, the tendency to decline in the population number will increase. High number of warthogs during the wet season may be due to the availability of food items and cover. During the dry season, when availability of food item declines, warthogs may migrate to other localities in search of food and cover.

Knowledge of sex ratio and age distribution of individual mammals is crucial for the evaluation of the viability of the species, because these variables reflect the structure and dynamics of the population. The significant difference observed between the different counting blocks in the two seasons may be because of the peak birth of the animals during the wet season, abundance and palatability of food during the season and influence of human activity. During the present study, the overall sex ratio showed more females (1:1:5) than males. Possible reasons for unequal postnatal sex ratio are due to an increased predation pressure on males due to its greater boldness and the emigration of subordinate males to more preferable habitat.

Distribution of individuals aggregated in groups of different size differs among habitats in each season. Warthogs are social animals. The variation in group size during the wet and dry seasons could be a result of change

in abundance of resource required in different habitat type and ambient weather conditions. During wet seasons the animal congregate to avoid predation. The variation in group size during wet and dry season may also be as a result of seasonality in breeding.

The distribution of warthogs in different vegetation varied depending on the season. Woodland cover is important in the protection against predation and human disturbance. Seasonal trends in the use of woodland vegetation versus open grassland area confirm the importance of availability of food resource in spatial pattern of the warthog. The dependence of species habitat relationship on factors ranging from local vegetation structure to landscape features suggests that several processes operate simultaneously at different scales of influence. The present study showed the presence of strong interaction between the habitat and warthogs. This indicates that certain habitats are very important for the survival of warthogs. Data of the present study showed that Desert warthogs live in areas where few other Grant's gazelle and livestock also depend upon. Desert warthog's associate with Grant's gazelle more frequently than with other wild herbivores and livestock. Such interactions would probably explain that the two species are not ecological competitors as revealed from different feeding strategies.

Households use the Park ecosystem as pasture land for their livestock. The major landscapes used for grazing are

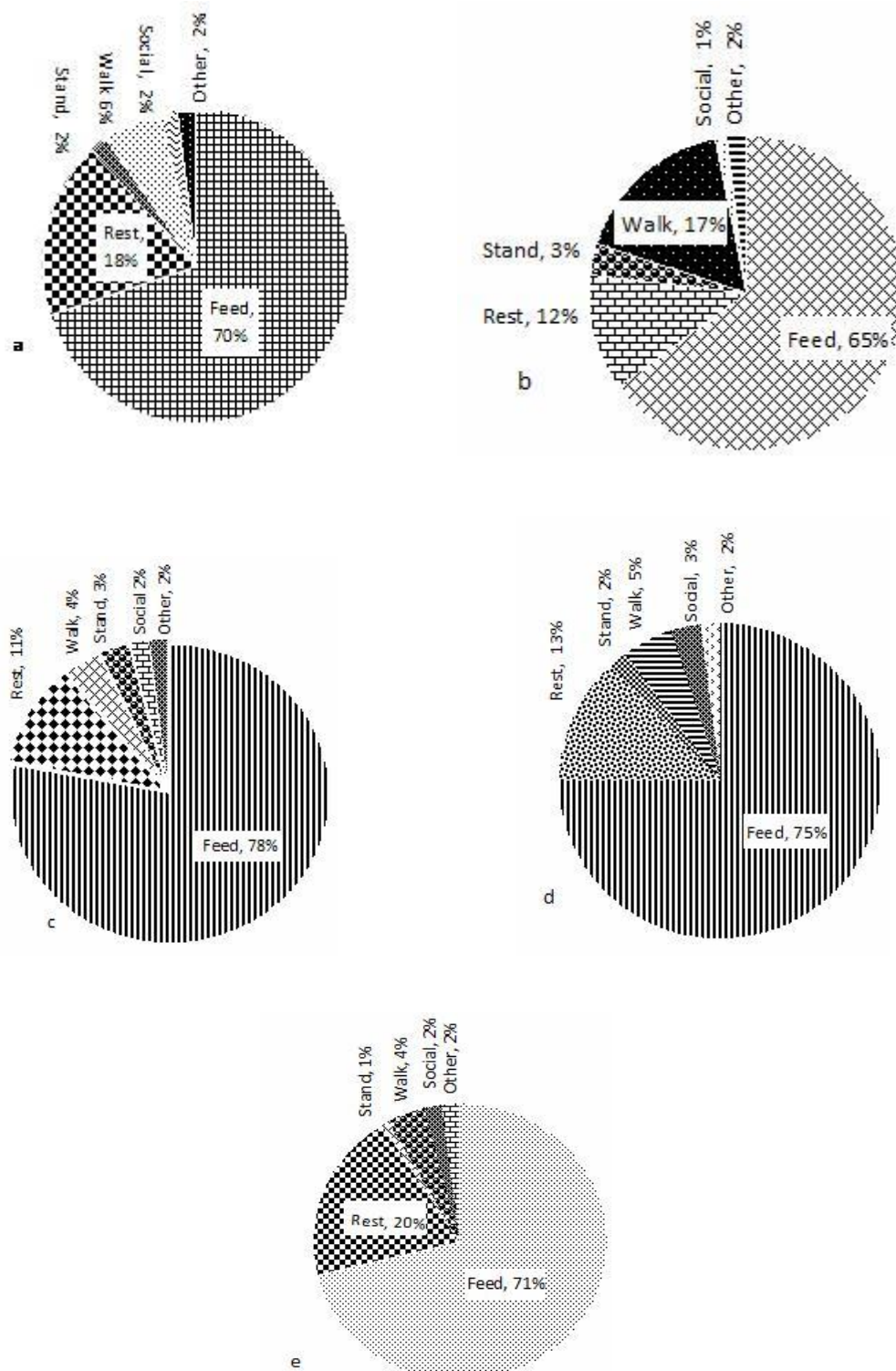


Figure. 5. Activity patterns of warthogs based on age and sex classes: (a) adult females, (b) adult males, (c) sub-adult female, (d) sub-adult male, (e) all groups combined.

woodland, farmland and wetland. Wetlands are the major grazing places mainly during the dry season. Mostly, households from inside the Park are major users followed

by households from outside. Households from inside the Park (especially Desta Abijata) are dependent on Abijata wetland because of their closeness and less *acacia* woodland

cover.

The effective management of wild animal populations depends on a thorough knowledge of how each species interacts with its environment. One of the most useful methods for describing this relationship is to quantify the activity patterns shown in different areas and seasons. The pattern of an animal's behavior may be driven by a variety of external factors such as forage availability, environmental conditions or living in a group.

Warthogs were found to spend the largest part of the day on feeding followed by resting or lying down. This feature can partly be attributed to high temperature recorded in the study areas, which leads to an overall decrease in activity. At the same time, ruminating animals are forced by the nature of their digestive physiology to alternate periods of feeding with periods of rumination, which usually takes place while lying down. Well defined high intensity feeding periods were recorded during early morning and late afternoon. During the dry season, an increase in the time spent grazing is evident for all social groups. This tendency is an attempt to compensate for the reduced forage quality normally observed during the dry periods.

When the different age and sex groups were compared, it was found that adult females spent relatively more time resting or lying down. Territorial behavior is lacking in warthogs. They experience limited attack by territorial male and also occupy areas with good grazing ground (which requires a shorter grazing period). This might give them more time to rest. Sub-adult males and sub-adult females spend more time grazing than do the adult males and females. Adult males largely invest more time and energy for territorial defense. Sub-adult males usually occupy marginal areas with poor grazing and, therefore, feed for longer periods in order to get the required nutritional levels. At the same time, sub-adult females also need more energy for body maintenance than adult males and females.

In the park, a warthog spent significantly more time resting between 10.00 and 16.00 h. Probably this is a behavioral mechanism that animals use to cope with thermal stress during the hottest part of the day and to maintain their water balance. These animals were more active in the early morning and late evening when seeking food, hence foraging was the most represented activity.

When food resources are plenty, as is apparently the case during the wet season, the time and energy spent on feeding would be less than when there is shortage of food resources during the dry season. The variation in the activity levels observed between wet and dry seasons might be determined by a wider range of factors such as food availability, weather conditions, nutritive demand and protection from predation as suggested earlier by Treydte et al. (2006). In wild habitats, animals might adapt to avoid localities where human interactions are frequent (Wells and Barandon, 1992). They would also adapt to use the

resources in such area by changing the timing of their activity schedule to avoid direct interactions with humans (Estes, 1991). It is also important to reveal that in the present study area, there are human interactions, particularly during the day time due to the large number of settlers in the park. The settlers in the park move through the park for various purposes, however, no poaching was recorded on warthogs in the area. As the extent of suitable habitat is limited in the context of human settlements in the park, the resources available for warthogs are limited, and hence mainly during the dry season they are forced to forage mostly on the park area which is less impacted by human pressure.

Conclusion

Wildlife is a land resource of cultural, ecological and economic significance. It is a renewable resource whose survival depends, among other factors, on the quality of habitats. Destruction or loss of wildlife habitats reduces their potential utility. Livestock population and dogs should be controlled in Abijata-Shala Lakes National Park for conservation of the population of wildlife in the park in view of competition for food, space and cover, and disease transmission. Intensive grazing by domestic animals along with the wildlife populations might favor bush encroachment, which in turn would reduce the effective grazing area for desert warthog. The decline could have been through reduced reproduction rates, increased mortality rates or increased competition for food resources between livestock. Wildlife conservation in the park is increasingly coming under pressure due to changing land uses in the wildlife dispersal areas. Despite the current dependency of the local population (inside and outside of the Park) on the natural resources of the Park, they are rapidly degrading their own livelihood base. Therefore, conservation awareness to local people should be developed.

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