FIELD NOTES

Black rhino population dynamics and the hidden cost of poaching at Solio Game Reserve, central Kenya

Felix Patton

Solio Ranch, PO Box 2, NaroMoru, Kenya
email: felixp@africaonline.co.ke

Introduction

At the beginning of 2009, Solio Game Reserve (SGR) in Central Kenya was home to 68 black rhinos at a density of 0.99 per square kilometre (km^2). This represented a very high density for a region where 0.3 rhinos/(km^2 was more typical and had been thus for over a decade.

There were three main outcomes from this high density: i) an ability for the rhinos to co-exist without excessive aggression (leading to deaths) ; ii) a depletion of the preferred, better quality food species such as *Acacia drepanalobium*; iii) an extended inter-calving interval at over three years. Since the "Mission" of SGR was to breed rhinos for translocation to other protected areas/reserves in order to develop the national population, this latter outcome was of major concern.

The black rhino management strategy of SGR was to reduce the population to fewer than 50 individuals through a programme of translocations and expected losses due to a high ratio of ageing to younger individuals.

On 9 June, 2009 an unexpected event happened - the death due to poachers of an adult male black rhino – the precursor to a further 15 black rhino and 44 white rhino poaching deaths up to the end of 2014. Furthermore, 7 black rhino individuals died as the after effects of poaching.

In addition, 13 more individuals died from 'natural causes' and another 13 were translocated.

This paper details the changes to the SGR black rhino population between 2009 and the end of 2014 in Solio Game Reserve.

Currently, the adult males are located in three breeding male territories, which only covers one-third of the area of the reserve. The remaining two-thirds of the reserve have no clear breeding male.

Breeding males

Poachers killed seven breeding males.

Two breeding males were translocated on the grounds of safety as they were regularly seen from a main road that ran parallel tothe fence line.

Three breeding males died from fighting injuries – an older male fought with two younger males. As the territorial males surrounding the territory of the older male died, so the older male increased its ranging as it sought to compensate for the deaths of four females in its territory. In doing so it came across the two competitor males and acted aggressively - after one fight its long rear horn was snapped down leaving just the triangular base. All three males succumbed to their injuries.

One breeding male moved out of its territory to a limited area near to water. The change in its behaviour suggests that its vision had become severely restricted.

Current breeding potential

Only one male has been seen breeding and has a well-defined range.

An older male who had surrendered its 'breeding rights' to a younger male which was subsequently

Table 1: Black Rhino Population Dynamics in Solio Game Reserve 2009 to 2015

Population	2009		2015	Change %
Males				
Adult	16		10	-38%
Sub-adults/Calves	19		13	-32%
Sub-total males	35		23	-34%
Females				
Adult	20		16	-20%
Sub-adults/Calves	13		10	-23%
Sub-total females	33		26	-21%
Total	68		49	-28%
Poaching		16		
Poaching after effects		7		
Natural causes		13		
Trans-located		13		
Sub-total reduction		49		

poached, has been seen back in its former territory, as it now has no competition. Whether it is capable and accepted for breeding has yet to be observed.

One young male changed its range from the east of the river to the far north-west after being observed fighting with territorial males so, along with two other males of similar age, the territory of the previously mentioned visually impaired male will hopefully be covered.

Two young males of 7.5 to 8 years old range in the territory of the older male killed by fighting and could take over as the breeding males.

Breeding females

Poachers killed seven breeding females.

No breeding females were translocated but four sub-adult females were moved to help start a new population in western Kenya.

Four breeding females died – two of old age, one from a wound probably caused by fighting and one was euthanized having been wounded when charging a monitoring patrol.

Current breeding potential

Nine mature females have calves although three of the females have not been seen for over 20 months.

Four younger females have calves. Two young females, who were expected to calve and who had been highly visible, have not been seen for over a year. One of these is possibly an unidentified sub-adult female killed by lions in 2014.

One young female of breeding age has yet to have a first calf. It changed its home range from the south-east to the south-west of the reserve possibly in order to find a satisfactory mate or to avoid the unwelcome attention of two young males.

Main Range Changes in the Period

Young male no.40 changed area from the south-west of the river to the south-east of the river when around 8 years old.

Young male no.54 changed area from south-west of the river to the centre-east of the river when around 9 years old.

Young male no.55 changed area from centre east of the river to the far north-west of the reserve when around 7.5 years old.

Young male no.53 extended its range eastwards such that included an area across the river when around 10 years old. This range extension was enabled by the deaths of competitor males in the new area while allowing for the male to avoid other males in its normal range.

Although there were no direct observations of fighting recorded by monitoring patrols, it is likely that the reason for the changes in area for all these young males was due to being ejected from their former ranges by the territorial male as they had reached an age and size to become competition.

Young female no.44 changed her area from south-west of the river to south-east of the river when around 7 years old. She had had her first calf at around 5.5 years old but lions killed the calf when she was 3 months old. Soon after the death of the calf, the territorial male no.1 was always seen with the female for some five months until he suddenly changed range when, the next day and for the next two months, he was with the territorial male no.35 of the new area.

Female no.44 had her second calf around 14 months after she was observed to have moved range so it was not clear which of the two males was the father but the possibility exists that the change of range was to seek out a different male for breeding.

Young female no.43 changed her range from the centre-east of the river to the centre-west of the river when around 8 years old. She immediately consorted with the territorial male no.39 suggesting she was looking for a different mate to the territorial male in her former range.

Young female no.61 changed her range from south-east of the river to south-west of the river when around 7 years old. Following a poaching incident there was no breeding male in her former range and it is likely that the range change was due to the female seeking a mating opportunity.

The hidden cost of poaching summarised

As stated previously, the loss of seven territorial males resulted in around two-thirds of the reserve area not being covered by breeding males.

The loss of seven breeding females resulted in the loss of potentially nine new calf births in the period and more in subsequent years. It also led to increased aggression among males seeking breeding rights over the remaining females resulting in the deaths of three males from fighting injuries.

As poaching pressure increased over the period, so did the need for increased security. This led to the secondment of a large contingent of Kenya Wildlife Service armed rangers within the reserve, which required transport and camping facilities. There was a need for night vehicle patrols, ambushes and daytime logistics travel around the reserve. The unfortunate noise and disruption caused by these manoeuvres, plus the poaching resulted in previously easy to monitor rhinos becoming secretive and hard to find. Ten individuals plus three calves have not been seen for over a year, two individuals of which have not been photographed since 2010. It is not certain therefore, that all of these individuals are still alive and have not been taken by the poachers.

It is clear that the 'Mission' of SGR – to breed rhinos for relocation to other reserves in order to develop the national population – has been more seriously compromised by the incidence of poaching than simply the deaths of 14 breeding black rhinos. The recent escalation of poaching has not only resulted in the loss of nine potential new births, but has had an impact on rhino behaviour. (See Plate 12; centre page vii)

Movement patterns and resource needs of Kamuku elephants along migration routes in Nigeria

Tajudeen Okekunle Amusa,[1] Johnson Adedayo Ogunjobi,[2] Ibrahim Jauro Fxentrimam[3] and Kikwashi Abdullahi Garba[3]*

[1]Department of Forest Resources Management, University of Ilorin, Ilorin, Nigeria
[2]Federal College of Wildlife Management, Forestry Research Institute of Nigeria, New Bussa, Nigeria
[3]Kamuku National Park, Birnin Gwari, Kaduna State, Nigeria
*Corresponding author email: teejayui@gmail.com

Introduction

The project "Understanding movement patterns and resource needs of Kamuku elephants along migration routes in Nigeria" is an extension of previous work and conservation activities aimed at enhancing the protection of the elephants of Kamuku National Park (NP) and its environs. Preceding work on the Kamuku elephants showed some areas within the project site as important locations that serve as migration routes for the elephants (Amusa et al. 2013). Therefore, an understanding of movement patterns and resource needs of the animals along migration routes will help to conserve *key* elephant habitat and resources. This will provide further impetus for enhanced protection of the Kamuku NP and its adjoining unprotected areas as an important elephant range and corridor, linking different locales in north-west and north-central parts of Nigeria. Apart from this, movements of large mammals such as elephants are considered to be one of the most important ecological factors which influence the distribution of other small herbivores. Thus, protecting elephant migration routes will ensure the conservation of other endangered plants and animals in the area. In addition, information on movement patterns and resource needs of the elephants will also go a long way in reducing habitat fragmentation which has been identified as a key threat to the viability of a sustainable elephant population in the project area. Specifically, the project was set to ascertain the ranges and movement patterns of elephants in and around Kamuku NP and to identify and estimate abundance of important food resources of elephants along migration routes.

The present project covers the Kamuku NP, Mando Forest Reserve (FR), Alawa Game Reserve (GR), and Kuyambana GR. Kamuku NP is located in Birnin Gwari Local Government Area of Kaduna State, north-western Nigeria. It is geographically situated on longitude 10°45'N and latitude 06°30'E and covers an estimated area of 1,120 km^2. Mando FR is located in Chukun Local Government Area, Kaduna State on longitude 10°39'N and latitude 6°34'E, with an estimated area of 306.8 km^2. Alawa GR is situated in Rafi Local Government Area of Niger State on longitude 10°20'N and latitude 6°30'E, with an area of 296.2 km^2. Kuyambana GR is in Maru Local Government Area of Zamfara State on longitude 11°17'N and latitude 6°41'E, with an estimated area of 2,614 km^2. Participatory rural appraisal (PRA) and rapid rural appraisal (RRA) techniques, including focus group discussion (FGD) and interview schedule (IS) were used in conducting the work. PRA and RRA are used to encourage local people's participation. This is now widely advocated and documented as a philosophy and mode of practice in the development and conservation narrative (Chambers 1994; Lawrence and Molteno 2008). This approach was used to obtain information on the range of local people's understanding and knowledge of elephant conservation and status in the area, as well as to elicit their active participation in the study.

Elephant movement routes were located and identified based on the interviews, village discussions and direct field observations. The direct observation focused on elephant dung piles, feeding signs, footprints impression and GPS tracking of migration routes in and around the project sites. Observations of elephant feeding signs on food trails were further used to determine elephant food resources in different ranges and migration routes. The trails taken by elephants were followed and all the plants showing signs of being fed upon by the animals were recorded. The Flora of West Tropical Africa, Trees of Nigeria,

Flora of Nigeria Grasses, Savanna Trees of Nigeria and Flora of Nigeria Sedges were used to verify names of families and species identified in the field (Keay, 1989; Hutchinson and Dalziel, 1954–1968).

Elephant migratory pattern

Movement from Kamuku NP to Mando FR via the community of Tundun-bage

Elephants usually move from Kamuku NP (particularly around Gwaska and Goron-dutse communities) to an old settlement called Kewaye, where they browse on plants such as *Borassus aethiopum, Cussonia barteri, Adansonia digitata,* and *Detarium microcarpum*. They then migrate to another old settlement called Gwaifata, where they stay for some weeks, depending on the season. On leaving Gwaifata they move to Tsohon Garin Gayam, where they also stay for some days and then move to Rafin Gora where they stay for over two weeks, excavating the roots of *Cochlospermum tinctorium* and browsing on such plants as *Entada africana,* and *Cussonia* spp. as well as eating *Vitellaria paradoxa* fruits. Seasonal rivers in the area help in sustaining the animals' water needs for weeks. When they leave Rafin Gora they also progress to Chidago area for some days, browsing on plant resources in the area. Afterwards they migrate to Tundun-bage. On leaving Tundun-bage they sometimes return to Kamuku NP via the same route. Alternatively, they may decide to migrate to Mando FR through Kurebe area (around Udawa) in Kaduna State.

Movement of elephants from Mando FR to Alawa GR

On reaching Mando FR (through Kurebe), elephants move to Kwaki community forest in Niger State. They then pass through to old Kwangwama settlement, where they stay for some days. Thereafter they move to Wulga area (in Ringa) where they also stay most time before moving to Gwadogwado area in Alawa GR. When in Alawa, the elephants spend most of their time around Ringa and Mangoro, where they browse in the old settlement.

Movement from Kamuku NP to Kuyambana GR

From Kamuku NP, elephants also migrate to Kuyambana GR through Mariga River, Dansadau and Tureta to Mallamawa Grazing Reserve in Bukkuyum Local Government Area of Zamfara State. The Mariga River bordering Kamuku NP and Kuyambana GR is an important water source for the elephants. We were unable to conduct any proper survey in this location given the security challenges in the area. Nonetheless, our interaction with local communities revealed that another game reserve, Kogo GR (Katsina State), forms part of the elephant migratory route in the project area. All these movements are made by the elephants using cattle migratory routes. The elephants migrate at any time of the day and night once the weather is conducive. More often, they prefer moving at night to avoid human disturbances. They often destroy farm crops along their migratory routes. Plate 9; centre pages (v) shows a graphical presentation of the elephant movement pattern in Kamuku National Park and surrounding areas.

Elephant resource needs and availability along migration routes

The Kamuku elephants feed on a wide variety of plants. A total of 110 elephant foodplant species belonging to 40 families were identified in the project area. These included 11 species of cultivated plants and 99 species of non-cultivated plants (Tables 1 and 2). The non-cultivated plants are typical of the Northern Guinea savanna ecosystem. These comprised 48 tree species, 23 shrubs, 9 herbs, 14 different grasses, 3 creepers and 2 climbers (Table 3). About 18.2% of the plant species belonged to family Poaceae while 10.1% belonged to family Mimosaceae (Figure 2). The survey also reinforced the well known fact that the Mariga River bordering Kamuku NP and Kuyambana GR remains an important water source for the elephants.

Table 1. Cultivated plants utilized as food by elephants in the project area

Family	**Scientific name**	**Common name**	**Local name**	**Habit**
Fabaceae	*Arachis hypogeal,* L.	Groundnut	Ayayaa	Herb
Cucurbitaceae	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Water melon	Guna shaanu or kankana	Vine (Trailer)
Bignoniaceae	*Crescentia cujete,* L.	Calabash tree	Iccen kwarya	Tree
Convolvulaceae	*Ipomoea batatas*, (L.) Lam.	Sweet potatoes	Dankali	Herb
Euphorbiaceae	*Manihot esculenta,* Crantz	Cassava	Rogo	Herb
Poaceae	*Oryza sativa,* L.	Rice	Shinkafa	Grass
Poaceae	*Panicum miliare,* Roth ex Roem. & Schult.	Millet	Daawa	Grass
Poaceae	*Saccharum officinarum,* L.	Sugarcane	Rakee	Grass
Poaceae	*Sorghum bicolor,* (L.) Moench	Guinea corn	Daawa	Grass
Fabaceae	*Vigna unguiculata,* (L.) Walp.	Cowpea	Waake	Herb
Poaceae	*Zea mays,* L.	Maize	Masara	Grass

Table 2. Non-cultivated plants utilized as food by elephants in the project area

S/N	Family	Species	Habit
1	Anacardiaceae	*Lannea acida* A. Rich	Tree
2		*Lannea Kerstingi* Engl & K. Kiause	Tree
3		*Lannea schimperi* (Hochst. ex A. Rich) EngI.	Tree
4	Annonaceae	*Annona senegalensis* Pers.	Shrub
5	Apocynaceae	*Voacanga africanna* Stapf.	Shrub
6	Araliacceae	*Cussonia barteri* Seemann	Tree
7	Asteraceae	*Aspilia africana* (Pers.) *C.* D. Adams	Herb
8	Balanitaceae	*Balanites aegyptiaca* (L.) Dcl.	Tree
9	Bignoniaceae	*Stercospermum kunthianum* Cham.	Tree
10	Bombacaceae	*Adansonia digtata* L.	Tree
11		*Bombax costatum* Peliegr. & Guillet	Tree
12	Burseraceae	*Boswellia dalzielii* Plutch	Tree
13	Celastraceae	*Maytenus senegalensis* (Lain.) Exell.	Shrub
14	Cochlospermaceae	*Cochlospermum pl*anchoni Hook. F.	Shrub

15		*Cochlospermum tinctorium A.* Rich.	Shrub
16	Combretaceae	*Anogeissus leiocarpus* (DC.) Guill & Pcrr.	Tree
17		*Combretum* adenogonium steud. ex A. Rich	Tree
18		*Combretum glutinosum* Perr. ex DC.	Tree
19		*Combretum molle* Br. & G. Don.	Tree
20		*Terminalia avicennioides* Guill & Perr.	Tree
21		*Terminalia schimperiana* Hochst	Tree
22	Compositate	*Tridax procumbens* L.	Herb
23	Dioscoreaceae	*Dioscorea dumetorum* (Kunth) Pax	Climber
24	Dipterocarpaceae	*Monotes kerstingii* Gilg.	Tree
25	Ebenaceae	*Diospyros mespiliformis* Hochst. ex A. DC.	Tree
26	Euphorbiaceae	*Drypetes floribunda* (Mull. Arg) Hutch	Tree
27		*Euphorbi*a *convovuloides* Hochst. ex Benth.	Herb
28		*Euphorbia hirta* L.	Herb
29		*Securinega virosa* (Roxb. ex Wild) Baill.	Shrub
30		*Bridelia ferruginea* Benth	Tree
31		*Uapaca togoensis* Pax.	Tree
32	Fabaceae	*Afzelia africana* (Sm.)	Tree
33		*Burkea africana* Hook.	Tree
34		*Daniellia oliveri* (Rolf Hutch. & Dalz.)	Tree
35		*Detarium microcarpum* Guill & Perr.	Tree
36		*Isoberlinia doka* Craib & Stapf	Tree
37		*Piliostigma thonningii* (Schum.) Milne Readhead	Shrub
38		*Tamarindus indica* L.	Tree
39		*Isoberlinia tomentosa*	Tree
40	Hymenocardiaceae	*Hymenocardia acida* Tul.	Shrub
41	Liliaceae	*Gloriosa simplex* L.	Climber
42	Loganiaceae	*Strychnos innocua* Del subsp. i*nnocua* var. *pubescens* Solered.	Tree
43		*Strychnos innocua* Del. Subsp *innocua* var. *innocua*	Tree
44		*Strychnos spinosa* Lam.	Tree
45	Malvaceae	*Sida cordifolia* L.	Herb
46		*Sida pilosa* Retz	Herb
47		*Azanza garcheana*	Shrub
48	Meliaceae	*Khaya senegalensis* (Desr.) A. Juss	Tree
49	Menispermaceae	*Pseudocedrela kotschyi* (Schweinf.) Harms.	Tree
50	Mimosaceae	*Entada africana* Guill & Perr.	Tree

51		*Faidherbia albida* (Del.) A. Chev.	Tree
52		*Mimosa pigra* L.	Shrub
53		*Parkia biglobosa* (Jacq) Benth	Tree
54		*Prosopis africana* (Guill & Perr.) Taub.	Tree
55		*Acacia gourmaensis* A. Chev.	Shrub
56		*Acacia senegal* (L.) Willd	Shrub
57		*Acacia sieberiana* DC. J var. *sieberiana*.	Tree
58		*Acacia seyal*	Shrub
59		*Acacia nilotica*	Shrub
60	Moraceae	*Ficus thonningii* Blume.	Tree
61		*Ficus platyphylla* Del.	Tree
62	Nyctaginaceae	*Boerhavia diffusa* L.	Herb
63	Ochnaccae	*Lophira lanceolata* var Tiegh. ex Keay	Tree
64	Olacaceae	*Ximenia americana* L.	Shrub
65	Palmae	*Borassus aethiopum* Mart.	Tree
66	Papilionaceae	*Indigofera macrophylla* Schum	Shrub
67		*Indigofera secundiflora* Poir.	Herb
68		*Pericopsis laxiflora* (Benth. ex Bak.) Van Meeuwen	Tree
69		*Pterocarpus erinaceus* Poir	Tree
70		*Swartzia madagascariensis* Desv.	Tree
71	Poaceae	*Axonopus compressus* Beauv	Creeper
72		*Chloris gayana* Kunth	Grass
73		*Chloris pilosa* Schum.	Grass
74		*Cymbopogon giganteus* Chiov.	Grass
75		*Cynodon dactylon* (L.) Pers.	Creeper
76		*Eluesine indica* Gaertn.	Grass
77		*Imperata cylindrica* P.Beauv.	Grass
78		*Panicum brevifolium* L.	Grass
79		*Panicum maximum* Jacq.	Grass
80		*Pennisetum pedicellatum* Trin.	Grass
81		*Pennisetum purpureum* Schum. (Elephant grass)	Grass
82		*Setaria anceps* Massey	Grass
83		*Sporobolus pyramidalis* Beauv.	Grass
84		*Crotalaria confusa* Hepper	Herb
85		*Andropogon gayanus* Kunth.	Grass
86		*Andropogon tectorum* Schum. & Thonn.	Grass
87		*Digitaria horizontalis* Wild	Creeper

88		*Hyparrhenia rufa Stapf.*	Grass
89	Polygalaceae	*Securidaca longepedunculata* Fres.	Shrub
90	Rubiaceae	*Crossopteryx febrifuga* (Afzel .ex G. Don) Benth	Tree
91		*Mitragyna inermis* (Wild.) O.Ktze	Shrub
92		*Nauclea latifolia* Sm.	Shrub
93		*Gardenia aqualla* Stapt & Hutch.	Shrub
94		*Gardenia sokotoensis* Hutch.	Shrub
95	Sterculiaceae	*Sterculia setigera* Del.	Tree
96	Sapotaceae	*Vitellaria paradoxa* Gaertn. F	Tree
97	Tiliacea	*Grewia villosa* Wild.	Shrub
98		*Grewia mollis* Wild.	Shrub
99	Verbanaceae	*Vitex doniana* Sweet.	Tree

Table 3. Distribution of plant species (non-cultivated) identified as being utilized as food by elephants in the project area according to the habit

Habit	Number	Percentage
Tree	48	48.5
Shrub	23	23.2
Herb	9	9.1
Grass	14	14.1
Climber	2	2.1
Creeper	3	3.0

Figure 2. Distribution of plant species (non-cultivated) by taxonomic family

Recommendations

There is need for habitat improvement as well as restoration of preferred food resources of elephants in and around the Kamuku NP. Elephant routes need to be protected from various anthropogenic activities such as bush burning, farming, livestock grazing, fuelwood exploitation and logging. We believe that the identified elephant ranges should be viewed as a nationally important wildlife conservation area, and as a biologically important corridor. It is therefore, our candid opinion that a coherent strategy for the conservation and management of the animals in all the study locations should be developed. Continuous sensitization, support and empowerment of local people through community initiatives should be implemented in the Support Zone Communities in order to ensure an enduring participation in the conservation and protection of wildlife and natural resources in the area. Apart from this, continuous ecological monitoring is advisable in order to understand the long-term population development of elephants in Kamuku NP and adjoining areas. Thus, the development of a simple, low cost and sustainable monitoring system is essential for an assessment of the population structure and dynamics of elephants. Data currently being collected by community-based elephant monitoring committees could potentially form the basis for such a monitoring system. On their own, however, the data may not be sufficient for an accurate estimate of elephant numbers. A protocol is recommended that combines direct field observations from encounters with elephant groups with regular dung counts along permanent transects by park rangers during their routine anti-poaching patrols. A more detailed study using radio/satellite tracking is proposed as well as

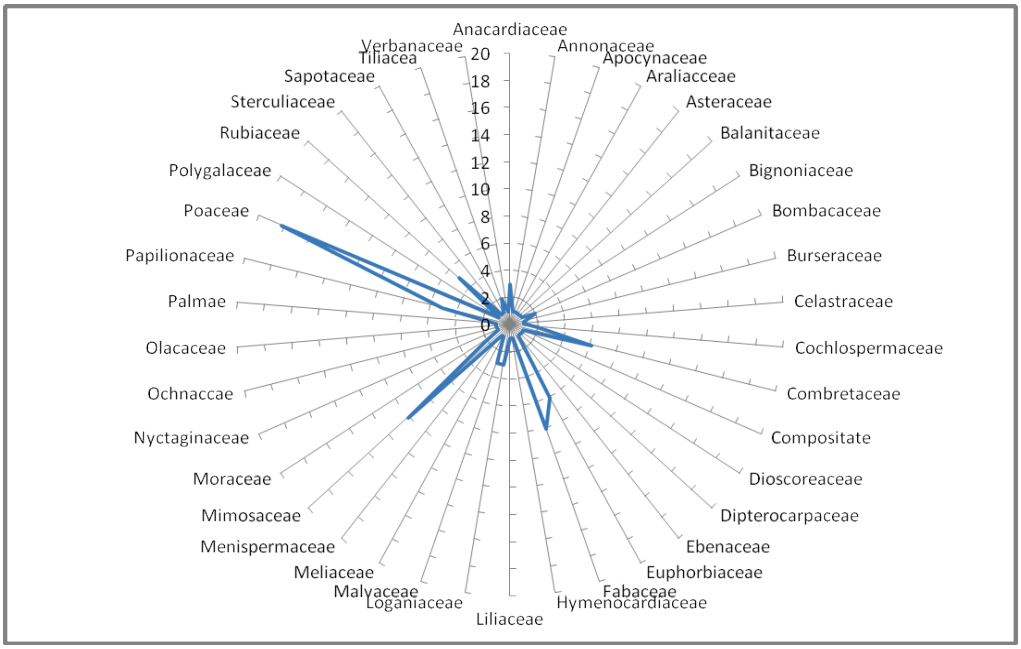

Figure 2. Distribution of plant species (non-cultivated) by taxonomic family

immediate efforts to aid restoration of the landscape, the elephants' paths and habitat in places where they are seriously encroached.

Acknowledgements

We are grateful to Rufford Small Grants Foundation for providing financial support to carry out this work through the grants RSG 53.10.09 and 11493-2. We deeply appreciate the logistics and personnel assistance provided by the Nigerian National Park Service and Kamuku NP management authorities led by Mr Abdullahi Ahmad. We also thank all village leaders and communities in the project area for providing the enabling environment to carry out the survey. We sincerely thank the community-based elephant conservation and monitoring committees, members of survey corps as well as staff and rangers of Kamuku NP.

References

Amusa TO, Ogunjobi JA, Halidu SK, Likita IB, Muraina AR, Fxentirimam IJ, Gunu AM. 2013 Participatory survey of elephants *(Loxodonta africana)* in Kamuku National Park and its environs, northwestern Nigeria. *Pachyderm* 53:99–102.

Chambers R. 1994. Participatory Rural Appraisal (PRA): analysis of experience. *World Development* 22:1253–1268.

Hutchinson J and Dalziel, JM .1958– 1968. *Flora of West Tropical Africa,* 3 Volumes. Crown Agents for Overseas Development and Administration, London

Keay RWJ. 1989. *Trees of Nigeria*. Oxford Science Publications Clarendon Press Oxford. 476pp

Lawrence A, Molteno S. 2008. *Participatory science for sustainable wild harvests – a methods handbook*. University of Oxford, Oxford.