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Population Status and Habitat Choice of Hippopotamus (*Hippopotamus amphibious)* at Gashaka Gumti National Park, Nigeria

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Abstract: Hippopotamus *(Hippopotamus amphibious)* are nocturnal animals thought to have an African or Asiatic origin. In African, most hippopotamus are found in rivers throughout the savannah zone and main rivers of forest zone in Central Africa and like any other large mammal, their problems differ from one domain to the other involving human threats, such as habitat destruction, hunting pressure and urbanization. This study was designed to determine the population status and habitat choice of hippopotamus amphibious at Gashaka Gumti National Park, Nigeria using Semi Structural Questionnaires (SSQ), footprints count and direct observation methods. The results indicated that out of the 5 hippopotamus pools mentioned by the respondents, 3 (Mayo Jerandi, Mayo Karamti and Mayo Kam) were observed to be fully functional hovering roughly ±4 individuals. However, the mode of occupancy differed significantly ($p<0.05$) between the 3 functional pools. Measured footprints suggested the presence of both adults and infants (30×27, 31×28, 32×29 and 33×30 cm). Home range ranges between 10^2 and 400 m^2 and pools were mostly sited in the savannah areas (75%) cutting across the candidate rivers than the forested regions (25%) of the Host Rivers. However, there was no significant difference ($p<0.20$, $n = 102$) in the depth of the 4 functional pools. Hippopotamus in the study area spent most of their time with enormous fishes (54.5%) and therefore, susceptible to regular disturbances due to controlled or uncontrolled fishing. Based on the findings from this study, immediate and intensified conservation effort is required through research and protection techniques to reduce or absolutely eradicate further demise.

Key words: Population, habitat, hippopotamus amphibious, footprints, Gashaka

INTRODUCTION

Hippopotamus (*Hippopotamus amphibious*) are nocturnal animals believed to have originated from African or Asia and evolutionally believed to have evolved from a pig-like ancestor and the two lines probably diverged about 40 million years ago (Glen, 2005). They occur in rivers throughout the savanna zone of Africa and main rivers of forest zone in Central Africa. Their nocturnal habits have particularly made it very difficult to determine their population status and feeding ecology. Hippopotamus resemble gigantic, amphibious pigs with enlarged lower jaw and canines, four large blunt toes on each foot and a very rotund body (Dunn, 1993). However, there are clear regional differences in population size, diet and niche. Hippopotamus, like any other wild animal species are also faced with conservation threats which are probably responsible for its disappearance of some species from India and at least three species from Madagascar (Kingdon, 2008; Ajayi, 1979; Anthony *et al*., 2007). The living pygmy hippopotamus clearly represents the more conservative type (Brust, 1998).

It is therefore, pertinent to develop a sound understanding of their existence and distribution to pave the way for adequate conservation strategies (Oates, 1999). This phenomenon is very requiring in Nigeria and Gashaka Gumti National Park in particular where a unique and yet unstudied population still exists. Even though, previous reports have revealed their existence inside Gashaka Gumti National Park, there is no detailed study on their habitat, population status and ranching behaviour. Hence, the constraint on the development of acceptable and implementable conservation strategies for the hippopotamus of the park that appears to be somewhat endangered (Dunn, 1999).

This situation necessitated the commencement of this study with an attempt to fill the noticeable gap on the estimate of their living number and also to reflect on their ranching patterns and habitat quality through the use of foot prints and pool characteristics.

MATERIALS AND METHODS

Study site: This survey took place in the prominent rivers of Gashaka Gumti National Park (GGNP; Fig. 1). GGNP

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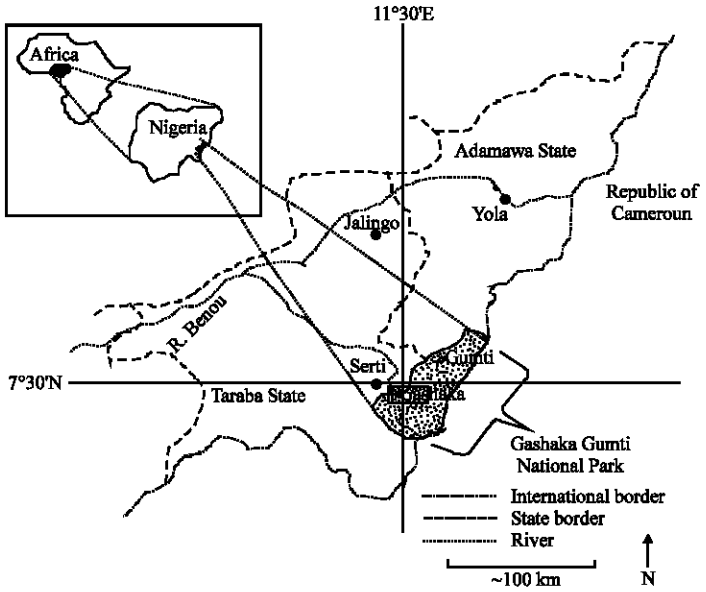

Fig. 1: Map showing the location of Gashaka Gumti National Park (Warren, 2004)

covers an area of about 6,700 km^2 and is Nigeria's largest national park, straddling the Cameroonian border (06°55'-08°13'N, 11°13'N-12°11'E). GGNP is mountainous and forming part of the eastern highlands of Nigeria and Africa's Gulf of Guinea forests, considered a hotspot of biodiversity (Oates *et al*., 2004). GGNP is divided into the relatively flat Gumti sector in the North and the mountainous Gashaka sector in the South. Habitat types include flat grassland, Guinea savannah-woodland, riverine and gallery forest, lowland rain forest, montane forest and montane grassland. The major rivers of the park include River Kam, Karamti, Gashaka, Jeradi, Gamgam, Ngiti and Yim (Sommer and Ross, 2011a).

Climate: Weather data for Kwano from 2001-2008 reveal pronounced annual wet and dry seasons with corresponding fluctuations in temperature and humidity (Sommer and Ross, 2011b). The mean minimum temperature is 20.9°C and the mean maximum 31.9°C. Heavy downpours begins from mid-April to mid-November and are followed by 5 months with very little or no rainfall. The yearly average rainfall is 1,973 mm (range 1,683-2,337 mm).

Study design: Data was collected for 4 months (November to January), on 20 days per month. Semi-structural questionnaires were administered randomly amongst experienced rangers from the research unit and four ranges (Filinga, Gumti, Gamgam and Central squad) of the Gashaka Sector (GS) of GGNP to establish information on the availability, abundance and hippopotamus pools of the park. Direct observations (visual methods) following Coulson (1980) were also adopted on the major perennial rivers of the GS (Kam, Gashaka, Yim, Gamgam) to establish information on their population status, ranching patterns and pool characteristics.

Data collection technique

Semi-Structural Interview (SSI): Semi-structural questionnaires were well designed and administered randomly to all rangers under the research unit and rangers from Filinga, central squad, Gamgam and Adagoro ranges who have spent at least 10 years in service with GGNP to establish information on the existence of hippopotamus inside Gashaka Gumti National Park.

Direct observation: For the determination of the population status and site characteristics of hippopotamus by direct observation, random walks of all the major rivers in the GS of GGNP were made on a stretch in 4 days (a river/day) to reduce incidence of double counting as a result of inter-pool transfer. Where possible, foot prints were measured, counted, recorded and followed carefully to determine whether hippopotamus occupy pools inter-changeably. Repeated and alternating visits were carried out for 5 days (between 7-4 p.m.) per hippo pool on monthly basis to gather information on their population indices, ranging patterns and habitat characteristics. Where possible, faecal samples were also collected and subjected to a quick examination of the foot intake.

Data analysis: Descriptive statistics involving, such as percentages, tables, figures and inferential statistics involving the use of Chi-square, ANOVA, student t-test and Mann-Whitney U-test were also used for the analysis of the data.

RESULTS

Determination of the abundance and distribution of hippopotamus at GGNP: A total of 5 hippopotamus pools (Mayo Jeradi, Karamti, Kam, Gashaka and Gamgam) were suggested by the Rangers to be functional hippopotamus pools in the Gashaka sector of GGNP. Further investigation through direct observation indicated that out of the 5 hippopotamus pools thought to be existing, only 3 (Mayo Jerandi, Karamti and Kam) were observed to be fully functional (Table 1). However, the mode of occupancy differed significantly ($p<0.05$) between the 3 functional pools. Mayo Karamti hippopotamus pool was most stable in term of occupancy (Table 2) and number (n = 1) throughout the period of this study. During some visits, hippopotamus were in avoidably absent from Mayo Kam (n = 2) while Jarandi hippo pool (n = 1) was based on observed artefacts which included foot prints, faecal droppings and grazing signs around the pool axis. In other words, there was no direct of the hippopotamus in the pool.

Foot prints as determinants of hippopotamus reproductive status: Observed foot prints (n = 33; Table 3) were carefully measured and categorised into four foot size classes (30×27, 31×28, 32×29, 33×30) to elucidate information on their population indices and potentials. The smallest foot size-class category (30×27) was observed from the same pool with the second largest foot size-class category (32×29 while the other foot size-class categories (30×28 and 33×30) were from independent pools. The paired foot size-class categories (30×27 and 32×29) suggest that the hippopotamus in this pool maybe an adult and a sub-adult or infant.

Home range and habitat characteristics of hippopotamus at GGNP: The home range (Table 4) of hippopotamus at GGNP ranges between 10^2 and 400 m^2. Hippopotamus at GGNP sited their pools (Table 5) mostly in the savannah areas (75%) cutting across the candidate rivers than the forested regions (25%) of the Host Rivers while no pool was observed in the grassland parts (0.0%) of the inhabiting rivers. For those pools observed in the forested parts of the Host Rivers, open canopy was most preferred (80%) while only few (20%) occupied pools fall under closed canopies (Table 6). Considering pool site characteristics (Table 7), hippopotamus at GGNP showed

Table 1: Hippopotamus distribution at the Gashaka sector of GGNP

Pools	Present	Absent	Paired	Not paired
Mayo Jeradi	✓	-	-	✓
Mayo Karamti	✓	-	-	✓
Mayo Kam	✓	-	✓	-
Mayo Gashaka	-	×	-	-
Mayo Gamgam	-	×	-	-

Present = ✓; Absent = ×; Field Survey, 2012

Table 2: Hippopotamus number and pool occupancy status

Pools	October	November	December	January	Occupancy (%)
Mayo Jeradi	-	-	1	-	-
Mayo Karamti	1	1	1	1	100
Mayo Kam	-	-	2	1	25
Mayo Gashaka	-	-	-	-	-
Mayo Gamgam	-	-	-	-	-
Total	1	1	4	2	-

Table 3: Hippopotamus food-print sizes in the study area

Length	Width (cm)	Frequency	Frequency (%)
32	29	18	54.54
31	28	4	12.12
30	27	5	15.15
33	30	6	18.18
Total	-	33	100.00

Field Survey, 2012

Table 4: Home range of hippopotamus in the study area

Distance $(m)^2$	Frequency	Percentage
2	2	9.09
3	3	13.63
5	5	22.72
7	3	13.63
8	3	13.63
10	1	4.63
16	1	4.63
25	2	9.09
27	1	4.63
400	1	4.63
Total	22	100.00

Table 5: Habitat type of hippopotamus in the study area

Habitat type	Frequency	Percentage
Savannah	6	75
Grassland	-	-
Forest	2	25
Total	8	100

Table 6: Canopy effect on pool selection by hippopotamus in the study area

Canopy	Frequency	Percentage
Open	8	80
Closed	2	20
Total	10	100

Table 7: Hippopool characteristics in the study area

Pool location	Width (cm)	Percentage
Rocky	-	-
Sandy	6	75
Under tree	2	25
Rocky and sandy	-	-
Rocky under tree	-	-
Sandy under tree	-	-
Rocky, sandy under tree	-	-
Total	8	100

Field Survey, 2012

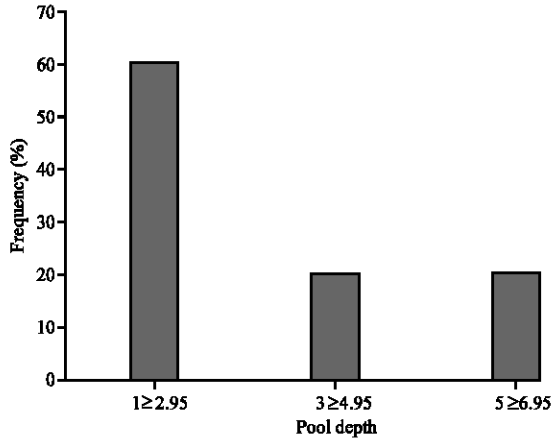

Fig. 2: Hippopotamus pool depth determination

Table 8: Relationship between hippopotamus and fish in the study area

Fishes visible	Frequency	Percentage
Few	2	18.2
Many	3	27.3
Enormous	6	54.5
Total	11	100.0

Field Survey, 2012

preference to sandy pools (85%) whose depth ranged from 2-7 m with enormous fishes (75%). However, there was no significant difference ($p<0.20$, $n = 102$) in the depth of the 4 functional pools (Fig. 2).

The relationship between hippopotamus and fishes in the study area: The result of the relationship between the hippopotamus and fishes (Table 8) show that hippopotamus in the study area spent most of their time with enormous fishes (54.5%) followed many fishes (27.3%) while instances where only few fishes were observed in the pools with the hippopotamus were comparatively low (18.2%).

DISCUSSION

Abundance and distribution of hippopotamus at Gashaka sector of GGNP: The results (Table 1) based on respondents from questionnaires revealed 5 functional hippopotamus pools in the Gashaka Sector of Gashaka Gumti National Park. Further studies based on direct observation and used of artefacts (footprints) show that a representative population ($n = 5$) of hippopotamus still exists in the park. However, the hippopotamus tend to live a solitary life as each (on the average) was found to be occupying independent pool summing up to 3 functional pools (Mayo Jerandi, Karamti and Kam) in the study area. This is a clear indication that the hippopotamusg at Gashaka sector of GGNP are on the decline and others probably extinct, since up to 5 pools ever existed. The rate of disappearance of hippopotamus in the study area could not be determined at this stage due to lack of an existing data on the past number. Based on the current number ($n = 5$) of hippopotamus occupying 3 pools, the ratio is roughly 1.3 to a pool which means that regardless of birth rate, 5 pools were hosting 7 hippopotamus on the average. Since, the revealed number ($n = 5$) comprise an infant or sub-adult (as shown by the footprints), it means that only 4 hippopotamus were adults during the period of this study which further suggests that there would have been >7 hippopotamus' when the 5 pools were fully functional. It is, therefore not out of place to state that >3 hippopotamus drastically disappeared from the park between 1991 (when GGNP became a national park) and as at the time of this study. One of the hippopotamus was found dead by the rangers at River Kam just before the commencement of this research but the cause of the death was not known to the Rangers. The mode of occupancy differed significantly ($p<0.05$), between the 3 functional pools but the number of hippopotamus per pool was constant during the study period. This may be an indication that hippopotamus at the Gashaka sector of GGNP do not use pools interchangeably. This habit of pool utilisation could, also shed light on the fact that each pool might be representing a given ancestor which probably suffered from environmental threats. The threats may, include disease outbreaks, hunting pressure, river poisoning by fishermen and conflict due to territorial defense within, species through which a single or combination of these adversity could result into serious injuries and consequent death (Smuts and Whyte, 1981).

Foot prints as determinants of hippopotamus reproductive status: Studies of the foot prints revealed that Mayo Kam river is home for 2 hippopotamus (an adult and an infant) indicating that reproduction of some sort still exists among the inhabitants. Based on the result, it can be stated that the hippos of GGNP are reproducing favourably as there are presence of infant footprints (30×27 cm, 15.15%). However, adults hippopotamus appeared to be highly available (32×29 cm, 54.54%) than all other age classes as determined by the footprints, indicating a declining population. One would expect to have 3 individuals on record to support this information but it could be that the third member, perhaps the male could have been exterminated or could be coming from a neighbouring pool to socialise and perhaps return to the host pool thereafter. Similarly, the 2 existing hippos could be an adult-male and a sub-adult as a product of environmental resistance unfavourable to the adult female, probably the mother of the sub-adult. However, the absence of small footprints (probably infants) may not necessarily be an indication of a reproductively impaired

population but could also be revealing a characteristic hider-behaviour shown by this sub species of hippopotamus: A situation whereby lactating mother hides her infant while on grazing. The idea as for other large mammals may be to increase protection over their offsprings from a resulting predation. Interestingly, the observed hippopotamus number was stable throughout the period of this study signifying that the result of natural benefits, such as inaccessibility due to lack of road network, terrain, dense vegetation and mode of daily life style shown in hippopotamus. Mention earlier all, the existence of the national park has an added protection advantage on the large mammals if the objectives are strictly abide by.

Home range of hippopotamus in the study area: The results (Table 4) indicate the distant interval covered by the hippopotamus during night foraging through the use of footprints/faeces left behind by these mammals in the study area. These spoors/faeces provide information on how long a hippopotamus can move away from the pool (home range). Results indicate that the longest distance covered was 4 km^2 while the least distance was 1 km^2. These findings agree with Wootton (1987) who reported that hippopotamus travels between 4-5 h each night, covering 1.609 or 3.218 km. However, they do not usually venture far from the river. The observed footprints/faeces within 4 km^2 may be related to their feeding habits and age structure of the individuals; a situation whereby food location will always determine how far they had to travel to gain the much needed energy, get rid of their competitors and the length of available feeding time before is bright, males may have to cover long distances in order to socialise (density effect), movement may be restricted by the strength of infants for lactating females and balanced sex ratio encouraging short distant-interval during foraging activities (Lewison and Carter, 2004).

Habitat characteristics of hippopotamus at GGNP: Generally, hippopotamus at GGNP sited their pools mostly in the savannah (75%) and forested areas (25%) cutting across the Host Rivers. Results from this study agrees with Kingdon (2008)'s report that hippopotamus inhabit forested areas and water courses where they shelter by day in ponds while on land they appear to be silent and solitary grazers. However, slight differences exist in that the GGNP hippopotamus selected mostly the savannah area despite the fact that some sorts of gallery/riparian forests occur along the host river banks with somewhat excellent potential ponds with equal chances to have been occupied as pools. However, this finding may be related to the type of food eaten by the hippopotamus (grasses; Kingdon, 2008) which are the dominant plant species in the savannah zones of the study area. There is no doubt that hippopotamus are nocturnal animals and therefore, engage on foraging and other movement related activities only at night. However, movement within the forested areas was observed to be orderly through well established forest trails that tend to scatter randomly as they approach grassy areas. The smooth trails cutting through the dense forests could probably be an indication of their requirement for open environment to avoid obstructions during movements to grazing fields. Since, they spend the whole day submerged with the head always above water, they may also preferred the savannah region because of its open nature which invariably provides for distant visibility and enhances self protection from predators, such as hippopotamus hunters. Savannah environments also receive high sun intensity which they very much need for sun-basking. On a more specific note, individual pools were investigated to shed more light on whether hippopotamus do need open areas or is the general choice of savannah regions a matter of chance. The suggestions on the hippopotamus' choice of pools in savannah areas is further supported by their preference to sitting pools in canopies even when for some reasons (utilising what is available, avoiding human disturbance, getting rid of fire incidence and to reduce competition with other grazers) they must live in pools located in the forested zones. Less regarded is the fact that other factors, such as visibility and poor canopies nature of the region may also have an influence on the choice of pooling sites. The question is that hippopotamus are nocturnal animals and spend the whole day resting inside the river so what would they need the visibility and open canopies for instead of the forested regions (25%) of the host rivers. If open canopies are to be considered as candidate area for hippopotamus pools then it will initially sound strange to have no records of functional pools in the grassland areas appearing to be somewhat derived grasslands (0.00%).

Hippopotamus at GGNP showed preference to sandy pools (85%) whose depth ranged from 1-9 m with enormous fishes (75%) around the hippopotamus. However, there was no significant difference ($p<0.05$, $n = 102$) in the depth of pools between the 4 functional pools. Hippopotamus' preference to shallow parts of the rivers (1-2.95 m deep) at the Gashaka sector of GGNP may be related to the sloppy nature of the area that presumably encourages fast surface current that drastically reduces, as the rivers approach flat terrains that tend to wider. However, other slightly deeper parts (5-6.95) of the host rivers were also used as pools in certain areas of the park, dismissing clarity on the

influence of river depth on pool selection by the hippopotamus. The differences and inconsistency in the depths of rivers used by hippopotamus may be related to the bias nature of the data collection.

The relationship between hippopotamus and fishes in pools occupancy: The presence of fish in the functional pools was also determined. The result shows that the pool has enormous fishes (75%) and the least had about 25% (Fig. 1). These findings may also reflect on the type of interaction existing between the hippopotamus and their pool mates (fishes). According to Michael (2000) and Dudley (1998), hippopotamus prey on fish in rare cases but looking at these results, one may be correct to conclude that this hippopotamus population do not eat fish, however live in commensalism with fish. This fact is supported by the established fact that all preys run away from their predators which was not the case between the study subjects. Not-with-standing and in line with (Harrison *et al*. 2008), their presence may be an indication that hippopotamus presumably carry out selective cropping with respect to fish species that exist in their host rivers and the enormous fishes observed around the hippos in the same pool may only reflect on the high fish content of the rivers at GGNP. Similarly, fishes may also lack the senses to recognise the hippopotamus' predation rate among them or view the hippopotamus as their predators and as such will also roam around them irrespective of the risk involved.

CONCLUSION

The *Hippopotamus amphibious* still exists inside Gashaka Gumti National Park, Nigeria. Findings from this study shows that its population is on the decline and will soon go into extinction if immediate intervention and concerted effort from the government, non-governmental organization and conservation agencies is not put in place. However, the population status indicated the presence of infants thereby supporting future conservation success should any conservation action be implemented immediately. The long term conservation potentials of *Hippopotamus amphibious* is further seconded by the improvised habitat conditions and high fish population sharing the same pools with them which are suitable enough to encourage their activity budgets, such as travel, foraging/grazing, resting, pooling and socialising. Based on the findings from this study, immediate conservation effort should be intensified through research and protection techniques to reduce or absolutely eradicate further demise.

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REFERENCES

Ajayi, O., 1979. Wildlife conservation and management. East Afr. J. Wildlife, 16: 85-95.

Anthony, R.E., M.F. Sinclair and C. Graem, 2007. Wildlife Ecology, Conservation and Management. 2nd Edn., Blackwell Publishing, New York.

Brust, B.W., 1998. Hippos (Zoo Book Series). Wildlife Education Ltd., USA., ISBN-13: 9780937934548, pp: 54-56.

Coulson, I.M., 1980. Annual hippopotamus census, South-Eastern Lowveld. Progress Report No. 4, Project No. GNP/H4/4a/2, Department of National Parks and Wildlife Management, Harare, Zimbabwe.

Dudley, J.P., 1998. Reports of carnivory by the common hippo *Hippopotamus amphibius*. S. Afr. J. Wildlife Res., 28: 58-59.

Dunn, A., 1993. The large mammals of Gashaka Gumti National Park, Nigeria: Line transect surveys from forest and savannah. http://agris.fao.org/agris-search/search/display.do?f=1996/GB/GB96255.xml; GB9601726.

Dunn, A., 1999. Gashaka Gumti National Park, Nigeria: A Guide Book. NCF/WWF, Lagos, Nigeria, pp: 31-32.

Glen, F., 2005. Hippos Natural History and Conservation. Voyageur Press, USA., pp: 15-19.

Harrison, M.E., M.P. Kalindekafe and B. Banda, 2008. The ecology of the hippopotamus in Liwonde National Park, Malawi: Implications for management. Afr. J. Ecol., 46: 507-514.

Kingdon, J., 2008. The Kingdon Field Guide to African Mammals. Academic Press, San Diego, USA., pp: 305-307.

Lewison, J.B. and J. Carter, 2004. Exploring behavior of an unusual megaherbivore: A spatially explicit foraging model of the hippopotamus. Ecol. Modell., 171: 127-138.

Michael, L., 2000. Hippopotamus (Natural World). Hodder Wayland, UK., pp: 72-75.

Oates, J.F., 1999. Myth and Reality. How Conservation Strategies are Failing in West Africa. University of California Press, Berkley, USA.

Oates, J.F., R.A. Bergl and J.M. Linder, 2004. Africa's Gulf of Guinea Forests: Biodiversity Patterns and Conservation Priorities. Conservation International, Washington, DC., USA., ISBN-13: 9781881173823, Pages: 90.

Smuts, G.L. and I.J. Whyte, 1981. Relationships between reproduction and environment in the hippopotamus *Hippopotamus amphibious* in the Kruger National Park. Koedoe Afr. Prot. Area Conserv. Sci., 24: 169-185.

Sommer, V. and C. Ross, 2011a. Primates of Gashaka: Socioecology and Conservation in Nigeria's Biodiversity Hotspot. Springer, New York, ISBN-13: 9781441974037, Pages: 531.

Sommer, V. and C. Ross, 2011b. Exploring and Protecting West Africa's Primates: The Gashaka Primate Project in Context. In: Primates of Gashaka: Socioecology and Conservation in Nigeria's Biodiversity Hotspot, Sommer, V. and C. Ross (Eds.). Springer, New York, pp: 1-37.

Warren, Y., 2004. Olive baboons (*Papio anubis*): Behaviour, ecology and human conflict in Gashaka Gumti National Park, Nigeria. Ph.D. Thesis, University of Surrey, Roehampton, UK.

Wootton, J.T., 1987. The effects of body mass, phylogeny, habitat and trophic level on mammalian age at first reproduction. Evolution, 41: 732-749.