Feeding preference of the African elephant *(Loxodanta africana)* on woody plant species in Rubondo Island National Park (RINP), Tanzania

Simon Mwambola[1*], Jasper Ijumba[1], Wickson Kibasa[2], Emanuel Masenga[3], Ernest Eblate[3] Canisius J. Kayombo[4]

[1]Nelson Mandela African Institution of Science and Technology, School of Life Sciences and Bio-engineering, P.O Box 447, Arusha, Tanzania.
[2]Tanzania National Parks, Rubondo Island, P.O Box 3134, Arusha
[3]Tanzania Wildlife Research Institute, P.O Box 661, Arusha
[4]Olmotonyi Forestry Training Institute, P.0 Box 943, Arusha
*corresponding author email: mwambolas@nm-aist.ac.tz

Abstract

Studying interactions between elephant and habitats is valuable for assessing the welfare of elephant populations and their habitats. The study was carried out in RINP between March and July 2014 constituting wet and dry seasons to assess the feeding preference of the African elephant (*Loxodonta africana*) on woody plant species. Purposive sampling was used for gathering data from 26 sample plots, sized 50m x 50m each. Plots were designed immediately after the herd (s) had passed on the various habitats. Frequency and percentage was used to estimate utilization of individual plant species and their parts. Chi-square test and excel were used to analyze feeding pattern preference. The present study found 22 species of plants in 13 families foraged by African elephants in Rubondo Island National Park. Plant species observed to be utilized mostly by elephants included *Croton sylvaticus* (13.33%), *Croton macrostachyus* (11.11%), *Aeschynomene elaphroxylon* (8.88%), *Chaetacme aristata* (8.88%), *Ekerbegia capensis* (8.88%), *Saba comorensis* (6.67%), and *Phoenix reclinata* (6.67%). There was difference in feeding preference between stem and leaves in woody plant species ($\chi 2=86.462$, $P < 0.05$) which suggested that elephants prefer more leaves than stem. This study presents useful information in understanding the interaction between the African elephant and vegetation in RINP.

Keywords: *African elephant (Loxodanta africana*), feeding preference, island, woody plant species.

{**Citation**: Simon Mwambola, Jasper Ijumba, Wickson Kibasa, Emanuel Masenga, Ernest Eblate, Canisius J. Kayombo. Feeding preference of the African elephant *(Loxodanta africana)* on woody plant species in Rubondo Island National Park (RINP), Tanzania. American Journal of Research Communication, 2014, 2(11): 102-113} www.usa-journals.com, ISSN: 2325-4076.

Introduction

African elephants are generalist herbivores that are relatively non-selective and reliant on widely distributed resources (Laws, 1970; Owen-Smith, 1988).). They are mixed feeders, ingesting both

grass and browse in varying proportions (Stephenson, 2007; Peter, 2003). Being bulk feeders elephants prefer to spend most of their time in areas with high plant biomass (Olff *et al.,* 2002; Barnes, 1982). They have the ability to migrate for a long distance in searching for food, water and when escaping hunting activities. Unlikely other connected ecosystems, Rubondo Island National Park is a small island with no connected ecosystem. It constitute the mosaic of different primary forest, forming dense canopy cover and lake-edge vegetation, variety of grasslands, *Acacia* open woodland and forest thicket communities (TANAPA, 2003).

There is dearth of scientific published information and knowledge on the ecology of the RINP elephant since when they were introduced between 1972 and 1972 (TANAPA, 2003; TAWIRI, 2012; TANAPA, 2014). Studying vegetation characteristics and other important resources in conservation areas provide useful knowledge on the determinants of the density and distribution of elephants in forests (Wing & Buss, 1970). Random stratification, systematic and purposive approaches may be used in collection of vegetation data basing on the objectives, resources available and nature habitats in the study area.

In unpublished report by Ernest Mjingo it was stated that, savanna eco-systems African elephants have been observed to prefer mostly tree branches than other parts. This is partly explained by the observed frequent pushing and falling of trees caused by elephants in savannah ecosystems (Gadd, 2002; Mapaure & Moe, 2009). Elephant's browsing can enhance availability of the nutrient contents in terms of proteins and essential minerals in plant parts (Holdo, 2002). Unlike other herbivores, elephants are adapted to use a wide range of plant species and various parts of them (Kerley *et al*., 2008). Effects due to herbivory by elephants may include debarking, breaking, felling, pushing over or uprooting young trees and seedlings during browsing, or when young bulls engage in social displays (Smallie & O'Connor, 2000). This habit may reduce tree species diversity, mortality and undersized growth (Chira & Kinyamario, 2009). While this feeding behavior of elephant might be seen as disturbance to ecosystem structure, it plays an important ecological role in savannah and forest ecosystems through maintaining suitable habitats for numerous species (Stephenson, 2007).

Being mega herbivores, elephants need to take sufficient amount of forage and water per day. Elephant can take up to 300kg of nutrients and 225L of water per day (Stephenson, 2007). This means that elephant require large home range and extensive habitats to meet their basic requirements. However in a situation where there is closed and small ecosystem like in RINP the management of elephant population would become a great challenge when they are great in number. The fact that RINP is an island having dry land of 236.8 Km^2 with a growing elephant population, approximately 102 individuals currently, it is important to study their feeding behavior, to generate useful information for their management purposes. This study determined the feeding preference of African elephants in RINP and how they interact with the forests in a closed ecosystem.

Material and methods

Study site

Rubondo Island is located in the southwestern portion of Lake Victoria (2 ^{o} 18′ S, 31 ^{o} 50′ E) at an altitudinal range of 1,100–1,500m above the sea level (Figure 1) (Moscovice *et al*. 2007). Rainfall is bimodal. Rainy seasons take place between October to December (short) and March to May (long), dry seasons are January and February, then June to September (TANAPA, 2003).

Temperatures are moderate throughout the year with minimum and maximum at around 16^{o}C and 26^{o}C respectively.

The habitat is dominated by mixed evergreen and semi-deciduous forest, with common species including *Croton sylvaticus, Drypetes gerrardii, and Lecaniodiscus fraxinifolius*, and often with a dense understory of lianas, or woody vines (Moscovice *et al*. 2007). Common native fauna include the vervet monkey *(Chlorocebus aethiops)*, sitatunga *(Tragelaphus spekei)*, and bushbuck *(Tragepahalus scriptus).* In addition to African elephant *(Loxodonta africana)* there are 12 other introduced species on the island, including chimpanzees *(Pan troglodytes)*, giraffes *(Giraffa camelopardalis)*, black and white colobus *(Colobus abysinnicus), Suni antelopes (Nestrogus moschatus) and Black rhinoceros (Diceros bicornis)* (Borner, 1985). This study was conducted between March and July, 2014. Rubondo Island was gazzeted on 18th of January 1977 and became the tenth National Park in Tanzania.

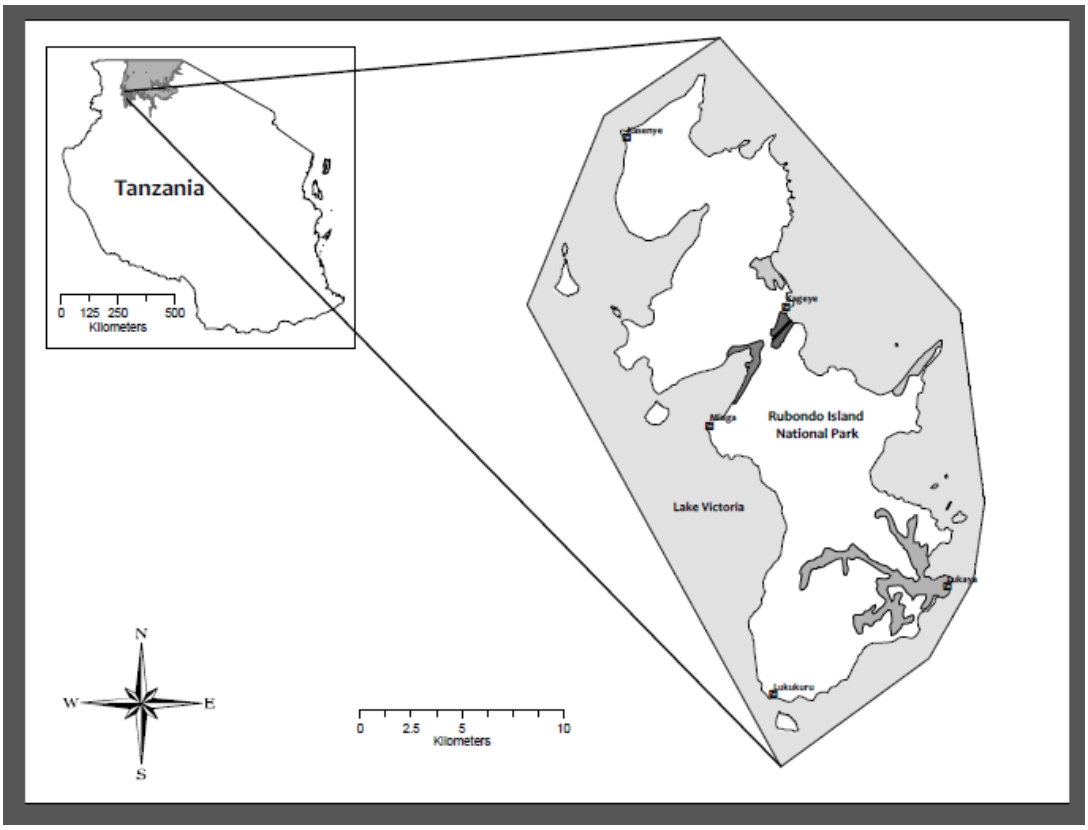

Figure 1: The map of Tanzania showing the location of Rubondo Island National Park, Tanzania.

Sampling and Data collection

The study of woody plant species which are preferred by elephants in Rubondo Island was conducted through plot sampling. Sample plots consisted of 50m by 50m each (Figure 2). Due to the limited time and financial constraints plot samples were distributed purposively with significant representative of all habitats in the park. Data collection was done either along with

dung survey or after the herd of elephant has passed in various habitats. The main assumption was that, elephants use almost 90% of whole habitats in the Island. Consumed plants in plot samples were identified and unidentified species were carried to botanist in Olmotonyi Forest Training Institute in Arusha for identification. Park rangers gave the information on encounter of elephants either through their normal patrol or visits of elephants in ranger posts. The study was limited by behavior of elephants of feeding during the night hours and being aggressive when approached for close observation.

Data on feeding preference of the elephants was gathered by observing on the type of plant species browsed, part affected, observed percentage of utilization, altitude, vegetation/ habitat type and records of GPS coordinates of location of plot samples. Observational examination on the elephant dung-piles was done to determine the presence of seeds on the deposited dungs.

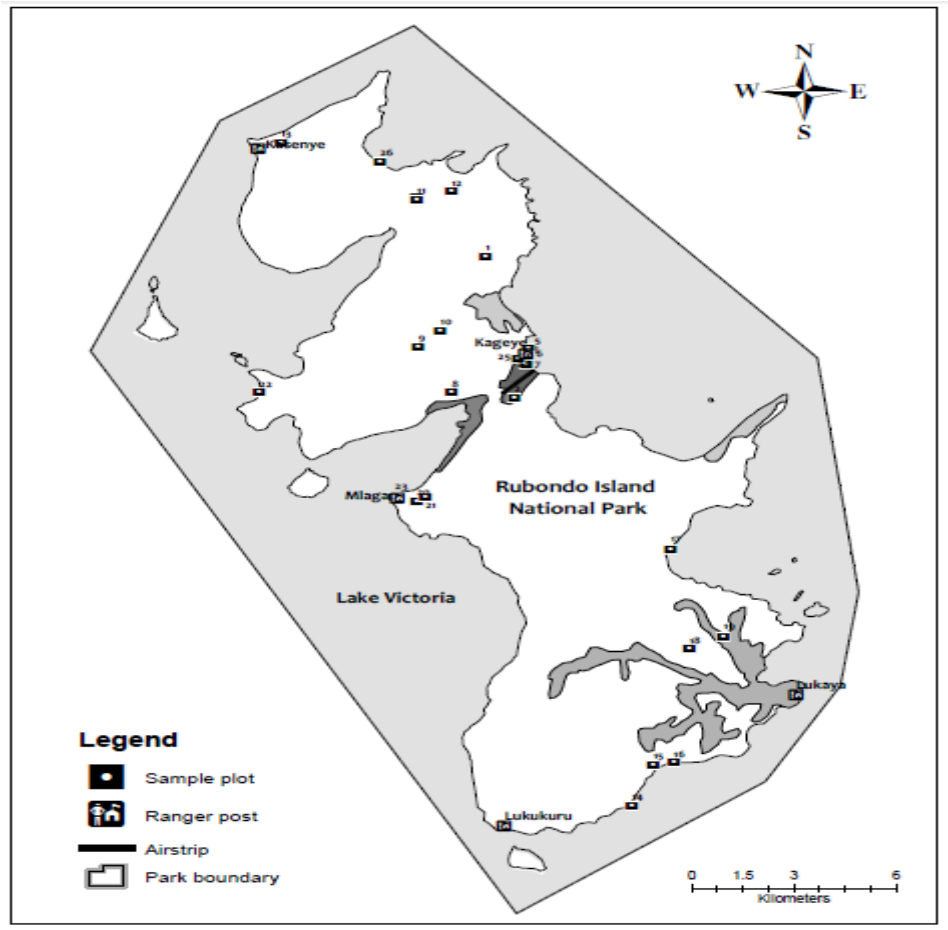

Figure 2: Map of RINP showing distribution of vegetation sample plots.

Data analysis

Feeding preference on plant species by elephants were analyzed by computing the frequency of foraging on individual plants and the parts affected on each species. SPSS computer software was used to compute the Chi-square test in determining feeding preferences on parts of the woody plant species.

Results

Feeding preferences by elephants in Rubondo Island

Total of 26 sample plots each 50m x 50m were surveyed purposively in Rubondo Island. 20 woody plant species belonging to 13 families were found to be consumed by elephants in Rubondo Island (Table 1). Among the identified plant species 17 were trees and 3 were woody climbers. Fruits of *Citrus limon*, seeds of *Phoenix reclinata* and pods of *Senna spectabilis* were observed in the dung piles of elephants. The lower land of the Island (close to the lake shore) was found to be utilized more compared to the upper land.

Debarking, browsing and stem chewing were observed to be the main modes of feeding on woody plants (Table 2). High relative frequency of utilization of encountered plant species was encountered on; *Croton sylvaticus* (13.33%), *Croton macrostachyus* (11.11%), *Aeschynomene elaphroxylon* (8.89%), *Chaetacme aristata* (8.89%), *Ekerbegia capensis* (8.89%), *Saba comorensis* (6.67%), and *Phoenix reclinata* (6.67%) (Table 3). Observational study on degree of destruction on individual plants found *Phoenix reclinata* (20-80%), *Ekebergia capensis* (5-80%), *Croton sylvaticus* (40-60%) and *Chaetacme aristata* (5-30%) experienced high extent of destruction due to foraging habit of elephants in the island (Table 2). In determination of feeding preference on different parts of the plant we obtained that elephant in RINP prefer more leaves than stem ($\chi 2$=86.462, P value< 0.05) (Appendix 1).

Bush buck and Vervet monkeys were observed to forage in broken *Croton, Haplocoelum and Phoenix* plant species. Plants which were observed to be either broken or utilized to death included *Phoenix reclinata, Croton macrostachyus, Margaritaria discoidea, Salacia madagascariensis* and *Periploca linearifolia*. Terrestrial habitat is inhabited by woodland, shrub-land, thickets and glades where by aquatic habitat is covered by marshes and *Aeschynomene elaphroxylon.*

Table 1. Woody plant species encountered to be utilized by elephants in RIP, 2014

S. No	Botanical name	Family	S. No	Botanical name	Family
1	*Haplocoelum inopleum*	Sapindaceae	11	*Ficus lutea*	Moraceae
2	*Periploca linearifolia*	Asclepiadaceae	12	*Ficus sycomorus*	Moraceae
3	*Aeschynomene elaphroxylon*	Fabaceae	13	*Landolphia buchananii*	Apocynaceae
4	*Albizia gummifera*	Fabaceae	14	*Lannea fulva*	Anacardiaceae
5	*Annona senegalensis*	Annonaceae	15	*Lecaniodiscus fraxinifolius*	Sapindaceae
6	*Antiaris toxicaria*	Euphorbiaceae	16	*Margaritaria discoidea*	Euphorbiaceae
7	*Chaetacme aristata*	Ulmaceae	17	*Phoenix reclinata*	Arecaceae
8	*Croton macrostachyus*	Euphorbiaceae	18	*Saba comorensis*	Apocynaceae
9	*Croton sylvaticus*	Euphorbiaceae	19	*Salacia madagascarensis*	Celasteraceae
10	*Ekebergia capensis*	Meliaceae	20	*Senna spectabilis*	Fabaceae

Table 2. Growth forms, parts consumption on woody plants and mode of feeding

	Growth form			Part consumed		
Plant species consumed	**Tree**	**Pole/sapling**	**Woody climber/liana**	**Stem**	**Leaves**	**Mode of feeding**
Phoenix reclinata	v			V	v	chewing stem/browsing
Ekebergia capensis	v			V		Debarking
Croton sylivaticus	v	V			v	Browsing
Croton macrostachyus	v			V	v	Debarking/browsing
Chaetacme aristata	v				v	Browsing
Aeschynomene elaphroxylon	v				v	Browsing
Annona senegalensis	v				v	Browsing
Lecaniodiscus fraxinifolius	v			V		Debarking
Saba comorensis	v			V		Debarking
Ficus lutea	v			V		Debarking
Periploca linearifolia			v	V		Debarking
Senna spectabilis	v				v	Browsing
Albizia gummifera	v			V		Debarking
Antiaris toxicaria	v			V		Debarking
Haplocoelum inopleum	v				v	Browsing
Landolphia buchananii			v	V		Debarking
Margaritaria discoidea	v			V		Debarking
Salacia madagascarensis			v	V		Debarking
Ficus sycomorus	v			V		Debarking
Lannea fulva	v			V		Debarking
TOTAL	***16***	***1***	***3***	***19***	***9***	

Table 3. Frequency of encounter rate of consumed plant species across surveyed sample plots

S. No	Plant species	Frequency of encounter	Percentage of frequency
1	*Croton macrostachyus*	6	13.33
2	*Croton sylivaticus*	5	11.11
3	*Aeschynomene elaphroxylon*	4	8.89
4	*Chaetacme aristata*	4	8.89
5	*Ekebergia capensis*	4	8.89
6	*Saba comerensis*	3	6.67
7	*Phoenix reclinata*	3	6.67
8	*Annona senegalensis*	2	4.44
9	*Haplocoelum inopleum*	2	4.44
10	*Lecaniodiscus fraxinifolis*	2	4.44
11	*Periploca linearifolia*	1	2.22
12	*Albiziagummifera*	1	2.22
13	*Antiaris toxicaria*	1	2.22
14	*Ficus lutea*	1	2.22
15	*Ficus sycomorus*	1	2.22
16	*Landolphia buchananii*	1	2.22
17	*Margaritaria discoidea*	1	2.22
18	*Salacia madagascarensis*	1	2.22
19	*Lannea fulva*	1	2.22
20	*Senna spectabilis*	1	2.22

Discussion

Feeding preference by elephants in Rubondo Island

Out of 20 plant species identified 17 were trees, 3 woody climbers and 1 sapling. Results suggested that there is difference in feeding preference between stem and leaves of the trees observed, generally elephant seems to consume leaves than stem ($\chi 2=86.462$, d.f 19, $P < 0.05$). Although height of the plant might be among the factor contributed to the observed difference, but also it seems there may be a relationship between feeding preference with palatability of the plant parts. The higher the height of stem the fewer amounts of fruits and leaves foraged by the elephants. Our findings showed that elephants are generalist in herbivory although some extent on preference was observed on some species ((*Croton sylvaticus* (13.33%), *Croton*

macrostachyus (11.11%), *Aeschynomene elaphroxylon* (8.89%), *Chaetacme aristata* (8.89%), *Ekerbegia capensis* (8.89%), *Saba comerensis* (6.67%), and *Phoenix reclinata* (6.67%) (Table 3). Among frequently utilized plants *C. macrostachyus, P. reclinata, A. elaphroxylon,* and *S. comorensis* had high species richness and evenness. Availability of these plant species in various areas makes central and northern zones to provide the suitable habitats for elephants in RINP. Regular distribution of preferred plants close to the lake shore influences elephants to use most of their time utilizing the habitats.

Debarking, browsing and breaking on woody plants were the common observed means of foraging by elephants in RINP. Ecologically, being non selective elephants may influence the change in species richness and composition. As a result decrease in species diversity may have negative impacts to herbivores in RINP in relation to the destructive mean of feeding on vegetation in forests including RINP. *Croton macrostachyus* was observed to be browsed at stage of sapling growth form this might have been due to high concentration of nutrient such as Potassium, Sodium, Magnesium and Phosphorus which are normally higher in young leaves than all other leaves (Jachmann & Bell, 1985). *Ficus* species was categorized as low in utilization although opportunistic surveys found that they are highly distributed along the lake shore. The species evenness of *Ekebergia capensis* was found to be low but it is debarked severely almost 5 to 80%. Repeated herbivory on this plant species may lead to extinction in RINP.

Exceptional and peculiar mode of feeding was observed on consumption *of P. reclinata* in which stem, leaves and fruits are foraged by elephants on various habitats. Contrary to other woody plants species, preference of elephant to *Phoenix reclinata* species was on chewing the inner section of the stem. This might have been due to easy breaking and access the juicy contents at the inner part of stem. Leaves and fruits of Phoenix species are also well consumed by elephants in Rubondo Island. Distribution of *Phoenix reclinata* is restricted along the lake shore 500m to 1 km from the water margin towards inland. Our study found that nurseries of *Phoenix reclinata* were observed in the dense forests due to effect of seed dispersal by elephants. Although Phoenix species is highly destructed and consumed by elephants causing to its death, good enough elephants themselves disperse its seeds through foraging the fruits. Purposive and opportunistic surveys on elephant dung piles revealed the presence of fruits of *Limon citrus,* pods of *Senna spectabilis* and seeds of *P. reclinata.* Hence, elephants play important role of dispersal of plant species in RINP. It has reported that *Senna spectabilis* and *Limon citrus* are among the more distributed exotic plant species in the island and *Senna spectabilis* is likely to affect the species composition of indigenous plants in the island (W. Kibasa per. comm., 2014). Bushbucks and Vervet monkeys were encountered feeding on either broken or fallen trees, hence revealing the role of elephants to other wild animals by either enhancing nutrients availability or paving the paths for easy access to new resources.

Another exceptional observational was encountered in in aquatic habitats whereby elephants preferred to browse on *Aeschynomene elaphroxylon* which is found from inland 15m to 30m in lake water. Elephants spent not less than one hour browsing stems and leaves on *Aeschynomene elephroxylon* during the night hours, probably it has high nutrient value. The results from direct observation and analysis of food materials in the dung-piles showed that there was no change on type of food for elephants in wet and early dry seasons Sometimes it was found that trees were fallen or broken without foraging sign as result of either social display by sub-adult or paving the way for easy penetration due to large body of elephants. Our general observation showed that

showed there was no change on the type of food for elephants in wet and early dry seasons. Almost all habitats are used by elephants with less observation in the southern part which is inhabited by dense and spiny thickets in RINP. Similar to other tropical ecosystems vegetation in Rubondo Island provides enough resources for the existence of this largest land living organism in the World (Harris *et al.* 2008). Elephant density of 0.423 per square km^2 may suggest that there is steady environment for supporting the elephant population in the island since the forests are still intact and healthy (Mwambola *et al*. 2014).

Conclusion and recommendations

Basing on our findings African elephants have successfully succeeded to adapt to survive in forest areas since they were introduced from savanna habitats about 42 years ago. The existing habitats are able to support the survival of elephants and other animals in the wild. The forest structure is still closed and intact, but the rapid growth of large herbivores like elephant may lead to over utilization of limited resources in the island. As a result forests may be transformed to shrubs and grasslands. There is significant relationship between increased age and number of elephants and the level of destruction in conservation areas. Hence increased number of elephants may impose loss of suitable habitats to herbivores. Further study is needed to understand the influence of chemical contents of the plant species on food selection by elephants the area. This will provide foundation to explain scientifically for the causes of feeding preference of the African elephant beyond physical observation in area which was originally gazetted as a sanctuary for endangered species in Tanzania and Worldwide.

Acknowledgements

This study is indebted many thanks to Government of United Republic of Tanzania through Commission for Science and Technology and The Nelson Mandela African Institution of Science and Technology (NM-AIST) for the financial support that helped to conduct this study. Special thanks to the management of Tanzania Wildlife Institute (TAWIRI) and Tanzania National Parks (TANAPA) for permission to conduct research in Rubondo Island. Furthermore, Jeremiah Johansen and Sam Ramadhan are thanked for their assistance during data gathering.

References

Barnes, R.F.W. (1982). Elephant feeding behaviour in Ruaha National Park. *African Journal of Ecology* 20: 123 – 136.

Blake, S., Deem, S.L., Mossimbo, E., Maisels, F. & Walsh, P. (2009). Forest Elephants: Tree Planters of the Congo.

Borner M. 1985. The rehabilitated chimpanzees of Rubondo Island. *Oryx* 19: 151–154.

Chira, R.M. & Kinyamario, J.I. (2009). Growth response of woody species to elephant foraging in Mwea National Reserve, Kenya.

Gadd, M.E. (2002). Impact of elephants on marula tree *Sclerocaryabirrea.* [http://www.3interscience.wiley.com] site visited on 06/08/2014.

Giliba, R.A., Boon, E.B., Kayombo, C.J., Musamba, E.B., Kashindye, A.M. & Shayo, P.F. (2011). Species Composition, Richness and Diversity in Miombo Woodland of Bereku Forest Reserve, Tanzania). *J Biodiversity* 2(1): 1-7

Harris, G.M., G.J. Russel, R.J. van Aarde & Pimm, S.L. (2008). Rules of Habitat use of savanna elephants in southern Africa. *Oryx* 42: 66 – 75.

Holdo, R. M., Dudley, J. P. &. McDowell, L. R. (2002). The role of sodium in the ecology of the African elephant *Loxodonta Africana* in a semi-arid woodland. *Journal of Mammalogy* 83: 652–664

Jachmann, H. & Bell, R.H.V. (1985). Utilization by elephants of *Brachystegia* woodlands of Kasungu National Park, Malawi.*African Journal of Ecology,* 23: 245- 258.

Kent, M. & Coker, P. (1992). Vegetation description and Analysis. John Willy & Sons, New York.

Kerley, G.H.I., Landman, M., Kruger, L. & Owen-Smith, N. (2008).Effects of elephants on ecosystems.Elephant Management: A Scientific Management of South Africa. In: Scholes, R.J. and Mennell, K.G. (Eds.). Witwatersrand University Press, Johannesburg.

Kisingo, A. W. (2008). Wildlife census on Rubondo Island National Park. FZS, African Program Office, Serengeti. Un-published report.

Laws, R. M. (1970). Elephants as agents of habitat and landscape change in East Africa. *Oikos*.

Majid, K., Gilbert, B.I. & Jeremiah, L.S. (2010). Role of *Acacia* and *Erythryna* trees in forest regeneration by vertebrate seed dispersers in Kibale National Park, Uganda.

Mapaure, I. N. & B. M. Campbell. (2002). Changes in Miombo woodland cover in and around Sengwa Wildlife Research Area, Zimbabwe in relation to elephants and fire. *African Journal of Ecology* 40: 212 – 219.

Moscovice, L.R., Issa, M.H., Petrzelkova, K.J., Keuler, Snowdon C.T, &. Huffman M.A N.S.(2007). Fruit Availability, Chimpanzee Diet, and Grouping Patterns. on Rubondo Island, Tanzania *American Journal of Primatology* 69: 487–502.

Ndibalema, V.G., Qolli, S.N.2 & Maganga, S.L.S. (2014). Effect of Elephant Browsing on Selected Species of Acacia along The Great Ruaha River in Ruaha National Park, Tanzania. *Ethiopian Journal of Environmental Studies & Management* 7(2): 124 – 133

Olff, H., Ritchie, M.E. & Prins, H.H.T. (2002). Global environmental controls of diversity in large herbivores. *Nature* 415.

Owen-Smith, R.N. (1988). Mega herbivores: the influence of very large body size on ecology. Cambridge University Press, Cambridge.

Smallie, J. J. & O'Connor, T.G. (2000). Elephant utilization of *Colophospermum mopane*: possible benefits of hedging. *African Journal of Ecology* 38: 352 – 359.

Simpson, C. D. (1978). *Effects of elephant and other wildlife on vegetation along the Chobe River, Botswana*. Occasional Papers, The Museum, Texas Tech University.

Stephenson, P.J. (2007). WWF Species Action Plan: African elephants, 2007-2011, WWF, Gland, Switzerland.
Arusha, Tanzania.

Tanzania National Parks (TANAPA). (2003). Rubondo Island National Park. General Management Plan 2003-2013. Arusha, Tanzania.

Tanzania Wildlife Research Institute (TAWIRI). (2012). Priority areas for conservation areas in Tanzania. Arusha, Tanzania.

Wing, L.D. & Buss, I.O. 1970. Elephants and forest. *Wildlife Monographs* 19: 1 – 92.

Apendix 1. Percentage utilization of woody plant species by elephants in RINP

Plot name	Name of plant species	Utilization/%	PART AFFECTED
1	*Chaetacme aristata*	5	Leaves
1	*Ekebergia capensis*	5	Stem
1	*Ficus sycomoras*	2	Stem
1	*Lecaniodiscus fraxinifolis*	2	Stem
2	*Annona senegalensis*	2	Stem
3	*Lannea fulva*	1	Stem
3	*Annona senegalensis*	50	Stem
3	*Phoenix reclinata*	30	Stem
3	*Phoenix reclinata*	30	Leaves
3	*Periploca linearifolia*	50	Stem
4	*Chaetacme aristata*	80	Leaves
4	*Croton macrostachyus*	60	Leaves
4	*Salacia madagascarensis*	10	Stem
5	*Croton sylvaticus*	50	Leaves
6	*Croton sylvaticus*	40	Leaves
6	*Chaetacme aristata*	30	Leaves
7	*Ekebergia capensis*	80	Stem
7	*Croton sylvaticus*	50	Leaves
8	*Phoenix reclinata*	80	Stem
9	*Saba comorensis*	30	Stem
10	*Croton macrostachyus*	10	Leaves
10	*Croton macrostachyus*	10	Stem
11	*Antiaris toxicaria*	20	Stem
11	*Croton macrostachyus*	25	Stem
12	*Croton macrostachyus*	25	Leaves
13	*Chaetacme aristata*	20	Leaves
14	*Aeschynomene elaphroxylon*	30	Stem

14	*Croton macrostachyus*	15	Leaves
15	*Lecaniodiscus fraxinifolis*	40	Stem
15	*Croton sylvaticus*	50	Leaves
16	*Aeschynomene elaphroxylon*	60	Stem
17	*Aeschynomene elaphroxylon*	50	Leaves
17	*Saba comorensis*	10	Stem
18	*Senna spectabilis*	40	Leaves
19	*Haplocoelum inopleum*	10	Leaves
20	*Croton sylvaticus*	60	Leaves
21	*Saba comorensis*	50	Stem
21	*Landolphia buchananii*	10	Stem
22	*Aeschynomene elaphroxylon*	40	Leaves
23	*Croton macrostachyus*	80	Leaves
23	*Haplocoelum inopleum*	10	Leaves
23	*Ekebergia capensis*	20	Stem
24	*Margaritaria discoidea*	10	Stem
24	*Ekebergia capensis*	20	Stem
25	*Ficus lutea*	50	Stem
25	*Phoenix reclinata*	45	Stem
25	*Phoenix reclinata*	45	Leaves
25	*Albizia gummifera*	20	Leaves
26	*Croton macrostachyus*	50	Leaves